

FLUKE®

Introducing the Rugged NEW Fluke 70 Series III Digital Multimeters,

Rough handling and high voltage are tough on a meter. But the new Fluke 70 Series III takes it all in stride.

It's built tough inside and out. With overvoltage protection to guard against spikes up to 6 kV, and safety ratings to prove it. It even protects against measuring voltage if the knob is accidentally set on ohms. Plus its rugged, overmolded body armor case offers constant protection no matter how much you throw it around.

As tough as it is, the 70 Series III is very easy on you. Its tapered design fits more easily in your hand, pocket, and tool box. The display is 40% larger, with extra large characters that are easy to read from a distance. Plus, there's easier access to Fluke's patented Touch Hold® mode which automatically captures the measurement, beeps, and locks it on the digital display for later viewing.

No matter how tough your job is, the new Fluke 70 Series III is even tougher. There are five models to choose from. And of course, they're backed by a lifetime warranty.

Fluke Multimeters
*Keeping your world up
and running.*

Take a demo.
Find out just how tough the new 70 Series III DMMs really are. Visit Fluke at www.fluke.com or call **1-800-44-FLUKE** for the distributor nearest you.



The tough just got tougher.



© 1997 Fluke Corporation, P.O. Box 9090, M/S 250E, Everett WA 98206-9090, U.S. (800) 44-FLUKE or (425) 356-5400. Canada (905) 890-7600. Europe (31 40) 2 678 200. Other countries (425) 356-5500. Web access: www.fluke.com. All rights reserved. Ad no. 00991

CIRCLE 121 ON FREE INFORMATION CARD

CONTENTS

DECEMBER 1997

ON THE COVER

35 BUILD THE ASTRO-TREKER

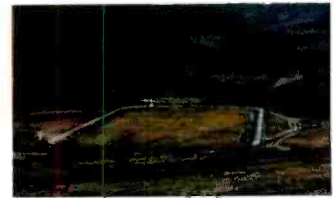
Every once in a blue moon, a project crops up that has nearly no practical applications, yet still is so impressive that everyone who sees it in action wants to try it for themselves, or better still, get one for themselves. This month's cover story is just such a project. Called the Astro-Treker, it puts the user at the controls of a simulated hovercraft. But this is no video game; instead it is an electromechanical device that obeys all the laws of physics, and is as hard to master, and fun to do, as flying a helicopter or even piloting a lunar lander. It can even be modified to provide a variety of different diversions and games, and makes a great Christmas gift.

— *G. Randy Slone*



TECHNOLOGY

9 PROTOTYPE



Driverless cars for intelligent roads, a biology lab on a chip, and lots more.

51 ALL ABOUT DVD



A look at what DVD is, how it works, and why it could soon replace CDs, laserdiscs, and CD-ROMs.

— *Stephen J. Bigelow*

59 READING AUTOMOBILE COMPUTER-SERVICE CODES

It's easy to do, can save you lots of money, and you don't even need any special equipment. — *Thomas Fox*

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) December 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 \$4.50. © 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.

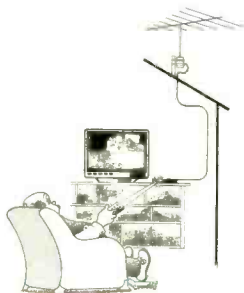
A stamped self-address envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

BUILD THIS

42 TWINKLING HOLIDAY ORNAMENT
It's just the thing to brighten up your holidays with some electronic sparkle.
— *David Williams*

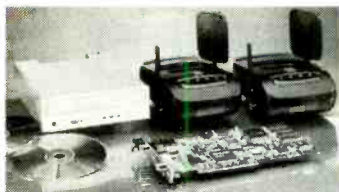


45 A REMOTE CONTROL FOR YOUR ANTENNA
Add the convenience of a remote control to any outdoor antenna rotator system.
— *William G. Grimm*

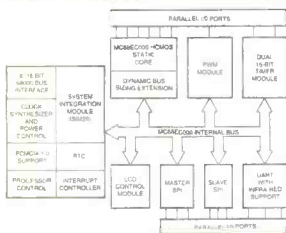


DEPARTMENTS

6 EQUIPMENT REPORT
Hi-Val combination DVD-ROM/DVD-video player.

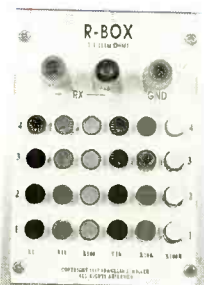


18 SERVICE CLINIC
On-line tech tips, tools, and test gear for the troubleshooter.
— *Sam Goldwasser*



25 COMPUTER CONNECTIONS
Inside the Pilot palmtop computer.
— *Jeff Holtzman*

28 AUDIO UPDATE
Building a resistor-substitution box.
— *Franklin J. Miller*



64 TECH MUSINGS
Radio astronomy, the enigma of the Faraday disc, and more.
— *Don Lancaster*

AND MORE

4 EDITORIAL

8 Q&A

22 NEW PRODUCTS

24 LETTERS

63 NEW LITERATURE

112 ADVERTISING INDEX

112 ADVERTISING SALES OFFICE

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

MARIE FALCON, 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 112.

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

EDITORIAL

Trouble for DVD?

Were you planning to get yourself one of those hot, state-of-the-art DVD players for your home-entertainment system for Christmas? Or are you one of those early adopters who had to be the first on your block with the hottest development in home video in years? Well, I'm afraid I've got some bad news for you.

Just as things seemed to be looking up for DVD, with a strong holiday selling season poised to firmly establish the standard and the medium, a consortium made up of several major consumer-electronics manufacturers (Zenith, Matsushita, and Thomson), several top Hollywood studios (Disney, Paramount, Universal, and DreamWorks), and one of the biggest

consumer-electronics retailers in the country (Circuit City) announced a new disc format for home entertainment. And, of course, it won't work with existing DVD players.

Called Divx, the key to the system is low-cost titles that will run about \$5 each. The catch is that they can be viewed only for 48 hours, after which they will no longer work. At that point they can be thrown away or unlocked again for an additional fee. The discs can only be viewed on a Divx-compatible DVD player, which will require a telephone connection to a central Divx computer and is expected to cost about \$100 more than a standard DVD player. The Divx player will also play standard DVD discs.

Just lovely. As you might imagine, the reaction within the DVD community has

been akin to someone shouting fire inside a crowded theater. The home-video rental industry is also appalled as this could easily spell the end of their business. And how about consumers who have spent hundreds, or even thousands of dollars on technology that might soon be obsolete? Let's just say that most of their reactions can't be reprinted in a magazine that might be viewed by minors.

If you are wondering what the impetus behind Divx might be, the answer is simply money—lots and lots of money. The system gives its proponents a direct line into the lucrative home-video rental market. The studios also like the extra layer of protection that the system gives their copyrighted works. The first Divx players and discs are expected to be available in

Continued on page 98

ProtoLab 4.0

Easy-to-use circuit simulation package from the leader in electronic prototyping.

- **Designed for use with Windows®95**
- **Low Cost - \$49.95**
- **Design circuits instantly while choosing from a complete list of active and passive components**
- **Analyze circuits using built-in test instruments.**

4.0 - C:\PLAB\AMP_BIP.WPF

Close

Insert

Transistor pnp

Transistor pnp

channel MOSFET

Drag screen to shift schematic. Right button or H to return to the previous actions.

Start ProtoLab 4.0 - C:\PLAB\AMP_BIP.WPF

Create and Analyze Circuits INSTANTLY for only \$49.95!



GLOBAL SPECIALTIES
SOFTWARE

INNOVATIVE PRODUCTS. UNSURPASSED QUALITY.
1-800-572-1028 • For a demonstration, visit:
www.globalspecialties.com

Windows®95 is a U.S. registered trademark of Microsoft Corporation.

CIRCLE 122 ON FREE INFORMATION CARD

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 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.

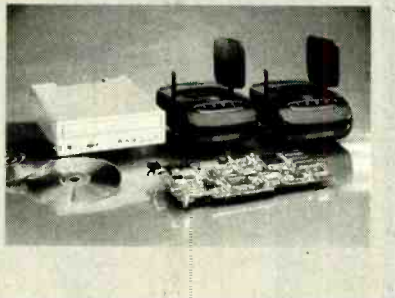
Learn Dept. LEC-01, 113 Gaither Drive,
INCORPORATED Mt. Laurel, NJ 08054-9987

EQUIPMENT REPORT

A COMBINATION DVD-ROM AND DVD VIDEO PLAYER FROM HI-VAL

Can't decide between a DVD video player for your living room or a DVD-ROM for your PC? Why not get both?

CIRCLE 15 ON FREE INFORMATION CARD



As most undoubtedly know, DVD (digital versatile disc) is the hottest new "must-have" technology in both the consumer-electronics and computer fields. At least it's a "must-have" until you take a look at current retail prices. As with most new technologies, initial pricing has been largely aimed at the so-called "early adopters," those with the desires and finances to be the first on their block with the "latest and greatest." And if you are looking to equip both a home-entertainment system and a PC with this new technology, the sticker shock is doubled.

However, while the advantages offered by DVD in the home-entertainment field could perhaps be debated, there is little doubt that in short time the DVD will largely replace the CD-ROM in PCs everywhere. Their greatly expanded storage capabilities make that a cinch in these days of bloatware applications and bigger, better, and louder computer games.

Here's an idea: Wouldn't it be great to be able to equip your PC with a DVD drive and be able to use that same drive as a DVD player for your home-entertainment system? Well, dream no more, as that's now a reality thanks to an innovative DVD upgrade bundle put together by Hi-Val, Inc. That bundle, which retails for \$799, includes a Toshiba DVD-ROM drive, which is a DVD player and 8× CD-ROM drive all in one unit, and an AC-3/MPEG2/MPEG1 audio-decoder card that works in con-

junction with an existing sound card. The DVD-ROM drive can play DVD movies and DVD games and is backward-compatible with music CDs and CD-ROMs.

The Hi-Val package also includes RF Link's Wavecom Sr., a wireless transmitter for audio, video, and infrared-remote signals. It transmits DVD movies up to 300 feet through walls, floors, and ceilings to a cable or composite video input on a TV or VCR. An infrared receiver on the Wavecom transmitter transfers any remote-control signals to an infrared re-transmitter on the Wavecom receiver. Unfortunately that particular feature is of little use with the DVD kit because the DVD-ROM drive does not offer remote control. Still, with the wireless transmitter, DVD movies can be viewed on a TV in another room while someone works on the computer doing other things. For more information on the Wavecom Sr., see Equipment Reports in the October, 1997 issue of **Electronics Now**.

To use the DVD system, you need Windows 95 and a minimum of a Pentium 133 with 8 MB of RAM, 4 MB of hard disk space, PCI bus mastering, one vacant PCI slot, and a PCI video card that supports DirectX (Direct Draw) at 16-bit color. However, it is recommended that you have a Pentium 166 or higher with 16 MB of memory. The DVD-ROM drive supports DVD-Video, CD-Extra, Video CD, Photo CD, Orange book, multi-session, CD-Audio, CD-ROM, CD-I, and CD-ROM XA, but not CD-R recordable media.

DVD

DVD is based on the Compact Disc and the industry-standard MPEG-2 bit rate reduction. In its most basic form, a DVD disc can hold 4.7 GB of data, which is the equivalent of seven CD-ROMs; multi-layer and/or double-sided discs can hold up to four times as much (more on that in a moment) That's enough storage for over two hours of high-quality full-motion video, additional data tracks, and surround-sound audio. DVD is backward-compatible with CD-ROM. The data-transfer rate for DVD movies is about 600 kilobytes-per-second and for data applications, rates of 1.3 megabytes-per-second or more are typical.

MPEG-2 compression identifies portions of a video segment that are unchanged from frame to frame and stores only the data describing the differences between them. Other technologies that make use of MPEG-2 compression technology includes DSS satellite TV.

DVD supports two audio-encoding systems: Dolby Surround AC-3 and MPEG-2 Audio. The Dolby AC-3 standard has five signal channels plus a non-directional subwoofer channel. Dolby AC-3 gives each of the five audio channels (left, center, and right speakers in the front, and left and right surround in the rear) its own data stream. MPEG-2 Audio can do the same arrangement plus add left-center and right-center channels.

The initial DVD specification calls for a single-sided, single-layer disc with 4.75 GB of storage. To squeeze that much onto a disc, DVD-ROM uses a shorter-wavelength laser than standard CD-ROM, and can read smaller data pits on a tighter spiral track. And because the data layer is only half as thick as on a conventional CD, manufacturers can make double-sided DVD discs with the same thickness as conventional CDs (1.2 mm). Double-sided discs must be turned over to access the data on the other side. By sandwiching a semitransparent layer on top of a reflective layer, a DVD disc can have two layers of data on one side.

A drive equipped with a variable-power laser beam can read the data on both layers. A double-sided DVD disc with dual layers has a capacity of 17 GB.

The DVD-ROM drive included in the Hi-Val bundle has an ATAPI interface and a transfer rate of 1350 kilobytes-per-second for DVD and 1200 kilobytes-per-second for CD-ROM. It has a seek time of 140 milliseconds for DVD, and 110 milliseconds for CD-ROM. The front panel has a built-in headphone jack, volume control, and eject button, plus separate DVD, CD, and Busy indicator lights. The drive features 4× sampling and digital filtering for CD audio.

The Hi-Val Cinemaster DVD card is a PCI-based, bus-mastering plug-and-play card for a PC. Using Quadrant International's VideoInlay technology, digital video is transferred directly over the PCI bus to the graphics card. The video signal is also output on external composite and S-Video connectors for transferring DVD video to a TV (unfortunately, the Wavecom Sr. wireless transmitter cannot transmit the S-Video). Dolby AC-3 audio is decoded on-board and down mixed to 2-channel Dolby Pro Logic, available for external amplification or Pro Logic decoding. The AC-3/MPEG2/MPEG1 audio decoder card works in conjunction with an existing sound card.

Installing The Bundle

Installing the Hi-Val DVD upgrade kit is very easy, as the DVD-ROM drive behaves basically like an IDE CD-ROM drive and the Cinemaster AC-3 card features plug-and-play operation. The plug-and-play card installed in minutes in a vacant PCI slot with the drivers loading flawlessly from diskette. The 5.25-inch internal DVD-ROM drive installs in a standard-size drive bay. It has the familiar master/slave/cable select jumper on the back as well as the ATAPI interface and audio output. An audio cable connects from the back of the DVD drive to the AC-3 card and another goes from the AC-3 card to the original sound card's audio input.

Despite the above, we did encounter some problems. Although there's no reason why the DVD drive can't work off the same IDE controller as the original CD-ROM drive in a system, our test-bed system was fussy—it didn't like two drives connected to the same IDE controller no matter what the combination was. We

had to settle for the hard drive on the primary IDE controller and the DVD drive on the secondary IDE controller with its jumper set to the cable-select position. To accommodate the new drive, the original CD-ROM drive had to be removed from the system; that could be a problem for some since, while the DVD drive also is an 8× CD-ROM drive, it can't read CD-R, which most CD-ROM drives can handle.

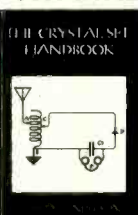
Some Final Thoughts

For the meantime, DVD-ROM games and resource discs provide the same basic features as current CD-ROMs, but with greatly expanded content. However, enhanced DVD features such as multiple camera angles and languages will soon be put to use in a new generation of multimedia entertainment software. The Hi-Val bundle includes Spycraft, The Daedalus Encounter, Silent Steel, Muppets Treasure Island, Encyclopedia Electronica, and Wing Commander IV DVD software.

The quality of DVD video has been hailed as spectacular, and now that we've had some hands-on experience we must concur. Everything we've sampled to date has provided a crystal-clear picture with CD-quality audio comparable to what's available via laserdisc or DSS satellite TV. For those who can't decide whether they prefer letterbox or traditional pan-and-scan versions of movies, the discs generally offer both versions. Video can be viewed on the computer monitor, or, even better, on a large-screen TV with the wireless transmitter. All in all the Hi-Val bundle is a terrific package.

We've made the jump to DVD, PC-first. If you think DVD is for you and your PC, then contact Hi-Val directly (Hi-Val, Inc., 1300 East Wakeham Avenue, Santa Ana, CA 92705; Tel: 714-953-3000; Web: <http://www.hival.com>) today, visit your local computer store, or circle 15 on the Free Information Card. **EN**

Get your copy of the CRYSTAL SET HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$4.00 for shipping and handling. Clegg Inc., P.O. Box 4099, Farmingdale, NY 11735. USA Funds ONLY! USA and Canada—no foreign orders. Allow 6-8 weeks for delivery. MA01

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

NEW! WINDRAFT® & WINBOARD®
CAD SOFTWARE FOR WINDOWS®

Schematic design,
PCB layout
programs on
CD-ROM



U.S. Version Only

- User-definable parts palette for 20 frequently used parts
- Library of 700 module footprints, including SMT
- Imports BMP graphic files
- True-type fonts
- Design statistics and on-screen pin count indicator
- 200-pin capacity (upgradable to higher pin capacities)



For CAD Software literature,
use reader service # 71

or call 1 (800) 683-6837
for catalogs.

Visit our website at
www.nteinc.com



NTE ELECTRONICS, INC.
ACTION, NOT EMPTY PROMISES



Q & A

READERS' QUESTIONS, EDITORS' ANSWERS

Who's On First?

Q I need a switch arrangement to use in my church's Sunday School class. When a teacher asks a question, the first of the five or six students who knows the answer will activate his or her switch. This will turn on a light to identify the student and also disable all the others' switches. Can you give me any ideas? — A. N. M., San Antonio, TX

A This kind of circuit is sometimes called a "game-show timer," and over the years, several designs have been published that handle two or three contestants using relays or flip-flops. With six contestants, though, the traditional circuit gets rather complicated, so we decided to start from scratch and do it a new way.

less of the inputs.

Initially, pin 11 is high and so are all the inputs and outputs. When a contestant presses a button, the appropriate input and the corresponding output go low. When any output goes low, the diodes ensure that pin 11 will also go low and the 74HC573 will latch. Further inputs are then ignored until the reset button is pressed.

The 74HC540 serves as an output buffer. It inverts the output signals (so that you get one output high and the rest low, not the other way around) and keeps the load, such as LEDs, from affecting the 74HC573. Figure 2 shows how to connect LEDs and lamps to the output. If you need a buzzer to sound when a button is pressed, add the circuit in Fig. 3.

extremely unlikely, and if it happened, you'd be justified in calling it a tie.

How Autofocusing Is Done

Q I was wondering how the auto-focus feature works on modern cameras. Could you provide the basic theory and maybe an illustrative circuit? — E.L.H., U.S. Armed Forces, Germany

A Certainly. Consider an auto-focusing video camera first. High frequencies in the video signal correspond to fine detail in the image. So in order to focus the lens, all you have to do is position it so that the high frequencies in the signal are as strong as possible. (It's a lot like aligning an audio-tape head for the best

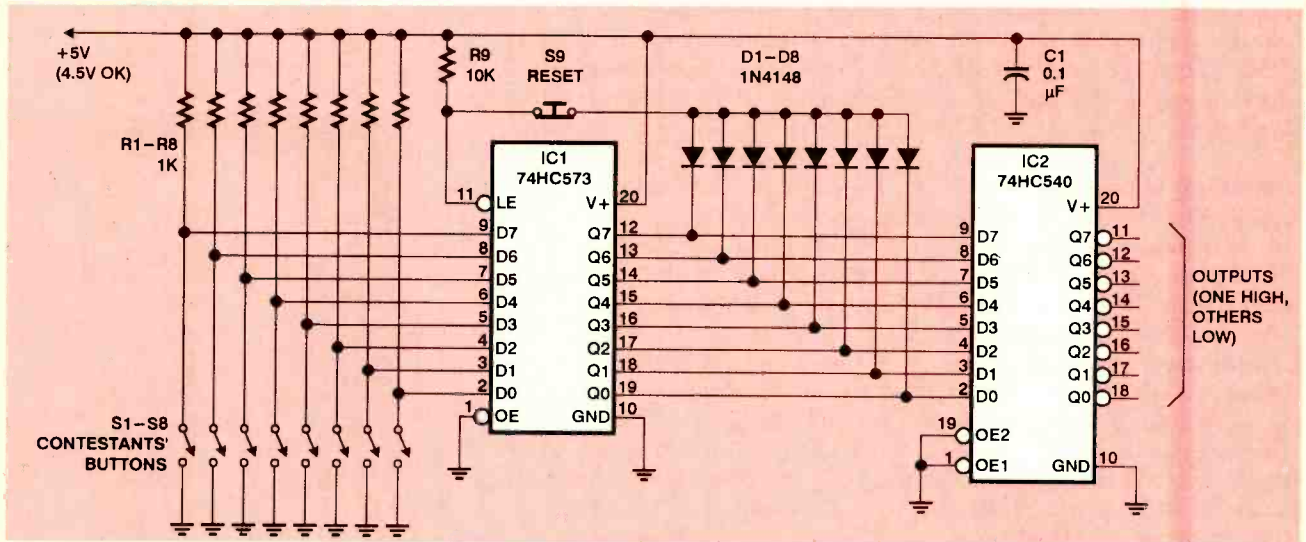


FIG. 1—HERE'S A GAME SHOW TIMER that can be used for up to 8 contestants. The first switch closure latches IC1, locking out the other switches. If you wish, you can substitute 74HCT chips for the 74HC chips shown here.

Figure 1 shows our solution, which relies on timing rather than relay logic. The 74HC573 is a latching 8-bit buffer; pin 11 tells it how to behave. When pin 11 is high (+5V), the input signals are transmitted unchanged to the outputs; when pin 11 is low (0V), the outputs are latched and remain unchanged regard-

Note that this circuit doesn't actually contain any logic to keep two buttons from being actuated at the same time. Theoretically, two contestants could press their buttons simultaneously and turn on both of their lights. But they'd have to do it within about 20 nanoseconds of the exact same instant—which is

treble.) Figure 4 shows a block diagram of how it's done: The video signal is fed to a control circuit, which moves the focusing motor back and forth until it finds the maximum.

Autofocus SLRs work the same way, but the video signal comes from one or

Continued on page 15

Prototype

Intelligent Roads for Driverless Vehicles

BY BILL SIURU

While driverless cars gliding accident-free down automated roads remain years—or more likely decades—away, test tracks and roads now in use or being built are making use of technologies and techniques that might well find their way into tomorrow's intelligent roads and vehicles.

One such test facility is the 1.8 mile oval WesTrack at the Nevada Automotive Test Center near Carson City, NV. A visitor to that track would see four Navistar tractors pulling triple trailer combinations around the track virtually around the clock. That is part of a project to test 26 different experimental asphalt pavement formulations as part of the Federal Highway Administration "Accelerated Field Test of Performance-Related Specifications for Hot-Mix Asphalt Construction" project. Using accelerated testing, 10 years and 1.7 million total vehicle miles of pavement testing can be accomplished in only two years. The test speed is 40 mph.

What's different here is that to eliminate the monotony of up to 22 hours-per-day, 7 days-per-week driving, the trucks are driverless. The autonomous tractors are equipped with electronically controlled Detroit Diesel turbocharged engines and Twin Disc automatic transmissions. Braking is done with Midland-Grau Anti-Lock Brake System (ABS) on the tractors and all trailers, plus an elec-



AN AERIAL VIEW OF WesTrack at the Nevada Automotive Test Center (Nevada Automotive Test Center).

tronic brake valve for brake control.

Redundant guide-by-wire systems buried under the asphalt are used to laterally and longitudinally control the trucks. For added safety, all systems are connected to uninterruptible power supplies. Each tractor is equipped with guidance antennas mounted to the front bumper. Those are used to acquire the guide tones emitted by either primary or alternate wire paths, which are powered by audio amplifiers. The antennas, reading either the primary or alternate wire paths, provide a continuous feedback signal to the steering controller. Steering is accomplished by a robust stepper motor connected directly to a steering gearbox. Steering commands are based on the error signal generated from displacements from the center of the wire. The throttle, engine and transmission are

controlled by advanced electronics on the engine and automatic-transmission electronic control unit.

The trucks are controlled and monitored from a control room located beside the test track. Computers within the control room start and stop the vehicles, as well as regulate spacing and speed. Radio-frequency modems on each truck are used for communications for traffic and longitudinal control. Different frequencies are used to distinguish between the vehicles that are on the track at the same time.

As a fail-safe measure, the Differential Global Positioning System (DGPS) independently monitors the truck position and provides an input to the traffic control computer. Each vehicle has two computers shock mounted in the truck's sleeper, one for vehicle control and

FOR MORE INFORMATION

Chrysler Corporation
CIMS 485-06-48
1000 Chrysler Drive
Auburn Hills, MI 48326-2766

Nevada Automotive Test Center
PO Box 234
Carson City, NV 89702
www.WesTrack.com



ONE OF THE DRIVERLESS TRUCKS circling the WesTrack for pavement testing (Nevada Automotive Test Center).

one for monitoring more than 160 parameters on the truck's "health" that would be normally evaluated by a driver. The control room operator has one computer for each truck—with a display showing status of the truck in an easy-to-read format. There are diagnostic programs to aid in monitoring and correcting critical control parameters. If a critical parameter is out of bounds, the vehicle monitoring computer transmits a shut-down signal to the control computer.

The bottom line is that the longitudinal location of the trucks can be kept to within 50 mm (2 in.) of any measurement sensor installed in the pavement. There is a grid of five longitudinal and five transverse pavement strain gauges precisely installed in each of the 26 experimental pavement test sections located in the track. Automation insures the wheels hit the pavement at precisely the right locations.

Chrysler's Automated Durability Road

The Automated Durability Road at the Chrysler Proving Ground in Chelsea, MI is used to test vehicles to see how well they will hold up under the very worst road conditions. The 1.3 mile course replicates rough roads with large potholes, bumpy railroad crossings, and cobblestones. The track is so brutal on vehicles that it only takes about 2,000 miles of driving to equal the effects of

driving about 100,000 miles on normal roads.

Chrysler's test drivers dread this driving assignment and can only tolerate about four hours a day on a road where they hit a head-tossing pothole every five feet. However, since a robot can take this kind of punishment all day long, in all kinds of weather, and will not

be tempted to avoid any of the potholes, Chrysler engineers have developed a robotic driver that "sits" in the front seat of the test vehicles and actually steers, shifts gears, brakes, and accelerates. Levers that are attached to the robot act like feet and hands, pushing on the brake and accelerator pedals as well as shifting gears. A motor is connected to the steering wheel hub via a short driveshaft with universal joints.

The driverless vehicle is guided using a guide wire embedded in the track. Two inductive coil sensors mounted on the front of the vehicle receive signals from the wires and relay the information to a computer placed on the passenger seat. The closer the coil gets to one or the other guide wire, the greater the voltage. For example, when the signal in the right coil is too strong, it means the vehicle is drifting too far to the left. The computer, or vehicle controller, "steers" the vehicle by balancing the voltages at the coils so they are equal and the vehicle is thus on course.

Transponders, about the size of a roll of quarters, are buried in the road at 100-foot intervals. An antenna placed near the rear license plate keeps track of the vehicle's location at all times. The antenna emits a power burst that is



THE CHRYSLER AUTOMATED DURABILITY ROAD has a guidance wire embedded in the road. Twin inductive coil sensors temporarily mounted on the front of the vehicle measure pick up frequencies from the wire (Chrysler Corporation).

received by the transponders. The transponder sends back a signal to indicate its exact location. If the information does not match up, all vehicles sharing the track are immediately stopped. As a backup safety system, video cameras constantly monitor the track so the human traffic controllers in a "flight tower" can monitor the operation and stop the vehicles if there is a problem.

The vehicles are radio controlled using military radio-communications technology. Spread-spectrum transmissions are used to prevent messages from becoming scrambled or diverted by electronic interference, clouds, buildings, trees, etc., without any delay in response time. Five radio towers located strategically around the track relay instructions from the control tower to the vehicles. Vehicle speed, engine rpm, shock-absorber and coolant temperatures, oil pressure, and the electrical system are all monitored.

Three cars or vehicles are usually tested simultaneously, which greatly complicates the operation. The vehicles typically travel between 25–30 mph and have reached top speeds of 45 mph. Installing and removing the robot, control unit, antenna and sensors takes less than four hours so the system can be used to test many vehicles quite easily.

Besides relieving human drivers from fatigue and punishment of rough road durability testing, Chrysler says the robotic system saves four weeks in the development of a new vehicle because testing can be done around the clock in all kinds of weather. Finally, it improves the quality and repeatability of the testing by eliminating any driver variation.

Test Tracks Vs. Real Roads

While, as you've seen above, driverless vehicles are already being used on the test track, automated cars traveling down public highways are still quite far in the future for a variety of reasons. Indeed, vehicles may never be completely robotic. While the techniques and equipment already being used might be conceptually similar, operating automated vehicles on regular highways is a much greater challenge than ones that only have to circle a closed track.

For instance, clouds, trees, buildings, other vehicles, and any number of other variables make electronic interference a

much more significant problem on highways compared to the highly controlled environment of the test track. Extremely reliable and redundant systems are required to prevent accidents. For example, in the Chrysler system, current technology requires that the vehicles be spaced at least 200 feet apart, hardly practical on real roads.

Furthermore, major and expensive changes to the infrastructure—such as guidance wiring embedded in the road—and to individual vehicles would be required. Chrysler estimates it could cost as much as \$50,000 to equip each vehicle with robotic equipment with currently available technology. Finally, the in-vehicle equipment has to be made much smaller. For instance, Chrysler's robot, computer, and associated hardware occupy both front seats.

That said, the state of the art continues to evolve. Should driverless cars and intelligent roads eventually move out of the realm of science fiction, the techniques being developed today could well show the way. **EN**

Remote-Control Robot—Planetary Explorer

A hardy traveler, named "Nomad," set a new record by traveling farther than any remotely controlled robot has ever gone over rough territory. The four-wheeled robot logged more than 133 miles (215 km) across Chile's rugged Atacama Desert, a cold, arid region above 7,000 feet altitude. The field experiments this past summer were designed to prepare for future missions to Antarctica, the Moon, and Mars.

Scientists from NASA's Ames Research Center (Moffett Field, CA), and Carnegie Mellon University's Robotics Institute

(Pittsburgh, PA) performed experiments with Nomad for 45 days, from June 15 to July 31. Nomad avoided obstacles on its own and recognized meteorites planted in the desert as a test. The robot, developed at Carnegie Mellon, validated the use of color stereo video cameras with human-eye resolution for geology.

"The Atacama trek is a quantum leap for the planetary robotics culture, where the historical standard of travel has been yards, not miles," said principal investigator Dr. William L. "Red" Whittaker of Carnegie Mellon. "Although the 'straight-line' distance on a map was only about 13 miles, Nomad had to weave through very difficult terrain, and it made numerous sidetrips for science and to test the meteorite sensors."

Nomad is about the size of a small car. To maneuver through rough terrain, the robot has four-wheel drive and four-wheel steering with a chassis that expands to improve travel and stability over various terrain conditions. Four aluminum wheels with cleats provide traction in soft sand. For this terrestrial experiment, power was supplied by a gasoline generator that permitted travel speeds up to one mile per hour.

"Nomad drove itself through about 12 miles (20 km) of the 133 miles it traveled," said Dr. Mark Maimone, Nomad software and navigation leader at Carnegie Mellon. "Autonomous driving is critical for planetary exploration because the communications delay between Earth and planets can be many minutes. With autonomous driving, a robot can explore a much greater distance because it doesn't have to wait for a person to decide a safe route. The



THE NOMAD remote-controlled robot.

rover is able to see obstacles and recognize them on its own."

Nomad's unique onboard panospheric camera, separate from the color video stereo cameras, returned more than a million live video-based panoramas of the robot's surroundings from the Atacama. The camera takes a 360-degree picture—one frame per second—and did so throughout the mission. The high-resolution video camera focuses up into a hemispheric mirror similar to a store security camera. The video view includes all of the ground up to the horizon in the circle surrounding the Nomad.

"Nomad met or exceeded all of our objectives for this project," said Dave Lavery, telerobotics program manager at NASA headquarters (Washington, DC).

The total cost of developing Nomad and conducting the desert trek is \$1.6 million. The project is funded by NASA with in-kind support from corporate sponsors and educational foundations. NASA and Carnegie Mellon are formulating plans to look for meteorites in Antarctica in 1998 and 1999. **EN**

Biology Lab on A Microchip

University of Michigan (UM) biomedical engineering researchers have developed a technology that may one day eliminate much of the uncertainty and expense involved in current medical diagnostic and genetic testing procedures. With just a small blood sample, your doctor may be able to scan your DNA using the UM device to get immediate answers to questions as serious as "Will my baby be born healthy?" or as simple as "Will an antibiotic help my sore throat?"

Currently, DNA analysis is time-consuming, and requires a complete molecular biology laboratory, and at least ten individual procedures performed by highly skilled technicians. "Our goal is to automate the process by, in essence, shrinking the lab to fit on one silicon microchip," said David Burke, assistant professor of human genetics. Cutting the cost, time, and technical skill required for DNA analysis also could lead to wider applications in genetic studies, self-testing kits, forensics test-

ing, water analysis, agriculture, and biology, Burke adds.

In the *Proceedings of the National Academy of Sciences*, Burke and his colleagues reported initial test results on five microfabricated components and their preliminary integration into a DNA-analyzing chip just 3-cm (about 1-inch) long and ½-cm wide. According to Mark Burns, associate professor of chemical engineering, the device relies on a thermocapillary pump to mix drops of pure DNA with an enzyme solution and drive the DNA through five different components on the microchip.

Because the device is fabricated with conventional techniques, it should be inexpensive and easy to produce in large quantities. However, significant technical problems still have to be solved regarding handling such small amounts of liquids, and the interactions between liquids and materials in the chip. **EN**

Low-Visibility Airport Operations

At Hartsfield-Atlanta International Airport, NASA recently demonstrated an aircraft technology to keep commercial aircraft moving safely on runways and taxiways, regardless of visibility. A total of 53 flight tests were performed for airline and industry executives, and officials of the FAA and other government agencies.

► Roboshop

The first fully-automated convenience store, Robot Shop Super 24, opened in Tokyo this past spring. The store has 85 square meters of selling space, and offers 2,500 items, but there's nary a clerk in sight—robots deliver the items you select. Shelf space is rented by the month to companies who want their products on display. And it's the distributor or manufacturer, not the store, that sets the prices. (BY CHARLES WHIPPLE, COURTESY LOOK JAPAN, AUGUST 1997.)

The technology is actually many technologies rolled into one system, on the ground and in the aircraft. Onboard NASA's Boeing 757 research aircraft, were two integrated subsystems: The Roll-Out Turn-Off Guidance subsystem was developed at NASA's Langley Research Center (Hampton, VA) and the Taxiway Navigation & Situation Awareness (T-NASA) display subsystem was developed by NASA's Ames Research Center, (Moffett Field, CA). The airborne systems and displays aid the pilot in touchdown, on the runway, in exiting the runway on to the taxiway, and during taxiing.

As the B757 approaches the airport, computer-generated graphics outline the correct runway and its precise location on a glass visor mounted between the pilot and the cockpit windshield. Once on the ground, the plane's position, as well as the position of other aircraft, is shown on an electronic moving map of the airport on the instrument panel. Using Global Positioning System and an airport layout database, displays are updated in real-time.

The glass visor, or heads-up display, shows the edges of the runway and taxiway with a series of computer-generated "cones." During taxiing, a turn is indicated by virtual cones and signs showing the angle and direction of the turn. As the pilot taxis down the runway, the cones and signs move and change. The pilot's cleared route looks like a virtual highway on the ground.

On the ground is a system of surveillance sensors and other equipment developed by the FAA. This system provides traffic positions to the aircraft via a computer datalink. A controller interface allows air traffic controllers to transmit instructions to the pilot by computer in parallel with normal voice communications, decreasing the chance for miscommunication. This computer link automatically reports if the 757 deviates from its approved path. A combined ground and airborne system can reduce the growing number of ground accidents and close calls.

The research is part of NASA's Terminal Area Productivity Program, led by the Ames Research Center. The program is expected to substantially increase aviation system capacity and safety in all weather conditions. **EN**

Q & A

continued from page 8

more linear CCD arrays that are in the light path only during focusing. Their performance is often enhanced by microlens arrays or other optical devices to exaggerate the difference between correct and incorrect focus.

"Point-and-shoot" cameras often use rangefinder autofocusing; that is, they view the same object from two different positions and measure the angular difference between the two views. Again, an electronic circuit operates the rangefinder and detects when the two images coincide. A block diagram of the system is shown in Fig. 5.

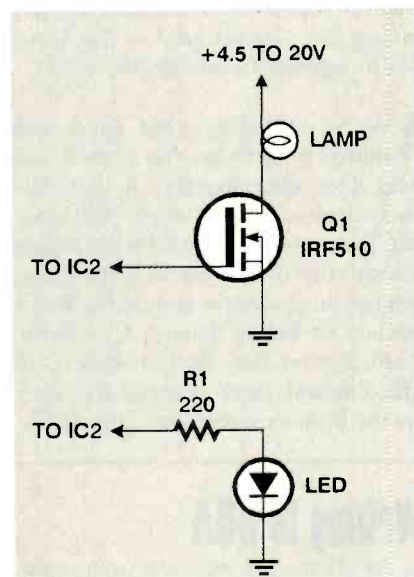


FIG. 2—THE OUTPUTS OF IC2 in Fig. 1 can be used to drive LEDs or lamps using the circuits shown here.

Several other methods of autofocusing have been tried over the years, including Polaroid's sonar system, which sends out an ultrasonic pulse and measures the time taken for it to echo back.

On slide projectors, "autofocus" means something quite different—all it means is that the projector focuses all slides alike, compensating for differences in the frames in which they are mounted. That is done by reflecting an infrared light beam off the surface of the slide and using two photocells to detect whether it is in the correct position.

Two good reference books on autofocusing are Sidney F. Ray, *Applied Photographic Optics* (Focal Press, 1994), and Norman Goldberg, *Camera Technology* (Academic Press, 1992).

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 Claggg, 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.

Sewing-Machine Controller Found

Spurred by reader A. R. Baker, who prodded us to look again at SCR and Triac speed controls, we've found the sewing-machine controller circuit requested by W. B. in our August issue. Here it is in Fig. 6. This is a true constant-speed controller because it uses feedback; as the motor slows down under load, the circuit responds to the

increased current flow by raising the voltage. However, the motor never gets more than half the incoming AC voltage; with a sewing machine this is presumably not a problem, since you don't run it at full speed anyhow.

This circuit appears in John Markus' *Electronic Circuits Manual* (McGraw-Hill, 1971), which credits it to a General Electric application note. Building it today, you can use RadioShack 276-1114 diodes and a RadioShack 276-1020 SCR. Be sure to use this circuit only

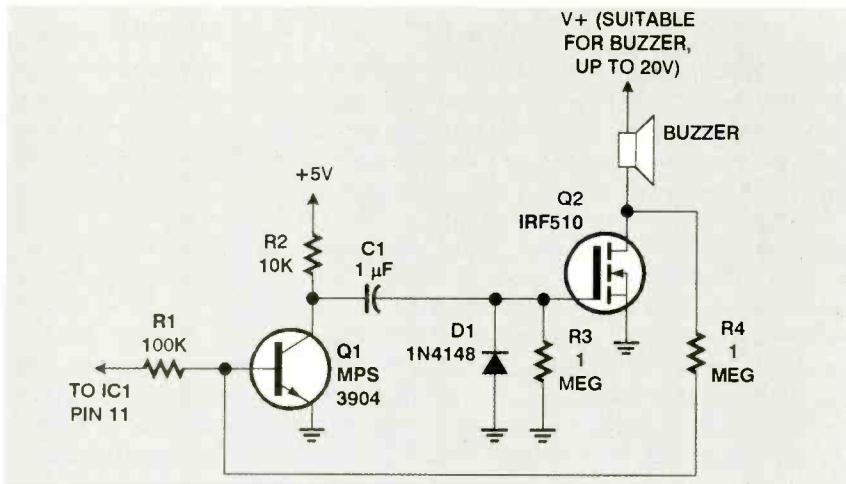


FIG. 3—THIS BUZZER CIRCUIT SOUNDS for one second when IC1 (in Fig. 1) latches. Diode D1 is included for fast recycling, but is optional.

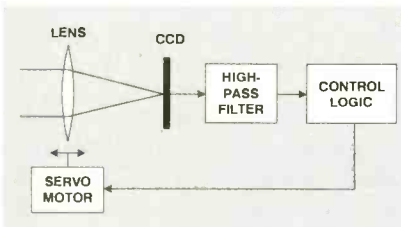


FIG. 4—IN A VIDEO CAMERA, the autofocus system positions the lens to maximize the high frequencies, which correspond to the fine details in an image.

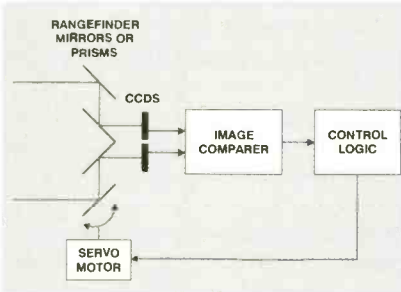


FIG. 5—A RANGEFINDER AUTOFOCUS SYSTEM measures distance by measuring the angle between two mirrors or prisms when they have been adjusted so that the images from both coincide.

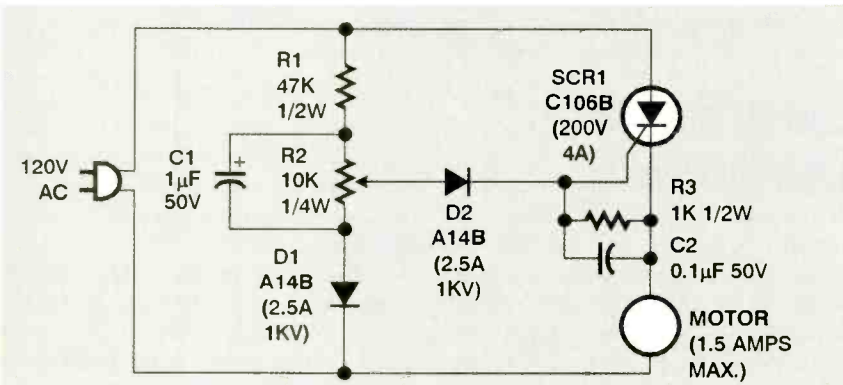


FIG. 6—THIS SEWING-MACHINE SPEED CONTROL circuit is based on one originally published in a General Electric application note in 1969.

or satellite phone that communicates with the telephone company's master antenna (on earth or in space) rather than with a base unit in your home. The range of a cellular phone is only a few miles, but the system automatically transfers you from one "cell" to another as you move around. Satellite phones work much the same way but use satellites in space rather than towers on the ground.

Tequipment Scope

Q I am trying to find the operator or service manual for an old oscilloscope I have. The scope was made in England in 1969 by Tequipment. The model is Type D53A.

I have already contacted Howard W. Sams, Hi Manuals, and Manuals Plus without any luck. Can you help? — Ron Shaw, 403 S. Jefferson, Carterville, MO 64835

A We're publishing your name and address in the hope that a reader can help. Our understanding is that Tequipment was bought out by Tektronix, but Tektronix does not normally supply manuals that old. Given the scope's English origin, you might also try the Radio Society of Great Britain, Cranborne Road, Potters Bar, Hertfordshire EN6 3JE, England, <http://www.rsgh.org>. They are the British counterpart of the ARRL.

Writing to Q&A

As always, we welcome your questions. Write to 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. Due to the volume of mail, we regret that we cannot give personal replies. **EN**

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.



JAMECO® - Your One Stop Component & Computer Source

Special Prices for Electronics Now Readers. Please mention VIP #DR7!

Leading Edge Fortiva 3000 Slim Desktop Computer

- 486DX2-66 motherboard
- IDE controller
- One 5.25", half height accessible bay
- 4MB RAM, expandable to 48MB
- 1.44MB floppy disk drive
- 8KB internal cache
- SVGA on-board monitor port
- Two serial ports (16450) and one parallel port
- Vertical riser with 3 ISA 8 or 16-bit expansion slots
- 101-key keyboard • Weight: 23.4 lbs.



Part No. Product No. Price
140468 486DX2-66 dsktp comp. **Special \$199.95**

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	\$152.95
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

PARALLAX 7 Basic Stamps



127693 130892

Basic Stamps are small computers using a variation of Basic, called PBASIC to control execution of many applications. The BS1-IC has 8 I/O lines, while the BS2-IC has 16 I/O lines which can be connected directly to buttons, LEDs, registers, and many other TTL level devices. • One-year warranty

Part No.	Description	Price
127693	Basic stamp BS1-IC	\$34.95
130892	Basic stamp BS2-IC	\$49.95

Muscle Wires Project Book

Get the facts behind the unusual properties of Muscle Wires. These unique nickel-titanium alloy Muscle Wires actually shorten in length when electrically powered, and can lift thousands of times their weight.



Part No.	Description	1-4	5-9
141330	Muscle Wires Proj. Bk.	\$19.95	\$17.95

Muscle Wires Book & Deluxe Kit

- Includes Flexinol, crimps and instructions
- | Part No. | Description | 1-4 | 5-9 |
|----------|-------------------------|---------|---------|
| 141348 | Muscle Wires deluxe kit | \$59.95 | \$53.95 |

METEX 3 1/2-Digit Digital Multimeter

- 3 1/2-digit LCD (.5" high digits)
- AC voltage: 200mV, 2V, 20V, 200V, 700V
- DC voltage: 200mV, 2V, 20V, 200V, 1000V
- AC & DC current: 20µA, 200µA, 2mA, 20mA, 200mA, 2A, 20A
- Resistance: 200Ω, 2KΩ, 20KΩ, 200KΩ, 2MΩ, 20MΩ
- Input impedance: 10MΩ
- Auto zeroing • One-year warranty



Part No.	Product No.	1-4	5-9
27115	M3800	\$39.95	\$35.95

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.



Part No.	Description	1-4	5-9
105646	66 piece tool kit	Special \$149.95	

Jameco 54 Watt Switching Power Supply

- Input: 110/220VAC @ 47/63Hz
- Output: +5VDC @ 5.0A, +12VDC @ 1.0A, -5VDC @ 1.0A, -12VDC @ 1.0A
- 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	FGS604A	\$44.95	\$39.95

Jameco ABS Cases w/ Clear Top

Case is made of a gray ABS plastic body with a clear polycarbonate top cover. It comes with screws of mounting boards or electronic part/component, rubber gasket for a tight seal on your equipment, drilled holes for mounting and enclosure.



Part No.	Size (L x W x D)	1-9	10-49	50-99
141823	2.3 x 2.2" x 1.2"	\$3.95	\$3.49	\$2.95
141831	4.6" x 3.2" x 1.8"	6.95	6.25	5.59
141840	6.3" x 3.2" x 1.8"	7.95	7.15	6.49
141858	7.0" x 5.5" x 2.5"	11.95	10.95	9.95

High Hand-held 5MHz Oscilloscope

This compact scope is perfect for the technician on-the-go or for students and lab technicians as well! The display is high contrast LCD with wide angle for visibility, and all functions are done from easy to use keypad.



Part No.	Description	Price
135941	5MHz oscilloscop.	\$269.95

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 3/4	4.95	4.49	3.95	3.49

JAMECO IC Function Tester/Emulator

- Any DIP type IC up to 40-pins can be inserted into the universal TEST TOOL socket for function emulation
- A 360 tie point solderless bread-board provides free wiring space for any additional circuits
- Size: 10.0"L x 6.5"W x 1.5"H
- Weight: 1.5 lbs. • One-year warranty



Part No.	Description	Price
119107	Tester/emulator	Special \$39.95

Hyundai Full Page Monitor

- PC/XT/AT and compatibles
- 15" portrait-oriented, monochrome display
- Works with any IBM-compatible VGA system - no special video controller needed
- Size: 11.7"W x 15.0"D x 13.9"H
- Weight: 26.0 lbs.



Part No.	Description	Price
127909	Full page monochrome	Closeout \$59.95

Computer-TV Converter

- For PC/Macintosh



Part No.	Description	Price
126800	AverKey/3	Closeout \$249.95

Front Flip Down Plastic Case

- Drawers open and close simultaneously
- Case color: black; drawer color: red
- Size: 13.5"L x 3.8"W x 14.3"H
- Weight: 2.8 lbs.



