

LOWER YOUR LIGHTING BILL BY 90 PERCENT!

APRIL 1997

# Popular Electronics<sup>®</sup>

Build a

## Lie Detector

Find out who's telling the truth,  
or just learn to relax with  
this GSR monitor

### Recharging Electric-Vehicle Batteries

See how EVs are staying  
on the roads longer

### Learn how to Service Camcorders

Avoid high repair bills—  
fix your own camcorder

### All About Amateur Communication Modes

A historical look from  
Morse code to computers



\$3.99 U.S.  
\$4.50 CAN.



McGraw-Hill  
A GERRY-STECK  
PUBLICATION

0 09128 48784 7





# Popular Electronics®

APRIL 1997

Vol. 14, No. 4

g

A GERNSBACK  
PUBLICATION

## COVER STORY

### 31 Build a Lie Detector

Find out who's telling the truth with this Galvanic Skin Resistance monitor. Just press two fingers on the Detector's "electrodes" and you're all set. It's great for parties or even classrooms. The Lie Detector can also be used as a biofeedback device by providing you with a visual and audible indication of how your skin's resistance is changing—*Skip Campisi*

## CONSTRUCTION

### 42 Build a High-Efficiency Lighting System

Tired of high lighting bills? Quit wasting electricity on lights that don't work as efficiently as they could; here's a better option. With this system you'll save 90 percent on your monthly lighting bill—these are substantial savings you'll notice right away. Build these units for both home and office lights and save at both locations—*Stephen R. Rosenberg*

## FEATURES

### 39 Recharging Electric-Vehicle Batteries

Electric vehicles have finally hit the streets, but just how far can you travel in them before they run out of battery power? Join us for a look at the methods and systems being put in place to ensure EVs get you to and from your destinations—*Bill Siuru*

### 45 All About Amateur Communications Modes

The technology used by radio amateurs has certainly improved over the years; we've really come a long way. Here's a historical exploration of the many communications methods used by hams, past and present. From Morse code to computers, it's all right here—*Karl T. Thurber, Jr.*



Page 31



Page 39



Page 42

POPULAR ELECTRONICS (ISSN 1042-170-X) Published monthly by Gernsback Publications, Inc. 500 Bi-County Boulevard, Farmingdale, NY 11735. Periodicals postage paid at Farmingdale, NY and at additional mailing offices. One-year, twelve issues, subscription rate U.S. and possessions \$21.95, Canada \$28.84 (includes G.S.T. Canadian Goods and Services Tax Registration No. R125166280), all other countries \$29.45. Subscription orders payable in U.S. funds only. International Postal Money Order or check drawn on a U.S. bank. U.S. single copy price \$3.99. Copyright 1996 by Gernsback Publications, Inc. All rights reserved. Hands-on Electronics and Gizmo trademarks are registered in U.S. and Canada by Gernsback Publications, Inc. Popular Electronics trademark is registered in U.S. and Canada by Electronics Technology Today, Inc. and is licensed to Gernsback Publications, Inc. Printed in U.S.A.

Postmaster: Please send address changes to Popular Electronics, Subscription Dept., P.O. Box 338, Mount Morris, IL 61054-9932

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

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



PRODUCT REVIEWS

**8 Hands-On Report**  
Heathkit camcorder servicing course

**12 Product Test Report**  
Canon ES6000 camcorder

COLUMNS

**20 Net Watch**  
Become Your Own Travel Agent—*Dan Karagiannis*

**25 Multimedia Watch**  
A Pair of Unusual Controllers—*Marc Spiwak*

**27 Scanner Scene**  
Scanning the Wild Blue Yonder—*Marc Saxon*

**57 Think Tank**  
Craig's Back With a Vengeance—*John Yacono*

**60 Antique Radio**  
Roaming the Stars Once More—*Marc Ellis*

**62 DX Listening**  
Answering Mail—*Don Jensen*

**63 Computer Bits**  
Customize Your Greatest Hits Web Page—*Jeff Holtzman*

**65 Circuit Circus**  
Code-Practice Oscillators—*Charles D. Rakes*

**68 Ham Radio**  
A New Chip for RF Builders—*Joseph J. Carr*

DEPARTMENTS

**4 Editorial**

**6 Letters**

**28 New Products**

**29 Electronics Library**

**71 Popular Electronics Market Center**

**102 Advertiser's Index**

**102A Free Information Card**

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

EDITORIAL DEPARTMENT

**Dan Karagiannis**, editor  
**Teri Scaduto**, assistant editor  
**Evelyn Rose**, editorial assistant  
**Joseph J. Carr, K4IPV**,  
contributing editor  
**Marc Ellis**, contributing editor  
**Jeffrey K. Holtzman**,  
contributing editor  
**Don Jensen**, contributing editor  
**Charles D. Rakes**,  
contributing editor  
**Marc Saxon**, contributing editor  
**Marc Spiwak**, contributing editor  
**John Yacono**, contributing editor

PRODUCTION DEPARTMENT

**Ruby M. Yee**, production director  
**Ken Coren**,  
desktop production director  
**Lisa Baynon**, desktop production  
**Kathy Campbell**,  
production assistant

ART DEPARTMENT

**Andre Duzant**, art director  
**Russell C. Truelson**, illustrator

CIRCULATION DEPARTMENT

**Jacqueline P. Cheeseboro**,  
circulation director  
**Theresa Lombardo**,  
circulation assistant

**Michele Torrillo**,  
POPULAR ELECTRONICS bookstore

BUSINESS AND EDITORIAL OFFICES

Gemsback Publications, Inc.  
500 Bi-County Blvd.  
Farmingdale, NY 11735  
1-516-293-3000  
FAX: 1-516-293-3115

Web: <http://www.gemsback.com>  
President: **Larry Steckler**

SUBSCRIPTION  
CUSTOMER SERVICE/  
ORDER ENTRY

1-800-827-0383  
7:30 AM - 8:30 PM EST

Advertising Sales Offices  
listed on page 102

Composition by Mates Graphics

Cover illustration by Michael Linley

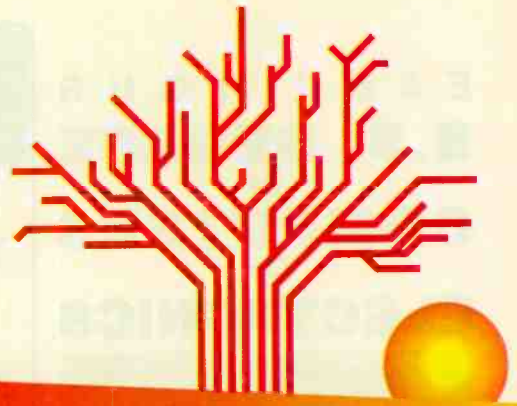


Since some of the equipment and circuitry described in POPULAR ELECTRONICS may relate to or be covered by U.S. patents, POPULAR ELECTRONICS disclaims any liability for the infringement of such patents by the making, using, or selling of such equipment or circuitry, and suggests that anyone interested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



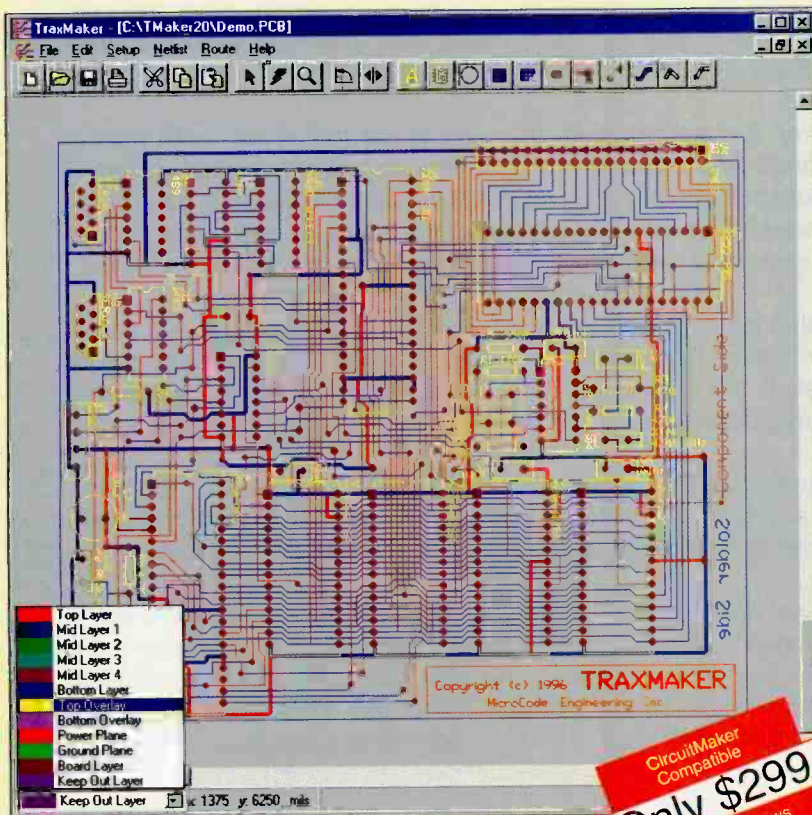
# TraxMaker<sup>®</sup>

A Virtual Environment For  
Growing Printed Circuit Boards



**“Finally, a low cost, easy to use, professional quality, PCB design tool”**

TraxMaker is a Printed Circuit Board (PCB) layout program that supports multiple layers along with full auto placement of components and autorouting of tracks. TraxMaker makes good design practice easy, according to user definable “Design Rules”. It has a familiar, easy to learn Windows interface. TraxMaker is a truly cost effective package which is sure to handle your most demanding PCB design tasks. TraxMaker can be used as a standalone product or with compatible schematic capture products. When used in conjunction with CircuitMaker, TraxMaker completes a powerful beginning to end circuit design system.



## TraxMaker Features

- Exceptionally easy to learn and operate
- 6 signal layers plus power and ground planes, top and bottom overlays, and solder and paste masks
- Built-in autorouter which provides routing of entire board, individual nets, pad to pad (without net), or interactive (using ratsnest)
- Automatic component placement with user definable placement grid and keep-out areas
- Full support for both through-hole and surface mount components
- Output to any Windows compatible printing device, Gerber files, and Excellon N/C drill file
- Import CircuitMaker, Protel, and Tango netlists
- Orthogonal, curved, and any angle tracks
- Design objects include tracks, pads, vias, arcs, free text, rectangular and polygon fills
- Includes a wide selection of component patterns and new patterns can be quickly and easily created
- Choose either Metric or English units
- Maximum resolution of .001 inches (1 mil)
- Maximum board size of 32 x 32 inches

## FREE Functional Demo

Product literature and a free functional TraxMaker demo are available on the Internet at <http://www.microcode.com>, on CompuServe (GO MICROCODE) and on America Online by doing a file search for TraxMaker

Call Now to Order or  
Request Additional Information

# 800-419-4242



# EARN YOUR B.S. DEGREE IN COMPUTERS OR ELECTRONICS



## By Studying at Home

Grantham College of Engineering, now in our 46th year, is highly experienced in "distance education"—teaching by correspondence—through printed materials, computer materials, fax, modem, and phone.

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

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

(1) The B.S.E.T. with Major Emphasis in Electronics.

(2) The B.S.E.T. with Major Emphasis in Computers.

(3) The B.S.C.S. — the Bachelor of Science in Computer Science.

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

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

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

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

# EDITORIAL

## Truthfully Speaking

They have been around for years and used in thousands of police investigations. But even in this decade of high-profile criminal cases, lie detectors, or polygraphs, are still not admissible as evidence in most courts.

Why is that?

The answer lies (no pun intended) in how professional lie detectors work. They are called "polygraphs" because they measure various biological factors—such as heart and respiratory rate, and Galvanic Skin Resistance (GSR)—to determine when someone's "fibbing." The idea behind taking those measurements is that people supposedly get nervous when they lie; as a result their readings should change accordingly.

However, it might not work that way in the real world. Let's face it, everyone's different. Even if you begin with a solid baseline reading of a relaxed subject to use as a reference point for changing conditions, it's impossible to tell whether that person is lying or just going through some kind of biological fluctuations peculiar to him or her.

Does that mean polygraphs don't work? Or that they only work sometimes on some people? Well, we decided to let you try to figure out for yourselves the answers to these questions this month by presenting our own Lie Detector.

Of course, building a complete polygraph is impractical for most. That's why our Lie Detector works by monitoring just one of the factors I mentioned earlier: a subject's changing skin resistance.

Once you build the unit, you can gather your friends and have some fun trying to figure out who's telling the truth or not. Or, perhaps you'd just like to practice varying your skin resistance by using the Lie Detector as a biofeedback device. Either way, we're sure you'll enjoy experimenting with GSR. The story begins on page 31.

*Dan Karagiannis*

Dan Karagiannis  
Editor



# *Your Ultimate Source For Electronic Components*

## *Internet Access..*

- *24 hours-a-day, seven days-a-week*
- *Online ordering & stock status*
- *Fast, efficient parts search*
- *No minimum order*



[\*http://www.digikey.com/cx\*](http://www.digikey.com/cx)

***Digi-Key***<sup>®</sup>

A large, dense pile of various electronic components, including resistors, capacitors, and integrated circuits, arranged in a circular pattern. The components are illuminated with a blue light, creating a sense of depth and abundance.

*#1 for Availability of Product  
#1 for On-Time Delivery  
#1 for Overall Performance*

*Same-Day Shipment on orders entered by 5:00 p.m. central time!*

CIRCLE 173 ON FREE INFORMATION CARD



# LETTERS

## A Call To Our Readers

### POPULAR ELECTRONICS NEEDS YOU

*Are you looking for a challenging and rewarding change of career? If you are a **Popular Electronics** reader, and live in the Long Island area, we might have just the position for you to take on.*

*We're looking for someone with a background in electronics, as well as excellent communication skills, to fill our current opening for an Associate Editor. Why not put your love of electronics to work for you?*

*This is an on-the-site, permanent position; no freelancers or telecommuters will be considered. If you're interested, send a resume and cover letter with salary requirements to:*

Dan Karagiannis  
Editor  
**Popular Electronics**  
500 Bi-County Blvd.  
Farmingdale, NY 11735

*We offer an attractive health- and dental-care package, and are an equal-opportunity employer.*

*If you'd like to be a part of the magazine that's brought you the best in electronics for years, we want to hear from you.*

—Editor

### WHERE ARE ALL THE CORRECTIONS?

I've been reading **Popular Electronics** for about five years now, and have built several of the projects that you published. However, I have a question: I haven't noticed any corrections in your *Letters* column for a while; have you stopped publishing them?

Also, are you planning on posting corrections to your Web site so we can access them quicker? The reason I'm asking is I've built things in the past, had them not work, and then found a correction a couple of months later that explains whatever problems I encountered.

Thanks in advance for any answer you can give me.

And keep up the good work.

L.B.

Los Angeles, CA

*Thank you for writing. The reason you haven't been seeing corrections recently is there haven't been any. Because this is a technical magazine we make every effort possible to ensure the projects published will work as published.*

*However, sometimes errors in artwork or text are missed, and in the past we have had to wait to bring them to the attention of our readers due to editorial lead time. For example, if an error is caught when a magazine hits the stands, we've already completed the following issue by that time.*

*But we have been planning and preparing to implement one of the suggestions you made. In addition to discussion forums that we will be adding to our Web site, you'll also be able to read online corrections before they are printed in this column of the magazine. That could save a month or more of aggravation if a particular circuit isn't working properly.*

*Hope this answers your questions.*

—Editor

### HAVES & NEEDS

I have subscribed to **Popular**

#### KEEP IN TOUCH

Now there are more ways than ever to contact us at **Popular Electronics**.

You can write to:

Letters  
**Popular Electronics**  
500 Bi-County Blvd.  
Farmingdale, NY 11735

Or you can send e-mail to:

peeditor@gernsback.com

And don't forget to visit to our Web site at:

<http://www.gernsback.com>

**Electronics** for two years. I would like to find out where I might be able to get the tuning and band-spread knobs for a Hallicrafter S53 receiver. (The tuning and band-spread knobs are both identical.)

I am willing to pay for these items, and I will also cover any shipping costs.

Thank you.

ALBERT C. ANDERSON  
5258 Cordelia Ave.  
Baltimore, MD 21215-5023

Several years ago, I got involved in electric-flight, radio-controlled, model aircraft. The first plane I built was involved in a don't-bother-to-fix-it-type of crash.

Now, the only salvageable items from the wreck were the plane's two servos, although I have been trying to fix the electronic speed control, which is an integrated receiver/speed control that cost me about \$200.

Crashes are not uncommon, and I can't afford to keep replacing the integrated unit. What I'm looking for are plans for building a separate speed control.

I could buy stand-alone receivers for a relatively cheap \$70 per crash. I'm also pretty sure that I could build the simple speed controls for pennies each.

Does anyone out there have any ideas?

Any assistance from the readers of **Popular Electronics** would be greatly appreciated!

MIKE CRISWELL  
2810 Florence Street  
Hopkinsville, KY 42240

I am trying to locate an operator's manual for an Eico VOM that I have. The only information I have is its model number, which is 565.

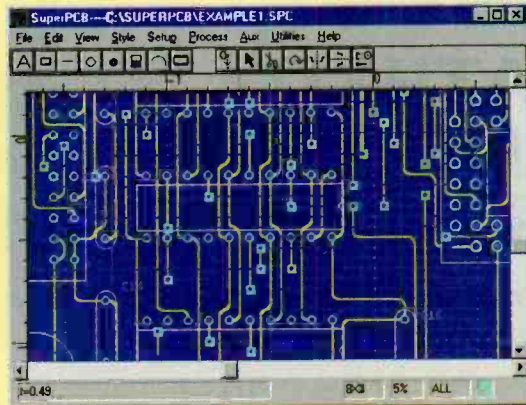
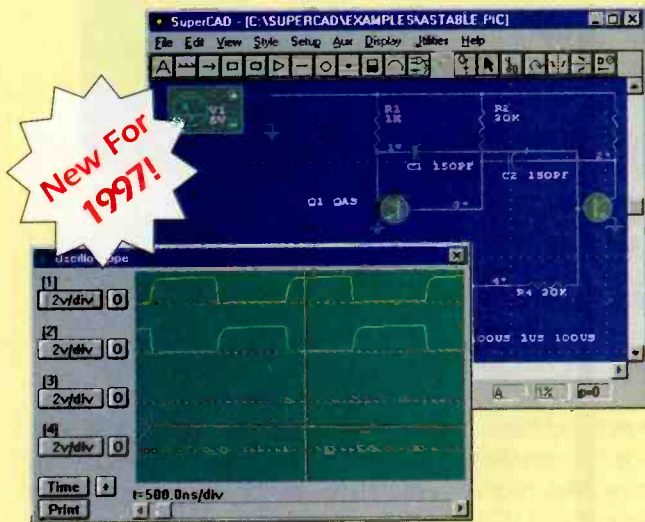
Thanks in advance for any help that you or the readers of your fine magazine can give me.

LARRY COOK  
362 East South Street  
Richland Center, WI 53581-2721



# Announcing **mentalMAX™**

The First All-In-One Circuit Design Software Package!  
Only \$549!



## **Complete Schematic Entry Software**

mentalMAX includes the easy-to-use, powerful SuperCAD schematic entry software. SuperCAD comes with nearly 1800 parts including most TTL and CMOS logic, opamps, discrete symbols, and others—plus you can easily add custom symbols.

Because of our association with McGraw-Hill in producing the **Encyclopedia of Electronic Circuits** CD ROM (available separately for \$99), the SuperCAD schematic editor is fast becoming a standard for schematic entry. The Encyclopedia includes 1000 SuperCAD schematics in 142 different categories (audio, radio, etc) that can be used as a starting point for designs.

## **Mixed Mode SPICE Simulator**

For simulating purely analog circuits or circuits with some digital components, mentalMAX includes mentalSPICE. This simulator is based on the Berkeley SPICE 3F5 simulator and allows you to do timing analysis, frequency analysis, DC curve analysis and others. It comes with over 350 semiconductor and 250 IC models. Signals can be introduced into a circuit using a virtual function generator, and the resulting waveforms can be viewed in the Oscilloscope window.

## **Digital Simulator**

For heavy-duty analysis of computer interfaces, timers, state machines, controllers, and others, mentalMAX provides the digital simulator SuperSIM. This comes with 150 common TTL and CMOS models. You can stimulate circuits with a built-in virtual pattern generator and view results in a logic analyzer window. You can also single-step a circuit and monitor its progress using virtual LEDs and displays.

## **Circuit Board Layout Software**

mentalMAX comes with the popular SuperPCB program for doing layouts on printed circuit boards up to 32" x 32". SuperPCB features 1 mil (.001") resolution, 2 signal layers, silk-screen, paste and solder mask layers. It includes industry-standard Gerber and Excellon outputs, and you can also print your artwork on laser and other printers. SuperPCB comes with 150 package parts for both through-hole and surface-mount devices; you can add your own parts.

In many cases SuperPCB can automatically build a circuit board from just a SuperCAD schematic input, using the built-in autorouter and auto-placement tools. You can also layout or edit circuit board artwork using SuperPCB's intuitive, easy to learn editing features.

## **Buy With Confidence**

Our products come with a 30-day money-back guarantee and free, unlimited technical support.

## **Free Functional Demo**

You can obtain a free demo from the Internet at <http://www.mental.com>, or give us a call.

Call now for more information or  
to order

# 800-794-2141





# HEATHKIT CAMCORDER SERVICING COURSE



*If you're interested in learning how to service camcorders, this servicing course is the way to go.*

**C**amcorders are everywhere these days. Anybody can now buy what is essentially a hand-held TV studio, and instantly become an amateur movie producer/director.

Camcorders come in many flavors. With features such as autofocus and automatic light compensation, camcorders make it easy to point and shoot—anybody can do it, and the results can be impressive.

Yes, camcorders are very easy to use, but the technology that makes them so easy to use also makes them quite fragile. And when you have lots of people carrying around these fragile devices, many of them are bound to fall from high places, get soaked in a thunderstorm, and otherwise succumb to an unexpected demise. In other words, lots of camcorders end up needing servicing of some kind, whether it be to repair a smashed lens, or just clean the heads after many hours of use.

All these camcorders in need of servicing are a veritable gold mine for anyone who can repair them. The problem is that while anybody can use a camcorder only highly trained individuals should attempt servicing them. When untrained people try to service camcorders, they run the risk of causing more problems than they could fix.

Even somebody who's familiar

with VCRs should not mislead themselves into thinking that camcorders and VCRs are the same. Yes, many of the components found in a VCR are also found in a camcorder. The belts, gears, motors, pulleys, springs, and circuit boards are all there. But many familiar parts, such as the tuner section of a VCR, are missing from a camcorder. That doesn't present a problem to those familiar with VCRs, but the presence of things like an autofocus lens and CCD (charge coupled device) can present problems.

A camcorder is essentially a VCR minus the tuner, but with an autofocus camera added. Advanced camcorders also have additional features thrown in such as image-stabilization circuitry and color viewfinders, so a camcorder really is a whole different animal than a VCR.

With all of the potential problems that can arise with camcorders, and all of the general maintenance they require, it makes good sense for those involved in electronics repair to familiarize themselves with camcorders. Then they can tap into the "well" of broken and in-need-of-service camcorders and start making some good money. Camcorder servicing is also a good career opportunity. It is a career that is sure to have years and years of job security.

There are many ways you can

learn about camcorder servicing. You can take a formal course at an electronics school, get a job as an apprentice with someone who already services them, or you can wing it by gathering together a camcorder in need of servicing, the necessary replacement parts and tools, and all of the required documentation. Or you could take the easy way out with Heathkit's Camcorder Servicing Course, which teaches you all about basic camcorder maintenance, and how to perform various repairs. All materials in this course are of the highest quality. Documentation is clearly written and error-free—that goes a long way to understanding how anything works.

**The Camcorder Course.** The Heathkit Camcorder Servicing Course comes with everything you need to perform basic camcorder maintenance. But the heart of the course is the camcorder included with it. The camcorder is a full-size RCA VHS-HQ unit. While this unit is admittedly bulkier and heavier than most on the market, and is certainly not the one you would want to take on vacation with you, the full-size unit is easier to service than compact units. That makes it the perfect choice for a course in which you are required to open up the unit and service and replace various parts.





# World's quietest and most effective air purification system finally available to the public!

Breakthrough air purification system uses negative ions to actively remove contaminants better than any other filter and operate in total silence.

by Vicky S. Hindelang

**D**o you have a problem with the air in your home? Is it musty and stale? Do you sneeze the second you walk in the door? Are you bothered by tobacco smoke, dust, dander or odors? Trust me...you are not alone.

But, because you don't want a bulky, noisy air filter, you just live with the problem. A remarkable new product is now available that ends this compromise: Clearveil 250's compact design rids your home of airborne contaminants and operates in total silence.

**Proven technology.** Clearveil 250, a fanless electronic air purifier, uses patented microprocessor-controlled ionization and collection technology for contaminate removal. This method has been proven superior to other air filters, including High Efficiency Particulate Arresting (HEPA) filters. Clearveil is Japan's market leader in air purification devices, selling over 350,000 units since 1988.

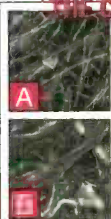
**The best method.** In the past, the HEPA filter was considered to be the most

effective air purification method. But the technology behind Clearveil is significantly more advanced. Scientific studies have shown Clearveil to be more effective in capturing a higher percentage of even the smallest contaminants.

HEPA filters have a certain level of permeability because they must allow air to pass through them. This means that small dust particles including bacteria, viruses, smog and tobacco smoke are also free to pass. But Clearveil's non-permeable sheet doesn't allow those particles to escape. This makes a big difference to anyone concerned with pure, pollutant-free air.

**Energy efficient.** Because Clearveil is so unobtrusive you will want to run it all day long. And since it only uses about four watts of electricity, you can! One Clearveil unit, running 24 hours a day, will only cost about \$4 a year! Just one Clearveil unit will purify a 250-square-foot area. Additional units can be purchased to purify the air in larger homes or office buildings.

## THE CLEARVEIL ADVANTAGE

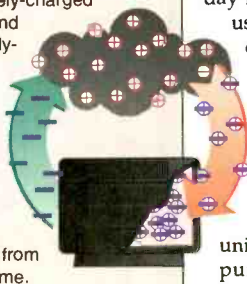


After 168 hours of use, the Clearveil filter (B) has collected much more dust than the HEPA filter (A).

- **No noise.** Because it doesn't rely on a fan, Clearveil operates in perfect silence. 24 hours a day.
- **No misses.** Because it doesn't draw air through a filter, Clearveil catches minute particles of dust that even HEPA filters miss.
- **No mess.** Clearveil uses a positively-charged collection sheet to draw the negative ions back into the unit; once they have collected dust.

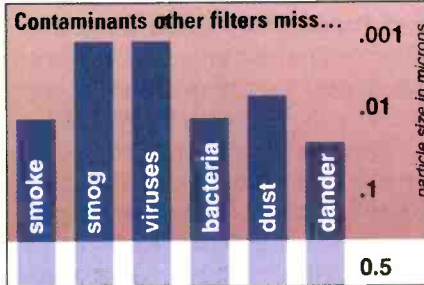
## How it works

- 1 Clearveil releases negative ions.
- 2 The negative ions combine with positively-charged dust particles and form a negatively-charged unit.
- 3 Then a collection plate with a positive charge attracts those negatively-charged units, removing them from your air and home.



“The success of Clearveil...is directly attributed to the design of a sleek, silent unit that removes smoke, microbacteria, dust and viruses while replenishing negative ions to levels found in clean, mountain air.”

—Gary Jones, Marketing Director, Clearveil Corp.



**You'll feel healthier.** Negative ions do more than just remove the harmful contaminants from the air that you breathe. They can actually improve your environment, making it healthier and more invigorating. Studies have shown these ions can help increase alertness and ease tension.

**HEPA filters are rated to remove contaminants as small as .3 micron. But many contaminants, including dander, smoke and viruses, consist of smaller particles. Clearveil's superior collection system will remove particles as small as .001 micron.**

**Risk-free.** Clearveil is backed by Comtrad's exclusive risk-free home trial. Try it, and if you're not totally satisfied, return it within 90 days for a full refund, "No Questions Asked." It also comes with a one-year manufacturer's limited warranty.

**Three easy payments.** We're so sure you'll love what Clearveil does for your environment that for a limited time we're offering it at the special introductory price of \$199. And for credit card customers you can get the Clearveil for three monthly payments of \$67. We guarantee that you'll notice a difference in the air you breathe and that Clearveil will operate in total silence. If you don't agree, return it for a full refund, "No Questions Asked."

Clearveil is so compact you can put it anywhere!

**Clearveil 250** ..... \$199 \$16 S&H  
**Credit card customers: Three payments of \$67**  
**Replacement sheets (12)** ..... \$20 \$2 S&H  
 For optimum results, replace the sheet once a month.

Please mention promotional code 894-PL-10227.

For fastest service call toll-free 24 hours a day

**800-236-6139**



To order by mail, send check or money order for the total amount including S&H. To charge it to your credit card, enclose your account number and expiration date.

Virginia residents only—please add 4.5% sales tax.

**comtradindustries**  
 2820 Waterford Lake Drive, Suite 102 Midlothian, VA 23113

You also have the added convenience of being able to use standard VHS tapes that are—figuratively—a dime a dozen these days. (Note, however, that Heathkit, RCA, and **Popular Electronics** magazine all recommend that you *don't* ever use cheap no-name tapes in any deck, or you're asking for trouble.)

While the RCA camcorder uses full-size VHS cassettes, and is considered large by today's standards, it is by no means as large or as heavy as the first full-size units were. And even though the full-size VHS format is now considered somewhat outdated for a camcorder, this unit is loaded with features that didn't exist when camcorders first came out. This results in beautiful video recordings, whether they are made indoors or out, or in brightly or dimly lit locations. While the camcorder records audio in mono-only, this is more than sufficient for the bulk of home video recording and sufficient for the servicing course.

The RCA camcorder also includes many frills that you might not expect to see in a full-size unit. Among them are 1-lux low-light recording, which means that you will rarely need auxiliary lighting to record a scene. Even with the lights dimmed to a cozy level for chatting with company, the 1-lux camcorder can produce good results. A 12× power zoom quickly brings you closer to or farther from the action. The unit also includes a built-in 2-line/2-page titler so you can add captions to your home videos.

The camcorder comes with an AC charger, one battery pack good for about an hour's use, a lens cover, a shoulder strap, and a cable for connecting the unit to a TV. However, a full line of optional accessories for the camcorder, such as extra-capacity battery packs, AC/DC chargers, hard and soft cases, an automobile power cord, and add-on lighting is available from RCA. An accessory hot shoe is located on the top of the camcorder for connecting things such as auxiliary lights.

The camcorder has quick-response infrared autofocus. This is

much more effective and faster to react than sonar-type autofocus systems. Simply put, whatever you're recording stays in focus. For times when the autofocus might not work, such as when shooting through glass, the autofocus can be turned off and you can focus manually.

A feature called PROedit makes for smooth transitions between starts and stops and at points of dubbing. This feature is made possible by the flying erase head contained within the camcorder. The flying erase head is a nice thing to have because home videos are usually the result of many starts, stops, and dubs. An unedited home video is often more boring than the worst B-movie, and an edited video with lots of "junk" visible between edits isn't much better.

The camcorder includes many features that help you make great video. But the point behind the course is servicing, so let's see how the course teaches that.

**Servicing the Camcorder.** Plenty of documentation is included with the Camcorder Servicing Course. Besides the manual for the course supplied by Heathkit, which covers all of the experiments and activities pertaining to the course, a camcorder textbook is also thrown in that describes the general maintenance and repair of camcorders. In addition, the RCA service manual for the particular camcorder is also included. This is the same service manual that an authorized RCA repair shop would use. The manual covers all mechanical and electrical operation of the camcorder, and offers tips on troubleshooting, as well. We know that factory service manuals often cost hundreds of dollars by themselves—ridiculous but true.

Two prerecorded tapes and one blank one come with the course. One of the prerecorded tapes, the Heathkit test-pattern tape, provides you with all the test patterns you need for testing and adjusting any VHS equipment. The other prerecorded tape teaches you how to do surface-mount soldering repairs,

which is absolutely necessary inside the cramped housing of a camcorder. The blank tape, of course, is for recording things on with the camcorder.

Also included with the course is a clear plastic VCR tape simulator that lets you observe how a VCR is operating without having an actual tape installed. This lets you see mechanisms that would normally be blocked by an actual tape, and also prevents a good tape from being ruined by a malfunctioning camcorder. Of course the VHS cassette simulator can be used to troubleshoot any VHS player/recorder.

The course includes all of the common hand tools you need to service a camcorder. These are screwdrivers, pliers, cutters, and soldering tools including a soldering iron. The only things you'll have to supply to get the most out of the course are a multimeter and an oscilloscope. You do, of course, need a TV set in order to view the recordings you make. You can play back tapes in the camcorder and watch them in its black-and-white viewfinder, but you can't see enough detail, color or otherwise, to know whether servicing is required. So you have to supply a TV set, as well, but most people should have no trouble locating a color TV—they are quite common these days!

All of the basic maintenance supplies, such as cleaners and lubricants, are supplied with the course. These include video-head cleaner, lintless swabs, chamois wands, grease, and rubber revitalizer. Surprisingly, these supplies are all you need to service most of the camcorders you'll see. That's because, more often than not, all a camcorder needs to get it working again is a good cleaning and lubrication of its moving parts. And sometimes all a slipping belt or tire needs is a quick application of rubber revitalizer, which both cleans the rubber and makes it "grippy" again.

Material is included in the course to familiarize oneself with VHS tapes and how they operate.

*(Continued on page 16)*





# Product Test Report

## Canon ES6000 Camcorder

BY STEPHEN A. BOOTH

**B**y any standard, Canon's ES6000 is a handful. The new camcorder combines all the advanced features introduced in earlier models into a single high-end, Hi8-format bundle.

Those advanced features include Canon's unique Eye Control technology for focusing and camcorder operation, and the recently introduced Auto Editing Function for in-camera assembly editing and VCR dubbing. Besides these, there's Canon's Optical Image Stabilization—by which the gyroscopic lens itself corrects for operator movement, rather than depend on electronic signal processing.

Consequently, there's a lot to learn about the ES6000, and the comprehensive instruction manual is must-reading. As you'd expect, there's an Easy Recording mode for point-and-shoot-type movie-making. But for all its automation, this camcorder also offers the manual controls that advanced videographers demand.

### FEATURES

The most unusual function in the ES-6000 is Eye Control, a system unique to Canon for either focusing the lens, or for hands-free operation of the camcorder's controls. It actually focus-

es your subject or activates camcorder functions by tracking the movement of your eye in the color viewfinder.



*Fig. 1. As this vectorscope photo shows, the ES6000's phase is right on target while its chroma—at the rim of the scope, above the crosshairs—is slightly oversaturated.*

How so? In the Eye Control Focus mode, two beams of infrared light detect the position of your pupil, and transmit the data regarding direction and speed to the lens-focusing motor. Operation is similar in the Eye Control Switch mode: You eyeball a function on the Menu displayed at the edges of the viewfinder, and it's activated.

Canon says the IR beams are harmless. The system works with eyes

of virtually any color or shape, through prescription glasses or contact lenses—anything but opaque or reflective lenses. A simple set-up process calibrates the system to your eyes. There are memories for two settings—either for different individuals, or, for an individual who might sometimes wear eyeglasses. After this, it's set—but a "Guest" mode enables the Eye Control to be recalibrated for other users.

Eye-controlled switching is an alternative to the focus mode. In this mode, the ES6000 reverts to conventional, centered autofocusing. In either case, the main benefit of eye-control is steady videos because generally, there's less need to move the camcorder.

For example, with eye-controlled effects your hands don't have to fumble for tiny buttons. With eye-control focus you won't have to move the camcorder much to keep moving subjects sharp—and operator-shake does become magnified at extreme telephoto lens settings. That operator-shake is further minimized by the image-stabilization technology built into the ES6000, a particularly useful feature given this Hi8 camcorder's extreme 20× and 40× telephoto magnifications.

The other useful technology built into the ES6000 is its Auto Editing Function. Like similar systems, such as the Random Assembly Edit in JVC's camcorders, an on-board memory lets you edit your camcorder tapes for dubbing to a VCR.

With the ES6000, you can select and, if you wish, rearrange up to eight segments of any length, and the camcorder remembers the sequence. When you're ready to dub, the ES6000 has an infrared transmitter that controls the recording and transport function of any VCR you connect for copying. Because the camcorder includes RC Time Code, your editing can be accurate to the frame.

### TEST RESULTS

The ES6000 underwent the usual battery of electrical exams at the Advanced Product Evaluation Laboratory



*Thanks to Canon's Eye Control system, using the ES6000 camcorder couldn't be simpler. Combine that with its other great features, like built-in optical image stabilizing, and you have a superior camcorder.*



# New breakthrough clones TV signals and sends them to any other TV in your home

Recoton's new development duplicates cable, TV, VCR and satellite signals and transmits them...without any wires!

by Charles Anton

Today, television choices are virtually unlimited. Between cable, satellite TV, videos and network programming, it's almost a full-time job trying to keep up with all the alternatives. And it promises to get more complicated in the future. Breakthroughs in fiber optic technology will bring over 500 channels into your home.

**Home broadcasting breakthrough.** The problem with all this technology is the expense required to maintain your system and keep it up-to-date. Now, a wireless video broadcasting system from Recoton gives you the power to utilize this technology without the hassle and expense of re-wiring your entire home.

Today, Recoton introduces the next generation in wireless broadcasting. The wireless video broadcaster transmits (re-broadcasts) cable, TV, VCR or satellite programs to any other TV in your home...wirelessly!

**Wave of the future.** Never drag your VCR from room to room again: Recoton's wireless video broadcasting system transmits video or TV signals to any other TV in your home.

Because the system is totally wireless, you won't have to worry about running miles of wires. Besides, who wants to install cable in every room of their home? With Recoton's wireless video broadcasting system, you



won't have to. You can even watch one program on your main TV while someone else watches something different on another TV. It's just like having a personal broadcasting system in your home—and it's legal in every state.

**Hi-tech home broadcast.** Recently, the Federal Communications Commission allocated a band of radio frequencies specifically for wireless, in-home product applications. Recoton took advantage of the FCC ruling by creating and introducing wireless equipment that can transmit within the prescribed frequency over distances of up to 150 feet.

**One transmitter, unlimited receivers.** One transmitter will operate an unlimited number of receivers. This means that a transmitter in the den can send signals to a TV in the living room, kitchen, bedroom and anywhere else you may have a TV. Recoton puts your favorite programs where you want them most.

**Unlimited choices.** Since the broadcasting system uses the latest in 900 MHz frequency signals, there is no time-consuming or complicated wiring. The receiver can be easily moved from one television to another.

The transmitter will also broadcast to multiple receivers, so you can watch the same program on multiple TVs simultaneously. The transmitter connects to the source TV; the receivers simply connect to the others.

**Exclusive factory-direct offer.** With this breakthrough in home video broadcasting technology, you can have the convenience of your own personal wireless broadcasting system for a fraction of the cost of owning your own TV station. For a limited time only, we are offering Recoton's wireless video broadcasting system (one transmitter and one receiver) for the low price of \$99. You can order additional receivers for other TVs for just \$59 each.

**Risk-free offer.** The wireless video broadcasting system by Recoton is backed by Comtrad's exclusive risk-free home trial. Try it, and if you are not completely satisfied, simply return it within 30 days for a full "No Questions Asked" refund. It also comes with a 90-day manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

**Video Broadcasting System**..... \$99 \$9 S&H  
Includes one transmitter and one receiver.

**Additional receivers (each)**..... \$59 \$7 S&H

Please mention promotional code 173-PL-10226  
For fastest service, call toll-free 24 hours a day

**800-704-1201**



To order by mail, send check or money order for the total amount including S&H (VA residents include 4.5% sales tax). Or charge it to your credit card by enclosing your account number and expiration date.

**COMTRAD INDUSTRIES**

2820 Waterford Lake Drive, Suite 106  
Midlothian, Virginia 23113

## Wireless Video Breakthrough...

**Cable** Broadcast cable channels, even premium channels, to other TVs in your home that are not wired for cable.

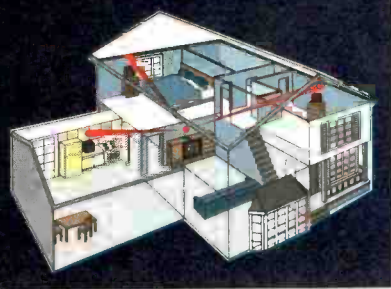
**Videos** Transmit signals from one VCR to any room, even if someone is watching TV in the room that the VCR is in.

**Satellite programs** Watch satellite programs throughout your home without stringing miles of cable everywhere.

**Live video** View home videos as you film them or turn your camcorder into a security camera.

**Network programs** If the main TV is hooked up to an antenna, you can broadcast its clear signal to all the others.

Recoton's video broadcasting system clones the accessories (cable, satellite, VCR, etc.) of one TV and broadcasts it to any other TV in your home...without wires!



(APEL), an independent testing facility located in Bethel, Connecticut. For the first time, though, you're seeing the results of a new—and overdue—method for measuring illumination.

You might think "They don't make 'em like they used to" if you compare the 10-lux rating of the ES6000 to the low-light sensitivity of last year's camcorders. It's an honest assumption. Henceforth the low-light ratings will be two- to five lux higher than the one- to five-lux scores obtained in recent years.

With lux, the lower the number, the better the camcorder's ability to record in low-light conditions. But camcorders haven't gotten worse. Instead, manufacturers have finally agreed on a single standard for measuring light sensitivity. This measurement, developed under the auspices of the Electronic Industries Assn., will be used on all advertising and packaging, and by all labs that conduct independent tests, such as for magazines.

For the first time, you'll be able to compare low-light performance among camcorders for the 1997 model-year and beyond, but not against older ones. You never could. In the past, each manufacturer measured lux differently—and by whatever method yielded the best rating. Magazines and independent labs tested differently from one another too, but APEL's method at least was consistent, so you could compare camcorders over time.

For the record, lux is a metric version of the footcandle measure. One footcandle is the illumination on a surface one foot distant from a standard candle in a dark room—and it's equal to 10 lux. In real-world conditions, the indoor lighting in a typical home ranges from 60 to 100 lux, about the same as the interior of a church, or an outdoors amusement park at night. Meanwhile, the typical business office, supermarket and department store weigh in at about 600 lux. On a clear day, nature's outdoor lighting hits 2000 lux an hour after sunrise.

APEL was one of the companies that participated in developing the new lux spec, formally called EIA Standard EIA-639. Besides the consistency it provides for rating illumination, APEL president Frank Barr points out that EIA-639 also mandates specific performance levels in other key camcorder measurements—including resolution and signal noise. Consequently, a man-

ufacturer can't steal a better lux rating at the cost of fuzzy, grainy images. When you read APEL's test data in Table 1, keep the following in mind.

"Illumination" rates the camcorder's ability to record in low light and still capture a viewable image. At 10 lux the ES6000 is typical of the higher-resolution Hi8-format. You'll get better indoor movies though if you invest in an inexpensive accessory lamp—if only to punch-up colors.

Perhaps a more meaningful measurement for camcorders is "signal-to-noise." It's measured under optimal lighting conditions and shows the amount of usable signal, for color (Chroma AM) and brightness (Luminance, black-and-white), above the threshold of electrical noise. On both video (the on-tape recording) and camera (straight through-the-lens operation) output, the ES6000 performs well.

The S/N ratio for the camcorder's AFM stereo recording is quite good. Meanwhile, the input sensitivity for the external microphone jack isn't the most sensitive APEL has measured, but still means you can equip this camcorder with many affordable accessory mikes.

"White balance" rates a camcorder's ability to adjust to different temperatures of light, for example, sunshine or incandescent, to reproduce white purely (and thereby, correctly-balanced colors). The ES6000's automatic adjustment performs just fine here. Ditto for "color contamination," the test that would reveal the presence of unwanted color when the camcorder's trained on a black-and-white test pattern.

In "resolution" the ES6000 is typical of Hi8 camcorders—360 lines of horizontal resolution recorded to tape at the video output. This is close to the

**TABLE 1—TEST RESULTS**

The following test results were furnished by the Advanced Product Evaluation Laboratory, an independent testing facility located in Bethel, CT.

**Brand:** Canon  
**Model:** ES-6000  
**Price:** \$1,699.  
**Weight:** 2.25 pounds (including battery and cassette)

**Video Measurements:**

Minimum Illumination: 10.0-lux  
 Resolution (Video Output): 360 lines  
 (Camera): 450 lines

Signal-to-Noise Ratio (Video Output):  
 Chroma AM: 42.0 dB  
 Luminance: 41.9 dB

Signal-to-Noise Ratio (Camera):  
 Chroma AM: 49.3  
 Luminance: 41.2

Color Contamination: 5 IRE

White Balance: 5 IRE

Streaking/Lag, Image Retention: Excellent

Color Quality (see Fig. 1):  
 Phase Accuracy: Excellent  
 Chroma Saturation: Slight oversaturation

Minimum Focus Distance:  
 Telephoto: 31 inches  
 Macro: 0.25-inch

**Audio Measurements:**

Signal-to-Noise Ratio: 59.2 dB

Maximum Output (built-in mic): 0.72-volts

Input Sensitivity (external mic): 4.7-millivolts



# Take This Giant Circuit Library For Only \$14<sup>95</sup>

when you join the  
**Electronics Engineers' Book Club®**

Hundreds of circuit ideas  
alphabetically arranged—from  
Alarm circuits to Zero  
crossing detector circuits!

"...includes schematics for the latest electronics  
circuits from industry leaders..."—Popular Electronics

Turn to this comprehensive circuit library for hundreds of project ideas...and concise pinout diagrams and schematics. In each volume you'll find more than 700 electronic and integrated circuits and 100+ circuit categories right at your fingertips to give you ideas you can use on the job or at your workbench.

If coupon is missing, write to: Electronics Engineers' Book Club® A Division of The McGraw-Hill Companies P.O. Box 549, Blacklick, OH 43004-9918

## The Encyclopedia of Electronic Circuits Volumes 1-4

by Rudolf F. Graf



### As a member of the Electronics Engineers' Book Club...

you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off the regular publishers' prices. If you want the Main Selection, do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want due to late delivery of the bulletin, you can return it at our expense. Your only obligation is to purchase 3 more books during the next 2 years, after which you may cancel your membership at any time. And you'll be eligible for FREE BOOKS through our Bonus Book Program. Publishers' Prices Shown © 1997 EEBC

## **ELECTRONICS ENGINEERS'** BOOK CLUB®

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

**YES!** Please send me *The Encyclopedia of Electronic Circuits-Vols. 1-4* (5861488), billing me just \$14.95, plus shipping/handling & tax. Enroll me as a member of the **Electronics Engineers' Book Club** according to the terms outlined in this ad. If not satisfied, I may return the books without obligation and have my membership cancelled.

Name \_\_\_\_\_  
Address/Apt.# \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_  
Zip \_\_\_\_\_ Phone \_\_\_\_\_

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

PIF497

theoretical limit of 400 lines (compared to 240 for the conventional 8mm format). Resolution means sharpness, and it's gauged by the number of image-making lines the camcorder records, in picket-fence fashion across your TV screen. It's much higher (450 lines) in "camera" mode.

The test for streaking/lag, image retention looks for flares or tails of light and color that trail behind the highlights of a moving subject. You'll see this on TV sportscasts, usually when light reflects off shiny helmets. It's virtually nonexistent with the CCD-based image sensors used in camcorders.

The tests for color quality examine phase accuracy and chroma saturation. Each is measured using the color red—the most difficult for video to reproduce. The Phase Accuracy portion of the test looks for deviation from true red, toward magenta or yellow. Chroma Saturation gauges depth, or intensity of hue.

As the vectorscope photo (see Fig. 1) shows, phase is right on target while chroma—at the rim of the scope, above the cross-hairs—is slightly oversaturated. Saturation, over and under, does affect an image visibly. The richer red of

the ES6000 can be toned down with your TV's color controls.

## OTHER FEATURES

The ES6000 comes with a feature seldom seen in camcorders anymore: Negative/Positive conversion. Although Canon touts this as a movie-making special-effect (along with solarization, mosaic, black-and-white, and sepia recording) it has a very practical function.

In conjunction the optional FP-100 Film Adapter (\$199), this function lets you convert color film negatives to positive images for recording on video. The adapter also works with transparency slides, and offers another neat trick. Besides recording photos to video, you could use the camcorder, in camera mode, to input photos directly to a personal computer without the added expense of a photo scanner. Whence, the importance of the ES6000's 450-line camera resolution. ■

**FOR MORE INFORMATION**

Canon USA, Inc.  
One Canon Plaza  
Lake Success, NY 11042  
**CIRCLE 82 ON FREE INFORMATION CARD**

## HANDS ON REPORT

(continued from page 10)

After all, how can you service a recorder or player when you don't know how the cassette itself operates. After that, one can open up the camcorder and take a look inside. It is important to become visually familiar with the inside of a camcorder before attempting to take it apart. After that you can remove whole sections of the camcorder and service them.

All of the sections inside the camcorder are thoroughly discussed. The sections include the camera portion that receives and processes an image for recording and the video circuitry that the camcorder has in common with a VCR. Servos, sensors, motors, audio circuitry, power supplies, and everything else is also covered. Once a camcorder is physically back up to snuff, all of the adjustments that lead to a clean recording must be performed, and the course discusses these, as well.

As one might imagine, the workings inside a camcorder are governed by a microprocessor. The course covers all aspects of the microprocessor's operation, and how it controls camcorder functions.

While you'll probably want to start servicing the camcorder as soon as you open up the box, you should note that the unit is brand new, under factory warranty, and shouldn't require any servicing for years to come. It's just that the course makes it so tempting to open up the camcorder and start disassembling it. But that is the intent of the course, and Heathkit has obviously done its job well.