Part No.	Description	1-9	10-99	100+
142990	Flip Down Case	\$19.95	\$17.95	\$15.95

Hyper Peppy Robot Kit

- Changes course when it comes in contact with an object or hears a loud sound



Part No.	Description	Price
140863	Robot kit	Special \$19.95

Making Your Own Printed Circuit Board Book

Design and create your own printed circuit board inexpensively and reliably. (37 pages)

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	Special \$34.95
124476	28.8 int. modem	Special \$59.95

137998	14.4 int. modem (w/voice)	44.95
141292	28.8 ext. modem	79.95
136864	33.6 int. modem (SAVD)	79.95
145015	33.6 int. modem	59.95
136872	33.6 ext. modem (SAVD)	119.95
145023	K56 Flex int. modem	149.95
145031	K56 Flex ext. modem	169.95

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
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

SOLETEK Cordless Phone by AT&T

- Two channel operation
- Tone/pulse dialing
- Redial, speed dial and mute buttons
- Factory reconditioned • UL approved
- Operating range 100 yards
- Weight: 1.3 lbs. • 90-day warranty



Part No.	Description	Price
133743	Cordless phone	Special \$34.95

Internal CD-ROM Drives

- 5.25" half-height design
- Include software
- Include audio cable
- One-year warranty



Part No.	Mfg.	Speed	Interface/Type	Price
131342	NEC	4X	EIDE	\$59.95
133031	Philips	6X	ATA/EIDE	Closeout \$9.95
140679	IBM	6X	ATA/EIDE	69.95
134244	Mitsumi	8X	ATAPI/EIDE	89.95
141233	BCD	16X	ATA/EIDE	99.95

JAMECO ELECTRONIC COMPONENTS COMPUTER PRODUCTS

© 1997 Jameco 12/97

Order Toll Free 24-Hours

7-Days a Week!

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



Mention V.I.P.# DR7

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

On-Line Tech Tips, Tools, and Test Gear for the Troubleshooter

LAST TIME WE INTRODUCED YOU TO THE BASICS OF TROUBLESHOOTING JUST ABOUT ANYTHING ELECTRONIC. THIS TIME, WE'RE GOING TO PICK UP RIGHT WHERE WE LEFT OFF AND TAKE A CLOSE LOOK AT ON-LINE TECH-TIP DATABASES, AND THEN

go on to look at the kinds of tools you really ought to have. But first, we need to deal with some old business.

It has come to our attention that due to production problems, several errors crept into the September, 1997 installment of Service Clinic. In Fig. 2, which also re-ran as Fig. 1 in October, the black and green wires on the AC plug are shown reversed; the green wire, of course, should go to the chassis ground. Also in that figure, the ground on the Magnatron should be to the chassis, and a dot is missing at the intersection between the anode of the HV diode and FA. Finally, in the middle of page 25, the value of the capacitor is given in °F; it should of course be in μF. We are sorry for any inconvenience that might have been caused by these errors and have taken steps to help prevent similar ones from cropping up in the future. Now that that's out of the way, let's move on to this month's topics.

Tech-Tips Databases

A number of organizations have compiled databases covering thousands of common problems with VCRs, TVs, computer monitors, and other electronic equipment. Most charge for their information but a few, accessible via the Internet, are either free or have a very minimal monthly or per-case fee. In other cases, a limited but still useful subset of the for-fee database is freely available.

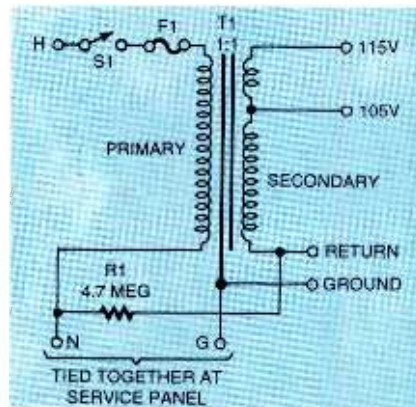


FIG. 1—HERE'S THE SCHEMATIC FOR A TYPICAL ISOLATION TRANSFORMER. It protects you against shock hazards when working on "hot chassis" equipment.

A tech-tips database is a collection of problems and solutions accumulated by the organization providing the information or other sources based on actual repair experiences and case histories. Since identical failures often occur at some point in a large percentage of a given model or product line, checking out a tech-tips database might quickly identify your problem and solution.

By using a tech-tips database, you can often simplify your troubleshooting or at least confirm a diagnosis before ordering parts. My only reservation with respect to tech-tips databases in general—and this has nothing to do with any one in particular—is that symptoms can sometimes be deceiving. A solution that works

in one instance may not apply to your specific problem. Therefore, an understanding of the hows and whys of the equipment along with some good old-fashioned testing is highly desirable to minimize the risk of replacing parts that turn out not to be bad. In simpler words, use these databases as an assistant, not as a replacement for logical troubleshooting techniques.

Another disadvantage to the databases is that you do not learn much by just following a procedure developed by others. There is no explanation of how the original diagnosis was determined, or what might have caused the failure in the first place. Nor is there likely to be any list of other components that might have been over-stressed by the original problem, and that might fail in the future because of it. Knowing that you need to replace "Q701" and "C725" to get this specific piece of gear going again in this specific instance is fine for now, but that "knowledge" won't help you to repair a different model or a different problem in the future.

One alternative to tech-tips databases is to search at <http://www.dejanews.com/> or the sci.electronics.repair Usenet news group for postings with keywords matching your model and problem. Having said that, here are three tech-tip sites for computer monitors, TVs, and VCRs:

- <http://www.anatekcorp.com/techforum.htm> (Free)
- <http://www.electronix.com/elexcorp/techsweb.html> (\$8/month)
- <http://elmswood.guernsey.net/> (Free, currently very limited)

The following source is just for monitors. Some portions are free but others require a \$5 charge; however, that charge could get you a personal reply from a technician experienced with your

monitor, so it could be well worth it:

- <http://www.netis.com/members/bcollins/monitor.htm>

Some free monitor repair tips are also available at:

- <http://www.kmrtech.com/> Tech-tips of the month and "ask a wizard" options are available at:

- <http://members.tripod.com/~ADC/C/> — (Home page)

- <http://members.tripod.com/~ADC/C/tips.htm> — (Tech-tips of the month)

The following is specifically for microwave ovens. In addition to a large database of specific repairs, there is a great deal of useful information and links to other sites:

- <http://www.yup.com/microtech/>

Hand Tools

Invest in good tools. If you are into garage sales, you can often pick up excellent, well-maintained tools very inexpensively, but be selective—there's a lot of junk out there. In the end, substandard tools will slow you down and prove extremely frustrating to use. Keep your tools healthy—learn to use a whetstone or grinding wheel where appropriate (screwdrivers, drill bits, etc.) and put a light film of oil (e.g., WD40) on steel tools to prevent rust.

Some of the basic hand tools you will need to accumulate include:

- Standard screwdrivers of all types and sizes including straight, Philips, Torx. You'll also need a notched straight blade

for VCR mechanical tracking adjustment—you can make one out of a standard screwdriver or buy one.

- Jewelers' screwdrivers—both straight and Philips. These are generally inexpensive but quality usually varies in direct proportion to the price.

- Small socket driver set.

- Security bits for some video games, PS2s, etc.

- Hex key wrenches or hex drivers. You'll need miniature metric sizes for VCRs.

- Pliers—long nose, round nose, curved. Both smooth and serrated types are useful.

- Adjustable wrench (small).

- Cutters—diagonal and flush.

- Linesman's pliers.

- Wire strippers—fixed and adjustable.

- Crimp tool.

- Alignment tools—at least a standard RCA type for coils.

- Files—small set of assorted types including flat, round, square, and triangular.

- Dental picks—useful for poking and prodding in restricted areas (but you knew that).

- Locking clamps and or hemo-stats—for securing small parts while soldering, etc.

- Magnetic pickup tool—you can never tell when you will drop something deep inside a VCR. If you keep a strong magnet stuck to your workbench, you can use it to magnetize most steel tools such as screwdrivers. Just keep anything magnetized away from the tape path and magnetic heads (and magnetic media!).

- Hand drill, electric drill, drill press—one or all. A small bench-top drill press (about 8 inches) is invaluable for many tasks. A good set of high-speed bits (avoid the 1000 bits for \$9.95 variety). Also, miniature bits for PCB and small plastic repairs are likely to be needed.

- Soldering and de-soldering equipment. You don't need a fancy rework station; a 25-watt iron and hand de-soldering pump will be adequate for most tasks.

Basic Test Equipment

Obviously, you can load up on exotic test equipment, but it is far from required. What's listed here are those instruments that are most used. You might at first not consider all of what follows to fit the category of test equipment, but an old TV, for example, can often provide as much or more useful information about a video signal than a fancy waveform analyzer:

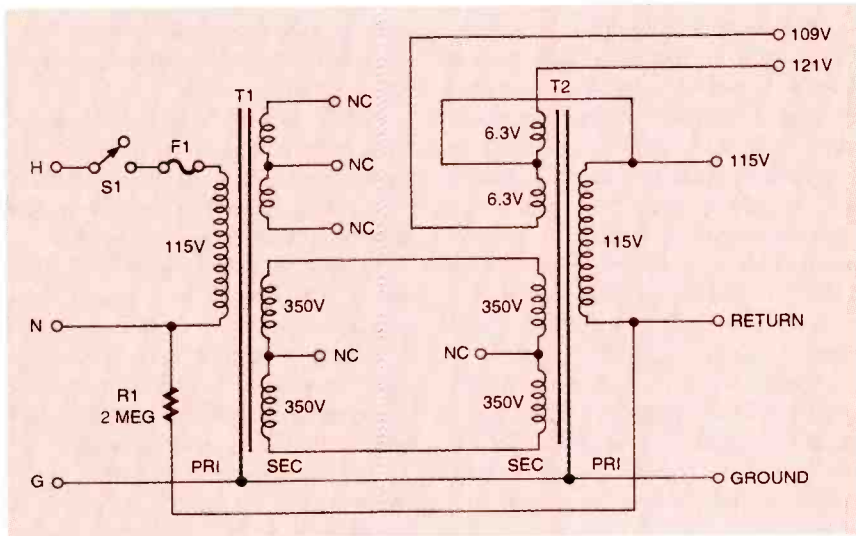


FIG. 2—YOU CAN BUILD YOUR OWN ISOLATION TRANSFORMER using back-to-back power transformers salvaged from old tube-type TV receivers.

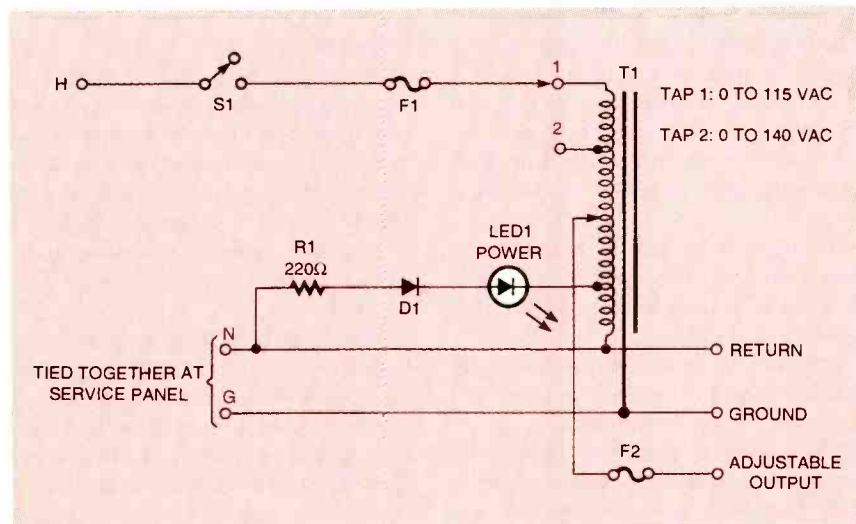


FIG. 3—THE INTERNAL WIRING OF A TYPICAL VARIAC is shown here. A VARIAC lets you vary the AC line voltage that is input to a piece of equipment, something that is a very helpful asset when troubleshooting.

•DMM and/or VOM—I prefer to have both. A good old Simpson 260 analog meter is better in many ways than a cheap digital multimeter. For most measurements, I still use a 25-year-old Lafayette (remember them?) VOM. I only go for the DMM when I need to measure really low resistances or where better accuracy is needed (though that can be deceptive). Just because a DMM has 3½ digits does not mean it is that accurate. Check the manual, it may prove enlightening. The Simpson 260 also has a nice 5000-volt AC/DC scale that many newer digital instruments lack.

Scales for transistors, capacitors, a frequency counter, etc. are not really essential. A diode-test function on a DMM is needed, however, to properly bias semiconductor junctions. However, even that is not useful for in-circuit tests or for some power transistors or transistors with built-in damper diodes and/or base resistors.

Make sure you have a good well-insulated set of test probes. This is for your own safety as you may be measuring relatively high voltages. Periodically inspect those for damage and repair or replace as needed. If the probes that came with your multimeter are substandard—flimsy connectors or very thin insulation—replace them as well.

A high-impedance high-voltage probe is sometimes useful for TVs and monitors. You can build one that will suffice for most consumer-electronics work.

•AC clamp-on ammeter—This tool permits the measurement of currents in appliances or electrical wiring without having to cut any wires. At most, you will need an easily constructed adapter to permit access to a single conductor of a line cord. Some multimeters offer this as an option.

•Oscilloscope—You'll need a dual trace, 10- to 20-MHz minimum vertical bandwidth unit; also one with delayed sweep is desirable, but not essential. Make sure you obtain a good set of proper 10×/1× probes. High vertical bandwidth is desirable but most consumer electronics work can be done with a 10-MHz scope. If you get into digital debugging, that is another story—bandwidths of 100 MHz and up will be required. If money is no object, buy a good digital storage scope. You can even get relatively inexpensive scope cards for PCs, but unless you are into PC-controlled instrumentation, a stand-alone scope is much more useful.

If money is a concern (or perhaps even if it isn't) consider one of the old "war horses" you often see on the surplus/used market. You will usually get more scope for your money and these things last almost forever. My "good" scope is the militarized version (AN/USM-281A) of the Hewlett-Packard 180 lab scope. It has a dual-channel 50-MHz vertical plug-in and a delayed-sweep horizontal plug-in. I have seen these going for under \$300 from surplus outfits. Other types of plug-ins are available as well. For a little more money (\$400-\$700 on the surplus/used market), you can get a Tektronix 465 100-MHz scope that will handle all but the most demanding tasks.

You don't absolutely need an oscilloscope when you are just starting out in electronics, but it would help a great deal. It need not be a fancy one at first, especially if you are not sure if electronics is for you. However, being able to see what is going on can make all the difference in your early understanding of much of what is being discussed in the textbooks and the newsgroups. You can probably find something used that will get you through a couple of years for less than \$100. An oldie but goodie is much better than nothing at all even if it isn't a dual channel or high-bandwidth model.

•Logic probe—These are used for quick checks of digital circuitry for activity. A logic pulser can be used to force a momentary 1 or 0. Some people swear by these. I consider them of marginal value at best.

•TV set and/or video monitor—One of these, and preferably a color unit, is needed for testing video equipment like VCRs, camcorders, laserdisc players, etc. I have an old CGA monitor that includes an NTSC input as well on my bench. A great deal of information can be gathered more quickly by examining the picture on a TV or monitor than can be learned by examining the video waveform on a scope.

•VCR or other video-signal source—You'll need this for testing video monitors and TVs. Look for one with both RF and baseband outputs.

•Stereo tuner or other audio-signal source—This one is, obviously enough, for testing audio equipment.

•Audio signal generator—A function generator (sine, square, triangle) is nice as well. The usual audio generator will output from a few Hz to about 1 MHz.

•Audio amplifier—The input should be selectable between line level and mic

level, and be brought out through a shielded-cable to a test probe and ground clip. This is useful for tracing an audio circuit to determine where a signal is getting lost. The amplifier's output should be connected to a loudspeaker

•Signal injector—A readily accessible portable source of a test tone or other signal (depending on application) that can be introduced into the intermediate or early stages of a multistage electronic system. For audio, a simple transistor or 555 timer based battery-powered oscillator can be built into a hand-held probe. Similar devices can be built for RF or video testing.

•RF signal generator—This is needed for serious debugging of radio and tuner front-ends. These generators can get quite sophisticated (and expensive) with various modulation/sweep functions. For most work, such extravagance is unnecessary.

•LCR meter—While a capacitor tester is desirable, I prefer to substitute a known good capacitor rather than trusting a meter that will not test under the same conditions as exist in-circuit.

•Adjustable power supplies—At least one of these should be a totally indestructible type—one you can accidentally short out without fear of damage. Mine is a simple 1 amp 0-40-volt transformer and rectifier/filter capacitor affair with a little Variac for adjustment.

If you would like to try building your own test gear, *Test Equipment Projects You Can Build*, by Delton T. Horn, published by Tab Books, a division of McGraw-Hill, Inc., 1992 has a number of simple projects you can try.

Transformers

Isolation transformers are essential to safely work on many types of equipment with exposed AC line connections or that have a live (hot) chassis. Variable transformers provide a convenient way to control the input voltage to equipment to determine whether a fault still exists or to evaluate performance at low or high line voltage.

Make it a habit to use an isolation transformer to power the equipment you are troubleshooting whenever possible. Portions of TVs, monitors, switch-mode power supplies, and many other types of equipment are frequently fed from a direct connection to the AC line without a power transformer (which would provide the isolation function). The DC power rails will typically be

between 150 and 300 volts and can deliver momentary current of potentially lethal multiple amps!

Since earth ground and the power line neutral are connected together at your service panel (fuse or circuit-breaker box), grounds like cold water pipes, test equipment chassis, and even a damp concrete floor make suitable returns for the line voltage (hot or live wire). Since this is equally true whether the conductor is a wire or your body, such a situation is very dangerous. An isolation transformer as its name implies provides a barrier that protects against accidental contact with an earth ground. With the transformer in place, such contact results in negligible current flow (mainly due to the parasitic capacitance of the transformer)—a slight tingle at worst. That also protects your test equipment as well as the device you are troubleshooting, since without an isolation transformer, a similar accidental contact could result in a short circuit, sparks, destroyed parts, etc.

Figure 1 shows the schematic of a typical isolation transformer. Note that the ground is included on the secondary side. That is actually needed for safety with certain types of equipment like microwave ovens where the HV return is to the chassis. Most other consumer gear will only have a 2-wire cord and do not use the ground.

Even though the power line neutral and ground wires are tied together at the main service panel (fuse or circuit-breaker box), the transformer prevents any significant current flow between any of its outputs and earth ground should a fault occur. The resistor in Fig. 1 permits any static charge to leak off to ground. Since it is quite large—several megohms—no perceptible current flows between the secondary and primary sides, but that value is still low enough to dissipate any static charge. **CAUTION:** The resistor must be a high-voltage rated type (as in 4200 volts, isolation, large-size, light-blue color) to assure that arc over will not result due to voltage differences that may be present when the isolation transformer is being used in its normal manner.

Isolation transformers can be purchased or you can make your own out of a pair of similar power transformers connected back to back. I built mine from a couple of old tube-type TV power transformers mounted on a board with an outlet box. Their high-voltage secondary windings were connected together. The

unused low-voltage secondary windings can be put in series with the primary or output windings to adjust voltage. The schematic is shown in Fig. 2. Note that there should be a fuse in the primary to protect against faults in the transformer as well as the load. Use a slow-blow type. The inrush current of the transformer will depend on the part of the cycle when the switch is closed (worst is actually near the zero crossing) as well as the secondary load. Though not shown in the schematic, it is a good idea to also place a fast-blow fuse in series with the secondary to protect the load. However, the inrush current of the degaussing coils in TV sets and monitors will often pop a normal or fast-blow fuse when no actual problems exist. (It is probably a good idea to disconnect the degaussing coils while testing unless they are suspected of being the source of the problem.)

A variable autotransformer (also known as a Variac, which is the trade name of one manufacturer) doesn't need to be large—a 2-amp unit mounted with a switch, outlet and fuse will suffice for most tasks. However, a 5-amp or larger Variac is desirable. If you will be troubleshooting 220-VAC equipment in the US, there are Variacs that will output 0 to 240 VAC from a 115-VAC line. As valuable as a Variac can be, it is important to remember that a Variac is **NOT an isolation transformer!** Don't make the mistake of using one in place of an isolation transformer. Note that there are combination units, also known as variable isolation transformers. If you have one, great; but if not, there is no need to buy such a combination unit. A Variac followed by a normal isolation transformer will work fine.

Figure 3 shows the internal wiring of a typical Variac. Note that there is no isolation as the power-line neutral and ground are tied together at the main service panel (fuse or circuit-breaker box)! Also note that the "Power-LED circuit" in Fig. 3 is soldered directly to a winding location that has been determined to produce about 6 VAC.

Next time I'll continue this discussion by presenting my thoughts on some basic ancillary equipment every troubleshooter ought to have, as well as some hints on where and how to get service literature including schematics. In the meantime, why not visit my sci.electronics.repair FAQ site on the Internet at www.repairfaq.org. You can reach me directly via e-mail at sam@stdavids.picker.com. **EN**

You can Build Gadgets! Here are 3 reasons why!

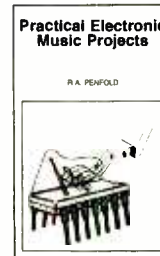
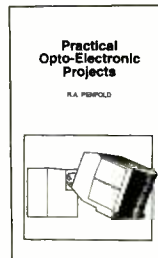


BP345—GETTING STARTED IN PRACTICAL ELECTRONICS \$5.95

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

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—all are easy to build.



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 that you can buy. The project categories are guitar, general music and MIDI.

Mail to:

Electronic Technology Today, Inc.

P.O. Box 240

Massapequa Park, NY 11762-0240

Shipping Charges in USA & Canada

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

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

Number of books ordered.

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

Name _____

Address _____

City _____ State _____ ZIP _____

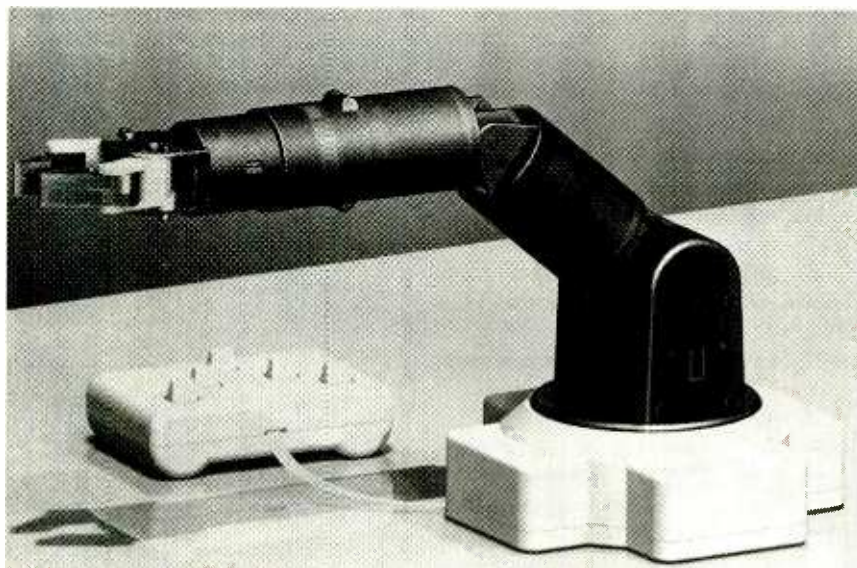
Please allow 6-8 weeks for delivery.



NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Robotic Arm Trainer Kit



CIRCLE 20 ON FREE INFORMATION CARD

The Robotic Arm Trainer Kit from OWI teaches the basic principles of robotic sensing and locomotion. It includes a five-switch wired controller that permits the arm to grab and release, lift, lower, rotate both the wrist and the base, and pivot sideways 120 degrees. Five motors and five joints allow for flexibility and fun.

After the robotic kit is assembled, the dynamics of the gear assembly can be observed through the transparent arm. The state-of-the-art gear mechanism is a combination of link-mechanism with a motor gear-box control.

The robotic arm has a maximum length of 18 inches outwards and a maximum height upwards of 14 inches. It uses 4 "D" batteries (not included) as a power source and has a suggested selling price of \$69.95

OWI Incorporated

1160 Mahalo Place
Compton, CA 90220-5443
Tel: 310-638-4732
Fax: 310-638-8437

Mini-Stick Meters

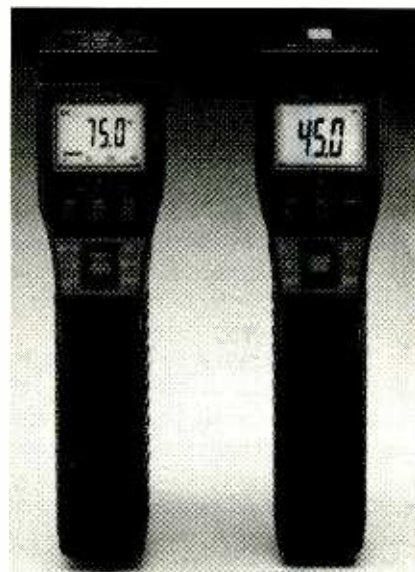
Wavetek has introduced two uniquely shaped digital multimeters, the ST75 and TM45. Traditional handheld DMMs must be put down by the technician while holding the test leads. The "mini-stick" design of these meters, however, allows the user to simultaneously hold the meter safely and read the display.

Designed especially for electricians, plant and maintenance engineers, and others who need a compact tool, the small thin style of the meters makes it easy to carry in tool belts and helps it fit easily in tool boxes (it measures approximately 6³/₄-inches high by 1⁵/₈-inches wide at its widest). Wavetek's ST75 and TM45 are very useful for applications where space is tight, for quick tracing on wiring panels and circuits, and for blower and motor circuit troubleshooting.

The ST75 is a complete volt/ohm stick DMM, featuring digital and analog bargraph display, 3200-count resolution, autoranging, data hold, quick continuity

checking, and diode testing. It measures DC and AC voltage up to 600 volts and resistance up to 32 megohms.

The TM45 is a digital thermometer, geared to commercial and industrial applications, with a wide temperature range up to 2000° Fahrenheit and 1300° Celsius. Features include temperature measurement that is switchable between Fahrenheit and Celsius, compatibility with Type K-thermocouples, and data and maximum display hold.



CIRCLE 21 ON FREE INFORMATION CARD

Priced at \$99.95 each, both meters are available from local distributors and national catalogs.

Wavetek Corporation

Instrument Division
9045 Balboa Avenue
San Diego, CA 92123
Tel: 619-279-2200
Fax: 619-565-9558

In-Circuit Capacitance Checker

The CapAnalyzer 88 from Electronic Design Specialists (EDS) is an electrolytic capacitor checker that automatically discharges the capacitor, measures DC resistance and equivalent series

resistance (ESR), and looks for shorts in circuit—all in one step.



CIRCLE 22 ON FREE INFORMATION CARD

It measures values from 0.47 μF to 2200 μF in-circuit with complete accuracy. (All signals are under 50 mV with a 5-ohm test impedance to prevent false readings.) Since it takes only 2.5 seconds to test each capacitor, an entire PC board can be checked in minutes.

The beeper on the CapAnalyzer 88 allows the technician to look at the circuit being checked rather than having to keep his eyes on the instrument. A slider control sets the value of DC resistance at which the alarm beeper goes off. When the equivalent series resistance is being read, the beeper will also sound—from one to five beeps—depending on the actual ESR reading and the quality of the capacitor.

The state-of-the-art design uses a microprocessor and a two-color, 20-segment, LED meter that reads ESR with a resolution down to 0.1 ohm. A handy, three-color chart on the front panel shows typical ESR readings for good and bad capacitors. Included is a one-handed, gold-plated tweezer probe that can check both conventional and surface-mount capacitors.

The CapAnalyzer 88 has a suggested retail price of \$169.

Electronic Design Specialists

4647 Appalachian Street
Boca Raton, FL 33428
Tel: 561-487-6103

Auto-Ranging Automotive Multimeter

HC Protek's Model D-688, a handheld diagnostic test instrument, helps speed automotive repairs by providing fast, thorough, on-the-job analysis of systems and components found in auto-

mobiles. Applications include testing of sensors, solenoids, and components; coils, diodes and alternators; ignition and engine systems; cooling heating, and lighting systems; and charging systems in an automobile.



CIRCLE 23 ON FREE INFORMATION CARD

This auto-ranging multimeter has a 4000-count, $3\frac{3}{4}$ -digit LCD readout with a 42-segment bargraph. The instrument can measure, memorize, and recall both duty cycle and dwell, as well as tach (RPM) settings for fast, curb, and baseline idle specifications on vehicles with or without distributors. It also measures AC/DC current up to 15 amps and monitors changing trends in throttle position and other output sensors. The Model D-688 gives minimum/maximum average readings, as well as temperature readings in both Fahrenheit and Celsius. A 0- to 2000-kHz frequency counter is built-in. Other features include data hold, a continuity buzzer, and overload protection.

The Model D-688 costs \$249.95.

HC PROTEK

154 Veterans Drive
Northvale, NJ 07647
Tel: 201-767-7242
Fax: 201-767-7343
E-mail: HC_protek@aol.com
Web:

<http://www.techexpo.com/WWW/hcprotek>

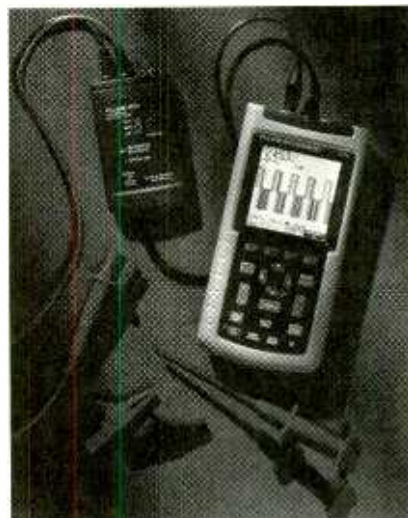
Differential Voltage Probe

Floating measurements are often required on electrical and industrial power systems. The Fluke DP120 Differential Voltage Probe for oscilloscopes allows users to safely make such

measurements. It is designed for use with Fluke's range of ScopeMeter test tools, CombiScope instruments, and with analog oscilloscopes and accessories.

The DP120 has a 20 MHz bandwidth and selectable 20 \times or 200 \times attenuation. Each instrument channel used with a DP120 probe can be connected to a different ground potential. When used with a battery-operated test instrument, a single DP120 provides a dual-channel measurement capability on systems with two different ground potentials.

Typical situations for which the voltage probe offers solutions include measurements on variable-speed motor controls, uninterruptible power supplies, process controllers, and other systems with multiple ground levels. In many industrial installations, control electronics are connected to PLCs, and measurements need to be referenced to earth ground. However, in power circuits, the output devices are usually floating. Therefore, measurements on the grounded and power sides may be necessary in a single session, which can be easily accomplished with DP120 Differential Voltage Probe.



CIRCLE 24 ON FREE INFORMATION CARD

Included with the DP120 are shrouded 4mm banana-probe tips, sets of pin-grabber test clips, and large-jaw alligator clips. Also provided is a 9-volt battery that allows up to eight hours of operation. The DP120 probe is priced at \$395.

Fluke Corporation

P.O. Box 9090
Everett, WA 98206
Tel: 800-FLUKE
Fax: 800-FLUKE-FAX
E-mail: fluke-info@tc.fluke.com
Web: <http://www.fluke.com>



LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

Shielded From the Truth

It has come to our attention that the schematic diagram (Fig. 1) for the Quick Tester that appeared on page 53 of the October 1997 issue of Electronics Now was reproduced incorrectly. The connection between J2 and J4 should only connect to the shield of J2. With that connection wired through J2 as originally shown, R1, R2, and S2 have a direct short across them, making that portion of the circuit ineffective. We are sorry for any inconvenience that might have been caused.—Editor

"Smartbox" Updates

I recently built Anthony Caristi's "Smartbox" (*Electronics Now*, July 1997). I encountered two problems with the project. First, the IRF9Z30 P-channel MOSFET no longer exists. An IRF9Z34, which has a higher current rating, can be substituted, according to the manufacturer. The second problem is with the foil pattern itself. IC3 pin 8 (V_{CC}) is not connected. The problem can be fixed by soldering a jumper from the V_{CC} side of R5 to IC3 pin 8.

DAVID WASILKO
Mililani, HI

Bring Back Fips

I've been a loyal subscriber to *Electronics Now* (and its predecessor, *Radio-Electronics*) since about 1962, when I was about 12. Now I'm a senior EE at a high-tech company, and I'm still a subscriber. Why? Because your magazine fills the gap between the world of industrial applications, which I live in, and commercial products (audio, video, etc.). You have enough basic things for the newcomers, and enough details and interesting things for the oldtimers. That must be a difficult balance to keep.

My only wish is that someday you'd reprint (maybe as PDF files on your Web site) the April Fools' articles published in the 1950s and 1960s under the pen name

"Mohammed Ulysses Fips." Looking back, it is remarkable how many of those humorous articles accurately predicted future advances or technology. For example, your September 1997 issue contained an article on noise-canceling earphones. The April 1964 issue contained an article titled "Snorekill" on a noise-canceling system for the bedroom. Other April Fools' articles that I remember and that were equally predictive include Paperthin Radio (1960), Teleyeglasses (1963), and Three-dimensional Television (1965).

FRANK DEMAREST
via e-mail

Northwest Missouri Winter Hamfest

The eighth annual Northwest Missouri Winter Hamfest will be held on January 17, 1998 from 9 a.m. to 4 p.m. at the Ramada Inn, located right off I-29, in St. Joseph, Missouri. Special room rates are available for Hamfest participants.

Major exhibitors, an indoor flea market, and a swap fest are all part of this event. Talk-ins will take place on 146.85 and 444.925. FCC exams will be given. Admission fee is \$2 for pre-registration and \$3 at the door.

For further information, contact Northwest Missouri Winter Hamfest, c/o Jean Pearson, KC0GB, P.O. Box 8547, St. Joseph, MO 64508.

JEAN PEARSON
Hamfest Secretary

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.

Mars On The Rocks

I strongly disagree with your editorial in the October, 1997 issue of *Electronics Now*. That \$1.00 each you mentioned as our contribution to the Mars Lander project has been taken and spent without our permission. And further more, it is taken from our grandchildren and, at the rate we're going, maybe our great-grandchildren.

I am a scientifically-oriented person—a retired technical writer and programmer—and I do not approve of the way we spend money on the space program in general. If sending a robo-cart to Mars to photograph rocks (yeah, I know much more than that) is so important, and if it seems to be entertaining, why can't such exploits be privately sponsored? I can just see the Sojourner coming down its ramp, and deploying a banner with Tide or Coca-Cola on it.

When you consider the money that is spent on commercials with high-paid entertainers, we could have had a colony on the Moon and maybe even on Mars by now.

JOHN P. LYMAN
Casselberry, FL

Dim Future for Technicians?

I read with much interest Dr. Joel Goldberg's article, "Recruiting Tomorrow's Electronics Technicians" in *Electronics Now*, October 1997. I might just be able to give him a reason for the current lack of qualified technicians. I can't say much for the rest of the country, but salaries for technicians here in New Jersey are just plain pathetic.

Since the huge layoffs by Hewlett-Packard, Lockheed, and others in the late 1980s and early 1990s, thousands of fully-qualified technicians have flooded the job market. With this glut of highly-skilled people, employers got smart in a hurry!

Even though the economy is "boom

Continued on page 27

Penetrating the Pilot

THE PALMPILOT FROM 3COM IS THE HOTTEST COMPUTER DEVICE TO HIT THE MARKET IN YEARS. I RECENTLY ATTENDED A DEVELOPER'S CONFERENCE AND AM NOW MORE CONVINCED OF THAT THAN EVER. ESTIMATES AT THE SHOW WERE

that sales would top one million units by October. That's after 1.5 years and two product generations.

Market research (DataQuest) shows that the Pilot has in that time grabbed 51% of the market for hand-held computers. The product category itself is vaguely defined and under constant revision—basically, every time someone releases a new device, the categorization scheme must be revamped. Windows CE ("Consumer Electronics") appears to be the big loser here; shrinking Windows to run on a tiny screen and keyboard does not work.

At the conference, a 3Com employee stated that the Pilot's growth correlates with that of every large consumer electronics success (except audio CD), including VCRs, cell phones, and more. That person also exclaimed that the Pilot market has the feel of the early years of the PC industry, before "Wintel" swallowed everything. Everyone I talked to seemed to feel that excitement—even the young'uns who weren't there the first time around. No one company owns the market, nor has competition reduced it to low-profit commodity status where cost-cutting is more important than innovation.

For years, many people (including me) have been predicting the advent of something like the Pilot. The early 1990s saw a spate of such offerings, all of which flopped. Then R&D money became hard to get, because PDAs were viewed as a

losing proposition. The Pilot has single-handedly changed that perception once and for all. The Pilot has legitimized the PDA market.

the other existing PDA vendors have released and/or are working on Pilot knockoffs. It will be interesting to see whether anything will seriously eat into the Pilot's market before Microsoft does get it right. In the meantime, I believe that there is lots of opportunity for software and hardware add-ons.

To catch up on what's hot, see the Resources sidebar elsewhere in this article. In particular, two Web sites—Adam's (<http://www.inforamp.net/~adam/pilot/>)

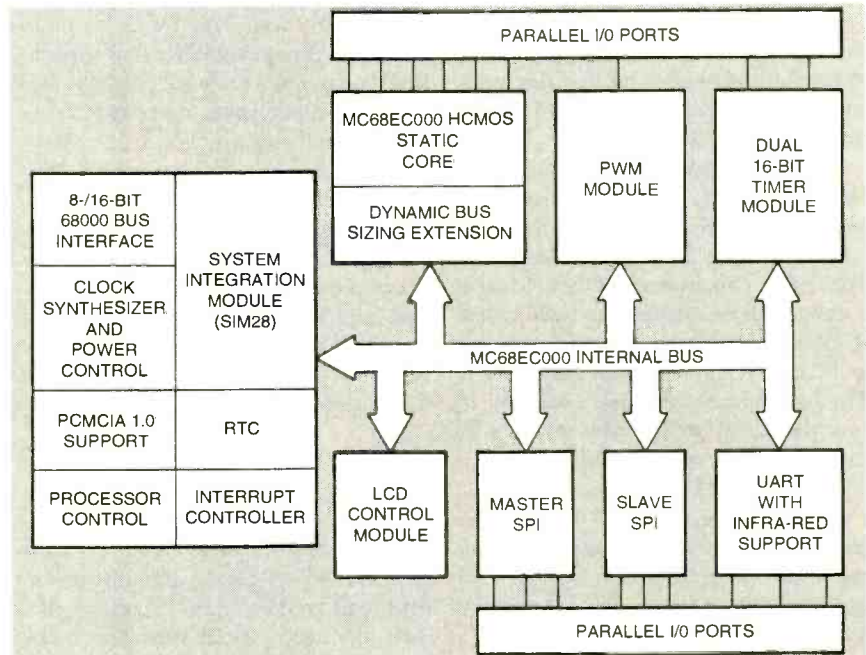


FIG 1—MOTOROLA'S DRAGONBALL CPU is an MC68000-family compatible device with lots of built-in peripheral support, including LCD controller, UART, clock, timers, and more.

Competition is heating up. Windows CE 1.0 has flopped, and CE2 is due this fall. There's an old adage that it takes Microsoft three times to do anything right. Perhaps CE3 will follow in another year. Meanwhile, Sharp and some of

and Stingersoft (<http://198.70.114.128/stinger/stingersoft.cfm>)—will link you to just about all current products and other major Web sites. You'll also want to check out the Pilot news groups. Both hardware and software developers will want to look

at Darrin Massena's site (<http://www.massena.com/darrin/pilot/index.html>).

For my part, I'm going to be investing some time in Pilot development, and I'm going to share some of what I learn with you here. To get started, I'm going to talk about the overall Pilot architecture, and focus in on the underlying CPU. In coming months, I plan to talk about hardware interfacing, and programming in assembly, C, and possibly other languages. I've got several ideas for what I think will make interesting projects. Please feel free to contribute suggestions, or to submit projects of your own. So, let's get started already!

The Basics

In case you missed my earlier columns, here's a quick synopsis. The Pilot is a handheld computer that runs on two AAA cells. It has a 160×160 pixel screen measuring 56 cm on a side, yielding a 0.35mm dot pitch. It has no keyboard; rather, it depends on an easy-to-learn (basics in minutes, fluency in hours) and effective handwriting-recognition system called Graffiti. You can stroke directly on the 56×56 screen area; there is also a dedicated 60×20 mm area directly beneath the screen where you enter Graffiti strokes, and that also has a set of pseudo-dedicated buttons for performing specific functions.

Various models come with 128K to 1MB of memory, and third parties can bump it to 2MB and 3MB (voiding the warranty). The high-end model, the PalmPilot Pro, comes with a backlit screen, 1MB of memory, and additional ROM-based software—primarily a built-in TCP/IP stack. It lists for about \$400. The backlight is extremely nice, and if you download many add-ons, you'll almost certainly want the extra memory. If you only use it for its intended purpose, a standard 512K model could probably keep you happy for a long time—and you can always upgrade (memory, not the backlight). For serious work, you should pretty much forget the 128K model.

What can you do with a Pilot? It's primarily an organizer. Sound boring? Not really. I have literally sat in restaurants and been approached by waiters who after a short demo walk away saying, "Cool!"

An anecdote I heard at the conference has it that a little old lady, initially a total skeptic, ended up being converted by the ability to have her address list with her at all times. I could see old-timers using the

alarm function as a medication reminder. And with a little interface work, it could be used as an add-on to any number of biomedical devices for measuring and displaying current conditions. More on that later.

It, of course, offers the type of functions you would expect in an organizer: datebook, telephone/address list, to-do list, and memos. A fifth built-in function is a calculator. The Pro version also comes with e-mail and expense applications. Shareware and commercial add-ons include a (poor) spreadsheet; several outliners; Internet applications; fax, draw and paint programs; games (of course); and lots more.

A key component of Pilot's success is its one-button "sync" process, which synchronizes all added, modified, and deleted data, in both directions, between the Pilot and a desktop application, either Pilot's own Pilot Desktop, or any of a number of leading PIMs (Personal Information Managers). Syncing normally occurs via the built-in RS-232 port, but there are now options to perform remote syncing via modem, and most recently via a LAN. Synchs occur via conduits, essentially DLLs for moving data between the Pilot and applications programs. Custom conduits and TCP/IP applications represent a big market opportunity.

You can buy Pilots at major consumer-electronics and office-supply outlets, Egghead, and the larger computer catalogs. The Pilot news group frequently has sale offers from various companies. Last summer, one company briefly sold the full Pro model for \$299, or \$100 below list. Check www.pdapage.com to find current best prices.

Inside

For our purposes, there are three points of interest about the Pilot's hardware architecture. One, it is built around a 68000-family microprocessor, Motorola's MC68328 "Dragonball." Two, the only official interface to the device is an RS-232 port. Third, it has a switching power supply, which generates 3.3 volts for the CPU, as well as the RS-232 voltages. The remainder of this column will provide a quick capabilities overview of Dragonball. Next time, we'll start seeing how this richness can be put to use.

Dragonball is 144-pin flat-pack device. It contains a CPU that is claimed to be 100% compatible with the MC68000

family. The CPU itself has a 16-bit data bus (which can operate in both 8- and 16-bit modes for I/O purposes), and a 24-bit address bus. Internally it contains eight address registers, eight data registers, a condition-code register, a stack pointer, and a program counter.

Dragonball also contains a System Integration Module (SIM28) with an incredible set of capabilities, only some of which are used in the Pilot. Highlights include support for static RAM, EPROM, and flash memory; hardware and software watchdog timers; 77 individually programmable I/O pins; PCM-CIA 1.0 support; a UART with IRDA support; a dual-channel 16-bit counter/timer; a PWM (pulse width modulation) output for tone generation; a real-time clock with one programmable alarm; a power-management module; an LCD control module; pager interface; and a full CMOS implementation that allows clock operation from DC to 16.7 MHz. A block diagram of the CPU appears in Fig. 1.

The clock is normally driven by a 32.768-kHz crystal, which in turn drives an internal phase-locked loop (PLL). The PLL can multiply the crystal frequency by a number of programmable factors, yielding CPU clocks ranging from about 10 MHz to 16.7 MHz. To implement power saving, the system is normally off. An interrupt to the PLL causes the system to wake up within two milliseconds. There is an extremely sophisticated software-controlled power-

RESOURCES

Shareware

<http://www.inforamp.net/~adam/pilot/>
<http://207.112.193.10/pilotgear/index.html>
<http://198.70.114.128/stinger/stingersoft.cfm>

Developer Information

<http://www.massena.com/darrin/pilot/index.html>
<http://www.sls.lcs.mit.edu/raylau/pilot/>
<http://www.usr.com/palm/pilotlinks.html>
<http://www.roadcoders.com/pilot/index.html>
<http://www.shoppersmart.com/lehett/gccwin32.html>
<http://www.usr.com/palm/dresources.html>

Newsgroups

alt.comp.sys.palmtops.pilot
news.massena.com/pilot.programmer
news.massena.com/pilot.programmer.codewarrior
news.massena.com/pilot.programmer.gcc
news.massena.com/pilot.programmer.jump
news.massena.com/pilot.programmer.pila

control module that, for example, lets the CPU sleep while DMA operations keep an LCD screen refreshed. The screen itself may be up to 240 rows × 1024 columns in sixteen shades of gray. The Pilot OS directly supports only bi-level tonality, but several apps are experimenting with the gray scaling. (Unfortunately, the results are pretty disappointing from what I've seen. The screen is definitely the Pilot's weakest link.)

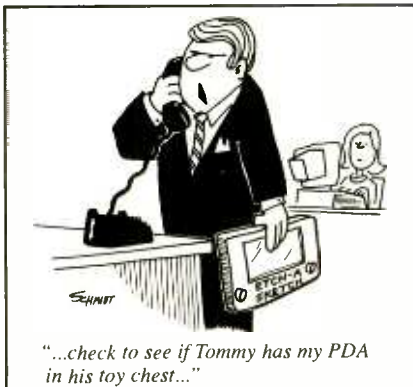
The real-time clock provides hours, minutes, and seconds data. It has an n-minute countdown timer that can generate an interrupt after n minutes. The RTC also has programmable one-second, one-minute, and one-day interrupts. The counter-timers provide a maximum period of 524 seconds and resolution of 240 ns (at the 16.7 MHz clock). The two timers can be cascaded for 32-bit operation.

Dragonball contains ten general-purpose parallel I/O ports, several of which are multiplexed with internal CPU functions. For example, Dragonball directly exposes the lower 24 address lines. However, parallel port A also exposes address lines 24-31, providing a full 32-bit address space. Port B multiplexes with the low-order data bus lines (D0-D7). Port C multiplexes with various CPU control signals. Port D has special features for interfacing a matrix keyboard. Ports G, K, and M multiplex interrupt, timer, PCMCIA, and serial I/O signals.

The serial interface provides four standard signals (TSD, RXD, CTS, and RTS), and may be programmed to run at rates of 300-115,200 bps. Pilots usually run their Synchs at 57,600 bps.

Wrapping Up

That's it for now. Next time we'll discuss software development tools, and start looking at ways of getting data in and out of the Pilot via the RS-232 port. Until then, you can stay in touch with me via e-mail at jkh@acm.org. **EN**



LETTERS

continued from page 24

ing” according to the low unemployment rates, what is not mentioned is the fact that underemployment is also booming—people settling for wages only 1/2 to 2/3 of what they were getting, just to survive. Ad after ad reads “entry level; minimum 5-10 years of experience.”

A Field Service Technician of the 1980s would be furnished with a company vehicle, uniforms, tools and instruments, and training as required. A good technician then earned between \$50 and \$75 per hour. However, a recent ad wanted a fully-experienced technician with 5+ years of experience. He was to supply his own vehicle (with his own insurance!), and his own equipment and tools for field servicing. Starting salary: low \$20,000s!!! That's about \$10 an hour, folks. Pretty sad, no?

If that is all new recruits have to look forward to, I can see why they would NOT want to waste their time with any additional schooling. Stocking shelves at the local supermarket is competitive in salary. I can vouch for this in NJ, as I've been in the same boat since 1989. Pathmark looks good!
SKIP CAMPISI
S. Bound Brook, NJ

Free Circuit Encyclopedia

Just a quick note to let everyone know that a free, downloadable program that is an encyclopedia of electronic circuits, formulas, charts, graphs, etc. is available on the Web at our site (<http://members.aol.com/cybercir/index.html>). It provides a wealth of electronics information for the hobbyist or professional. The program is not time-limited or de-featured in any way, although it does contain fewer items than the retail version that's available.

Also at our Web site is a “Circuit du Jour” that is changed periodically. This is a specially selected circuit (or other electronics information) that visitors will find useful.

DAMIAN BONICATTO, PTM
via e-mail **EN**

POPTRONIX
Awaiting your call! Online Edition
<http://www.poptronix.com>

BEST DEALER PRICING!
CABLE DIRECT
CONVERTERS • FILTERS
DESCRAMBLERS
IMPROVE YOUR IMAGE WITH
VIDEO STABILIZERS

FREE CABLE TV CATALOG! **100% MONEY BACK GUARANTEE!**

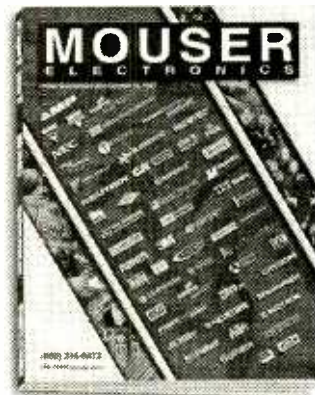
Now you can tune-in your favorite cable TV programming and **SAVE \$100'S - EVEN \$1000'S** on premium CABLE TV EQUIPMENT.