Heathkit's Camcorder Servicing Course sells for \$1295. While that sounds steep at first, remember that the course includes a brand-new camcorder and everything you need to keep it working forever—well almost. ■

## Turn Your Multimedia PC into a Powerful Real-Time Spectrum Analyzer

### Features

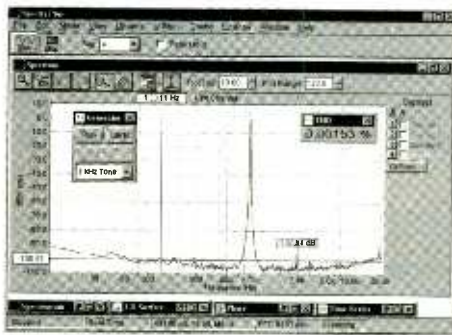
- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- Up to 65,536 pt FFT
- Octave analysis (1/1 - 1/24)
- THD, IMD, SNR measurements
- Signal Generation
- Digital Filtering
- Triggering, Decimation
- Transfer Functions, Coherence
- Dynamic Data Exchange (DDE)
- Time Series, Spectrum Phase, Spectrogram and 3-D Surface plots
- Real-Time Recording and Post-Processing modes

### Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

### System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor



Real-Time FFT Analyzer (single channel)	\$299
Options:	
Dual Channel Operation	\$99
Recording, Post-Processing Modes	\$99
Signal Generator	\$99
Professional Quality Sound Cards Available	Call

**DOWNLOAD FREE  
30 DAY TRIAL!**

[www.telebyte.com/pioneer](http://www.telebyte.com/pioneer)

**Spectra Plus 4.0**  
Affordable Signal Processing Software

**PHS**

Pioneer Hill Software  
24460 Mason Rd. N.W.  
Poulsbo, WA 98370

Sales: (360) 697-3472

Fax: (360) 697-7717

e-mail: [pioneer@telebyte.com](mailto:pioneer@telebyte.com)

CIRCLE 175 ON FREE INFORMATION CARD

**FOR MORE INFORMATION**

Heath Company  
Benton Harbor, MI 49022  
Tel. 800-253-0570



# It's Not Just Training...

*"I needed a refresher in fundamentals and a piece of paper that said I had a degree. CIE gave me both."*

**Louis P. Briant**  
Senior Engineer  
Sentel Corp.

*"CIE allowed me to use my G.I. Bill benefits and independent-study allowed me to continue my studies while deployed."*

**Charles Hopper**  
Electronics Senior Chief  
U.S. Navy

*"The fact that I intended to continue pursuing my Associate Degree with CIE was a key factor in being considered for my current position."*

**Annamarie Webster**  
Project Engineer -  
Instrumentation  
Ketchikan Pulp

*"My associates at work recommended CIE... The lessons were structured so they were easy to comprehend."*

**Vincent R. Buescher**  
Communications Technician  
AT&T

*"I reentered and received my A.A.S. degree from CIE because of the good experiences I had in one of CIE's career courses."*

**Maurice M. Henthorn, Jr.**  
Electronic Technician  
The Denver Post

Independent study from CIE will give you the skills you need to win your own independence in a successful career.

At CIE, we pride ourselves in keeping pace with the latest developing technologies. In turn, this assures our students that upon graduation they can mesh seamlessly into a variety of exciting and rewarding technology-based careers.

Back in the 1930's, we specialized in teaching radio and television sciences. Today, it's computer technology, programming, robotics, broadcast engineering, information systems management, and the electronics behind it all.

But some things have not changed, like the desire of CIE's faculty and staff to see their graduates succeed.

That is why at CIE we teach not only the hands-on, practical aspects of electronics technology, but also delve into the "why" behind today's technology. Why does it work the way it does?

The insights to be gained from such a broad, rich and comprehensive

education at CIE matches or exceeds those gained through

traditional commuter institutes while providing an education schedule to match your commitments and lifestyle.

Our patented learning program is specifically tailored for independent study and backed up by a caring team of professional educators who are at your call whenever you need their help.

At CIE, we'll match our training with your background and career goals and help you decide which of the many career courses that we offer suits you best. We offer an Associate Degree Program and through our affiliation with World College a Bachelor Degree



**Computer Programming**



**Electronics Technician**

Program.

If you have the sincerity, the smarts and the desire, CIE can make it happen. CIE is already the institute of choice for many Fortune 1000 companies. Why shouldn't you be next?

# ...It's an Education.



1776 East 17th Street  
Cleveland, OH 44114  
(216) 781-9400 • 1-800-243-6445

**YES!** Please send me more information on:

- CIE's Associate Degree Program
- CIE's Career Courses
- World College's Bachelor Degree Program

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone: \_\_\_\_\_

Check for G.I. Bill  Active Duty  Veteran

AH90

# NET WATCH

## Become Your Own Travel Agent

BY DAN KARAGIANNIS

Ask anyone in the industry and they'll tell you that travel agencies are in trouble. Such forecasters of doom will explain how "times are tough" and people aren't going away on trips anymore. I suppose they might be right.

However, this month I'm going to add my own reason why conventional travel agents might lose some sleep. It seems that there is a brand new way to make your airline, hotel, and car-rental reservations—all without the

have. Actually, you're presented with so many options once you log on that I'm going to have a difficult time keeping short my description of what you can accomplish here.

For starters you're presented with a ticker-tape-type banner at the top of the screen. This "news flash" banner lets you know what airlines are offering specials, and could give you some valuable hints to planning your next trip around whatever fare wars are currently being waged.

When you first click on it you're presented with several choices: Flights, Cars, Hotels, Retrieve Existing Reservations, and Vacation Packages.

Flights lets you either look through flight timetables and listings of fares, pick a particular flight you'd like to catch, or (this is my favorite) find the three lowest fares available to your destination.

How the lowfare finder works is simple. First you choose a login ID and password. This is because Travelocity will let you save itineraries and actually pay for them online using a credit card and a secure browser mode.

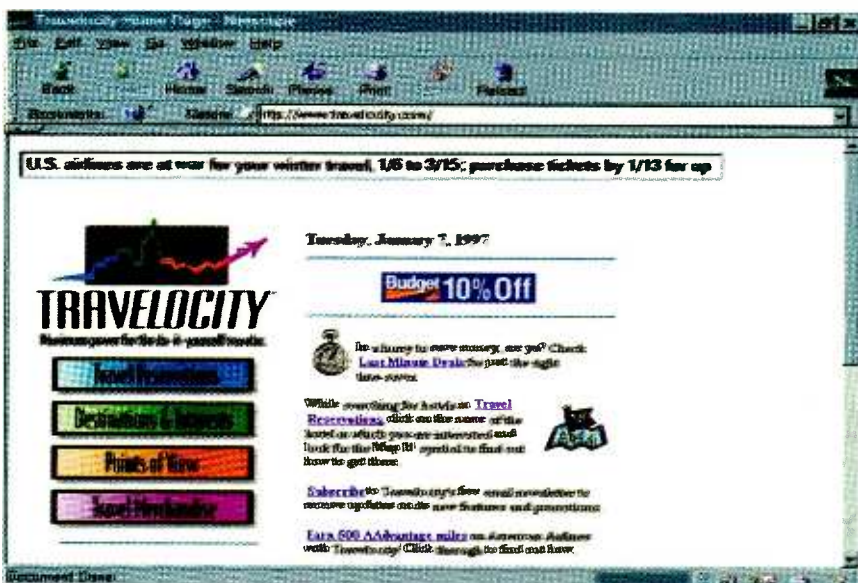
Next you enter the number of passengers, the type of class you'd like to fly (picking "low fare with restrictions," which seats you in coach, yields the best prices), and airline preferences. The form goes on to let you select what's most important to you in choosing a flight; you'll have to rank factors like price, whether it's non-stop, etc.

With all the preliminaries set, you must then choose the most obvious parameters: where you're leaving from, where you're going, and when you want to travel. The same goes for the return leg of your trip. You could enter several such segments, taking you from place to place, if you have a need to get to more than one place, that is.

Once you enter your data you submit it, wait a moment, and before you know it, the three lowest fares available will show up on your screen. Each gives you all the flight information you'll need to make up your mind.

The Cars reservation link is similar in that you're presented with a form to fill out online. Except here you are asked for the price range and type of car you're looking for, along with where and when you'll need it. You can even link to rental policies and rules of each company.

Choosing a hotel is another simple online process. What's neat about this reservation system is that you can make special requests. And I don't just mean whether or not your room is a smoking or non-smoking one. You can



Forget about going to travel agents or calling for flight information, Travelocity lets you arrange all your getaways online.

help of another living soul. Welcome to the age of do-it-yourself trip planning, all made possible by your computer, modem, and Net connection.

I found a travel site on the Web that's so comprehensive, covering any others in detail this month would only use up space. So, I decided to focus on that site, and briefly mention a few others. Let's get to our premier online marvel, shall we?

### TRAVELOCITY

Our featured site this month is one that I'm not only impressed with, but somewhat addicted to as well. Called Travelocity, it's sure to handle just about any travel concern you might

To the right of this page you'll find headline topics of interest. These change on occasion, but when I was last here they included links to special last-minute airfare deals, and information on how to earn 500 AAdvantage miles on American Airlines by using Travelocity.

On the same opening page you can choose from Travel Reservations, Destinations & Interests, Points of View, and Travel Merchandise. Let's now spend some time on each of these impressive sites, beginning of course with the heart of Travelocity.

The Travel Reservations section is definitely the area of Travelocity where you'll spend most of your time online.



# How to make your car invisible to radar and laser...legally!

Rocky Mountain Radar introduces a device guaranteed to make your car electronically "invisible" to speed traps—if you get a ticket while using the product, the manufacturer will pay your fine!



■ **The Phazer will "jam" both radar and laser guns, preventing police from measuring your speed.**

If your heart doesn't skip a beat when you drive past a speed trap—even if you aren't speeding—don't bother reading this. I can't tell you how many times that has happened to me. Driving down the interstate with my cruise control set at eight miles over the limit, I catch a glimpse of a police car parked on the side of the road. My heart skips a

beat and for some reason I look at my speedometer. After I've passed the trap, my eyes stay glued to my rear view mirror, praying the officer will pass me up for a "bigger fish."

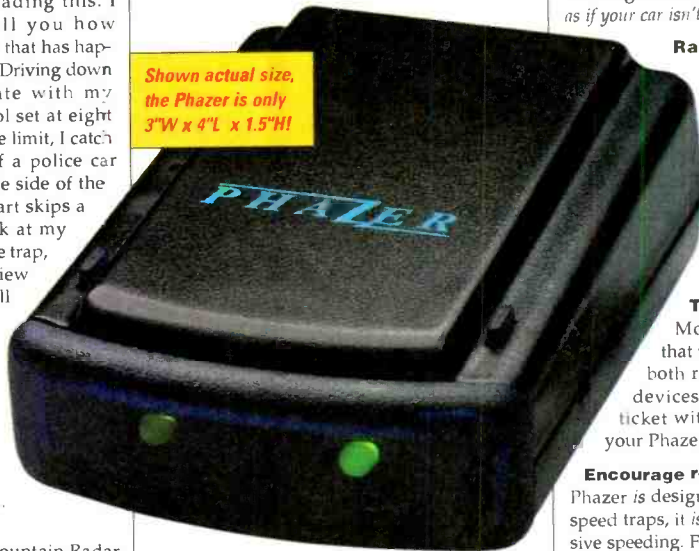
It seems that as speed-detection technology has gotten more and more advanced, speeding tickets have become virtually unavoidable. And although devices exist that enable motorists to detect these speed traps, they are outlawed in many states... including mine.

**The solution.** Today, Rocky Mountain Radar offers drivers like me a perfect solution—the Phazer. Combining a passive radar scrambler with an active laser scrambler, the Phazer makes your automobile electronically "invisible" to police speed-detecting equipment.

The radar component works by mixing an X, K or Ka radar signal with an FM "chirp" and bouncing it back at the squad car by way of a

waveguide antenna, effectively confusing the computer inside the radar gun. The laser component transmits an infrared beam that has the same effect on laser Lidar units.

Shown actual size, the Phazer is only 3"W x 4"L x 1.5"H!



**Perfectly legal.**

Some radar devices have been outlawed because they *transmit* scrambling radar beams back to the waiting law enforcement vehicle. The Phazer, however, *reflects* a portion of the signal plus an added FM signal back to the police car. This, in effect, gives the waiting radar unit an electronic "lobotomy."

Best of all, unless you are a resident of Minnesota, Oklahoma or Washington, D.C., using the Phazer is completely within your legal rights.

**HOW TO MAKE YOUR CAR DISAPPEAR**

Radar and laser scramblers are devices that foil speed traps by making vehicles electronically "invisible" to police radar. Radar scramblers mix a portion of the radar signal with background clutter and reflect it back to the squad car. This technique, pioneered by Rocky Mountain Radar, creates an unreadable signal that confuses the computer inside the radar gun.

The laser scrambler in the Phazer works in a similar manner. It transmits a special infrared beam with information designed to scramble the laser signal. The result? Readouts on police radar and laser guns remain blank. As far as the police officer is concerned, your vehicle is not even on the road.

■ **The Phazer makes your car invisible to police radar and lasers or the manufacturer will pay your speeding ticket!**



**How it scrambles radar.**

Police radar takes five to 10 measurements of a vehicle's speed in about one second. The Phazer sends one signal that tells the radar the car is going 15 m.p.h. and another signal that the car is going 312 m.p.h. Because police radar can't verify the speed, it displays no speed at all. *To the radar gun, your car isn't even on the road.*

**Works with laser, too!** The Phazer also protects your vehicle from Lidar guns that use the change in distance over time to detect a vehicle's speed. The Phazer uses light-emitting diodes (LEDs) to fire invisible infrared pulses through the windshield. Laser guns interpret those pulses as a false indication of the car's distance, blocking measurement of your speed. *Again, it's as if your car isn't even on the road.*

**Range up to three miles.**

The Phazer begins to scramble both radar and laser signals as far as three miles away from the speed trap. Its range of effectiveness extends to almost 100 feet away from the police car, at which point you should be able to make visual contact and reduce your speed accordingly.

**Ticket rebate program.**

Rocky Mountain Radar is so confident that the Phazer will protect you from both radar and laser speed-detection devices that if you do get a speeding ticket within the first year while using your Phazer, they will pay your fine!

**Encourage responsible driving.**

While the Phazer is designed to help you (and me) avoid speed traps, it is *not* intended to condone excessive speeding. For that reason, the manufacturer will only pay tickets where the speed limit was not exceeded by more than 30%, or 15 miles per hour, whichever is less.

**Risk-free.**

Thanks to the ticket rebate program, speed traps don't make my heart skip a beat anymore.

Try it. Your car will be invisible to police radar and laser, or the manufacturer will pay your fine! It's backed by our risk-free trial and three-year manufacturer's warranty. If you're not satisfied, return it within 90 days for a full "No Questions Asked" refund.



■ **The Phazer is a completely legal way to protect yourself from speed traps (except in OK, MN and Washington DC).**

The Phazer ..... \$199 \$14 S&H

Please mention promotional code 1901-PL-10225.

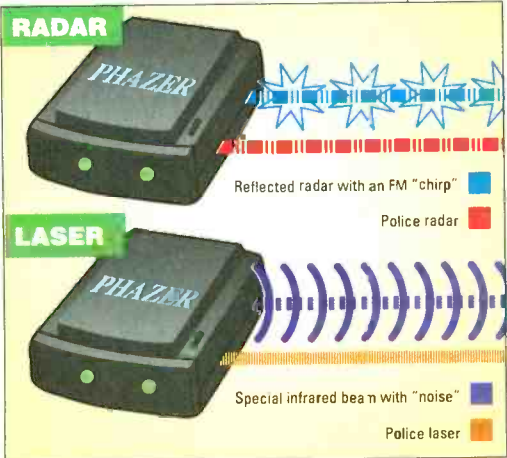
For fastest service call toll-free 24 hours a day

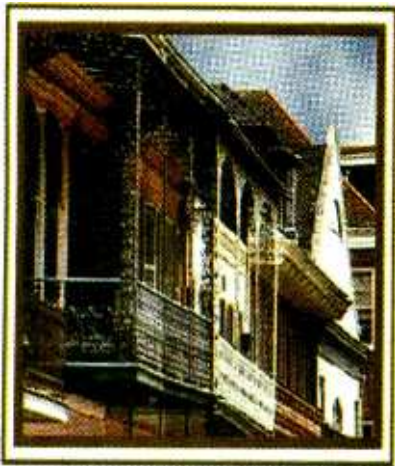
**800-992-2966**



**comtradindustries**

2820 Waterford Lake Drive, Suite 102 Midlothian, VA 23113





Want a look at where you're going before you get there? Load some photos of your next destination; shown here is some New Orleans architecture courtesy of Travelocity.

actually look for hotels that have entertainment, indoor pools, exercise facilities, etc.

Once you make travel plans, you can store them and get them later with Retrieve Existing Reservations. Need some more ideas about how to put it all together? Check out Vacation Packages for getaways that are text-book perfect.

Now that we covered that first feature of Travelocity, it's time to move on to the others I mentioned. Our next is Destinations & Interests, which is a first-rate section in itself. The page opens with a banner and a clickable map of the world; the banner lets you choose from Maps, Photos, Videos, Currency, Weather, or Features.

Selecting Maps is the same as picking a destination off the onscreen map. You'll get just what the name implies—maps, maps, and more maps to help you plan your trip.

Photos and Videos are similar in that they both let you see the places you plan on visiting before you actually buy a ticket. I personally liked the short video tours, which are provided in Quicktime format. Check out New Orleans, Paris, Cancun, and several other fun getaway spots.

Selecting Currency will provide you with a feature that's very useful to world travelers. Simply choose a unit of currency from the list provided, enter an amount in that currency, and select a unit to translate the amount into. Just about every country's currency is here, so consider yourself free of conversion tables and formulas for good.

Weather provides you with current climate information about North America, Europe, and Asia. Under each little map of these regions you can choose from: Full-Size Map, Airport Conditions, Current Outlook, and Forecasts. All of these are pretty self explanatory.

Last in this section is Features, which presents you with several travel-article titles. Just click on a story about a region you're interested in to read more.

The next section you can visit in the Travelocity site is Points of View. There you can link to World Views, Travelive, Bulletin Boards, and Trivia.

In World Views you'll find featured reviews (which are updated regularly) written by travel writers and Worldview's editorial staff. When I logged on before writing this column, there was a winter-sports feature.

Travelive lets you chat in real time with other travelers and industry insiders. The site uses the WebChat Broadcasting System (WBS), which means you only need a standard browser to participate (unlike Internet Relay Chat, for which you need special IRC software). You can talk about destinations, travel styles, and languages.

The Bulletin Boards let you participate in non-real-time online discussions about travel. These are like USENET groups and BBS forums. You'll find posted tips for traveling with kids, adventure travel, insider travel tips, and more.

Last in this section is Fun & Games. There are no prizes, but if you feel like having your travel knowledge challenged, you should enjoy this section's trivia games.

The final major section at Travelocity is Travel Merchandise. Here's where you'll find AC Adapters, Books, Games, Luggage, Maps and Guides, and links to dozens of other types of products that you wouldn't want to leave home without. There's even software you can buy to help you plan a getaway, though I can't imagine what such software does that this site doesn't already cover!

## FOR FREQUENT FLYERS

While Travelocity is a great site, some of you reading this might have a frequent-flyer plan with, or just a preference for, a specific airline. If that's the

## HOT SITES

**Travelocity**  
<http://www.travelocity.com>

**American Airlines**  
<http://www.amrcorp.com>

**Continental Airlines**  
<http://www.flycontinental.com>

**Delta Airlines**  
<http://www.delta-air.com>

**Northwest Airlines**  
<http://www.nwa.com>

**Pan Am Airlines**  
<http://www.panam.com>

**TWA**  
<http://www.twa.com>

**United Airlines**  
<http://www.ual.com>

**USAir**  
<http://www.usair.com>

case, and you only want a way to make airline reservations, you might want to cut out the middle man and go straight to your carrier-of-choice's web site.

In this month's "Hot Sites" box you'll find URLs for American, Continental, Delta, Northwest, Pan Am, TWA, United, and USAir. I'm often logged on to Delta's site in particular, because I'm a new frequent flyer with them, but the other companies have great Web pages as well.

That's it for this month. Until next time, I hope all your travels online and through the air are pleasant ones. Want to drop me a line? Feel free to do so at [peeditor@gernsback.com](mailto:peeditor@gernsback.com) or *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■



"But why do you need a mobile answering machine?"



# CATALOG SUPERMARKET



## Top Secret Consumertronics

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

**number 504 in coupon**



## RNJ Electronics, Inc. New 1997 Catalog

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

For a catalog call 1-800-645-5833.  
**number 509 in coupon**



## All Phase Video Security Inc.

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

**number 503 in coupon**



## Professional Sign Making Machines

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

**number 508 in coupon**



## A.M.C. Sales, Inc.

A.M.C. Sales, Inc., a 27 year old company, specializing in Electronic Surveillance offers its catalog which contains equipment of all types for the individual and/or company who are active in Electronic Surveillance. 80 to 100 items are displayed and priced, a must for the amateur and/or professional. **\$5.00**

**number 507 in coupon**



## American Eagle Publications

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

**number 500 in coupon**

## ORDER YOUR CATALOG TODAY!

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

- |  |          |                                  |          |
|--|----------|----------------------------------|----------|
| 500 - American Eagle Catalog           | - \$2.00 | 506 - Mouser Electronics Catalog | - Free   |
| 501 - American Innovations Catalog     | - \$6.00 | 507 - A.M.C. Sales Inc. Catalog  | - \$5.00 |
| 502 - Antique Radio Classified         | - \$4.00 | 508 - California Digital Catalog | - \$2.00 |
| 503 - All Phase Video Security Catalog | - \$2.00 | 509 - RNJ Catalog                | - \$2.00 |
| 504 - Consumertronics Catalog          | - \$3.00 | 510 - EDE Spy Outlet Catalog     | - \$5.00 |
| 505 - Information Unlimited Catalog    | - \$2.00 | 511 - IEC Catalog                | - \$2.00 |

Payment, please check one  Check  Money Order  
Total for items selected \$ \_\_\_\_\_ Service and Handling \$1.50 \_\_\_\_\_ Total Enclosed

Name \_\_\_\_\_

Street \_\_\_\_\_

City/State/Zip \_\_\_\_\_

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

Void after June 30, 1997

# ORDER YOUR CATALOG TODAY!

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

- |  |          |                                  |          |
|--|----------|----------------------------------|----------|
| 500 - American Eagle Catalog           | - \$2.00 | 506 - Mouser Electronics Catalog | - Free   |
| 501 - American Innovations Catalog     | - \$6.00 | 507 - A.M.C. Sales Inc. Catalog  | - \$5.00 |
| 502 - Antique Radio Classified         | - \$4.00 | 508 - California Digital Catalog | - \$2.00 |
| 503 - All Phase Video Security Catalog | - \$2.00 | 509 - RNJ Catalog                | - \$2.00 |
| 504 - Consumertronics Catalog          | - \$3.00 | 510 - EDE Spy Outlet Catalog     | - \$5.00 |
| 505 - Information Unlimited Catalog    | - \$2.00 | 511 - IEC Catalog                | - \$2.00 |

Payment, please check one  Check  Money Order

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

Name \_\_\_\_\_

Street \_\_\_\_\_

City/State/Zip \_\_\_\_\_

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

Void after June 30, 1997

2



## Antique Radio Classified

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

number 502 in coupon

## AMERICAN INNOVATIONS

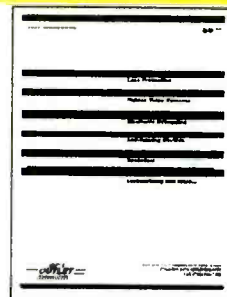
**SURVEILLANCE  
COUNTERSURVEILLANCE  
PROTECTION  
SECURITY EQUIPMENT**  
FOR BUSINESSES, INDIVIDUALS &  
LAW ENFORCEMENT AGENCIES

## American Innovations Catalog

Featuring: Micro Cameras, Hidden Cameras, Board Cameras, Voice Changers, Scrambling Systems, Tracking Devices, Transmitters, Bomb & Weapons Detection, Drug Detection, Telephone Analyzers, Tape Recorder Detection, Video Detection, Recording Devices, Telephone Recorders, PBX Security, Wireless Video Systems, Night Vision, Bionic Ears, Body Armor, Air Tasers, And Much More...

**\$6.00** (Includes \$10 discount off 1st order.)

number 501 in coupon



## EDE Spy Outlet

The Latest High Tech Professional Electronic Devices. Our latest catalog offers a **HUGE** selection of surveillance, counter-surveillance/privacy devices: hidden video equipment, pinhole camera w/audio \$144., electronic kits, telephone recording systems: 7-Hour \$125. - 16-Hour \$199., touch tone decoders, scanners, bug/phone tap detectors, voice disguisers, telephone scramblers, locksmithing tools, and more. **\$5.00**

number 510 in coupon

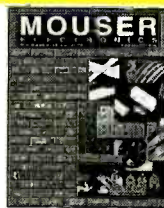


## Information Unlimited

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

number 505 in coupon

Free



## Electronics Purchasing Manual

For same day shipping, helpful technical assistance, no minimum orders and broad inventory selection, send for Mouser's newest catalog featuring 68,000+ components from 125+ leading manufacturers including 3M, Amp, NEC, SGS Thomson, Rohmn and more. Mouser also provides many specialized services including cross-referencing, same day credit, drop shipments, scheduled orders and guaranteed pricing. **Mouser Electronics**, 958 N. Main St., Mansfield, TX, 76063. Catalog (800) 992-9943; Fax (817) 483-0931; <http://www.mouser.com>; E-mail: [catalog@mouser.com](mailto:catalog@mouser.com).

number 506 in coupon

## IEC

We are committed to quality products ...

Kit Products Catalog

Orders:  
(423)584-8600

COPYRIGHT © 1997  
International Electronics Corp.  
ALL RIGHTS RESERVED

## International Electronics Corporation

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

number 511 in coupon



# MULTIMEDIA WATCH

## A Pair of Unusual Controllers

BY MARC SPIWAK  
TECHNICAL EDITOR  
WINDOWS MAGAZINE

I've tried to keep you all—and myself—up to date on the wide variety of controllers available for PCs. Because even if you only need a mouse for what you do with your computer today, you or someone you know might have to do something out of the ordinary some day. And sometimes tasks can be made a lot easier with a specialized controller of some kind. So this month I've got two very specialized PC controllers, one intended mostly for business presentations and the other obviously for gaming.

### REMOTEPPOINT PLUS

I've reported on products manufactured by Interlink Electronics before. Interlink's ingenious force-sensitive resistor (FSR) technology uses a thin film that changes its resistance according to the pressure applied to it. The material indicates how much pressure is applied and where on the film the pressure is applied. The latest FSR device I've seen Interlink demonstrate (but will report on in a future column) is a new kind of touch pad for notebook computers.

Traditional touch pads generate a capacitive field above them that responds to moisture in your fingertip. You don't even have to touch the pad for it to respond. I find these very flaky in general, and I'm always inadvertently highlighting, cutting, and moving text. Interlink's touch pad will use much less power by not having to generate the field and should be a lot more predictable by requiring a light force on the pad to make it do anything. Interlink will OEM the device to certain notebook manufacturers and will also market a standalone touch-pad controller that I'll report on as soon as I get one.

This month I will discuss Interlink's newly designed *RemotePoint Plus*, a handheld wireless infrared (IR) mouse. It's sort of like a TV remote with a circular rubber disc that can be tilted 360 degrees. The tilting motion replaces a mouse's X-Y movement by moving the cursor in the direction that the disc is tilted. Cursor speed depends on the

amount of pressure applied to the edge of the disc. You point *RemotePoint Plus* at a small desktop IR receiver that plugs into your computer's mouse port. The transmitter works up to 40 feet away from the receiver.

The original *RemotePoint* basically had just primary (left) and secondary mouse buttons. In addition to those buttons, the new *RemotePoint Plus* has four extra buttons that can be assigned to as many as 15 functions

Game Pad. This one looks and feels like the handle bars from a futuristic, miniature motorcycle. It's very comfortable to hold and all of the buttons are easy to access. The game pad has 6 action buttons, an 8-way cross-key pad, and 2 trigger buttons. It works with games running under Windows 95 or in an MS-DOS box in Windows 95. Because it's a digital controller with exotic new drivers, the game pad won't work with a lot of older software. It



*Interlink's RemotePoint Plus is a handheld wireless infrared (IR) mouse. In addition to primary (left) and secondary mouse buttons, it has four extra buttons that can be assigned to as many as 15 functions to access presentation tools, start games, mute sound, launch a Web browser, and so on.*

to access presentation tools, start games, mute sound, launch a Web browser, and so on. Software bundled with the device provides more than 50 presentation screen tools including an on-screen highlighter, laser-pointer emulator, underliner, and more. Anyone who does business presentations will definitely want to have a *RemotePoint Plus*. It has a suggested list price of \$199.95.

### THE SIDEWINDER

This month I've also got a new controller from Microsoft: the *SideWinder*

does provide lightning-fast response for games that do work with it, though.

Up to four users can play games simultaneously by daisy-chaining game pads together, with all the functions of each pad maintained. The *Game Device Profiler* software lets you create macros by programming complicated multibutton and keyboard strokes into single button presses. That gives you the edge in games that require a lot of complicated maneuvers. To use the *SideWinder* game pad you need a 486/66 or higher multimedia PC and Windows 95.



The Microsoft SideWinder Game Pad looks and feels like the handle bars from a futuristic, miniature motorcycle. It has 6 action buttons, an 8-way cross-key pad, and 2 trigger buttons.

## NEW STUFF

I've been into photography for a long time. I actually had my own darkroom, back when I was a kid, for processing and printing black-and-white photos. While I haven't done any photographic work in a long time, aside from taking pictures that is, I'm sure the skills would come back to me in an instant. However, some day soon, my long-lost skills won't even be valuable anymore—digital cameras and computers are taking over everything. MGI Software is helping photographers get their feet wet in digital processing, without the use of a digital camera. You start with regular film.

The *MGI PC PhotoStarter Kit* (\$24.99) is intended for beginners. The kit includes everything you need to place, edit, and manage photos on your PC. The kit includes a 12-exposure roll of Kodak 35mm film and free Kodak processing of film to disk—you pay for the regular developing, and they throw in electronic prints for free. You also get *MGI PhotoSuite Starter Edition* software and a helpful guide with step-by-step instructions.

*MGI PhotoSuite 8.0* is for those who've already played with image-editing software and know they like it. *PhotoSuite 8.0* includes everything you need to customize and catalog your photos: 30 special effects, a photo lens kit, image capture, a slide show, photo albums, and more. This package sells for \$74.95, and it's only \$49.95 if you upgrade from the *PhotoStarter* kit.

There's new software this month from Microsoft. For one there's the newest release of the Encarta encyclopedia, *Encarta 97*. This is basically an update to the ever popular treasure chest of information, except that now you can buy two versions: there's the usual *Encarta 97 Encyclopedia* on a single CD for \$54.95 and a new *Deluxe Edition* that comes on two discs for \$79.95. The *Deluxe Edition* contains nearly twice as much multimedia content as the regular version, with more pictures, more video clips, extensive Internet links, and 18 months of free online updates. Also available is the new *Encarta 97 World Atlas*. Including 1.2 million places and over 8000 web links, this is the biggest world atlas ever, and all for only \$54.95.

I've also got Microsoft's latest release of its interactive movie guide, *CineMania 97*. This one contains all you'd ever want to know and more about more than 25,000 movies—who starred in them, what they're about, the director, the producer, and so on. All information is cross referenced. For example, if you know one movie someone has been in, all the others will show up as well. There are also plenty of still images, video clips, movie reviews from respected critics, and other fascinating information. *CineMania* can also sug-

gest movies for you to watch based on types and topics. If you like movies, you'll find this disc to be valuable.

Microsoft apparently wants to help you with everything under the sun, and buying a new car is one of them. Unless you know exactly what you want, there are just too many makes, models, and features to choose from. The *Microsoft CarPoint* Internet car-buying guide is a huge database of information on new cars. Find out what the features cost, where the hidden charges are, and much, much more. *CarPoint* can help you decide on a model based on the features that are most important to you. You can even check out the interiors of new cars with *Surround Videos* that let you see 360-degree views. Visit *CarPoint* on the Web at <http://carpoint.msn.com/>.

Star Wars fans are going to do cartwheels when they find out that not only is the trilogy of original movies being re-released along with special digital enhancements, but also that *The LucasArts Archives Vol. II: The Star Wars Collection* is now available. The collection includes three classic titles: *Rebel Assault*, *Rebel Assault II: The Hidden Empire*, and *TIE Fighter Collector's CD-ROM*. You also get the *Dark Forces Super Sampler Edition*. But the icing on the cake has to be the bonus CD-ROM, *Making Magic: A Behind the Scenes Look at the Making of the Star Wars Trilogy Special Edition*. *Star Wars* was released about 20 years ago, and a lot has happened to movie-making technology in the years since. *Making Magic* shows you how some of the movie magic is done today.

I've three new children's software titles this month from *DreamWorks Interactive*. The first one is *Goosebumps: Escape From HorrorLand*, where you are trapped in a scary theme park. It's based on RL Stine's series of children's books. *Someone's in the Kitchen!* is a musical multimedia title that lets kids experiment in the kitchen without making a mess. Kids can follow recipes or create their own, and they learn about food and kitchen safety along the way. *The Neverhood* is a multimedia adventure game with photo-realistic environments created from over three tons of clay. You play the hero Klaymen and must save the *Neverhood* from Klogg, an out-of-control clay creation.

### WHERE TO GET IT

#### DreamWorks Interactive

640 North Sepulveda Blvd.  
Los Angeles, CA 90049

CIRCLE 60 ON FREE  
INFORMATION CARD

#### Interlink Electronics

546 Flynn Road  
Camarillo, CA 93012

CIRCLE 61 ON FREE  
INFORMATION CARD

#### LucasArts Entertainment Company

PO Box 10307  
San Rafael, CA 94912

CIRCLE 62 ON FREE  
INFORMATION CARD

#### MGI Software Corp.

40 West Wilmot Street  
Richmond Hill, Ontario  
Canada L4B 1H8

CIRCLE 63 ON FREE  
INFORMATION CARD

#### Microsoft Corporation

One Microsoft Way  
Redmond, WA 98052

CIRCLE 64 ON FREE  
INFORMATION CARD



# SCANNER SCENE

## Scanning the Wild Blue Yonder

BY MARC SAXON

**A**eronautical monitoring is one of the rare aspects of the hobby that offers scanner owners a taste of DXing. High-altitude aircraft can be monitored while they are several hundred miles off into the distance. To add

Using the CD-ROM through a Windows program, you can look up any aircraft by its tail number or its owner's name, or by its category, its make and model, or its engine make and model. Remember that an aircraft's tail regis-

243-9889; Web: <http://hitech.superlink.net/>.

### McMONITORING

No doubt about it, fast-food drive-through windows continue to attract an inordinate amount of attention from scanner owners. Although we have run some of the frequencies in the past, we continue to get letters providing frequencies as well as asking for them.

Whatsamatta—you can't enjoy a burger and fries in your car without also eavesdropping on the counter folks? Think maybe they're talking about you behind your back? They might be!

Although frequencies vary from location to location, many McDonalds are reported to be using 30.84, 31.00, 33.14, 35.02, 151.715, 151.775, 151.895, 154.06, 154.57, 154.60, 154.70, 165.60, 169.446, 170.245, 170.305, 171.105, 171.905, 467.775, and/or 467.55 MHz.

Burger King is said to prefer 30.84, 31.00, 154.57, 170.305, 457.5625, 457.60, 467.825, 467.7875, and 461.2875/466.2875 MHz.

Try a Taco Bell on 30.84, 31.00, 33.40, 154.515, 154.54, 154.57, 457.5375, 457.55, 460.8875, 461.0375, 461.0875, 461.5375, 464.9625, 466.0375, 466.8075, 466.5375, 468.3875, and/or 469.9625 MHz.

If you're at a KFC, don't be a chicken! Try 30.84, 31.00, 33.40, 154.57, 170.305, 457.5875, 457.60, 460.8875, 461.0875, 462.75, 462.7625, 465.8875, 467.8125, and/or 467.8875 MHz.

Keep in mind that you won't hear anything if you drive much beyond the limits of the parking lots of these places because they use short-range equipment. Some places use single frequency (simplex) systems, in which case you will hear both sides of conversations. Otherwise, they are transmitting and receiving on different channels, and you'll pick up only half of what's being said, unless you use two scanners. Two scanners? You wouldn't go that far, would you?

Oh dear.

continued on page 69 27



### Search by Tail Number

785C

TYPE THE TAIL #. NO 'N' IS REQUIRED FOR U.S.A.

Tail	Make	Use	model	Serial #
785AA	BEECH		35-B33	CD-413
785AR	CESSNA		172N	17273549
785AU	BOEING		737-4B7	25024
785BK	CESSNA		182Q	18265768
785C	STINSON		108-3	108-3785
785DK	BEECH		C23	M-2250
785DL	LOCKHEED		L-1011-385-1	193A-1121
785EL	LUDTKE EDWARDL		THORP T-18	2026

PRESS ENTER - TO DISPLAY RECORDS

USE UP AND DOWN ARROW KEYS TO MOVE THE POINTER

YOU CAN ALSO USE PAGE UP AND PAGE DOWN

With the International Air CD-ROM, finding information on a particular aircraft couldn't be easier.

a further touch of MHz spice, the aircraft you'll monitor might have originated at some exotic foreign locale. No matter, English is the language for all aeronautical communications.

A common complaint from scanner owners, however, has been that although aircraft make for great VHF scanning, not knowing their types, owners, and other stats keeps them too anonymous. You can't look them up, like the police or fire stations a scanner can receive. That was true—but not any longer!

Thanks to the *International Air* CD-ROM, you can now search out the information on virtually every individual aircraft (well, except for military) registered in 84 nations of the world. The data covers 23 categories, such as airliners, private aircraft, agriculture, training, weather, balloons, gliders, research, utility, racing, acrobatic, and more.

tration number constitutes its official radio call letters or identification. You can learn the year an aircraft was built, its number of engines, city of registry, number of passengers, maximum take-off weight, average cruising details, engine horsepower, and fuel-consumption rate. There are also pilot records, as well as telephone and fax numbers for pilots and aircraft owners in the U.S. and Canada.

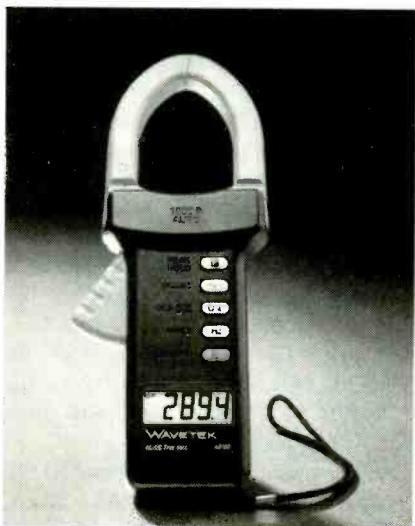
An enormous amount of useful data is available on this CD-ROM. Any aircraft you monitor can be identified in seconds. New editions are updated quarterly in order to keep the information current. *International Air* installs quickly and easily and is very user-friendly. It comes with a 22-page manual just in case questions arise.

The CD-ROM costs \$189. It's sold by International Air CD, 2234 North Federal Highway, Boca Raton, FL 33432; Tel. 561-243-1219; Fax: 561-

# New Products

## CLAMP-ON AMMETER

Wavetek's Model AD105 clamp-on ammeter is designed for the installation, testing, verification, servicing, and troubleshooting of today's electrical systems and equipment. Its clamp style allows for both AC and DC amp measuring and frequency test in a non-invasive manner for quicker and safer current measuring.



The Model AD105 features a large LCD readout, autoranging, true-RMS measuring, and a peak-hold button. Hall-effect technology allows for the measuring of both AC and DC current to 1000 amps and frequency to 10 kHz. The ammeter's "hand-guard" design meets international safety standards. Wavetek's No Hassle™ warranty assures that the ammeter will be replaced anywhere in the world with an instant, over-the-counter exchange, if necessary.

The Model AD105 clamp-on ammeter has a list price of \$224.95. For additional information, contact Wavetek Corporation, 9045 Balboa Avenue, San Diego, CA 92123; Tel: 619-279-2200; Fax: 619-565-9558.

**CIRCLE 80 ON FREE INFORMATION CARD**

## DIGITAL VOICE RECORDER

Sony's Voice File Model ICD-50 is a palm-sized IC chip recorder that holds up to 99 messages in each of two sep-

arate files. Measuring just 2-1/8 x 3-3/8 x 7/8 inches and weighing only 2-3/4 ounces, the digital recorder is equipped with a backlit digital LCD readout that clearly displays recording and feedback functions.



The Voice File provides crisp, distortion-free recordings, with up to 16 minutes of continuous recording time. Messages can be recorded over again and again. The ICD-50 also features a built-in alarm with personal message reminder.

Messages and notes can be recalled easily at a later time. At the touch of a button, the recorder's quick random access and flash memory capabilities help locate and play specific messages.

The scan function allows users to play back the first few seconds of each message. The insert function allows users to add additional information to an existing message.

The Voice File ICD-50, which runs on one "AAA" battery, has a suggested retail price of \$189.95. For further information, contact Sony Electronics, 1 Sony Drive, Park Ridge, NJ 07656; Tel: 800-222-SONY; Web: <http://www.sony.com>.

## MONITOR-TOP ORGANIZER

Kantek's Spectrum Superstor™ provides quick access and convenient storage of office and computer essen-

tials, placing everything right at your fingertips—on top of your computer monitor. It takes up no desk space, and clears much of the clutter off your desktop.

The Superstor holds and organizes all sorts of office supplies and computer media, with compartments sized to hold CD-ROMs, 3.5- and 5.25-inch disks, ZIP disks, back-up tapes, paper, stationery, envelopes, note and full-size pads, file folders, and Post-Its. Holes in the top of the unit hold pens, pencils, markers, scissors, and rulers. The compartments are adjustable to accommodate an assortment of supplies.



The Superstor works with all popular monitor and terminal sizes (from 12 to 21 inches) and slopes. Its mounting system allows full tilt, swivel, and centering adjustability for efficient positioning. The organizer is compatible with all existing glare filters and copy holders. It can also be used as a desk-top organizer.

The Superstor monitor-top organizer has a suggested retail price of \$49.95. For further information, contact Kantek Inc., 15 Main Street, East Rockaway, NY 11518; Tel: 516-593-3212 or 800-536-3212; Fax: 516-593-3295; e-mail: [kantek@interserv.com](mailto:kantek@interserv.com); Web: <http://www.kantek-spectrum.com>.

**CIRCLE 81 ON FREE INFORMATION CARD**

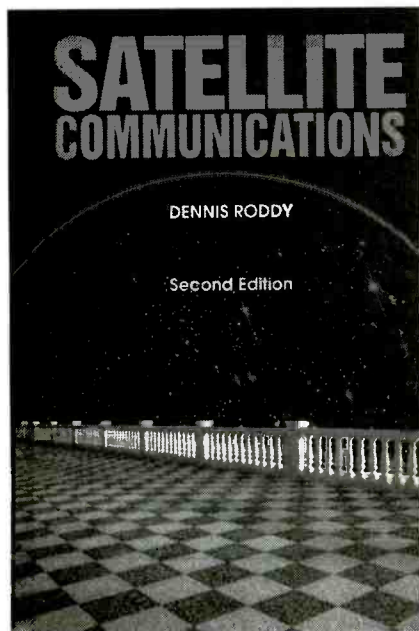


# ELECTRONICS LIBRARY

## SATELLITE COMMUNICATIONS Second Edition

by Dennis Roddy

This book provides students, technologists, and engineers with an introduction to the complexities of satellite communications systems that is both comprehensive and readable. It delivers clear explanations, in plain English, of all types of analog and digital systems in use today, without glossing over important technical details.



The book covers the many practical issues that are of interest to professionals and students alike. It presents the latest information on frequency-division multiple access (FDMA) and time-division multiple access (TDMA) and how those competing methods of satellite access measure up. It explains orbital mechanics, with full descriptions of hardware such as satellite structures, antennas, and earth stations. The second edition also explores cutting-edge applications including global-position-satellite and mobile-satellite systems.

*Satellite Communications, Second Edition, costs \$60 and is published by McGraw-Hill, Inc., 11 West 19th Street, New York, NY 10011; Tel. 800-322-8158.*

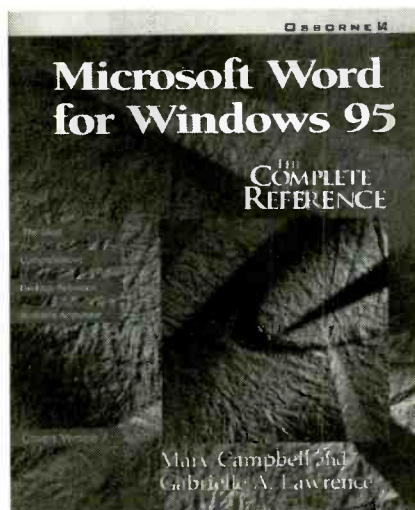
**CIRCLE 90 ON FREE  
INFORMATION CARD**

## MICROSOFT WORD FOR WINDOWS 95

### The Complete Reference

by Mary Campbell &  
Gabrielle A. Lawrence

This book provides clear answers about the newest version of the best-selling word processing system, Microsoft Word. Written in an easy-to-use format, with helpful tips, shortcuts, and techniques presented along the way, the book is designed to help readers quickly and effortlessly find the information they need. Beginners will learn how to install Word for Windows 95 and find thorough instructions on creating, editing, and formatting documents. More advanced users will find information on topics including how to exchange data with other applications, use Word's desktop-publishing features, and use Word in a workgroup environment.



The book describes every Word for Windows 95 feature, menu item, command, and function, and provides examples on every topic. An alphabetic reference of all Word for Windows 95 features and a handy cross-referenced index are included.

*Microsoft Word for Windows 95: The Complete Reference costs \$29.95 and is published by Osborne/McGraw-Hill, 2600 Tenth Street, Berkeley, CA 94710, Tel. 800-227-0900.*

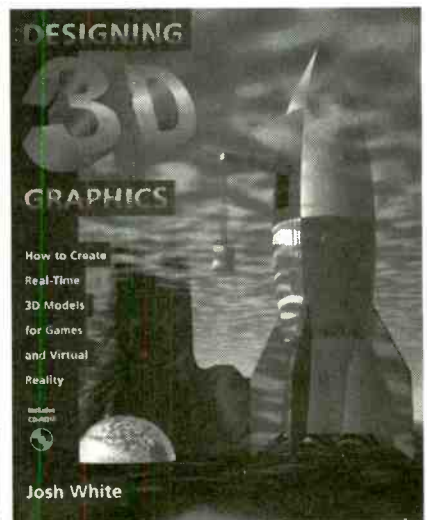
**CIRCLE 91 ON FREE  
INFORMATION CARD**

## DESIGNING 3D GRAPHICS: How to Create Real-Time 3D Models for Games and Virtual Reality

by Josh White

This book-and-CD-ROM package gives readers everything they need to create sophisticated real-time 3D graphics for games and virtual-reality applications. The book is full of design tips, animation techniques, and step-by-step directions for the most popular drawing tools. The accompanying CD-ROM features a collection of 3D objects and textures that can be used immediately, a sample of every 3D model shown in the images in the book, and textured models.

The author, a professional computer graphics artist, reveals his in-depth knowledge of software tools and hands-on modeling techniques. Readers learn how to design 3D artwork that is optimized for real-time; create realistic 3D objects that render at a high frame rate; master industry-standard tools such as 3D Studio and Photoshop; and create graphics for different platforms, including PC, Macintosh, Sony Playstation, Nintendo, and Sega.



*Designing 3D Graphics costs \$39.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-225-5945; Web: <http://www.wiley.com/compbooks>.*

**CIRCLE 92 ON FREE  
INFORMATION CARD**

# RETAILERS THAT SELL OUR MAGAZINE MONTHLY

## Alaska

Frigid North Co.  
1207 W. 36th Avenue  
Anchorage, AK 99503

## California

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

Ford Electronics  
8431 Commonwealth Avenue  
Buena Park, CA 90621

All Electronics  
14928 Oxnard Street  
Van Nuys, CA 91411

Gateway Electronics of CA  
9222 Chesapeake Drive  
San Diego, CA 92123

Mac's Electronics  
191 South "E" Street  
San Bernardino, CA 92401

Electronics Warehouse  
2691 Main Street  
Riverside, CA 92501

Orvac Electronics  
1645 E Orangethorpe Ave.  
Fullerton, CA 92631

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

JK Electronics  
6395 Westminster Blvd.  
Westminster, CA 92683

Marvac Dow Electronics  
980 S. A Street  
Oxnard, CA 93030

Kandarian Electronics  
1101 19th Street  
Bakersfield, CA 93301

Whitcomm Electronics  
105 W. Dakota #106  
Clovia, CA 93612

Marvac Dow Electronics  
265-B Reservation Road  
Marina, CA 93933

Minuteman Electronics  
37111 Post St., Suite 1  
Fremont, CA 94536

HCS Electronics  
6819 S. Redwood Drive  
Cotati, CA 94931

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

Metro Electronics  
1831 J Street  
Sacramento, CA 95814

The Radio Place, Inc.  
5675-A Power Inn Road  
Sacramento, CA 95824

HSC Electronics  
4837 Amber Lane  
Sacramento, CA 95841

## Colorado

Gateway Electronics of CO  
2525 Federal Blvd.  
Denver, CO 80211

## Connecticut

Signal Electronics Supply  
589 New Park Avenue  
W. Hartford, CT 06110

Cables & Connectors  
2198 Berlin Turnpike  
Newington, CT 06111

Electronic Service Prod.  
437 Washington Avenue  
North Haven, CT 06473

## Georgia

Norman's Electronics, Inc.  
3653 Clairmont Road  
Chamblee, GA 30341

## Illinois

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

## Maryland

Mark Elec. Supply Inc.  
5015 Herzel Place  
Beltsville, MD 20705

Amateur Radio Center  
1117 West 36th Street  
Baltimore, MD 21211

## Massachusetts

U-Do-It Electronics  
40 Franklin Street  
Needham, MA 02194

## Michigan

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

The Elec. Connection  
37387 Ford Road  
Westland, MI 48185

## Minnesota

Acme Electronics  
224 Washington Avenue N.  
Minneapolis, MN 55401

## Missouri

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

William Elec & Ind Supply  
803 Davis Blvd.  
Sikeston, MO 63801

## New Jersey

Lashen Electronics Inc.  
21 Broadway  
Denville, NJ 07834

## New York

Sylvan Wellington Co.  
269 Canal Street  
New York, NY 10013

R&E Electronics  
4991 Rt. 209  
Accord, NY 12404

Unicorn Electronics  
Valley Plaza  
Johnson City, NY 13790

## Ohio

Philcap Electronic Suppliers  
275 E. Market Street  
Akron, OH 44308

## Oregon

Norvac Electronics  
7940 SW Nimbus Avenue  
Beaverton, OR 97005

## Pennsylvania

Business & Computer Bookstore  
213 N. Easton Road  
Willow Grove, PA 19090

## Texas

Mouser Electronics  
2401 Hwy. 287 N  
Mansfield, TX 76063

Tanner Electronics  
1301 W Beltline  
Carrollton, TX 75006

Electronic Parts Outlet  
3753 B Fondren  
Houston, TX 77063

Electronic Parts Outlet  
17318 Highway 3  
Webster, TX 77598

## Washington

Amateur Radio Supply Co.  
5963 Corson Ave., Ste 140  
Seattle, WA 98108

If you'd like to sell our magazine in your store,  
please circle 180 on Free Information Card.