30 DAY FREE TRIAL!

VISA

MODERN ELECTRONICS
1-800-906-6664
2609 S. 156TH CIRCLE • OMAHA, NE 68130
<http://www.modernelectronics.com>

ELECTRONIC COMPONENTS



Call for your **FREE** 356 page catalog TODAY!

- 69,000+ Products
- 135 Manufacturers
- Same Day Shipping
- No Minimum Order

800-992-9943

817-483-6828 Fax: 817-483-0931
www.mouser.com catalog@mouser.com

958 North Main St., Mansfield, TX 76063

CIRCLE READER SERVICE NUMBER 332

Building a Resistor Substitution Box

NOW THAT YOU'VE COMPLETED YOUR AUDIO GENERATOR, YOU'RE ALMOST READY TO START DOING SOME REAL TESTING. BUT FIRST, SINCE MOST OF THE TESTS YOU ARE GOING TO WANT TO PERFORM WILL REQUIRE SOME SORT OF TEST

fixture or related device, we'll build a unit that will make your testing chores easier.

A Resistor Substitution Box

Last time we discussed building load resistors so we could test amplifier outputs. This time I am going to show you a neat little resistor substitution box (R-Box) that has an almost endless list of applications. It can provide resistance outputs of 1 ohm to 11.11 megohms just by pushing the appropriate combination of buttons on the front panel. If you decide to build this box, be sure to use only precision components; close resistor tolerances—I use only 1% devices here—helps make a very accurate box.

Our assembled unit is shown in Fig. 1. To select values, you merely punch in the resistance you need using the push-button pad and it appears across the terminals labeled RX at the top of the unit. For example, if you needed 7300 ohms you would push the 4 key and the 3 key in the row above X1K—that will give you 7000 ohms at the terminals. Then you would depress the 3 key in the X100 row. That adds 300 ohms to the 7000 ohms. The switches stay down and the selected value is available across the RX terminals. For 570 ohms, push the 4 and 1 buttons in the X100 row, and the 3 and 4 buttons in X10 row. It's just that easy.

Construction

The complete schematic for the substitution box is shown in Fig. 2. For eas-

iest construction, a PC board is recommended. An appropriate pattern is provided here, and the corresponding parts-placement diagram is shown in Fig. 3. Note that, as indicated in that figure, the resistors are all mounted on the foil side of the board. The switches are mounted on the component box in the usual fashion.

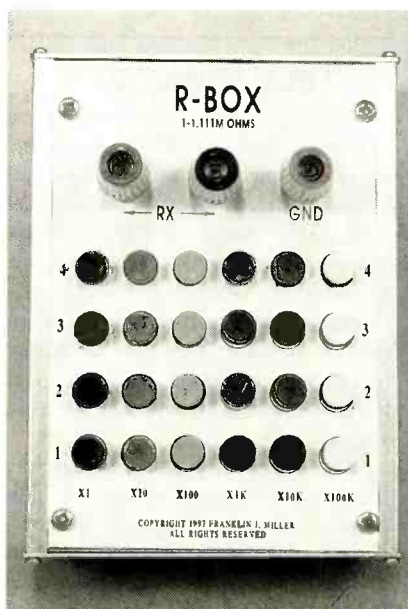


FIG. 1—HERE'S THE FINISHED resistance substitution box (R-Box). It's small, easy to assemble, and has many uses on any electronics bench.

Note that the PC pattern and schematic indicate the use of DPDT switches, though only one section of

each is used. Those switches are used because they are included in the available kit (see Parts List) and they are easier to find (in the author's experience) than latching SPDT pushbuttons.

Construction is very simple. The 24 switches are all mounted right on the board. Make sure that you insert them so that they fit flat and tight against the board. This is important! If you don't get it right, the knobs will not fit properly onto the top plate. (Note: If you elect not to use the available kit, make sure you select an enclosure that's a suitable depth for the switches you use. The critical dimension here is the depth of the box; it should be selected so that, when the board is mounted inside, the switch buttons protrude suitably through the top plate.) Do not install J1-J3 at this time.

Once you have mounted all of the components (except J1-J3) and you have carefully inspected the PC-board assembly, put it aside. The next step is applying the top-panel overlay. If you choose to buy the kit, an overlay and pre-punched enclosure is provided. If you elect to build your own overlay, the appropriate panel markings are shown in Fig. 1. A drilling guide is shown in Fig. 4.

The overlay supplied with the kit comes with an adhesive backing. To ensure that it will adhere properly, you must first make sure that the top panel is very clean. A small amount of acetone, which can be purchased at any paint store, will do the job nicely. Since its vapors can be hazardous, make sure you are working in a well-ventilated area.

Now you need a small bottle of water with a spray attachment. It will allow you to move the overlay around for precise placement. Place both the top panel

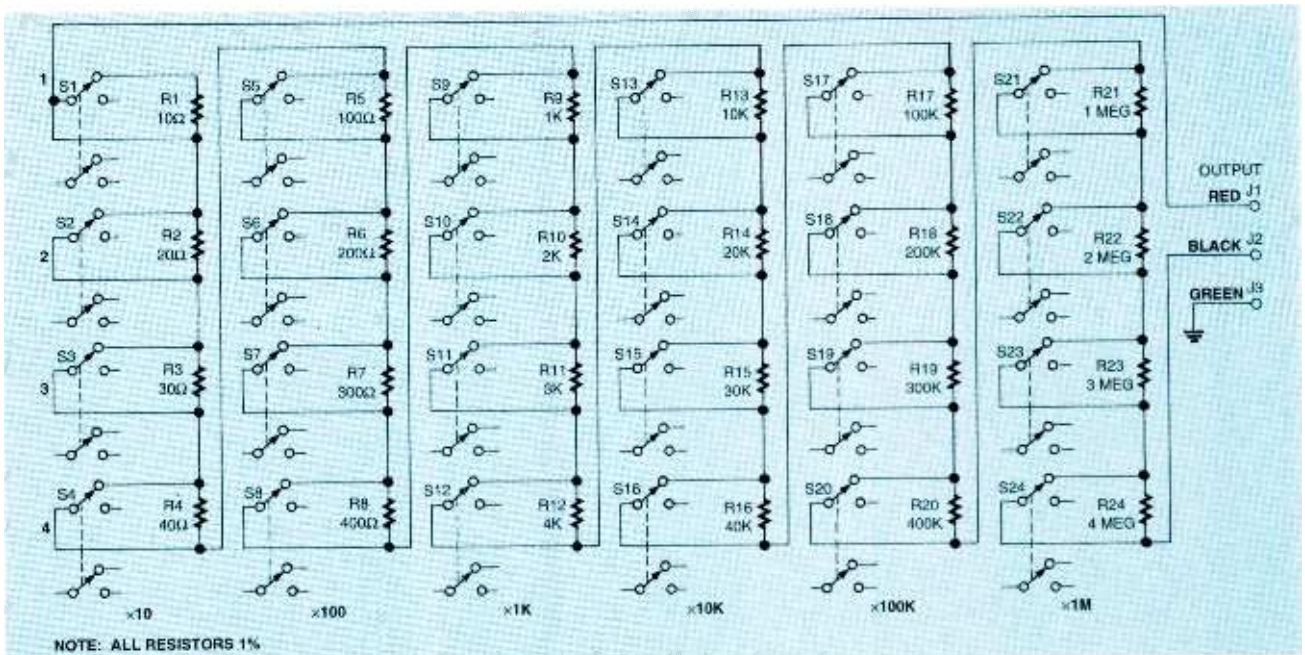


FIG. 2—THIS COMPLETE SCHEMATIC OF THE R-BOX shows that it's essentially an assembly of resistors and switches mounted on a small PC board.

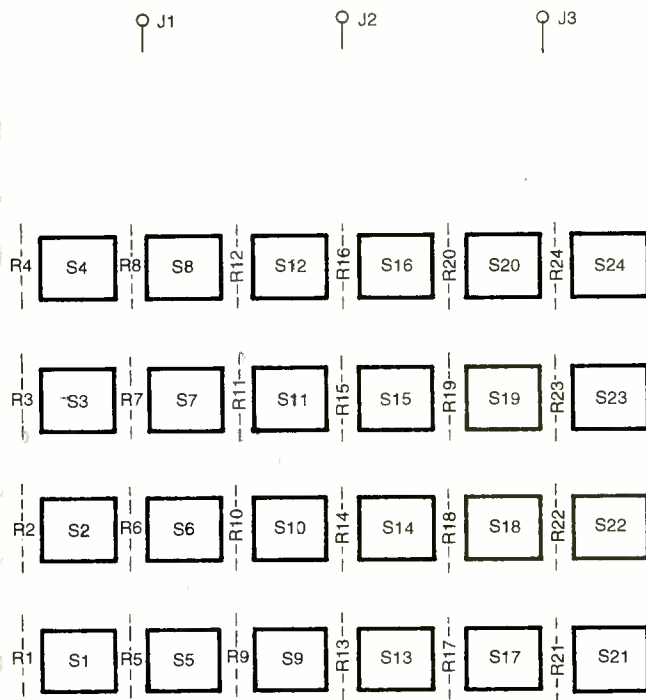


FIG. 3—AS SHOWN IN THIS PARTS-PLACEMENT DIAGRAM, all of the resistors mount on the foil side of the board. That was done to make the R-Box small and convenient to use.

and the overlay in front of you, with the three holes at the top. Remove the overlay backing and align the top upper left corner of both pieces. Once the label is aligned, gradually smooth the balance of the overlay down using the side of your hand. Once this is done, use an orange stick (available in the beauty section of any supermarket) as a rolling device to get out all the bubbles. Let the top panel dry overnight to be sure all of the water has evaporated.

The next step is to put the knobs (supplied with the kit) on the switches. Position the PC board in front of you, with the three pads for J1-J3 toward the top. There are four rows and six columns. Use black buttons for the first column, located on the far left. As you go to your right, use the red, yellow, green, and blue buttons. The white buttons, on the extreme right, complete the chore. They will just snap on.

Now install the banana jacks through the top panel. Go from left to right and insert red, black, and green, in order, tightening the nuts that hold them in place as you go. There are four 2.5-mm \times 10-mm long screws and $\frac{1}{8}$ -inch long spacers with nuts and lock washers that insert in the four corners of the top panel. Insert the four screws and turn the assembly over. Slip the spacers over the screws. Now the printed-circuit board should fit onto the spacers. Place a ground-lug washer over the spacer at the upper left-hand corner of the board;

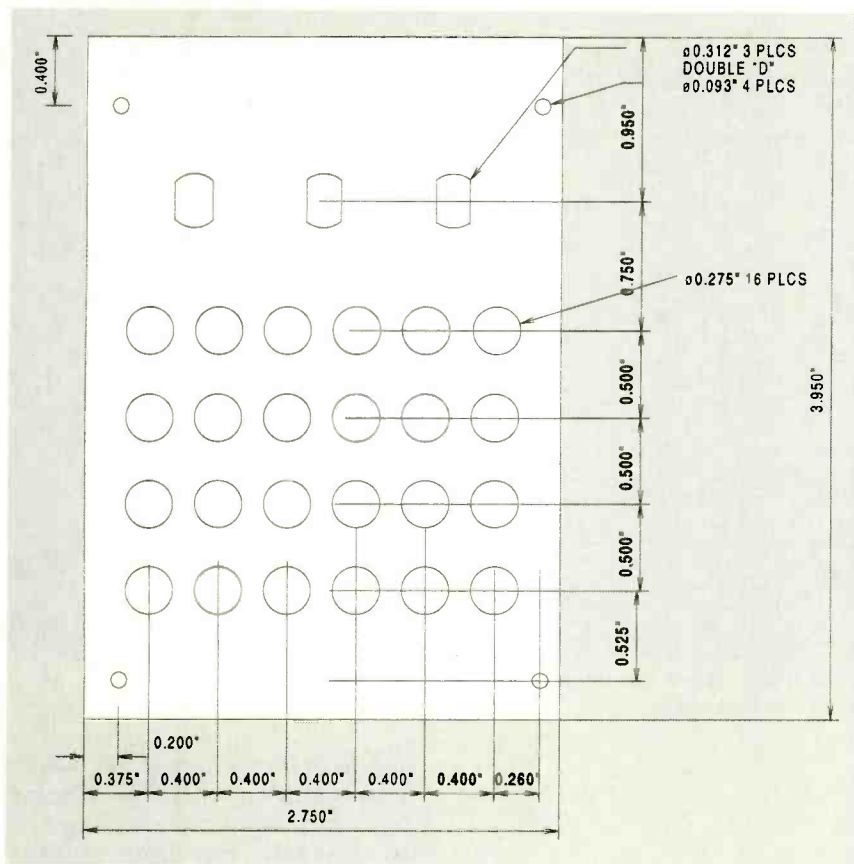
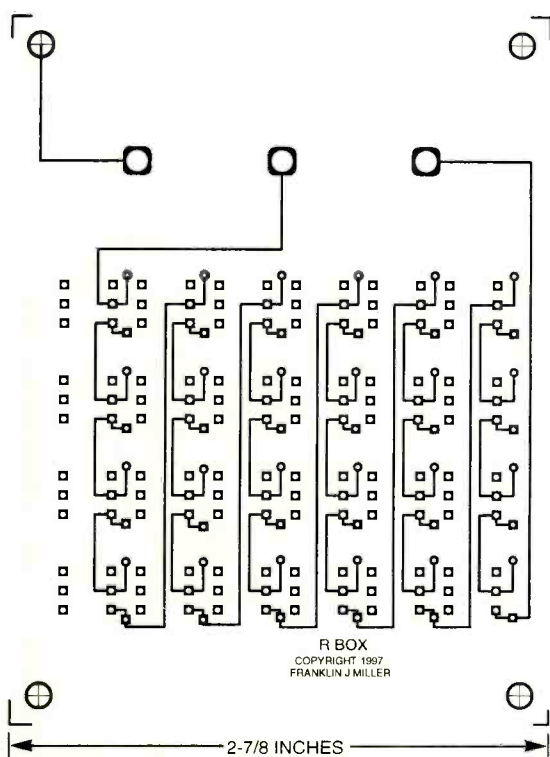


FIG. 4—YOU'LL NEED THIS DRILLING GUIDE for the top panel if you chose to build the R-Box without the benefit of the kit. Follow it closely to get a really attractive unit.



PARTS LIST

RESISTORS

(All resistors are 1/8-watt 1%, metal-film units.)

- R1—10-ohms
- R2—20-ohms
- R3—30-ohms
- R4—40-ohms
- R5—100-ohms
- R6—200-ohms
- R7—300-ohms
- R8—400-ohms
- R9—1000-ohms
- R10—2000-ohms
- R11—3000-ohms
- R12—4000-ohms
- R13—10,000-ohms
- R14—20,000-ohms
- R15—30,000-ohms
- R16—40,000-ohms
- R17—100,000-ohms
- R18—200,000-ohms
- R19—300,000-ohms
- R20—400,000-ohms
- R21—1-megohm
- R22—2-megohms
- R23—3-megohms
- R24—4-megohms

ADDITIONAL PARTS AND MATERIALS

- S1—S23—DPDT pushbutton switch, latching, see text
- J1—Banana jack, red
- J2—Banana jack, black
- J3—Banana jack, green
- PC board, cabinet (see text), front-panel decal, pushbutton knobs, mounting hardware, solder, etc.

Note: The following items are available from Franklin J. Miller, 2100 Ward Drive, Henderson, NV89015: A complete kit, including pre-drilled aluminum case, front-panel label, push button knobs, PC board, and all components; \$70. Price includes shipping inside the continental United States.

the mounting hole there has a trace leading to the pad for J3. Then install all of the lock washers and nuts. Tighten the nuts only finger tight. Turn the unit over to be sure that all of the push buttons work without any problems. Then tighten the four screws and nuts to the final fit.

Now you can solder the banana jacks to the PC board. The last step is to assemble the rest of the case.

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.



Industrial Robotics

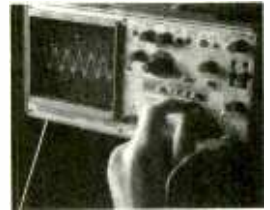
Since 1934, CIE has been on the forefront of an ever expanding technological revolution.

ment. CIE's curriculum is unique from other independent-study schools in the respect that we not only provide hands-on training utilizing today's technology we also instill the knowledge and understanding of why technology works the way it does. This is the foundation upon which every CIE graduate can trace their success back to and in which CIE's reputation as a quality learning facility is based on.



Project Engineer

Independent study is not for everyone. But, if you have the desire, the basic intellect and the motivation to succeed, CIE can make it happen. Our learning program is patented and each lesson is designed for independent study while our instructors are available to assist you whenever you feel you need help. 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

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

AE110

Name _____

Address _____

City _____

State _____ Zip _____

Phone: _____

Check for G.I. Bill Details

- Active Duty Veteran

successful career the same way you can...by sending for your free CIE course catalog and judging for yourself if CIE's for you.



Computer Programming

CIE

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

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

ALL ELECTRONICS

C O R P O R A T I O N

QUALITY PARTS

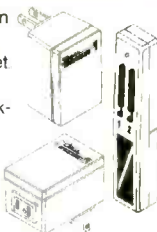
FAST SHIPPING

DISCOUNT PRICING

CALL, WRITE, FAX
or E-MAIL For A
Free 96 Page
CATALOG.
Outside the U.S.A.
send \$3.00 postage.

2 Channel RF Remote Control

"Total Command™" by Leviton Operate TV, lamps and other appliances from up to 100 feet away. Turn-on house lights from your car. Simple to hook-up and use. Includes two receivers on separate frequencies and a two button hand-held transmitter that controls them. Requires 9 volt battery (not included). Clam-shell display packaging.



\$17⁹⁵ each
CAT # TCR-1

Low Power Audio Amp

Motorola MC34119P Low power audio amplifier suitable for speakerphones or talking picture frames. The 8 pin DIP package requires only a few additional parts, operates on 2 - 16 volts and drives speakers of 8 ohms or greater. Output power exceeds 250 mW with 32 ohm speaker. Power-down option saves power in battery driven applications. Hook-up sheet. Large quantity available.



60¢ each
CAT # MC34119P
50 Pieces - \$25.00

Light Activated Intrusion Alarm

Leviton "Snapit-Alert" # 830-51031 This handy light activated alarm buzzes intermittently when exposed to light. Use it in desk drawer, gun rack, medicine cabinet, refrigerator, school locker or file cabinet to prevent children or unwanted intruders from being where they don't belong. Red plastic case with self-adhesive Velcro backing. 2.5" x 3" x 0.84". Operates on 9 volt battery (not included). Good-looking retail packaging.



CAT# SNA-2
\$2⁵⁰ each
10 for \$20.00

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 \$1²⁰**

10 for \$ 5.00 • 100 for \$ 45.00
1000 for \$ 400.00

3 Volt Lithium Coin Cell with PC Leads

Panasonic # BR2330-1GU 3 volt, 255 mAh coin cell. Lithium batteries have a very long shelf life and are great for memory back-up protection. 0.9" diameter x 0.12" thick. 0.7" between positive and negative pc leads.



VERY SPECIAL PRICE
LARGE QUANTITY AVAILABLE

75¢ each
CAT #LBAT-16
20 for \$12.00
100 for \$45.00
1000 for \$300.00

2 1/2" 8 ohm Speaker

Panasonic # EAS65P76A3 8 ohm 0.4 watt speaker with soft-edge paper cone producing good sound quality. 0.93" overall depth. 2.25" wire leads with 2 prong (0.1" spacing) socket connector.

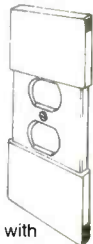


Large quantity available.

CAT# SK-255
\$1⁰⁰ each
10 for \$8.50
100 for \$70.00

Tamper Resistant Electrical Outlet Cover

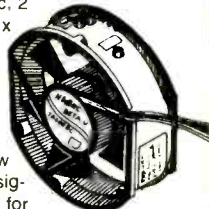
Leviton # 830-86022 "Kiddy Cop" Prevents children from playing with electrical outlets and risking electrical shock. Beige spring loaded outlet cover closes automatically when outlets are not in use. Fits all standard dual wall outlets. Easy to install. Remove existing wall plate and replace with outlet guard. Individual display packaging with screw. CAT # OG-022



\$1⁵⁰ each
10 for \$12.50

High Capacity "Smart" Fan

Nidec Beta V™ Model A34305-29 245 CFM @ 13.8 vdc, 2 amps. 6.75" x 5.92" x 2". 5 blade, high-volume fan with metal housing and struts. Features: Alarm circuit indicates stopped or slow condition. Also has signal and control leads for coordinating two or more fans. Six 8" long hook-up leads. UL, CSA listed.



CAT# CF-42 **\$15⁰⁰** each

Twist-On F-56 Connector

Twist-on co-ax connector for RG-6 cable. CAT #FTO-56R



100 for \$15⁰⁰
500 for \$50.00 • 1000 for \$70.00

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.

When was the last time you built a project that was truly impressive to almost everyone regardless of their age group or technical background? The Astro-Treker presented here is just such a project. It places the operator in the pilot's seat of a simulated hovercraft. To fly it properly takes all of the skill needed in real interactive flight. Depending on the maneuvers being attempted, the Astro-Treker is simple and safe enough for entertaining small children. It also has the capability of challenging the most serious game player.

Like most good video games, speed and skill levels on the Astro-Treker will automatically increase with experience. Since it is a real electromechanical device, all of the laws of physics are obeyed all the time. Inertia, centripetal force, weight, and gyroscopic action continuously interact to give the operator the feeling of literally flying a lunar lander or helicopter.

The Astro-Treker is inexpensive, durable, and will not wear out even with a lot of abuse.

Counterbalanced Flight. Reduced to basics, the Astro-Treker is a gimballed arm that acts much like a seesaw. On one end of the arm is a "flyer" that consists of some electric-motor-driven propellers; a counterweight is located at the other end. The balance of the arm is adjusted such that the flyer will always fall to the ground when it is at rest.

There are three electric motors in the flyer. Each one has a propeller mounted to it. The propeller of the center motor points straight up; its function is to lift the flyer straight up. The other two motors point away from the center motor at about a 45° angle. Those motors will provide some lift, but they will also drive the flyer in the direction they are pointing.

Choosing a motor with enough torque and a propeller that can use that torque to produce thrust will determine how well the Astro-Treker performs. The author's prototype can easily achieve about 50 revolutions per minute. Traveling in a 6-1/2-foot-diameter circle means that the Astro-Treker can move over 1000 feet per minute, or almost 12 miles per hour!

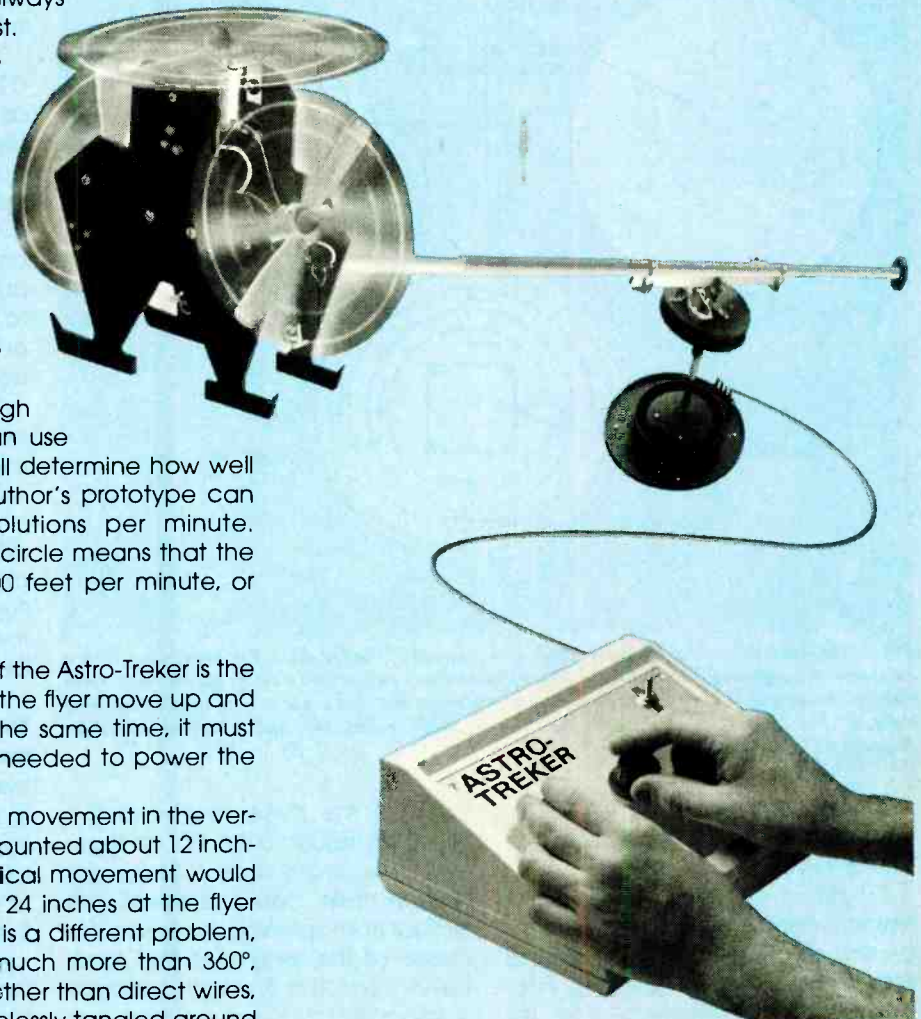
The Central Gimbal. The heart of the Astro-Treker is the gimbal that it rides on. It must let the flyer move up and down as well as in a circle. At the same time, it must provide the electrical contacts needed to power the electric motors.

Simple wires can easily handle movement in the vertical direction. With the gimbal mounted about 12 inches above the floor, the total vertical movement would not be much more than about 24 inches at the flyer itself. Spinning around in a circle is a different problem, however. If you want to travel much more than 360°, you have to use some method other than direct wires, which would soon become hopelessly tangled around

BUILD THE ASTRO- TREKER

*Here's a simple-to-build
toy that can provide
hours of fun and enjoyment.*

G. RANDY SLONE



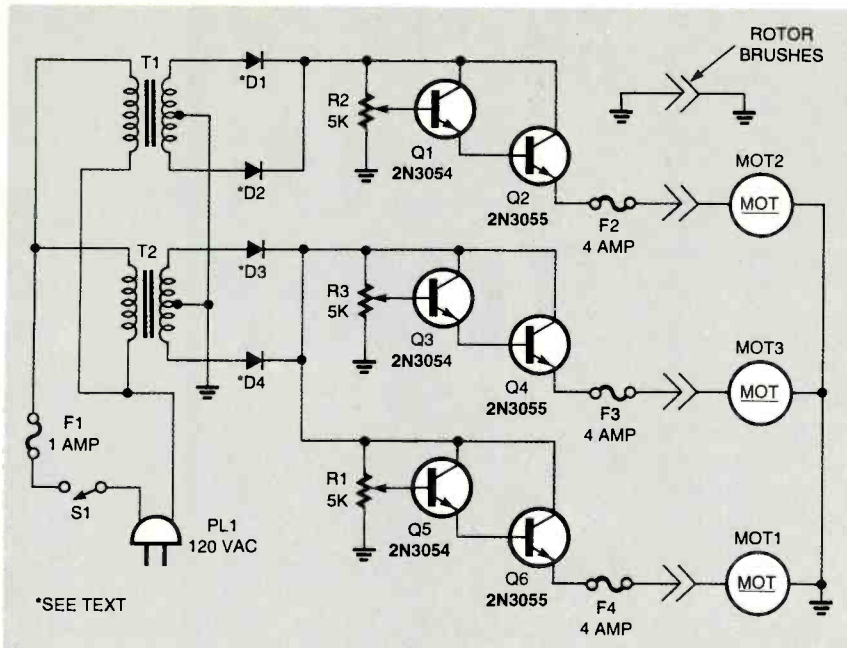


Fig. 1. The Astro-Treker uses a very simple current-amplifier circuit to control the three motors. Diodes D1–D4 are inexpensive high-current units that are readily available at RadioShack.

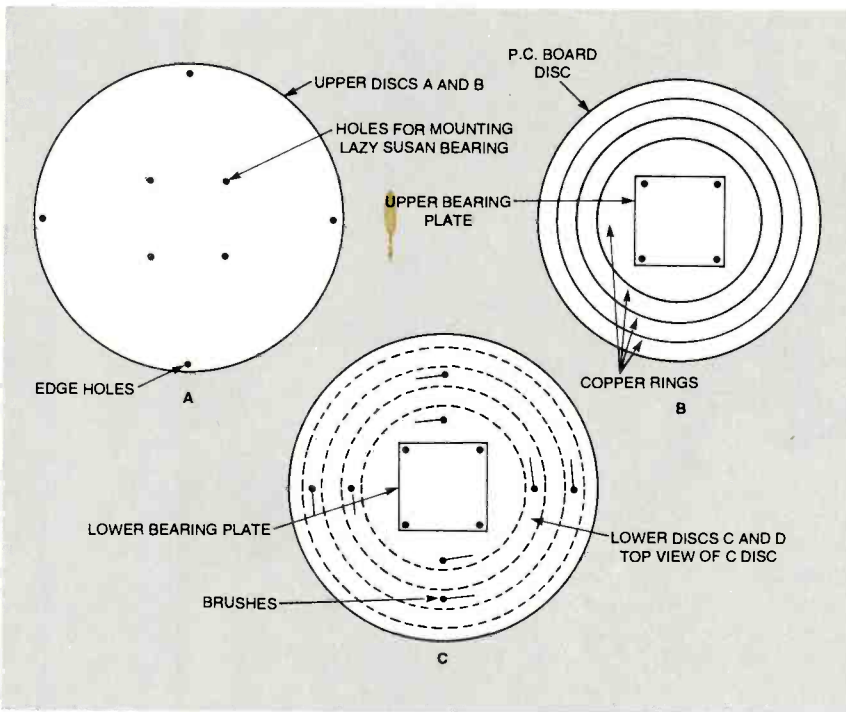


Fig. 2. The Astro-Treker's gimbal is a simple arrangement of stacked discs. The upper disc (A) is a sandwich of 2 stiffening discs and a P.C. board that has been etched with a series of concentric rings (B). The lower disc (C) is a sandwich similar to the upper disc, but it has a set of brushes mounted on it that make electrical contact with the rings on the P.C. board. The central bearing is used for additional electrical contact.

the base. You would also have to travel back the same distance to return to your starting point.

Electrical contact in the Astro-Treker is made by a series of concentric slip rings mounted around the gimbal's rotation bearing. Four contacts are needed—one for

each of the three motors plus a common return. Such an arrangement will create a bit of drag and friction that could prevent the gimbal from spinning. However, because of the length of the Astro-Treker's arm, the flyer can generate a fair amount of torque that can

easily overcome any drag caused by the slip rings. Put another way, with a 3-foot arm, the flyer can travel 18 feet while the slip rings will only move 17 inches.

While only one brush would be needed for each contact, two brushes are used. Each brush is mounted 180° from its companion. That way, continuous and reliable contact can be maintained between the motors and the controller. Having reliable electrical contact will prevent electrical arcing—a prime cause of contact erosion and "pitting" that would roughen the surface of the slip rings.

The Control Panel. The control panel contains the power supply and the circuit that adjusts the power supplied to the three electric motors. It is a very simple design as can be seen in the schematic diagram of Fig. 1. Since each circuit is identical, we will only discuss one circuit—the other circuits work the same.

A full-wave rectifier is formed by D1 and D2 with the center tap of T1 as a ground reference. The unfiltered direct current is applied to R2 and a Darlington-pair amplifier stage formed by Q1 and Q2. As R2 is rotated, a variable current is applied to the base of Q1. The output current from Q1 is then applied to the base of Q2. The much higher output current from Q2 is then applied to MOT2.

Short-circuit protection is provided by F2. Using the suggested motor and propeller, each circuit will have to supply about 1.2 amps. However, any sudden surges will cause the motors to draw much more current for very brief periods. Fuses with a rating much less than the suggested 4 amps will tend to blow out if R2 is spun rapidly.

There is nothing special about the particular choice of transistors for Q1 and Q2—they just happened to be readily available in the author's "junk box." The only important design point is that Q1 be able to supply enough current to let Q2 supply enough current to the motor.

In developing the control circuit for the Astro-Treker, the old saying that "simpler is better" certainly

applies. Pulse-width modulation controls would certainly improve the low-speed torque of a DC motor, but at low speeds, the propellers will not develop enough thrust to move the Astro-Treker. Even including filter capacitors to remove the ripples from the rectified power is not needed for electric motors. If a short circuit occurs between F2 and ground, the impedance of T1's secondary will limit current to a level that is less than the maximum level that Q2 can pass. If a filter capacitor was used in the circuit, additional short-circuit protection would be needed to prevent the charge on the capacitor from burning out the transistor before the fuse pops. With the Astro-Treker, simply replace the fuse—and the fun is ready to begin again.

It was also found that using a regulated power source tended to detract from the overall enjoyment of the Astro-Treker. Although any fluctuations in the line current will change the motor speed for any particular throttle setting, that "feature" adds to the realism of piloting the Astro-Treker. In the real world, aviators have to deal with such problems as air pockets, winds, and storms.

Building the Rotor. Building the Astro-Treker is easy and forgiving. Most of the parts and materials that are needed are likely to be found in your "junk box" or readily available from a variety of local suppliers. A broad range of parts substitutions or modifications can be incorporated to bring the construction cost down to fit almost any project builder's budget. In addition, the performance of the finished product primarily depends upon the basic laws of physics rather than construction variables, programs, or calibration techniques.

The rotor is made from five discs as shown in Fig. 2A. Each disc is 7 inches in diameter. The upper discs ("A" and "B") and the lower discs ("C" and "D") are made from 1/8-inch-thick plastic sheet. A suggested material is the textured ABS plastic that is used for custom automobile stereo-component installations. That material is inexpensive,

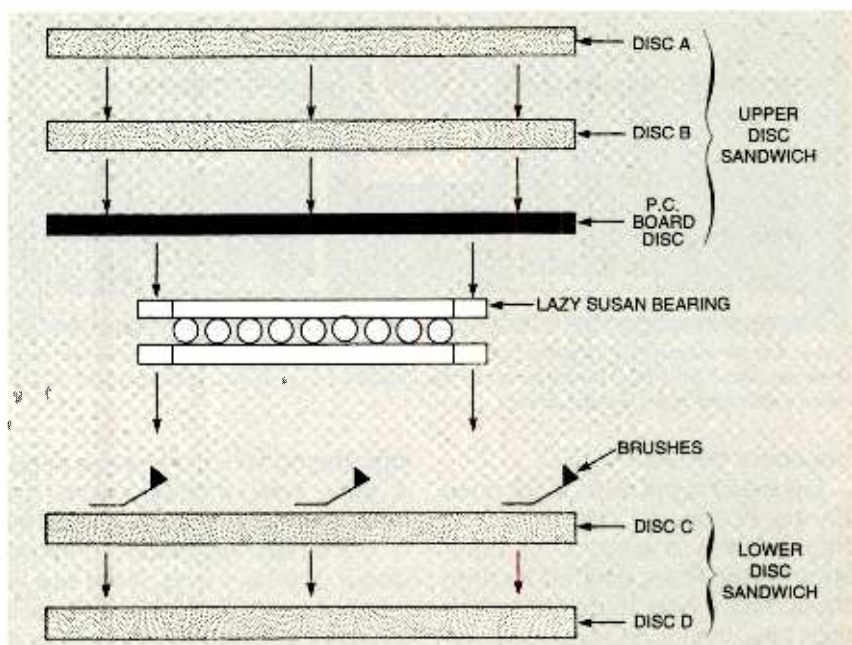


Fig. 3. When building the central gimbal, mount two discs and the PC board together to form the upper sandwich. The lower sandwich is the same, only with brushes instead of the PC board.

easy to work with, attractive, and extremely durable. However, other non-conductive materials, such as Plexiglas or particleboard will work equally well. The combined discs A-B and C-D are used only to strengthen the entire assembly. Therefore, if you wanted to use 1/4-inch-thick particleboard, plywood, or some other rigid material, only two discs might be needed.

The PC board disc is 6 1/2-inches in diameter and constructed from any quality type of single-sided PC-board material. It is best not to use a fiberglass-based PC board. The copper surface on those types of boards tends to have a textured surface caused by the fiberglass strands. Some electrical arcing problems could result from the rough surface. Three grooves are cut with a grinding tool or etched on the disc as shown in Fig. 2B. Those rings form the contact rings that pass current to the motors. The width of those rings can vary, depending on the size of the brushes you decide to use. The innermost ring is actually a solid circular plate of copper foil.

A "lazy susan" bearing connects the two disc sandwiches together. It also serves as an additional contact for the innermost contact ring (the circle) on the PC board. That contact will be used for the com-

mon return for each of the three motors. Since that contact will be carrying up to three times the current of any one of the other brushes, having additional metal contact area will help prevent arcing in the return brushes.

The rotor brushes are made from the movable contact arms of old relays or leaf-type switches. They are mounted on the lower disc sandwich, sliding against the rings on the upper disc sandwich.

After the discs are cut to size, drill holes at the edges of the discs in the approximate locations shown in Fig. 2A. Those holes will take screws and nuts to bolt the disc sandwiches together. When drilling the holes, it is a good idea to align the discs in a stack and drill all of the holes at the same time. That way, the holes will line up correctly. Screws and nuts will also be used to bolt the lazy susan bearing to the disc sandwiches. The size and locations of those holes will depend upon the actual bearing you will be using.

Bolt the upper disc sandwich together first. Position the PC board on the sandwich so that it is centered as closely as possible about the bearing. Mark the holes where the bearing screws will go through the PC board and drill them out. The bearing is then mounted on

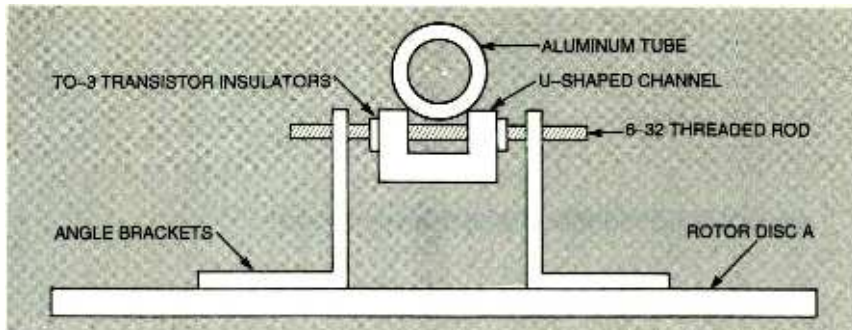


Fig. 4. The pivot bearing is simply a threaded rod that runs through an aluminum channel. Nylon screw insulators for a TO-3 transistor act as the actual bearings. Angle brackets support the pivot channel above the upper disc sandwich.

the upper disc sandwich.

Locate and drill three small holes on the PC board. They should be near the rims of each of the outer rings. Wires will be inserted through those holes and soldered to the rings later. The locations of the holes are not critical. The only points to keep in mind is that the brushes should not ride over any solder joint and that keeping the holes next to each other makes for a neater and more professional-looking job.

Position the brushes on the lower disc sandwich as shown in Fig. 2C. There should be two brushes per ring. The brushes should also ride close to the center of each ring. Temporarily mounting the lower disc sandwich to the lazy susan bearing will help to locate the exact positions of the brushes. Once the locations are found, drill the holes and mount the brushes with screws and nuts. After the brushes are mounted, the lower disc can be bolted to the lazy susan bearing.

Bend the brushes into a slight curve so that the contact points rest flat on the PC board rings. Very little upward pressure from the brushes is needed for good contact. If the contacts are flat, there should be the same mechanical resistance to rotational movement regardless of which direction the rotor is turned. Apply a thin film of non-conductive lubricant on the PC board ring surface to reduce friction and wear. The final assembly goes together as shown in Fig. 3.

Building the Pivot Arm. The pivot arm that is mounted to the top of the rotor lets the Astro-Treker move up and down for takeoffs and land-

ings. The construction details in Fig. 4 show how straightforward the mechanism is. The pivot arm itself is a U-shaped aluminum channel about 20 inches long. Drill a pair of holes across the channel walls at its midpoint so that a short length of 6-32 threaded rod can be used as a pivot point. A pair of screw insulators for a TO-3 transistor are used for the pivot bushings. It might be necessary to place locking nuts on the ends of the threaded rod in order to hold it in place. You might also need to place spacer washers between the angle brackets and the transistor insulators in case the channel tends to "wobble."

An additional hole will be needed at the bottom of the channel near the center pivot. A grommet will be inserted in that hole. The grommet should be large enough to let four 22-gauge wires pass through.

The pivot is mounted to the upper disc sandwich with a pair of 1½-inch angle brackets. Locate the brackets in such a way that the pivot is as centered as possible on the disc. Just remember to keep the bottom of the aluminum channel at least 1 inch above the top of the rotor to allow sufficient clearance for full vertical movement of the flyer.

Building the Base. A simple and convenient way to make a solid base for the Astro-Treker is to use a small desktop-microphone stand. To increase the stability of the base, mount the stand to a piece of ½-inch-thick plywood about 11 inches in diameter. Mounting four rubber feet to the underside of the plywood will keep the Astro-Treker from sliding around on a slick floor.

An easy way to mount the microphone stand to the bottom of the gimbal is by using the microphone holder that comes with the microphone stand. The top section of the plastic holder is a U-shaped piece with two holes near the top. Using a pair of 1½-inch angle brackets, place two of their faces together. Slide the bottom section of the T-shaped structure down into the U-shaped top of the microphone holder. Align the holes from the two angle brackets with the two holes in the microphone holder. Insert an appropriate size bolt through the holes, and tighten the assembly together with a nut and washer. You might have to insert a few washers in between the angle brackets and the microphone holder for a snug fit. The flat surface formed by the top of the two angle brackets can then be mounted to the bottom of the gimbal with bolts or screws the same way that the pivot was mounted to the top of the gimbal. The finished base will look like Fig. 5.

Building the Flyer. The flyer itself is a very simple design. Begin by cutting out two identical sides from some 1/8-inch plastic sheet or similar material. The pattern for the flyer is shown in Fig. 6.

The suggested motors have two tapped mounting holes in the front end of their case. Using two 1-inch angle brackets for each motor, mount one angle bracket to each motor mounting hole. The opposite end of the angle bracket should be pointing toward the rear of the motor.

The pattern for the flyer has three flat areas—one at the top center of the pattern and two that face at 45° angles at the upper corners. The motors will be mounted at those locations. Starting with one pre-cut side, mark a drilling location for one of the angle brackets that are attached to a motor. The motor should be centered within the flat edge, and the end of the motor that the brackets are attached to should be even with the edge of the side. Mark drilling locations for the other two motor locations.

Holding both patterns together, drill through the marked locations.

Both sides will now be exact mirror images of each other. Mount the motors to the sides with appropriate screws and nuts. Tighten the motors down securely.

The shape of the flyer was designed with the recommended motors and propellers in mind. If you want to use a different shape or different hardware, there are several design points to keep in mind. The motors should be mounted at equal distances from each other, the two outer motors should face outward at a 45° angle, and the propellers should not strike anything on the flyer—including other propellers!

The suggested propellers are excellent for the Astro-Treker. They are well balanced, flexible to the point of being almost unbreakable, rubber-tipped for additional safety (an important consideration if little children will be around), and they press-fit very tightly onto the motor shafts without any modification.

The balance rod is a 6½-foot length of ¾-inch o.d. aluminum tube. The Astro-Treker's travel path will be about 6-feet 8½-inches in diameter including the flyer. If you don't have the available floor space for something that large, simply reduce the length of the balance rod. The actual length of the balance rod will not affect the operation of the Astro-Treker. However, a longer rod will make for a more impressive device. Drill a hole in the balance rod large enough to pass four wires. Locate the hole at about the center of the balance rod.

The flyer is mounted to one end of the balance rod with two small angle brackets using similar techniques that were used for the pivot and the gimbal. It is a good idea to place a few rubber grommets between the angle brackets and the flyer in order to reduce any vibration that might be generated by the motors and propellers. Make sure that the hole that was drilled in the center of the balance rod faces down. That way, the wires for the motors will be hidden when the balance rod rests on the channel. Before mounting the flyer permanently to the balance rod, a hole is needed in the side of the flyer where the balance rod meets the

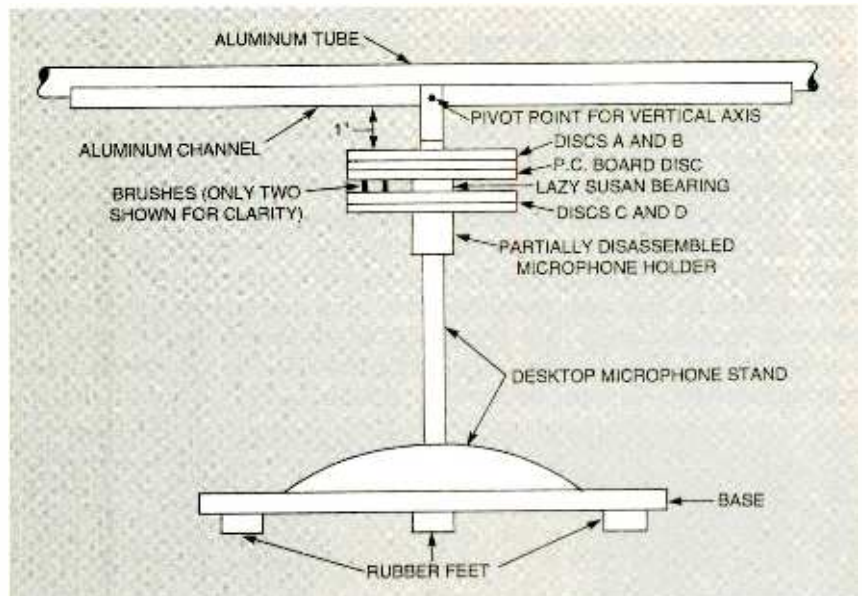


Fig. 5. The Astro-Treker's base is built around a desktop microphone stand.

flyer. That hole will be passing the wires between the motors and the gimbal.

A counterweight is mounted to the opposite end of the balance rod. It should be a little heavier than the flyer and can be constructed from any convenient weight that can be mounted on the end of the rod. One example is to use a set of large washers mounted on a bolt or scrap piece of threaded rod. One end of the bolt is then inserted into the hollow end of the balance rod and attached in any convenient manner.

Test the balance of the flyer and the counterweight by placing the balance rod on the pivot arm. Slide the balance rod back and forth on the aluminum channel until the counterweight and shuttle are balanced horizontally. If the balance is correct, the distance from the pivot center to the outside face of the shuttle will be about 2 inches longer than the distance from the pivot center to the outside face of the counterweight. If the balance is wrong, add or remove washers from the counterweight as needed until the correct balance is achieved.

Building the Control Panel. The control panel is very simple from both a design and a construction standpoint. Since there are very few components that can be mounted on a PC board, one is not

used; the entire unit is hand wired. Simply follow the schematic diagram in Fig. 1.

If you want, you can use a single 24-volt center-tapped transformer that can supply at least 3 amps. That would eliminate the need for two additional diodes. Unfortunately, a single transformer of that size will not fit inside the suggested enclosure. The transistors need to dissipate about 13 watts each under the worst-case conditions. Those components need to have adequate heat sinking.

Wiring and Final Assembly. The final wiring simply consists of connecting the outputs from the control panel to the individual motors. A good choice for the wire is 22-gauge stranded wire used for alarm systems. It is very flexible, durable, and can easily handle the current loads of the Astro-Treker.

A four-wire cable about eight feet long runs from the control panel to the base of the gimbal. The length can be adjusted to your own preference; however a longer cable will let the operator sit on a nearby chair while using the Astro-Treker. A way to disconnect the control panel might be a good idea, so that the Astro-Treker can be disassembled and stored away. A spring-loaded stereo-speaker terminal strip mounted on either the control panel or the microphone

base is ideal.

The bottom of the rotor has eight bolts for the eight brushes and four bolts for the center bearing. Wire the two innermost brushes to one of the bolts used for the bearing. Suitably-sized lug terminals can be used to make the connections. Wire the other pairs of brushes for each ring in the same manner. The control wires (or the wires from the optional terminal strip) are then connected to the brushes. The common return wire must be con-

completed, the three wires can be glued permanently in place with caulk or epoxy filler, which acts as a strain relief. The fourth wire (Circuit common) is connected to the most convenient one of the four bolts used to mount the upper disc to the upper plate of the bearing.

Bundle the wires together and feed them through the grommet in the channel. Enough slack should be left to form a loop for flexibility. Lay the wires in the channel and run them out to the closest end.

might think. Add about a foot or so to the estimated length and cut four wires. One wire is attached to the common negative terminals of the three motors. The remaining three wires attach to the positive terminals.

Route the four motor wires through the hole in the side of the flyer and into the balance rod. Feed them through the hole in the center of the balance rod, lay the balance rod on top of the pivot channel, and route the wires out to the same end of the channel as the four wires coming from the top of the rotor.

Connect the common wire to the innermost brush wire. The other wires are to be connected to their respective control wires as shown in the schematic diagram of Fig. 1. If you lose track as to which wire goes where, a simple continuity test with an ohmmeter will identify the individual wires. For example, the wire connected to F2 should connect to the "+" terminal of the center motor.

The balance rod can be attached to the pivot channel by several methods. Tie wraps can be used for a permanent mount, with the wires soldered together. To make the Astro-Treker easy to dismantle and store, you could use rubber bands or small hose clamps instead of tie wraps. Very little pressure is needed to hold the balance rod in place. For that arrangement, a four-conductor plug is needed for the wiring connections.

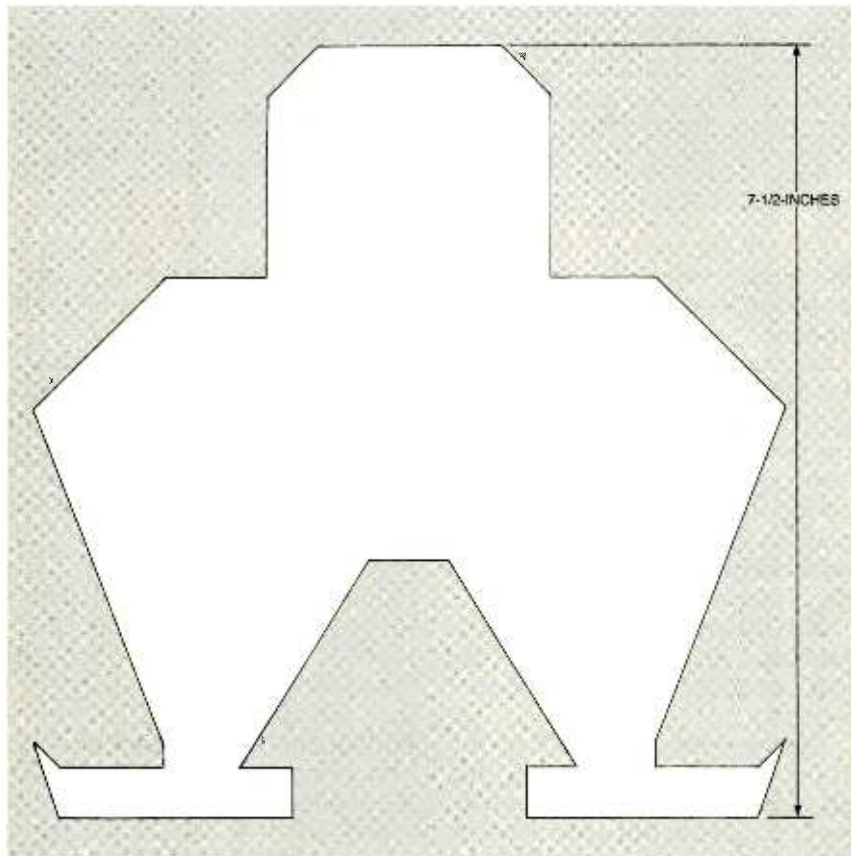


Fig. 6. Here is a suggested pattern for the flyer's body, drawn half-size. The landing feet are shaped like hooks so that the flyer can be used to pick up and move objects that have wire loops in them. The three flat surfaces at the top show where the three motors are to be mounted. The locations are designed to prevent the propellers from striking each other.

ected to the innermost brushes that are connected to the bearing. The other connections can be made in any order.

Cut four 22-inch lengths of wire. Strip a small length of insulation from one end of each wire. Insert the wires into the holes that were drilled in the upper disc sandwich. Solder them to the outside edge of each ring. If done properly, the brushes have been adjusted to ride in the center of each ring, so they won't hit the solder joints. When

Each terminal on the flyer motors is marked with a "+" and "-" symbol. The "-" terminals on all three motors are soldered together with lengths of wire. Estimate the length of wire needed to run from the flyer motors, through the balance rod, out the hole in the center of the balance rod, and out to the end of the pivot channel. That end of the pivot channel will be the end closest to the counterweight, so the wire lengths running from the shuttle will have to be longer than you

Testing and Set-Up. Electrical testing of the Astro-Treker is simply a matter of rotating the three speed control potentiometers on the control panel and verifying smooth, minimum-to-maximum speed control of each associated motor/propeller. At maximum speed, a DC voltmeter should indicate about 10.5 volts DC applied to each motor. Maneuvering action of the flyer largely depends upon the position of the balance rod. As the balance rod is moved forward, the apparent weight of the flyer is increased. That will increase the response time and maneuverability. Sliding the balance rod back will have the opposite effect on the

Astro-Treker. A little experimental operation will provide a good feel for where the best position for the balance rod should be.

Using the Astro-Treker. With three simple controls, flying the Astro-Treker is somewhat self-explanatory. For vertical flight, the obvious choice is to activate the center propeller. A less obvious method is to use both outboard propellers at equal thrust. Since they are mounted at an angle, they will provide both upward and sideways movement. If one motor is running faster than the other is, the flyer will start drifting sideways in one direction.

Moving sideways can become a bit trickier, especially if you are attempting to move in a straight line without losing or gaining altitude. As one of the outboard motors is activated and begins to add thrust to the flyer, the thrust from the center motor should be cut. That will compensate for the additional vertical thrust from the outboard motor.

To slow down over a target without changing altitude, increase the thrust on the motor facing the "rear" of the flyer while cutting power to the motor at the "front". That way, reverse-thrust "brakes" can be applied while maintaining the overall balance of vertical thrust.

The bottom-line effect is one of actual interactive flight. With a little practice, the operator can precisely control the flyer position for a variety of skilled maneuvers, including landings, takeoffs, hovering, transportation of "cargo" objects, or even "space war" games.

Games. "Cargo" objects can be devised that can be hooked with the flyer's landing feet. Space toys or other objects can be modified for that purpose by placing a loop of wire through them. The weight of the objects will have a profound effect on lift, speed, and inertia of the Astro-Treker. In addition, the size of the wire loop placed through the cargo object will affect the degree of difficulty in pick-up and release. By varying the weight and loop-size of the cargo, the skill level of game play can be infinitely

PARTS LIST FOR THE ASTRO-TREKER

CONTROL PANEL

- T1, T2—24-volt, 2-amp center-tapped transformer (RadioShack 273-1512 or similar)
- D1-D4—6-amp, 50-volt PIV diodes (RadioShack 276-1661 or similar)
- R1-R3—5000-ohm, 1/2-watt potentiometer (RadioShack 271-1714 or similar)
- Q1, Q3, Q5—2N3054 transistor
- Q2, Q4, Q6—2N3055 transistor
- F1—1-amp fuse
- F2-F4—4-amp fuse
- S1—Single-pole, single-throw switch, 5 amp
- PL1—2-conductor line cord

ADDITIONAL PARTS AND MATERIALS

- MOT1-MOT3—18-volt DC high-speed motor (RadioShack 273-256 or similar)
- Heatsink, cabinet (RadioShack 270-216 or similar), fuse holders (RadioShack 270-739 or similar), knobs (RadioShack 274-402 or similar), strain relief, transistor-mounting hardware, 1/2-inch plastic sheet (Parts Express 265-948 or similar), 5-inch propellers ("PROPSHOT" toys No. 9159, distributed by Lanard Toys, 101 S. Sterling Terrace, Sugar Creek, MO 64054, or similar), 1-inch angle brackets, 1 1/2-inch angle brackets, 1/2-inch x 3/8-inch aluminum channel, 3/4-inch o.d. aluminum tube, washers, 6-32 threaded rod, TO-3 nylon transistor screw insulators, PC board, 3-inch lazy susan bearing, microphone stand (RadioShack 33-370 or similar), microphone stand adapter (RadioShack 33-4005 or similar), 1/2-inch plywood, rubber feet, 4-position speaker terminal (RadioShack 274-622 or similar), 22-gauge stranded wire (RadioShack 278-862 or similar), brushes, etc.

NOTE: The following items are available from SEAL ELECTRONICS, P.O. Box 268, 3898 Kentucky Rt. 466, Weeksbury, KY 41667-0268, Tel: 606-452-4135: Set of 3 propellers, \$12.00 plus \$4.50 shipping and handling charge; Transistor-Heatsink Assembly with Q1-Q6 and three fuse holders pre-mounted to a 4 x 9 x 3/4-inch heatsink with instructions, \$15.50 plus \$5.00 shipping and handling charge; pre-fabricated Gimbal Assembly includes all parts, hardware, and 20-inch channel pivot lever with instructions (minor assembly required), \$38.50 plus \$5.50 shipping and handling charge.

altered by the operator as his or her skill increases with experience.

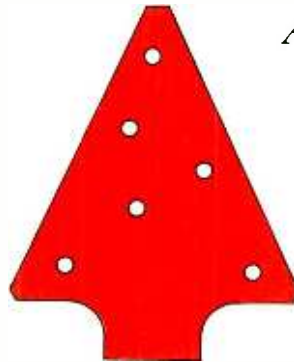
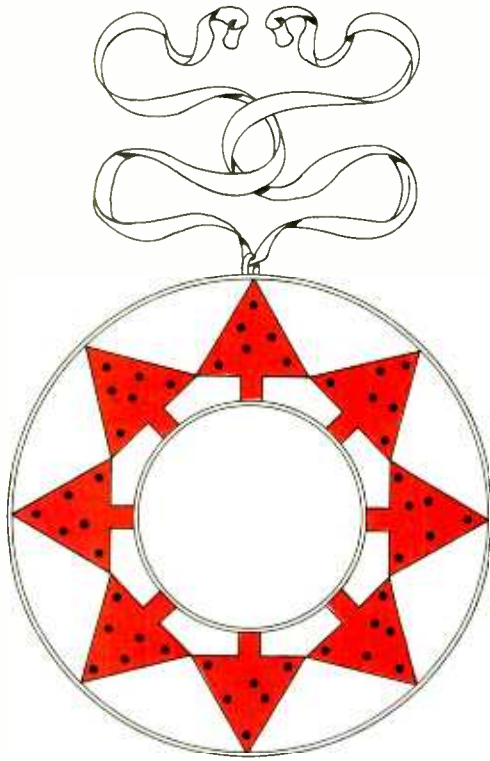
While small children can be entertained for hours by just "flying" the shuttle, older children and adults enjoy challenging themselves and each other to the skill required picking up and transporting objects. Inexpensive plastic dining-table place mats make excellent imaginary "planets" for landing and targeting purposes. Depending on the acquired skill level of the game player, maneuvering action and control response can be very rapid.

Options and Modifications. While the Astro-Treker itself is visually impressive, various modifications and additions can add to the visual effects and enhance the games that can be played. For example, LEDs in various colors can be placed on the flyer and can be wired in parallel with the motors. One particularly striking effect is to use three high-brightness LEDs, such as RadioShack 276-206s. Put one wired in parallel with each motor, and mount them so that they are pointing down toward the landing feet of the flyer. A 33-ohm resistor should be connected in series with each LED to provide the necessary current limiting. The effect is an illusion of orange fire exhausting from the bottom of the flyer that varies in intensity as the motor speed changes. Flashing lights or other lighting that is more dramatic is possible, limited only to your imagination.

Another option is to connect an electromagnet, such as the coil from a small 12-volt DC relay, in parallel with the center motor. The electromagnet is mounted to one of the landing feet of the flyer and is used for picking up and dropping iron-bearing metal objects. Since both directional motors provide substantial lift as well as direction, the shuttle can be maneuvered without the use of the center motor. The goal in that case would be to fly over a small metal object, pick it up with the electromagnet by starting the center motor, transporting it to a target location, and drop it on the target by stopping the center motor. Such a maneuver can be quite tricky because

Continued on page 44

BUILD THIS TWINKLING HOLIDAY ORNAMENT



An electronic Christmas ornament is just the thing to brighten the tree this Holiday!

DAVID WILLIAMS

Working with Surface-Mount Components. Working with surface-mount components requires proper tools and materials. You will need a soldering iron, a vise, tweezers, and a magnifying glass. The soldering iron should have a rating of 25 to 35

A great way to get into the spirit of the Holidays is by building this electronic Christmas ornament. This project makes a great conversation piece that also gives you practice working with surface-mount components. The ornament is shaped like a miniature tree with multi-colored flashing LEDs that twinkle just like the real thing! The entire circuit is powered by a coin-cell battery. The ornament is small enough to be hung on your Christmas tree or around your neck at your favorite holiday party. Either way, it's guaranteed to attract lots of attention!

drawn by the LEDs. Momentary push-button switch S1 toggles the display on and off. Each HT2030 draws less than 1 microamp of current when in the standby mode.

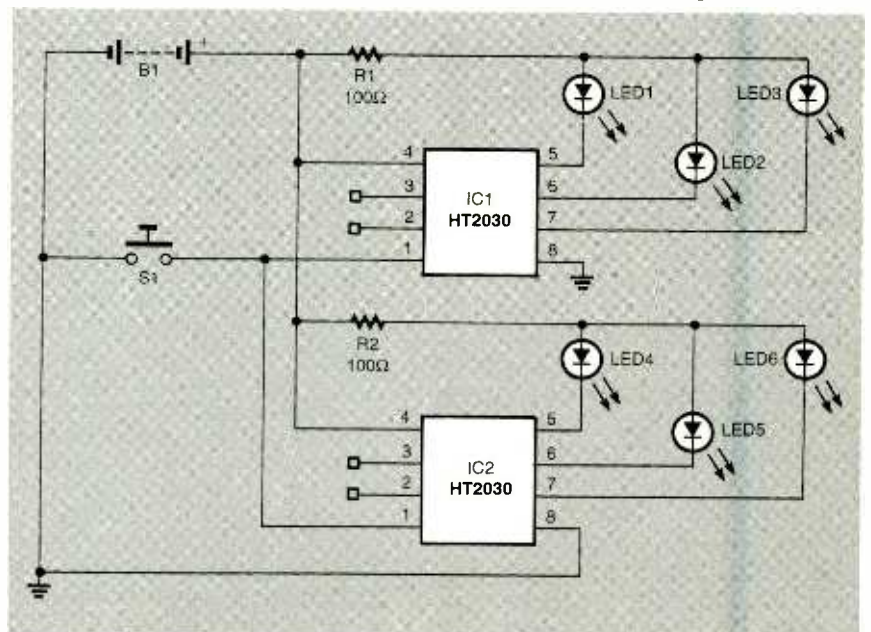


Fig. 1. The Twinkling Ornament is built around the Holtek HT2030. That surface-mount device contains all of the circuitry needed to flash three LEDs in sequence.

Circuit Description. The schematic diagram in Fig. 1 shows the simplicity of the Twinkling Ornament. The circuit is based on the HT2030 CMOS LED-driver chip from Holtek Microelectronics Inc. That surface-mount chip contains a built-in oscillator, sequencing logic, and output drivers for three LEDs. Two chips (IC1 and IC2) are used to get a twinkling effect from six LEDs.

The circuit is powered by B1, a single 3-volt lithium coin-cell battery. Resistors R1 and R2 limit the current

watts with a fine conical tip about $\frac{1}{16}$ inch in diameter. The materials required are solder, a drop dispenser, liquid flux, and a flux remover.

The solder should be a very fine wire type (no thicker than 0.02 inches in diameter) and should have a 63/37 tin-lead mixture for best results. Tin-lead solders that are made up of 63% tin and 37% lead are called *eutectic* solders. Normally, when solder is melting, it has what is called a *pasty range* in which it is part solid and part liquid—very much like the slush formed by melting snow. Eutectic solders do not have a pasty range—they go from liquid to solid and back all at once. The big advantage to eutectic solders is that it is almost impossible to make a cold-solder or disturbed

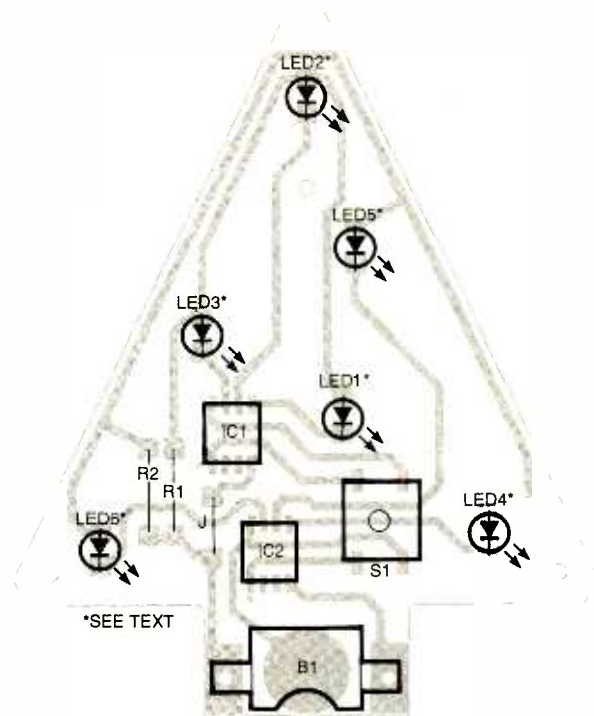


Fig. 2. The Twinkling Ornament uses a combination of surface-mount and through-hole components. Since all components except the LEDs mount on the foil side of the board, a foil-side view is shown in this parts-placement diagram.

PARTS LIST FOR THE TWINKLING HOLIDAY ORNAMENT

- R1, R2—100-ohm, 5%, $\frac{1}{8}$ -watt, surface-mount resistor
- IC1, IC2—HT2030 3-LED Flash Driver IC, surface-mount (Holtek)
- LED1—LED6—Light-emitting diodes, size T-1, various colors (see text)
- S1—Push-button switch, surface-mount (Digi-Key SW416-ND or similar)
- B1—3-volt lithium coin-cell battery, size CR1220 (RadioShack 23-188 or similar)
- Printed-circuit board, 12-millimeter coin-cell battery holder (Digi-Key 3000K-ND or similar), solder, etc.

Note: The following items are available from LNS Technologies, 20993 Foothill Blvd, Suite 307R, Hayward, CA 94541-1511; Tel: 800-886-7150: Complete kit of parts including etched and drilled printed circuit board, switch, battery holder, ICs, and all other components listed above (XMASTREE-KIT), \$18.00; IC₁, IC₂, (ICHT2030), \$4.00 each; PCB board only (XMASTREE-PCB), \$7.00. Please add \$5.00 for shipping and handling. California residents add appropriate sales tax. MasterCard and Visa orders are accepted. No C.O.D. orders will be accepted.

The HT2030 IC is also available from A11tronics, 2300 Zanker Rd., San Jose, CA 95131, Tel 408-934-9773.

joint—one in which the lead has been moved while the solder was solidifying. Those types of joints are usually a dull gray in appearance. They have not made a good chemical bond between the lead and the PC board, and will soon fail to conduct electricity.

The best way to solder a surface-mount component to a PC board is to first apply a tiny amount of liquid flux to one PC board pad using the drop dispenser. Then, using the soldering iron and solder, "tin" the pad by creating a small pool of solder on the pad. Let the solder solidify.

Pick up the surface-mount component with a pair of tweezers and position it in the proper location over the pad. Next, use the soldering iron to reflow the solder so that the component sinks into the solder pool. Remove the iron and let the solder cool. The component will be held in place on the board. The rest of the part can then be soldered in the traditional manner.

The process might sound difficult, but with the aid of a magnifying glass and a little patience, things should go smoothly.

Surface-Mount PC Board Fabrication. Since the Twinkling Ornament uses a combination of through-hole and surface-mount components, an etched circuit board is a must. Fabricating an SMT circuit board is identical to making a traditional single-sided board; however, since the component pads and traces on an SMT board are smaller and more delicate, etching must be done very carefully. Check the etching process frequently to avoid any over-etching that could damage the copper traces and check each trace for continuity after the board is finished.

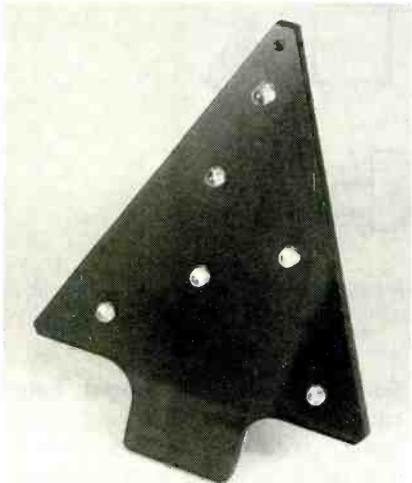
If you don't want to fabricate your own board, a pre-etched one can be purchased from the source given in the Parts List.

Construction. Now that you know how to work with surface-mount components, it's time to start building the Twinkling Ornament. The parts-placement diagram for the twinkling ornament is shown in Fig. 2. With the exception of the LEDs, all of the components will be mounted on the foil side of the board. For that reason, the parts-placement diagram that is shown

here is a view of the board from the foil side.

Begin by using a piece of insulated solid wire for the jumper wire. The jumper wire is installed on the foil side of the board. After soldering it in place, clip the excess leads flush with the opposite side of the board. Install and solder R1 and R2 in the same way. Then attach IC1 and IC2, making sure to orient pin 1 of each IC as shown in Fig. 2, using the surface-mount technique described earlier in this article.

You'll also use surface-mount techniques to attach the battery



Here's the completed ornament. Whether hung on a tree, worn around your neck, or used in some other decorative way, it can add a touch of electronic sparkle to your holidays.

holder to the PC board. Make sure that the open end of the battery holder is facing away from the top of the tree so the battery can be inserted from the bottom. Next, mount push-button switch S1. The LEDs are mounted on the component side of the PC board in the conventional manner. You can use LEDs of various colors for a more realistic effect. Since LEDs are polarized, make sure to observe the proper orientation.

The finished Twinkling Ornament will only have the LEDs visible from the front of the unit—the rest of the circuit will be hidden on the back of the board.

Checkout and Use. Before testing the Twinkling Ornament, clean any flux from the foil side of the board with a flux remover or alcohol. Examine the assembled board to make sure that there are no solder bridges or cold joints. Install the battery by sliding it into the holder with the negative side against the PC board. Turn the Twinkling Ornament on by pressing S1. If all is well, the six LEDs on the unit should begin blinking at once.

If some LEDs blink but others do not, check to see if the LEDs are installed correctly. If all three LEDs on one of the ICs do not work, check the connections around that IC. The resistor for that IC

should also be checked. It is also possible that the IC is defective. When replacing an IC, be careful not to overheat the chip. Semiconductors—especially surface-mount ICs—are very sensitive to heat.

If neither circuit is working, there might be a problem with the battery or its holder. It is also possible that both ICs are defective—especially if they were overheated. It could also be that ALL of the LEDs were installed backwards—a fairly common thing to do if the polarity markings were misidentified to begin with!

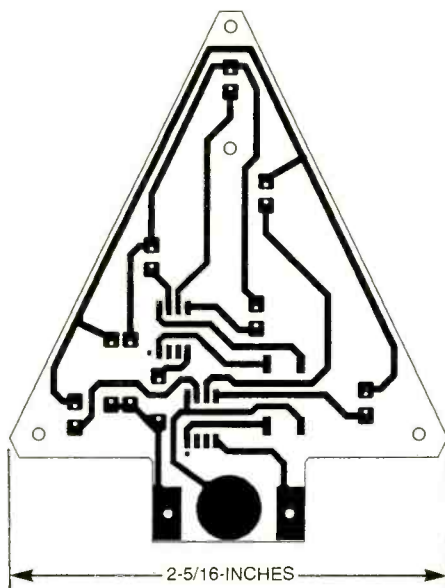
The PC board has a small hole at the top that can be used to attach the Twinkling Ornament to a hook or necklace loop. You can use your imagination to decorate the component side of the board. Try paint, glitter or perhaps a dark green plastic or cardboard overlay. No matter how you decide to decorate it, your holiday ornament will probably be so popular that you will need to build extras for your family and friends! Ω

ASTRO-TREKER

(continued from page 41)

the center motor will speed up as the electromagnet is energized. If the metal object is of sufficient weight, the additional lift provided by the center motor will be canceled out by the weight of the object. It can be more fun and challenging to choose items whose weight is not proportional to the lift generated by the center motor. That would need rapid compensation from the directional motors. With the addition of another brush/ring contact, the electromagnet can be powered independently of the motors.

The basic concept of the Astro-Treker can be used for constructing a variety of action games and toys. The easy-to-build rotor can also be used in robotics, displays, rotating signs, and science projects. However, you'll probably be having way too much fun with the Astro-Treker to worry too much about practical applications. Ω



The tree-shaped Twinkling Ornament uses a single-sided PC board to hold both the surface-mount and through-hole components.

TV antennas are directional. They receive strongly from one direction and reflect signals from other directions. The direction an antenna receives best from is the direction closest to the shortest element of the antenna. If you live in an area where TV stations are scattered all around you, you probably have a motorized antenna rotator that lets you point your antenna in the direction of the TV station that you're watching.

You've probably also noticed something annoying about antenna rotators. Although the TV, VCR, stereo, and everything else in your home-entertainment system can be operated by remote control, the antenna rotator requires a trip to the control box to get the picture right. It's almost impossible to remember where all the "sweet spots" are for each station. Televisions might be using the latest 1990s technology, but antenna rotators are still technologically back in the 1950s. What would be great is to have an antenna rotator control that can be operated by the remote control.

The Remote-Controlled Rotor (RCR) is just such a device. It brings the control of your antenna to your fingertips with the use of a programmable-infrared remote control. It substitutes for the mechanical controllers typically used in the home. It has the added feature of channel-direction memory. Channel directions can be taught to the RCR so that a particular direction can be recovered whenever you want to tune a channel in again.

Based on microcontroller technology, the Remote-Controlled Rotor is small enough to be tucked among a collection of videotapes. It has been tested with Channel Master, Alliance, and RadioShack rotators. It has also been tested with various "universal"-type programmable remote control.

Circuit Description. The schematic diagram of the RCR is shown in Fig. 1. It is built around IC4, a PIC16C56 microcontroller. The program burned into it decodes the infrared signals and decides how to respond

The author would like to express his appreciation to Bruce Jones for his help and assistance in the testing of this project.

BUILD A REMOTE CONTROL FOR YOUR ANTENNA

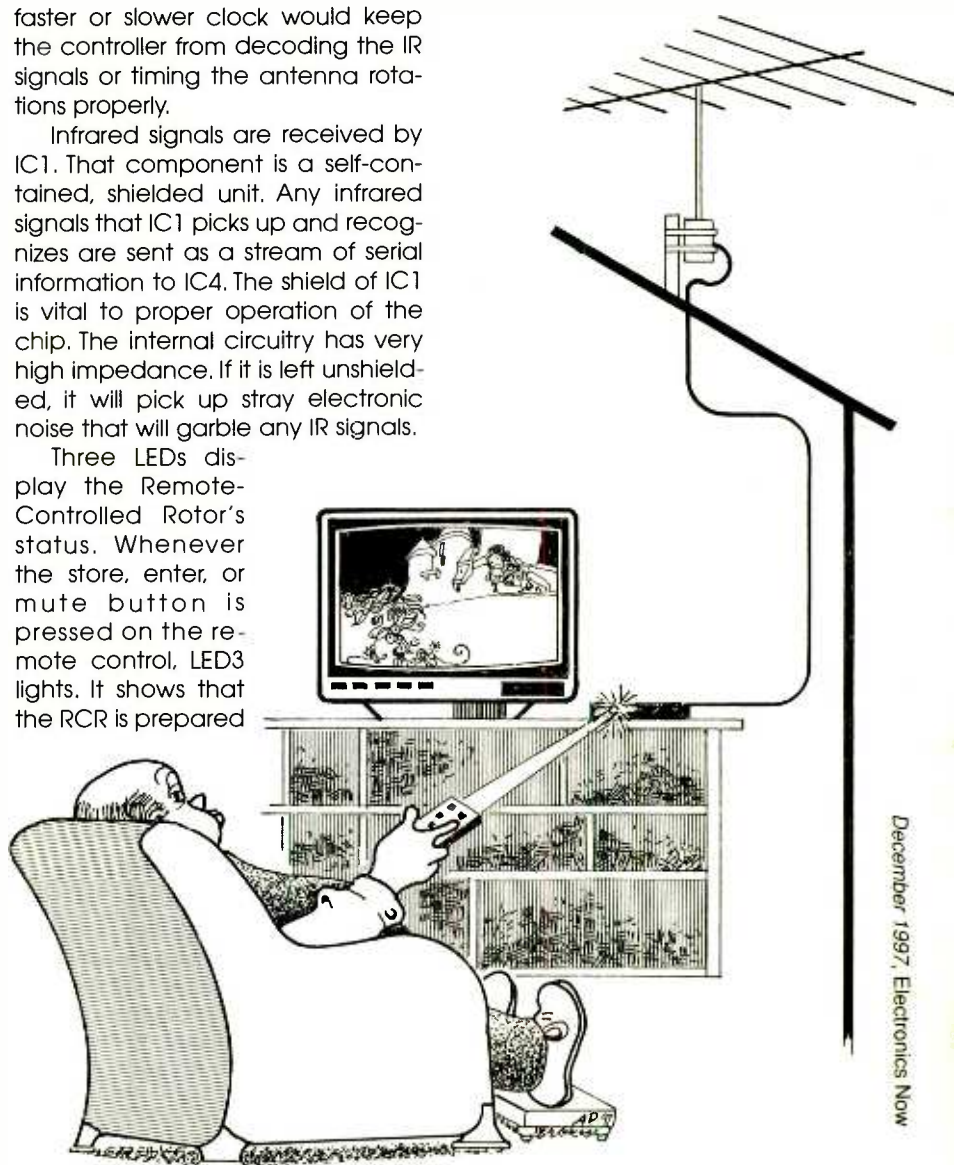
Program your antenna direction to pick up any TV station just by selecting the channel number on your remote control!

to them. The controller is clocked by XTAL1, a 4-MHz ceramic resonator. Since the software is designed around that exact clock speed, a faster or slower clock would keep the controller from decoding the IR signals or timing the antenna rotations properly.

Infrared signals are received by IC1. That component is a self-contained, shielded unit. Any infrared signals that IC1 picks up and recognizes are sent as a stream of serial information to IC4. The shield of IC1 is vital to proper operation of the chip. The internal circuitry has very high impedance. If it is left unshielded, it will pick up stray electronic noise that will garble any IR signals.

Three LEDs display the Remote-Controlled Rotor's status. Whenever the store, enter, or mute button is pressed on the remote control, LED3 lights. It shows that the RCR is prepared

WILLIAM G. GRIMM



frequencies in the supply are filtered by C8 and C9, with C5 filtering the high frequencies.

Construction. The method chosen to build the RCR is not critical. No space- or frequency-sensitive components are involved. The easiest method is to use a single-sided circuit board. A foil pattern has been provided should you wish to etch your own board. Pre-etched boards are available from the source given in the Parts List, as are several of the more unusual items, such as a pre-programmed microcontroller chip and an infrared-transparent bezel for the case.

If you use a pre-etched board or fabricate one from the foil pattern, the parts-placement diagram in Fig. 2 will show you where the components are located. The board has a breakaway portion. That breakaway portion will form a back panel that will fit into a PacTec JM-42 project box. Start by breaking the back panel off the board at the perforations. Solder all of the components to the board.

When soldering the components onto the board, it is easiest to start with the smallest parts first. A jumper wire between IC3 and LED3 is a good starting point, followed by the resistors and diodes. If you have difficulty finding the regulator specified for IC2, you can use a standard LM7805, but you'll have to bend the IC over a bit in order to make it fit within the suggested enclosure. A larger enclosure can also be used, but you'll then have to design a different back panel that will fit around the connectors.

Microcontroller IC4 needs to be programmed with the RCR instructions before it is installed in the board. As mentioned, a pre-programmed part is available from the source given in the Parts List. If you are able to program a PIC chip, the source and object codes are both available from the **Electronics Now** FTP site (<ftp://ftp.gernsback.com/pub/EN/rcr.zip>).

Jumper JP2 selects the type of infrared commands to which the RCR will respond. If JP2 is shorted, the unit will respond to Teknika TV commands. With JP2 left open, the commands will be for a M/A-COM

PARTS LIST FOR THE REMOTE-CONTROLLED ROTATOR

SEMICONDUCTORS

IC1—LTM8834-7 (LiteOn) or GP1U521Y (Sharp) 40-KHz-carrier infrared module (Digi-Key LT1060-ND or similar)
IC2—L78M05CX 5-volt voltage regulator, integrated circuit (Mouser 511-L78M05CX or similar)
IC3—93C46 serial EEPROM, integrated circuit
IC4—PIC16C56-XT/P programmed microcontroller, integrated circuit
D1, D2—1N4148, silicon diode
D3—1N4001, silicon diode
LED1—LED3—Light-emitting diode, red, right-angle mount

RESISTORS

(All resistors are 1/4-watt, 5% units.)
R1—100,000-ohm
R2, R3—1000-ohm
R4—220-ohm

CAPACITORS

C1—optional, see text
C2, C3—33- μ F, 35-WVDC, non-polarized, electrolytic
C4, C5—0.01- μ F, ceramic-disc
C6, C7—1- μ F, metalized polyester
C8—120- μ F, 35-WVDC, electrolytic
C9—47- μ F, 10-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

J1—Power connector for transformer
J2–J5—Right-angle screw terminals (Mouser 534-8190 or similar)
JP1, JP2—2-pin jumper posts
RES1—4-MHz ceramic resonator (Panasonic EFO-EC4004A4 or similar)
RY1, RY2—5-volt single-pole, single-throw relay (Omron G6B-1114P-US-5VDC or similar)
19-volt, 1-amp AC wall-mounted transformer, enclosure (PacTec JM-42 or similar), infrared-transparent lens, jumper blocks, PC board, solder, hardware, etc.

Note: The following items are available from: Remote Control Rotator, 12811 Bluhill Road, Silver Springs, MD 20906: full kit (not including remote control or rotator), \$55.99; printed-circuit board with back plate, \$21.27; pre-programmed IC4, \$9.00. A limited number of remote controls are also available for \$3.49. Please add \$5.00 shipping and handling. Maryland residents please add appropriate sales tax.

cable-converter box. The choice depends upon the type of universal remote control you will be using. Once you decide what type of arrangement will be best for your setup, set JP2 accordingly.

Jumper JP1, on the other hand, simply connects C1 into the motor-run capacitors. Its use, along with C1, will be discussed in the section on motor-run capacitors. It is only needed if you have to use the optional C1 capacitor in order to create a custom motor-run capacitor value. For now, leave C1 out and do not short JP1.

Once all of the parts have been soldered to the board, inspect your work carefully. Place the back panel over the connectors and mount the board and back panel into the enclosure. If you are using the suggested enclosure or another enclosure that the back panel will fit into, you might have to file or sand the edges of the panel in order to get it to fit.

Place the infrared-transparent bezel in the front of the enclosure and close the unit. The Remote-

Controlled Rotator is now ready for testing and setup.

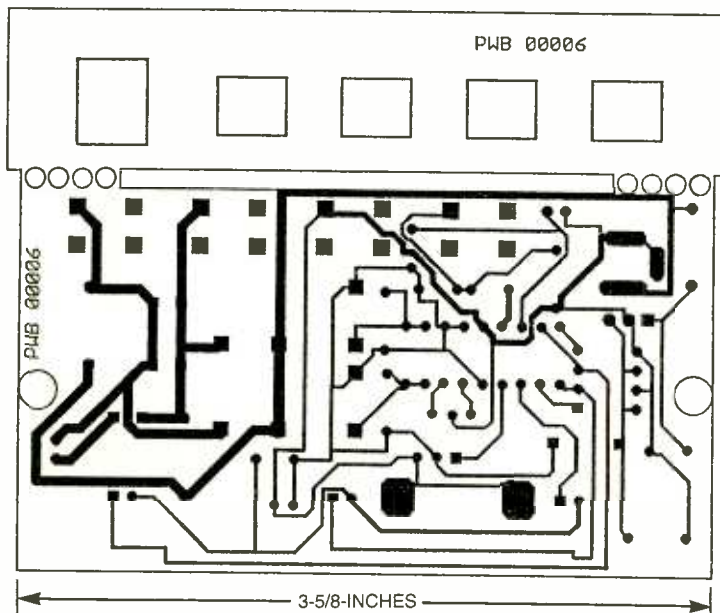
Testing and Setup. Follow your programmable remote control's instructions to set it up as a M/A-COM cable converter or the oldest type of Teknika TV. The choice depends upon how you set JP2.

The RCR takes the place of the old rotator-control box. Simply disconnect the control wires from the old box and connect them to the RCR. Typically, the wires on most rotators are numbered from 1 to 3 or 4, and are connected the same way. On the RCR, wire 1 goes to J2, wire 2 goes to J3, wire 3 goes to J4, and wire 4 (if present) goes to J5.

Connect the wall transformer to J1. Plug the transformer into the most convenient outlet. The On/Run LED should come on.

If you have a 4-wire rotator (such as Alliance), you might need to press the channel-up and then the channel-down buttons. That will get the RCR to figure out that a 4-wire motor is connected to it.

Press "9" then "1" (referred to as



The foil pattern for the Remote-Controlled Rotator also has a back panel that can be snapped off and used on the case. The square holes in that part of the board will match up with connectors J1-J5.

"91" from here on) on the remote. The LEDs should start blinking, indicating that the rotator is moving. The RCR and the rotator are synchronizing themselves. That should last for about a minute or so.

If the unit does not work, check your work carefully. Polarized components must be inserted correctly.

If the RCR seems to work but the rotator doesn't spin the antenna, check that the wires are connected properly. There is also a possibility that one or more of the control wires has broken, especially on an older installation. Old wire might work OK as long as it is not disturbed, but brittle insulation could

crumble, resulting in a short.

Don't be in too much of a hurry to get on the roof to replace the old rotator motor. The motors are designed for extended exposure to the elements, and are far more durable than the control boxes. If the motor does need replacement, you can check with a local TV-repair shop or electronic-appliance store for new motors. You could also contact the original manufacturer if you do not want to try a different brand.

Installation and Use. The RCR can sit near the television, tucked into any unobtrusive location. The only important thing to remember is that IC1 must be able to "see" the infrared pulses from the remote control. Depending on the RCR's location and the room itself, direct line-of-sight might not be necessary. Sometimes the infrared pulses will reflect strongly off a white ceiling and still be bright enough for the RCR to successfully detect them. Simply connect it up and press "91" to synchronize the rotator to the RCR.

By pressing "70," "71," "72," "73," or "74," you can aim the antenna counter clockwise North, East, South, West, and clockwise North respectively. Those preset directions can be used to find the best reception for a particular TV station. Those special channel directions are:

- 70—counter-clockwise North
- 71—East
- 72—South
- 73—West
- 74—clockwise North

If you know that a particular station comes from a city to the east, for instance, press "71". Using the channel up and channel down buttons, adjust the antenna position for the best picture.

With the Teknika TV-set arrangement, the "Mute" button acts as the command to store a channel direction. With the M/A-COM cable-converter option, the "Enter" button is used to store the channel-direction information. To store the direction of a TV station, press the "Enter" or "Mute" button and the two digits for the station number. Alternately, you can also press "99" plus the two-

Continued on page 62

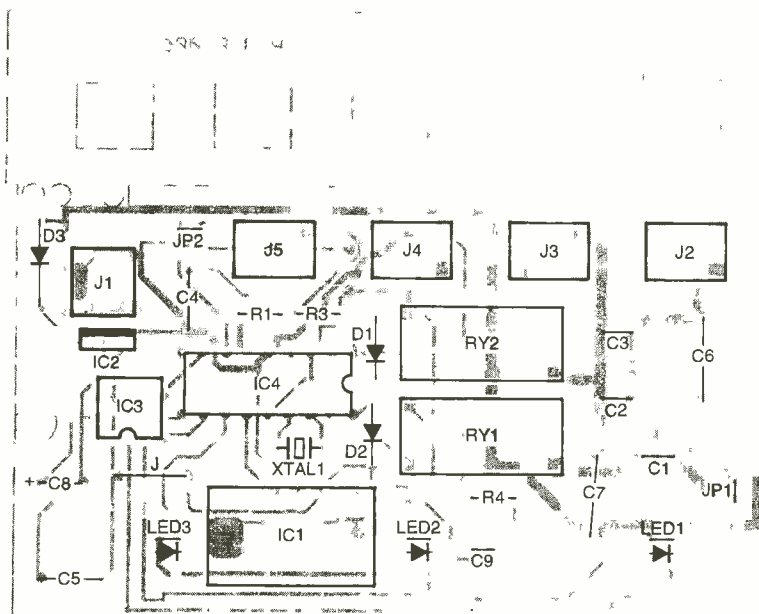


Fig. 2. Here's the parts-placement diagram for the Remote-Controlled Rotator. The entire circuit fits onto a single-sided board with only one jumper needed.



ALL ABOUT DVD

The new, hot consumer-electronics product, the power of DVD is really unleashed when used in a personal computer.

Here's why, and how easy it is to harness that power in your own set up.

STEPHEN J. BIGELOW

The compact disc (CD) opened up a whole new world of possibilities for the PC. Those simple, mass-produced plastic discs could hold up to an hour of stereo music, or as much as 650MB of data. Software makers quickly found the CD-ROM to be an outstanding medium for all types of multimedia applications, large databases, and interactive games. But today, the CD-ROM is showing its age, and a single CD no longer provides enough storage for the increasing demands of data-intensive applications. Fortunately, a new generation of high-density optical storage media, called DVD, is now appearing. The home-entertainment applications of DVD, which alternately has been defined as "Digital Video Disc" and "Digital Versatile Disc," have been well publicized. But more important to computer users is that DVD technology promises to supply up to 17GB of removable storage for your desktop PC. This article explores the background and workings of DVD, particularly for computer applications; shows you the steps for installing a DVD package in your own PC; and offers some basic troubleshooting that can keep you out of trouble.

Lots of Promise. The argument for DVD is a compelling one because having gigabytes of removable

storage to work with opens up some exciting possibilities for entertainment and software development. As DVD works its way into the marketplace, you're going to see designations such as DVD-Video, DVD-Audio, and DVD-ROM. DVD-Video is the approach used to store movies on the disc (analogous to the way audio is placed on CDs). DVD-Audio (not currently available but expected within a couple of years) is the audio format that might someday replace today's audio CDs. In addition to offering much higher storage capacity, which, among other things, will allow special effects such as surround, these discs will also allow some video or photographs to be displayed on a TV. DVD-ROM refers to computer-based software and data recorded on the disc. Where audio CDs can be played on CD-ROM drives, DVD-Video and eventually DVD-Audio discs will be playable on DVD-ROM drives in your PC.

Understandably, there are a lot of players looking to make the most of what DVD has to offer. Hollywood has been a major factor in the development of DVD-Video—placing full-length movies, sound tracks, and even multi-lingual sub-titling on a single disc. Since all DVD discs are read by laser, there is no physical contact between the disc and its player. The result is that the disc

won't wear out like VHS video tapes.

Business presentations, education, and professional training will also benefit from DVD technology. Animations, charts, and interactive applets can be integrated with real-time video. This offers a truly immersive training experience that CD-ROM technology has only approached.

Applications for archiving are limitless. Mapping programs, telephone directories, encyclopedias—any software that now spans several CDs can be concentrated on one DVD disc, and dramatically expanded to offer unprecedented detail. Any data-intensive computer software (especially 3D and other interactive games) will get a real boost from the sheer storage volume offered by DVD-ROM.

Specifications and Standards. The next steps in exploring DVD are to understand the various specifications "on the box," and to become familiar with the specifications that make DVD work and what a DVD will support. You don't need a lot of technical details, but you should recognize the most important points that you'll probably run across while reading documentation.

The *access time* is the time required for the drive to locate the required information on a disc. Optical drives like CD and DVD are relatively slow and can demand up

to several hundred milliseconds to access information. In fact, because of the massive amount of data and the greater density, DVDs are actually slower than ordinary CD-ROMs. For example, access time for a normal CD is 180ms, while currently available DVD kits sport access times that range between 200 and 470ms.

Once data has been accessed, it must be transferred from the disc to the system. The *data transfer rate* measures how fast data can be read from the disc. There are two typical means of measuring the data rate; the speed at which data is read into the drive's on-board buffer (the "sequential" data transfer rate), and the speed at which data is transferred across the interface to the drive controller (the "buffered" data transfer rate). As an example, one currently available DVD drive offers a *sequential* data transfer rate of 1.35MB/s, and 900KB/s for an ordinary CD (about equal to a 6X CD-ROM drive). By comparison the drive can support *buffered* data transfer rates of 8.3MB/s (DMA Mode 2), 13.3MB/s (DMA Mode 1), or 11.1MB/s (PIO Mode 3). As a result, the DVD-ROM drive is compatible with most EIDE drive controllers.



Fig. 1 One way that DVDs squeeze more data on a disk is to space the lands and pits that contain the data much tighter. The spacing for a DVD disk is shown on the left; that for a standard CD on the right.

CD technology is defined by a set of accepted standards—we have come to know these as "books." Since each CD "book" was bound in a different color jacket, each standard is dubbed by color. For example, the standard that defines CD audio is called Red Book. Similarly, DVD technology is defined by a set of "books". There are five books (labeled A through E) which relate to different applications: Book A defines the format

and approach used for DVD-ROM (programs and data); Book B defines DVD-Video; Book C defines DVD-Audio (this specification is still under development); Book D defines DVD-WO (write once); and Book E defines DVD-E (erasable or re-writeable) and DVD-RAM.

All DVD discs must use a data format that describes how data is laid out. Data formats are critical because they outline data structures on the disc such as volumes, files, blocks, sectors, CRCs, paths, records, file-allocation tables, partitions, character sets, time stamps, as well as methods for reading and writing. The format used by books A, B, and C is called the *UDF Bridge*. The UDF Bridge is a combination of the UDF (Universal Disk Format created by OSTA—the Optical Storage Technology Association) and the established ISO-9660 format used for CDs. You may see the UDF referred to as standard ISO/IEC 13346. The UDF is a very flexible format that has been adapted to DVD, and made backward-compatible to existing ISO-9660 operating-system software (such as Windows 95). Actual use of this disk system on DVD discs will depend in large part on what Microsoft dictates as the future operating system standard. Stand-alone DVD movie players are supposed to use UDF, while computer applications will use the UDF Bridge until UDF support becomes universal (possibly as early as Windows 98).

Even with the huge data capacities offered by DVD, an entire movie's worth of real-time audio and video would never fit on a DVD without some form of compression. Both audio and video must be extensively compressed, and MPEG (Motion Pictures Experts Group) compression has been the scheme of choice. Video compression uses fixed-data-rate MPEG-1 (ISO/IEC 1117-2) at 30 frames-per-second with resolutions of 352 × 240, or variable-data-rate MPEG-2 (ISO/IEC 13818-2) at 60 frames-per-second with resolutions of 720 × 480. Audio compression uses MPEG-1 (ISO/IEC 1117-3) stereo, MPEG-2 (ISO/IEC 13818-3) 5.1 and 7.1 surround sound, or Dolby AC-3 5.1 surround and stereo (the audio designations "5.1" and "7.1" indicate five—or seven—

signal channels, plus one subwoofer channel). MPEG-2 and AC-3 audio compression allow 48 thousand samples-per-second, where MPEG-1 allows only 44.1 thousand samples per second. MPEG-2 compression is typically regarded as the preferred scheme for DVD.

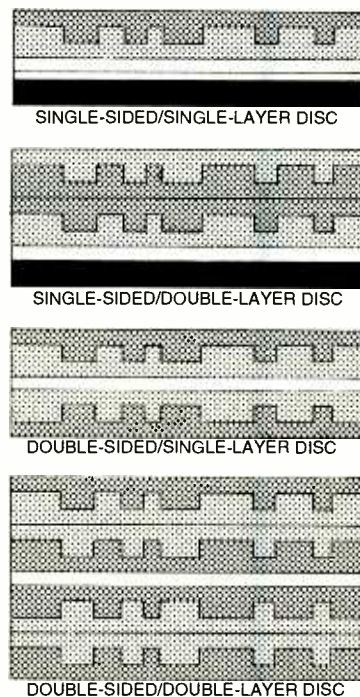


Fig. 2. Each side of a DVD can contain two layers of information, and both sides of the disk can be used.