Just about everyone is familiar with the "polygraph" instrument, or "lie detector" as it is commonly known. A typical unit will monitor respiratory rate, heart rate, and galvanic skin response (GSR) as a subject is being questioned. Some units also use an EEG to monitor brain waves. A skilled operator supposedly can determine if the subject is being truthful or not.

Of all the components of a typical polygraph, the easiest circuit for a hobbyist to reproduce is the GSR monitor, which will indicate relative changes in skin resistance. Such a device is the basis for the simple *Lie Detector* described in this article. While it only lets you perform one of the tests of a traditional polygraph, the Lie Detector could still provide you with hours of fun, and might even help you catch a "fibber."

**GSR Basics.** While most hobbyists know how to measure resistance in a circuit, few know how to measure it in skin. Let's take a brief look at how that is possible.

Skin resistance varies at the rate of about 0.01 to 0.5 Hz under normal "at rest" conditions. However, the factor most important to us is the degree of perspiration, which drastically affects skin resistance under certain conditions.

As your skin has an average of 500 to 600 sweat glands per square inch, a simple set of non-invasive electrodes is all that is required for good skin contact, assuming constant electrode pressure and contact area are maintained during testing. The resistance change is most easily observed at the fingers and palms of the hands, and the soles of the feet.

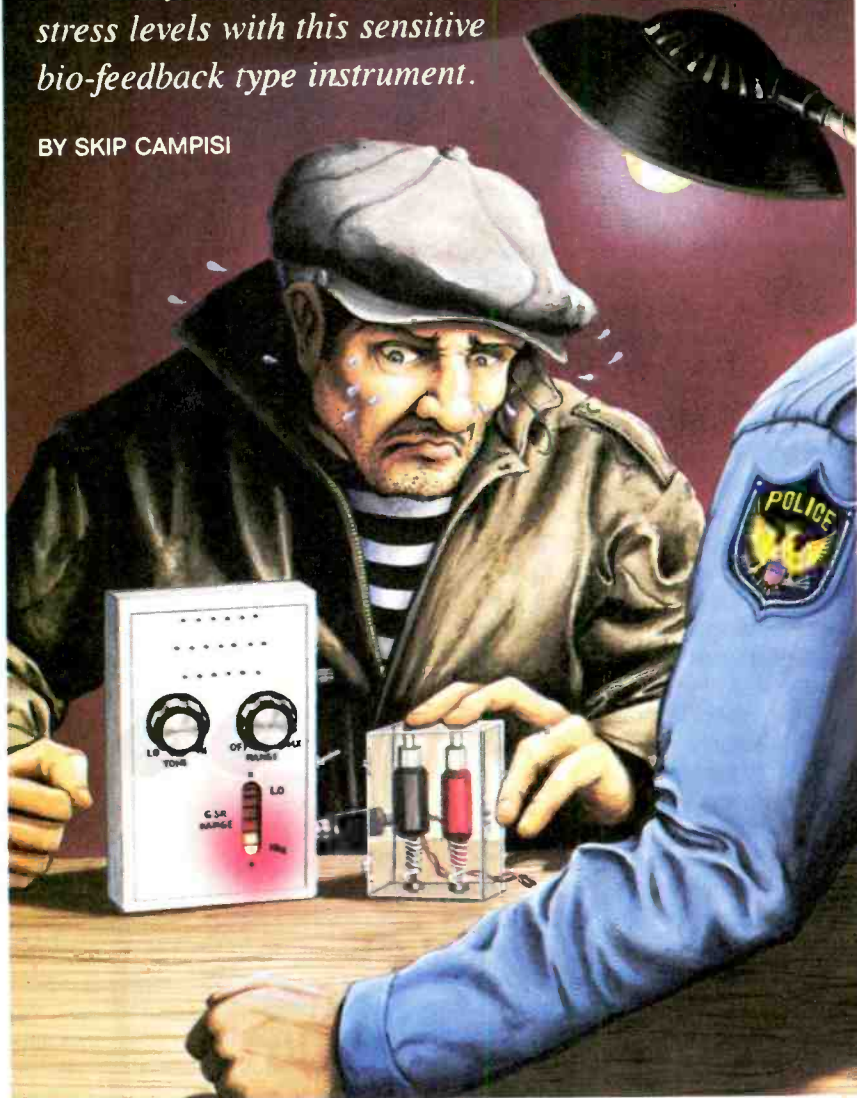
Because the degree of perspiration is related to stress levels in the body, stress directly affects skin resistance. The more stressed or excited you become, the more you perspire, and skin resistance drops accordingly. Strangely enough, not all skin areas seem to be affected equally, and tend to behave actively at one time, and then become inactive at other times!

Obviously, galvanic skin response is ripe for further experimentation as far as different types of electrode contacts and placement are concerned. The Lie Detector presented here is just

# BUILD A LIE DETECTOR

*Monitor your skin's change in resistance for varying stress levels with this sensitive bio-feedback type instrument.*

BY SKIP CAMPISI



the "tool" required for advanced experimentation, having all of the capabilities for expansion, with precise control of GSR measurements already incorporated in its design.

**Circuit Description.** To make an accurate resistance measurement of

any type, a stable constant-current generator of some type is the basic requirement. Due to the small contact area of the electrodes used for the prototype instrument, the skin resistance to be measured is in the megohm range; thus the current required for a usable output voltage is

quite low.

To generate stable currents of 1 microampere and lower, special constant-current circuitry is required, with the ability to go down to zero current (no leakage)—a very desirable quality. This would allow control down into the lower nanoampere range for measurements of very “dry-skin” conditions.

The schematic diagram for the Lie Detector is shown in Fig. 1. Basically, the circuit can be divided into three sections: a current generator, a visual (LED) display, and a tone generator. A standard alkaline 9-volt battery (B1) provides sufficient power for the circuit. More about this power supply later.

The current generator composed of Q1 (2N3906) and Q2 (2N3904) and their associated components is quite unusual, as it allows adjustment down to zero current. This is not normally possible with either a current “source” or a current “sink” alone. By combining a source and a sink, however, it is possible to have one cancel the other by adding equal and opposite currents.

Changing the current in either section will provide a difference current (either positive or negative) at the output. In this generator, Q1 is configured as the current source, and Q2 is configured as the current sink. Note that their collectors are directly connected to each other and the output, and that both sections are symmetrical.

An infrared light-emitting-diode, LED1, presents an input voltage of about 0.9 volts to Q1, which is in an emitter-follower configuration. As Q1's base-emitter voltage is about 0.6 volts, about 0.3 volts appears across the series combination of R1 and R2, which equals around 10,000 ohms when calibrated.

Thus a constant current of about +30 microamperes is sourced from Q1's collector. Also, LED1 provides temperature compensation for Q1's base-emitter forward voltage; thus the constant current is also relatively temperature stable.

With potentiometer R5 (the “range” setting) in its full counter-clockwise (“off”) position, LED2, another infrared light-emitting-diode, generates an equal but opposite current of -30 microamperes that is sunk by Q2's col-

lector. Thus the net difference output current is equal to zero. Potentiometer R1 allows exact matching of these two currents to compensate for component variations between the source and sink sections.

Utilizing an audio (semi-log) taper for potentiometer R5, allows very fine control of output current by “stacking-up” progressively higher currents near the end of the shaft rotation.

Turning R5 in a clockwise direction gradually reduces the negative current sunk by Q2 to a minimum of -15 microamperes. Thus a nominal +30 microamperes (sourced) added to -15 microamperes (sunk) yields a maximum sourced output of +15 microamperes, which is sufficient for most skin conditions.

When the sink and source current sections are in proper balance, you can expect the following output currents while you're turning R5 in the clockwise direction: 0 to +1 microampere over the first 33% of rotation; +1 to +5 microamperes over the next 33%; and +5 to +15 microamperes over the last 33% of rotation. This allows extremely fine adjustment over a large range (three or more decades) of current using only one control.

The output current is applied via jack J1 to the electrode cable harness made up of spring-loaded RCA phono plugs PL2 and PL3, which are connected to PL1. As you can see in the schematic, PL1 connects to J1, and the skin area to be tested is applied to PL2 and PL3. The configuration of these electrodes (more about this later) assures constant pressure and contact area for consistent readings.

The voltage drop generated by the constant current through the skin resistance is applied to IC1, an LM358 dual op-amp. Section IC1-a is configured as a non-inverting, high-impedance buffer, driving IC1-b, which is configured as a unity-gain inverting amplifier. Resistors R8 and R9 set the reference level (+4.5 volts) for IC1-b, allowing its output to swing in exactly the opposite direction from which your skin's voltage drop changes during testing.

A CD4046 CMOS phase-locked-loop, IC2, is configured as an audio-frequency, voltage-controlled oscillator. The control voltage is obtained from IC1-b, the inverting amplifier; thus the output frequency

drops as your skin resistance rises. This is desirable as a drop in pitch would indicate a lowering stress level, and a rise in pitch would indicate more stress or excitement.

A high-impedance piezoelectric speaker element, BZ1, is directly driven by IC2's output to more than ample sound levels. As a result, no power amplifier is required. The output pitch is variable via potentiometer R10, to whatever range suits the user.

The visual display is provided by IC3, a LM3914 dot/bar display driver, and DISP1, a 10-segment light-emitting-diode bar-graph display (ten separate LEDs could also be used, if desired). The input of IC3 is taken from IC1-a's output; thus the display follows the magnitude of your skin's resistance.

To preserve battery life, IC3 is configured to present a “dot” display, illuminating only one LED (at about 6 mA) at a time. Diode D1 and LED3 set the LED connected to pin L10 of IC3 to have a trip point of about +7 volts, while LED4 sets the LED connected to pin L1 of IC3 to have a trip point of about +2 volts. Thus, the entire display covers about 5 volts, at 0.5 volts per step, centered around the midpoint of +4.5 volts.

Jack J2 is also connected to IC1-a's output, and provides a DC voltage output equal in magnitude to the voltage drop across your skin resistance. This output can be monitored via a DVM or a chart recorder for precise readings. If long-term measurements are desirable, a line-operated 7- to 10-volt regulated DC power supply should be substituted for B1.

**Construction.** As the Lie Detector operates in the lower frequency spectrum, actual layout and fabrication methods are not critical to performance. Use any convenient method; however, keep leads as short as possible to avoid noise pickup.

The author's prototype was built using a RadioShack number 276-170 “PC board.” Using such a board can simplify assembly, but any perforated board will work just as well.

Begin by installing sockets for the ICs. Then begin wiring the circuit following the schematic in Fig. 1. Note that for long-term temperature stability, all fixed resistors should be metal-film units, and all variable resistors should be cermet or other similar low



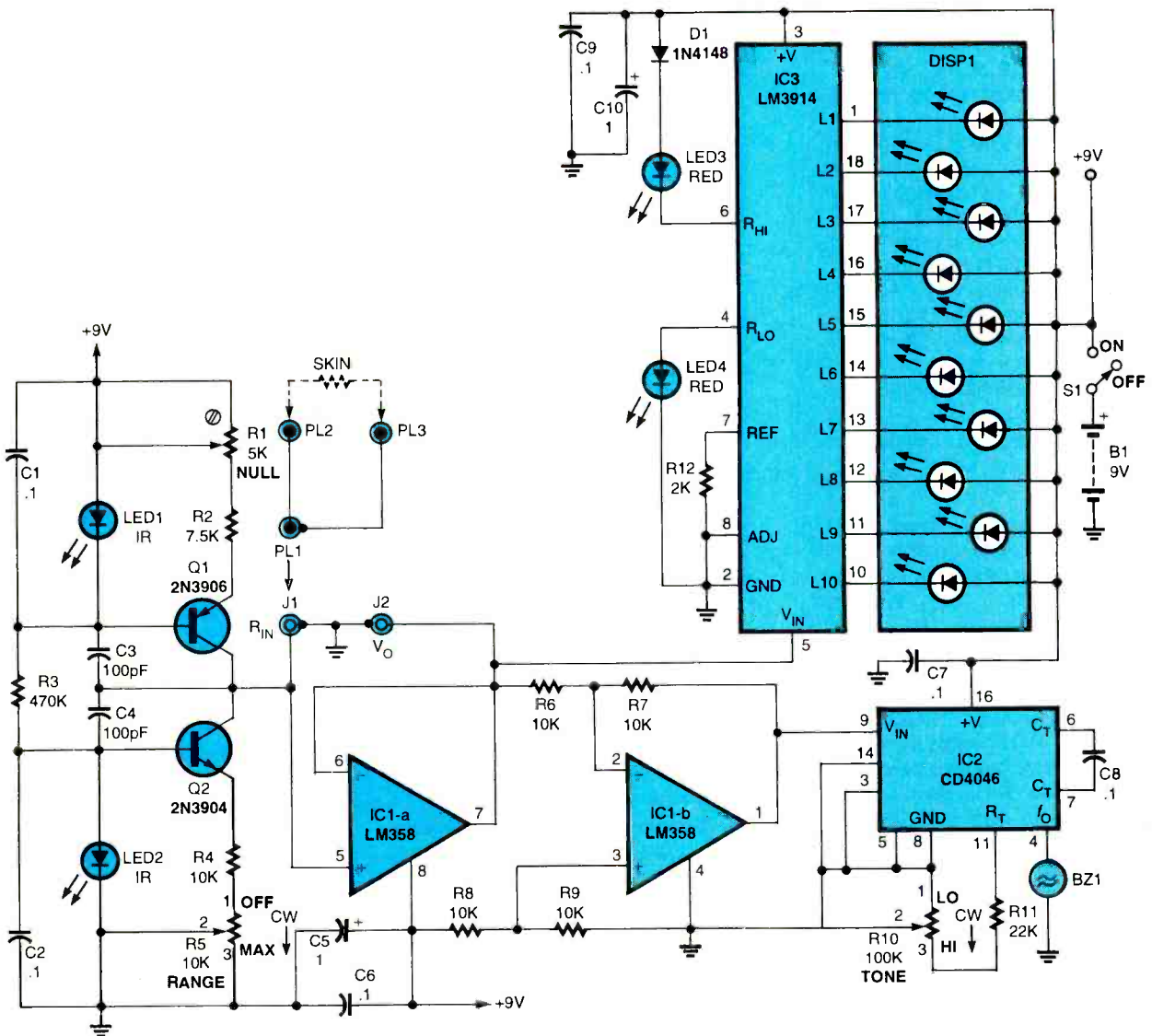


Fig. 1. Here's the schematic for the Lie Detector. Plugs PL2 and PL3 provide skin-resistance inputs. Both visual and audible output readings are available from DISP1 and BZ1.

tempco materials.

For proper operation, R5 and R10 must have their lugs connected correctly. With the shaft of the unit pointed directly at you, and the lugs positioned at the top, the right-hand lug is lug 1, the center one is lug 2, and the left one is lug 3. Potentiometer R5 has lugs 2 and 3 shorted together to ground, while R10 has lugs 1 and 2 shorted together to ground.

While installing the parts to the board, be careful to follow proper orientation of the polarized components. Depending on which enclosure you will use (the one used in the author's prototype is specified in the Parts List), you could mount all the parts except the Piezo speaker ele-

ment on board, and then drill holes to allow access to the parts. Otherwise, the potentiometers, power switch, and possibly the jacks will have to be mounted off-board and connected with insulated leads.

When all the on-board parts are connected, it's time to prepare the enclosure. If you will be operating in an area prone to 60-Hz hum or RFI, a shielded enclosure should be considered rather than the plastic enclosure specified, as the Lie Detector is a very high-impedance circuit.

Drill a series of 1/16-inch diameter holes, evenly spaced, in a grid-type pattern in the top cabinet half, at the approximate location of where you will mount the speaker element inter-

nally. Then, drill holes for the potentiometers, display module, jacks, and power switch.

Use two thin beads of silicone rubber sealant to mount the speaker inside the cabinet. Don't press the speaker down flat, rather, let it "float" on the rubber. Set the assembly aside to cure the sealant. You could also label the controls and use a clear acrylic spray overcoat, if desired.

To complete the board assembly, install the 9-volt battery and the ICs correctly in their sockets and turn on the power. Set your DMM to read current on its 200- $\mu$ A scale. Connect the common DMM lead to the junction of R8, R9, and pin 3 of IC1 and the positive lead to J1's center conductor.

## PARTS LIST FOR THE LIE DETECTOR

### SEMICONDUCTORS

- IC1—LM358 dual op-amp, integrated circuit  
 IC2—CD4046 CMOS phase-locked loop, integrated circuit  
 IC3—LM3914 dot/bar-graph display driver, integrated circuit  
 Q1—2N3906 PNP transistor  
 Q2—2N3904 NPN transistor  
 D1—1N4148 silicon switching diode  
 DISP1—10-segment LED display (RadioShack number 276-081 or equivalent)  
 LED1, LED2—Infrared light-emitting diode  
 LED3, LED4—Light-emitting diode, red

### RESISTORS

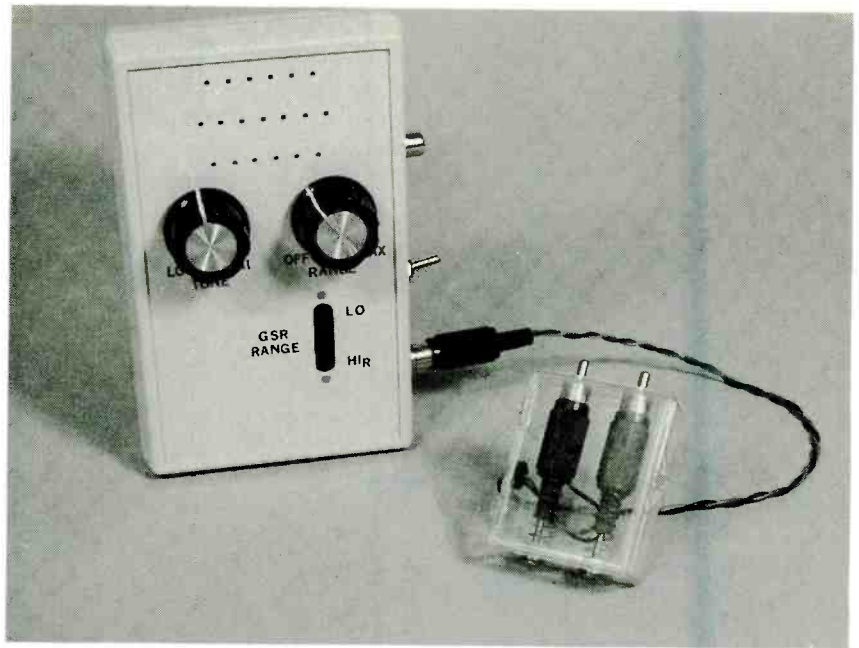
- (All fixed resistors are 1/4-watt, 5% carbon-film units.)  
 R1—5000-ohm single-turn trimmer potentiometer  
 R2—7500-ohm  
 R3—470,000-ohm  
 R4, R6—R9—10,000-ohm  
 R5—10,000-ohm audio-taper panel-mount potentiometer (RadioShack number 271-1721 or equivalent)  
 R10—100,000-ohm linear-taper panel-mount potentiometer (RadioShack number 271-092 or equivalent)  
 R11—22,000-ohm  
 R12—2000-ohm

### CAPACITORS

- C1, C2, C6, C7, C9—0.1- $\mu$ F, monolithic ceramic  
 C3, C4—100-pF, monolithic ceramic  
 C5, C10—1- $\mu$ F, solid-tantalum electrolytic  
 C8—0.1- $\mu$ F, Mylar

### ADDITIONAL PARTS AND MATERIALS

- BZ1—Piezoelectric speaker element (RadioShack number 273-091 or equivalent)  
 PL1—PL3—RCA-type phono plug, strain-relief (RadioShack number 274-319 or equivalent)  
 J1, J2—RCA-type phono jack, panel-mount (RadioShack number 274-346 or equivalent)  
 S1—SPDT miniature toggle switch, 1-ampere  
 B1—9-volt alkaline battery  
 Perforated board, plastic enclosure (RadioShack number 270-213 or equivalent), control knobs, two 1/4- $\times$  1-inch coil springs (compression type), two #4-40  $\times$  1-inch machine screws with nuts, 1/2-inch spacers, 2 1/4-inch small plastic box or vial, IC sockets, hardware, wire, solder, etc.



As shown in this photo, the electrodes used with the Lie Detector are two spring-mounted RCA plugs.

Set R5 to its full counter-clockwise ("off") position. Adjust R1 back and forth and you should see the current vary between about  $\pm 5$  microamperes. Now set R1 for a reading of 0.0 to  $-0.2$  microamperes. This will assure that R5 will actually reach the zero current level. Advance R5 clockwise and the current should rise to its maximum of  $+15$  microamperes at the end of rotation.

The cabinet construction is now complete. Assemble the cabinet halves and install the knobs on their control shafts. Using large-diameter plastic knobs makes adjustments simple, and reduces noise coupling to the circuit.

**The Electrodes.** The "key" to successfully completing a functional GSR monitor or lie detector is in using quality electrodes for the measurements. As stated before, contact area and pressure must be maintained to realize consistent results.

Small-contact-area, spring-loaded electrodes were chosen for the author's prototype, due to the wide availability of the components. Details will be given here for easy duplication, but feel free to experiment! Although the prototype electrodes work extremely well, many alternate methods exist.

The first thing you need is a small plastic box or vial measuring about

2 1/4-inches long. It should be thick enough to clear the diameters of phono-plugs PL2 and PL3, and wide enough to have both plugs side-by-side on 3/4-inch centers. The prototype measured 3/4  $\times$  1 3/4  $\times$  2 1/4 inches.

Begin by drilling two 1/8-inch-diameter holes on one end of the box spaced 3/4 inch apart and centered on the end. Drill two 1/4-inch-diameter holes exactly opposite the 1/8-inch holes on the other end of the box. Note: These two box ends are the ones separated by the 2 1/4-inch dimension.

Install a #4 flat washer on a #4-40, 1-inch screw, and install it in one of the 1/8-inch holes, capturing it with a #4-40 nut on the inside of the box. Repeat the process with another screw in the remaining 1/8-inch hole. Leave the nuts a little loose.

Unscrew the plastic grip from PL2, and cut off the ground lug. Solder a 12- to 18-inch length of 22-gauge stranded, Teflon insulated hookup wire to the center conductor lug. Drill a 3/32-inch diameter hole in the plastic grip end, right alongside and parallel to the strain-relief section of the grip.

Install the plastic grip back on PL2, feeding the wire through the 3/32-inch hole, rather than the strain-relief. It should screw right on without twisting the wire. Prepare PL3 in the same manner. Obtain a couple of light-gauge (0.010- to 0.015-inch wire di-

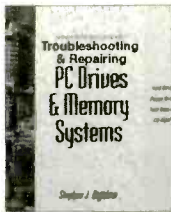


# 5 BOOKS FOR ONLY \$4.95

WHEN YOU JOIN THE **Electronics Book Club®**

VALUES TO \$189.75

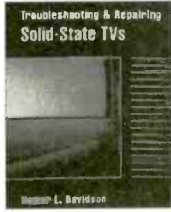
The leading source of information for electronics hobbyists for over 30 years!



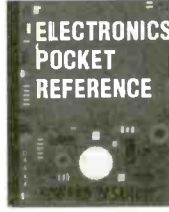
0053146 \$24.95



036432X \$29.95



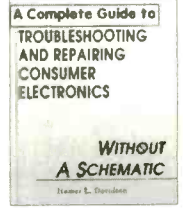
0157537-XX \$44.95  
Hardcover/Counts as 2



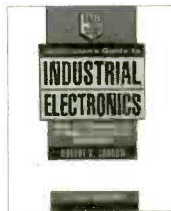
0487375 \$24.95



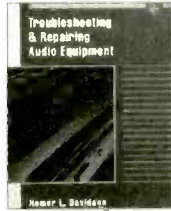
0331898-XX \$89.50  
Hardcover/Counts as 2



0156492 \$34.95  
Hardcover



0112738-XX \$45.00  
Hardcover/Counts as 2



0157553-XX \$44.95  
Hardcover/Counts as 2

073092X \$21.95

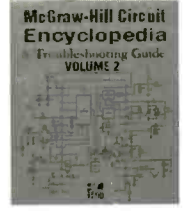
1577564 \$22.95

155016X-XX \$34.95  
Counts as 2

1575472 \$27.95

1554637 \$16.95

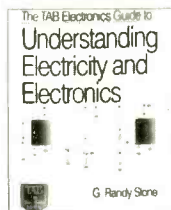
0304068 \$15.95



0376115-XX \$36.95  
Counts as 2



0535469 \$29.95



0582157 \$26.95



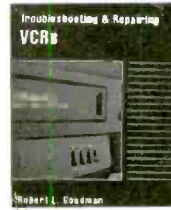
9122264-X \$39.95  
Counts as 2



1570519 \$17.95



015676X-XX \$69.00  
Counts as 2



0241996 \$44.95  
Hardcover



5869179 \$12.95



5872625-XX \$30.00  
Counts as 2



0717753 \$19.95



0052387 \$28.95  
Hardcover



0157626 \$24.95



1574875 \$19.95



0650780-XX \$24.95  
Counts as 2

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

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

PE497

ameter) springs about an inch long. They should slide easily onto the strain-relief section, and butt up against the ends of the grips without sliding up the grips.

Install a spring on PL2's strain-relief and slide the strain-relief and spring over one of the #4-40, 1-inch screws. Guide the wire out the side of the box through a small hole. Apply pressure to PL2 to compress the spring until you can slip PL2's center conductor through the  $\frac{3}{4}$ -inch hole on the opposite end.

Allow PL2 to snap in place, and then tighten the nut to secure the screw. Assemble PL3 in the same manner, routing its wire out of the same-side hole as PL2's wire. Arrange the wires in the box so that the plugs move freely on their springs. Twist the pair of wires together, and terminate them with phono-plug PL1, using both of its lugs.

Try pressing the center conductor pins of PL2 and PL3 flush to the cabinet end simultaneously with one finger. It should take very little pressure. If it appears that the pressure might be uncomfortable, you can cut down the length of the springs, or replace them with weaker units. A comfortable grip for somewhat long periods of time is mandatory for proper and consistent measurements!

**Using the Unit.** To observe the following initial GSR measurements, you have to prepare your body first! Wash and dry your hands completely to remove any material that may hinder proper readings, such as flux, oil, etc. You should also be in a semi-relaxed mental state. If you happen to be "hyped up" at the time, you may only see little, if any, GSR change.

Plug the electrode assembly into J1 and set R5 and R10 to their mid positions. Be seated in a relaxed position and turn on the power. Grasp the electrode assembly in one hand and using either one or two fingers, press the pins of PL2 and PL3 down flush to the box surface.

Use a relaxed grip, as even the tension caused by a "death grip" on the electrodes will disturb the readings of this extremely sensitive device. As long as the pins are gently held flush to the surface, you will get perfect readings.

Now adjust R5 until DISP1 shows an indication near the center of its scale. If you can't get an indication on the

scale, change your area of finger contact on the pins slightly. There are "dead spots" on some skin areas probably due to old injuries, burns, etc. If you are of the type with hands that have very high perspiration rates, you may need higher currents than provided. More about this later.

Once you are in the correct operating range, you may now adjust R10 for any pitch that pleases you. Pick a pitch at which it that is easiest for you to detect a pitch change. This varies for each individual, and may take a little experimenting.

Now just relax and listen to the tone. As you relax even more deeply, the pitch will start to slowly drop as your skin resistance increases due to less perspiration. The slightest new physical activity will send the pitch right back up! Try scratching your neck, or shaking your free hand, for example.

After a second or two, the pitch will go right up. Stop moving, and it will drop again. Try grasping the electrodes with different fingers and even the other hand, looking for a real "sweet spot." The author found that the first two fingers on his left hand would send the range display right off the scale with only mild exertion, while his wife's right hand worked better for her.

If you normally have trouble relaxing, the Lie Detector by itself may not work too well for you. You may require a "visual" aid to stimulate "alpha-wave-type" bio-feedback rhythms in your body. The author's "Multi-Chrome Projector" (see the January 1997 issue of **Popular Electronics**) is just such a device.

Once you are able to relax, you'll notice how simple anxieties, such as those caused by lies, could change your GSR readings. But what if the device isn't working for you?

**Alterations.** If it turns out that you require more current to get "on scale," there are several alterations you can make in the current generator section of the circuit to accomplish this. You can easily add another 5 microamperes just by resetting R1 with your DMM for a maximum positive calibration reading, rather than nulling at zero microamperes. With this setting you will no longer achieve "zero" output.

To gain 5 microamperes and still be

able to achieve "zero" output, you may connect a 47,000-ohm resistor in parallel with R3. Replacing LED1 and LED2 (infrared LEDs) with standard "red" LEDs will just about double the available output current, and still enable the device to reach zero output current. Of course, you can always reduce the values of R1-R5 proportionally for higher current levels if you care to go that far.

Different electrode designs could also require higher current levels; especially those with large contact areas. The key word here is "experiment." A third electrode, possibly clipped lightly to an earlobe and connected to ground, may indeed show some interesting results.

If you plan on using the Lie Detector to drive an external DVM for higher resolution readouts, or a chart recorder for permanent records, it might be wise to make the modifications already described. As the LM358 is only capable of driving capacitive loads of less than 50 pF, the output cable from J2 should be short coax, or a "twisted-pair" if long runs are required.

As you can see, the Lie Detector is a very flexible GSR monitor, requiring only your imagination for applications and experiments. Try using it to help you relax. As for its name, can it really detect lies? You'll have to build one and judge for yourself! ■



"This time I think it's definitely a hardware problem."

### ANTIQUE RADIO CLASSIFIED Free Sample!

Antique Radio's  
Largest Circulation Monthly.  
Articles, Ads & Classifieds.  
6-Month Trial: \$18.95. 1-Yr: \$36.95 (\$53.95-1st Class).  
A.R.C., P.O. Box 802-L16, Carlisle, MA 01741  
Phone: (508) 371-0512 VISA/MC Fax: (508) 371-7129



**T**hey're finally here! Electric vehicles (EVs) have hit the streets of America. Late last year, General Motors introduced the EV<sub>1</sub> electric-powered coupe, which is currently available from Saturn dealers in Los Angeles, San Diego, Phoenix, and Tucson.

The GM EV<sub>1</sub> is essentially the same as the Impact that GM began building in 1992, but with a big difference. Instead of running on gas, it has 26 12-volt lead-acid modules that deliver energy. Under the hood there's a 137-horsepower electric motor driving the front wheels. Top speed is 80 MPH, and the EV<sub>1</sub> can accelerate from 0–60 MPH in 7.7 seconds.

Depending on terrain, temperature, use of accessories, driving style, etc., the EV<sub>1</sub> can go 70–90 miles between recharges, which take up to three hours when connected to a 220-volt source, and up to 15 hours when connected to 110 volts. However, under the worst driving conditions (cold weather and hilly roads) it might go as few as 40 miles before depleting its batteries. It has a sticker price of around \$34,000, though it is only currently available for lease.

In addition, Chevrolet and Ford will soon be offering electric-powered Chevrolet S-10 and Ford Ranger pickups, mainly to commercial-fleet operators. Chrysler's entry in the EV market is the EPIC, a Dodge Caravan/Plymouth Voyager minivan converted to electric power. Many of the world's other major automakers are working on EVs and many independent companies are also developing them.

**Pressure for Electric Vehicles.** The impetus for EVs in the U.S. comes mostly from California. Originally, the California Air Resources Board (CARB) mandated that by 1998, 2% of the vehicles sold by the major automakers in California had to be zero-emission vehicles (ZEV), in other words EVs. The percentage jumps to 10% in the year 2003.

Mainly because of pressure from the automakers most affected by the mandate—Chrysler, Ford, GM, Honda, Nissan and Toyota—who are aided by oil companies and their trade associations, the mandate will

# RECHARGING ELECTRIC-VEHICLE BATTERIES



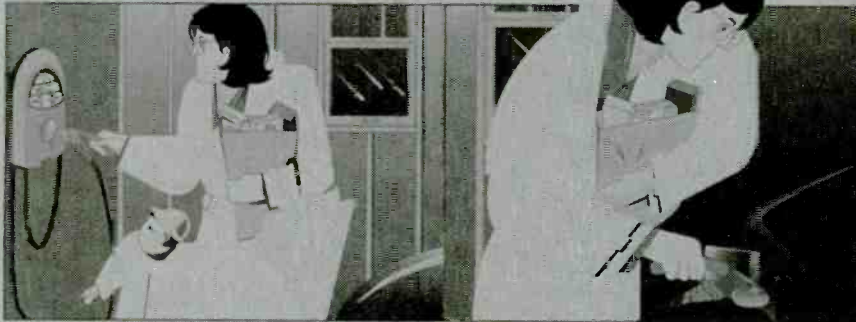
*Electric cars are finally making their appearance in America. Learn what techniques are being used to keep them charged up and ready to roll.*



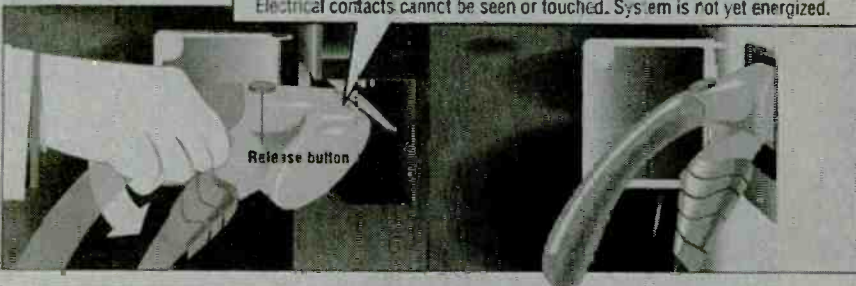
# How Conductive Charging Works

Conductive charging is user-friendly and designed with the customer in mind.

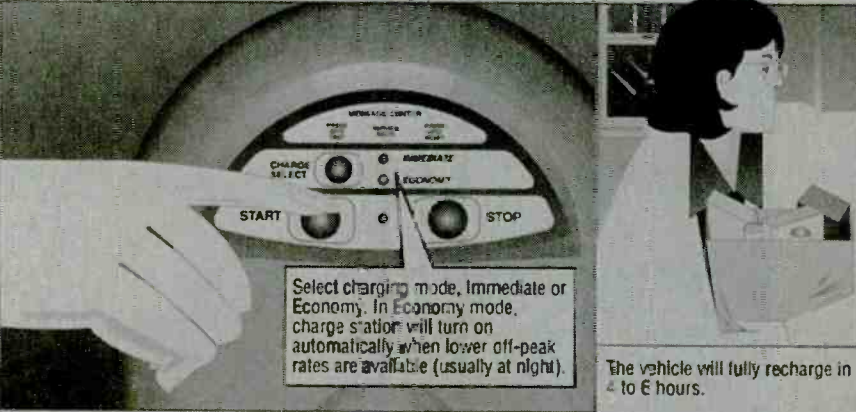
Open charge port door on vehicle and then remove connector from charge station.



Insert connector into vehicle charge port and push down handle until connector snaps into locked position.



Press start button on charge station. Once charge station and vehicle agree all systems are O.K., charging begins.



Press stop button on charge station. Remove connector from the vehicle by pressing the release button on or top of the connector handle. Return connector to storage position on the charge station.

Source: SCT Systems Inc.

**Conductive charging is safe, convenient, and low cost. It is considered by most major automotive manufacturers to be the most efficient method of charging.**

## Safety

Uses the latest safety management technology and is safe to use in all weather conditions. Vehicle and charge station exchange important safety information before electricity flows from charge station to vehicle.

- Checks for proper connection to vehicle
- Checks that charge station is ready to supply energy
- Confirms vehicle battery type
- Vehicle confirms charge station capacity
- All safety systems O.K.

## Convenience

Researched and designed with the input of consumers for ease of use.

## Low Cost

High efficiency to minimize energy loss and cost to customer. Inexpensive to manufacture due to simple design.

## Easy to Service

Any licensed electrician can service. No special tools, expensive diagnostic equipment or specialized training is required.

## Compatible Worldwide

Automakers and utilities have worked together closely to design the conductive charging system to meet worldwide standards.

Here's a step-by-step look at how conductive charging works.

be scaled back a bit. Instead, of the 2% requirement equating to about 22,000 ZEVs annually, the automakers

will most likely offer some 14,000 EVs in 1998, all voluntarily. This group successfully convinced the CARB that

they cannot produce or, in reality, sell this many EVs to interested Californians. With the range between



charges being less than 100 miles even under ideal climate and driving conditions, several hours required for battery recharging, and list prices as much as three times more than equivalent gasoline powered vehicles, EVs are still not ready for prime time. CARB's 10% requirement for 2003 remains in effect.

**Recharging Facilities.** Besides the EVs, the infrastructure to keep them rolling is also being developed. This includes the very important battery recharging. The design as well the location and number of recharging facilities is dictated by the EV's somewhat limited range and need for frequent recharges. Unlike a filling a tank with gasoline, which takes only a few minutes, recharging an EV battery pack can take hours, even all-day or overnight for deeply discharged ones. Therefore, recharging would be done where people stay for relatively long periods of time—homes, offices, factories, apartment complexes, etc. "Quick charge" recharging stations for "topping off" batteries could be located at shopping malls, movie theaters, health clubs, restaurants, or other places where people stay for moderate periods of time.

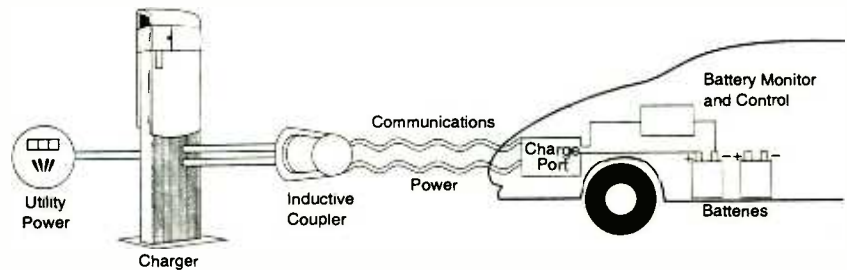
Besides transmitting electricity for recharging, "smart" chargers communicate with the EVs they are charging. The information exchanged in this manner includes checks for proper connection, that the vehicle is ready to accept the charge, the compatibility between the facility and the EV's recharging system, and if all the on-board safety systems are operating correctly.

Rechargers themselves would be part of the EV so that charging facilities need only provide generic electric power. Computers in the EV's recharger would continually monitor items such as battery state-of-charge, individual battery-module voltages, and temperatures and usage history.

Other requirements for recharging facilities includes the user friendliness of a gasoline pump and of course, foolproof safety. While fill-ups with gasoline always present an explosive risk, albeit a minute one, EVs represents potential electrical shock and burn hazards plus the remote possibility of an exploding battery.



The GM EV, might look a lot like the GM Impact, but the EV, runs on batteries.



This diagram shows how inductive charging systems work. The Magne Charge system in particular can handle power levels from 1.5 to 25 kW.

**Conductive Charging.** If EVs are to be used like gasoline fueled vehicles, recharging facilities have to have standardized connections. Currently, two basic means to transfer electricity from the recharging station to the EV are being developed for U.S. EVs: conductive and inductive charging. Many experts in the EV industry believe the recharging techniques must be further standardized. Otherwise, there could be a repeat of the VHS vs. Beta videotape controversy.

Of the two, conductive charging is the most familiar since it is effected by a heavy-duty cable and plug like the type used to transfer electricity to appliances. For EV recharging, conductive charging is bit more complicated, though, since information also has to be communicated via the connection and cable. Ford and Chrysler have joined forces to develop a common conductive charging system for their production EVs. SCI Systems, Inc. did the actual development to the specifications of Ford, Chrysler, five other major automakers, electric utility companies, and CARB.

According to Ford and Chrysler, conductive charging was chosen for several reasons. Besides being safe, it is the most efficient and cost-effective method of charging available. Being the traditional method of connecting electrical equipment to power sources, it is well understood by electricians. In addition, installation requires no special tools, expensive diagnostic equipment, or specialized training. Like a clothes dryer, the EV charging system would use a unique, yet standardized, plug that is easy to use and safe under all weather conditions because the electrical contacts cannot be seen or touched. Also it does not produce a high-frequency magnetic field that could result in electromagnetic and radio-frequency interference.

With the SCI conductive charging system, drivers could choose from two charging modes. Selecting the "Immediate" mode results in charging starting right away. With the "Economy" mode, charging will instead automatically start when lower off-peak

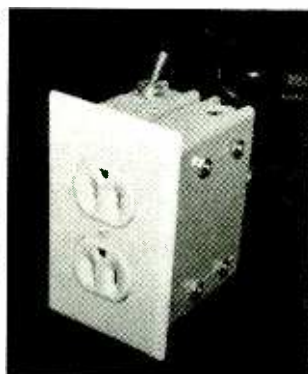
(Continued on page 70)

# BUILD A HIGH-EFFICIENCY LIGHTING SYSTEM



*Lower the cost of your monthly lighting bill by 90 percent!*

the latter consists of two identical current pulses of opposite polarity per cycle; eliminating one pulse decreases current by fifty percent. Also, the second pulse may arrive prior to the full release of heat energy, thereby wasting the energy released by the second bipolar current pulse. With pure resistive loads, heating continues after the pulse ends (the pulse actually used by the Lighting System is from 151 to 168 degrees). By correcting for these problems found in standard lamps, the High-Efficiency Lighting System (when used with the lamp specified in the Parts List) manages to use 90% less electricity.



BY STEVEN R. ROSENBERG

**A**re you wasting electricity? If you're using standard light fixtures in your home or office, then you definitely are spending more for illumination than you have to. The truth of the matter is that conventional lamps are nowhere near efficient. For that reason, in this article we'd like to introduce you to a more economical source of light: *The High-Efficiency Lighting System*.

With this easy-to-build unit you'll save a bundle on electric bills in no time. That's because the Lighting System uses about 10% of the electricity that a standard lamp uses! Just think how much you'll save if you build one for every room.

**Lamp Efficiency.** When dealing with lamps, as well as many other

types of electrical devices, achieving efficiency requires reducing the amount of energy used up, without weakening the output. Performing this with a transformer has been done, but it is rather ineffective. We needed to find a better way.

When solid-state components are used to simulate a step-down transformer, a secondary voltage is produced with the reliability of a transformer, but at a much more efficient rate. You see, as a generator rotates through its 360-degree cycle, sine-wave energy is produced. At any given fraction of a degree this energy can be conducted through a thyristor. That will result in an instantaneous voltage, unipolar power pulse.

A unipolar pulse is more efficient than a bipolar pulse. That's because

The bar graph shown in Fig. 1 demonstrates how much less power is used by a 30-volt, 50-watt lamp connected to the Lighting System, as opposed to that used by a standard light fixture. Keep in mind that the light output by the Lighting System lamp is equal in brightness to that of the conventional light fixture.

The efficiency of the System can translate into very tangible savings on your electric bill. For example, if you have a lamp that needs to stay on 24 hours a day, seven days a week, you should save approximately \$100 a year.

**Circuit Description.** The schematic for the Lighting System is shown in Fig. 2. Plug PL1 connects to a standard 117-VAC outlet to provide power for the circuit. A capacitive/resistive filter made up of C6 and R5 eliminates SCR tracking of



**TABLE 1**

Conduction Angle (Degrees)	Lamp Voltage (Volts)	Lamp Current (Amperes)	Power Used (Watts)	Lumens (Foot Candles)	Lamp Simulated (Watts)
151.10	12.30	0.60	7.38	1750	100
152.00	10.81	0.57	6.16	1190	75
158.70	9.28	0.50	4.64	870	60
159.70	8.85	0.48	4.24	810	50
162.50	7.69	0.45	3.46	505	40
167.60	5.42	0.36	1.95	190	25

the AC source voltage; S1 is the power switch.

Capacitors C2-C4 are used to prevent undesirable triggering of SCR1-SCR3 from transient voltage, and for this reason are connected between the gates and cathodes

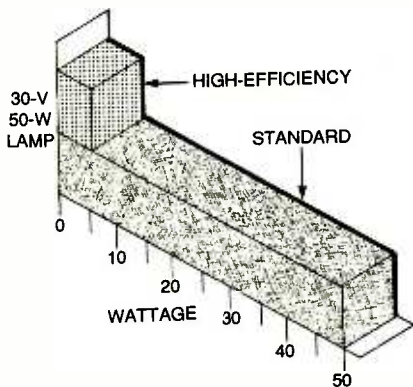


Fig. 1. As shown in this bar graph, a 30-volt, 50-watt lamp connected to the High-Efficiency Lighting System uses only 10 percent of the power used by a conventional light fixture.

of the thyristors. Decoupling against line-voltage transients acting on unijunction-transistor Q1 is provided by capacitor C5. As a result, positive or negative transients on the unijunction supply voltage will not trigger Q1.

Transistor Q1 is connected through resistor R3 to the voltage "low side" and directly to the gate of SCR1. The other base of Q1 connects through the serial combination of resistors R1 and R2 to the "hot side" of the supply. Resistor R1 drops the AC source voltage to the supply voltage of the timing circuit, while resistor R2 serves to compensate Q1 from thermal variations. Potentiometer R4 can be used to vary the brightness of the circuit as it determines the charging voltage on timing capacitor C1, and the

range of conduction angles available (more on this later).

Thyristors SCR2 and SCR3 are connected in parallel to improve stability and to allow two lamps to be powered by the circuit. The lamps, I1 and I2, plug into AC sockets SO1 and SO2. Note that the cathodes of SCR2 and SCR3 are connected to the sockets, while the anodes connect to the hot side of the AC supply. This configuration removes the low-voltage load from the power supply of Q1 and supplies the load through the thyristors.

**Construction.** The author's prototype for the Lighting System was built on a printed-circuit board. If you'd like to do the same you can either etch your own board using the template shown in Fig. 3, or order a board from the source mentioned in the Parts List (complete kits of parts are available from the source as well). Another option is to build the circuit on a piece of perforated board.

For those using a PC board, refer to the parts-placement diagram while building the unit. To begin

assembly, attach two wires to the board to allow for connections to toggle-switch S1 and AC-sockets SO1 and SO2. The wire leading to S1 should be red, signifying a direct connection to the house wiring.

Install R5, C3, C4, C6, SCR2, and SCR3 to the board, being careful to orient correctly the last two parts. The thyristors have an on-state current of 4-8 amps and a peak reverse voltage of 200-600 volts maximum. These parts are strongly recommended because the high conduction angle of the switching in the circuit could lead to component failure. Only use the highest-rated (in terms of amperage) SCR available; heatsink material is recommended for extended service.

Make the following off-board connections shown in the parts-placement diagram. Attach switch S1 to the red wire you installed, then connect the other terminal of the switch to PL1 with one lead of an AC line cord (make sure to use the lead that is *not* connected to the wide blade of PL1). Connect the other lead of the line cord (the one connected to the wide blade of

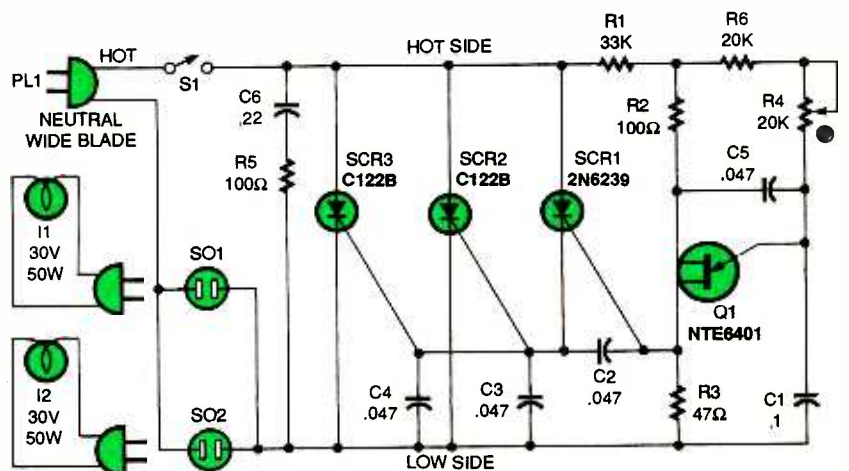


Fig. 2. Here's the schematic for the Lighting System. Lamps I1 and I2 plug into AC sockets SO1 and SO2, providing two efficient sources of light.

## PARTS LIST FOR THE HIGH-EFFICIENCY LIGHTING SYSTEM

### SEMICONDUCTORS

Q1—NTE6401 or EGC6401 N-channel unijunction transistor

SCR1—2N6239 200-volt, 4-ampere silicon-controlled rectifier

SCR2, SCR3—C122B 200-volt, 8-ampere silicon-controlled rectifier

### RESISTORS

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

R1—33,000-ohm

R2—100-ohm

R3—47-ohm

R4—20,000-ohm, trimmer potentiometer

R5—100-ohm

R6—20,000-ohm

### CAPACITORS

C1—0.10- $\mu$ F, 50-WV, Mylar

C2-C4—0.047- $\mu$ F, 200-WV, Mylar

C5—0.047- $\mu$ F, 50-WV, ceramic disc

C6—0.22- $\mu$ F, 250-WV, Mylar

### ADDITIONAL PARTS AND MATERIALS

IL, I2—30-volt, 50-watt lamp, General Electric order code 16385, description 50A21, or equivalent

SO1, SO2—Two-terminal AC socket

PL1—Two-terminal AC plug, polarized

S1—SPST toggle switch

Printed-circuit materials, plastic electrical box, AC receptacle cover plate, AC line cord, wire, solder, hardware, etc.

**Note:** The following are available from Advance Power System (1307 Maple Ave., South Plainfield, NJ 07080; Web: <http://members.aol.com/Apsinfo/Apsinfo.html>; e-mail: [apsmail@aol.com](mailto:apsmail@aol.com)): etched and drilled PC board—\$9.50; kit of parts including everything except the lamps—\$25.50; assembled and tested kit, not including lamps—\$35.50; two lamps—\$6. Add \$2.50 for shipping and handling; NJ residents please include appropriate sales tax. Please allow 4 to 6 weeks for delivery.

PL1) to one terminal of each of the two AC sockets. Connect the other terminals to the remaining lead you soldered to the board earlier.