One of the most important aspects of any technology is "backward compatibility"—how well will the new device support your existing media. The same issue is true for DVD drives. Since DVD technology is designed as an improvement over existing CD-ROMs, the DVD was designed to *replace* the CD-ROM rather than co-exist with it. Ideally, you'd remove your CD-ROM and replace it with a DVD-ROM drive. This means that the DVD must be compatible with as many existing CD-ROM standards as possible. A typical DVD-ROM drive will support CD audio, CD-ROM, CD-I, CD Extra, CD-ROM/XA, and Video-CD formats. Multi-session formats such as Photo CD are not yet supported on all DVD drives. One format that is not supported by any DVD drive yet is the CD-R (recordable CD) format. The laser used in a DVD cannot read

TABLE 1—SPECIFICATIONS OF DVD AND CD MEDIA

Specification	DVD	CD-ROM
Diameter (mm)	120	120
Disc Thickness (mm)	1.2	1.2
Substrate Thickness (mm)	0.6	1.2
Track Pitch (µm)	0.74	1.6
Minimum Pit Size (µm)	0.4	0.83
Wavelength (nm)	635/650	780
Single Layer Capacity (GB)	4.7	0.65

the CD-R, and in some cases, may even damage the CD-R disc. However, new CD-R blanks are being developed that should overcome this problem.

DVD Media. At its core, DVD technology is identical to classical CD-ROMs—data is recorded in a spiral pattern as a series of pits and lands pressed into a plastic substrate. The actual size and dimensions of a DVD are identical to our current compact discs. However, there are some key differences which give DVD its advantages.

First, the data pits themselves are highly compressed on the disc—where classical CDs use spiral tracks that are 1.6 µm apart, DVD tracks are only 0.74 µm apart. A typical pit on a classic CD is 0.83 µm, but DVD pits are just 0.4 µm. Table 1 lists the specifications for DVD and CD media. In short, the data on a DVD is *much* denser than on a regular CD. Figure 1 compares the data densities of DVD's and CDs. In order to detect the DVD's smaller geometries, the laser used in a DVD operates at a much shorter wavelength (a short-wavelength red laser is used).

Second, DVD can use two "layers" of pits and lands (each in their own reflective layer). The laser focus control can select which layer to read.

Finally, a regular CD only uses one side of the disc, but both sides of the DVD can be used. Combined with the multi-layer technique, the DVD can supply up to four layers of data to a DVD drive (see Fig. 2). In actual practice, DVD-ROM discs will likely only use one side of the disc—at least for a while. What all this means is that a DVD can offer up to 8.5GB of storage for a single-sided DVD, or up to 17GB of storage for a double-

sided DVD.

Caring for a DVD Disc. As with CDs, a DVD disc is a remarkably reliable long-term storage media (conservative expectations place the life estimates of a DVD disc at about 100 years). However, the longevity of an optical disc is affected by its storage and handling—a faulty CD can cause file and data errors that you might otherwise interpret as a defect in the drive itself. You can get the most life out of your optical disc by obeying the following rules:

Don't bend the disc. Polycarbonate is a forgiving material, but you risk cracking or snapping (and thus ruining) the disc.

Don't heat the disc. Remember, the disc is plastic. Leaving it by a heater or on the dashboard of your car will cause melting.

Don't scratch the disc. Laser wavelengths have a tendency to "look past" minor scratches, but a major scratch can cause problems. Be especially careful of circular scratches (one that follows the spiral track). A circular scratch can easily wipe out entire segments of data that would be unrecoverable.

Don't use chemicals on the disc. That especially includes chemicals containing solvents such as ammonia, benzene, acetone, carbon

tetrachloride, or chlorinated cleaning solvents. Such chemicals damage the plastic surface.

Eventually, a buildup of excessive dust or fingerprints can interfere with the laser beam enough to cause disc errors. When this happens, the disc can be cleaned easily using a dry, soft, lint-free cloth. Hold the disc from its edges and wipe radially (from hub to edge). Do not wipe in a circular motion. For stubborn stains, moisten the cloth in a bit of fresh isopropyl alcohol (do not use water). Place the cleaned disc in a caddy or jewel case for transport and storage. Contrary to popular belief, DVD discs are not more sensitive to scratches or dust than ordinary CDs.

DVD Drives. A DVD drive looks almost identical to a CD-ROM drive in size, shape, and layout. In fact, if not for the "DVD" logo on the tray, you'll probably mistake a DVD-ROM drive for a CD-ROM drive. The front of a DVD drive (see Fig. 3) carries all of the standard features that you'd find on any CD-ROM. A motorized disc tray loads and unloads the disc. You can close or open the tray by toggling the Eject button. It's interesting to note that a DVD-ROM won't eject a disc that is "locked" by a software application (such as a running movie). You will need to close your DVD application before ejecting the "locked" disc. The Busy indicator lights whenever data is being read from the drive. Since the DVD drive also supports CD audio, you can connect headphones to the headphone jack, and adjust volume right from the front panel.

Much of the rear of a DVD-ROM may also look familiar (see Fig. 4). Power is connected through a 4-pin

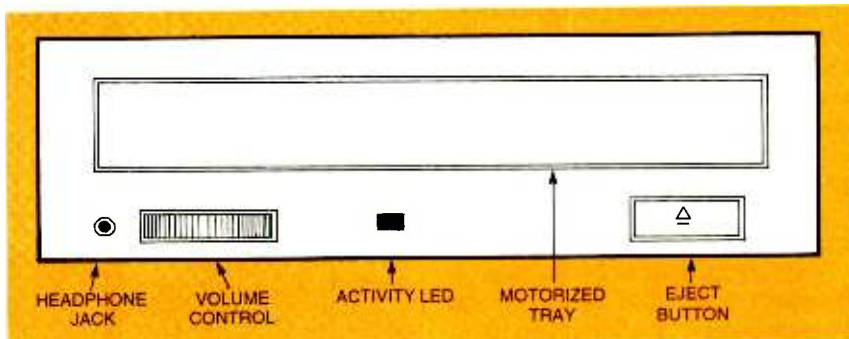


Fig. 3. The front of a DVD drive will be familiar to users of CD-ROM drives as it has the same look and controls.

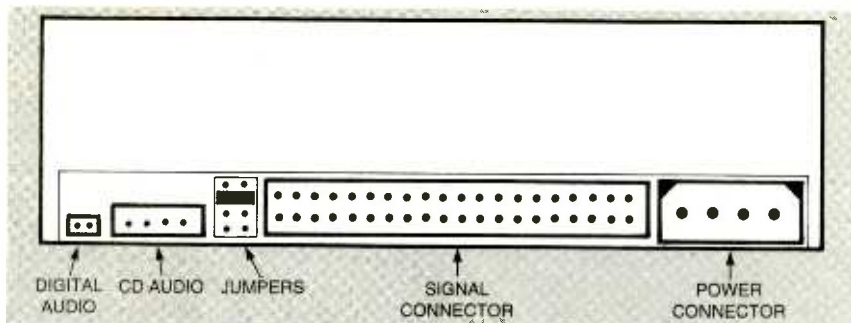


Fig. 4. The rear of a DVD drive sports the connectors needed to interface it with the rest of the system.

Molex connector, so you can use any suitable power connector from your power supply. The signal connector is typically either EIDE (40-pin) or SCSI (50-pin), and connects the drive directly to your existing controller. Unlike early CD-ROM drives, DVD-ROM drives do not use "proprietary" drive controllers. A series of small jumpers allows you to set the drive's identity. For SCSI-type drives, you can set the SCSI ID (usually ID2 through ID6). For EIDE-type drives, you will set the drive as either a primary ("master") or secondary ("slave") drive. If you're running an EIDE DVD-ROM along with a hard drive, the hard drive would typically be the "master" device, and the DVD-ROM drive would be the "slave" device. If you're running the DVD-ROM drive alone, set it as the "master" device. Finally, there are two audio output connectors; a 4-pin CD audio connector which attaches to a sound board, and a 2-pin digital audio connector which supplies sound to a digital audio tape (DAT) or other digital recording system.

Things get a little more interesting when you look inside the DVD-ROM drive (see Fig. 5). Looking in from the top of the drive, you'll see the major sub-assemblies needed to operate the drive. That black circular wheel near the tray is the spindle motor which turns the disc. You can also see the laser assembly, and the laser sled that the laser rides back and forth on. A small motor drives a screw which runs the sled. The load/unload mechanics are obscured below the plastic tray.

The main electronics deck is mounted on the underside of the drive (see Fig. 6). This is a single printed-circuit board that contains all of the circuitry needed to run the

drive interface, load/unload motor, audio amplifiers, spindle motor, laser, and laser sled.

One item of particular interest in Fig. 6 is the removable IC. That chip contains firmware for the drive, as well as the "region codes" for the drive. Motion picture studios want to control the home release of movies in different countries because theater releases are not simultaneous. Therefore, they have required that the DVD standard include codes that can be used to prevent playback of certain discs in certain geographical regions. Each player is given a code for the region in which it's sold. The player will refuse to play discs that are not allowed in that region. This means that discs bought in one country might not play on players bought in another country. Table 2 lists the code numbers, and the regions each number covers. Keep in mind that region codes are entirely optional, and discs without codes will play on any player in any

country.

The MPEG-2 Decoder Board.

Although the DVD drive requires a SCSI or EIDE drive controller for normal program data, DVD video and audio do not use that data path. There are two reasons for this. First, the data required to reproduce real-time video and audio would bog down even the fastest PC. Second, video and audio data are highly compressed using MPEG standards, so even if the PC bus wasn't bogged down by the compressed data, the decompression process would load down the system with processing overhead. In order to play DVD audio and video, DVD-ROM drives require a stand-alone, hardware-based MPEG-2 decoder board such as the one in Fig. 7. That MPEG-2 decoder board works independently of the drive controller system, video system, and sound system.

When the original video source is recorded for DVD, MPEG-2 analyzes the video picture for redundant data. In fact, over 95% of the digital data that represents a video signal is redundant, and can be compressed without visibly harming the picture quality (also referred to as "loss-less compression"). By eliminating redundant data, MPEG-2 achieves excellent video quality at far lower bit rates.

MPEG-2 encoding for DVD is a two-stage process. The original signal is first evaluated for complexity,

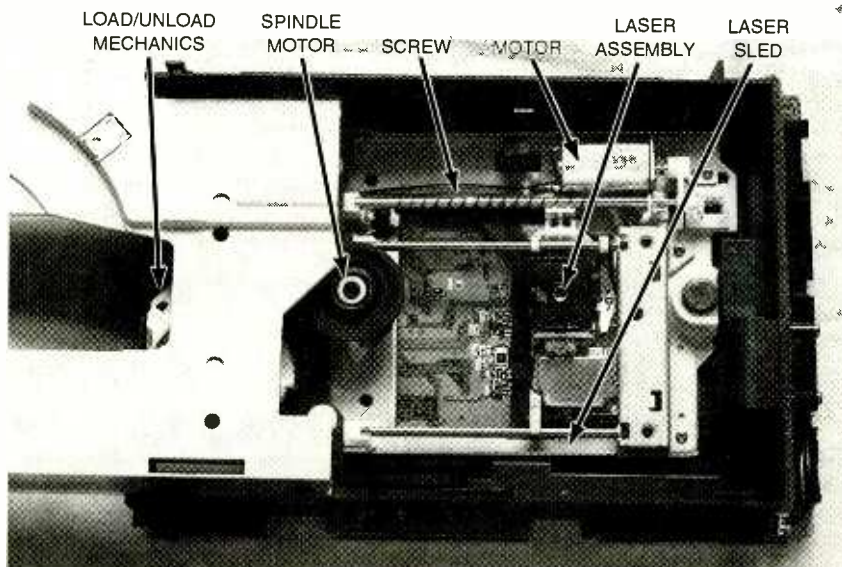


Fig. 5. Inside a DVD drive. This top view shows most of the drive's mechanics.

then higher bit rates are assigned to complex pictures, and lower bit rates are assigned to simple pictures. This allows for an "adaptive" variable bit-rate process. The DVD video format uses compressed bit rates with a range of up to 10Mbits/s. Although the "average" bit rate for digital video is often quoted as 3.5Mbits/s, the actual figure will vary according to movie length, picture complexity, and the

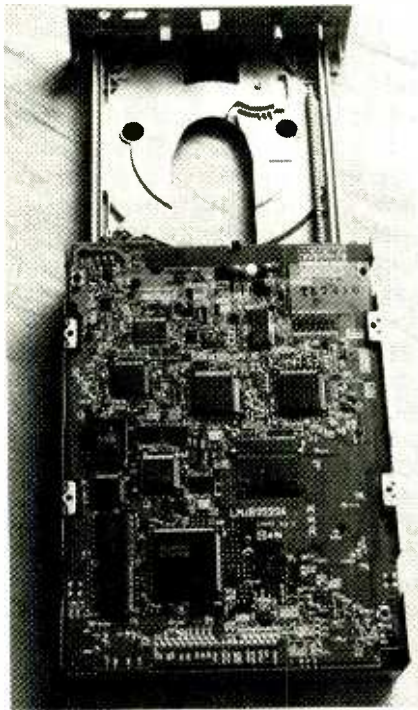


Fig. 6. The drive's main circuit board is mounted on the underside of the drive.

number of audio channels required. With MPEG-2 compression, a single-layer, single-sided DVD has enough capacity to hold two hours and 13 minutes of video and audio on a 12cm disc. At the nominal average data rate of 3.5Mbits/s, that still leaves enough capacity for discrete 5.1 channel digital sound in three languages, plus subtitles in four additional languages.

In addition to MPEG-2, audio can be encoded using Dolby AC-3 (also called "Dolby Surround AC-3" or "Dolby Digital"). With five channels and a common sub-woofer channel (5.1), you get the effects of 3D surround sound with right, left, center, left ear, right ear, and common sub-woofer speakers. AC-3 runs at 384Kbits/s.

In actual practice, DVD products sold in North America and Japan will include Dolby AC-3 sound on the accompanying MPEG-2 board, while DVD products sold in Europe will likely use the MPEG-2 audio standard.

As shown in Fig. 8, there are five major connections on the MPEG-2 decoder board. Those are an Analog Input jack, an Analog Output jack, a Digital Output jack, a Monitor connector, and a Video Input connector. The Analog Input is rarely (if ever) used in normal operations, but it may be handy for mixing in an auxiliary audio signal to the decoder board. The Analog Output signal provides the master audio signal, which is fed to the Line Input of your existing sound board. The advantage of using a Line Input is that you don't need a volume control on the decoder board. Instead, you can set the Line Input volume through your sound board's "mixer" applet. When you play a DVD video, any audio will continue to play through your sound board and speakers. The Digital Output is intended to drive an external Dolby Digital device, so you will probably not be using the Digital Output in most basic PC setups.

The MPEG-2 decoder board will now drive your VGA/SVGA monitor through the Monitor connector. This is important because the decoded video stream is converted to RGB information, and fed to the monitor directly—that avoids having to pass the video data across the PCI bus to your video card. The normal output from your video card is looped from your video board to the decoder card, so while the decoder board is idle, your normal

video signal is just "passed through" the MPEG-2 board and then on to the monitor.

Installing a DVD Drive System.

Now that you've got a handle on the essentials of DVD, we can get to the fun part—a complete installation of a typical system, the Creative Labs PC-DVD package (retail \$500). The kit comes complete with a Matsushita EIDE DVD-ROM drive, MPEG-2 Decoder board, video loop-back cable, CD audio cable, Line Input audio cable, and IDE (40-pin) data cable. The actual installation process took this author under an hour, but your installation may take longer depending on how much hardware you need to or want to re-arrange. (Note: Before you attempt any new drive installation on your PC, be sure to perform a complete system backup of your entire system first, and keep a bootable floppy diskette handy in case of emergencies.)

Before you start any DVD installation, you'll need to make sure your system meets some basic requirements. DVD installation requires a 90MHz Pentium PC with at least 16MB of RAM running Windows 95. At least 4MB of hard-drive space will be needed for DVD drivers and application software, and your system's motherboard must have at least one PCI bus slot available for the MPEG-2 decoder board. Finally, there should be one open external drive bay available for the DVD-ROM drive itself.

There are two other issues that you need to consider before starting the installation. First, consider your existing CD-ROM drive (there's almost certainly one in your sys-

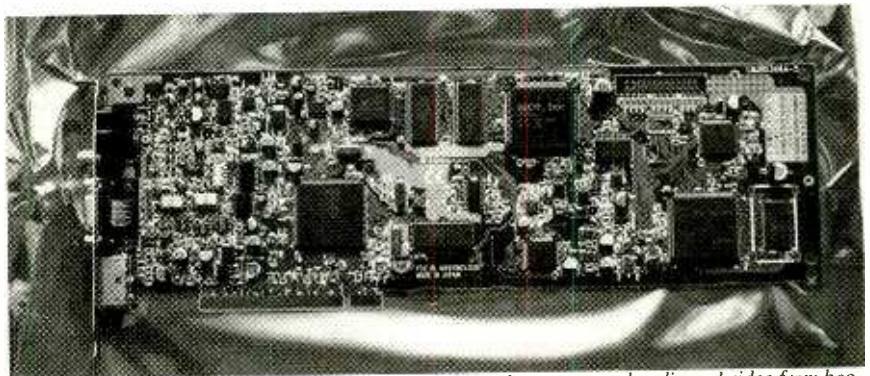


Fig. 7. The use of a MPEG-2 board like this one prevents the compressed audio and video from bogging down a PC.

TABLE 2—REGION CODES

Code	Region
1	Canada, US, and US territories
2	Japan, Europe, South Africa, Middle East (including Egypt)
3	Southeast Asia, East Asia (including Hong Kong)
4	Australia, New Zealand, Pacific Islands, Central America, South America, Caribbean
5	Former Soviet Union, Indian Subcontinent, Africa (also North Korea, Mongolia)
6	China

tem). Ideally, you'd like to remove the CD-ROM and install the DVD-ROM in its place. However, you may want to keep the CD-ROM in place if: (1) you use CDs (such as Photo CDs) that you know the DVD-ROM drive will not support, or (2) if you want to continue using DOS-based CDs. The DVD software and drivers do not support DOS, so you would lose all CD capability under DOS by removing the CD-ROM (that's one point that the DVD documentation leaves out).

Second, consider your DVD drive's interface. SCSI drives are rather straightforward since you can simply set the drive ID, then connect the drive directly to the SCSI cable (you may need to re-terminate the SCSI cable). EIDE drives are a bit tricky—most PCs today offer two IDE ports—a primary EIDE port which can support two EIDE devices, and a secondary IDE port that can also support two devices. If you can, install the EIDE DVD-ROM as the "slave" device on the EIDE port (alongside your hard drive). However, if you have two EIDE hard drives in the system, you should make the DVD drive the "master" device on the secondary IDE port. You may recall that older CD-ROM drives could present problems when used with hard drives, but DVD-drives use more current interfaces, and should not interfere with an existing hard drive's operation.

The hardware process basically consisted of four steps; install the drive, cable the drive, install the decoder board, and cable the decoder board. Once the hardware is in place, you can then install the drivers and application software. If you've ever installed standard "multimedia kits" (consisting of a CD-ROM drive and sound

card), then installing a DVD-ROM kit should be a snap. (Note: When working inside your PC, remember to keep the system turned off and unplugged. You should use a properly grounded anti-static wrist strap to remove any electrostatic charges from your body, but you should at least touch the PC's metal chassis regularly during the installation process.). Let's walk through the procedure:

Install the drive. Mount the DVD-ROM drive in an open drive bay, and secure it into place with four screws. As with all drives, be sure not to over-tighten the screws—that could warp the drive just slightly and throw it out of alignment. Also check the jumpers on the rear of the drive. If the drive is SCSI, set the jumpers for the proper SCSI ID. For EIDE drives, set the drive as either "master" or "slave". If you plan to run the drive

alongside a hard drive, set the DVD drive as "slave". If you plan to run the DVD drive on its own controller port, set the DVD drive as "master".

Cable the drive. There are typically three cables that need to be connected to the DVD-ROM drive: A drive power cable, a data cable, and a CD audio cable. You can use any four-pin drive power cable, but do not use a power cable from a "Y-splitter". Splitting your power that way can sometimes cause erratic drive behavior. For "slave" drive configurations, you can connect the existing 40-pin signal cable to the data connector on the back of the drive (one end of the cable connects to the drive controller, one end connects to the hard drive, and the third unused connector attaches to the DVD drive). For "master" drive configurations, you can use the 40-pin cable that came with the DVD package. Finally, connect the CD audio cable between the DVD drive and the CD audio connector on your sound board. If you plan on leaving your existing CD-ROM in place, and playing any CD audio from the CD-ROM drive, don't connect the DVD drive's CD audio connector. (Note: Remember to align pin 1 on the signal cable with pin 1 on the DVD drive. You can tell pin 1 on a ribbon cable by the red or blue stripe that

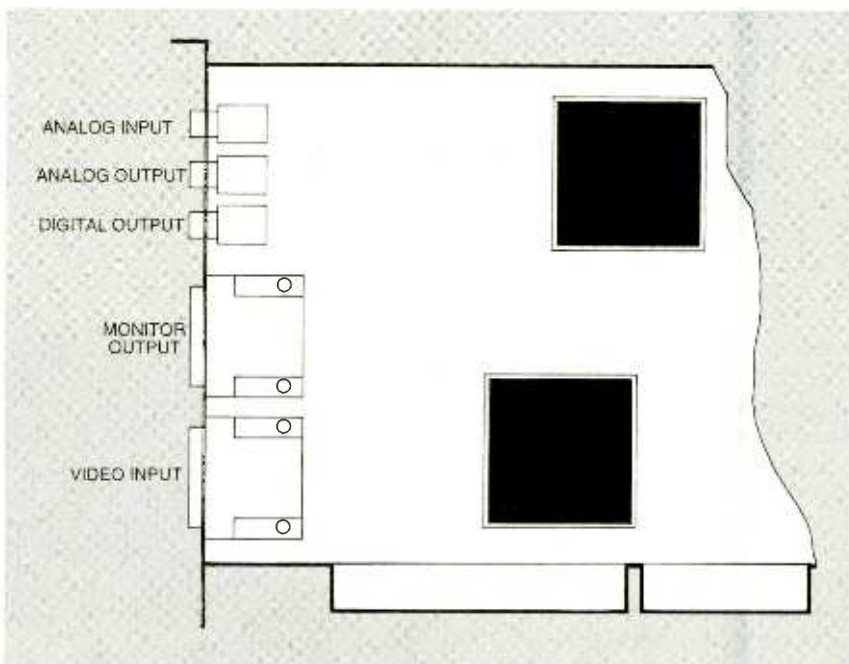


Fig. 8. These are the five connectors found on the rear of an MPEG decoder card. Their functions are described in the text.

runs along the cable.)

Install the decoder board. Once the drive is in place, your next step is to install the MPEG-2 decoder board. You do not need to configure the decoder board first—rather than jumpers, the decoder is configured through software. Find an unused PCI bus slot, and mount the board—you might need to remove one of those little metal plates from the expansion slot opening first. You can use the little screw from that metal plate to secure the decoder board into place. Make sure that the board sits evenly and completely in its bus slot, and *never* force an expansion board.

Cable the decoder board. The last step is to interconnect the MPEG-2 decoder board with the other devices in your system. In general, there are three connections that you have to make. Disconnect the monitor from your video board, and attach it to the decoder's Monitor connector. Use the loop-back cable to attach the video signal from your video board to the decoder's Video Input connector. Then use the sound cable to connect the decoder's Audio

Output to the Line Input jack of your sound board.

Software Installation. As noted above, the MPEG-2 decoder board packaged with the Creative Labs PC-DVD kit lacks jumpers. Instead, the decoder is configured exclusively through software—that simplifies the hardware-installation process and reduces the chances of hardware conflicts due to incorrectly set jumpers. The software installation process involves three phases: installing the decoder drivers, installing the DVD-ROM drivers, and installing the DVD applications.

The first time you reboot your PC after the hardware installation, Windows 95 will automatically detect the new hardware. It won't identify the hardware exactly, but it will identify the hardware as a "PCI Multimedia Device". Insert the driver diskette into your floppy drive, and select the *diskette provided by the manufacturer* option when prompted. Windows 95 will install the decoder board drivers, and configure the board. When Windows 95 asks you to restart the system, choose *NO*.

The next step is to install the DVD-ROM drivers. Choose *Start*, then *Run*, then type *A:/SETUP*. Click *OK*. The setup routine will install the drivers for your DVD drive, and configure it appropriately. When the installation is complete, Windows 95 will ask you again to restart the computer. This time, remove the driver diskette and select *OK* to restart the computer. The next time Windows 95 starts, your DVD drive and decoder board should be active.

The last step is to install any DVD applications (such as a DVD control panel or DVD-Video player). The applications will usually be on a separate floppy disk. Insert the floppy disk. Click *Start*, then *Run*, then type *A:/SETUP*. Then all you need to do is follow the instructions. (Note: This section describes the installation of one DVD kit—your own software installation requirements may be different. Always read through your installation instructions thoroughly.)

Optimizing Video for DVD. DVD works best using a resolution of at least 800 × 600, and a "High Color" (16-bit or 65K-color) mode. If your video card will support even higher resolutions or color depths, feel free to use them. Use your Display icon under your Control Panel to adjust the video configuration as needed.

Basic DVD/MPEG-2 Troubleshooting. Even though a DVD package should install with an absolute minimum of muss and fuss, there are times when things just don't go according to plan. Software and hardware problems can both interrupt your DVD system. The following symptoms cover some of the most common troubleshooting issues.

Symptom 1: *The DVD drivers refuse to install.* This is almost always because Windows 95 is having a problem with one or more .INF files on your driver installation disk(s). Check with your DVD vendor to confirm whether you need to delete one or more entries in your OEMxx. INF file(s) (where "xx" is any suffix). You may also need to delete one or more entries from a MKEDVD.INF file. The .INF files are typically contained in the C:\WINDOWS\INF\OTHER directory. Once you've corrected the appropriate .INF file(s), you can

DVD GLOSSARY

- CD (Compact Disc)**—removable optical storage capable of holding up to 650MB of data using 12cm optical discs.
- CD Audio**—the original "red book" format adopted by Sony and Philips in 1980 used to record music and voice audio. Also called compact disc digital audio (CD-DA).
- CD Bridge**—a "bridge" disc adds information to a CD-ROM/XA track which allows the track to be played on a CD-I player. The bridge disc can be played on a CD-I player connected to a TV, or a CD-ROM/XA player connected to a computer. Typical examples of CD bridge discs are Photo CDs and Video CDs.
- CD-I (Compact Disc Interactive)**—a 1996 standard which extends CD-ROM capabilities by adding search and "navigation" features to the disc.
- CD Extra**—also called CD Plus or Enhanced CD. A two-session disc which stores audio tracks on one "session", and CD-ROM data on another "session".
- CD-R (Compact Disc Recorder)**—a drive capable of writing data or audio information to blank CD media.
- CD-ROM (Compact Disc Read Only Memory)**—the classic "yellow book" standard for recording programs and data to a CD.
- CD-ROM/XA (CD-ROM Extended Architecture)**—a disc format developed in 1988 which greatly improves the synchronization of audio and video data on a CD for playing multimedia titles.
- DVD (Digital Video Disc or Digital Versatile Disc)**—the generic term used to describe the next generation of high-density optical storage discs capable of holding up to 17GB of data.
- MPEG (Motion Pictures Experts Group)**—the industry group responsible for developing compression standards for multimedia content (primarily audio and video).
- PCI (Peripheral Component Interconnect)**—the current high-performance 32/64-bit expansion bus architecture used in today's Pentium-based PCs.
- Photo CD**—a type of CD bridge disc based on CD-ROM/XA. A standard released by Kodak in 1990 designed for storing high-quality photographic images.
- Video CD**—a type of CD bridge disc based on CD-I designed for playing movies and other commercial multimedia presentations.

Accredited B.S. Degree in Computers or Electronics

by studying at Home

Grantham College of Engineering
offers 3 distance education programs:

- B.S.E.T. emphasis in Electronics
- B.S.E.T. emphasis in Computers
- B.S. in Computer Science

NEW!

-Electronics Workbench Professional 5.0 included in our B.S.E.T. curriculums
-Approved by more than 200 Companies, VA and Dantes, (tuition assistance avail.)

For your free catalog of our programs dial
1-800-955-2527

<http://www.grantham.edu>

GCE

Your first step
to help yourself
better your future!



Grantham College of Engineering
34641 Grantham College Road
Slidell, LA 70460-6815

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

**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](http://WWW.800-GOCABLE.COM)**

VISA MASTERCARD

VISUAL

COMMUNICATIONS INC.
ORDERS/CATALOG 1-800-GO-CABLE
TOLL FREE TECH. DEPT. 1-888-519-TECH EST. 1976

re-install the DVD drivers:

- Click *Start*, select *Settings*, then click on *Control Panel*. Double-click on the *System* icon.
- Click on the *Device Manager* tab, then select "Sound, Video, and Game Controllers".
- Select the DVD driver(s), then click *Remove*.
- Exit the *Device Manager* and reinstall the drivers again.

Symptom 2: *The DVD drive isn't detected.* There are several possible reasons why the DVD drive would not be detected. Check the power connector attached to the drive, and make sure that the drive isn't being powered from a "Y splitter" power cable. Check the signal cable next. Both SCSI and EIDE signal cables must be attached securely to the drive. SCSI interfaces are complicated a bit by termination. Make sure that the drive is jumpered properly for its SCSI ID or EIDE "master" or "slave" relationship. Finally, make sure that the DVD drivers are installed and running. Check the drivers under the "Sound, Video, and Game Controllers" entry of the *Device Manager*.

Symptom 3: *The DVD motorized tray won't open or close.* The most common issue here is the DVD application itself. Some DVD applications (such as DVD-Video player applications) will "lock" the disc tray closed. Try closing all open applications. If the tray still won't open, try restarting the PC. That should clear any "software lock". If the tray still refuses to open or close, the drive itself may be defective—you can "force" the tray open using a straightened paper clip in the emergency eject hole in the front of the drive.

Symptom 4: *There is no audio when playing an audio CD.* This is a common problem—especially during new DVD-drive installations. Chances are that you did not connect the CD audio cable between the DVD drive and the sound board. If so, the cable may be reversed (or defective). Of course, if you're still using your original CD-ROM drive, and the CD-ROM is connected to the sound board, there will be no CD audio from the DVD drive—there is no way to "parallel" the sound cable.

ABOUT THE AUTHOR

Stephen J. Bigelow is the author of "Troubleshooting, Maintaining, and Repairing Personal Computers: A Technician's Guide" (published by McGraw-Hill). He can be reached by e-mail at sbigelow@cerfnet.com. You may also visit the Dynamic Learning Systems world wide web site at <http://www.dlspubs.com>. Comments and questions about this article are welcome at any time.

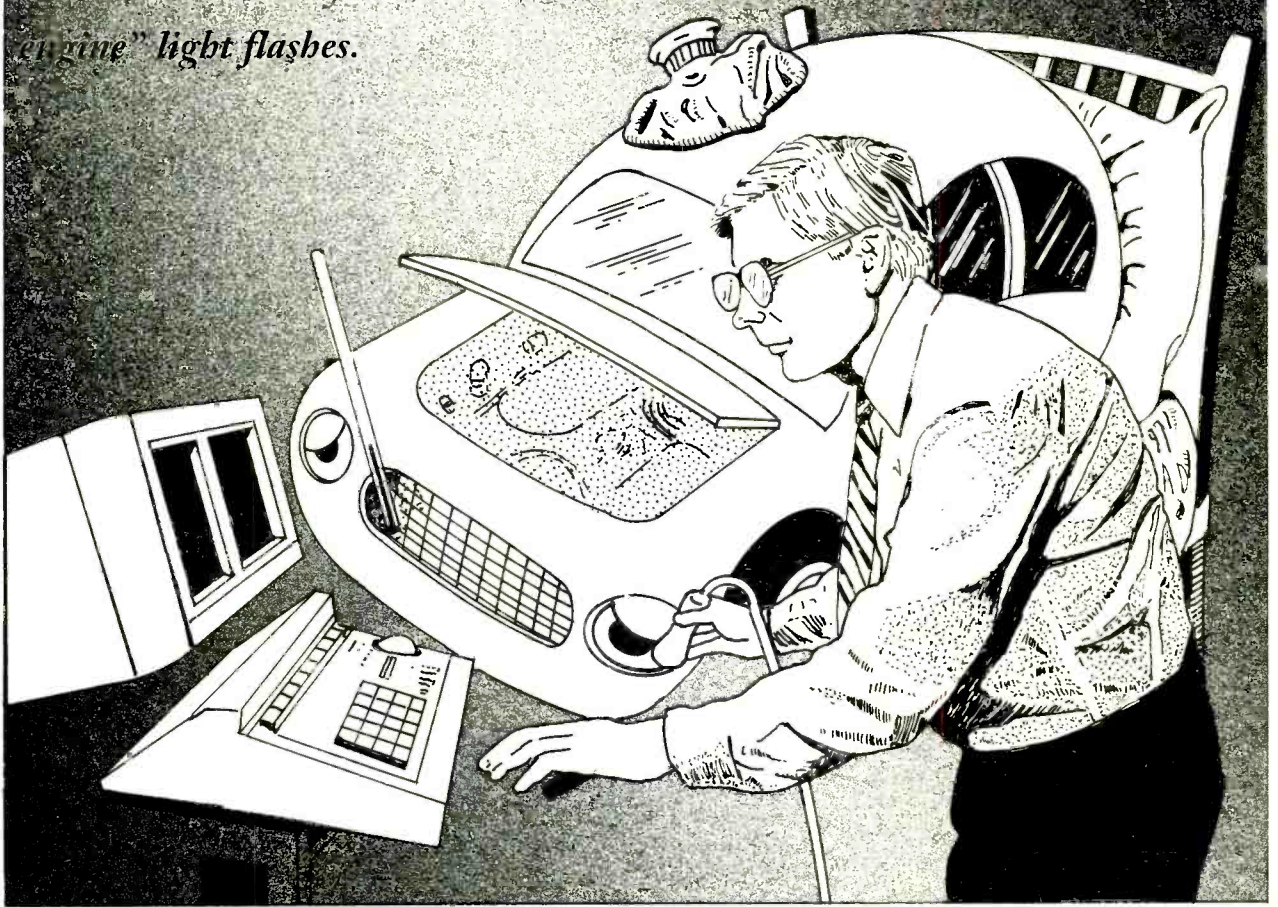
Symptom 5: *There is no DVD audio while playing a movie or other presentation.* Here's another common oversight during new DVD installations. Check the external audio cable attached between the MPEG-2 decoder board and the Line Input jack of your sound board. The cable might be plugged into the wrong jack(s), or the cable might be defective. Also check the sound board's "mixer" applet and see that the Line Input volume control setting is turned up to an acceptable level.

Symptom 6: *Video quality appears poor.* MPEG-2 compression is well-respected for its ability to reproduce high-quality images. The problem with "poor" image quality is almost always because of your video configuration—your color depth or resolution are too low. DVD-Video playback is best at resolutions of 800 X 600 or higher, and color depths of 16-bits (High Color) or higher (i.e. 24-bit True Color). In most cases, 256 colors will result in a "dithered" appearance.

Symptom 7: *You see an error message that says "Disk playback unauthorized".* The region code on the DVD disc does not match the code embedded into the drive. There isn't much that can be done when this error occurs. Note that region code limitations are only applied to DVD-Video movie releases—computer-software programs and data discs are not marked with region codes.

Conclusion. DVD offers advantages that CD-ROM never had—tremendous storage space, and high-quality audio and video playback. Coupled with the fact that most CDs will work with DVD drives, it seems that the DVD is poised to replace the CD-ROM over the next few years. ☺

Find out what ails your car when the "check engine" light flashes.



Almost all late-model cars on the road today have some form of computer control for their engines. Sometimes those control computers are referred to as ECUs (for *Electronic Control Unit*), ECMs (*Electronic Control Module*), or ECAs (*Electronic Control Assembly*). Those systems have made the automotive industry the number one user of microcontroller chips. The demand the auto manufacturers have for computer chips appears to be insatiable. Automotive engineers are writing the specifications for a large number of new designs—including some of the so-called "general purpose" devices. One example of that is the Motorola 68HC11. While that chip started out as one specifically designed for cars, today it is used in a variety of applications, many of which aren't related to automotive electronics at all!

Facing a computerized engine can send a chill up the spine of

Reading Automobile Computer- Service Codes

THOMAS FOX

many shade-tree mechanics—including those that are desktop-computer "experts." Even if they can swap out a motherboard quicker than they can replace a new battery in a car, some of them cringe in fear that some day the CHECK ENGINE or SERVICE ENGINE SOON warning light will go on in their computerized chariot. What do they do then?

Thanks to the foresight of automotive designers, the solution is relatively simple—check out the computer's service code. Those service codes are also referred to as "trouble codes." However, before you can find out what the code is, the computer system's self-diagnostic feature must be enabled.

Entering the Diagnostic Mode. In order to read the trouble codes stored in an engine computer, the computer must be told to reveal what it found. That is done by placing the unit in a "diagnostic mode."

Depending on the manufacturer, there are different procedures for doing that. While the descriptions presented here will work with most American cars, you should always make sure that the procedure you are about to follow is correct for your particular vehicle. If you don't follow the manufacturer's directions exactly, you could damage the engine computer. Replacing that device is very expensive. In the words of the old saying—look before you leap.

Of the major American automobile manufacturers, Chrysler has the simplest way of entering the computer's diagnostic mode. Put the car's ignition key in the ignition switch. You should not start the car at any time during this procedure. Within a 5-second time frame, turn the ignition switch ON-OFF-ON-OFF-ON. Remember, do not try to actually start the car.

In General Motors cars, first find the diagnostic connector. It usually is in an easy-to-reach spot under the dash and near the steering column. A typical GM diagnostic connector is shown in Fig. 1. With the ignition in the OFF position, connect together points A and B of the diagnostic connector with a short length of a solid 22-gauge hookup wire. A paper clip bent into an appropriate shape will also work. **Be careful—if you connect the wrong terminals together, you can damage the computer.** Once points A and B are jumped, put the ignition switch in the "on" position but do not attempt to start the vehicle.

As with the other auto manufacturers, no expensive equipment is needed to enter the diagnostic mode with many Ford cars. However, Ford-built cars have a slightly more confusing way of getting the computer into its diagnostic mode. Because of that, details will not be given since a wrong connection could damage the vehicle's computer system. An overview of the process is nevertheless interesting to those that will be working on Ford cars. As with any vehicle, a decent service manual will be valuable to anyone attempting to fix any modern auto.

Ford locates its diagnostic connector in the engine compartment.

Also located in the engine compartment is the diagnostic test lead. In order to enter the diagnostic mode, a connection must be made from the diagnostic test lead to the upper right hand connection (looking at its front) of the diagnostic terminal. Since both connectors are female, an appropriate jumper wire must be used. For details, consult the service manual or a book on electronic ignition systems.

By the way, Ford cars that don't

codes that have been stored in the computer that caused the "check engine" light to light up in the first place! For instance, if a GM car flashes a code of 55 (five rapid flashes, a pause, and five more rapid flashes), that indicates that the oxygen sensor might be faulty. With Chrysler cars, that same code indicates the end of the test and on Ford cars it means that there is either a charging system problem or that there is no ignition-key-switched power being applied to

TABLE 1—Selected General Motors Service Codes

This table is a general listing of selected codes for GM cars and light trucks that have the CHECK ENGINE or SERVICE ENGINE SOON light. Most late model cars have many more codes than those listed here. For detailed listings and more information for individual vehicles, refer to the specific service manual. The information for this table was taken from Wells Mfg. Corp's booklet "Sure You Can Work on Electronic Ignition."

CODE WHAT CODE INDICATES IN GM VEHICLES

12	System Test Code; Also no RPM Pulses to Electronic Control Module
13	Oxygen Sensor Circuit
14	Shorted Coolant Sensor Circuit
15	Open Coolant Sensor Circuit
21	Throttle Position High
23	Mixture Control Solenoid Low
24	Vehicle Speed Sensor Circuit—Park/Neutral Circuit Failure
31	Canister Purge Solenoid
32	Baro Sensor Circuit Low
34	Differential Pressure Vacuum
42	Electronic Spark Control
44	Lean Exhaust Indication
45	Rich Exhaust Indication
51	Bad PROM
55	Faulty Oxygen Sensor, Electronic Control Module
56	Add Coolant, Port Throttle System Vacuum Sensor
88	Electronic Control Module Circuit (1985 and later)

have a "check engine" light require some additional equipment, such as an analog VOM, to display service codes.

Reading and Interpreting the Code.

Now that the computer is in diagnostic mode, you're probably thinking, "What now? Some sort of 'trouble codes' were mentioned, but how do I read them? There isn't a video monitor or even a LCD or LED display in my car!"

The automotive designers have already thought of that. The trouble codes are flashed out on the "check engine" light. Once in the diagnostic mode, that warning light will flash the appropriate code or

the processor.

A short table of General Motors service codes is given in Table 1. The information in that table only mentions some general codes that are used on most GM vehicles. Newer codes are added to specific models that use new engine technology. As mentioned previously, you should always use a code table for your specific make, model, and year vehicle.

Low-Cost Diagnostic Equipment.

Today, there is a variety of low-cost diagnostic equipment available. Some of it is quite useful. Other items are of questionable value. One example of the latter is the

"code readers" for GM cars. It usually consists of a small device that plugs into the diagnostic connector and a booklet of codes. Many of those inexpensive "code readers" don't have a readout—they depend solely on the CHECK ENGINE or SERVICE ENGINE SOON light. Those types of readers appear to be nothing more than a fancy "paper clip" that puts the computer into its diagnostic mode. While that type of tester comes with a booklet that includes code listings, several reference books are available that contain the same information plus a wealth of additional information concerning your car's electrical, computer, and emissions systems. One example of that type of book is "Sure You Can Work On Electronic Ignition," published by Wells Manufacturing Corporation, Fond du Lac, WI 54936.

Understand that we are not say-

Clearing Codes. With computers controlling and monitoring more automotive systems, the behavior of those systems can sometimes confuse the average person who has had plenty of experience with older, "pre-intelligent" systems.

Once, a few years back, the author was driving his 1988 Chevrolet pickup truck up a hill. The wheels spun wildly on some wet leaves trying to grip the road. Once the truck got to the top of the hill, I noticed that the brake light was on. The parking brake was off and the brake-fluid level was OK. A quick check of the truck's electrical circuit diagram showed that three things could turn on the light—the parking brake, a low brake fluid level, and a problem with the anti-lock-brake (ABS) system!

After having visions of an expensive repair job come to mind, I realized that perhaps the ABS comput-

utes and then reconnected. The trouble code in the ABS system cleared, and everything worked fine after that.

Shortly after that incident, a friend of the author related a similar experience. He, however, was so worried about the brake light that he rushed his truck to a garage. Luckily, the people there were honest and competent. Instead of replacing the ABS system's computer, they also disconnected and reconnected the battery. He was lucky—his repair bill was only \$25.

Disconnecting the Battery—A Miracle Cure?

While the solution to the brake light problem was correct, the reasoning behind it was not the best course of action. Disconnecting the battery might have erased the error messages stored in the ABS's memory, but that doesn't mean that all problems will go away that easily. Automotive computers can store and remember several trouble codes—even if the immediate cause of the trouble clears itself. Capturing an intermittent problem can be as useful as tracing a "hard" failure.

CAUTION: It isn't wise to neglect any BRAKE warning light—even if it is generated by the ABS system for some frivolous reason. When that light is on, the ABS system will not assist in panic stops. While some recent research has indicated that ABS systems aren't as great as they were first believed to be, they nonetheless are a valuable addition to any vehicle.

If you have fixed a problem with your engine and it is running perfectly, do not forget to disconnect the battery for a minute or so. That will erase the error codes that were stored in the computer's memory.

Hard Failures. What if you are faced with a trouble code that seems to be a real failure? Replace the part indicated by the code? That type of repair job might be beyond the capability of the novice or "shade-tree" mechanic. However, there is a good chance that the problem is not a faulty component. Probably the biggest cause of failures in cars today is a

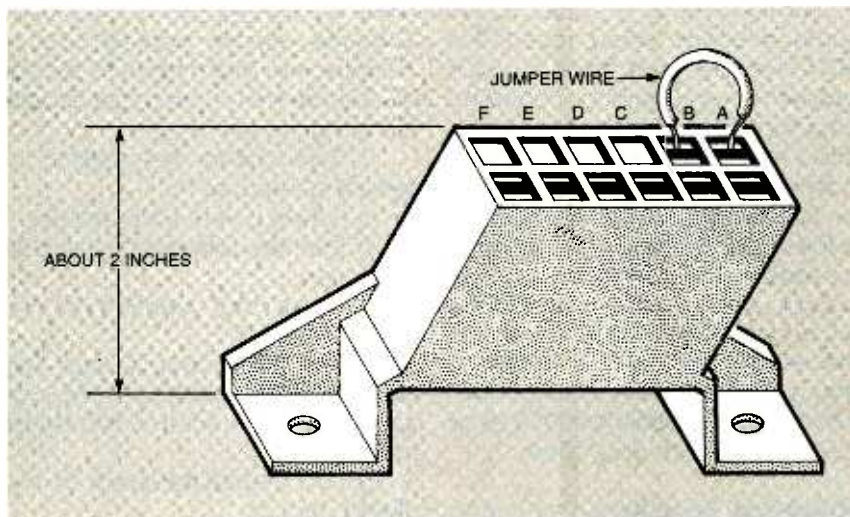


Fig. 1. A typical diagnostic connector for a General Motors vehicle looks like this. To put the computer into its diagnostic mode, simply jumper the two terminals shown with a short length of wire or a bent paper clip.

ing that those low-cost code readers don't do what they claim. The main point is that there are other less expensive ways to do the same thing. It is also important not to confuse code readers with automotive diagnostic scanners. Diagnostic scanners, some of which can cost upwards of \$250, have their own built-in display. Any error codes are indicated on the display in plain English. They also have several additional features that are sure to be useful to the professional automotive-repair technician.

er became confused because of the spinning wheels. In an anti-lock-brake system, each wheel has a speed sensor to measure the rotation of each tire. If some wheels are spinning much faster than the others, the brakes are pumped electrically to prevent the wheels from locking up and skidding. It could be that the ABS saw the drive wheels spinning so fast that the calculated spin rate went beyond the computer's ability to keep track of the spin.

The positive battery terminal was disconnected for a few min-

bad, dirty, or corroded connector, or a broken wire. To test for that, use an ohmmeter to run a continuity check on the wires leading to the sensor or other electrical part indicated by the service code. If you're not sure what goes where, check all suspected wires and connections. Continuity checks should only be done when the ignition switch is in the "OFF" position.

Another option is to run a "wiggle test." Just as its name indicates, a suspect wire or connection is tested by wiggling it back and forth. A meter with an audible continuity tester is useful if you don't have someone else available to watch the meter while you're working in the engine compartment.

A variation of the wiggle test is to perform it with the engine running. That method is quite a bit more dangerous because of the running engine. The first thing to do is to clear the trouble codes by temporarily disconnecting the battery. After reconnecting the battery, start the vehicle and wiggle the wires or connectors one at a time. Have someone watch the warning light on the dash to see when it goes on.

WARNING: USE EXTRA CAUTION HERE! Remember that you are poking around in the engine compartment while the engine is running. If you put your hand near something that is moving you could be injured. Also, make sure you don't wear loose fitting clothing.

Combining a continuity check along with a power-off wiggle test is often more effective than the standard continuity test or the power-on wiggle test.

If a wire or connector flunks either test, first clean or replace the connector. If it still flunks, replace the wire. If the vehicle passes the wiggle test and continuity check, and the "warning light" doesn't light, the problem may have been "just one of those things"—perhaps caused by an electrical surge from a nearby lightning bolt. Most computer systems clear the service codes after 20 to 50 car starts. Therefore, if the warning light was caused by "just one of those things," it might clear itself up in a week or so of normal operation. Ω

REMOTE CONTROL ANTENNA

(continued from page 48)

digit station number if your remote does not have or does not support an "enter" button. Don't forget to press "zero" for a single-digit channel (channel 2 is "02"). When the "Enter" or "Mute" button is pressed, the Store LED should come on. When the first digit of the channel number is pressed, the Channel LED should come on as well, lighting all three LEDs. When the second digit of the channel number is pressed the Store and Channel LEDs will go out. If you want to return to the position of any particular channel, simply press its two-digit number without any other buttons.

Only channels 02 to 69 can be stored. Channels 70 to 74 are preset for the North-South-East-West directions and cannot be changed.

For the RCR to go back to the same direction when asked, the RCR memory must have a value properly representing antenna direction. To remove any accumulated errors, the RCR will automatically re-synchronize itself periodically. Synchronization can also be forced by pressing "91". Synchronization, as described before, consists of the rotator turning to the full counter clockwise position and establishing that position as the one from which all others will be calculated. This will enable the RCR to hit the right direction each time.