You now have to test the partially assembled board before you can proceed with assembly. Plug a stan-

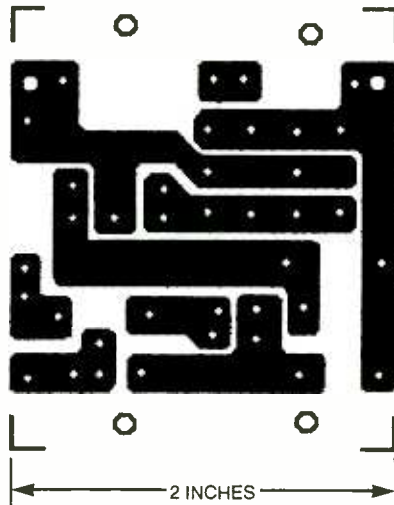


Fig. 3. This is a full-size foil pattern for the Lighting System PC board.

dard 120-volt lamp into SO1 and plug PL1 into an AC outlet.

Use an alligator-clip-equipped jumper to briefly connect the gates of SCR2 and SCR3 to the AC hot side. The lamp should light. If the lamp is on all the time, or it does not light, check that the SCRs are installed correctly and not overheating, and the circuit components are of the correct voltage rating.

Unplug the circuit from the outlet and connect SCR1 and C2 to the board. Plug in PL1 again and test the circuit as just described. Once you're sure the aforementioned components are working properly, mount the remaining components to the PC board as shown in Fig. 4.

Verify that you can vary the conduction angle with R4 (although it is board-mounted in the prototype, potentiometer R4 can be replaced with an off-board component).

**Setup and Use.** As hinted at earlier, you will need to select a conduction angle using R4. To do this, connect a standard 100-watt, 120-volt AC lamp to the circuit. Adjust R4 until the standard lamp is almost extinguished.

Disconnect the 120-VAC lamp and connect the 30-volt lamp specified in the Parts List (make sure you don't use a three-way lamp, as it will drastically reduce the life of the bulb). Connect a DMM across the lamp's terminals. As you perform the next step, be certain to keep the voltage of the lamp below 15 VDC. Adjust R4 until the values measured across the lamp are 12.3-volts DC at 0.6 amperes. These values will result in a conduction angle of 151.1 degrees, which results in a 1750-foot-candle measurement. This is equivalent to a conventional 100-watt lamp's advertised initial lumens. The average power used at this setting is 12.3 volts  $\times$  0.6 amperes, or 7.38 watts.

It is possible to simulate conventional lamps that have other wattage values by setting a different (Continued on page 56)

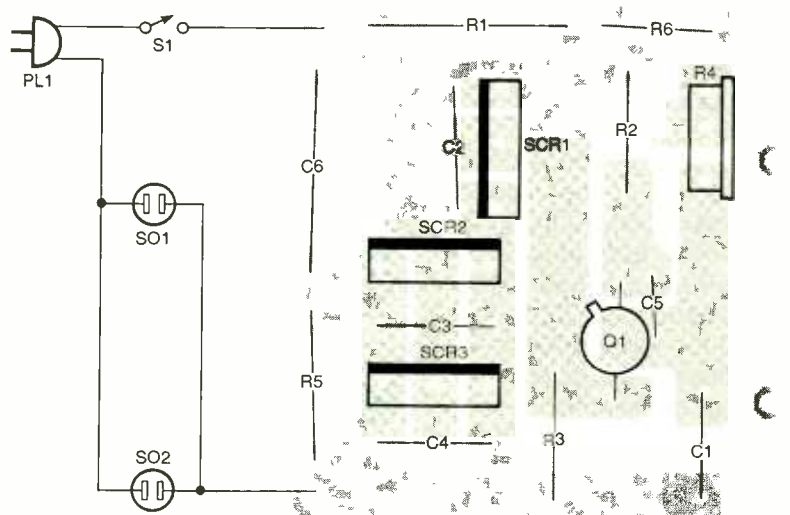


Fig. 4. If you're building the System on a PC board, use this parts-placement diagram as a guide.



# ALL ABOUT AMATEUR COMMUNICATION MODES



*From Morse code to the digital age, here's a look at the past and present communication methods used by radio amateurs.*

BY KARL T. THURBER, JR.

**A**mateur radio is more exciting than ever, due largely to high-tech and digital operating modes and personal computers. But the vast number of communicating options available to hams today is only part of the story. Join us now for a look at the past, present, and future of amateur communication modes.

**Classic Non-Digital Modes.** One way to appreciate today's high-tech digital modes is to contrast the present with the pre-high tech days—say, the 1940s and 1950s. The radio and electronics world was different then; FM repeaters, packet radio and exotic digital modes, amateur satellite communications, and PCs didn't exist. The 1940s and 1950s were mostly an "analog world."

Amateurs could exchange messages by Morse telegraphy, voice (AM, FM, and SSB, or single-side-

band); a few pioneering amateurs could even use TV. One classic digital mode, radioteletype (RTTY), was available, but it was more mechanical than digital. More sophisticated communication modes such as facsimile (fax), satellite, and packet weren't available.

The earliest radio amateur communications mode was that of spark, but it's been gone for about two-thirds of a century. Another simple mode, which is still in use today, is CW. That system consists of interrupting a "continuous wave" (CW) carrier in accordance with a code, such as International Morse (you could call it a digital mode if you wanted to).

Amplitude modulation, or AM, is an early form of voice communications. This relatively broad mode was the standard on the amateur bands until the 1950s, when a related mode became popular. That higher-tech mode was SSB (single-

sideband).

SSB telephony makes use of a reduced or suppressed carrier and just one sideband, unlike AM, which transmits the full carrier and both sidebands. Either sideband can be used, but radio amateurs normally use lower sideband (LSB) below 10 MHz and the upper sideband (USB) above 10 MHz. SSB with little or no carrier isn't popular with broadcast-band and shortwave broadcasters because it can be difficult to tune.

Narrow-band frequency modulation (NBFM) is used widely on VHF and UHF, not just by amateurs but by many communications users—although AM still is standard on the VHF civilian and UHF military aircraft bands. FM is fairly immune to static.

**Packet Radio.** One form of "data by radio" in which the data is transported between PCs and radio transceivers is called packet radio. It's a high-speed, space-efficient



*There's still room in this high-tech, digital amateur-radio world for a simpler mode: Morse Code, or CW. This MFJ electronic keyer combines built-in dot-dash memories, speaker, sidetone, and pushbutton mode selection with a classic paddle.*

mode that lets you send, receive, store, and forward messages. It's similar to RTTY, but data are sent at a higher speed, and in a "connected" (telephone-like), nearly interference-free, error-checking mode.

Packet sends data in small bundles. Each contains the sending and receiving station call signs and optional routing. The packets are sent one at a time; each is acknowledged when received. When a packet arrives error-free, the receiving station sends an "OK" (an ACK) and the next packet is transmitted. If a packet isn't received correctly, it's retransmitted.

Most packet is at a slow rate of 1200 bits per second (bps), although 9600 bps is becoming common. Some amateurs even experiment with higher rates. Even though the data transfer rates are relatively slow for the moment, packet provides low-cost, global connectivity, and it's still clear that higher speeds are on the way.

Packet radio seems to have three main advantages over simpler digital modes, such as RTTY. These are transparency, error correction, and automatic control.

First, transparency simply refers to the fact that a packet station's operation is transparent to you. Your Terminal Node Controller (TNC) automatically "packetizes" your message, keys the transmitter, and sends the packets. While receiving packets, the TNC automatically decodes them, checks for errors, and displays received messages. A

packet TNC also can be used as a packet relay station, or digipeater.

Second, packet radio offers built-in error detection and correction. When you receive a packet, it's checked for errors and displayed only if correct. If the receiving station detects an error, it discards the faulty packet and does nothing. As mentioned earlier, after a while without an ACK from the receiving station, the transmitting station resends the packet. If the data can't be delivered intact, transmission is aborted.

Finally, there's automatic control. One advantage of packet is the ability for many users to use the same frequency simultaneously. With VHF/UHF packet, you can operate in an automatic control mode and leave your station (and its "mailbox") on at all times.

Some view packet as a tool to enhance their overall enjoyment of the hobby; others go further, using packet as their main means of on-the-air communication. With these thoughts in mind, let's detail the most popular applications of VHF/UHF packet today.

You can use packet radio to communicate directly with other amateurs, even over long distances using a packet radio network. Thus, you may find yourself chatting with an amateur in the same town, in the next state, or even halfway around the earth—without using HF.

Many packet operators communicate using BBS technology, which lets you transfer mail and bulletins over the network. Like telephone-line BBSs, PBBSSs promote "time-shifting": you can transfer information between users who needn't be on the air and connected to the BBS at the same time. Besides mail and bulletins, many PBBSSs also have a file section, and some PBBSSs offer additional services.

A recent refinement is the use of packet radio for "DX spotting" to announce the presence of "choice" DX stations they find on HF. DX spotting allows hundreds of contesters and DXers to be connected to the same system at the same time for DX reports.

Pavillion Software's DX-Cluster, formerly known as PacketCluster (R), lets multiple stations connect to the DX-Cluster station or node, or to connect to other nodes to form a network. It offers DX spotting and logging, real-time announcements, talk and mail, database access, and much more.

While packet radio isn't one of the more popular modes for awards-seekers, some packet operators do enjoy such pursuits. The ARRL, for example, issues packet-radio endorsements to the basic Worked All States (WAS) award, although it doesn't issue packet WAS as a separate award.

Two ARRL contests specifically include packet radio. One is Field Day, in which participants can earn bonus points for making packet contacts. A second is the ARRL RTTY Roundup, a "digital contest" for RTTY, AMTOR, and packet modes. The objective is to work as many digital stations as you can worldwide. So far, most HF digital contesting has focused on these modes; PacTOR, G-TOR, and CLOVER (to be discussed later) are not yet popular contest modes.

Packet radio lets you handle message traffic. By "traffic" we mean radiogram messages sent via the ARRL's National Traffic System (NTS). Amateur packet and other digital mode stations and PBBSSs are well suited to exchanging traffic, and the NTS depends heavily on these modes to move vital messages. To find out more about traffic-handling, check into a local VHF/UHF voice network on an FM amateur repeater, or contact your ARRL Section Manager. The ARRL Operating Manual also contains information on procedures.

It's also possible to perform public service and emergency communications with packet radio. Many amateurs have their digital-mode stations ready for emergencies. The stations can become "digital lifelines," since transmissions don't depend on telephone lines. Packet, RTTY, and AMTOR can provide some security for messages while freeing voice channels for other uses. PBBSS



also are used productively for these purposes.

Another high-tech use of packet radio is to monitor and communicate with amateur satellites. Many satellites are orbiting bulletin boards, relaying packet messages around the world. Others transmit images that you can display on your computer screen.

Finally, it's possible to transfer files between packet stations, using the TCP/IP protocol. Transfers are more satisfactory at higher bps transfer rates, but are still practical at 1200 bps (more on this later).

**Packet Equipment.** Now that we've discussed the main things you can do with packet, let's talk about how you can get in on the action. One special piece of equipment you'll need is a terminal node controller, or TNC. TNCs resemble phone modems that connect PCs and telephones to transmit computer data. But TNCs, or "radio modems," transmit data by radio rather than wire. TNCs usually contain the modem (used to interface with your radio) and a microprocessor or packet assembler and disassembler (PAD).

In transmitting, the TNC assembles packets from the data on the RS-232 serial line, computes an error check for the packet, modulates it at audio frequencies, and generates appropriate signals to transmit over the radio. On receiving, it reverses the process, translating the audio the radio receives into a data stream on the RS-232 line. Most TNCs use 1200 bps for local VHF and UHF packet, and 300 bps for HF communication. FCC regulations allow higher speeds on VHF and UHF, but not on HF.

You'll need a radio transceiver, too. For 1200 bps UHF/VHF packet, you can use commonly available FM transceivers. For HF packet, 300 bps data is transmitted using SSB. For high speed packet (greater than 1200 bps), modified radios may be required.

For packet transmissions, you can use a computer running a terminal-emulator program, a packet-specific

program, or just a so-called "dumb terminal" as a user interface. Almost any modem communications program can be adapted for packet, but there are also custom packet programs.

There are three basic TNC operating modes: command, converse, and transparent. You use the command mode to configure and control the TNC; the converse and transparent modes are used to

especially since you might already have some of the components. TNCs are around \$130 and up. MCPs cost \$300 or more.

If you already own a PC, you already have the potentially most expensive part of a packet station. And, if you have an amateur FM transceiver (or HF SSB transceiver), then you're set. If not, you can purchase a used two-meter FM transceiver from \$100-\$250; new ones



*MFJ offers TNCs for HF and VHF packet radio, several of which are based on classic TAPR designs. Thousands of units similar to this rugged basic model are used as digipeaters, nodes, and BBSs, and in commercial applications.*

communicate with others. You use the converse mode for most communications, while the transparent mode sends special characters to another station without being interpreted as commands by your TNC.

Most VHF packet activity is on 2-meter FM. You'll also find packet on UHF, on 222 and 420 MHz. Packet is alive on 6 meters as well, with many opportunities for DX under the right ionospheric conditions.

Once you have all the basics, can you get your station up and running? Most TNCs connect to the transceiver microphone plug for push-to-talk and transmit audio connections, plus they need a connection to the audio output from the FM receiver. If you can plug an RS-232 cable into a modem, and wire the TNC to your radio, you have the technical savvy to get on packet.

The cost of setting up your station shouldn't hold you back either,

cost from about \$300 up. An HF rig costs more.

**Packet Operation.** A protocol is a standard stating how computer systems communicate with each other. One of the more popular protocols for amateur packet radio is known as AX.25.

The amateur AX.25 protocol standard was developed in the 1970s and accepted by the FCC and ARRL in the 1980s. It's based on the wired-network commercial protocol X.25, which was modified to suit amateur needs. One advantage of AX.25 is that every packet that's sent contains the sender's and recipient's callsign, thereby providing station identification.

The Automatic Packet Reporting System (APRS) sends and receives station location or position information from various types of stations, including fixed and mobile stations,

nodes, digipeaters, DX clusters, packet mailboxes, and the like. APRS graphically applies packet radio to real-time events by displaying information as a symbol on a map on your PC screen.

The position information includes, as a minimum, latitude, longitude, and station type. APRS is very useful in emergencies, exercises, weather nets, and other events that are most concerned with where things are and where they're going. Several firms, including PacComm, make equipment compatible with APRS and with GPS (Global Positioning System) satellite receivers.

Loosely related to packet operation is another VHF/UHF digital mode that's just getting off the ground: digital paging. The technology is being heavily promoted by Kantronics. Digital-paging transmission and reception formats adhere to the same Radiopaging Code No. 1 (POCSAG) signal format used by paging providers. Thus, most commercial pagers can be converted to amateur use.

If you're on packet, you already have much of the equipment needed; the Kantronics KPC-9612 TNC handles this mode. Kantronics offers pager crystals and will sell refurbished and "recrystallized" pagers for 2 meters and 70 cm. Pagers promise to be useful for amateur emergency communications.

### Packet Networking and Gateways.

If you're too far away from another station to make a direct connection, you can use the nodes, or switches, of a packet network. A wide variety of available networking schemes include digipeaters, KA-Nodes, TheNet, NET/ROM, ROSE, X1J, TPRS TexNet, FlexNet, and others.

Gateways offer access to another type of network, usually nonamateur. In the radio network world, you'll also see references to wormholes, amateur links that pass through nonamateur services, like the telephone system or the Internet.

Digipeaters made up the first packet networking schemes, but they're largely obsolete today,

Digipeating, short for digital repeating, allows you to extend the range of your station by retransmitting packets addressed to the digipeater. But the links between digipeaters aren't 100-percent efficient, and they're dumb: they simply look at a packet, and if the call sign is in the digipeater field, they resend the packet.

Digipeating worked well with only a few people on the channel. However, as long-distance packet became more popular, digipeaters clogged the airwaves. Also, if a packet got lost by one of the digipeaters, the originating station had to retransmit the packet, forcing every digipeater to transmit again.

Kantronics improved on the digipeater concept with KA-Nodes. As with digipeaters, KA-Nodes repeat AX.25 frames. But a KA-Node

NET/ROM was one of the first networking schemes to address the problems with digipeaters. You connect to a NET/ROM station as if connecting to any other packet station. From there, you can send commands to instruct the station to connect to another local user or to another NET/ROM station. This scheme improved reliability considerably.

Another scheme is ROSE, which is an acronym within an acronym, standing for the "Radio Amateur Telecommunications Society (RATS) Open Systems Environment." A ROSE network includes a PBBS, an online callsign directory and database server, a bulletin broadcast controller, a message management system, a packet switch, and other features.

Now let's get back to gateways,



*TAPR, a nonprofit, scientific R&D corporation, is one of the cradles of amateur radio packet civilization. Various other high-tech and digital interests are supported on the TAPR home page, including spread spectrum, DSP, networks, the Internet, and other special interests. TAPR is found at <http://www.tapr.org>.*

acknowledges every transmission for each link instead of over the entire route; this allows for more reliable connections than digipeaters, because acknowledgments are only carried on one link. KA-Nodes are not true networks, and they don't offer automatic routing as do other schemes, like NET/ROM.

which let you access other bands and operating modes. Gateways allow connectivity between two normally "non-connectable" communication technologies. For these reasons Gateways have become an integral part of most PBBS and digital networking schemes. They include crossband gateways,



Internet/packet radio BBS gateways, and packet wormholes via the Internet.

You can participate in a variety of activities using an Internet-to-packet radio gateway. These include transferring files; "Telnetting," or accessing TCP/IP stations remotely through the gateway; and sending and receiving e-mail. Another activity is a "QSO bridge," a keyboard-to-keyboard QSO (contact) roundtable in which you enjoy real-time conversations.

### **TCP/IP and Packet Radio.**

Transmission Control Protocol/Internet Protocol, or TCP/IP, is a "suite" of protocols used over the Internet. Amateur TCP/IP nets, referred to collectively as AMPRNet, use an adaptation of Internet TCP/IP protocols. TCP/IP protocols provide a high level of flexible, intelligent packet networking that isn't possible with AX.25. Actually, TCP/IP software emulates many TNC functions so you aren't limited to the functions programmed into the TNC, which now can be programmed to do much more.

TCP/IP networks are mostly local and regional. But TCP/IP enthusiasts see a future when the entire country, and perhaps the world, will be linked by TCP/IP using microwave and satellites. Presently, most TCP/IP activity is on 2 meters and 70 cm.

What are some of the benefits of your using TCP/IP, in addition to its inherent ability to multitask (do several things simultaneously)? Let's take a brief look at some benefits:

With TCP/IP you can send mail reliably. You need only prepare the message and leave it in your own TCP/IP "mailbox." Your PC will attempt to make a connection and deliver the message directly—there are no PBBSs involved. The message packets travel through the net until they reach the other station. In the meantime, you can talk to, or receive mail from, the other station. If someone can't connect to you because you're not on the air, their PC holds the message and tries later.

With FTP software and TCP/IP, you

can pass binary files over the Internet to other stations. Under TCP/IP, you can send and receive mail or talk to others while the transfer is occurring.

Already amateurs and other hobbyists have constructed Internet Web pages and USENET newsgroups for a variety of purposes. You might want to check out some of these newsgroups:

- alt.ham-radio.packet
- alt.radio.digital
- rec.radio.amateur.digital.misc
- rec.radio.amateur.equipment
- rec.radio.amateur.homebrew
- rec.radio.amateur.misc
- rec.radio.amateur.space
- rec.radio.info
- rec.radio.swap

But some amateurs also have constructed packet TCP/IP "radio Webs" with on-the-air, Internet-style Web page servers. Doing so effectively blends their several interests in amateur radio, computer communications, and networking.

As for hardware, all you really need is a computer; a 2-meter FM transceiver; and a "KISSable" TNC, one with KISS ("Keep It Simple Stupid") mode capability.

The heart of your TCP/IP setup probably will be the TCP/IP-based software written for the IBM PC by Phil Karn, KA9Q, called NOSNET, or simply "NOS." NOS, the Network Operating System, takes care of all TCP/IP functions, using your "KISSable" TNC. You'll find NOS software on CompuServe in the HamNet Forum, among other places on BBSs and the Internet.

When you place your TNC in KISS mode, you disable the AX.25 protocols and reduce it to a basic packet modem; the host PC must implement all high level protocols. Thus all of the incoming and outgoing data are processed directly by your PC and its software, not by your TNC. Most recent TNCs and MCPs have this feature.

You also need your own IP address, much like on the Internet. AMPRnet volunteer IP address coordinators issue the IP addresses; you have to contact the coordinator in your area for an address. But you

don't need to memorize the addresses of TCP/IP-equipped stations; NOS keeps track of them. When you try to contact another station using TCP/IP, all network routing is performed automatically according to the TCP/IP address of the distant station. TCP/IP networks are transparent to most users.

Most amateur TCP/IP networks depend on dedicated switches to move data through the system. Like NET/ROM nodes, TCP/IP switches communicate with each other over high-speed backbone links on 222 MHz or 70 cm. Many TCP/IP users access local switches on 2 meters, at 1200 bps, while TCP/IP switches use backbone links to relay data at 9600 bps or higher.

### **HF Digital Communications**

**Modes.** Packet radio is one of amateur radio's most popular modes. But today's digital world is more than just packet, which isn't all that great a communications medium on HF. The packet goal of efficiently, rapidly, and reliably transmitting information between distant stations is still elusive: sending data via HF radio is downright tricky. Ionospheric conditions change rapidly, frequently causing distortion and errors in received data.

While you can generate each of the new and high-tech digital modes using a dedicated controller, the advent of one particular piece of hamshack equipment is largely responsible for amateurs being able to use a wide variety of digital modes. That device is called the Multimode Communications Processor, or MCP.

Today, the heart of many digital-equipped hamshacks is an MCP that lets you use several digital modes with your transceivers. All modes may be handled by the same box, which like a TNC incorporates microprocessor design features and internal memory. With MCPs, you may be able to operate Packet, PacTOR, AMTOR, RTTY, SSTV, fax and WeatherFax (WeFax), CW, and several other high-tech modes.

Before we explore more sophisticated HF digital modes, let's discuss

RTTY (Radio TeleType), a common HF communications protocol. RTTY is a half-duplex, non-error-correcting mode. It's primarily for single keyboard-to-keyboard contacts, and operating practices closely resembling those of Morse. RTTY still is king of digital DXing and contesting.

RTTY uses Baudot encoding, a five-bit code. These five bits allow only 32 possible combinations, not enough for a full alphanumeric character set. While ASCII coding can be used in RTTY, it's uncommon. Most RTTY is at a slow 45 bps (about 60 WPM, in Morse terms), as opposed to telephone modems which typically use 9600 to 28000 bps and VHF packet at 1200 bps or higher.

So just how efficient and effective is packet when used under real world, rough-and-tumble HF conditions? The AX.25 protocol isn't an efficient protocol for HF. Even using a good radio modem, you frequently get errors—with the AX.25 protocol, one bad bit makes an entire packet unusable. This is the main reason why AX.25 isn't good to use on the error-prone channels typically encountered on HF.

Presently, no better packet HF protocol is available. However, candidates for improved HF digital communications performance include Pactor, G-TOR, and CLOVER. You can expect to see more exotic modes develop over the next few years.

Generally, to operate HF packet you need an MCP, a HF SSB transceiver, and a PC running an appropriate terminal software program. All MCPs today have HF packet capability; so do many packet-only TNCs. You probably already have the SSB transceiver, and likely have a PC. (Actually, it's possible to operate all HF digital modes except CLOVER without using a computer, using a simple data terminal.)

Operating on HF packet is different from VHF/UHF packet: interference and noise are anathema. Whereas you can use 1200, 9600, or even higher bps data rates on VHF and UHF, and lots of high-speed packet equipment is available, FCC

regs place an upper limit on the maximum data rate on HF. This is 300 bps below 28 MHz, and 1200 bps on 10 meters.

Another difference is the way in which the packet-radio signals are generated. On VHF and UHF, we usually use audio frequency shift keying (AFSK), with audio tones being applied to the FM transceiver's mike input. On HF, we normally use the SSB signal to generate an FSK (frequency shift keying) signal. Most packet activity today is on 2-meter VHF, using FM AFSK.

Amateur Teleprinting Over Radio (AMTOR) was one of the earliest methods of bringing amateur HF digital communications into the computer age. It's an error-checking mode for HF text communication that minimizes interference (QRM), fading (QSB), and static (QRN), one that's suitable for casual keyboarding and contacting HF BBSs. Importantly, you often can maintain a usable connection during poor signal-to-noise (S/N) ratio conditions when a packet connection wouldn't hold.

In one sense AMTOR's a throwback to an earlier era, in that it uses the same character set as Baudot, encoded differently: each character has a constant mark to space ratio. This constant ratio is how errors are detected. Errors are corrected

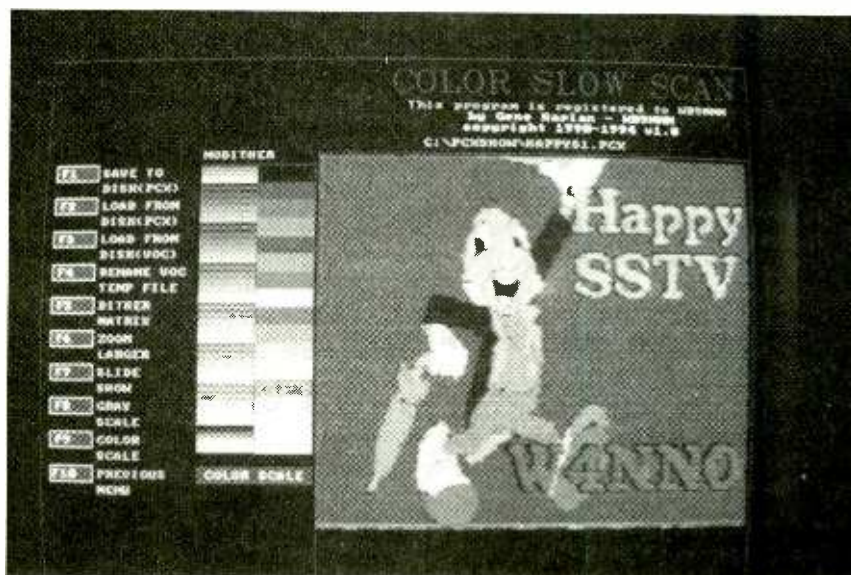
using either of two methods: ARQ (Automatic Retransmit reQuest), and FEC (Forward Error Correction). However, the five-level code makes binary data difficult to send, error correction is weak, and effective "throughput" is low.

In ARQ mode, two stations connect. The station with data to transmit sends three characters, then waits for the other to send an acknowledgment. This activity makes for the "chirp-chirp" sound of AMTOR ARQ signals, and it means that each station transceiver must switch from sending to receiving mode quickly. Each station also has to turn the link over to the other station at the end of each exchange.

Before you operate AMTOR ARQ mode, you have to choose a selective call identifier, or SELCAL, a series of letters of your choosing that you use to establish the link. Most amateurs use some combination of letters that match part of their callsign.

Unlike in ARQ mode, in FEC mode one station can communicate with many others at once, since there's no back-and-forth acknowledging of data. FEC gets its error-correction capability from time diversity, in which it sends characters twice. In FEC mode, you can call CQ to make contacts.

Both AMTOR and packet are popular on HF, but performance



Color Slow Scan for the Sound Blaster SSTV software from Harlan Technologies offers color SSTV send and receive using your PC and its sound card. Color and black-and-white, receive-only versions also are available. A typical received SSTV image is shown.



isn't optimum. Packet Teleprinting Over Radio (PacTOR), which appeared in 1990, is a robust, RTTY-like, error-correcting mode to overcome the shortcomings of packet and AMTOR on HF. PacTOR is like an enhanced AMTOR combining its best features with packet, for operation on noisy, fluctuating channels. There's about a fourfold increase in throughput over AMTOR. A new version, PacTOR II, is even more robust.

produce severe signal distortion, and so it takes measures to compensate for the distortion and maximize data throughput.

Developed jointly by Ray Petit, W7GHM, and HAL Communications president Bill Henry, K9GWT, it's a very popular HF mode, since CLOVER arguably offers the best overall HF digital performance. CLOVER also is very conserving of spectrum space: it requires only

First used in 1994, G-TOR is a high-throughput, narrow-bandwidth hybrid HF system developed by Kantronics Corp. G-TOR stands for Golay-coded Teleprinting Over Radio. It makes use of the error-correction system created by M.J.E. Golay used in space vehicle communications to ensure that data transmitted from the vehicle could be recovered despite serious errors caused by noise and interference. Like CLOVER, the system is very conserving of spectrum space and usually takes up 500 Hz or less.

Reliability and effective data rates generally are superior to both AMTOR and PacTOR modes; in fact, G-TOR sometimes even approaches CLOVER's efficiency. Operating using G-TOR is fairly simple and is similar to operating AMTOR or PacTOR.

**Spread Spectrum.** Spread spectrum isn't a discrete modulation scheme. Rather, it tries to get around the twin obstacles of sending greater and greater amounts of information: frequency congestion and bandwidth. It involves "slicing" a whole band of frequencies into various frequency ranges that it uses almost simultaneously. A signal is present only on one frequency at a time, but the overall effect is like being able to operate on a whole band of frequencies.

First allowed by the FCC in amateur radio in 1980, spread spectrum is still an experimental mode that's limited to certain frequencies and implementation methods. It requires sophisticated equipment that few amateurs have, and it also suffers from the objections of amateurs who don't like its basic (and arguably inefficient) premise of using whole bands of frequencies. But it has potential advantages in being able to resist interference and share frequency bands with other users.

#### **Image Communication Modes.**

Many amateurs effectively extend the PC and home-video revolutions to amateur radio. They send and receive images by graphical modes such as fax (facsimile), FSTV



*A popular DSP receiver enhancement device is the JPS NIR-12 Dual DSP Noise/Interference Reduction Unit. The NIR-12 provides "spectral subtraction" noise reduction in addition to dynamic peaking. The spectral subtraction mode is effective in reducing impulse noise.*

This hybrid mode sends error-free data by using a handshaking system which requires that the receiving station send an ACK if data is received intact. PacTOR's most important feature is that of memory ARQ, which lets even noisy packets be restored: it tries to compensate for incomplete data by looking for missing data and filling the gaps. PacTOR also adjusts its speed automatically to changing band conditions.

PacTOR has built-in message storage and can hook up to most APLink systems; you can pass traffic interchangeably using PacTOR or AMTOR. There also are many PacTOR BBSs on the air.

CLOVER is a complex and very efficient HF digital communications waveform, system, and protocol, named after its clover-like oscilloscope wave pattern. The proprietary CLOVER properly recognizes that HF signal propagation may

about 500 Hz, as compared with about 2 kHz for HF packet and 1 kHz for AMTOR.

CLOVER uses a four-tone modulation system; you can manually or automatically select any of ten modulation formats to adjust to different conditions. CLOVER incorporates ingenious adaptive modulation schemes: the more complex, high speed modulation formats are used when conditions allow them, while the slower, less error-prone modes are used otherwise.

To use CLOVER, you need a special HF digital modem, usually an IBM PC-compatible HAL Communications computer card, along with terminal software. But you won't need a separate interface since the PC card performs this function. And, while early cards were CLOVER-only, newer cards have multimode capability and offer RTTY (both Baudot and ASCII), AMTOR, and PacTOR.

(fast scan television), and SSTV (slow-scan television)—sometimes the latter two modes are lumped together as amateur TV, or ATV.

SSTV and fax can be handled by multimode hardware interfaces and appropriate PC software. The more advanced MCPs offer a sort of "one-stop communications center" for various on-the-air modes including CW, RTTY, PacTOR, AMTOR, fax, SSTV, and more.

Fax is the oldest amateur image

mode. Offering higher image resolution than SSTV or even FSTV, fax sends a high-resolution photocopy of a two-dimensional image of a piece of paper or a still photograph.

Today, amateur faxes usually are sent using PCs equipped with special software. The images sent may be in any one of several different formats that may be displayed as received or saved to a disk file for later viewing. Color fax also is possi-

ble, though the ups-and-downs of HF transmission generally limit its successful use to VHF and UHF.

Many amateurs and SWLs also enjoy receiving government WeatherFax (WeFax) broadcasts, which often originate from weather satellites, to obtain a graphical depiction of the weather. The bulk of this activity lies below the amateur 2-meter band, in the 137-138 MHz range using AM video subcarriers, and at 1691 MHz using FM transmission formats.

You can use SSTV to transmit black-and-white or color still pictures on HF, using relatively narrow bandwidths comparable to those used by SSB stations. Conventional SSB rigs generally are used to transmit and receive SSTV signals.

Recent years have witnessed the availability of inexpensive MCPs and PC-based scan converters. You can use an MCP for SSTV, or you can use a dedicated SSTV adapter. Several firms offer dedicated SSTV hardware and/or software, including Absolute Value Systems and Harlan Technologies.

Getting on FSTV isn't a great deal different from voice modes, except that you also hook up your camcorder to provide the signal input to your transmitter, and use your TV set to receive the picture. A special radio isn't required. Amateurs typically show their radio hamshacks, home videos, construction projects, and computer graphics, or they repeat SSTV video and audio. Some even transmit local radio club meetings for shut-ins.

A FSTV signal looks like a commercial TV signal; you won't find FSTV on HF. Rather, it's on UHF, mostly on the 70-cm band because of the spectrum space required, and there also are many UHF FSTV repeaters across the country. Some FSTV buffs equip themselves with professional equipment, including special-effects devices to manipulate and control video images. A full range of FSTV equipment is offered by PC, Electronics and several others.

**Satellite and Space Communications.** Since 1961, when the first

## SUGGESTED READING

### Books

Baker, Keith, KB1SF. *How to Use the Amateur Radio Satellites, Third Edition.* Washington, DC: The Radio Amateur Satellite Corporation, 1992.

Crisler, M. *The PACSAT Beginner's Guide.* Washington, DC: The Radio Amateur Satellite Corporation, 1991.

Curtis, Anthony R., K3RXK. *HamSat Handbook.* Lake Geneva, WI: Tiare Publications, 1993.

Curtis, Anthony R., K3RXK. *Outer Space Frequency Directory.* Lake Geneva, WI: Tiare Publications, 1994.

Davidoff, Martin, K2UBC. *The Satellite Experimenter's Handbook, Second Edition.* Newington, CT: The American Radio Relay League, Inc., 1990.

Ford, Steve, WB8IMY, ed. *The ARRL Operating Manual, Fifth Edition.* Newington, CT: The American Radio Relay League, Inc., 1995.

Ford, Steve, WB8IMY. *Your HF Digital Companion.* Newington, CT: The American Radio Relay League, Inc., 1995.

Heatke, John, KD7WS. *Using Computer Bulletin Boards, Third Edition.* New York: MIS Press/Henry Holt & Co, 1995.

Horzempa, Stan, WA1LOU. *Practical Packet Radio.* Newington, CT: The American Radio Relay League, Inc., 1995.

Mayo, Jonathan, L., KR3T. *The Radio Amateur's Digital Communications Handbook.* Blue Ridge Summit, PA: TAB Books, 1992.

Schetgen, Robert, KU7G, ed. *The ARRL Handbook for Radio Amateurs, Seventy-Third Edition*

(1996). Newington, CT: The American Radio Relay League, Inc., 1995.

Taggart, Ralph, WB8DQT. *Weather Satellite Handbook, Fifth Edition.* Newington, CT: The American Radio Relay League, Inc., 1994.

### Articles

Anderson, Phil, W0XI. "Ham Radio Paging: Putting 'POCSAG' on Packet." *CQ VHF*, July 1996.

Bible, Steve, N7HPR. "Spread Spectrum: It's Not Just for Breakfast Any More!" In the *Digital Communications* column, *QEX*, June 1995.

Bible, Steven, N7HPR, and Greg Pool, WH6DT. "Amateur Radio on the World Wide Web." *QST*, June and July 1995.

Ford, Steve, WB8IMY. "Exploring the Internet." *QST*, September through December 1994.

Ford, Steve, WB8IMY. "Gateways: Amateur Radio Meets the Internet." *QST*, January 1995.

Ford, Steve, WB8IMY. "KISSes, POPs, and Pings." *QST*, June 1995.

Hershberger, Dave, W9GR. "DSP—An Intuitive Approach." *QST*, February 1996.

Kleinschmidt, Kirk, NT0Z. "Go Digital!" *QST*, September 1994.

"Packet Bulletin Boards—Ham Radio's 'General Store.'" In the *Basics* column (no author stated), *CQ VHF*, June 1996.

Rotolo, Don, N2IRZ. "A Packet Networking Primer." *CQ VHF*, June 1996.

Townsend, Jay, WS7I. "CQ Reviews: The HAL Communications P38 HF Radio DSP Modem." *CQ*, October 1995.



## NAMES AND ADDRESSES

### **Absolute Value Systems**

115 Stedman St.  
Chelmsford, MA 01824-1823

### **Advanced Electronic Applications (AEA)**

P.O. Box C2160  
Lynnwood, WA 98036

### **Amateur Radio Research and Development Corp.**

P.O. Drawer 6148  
McLean, VA 22106-6148

### **Amateur Television Quarterly**

3 North Court St.  
Crown Point, IN 46307

### **American Radio Relay League, Inc.**

225 Main St.  
Newington, CT 06111-1494

### **International Digital Radio Association**

P.O. Box 2550  
Goldenrod, FL 32733-2550

### **HAL Communications Corp.**

1201 West Kenyon Road  
PO Box 365  
Urbana, IL 61801-0365

### **Harlan Technologies**

5931 Alma Dr.  
Rockford, IL 61108

### **JPS Communications, Inc.**

P.O. Box 97757  
Raleigh, NC 27624-7757

### **Kantronics**

1202 East 23rd St.  
Lawrence, KS 66046-5099

### **MFJ Enterprises, Inc.**

P.O. Box 494  
Mississippi State, MS 39762

### **MIS Press**

**A division of Henry Holt & Co.**  
115 West 18th St.  
New York, NY 10011

### **P.C. Electronics**

2522 Paxson Lane  
Arcadia, CA 91007-8537

### **PacComm Packet Radio Systems, Inc.**

4413 N. Hesperides St.  
Tampa, FL 66614-7618

### **Pavillion Software**

c/o XX Towers, Inc.  
814 Hurricane Road  
Mason, NH 03048

### **Radio Amateur Satellite Corp.**

P.O. Box 27  
Washington, DC 20044

### **Radio Amateur Telecommunications Society (RATS)**

P.O. Box 93  
Park Ridge, NJ 07656-0093

### **Tab Books**

**A division of McGraw-Hill, Inc.**  
P.O. Box 5445  
Blacklick, OH 43004-0545

### **Texas Packet Radio Society**

P.O. Box 50238  
Denton, TX 76206-0238

### **Tiare Publications**

P.O. Box 493  
Lake Geneva, WI 53147

### **Tucson Amateur Packet Radio Corporation**

8987-309 E. Tanque Verde Rd.  
#337  
Tucson, AZ 85749-9399

Orbiting Satellite Carrying Amateur Radio (OSCAR) was launched, amateurs have communicated via satellite over thousands of miles using VHF and UHF frequencies that normally are used for short distance communications.

Many amateur satellites contain microcomputers that provide specialized information and communications. Some have onboard cameras that let you download images of the earth and the stars. Others provide "store-and-forward" packet

mailboxes for message transfers. Some satellites use the AX.25 protocol; others use special packet protocols developed for satellite communications.

Since 1984, when OSCAR 10 was used as a repeater to connect packet stations on the two coasts, packet radio TNCs and related gear has been carried aboard amateur satellites. This has enabled packet communications either of a real-time or "store-and-forward" (PBBS-like) nature—the latter is more

common. There are some amateur satellites in orbit that are dedicated to packet radio (called "PACSATs"). These are PBBS-like and help distribute packet traffic around the world.

You'll find PACSAT operation to be fairly similar to conventional, earth-bound packet, and the same AX.25 protocol is used. But the PACSATs use a variety of data rates and signal modulation schemes and formats. Special modems must be used with your TNC to communicate with the 1200-bps phase shift keying (PSK) satellites (PacComm makes dedicated "satellite modems" to support both modes). You also need a 2-meter FM transmitter to send data and a 70-cm SSB rig to receive downlink transmissions.

Several satellites are 1200 bps PACSATs; these are OSCAR 16, OSCAR 19, and OSCAR 26. OSCAR 22, OSCAR 23, and OSCAR 25 are 9600-bps PACSATs. The 9600-bps birds have become popular—their 9600-bps capability is excellent for a satellite that may be "in view" for but short periods. Unfortunately, the PACSATs can serve only so many stations at one time.

Several packet-radio based Shuttle Amateur Radio Experiments (SAREX) have been conducted by amateur astronauts. Usually special "robot software" is used that enables stations to make contact with the Shuttle. This onboard software recognizes connect requests, sends sequential contact numbers to the station, disconnects, and logs the contact. The Shuttle also carries a beacon which transmits lists of successful contacts. Most of the experiments are digital-based, but ATV operators have successfully transmitted 70-cm FSTV signals to the Shuttle.

Russian cosmonauts have conducted live packet QSOs using amateur radio aboard the Russian Mir Space Station. It uses standard, 1200-bps AFSK packet. The station includes a PBBS-style mailbox for communicating with the cosmonauts.

While Mir is fairly simple to work, and no special equipment is need-

ed, the problem with actually working it is its erratic schedule, caused by the cosmonauts' scrambling to find the time to operate. They're sometimes forced to turn off their amateur equipment altogether to avoid interference to other systems during critical duties and tests.

The Phase 3D international satellite project is a replacement for the amateur workhorse satellite, OSCAR 13, which soon will plunge into the atmosphere and be destroyed. But it's more, being aimed squarely at reducing the cost and complexity of ground-based, satellite-capable amateur stations. It adds several new frequency and data format choices, including digital-mode capabilities.

The new satellite will have powerful transmitters, receivers, and antennas for frequencies from 21 MHz to 24 GHz. The new satellite also will be easy to find, since its orbit will place the satellite at the same position above your horizon every 48 hours.

Communications with manned spacecraft and satellites are not the only amateur digital comms in the "outer space" realm. For several years, amateurs have experimented using "natural space objects" for packet radio communication. They long have used packet radio in meteor scatter communication, bouncing packets off the ionized trails of meteors that enter the earth's atmosphere, allowing much greater than line-of-site between VHF and UHF packet stations.

Amateurs also have used earth-moon-earth (EME), or "moon-bounce" communications, to bounce their own beacon signals off the moon and listen to them on the rebound. Two-way moon-bounce is a little more difficult, however, as EME signals typically are very weak and fluttery.

**DSP: Digital Magic.** A promising technology that can dramatically enhance your hobby enjoyment is digital signal processing (DSP). DSP represents a highly flexible, entirely digital approach to decoding, encoding, modulating, demodulat-

ing, and filtering signals for various operating modes.

Unlike regular analog communications processors, DSP units use software to encode and decode signals, so they aren't dependent on specialized hardware. In DSP systems, the incoming audio is converted into digital data for very effective, thorough processing by the DSP software, which rejects noise and interference according to the specified bandwidth. The result of this processing is converted back into audio for your MCP.

Most applications have focused on receiver filtering, where DSP-based CW filters add narrow, razor-sharp selectivity to receivers that lack it. Since DSP filters are virtual, existing only in microprocessors, they also can offer "adaptive filtering" to react to changing conditions, automatically reduce noise or hiss on weak signals, and notch out interference.

DSP filters are being used to perform more and more functions. Besides receiver filtering, we're seeing DSP-based filters in transceivers, MCPs, TNCs, and radio modems to do such things as generate SSB, process speech, generate and detect FSK and FM signals, and more. Best of all, with a DSP processor it's possible to add practically any mode to your MCP by adding new software.

**PCs in the Radio Hamshack.** Do you use a PC in your radio shack? If so, great, since you have to have one for at least some of the digital modes. Microcomputers perform valuable tasks in the radio hamshack and listening post, from doing calculations to cutting down on record-keeping time to beaming in on other stations.

While computers other than the IBM PC and compatibles can be used in the hamshack, the IBM PC has pretty much become standard. But any computer for which you can obtain terminal-emulation software will work in digital communications, except for CLOVER, which requires a CLOVER board installed in an IBM PC.

Hamshack PC software used to be quite limited, and it focused on QSO and contest logging. But amateur software has come a long way since it first appeared in the late 1970s. Today, hamshack software lets you use your PC for much more, including at least a dozen-and-a-half distinct classes of hamshack software applications.

These applications include Morse Code and radio-theory practice, instruction, and testing; computer-based radio and station control; logging, contesting, and awards tracking; automated QSL card processing; directional-antenna aiming; radio propagation prediction; antenna design and modeling; satellite tracking and antenna control; CW and RTTY reception and transmission; and support for packet radio and other digital communications modes.

Other hamshack computer applications you may enjoy include support for image communications such as fax, WeFax, SSTV, and FSTV; electronic circuit design and performance calculation; CD-ROM based callsign lookup; and online communications. ■

---

## BUILD A LIGHTING SYSTEM

*(Continued from page 44)*

---

conduction angle. Use Table 1 to set your Lighting System for light levels that mimic 75-, 60-, 50-, 40-, and 25-watt lamps.

With the potentiometer set, you can complete the Lighting System by mounting it in a plastic electrical box with an AC receptacle cover. You can also modify a small project box. No matter what enclosure you use, however, *never touch any of the components while the circuit is plugged in and turned on!*

If the glow of the lamp seems to waver, check that other appliances on the circuit are in good condition. Also check that all outlets have the proper polarity (housewiring testers are available for this purpose); appliances with reverse polarity can adversely affect the circuit. ■



# Think Tank

## Craig's Back With a Vengeance

BY JOHN J. YACONO  
TECHNICAL EDITOR  
WINDOWS MAGAZINE

This month, we've got various circuits from a former contributor, Craig Kendrick Sellen. Since he's sent enough circuits to fill a column he'll get a 1967 MCL1010 chip and a kit in addition to the book we award for single submissions. If you'd like to try for a book, or the whole ball of wax, send your own complete circuit schematics and explanations to *Think Tank*, Popular Electronics, 500 Bi-County Blvd., Farmingdale, NY 11735.

Last month we talked about the characteristics of a diode and it seems like a good idea to discuss its "characteristic curve." A characteristic curve is a plot of the current through a device vs. the voltage applied across it. For a standard diode the plot looks like Fig. 1.

The action of applying positive potential to the anode or "forward biasing," results in the upper half of the graph. Note the diode does not conduct current until after the barrier potential is overcome by the application of voltage greater than the barrier voltage. That's around 0.7 volts for silicon-based diodes and 0.3 volts for germanium units. Even after that, though, the curve is not linear, particularly before the knee-bend. Linear behavior is really what you'd see with a resistor, but not a diode. That's important to keep in mind if you pass an audio signal through a diode: low-level signals that would fall around the knee bend or dip into the barrier-potential region would be very distorted.

Another important figure of merit in the forward-bias state is the maximum forward current, labeled  $I_{FMAX}$ . That's the maximum recommended current for the device. Running the diode beyond that would cause it to overheat and fail.

As you can see, when reverse biased, a tiny amount of "leakage current" flows through the diode. You can increase the current passing through the diode if you apply a voltage greater than the "reverse breakdown voltage" or "peak-inverse voltage" (PIV). When a diode is designed to be a "rectifier," a device that only permits current flow in one direction, it's not intended to work

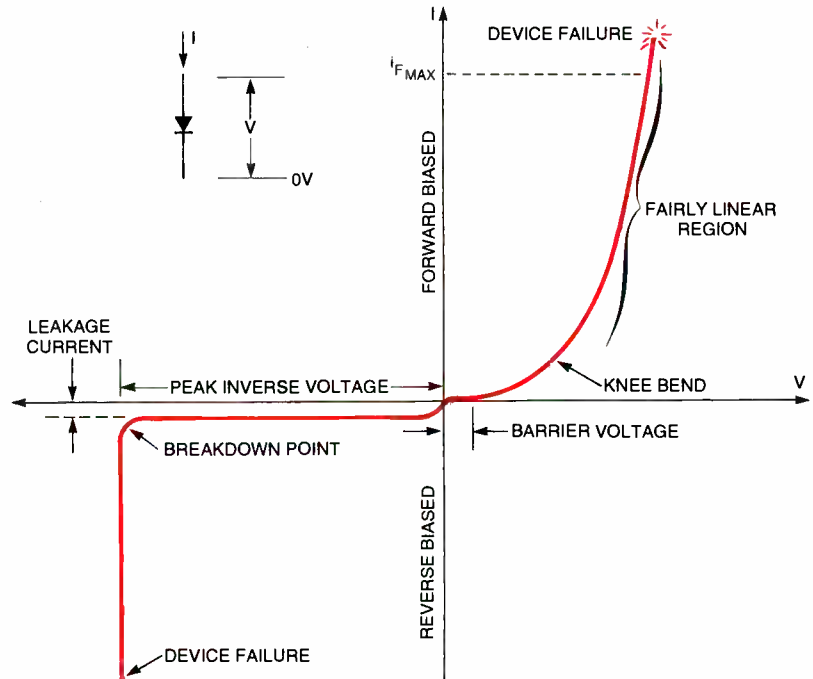


Fig. 1. Here's the characteristic curve of the current through a standard diode vs. the voltage applied across it.

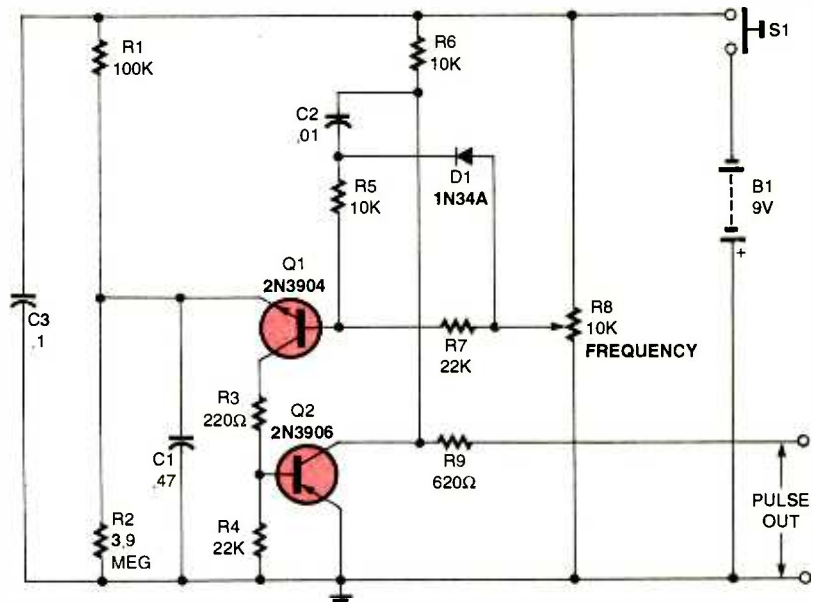


Fig. 2. This simple pulse generator can provide several waveforms. Potentiometer R8 sets the frequency.

below the reverse breakdown point.