Motor-Run Capacitors. The motors used in antenna rotators are two-phase AC motors. They use motor-run capacitors to create the second phase. Between the inductance and reactance of an L-C circuit, the current on one leg of the motor is advanced ahead of the voltage.

The motor-run capacitors between screw terminals J2 and J3, as shown in Fig. 1 are C1, C2, and C3. It is important that they be bipolar electrolytic capacitors, commonly used in audio equipment. Because AC is present, a polarized capacitor will boil and explode due to the reversing voltages. Do not substitute regular polarized capacitors for those devices.

The value of the capacitors must be tuned to the rotator being used. Channel Master, Alliance, and RadioShack units work best with 66- μ F capacitors. Since that value is not a standard value that is commonly available, connecting two 33- μ F capacitors in parallel is an easy way to get the desired values. Since capacitors in parallel add their values together, C2 and C3 create the 66- μ F motor-run capacitor. If you are experimenting with another type of rotator, C1 has been included as a blank socket for experimentation with capacitor values.

Using the wrong capacitor value will cause the rotor to "creep." In that situation, the rotator will not come back to the same place in its rotation each time it is moved. The antenna direction will tend to stay clockwise or counter-clockwise of the correct alignment. If you are using a rotator other than Channel Master, RadioShack, or Alliance, you might have to test for the proper motor run capacitance by doing the following:

- 1) Synchronize the rotator by selecting channel 91.
- 2) Tune in a very weak station.
- 3) Spin the antenna for the best reception.
- 4) Store that position in the RCR's memory.
- 5) Turn the rotator at least 180 degrees away, using the pre programmed North, South, East, or West commands.
- 6) Turn the rotator back to the stored position.
- 7) Repeat steps 5 and 6 several times.

If after several times the rotator has come back to the weak station properly, the capacitor value is correct. If the rotator must be moved clockwise (as viewed from above) by pressing channel up on the remote to tune in the weak station, less capacitance is needed. If the rotator must be moved counter clockwise by pressing channel down to tune in the weak station, more capacitance is needed.

Once the Remote-Controlled Rotator is set up, you will be ready to explore the VHF and UHF to store all of those hard-to-get stations in memory. Ω

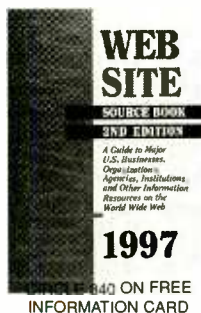


NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Web Site Source Book 1997: 2nd Edition

Edited by Darren L. Smith
Omnigraphics, Inc.
Penobscot Building
Detroit, MI 48226
Tel: 800-234-1340
Fax: 800-875-1340
\$78



Designed especially for business and professional users, this updated and expanded 904-page book provides key information for more than 12,600 Web sites of major businesses, organizations,

agencies, and institutions throughout the U.S. The second edition has added over 6,000 new entries, and two new categories: Counties and Real Estate. The listings include the name of the company or organization, mailing address, telephone and fax numbers, and Web and e-mail addresses.

Each entry appears twice: alphabetically arranged by the name of the company, agency or organization; and then in the classified section under approximately 100 subject headings. Users can find contact information for sources under categories, such as arts and entertainment, banking, colleges and universities, government agencies, hotels and resorts, magazines and newsletters, publishers, retailers, science and technology, and travel.

Programmable Logic Controllers: An Introduction

by W. Bolton
Newnes, Butterworth-Heinemann
225 Wildwood Avenue, Unit B
P.O. Box 4500

Woburn, MA 01801-2041
Tel: 617-928-2500
Fax: 617-933-6333
Web: <http://www.bb.com/bb>
\$28.95



Rapid technological advances have made the PLC (programmable logic controller) an important part of many industries, from petrochemicals to food production. This book provides an

accessible introduction to PLCs for students, and for engineers who want a working knowledge of PLCs.

Readers are shown how to identify the main design characteristics and internal architecture of PLCs, as well as the characteristics of commonly used input and output devices. Methods for writing programs for the logic functions, and programs involving relays, timers, counters, shift registers, sequencers, and data handling are explained. Testing and debugging methods are also completely discussed in the text.

The book includes numerous examples and programming problems that cover technology from a range of manufacturers. There are illustrations throughout the text to help the reader understand the concepts.

Catalog 104

Switches Plus
192 Pepe's Farm Road
Milford, CT 06460
Tel: 800-792-4757 or 203-876-2697
Fax: 800-792-5877 or 203-876-7285
Web: www.switchesplus.com
Free

This 50-page catalog from Switches Plus offers hundreds of products. They include pushbuttons, pilot lights, potentiometers, key/knob selectors, joysticks, emergency stop switches, power sup-



CIRCLE 342 ON FREE INFORMATION CARD

plies, and vandal-proof keypads. New encoders that allow keypads to directly interface with PCs are highlighted.

The catalog features detailed specifications on each type of product. Most switches are oil-and-water-tight, and they can withstand hazardous environmental conditions. Installation hints are also included.

The Web site noted above offers pricing, dimensions, technical details and monthly specials.

Catalog AV97

Aven Tools Inc.
4676 Freedom Drive
Ann Arbor, MI 48108
Tel: 313-073-0099
Fax: 313-973-0097

Free



CIRCLE 343 ON FREE INFORMATION CARD

Aven's 1997/1998 catalog features 105 pages of tools for the electronics, electrical, engineering and industrial markets. Tools from Aven and other manufacturers, such as Accu-Tek, Niptec, Technik, and Klein,

are included. Tips on selecting the right tool for the job are found throughout the catalog. A helpful table of contents and an index by product number are included.

The catalog offers a broad selection of tweezers, pliers and cutters, screwdrivers and screwdriver bits, knives and blades, scissors, files, ceramic tools, wrenches, magnifiers and magnifying lamps, ultrasonic cleaners, static control products, and magnetic tools.

EN

Radio Astronomy, The Enigma of the Faraday Disc, and more

THIS MONTH, WE HAVE A FASCINATING COLLECTION OF BOTH PSEUDOSCIENCE AND REAL SCIENCE TOPICS. LET'S START OFF THIS MONTH'S VISIT WITH A LITTLE BIT OF THE REAL STUFF.

Radio Astronomy

A world-class Henrich Hertz SMT (submillimeter telescope) lies on a small hill in front of my driveway. I recently wrangled a special insider tour; because it was our monsoon season and the staff there was between experiments, I even got to get a real close look at what's happening inside the receiver pods. There is some amazing stuff coming down here.

A radio telescope is just a big radio receiver, but one that's extremely directional, low in noise, and quite sensitive. They are sometimes used singly, but could be grouped together into arrays using a process called interferometry.

Some radio telescopes investigate solar and planetary phenomena in the high-frequency range. Others use ordinary microwaves in the 300-MHz to 150-GHz microwave range. A 300-GHz signal has a wavelength of one millimeter. The latest specialized radio telescopes can deal with signals with much lower bandwidths than that, and can explore the Terahertz mystery band that we looked at in HACK84.PDF and EMERGOP4.PDF (available on my www.tinaja.com Web site).

Things get especially challenging in the 100 to 1000 GHz range. First, you must have a quite dry and very high site, hence the location on the 10,700-foot high hill that blocks my view to the south. Water vapor severely absorbs submillimeter signals. The receiving dish has to exceptionally conform to its para-

bolic shape; deviations must be kept to say a thousandth-of-an-inch or better over thirty five feet at all times.

You also have to work around all the restrictive atmospheric windows that get in your way, and the receiving electronics often has to be chilled to nearly absolute zero.

And, oh yeah, nobody yet knows how to construct decent mystery-band amplifiers or even power sources. So you are still stuck with a highly noisy and "klutzy" electronics technology that today is roughly comparable to microwaves

before 1940; in other words, it's practically the equivalent of a crystal set.

And therein lies a few of the SMT challenges. If you ever want to make friends with a radio astronomer, offer him stable one-Terahertz amplifiers with 20 decibels of gain, a 0.8-decibel noise figure, and at a price of \$4.98 per dozen.

Although the new millimeter and submillimeter telescopes can be used for SETI extraterrestrial-intelligence searches, most traditional researchers distance themselves from anything related to "E.T. phone home." Instead, they concern themselves primarily with mapping apparently natural instances of extraterrestrial radio-noise sources.

One important source for those signals is known as molecular resonance. Two of the most popular are the 21-centimeter hydrogen line at 1420 MHz and the 18-centimeter hydroxyl line at 1681

Deuterium	327.384 MHz	Carbon Monosulphide	48.991 GHz
Hydrogen	1420.406 MHz	Hydrogen Cyanide	88.632 GHz
Hydroxyl	1612.231 MHz	Carbon Monosulphide	97.981 GHz
Hydroxyl	1665.402 MHz	Carbon Monoxide	109.782 GHz
Hydroxyl	1667.359 MHz	Carbon Monoxide	110.201 GHz
Hydroxyl	1720.530 MHz	Carbon Monoxide	115.271 GHz
CH Radical	3263.794 MHz	Formaldehyde	140.840 GHz
CH Radical	3335.481 MHz	Duterated H Cyanide	144.827 GHz
CH Radical	3349.193 MHz	Formaldehyde	140.840 GHz
Formaldehyde	4829.660 MHz	Carbon Monosulphide	146.969 GHz
Water Vapor	22.235 GHz	Formaldehyde	150.498 GHz
Ammonia	23.694 GHz	Carbon Monoxide	219.560 GHz
Ammonia	23.723 GHz	Carbon Monoxide	220.399 GHz
Ammonia	23.870 GHz	Carbon Monoxide	230.538 GHz
Excited Hydrogen	36.466 GHz	Methanol	258.507 GHz
Silicon Monoxide	42.821 GHz	Hydrogen Cyanide	265.886 GHz
Silicon Monoxide	43.122 GHz	Carbonyl Sulfide	461.907 GHz

FIG. 1—SOME MOLECULAR RESONANCE FREQUENCIES of interest to centimeter, millimeter, and submillimeter radio astronomers.

MHz. The area between those two makes up a transparent window that's nicknamed the "water hole."

The presence of energy at or near a molecular resonance usually reveals the presence of that molecule. Because of a "red shift" Doppler effect, modest frequency differences from what is expected can tell you whether an energy source is moving towards you or away from you. Other radio-energy sources are associated with pulsars, quasars, black holes, and supernovas. They often paint a wildly different picture of the universe than optical telescopes do.

I've summarized some other key molecular resonance frequencies for you in Fig. 1.

The SMT

The particular SMT I visited handles radio-astronomy wavelengths from 0.3 to 2 millimeters, or frequencies from 150 GHz to 1000 GHz, the latter being a full Terahertz. Thus, this scope starts where older millimeter instruments have left off.

The 35-foot dish is in fact accurate to a mil or so. Specifically, their goal was 15 microns of rms error (there's about 18 microns in a thousandth of an inch) and currently they are under twenty microns or so and improving. At present, this is the finest SMT dish anywhere in the world.

The dish is set up as an AZ-EL mount, which is an abbreviation for azimuth and elevation. Most of the azimuth part is handled by rotating the

entire building! Special "windup" cables and flexible pipes let their building spin 270 degrees in either direction, at a clip of 60 degrees per minute. Elevation is handled by tilting the dish over a -2- to 91-degree range.

There is a secondary Cassegranian reflector way out in front, near the parabolic-dish focus. It can only be reached by a scary circus-tightrope platform. The secondary reflector redirects their received beam down through the middle of the main dish. At that point, a flipable mirror deflects the beam out a chosen end of the middle of the elevation axle. The beam then goes to one of two receiver pod rooms.

The neat thing about this setup is that the intended receivers can be bolted down onto fixed optical benches in more or less ordinary rooms. With use of beam splitters, up to six experiments (three on each side) could be conducted nearly at once.

The secondary reflector also is used for minor tracking (ever try to smoothly move a building by a few microns at a time?), as well as to purposely switch on and off axis, modulating the beam for better detectability. The latter is an update of the ancient astronomical "blink comparator" technique. Their typical chopping frequencies are 10 or 25 Hz, depending on need.

I'm also told that you can hang a dipole on the secondary to make a dandy two-meter ham receiver. Their 200 mile line-of-site visibility does not hurt DX all that much, either.

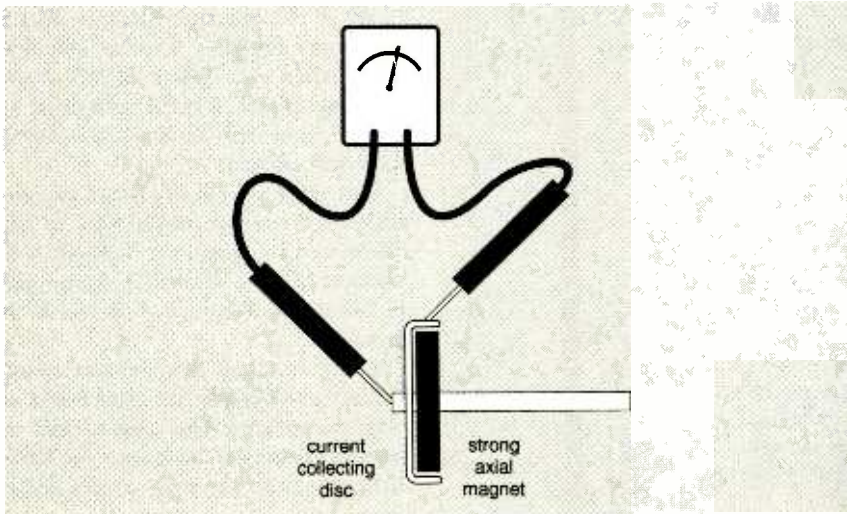


FIG. 2—"FREE ENERGY" ENTHUSIASTS claim to see a homopolar voltage with zero relative motion between a spinning magnet and collecting disc. Sure enough, you can easily convince yourself you are measuring some disc voltage or current, if you are careless enough about your bad lab work.

**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) 428-8073

FREE catalog: <http://www.tinaja.com>

Back in the receiver rooms, two different technologies can be used at one of the six selectable focal points. Several frequencies can be monitored at once. A bolometer, which is a broadband heat detector, can be used to determine the overall energy being received.

The other option is a tunable superhetrodyne receiver. In that, a Gunn-diode oscillator and multiplier chain generates a frequency near that of the intended reception frequency. That local oscillator frequency is beamed together with the received signals through a window onto a supercooled SIS tunnel-junction diode. The two beams interact with the diode's nonlinearity, producing sum and difference signals. The difference signal is routed to a microwave intermediate-frequency amplifier chain. From there, the received signal is further downconvert-

ed, then is amplified, filtered, and undergoes digital signal processing. The usual output is in the form of an intensity map, often in pretty false colors.

Oh yes, the cooling. Much of the universe lies at a "night sky" temperature of 4.5 degrees Kelvin, which is four degrees above absolute zero. Ideally, your detector should be at a temperature that is substantially less than that. To accomplish that, critical portions of the receiver electronics are placed in special Dewars, which are related to plain old thermos bottles, but might be the size of a commercial soft-drink supply canister.

Liquid nitrogen is first used as an intermediate cooler. It turns out that ordinary liquid helium-4 boils at 4.22 degrees Kelvin. But there is a magic and stupendously expensive helium-3 isotope that boils at a significantly lower temperature. By evaporatively diffusing

helium-3 into helium-4, a special cryogenic-refrigeration device offers cooling to within a fraction of a degree of absolute zero. Since there is only one naturally occurring helium atom out of 10,000 that is this magic helium-3, special and elaborate recycling compressors recover and reuse this elixir.

For lots more information, you can visit the SMT's Web site at maisel.as.arizona.edu:8080. Seasonal Saturday tours are available through the folks at Discovery Park. All day tour costs are around \$30. More details on tours and their amateur astronomy club can be found on the Web at www.discovery-park.com.

Some Resources

A superb collection of state-of-the-art submillimeter receiver papers is available for your free downloading at cfarx1.harvard.edu/ix_lab/papers. For lots more, just search the Web under "submillimeter". I have gathered a few additional radio telescope names and numbers for you as this month's resource sidebar.

One good starting point is the NRAO at info.aoc.nrao.edu. The VLA astronomy site, which is just outside of Magdalena, New Mexico, is certainly worth your visit. If you do go, the little-known, secret, Langmuir thunderstorm lab is on the next mountain over; even less known is that summer visitors are welcome to that remote site.

An individual by the name of Jeffrey Lightman now publishes *Amateur Radio Astronomy: Systems, Procedures and Products*. It is sold through his Radio Astronomy Supplies. Cost is \$40. He also carries the *Robert Sickness Radio Astronomy Handbook* at the same price, as well as lots of other books, videos, hardware, and software.

One good journal I've found on submillimeter receiver technology is the *International Journal of Infrared and Millimeter Waves*. The *IEEE Transactions on Microwave Theory and Techniques* is also useful.

Many hundreds of radio astronomy books are stocked by Amazon Books at www.amazon.com. One pricey title is *Instrumentation and Techniques for Radio Astronomy* from the folks at the IEEE Press.

As to amateur astronomy resources in general, I have just posted a hot linked download as RESBN67.PDF on my <http://www.tinaja.com>.

SOME RADIO ASTRONOMY RESOURCES

Caltech Submillimeter Observatory

111 Nowelo St.
Hilo, HI 96720
(808) 935-1909

Discovery Park

1651 32nd St.
Safford, AZ 85546
(520) 428-6260

Harvard Submillimeter Array

60 Garden St.
Cambridge, MA 02138
(617) 495-7489

Hat Creek Observatory

42231 Bidwell Road
Hat Creek, CA 96040
(916) 335-2364

IEEE Press

445 Hoes Lane
Piscataway, NJ 08855
(908) 981-0060

IEEE Transactions on Microwave Theory and Techniques

445 Hoes Lane
Piscataway, NJ 08855
(908) 981-0060

International Journal of Infrared & Millimeter Waves

233 Spring St.
New York, NY 10013
(212) 620-8000

Jet Propulsion Laboratory

NASA
Pasadena, CA 91109
(818) 354-5011

NRAO Observatory

PO Box 2
Greenbank, WV 24944
(304) 456-2011

Radio Astronomy Supplies

190 Jade Cove Drive
Roswell, GA 30075
(770) 992-4959

Radio Sky Publishing

PO Box 3552
Louisville, KY 40201
www.win.net/~radiosky

SETI Institute

2035 Landings Dr.
Mountain View, CA 94043
(415) 961-6633

SETIQuest

174 Concord St.
Peterborough, NH 03458
(603) 924-9631

SMT Telescope

University of Arizona
Tucson, AZ 85721
(520) 621-5290

Society of Amateur Radio Astronomers

247 N Linden St.
Massapequa, NY 11758
(516) 798-8459

VLA Astronomy Site

PO Box "O"
Socorro, NM 87801
(505) 772-4011

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.

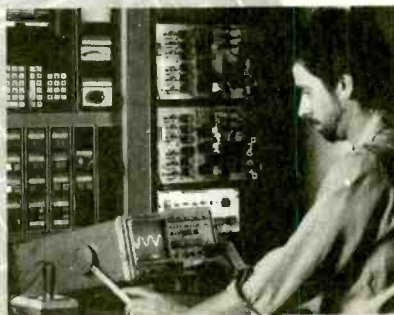
World College continually works to provide its students with the most advanced education tools. From the latest equipment and reference books to breakthrough computer-simulated experiments, students are exposed to the latest technological advancements.

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
WAE56

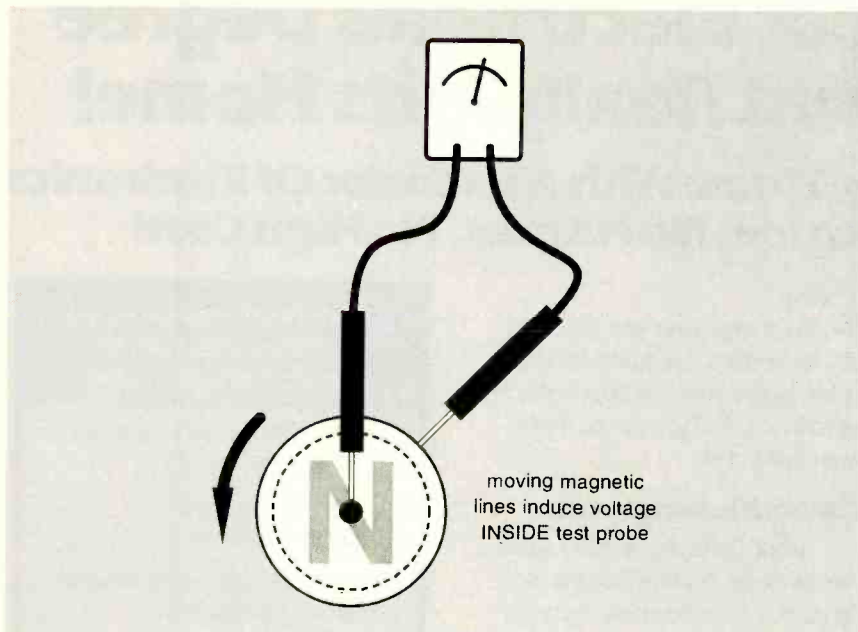


FIG. 3—AN END VIEW clearly shows what is really happening: The voltage or current you see is generated inside of the test lead by simple induction. In essence, the test leads form a one-turn stator winding loop.

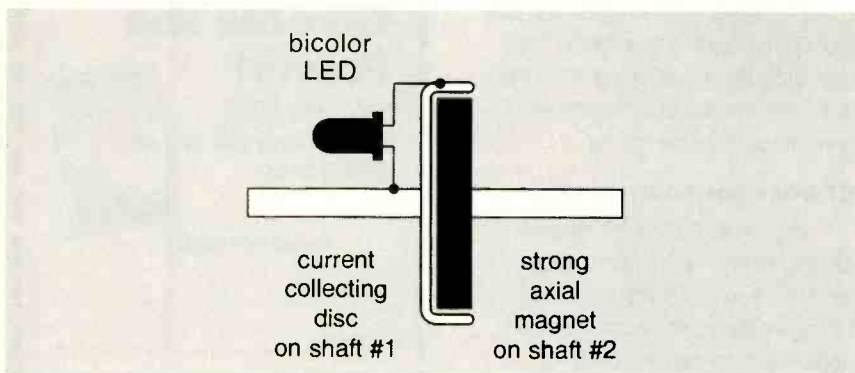


FIG. 4—A “STATORLESS” TEST SETUP to search for mythical homopolar currents. I would expect the LED to light to one color given enough positive relative rotation, and light to the other color on enough negative relative rotation. Brightness should be independent of absolute magnet speed.

The Enigma of The Faraday Disc

There is a cute variation on the homopolar generators we looked at last month that is newly kicking around the Web. Some pseudoscience enthusiasts may show you a “simple experiment” that “proves” you get homopolar energy when there is zero relative motion between the moving magnet and its collecting disc.

Naturally, I believe that claim lies somewhere between “a useful adjunct for porcine whole body cleanliness” and total hogwash. Figure 2 shows the scheme. A strong axially polarized disc magnet is placed on a shaft next to a fixed current collecting disc or cup. Spin both with an electric drill, and sure enough, you could easily convince yourself you are measur-

ing voltage and current from shaft to the edge of the disc despite there being zero relative motion between the two. Too bad it ain't so.

Take a close look at the bottom inch of the shaft test probe in Fig. 3. It shows that in this set up, you have moving magnetic flux lines cutting a conductor (the probe itself). *Ergo*, classic physics tells us you'll get an induced voltage. In other words, the voltage you see is generated inside of the test probe, not across the collecting disc!

To prove this to yourself, just move your probes around. In particular, I'd certainly expect the polarity would reverse if you put the probe on the other side of the magnet.

One more time: The voltage is being induced inside of your test probe! In essence what you have is a one-turn stator coil formed by your test probes and leads.

The voltages and currents claimed suggest hundreds of microwatts of power, which is about the usual measurement-error “fumes” you'll probably find in almost any lab. I'd expect a modern magnet at high speeds to produce watts to tens of watts in a real generator. I'd also be wary of measurements that are one-millionth of the field energy present in the nearby electric drill.

It seems that Faraday himself also felt he observed a homopolar output with a zero relative motion between rotating collector and magnets. Was Faraday right, in which case nobody's bothered to commercially develop an obviously powerful new generator in the last 162 years, or was he wrong, making a subtle but simple lab error in which all of the observed voltages were generated inside of his test leads?

I feel the elegantly simple test of Fig. 4 can easily sort this out. The trick is to eliminate any “stator” on your machine and get rid of all measurement wires. Instead, you'll immediately convert your generated electricity to light. Do this by soldering a two-color LED between the center and the edge of your collecting disc. Then arrange for the disc and your magnet to be separately rotatable.

Here's what I'd expect to happen: Keep the magnet stationary and then rotate the disc fast enough to light the LED to normal brightness. Now, start spinning the magnet in the same direction as the collecting disc. As the magnet speed increases, I'd expect your LED to dim. When the magnet speed is zero relative to the collecting disc, I'd certainly expect zero light output. And as the magnet speeds up I'd expect a brighter light of the opposite color. The results should depend only on the relative speeds between your disc and the magnet and not upon the absolute speed of the magnet.

If I am wrong on the results of this simple experiment, I will be most happy to publicly apologize. But then again, you won't be worrying about that, because your picture will be on the cover of *Science* magazine. Many thanks go to Bill Beatty of www.eskimo.com/~billb for all his “look at the stator” comments on this. Visit his great Web site, which covers both real science and pseudo-

science in depth. Details on the experiment itself can be found lurking around www.keelynet.com, and much more on pseudoscience is at www.tinaja.com/pseudo01.html.

A Clarification or Two

Uh, whoops. The energy density figures in my recent hydrogen story (Tech Musings, **Electronics Now**, September 1997) were high by 1000. In reality, hydrogen has an energy density of around 38,000 watt-hours-per-liter or 38 kilowatt-hours-per-liter. All these values have been corrected in MUSE115.PDF, which is on my www.tinaja.com Web site. Sorry about that.

Continuing with our discussion of that column, one individual was critical of my failing to include Brown's Gas. Brown's Gas is a stoichiometric mix of two parts of hydrogen to one part of oxygen. It sees some limited commercial use in specialized welding torches. But unquestioning Brown's Gas enthusiasts make outrageous claims, such as overunity energy production, radioactive-waste neutralization, and even negative pressure generation, all without credible and verifiable proof to any acceptable standards; at least none that I've seen.

I strongly feel that Brown's Gas clearly passes my subjective "looks like a duck; quacks like a duck; is gonna lay some eggs" pseudoscience test, if for no

other reason than the outlandish claims and nature of the totally clue-challenged denizens it attracts to the Web.

Pseudoscience is a field I closely monitor because it includes such mesmerizingly awful fiction; stuff that is not even wrong. If I ever do discover any credible evidence to the contrary, I'll be most happy to research Brown's Gas in more depth and thoroughly report it, though I do not expect that to happen until after a certain warm place freezes over. You can find more on tinaja.com/pseudo01.html.

New Tech Lit

There's a whole flock of new and free CD-ROM data disks this month: From Texas Instruments, there's the *Logic Selection Guide and Data Book*; from Hitachi, their *H8/300 Series Embedded Microprocessors* disk; from Sharp, a *Flash Memory Data Book*; and from Ricoh, full details on *CD Recording Media*.

Home Power magazine offers their new *Solar 2* CD-ROM. It uses the latest version of Acrobat for totally searchable and full color images of 3900 pages of *Home Power* from Issue 1 through 42. Topics include everything from photovoltaic cells on up through electric vehicles to solar cooking to water pumping and more. It costs \$29, including US shipping.

Several exciting new laser printer-repair instruments are newly offered from Laser Wizard. Those calculator-size units plug into popular Canon engines and give you all sorts of new-found diagnostic and control powers. Their PIC-based SX30 runs \$295 and is the basic unit for SX engines. Add-on \$99 adaptors are available for the NX and BX engines. These can let you manually control the printer at the engine level while overriding cover switches and reading error messages.

Laser-printer training and repair parts still remain available from Don Thompson, while cartridge refilling opportunities abound in *Recharger* mag-

NAMES AND NUMBERS

Alsa Softouch

2640 E 37th St.
Vernon, CA 90058
(213) 581-5200

Applied Microwave & Wireless

2245 Dillard St.
Tucker, GA 30084
(770) 908-2320

Hitachi

2000 Sierra Point Pkwy.
Brisbane, CA 94005
(415) 589-8300

Home Power

PO Box 520
Ashland, OR 97520
(916) 475-3179

Innovation

2011 N Shoreline 21L-415
Mountain View, CA 94043
(415) 933-6502

KeelyNet BBS

Box 1031
Mesquite, TX 75149
(214) 324-3501 (BBS)

Langmuir Laboratory

NM Institute of Mining & Technology
Socorro, NM 87801
(505) 835-5423

Laser Wizard

705 G Washington Ave.
Norristown, PA 19403
(610) 539-4708

Lindsay Publications

PO Box 538
Bradley, IL 60915
(815) 935-5353

Newnes

313 Washington Street
Newton, MA 02158
(617) 928-2500

Recharger

4218 W Charleston Blvd.
Las Vegas, NV 89102
(702) 438-5557

Ricoh

3001 Orchard Parkway
San Jose, CA 95134
(800) 957-3436

Science/AAAS

1333 H St. NW
Washington, DC 20005
(202) 326-6400

Sharp

Sharp Plaza
Mahwah, NJ 07430
(201) 529-8757

Synergetics

Box 809
Thatcher, AZ 85552
(520) 428-4073

Texas Instruments

PO Box 809066
Dallas, TX 75380
(800) 336-5236

Don Thompson

6 Morgan #112
Irvine, CA 92718
(714) 855-3838

Wireless Design & Development

301 Gibraltar Dr.
Morris Plains, NJ 07950
(201) 292-5100

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 email: don@tinaja.com
Web page: <http://www.tinaja.com>

azine ads and stories. More on the neat things you can do with toner in RESBN68.PDF on www.tinaja.com.

Free samples of a new ultra-tough Softouch leather-like coating is available from Alsa.

New books from Newnes include *Inside PC Card Design* by Faisal Haque and *Cellular Telephones and Pagers Overview* by Steve Gibson. The latest of "new" old titles from Lindsay Publications include *I.C. Engines Volume I*, which is a collection of patents on early internal combustion engines, and new books on lathes, saw blades, and milling machines. Lindsay's Web page is at keynet.net/~lindsay.

Innovation is a brand new publication for you users of high-end graphics computers. It is apparently a continuation of an older *IRIS Universe* magazine. Free subscriptions are available to those with a genuine interest. Two useful wireless trade journals are *Applied Microwaves & Wireless* and *Wireless Design & Development*.

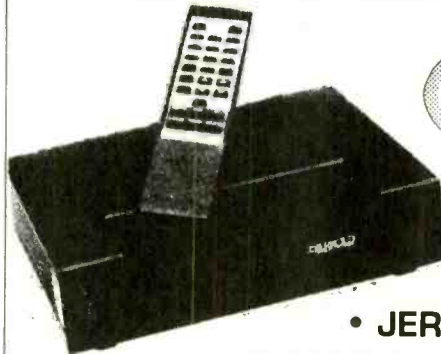
For the insider secrets of starting up your own technical venture, see my *Incredible Secret Money Machine II*, which is available as mentioned in my nearby Synergetics ad. You can also preview the introduction at www.tinaja.com/ismm01.html. Also check my new Infopack service, which quickly gives you custom and cost-effective research solutions. As usual, most of the mentioned items should appear in the "Names & Numbers" or in the "Radio Astronomy Resources" sidebars. Always do check here before you call our US technical helpline shown in the "Need Help?" box you'll find nearby. Let's hear from you. **EN**



**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.
VISIT US ON THE WEB AT WWW.ABCTEST.COM**

TEK 7B15 1 GHZ DELAYING TIME BASE	\$250.00	TEK 2245 100 MHZ 4 CHANNEL O-SCOPE	\$1200.00
TEK 2465A 350 MHZ 4 CHANNEL O-SCOPE	\$3200.00	TEK 7A19 600 MHZ SINGLE TRACE AMPLIFIER	\$150.00
TEK 7A26 200 MHZ DUAL TRACE AMPLIFIER	\$75.00	TEK 7B85 400 MHZ DELAYING TIME BASE	\$125.00
TEK 7904 500 MHZ MAIN FRAME	\$250.00	HP 1630D 25 MHZ LOGIC ANALYZER	\$250.00
TEK 5771/77 CURVE TRACER	\$1500.00	TEK 7S11 SAMPLING PLUG IN	\$200.00
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
DRANETZ 626 DISTURBANCE ANALYZER	\$1500.00	HP 8182A 50 MHZ PATTERN GENERATOR	\$800.00
GENRAD 1657 RLC BRIDGE	\$750.00	PHILLIPS PM3296 400 MHZ OSCILLOSCOPE	\$1000.00
TEK 7D20 PROGRAMMABLE DIGITIZER	\$500.00	EMI SCR 7.5-300 7.5V 300A POWER SUPPLY	\$500.00
TEK 465 100 MHZ OSCILLOSCOPE	\$400.00	HP 8558B SPECTRUM ANALYZER	\$1500.00
TEK 465B 100 MHZ OSCILLOSCOPE	\$450.00	WAVETEK 175 WAVE FORM GENERATOR	\$500.00
TEK 2335 100 MHZ OSCILLOSCOPE	\$1200.00	WAVETEK 157 PROG. WAVE FORM SYNTH.	\$500.00
TEK 2215 60 MHZ OSCILLOSCOPE	\$350.00	RACAL DANA 1901 100 MHZ COUNTER	\$200.00
TEK 496P 1KHZ-1.8GHZ SPECTRUM ANALYZER	\$5000.00	VALHALLA 2790B SYSTEM INTERFACE	\$150.00
BRADLEY 132 SCOPE CALIBRATOR	\$700.00	GENRAD 1683 RLC BRIDGE	\$300.00
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
TEK FG504 40 MHZ FUNCTION GENERATOR	\$500.00	FLUKE 5200A AC CALIBRATOR	\$1500.00
HP 54100A 1GHZ DIGITIZING OSCILLOSCOPE	\$3000.00	TEK TM504 4 SLOT POWER FRAME	\$125.00
HP 8170A LOGIC PATTERN GENERATOR	\$150.00	HP 4955A PROTOCOL ANALYZER	\$500.00
SYSTRON DONNER DPSD 50	\$500.00	MAGTROL 4614 POLYPHASE POWER ANLZR.	\$300.00
LEADER LSG215A 125 MHZ SIGNAL GENERATOR	\$700.00	TEK CT-5 HIGH CURRENT TRANSFORMER	\$500.00
SPECIAL THIS AD ONLY TEK 475 200 MHZ OSCILLOSCOPE REGULAR PRICE \$500.00 SALE PRICE \$400.00			
SPECIAL THIS AD ONLY TEK DAS 9100 AS IS NO PROBES THESE UNITS ARE UNTESTED NOT REJECTS \$150.00			

**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

Since 1965, we've worked to make sure all children have the opportunity to learn valuable lessons during the years when it's easiest for them to learn.

To find out how you can help, call your local Head Start.

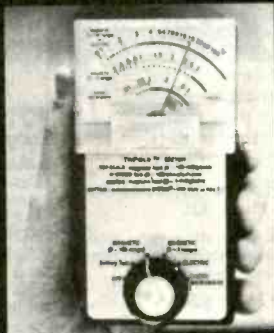


**Nurture the future
BE A HEAD START VOLUNTEER**



Electronic SHOPPER

**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 \$144.5C postpaid.

AlphaLab, Inc. / 1280 South Third West / Salt Lake City, UT 84101-3049
For literature and information, call (808) 874-9126

From MILLIWATTS to KILOWATTS

**RF POWER TRANSISTORS • TUBES
POWER MODULES**



Best pricing on U.S. & Russian



Transmitting & Receiving Tubes

Svetlana

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

**MOTOROLA
TOSHIBA**



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: rfp@rfparts.com



RF PARTS

435 SOUTH PACIFIC STREET
SAN MARCOS, CA 92069

Cable TV Converters

SAVE Dealers
\$100s Welcome

30 Day Money Back Guarantee

Call Us Last!

We will beat any advertised price

CD Electronics

No FL Sales

1-800-842-9670

<http://www.cdelectronics.com/cd>

3 Axis Motion Control System Complete, ready to run

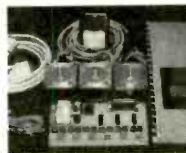
\$ 255.50 + 12.00 S/H

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. Suite3
Chandler AZ 85224
Ph (602) 940-9414
Fax (602) 940-2384



Digital Entertainment GREAT VALUES ON!



SAVE

Compare to Cable

30%-50%

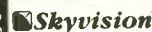
MORE ENTERTAINMENT OPTIONS
ALL THE HOT ACCESSORIES
PAY LESS



Fax: 218-739-4879
Int'l: 218-739-5231

1018 Frontier Dr.
Fergus Falls, MN 56537

Call Now **800-543-3025**
www.skyvision.com



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 \$29

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.

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.

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 \$24

The latest tricks and methods being used on the Net to pirate software (warez), Password Defaults, Packet-Switched Networks, Unix, Sprintnet, X.25, anonymous FTP. Examples, countermeasures, and more!

COOKIE TERMINATOR \$19

Browser cookie files that are forced onto your hard drive by website providers contain personal data accessible to Internet predators. Protect your privacy! CT details how to remove and stop these from destroying your privacy, and how to keep them off your drive!

INTERNET TRACKING & TRACING \$29

The Net is infected with spammers, stalkers, scammers and others who hide behind its anonymity. Learn step-by-step how to trace them down using this comprehensive, eye-popping manual! Invaluable!

Special!! All 3 above, Only \$59!

COMPUTER PHREAKING \$39

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!

BY AN ORDER OF THE MAGNITUDE \$49
The most comprehensive, hard-hitting, hi-tech survival book ever written! Topics include electronic, computer, cryptography, chemistry, weaponry, comms, energy, concealment, revenge, alarm, disguise & ID change. Field-expedient use of technology in various threat and conflict environments! More!

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.

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!



**WE'VE
GOT
IT!**

MCM ELECTRONICS®

Prices Effective
November 3
through
December 31, 1997
To take advantage of
these prices, you must
supply this
special price code: ▼
**SOURCE CODE:
ENS41**



NEW

DTMF Decoder With Display

Assembled board decodes all 16 DTMF digits from any speaker level source and displays information on an 8-digit LED display. Scrolling left or right allows display of up to 104 characters. Serial ASCII output and "ToneLog" IBM/compatible logging software allow viewing and storage on your PC. Power requirements: 12VDC, 200mA. Dimensions 6" x 2 1/2".

Order #	Description	(ea.)
111-2491	DTMF Decoder	\$105.00
111-2481	Interface cable (DB-25)	29.00
111-2482	Interface cable (DB-9)	29.00



**SAVE
50%**

30 Piece Security Screwdriver Insert Bit Kit

This is a complete set of security bits for all of those difficult service applications, such as IBM PS/2 monitors, cable boxes, telephone equipment and many others. Kit includes security hex keys, security torx bits, spanners, tri-wings and more.

Order #	Reg.	
22-1475	\$38.99	\$19.99



**SAVE
\$5**

60 Piece Audio Lamp Kit

Save when you purchase this kit, loaded with popular audio lamps used in the repair of amplifiers, tuners and tape decks. Kit contains 6V, 8V, and 12V Fuse type, sub miniature and grain of wheat bulbs.

Order #	Reg.	
102-007	\$22.95	\$17.95



Mylar Capacitor Assortment

Contains 200 short lead mylar capacitors. Voltages and values will vary. Voltages range from 50-603VDC. Values range from .001MFD-.47MFD.

Order #	(ea.)	
102-029		\$6.95



**YOUR
CHOICE
\$9**

8" Poly Cone Woofers

Perfect for replacement, upgrade or original manufacturing in most speaker applications. They feature polypropylene cone, foam surround and high temperature voice coil. Power capacity 70W/100W RMS/peak, 40Hz-3KHz response, 1 1/2" voice coil, 18 oz. magnet and SPL 87dB.

Order #	Impedance	Regular
55-1195	8ohm	\$11.95
55-1605	4ohm	10.95



**#72-545
Only**

NEW PRICE!

TENMA® \$49.95 (ea.)

Isolation Transformer

Provides isolation from AC line when servicing "hot" chassis equipment. Eliminates shock hazard and prevents damage to AC line operated test equipment. Includes fused 150VA isolated outlet and fused 500VA direct outlet. Dimensions 3 1/2" (W) x 5 1/2" (H) x 3 1/2" (D).



110 Watt Subwoofer Power Amp Module

MCM now offers the ultimate subwoofer power amp module for all your home audio and home theater projects. It can be built directly into most any existing subwoofer enclosure, requiring a cut-out of only 10" x 7", and accepts either speaker level or RCA inputs. Features include an auto sense circuit to turn on amp when music is present, and 60-160Hz continuously variable 12dB crossover.

**50-4465
\$179**



**FREE
Catalog!**

1-800-543-4330

Same Day Shipping!

In stock orders received by 5:00 p.m. (YOUR TIME), are shipped the same day.

Hours: M-F 7 a.m.-9 p.m., Sat. 9 a.m.-6 p.m., EST.



MCM ELECTRONICS®
650 CONGRESS PARK DR.
CENTERVILLE, OH 45459
A PREMIER FARNELL Company

SOURCE CODE: ENS41

Visit MCM's website at www.mcmelectronics.com

CIRCLE 333 ON FREE INFORMATION CARD

ELECTRONIX EXPRESS

WELLER SOLDERING STATION - MODEL WLC 100

- Variable power control (5 to 40 watts)
- Replaceable heating element
- Quality light-weight pencil iron

\$36⁹⁵



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

DUAL-TRACE OSCILLOSCOPE

Goldstar 9020

20MHZ **\$339⁰⁰**



DK 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.**



HELPING HAND

WITH

MAGNIFIER

#060836



\$3⁵⁰

RESISTOR KIT

1/4W 5% film. 5 pieces each of 73 values. 365 pieces total.

\$3⁹⁵

SOLDERING IRON STAND

W/SPONGE

#060842 **\$3⁵⁰**



1 LB. 60/40 Solder Roll .031" \$5⁹⁵

DESOLDER PUMP W/TIP \$3⁵⁰

#060820

15 TURN POT

69¢ ea.

Bourns 3006P series. All standard values available.

7 SEG. DISPLAY

60¢ ea.

MAN72 C.A.Red 0.3" MAN74 C.C.Red 0.3"

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 **\$159.00**

01PSGP4303D Digital Display **206.00**

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

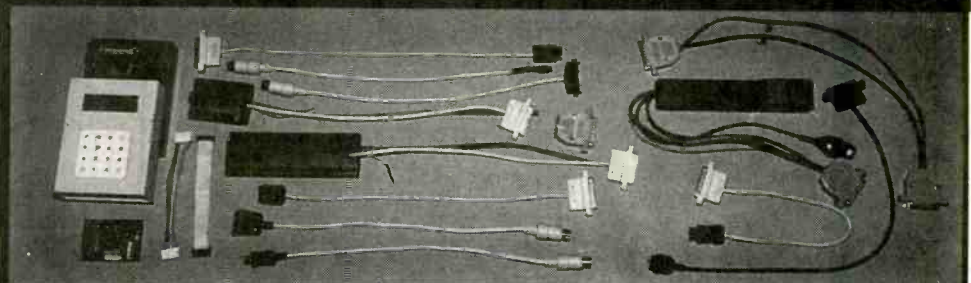
"7-WAY COPY CAT \$995.00*"

NEW!

7-Way

StarTac

\$1295.*



- 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 323 ON FREE INFORMATION CARD

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 - Dick's 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

HOWARD
HEINC 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

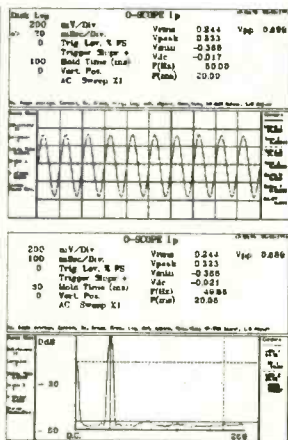
CIRCLE 314 ON FREE INFORMATION CARD

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>

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](http://www.mwikindustries.com)
EMAIL: MKENNY1989@AOL.COM

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, PGP 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 or 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

P. O. Box 97903, Raleigh, NC 276 24-7903

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

Test Equipment for Cost-Minded People

DC POWER SUPPLY

PS-303 \$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-303D \$314.95 dual, tracking
PS-305 \$219.95, 0-30VDC, 0-5A.

PS-305D \$399.95, dual, tracking.
8110 \$289.95 0-60VDC, 0-3A.
8112 \$399.95 0-60VDC, 0-5A.
8108(8109) \$549.95(\$699.95) 0-60VDC, 0-3A(5A), dual, independent tracking. Low ripple.
8102(8103) \$399.95(\$489.95) triple outputs, 0-30V/0-3A(5A) x 2, fixed 5VDC/3A, independent & tracking operation, constant voltage and current. Slave/Master, Serial/Parallel connection.
PS-1610S(8107) \$289.00(\$399.95) 0-16VDC(0-30VDC), 0-10A.
PS-2243(2245) \$139.00(\$159.00) 0-12/0-24VDC, 3A(5A).
8200(8201) \$179.95(\$239.95) 0-30VDC(digital meter), 0-3A(5A).
8210(8211) \$199.95(\$259.95) two digital meters.
8202(8203) \$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 SWEEMER 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-E5 ±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 1V-p

SW/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.

ON SALE - DC Power Supply

8102 \$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-303D \$974.95 \$282.95 dual outputs/tracking, CC&CV. Limited quantity. Full one year warranty.

RF SIGNAL GENERATOR

SG-4162AD \$229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals. Specification see SG-4160B

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%+1dg).
Freq. Counter & TCXO 5Hz-100MHz; 6.5 digits x1 & x20 attrn

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 < 5%; L-R Separation: >50dB.
EXT. MODULATION: Freq.: 50Hz-15KHz
L-R Separation: >45dB 100Hz-1KHz; >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

OSCILLOSCOPES

OS-7505B \$749.00 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-6101S \$1499.95 100MHz, 4ch/8 trns, delay sweep, cursor readout

DIGITAL MULTIMETER

DMM-120 \$24.95, 3½ digit, 600VDC/AC, 2ADC, 2MΩ, hFE/diode test.
DMM-123+Capacitance \$44.95, 3½ digit, 600VDC/AC, 10ADC/AC, 2GΩ, 20μF, hFE/diode test, continuity beeper.
DMM-125 \$54.95, Autorange/Bar Graph, 600VDC/AC, 2ADC/AC, 32MΩ, beeper.
MIC-35 \$59.95, Autorange, 3½ digit, LCD, 1000VDC/750VAC, 20MΩ, 20ADC/AC, diode/continuity check, data hold.
MIC-39 \$149.95, Autorange/Bar Graph, True RMS, 3½ 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 3VDC battery.

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 Impedance: (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 Impedance: 100KΩ,
Output Imped: 600Ω;
Speaker: 8 Ω
INJECTOR: Freq.: 1KHz
Squarewave Output Level: Continuously variable 0 - 45Vp-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 99.9mF.
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: 0.03V/1/3/3% full scale.
Accuracy: ±5%.

WF-3105A \$799.95, digital;
Function: LIN/WOW/Flutter/WTD.
Freq Counter: 10Hz-9.99MHz.
Indication: CCIR/DIN/JIS

ELECTRONIC/PC TOOL KITS

9245 \$29.99 U.S. Patented, 45-pos. Contents: IC Inserter, IC Extractor with securers & Bows, 3-prong part Retriever, #0 Phillips Screwdriver, 1/8" Flat Screwdriver, Self-Hold Tweezers, Metal Tweezers, Extra Parts Tube, Soldering Iron, Solder, Crimping Tool, Long-nose Plier, Cutting Plier, Zipper vinyl Case. Bits include: Phillips: #0, #1, #2, & #3; Flat: 1/8", 3/16", 1/4", 9/32"; PZ1, PZ2; T8, T9, T10, T15, T20, T25, T27, T30, T40, T45; Hex: 5/64", 3/32", 1/8", 5/32", 3/16"; Sockets: 3/16" (5mm), 7/32" (5.5mm), 1/4" (6mm), 9/32" (7mm), 5/16" (8mm).
8G23 \$34.99 U.S. Patented, 23-pos. Contents: IC Inserter, IC Tweezers, IC Extractor with securers & Bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Screwdriver, 1/8" Slotted Screwdriver, #0 & #1 Phillips, Reversible T10/T15 Bits, Reversible #2 Phillips ¼" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.
8088 Microprocessor Trainer \$699.00 BGC-8088, teach yourself 8088 based hardware design and software programming

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!



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 _____

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.