There are special diodes called "Zeners" that are designed specifically

to operate in that region when reverse biased. We'll talk more about them when we discuss how to use diodes as

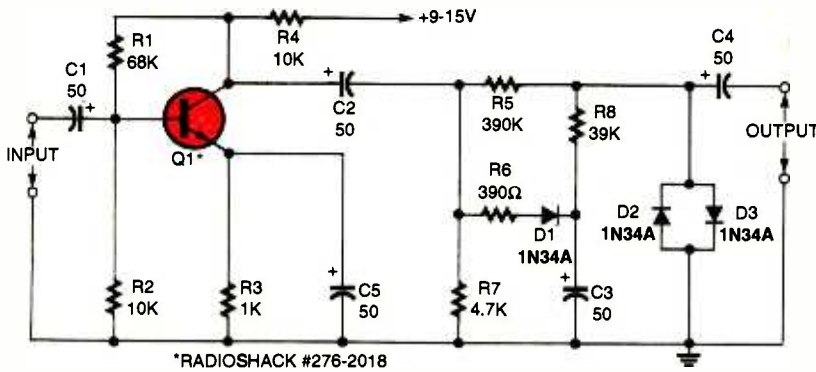


Fig. 3. Here's a compression-type amplifier that can be used to keep the volume level of an organ constant.

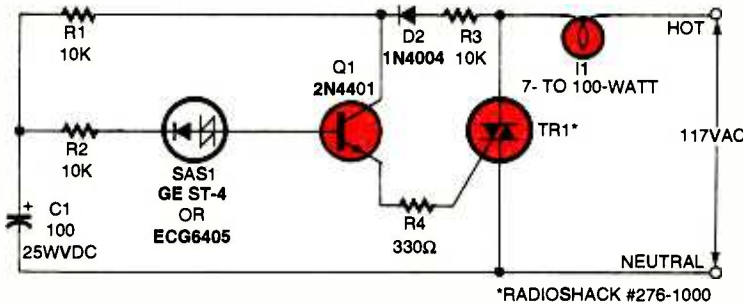


Fig. 4. With the component values shown, this flasher circuit has a rate of approximately once per second.

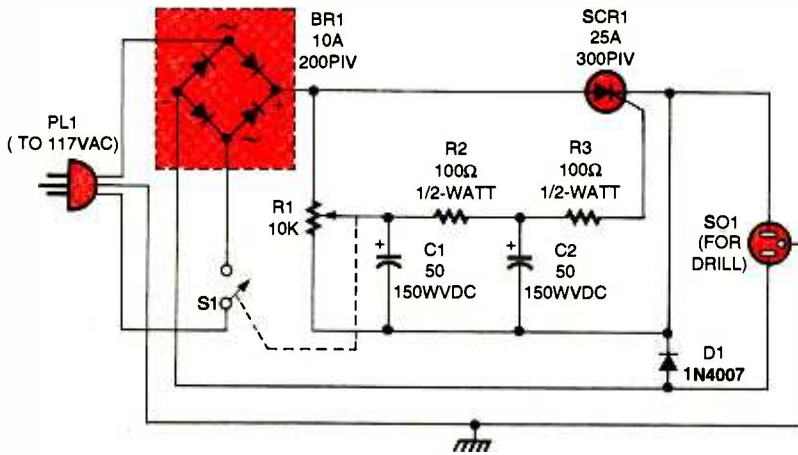


Fig. 5. Add this circuit to a single-speed drill to make it a variable-speed one.

voltage references and regulators. Now let's look at Craig's work.

## PULSE GENERATOR

I came up with a nifty pulse generator, shown in Fig. 2, which as you'll see can generate more than simple pulses. Timing-capacitor C1 is charged by battery B1 through R1, until Q1 is forward biased and starts conducting. When

this occurs a forward base bias is applied to Q2 through Q1 and R3. As Q2 starts conducting, a pulse is made across collector-load R6, which is coupled back to Q1's base through C2 and series-resistor R5. That drives Q1 to rapidly discharge C1, and then the cycle starts over. In essence Q1 and Q2 form a high-gain amp with C2 providing positive feedback. Diode D1 reduces

C2's recovery time, while R8 establishes Q1's base bias level and thus the point at which timing-capacitor C1 charges before feedback and capacitor discharge is initiated.

The lower Q1's initial base bias, the higher the circuit's repetition rate. Resistor R8 therefore serves as a frequency control providing nine octaves of coverage. The circuit will work from 5 to 25 volts, but a 9-volt source is optimum. Output impedance 600 ohms.

Although designed as a pulse generator, the circuit can provide other waveforms at various points. A sawtooth signal suitable for use as a linear scope sweep is available across C1. For frequency-divider, sweep-generator, and time-marker uses, synchronization pulses can be applied to Q1's base through a small capacitor. The frequency range can be shifted by using other values for C1 and C2. With values of 100  $\mu$ F for C1 and 3  $\mu$ F for C2, the circuit will work down to about 1/20 Hz. Lower values than those shown in the circuit will permit operation at ultrasonic frequencies, but it may be necessary to reduce resistor values to a tenth of those listed, except for R3, which should not be less than 100 ohms.

—Craig Kendrick Sellen, Waymart, PA  
Very unusual design. Interesting purposes, too! An AC powered supply, or at least regulation might make it more stable.

## COMPRESSION AMPLIFIER

The output signal level of an organ is dependent upon the setting of the foot-pedal volume control, the number of stops or voices switched in, and the number of keys depressed at a given moment. For a fixed volume-pedal setting and a fixed number of stops on line, the volume level heard will vary considerably, depending on how many keys are depressed simultaneously. Although the organist can compensate for the changes in volume by using the volume pedal, on a fast change of stops or a quick switch from solo to rhythm the audio change is too fast for the organist to react. A choppy audio burst is the result.

It is desirable to have a means for keeping the volume level constant when such rapid changes are made. To accomplish this, a compression-type amplifier like the Organ-Leveler shown in Fig. 3 can be used. Unlike compres-





# ANTIQUE Radio

## Roaming the Stars Once More BY MARC ELLIS

At the conclusion of last month's column, I was hoping to wrap up our work on the *Star Roamer* with a quick realignment. However, I was stymied by an intermittent connection that made the set's audio cut in and out in a random and unpredictable fashion.

For those who might just have joined us, the *Star Roamer* was a Knight Kit (Allied Radio's house brand) low-end communications receiver that was a

ing through the strongest station on the dial. Figuring that the problem could very well be a weak IF channel, I broke out the alignment equipment and began to hook it up to the set.

### ANNOYING INTERMITTENTS

That's when a new problem became obvious. It was one of those annoying hair-trigger intermittents. The

blob of solder on the upper eyelet (blocking the view below it), no solder had found its way to the wire passing through the lower one. Gingerly sliding the tip of a small iron through the wire tangle, I was able to deposit a drop of solder on the connection that had gone naked all these many years, and the problem went away—or so I thought.

With the radio still playing, I began moving it into position to hook up the signal generator and AC VTVM that I use for alignment. That's when I found the second intermittent! Now I'd hear loud static whenever I tried to pick up the radio by the upper right-hand corner of the front panel.

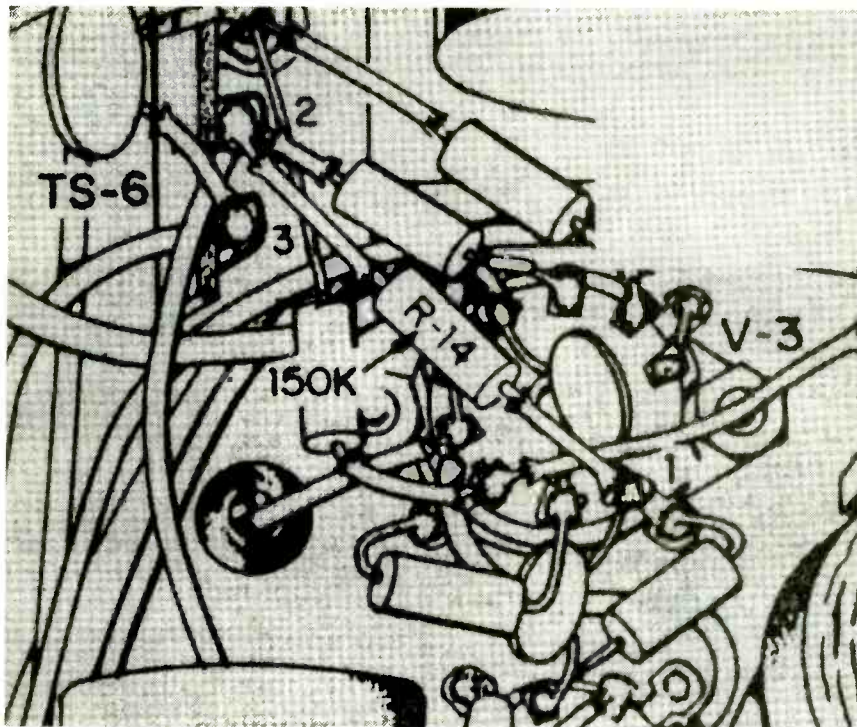
The second problem was almost as hard to find as the first because it disappeared completely when I turned the chassis upside-down. That obviously made it very tough to see where the bad wiring was. But, acting on a hunch that I had probably disturbed the wiring while searching for and repairing the first problem, I looked over the connections under the 12AX7 with a careful eye.

Sure enough, I found a couple of tube socket connections that were within a hair's-breadth of touching. No doubt I had disturbed them during my earlier explorations. Moving them a safe distance apart, I turned the chassis over again and checked for the problem. It was gone at last! Now I could get back to my realignment.

### SERIOUS TROUBLE-SHOOTING BEGINS

I connected a wire to the output terminal of the vintage Navy LM frequency meter that I use as a signal generator and wrapped the other end around the *Star Roamer's* 6BE6 converter (oscillator-mixer) tube. Tuning the LM to the set's IF frequency (455 kHz), I could hear the LM's modulated tone weakly in the speaker. Then I connected my equally vintage Ballantine AC VTVM across the speaker terminals so I could read signal strength.

Shutting off the set's AVC, as is required for alignment, I began tweak-



An annoying intermittent connection was finally discovered in the tangle of wires associated with the 12AX7 tube socket.

popular starter set for SWLs and would-be hams in the mid-1960s. Mine was rescued (in pretty good cosmetic condition) from a trash can by a friend. After changing the filter capacitors and replacing the selenium rectifier with a modern silicon unit, I tried it out—and discovered that the set would receive only on the broadcast band. Even those signals were weak, as well as distorted at higher volume.

On top of that, there was no AVC (automatic volume control) action, as evidenced by the fact that the "S"-meter remained rock-steady even when tun-

static would begin whenever the chassis was tapped, even lightly, almost anywhere on its surface. That made the trouble very difficult to localize, but I finally traced it to the tangle of wiring associated with the 12AX7 dual triode used as the first and second audio amplifier. Because the wiring for those two stages had to be crammed around the base of just one tube socket, it was quite dense and hard to check.

However, I finally found the problem in the lower eyelet hole of one of the 12AX7 socket's solder lugs. It seems as though, even though there was a large



ing the adjustments of the IF transformers while watching the meter. The adjustments seemed very sloppy and broad, and no amount of tweaking did much to increase the strength of the signal coming through the IF channel. Obviously, IF realignment, by itself, was not going to correct this problem.

Lack of AVC action, broad IF tuning, and distorted audio are classic symptoms of a bad AVC filter capacitor. To check that, I looked at the table of typical tube-pin resistance readings in the Star Roamer's construction manual. It told me that the reading from pin 7 (the control grid) of the 6BE6 converter tube to ground should be 3.4 megohms, just a little more than the value of AVC load resistor, R7 (a full-page schematic of the radio was reproduced in last month's column; space doesn't permit its inclusion this month).

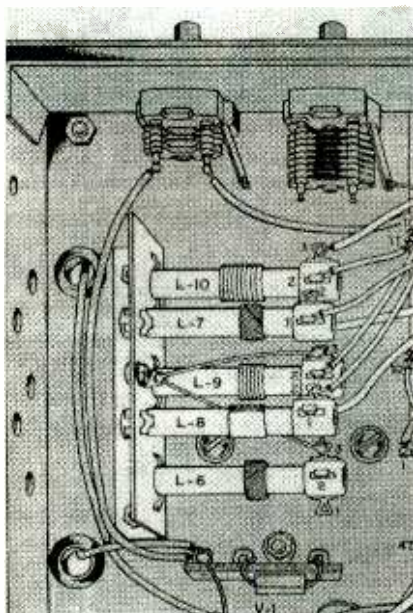
It was obvious from the schematic that if the filter capacitor (which is connected from the AVC line to ground) were leaky or shorted, that resistance value would become relatively small, or even zero. The cap is labeled C19 on the schematic shown last month. The resistance turned out to be about 200,000 ohms, so I quickly removed C19 (a 0.1- $\mu$ F, 16-volt, disc) and replaced it with an equivalent unit.

## FINAL ALIGNMENT

That brought the set to life in a very satisfying way. Signals were stronger, the sound was clean, and I could hear signals on the shortwave bands even with just a few feet of antenna wire draped around the workshop. Peaking the IF transformers once more, I found that the response was much sharper and that I was able to make a significant improvement in the sensitivity of the IF channel.

With the IF channel nicely tweaked and the set operating normally, I then went ahead and realigned the tuned circuits in the Star Roamer's front end. The realignment, which was done exactly per the specifications in the construction manual, involved adjusting the slug-tuned coils in the RF and oscillator circuits of each band for maximum response at certain test frequencies. Trimmer capacitors on the oscillator and RF sections of the main tuning capacitor also required adjustment.

In general, the RF circuits tune the set to receive the radio signal of interest. The oscillator circuits determine



The oscillator coils (L6-L10) for all five bands are mounted under the chassis, and adjusted through holes in the chassis apron.

where the signal will appear on the dial and must be adjusted accurately to obtain accurate calibration.

## TRYING OUT THE "ROAMER"

The Star Roamer covers 200 to 400 kHz and 550 kHz to 30 MHz in five bands. Listening at about 7:00 in the evening (CST), using the built-in loopstick for broadcast-band reception and a few feet of antenna wire for the long-wave and shortwave bands, I was able to detect at least some signs of activity everywhere.

On the broadcast band, I was able to hear strong local stations and some DX stations over the entire tuning range. There wasn't much to be heard on the 200- to 400-kHz band, which was to be expected given that my antenna was so short as to be nonexistent at those frequencies. Even so, I thought I could make out faint Morse signals from an automated aircraft beacon, probably a local one.

In the 1.8- to 4.8-MHz band, I could hear ham CW (Morse) signals at both 160 meters (about 1.8 MHz) and 80 meters (3.5 MHz). I also heard some typical "Donald Duck" ham sideband voice signals at 80 meters. But the Roamer's BFO (beat frequency oscillator), which worked well enough for its intended purpose of making CW signals audible, was not stable enough to provide the carrier reinsertion required

to make the sideband signals understandable.

Switching to the 4.8- to 12-MHz range, I found several very strong international broadcasters, some using English and some not, clustered around 6 MHz. Another group was heard clustered around 9.5 MHz. On the top band (12 to 30 MHz), I couldn't hear much of anything except some faint CW signals in the amateur 40-meter band (about 14 MHz).

I agree that this was not an outstanding performance. But, considering that the Roamer is a very minimal set and was operating from a very short antenna, the results establish that the radio is now operating pretty much as it was intended to do. ■

## THINK TANK

(continued from page 59)

that goes to pin 6 of IC1), reverse D2, and connect R4's free lead to the positive terminal of a 15- to 18-volt DC source that shares a ground with the rest of the circuit. Measure the voltage across the Zeners with an accurate meter, then restore the circuit to its original condition for normal operation.

—Craig Kendrick Sellen, Waymart, PA

*Keeping the Zeners in thermal contact is also a good idea to improve accuracy. Try sealing-bundling them together side-by-side in a piece of heat-shrink tubing packed with thermal grease.*

## COIN TOSSER

Shown in Fig. 7 is a CMOS coin-toss circuit that works well and can be built with a single 4011 or 4001 CMOS IC. (Note that IC pin numbers in the diagram apply for both the 4001 and 4011.) Two gates form a clock, and the others make up a bistable multivibrator.

With this circuit, it is necessary to adjust the 10,000-ohm potentiometer (R3) for a 50% duty cycle. If you don't have a scope to do this, simply measure the direct current flowing through each LED while adjusting R3. When the same current level flows through each LED, the clock will be adjusted for a 50% duty cycle.

—Craig Kendrick Sellen, Waymart, PA

*A common-cathode, three-terminal diode would be an interesting replacement for the LEDs. It would glow red or green to indicate heads or tails, glowing an eerie orange during oscillation.*

That's all we have for this month. 'Till next time, happy soldering! ■ 61

# DX LISTENING

## Answering Mail

BY DON JENSEN

Let's devote most of this month's column to your letters, starting off with something very basic.

Jerry D'Amato of San Francisco, CA, writes: "How can shortwave signals travel such great distances?"

It is a curious phenomenon, Jerry, particularly since radio signals travel in a straight line, while the earth's surface is curved. So before the electromagnetic energy goes too far from the transmitting antenna, it reaches the horizon and heads off into space.

How, then, is it possible to hear shortwave broadcasts thousands of miles away from the transmitter site? For the answer, consider a simple experiment you may have performed back in Mrs. Averback's grade-school science class. You placed a pencil in a glass of water; then viewed the glass from the side. The pencil seemed to have been broken just at the point where it entered the water. It seemed to bend off at a strange angle.

The reason, Mrs. Averback explained then, was that the light waves are affected by the different media through which they pass, in this case, ordinary air and the more dense water. The pencil really wasn't broken; it just looked that way because of the effect that these varying media have on the light waves. Like light, radio waves also are bent when they travel from one medium to a denser one.

As shortwave signals travel outward from the earth, they encounter the ionosphere, a region containing bands of gases circling the globe at altitudes of between about 50 and 200 miles. Here solar radiation causes changes in the makeup of the gases in the ionospheric belts. These changes, called ionization, alter the effective densities of these layers.

As radio waves encounter these layers on their outbound journey from



A woodcut illustration showing Tahitian drummers from a QSL card issued by Tahiti's short-wave station, RFO.

the earth, they are bent. If the ionization is great enough, the shortwave signals are bent back toward the earth at an angle equivalent to that which they entered the ionized zone.

You can think of it as reflection, although the process is really called refraction. The shortwave signals bounce back to the earth's surface, thousands of miles from their starting point, like a stone skipping off the surface of a lake.

It's not surprising that DXers call it "skip," this phenomenon that bounces the radio signal once or several times between the ionosphere and the earth's surface to make distant shortwave reception possible.

### TAHITI UPDATE

"I've been a shortwave listener for more than a dozen years, now," notes Maryanne Swift, Lexington, KY. "I used to hear Tahiti on shortwave around 11,825 kHz or so with quite good signals during the late night hours. I remember the great island music and, especially, the Tahitian drumming! But

I haven't heard the station for a long time. What happened to Tahiti?"

To be honest, Maryanne, it's been a long time since I heard the station too. There was some speculation that perhaps RFO Tahiti had left shortwave. But not long ago, DXer Terry Palmersheim visited Tahiti. He reported, via the Cumbre DX service, that the station is, for the present, alive and well on SW.

Terry says that RFO still broadcasts on shortwave, but only on 15,167 kHz and a local service medium-wave frequency of 738 kHz. Other former frequencies of 6,135 and 11,827 kHz are not in use.

The station plans to continue on shortwave until the transmitter gives out, and then it will not be repaired or replaced.

"Both medium wave and shortwave transmitters are on 24 hours, near as I could tell," Terry reported, "but the SW is really quite weak, even near the site. If they are using 20 kilowatts (of power) you couldn't convince me of that."

Still, according to reports, weak signals from RFO's 15.167 kHz transmitter have been heard on occasions in both Europe and North America. Keep trying, Maryanne.

### HARD TO UNDERSTAND

"One thing that bothers me about SW is the announcing, or rather, some of the announcers I hear," writes Tom Fenner of Rochester, NY. "They're supposed to be speaking English, but their accents are so bad they are really hard to understand."

Well, Tom, having once traveled across South America with little more to support me than my high school Spanish, I'm hesitant to criticize anyone struggling with *my* language.

But, on the other hand, shortwave stations that are making a conscious effort to reach English-speaking listeners really are fighting a losing battle when that very audience has trouble understanding the programming.

Peter Bowen recently wrote in the *North American SW Association's*

*continued on page 64*



# COMPUTER Bits

## Customize Your Greatest Hits Web Page

BY JEFF HOLTZMAN

This is part two of a series on putting HTML to practical use. Last time we showed how to create a basic "greatest hits" page that allows you to organize your favorite Web sites. This time we'll talk a little more about why such a page is useful, and then get into the nitty-gritty of how it works. Armed with this knowledge, you'll be able to customize your page.

But before we go on, let me address a concern that some of you might be having. Particularly, "why bother?" Internet Explorer (Microsoft) and Navigator (Netscape) both provide a means to mark and return to favorite Web sites. So why create an external solution? There are several reasons. One is that I use several browsers, and I need a solution that works with all of them. Another is that as the browser

wars continue, I don't want to be locked in to any one particular tool. My solution works with any browser.

### HOW IT WORKS

Refer to Listing 1 in what follows. The HTML page breaks down into ten sections. Section one (lines 1-6) provides a title for the page. This title is not displayed; rather it is what appears in the history list. It's really more the name of the page than its title.

Section two (lines 8-20) provides a table of contents for all the site groupings listed on the page. Overall, the TOC provides eight groups of sites. The first of those eight is the Delphi Sites; lines 22-43 contain the listings for the Delphi sites (we'll discuss the details later). The remaining seven sections provide placeholders for the

other seven site groupings.

Before continuing, we need to discuss Anchor Tags. Anchor tags are the most important tags in Web pages; it is anchor tags that allow the hypertext structure—the links among web pages—to be specified.

We use two kinds of anchor tags in this page. One simply labels a particular location in a document, like pinning a flag on a map. The other says to go to a new location, *i.e.*, to make the specified document the current document.

Let's look at section two, the TOC. It has a title (that does display), followed by an anchor tag and an unordered list of site groups. The page title is "My Favorite Sites." It is displayed in a style called Heading 1, or H1 for short. Squeezed in between the <H1> tag and the text of the page title

### LISTING 1—BASIC HTML FILE

```
1. <HTML>
2. <HEAD>
3. <TITLE>
4. My Favorite Sites
5. </TITLE>
6. </HEAD>
7.
8. <BODY>
9. <H1><A Name="TOP">My Favorite
Sites</H1>
10. <H2>My TOC</H2>
11. <UL>
12. <LI><A HREF="#Delphi Sites">Delphi
Site</A>
13. <LI><A HREF="#ShareWare
Sites">Shareware Site</A>
14. <LI><A HREF="#Other Sites 1">Other
Sites 1</A>
15. <LI><A HREF="#Other Sites 2">Other
Sites 2</A>
16. <LI><A HREF="#Other Sites 3">Other
Sites 3</A>
17. <LI><A HREF="#Other Sites 4">Other
Sites 4</A>
18. <LI><A HREF="#Other Sites 5">Other
Sites 5</A>
19. <LI><A HREF="#Other Sites 6">Other
Sites 6</A>
20. </UL>
21.
22. <H3><A Name="Delphi Sites">Delphi
Sites</A></H3>
23.
24. <TABLE BORDER WIDTH=50%>
25.
26. <TR>
27. <TH>Description</TH>
28. <TH>URL</TH>
29. </TR>
30. <TR>
31. <TD>Borland Developer's
Conference</TD>
32. <TD><A
HREF="http://www.dbex.com/bdc96.htm">
Borland DevCon</A></TD>
33. </TR>
34. <TR>
35. <TD>Delphi 32</TD>
36. <TD><A HREF="http://www.del-
phi32.com/">Delphi 32</A></TD>
37. </TR>
38. <TR>
39. <TD>cell 1</TD>
40. <TD>Cell 2</TD>
41. </TR>
42. </TABLE>
43. <A HREF="#TOP">Back</A>
44.
45.
46. <H3><A Name="ShareWare
Sites">ShareWare Sites</A></H3>
47. <A HREF="#TOP">Back</A>
48.
49. <H3><A Name="Other Sites 1">Other
Sites 1</A></H3>
50. <A HREF="#TOP">Back</A>
51.
52. <H3><A Name="Other Sites 2">Other
Sites 2</A></H3>
53. <A HREF="#TOP">Back</A>
54.
55. <H3><A Name="Other Sites 3">Other
Sites 3</A></H3>
56. <A HREF="#TOP">Back</A>
57.
58. <H3><A Name="Other Sites 4">Other
Sites 4</A></H3>
59. <A HREF="#TOP">Back</A>
60.
61. <H3><A Name="Other Sites 5">Other
Sites 5</A></H3>
62. <A HREF="#TOP">Back</A>
63.
64. <H3><A Name="Other Sites 6">Other
Sites 6</A></H3>
65. <A HREF="#TOP">Back</A>
66.
67. </BODY>
68. </HTML>
```

is an anchor tag, which names this location in this page. In this case, the name is simply "TOP." When viewed in a browser, that anchor tag displays nothing.

Following that is another heading style tag, followed by a list of items. It is the <UL> tag that specifies that all <LI> items until the following </UL> tag appear as bullet list items. If we had used an ordered list tag <OL>, the site groups would have been numbered in order. Each list item <LI> begins with a tag that resembles the following:

```
<A HREF="#..."> ... </A>
```

That is the other type of Anchor tag. It is a "goto" tag that specifies where the browser should pick up the next page to display. The text string between the quotation marks could specify any legal Web address. It could be a page on a site halfway across the world, or it could be a different page on the same site as our example is (hypothetically) running. Or it could be a location in the same page, which is the way we're using it.

The pound sign (#) and the text following it together are known as a bookmark. The bookmark could be preceded by a different site and page address, or, as used here, by nothing, in which case, the goto location is the same page.

As discussed so far, an anchor tag would do nothing. However, a text string between the anchor's start and end tags (where the second ellipsis (...) appears in the figure) appears as underlined text in a browser. When the user clicks on that underlined text, the browser knows that the corresponding bookmark says what to display next and does so.

The first item in the list specifies "#Delphi Sites" as the goto location. Scan down to line 22, and you'll see the actual destination specified by the bookmark-in this case, "Delphi Sites."

That's all it takes to create a hypertext jump, whether within the same Web page, or among pages separated by thousands of miles and hosted by completely different computer systems. That's the beauty of HTML.

To recap, there are two basic kinds of Anchor tags: HREF and NAME. The NAME type names the current location. The HREF type specifies a goto

location. Those are the key concepts. Understand those, and you can do quite a lot with Web pages.

## BACK LINKS

From our page TOC we have eight "outgoing" links to our eight site groups, beginning with Delphi Sites. We also have eight "incoming" links, one each from each of the eight site sections. For example, examine line 43, which displays underlined text ("Back"). When that's clicked, it causes the current page to be redisplayed literally from the top.

That's it for now. Next month we'll show how the table commands in the Delphi Sites section work. We'll also provide complete details for a page listing numerous sites of interest to **Popular Electronics** readers. ■

## DX LISTENING

*(continued from page 62)*

*Journal* about one such programming failure, Radio Prague's Economic Report.

"The host speaks with a very heavy Czech accent. In fact, his accent is so thick that it is frequently difficult to understand what he is saying. This in itself is bad enough, especially when you take into account the fact that shortwave propagation adds to the difficulties faced by listeners in comprehending what is said. But it is made even worse by the fact that his reading style is quite flat and boring.

"After a minute or so of hearing him speak, the listener's mind tends to shift elsewhere due to boredom, which in turn makes it quite difficult to concentrate on what is said....

"Of course, Radio Prague is not alone in this regard. Numerous international broadcasters use announcers with atrocious-speaking styles and accents."

To which, Richard Cuff, moderator of the *Journal* column, "Easy Listening," responded:

"Perhaps as these countries get their economies stabilized, they'll be able to enhance the speaking qualities of their on-air teams."

## VOA STILL GROWING

Al LoCicero, Jefferson City, MO, writes with word on a new Voice of America relay station under construction in the Pacific.

"The Mariana Radio Relay Station is

targeted for opening in December, 1998," says Al. "A contract was awarded last August to the Sayed Hamid Behbehani and Sons construction firm to build the new shortwave facility on the island of Tinian in the Commonwealth of the Northern Mariana Islands."

Three existing 500-kilowatt SW transmitters will be moved from a deactivated Radio Free Europe/Radio Liberty broadcasting site in Portugal. The \$20-million-plus facility will have four pairs of curtain antennas to transmit broadcasts to China, Southeast Asia, and Indonesia.

VOA programming in English, Standard Chinese, Cantonese, Khmer, Indonesian, Burmese, and Vietnamese will be relayed by the new station.

"The relay broadcast facility is being built on an 800-acre site made available to the U.S. Information Agency, the VOA's parent organization, by the Department of Defense."

## DOWN THE DIAL

Looking for some interesting shortwave listening? Try these:

**ALGERIA**—15,160 kHz. Radio Algiers International can be heard at 1800 UTC with English news, commentary, and program preview.

**AUSTRALIA**—9580 kHz. Radio Australia has English at 1030 UTC, with identification, international and business news, followed by a musical program.

**BOLIVIA**—9,625 kHz. Radio Fides has been noted through the evening hours until sign off at 0506 UTC. Programming is all in Spanish, with a disc jockey playing Bolivian rhythms and ballads, and taking phone-in requests.

**GERMANY**—15,600 kHz. Ireland's RTE Radio One is airing special programs via a transmitter owned by Deutsche Telekom in Germany. This has been heard signing on just before 1400 UTC. It identifies as "It's RTE Radio One coming to you live."

**MEXICO**—9,705 kHz. Radio Mexico International has English language news of Latin America at 0300 UTC, followed by a cultural affairs report and light music. It switches back to Spanish at 0330 UTC.

**SAO TOME**—4,750 kHz. Voice of America is relayed from this island location off the west coast of Africa. Look for it signing on at 0258 UTC with the program, Daybreak Africa, leading off with English news and a weather report. ■



# CIRCUIT CIRCUS

## Code-Practice Oscillators

BY CHARLES D. RAKES

Sitting here in front of the PC I glanced out at the early snow that covered the surrounding countryside and was reminded of a similar time back in the early '50s when the postman delivered a mysterious package to our door. Earlier in November that year Dad had secretly sent off an order to Burstein Applebee, our nearest electronic mail-order house, for a pair of deluxe code-practice oscillators. As I remember they were equipped with a built-in key, a tunable buzzer and a lamp for visual and secret code practice.

Dad was capable of copying 20 words a minute in his head while doing other things, and I was still struggling to reach the 5 WPM plateau. That prompted me to look elsewhere for someone to practice with that wasn't too familiar with the code but had an interest. The neighbor girl turned out to be the perfect neophyte for the visual code practice feature. Oh, I forgot to mention that each CPO had the code spelled out on a metal plaque so even if you didn't know "A" from "Z" you could search out each letter or number and decode a very slow-speed message.

Well you've probably guessed by now that we're going to look at some code-practice-oscillator (CPO) circuits this time around. Look them over and select one to build and use to increase your CW speed for a license upgrade or present one to a youngster who would enjoy becoming a Ham and going beyond the Tech level.

### TOUCH-OPERATED CPO

A touch-operated CPO is shown in Fig. 1. Here we have a single 4093 quad 2-input NAND-gate Schmitt-trigger, IC1, doing all of the CPO's chores. The gates of IC1-a are biased high through the two 22-megohm resistors (R1 and R2) keeping its output in the low state. Gates IC1-b and IC1-c are connected in an audio oscillator circuit that can only operate when pin 5 of IC1-b is high. The last gate of the 4093, IC1-d, adds isolation to the

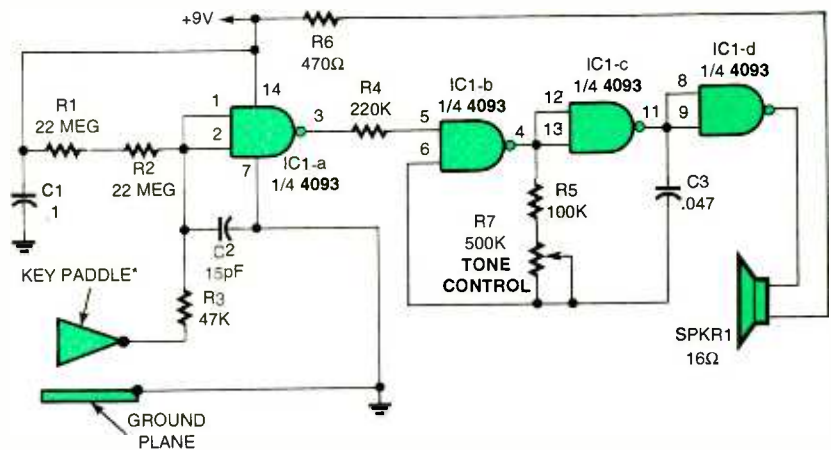


Fig. 1. Here's a touch-operated CPO that has a quad NAND-gate doing most of the work.

### PARTS LIST FOR THE TOUCH-OPERATED CPO (Fig. 1)

#### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)  
 R1, R2—22-megohm  
 R3—47,000-ohm  
 R4—220,000-ohm  
 R5—100,000-ohm  
 R6—470-ohm  
 R7—500,000-ohm potentiometer

#### CAPACITORS

C1—0.1- $\mu$ F, ceramic-disc  
 C2—15-pF, ceramic-disc  
 C3—0.047- $\mu$ F, Mylar

#### ADDITIONAL PARTS AND MATERIALS

IC1—4903 quad 2-input NAND-gate  
 Schmitt trigger, integrated circuit  
 SPKR1—16-ohm speaker  
 Paddle and ground-plane materials (see text), power source, wire, solder, etc.

oscillator's circuit and drives the speaker (SPKR1).

Touching the key paddle and ground plane lowers IC1-a's input gate voltage to near zero, allowing the output at pin 3 to go high. The tone generator then turns on and sends out an audio note.

The touch key paddle and ground plane can be made from a circuit board or any other conductible material. Note that the ground plane should lie flat for a hand rest and the key paddle should be positioned for ease of touch. Any

configuration that works best for you is the way to go.

### PLL CPO

Our second CPO (see Fig. 2) uses a 567 phase-locked loop, IC1, as the variable tone generator. The oscillator's frequency is set by R6, and the frequency range can be changed by selecting a different-value capacitor for C5. To

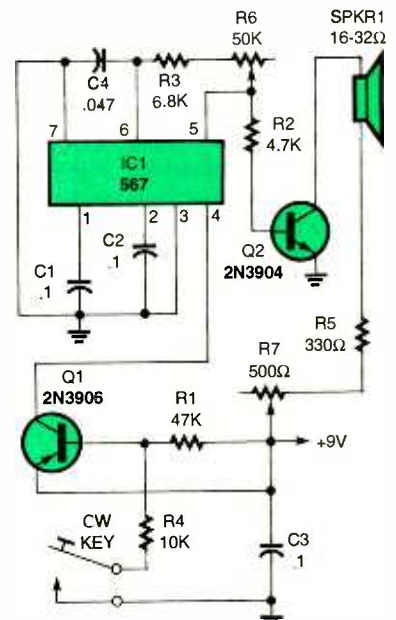


Fig. 2. This code-practice oscillator uses a 567 phase-locked loop, IC1, as its variable tone generator.

## PARTS LIST FOR THE PLL CPO (Fig. 2)

### SEMICONDUCTORS

IC1—567 phase-locked loop, integrated circuit  
 Q1—2N3906 PNP general-purpose transistor  
 Q2—2N3904 NPN general-purpose transistor

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)  
 R1—47,000-ohm  
 R2—4700-ohm  
 R3—6800-ohm  
 R4—10,000-ohm  
 R5—330-ohm  
 R6—50,000-ohm potentiometer  
 R7—500-ohm potentiometer

### ADDITIONAL PARTS AND MATERIALS

C1-C3—1- $\mu$ F, ceramic-disc capacitor  
 C4—0.047- $\mu$ F, Mylar capacitor  
 SPKR1—16- to 32-ohm speaker  
 CW key, power source, wire, solder, etc.

lower the oscillator's frequency range make the value of C5 larger, and to increase the frequency range reduce C5's value.

A general purpose 2N3906 PNP transistor, Q1, supplies power to the 567 through pin 4 each time the CW key is closed. Meanwhile, Q2, a general-purpose 2N3904 NPN transistor, buffers the oscillator's output and drives the speaker. Potentiometer R7 sets the output volume.

## WIRELESS TRANSMITTER

The next circuit, shown in Fig. 3, is a low-power, tone-modulated FM transmitter that can be used with any FM broadcast receiver for real wireless code practice. Transistor Q1 and its associated components make up a phase-shift audio-frequency generator circuit. Potentiometer R11 sets the tone frequency.

Transistor Q2 is connected in a high-frequency RF oscillator circuit that operates in the FM broadcast band. By adjusting C8 and the size of L1, the entire FM band can be covered. The audio output tone is coupled to the base of Q2 through C4, R4, and R12. Potentiometer R12 sets the modulation level. Transistor Q3 operates as a switch turning on the FM transmitter each time the CW key is closed.

Coil L1 is a home-made air-wound coil. Take a 6-1/2-inch length of 20-gauge enamel-covered wire and close-wind it around a 1/4-inch-diameter form;

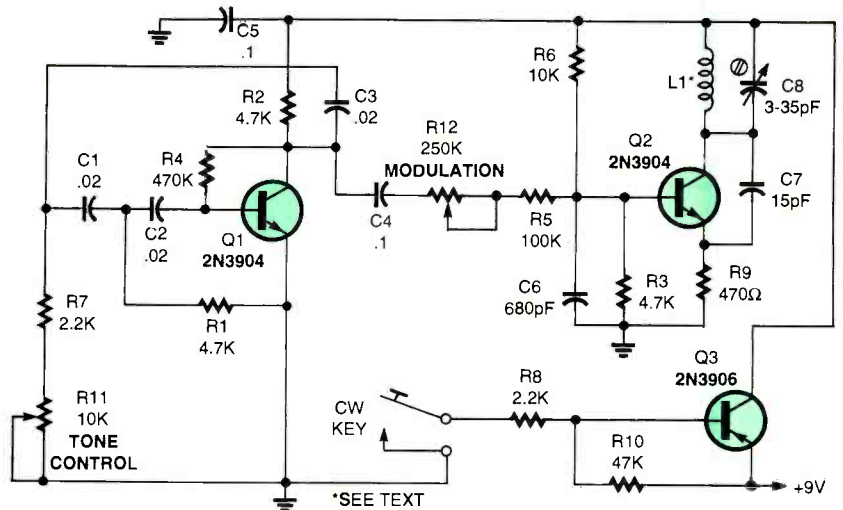


Fig. 3. This low-power, tone-modulated FM transmitter can be used with any FM broadcast receiver for real wireless code practice.

## PARTS LIST FOR THE WIRELESS TRANSMITTER (Fig. 3)

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)  
 R1-R3—4700-ohm  
 R4—470,000-ohm  
 R5—100,000-ohm  
 R6—10,000-ohm  
 R7, R8—2200-ohm  
 R9—470-ohm  
 R10—47,000-ohm  
 R11—10,000-ohm potentiometer  
 R12—250,000-ohm potentiometer

### CAPACITORS

C1-C3—0.02- $\mu$ F, Mylar  
 C4, C5—0.1- $\mu$ F, ceramic-disc  
 C6—680-pF, ceramic-disc  
 C7—15-pF, ceramic-disc  
 C8—3- to 35-pF, trimmer

### ADDITIONAL PARTS AND MATERIALS

Q1, Q2—2N3904 NPN general-purpose transistor  
 Q3—2N3906 PNP general-purpose transistor  
 L1—Coil made of 20-gauge enamel-covered copper wire (see text)  
 Power source, CW key, wire, solder, etc.

leave about 1/4-inch free at each end. Remove the insulation from the ends and slide the coil off the form. The overall length of the finished coil should be about 1/4 inch.

The circuit may be built on perforated board with all interconnecting leads kept as short as possible. Checking out the circuit is easy. Set R11 and R12 to mid position and close the CW key. Then set your FM receiver to a clear spot on the low end of the dial and slowly adjust C8. Once the tone is heard R11 may be set for the desired tone frequency and the tone level set by R12. If your oscillator won't tune to the top end of the band, carefully stretch the windings of L1 and retune. The circuit's operating range can be increased by adding a very short antenna to the emitter of Q2.

## CRYSTAL-CONTROLLED OSCILLATOR

Our next entry (see Fig. 4) takes the CPO to the ham bands via a simple

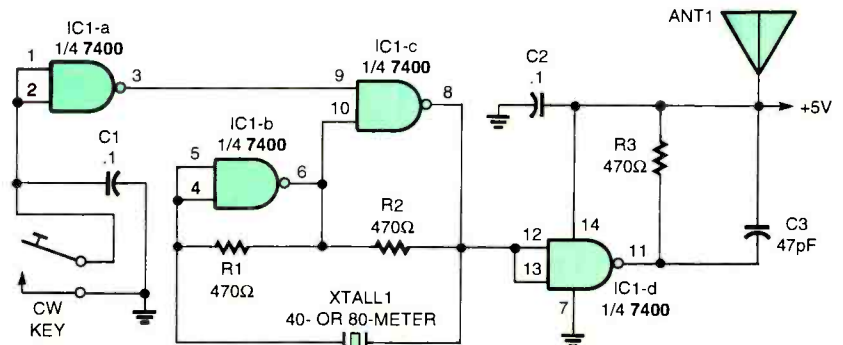


Fig. 4. Using a simple crystal-controlled oscillator, this CPO transmits on the ham bands.



## PARTS LIST FOR THE CRYSTAL-CONTROLLED OSCILLATOR (Fig. 4)

IC1—7400 TTL quad NAND gate, integrated circuit  
 R1-R3—470-ohm, 1/4-watt, 5% resistor  
 C1, C2—0.1- $\mu$ F, ceramic-disc capacitor  
 C3—47-pF, ceramic-disc capacitor  
 XTAL1—40- or 80-meter crystal  
 ANT1—Short clip lead antenna  
 CW key, power source, wire, solder, etc.

crystal-controlled oscillator. A single 7400 TTL (IC1) does it all. When the CW key is closed, IC1-a's output goes high allowing IC1-b and IC1-c to oscillate. The crystal supplies the feedback path setting the oscillator's operating frequency. The circuit will operate on the 40- and 80-meter bands.

Section IC1-d isolates the oscillator from the short antenna, ANT1. A clip lead should do here to get the signal out and about for operation.

Using this circuit couldn't be easier. Tune your ham-band receiver to the crystal's frequency and key down. If the receiver doesn't have a CW mode, turn on the BFO and tune for the desired CW tone.

## IR TRANSMITTER

Our last code-practice oscillator

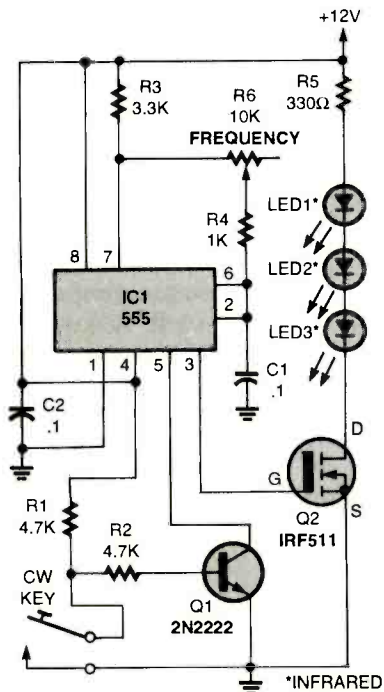


Fig. 5. Here's a CPO that transmits on IR using LED1-LED3.

## PARTS LIST FOR THE IR TRANSMITTER (Fig. 5)

### SEMICONDUCTORS

IC1—555 timer, integrated circuit  
 Q1—2N2222 NPN transistor  
 Q2—IRF511 hexFET  
 LED1-LED3—IR light-emitting diode

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)  
 R1, R2—4700-ohm  
 R3—3300-ohm  
 R4—1000-ohm  
 R5—330-ohm  
 R6—10,000-ohm potentiometer

### ADDITIONAL PARTS AND MATERIALS

C1, C2—0.1- $\mu$ F, ceramic-disc capacitor  
 CW key, power source, wire, solder, etc.

operates on IR; Fig. 5 shows the transmitter circuit. A 555 timer, IC1, is connected in an audio-oscillator circuit with its frequency set by potentiometer R6.

Transistor Q1, with the CW key up, is biased on, thereby holding pin 5 of IC1 low, and keeping it turned off. The 555 timer's output, at pin 3, ties to the gate of a power hexFET, Q2, which drives the three IR emitters, LED1-LED3.

Placing the CW key in the down position turns the 555 oscillator on. That sends out the audio tone signal via IR.

## IR RECEIVER

Take a look at the IR receiver circuit shown in Fig. 6. An IR phototransistor, Q1, is direct coupled to the input of op-amp IC1-a. The output of IC1-a is fed through the gain-control potentiometer

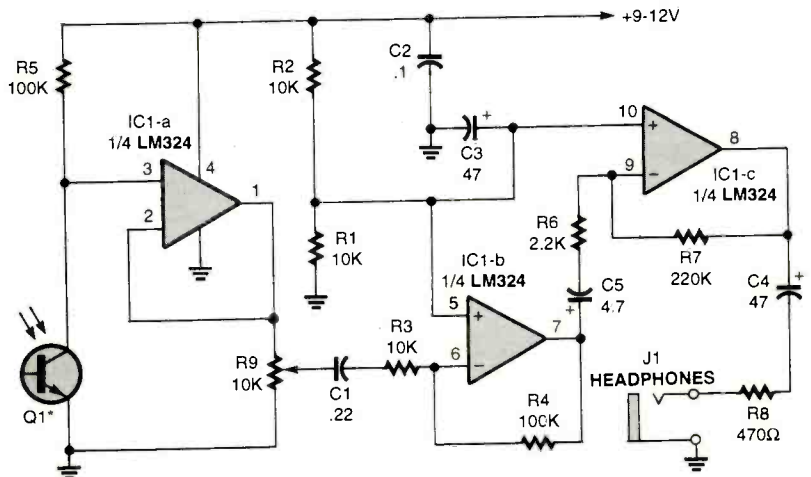


Fig. 6. This IR receiver works with the transmitter in Fig. 5.

## PARTS LIST FOR THE IR RECEIVER (Fig. 6)

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)  
 R1-R3—10,000-ohm  
 R4, R5—100,000-ohm  
 R6—2200-ohm  
 R7—220,000-ohm  
 R8—470-ohm

### CAPACITORS

C1—0.22- $\mu$ F, Mylar  
 C2—0.1- $\mu$ F, ceramic-disc  
 C3, C4—47- $\mu$ F, 25-WVDC, electrolytic  
 C5—4.7- $\mu$ F, 25-WVDC, electrolytic

### ADDITIONAL PARTS AND MATERIALS

IC1—LM324 quad op-amp, integrated circuit  
 Q1—IR NPN phototransistor (just about any IR unit will work)  
 J1—Phono jack  
 Reflector (see text), power source, wire, solder, etc.

(R9) to the input of op-amp IC1-b, which has a voltage gain of 10. Section IC1-b's output drives IC1-c, which has a voltage gain of 100. The output of IC1-c supplies audio to the headphones, via J1.

The IR LEDs from the last circuit and the IR phototransistor in this one may be mounted in reflectors to increase the CPO's operating range. Layout of either IR circuit isn't critical, so just about any assembly scheme should work.

Keep in mind that a CPO in the hands of a child can produce the spark that ignites a high-tech career and the chance for a better life. So until next month, good circuitry. ■

# HAM Radio

## A New Chip for RF Builders

BY JOSEPH J. CARR

For quite a long time RF circuit builders have known that Mini-Circuits (P.O. Box 350166, Brooklyn, NY 11235; Tel. 718-934-4500) has made reasonably priced RF components that work well. Perhaps the two most widely used Mini-Circuits components, at least in our circles, are the MAR-x series of monolithic microwave integrated circuits (MMIC), and the SBx/SRx series of doubly balanced mixers (DBM).

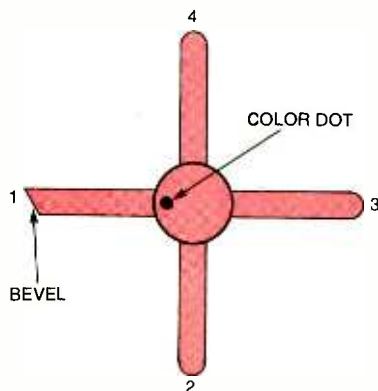
The SBx/SRx series mixers are widely available in unit quantities from dealers such as Ocean State Electronics (P.O. Box 1458, Westerly, RI 02891; Tel. 401-596-3080). One of the nice things about a DBM (as opposed to other forms of mixer) is that the DBM suppresses the local oscillator (LO) and RF signals in the output, so only the sum (LO + RF) and difference (LO - RF) signals exist (or other mixer products of higher order).

The other product is the line of MAR-x amplifiers. These MMIC devices provide gains from +8 to +20 dB, at power levels from 100 to 500 mW. Some of the MAR-x (the "x" is the specific type number for a particular member of the series) offer low noise figures (2.8 dB), while others offer higher power. Some operate from near-DC to 1,000 MHz, and others from near-DC to 2,000 MHz.

These amplifiers have a relatively constant input and output impedance over the entire frequency range. If impedance matching is necessary, use simple transformers to do the job rather than L-C matching networks. The standard input and output impedances are 50 ohms; impedance matching is not needed in most cases (50 ohms is the "standard" system impedance for RF circuits, except video where 75 ohms is used).