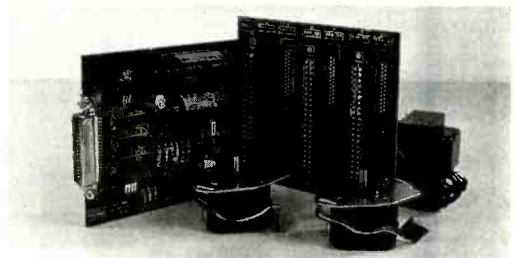
SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 FAX (707) 279-8883
<http://www.sq-1.com>

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

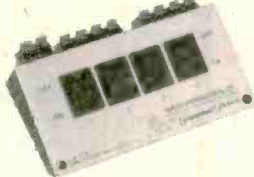
**FREE
244 PAGE
CATALOG**



**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.



WAS \$22⁵⁰ EACH NOW \$15⁰⁰ EACH

#EN-309-030

"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.



\$14⁹⁵ EACH

#EN-249-220

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)

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, Qts, Qrs, 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.

#EN-390-800 \$249⁰⁰ EACH



QUICKLY AND ACCURATELY MEASURES:
Fs, Qms, Qts, Qrs, Vas, BL, Re, Le, SPL @ 1W/1m, Mmd, Cm, and Rm IN MINUTES!

30 DAY MONEY BACK GUARANTEE

1 YEAR WARRANTY SAME DAY SHIPPING

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

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.

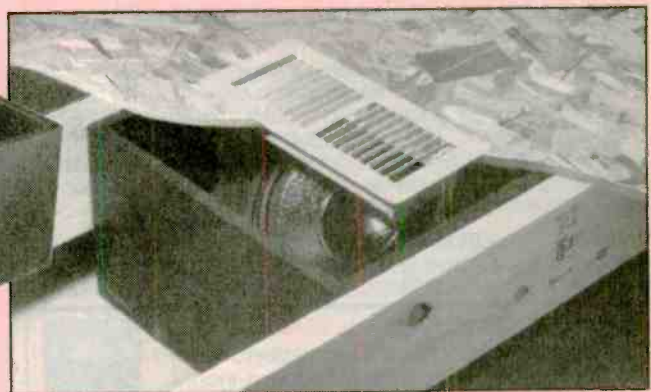
Specifications: 10" dual voice coil treated paper cone woofer with poly foam surround ◆ Frequency response: 30-100 Hz ◆ Nominal impedance: 8 ohms per coil ◆ Power handling: 100 watts RMS channel/140 watts max ◆ SPL: 89 dB 1W/1m ◆ Dimensions: 27" D x 14-5/8" W x 9" H ◆ Net weight: 29 lbs.

#EN-300-445

\$139⁹⁵ EACH



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

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.



Our Best Offer Ever on a High Quality Full Sized DMM

General
 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 (NEDA1604)
 Low Battery Indication: BAT on Left of LCD Display
 Dimensions: 188mm long x 87mm wide x 33mm thick
 Net Weight: 400g

\$19.00 any qty

DC Voltage (DCV)
 Range: Resolution: Accuracy:
 200mV 100µV
 2000mV 1mV ±(1%rdg+2dgts)
 20V 10mV
 200V 100mV
 1000V 1V
 Maximum Allowable Input: 1000V DC or Peak AC.

Resistance (Ω)
 Range: Resolution: Accuracy:
 200Ω 100mΩ
 2000Ω 1Ω ±(1.2%rdg+2dgts)
 20KΩ 10Ω
 200KΩ 100Ω
 2000KΩ 1KΩ
 20MΩ 10KΩ ±(2%rdg+10dgts)
 Maximum Open Circuit Voltage: 2.8V

DC Current (DCA)
 Range: Resolution: Accuracy:
 200µA 100nA
 2000µA 1µA ±(1.2%rdg+2dgts)
 20mA 10µA
 200mA 100µA
 10A 10mA ±(1.2%rdg+2dgts)
 Overload Protection: mA Input: 2A/250V fuse.

Diode Test
 Measures forward voltage drop of a semiconductor junction in mV test current of 1.5mA Max.

AC Voltage (ACV)
 Range: Resolution: Accuracy:
 200V 100mV ±(1.2%rdg+10dgts)
 750V 1V
 Frequency Range: 45Hz-450Hz
 Maximum Allowable Input: 750V rms
 Response: Average Responding. Calibrated in rms of a Sine Wave.

ohFE Test
 Measures transistor hFE.

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	PRICE EACH
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/Ferri 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	PRICE EACH
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!

CAT NO	DESCRIPTION	PRICE

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 315 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.



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 • 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



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.

CAT NO	DESCRIPTION	1	5
CA-H34A	PCB Mounted IRCCD Camera	\$99.00	\$85.00
A34	Power Supply Regulating Kit	\$6.95	----

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.



AMAZING PRODUCTS!

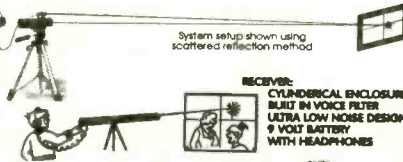


ELECTRONIC & SCIENTIFIC DEVICES

LASER WINDOW BOUNCE SCIENCE PROJECTS

USES SCATTERED AND DIRECT REFLECTIONS

Remarkable concept allows user to hear sounds within a premise over a beam of laser light reflected from a window or similar surface. Experimental device provides hours of interesting and educational use. Utilizes a visible red laser that simplifies alignment and discourages illegal use. Usable range will vary—expect about 20 to 50 meters. Optional lens will increase range 200 to 400 meters! Further range requires expensive optics. Requires a sturdy video tripod (not incl.) Caution—check local law in your state if planning to use for accessing oral communication.



System setup shown using scattered reflection method

RECEIVER: CYLINDRICAL ENCLOSURE BUILT IN VOICE FILTER ULTRA LOW NOISE DESIGN 9 VOLT BATTERY WITH HEADPHONES

LASER: SELECTED FOR COMPACTNESS 4-mw 645nm visible red BATTERY OPERATED 4 hrs

- LWB5 Plans.....\$20.00 LWB5K KIT/PLANS.....\$149.50
- LWB50 Ready to Use With Selected Laser Pointer.....\$199.50
- LWB70 Above With High Performance Laser Gun Sight, Long Range Extender Lens and Cushioned Headsets.....\$299.50

\$59.95 6 TRANSMITTER Projects

CAUTION: Check Public Law 90-352

- 1 Super Sensitive Ultra Clear 1 Mile+ Voice Transmitter
- 2 1 Mile+ Telephone Transmitter
- 3 Telephone "DROP IN" Transmitter Line Powered—Needs No Batteries!
- 4 Tracking/Homing Beacon "Beeping Transmitter"
- 5 Transmitter Rebroadcasts Video or Audio Outputs
- 6 Short Range TV/FM Disrupter NEAT PRANK!! Discretion Advised

All 6 Above Kits Plus FREE Info Data Pack on "HELPFUL HINTS" Using Wireless Devices

COMBOX Kits and Plans.....\$59.50

ULTRA BRIGHT LASERS

4 to 7x brighter 650-630 nm Radiation

ALL METAL CONSTRUCTION
1 YEAR WARRANTY

BATTERIES INCLUDED

LAPN65 15mw equiv 2000 ft.....\$29.95
LAPN63 30mw equiv 3000 ft.....\$69.95

FOCUSABLE LASER POINTER

LAPN65F Focusable Above LAPN65. \$59.95

JACOBS LADDER

Observe a pyrotechnical display of "traveling" fiery plasma. Starts off as 1/2" arc and expands to over 3" before evaporating into space. This is an excellent attention getting display as well as a winning science project! With arc control.

JACK1 Plans.....\$8.00
JACK1K Kit Minus Case.....\$129.50
JACK10 Ready to Use.....\$249.50

12KVGEN20 Pwr Supply Only.....\$99.50
12KVGEN2K Kit of Pwr Supply.....\$79.50

250KV TESLA COIL

10-14" of Explosive Bolts of Lightning

Transmit Wireless Energy Strange and Bizarre pyrotechnical effects. Ion Motors Anti-Gravity Size 20" H x 8" Sq Weight - 25 Pounds 115 Volts/2 Amps AC Labeled "Use Caution"

BTC3 Plans.....\$15.00
BTC3K Kit/Plans.....\$349.50
BTC30 Ready to Use.....\$449.50
BTC4 Plans, 500kv Unit.....\$20.00

BURNING LASER RAY GUN

UTILIZES LOSSLESS ENERGY CHARGING

All Parts Available

LAGUN2 Plans.....\$20.00

BURNING CO2 BENCH LASER

HOTTER THAN MOST TORCHES!

All Parts Available

LC7 Plans.....\$20.00

KINETIC ELECTRIC GUN

PIONEER A FUTURISTIC WEAPON!

500 Joules Energy Storage Constant Current Charging Triggered Spark Switch Ballistic Velocities Handheld Battery Operated Labeled A Dangerous product

PROTOTYPED IN OUR LABS JOIN THE RESEARCH!

EGUN1 Plans with Parts List.....\$20.00

All Parts are Individually Available

3Mi FM BC TRANSMITTER

Safety Product Allows Listening to Children or Invalids in Hazardous Areas, Pools, Ponds etc. Great Security Intrusion Alert Uses FM Table Top Radio.

FMV1K Kit/Plans.....\$39.50

ION RAY GUN PROJECTS ENERGY!

Star Wars Technology Demonstrates Weapons Potential!

IOG7K Kit/Plans.....\$99.50

GRAVITY GENERATOR

Demonstrates a unique phenomena of electrical reactions that produce the effect of "anti-gravity". You build and levitate a small mock space ship from simple materials. Excellent scientific demonstration of a fascinating method of levitation.

GRA1 Plans and Book.....\$20.00
GRA1K Pwr Sup Kit/Plans.....\$99.50
GRA10 Assembled Pwr Sup.....\$149.50

ELECTRONIC HYPNOSIS AND MIND CONTROL

Generates Highly Effective Audible and Visual Stimuli With Bio-Feedback That Can Induce Hypnotic as Well as ALPHA Relaxed States of the Mind. Place Subjects "Under" Your Control. Enhances Hidden PSYCHIC Ability in Many People!

MIND Plans.....\$15.00
MIND2K Kit and Plans.....\$49.50
MIND20 Assembled.....\$79.50

TELEPHONE TAPING SYSTEM EXTENDED X4 PLAY

Tapes Phone Conversation 20 Mega Input Z1 Check Low!

TAP30X Ready to Use.....\$84.50
BEEP10 Beeper Alert.....\$29.95

SHOCK FORCE FIELD/VEHICLE OBJECT ELECTRIFIER

Hand Shock Balls, Wands, Beadly Objects. Great Prankback for Those Who Suss!

SHK1K Kit of Pwr Module.....\$19.50

CYBERNETIC EAR!

Use For Courtesy Lowering of TV Volume Control etc. Detect Rattles and Other Mechanical Abnormalities, Leaking Gases, Air, or Corona. Great Safety Aid for Shop Enhances Most Hearing 3 to 4 Times! Adjustable Volume Control. Fits Easily Into Either Ear. Many Many Uses!

CYBEREAR Ready to use.....\$19.95

3 MI TELEPHONE TRANSMITTER

Tunable On FM Broadcast. Excellent Telephone Project. Only Transmits When Phone is Used

VWPM7K Kit/Plans.....\$39.50
BEEP1K BEEPER ALERT KIT.....\$19.95

ELECTRIC CHARGE GUN

WITH 15 FOOT RANGE!!

Stuns and Immobilizes Attackers From a Distance. More Knockdown Power than a Handgun! Check Your State Legality FREE!! 100KV Stun Gun

ECG10 With STUN100.....\$249.50

STUNGUNS SOLD SEPARATELY

STUN200 200KV StunGun.....\$49.50
STUN300 300KV StunGun.....\$69.50

HIGH CRIME AREA SECURITY! INFINITY+ TRANSMITTER

ROOM MONITOR/ LINE GRABBER/CONTROLLER

MONITOR YOUR PREMISES Avoid ambushes and break ins. ACCESS ON GOING CALLS Long Winded teenager! CONTROL 8 APPLIANCES Remote control your home!! EXTRA ADDED FEATURE!!! Includes Transceiver Handgun for Call Made from Pay Phone!!

TELCON3 Plans.....\$10.00
TELCON3K Kit/Plans.....\$99.50
TELCON30 Ready to Use.....\$149.50
Programmed With built in BEEPER ALERT

PHASOR BLAST WAVE PISTOL

130 db of Directional Sonic Shock Waves Energy Handheld and Battery Operated

PPP1 Plans.....\$8.00
PPP1K Kit/Plans.....\$49.50
PPP10 Ready to Use.....\$79.50

ATTENTION! HIGH VOLTAGE EXPERIMENTERS

Battery Powered Mini Sized Modules for research in: HOVERCRAFT, ION GUNS FORCE FIELDS, SHOCKERS etc

MINIMAX4 4KV@10ma.....\$19.50

ATTENTION!! RAILGUN EXPERIMENTERS HIGH ENERGY PULSER

EXPERIMENTORS AND RESEARCHERS RAIL GUN, COIL GUN, EXPLODING WATER, ANTIGRAVITY, MASS WARPING, LEVITATION, PLASMA PROPULSION, LATTICE SNAPPING, EMP etc

- Lossless Energy Charging
- Programmable Voltage to 2 KV and Energy Control to 3 KJ
- Triggered Spark Switch [IKJ]
- Universal 12 VDC or 115 VAC
- 7.5 X 7.5 X 7" Light weight

HEP3 Plans High Energy Pulser/Ignitor.....\$15.00
HEP3K Kit/Plans (Minus Energy Storage).....\$199.50
HEP30 Assembled (Minus Energy Storage).....\$299.50
HEPCAP 800 Joules Energy Storage.....\$199.50

INFORMATION UNLIMITED DEPT EN1097 BOX 716 AMHERST, N.H. 03031

24 Hr Toll FREE "Orders Only" Line 1-800-221-1705
Fax Your Order to 1-603-672-5406
9 to 5 pm EST Information Line 1-603-673-4730
See Our Web Site at <http://www.amazing1.com>

We Accept MC, VISA, Cash, MO, Checks. Please add \$5.00 Shipping. COD Orders Add Additional \$4.75. REQUEST A FREE CATALOG!!



**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.

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

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

Bring your ideas and inventions to life

With a Smithy 3-in-1 Lathe•Mill•Drill you can save time and money whether you own a business or just have a lot of great ideas. Mike Bloom of Intelligent Design Systems (Minnesota) owns a prototyping shop and several Smithys.

"We're an R & D company.

Companies come to us with problems and we design machines to solve them," Bloom said. "I used to co-venture off my prototyping but last year I

Bob Munden turned a love of shooting into quick-draw world records and a busy gun-customization business

spent more than \$140,000 in outside machine shops."

A current 3-ton gas centerfuge project involves 13 patents. "There are very few store-bought parts in the entire machine," Bloom said.

Intelligent Design Systems does



Above: The Smithy CB-1220 XL

only modeling and prototyping—no production. Bloom needed machines that could do good, precise work. "I've been happy with the tolerances we've been able to achieve. We're using our Smithys for modeling and actual components."

Big power, big performance Smithy's compact, versatile machine tools fit into a garage corner, are large enough to do the job, and sturdy enough to last a lifetime.

Beginner or seasoned pro, with a Smithy machine you'll be able to tackle any project you have in mind. We back each machine with a Premium Tool Pak, our *Machine Tool Basics* video, a toll-free machining helpline staffed by friendly, knowledgeable technicians, and much more. Smithys pay for themselves—we guarantee it! But you don't have to take our word for it. Do you want to talk machining with other Smithy owners? We'll refer you to owners in your area.

Call **1-800-345-6342** for your **FREE Info Pak** today--see what a Smithy could do for you!

FREE Info Pak

Smithy

1-800-345-6342

Ask for operator EN712

or write: Smithy • Dept. EN712 • PO Box 1517
Ann Arbor, MI 48106-1517

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 VidLink 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>

CONTROL MEASURE INPUT

RELAYS • LIGHTS • MOTORS
TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY
SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79



- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL
- 8 BIT A/D IN
- 12 BIT COUNTER
- UP TO 14K BMP/SEC

MODEL 45 \$189



- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 \$279



- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 60 \$179



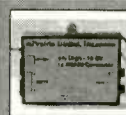
- 8 2-AMP RELAYS
- 16 DIGITAL I/O
- 1 8-BIT ANALOG INPUT

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
- 5.5 DIGIT
- UP TO 60 BMP/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 53578

CIRCLE 330 ON FREE INFORMATION CARD

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!

IEEE 1284

PRINTER CABLES

DB25 male to standard 36 Centronics Cable for HP Laser and others; meets 1284-IEEE standards



10' Cable

#CC-PR1-1284 \$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

12" Gooseneck Microphone

Electret Condenser, 3.5mm Stereo plug 100-16,000 Hz Freq. Response



#TM-MIC-3

\$4⁰⁰ each

3/\$10.00

AC to DC Converter



#TM-307 \$3.00 each

1.5V - 12V DC/300 ma

5/\$2.90 10/\$2.70

#TM-310 \$5.00 each

1.5V - 12V DC/1000 ma

20/\$4.90 50/\$4.40

4" Stereo Mini Phono Plug to 2 RCA Jacks

3.5 mm stereo mino phono plug to 2 RCA phono jacks



#AD-561

\$1.50 each

Miniature Mouse

2-Button, black Great for small hands or laptop!



#TM-290-MINI

\$4⁰⁰ each

SCSI CABLES

High Quality • Double Shielded • Twisted Pair

6 ft. DB25M to SCSI II (HD 50)



#CC-671-6 \$12⁰⁰ each

3 Ft. DB25 Male to 50 Cent.



#CC-669

\$4⁰⁰ each

3 Ft. SCSI 50 Cent. Male to Male



#CC-673

\$4⁰⁰ each

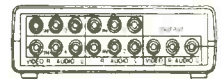
Audio/Video Switching Box

Switching Box

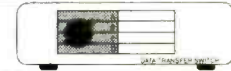
4 sets Audio/Video input, 1 set outputs; all RCA jack connectors, Hi-Isolation

#VA-4000

\$10⁰⁰ each



output to any AV Receiver or TV!!



Manual Data Switches

All Steel Case with gold-plated rotary switch and gold-plated connections

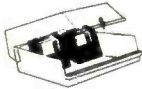
2WAY DB25 Female

#DS-252 \$6⁵⁰ each

And many others! Check out our Web Site!!

Diskette Filing Case

Holds 100 diskettes • Double row filing with lock



#TM-DSC-3

\$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



"TOUCHE" Touch Pad

- DB9 Serial Plug
- Plug and Play
- Lifetime warranty



#TM-269

\$21⁰⁰ each

14" SCSI III Cables

34 Twisted Pairs with drain wire Half Pitch Db 68 Male-to-Male



#CC-693-18

\$5⁰⁰ each

CD Jewel Case

Replacement for original



#TM-CD1

\$1.40 each

10/\$.33 100/\$.25

SCSI II Terminator

Forced Perfect Terminator for SCSI II



#CA-021-FP

\$7⁰⁰ each

4/\$20.00

Labtec Microphone

Stick-on monitor or clip on shirt 6 ft. cord; condenser mic



#TM-MIC-2

\$2⁰⁰ each

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!

I-EEE 1284 Printer Cable

10' Bi-Directional DB25 Male to Mini Centronic 36 A.K.A. type "A" - "C"

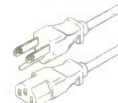
#CC-PR6-BIMIN

\$1.89 each



Standard PC Power Cord

6 foot



#CC-PWC

\$2⁰⁰ each

also available PC Power Extensions or Monitor Power

#CC-PWX

\$2⁰⁰ each

12v DC Fan

#TM-FAN

\$3⁰⁰ each

20/\$2.50

3 1/8" type; Standard replacement fan for PC/AT mini-full towers



SIMM Converter

allows 30 Pin memory to be used on 72 Pin mother board Left and right versions allow use of all available slots



#CA-MEM-A

#CA-MEM-B

#CA-MEM-C

#CA-MEM-D

\$5.00

Parallel Port

DB25 Female to 26 pin socket IDC

#CN-702 \$1.50 each

100/\$.40

#CN-702 \$1.50 each

100/\$.40

Local 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

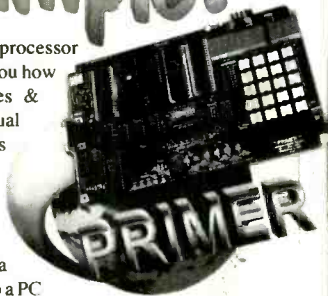
Call for quantity discounts • No out of state checks accepted • Most orders shipped same day

24895 Avenue Rockefeller, Valencia, CA 91355



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

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



59 x 40 x 14mm
 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

❖ 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.



BASIC
ELECTRICAL
SUPPLY &
WAREHOUSING
CORPORATION

- 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.I.S.W. to defraud any pay television operator, and we will not assist any company or individual in doing the same. Refer to sites pertinent for specifications.

P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775

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

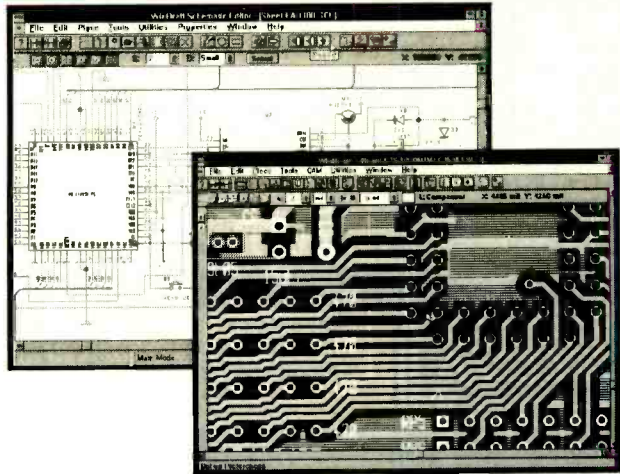
- ◆ Use True-Type fonts. Quickly copy and paste into other applications.
- ◆ Supports hierarchical designs, electrical rules checking, Annotation & Bill of Materials.
- ◆ Thousands of library parts and symbol editor included.

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 Specctra® 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 319 ON FREE INFORMATION CARD

Don't Put Your
 Baby's Health
 On The Line.

Get Prenatal Care Early
 Call 1-800-311-2229
 Confidential

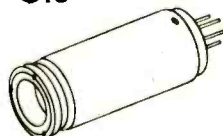
Take Care of Yourself
 So You Can Take Care of Your Baby.



**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**

December 1997, Electronics Now

**P
 C
 P
 L
 A
 C
 E**

89

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-16O - 16 channel relay output expansion board (form A relays 5A resistive)
 IO-16I - 16 channel opto-isolated input expansion board (12-24 VAC/VDC)
 IO-8ORI - 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 1A form A relays & 3 PB inputs)
 OI-TERM - RS485/RS232 connected LCD driver board (2 1A form A relays & 3 PB inputs)
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"

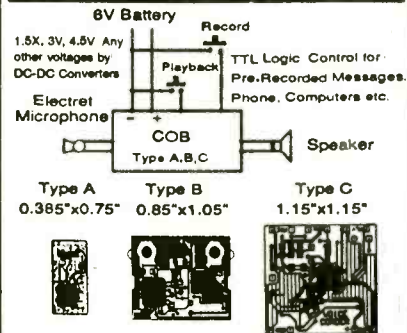
- 39 I/O + 8 A/D (10 bit) •
- 128K SRAM + 128K Flash •
- LCD/Keypad Interface •
- Fast 16 bit Motorola CPU •
- Affordable C Compiler •
- Comprehensive s/w Library •

* Intec Automation Inc. v: 250-721-5150
 www.islandnet.com/~iil 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

PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAMS DATA I/O ICE TECHNOLOGY HILO 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 MICROIV 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 L 199 EPROM 16G TO 1MEG
 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 icdevice@best.com

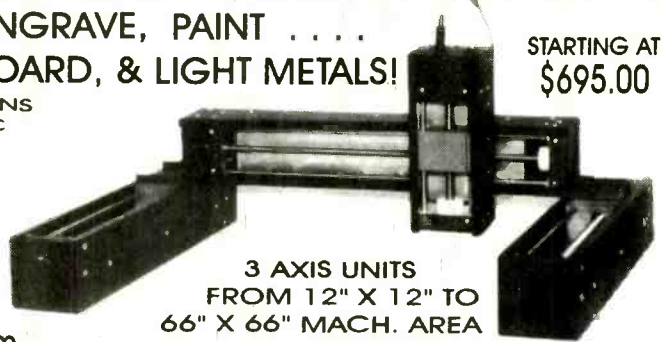
NEW! Cellphone E.S.N. readers \$250 each, cell phone programmers \$175 each, cell phones \$25 each, DSS satellite dish card readers and programmers \$125 each, credit card readers \$250 each, Cable T.V. notch filters 50 cents each, converter boxes \$50 each, magnetic strip card readers for ATM machines, bank cards, drivers license, and all types of data acquisitions all under \$200 each, You pay these super low prices when you deal directly with the manufacturers. When you order "Direct Connection" a 150 page directory published by Ed Treki Publications, you will receive the largest collection of names, addresses, and phone numbers of all the leading American and International manufacturers of these products never before available. Stop paying second, third and fourth hand prices and deal directly with the source!!! Order your copy of "Direct Connection" today for only \$99.95 plus \$5 shipping. All orders are sent C.O.D. Please call Ed Treki Publications 24 hour order hot line 914-544-2829.

ROBOTIC MACHINING

ROUTE, MILL, DRILL, CARVE, ENGRAVE, PAINT
 IN WOOD, PLASTIC, VINYL, PC BOARD, & LIGHT METALS!

STARTING AT
\$695.00

- 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



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

Cable TV Outlet



Factory Direct!



Get the Clearest Coverage of Sports, Movies, News, Main Events and Adult!

**-Unbeatable Wholesale Pricing-
-Converters/Descramblers-
-Filters and Accessories-
-Premium Channel Coverage-
-Full Satisfaction Guaranteed-**

QB VIDEO

Open M-F 9a to 5p (CT)

1-800-249-3025

Visa, MC & C.O.D.'s Welcome

!!! 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 information and antenna designs... ONLY \$14 PLUS \$2 S&H NO C.O.D.'s

Progressive Concepts
BOX 586 STREAMWOOD, IL 60107
(630) 736-9822 FAX: (630) 736-0353



Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

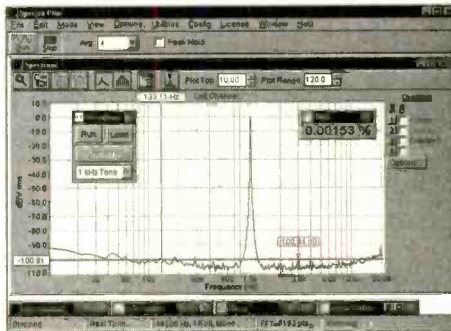
- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Digital Filtering
- Triggering, Declination
- Transfer Functions, Coherence
- Dynamic Data Exchange (DDE)
- Time Series, Spectrum 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

ALL POINTS BULLETIN !! BE ON ALERT FOR THE

PIC® KILLER! OEM (1K) PRICE \$1.99 EVAL KIT #7.00

A LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER

COMPARE:	16C54	MV1200		PINOUT:
OEM (1K) PRICE	\$2.57	\$1.99		RESET 1 20 VCC
PROGRAM DOWNLOAD	NO	YES		PD0 2 19 PB7
SINGLE CHIP OPERATION	NO	YES		PD1 3 18 PB6
BUILT-IN BASIC	NO	YES		XOUT 4 17 PB5
EEPROM DATA MEMORY	NONE	64		XIN 5 16 PB4
PROGRAM MEMORY	768 OTP	1K FLASH		PD2/INT 6 15 PB3
MATH REGISTERS	1	32		PD3 7 14 PB2
MAX INSTRUCTIONS/SEC	5M	20M		PD4/TMR 8 13 PB1/AD1
MAX COUNTER BITS	16	18		PD5 9 12 PB0/AD0
INPUT/OUTPUT BITS	12	15		GND 10 11 PD6
A TO D COMPARATOR	NO	YES		
HARDWARE INTERRUPTS	NONE	3		

® PIC IS A REGISTERED TRADEMARK OF MICROCHIP CORPORATION

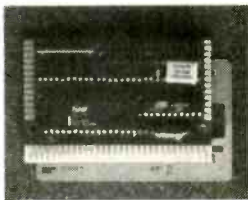
CREDIT CARD COMPUTER

OEM (1K) PRICE

\$21

EVAL KIT \$75.00

- SER PROGRAM DOWNLOAD
- 256kb NONVOLATILE MEM.
- LCD/KEYPAD INTERFACE
- ISA BUS (MODEM, MEM, ETC.)
- RS232/485 SERIAL TO 115.2KB
- ASSEMBLY/BUILT-IN BASIC
- 100 MICROAMP OPERATION



MVS BOX 850
MERRIMACK, NH 03054
(508) 792-9507

MVS

5yr Limited Warranty
Free Shipping
Hrs: Mon-Fri 10-6 EST

EPROM+ A DEVICE PROGRAMMER FOR BENCH AND FIELD



NEW!
16 MEG EPROM
SUPPORT PLUS
MORE!

SUPPORTS ALL STANDARD PARTS! USES PARALLEL PRINTER PORT!

- FIRST GENERATION EPROMS** (24 PIN) 2708, TMS2716*, 1702*, 25XX
- SECOND GENERATION EPROMS** (24, 28, 32 PIN) 2716 - 27C080 (8 MEG)
- 16 BIT EPROMS*** (40, 42 PIN) 27C1024 - 27C160 (16 MEG)
- FLASH EPROMS** (32 PIN) 28F, 29C, 29EE, 29F FAMILIES PLUS BOOT BLOCK
- EEPROMS/NVRAMS** (24-32 PIN) 28C04 - 28C010, X2210/12, ER5901, 12XX
- SERIAL EPROMS*** (ALL 8 PIN PARTS) 17, 24, 25, 35, 59, 80011, 85, 93, ER1400
- BIPOLAR PROMS*** (16-24 PIN) 74SXXX AND 82SXXX FAMILIES
- MICROCONTROLLERS*** (ALL FAMILIES) 874X, 875X, 87C5XX, 87C75X, 89C5X, 89CX051 68HC705, 68HC711, PIC12XXX - 16XXX, 17C4X PLUS FLASH AND 14000

- ◆ READ, PROGRAM, COPY COMPARE, FILE LOAD/SAVE (PLUS MORE!)
- ◆ FULL SCREEN EDITOR W/25 COMMANDS + BYTE & WORD MODES
- ◆ SOFTWARE RUNS UNDER DOS, WIN3.1/95 ON ANY SPEED MACHINE
- ◆ MADE IN THE USA • 30 DAY MONEY BACK GUARANTEE *ADAPTER REQUIRED DIAGRAMS INCLUDED

SYSTEM INCLUDES: PROGRAMMING UNIT, SOFTWARE, PRINTER PORT CABLE, PRINTED MANUAL AND POWER PACK

ANDROMEDA RESEARCH
P.O. BOX 222
MILFORD, OHIO 45150
(513) 831-9708 FAX (513) 831-7562

\$289

\$5.00 SHIPPING • \$5.00 C.O.D.
VISA • MASTERCARD • AMEX

PC PLACE

December 1997, Electronics Now

91

HOME AUTOMATION

World's Largest Selection!

**Widest Selection of
X-10 Devices Available**

Thousands 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@smarthome.com
website: smarthome.com

**Lowest Prices
Guaranteed!**

24 Hours Call 800-SMART-HOME 800-762-716

The Greatest Thing Since Sliced Bread

Our free Consumer Information Catalog lists more than 200 free and low-cost government booklets that are helpful and practical. To get your free copy, send your name and address to:

**Consumer Information Center
Department GT
Pueblo, Colorado 81009**

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.bsof.com>
E-mail: sales@bsof.com

BSOFT Software, Inc.

Phone 614-491-0832 * Fax 614-497-9971
444 Colton Road * Columbus, OH * 43207

POPTRONIX®

**Online
Edition**

We're on the web

FREE

**We are starting up,
but you can watch us grow!**

Projects for beginners to experts!
New Product information!
Bookstore—discover what's new!

<http://www.poptronix.com>

**WE'RE WITH YOU EVERY DAY
24 HOURS A DAY! DROP IN!
WE'D LOVE TO HAVE YOU VISIT!**

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

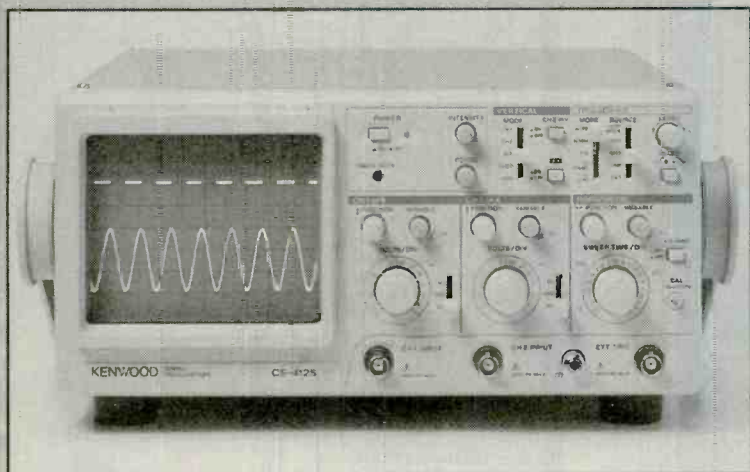
AES
Advanced Educational Systems

Call 1-800-730-3232

AES 575 ANTON BLVD., SUITE 300, COSTA MESA, CA 92626, USA

KENWOOD

...from the company you've
been listening to for years...

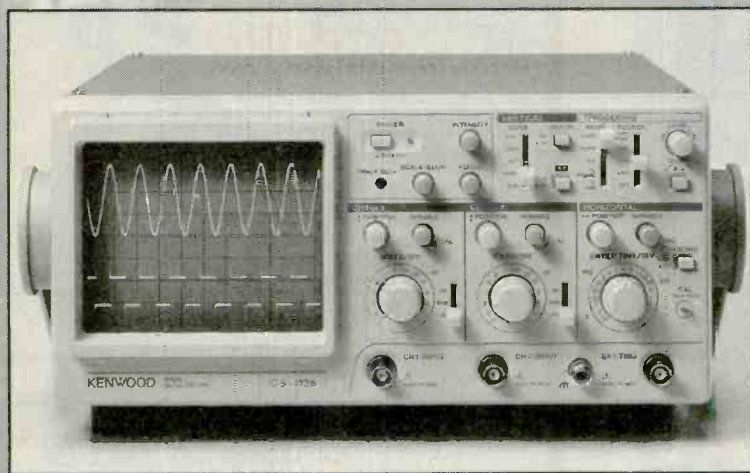


2-Channel, 20-MHz

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)



PRINT[™]
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

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

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: 075/175/475	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 316 ON FREE INFORMATION CARD



- PRODUCT ENGINEERING
- FIRMWARE DEVELOPMENT

"QUALITY IS OUR CAPITAL CONCERN."

- MICRO CONTROLLER & EPROM HARDWARE & SOFTWARE DEVELOPMENT

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 PROTOYPES 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

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. \$59.⁰⁰ or 2 for \$109.⁰⁰ or
 OPTREX. DMF5005 (non back-lit) \$49.⁰⁰ or 2 for \$89.⁰⁰
 20 character x 8 line 7xL x 2xH The built-in controller allows you to do text and graphics.

Alphanumeric—parallel interface

16x1.....\$7.00	20x2.....\$10.00	32x2.....\$8.00
16x1 (lg. char.).....\$10.00	20x4.....\$15.00	40x1.....\$8.00
16x2.....\$7.00	20x4 (lg. char.).....\$10.00	40x2.....2 for \$20.00
16x2 (lg. char.).....\$10.00	24x2.....\$10.00	40x4.....\$20.00
16x4.....\$15.00	32x4.....\$10.00	4x2.....\$5.00

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 \$25⁰⁰

LASER PRODUCTS

HeNe Laser Head (10mw max. output) TEM00, 15.5" long MFG: NEC \$89.⁰⁰

Laser Power Supply (for HeNe tube) \$79.⁰⁰

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, \$15⁰⁰

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 \$69⁰⁰

Ten-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 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)

POS & BAR CODE

MAGNETIC CARD READER \$25.⁰⁰

Includes: • 20 character dot matrix display with full alpha-numeric capability • keyboard 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 SUPPLYS \$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

60 WATT Dim: 8 1/2 x 4 1/2 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. \$500⁰⁰ Original cost device

Sony CCD Imager - designed for black and white composite video

cameras. Picture elements: 384 (H) x 491 (V) \$29⁰⁰

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# D16AL

4096 element CCD \$15.00

1024 element CCD \$10.00

2048 element CCD \$10.00 • 1728 element CCD \$10.00

MISCELLANEOUS

ADAPTEC 4070A (RLI) OR 4000A (MFM), SCSI Controller, your choice \$25⁰⁰

IBM 370 option XT and AT emulation boards \$25⁰⁰

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 \$69⁰⁰

9" COLOR SVGA MONITOR \$249.⁰⁰

Fully Enclosed - Tilt and swivel type.

HACKER CORNER

Encased Spread Spectrum RF Modem \$199.⁰⁰

The ProxLink Radio Module is a small communication device which replaces cables between RS-232 devices with wireless RF (Radio Frequency) technology. Attaching a pair of ProxLinks to any two devices with three wire asynchronous RS-232 ports allows wireless data transmission at rates up to 19.2 Kbaud (full duplex) over a range of 500 - 800 feet. Modules use 900 MZ spread spectrum radio for communication which does not require an FCC site license. A variety of configuration information (radio channel, baud rate, serial port configuration, etc.) can be programmed into module's non-volatile memory by host PC to provide compatibility and avoid overlapping systems. Configuration changes are supported by menu driven, on-board software. Commonly used Terminal Emulation software and transfer protocols can be used for configuring modules and transferring data between computers. ProxLinks require only 6-9 VDC (350 mA), RS-232 (9 pin sub - D) interface, and small (~ 4") whip antenna for operation. Unit size is 4.0" x 6.5" x 0.75". Installation schematics and application details available.

US made Micronics 486 VLB ALL in ONE \$39.⁰⁰ or 2 for \$69.⁰⁰

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 • 101x • 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 (LCX005BK8) \$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 TRANSCIVER \$49.⁰⁰ 2 for \$99.⁰⁰

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 Hz 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 18.990 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 1/2 W x 1 1/2 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 • 21 Key Domed Membrane Keypad • Intel 80C32 Processor • 2 PCMCIA Sockets (RAM/ROM) • Dallas DS1287 Realtime Clock • 2 Solid State Buzzers (Piezo Electric) • 4 Connectors • Rockwell ROM Chip • Telephone Line Interface (4 Pin "RJ" Connector) • RS-232C Interface (8 Pin "D" Connector) • Battery Pack Inside
 Note: We have a 30 day money back guarantee on this unit. This, while time of day and other introductory things are involved. The original capabilities of this unit cannot be guaranteed. Also, we do not have a sound, the 30 day money back guarantee was to go in the PCMCIA sockets. Requires 12 volt adapter for power. (Not included) Dimensions: 9-1/2 L x 6-1/4 W x 2-1/2 D • Original cost over \$450.00

SOLD OUT

Minimum Order: \$20.00. Minimum shipping and handling charge \$5.00. We accept cashiers 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.

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

Plug Power

UNIT OF INCRE DESIGNS INC.

The Smallest*, Lightest*, Coolest*,
5% Regulated, 10 Watt DC
Power Supplies are here!

* 1.9 x 2.1 x 1", 2.9 oz. Tiny, aren't they?

VDC @ Amps

5.0	1.6
9.0	1.1
12.0	0.8

\$29.95

SINGLE Qty. US\$
* NEXT DAY or 2 DAY AIR



SIX PlugPower in ONE power strip! See the web site!

Detailed Specs on web site!

www.plugpwr.com

CALL FREE in US & Canada:

1-888-PLUGPWR

(1-888-758-4797)

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., #465, Forest Hills, NY 11375. NO NY5 SALES.

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 cameras \$159⁰⁰, telephone recording systems: 7-Hour \$125⁰⁰ - 10-Hour \$139⁰⁰ - 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) 695-8660/(716) 691-3476

BUGGED??

EAVESDROPPING 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

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
FREE SHIPPING Visa • MC • Amx • Disc • COD's • Qty Pricing

CIRCLE 329 ON FREE INFORMATION CARD

CABLE TV CONVERTERS

Equipment & Accessories
Wholesalers Welcome

Call C&D ELECTRONICS

1-888-615-5757 M-F 10a-6p

TECHMART

Great buys on test equipment from industry leaders like Amrel, B&K, Biddle, Fluke, LG Precision, Hameg, Protek, Ramsey & Tektronix

Digital Oscilloscopes

New From Fluke!

- Model 123 Scopemeter
• 20 Mhz, dual channel
• Connect-and-View
• "Paperless" recording
• True RMS, 5000 count
• NiCd battery

FLUKE

123 Scopemeter, 2x20 Mhz	\$945
123S Scopemeter with RS232, software, hard case	\$1225
92B Scopemeter, 2x60 Mhz	\$1440
96B Scopemeter, 2x60 Mhz	\$1695
98 Automotive Scopemeter	\$2495
99B Scopemeter, 2x100Mhz	\$2085

- HAMEG
Model HM1507 Analog/Digital Oscilloscope
• 150 MHz, 2 chan.
• Dual time base
• 200 MS/s sampling
• Autoset, CRT R/O
• RS232 included



HM1507 Analog/Digital, 2x150 Mhz	\$1880
HM305 Analog/Digital, 2x30 Mhz	\$1035

TEKTRONIX

THS720A TekScope, 2x100MHz, DMM, 5mV/div, NiCd, RS232	\$2195
TDS220 2x100MHz, 1GS/s, cursors, LCD, Opt'l. RS232, 3.25 lbs!	\$1645
TDS210 Like TDS220 except 60 Mhz	\$945

Analog Oscilloscopes

HAMEG

HM1505 2x150 Mhz, 1 mV/div, Auto-Set, CRT R/O cursors, 2 T.B., RS232	\$1395
HM1004 2x100 Mhz, 1 mV/div, Auto-Set, CRT R/O cursors, 2 T.B., RS232	\$1295
HM304 2x35 Mhz, 1 mV/div, Auto-Set	\$835

LG Precision

OS9100P 2x100MHz, 2mV, delay swp.	\$899
OS9060D 2x60MHz, 1mV, delay swp.	\$783
OS9020A 2x20MHz, 1mV/div.	\$349
OS9020G 2x20MHz, w/1MHz func gen.	\$487

Digital Graph Meters

New, Improved, lower cost Fluke 867B

Graphical Multimeter

- 0.025% DCV Accuracy
- 300 KHz AC Meter BW
- 1 MHz Waveform BW
- 10 MHz Freq. Counter
- Component Test
- Logic Test



FLUKE

867B Graphical Multimeter	\$660
863 Like 867 less B/L, logic, etc.	\$470

Digital Multimeters

Fluke

10 V, R, 4000 ct.	\$59
11 V, R, uF, 4000 ct.	\$68
12 V, R, uF, Min/Max, 4000ct	\$81
16 V, R, uF, uA, %C, 4000ct	\$119
21 Like 75; yellow case	\$134
23 Like 77; yellow case	\$161
25 V, R, mA, MillSpex (shock, vibration, water)	\$199
27 V, R, mA, Min/Max, MillSpex (shock, vibration, water)	\$269
29 II Like 79; yellow case	\$179

12

27

79

87

70 II V, R, 3200 ct.	\$79
73 II V, R, A, 3200 ct.	\$97
75 II V, R, mA, 3200 ct.	\$129
76 RMS V, R, mA, LoR, uF, Hz, 4000 ct., Holster	\$179
77 II V, R, mA, 3200 ct., hstr	\$154
79 II V, R, mA, LoR, uF, 4000 ct., hstr.	\$175
787 DMM, process calbrtr.	\$445
83 V(.3% DC), R, uF, mA, Hz, Min/Max, rel., 4000 ct., hstr	\$235
85 V(.1% DC), R, uF, mA, Hz, Min/Max, rel., 4000 ct., hstr	\$269
87 RMS V, R, uF, mA, Hz, Min/Max, rel., 4000 ct., hstr	\$287
88 Automotive Meter	\$379
8060A RMS V(.04% DC), R, LoR, mA dB, dBm, rel., Hz, S, 19,999 ct.	\$413

Digital Multimeters

Versatile PROTEK 506

- AC/DCV, AC/DC A, Ohms
- True RMS, dBm
- 10 MHz frequency counter
- Min/Max, relative
- Capacitance, inductance
- Dual display
- RS232 interface

506 Digital Multimeter w/software	\$184
505 Like 506 but no RS232	\$148
D910F Multimeter V, mA, R, Hz, uF, hfe	\$94

Spectrum Analyzers

B&K Model 2625

- 0.15 to 1.05 GHz
- 100kHz-100MHz/div.
- -100 to +13 dBm
- 4 digit Freq/Marker display

Model 2625 Spectrum Analyzer	\$2395
Model 2630 2625 w/tracking gen.	\$2995
Model 2615 500 mHz Analyzer	\$1595
Model 2620 2615 w/tracking gen.	\$1895

Power Supplies

B&K 1670 Triple Output

- Variable 0-30 VDC, 0-2.5A
- 12 VDC fixed, 500 mA
- 5 VDC fixed, 500 mA
- 3 digit LCD's for VDC, ADC

B&K 1670 Triple Output DC Supply	\$189
B&K 1680 13.8 VDC fixed, 6 A peak	\$48
B&K 1682 13.8 VDC fixed, 15 A peak	\$94
Protek 3033B, 2x±30V, 1.5A, 5V, 5A	\$495

AMREL Programmable Power Supplies

- Standard GPIB
- Ext. DCV program Input
- 1mV, 1 mA regulation
- Three year warranty

Model PPS1302A 0-30 VDC, 0-2.5A	\$795
Model PPS1326 0-16 or 0-30 VDC	\$1195

Others available. Call, or visit www.amrel.com

General Test & Measurement

Audio & Function Generators

- 0.2 to 20 Mhz
- AM/FM Modulation
- 5 Digit Display
- 30 Mhz counter

4040

B&K 4040 20 Mhz Swp/Func Gen.	\$475
B&K 4017 10 Mhz Swp/Func Gen.	\$349
Protek B803 2 Mhz Swp/Func Gen.	\$299
Protek B820 200 kHz Audio Gen/Ctr.	\$228

Frequency Counters, Counter/Timers

- LG Precision FC2015 Counter/Timer, 0.2 Hz-150 Mhz, 8 digit display
- LG Precision FC2130 Counter/Timer, 0.2 Hz-1.3 GHz, Hi-Z & 50Ω inputs

Capacity Meters, RLC Bridges

- AMREL AR470D Wide range, high acc. \$195
- B&K 878 Wide range, dual display \$259
- B&K 810B Cap. meter, 0.1 pf-20 mf. \$95

Power/Harmonics Meters, Clamp Meters

- Fluke 41B Power/Harmonics Meter
- True RMS, 5V-600V
- True RMS current, 1A-500A
- Active power 10W-300kW
- Apparent power & PF
- Frequency & Harmonics

Fluke 41B Power/Harmonics Mtr.	\$1530
Fluke 39 (41B, less isolated RS232)	\$895

SPECIALS CORNER

- Excess, discontinued or old stock. ALL NEW!
- Bird 4304 Wattmtr, to 500W, 1000MHz \$299
- Fluke 40 Power/Harmonics Mtr. \$695
- Fluke 51 Digital Thermometer \$105
- Fluke 8062A Digital Multimeter \$299
- Fluke 8020B Digital Multimeter \$179
- Fluke 8021B Digital Multimeter \$159
- Fluke 801010 AC/DC Clamp Probe \$228
- Fluke 610 LAN Cabelmapper \$299
- Zircon ZTL137 Telco Exch. Simlir. \$399

800-554-8305

We accept VISA/Mastercard.
Shipping charges 4%; \$5 min., \$20 max.
pentec@bellsouth.net, Fax 770-772-9780

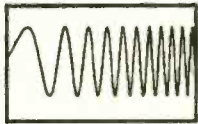
Any waveform you want!



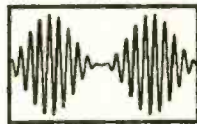
Starting at
\$795
Quantity 1
Money back
guarantee

- **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**

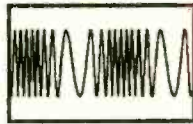
Telulex Inc. model SG-100



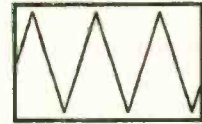
DC to 20 MHz linear
and log sweeps



Int/Ext AM, SSB,
Dualtone Gen.



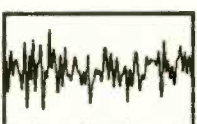
Int/Ext FM, PM,
BPSK, Burst



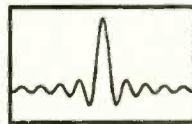
Ramps, Triangles,
Exponentials



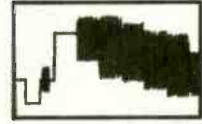
Pulse Generator



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

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: **Also Available:**

- 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!