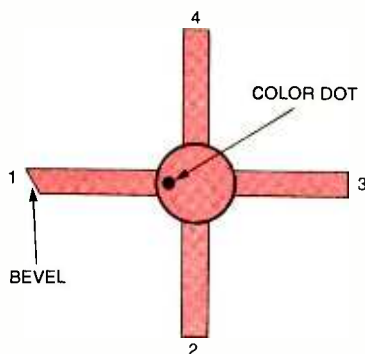
### THE ERA AMPLIFIERS

Mini-Circuits has continued the tradition of constant-impedance MMIC chips with the new ERA-x series devices. While the concept is similar to the MAR-x series, the specifications are quite exciting. The application circuitry is just



MAR-x DEVICES

A



ERA-x DEVICES

B

Fig. 1. Here are the packages of the MAR-x (A) and ERA-x (B) compared.

as simple as that of the MAR-x (indeed, it looks the same!).

The ERA-x devices are Gallium-Arsenide (GaAs) technology, which accounts for their frequency range. Some of the devices operate over the range near-DC to 3,000 MHz, while others operate from near-DC to either 4,000, 6,000, or 8,000 MHz. The "near-

Type No.	-1 dBComp (dBm)	NF (dB)	IP3 (dBm)
ERA-1	13	7	+26
ERA-2	14	6	+27
ERA-3	11	4.5	+23
ERA-4	19.1	5.2	+36
ERA-5	19.6	4	+36

DC" can be "DC," except for the fact that the input and output terminals are coupled to the external circuitry through capacitors. The low-end frequency limit is determined by these capacitors.

Table 1 shows the gain and operating frequencies for these devices. In each case, the type number shown is for the standard package. For surface-mount packaging add "SM" to the type number (e.g. ERA-1 is the standard drop-in packaging, while ERA-1SM is the same amplifier in surface mount packaging). Note that there are some minor gain differences between ERA-x and ERA-xSM in some cases.

Table 2 shows some of the other important parameters of the ERA series GaAs MMIC amplifiers. The noise figure gives us a measure of the amount of noise that is added to the system by the amplifier (nothing is noise-free). The lower the number the better the noise contribution. The noise figures shown in Table 2 are quite good, although for under 1,000 MHz, the 2.8-dB noise figure of the MAR-6 device by the same company is a better selection.

The power output is measured in dBm at the -1-dB compression point. A "dBm" is power decibels relative to 1 mW, or 10 LOG (PMW/1 MW).

The -1 dB compression point tells us something of the dynamic range of the device, as well as the maximum power available. It is measured in dBm also. The -1 dB compression point is the input level at which the gain drops off -1 dB from the nominal gain. If you graph power output vs. power input, the line is a straight line for whatever gain is achieved, up to the point where the amplifier begins to saturate. When that point is reached, the gain begins to drop a little. When the gain PO/Pin has

TABLE 1

Type No.	Frequency Range (MHz)	Gain (dB)
ERA-1	8,000	11.6
ERA-2	6,000	14.9
ERA-3	3,000	20.2
ERA-4	4,000	13.9
ERA-5	4,000	19.0



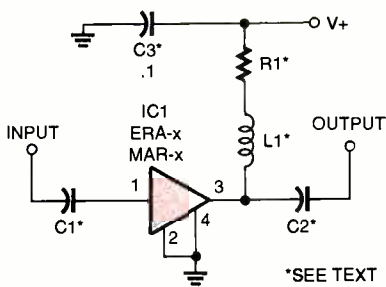


Fig. 2. This operating circuit can be used with MAR-x and ERA-x amplifiers. See text for component values.

dropped -1 dB from the linear region, we have the Pin value that is the -1 dB compression for that amplifier.

The other dynamic range measure is the third-order intercept point, also called TOIP or the IP3 point. If you graph PO vs. Pin, then you will note that the gain for harmonics generated in the amplifier increases more rapidly than the gain for the regular signal. At some point, usually above the -1-dB compression point, the gain for regular signals and the gain for harmonics generated will cross. The input signal power level (dBm) at which this occurs is the IP3 rating.

In larger quantities (e.g. ten each) the prices of these amplifiers are as low as \$1.80 and as high as \$4.15, depending on type number. Dealers will charge considerably more, but that is the price of buying small quantities. Mini-Circuits will accept credit-card orders, but may have a minimum order.

Mini-Circuits has several kits available for those who would like to experiment with all of the ERA-x devices. These kits include the K1-ERA for \$49.95 (ten each of ERA-1, -2, and -3) and the K2-ERA for \$69.95 (ten each of ERA-4 and -5). The surface-mount-version prices are the same; those kit numbers are K1-ERASM and K2-ERASM.

Figure 1 shows the package of the more familiar MAR-x devices, along with that of the ERA-x devices. The body of the MMIC devices is about the same size, but the leads on the ERA-x devices are shorter than the MAR-x series. Both of them have four leads: input, output, and two grounds (the use of two grounds is necessary at these frequencies. Pin no. 1 (input) is identified on both MAR-x and ERA-x by a dot and the fact that the end of the lead is beveled. In the case of the MAR-x

devices the type number is indicated by the color of the color dot, but on ERA-x devices all of the dots are red.

TABLE 3

FMIN (MHz)	C1,C2
1	0.1 μF
10	0.01 μF
100	1000 pF (0.001 μF)
500	100 pF
1,000	10 pF

### TYPICAL CIRCUIT

The standard circuit for the ERA-x devices is similar to that of the MAR-x, and is shown in Fig. 2. There are two grounds (neither optional, both are required). The input and output terminals are blocked for DC by capacitors C1 and C2. The values of C1 and C2 determine the minimum operating frequency. Values to 0.1 μF are used for low-frequency work, but if higher bands are being contemplated, then use the recommended values in Table 3.

These values are not absolute. Experiment with other values, if you please, but don't stray too far from these values (e.g. more than a 2:1 ratio).

The ERA-x devices want to see +5-volts DC applied through a resistor and an optional RF choke between pin 3 and ground. The devices draw 80 mA (0.080 A). From these bits of information you can calculate the value of resistance for R1. For example, if you use a 78L08 regulator, it produces a regulated +8-volt DC output. R1 is:

$$R1 = ((V+) - V)/I = (8-5)/0.080 = 3/0.080 = 37.5 \text{ ohms}$$

For practical reasons select a standard-value of 39 ohms for R1.

The RF choke is optional, and is used more as a peaking coil to smooth out gain variations as frequency increases. Typical values to try for starters are 100 μH from 1 to 10 MHz, 10 μH from 10 to 30 or so MHz, 1 μH to 100 MHz, and values between 0.01 and 1 μH above 100 MHz. For high VHF, UHF up to the top end of the response range, the "RF choke" is typically a ferrite bead slipped over a piece of 22-gauge solid hook-up wire.

The ERA-x and MAR-x series of chips makes designing wideband RF amplifiers a "game for all," even well into the microwaves.

I can be reached by snail mail at P.O. Box 1099, Falls Church, VA, 22041, or by e-mail at carrjj@aol.com.

## SCANNER SCENE

(continued from page 27)

### A.T.F.

Of all the vital federal agencies that always seem to be in the news, few have missions that equal the edge-of-the-seat, white-knuckle excitement of the U.S. Treasury's Bureau of Alcohol, Tobacco, and Firearms.

Based upon our compilation of information submitted by a number of readers, we have assembled a tentative listing of frequencies reported or presumed to be used by the ATF. You may have others, or see errors here. Your corrections are invited.

Bases and repeaters are found on 165.2875, 165.925, 166.5375, and 166.925 MHz. Local offices use 165.35 MHz. Car-to-car conversations can be heard on 165.9125, 166.85, 168.00, and 173.8875 MHz.

For surveillance, try 165.2875, 165.5125, 166.2875, 170.4125 MHz. The Organized Crime Task Force uses 164.55 and 168.8625 MHz. Treasury Common uses 165.4875, 166.4375, 166.4625, 414.80, and 414.90 MHz.

### TOO MUCH?

Alex Pressman, of Dallas, Texas, has a problem that is not at all uncommon. He wanted to increase the coverage of his scanner as much as possible to help with weak signals. So he added an in-line signal preamplifier that could boost incoming signals by as much as 20 dB. A good idea. But now Alex complains that his scanner keeps detecting and locking up on all sorts of "images and especially digital paging signals."

Whoa, Alex! Most scanner preamps have a variable gain control, and it sounds like you are running yours at full blast. You are obviously overloading the front end of your scanner with so many powerful local signals that it's having indigestion. Back down on that preamplifier's gain control and you'll see those unwanted images vanish, leaving just the stations you wanted to monitor in the first place.

Scanner owners in large metropolitan areas are more prone to that type of signal overload than folks who use scanners out in the boonies where local transmitters aren't quite so plentiful. Radiopaging transmitters operating in the 152-MHz band appear to be a prime culprit when it comes to interference complaints along these lines.

## ELECTRIC-VEHICLE BATTERIES

(Continued from page 41)

electric rates are offered by utility companies.

**Inductive Charging.** General Motors is using its Delco Magne Inductive Charger System, which transfers electricity using a magnetic field rather than metal-to-metal contact. The user inserts a lightweight, weatherproof plastic paddle, called an inductive coupler, into the vehicle's charge port. The coupler consists of copper secondary windings around a ferrite core encased in thick, non-conductive plastic. The Charge port is a "take apart" transformer consisting of the ferrite transformer core and the copper primary winding. After being transferred inductively at high frequencies (80–350 kHz) between the charger and charger port, the system rectifies the incoming AC power to DC power for battery recharging. High frequencies plus high voltages up to 260 volts means small physical size of components and cables for power

levels from 1.5 to 25 kW.

Like conductive systems, the inductive system could be installed just about anywhere there is source of electrical energy, including homes and offices. The microcomputer-controlled Magne Charge has the flexibility to interface with virtually any battery technology or configuration, and to any EV equipped with the Magne Charge charge port.

A bi-directional communications link uses close-coupled radio frequencies (915 MHz) for system monitoring, control, and built-in diagnostics. The link can be used for other functions such as communicating with the utility company for remote monitoring, automatic billing, control of load management, and reporting power-usage patterns.

According to GM, inductive coupling is safer because there is no direct metal-to-metal contact. This eliminates the possibility of electrical shock even under very wet conditions. Also, it stays cool during charging, does not need a heavy and bulky cable, and is easier to complete the connection. The system is designed so that the in-

ductive coupler cannot induce circulating currents in nearby objects, like jewelry, heating them to produce skin burns.

Finally, in some communities, zoning and building codes may have to be modified to allow charging facilities. New health, safety, fire, and rescue procedures and educational programs will have to be developed. Parking spaces will have to be dedicated for EV recharging in public and private parking lots. Also, trained technicians and special tools will be needed to service electric vehicles and charging facilities.

But despite all the steps that have to still be taken, the EVs are out there. How long will it be before you say goodbye to gasoline too? ■

**GIVE THE POWER  
TO BECOME.**



Buy One Get One

**50%**  
off!



Explore the Caribbean  
on a 6 or 13 day  
sailing adventure.

Call your travel agent or  
**1-800-327-2601**  
<http://www.windjammer.com>

 **Windjammer**  
Barefoot Cruises, Inc.

P.O. Box 190120, Dept. 5568,  
Miami Beach, FL 33139-0120

June - mid Dec. sailings only. Restrictions apply.

Have you ever given a gift  
so wonderful,  
someone carries it with them  
the rest of their life?

Please give blood.  
There's a life to be saved right now.

Call 1-800 GIVE LIFE

**Ad**  
Council



American Red Cross



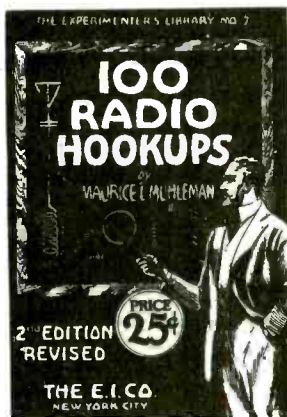
# Market Center™

## Paperback Books

GREAT BOOKS AT BUDGET PRICES

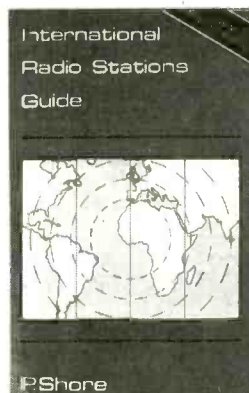
**100 RADIO HOOKUPS**  
—#7—\$3.00

First published in May, 1923 this popular booklet went into reprint editions nine times. It is packed with circuits, theory, antenna installation and tips on consumer radio receivers that were popular in the early 1920's. Antique radio buffs and those inquisitive about the early days of radio will find this booklet an exciting, invaluable and excellent reference into the minds of early-day radio listeners. Sorry, we cannot honor the original 25-cent cover price.



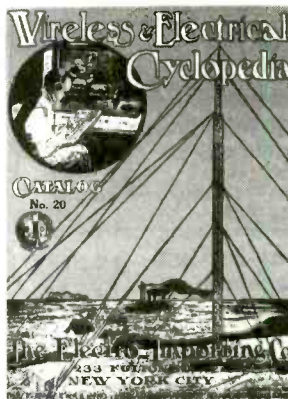
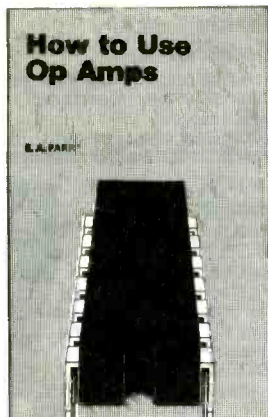
**INTERNATIONAL RADIO STATIONS GUIDE—BP255**  
—\$9.95

Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed as a guide for listening to the complex radio bands. Includes coverage on Listening to Shortwave Radio, ITU Country Codes, Worldwide Radio Stations, European Long Wave and Medium Wave Stations, Broadcasts in English and more.



**HOW TO USE OP AMPS**  
—BP88—\$5.95

The engineer's best friend is the op amp. This basic building block is found in many circuits, analog and digital alike. The op amp finds many useful purposes such as: oscillators, inverters, isolators, high- and low-filters, notch and band-pass filters, noise generator, power supplies, audio, MIDI, and much more. Prepared as a designer's guide, some limited math is used, however engineers and hobbyists alike find it a useful text for their design needs.



**WIRELESS & ELECTRICAL CYCLOPEDIA**  
—ETT1—\$5.75

A slice of history. This early electronics catalog was issued in 1918. It consists of 176 pages that document the early history of electricity, radio and electronics. It was the "bible" of the electrical experimenter of the period. Take a look at history and see how far we have come. And by the way, don't try to order any of the radio parts and receivers shown, it's very unlikely that it will be available.

**ELECTRONIC TECHNOLOGY TODAY INC.**  
P.O. BOX 240, Massapequa, NY 11762-0240

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**SHIPPING CHARGES IN USA AND CANADA**

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

**SORRY No orders accepted outside of USA & Canada**

Number of books ordered

Total price of merchandise .....	\$ _____
Shipping (see chart) .....	\$ _____
<b>Subtotal</b> .....	\$ _____
Sales Tax (NYS only) .....	\$ _____
<b>Total Enclosed</b> .....	\$ _____

**All payments must be in U.S. funds!**

ET01



# AMAZING ELECTRONIC & SCIENTIFIC DEVICES

Lasers, Tesla, Ions, Anti-Gravity, Magnetics & More!

Plans • Ready-to-Use • Easy-to-Build Kits

**Laser Ray Gun**  
Handheld, battery operated. Produces an intense burst of light capable of burning holes.  
LAGUN2 Plans ..... \$20.00  
LAGUN2K Kit / Plans ..... Price on Req



**250KV Tesla Coil**  
10-14" of Explosive Bolts of Lightning!  
• Transmit Wireless Energy  
• Ion Motors  
• Anti-Gravity  
• Strange and bizarre pyrotechnical effects  
• Many other experiments shown in detail  
• Award winning science project!

BTC3 Plans ..... \$15.00  
BTC3K Kit/Plans with coil ..... \$299.50  
BTC30 Assbl'd Ready to Use ..... \$399.50  
BTC4 Plans, 500KV unit ..... \$20.00



**ATTENTION: Experimenters & Researchers!**  
Anti-Gravity, Rail & Coil Guns, Mass Warping, Levitation Research, Exploding Water, Propulsion Drivers, Lattice Snapping, EMP etc. Loss-less Energy Charger with triggered spark switch. • Adjustable 500 to 3KV out  
• Charges up to 25KJ • Programmable Output  
HEP1 Plans ..... \$15.00  
HEP1K Kit/Plans with 500J ..... \$399.50  
HEP10 Lab Assembled - to your spec's. Write, call or fax for price & delivery



HEP10 ..... shown connected to potential rail gun system

**Visible Beam Gas Lasers**  
Millions degree temp equiv. Illuminates low level clouds  
• Light Shows  
• Window Listener  
• Optical Projects  
• 12/115V  
• Science Project

LAS1KM 1 mw, low cost Kit ..... \$69.50  
LGU6K 2-3mw Kit ..... \$119.50  
HNE70 5-7mw, ready to use ..... \$299.50




**Gravity Generator**  
Levitate an object!  
Great science fair project!

GRA1 Plans ..... \$15.00  
GRA1K Power Supply Kit/Plans .. \$99.50  
GRA10 Assbl'd Kit/Plans ..... \$149.50  
Includes text book on Anti-Gravity theory!



**Solid State Tesla Coil**

• Generate fiery electrical plasma discharge  
• Powers light and objects without contact  
• Experiment with electrical and mechanical fields. TCL5 Plans ..... \$8.00  
TCL5K Kit/Plans 12VDC ..... \$49.50



**Pioneer a Futuristic Weapon!**  
Electric Gun - prototype designed in our lab - Join the research!  
• Ballistic Velocities  
• Handheld • Battery Operated  
• Labelled as DANGEROUS Product  
Experiment now before it is classified as a firearm! EGUN1 Plans ..... \$20.00  
(Must be 21 for purchase of hardware)




**Ion Ray Gun**  
Project Energy!  
Star Wars technology demonstrates weapons potential. IOG7K Kit/Plans \$99.50




**4000 Volts 10ma High Voltage Module** - Ready to use - for many projects from hoverboards to pyrotechnics.  
MINMAX4 While they last! ..... \$19.50

**"Talking" Plasma Globe**  
Spectacular color. Pulsates to music, sounds! 8-9", with intensity and sound controls. PLASMA1 Ready to Use .. \$79.50




**Electronic Hypnotizer** *Caution Required*  
Control their minds! Programmable audible and visual stimuli induces hypnotic trances. HYP2K Kit with Book ..... \$39.95  
EH2 Hypnosis Book & Plans ..... \$14.95



**We can design and build high voltage systems - to your specs!**  
Call or fax us with your requirements!

## TACTICAL ELECTRONICS

**Cybernetic Ear!**  
Enhances normal hearing 3-4 times!  
Adjustable volume control, fits easily into either ear. Many, many uses.  
Ready to Use!  
CYBEREAR .... \$19.95



**ALL NEW Telephone Line Grabber/Infinity Transmitter**  
Use tone phone anywhere in the world to:  
• Monitor your premises - avoid break-ins  
• Access ongoing calls - longwinded kids  
• Control up to 8 appliances in your home!  
• Re-direct costly toll calls from pay phones!

TELCON3 Plans (credit to purch) .. \$ 10.00  
TELCON3K Plans/Kit ..... \$99.50  
TELCON30 Ready to Use ..... \$149.50



**Long Range "Ultra-Ear"** Parabolic Mic can hear a distant whisper! BUG Mother Nature!  
20" dish uses satellite technology to capture distant sounds. PM5 Plans ..... \$ 8.00  
PM5K Kit/Plans ..... \$149.50

• Optional Wireless Retrofit transmits captured sounds to an FM radio.  
WM5K Kit for Wireless Option .... \$29.50



**Phasor Sonic Blast Pistol**  
Rids areas of unwanted pests. Trains and conditions wild and domestic animals. Great for barns, attics, cellars, gardens.  
PPPIK Kit/Plans ..... \$39.50



**3 Mi Telephone Xmitter**  
• Tune-able 80-130 Mhz • Undetectable  
• Only transmits when phone is used  
VWPM7K Kit/Plans ..... \$39.50

**3 Mi Voice Transmitter**  
• Ultra-Sensitive Mike  
• Crystal Clear  
• Uses 80-130 MHz.  
FMV1K Kit/Plans ..... \$39.50



**FireBall Gun**  
Shoots flaming ball - two shot capacity. Great for special effects and remote fire starting! CAUTION REQUIRED!  
FIREBALL Plans (dangerous product) \$10.00



**Shocker Force Field/Vehicle Electrifier**  
Make hand and shock balls, shock wands and electrify objects. Great payoff for those wiseguys!  
SHK1K Easy to Assemble Kit ..... \$19.50



**Extended Play Telephone Taping System**  
• Tapes Phone Conversation • Extends Tape X4 • Check Local Laws before using!  
TAP30X Ready to Use ..... \$84.50



**"Drop-In" (Imi) Telephone Transmitter**  
Easily tunable over FM radio. Never needs battery! #DROPIK Kit/Plans ..... \$ 19.95




**See In Total DARKNESS!**  
• High Quality IR Night Vision  
Scope with IR illuminator.  
SD10 Ready to Use ..... \$199.50



**Electric Charge Gun**  
Life Is Precious - PROTECT IT!  
Stuns & immobilizes attackers 15 feet away! Check your state laws for legality. More knockdown power than most handguns. No permanent injury. ID coded. ECG1 Data  
(Creditable to purch) ..... \$10.00  
ECG10 Charge Gun, Ready to Use, includes FREE Stun Gun! ..... \$249.50  
STUN GUNS - sold separately:  
STUN100 100,000 Volts ..... \$34.50  
STUN200 200,000 Volts ..... \$49.50



**3 Mi Tracker Transmitter**  
• Tunable Output  
• Uses FM Radio  
• Excellent Signal Beacon  
HOD1K Kit/Plans ..... \$39.50



**MIND CONTROL!**  
Places subjects under your control. Programmable audible & visual stimuli with biofeedback. Induces strange & bizarre hallucinations without drugs. Caution - not FDA approved.  
MIND2 Plans ..... \$15.00  
MIND2K Kit and Plans ..... \$49.50  
MIND20 Assembled Unit ..... \$69.50



**FANTASTIC BRIGHTNESS!**  
High Quality Laser Pointer  
LAPN64 15mw equiv, 2000' ..... \$39.50  
LAPN61 50mw equiv, 4000' ..... \$84.50



**Window Bounce Laser Listener**  
Aim at window and listen to sounds from reflected light. CAUTION - Not for illegal use. LWB3 Plans ..... \$10.00  
LWB3K Kit/Plans (req's vid tripod) ..... \$149.50



**1000' Potato Cannon**  
Not a Toy! Uses electronic or piezo ignition. CAUTION REQUIRED!  
POT1 Plans (dangerous product) ... \$10.00



**VISIT US ON THE WEB!**  
<http://www.amazing1.com>

**INFORMATION UNLIMITED**

Dept PEM-7, Box 716, Amherst, NH 03031  
Phone: 603-673-4730 FAX: 603-672-5406  
MC, VISA, COD, Checks accepted Please add \$5.00 S & H

**CATALOG!**  
FREE with Order or send \$1 P&H

24 Hour Phone  
**800-221-1705**  
Orders Only Please!

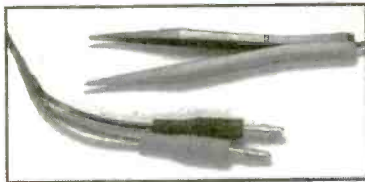


# TENMA®

## Test Accessories

Whether you're servicing in the lab or in the field, your success depends as much on your choice of test accessories as it does on the accuracy of your instruments. That's why professionals all over the world put their trust in Tenma. From test equipment to test accessories, Tenma products offer the performance and dependability professionals demand.

The new line of Tenma test accessories comply with IEC1010 international standards and are designed with the safety of the user in mind. So whether its design or repair, rely on Tenma to get the job done.

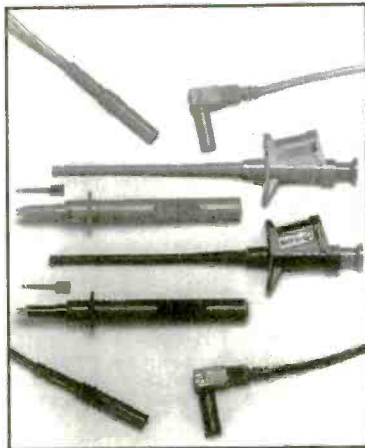


### SMD Surface Mount Tweezer Set

#76-001 ..... Reg. \$16.95

SALE

**\$14<sup>95</sup>**

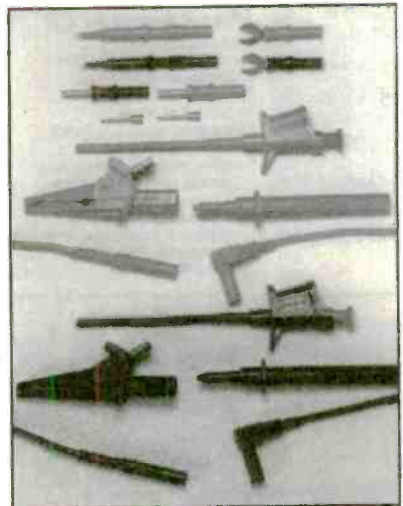


### Basic Test Accessory Kit

#76-081 ..... Reg. \$27

SALE

**\$19<sup>95</sup>**



### Deluxe Test Accessory Kit

#76-032 ..... Reg. \$53

SALE

**\$39<sup>95</sup>**

**Announcing!**  
MCM Electronics is now  
ISO9002 Certified.



Certificate No. RS#35690

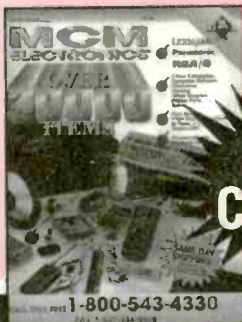
To get these discounts,  
you must supply this code:

**POP39**

### Same Day Shipping!

In stock orders received by 5:00p.m. (YOUR TIME), are shipped the same day from distribution centers near Reno, NV and Dayton, OH.

Prices effective from February 17,  
through March 29, 1997



**FREE  
Catalog**

1-800-543-4330

Authorized  
**Panasonic**  
*Quasar/Technics*  
Original Parts Distributor

**RCA**   
Premier  
Distributor

To order or receive a FREE catalog, Call...

**1-800-543-4330**

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

**CODE:POP39**



# ALFA ELECTRONICS

HIGH QUALITY TEST EQUIPMENT  
BEST PRICE



## DMM 89 \$179.00 Most Advanced DMM

-80.7 to 81.4 dBm with 4Ω-1200Ω  
20 reference impedances  
True RMS  
Frequency counter: 100 Hz - 10MHz  
Capacitance: 5nF-50mF  
Measure AC volt to 20kHz  
5000 counts, 0.1% basic accuracy  
Auto/manual range, fast bar graph  
Min/Max/Ave/DH/Relative/Zoom  
Auto power off  
Input warning  
Splash proof  
Volt, amp, ohm, logic, diode, continuity  
Ruggedized case  
Rubber holster included



## DMM A91 \$49.95 NOW \$39.00 Plus Free Case Solar Cell Powered Large Display

Diode, Continuity  
Volt, Amp, Ohm  
Data Hold  
Auto power off  
7 functions, 19 ranges  
3.5 Digit, 0.6% accuracy  
Auto/Manual ranging  
Energy saver  
Student & hobbyist's favor



## DMM 20 \$74.95

Inductance: 2mH-20H  
Capacitance: 2nF-200μF  
Resistance: 200-200MΩ  
Frequency: 2kHz-20MHz  
3.5 Digit, 0.5% accuracy  
DC/AC Current and Volts  
Transistor hFE, diode test  
Continuity, Duty %  
Peak hold/Max  
Ruggedized case  
Rubber holster \$8.00

Full line of DMMs,  
economy, compact,  
ruggedized, solar cell,  
automotive, heavy duty,  
industrial, electrical  
starts from \$19.95

Fluke Multimeter  
Fluke 12 \$84.95  
Holster C-10 10  
Fluke 73 II \$75.95  
Fluke 73 II \$97.50  
Fluke 75 II \$129  
Holster C70 \$16  
Fluke 77 II \$155  
Fluke 79 II \$175  
Fluke 29 II \$175  
Fluke 76 \$175  
Fluke 87 \$287  
Fluke 867 \$1199  
Scope Meter  
Fluke 97 \$1785  
Fluke 105 \$2799



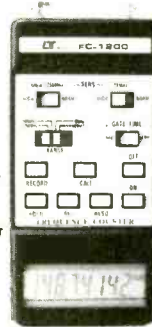
## LCR Meter 131D \$229.95

Most Advanced LCR  
Dual display: L/Q or C/D  
Inductance: 10mH-10,000H  
Capacitance: 10nF-10mF  
Resistance: 10Ω-10MΩ  
Auto/manual range  
Dissipation factor & Q factor  
Serial & parallel mode  
Relative mode for comparison  
and to remove parasitics  
Statistics, tolerance,  
Best for design, incoming  
testing & production  
SMD and chip component  
test probe \$25.00



## LCR Meter 814 \$189.95

Best Resolution LCR  
Inductance: 200μH-200H  
Capacitance: 20pF-20,000μF  
Resistance: 2Ω-20MΩ  
Resolution of 0.1μF, 0.1pF, and  
1mΩ are useful for high frequency  
and SMD  
Dissipation factor indicates leakage  
in capacitor and Q factor in inductor  
Zero adjustment to reduce parasitics  
Best for high frequency RF  
SMD and chip component test probe  
\$25.00  
Padded deluxe case \$6.00

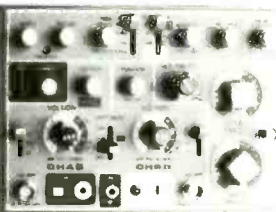


## Frequency Counter FC-1200 \$129.95

Frequency: 10Hz-1.25GHz  
Display: 8 digit LCD  
Period: 0.1μs-0.1s  
Records Max/Min/Average  
Data hold, relative mode  
Telescoping antenna \$8.00  
Deluxe case \$5.00

### Also Available:

AC/DC clamp meter, Light meter,  
Thermometer, pH meter, High voltage  
Probe, Digital Caliper, Anemometer,  
Electronic scale, Force Gauge,  
Tachometer, Stroboscope, Humidity  
& EMF adapter, Sound level meter,  
Frequency counter, SWR/field  
strength/power meter, Dip meter



## 20 MHz Oscilloscope with Delay Sweep PS-205 \$429.95

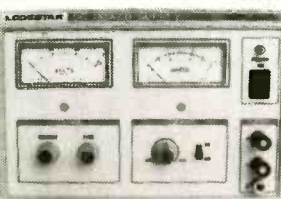
Dual Trace, Component test, 6" CRT, X-Y Operation, TV Sync, Z-Modulation, CH2 Output, Graticule Illum, 2 probes each has x1, x10 switch. Best price with delay sweep.  
PS-200 20 MHz DUAL TRACE \$339.95  
PS-400 40 MHz DUAL TRACE \$494.95  
PS-405 40 MHz DELAY SWEEP \$589.95  
PS-805 80 MHz DELAY SWEEP \$789.95  
PS-1000 100 MHz DUAL TRACE \$999.95  
Scope Probe: 60MHz x1, x10 \$15, 100MHz x1, x10 \$22, 250MHz x1, x10 \$28, 250MHz x100 \$39

## Digital Storage Scope

DS-303 30MHz, 20M Sample/sec \$849.95

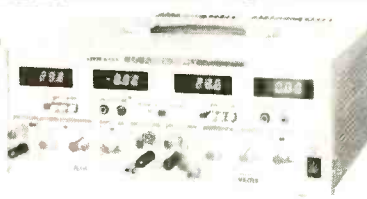
DS-303P w/ RS-232 interface \$1,049.95

Switchable between digital and analog modes  
2 K word per channel storage  
8 bit vertical resolution (25 Levels/div)  
Expanded Timebase 10ms/div - 0.5 s/div  
Refresh, Roll, Save all, Save CH2, Pre-Trig  
Plotter control



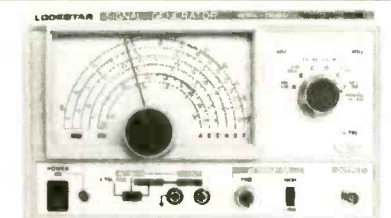
## DC Power Supply PS-303 \$159.00

0-30 VDC, 0-3A output  
Constant voltage & constant current mode  
0.02% + 2mV line regulation  
0.02% + 3mV load regulation  
1 mVrms noise and ripple  
Short circuit and overload protected  
PS-8200 with digital voltmeter \$179.00  
Also available: 30V/5A, 60V/3A, 60V/5A  
16V/10A, 30V/10A



## DC Power Supply Triple Output PS-8202 \$499.95

Two 0-30 VDC, 0-3A outputs  
One fixed 5VDC, 3A output  
Capable of independent or tracking operation  
Constant voltage and constant current mode  
Four digital meters for volt and current display  
Excellent regulation and low ripple  
Short circuit and overload protected  
Also available: 30V/5A, triple output \$549.95  
Dual tracking 30V/3A, 30V/5A, 60V/3A, 60V/5A



## RF Signal Generator SG-4160B \$124.95

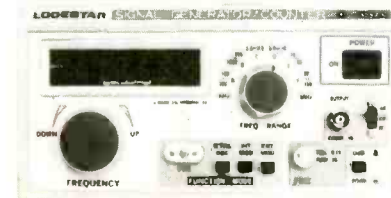
100 kHz-150MHz sinewave in 6 ranges  
RF Output 100mVrms to 35 MHz  
Internal 1kHz, External 50Hz-20kHz  
AM modulation  
Audio output 1 kHz, 1 Vrms  
Output Impedance: 50 Ohm  
Size: 5.9"H x 9.8"W x 8.1"D

## Audio Generator AG-2801A \$124.95

10Hz - 1MHz in 5 ranges  
Sine/square/triangle/pulse/ramp  
Output: 0-8Vrms sinewave  
0-10Vp-p squarewave  
Synchronization: ±3% of oscillation frequency per Vrms  
Output distortion:  
0.05% 500Hz - 50kHz  
0.5% 50Hz - 500kHz  
Output impedance: 600 ohm

## Function Generator FG-2100A \$169.95

0.2 Hz - 2 MHz in 7 ranges  
Sine/square/triangle/pulse/ramp  
Output: 5mV-20Vp-p  
1% distortion, DC offset + 10V  
VCF: 0-10V control freq. to 1000:1



## RF Signal Generator Counter SG-4162AD \$229.95

Generates RF signal same as SG-4160B  
6 digit frequency counter 1Hz - 150 MHz for internal and external source Sensitivity <50mV

## Audio Generator/Counter AG-2603AD \$229.95

Generates audio signal same as AG-2801A  
6 digit frequency counter 10Hz - 150MHz for internal and external sources Sensitivity <50mV

## Function Gen./Counter FG-2102AD \$229.95

Generates signal same as FG-2100A  
Frequency counter 4 digits  
Feature TTL and CMOS output  
Sweep Function Gen./Counter \$329.95  
0.5Hz to 5 MHz in 7 ranges  
Sweep: Linear 10:1/Log 10:1 20ms-2s  
AM Modulation  
Gated Burst, Voltage Control Gen.  
Generator Control Voltage & 6 digit counter 1Hz-10MHz for internal & external sources

# ALFA ELECTRONICS

P.O. BOX 8089, Princeton, NJ 08543-8089

(800) 526-2532/(609) 897-1135

FAX: (609) 897-0206

Visa, Master Card, American Express, COD, Purchase Order Welcome

1 YEAR PARTS AND LABOR WARRANTY

CALL / WRITE / FAX FOR FREE CATALOG

CIRCLE 26 ON FREE INFORMATION CARD



# EPROM+ PROGRAMMING SYSTEM USES PARALLEL PORT

**EPROMS** (24,28,32 & 40 PIN+)+27C AND 25XX  
1702\*,2708,TMS2716\*,32,32A,64,64A,128,128A  
256,512,513,011,010,101,1001,1000,1024,210,020  
2001,220,204R,4001/2,040,080,240,4096,68764/66  
**FLASH EPROMS** 28F256, 28F512, 28F010  
28F020,29C257,29C010,29C040,29F010,29F040  
**EEPROMS & NVRAMS** (18,24 & 28 PIN+CXX)  
2210, 2212, 2804, 2816, 2816A, 2817, 2864, 2865  
28256, 28C010, DS1220, DS1225, DS1230  
**SERIAL EEPROMS\*** (8 & 14 PIN PLUS CXX)  
E1400,M58657, 2401,02,04,08,16,32,65, 2444  
59C11,80011A,9306,46,56,66,8572,82,92,168/9XX  
**BIPOLAR PROMS\*** (16 THROUGH 24 PINS)  
74SXXX AND 82SXXX FAMILY  
**MICROCONTROLLERS\*** 8741, 42, 48, 49, 8751  
C51, 52, C52, 87C5XXX, 87C75X, 89C5X, 68705  
68HC705, 68HC11E9, PIC16CXX, TMS7742  
\*ADAPTER REQUIRED - DIAGRAMS INCLUDED

**SOFTWARE** READ,VERIFY,PROGRAM,COPY  
DISK FILE LOAD/SAVE, CHECKSUM, FULL  
SCREEN BUFFER EDITOR W/20 COMMANDS  
**READS** HEX, S-RECORD AND BINARY FILES  
**FAST-DEVICES** PROGRAM IN UNDER 20 SEC  
**RUGGED** (9"X6"X3")ENCLOSURE W/HANDLE  
**MADE IN USA - 1 YEAR WARRANTY**

**ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150**  
(513) 831-9708 FAX (513) 831-7562



**SYSTEM INCLUDES:**  
PROGRAMMING UNIT  
PRINTER PORT CABLE  
POWER PACK, MANUAL  
AND SOFTWARE.

## \$289

ADD \$5.00 SHIPPING  
\$5.00 C.O.D.  
VISA/MASTERCARD

## The Pocket Programmer

**\$129.95**



The portable programmer that uses the printer port of your PC instead of an internal card.

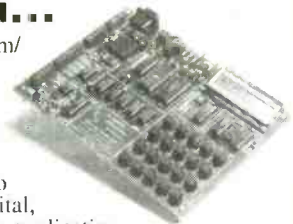
Easy to use software that programs E(E)prom, Flash & Dallas Ram. 27(C)/28(C)(F)/29(C)(F)/25 series from 16K to 8 Megabit with a 32 pin socket. Adapters available for MCU's 874X, 875X, Pic, 40-Pin X 16 & Serial Eprom's, PLCC, 5-Gang and Eprom Emulator to 32K X 8.

**Same Name, Address & Phone # for 13 Years.... Isn't it Amazing ?**

**Intronics, Inc.**  
**Box 13723 / 612 Newton St.**  
**Edwardsville, KS 66113** Add \$4.75 COD  
**Tel. (913) 422-2094** Add \$4.00 Shipping  
**Fax (913) 441-1623** Visa / Master Charge

# 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

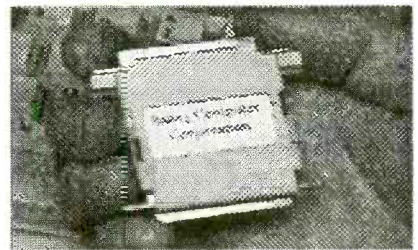
Call for Free Info Pack, or see  
WEB at <http://www.aesmicro.com>  
714-550-8094, FAX 714-550-9941



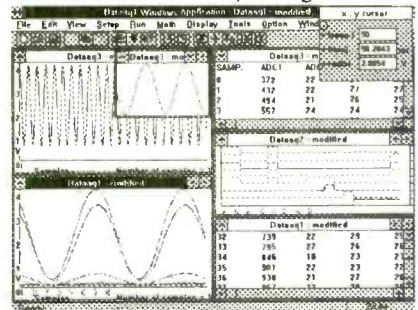
AES 970 W. 17TH STREET, SANTA ANA, CA 92706, USA

**Call 1-800-730-3232**

## PORTABLE DATA ACQUISITION FOR WINDOWS



- NO External Pwr Required, Uses Parallel Port
- 8 Analog Inputs, 8 Dig, 6 Dig Out
- Fully Featured Analysis S/W Included
- 10 Bit or 12 Bit Versions, Starting at \$99.95



**Base2 Computer Corp.**

P.O. Box 950, Pasadena, CA 91102

818-583-5525

<http://www.loop.com/~base2>

## 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 MICROLV	795 CHROMA SIMM/SIP
650 EETOOLS ALLMAX +	359 MOD-MCT-EMUPAIR
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 1 MEG
165 XELTEK ROMMASTER II	89 EPROM 1G TO 8MEG
479 MOD-MCT-EMUPA	129 EPROM 4G TO 8MEG
739 STAG ORBIT-32	250 EPROM 8G TO 8MEG



LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

## General Device Instruments

Sales 408-241-7376 Fax 241-6375 BBS 983-1234

Web [www.generaldevice.com](http://www.generaldevice.com) E-Mail [icdevice@best.com](mailto:icdevice@best.com)

## Be a computer repair expert!

Accredited, career-level home study course. You'll learn all about repairing, troubleshooting, installing, servicing, and upgrading PCs. Increase your value as an employee or open your own business. Send or call 24 hours a day for free career literature.



**Call 800-223-4542**

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_ Phone (\_\_\_\_) \_\_\_\_\_

City/State \_\_\_\_\_ Zip \_\_\_\_\_

## The School of PC Repair

6065 Roswell Road, PCDI  
Dept. JJE341, Atlanta, Georgia 30328

PC PLACE

April 1997, Popular Electronics

# WORLD'S SMALLEST

## Wireless Video Transmitters

Used by hundreds of hobbyists and professionals alike in R/C models, Robots, Surveillance Video, movie Special Effects, and Law Enforcement.

"... previously, I used expensive wireless units from Pelco, MVP, and Supercircuits. Nothing approaches the VidLinks in power, picture quality, size, and value. Thank you." *R. Leslie, CCTV Installer, NY.*  
"The best... Incredible color, resolution... very easy to use... cool." *P. Davis, Movie Props, CA.*

**Actual Size!!!**



## Live Remote Video From \$99.00

- Full 100 mW RF Power. Range 500ft. to 1/2mile •
- Crystal Controlled •
- High-Resolution Full Color/ B&W video •
- Fully epoxy encased- no exposed components •
- Fully assembled- only two wires to attach •
- MONEY BACK GUARANTEE. •

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>



# CABLE TV Converters & Descramblers

Compatible with  
**Jerrold, Scientific Atlanta,  
Pioneer, Oak, & Hamlin  
Equipment**

**BRAND NEW!**

**6-MONTH GUARANTEE**

**LOWEST PRICES**

*Volume Control & Parental Lockout Available*

**Greenleaf Electronics**

**1-800-742-2567**

**NO ILLINOIS SALES**

It is not the intent of Greenleaf Electronics to defraud any pay television operator and we will not assist any company or individual in doing the same.

## TRIDENT



**\$699<sup>00</sup>**

SV150

**1000KHz to 1.00GHz  
Spectrum Analyzer System  
Up to 500MHz Span. Two bands.**

All the advantages of a Spectrum Analyzer at a very affordable price. Great for interference and signal hunting. RS232 connect for logging signals to disk. Real time display sweep outputs on any X,Y scope. Variable span and sweep rate. Marker function and selectable bandwidth. Demods in AM/NFM/WFM plus BFO for CW/SSB modes. For instant information use our fax back service at 317 849 8683, #405. Or, email Scanns@www.acecomms.com . <http://www.acecomms.com/Scanns>.



**Order Line: 1 888 445 7717**

10707 E. 106th, Fishers, IN 46038 International: 317 842 7115

Fax 317 849 8794 Email: Scanns@www.acecomms.com

CIRCLE 25 ON FREE INFORMATION CARD



# DALBANI

UNIQUE REALTIME  
OSCILLOSCOPE  
BUILT-IN FUNCTION  
GENERATOR



Manuf # OS-9020G  
20MHz  
2-CH  
DUAL TRACE

Order N° 50-820



1 MHz FUNCTION  
GENERATOR

**Features**

• Wider than specified frequency response • High deflection factor of 1mV/div. • Wide dynamic range up to 30MHz without waveform distortion • Algebraic sum of CH1 and CH2 • Low drift with compensation circuit • Superb trigger sensitivity • Maximum sweep rate of video signals with internal TV sync. separator • Jitless trigger circuitry • CH1 signal output terminal available • Variable trigger hold-off • High precision X-Y phase difference measurement up to 50kHz • Built-in function generator with BNC output of 50Ω and TTL • Three kinds of waveform are available with 50Ω output • Flat output waveform frequency up to 1MHz

**Specifications:**

**Vertical deflection:** • Bandwidth :DC coupled (DC to 20MHz normal), AC coupled :(10Hz to 20MHz normal) • Deflection factor: 5mV/div to 5V/div in 10 calibrated steps of 1-2-5 sequence • Rise time: 17.5nS or less  
**Horizontal deflection:** • Time Base A: 0.2µs to 0.2S/div in 19 calibrated steps. 1-2-5 sequence • Uncalibrated continuous control between steps of at least 1: 2.5.



CALL TOLL FREE  
1-800-325-2264

**\$20 MINIMUM ORDER  
CALL NOW FOR YOUR  
232 PAGE FREE CATALOG  
1-800-325-2264**

**CODE PE96  
PLEASE MENTION  
WHEN ORDERING**

Items are subject to availability.  
Prices are subject to change without  
any prior notice.

**FLYBACK  
TRANSFORMERS**



Replaces  
GOLDSTAR 154-074R  
ORDER N° 63-0189

**\$12.50**

**HOT PRICES ON POPULAR SEMI'S**

Order N°	Brand	Min	Price
BU-208	TESLA	10	\$1.49
BU-208/O	TOSHIBA	1	4.50
2N-3055	TESLA	10	0.60
2N-3773	TESLA	5	1.20
2SD-1398	SANYO	10	1.49
2SD-1650	SANYO	5	1.69
STRD-1005	SANKEN	1	4.15
STR-30130	SANKEN	1	2.66
STRS-6301	SANKEN	1	8.50
TA-7777N	TOSHIBA	1	8.96
TDA-2005	SGS	5	1.49



**COLOR CODED  
LEADS HEAVY DUTY  
ORDER N° 56-500**

- 11" Long Wire Lead
- Insulated 1 1/2" Alligator Clips
- 20 Gauge Wire Size • 10 Leads
- BLACK, GREEN, RED, YELLOW, WHITE

**\$2.82**



**SOLDER WICK**

- Solder Remover
- Length 5 Feet

**85c**



ORDER N° 51-1050

Min. 2 pcs.

**TUN-O-WASH®  
ORDER N° 30-0100**

**\$7.50**

(CFC Free)

**Fast drying electronics  
grade cleaner for tuners,  
controls and PC boards.**

TUN-O-WASH is excellent cleaner and degreaser for tuners, controllers and PC boards.

- Designed for cleaning and degreasing consumer electronics • Cleans in one step, no rinsing required • Contains no ozone depleting compounds • CFC and HCFC free
- Not for use on energized equipment
- 12.5 Oz aerosol (12 cans per case)



**VCR ALIGNMENT TOOL KIT  
ORDER # 50-888**

The most popular

**\$24.99**

- VCR Head puller
- Retaining ring remover
- Spring hook
- Micro screwdriver
- Hex key set • Fitted vinyl • Soft zippered case
- Dimensions: 9 1/2"(W) X 12 1/4"(L)
- 7 Assorted head & guide aligners
- 3 Reverseable screwdrivers (Small-Flat-Philips)



**DIGITAL MULTIMETERS  
NEW! Digital**

- Overload protect 1000VDC or peak AC on all other ranges
- Input impedance 10M Ohm on all ranges • Base accuracy range ± 0.5 % to ± 1.0 % • Resistance 200Ω, 2K, 20K, 200K, 2M, 20M
- Audible continuity response lower than 50Ω • DC Voltage 200mV, 2V, 20V, 200V, 1000V AC Voltage 200mV, 2V, 20V, 200V, 200V, 700V

ORDER N° 50-815

**DALCO**



**\$19.95**

**LOGIC Probe**

ORDER N° 51-1015

- Length: 8 inches
- Range: 4.5 To 15 VDC
- Includes Test Leads • Compatible With TTL, DTL, RTL, HTL, CMOS, NMOS Logic

**\$8.99**

**SOLDER ROLL**

- 1 LB Spool
- 370 deg F melting point
- Fastest solder
- Alloy 60/40, tin lead, non corrosive flux, Diam. 1.2mm

ORDER N° 51-1005

**\$3.95**



**TEMPERATURE CONTROLLED  
SOLDERING STATION**

- Adjustable Temp.: 300°F - 790°F - 150°C - 480°C
- Grounded Tip for Soldering: Static Sensitive Devices, Heater Aid.
- Led Power Temperature Indicator
- Overheat Protection W/ Temperature Control
- Auxiliary Grounded Terminal
- Comes in digital LED display
- 48 Watts soldering iron

ORDER N° 51-1035

**\$64.00**



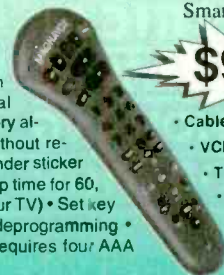
**Universal Audio/video Remote  
ORDER N° 82-1055**

• Controls basic functions of TV, VCR, cable box, and CD or laser player • Ergonomic design! Main buttons are in line with natural thumb motion • Two-minute memory allows time to replace batteries without re-programming • Programming reminder sticker inside battery compartment • Sleep time for 60, 30, or 15 minutes (according to your TV) • Set key recessed to prevent accidental deprogramming • Spanish Instruction included. • Requires four AAA Batteries (not included)

**MAGNAVOX  
Smart. Very smart**

**\$9.95**

- Cable (11 brands)
- VCR (68 brands)
- TV (77 brands)
- Compact disc and Laser Disc (94 brands)

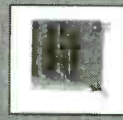




# CONTROL MEASURE INPUT

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 SMP/SEC

MODEL 45 ..... \$189



- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 ..... \$279



- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 60 ..... \$179



- 8 2-AMP RELAYS
- 16 DIGITAL I/O
- 1 8-BIT ANALOG INPUT

MODEL 40 ..... \$99



- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT
- OPTIONAL 12 BIT A/D

MODEL 70 ..... \$239



- RS-232 INTERFACE
- 18 BIT A/D
- 8.5 DIGIT
- UP TO 60 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 47 ON FREE INFORMATION CARD

**AT LAST! DC-20 MHz SYNTHESIZED PERFORMANCE FOR ONLY \$795!**

- DC-20 MHz, .1 Hz resolution, DC offset
- Linear/Log Sweep
- Internal/External AM
- Internal/External FM
- Internal/External PM
- Internal/External SSB
- Internal/External BPSK
- Dualtone Generation
- Internal/External FSK
- Burst
- DTMF Generation
- DTMF Detection
- Power Level Measure

**\$795**

**Arbitrary Waveform  
Generation Now  
Available!**



The SG-100 gives you clean, .1 Hz synthesized precision and a wide diversity of modulation functions all of which can be performed using an internally generated or externally applied signal. You also get signal analysis functions that are just not offered on any other signal source such as DTMF Detection and Power Level Measurement. And because you can download new instrument functions to Flash memory, you can ensure that your SG-100 will never become obsolete.

Call, email, or fax us for your free information kit. Visit us on the web for specs and applications.

**Telulex Inc.**



**C.O.D.**

**P.O.**

2455 Middlefield Way S, Mountain View, Ca. 94043  
Fax: (415) 938-0241 <http://www.telulex.com>

email: [sales@telulex.com](mailto:sales@telulex.com)

(415) 938-0240

CIRCLE 143 ON FREE INFORMATION CARD

## ATTENTION CABLE VIEWERS

CABLE VIEWERS...get back to your **BASIC** Cable Needs

**Call 800-577-8775**

For information regarding all of your **BASIC** cable needs.

- 5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT
- ❖ PRICE
  - ❖ EFFICIENT SALES AND SERVICE
  - ❖ WE SPECIALIZE IN 5, 10 LOT PRICING
  - ❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)
  - ❖ ANY SIZE ORDER FILLED WITH SAME DAY SHIPPING

We handle **NEW** equipment **ONLY** - Don't trust last year's **OBSOLETE** and **UNSOLD** stock!  
**COMPETITIVE PRICING—DEALERS WELCOME**

**HOURS: Monday-Saturday 9-5 C.S.T.**

It is not the intent of B.E.S.W. to defraud any pay television operator as we will not assist any company or individual in doing the same.  
\*Refer to sales personnel for specifications.

**BASIC  
ELECTRICAL  
SUPPLY &  
WAREHOUSING  
CORPORATION**

**P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775**



## 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, comomo 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

NOT  
FOUND IN  
BOOKSTORES!

## CONSUMERTRONICS

P.O. Drawer 537 Alamogordo, NM 88311

ORDER TODAY! 505-439-1776

Fax: 505-434-0234 (ORDERS ONLY)

Top Secret Homepage: users.aol.com/wlzguru/hl-tech.html

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 \$6.

## STOPPING POWER METERS

As reported on "60 MINUTES"! How devices can slow down (even stop) watt-hour meters - while loads draw full power! Device plugs into one outlet and normal loads into other outlets. Describes meter creep, overload droop, etc. Plans!

**THE I.G. MANUAL:** External magnetic ways (applied to meter) to slow down and stop power meters while drawing full loads. Plans. \$25.

**HW-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

Lozens 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.

## HACKING ANSWERING MACHINES

All the known ways answering machines are hacked to listen to and erase messages, end to convert them into mini-VMBS. Plus countermeasures - protect yourself from hackers/thieves! \$29.

## PHREAKING CALLER ID & ANI

Details on how they work and dozens of effective ways of defeating Caller ID, ANI, '69, '57, Call Blocking, '67 etc. Also describes Caller ID, Orange, Beige, Cheese & CF Boxes, ESS, S57, E-911, various Class services, CN/A, Non Pub DA, CAMA, DNR, 800-ECR, Diverters, LD Extenders, Centrex - much more! \$29.

## CELLULAR AND CORDLESS MODS

So explosive we can't even tell you what it's about! See our Catalog for our infamous cellphone mod guide - detailed, comprehensive, covers most makes - 10 times more info than any competitors' manual!

## THE HACKER FILES

Compilation of 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! \$49.

## MIND CONTROL

Fear increases over EM and ultrasonic mind control technologies especially implants! Many more lies published than facts. Secret agents are often used for reporting back to covert organizations. Learn shocking truth about this-bizarre phenomenal \$39.

## UNDER ATTACK!

Electromagnetic weapon attacks cause cancer, birth defects, and profound psychological and neurological disorders! This manual includes actual cases of EM attacks (we investigated)! Includes how to tell if you are under an EM attack, and specific countermeasures. Much more! Shocking! \$29.

## BY AN ORDER OF THE MAGNITUDE

The most comprehensive, hard-hitting, hi-tech survival book ever written! Topics include electronic, computer, comomo, chemistry, weaponry, cryptography, energy, concealment, revenge, alarm, disguise & ID change. Designs, tactics & strategies to survive an increasingly dangerous and brutal world. Field-expedient use of technology in various threat and conflict environments and scenarios. \$49.

## THE ULTIMATE SUCCESS MANUAL

How to lie, cheat, steal, influence, and intimidate your way to success! Underpaid? Overworked? Harassed? Manipulated? Forget job performance. This manual outlines what it really takes to make it to the top in today's corporate BS world! \$19.

## INTERNET CONS & SCAMS

Net cons and related frauds now rake in \$2+Billion annually! Most are done with little fear of prosecution. Detailed, + countermeasures.

## INTERNET TRACKING & TRACING

The Net is infected with spammers, stalkers, scammers, infectors, and other wrongdoers who hide behind its anonymity. Learn how to trace them down in this comprehensive, eye-popping manual!

## COMPUTER PHREAKING

Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS, etc are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary FLUSHOT+ protection system. Internet advice, password defeats, glossary - much more! Manual + PC Disk!

## BEYOND VAN ECK PHREAKING

Eavesdropping on TV and computer video signals using an ordinary TV described in detail. Includes security industry reports. Range up to 1 KM. Plans include both the Consumertronics and the original Top Secret Van Eck designs!

## CREDIT CARD SCAMS

Completely describes every known means of credit card fraud and scams, + countermeasures. Protect yourself!

## OTHER EXCITING TITLES!

### CONS & SCAMS \$34

Most comprehensive manual on C&S available! Details 100s, their many variations, and countermeasures!

### STEALTH TECHNOLOGY \$29

Every known police radar error - stealth method and material used to minimize radar and laser reflections - tactic and strategy to fight speeding tickets!

### THE PLACAK REPORT \$39

How to read and decrypt the magnetic flux-reversals on popular credit and debit card magnetic stripes. How to determine the decrypted PIN, PAN, bank number, dates, number of uses remaining. No hard work needed!

### HIGH VOLTAGE DEVICES \$29

Many HV device plans: Stun Gun, Taser, Prod, Cane, Flasher, Blastec, 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.

### ROCKET'S RED GLARE \$29

The most definite and comprehensive source on solid-propellant survival and amateur rocketry! Many plans!

### FREE! \$19

How you can get FREE money, jobs, land, housing, meals, medical care, equipment, merchandise, much more!

### POLYGRAPH DEFEATS \$29

How anyone can tell "the truth" to a "lie detector". Many proven methods to beat the test, and what to avoid.

# SHOCKING!

ALL-NEW TOP SECRET CATALOG. FEATURES 200+ SURVIVAL PRODUCTS! WILL BLOW YOUR MIND! MAIL \$3, OR \$1 WITH ORDER!

ORDER TODAY!!



# EARN MORE MONEY!

## Be an FCC LICENSED ELECTRONIC TECHNICIAN!



No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial 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. 240

### COMMAND PRODUCTIONS

FCC LICENSE TRAINING, Dept. 240  
P.O. Box 2824, San Francisco, CA 94126  
Please rush FREE details immediately!

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

## CABLE BOX EXPRESS

CALL 1-888-561-4796

FOR ALL YOUR CABLE TV NEEDS

### GET THE COMPLETE PICTURE

ORIGINAL EQUIPMENT

TEST ACTIVATORS

FILTERS (97,106,108,110)

REPLACEMENTS FOR ALL SYSTEMS

HAVE MAKE AND MODEL NUMBER READY!



GUARANTEED LOW PRICE!

\*\*SAME DAY SHIPPING\*\*

CALL NOW 1-888-561-4796


1 YEAR WARRANTY ON ALL PRODUCTS

VOID WHERE PROHIBITED

Anyone implying theft will be denied assistance



**Are you overpaying . . .**  
. . . your cable company?

**You are if . . .**   
. . . you are leasing their equipment.

- Forest Electronics, Inc. offers a complete line of New Cable Decoders and Converters that are fully Compatible with your cable system.
- All systems come with: Remote Control, & Parental Guidance Feature. Volume Control is also available.
- All Equipment is fully guaranteed & comes with a 30 day money back option.

For More Information Call Us 24 Hours a Day At:

**800-332-1996**

FAX: 813-376-7801



# 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 64 Page  
CATALOG.  
Outside the U.S.A.  
send \$2.00 postage.



## PC MOUNT POWER RELAY 24 Vdc

Potter & Brumfield # T90N5D12-24  
24 Vdc, 675 ohm coil. SPDT con-  
tacts rated 20 amps (N.O.), 10 amps (N.C.) @  
240 Vac. 1.15" X 0.09" X 0.65". PC terminals.  
UL and CSA listed.

CAT# RLY-55 **\$2<sup>00</sup>**  
each

10 for \$18.50 • 100 for \$150.00

## SPECIAL PRICE! TWIST ON F-56 CONNECTOR

We recently made a large  
purchase of this twist-on co-ax  
connector for RG-6 cable.  
Special pricing while  
the supply lasts.



CAT #FTO-56R

100 for \$15.00  
500 for \$50.00  
1000 for \$70.00

## S-VHS VIDEO CORD



4' cable with miniature 4 pin mini  
DIN plugs on both ends.

CAT# CB-363

**\$3<sup>00</sup>**  
each

10 for \$25.00  
100 for \$150.00

## "HI-8" VIDEO CASSETTE (USED)

SONY HI-8  
Top quality, metal  
particle 120 minute video  
cassettes. Used for a short  
time, then bulk-erased.  
Each cassette has its own  
plastic storage box.  
Satisfaction Guaranteed.



**\$3<sup>00</sup>**  
each

CAT # VCU-8

10 for \$28.00 • 100 for \$250.00

## THE INSULTINATOR A Programmable Electronic Insult Machine with Thousands of Sayings

"You're A Completely  
Slobbering Greasy  
Dweeb!"

"You're a totally ugly  
gross boring nerd!"

"You're A Totally Freaky  
Wacky Bonehead!"



Hand-held voice synthesizer  
plays a variety of insults  
which can be altered by selecting  
various programming buttons. Even though no  
profanity is used, a major nationwide retailer  
rejected these as being too insulting for their  
customers. Wild green and black case with belt  
or pocket clip. Includes 3 AA batteries.  
Attractive display package.

CAT# INS-5 **\$4<sup>95</sup>**  
each

case of 24 - \$4.50 each

## POWERFUL NEODYMIUM, RARE EARTH MAGNETS

Approx. 1.86" X 1.02" X  
0.08" thick.



CAT# MAG-26

**\$1<sup>50</sup>**  
each

25 for \$31.25  
100 for \$100.00

## RECHARGEABLE SEALED LEAD ACID BATTERIES

6 Volts 7 A/h  
Yuasa # NP7-6  
5.95" X 1.3" X 3.7".  
0.1875" qc connectors



**\$15<sup>00</sup>**  
each

CAT# GC-67

## SECURITY ALERT SIGNALLING SYSTEM

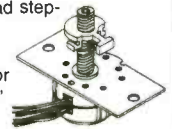
Designed for the traveler to hang  
on the inside of a hotel door,  
the Datawave KL-1 Security  
Alert emits loud beeps and  
flashing lights when someone  
knocks or if someone tampers  
with the door. Ideal for hearing  
impaired, the four high-  
brightness LEDs are easy to  
see from far away. Can be  
switched for audible alarm with  
lights or lights only. Requires  
3 AA batteries (not included).



CAT # KL-1 **\$9<sup>50</sup>**  
each

## SMALL STEPPER MOTOR

Unipolar, two phase, 6 lead step-  
per motor. 53 ohm coil.  
Operates well on 12 Vdc.  
15 degree per step. Motor  
body is 1" diameter X 0.5"  
0.08" (2mm) diameter  
shaft is 0.365" long. The shaft is covered with  
a threaded plastic sheath (0.25" dia X 0.75"  
long) which acts as a worm gear. This mech-  
anism, is not required, is easily removable.  
Rectangular mounting bracket, 1.73" X 1.10".



**\$1<sup>50</sup>**  
each

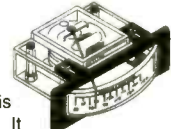
CAT# SMT-21

10 for \$12.50

## EDGEVIEW PANEL METER FS=1 MICROAMP

Mura

Beautifully constructed  
edgeview meter move-  
ment. 2.75" X 0.8"  
face. Scale is labeled  
"BEATS/MINUTE" and is  
calibrated from 50-150. It  
can be easily removed or reversed to create  
a blank scale. The black bezel is 3.53" X  
1.33" and can be adjusted or removed. 0.1"  
thick clear plexiglass case. Maximum case  
size behind mounting plane: 2.75" X 1.18"  
X 2.18". Solder lug terminals.



CAT # MET-47

**\$5<sup>50</sup>**  
each

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](mailto: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.



# RS-232 Networkable Devices

Only 2 Wires are Required to Operate Most NCD Devices from a Single RS-232 Serial Port.

Call NCD for a Free Catalog at our Missouri Office: (417) 646-2044



DISPLAY INCLUDED

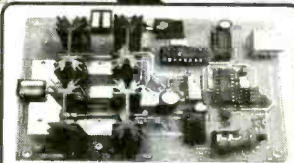
**NEW:** RS-232 programmable 240x64 Graphic Display Module. Upload your BMP/GIF Image Files at 9600/19200 Baud. Complete Support for 30x8 and 40x8 Text. Documentation and QBasic Software Gets You Running FAST!!! Counts as 2 Devices on the NCD RS-232 Network. Combine up to 8 GDSPs on a Single Serial Line. GDSP Intro: \$279. Fully equipped: \$349.

Includes Drivers in QBasic. Mac & Amiga Software Also Supported.

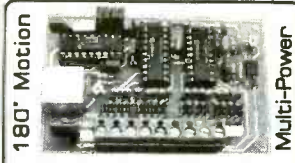
**RS-232** Combine 16 Devices in ANY Combination to Your RS-232 Port

**National Control Devices**  
 Contact Ryan Sheldon  
 Phone: (404) 244-2432  
 FAX: (417) 646-8302  
 Include \$5 Shipping.  
 Visa/MC Accepted.

NCD, Box 384, Osceola, MO 64776



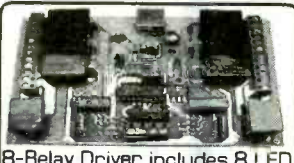
**High-Power DC Motor Controller:** 9-12 Volt Operation for Motors Up to 4 Amps. Forward/Reverse 64 Speeds. With Infrared Receiver. Hexfet H-Bridge Driver stage.  
**NCD-M1 Kit \$129 Asm \$159**



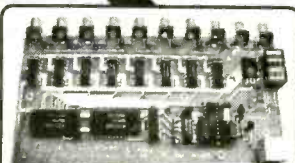
180° Motion

Multi-Power

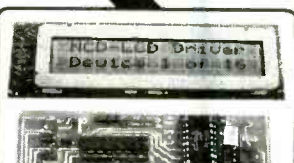
**8/16 Hobby Servo Controller:** Futaba-J Compatible, Infrared Receiver Included with SV16 upgrade. Perfect in all animatronic applications.  
**SV8 Kit \$79 Asm \$99**  
**SV16 Upgd Kit \$39 Asm \$59**



**8-Relay Driver:** includes 8 LED Status Lights. 12V Operation. Includes Infrared Receiver for Remote Operation. With Omron Mechanical Relays. Call for info on our 4-Relay Model.  
**R85 (5A) Kit \$109 Asm \$139**  
**R810 (10A) Kit \$129 Asm \$159**



**Audio/Video Switcher:** 8 Inputs, 2 Outputs, Infrared Controllable, Routes Any Input to Any Output. 12-18 volt DC operation. For Low-Power (Line-Level) Signal Switching.  
**AVS8 Kit \$129 Asm \$179**



**LCD Display Driver:** for Displays up to 40x2 (not inc). Two AUX outputs for Relay & Light. Connect up to 16 Displays per RS-232 port.  
**NCD-LCD Kit \$34 Asm \$44**

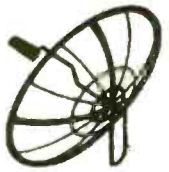
Infrared Transceiver for Remote RS-232 Communication with 16 IR Controllable Devices. **IRTR Kit \$39 Asm \$49**  
 RSB Serial Booster Gives your RS-232 Port the Power It Needs to Drive 16 NCD Devices. **RSB Kit \$29 Asm \$34**

On-Line Catalog: <http://members.aol.com/ncdcat/index.html> E-mail: [ncdryan@aol.com](mailto:ncdryan@aol.com)

## Cable TV

Descramblers • Converters

**FREE**  
 30 Day Trial



"Full Channel Viewing"

Movies \* Fights \* Events

Call Now - Save \$\$\$

One Year Warranty

**800-299-7985**

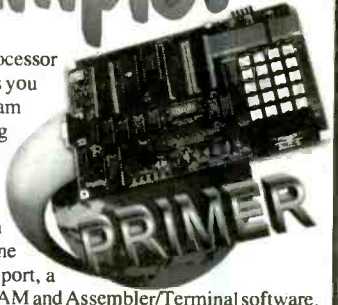
C.O.D.

QUALITY ELECTRONICS

Credit Cards

## Learn by Example!

The PRIMER 8085 Based Microprocessor Training and Control System shows you how to program by example. Program examples take you from writing simple programs to controlling motors. 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, a serial cable, 32K of battery backed RAM and Assembler/Terminal software.



### EXPERIMENTS USING THE PRIMER 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
- Using the Primer as an EPROM Programmer

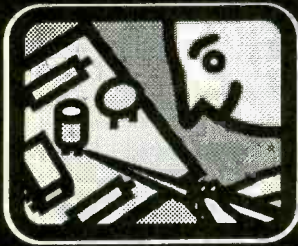
The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed.

**ENAC, inc.**

P.O. BOX 2042, CARBONDALE, IL 62902  
 618-529-4525 Fax 457-0110 BBS 529-5708

1985 - 1996  
 OVER  
**10**  
 YEARS  
 OF SERVICE





# RAINBOW KITS

Many of our kits are available completely built!

## WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-2 kit is a buffered wireless

mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. 6 to 12v DC. SIZE: 1.25" x 1" x 1.5"

WM2 KIT \$14.95

## MICRO-MINIATURE PHONE TRANSMITTER

We haven't seen a smaller phone transmitter than the MMPT2 kit. Powered by the phone, it requires no battery. Transmits both sides of a

phone conversation to an FM radio up to a 1/4 mile away. Tunable from 88 to 108MHz FM. Attach it to one phone or add it to the line to pick up all incoming calls. The MMPT2 is undetectable if properly installed. Unit has surface mounted parts, you install the leaded parts. Size .45" x .6"

MMPT2 KIT \$29.95

## MICRO-MINIATURE WIRELESS MIKE

So small you could hide this one on some real bugs! It's the smallest we've ever seen. With it's super sensitive mike it transmits a whisper or a room of conversation to an FM radio, tunable from 88 to 108MHz FM. With a proper antenna it transmits about 1/2 mile. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. Power requirement 6 to 12v DC. Size .35" x .9"

MMWM5 KIT \$34.95

## STROBE LIGHT

Do you need an attention getter, warning light, or flashing light for model airplanes? Then this kit is for you. Use it as an emergency light for your auto,

radio tower, even use it on your bicycle. Has a variable flash rate. Power requirement 6 or 12v DC. Size 3.5" x 1.9"

ST-1 KIT \$11.95

## FM STEREO TRANSMITTER

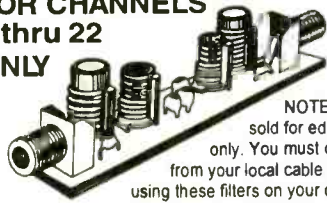
Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio

tunable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your CD's while mowing the lawn, Play music on one channel sing on the other. Clarity is excellent, approx. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls & crystal for stereo separation. 9v battery operation. SIZE: 1.5" x 2.5" x 3"

FMST-100 Cabinet \$8.95 KIT \$29.95

## TV NOTCH FILTERS FOR CHANNELS 2 thru 22 ONLY

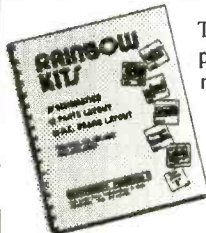
Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep beep beep. Works on cable channels (2 thru 22) only.



NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

DF-222

KIT \$14.95



This Manual contains schematics, parts lists & P.C. board layouts for many of the Rainbow Kits. Use your own parts to construct our kits.

**KIT BOOK \$14.95**  
\$9.95 with the purchase of any kit.

## INDUCTANCE METER

This is the kit everyone has been asking for. Turn your digital volt ohm meter into an inductance meter. It will read inductors 3uH to 7MH. Power requirement 9v DC. SIZE: 1.75" x 2.5"

IA-1 KIT \$14.95  
IA-1 CABINET \$8.95

## DIGITAL THERMOMETER

The DT-3 kit will turn your digital volt ohm meter into an accurate digital thermometer with .1 degree resolution. Measure temperatures from -40° to 250F°. The remote sensor is .25" sq. and can be mounted many feet from the meter. Power requirement 9V DC. SIZE: 2" x 1.35"

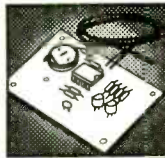
DT-3 KIT \$8.95

## CAPACITANCE METER

This kit will turn your digital volt meter into a capacitance meter. Turn that junk box of unmarked capacitors into a fortune of usable parts. Measure capacitors from <math>2.2\text{pF}</math> to 2.2uF. Power requirement 9v DC. SIZE: 1.80" x 2"

CA-1 KIT \$12.95

## TEMPERATURE GENIE



Ever lost frozen food because your freezer stopped? The TC-2 kit would have saved you money. An alarm activates when the temperature reaches a critical point. Turn ceiling fans on automatically when it gets too hot. This kit gives you 100mA of output. SIZE: 2" x 1.4" Power requirement 6 to 15V DC.

If you want to switch more power see our Triac (TP-1) or Relay (RP-1) Power kit.

TC-2 KIT \$7.95

## PHONE TRANSMITTER



Small but mighty, it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz to 130MHz FM. You can also use it as a speaker phone. SIZE: 1.25" x .6"

TEL-B1 KIT \$12.95

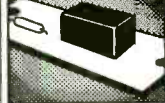
## SUPER SNOOPER BIG EAR



Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to 12v DC. SIZE: 1.75" x 1"

AA-1 BUILT \$29.95 KIT \$10.95

## RELAY POWER KIT

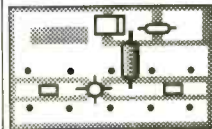


Increase the output of any kit from 100mA to 3 Amps If you need to switch more power, up to 300 Watts, with the Light Genie,

Temperature Genie, Timer or Vox kits, use the Relay Kit. We supply a two pole relay 1.5 Amps ea., tie both poles together and get 3 Amps. Size .75" x 2"

RP-1 KIT \$9.95

## WIDE BAND PRE-AMP



Uses PCB and surface mount technology for better performance. Use for scanners, HT's, Frequency counters, Satellite Receivers. It amplifies low-level (weak) signals. If the signal is extremely low, two amplifiers can be used in a series.

- 1MHz to 2.5 GHz 2.8dB NF
- 1dB compression=OdBm
- Gain: 1MHz- 20dB to 2.5GHz-6dB
- Power requirement: 12v @ 6Ma

WBA-6 KIT \$19.95



**ELECTRONIC RAINBOW**

Please add sufficient postage First lb \$5.00 Canada \$7.00  
Additional LB. Add \$1.00 US FUNDS ONLY  
We will accept telephone orders for Visa or Mastercard

**Electronic Rainbow Ind., Inc.**  
6227 Coffman Rd. Indianapolis, IN 46268

CALL 317-291-7262 FAX 317-291-7269  
INTERNET: www.rainbowkits.com







PO Box 421, Batavia, OH 45103

weedtech@iglou.com

513-752-0279

### Home Automation

Connects between a TW523 and an RS-232 serial port. Use your PC/Mac to receive and transmit all X-10 commands. Create your own program to control your home automation system, turning on/off any device plugged into an electrical outlet with response to time/date, other X-10 transmissions or any other computer input stimuli. **\$38.50**

### Caller ID / RS-232

Connects between a telephone wall jack and an RS-232 serial port. Decodes the caller ID data sent over the phone line and sends it to your PC/Mac, in a pre-formatted ASCII character string. Create your own program to log the name, number, date, and time of all incoming calls. Block out unwanted callers to your BBS/modem. **\$34.50**

### Telephone Call Restrictor

Connects to telephone wall jack. Disables all phones on the line if attempting to either: dial a number that has been stored in memory "Block" mode or, dial a number that has not been stored in memory "Allow" mode. Use touch-tone phone to enter telephone numbers into memory, and choose mode. Program from any phone on the line using your password. **\$35.00**

### 50 MHz Frequency Counter

Reads frequency from 1Hz to 50MHz and displays up to 7 digits on a 16x1 character LCD display. Auto-range feature provides floating decimal point and automatic placement of suffix (Hz, KHz, or MHz). Microcontroller based provides for very small parts count, only 2' x 3' blg. **\$48.50**

### Telephone Scrambler

Scrambles your voice before sending it over the telephone line. Prevent eavesdropping from an extension or tap. Connects between your telephone and wall jack. No modifications are required to your telephone. Full duplex operation. **\$43.00**

### IR Remote Control Receiver

Learns and records the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. Seven individual I/O pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **\$32.00**

### RS-232 Digital I/O

Give your home-brewed PC/Mac programs a link to the outside world! 12 I/O pins can be configured individually for input or output. Turn on/off relays, triacs, etc. Respond to button presses, switch changes, 4x4 matrix decoding with auto-debounce. Stack up to 16 units on the same serial port for a total of 192 I/O points. **\$32.00**

### DTMF Decoder/Logger

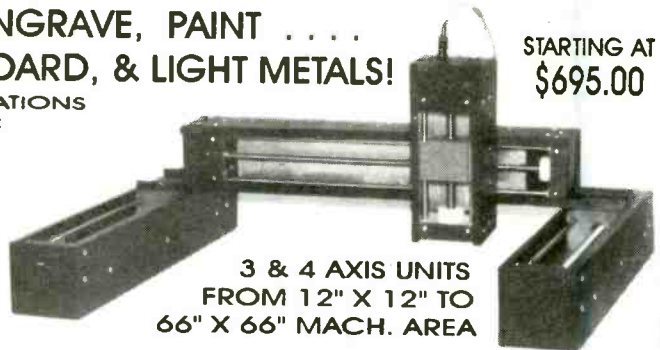
Keep track of all numbers dialed or entered from any phone on your line. Connects to your telephone wall jack. Decodes all 18 touch-tones and displays them on an LCD display. Holds the last 240 digits in a non-volatile memory. Scroll through and view all telephone numbers dialed, credit card numbers entered, etc. **\$54.50**

# ROBOTIC MACHINING

ROUTE, MILL, DRILL, CARVE, ENGRAVE, PAINT . . . .  
IN WOOD, PLASTIC, VINYL, PC BOARD, & LIGHT METALS!

STARTING AT  
**\$695.00**

- 4 & 5 MOTOR GANTRY MILL CONFIGURATIONS
- PC COMPUTER CONTROLLED CNC/DNC
- IMPORT/ EXPORT FILES TO OTHER CADS
- AUTO-BACKLASH COMPENSATION
- PRE-MACHINED HEAVY CASTINGS
- SIMULTANEOUS 4 AXIS MOTION
- FREE 3D CAD/CAM SOFTWARE
- AVAILABLE IN KITS OR ASSEMBLED
- EXPEDITE SERVICE ALSO AVAILABLE
- OPTIONAL ALUMINUM WAY COVERS
- .0005" RESOLUTION / AMERICAN MADE



3 & 4 AXIS UNITS  
FROM 12" X 12" TO  
66" X 66" MACH. AREA

U.S. CYBERLAB, INC. 14786 SLATE GAP RD., WEST FORK, AR 72774

CALL NOW FOR INSTANT SPECS 501-839-8293 24 HR. FAX-BACK

## 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 (52c) to:

**A&A Engineering**

2521 W. La Palma #K - Anaheim, CA 92801  
(714) 952-2114 - FAX: (714) 952-3280

## CONVERTERS & DESCRAMBLERS



**TARGET ELECTRONICS**

(800) 995-1749

We sell Test Chips!  
MC, VISA, AE, C.O.D

DEALERS  
WELCOME!

# BUY BONDS

## SILICON-CONTROLLED RECTIFIER PROJECTS

1586T—From TAB Books. A treasure trove of exciting projects using SCR's and other low-cost thyristor devices for power-control applications. Includes a sophisticated burglar-alarm system, an SCR-based smoke-alarm system, a remote-control garage-door opener, and a high-tech light dimmer that uses the output from your stereo to modulate the intensity of your lights. And then there are 20 more. To order—ask for book 1586T, and include your check for \$12.95 (includes s&h) in US and Canada, and order from — Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. US funds only, use US bank check or international money order. Allow 6-8 weeks for delivery.



MA09





ARE YOU LOOKING FOR  
NEW AND MOST  
INNOVATIVE PRODUCTS?

hard to find  
world wide products unique

IF SO, WE HAVE JUST THE RIGHT PRODUCTS FOR YOU!  
PRODUCTS FOR ALL AGES CAN BE FOUND IN OUR CATALOGS.  
THE BEST KNOWN BRANDS SUCH AS: IBM, ACER, ARMNOTE,  
TOSHIBA, NUREALITY, QUORUM, FUJI, PANASONIC, AND SO  
MUCH MORE! WE ALSO CARRY A WIDE RANGE OF PRODUCTS  
LIKE COMPUTERS, KEYBOARDS, MODEMS, MONITORS,  
MOTHERBOARDS, ELECTRONIC COMPONENTS, CHIPS,  
CABLES, PLUGS, ADAPTERS,  
CD ROMS, HARD DRIVES,  
FAXES, SCANNERS, LAPTOPS,  
TOYS, BUSINESS OPPORTUNITIES,  
SECURITY ALARM SYSTEMS.  
ALL YOU HAVE TO DO IS SEND \$9.00 U.S. \$15.00 CAN. TO  
BECOME A LIFETIME MEMBER OF THE GREAT SELECTION  
OF PRODUCTS THAT MANA ELECTRONICS HAS TO OFFER!  
INSTEAD OF SEARCHING, WE SEND IT RIGHT TO YOUR HOME!  
PRODUCTS ARE FACTORY FRESH, WARRANTIED AND REFUNDABLE.  
WE OFFER DEALS, DISCOUNTS, PROMOTIONAL GIFT ITEMS TO OUR  
MEMBERS WHILE YOU ARE CURRENTLY UPDATED WITH CATALOGS OF  
THE NEWEST AND MOST INNOVATIVE ELECTRONIC PRODUCTS AVAILA-  
BLE TODAY!

only \$9.00 U.S. \$15.00 CAN. 30 DAY REFUND.

order now! AND GET A FREE PEN!



SEND CHECK OR MONEY ORDER TO

**MANA**  
ELECTRONICS

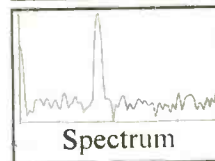
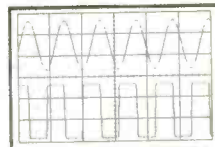
P.O. Box 67002 RPO Maples  
Winnipeg MB R2P 2T3  
(204)-697-3488



# OSCILLOSCOPES

from \$169 !!!

ATC O-Scope uses printer port to turn PC-AT into  
Digital Storage Oscilloscope, Spectrum Analyzer,  
Freq. Counter, Logger, DVM. DC-500KHz



- Print, log to disk, or export data
- Accepts standard scope probes
- Uses standard printer port
- Small and portable
- Works with laptops
- Same day shipping
- Made in U.S.A.
- Single channel units from \$169
- Dual channel units from \$349

**Options:**

- Probe sets
- Automotive probes
- Battery packs

Order yours today.

800 980 9806

MC/Visa/Amex

Allison Technology Corporation

8343 Carvel, Houston, TX 77036 USA

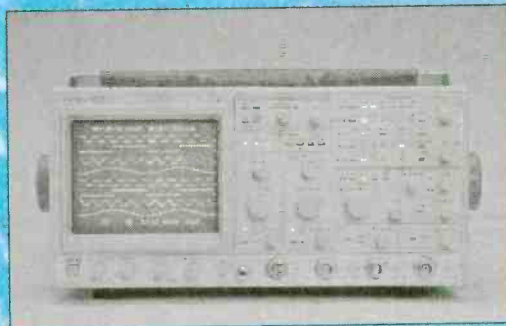
PH: 713 777 0401, FAX: 713 777 4746, BBS: 713 777 4746

<http://www.atcweb.com>

CIRCLE 137 ON FREE INFORMATION CARD

# TEST INSTRUMENT CATALOG !!!

Call, fax or email  
today for your free  
copy of our test  
instrument catalog,  
jam-packed with the  
**BEST VALUES**  
in test and  
measurement  
instruments avail-  
able today!!!



**PRINT**™  
Products International

8931 Brookville Rd \* Silver Spring, MD, 20910 \* 800-638-2020 \* Fx 800-545-0058 \*  
Email: [SMPRODINTL@aol.com](mailto:SMPRODINTL@aol.com)

CIRCLE 46 ON FREE INFORMATION CARD



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.

**Rubber Boot Included**

**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

**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.

**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.

**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

CAT NO	DESCRIPTION	PRICE
9300G	Rugged High Quality DMM with Rubber Boot	\$19.00



Our Best Offer Ever on a

High Quality Full Sized DMM

**\$19.00** any qty

**Resistance (Ω)**

Range: Resolution: Accuracy:

200Ω 100mΩ  
 2000Ω 1Ω  
 20KΩ 10Ω ±(1.2%rdg+2dgts)  
 200KΩ 100Ω  
 2000KΩ 1KΩ  
 20MΩ 10KΩ ±(2%rdg+10dgts)  
 Maximum Open Circuit Voltage: 2.8V

**Diode Test**

Measures forward voltage drop of a semiconductor junction in mV test current of 1.5mA Max.

**ohFE Test**

Measures transistor hFE.



**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" <b>NEW!</b>	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" <b>NEW!</b>	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" <b>NEW!</b>	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
CAT NO POSDEV	Positive Developer	\$.95	\$.80	\$.50



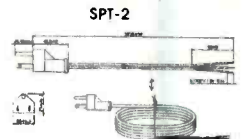
**Etching Tank** This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

**REDUCES ETCHING TIME!**

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	\$37.95

**AC Power Cords**

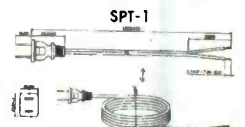
Our power supply cords are economical and practical for OEM and replacement applications. We stock 6' lengths, with the open end conveniently stripped and tinned (5mm).



CAT NO	SIZE	TYPE	RATING @		LENGTH (ft)	COLOR	TEMP
			125V (A)				
SPT-1BLACK	18/2	SPT-1	10		6	Black	60°
SPT-1GRAY	18/2	SPT-1	10		6	Gray	60°
SPT-2BLACK	18/3	SPT-2	10		6	Black	60°

**PRICE EACH**

CAT NO	1	10	100	500
SPT-1BLACK	\$.88	\$.57	\$.51	\$.46
SPT-1GRAY	.92	.61	.55	.49
SPT-2BLACK	1.97	1.21	1.07	.97



**Switchable Scope Probe Sets**

(Selectable X1/Ref/X10) These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 150MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

CAT NO	DESCRIPTION	1	10	100
HP-9060	Scope Probe Set DC~60MHz	\$16.49	\$14.49	\$11.58
HP-9150	Scope Probe Set DC~150MHz	24.95	21.95	18.62

**Etching Chemicals/Ferric Chloride**

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	1	5
ER-3	Makes 1 pint	\$3.50	\$2.75



**SEE OUR ON-LINE CATALOG AT**  
<http://www.cir.com>



## 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:

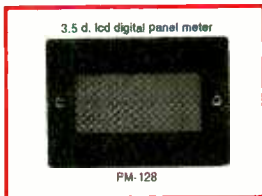
- Voltmeter
- Thermometer
- pH Meter
- dB Meter
- Watt Meter
- Current Meter
- Capacitance Meter
- LUX Meter
- LCR Meter
- Other Industrial & Domestic Uses

### PM-128: 3-1/2 LCD Digital Panel Meter

### PM-129: 3-1/2 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

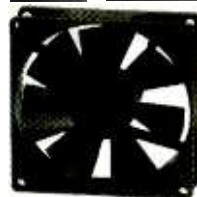
Maximum Input	: 199.9mV DC
Maximum Display	: 1999 counts (3-1/2 Digits) w/Automatic Polarity Indication
Indication Method	: PM-128 - LCD Display PM-129 - LED Display
Measuring Method	: Dual-Slope Integration A/D Converter System
Overrange Indication	: "1" Shown in the Display
Reading Rate Time	: 2-3 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	PRICE EACH				
		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	PRICE EACH			
	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 <sub>2</sub> 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

Westock 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	PRICE EACH		
		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	PRICE EACH	
		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 <http://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!

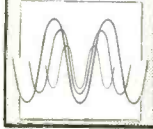
It's chock full of all types of electronic equipment and supplies. We've got I.C.'s, capacitors, resistors, pots, inductors, test equipment, breadboarding supplies, PC supplies, industrial computers, data acquisition products, personal computers and computer parts, plus much, much more. FAX us your name and address or call 800-811-5203, ext. 5, to leave a message on our catalog request line.





## HIGH POWER AUDIO AMPLIFIER CONSTRUCTION

High Power Audio Amplifier Construction



**BP277**—Here's background and practical design information on high power audio amplifiers capable of 300±400 watts r.m.s. You'll find MOSFET and bipolar output transistors in inverting and non-inverting circuits. To order your copy send **\$6.25 plus \$3.00** for shipping in the U.S. and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240**. U.S. and Canada only. Payment in U.S. funds by US bank check or International Money Order. Please allow 6-8 weeks for delivery. MA03



**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**

CHALLENGER SYSTEM 33-Channel 5280 - Gain Complete Grid \$265 Five Year Warranty FREE SHIPPING Visa • M/C • Amx • Disc • COD's • Qty Pricing

CIRCLE 145 ON FREE INFORMATION CARD



**The Catalog**

If you are not getting this catalog you are missing out on some of the best deals in electronics today! We have thousands of items ranging from unique, hard-to-find parts to standard production components. Call, write, or fax today to start your free subscription to the most unique catalog in the industry, filled with super values on surplus electronic and hobbyist type items. If you have a friend who would like to receive our catalog, send us their name and address and we will gladly forward them a complementary 100 page catalog.

Why pay more? Call today.

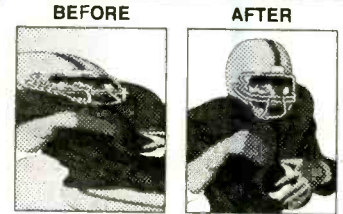


340 East First Street Fax Order Line  
 Dayton, Ohio 45402 1-800-344-6324

**Order Toll-Free**  
**1-800-344-4465**

CIRCLE 147 ON FREE INFORMATION CARD

## IMPROVE YOUR IMAGE! WITH OUR VIDEO STABILIZERS



**SUPER VHS MODEL AVAILABLE!**

The clearest picture possible playing back movies. **GUARANTEE** to eliminate copy protection.

- No Rolls/Jitters/Flickers/Fading
- Works on all TV's, VCR's Beta & Cable
- Gold Video Connectors & Cables Included
- 2 Year Warranty
- Money Back Guarantee



**VISION ELECTRONICS**  
**1-800-562-2252**  
 2125 S. 156TH CIRCLE • OMAHA, NE 68130

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"** pools 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.**

Send for **FREE DETAILS** or call

**1-800-800-7588**

WPT Publications

4701 N.E. 47th Street  
 Vancouver, WA 98661

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ St. \_\_\_\_\_ Zip \_\_\_\_\_

**1-800-800-7588**

## PROTOTYPES

Or large runs. PCBs, wave soldering, cabinets and other metal parts, silk screen printing, plastic injection, xformer/coil winding, etc. Assembly, wiring. Very low prices! Twin plant in Mexico. We ship to your door. **V&V. PH. (713) 537-7518 Fax. 011 (525) 361-5996.**

## START A CAREER IN ELECTRONICS!

Accredited home study course. Train now for a great career or sideline. You'll understand how electronics devices work so you can repair, install, and service audio equipment, microwave ovens, small appliances, alarms, and more. Earn good money as a technician in an electronics company—or open your own at-home business. For your free career literature, send or call 24 hours a day.

**CALL 800-223-4542**

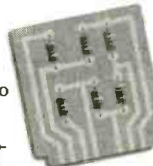
Name \_\_\_\_\_

Address \_\_\_\_\_

City/State \_\_\_\_\_ Zip \_\_\_\_\_

Phone (\_\_\_\_) \_\_\_\_\_ Age \_\_\_\_\_

**The School of Electronics, Dept. ELE341**  
 PCDI, 6065 Roswell Road, Atlanta, GA 30328



<http://www.xtronics.com/kits.htm>

Electronic Kits! As Seen on our WEB site!

Solderless Kits	Other Kits
Crystal radio \$5.75	FM Microphone \$6.95
Metal Detector \$8.50	Ultrasonic Translator (Hear ultrasonic-sound) \$18.50
MW IC Radio \$9.50	Glitter-Globe Buckminster Fuller \$14.95
Bend Wire Game \$7.95	Train Sound Module \$3.80
Audio Amplifier \$8.50	Sound operated control \$3.90
Home Alarm \$12.00	Light Receiver module \$3.90
Rain-Flood Alarm \$7.95	IR Receiver module \$3.90
Test Equipment Kits \$28.00	IR Transmitter \$3.90
Function Gen w/FM \$14.95	
Pulse Generator \$28.00	
RF Sig Generator \$28.00	

3209 W. 9th Street  
 Lawrence, KS 66049



ph 913 841 3089 Minimum Order \$20.00  
 FAX 913 841 0434 Shipping \$5.00 COD + \$2.00  
 See more kits at: Free shipping if over \$40.00

<http://www.xtronics.com/kits.htm>

## CABLE TV CONVERTERS

Equipment & Accessories  
 Wholesalers Welcome

**Call C&D ELECTRONICS**  
**1-800-310-1153 M-F 10a-6p**



# ELECTRONIC KITS! VOICE CHANGERS! AND MORE!

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

## ELECTRONIC KITS!

TOLL FREE ORDER LINE: 1-800-336-7389  
FAX LINE: 1-602-731-4748  
TECH SUPPORT NUMBER: 1-602-894-0992

**XANDI ELECTRONICS, INC.**  
MANUFACTURER OF HIGH QUALITY KITS

### 143.775 MHz CRYSTAL CONTROLLED TRANSMITTER KITS



**XTR300EZ** \$79.95  
**XTL3000EZ** \$99.95  
**XTL1000EZ** \$69.95

**XTR300 TRACKING TRANSMITTER KIT**  
Transmits continuous beep-beep-beep  
Ideal for locating lost or stolen items  
Range up to 1/2 mile

**XTL3000 LONG RANGE TRANSMITTER KIT**  
Sensitive built in microphone  
Range up to 1 mile  
Custom frequencies available

**XTL1000 TRANSMITTER KIT**  
Sensitive built in microphone  
Range up to 1/2 mile  
Custom frequencies available

#### CRYSTAL TRANSMITTER KITS

- Ultra-miniature surface mount construction.
- E-Z kit approach makes assembly a snap.
- Miniature battery and holder mounted directly to the circuit board.
- Transmit to any scanner type receiver

### BUG DETECTOR

**XBD500**  
\$149.95

- Professional quality.
- Not a kit, ready to use.
- Covers 1 to 2,000MHz.
- Uses new Microwave Integrated Circuit amplifier.
- Adjustable sensitivity.
- Audio jack for privacy ear phone.



Any intercepted signal causes an audio tone that increases from a low pitched growl to a high pitched squeal as the signal strength increases.

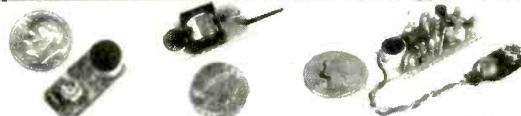
### 88-108 MHz FM RECEIVER

**XMR2000**  
\$29.95

- Worlds smallest FM radio.
- As small as a hearing aid.
- Weighs less than 1/4 oz.
- Digital touch tuning.
- Ideal for use with our 88-108MHz FM transmitters



### 88-108 MHz FM TRANSMITTER KITS



**XST 500EZ** \$49.95  
**XWB 1000EZ** \$46.95  
**XFM 100C** \$21.95

**XSP 250EZ** \$34.95  
**XTR 100C** \$29.95  
**XTT 100C** \$19.95

**XST 500** Voice transmitter. Range up to 1 mile. Supersensitive mic. Uses 9 volt battery. Uses surface mount components.

**XWB 1000** Voice transmitter. Range up to 1/2 mile. Includes mic and battery on circuit board. Uses surface mount components.

**XFM 100** Voice transmitter. Range up to 1 mile. 9 v battery and leaded components.

**XSP 250** Super-miniature telephone transmitter. Range 1/4 mile. Powered by phone line. Uses surface mount component.

**XTR 100** Tracking transmitter. Range up to 1 mile. Uses 9 volt battery. Transmits a BEEP - BEEP - BEEP tone

**XTT 100** Telephone transmitter. Range up to 1 mile. Uses 9 volt battery.



**XPC 400 TV CAMERA**  
400 LINES OF RES

- Use any TV or VCR with a video input connector.
  - Includes power cube.
  - About half the size of a pack of cigarettes.
  - See entire room through pin sized hole.
- Assembled \$269.95

**XVS100 TV TRANSMITTER**

- Use with XPC400, VCR, Camcorder, etc.
  - Power cube included.
  - Uses the UHF TV band.
  - Transmits video and audio.
  - Up to 100 foot range.
- E-Z Kit \$29.95

### PHONE VOICE CHANGER

16 levels of digital voice changing. Sound tougher, older or younger, female or male. Powered by 4 AA batteries. (Batteries not included).

Works with regular or multi-line phones. Connects between handset and phone. Note will not work with cordless or handset type telephones.



**T-2001 Assembled**  
\$69.95



**XLB-9 \$8.95**  
9V LITHIUM BATTERY

World's most powerful 9V battery! Twice the life of alkaline batteries.

**XLB-3 \$3.95**  
3V CAMERA BATTERY

Small 3V Lithium battery. For use with XTL3000, XTL1000, XTR300, and XWB1000.



**PROJECT BOX**  
\$14.95

Ideal project box to give your kits that professional look. Available custom drilled for the following kits: XFS108, XPS1000, XLC900, and XVA250.

### XANDI ADVANCED HOBBY KITS



**XPS 1000C**  
\$55.95

#### TELEPHONE SNOOP KIT

- Dial home from anywhere and hear inside your home.
- TouchTone coded for secure operation.
- Stop burglars and intruders.
- Reliable 24 hour protection.



**XLC 900C**  
\$49.95

#### SCANNER CONVERTER KIT(800-950MHZ)

- Uninterrupted coverage of the 800 to 950 MHz band!
- Works with any 400-550MHz scanner.
- Gain: 6 dB typical.
- Noise figure: 3 dB typical.



**XVA 250C**  
\$49.95

#### VOICE-STRESS ANALYZER KIT

- See at a glance if your being lied to!
- Subject need not be present. Works with voices from recordings, TV or radio.
- Has built-in microphone.
- Easy to use LED display output.



**XFS 108C**  
\$39.95

#### 88-108 MHz FM STEREO TRANSMITTER KIT

- Separate level control for both left and right channels.
- Output level circuit with test points for quick and easy tuning.
- Transmit from any stereo audio source to most any FM stereo receiver.

Serving the public since 1981  
**XANDI ELECTRONICS, INC.**  
1270 E Broadway Rd. # 113  
Tempe AZ 85282

**WE ACCEPT CHECK, VISA, MC, MO, COD**  
**SHIPPING & HANDLING EXTRA**



**SEND \$2.00 FOR COMPLETE CATALOG**

**REFUNDABLE ON FIRST ORDER**

**SEND MAIL ORDERS TO:**  
**XANDI ELECTRONICS**  
**BOX 25647**  
**TEMPE, AZ 85285-5647**

CIRCLE 134 ON FREE INFORMATION CARD

## CABLE T.V. EQUIPMENT

Friendly, Knowledgeable Service



**ORDERS CALL:  
1-800-361-4586**



- All Equipment New
- Convertors & Descramblers
- 30 Day Money Back Guarantee
- 6 Month Warranty
- Visa, MC, C.O.D. Welcome

**KDE ELECTRONICS, INC.**

P.O. Box 1494  
Addison, IL 60101

Info. 630-889-0281 HRS: Mon-Fri, 9-6 CST  
Fax 630-889-0283 Sat, 9-3 CST

## Electronic Training Videos



Learn electronics quickly and easily with UCANDO's computer-animated training videos. Students can learn at their own pace and professionals will find the UCANDO videos to be a valuable source of reference material. If these videos aren't the best learning tools you've ever seen, return them within 30 days for a

complete refund. These videos are being used by Tech-Schools, CET's, Military Branches, Ham Operators, Industries, and more, across the United States and around the world. Order today and see how UCANDO is ...

*"Changing The Way The World Learns Electronics."*

VCR Maintenance & Repair ... \$29.95 All others ... \$44.95 each  
• Intro to VCR Repair • Direct Current • Alternating Current • Semiconductors • Power Supplies • Amplifiers • Oscillators • Digital 1 • Digital 2 • Digital 3 • Digital 4 • Digital 5 • Digital 6 • AM Radio • FM Radio Part 1 • FM Radio Part 2 • TV Part 1 "Intro to TV" • TV Part 2 "The Front End" • TV Part 3 "Audio" • Fiber Optics • Laser Technology •

**SAVE!!! 6 videos for only \$240 or 12 videos for only \$450**



**1-800-678-6113**

or mail check or money order to:

UCANDO Videos

P.O. Box 928

Greenville, OH 45331

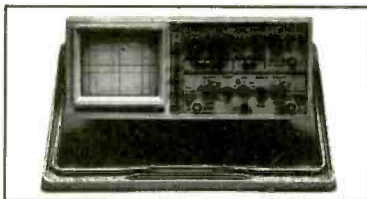
**FREE Shipping ... FREE Catalog**

CIRCLE 136 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!**

### 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](http://www.fotronic.com)

## 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](mailto:afoti@fotronic.com)



**TOLL FREE 1-800-99-METER**



# "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



### 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 free information kit that tells me how I can learn at home to become a professional VCR technician, in order to earn high extra income. Dept. 62623
- Interested in a career in Computer Repair, Maintenance and Upgrade? Dept. 64520
- NEW!** Satellite Dish / Electronics Course. Dept. 31395

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

\*Last name withheld by request.