- 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>

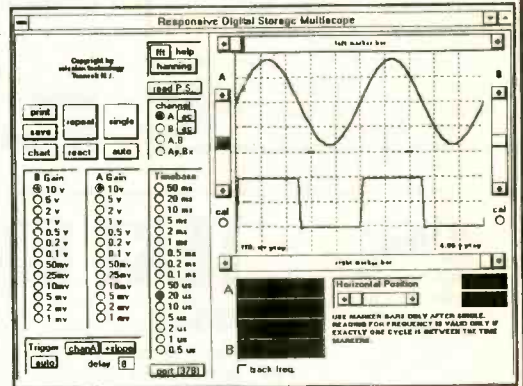
172 Harvard Road
Waterloo, ON N2J 3V3
CANADA
+1-519-886-4462 (ph.)
+1-519-886-4253 (fax)
support@siriusmicro.com

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.



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.



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

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

EDITORIAL

continued from page 4

certain test markets sometime this spring.

Will Divx fly? No one is certain. Proponents give it a resounding yes. However, many insiders in the home-video industry say that it is DOA, and might have a hard time even getting shelf space anywhere outside of Circuit City's stores (Circuit City owns a majority stake in Digital Video Express L.P., the developer of Divx). But one thing is certain: Throwing confusion into an emerging market is never a good thing. The timing here is such that holiday sales could fall well short of expectations, and thus stunt the growth and delay the acceptance of DVD, perhaps even enough to kill it.

we are certain you will enjoy. Called Prototype, each month it will offer a peek inside company R&D departments and university laboratories world wide. Once there, we'll peer over the shoulders of researchers and technicians to learn about emerging technologies, new trends in electronics, and exciting products under development.

Sure, some are certain to be merely pipedreams, destined to never see the outside of a lab, but others could profoundly affect our personal and professional lives some day. Which is which? Ahh, there's the fun, as no one can be certain; you'll just have to read and judge for yourself.



Carl Laron
Editor

Write PIC programs in **BASIC!** \$99⁹⁵



PicBasic Compiler

BASIC makes it easy for you to program the fast and powerful Microchip PIC microcontrollers.

- ♦ Expanded BASIC Stamp 1 compatible instruct'ns
- ♦ 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>



Introducing Prototype
On a more pleasant note, we are proud to introduce a fascinating new feature that

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**

EXERCISE.

American Heart Association



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 313 W. Main St. Fairborn, OH 45324 (937) 878-9878

CABLE TV CONVERTERS

Equipment & Accessories
Wholesalers Welcome

Call **C&D ELECTRONICS**
1-888-615-5757 M-F 10a-6p

TEST EQUIPMENT SALES

customer satisfaction #1 priority!

MC & VISA ACCEPTED

TEK 2465-05.....\$4295
350 MHz 4 channels with TV trigger opt. CRT readout, delta volts, cursors, delayed sweep, time measurement and save features.

HP3325A-002.....\$2195
Synthesizer/Function Generator with high voltage option.

HP 4275A-001.....\$5195
Multifrequency LCR meter

HP 8111A\$1695
20 MHz Pulse Generator

HP 3314A\$2895
Multi-Waveform Generator

BRAND NEW W/ 3 YR. MFG. WARRANTY

TEK THS710.....\$1575
60 MHz handheld digital scope

TEK THS720.....\$1925
100 MHz handheld digital scope

FLUKE 105B.....\$2195
100 MHz scope complete with PC software

FLUKE 45.....\$595
dual display DMM

NEW SCOPES IN STOCK

P.O. BOX 986
LONDONDERRY, NH 03053

PHONE (800) 684-4651
FAX (603) 425-2945

ASK ABOUT OUR NEW
TEKTRONIX & FLUKE
PRODUCTS

* 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 \$ 7.85 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.

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.

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 !

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.

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.

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.

3 1/2 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.

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.

300W High Power Mono Amplifier TA-3600 (5 lbs.) ▲▲▲



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

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.

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

Metal Cabinets

Aluminum Front Panel

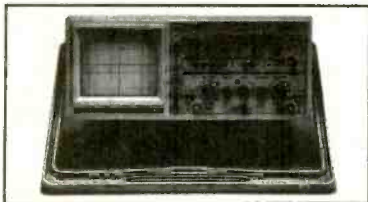
- LG-1273 3x12x7" (4 lbs.) \$ 26.50
- LG-1684 4x16x8" (7 lbs.) 32.50
- LG-1924 4x19x11 1/2" (10 lbs.) 38.25
- LG-1925 5x19x11 1/2" (10 lbs.) 42.00
- LG-1983 2 1/2 x 19 x 8" (7 lbs.) 35.25

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.

CIRCLE 215 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!

VISA MasterCard AMEX C.O.D. **TOLL FREE 1-800-99-METER**

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!

See us on the Web!
www.fotronic.com

1-800-996-3837

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

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

CHECK CAPACITORS IN-CIRCUIT WITH 100% ACCURACY IN 3 SECONDS---GUARANTEED

Automatically discharges capacitor, checks for DC leakage (DCR) and beeps below your preset value, measures ESR on LED bar and beeps from 1 to 5 beeps for values from good to bad.

- ONE-HANDED GOLD-PLATED TWEEZER PROBE
- HANDY 3-COLOR CHART SHOWS TYPICAL READINGS
- 20 SEGMENT LED METER DISPLAYS ESR FROM 0.1 TO 20 OHMS
- PORTABLE, RUNS ON AAA BATTERIES



* 60 DAY TRIAL PERIOD WITH MONEY-BACK GUARANTEE AVAILABLE FROM MOST MAJOR DISTRIBUTORS

(561) 487-6103 VISA MasterCard DISCOVER **\$169**

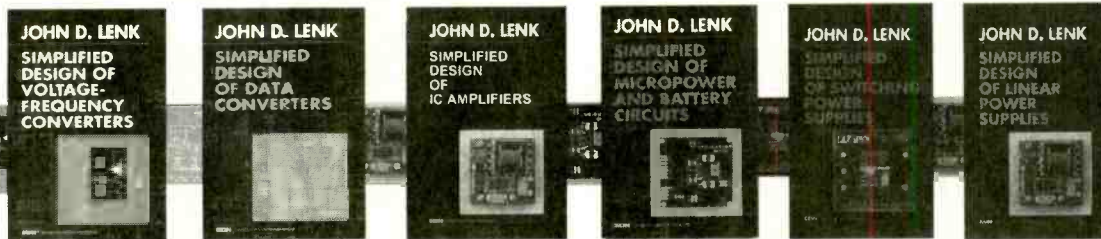
ELECTRONIC DESIGN SPECIALISTS

we make test equipment designed to make you money

Key Titles from...



Buy more than 1 book and take 15% off total order



Simplified Design of Switching Power Supplies

by John D. Lenk
1996 • 225pp • pa • 0-7506-9821-7 • \$29.95

Simplified Design of IC Amplifiers

by John D. Lenk
1996 • 240pp • pa • 0-7506-9508-0 • \$29.95

Lenk Series

Simplified Design of Voltage-Frequency Converters

by John D. Lenk **NEW**
September 1997 • 304pp • pa • 0-7506-9654-0 • \$29.95

Simplified Design of Data Converters

by John D. Lenk **NEW**
April 1997 • 242pp • pa • 0-7506-9509-9 • \$29.95

Simplified Design of Linear Power Supplies

by John D. Lenk
1996 • 246pp • pa • 0-7506-9820-9 • \$29.95

Simplified Design of Micropower and Battery Circuits

by John D. Lenk
1996 • 240pp • pa • 0-7506-9510-2 • \$29.95

Audio Power Amplifier Design Handbook



PC Card



PCB Design Using AutoCAD
by Chris Schroeder
Aug 1997 • 336pp • pa • 0-7506-9834-9 • \$44.95

Inside PC Card
by Faisal Haque
1996 • 352pp • ha • 0-7506-9747-4 • \$52.95

Audio Power Amplifier Design Handbook
by Douglas Self
1996 • 256pp • pa • 0-7506-2788-3 • \$34.95

Understand Electronic Filters
by Owen Bishop
1996 • 180pp • ha • 0-7506-2628-3 • \$26.95

High Performance Audio Power Amplifiers
by Ben Duncan
1996 • 288pp • ha • 0-7506-2629-1 • \$59.95



Digital Storage Oscilloscopes
by Ian Hickman
1996 • 208pp • pa • 0-7506-2856-1 • \$39.95



More Books from Newnes

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-BOOK 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 or company purchase order is required for all orders. 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.

A member of the Reed Elsevier plc group

TS232

Visit our web site: <http://www.bh.com/newnes>

December 1997 Electronics Now

CALL TOLL FREE
(800) 292-7711 orders only
Se Habla Español

C&S SALES

EXCELLENCE IN SERVICE

LOOK FOR OTHER
MONTHLY SPECIALS
ON OUR WEBSITE

NEW XK-700 Digital / Analog Trainer

Elenco's newest 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 waveforms and a 1560 tie point breadboard area. Tools and meter shown optional. (Mounted in a professional tool case made of reinforced metal).

XK-700
Assembled and Tested
\$189.95

XK-700 - SEMI KIT
w/ Fully Assembled PC Board
\$174.95

XK-700K - Kit
\$159.95



Made in the USA

Volt Alert™ By FLUKE

Volt Alert™ is the new pocket-sized AC line voltage detector from Fluke. Easy to use - just touch the tip to an outlet or cord. When it glows red, you know there's voltage in the line.

Electrician's, maintenance, service, and safety personnel can quickly test for energized circuits and defective grounds on the factory floor, in the shop, or at home.

- Fits in shirt pocket for convenience
- All outer surfaces are unconductive for safety
- Detects voltage metallic contact.

#1AC **\$19.50**



DIGITAL LCR METER

Model LCR-1810 **NEW**

\$99.95



- Capacitance .1pF to 20µF
- Inductance 1mH to 20H
- Resistance .01Ω to 2000MΩ
- Temperature -20°C to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

20MHz Sweep / Function Generator with Freq Counter

B&K 4040

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

10MHz B&K 4017 \$309
5MHz B&K 4011 \$239



\$399

15pc VCR Service Tool Kit

TK-1400



Ideal for both the do-it-yourself or the professional. 15 tools in a black vinyl case.

\$31.95

Model XP-581

4 Fully Regulated DC Power Supplies In One Unit
4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

\$89.95



SATELLITE FINDER

Model SF-100A



- Aligns Satellite Dishes
- Range 950-2050MHz
- Audio Tone
- Compact Size
- Self Power Check

\$39.95

Digital Multimeter

Model M-1700

\$39.95

11 functions including freq to 20MHz, cap to 20m F. Meets UL-1244 safety specs.



Technician Tool Kit

TK - 1500



28 tools plus a DMM contained in a large flexible tool case with handles ideal for everyone on the go.

\$49.95

Kit Corner

over 100 kits available

AK-700

\$14.95

Phone kit with training course.



REMOTE CONTROL CAR KIT

MODEL AK870



- 7 functions
- Remote control included

\$24.95

No Soldering Required

Model AM/FM-108K

Transistor Radio Kit

with training course

\$29.95



35mm Camera Kit

Learn all about photography

\$14.95 AK-540



No Soldering Required

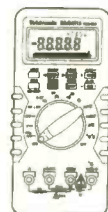
The New DMM900 Series Handheld Digital Multimeters

For high-performance digital multimeters that are accurate, reliable, and rugged, the DMM900 Series extends the Tektronix line of already affordable DMMs. Twice the accuracy. Up to 10 times the resolution. And a full range of capability that spans voltage, current, digital multimeters features a dual numeric display, 3-year warranty, and autoranging capability. All backed by the reliability of the Tektronix brand.

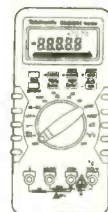
Features

DMM912, DMM914, DMM916

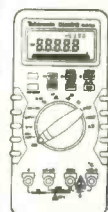
- 40,000 Count Display
- 0.06% Basic DC Volts Accuracy (DMM916)
- DC Voltage Ranges from 400mV to 1,000V
- AC Voltage Ranges from 4V to 750V (True RMS)
- AC and DC Current Ranges from 10,000µA to 10A
- Resistance Ranges from 400Ω to 40MΩ
- Capacitance Ranges from 4nF to 40µF
- Frequency Ranges from 400Hz to 2MHz
- Temperature Measurements from -50°C to +980°C (DMM916, DMM914)
- 3 Year Warranty
- CE Marking



DMM 912
\$189



DMM 914
\$235



DMM 916
\$275

GUARANTEED LOWEST PRICES ON TEK DMMs

WE WILL NOT BE UNDERSOLD 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

Same Day
Shipping

C & S SALES

Your one stop source for
all your electronic needs!

CALL OR WRITE FOR OUR
NEW FREE 64 PAGE
CATALOG!
(800) 445-3201

Fluke Scopemeters



123...NEW..... \$950
92B..... \$1445
96B..... \$1695
99B...NEW..... \$2095
105B..... \$2495

**ALL FLUKE
PRODUCTS
ON SALE**

B & K PRECISION SCOPES

100MHz THREE-TRACE

Model 2190A



- 1mV/division sensitivity
- Sweeps to 5ns/division
- Dual time base
- Signal delay line
- 15KV accelerating voltage

\$1295.00

60MHz DUAL-TRACE

Model 2160



- 1mV/division sensitivity
- Sweeps to 5ns/division
- Dual time base
- Signal delay line
- V mode - displays two signals unrelated in frequency
- Component tester

\$895.00

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

\$695

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 2120B - 2 Year Warranty

Special \$375

Model 2125A with delayed sweep

\$539.95



- 1mV/division sensitivity
- AUTONORM 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 - \$1695
Model 2620 w/ tracking
generator - \$1895

1.05GHz Series

Model 2625 - \$2395
Model 2630 w/ tracking
generator - \$2995



Quality Scopes by Elenco

Lowest Prices of the Year!



60MHz

DS-603 **\$1350**

- Analog / Digital Storage
- 20MS/s Sampling Rate

S-1360 **\$749**

- Analog with Delayed Sweep

100MHz

S-1390 **\$995**

- Analog

Includes
Free Dust
Cover and
Probes



25/30MHz

DS-303 30MHz **\$1095**

DS-203 20MHz **\$725**

- Analog / Digital Storage

S-1330 **\$439**

- 25MHz Analog
- Delayed Sweep

S-1325 **\$325**

- 25MHz Analog

**2 Year
Warranty**

SIMM MODULE TESTER

B & K 898

\$625

- Tests 72 and 30 pin SIMMs to 36 bits.
- Stand alone and portable. No other equipment required.
- Automatically identifies width, depth and speed of SIMMS.
- 10 built-in tests identify most memory defects Preheat cycle prior to test.



PORTABLE SEMICONDUCTOR TESTER

B & K 510

- In or out-of-order circuit tests for transistor, FETs, SCRs and darlington.

\$199.00



Fluke Multimeters

Model 701I	\$75	Model 83	\$235
Model 731I	\$97	Model 85	\$269
Model 751I	\$129	Model 87	\$289
Model 771I	\$154	Model 863E	\$475
Model 791I	\$175	Model 867BE	\$650

B&K Precision Multimeters

Model 391	\$143	Model 388A	\$99
Model 390	\$127	Model 2707	\$75
Model 389	\$109	Model 2860A	\$79
Model 5390	\$295	Model 5370	\$219
Model 5380	\$265	Model 5360	\$195

MX-9300

Four Functions in One Instrument

Features:

- One instrument with four test and measuring systems:
 - 1.3GHz Frequency Counter
 - 2MHz Sweep Function Generator
 - Digital Multimeter
 - Digital Triple Power Supply
- 0-30V @ 3A, 15V @ 1A, 5V @ 2A



\$459⁹⁵

GUARANTEED LOWEST PRICES

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
http://www.elenco.com/cs_sales/



15 DAY MONEY BACK
GUARANTEE

FULL FACTORY WARRANTY
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

Smart Battery Charger



JUN 87 QST
BY WARREN DION N18BB

FOR GEL-CELLS or LEAD ACID BATTERIES.
Features: Precision temperature tracking voltage reference & three mode charging sequence. Standard kit is for 12V @ 1/2 or 1 Amp, user selectable. Can be connected to the battery indefinitely, will not overcharge. Weighs 2 pounds and measures 4"W x 5 1/2"D x 2 1/2"H. Finished enclosure included in kit.

Complete Kit Only \$59.95
Assembled & Tested \$79.95

CA Residents add 7.75% sales tax. S&H: \$5.00 (insured). Foreign orders add 20%. For more info or price list; send legal size SASE (\$2e) to:

A&A Engineering
2521 W. La Palma #K • Anaheim, CA 92801
(714) 952-2114 • FAX: (714) 952-3280



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\$79.95, our Starter Package (AD1ISP) 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 68HC811E2, 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 • AmericanExpress • Discover
TECHNOLOGICAL ARTS
308 Aragona Blvd., Suite 102, Box 418, Va. Beach, VA 23462
1644 Bayview Avenue, Box 1704, Toronto, ON M4G 3C2
voice/fax: (416) 963-8996 www.interlog.com/~techart

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

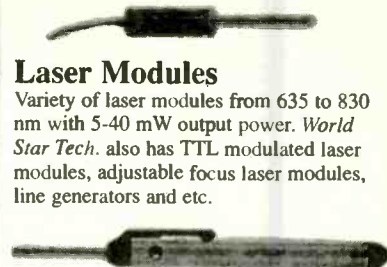
Printed Circuits in Minutes Direct From LaserPrint!

- 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 Inquires Invited



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>

Slot Machines \$ 599.00



- Free Shipping
- Slot Machine Demo Video \$ 5.99
- 40 - Minutes
- 33" High 20" Wide 14" Deep
- Brochure \$ 1.00
- Magic Box
- Test Chips
- Filter Kits
- Notch Filters

Video Media www.nutnet.com
P.O. Box 93/6025
Margate, Fl. 33093
(954)-752-9202

UPGRADE YOUR COMPUTER!

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) \$20	WD 1 2Gb IDE \$185	33.6 Int Fax/Modem \$68
4Mb (1x32-80 ns) \$18	WD 1 8Gb IDE \$200	33.6 Int USR Fax/Modem PNP \$150
8Mb (2x32-80 ns) \$34	WD 2 1Gb IDE \$215	33.6 Ext USR Fax/Modem PNP \$175
16Mb (4x32-60 ns) \$64	WD 2 5Gb IDE \$230	33.6 Int USR Fax/Modem voice \$185
32Mb (8x32-60ns) \$125	WD 3 1Gb IDE \$250	56k Int Supra Fax/Modem voice \$180
32Mb (4x64-10ns) \$150	WD 4 0Gb IDE \$325	
CPU's	Video Cards	Sound Cards
AMD K5-90 \$55	256K ISA VGA \$24	16-bit Sound Blaster Pro compatible \$20
AMD K5-PR100 \$80	Trend 8900 1Mb \$32	16-bit Sound Blaster \$55
AMD K6-200 \$330	ISA SVGA \$32	Sound Blaster 32 PNP \$95
Cyrix 685-P166+ \$85	Cyrix Logic 5429 1Mb \$38	
Cyrix 686-P200+ \$120	YLB SVGA \$38	
Cyrix MK 200 \$290	Trend 9680 1Mb PCI SVGA w/MPEG \$38	
Intel Pentium 133 \$145		
Intel Pent 200mhz \$290		
Intel Pent 233mhz \$500		
Motherboards	Miscellaneous	Controller Cards
486px PCI 256K \$95	1.44Mb FDD \$28	ISA MUX I/O IDE \$13
Pentium Intel Triton2 VX 512K L2, dimms \$105	1.2Mb FDD \$55	PCI Adaptec 2940 SCSI-2 test \$200
Pentium Intel Triton2 TX 512K L2, dimms \$155	8X CD-ROM IDE \$80	
Pentium Intel Triton2 TX 512K L2, ATX \$150	16X CD-ROM IDE \$95	
	HP T3000 3.2 gb tape backup \$220	
	3-button serial mouse \$9	
	101-keyboard \$16	

Prices and availability subject to change without notice.
CALL FOR DAILY LOW PRICES!

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>

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.



Wireless Video Headquarters



The Cube



World's Smallest TV Transmitter

Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies- that's a nickel in the picture! Transmits color or B&W up to 150' to any TV tuned to cable channel 59 with a solid 20 mW of power. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Deluxe model includes sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Our cameras shown below have been tested to mate perfectly with The Cube and work great. Fully assembled.

- C-2000 Video Transmitter Cube.....\$89.95**
C-3000 Video and Audio Transmitter Cube.....\$149.95



CCD Video Cameras

If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. These cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, these are super IR (Infra-Red) sensitive! Available with Wide-angle (80°) or super slim Pin-hole style lens. Both run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our Interface board (below) for Audio sound pick-up and direct wire connection to any Video monitor or TV video/audio input jacks. Fully assembled.

CCDWA-2 CCD Camera, wide-angle lens.....\$99.95
 CCDPH-2 CCD Camera, slim fit pin-hole lens.....\$99.95

CCD Camera Interface Board

Here's a nifty little kit that eases hook-up of your CCD camera module to any video monitor, VCR or video input TV set. The board provides a voltage regulated and filtered source to power the camera (CCD Cameras require a stable source of power for best operation), sensitive electret condenser mike for great sound pick-up and RCA Phono jacks for both audio and video outputs. Runs on 11 - 20 VDC.



- IB-1 Interface Board Kit.....\$14.95**

Budget TV Transmitter



Transmit audio and video to any TV set with this fully assembled transmitter. Although not tiny, it still offers some neat features. Takes standard 1 volt p-p video and audio and transmits on any UHF TV channel of your choice from 17 - 42. Has rugged metal case, includes AC adapter, whip antenna and even RCA phono plug patch cords! Can also run on 12 VDC.

- VS-2 Video and Audio Sender, Fully Assembled.....\$29.95**

IR Illuminator for CCD Cameras

See in total darkness with one of our CCD video cameras and this IR illuminator! IR light can't be seen, illuminate the scene with IR and a CCD camera 'sees' just fine. The array of 24 extra high intensity LEDs are invisible to anybody - except for aliens and Casper! Runs on 12 VDC. Illuminates similar to that of a bright flashlight.



- IR-1 IR Illuminator Kit.....\$24.95**

MicroEye CCD Camera & Transmitter Combo

We married together one of our quality CCD cameras, a sensitive electret microphone and a small TV transmitter to give you a super neat - and tiny - all in one, 'knows all, sees all, hears all' package! Small enough to fit into a cigarette pack and powerful enough to transmit up to 150' to any standard TV set. Tunable to operate on TV channels 4, 5, or 6 and runs on 9 to 20 VDC. The sensitive mike picks up normal voice within an average size room. Ideal for private detectives, investigators, hobbyists, babysitters, model rocketeers, RC airplanes and other uses limited only by your imagination. Camera module is fully wired and the transmitter unit is an easy to build kit that goes together in an evening. Includes all parts, handsome jet-black case and clear, concise instructions with ideas for use. And, don't forget, our CCD cameras are very sensitive to IR light - just add the IR-1 IR Illuminator kit for see-in-the-dark operation!



- ME-2000 MicroEye TV Transmitter Combo\$149.95**

Wavecom Wireless Video and Audio Transmission System

Transmit extremely clean and sharp video and audio up to 300 feet. Wavecom transmits in the 2.4 GHz band using FM and circular polarization for state-of-the-art transmission. There is no fading, ghosting, humming, buzzing or picture rolling when using the Wavecom. System consists of two parts, a transmitter unit and a receiver unit. Switch selectable 4 channel operation allows use of multiple Wavecoms in the same geographic area. Connections are video and audio in and out using standard RCA phono jacks. Includes AC wall plug adapters, patch cords, coax cable jumper, TV antenna A/B switch and complete hook-up instructions. Fully assembled with one year warranty.



The Wavecom Sr. has all of the features above plus adds the capability of transmitting your TV/DSS/VCR remote control signals from the receiver unit back to the transmitter unit. This is great for controlling your DSS satellite receiver or VCR from any room in the house. We also offer the small internal transmitter module assembly for those who wish to make their own concealed video transmitter system. Module is about the size of a couple of matchboxes and includes microwave patch antenna.

- WC-1 Wavecom Jr. Wireless System.....\$189.95**
WC-5 Wavecom Sr. with Remote Capability.....\$239.95
WC-TX Transmitter Module Assembly.....\$105.00



RAMSEY ELECTRONICS, INC.

793 Canning Parkway Victor, NY 14564

Call for our free catalogue or visit us on the web: www.ramseyelectronics.com

Toll-free Order Service: 1-800-446-2295

Sorry, no technical info or order status at this number

For Tech Info or Order Status, Call the Factory Direct
Phone (716) 924-4560
Fax (716) 924-4555



ORDERING INFO: 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 CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.





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	69.95	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 (16C5x,61,62x,71,84)	\$49.95
EP-PIC64 (62-5,72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51 (8751,6551)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC711D3)	\$39.95
EP-16 (16bit 40pin EPROMs)	\$49.95
EP-28 (28pin 40pin EPROMs)	\$39.95
EP-SEE2 (93x, 24x, 25x, 85x)	\$39.95
EP-750 (87C750, 1, 2)	\$59.95
EP-PEEL (IC22x10, 18x8)	\$59.95
EP-1051 (89C1051, 2051)	\$39.95
EP-PLCC (PLCC EPROMs)	\$49.95
EP-SOIC (SOIC EPROMs)	\$49.95

Many Other Adapters Available

M²L Electronics
310/837-7818 Fax/BBS: 310/841-6050
3526 Jasmine #4, Los Angeles, CA 90034
CA orders add 8.25% sales tax.
<http://www.m2l.com>



WHOLESALE PRICES
STARTING AS LOW AS \$99.00

CABLE TV
DESCRAMBLERS
CONVERTERS
FILTERS · VIDEO STABILIZERS

1 Year Warranty on All Products.
Affordable Extended Warranty.
FREE CATALOG!

30 Day FREE TRIAL

Call the Cable Professionals 24 Hours A Day!

Orion
Electronics

1-800-379-3976
[HTTP://WWW.ORION-ELECTRONICS.COM](http://www.orion-electronics.com)

Timid about getting on the...
World Wide Web?

You've heard about the *Information Superhighway* and all the hype that goes with it! Sort of makes you feel timid about getting on the Web. Put your fears aside! A new book, *The Internet and World Wide Web Explained*, eliminates all the mystery and presents clear, concise information to build your confidence. The jargon used is explained in simple English. Once the tech-talk is understood, and with an hour or two of Web time under your belt, your friends will believe you are an Internet guru!

To order Book #403 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.

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

"I earned \$1,000 on just 12 VCR repairs in one week"

A true statement by Paul B.* of San Pedro, California

How to cash in on skyrocketing field of VCR repair!

You too can earn up to \$85 an hour, pocket \$200 a day, double your income...in the high-profit field of VCR repair...part-time or full time. There are over 77 million VCR's currently in use in America today - a lot of business out there just waiting for you!

Here is a once-in-a-lifetime opportunity to go into a booming business of your own, make really big money starting right away, be your own boss and enjoy financial freedom and security.

It's easy to learn VCR cleaning, maintenance and repair at home in just a few short weeks through Foley-Belsaw's unique method which emphasizes the mechanics involved in 90% of all repairs, without dwelling on all the unnecessary basic electronics. This exclusive practical hands-on course was developed and proven over a long period of time in an actual VCR repair shop. It combines simple step-by-step lessons with easy-to-follow video cassette guidance. No special experience or electronics background is necessary. Just average mechanical aptitude and the ability to follow simple A-B-C repair procedures that are clearly outlined for you. And when you complete the course you will receive the School's official diploma attesting to your expertise.

Send coupon today for FREE Fact Kit. No obligation.

Don't miss out on this opportunity to give your income a tremendous boost. Send in the coupon NOW. Get all the facts and study them in the privacy of your own home. There's absolutely no obligation and no salesmen will call on you. So don't delay. Mail the coupon today!

"I started 3 months ago, now earn over \$900 a week."
D K., New York, NY

"Took in over \$3,200 in the past 10 days!"
H.H., Denver, CO

"Doubled my income within 6 weeks."
R.B., Bakersfield, CA

*Last name withheld by request.



MAIL TODAY FOR FREE INFORMATION PACKAGE

**Foley-Belsaw Institute,
6301 Equitable Road
Kansas City, MO 64120-1395**



CHECK ONE BOX ONLY FOR FREE INFORMATION KIT!

YES, without obligation send me information on how I can learn at home to become a VCR technician. 62721

- | | |
|---|--|
| <input type="checkbox"/> Computer Repair 64622 | <input type="checkbox"/> TV/Satellite Dish 31493 |
| <input type="checkbox"/> Computer Programmer 35440 | <input type="checkbox"/> Electrician 95297 |
| <input type="checkbox"/> Networking Specialists 39258 | <input type="checkbox"/> Computer Specialist 38271 |

Name _____

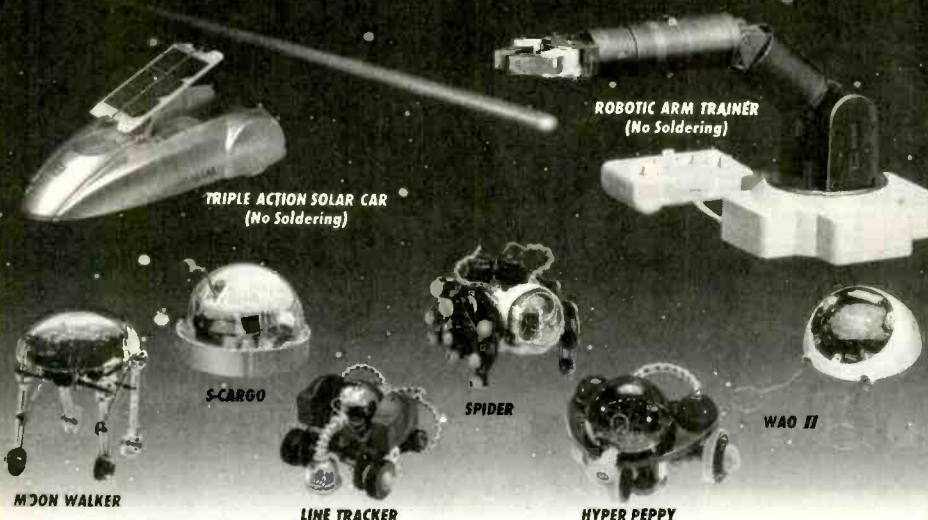
Address _____

City _____ State _____ Zip _____

CIRCLE 334 ON FREE INFORMATION CARD

www.americanradiohistory.com

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.

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.



Visit our homepage @ <http://www.owirobot.com>

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

Plant Trees for America™

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 The Ad Council
© The Advertising Council



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 1-800-532-4600.



SECOND HARVEST
TOGETHER WE CAN END HUNGER'S HOLD

www.secondharvest.org

MEMBRANE SWITCH KITS!

FLAT PANEL KEYPADS ASSEMBLE IN MINUTES WITH YOUR LEGEND

AVAILABLE IN 4, 12, 16, 24 & 40 KEY TYPES



CONNECTOR AND BEZEL INCLUDED!

OPTIONAL "CLICKDOMES" AVAILABLE

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-550 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 283 ON FREE INFORMATION CARD

MICRO SIZE CCD VIDEO CAMERAS

MB-750U
Video Camera
\$99.95

MB-705UX
C-Mount Camera
with Lens Included;
8 or 12mm Lens
your choice!

IP-850i Lipstick
Camera

IP-850i Excellent
monitoring Camera,
and ideal for CU-SeeMe.
\$249.95

Cost Effective Color
Board Cameras
MB-1282 **\$199.95**
with Built-In Audio out

Pinhole Versions
Available

See More Products @

Polaris Industries
<http://www.polarisusa.com>
800.752.3571

Free Catalog

470 Armour Drive NE • Atlanta GA 30324 • Tech Info: 404-872-0722 • FAX 404-872-1038

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.



5 Axis Robotic Arm Kit \$195.00



Build your own functional Robotic Arm

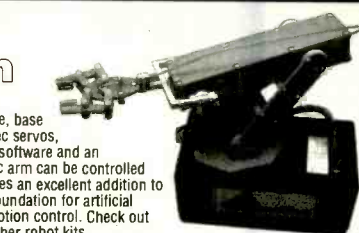
The kit comes complete with all hardware, base enclosure, structural components, 6 Hitec servos, MiniSSC II servo controller, Quick Basic software and an illustrated assembly manual. This robotic arm can be controlled from any micro with a serial port! It makes an excellent addition to a small mobile robot base. It is a great foundation for artificial intelligence experiments and teaching motion control. Check out our web site for more information and other robot kits.

- 3 Axis Version \$155.00
- Mobile Version \$250.00
- 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
Peekin, IL 61554-1403 USA



Tel: 309-382-1816
Fax: 309-382-1254
www.lynxmotion.com
jtaye@lynxmotion.com



ELECTRONIC SHOPPER

CLASSIFIED

CABLE TV

CABLE Descrambling New secret manual. Build your own descramblers for cable and subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, \$12.95, \$2 postage. **CABLE-TRONICS**, Box 30502R, Bethesda, MD 20824.

CABLE TV descramblers. One piece units. Pioneer 6310's, Scientific Atlanta 8580's, Dpv 7's and others. Lowest prices. Money back guarantee. **Precision Electronics** Houston, TX 1 (888) 691-4610.

CABLE test modules/cubes. Pioneers, S/A, Tocoms, Jerrolds. Quantity discounts. Call DCR Tel: (718) 624-8334 Fax: (718) 246-9731. 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.

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 \$5.00. 1 (800) 818-9103.

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.

DESCRAMBLE CABLE USING SIMPLE CIRCUIT. E-Z TO FOLLOW INSTRUCTIONS \$10.00. COMPLETE KIT WITH FREE BULLET 'TERMINATOR' \$20.00. 1-800-522-8053.

CABLE BULLET "TERMINATOR, and I.D. BLOCKER." Electronically shields yourself and your box. Factory Direct. **LIFETIME GUARANTEE.** \$14.95 1-800-820-9024.

CABLE TV EQUIPMENT & ACCESSORIES. Wholesalers Welcome! 30 Day Moneyback Guarantee! Free Catalog! **PERFORMANCE ELECTRONICS, INC:** 1-800-815-1512.

PHOENIX!!! THE MOST ADVANCED JERROLD DIAGNOSTIC DEVICE PERIOD. DEALERS WELCOME. MAKFIT RESEARCH: (800) 220-3543. <http://members.aol.com/makfit> e-mail: makfit@juno.com

Signal Eliminator can block severe TV interference or unwanted channels! Visit us on the web today at <http://members.aol.com/tvfilter>. Request a free brochure by mail or voicemail. **Star Circuits**, PO Box 94917, Las Vegas, NV 89193. 1-800-433-6319.

CABLE DESCRAMBER/VIDEO OUTLET ORDER TODAY AND HAVE IT TOMORROW. Guaranteed lowest price. Don't pay more. 24 Hr. tech support group. Open 7 days-24hrs. daily. We will not be undersold. C.O.D. & Credit cards. **Life-time Warranty 1-800-586-9920**

REPAIRS-SERVICES

PCB Designs. Professionally mastered in "TANGO". **AWESOME DESIGNS**, P.O. Box 214, Aurora, Ohio 44202-0214. E-Mail: AwesomeDesigns@worldnet.att.net

MISCELLANEOUS ELECTRONICS FOR SALE

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.

TUBES: For sale large stock on hand. Call 1-800-370-3390 or dwarders@telepath.com.

TWO cellular phones on one number. No extra monthly fees. Use your existing service. 1-601-843-1044.

PLANS-KITS-SCHEMATICS

FREE Catalog. 100 Leading-Edge kits. K1, PIC. Full instructions, source code. 1 (800) 875-3214. **SCIENCE FIRST**, 95 Botstord 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-N12, Paradise, CA 95967.

AWESOME Kits: Voice changers, Levitators, Lasers, gas sensors and more! Catalog \$1.00. **LNS TECHNOLOGIES**, 20993 Foothill Blvd., Suite 307R, Hayward, CA 94541. www.ccnet.com/~lnstech

MUSICAL Lights-build a color organ. Let your stereo control your lighting system or Christmas lights. Easy, inexpensive and fun to build. **Complete** documentation \$19.95. **JAK ENGINEERING**, 2712 16th Ave. S., Minneapolis, MN 55407.

MINI-Testbench Kit. Counter, logic analyzer, oscilloscope, generator modes, RS232 interface. Small, portable, inexpensive. Also, quickest **Protoboards** available. **ORICOM TECHNOLOGIES**, 303-444-9776. www.sni.net/~oricom

BIO-Stimulator feature in PE June issue. **Tone** muscles, relieve aches and pains with electronic acupuncture. Updated kit with enclosure \$40.00 plus \$2.50 S&H. **RAH PROJECTS**, P.O. Box 15904, N.B., CA 92659.

SATELLITE EQUIPMENT

VIDEOCYpher II descrambling manual. Schematics, video and audio. Explains DES, EPROM, CloneMaster, Pay-per-view \$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.

OBTAINING sound for your VCII and VCII Plus is easy. No codes needed. Details 1 (800) 211-5635.

FREE Big Dish Catalog-Low prices-Systems, Upgrades, Parts...and "4DTV". Call Skyvision 800-543-3025. International 218-739-5231. www.skyvision.com

FREE DSS TEST CARD information package. Works on new system and turns on all channels including PPV, adult and sports channels. Write **SIGNAL SOLUTIONS**, 2711 Buford Rd., Suite 180, Richmond VA 23235.

BUSINESS OPPORTUNITIES

I'M making a "bundle" reclaiming scrap gold from junk computers. Free info: 24 hrs, (603) 645-4767.

ELECTRONICS Businesses. Home based. Part/Full time. 250pg Comprehensive Guidebook, insider information. \$19.95 24hr recording (800) 326-4560 x159.

EASY work! Excellent pay! Assemble products at home. Call Toll Free 1-800-467-5566 ext. 5192

EDUCATION & INSTRUCTION

LEARN Electronics. Home study. Outstanding careers. Free literature. P.C.D.I., Atlanta, Georgia. 1 (800) 362-7070 Dept. ELP342.

SCRAMBLING NEWS

BEST satellite TV news includes coverage of piracy. Voice/Fax (716) 283-6910. www.scramblingnews.com

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.

Huge test equipment sale! NO REASONABLE OFFER REFUSED! 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; e-mail: astmrktg@wrench.toolcity.net

WANTED: USED TEST EQUIPMENT, TURN IDLE OR UNWANTED EQUIPMENT INTO CASH. **AST GLOBAL MARKETING:** Voice: 888-216-7159; e-mail:astmrktg @wrench.toolcity.net

THE SMART CHOICE

FOR OVER 47 YEARS, THE SERVICEMAN'S CHOICE FOR IN-VOICES AND SALES BOOKS HAS BEEN



DELRIICH 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

NOW HEAR THIS! ELECTRONIC EAVESDROPPING EQUIPMENT DESIGN

By Winston Arrington

This 126-page revised edition contains 117 schematic diagrams and text of our production equipment. 29 Crystal, 35 Room, 32 Telephone, 15 Phantom Zero, Infrared, Countermeasures equipment, and more. Request a free detailed explanation sheet of contents. **PRICE:** \$150.00 + S&H. U.S. \$6.00, Canada \$8.00.

SHEFFIELD ELECTRONICS CO.
P.O. Box 377940-C, CHICAGO, IL 60637-7940
Tel. (773) 324-2196

Code: 377940-C

CABLE T.V. Converters & Equipment WISE PRODUCTS

30-day money back
1-year warranty

Dealers
Welcome!

1-(800) 434-2269

Visa, MC, Amex, COD

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

EDUCATION

HIGH SCHOOL DIPLOMA At Home, Accredited, Fast, "Failure-Proof" 1-800-470-4723: American Academy, 12651 S. Dixie Highway, Miami, FL 33158.

FINANCIAL

CASH NOW FOR FUTURE PAYMENTS! We buy payments from Insurance settlements, Annuities, or Mortgage Notes. We also buy Military Annuities (VSI's). Call R&P Capital Resources at 1-800-338-5815 ext. 500.

VIDEO INVERTER

Create & Restore Inverted Video

R.C. Distributing
P.O. Box 552 • South Bend, IN 46624
Website: www.south-bend.net/rcd

For Free Information Package on Completed Units and Pricing
Call 219-236-5776

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

HOWARD HEINC ELECTRONIC INSTRUMENTS INC
Your Desoldering Specialists

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	88	—	M ² L Electronics	106
—	ABC Electronics	72	215	Mark V Electronics	99
—	Aegis Research, Canada	86	333	MCM Electronics	75
—	AES	92	—	Meredith Instruments	89
214	All Electronics	34	—	Merrimack Valley Systems	91
—	Allison Technology	78	128	MicroCode Engineering	CV3
—	Allstar Electronics	96	—	Micro Engineering Labs	98
—	AlphaLab	73	—	Modern Electronics	27
—	Amaze Electronics	97	332	Mouser Electronics	27
320	American Eagle Publications	78	—	MWK Industries	78
283	American Innovations	109	—	NRI Schools	49
—	Andromeda Research	91	—	NS International	98
324	Basic Electrical Supply	88	71	NTE Electronics, Inc.	7
325	Bel-Merit	106	—	Orion	106
—	Bsoft Software, Inc.	92	286	OWI	108
326	Butterworth-Heinemann	101	262	Parts Express Inc.	81
327	C&S Sales, Inc.	102	329	Pioneer Hill Software	91
311	Capital Electronics	94	—	Polaris Industries	109
315	Circuit Specialists	82	330	Prairie Digital	86
—	Cleveland Institute of Electronics	33	264	Print (Pace)	93
—	Command Productions	80	—	QB Video	91
226	Consumertronics	74	78	Radio Shack	3
323	CTG	76	266	Ramsey Electronics	105
—	Cybermation	80	—	RC Distributing Co.	111
—	Ed Treki Productions	90	—	RF Parts	73
—	EDE - Spy Outlet	96	321	Roger's Systems Specialist	87
—	Electronic Design Specialists	100	—	Sheffield Electronics	111
335	Electronic Express	76	—	Sil Walker	109
—	Electronic Technology Today	21	—	Sirius Micro Systems	97
—	Emac Inc.	88	—	Smithy	86
121	Fluke Corp.	CV2	—	Square 1 Electronics	80
334	Foley-Belsaw Co.	107	—	Starlet Systems	106
331	Fotronic	100	—	Street Smart Security	94
—	General Device Instruments	90	328	Sun Equipment	79
122	Global Specialties	4	—	Tab Books	13
—	Grantham Col. of Engineering	58	—	TCS Electronics	108
—	Home Automation	92	—	TECHMART	96
—	Home Controls	110	—	Technical Serv. & Solutions	110
314	Howard Electronics	77	322	Telulex	97
—	Howard Electronics	111	—	Test Equipment Sales	98
—	Imre Designs	96	275	Timeline	95
—	Information Unlimited	84	—	U.S. Cyberlab	90
126	Interactive Image Technologies	CV4	—	Visual Communications	58
319	IVEX Design International	89	316	White Star Electronics	94
—	Jameco	17	—	World College	69
—	James Electronics	72	—	WPT Publications	100
—	Learn Inc.	5			

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 Torrillo
 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

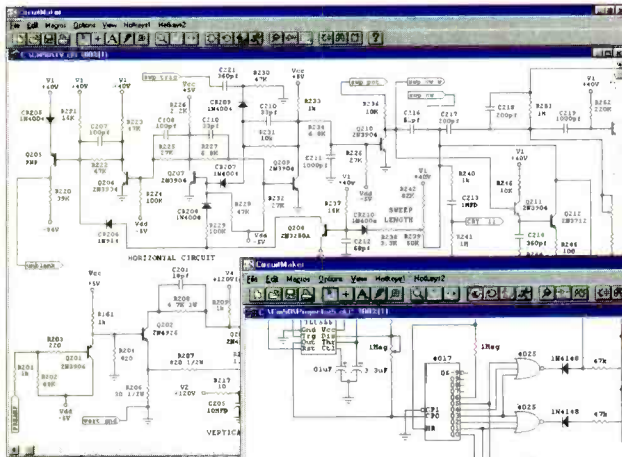
Megan Mitchell
 National Representative
 9072 Lawton Pine Avenue
 Las Vegas, NV 89129
 Phone/Fax 702-240-0184
Lorri88@aol.com

Customer Service
 1-800-999-7139
 7:00 AM - 6:00 PM M-F MST

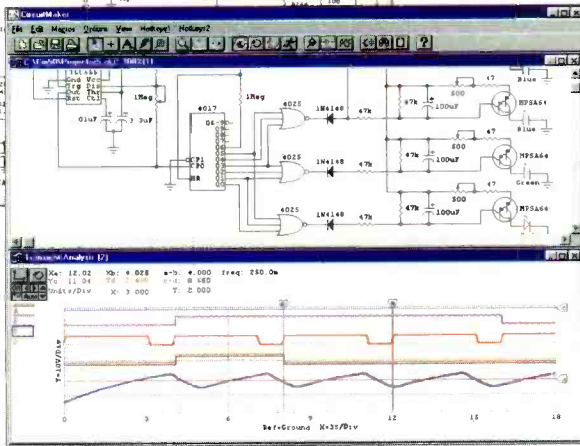
Professional Power

at a hobbyist price.

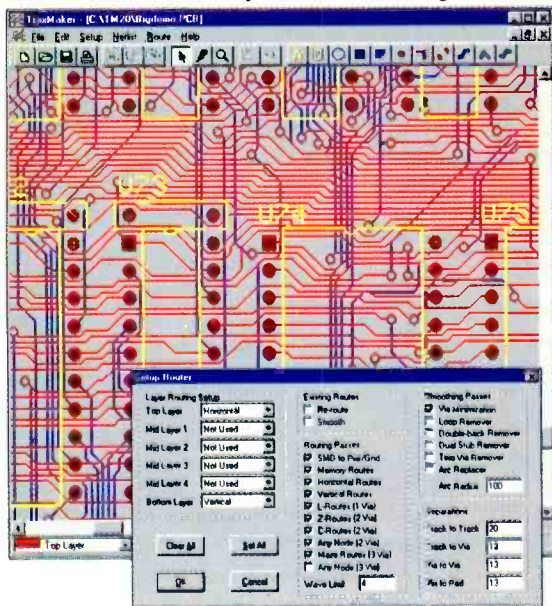
That has been our philosophy at MicroCode Engineering since 1987. So it's no surprise that **CircuitMaker** and **TraxMaker** are the leading software tools for affordable, easy-to-use circuit design, simulation and PCB layout.



CircuitMaker®
– schematic capture and simulation



TraxMaker® – PCB layout and autorouting



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

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**

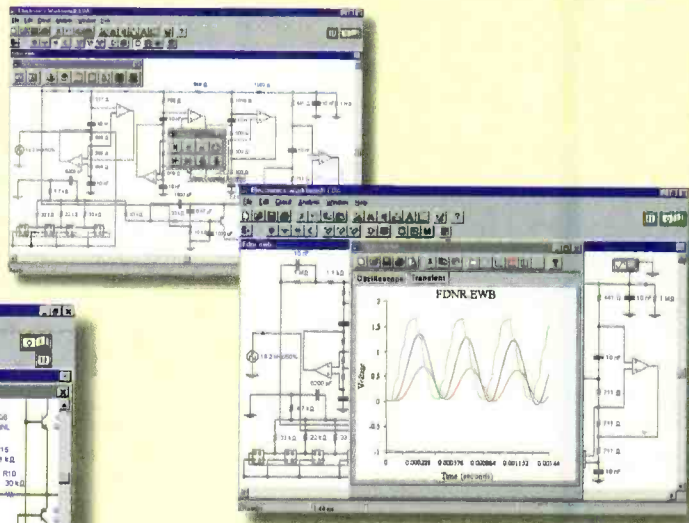
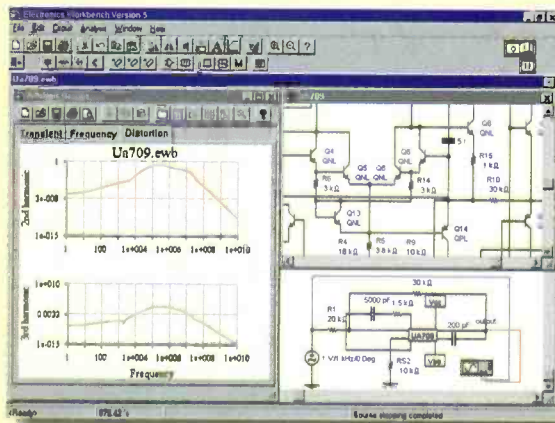
TraxMaker Version 2 **\$299**

CircuitMaker Design Suite™ **\$549**

(CircuitMaker and TraxMaker)

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



INTERACTIV

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