**FREE CATALOG  
CALL TOLL FREE  
1-800-338-0531**

E-Mail: [xpress@parts-express.com](mailto:xpress@parts-express.com)



**Parts  
Express**

**30 DAY MONEY  
BACK GUARANTEE!**

340 E. First St., Dayton, OH 45402-1257  
Phone: 937-222-0173 ♦ Fax: 937-222-4644

**Amplified Indoor  
FM Antenna**

17" tall, amplified FM antenna. Improves reception with weak FM signals. 18 dB of gain. Includes AC adaptor, gain control, and 75 ohm coaxial cable terminated with an "F" connector.

**HOT  
NEW  
ITEM!**



#PO-219-055 ..... **\$12<sup>90</sup>**

**Cable TV Stereo Decoder**

When used in conjunction with a cable TV converter or cable ready VCR, this handy device allows you to feed the cable TV stereo signal into your home sound system for superb audio reproduction of your favorite shows, movies, and sporting events.



#PO-189-110 ..... **\$19<sup>90</sup>**

**Digital Video Stabilizer**

The digital video stabilizer will eliminate the constant picture distortion caused by the copyright protection on movie videotapes. This unit is fully automatic and operates on one 9V battery which is included.

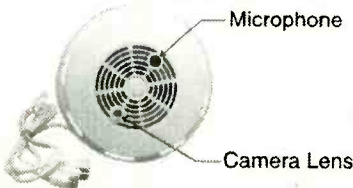


#PO-180-320 ..... **\$17<sup>95</sup>**

**Decoy Cameras**

These 1/3" CCD cameras offer a clever means of disguise. Both feature a 3.6mm wide angle lens, built-in electronic shutter, and a 12 VDC power supply. Minimum illumination: 0.3 lux. 400 line resolution. Smoke detector decoy camera includes an audio output.

**AFFORDABLE  
HIGH TECH  
SURVEILLANCE!**



Part #	Description	Price
PO-335-535	Smoke detector decoy	\$249.50
PO-335-540	Decoy clock camera	299.95

**"The Sound Bridge"  
FM Stereo Wireless Transmitter**

The Sound Bridge is a mini FM wireless transmitter that can be used to broadcast stereo sound from any audio source like portable CD players, TVs, electronic games, CD-ROM, even computer soundcards, to your home stereo receiver! Adjustable from 89 to 95.5 MHz.



**HOT  
NEW  
ITEM!**

#PO-249-220 ..... **\$14<sup>95</sup>**

**Portasol/Weller Butane  
Soldering Tool**

**NO CORDS,  
NO BATTERIES!**



This cordless, refillable, butane powered soldering tool is ideal for any on-site soldering job. Provides up to 35 watts with a temperature range up to 700 degrees F. Includes flint ignitor in plastic case, safety cut off switch, and C-2 chisel tip.

#PO-372-150 ..... **\$25<sup>95</sup>**

**150 MHz Oscilloscope Probe  
Kit**

Deluxe probe kit features a modular design for longer life, switchable 10:1 probe with 150 MHz bandwidth, 2.8 ns rise time, and adjustable capacitance from 10-35 pF. 60" in length.

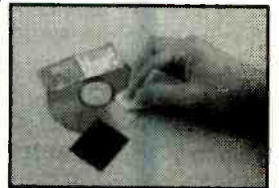


**GREAT  
VALUE!** ..... **\$29<sup>95</sup>**

#PO-390-100 ..... **\$29<sup>95</sup>**

**Memorex CD Repair And  
Maintenance Kit**

Don't throw away expensive CDs because of annoying mistracking and skipping errors! The Memorex CD Repair kit contains enough solution and materials to clean and repair 12 compact discs.



#PO-249-032 ..... **\$1<sup>95</sup>**

**5" Sealed Back Midrange**

5" heavy duty sealed back midrange with deluxe mesh grill. 1" aluminum voice coil. Popular midrange for auto sound installations. ♦Power handling: 35 watts RMS/50 watts max ♦Voice coil diameter: 1 inch ♦Impedance: 8 ohms ♦Frequency response: 800-10,000 Hz.



#PO-280-030 ..... **\$7<sup>50</sup>**

**1", Titanium Dome Tweeter**

Features a ferro fluid cooled Kapton voice coil and a rubber surround. Very natural sounding high frequency reproduction with extended response to 30KHz. ♦Power handling: 50 watts RMS/75 watts max ♦Voice coil diameter: 1", ♦Impedance: 8 ohms ♦Frequency response: 2500-30,000 Hz.



#PO-275-050 ..... **\$16<sup>50</sup>**

Dayton Loudspeaker Co.®

**3 Channel Color Organ Kit**

This sound to light unit features three separate outputs, which can be controlled independently. Each output reacts to three different bands of the musical spectrum: bass, midrange, and treble. Has built-in microphone, so no connection is required to music source, but a line input is provided.



**SUPER  
QUALITY  
KIT!**

#PO-320-210 ..... **\$59<sup>95</sup>**

**6-1/2" Woofer**

Polymer resin treated paper cone with poly foam surround. Long throw voice coil design helps to deliver powerful bass output. Perfect for bookshelf type speakers. Mfg. #C16L020-51F. ♦Power handling: 60 watts RMS/120 watts max. ♦Voice coil diameter: 1-1/4 inches ♦Impedance: 8 ohms ♦Frequency response: 57-7000 Hz.



PIONEER

#PO-290-023 ..... **\$19<sup>95</sup>**



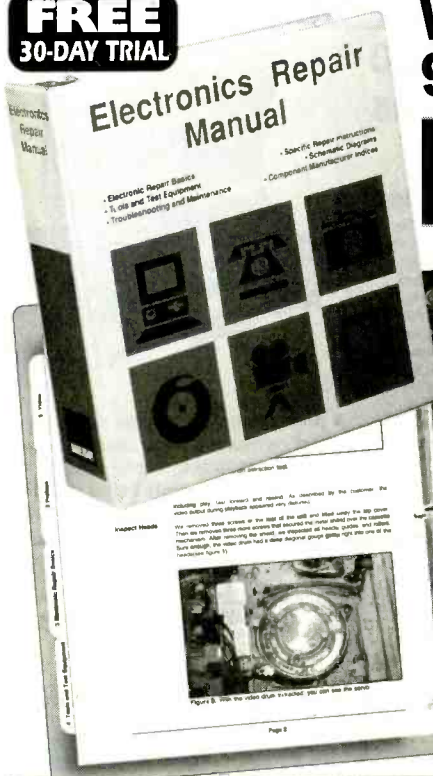
♦30 day money back guarantee ♦\$20.00 minimum order ♦We accept Mastercard, Visa, Discover, and company C.O.D. orders ♦24 hour shipping ♦Shipping charge = UPS chart rate + \$1.90 (\$5.00 minimum charge) ♦Hours 8:00 am - 8:00 pm ET, Monday - Friday ♦9:00 am - 5:00 pm Saturday. Mail order customers, please 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**



# Our #1 Best-Selling Home Electronics Repair Manual

**FREE  
30-DAY TRIAL**



# WEKA'S GIANT 900-PAGE BIBLE OF EASY ELECTRONICS REPAIR

YOURS FOR ONLY  
2 EASY PAYMENTS OF  
**\$24.95**

**FILLED WITH  
Troubleshooting  
Diagnostic Tips...  
Step-By-Step "Model  
Specific" Instructions...  
Charts, Photos & Easy-  
To-Follow Diagrams...  
PLUS Directory Of  
Parts Dealers!**

**ALL THE INSTRUCTIONS YOU NEED TO FIX  
TVs, VCRs, STEREOS, CAMCORDERS, PHONES, CD PLAYERS, FAXES,  
COMPUTERS, WALKMANS, AUTO RADIOS, VIDEO GAMES, & MORE!**

**Don't Waste Time & Money At Electronics Repair Shops!  
NOW FIX IT YOURSELF FOR SAVINGS,  
PROFIT... AND SATISFACTION!**

Now you don't have to be a professional technician to get PERFECT electronics repairs at home... at a fraction of repair shop costs! Whether you enjoy doing your own repairs or want an extra part-time income, this famous nationally advertised **WEKA ELECTRONICS REPAIR MANUAL** gives you easy-to-follow instructions for fixing nearly every electronic device you can think of... from popular manufacturers like SONY, RCA, IBM, NINTENDO and more! Plus, you get more than just easy instructions, YOU GET A FULL ELECTRONICS BIBLE that teaches you everything from basic

electronics principles to advanced troubleshooting and repairs!

### UPDATED SUPPLEMENTS!

About 4-5 times a year, we'll send you updated 140-page repair supplements for all the newest electronic products available. Examine these supplements at home FREE for a full 30-days. If you decide to add them to your Manual, they're yours for just \$35.00 each plus shipping and handling. There's **NO RISK, NO OBLIGATION!** ORDER YOUR 900-PAGE ELECTRONICS REPAIR MANUAL NOW!

**Yes, 900 Instruction-Filled Pages In Wipe-Clean Vinyl Binder!**



- LOOSE-LEAF FORMAT!
- PAGES LIE FLAT!
- TABBED CHAPTER PAGES!
- PHOTOS, CHARTS, DIAGRAMS!
- EXPLODED VIEWS!
- STEP-BY-STEP FIXES!
- TROUBLESHOOTING INSTRUCTIONS!
- TEST EQUIPMENT PRIMER!
- SAFETY PRECAUTION CHECKLIST!
- ELECTRONICS REFERENCE GUIDE!
- PREVENTIVE MAINTENANCE TIPS!
- HOW TO USE TOOLS OF THE TRADE!
- MANUFACTURERS' DIRECTORY!
- PARTS SUPPLIERS!
- PLUS MUCH MORE!

CIRCLE 321 ON FREE INFORMATION CARD

CALL TOLL-FREE NOW FOR 30-DAY HOME TRIAL!

**1-800-222-WEKA**

FAX: 1-800-256-5915 E-MAIL: 102132.1245@compuserve.com

WEKA PUBLISHING, INC., 1077 Bridgeport Ave.,  
P.O. Box 886, Shelton, CT 06484

- YES!** Please rush my ELECTRONICS REPAIR MANUAL. I'll pay now by check or credit card and save \$10 off the regular price! If I'm not 100% satisfied, I may return the book within 30 days for a full refund of the purchase price.
- SAVE!** Bill my credit card in 2 easy monthly payments of \$24.95 plus \$6.50 shipping & handling.
- VISA\*  MASTERCARD\* Exp. Date
- Account #
- Signature \_\_\_\_\_
- Phone (  ) \_\_\_\_\_
- SAVE!** My check is enclosed for \$49.90 plus \$6.50 s&h.
- Add \$10.00 for EXPRESS DELIVERY guaranteed within 5 business days from receipt of order. (Prepaid U.S.A. orders only, no P.O. Boxes.)
- Bill me later for the regular price of \$59.95 plus \$6.50 shipping & handling, subject to credit approval. Signature and phone number required to process your order. P.O. Box addresses must be prepaid.

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

In Canada, please add \$10. Overseas orders add \$15 (foreign orders must be prepaid). U.S. funds only. CT residents add 6% sales tax. Supplements are just \$35 each plus shipping & handling. They will be sent 4-5 times a year on a fully-guaranteed, 30-day trial basis. They may be cancelled at any time. 33234

April 1997, Popular Electronics

**CALL TOLL FREE**  
**(800) 292-7711 orders only**  
**Se Habla Español**

**C&S SALES**  
**EXCELLENCE IN SERVICE**

**CALL OR WRITE FOR**  
**A FREE 60 PAGE**  
**CATALOG!**  
**(800) 445-3201**

**XK-550 Digital / Analog Trainer**

Elenco's advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square wave forms. 1560 tie point breadboard area.

**XK-550**  
**Assembled and Tested**  
**\$169.95**

**XK-550K - Kit**  
**\$139.95**

Tools and meter shown optional



**TK-3000**  
**\$89.95**

**Tools Included:**

- SR-2 - Deluxe Soldering Iron
- SH-1 - Soldering Iron Stand
- ST-1 - Diagonal Pliers
- ST-2 - Long Nose Pliers
- ST-30 - Deluxe Wire Stripper
- SE-1 - Solder Ease Kit
- ND-3 - 3 pc. Nut Driver Set
- TL-8 - Precision Screw Drivers
- ST-5 - Screw Driver Slotted 3/16"
- ST-6 - Screw Driver #1 Phillips
- ET-10 - IC Puller
- SP-2 - Solder Pump
- ST-20 - Safety Goggles
- ST-9 - Pocket Screw Driver
- ST-4 - Solder Tube
- SW-3 - Solder Wick



A professional technician service tool kit in a metal reinforced tool case with heavy-duty handle and locks. A removable pallet handles most of the tools listed with more room for tools and parts in the lower half.

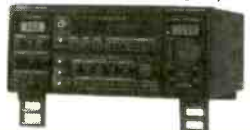
**GF-8026 w/ Frequency**

- Linear and Log Sweep
  - .02Hz to 2MHz
  - Counter Range 1Hz to 10MHz
  - 4 Digit Display
- \$225**



**MX-9300 Four Functions In One**

• 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)



**\$479.95**

**Model XP-581**

**4 Fully Regulated DC Power Supplies in One Unit**  
 4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A  
 1 Variable - 2.5 - 20V @ 2A

**\$85**



**Auto Ranging Hand-Held DMM w/ Bar Graph**  
**Model EDM-163**

**\$99.95**

7 Functions with data hold  
 Compares to Fluke Model 77II

**Digital Multimeter**  
**Model M-1700**

**\$39.95**

11 functions including freq to 20MHz,  
 cap to 20µF. Meets UL-1244 safety specs.



**Fluke Multimeters**

<b>70 Series</b>	<b>80 Series</b>
Model 70II .....\$69.95	Model 83 .....\$235.00
Model 73II .....\$97.50	Model 85 .....\$269.00
Model 75II .....\$135.00	Model 87 .....\$289.00
Model 77II .....\$154.95	
Model 79II .....\$175.00	

**B&K Precision Multimeters**

Model 391 .....\$159.00	Model 388A .....\$99.00
Model 390 .....\$139.00	Model 2707 .....\$79.00
Model 389 .....\$109.00	Model 2860A .....\$85.00

**Kit Corner**

over 100 kits available

**PT-223K**

**\$15.95**

Phone kit with training course.



**Fiber Optics Technology**  
 with training course  
**Model FO-30K**

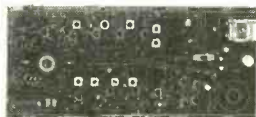
**\$19.95**



**Model AM/FM-108K**  
**Transistor Radio Kit**

with training course

**\$29.95**



**M-1005K**  
**Compact Multimeter Kit**

**\$19.95**

6 Functions & Transistor Test



**Model M-6100**

**Programmable DMM**

Includes **FREE** Computer Interface and **FREE** Software

- Analog Bar Graph
- Large 3 3/4" LCD Display
- Menu Driven
- Triple Display
- RS-232 Interface
- True RMS
- 9 Basic Functions including cap. & freq.
- Auto Power Off
- Easy-to-use

**\$125**



**WE WILL NOT BE UNDERSOLD**

**C&S SALES, INC.**

UPS SHIPPING: 48 STATES 5%  
 OTHERS CALL FOR DETAILS  
 IL Residents add 8% Sales Tax

150 W. CARPENTER AVENUE  
 WHEELING, IL 60090  
 FAX: (847) 520-9904 (847) 541-0710  
[http://www.elenco.com/cs\\_sales/](http://www.elenco.com/cs_sales/)



**15 DAY MONEY BACK**  
**GUARANTEE**  
**FULL FACTORY WARRANTY**

PRICES SUBJECT TO CHANGE WITHOUT NOTICE



**FREE PROBES  
WITH ALL  
SCOPES**

# OSCILLOSCOPES

**Lowest Prices of the Year!**

**CALL OR WRITE FOR  
A FREE 60 PAGE  
CATALOG!  
(800) 445-3201**

## B&K Precision Scopes

### 60MHz ANALOG WITH DIGITAL STORAGE

- Model 2560**
- Cursors and readouts
  - RS-232 port
  - 20MS/s real time sampling
  - 1GHz equivalent time sampling (at 0.1µs/div.)
  - Prints via RS-232 port to any HP-GL printer
- \$1995**



### 20MHz ANALOG WITH DIGITAL STORAGE

- Model 2522A**
- 20MHz analog bandwidth
  - 20MS/s sampling rate
  - 2K memory per channel
  - 300MHz equivalent time sampling
  - Pre-trigger capture
- \$869.95**



### 100MHz THREE-TRACE

- Model 2190A**
- 1mV/division sensitivity
  - Sweeps to 5mV/division
  - Dual time base
  - Signal delay line
  - 18KV accelerating voltage
- \$1379.95**



### 60MHz DUAL-TRACE

- Model 2160A**
- 1mV/division sensitivity
  - Sweeps to 5mV/division
  - Dual time base
  - Signal delay line
  - V mode - displays two signals unrelated in frequency
  - Component tester
- \$949.95**



### 40MHz DUAL-TRACE

- Model 1541C**
- 1mV/division sensitivity
  - Video sync separator
  - 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 2120 - 2 Year Warranty**
- Special \$389.95**

- Model 2125 with delayed sweep**
- \$539.95**



- 1mV/division sensitivity
- AUTO-NORM triggered sweep operation
- AC, TVH, TVV and line coupling
- Calibrated 19 step time-base with x10 magnifier
- Compact low-profile design

## Quality Scopes by Elenco



**60MHz**

**DS-603 \$1350**

- Analog / Digital Storage
- 20MS/s Sampling Rate

**S-1360 \$749**

- Analog with Delayed Sweep

**40MHz**

**S-1345 \$569**

- Analog with Delayed Sweep

**S-1340 \$475**

- Analog

**25/30MHz**

**DS-303 \$1095**

- Analog / Digital Storage

**S-1330 \$439**

- 25MHz Analog
- Delayed Sweep

**S-1325 \$325**

- 25MHz Analog

**2 Year  
Warranty**

### OSCILLOSCOPE SELECTION CHART

ANALOG		Sensitivity (max)	No. of Channels	Sweep Rate Max ns/div	Delayed Sweep	Video Sync	Component Tester	Beam Find	Time Base
Model	Bandwidth MHz								
S-1360	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1345	40	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1340	40	1mV/div	2	10ns/div	No	Yes	No	No	1
S-1330	25	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1325	25	1mV/div	2	10ns/div	No	Yes	No	No	1
DIGITAL STORAGE		Analog Sen (max)	No. of Channels	Sampling Rate	Memory Channel	Internally Backed Up	Pretrigger %	Output	
Model	Bandwidth MHz								
DS-303	30	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232	
DS-603	60	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232	

## Affordable Spectrum Analyzers by B&K

### 500MHz Series

- Model 2615 - \$1595**
- Model 2620 w/ tracking generator - \$1895**

### 1.05GHz Series

- Model 2625 - \$2395**
- Model 2630 w/ tracking generator - \$2995**



## HITACHI SCOPES

**Inventory Reduction Sale**  
**Lowest Prices of the Decade!**

- V-209 - 20MHz Battery Operated Was \$1505, NOW \$1095 Save \$410
- V-422 - 40MHz Was \$965, NOW \$765 Save \$200
- V-525 - 10MHz w/ Cursors Was \$1355, NOW \$955 Save \$400
- V-552 - 50MHz Was \$1195, NOW \$850 Save \$345
- V-555 - 50MHz w/ Cursors Was \$1375, NOW \$975 Save \$400
- V-695 - 60MHz w/ Cursors Was \$1815, NOW \$1395 Save \$420
- V-1065A - 100MHz w/ Cursors Was \$2139, NOW \$1565 Save \$574
- V-1560 - 100MHz Was \$1790, NOW \$1490 Save \$300
- V-1565 - 100MHz w/ Cursors Was \$1960, NOW \$1595 Save \$365
- V-252 - 20MHz **\$419**

## Fluke Scopemeters



- 91 ..... **\$1225**
- 92B ..... **\$1445**
- 96B ..... **\$1695**
- 97 ..... **\$1795**
- 97A ..... **\$2945**
- 99B ..... **\$2095**

Call or write for complete specs.

**WE WILL NOT BE UNDERSOLD**

**C&S SALES, INC.**

UPS SHIPPING: 48 STATES 5%  
OTHERS CALL FOR DETAILS  
IL Residents Add 8% Tax

150 W. CARPENTER AVENUE  
WHEELING, IL 60090  
FAX: (847) 520-9904 (847) 541-0710  
[http://www.elenco.com/cs\\_sales/](http://www.elenco.com/cs_sales/)



**15 DAY MONEY BACK  
GUARANTEE**  
**FULL FACTORY WARRANTY**  
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 32 ON FREE INFORMATION CARD

## The ZEIT by ARCRON Radio-Controlled Clock

- All World Time Zones with Precise Time
- Tell Time by the Atomic Clock that governs time for radio stations and space flights
- Sets Self By The NIST Radio Waves (WWVB 60KHZ)
- Direct Link With World's Most Accurate Clock

Time, Hours, Minutes, Seconds  
 Reception /Signal Strength  
 Date or 2nd Time Zone  
 Back Light Dial for Night  
 US and World Time  
 All World Time Zones  
 ARC Program Symbol  
 Dual Alarm Function



**ONLY \$149.95**

S&H \$4.95

M/C - VISA - DISCOVER - AMEX

### NEVER SET YOUR TIME AGAIN !!! WITH HIGH-TECH RADIO CONTROLLED ATOMIC CLOCK !

Automatically sets accurate time, date and adjusts for the start and end of daylight savings time

- Receives Radio signal from US Atomic Clock
- Superior Signal Reception Sensitivity (below 20y V/m)
- Continuous Oscillator Calibration
- Internal Quartz Oscillator
- Integrated Internal Ferrite Omnidirectional Antenna
- Battery Operated with Low Battery Indicator
- Warranteed
- 2.60" x 5.30" x 4.45"

ORDER YOURS DIRECT FROM ARCRON ZEIT

CALL TOLL FREE 24 HOURS 1-800-985-TIME (8463)

## BE LESS PRODUCTIVE AT THE OFFICE.

The office has always been a place to get ahead. Unfortunately, it's also a place where a lot of natural resources start to fall behind. Take a look around the next time you're at work. See how many lights are left on when people leave. See how much paper is being wasted. How much



electricity is being used to run computers that are left on. Look at how much water is being wasted in the restrooms. And how much solid waste is being thrown out in the trash cans. We bet it's a lot.

Now, here are some simple ways you can produce less waste at work.

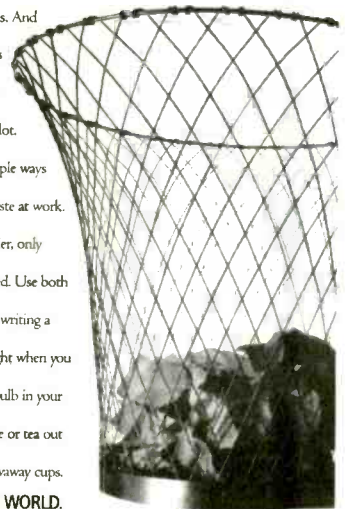
When you're at the copier, only make the copies you need. Use both sides of the paper when writing a memo. Turn off your light when you leave. Use a lower watt bulb in your lamps. Drink your coffee or tea out of mugs instead of throwaway cups.

IT'S A CONNECTED WORLD. DO YOUR SHARE.

Set up a recycling bin for aluminum cans and one for bottles. And when you're in the bathroom brushing your teeth or washing your face, don't let the faucet run. Remember, if we use fewer resources today, we'll save more for tomorrow. Which would truly be a job well done.

FOR MORE INFORMATION AND TIPS

CALL 1-800-MY-SHARE



## CABLE TV

CONVERTERS AND DESCRAMBLERS

WE CARRY A FULL LINE OF CONVERTERS AND DESCRAMBLERS COMPATIBLE WITH MOST MAJOR BRANDS INCLUDING:

- Scientific Atlanta™
- Jerrold™
- Tocom™
- Zenlth™
- 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. 110-54 Queens Blvd., #465, Forest Hills, NY 11375. NO NYS SALES.

## SURVEILLANCE

The Latest High Tech Professional Electronic Devices

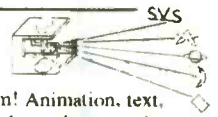
Our latest catalog offers a HUGE selection of surveillance, counter-surveillance/privacy devices: pinhole camera w/audio \$199<sup>00</sup>, hidden video, electronic kits, telephone recording systems: 7-Hour \$125<sup>00</sup> - 16-Hour \$199<sup>00</sup> touch tone decoders, scanners, bug/phone tap detectors, voice disguisers, telephone scramblers, locksmithing tools, and more.

Catalog \$5.00

### SPY OUTLET

PO Box 337, Buffalo NY 14226  
 (716) 691-3476/(716) 695-8660

## \$139\* Laser LightShow



Draw with a laser beam! Animation, text, music & more! Includes galvos, mirrors, servo amp, demo software disk, analog and digital computer interface. Use an inexpensive pen pointer or high power gas laser.



## Computerized Motors \$39\*

Includes: 2 Stepper motors, 2 DC motors, computer interface, training manual, & demo software disk. Expandable! Up to 12 motors, up to 3 amps per phase.

Now with 4 Axis Linear Interpolation

\* Add \$6 for shipping. Computer with parallel printer port & cable, assembly, power supply, & laser are required.

### FREE FLYER

Voice 510-582-6602 Fax 510-582-6603



1273 Industrial Pkwy West Bldg. 460  
 PO Box 55125 Hayward CA 94545-0125



Don't rent own!

# Cable TV Descramblers

## We'll beat Any Price!

- Same Day Shipping!
- 30 Day Money Back Guarantee
- Credit Cards/C.O.D.

Have make and model number of equipment used in your area  
**REPLACEMENTS FOR MOST SYSTEMS**

CALL TOLL FREE  
**CABLE DISCOUNT**  
**1-800-684-9135**

NO NEW JERSEY SALES!  
 Anyone implying theft of service will be denied assistance.

# HOME AUTOMATION

## World's Largest Selection!

Widest Selection of  
 X-10 Devices Available

Hundreds of hard-to-find automation, X-10 and wireless control products. Computer interfaces, software, development tools, lighting control, telephone systems, security systems, surveillance cameras, infra-red audio/video control, HVAC, pet care automation, wiring supplies, books and videos and much more!

Packed with Pictures  
 & Diagrams



**HOME AUTOMATION SYSTEMS, Inc.**

Questions: 714-708-0610 Fax: 714-708-0614  
 e-mail: catalog@smarthome.com  
 http://www.smarthome.com/smarthome

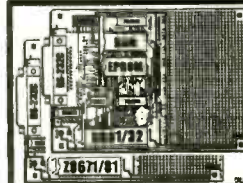
**Lowest Prices  
 Guaranteed!**

24 Hours **Call 800-SMART-HOME** 800-762-7846

### Remote Automotive Engine Starters

Warm up your car in the winter. Cool it off in the summer.  
**SmartStart MCS-100** Real Time clock based. Programs like a VCR. The engine starts at the times you set, up to 4 start times per day. Also set the run time, day and time.  
**TouchStart MCS-200** Start and stop the engine, and honk the horn with a 2 channel key chain transmitter up to 300 ft. away.

Plans and parts list only. \$14.00 each + \$3.50 SH.  
 Send check or M.O. to: Modern Circuit Solutions Corporation  
 P.O. Box 212 Cedarburg, WI 53012-212



**Prototype it FAST!**  
 with Protoboard! 8081 or 128  
 Fully assembled 2051 or 22 80C  
 4.5 x 8 inch board w/ large proto area  
 Supports up to 32K EPROM - 32K RAM  
 Chips in sockets - 6 volt operation  
 Op-eyes in EPROM w/ source and 2-lead  
 Full deck of schematic - no repeats  
**Ready to run... \$99.00 ea.**  
 Software Science  
 2740 Roundbottom Rd.  
 Cincinnati, Ohio 45244  
**1 888 561-2860**

### BROADCAST TRANSMITTER

The FMS2 studio quality transmitter is FULLY crystal controlled and programmable to any FM broadcast frequency.  
 Unit features, ALC, 2:1 compressor, audio buffer/amplifier, pre-emphasis, roll off filter, stereo generator, digital PLL tuning, 75 MHz-125MHz bandwidth, 500mW power output and a special introductory price of only \$295.00 US.  
 SCHEMATICS FOR UNIT \$27.00 CATALOG 800-504-1178  
 FAX POLL INFO 416-243-1067 TEK LINE 416-243-2260

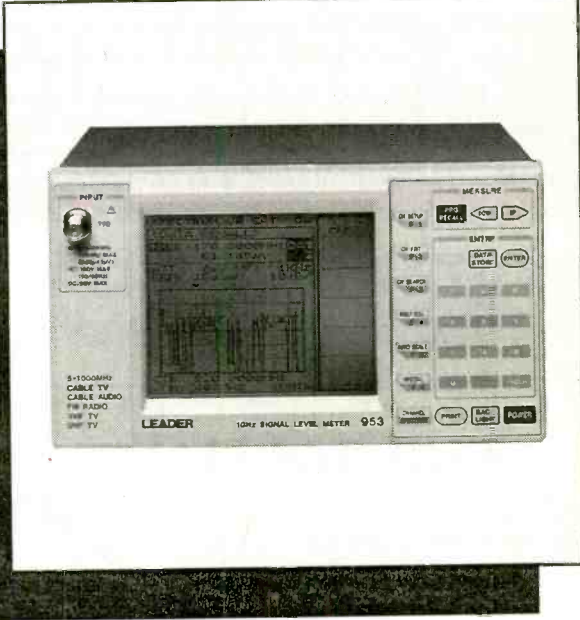
# LEADER

## For Professionals Who Know The Difference

- Oscilloscopes
- Video Sync/Test Generators
- Waveform Monitors/Vectorscopes
- EFP/ENG Instruments
- RF Signal Level Meters
- Audio Generators & Meters
- Frequency Counters
- Meters & Bridges
- Power Supplies
- Function Generators
- RF Generators



Test Instruments, Equipment, Tools & Supplies For Electronic Production, Maintenance & Service  
 8931 Brookville Road, Silver Spring, MD, 20910 \* 800-638-2020 \* Fax 800-545-0058



Call, fax or email for your free test and measurement instrument catalog today!  
 800-638-2020 \* Fax 800-545-0058  
 Email: SMPRODINTL@aol.com

# COUNTERSURVEILLANCE MANUFACTURER

## AI-6600 PHONE TAP DETECTOR



- DETECTS:**
- Radio Frequency Taps
  - Series and Parallel Taps
  - Line Impedance Taps
  - Extension Phone Listeners

**\$149<sup>95</sup>**

## AI-2100 VIBRATING TRANSMITTER DETECTOR

**\$189<sup>95</sup>**

- DETECTS:**
- Body Wires
  - FM Wireless Mics
  - AM Transmitters
  - UHF Transmitters



## AI-5500 COMPLETE SAFETY SYSTEM

- DETECTS:**
- All Phone Taps and Extension Phone Listeners
  - All Body Wires, Wireless Mics, AM/FM and UHF Transmitters
- DEFEATS:**
- All Body Wires, Transmitters and Distance Microphones with its built-in white noise generator

**\$379<sup>95</sup>**



## TRVD-900 TRANSMITTER / TAPE RECORDER & VIDEO DETECTION SYSTEM

- DETECTS:**
- Body Wires
  - FM Wireless Mics • AM Transmitters • UHF Transmitters
  - Tape Recorders • Video Equipment

Alerts User By Vibrating and/or Illuminated LEDs

**\$495<sup>00</sup>**

## WSS-100 WIRELESS SURVEILLANCE SYSTEM SEES & HEARS EVERYTHING!

- FEATURES:**
- 2.4 GHz Video / Audio Transmitter
  - 4 Channel Receiver • 300' Transmission Range
  - Black & White CCD w/ Auto-Iris Lens • 410(H) TV Line Resolution
  - FCC Approved Frequency



**\$649<sup>95</sup>**

Send \$6.00 for 32-Page Catalog (FREE w/ Purchase)

Items May Be Purchased by Certified Check, Money Order or C.O.D.

## AMERICAN INNOVATIONS, INC.

119 ROCKLAND CENTER ~ SUITE 315 • NANUET, NY 10954

Voice: (914) 735-6127 • Fax: (914) 735-3560

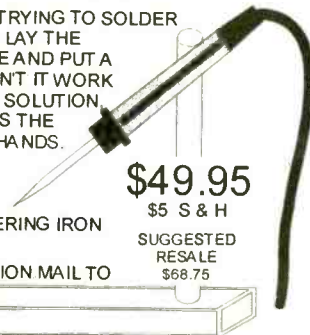
HTTP://WWW.SPYSITE.COM • E-MAIL: AMERICAN@SPYSITE.COM

Quantity Discounts Available



## THE 3rd HAND

EVER NEED A 3rd HAND WHILE TRYING TO SOLDER 2 PIECES TOGETHER? SO YOU LAY THE SOLDERING IRON ON THE TABLE AND PUT A WEIGHT ON IT. NOT ONLY DOESN'T IT WORK BUT IT'S DANGEROUS. TRY OUR SOLUTION. A WELL BUILT BASE THAT HOLDS THE IRON IN PLACE TO FREE YOUR HANDS. FULLY ADJUSTABLE, WILL FIT MOST IRONS.



**\$49.95**

\$5 S & H

SUGGESTED RESALE \$68.75

KIT INCLUDES BASE AND SOLDERING IRON & COMPLETE INSTRUCTIONS

TO ORDER OR MORE INFORMATION MAIL TO R & S

2788 C.R. 135  
DOLA OHIO, 45835

TEL: 419/759-2558 FAX: 419/365-5112

MASTERCARD - VISA

## OWN A MACHINE SHOP

The Smithy 3-in-1 lathe-mill-drill gives you all

3 basic machine tools in one easy-to-use benchtop machine. Save time & money. For home or business.

Call for your FREE Info Pak & instructional video.

**1-800-345-6342**

**FREE Info Pak**

Ask for Operator PE4

or write

Dept. PE4  
PO Box 1517  
Ann Arbor, MI  
48106-1517

**Smithy**



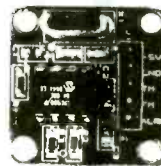
Thanks.

Remember - only you can prevent forest fires.

## Mini-Mods

Miniature Engineering Modules

Add real time to your design today!!!



with the Pocket Watch only \$19.<sup>95</sup>

1"x1", keeps real time w/ alarm function, perfect for Basic Stamps and micro-controllers, simple serial communication



SOLUTIONS CUBED

3029 F Esplanade  
Chico, CA 95973  
phone (916) 891-9045  
fax (916) 891-1643

www.solutions-cubed.com

Whaddya Say To A Guy Who's Had The Same Job For 50 Years, Has Never Called In Sick Or Showed Up Late, Never Taken A Vacation Or A Holiday, Never Asked For A Raise Or Griped About His Bonus And, Believe It Or Not, Has No Plans For Retirement?





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)	20µA	*	*	*	*	*
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	54.95	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

**New Surveillance Devices!**

**Smoke Alarm and Table Clock Video Cameras**  
 Ultra miniature video cameras hidden in smoke alarm or alarm clock - your choice. Wide field of view and super .1 lux low light sensitivity! Undetectable!  
 SC-600 TC-70 High quality B/W with 420 lines of resolution for ultra sharp images.  
 Direct output of video and audio. **\$189.95 ea.**

**Best price on surveillance cameras anywhere!**

**Telephone Transmitter Kit** hidden in dual modular adaptor. Transmits both sides of conversation to any FM radio up to 1/4 mile. "SnapKit" technology. Uses phone line for power and antenna. Goes completely unnoticed. **MA-100 \$25.95**

High quality cassette deck plugs directly into telephone jack! Records up to 12 hours of conversations on a single cassette. Recording starts and stops automatically when phone is used!  
**THR-12 12 Hour Telephone Recorder \$99.95** Free shipping! Check/MO Question line: (972) 255-7490  
**Seymour-Radix Inc. Box 166055-E Irving, TX 75016**  
 Now you can visit us on the Internet at <http://www.why.net/home/sr/>

**"FULL VIEWING" CABLE BOXES**

**FREE** Converter Box Catalog Open Every Day!

**LOWER YOUR CABLE BILL NOW!**

**CHANNEL SURFERS**

**1-800-447-7634**

**CABLE TV CHANNELS**

EQUIPMENT *Direct!* **FREE 30 DAY TRIAL**

**GUARANTEED**

SAVE \$1000's  
 The Nationwide source for cable TV equipment.

**"BUY WHERE THE DEALERS BUY"**

**FREE** TV Cable Descramblers, Converter Starters and Magic Box Catalog. Open Every Day!

**UNLEASH NOW WITH Video Decoder**

Eliminates copy protection on any tape  
 Copy any rental/bought tape  
 Power Cord and RC Plugs included

2 Year Warranty  
**CALL NOW!**  
 Member Better Business Bureau

**MEGA ELECTRONICS**  
**1-800-676-6342** VISA • MC • COD

**FREE 30 Day Trial!**

**BUGGED??**

**FAVESPLOTTING** 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**

**CABLE DIRECT**

**CONVERTERS  
 DESCRAMBLERS  
 VIDEO STABILIZERS  
 FILTERS**

**100% MONEY BACK GUARANTEE!**

**30 DAY FREE TRIAL**

**FREE Cable TV Catalog.**

VISA MasterCard Discover

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

**MODERN ELECTRONICS**

**1-800-906-6664**  
 2125 S. 156TH CIRCLE • OMAHA, NE 68130



MONDO • TRONICS

# ROBOT STORE

\* KITS \*

Your

\* BOOKS \*

Mailorder

\* PARTS \*

Source

\* VIDEOS \*

For

\* MODELS \*

Robots!

\* MORE! \*

(REQUEST OUR FREE CATALOG)

www.robotstore.com

# 800-374-5764

Or write to us:

524 San Anselmo Ave #107-124  
San Anselmo CA 94960

Phone 415-455-9330

Fax 415-455-9333

Email info@mondo.com

### CABLE T.V.

Buy Direct From the Wholesaler  
We will match or beat any advertising  
Save \$\$\$



• Tocom • Pioneer • Jerrold  
• Zenith • Century • Panasonic  
and more

1 Year Warranty 30 days money back  
Visual Concepts 1-888-838-4444

### CONTROL YOUR WORLD

32K HC11  
**ModCon**  
Low Cost Microcontroller boards & kits + Applications  
**ZORIN** <http://ZORINco.com>  
or call (206) 282-6061

# CLASSIFIED

## CABLE TV

**ATTN. CABLE** box owners! Order your ID signal stopper now. Send \$23.00 to **R.R. ENTERPRISE**, Box 3532, Easton, PA 18043.

**CABLE descrambling**, new secret manual. Build your own descramblers for cable and subscription TV. Instructions, schematics for **SSAVI**, gated sync, sinewave, some free methods (HBO, Cinemax, Showtime, UHF, Adult) \$12.95, \$2.00 postage. **CABLETRONICS**, Box 30502PE, Bethesda, MD 20824.

**CABLE TV equipment & accessories**. Wholesalers welcome! 30 day moneyback guarantee! Free catalog! **PROFORMANCE ELECTRONICS, INC.**, 1 (800) 815-1512.

**CABLE descrambler!** Anyone can build in seven steps with **Radio Shack** parts. Plans/kit from \$5.00. plus free bonus. 1 (800) 818-9103.

**DESCRAMBLE** cable using simple circuit. E-Z to follow instructions. \$10.00. Complete kit with free "Bullet Stopper". \$20.00. 1 (800) 512-8053.

**CABLE "Bullet Terminator and I.D. Blocker"**. Electronically shields yourself and your box. Free Hackers Guide included. Lifetime guarantee. Wholesale prices. 1 (800) 820-9024.

**BIG Sale!!** Notch filters \$18.00. External Activators \$125.00. Descramblers from \$99.00. Test chips from \$5.00. Bullet/I.D. \$10.00. Name brand cable descramblers from \$135.00. Let us beat your best price. 1 (800) 449-9189 Anytime.

**CABLE TV descramblers**. One piece units. Pioneer 6310's, Scientific Atlanta 8580's, DPV7's and others. Lowest prices. Money back guarantee. Houston, TX (713) 691-4610.

**CABLE** - test chips; Jerrold; Pioneer; Tocom; Scientific Atlanta, Zenith, Jerrold cubes; Pioneer programmable cubes; **HUDSON**, 1 (800) 863-3237.

**CABLE TV notch filters**. Request our free brochure by calling our voicemail at 1 (800) 433-6319 or write to **STAR CIRCUITS**, PO Box 94917, Las Vegas, NV 89193.

**DESCRAMBLE** cable with simple circuit added to Radio Shack RF modulator and using VCR as tuner, instructions \$10.00. **TELCOM**, Box 832P04, Brusly, LA 70719.

**ZENITH** compatible test chips-activates full test mode. All except P21. \$24.95 **REALVIEW** (888) 732-5843 Visa/MC/Cod.

**"UNIVERSAL" descrambler** - Works with virtually any system. Fully assembled. \$129.95 + \$5.00 S&H. **"Bullet" Buster** - Protect your cable box against the infamous "bullet", ID and "cuckoo" signals. \$19.95 + \$3.00 S&H. **Cable-Safe**. Guarantee cable privacy. The one-way valve for your cable TV signal. \$29.95 + \$3.00 S&H. **"Cable Unscrambled"** - Everything you want to know about cable, but are afraid to ask. \$10.00. **"Descrambler Schematics Revealed"** - A powerful guide to descrambling schemes. \$10.00. **"Baseband Video Explained"** - Discover what a baseband signal is and how it's constructed. \$10.00. Special offer - Get all three booklets for only \$25.00! **VISA/MC/AMEX. ELECTROMAN**, Box 24474, New Orleans, LA 70184. (504) 482-3017. Free Catalog.

**CABLE TV**, descramblers, converters. Quantity discounts. 30 day free trial. Competitive prices. Call now! 1 (800) 322-0921 **REGAL SALES, INC.**

**FULL** line of cable descramblers and accessories for all types of systems. Test kits. Auto multimode. Etc... Everything you need. Call (808) 735-9988. Best price guaranteed.

**CABLE Descramblers** - Why rent! Own your cable TV equipment. Access all premium and basic channels. Please have model number of cable box when calling. **CABLE CONNECTION** at 1-888-83-CABLE.

**CABLE TV Mega Cube Sale!! New!!** Jerrold Multi Mode Cube with Auto-Timer \$119.00 ea. Jerrold Standard Cube + Filter \$88.00 ea./Super Pico-Q + Filter \$130.00 ea. Quantity discounts and Kits Available!! 1 (800) 660-CUBE. Place your order or leave a message on our voice mail order line.

**ATTENTION PZ-1-2** cable box owners. Schematic for simple turn-on circuit. Send \$24.95 + \$3.00 shipping to **W.A.W.G.&L.**, 78 Satinwood, Cheaktowaga, NY 14225.

## SATELLITE EQUIPMENT

**VIDEOCYpher II** descrambling manual. Schematics, video and audio. Explains **DES**, **EPROM**, **CloneMaster**, Pay-per-view (HBO, Cinemax, Showtime, Adult, etc.) \$16.95, \$2.00 postage. Schematics for Videocypher Plus, \$20.00. Schematics for Videocypher 032, \$15.00. Collection of Software to copy and alter EPROM codes, \$25.00. **VCII Plus EPROM**, binary and source code, \$30.00. **CABLETRONICS**, Box 30502PE, Bethesda, MD 20824.

**DSS Hacking**: How to construct and program smart cards, w/pic16C84, software. Complete DSS system schematics. \$16.95. **CABLETRONICS**, Box 30502R, Bethesda, MD 20824.

**OBTAINING Sound** for your **VCII** and **VCII Plus** is easy. No codes needed. Also **DSS Test Card** information. Details: 1 (800) 211-5635.

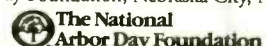
**IMPROVE** your satellite picture. **Focus Maximizer** is a diagnostic tool that optimizes feedhorn spacings. \$26.50. Free brochure. **WATERSHED ELECTRONIC DEVELOPMENT** (800) 756-7854.

**MINIDISH** satellite systems, surround sound, big TVs, total home entertainment systems. Discount prices. Free information. **STAR VISION DIRECT**: (800) 899-9707, 8am-10pm Pacific.

**ECHO Star Satellite Dish Networks** for sale, so call about these state of the art systems at (812) 295-4240.

### Trees Make a World of Difference™

Find out how trees can make a world of difference for you, and your neighborhood. For your free brochure write: Trees For America, The National Arbor Day Foundation, Nebraska City, NE 68410.





## MISCELLANEOUS ELECTRONICS FOR SALE

**THE Case Against Patents.** Thoroughly tested and proven alternatives that work in the real world. \$28.50. **SYNERGETICS PRESS**, Box 809-C, Thatcher, AZ 85552. (520) 428-4073. Visa/MC.

**POOR** reception on your A.M. radio? Our signal booster will help. Guaranteed! Send \$2.00 for details (refundable with order). **FALA ELECTRONICS**, PO Box 1376, Dept. 4, Milwaukee, WI 53201.

**FM Micro-Broadcasting 88-108MHz.** Assembled PLL transmitters and rf amps mono/stereo 1/2-100 watts. Photo catalog/info call (250) 642-2859. **R. SCOTT COMMUNICATIONS, LTD.** We ship world wide from Canada.

## PLANS-KITS-SCHEMATICS

**TRANSISTOR** Data Tables — Given are the basic electronic parameters for the worlds popular transistors in one volume. A must for servicemen, hobbyists and engineers. Order "Transistor Data Tables" (BP401) for only \$9.95 (price includes shipping) from **ELECTRONIC TECHNOLOGY TODAY, INC.**, PO Box 240, Massapequa Park, NY 11762-0240. USA and Canada only. US funds.

**CRYSTAL Set Handbook** — Visit antiquity by building the radios your grandfather built. Assemble a "Quaker Oats" rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$4.00 for shipping and handling. **CLAGGK INC.**, PO Box 4099, Farmingdale, NY 11735. US funds only! USA and Canada — no foreign orders.

**HEATH COMPANY** is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. Phone: (616) 925-5899, 8-4 ET.

**HACKERS** catalog. **Hard-To-Find** kits and assembled equipment (**Red box, spy, cable** etc.). **Low prices.** \$1.00. **SMITH-05**, Box 371, Cedar Grove, NJ 07009.

**ELECTRONIC** Project Kits. [www.qkits.com](http://www.qkits.com). 1 (888) GO-4-KITS, 292 Queen St., Kingston, ON., K7K 1B8. **QUALITY KITS.**

**MONITORS** made simple. Learn to repair computer monitors! Case studies, illustrations, parts sources, manufacturers included! 136 pages, soft-cover. \$19.95 + \$2.50 shipping. Order today! Send check or money order to **PIKES PEAK PRESS**, 321 W. Henrietta Ave., P.O. Box 1301, Woodland Park, CO 80866. (719) 687-1499.

**TRANSFER** paper for printed circuits with laser or copier, excellent quality. 30 sheets 8.5 X10 with instructions \$24.00, send check or money order to **G. SANTA MARIA**, 1602-A Washington Ave., Suite #915, Miami Beach, FL 33139.

**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-P4, Paradise, CA 95967.

**AWESOME** Kits: Voice changers, levitators, lasers, gas sensors and more! Catalog \$1.00. **LNS TECHNOLOGIES**, 20993 Foothill Blvd., Suite 307P, Hayward, CA 94541. [www.ccnnet.com/~lnstech](http://www.ccnnet.com/~lnstech)

## BUSINESS OPPORTUNITIES

**START** your own technical venture! Don Lancaster's newly updated **Incredible Secret Money Machine II** tells how. We now have autographed copies of the Guru's underground classic for \$18.50. **SYNERGETICS PRESS**, Box 809-C, Thatcher, AZ 85552. (520) 428-4073. Visa/MC.

**TELEVISION** pays! Market the fastest selling, most advanced digital minidish satellite home entertainment system. Discount prices. You profit! Free information. **STAR VISION DIRECT:** (800) 899-9707, 8am-10pm Pacific.

**EASY work! Excellent pay!** Assemble products at home. Call toll free 1 (800) 467-5566 Ext. 5730.

**HOME-Based Travel Agency** \$495.00. Overview (800) 942-9304 Ext. 21928. **DR. MITTEN** (847) 872-5737.

## EDUCATION

**FCC/CET** software. General Radiotelephone, CET preparation. Five 3.5 inch diskettes. Q/A format: interactive, comprehensive. EGA/VGA. Complete program, \$35.00. **TUTOR-TECH**, 170 Locksunart Way, #2, Sunnyvale, CA 94087. (408) 481-9543.

## INVENTORS

**PATENT, Trademark, Copyright, Searches/Applications. C.J. HUSAR & ASSOCIATES.** Searches for as low as \$190.00. Visa/MC accepted. Minutes from U.S. patent office. P.O. Box 219, Garrisonville, VA 22463. (703) 551-4050 M-F 8am - 4:30pm Est.

## KEEP YOUR C-BAND SYSTEM RUNNING STRONG!

Free Buyer's Guide  
BEST VALUES ON...

- Receivers, including 4DTV
- Dish Movers & LNB's, all kinds
- Tune-up Kits, Tools & Parts
- Skypac™ Programming
- Toll Free Technical Help



Inr1218-739-5231 Fax: 218-739-4879

800-334-6455  
[www.skyvision.com](http://www.skyvision.com)

**Skyvision**

## 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)

**VISUAL**

**COMMUNICATIONS INC.**

**FOR ORDERS 1-800-GO-CABLE**

CATALOG & TECH. SUPPORT 717-620-4363 EST. 1976

## BE AN ELECTRICIAN!

Home study. Maintain and install electrical systems, wiring, utilities, phones, and more. **FREE LITERATURE: 800-223-4542**

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_ Phone \_\_\_\_\_

City/State \_\_\_\_\_ Zip \_\_\_\_\_

The Electrician School, PCDI, DEPT TEE341  
6065 Foswell Road, Atlanta, Georgia 30328



## Converters & Descramblers Call 1-800-715-6789

30 Day Money Back Guarantee

FREE Catalog



- Panasonic®
- Jerrald®
- Pioneer®
- Zenith®
- Scientific Atlanta®

ALL MAJOR CREDIT CARDS ACCEPTED

13492 Research Blvd • Suite 120-113 • Austin, TX 78750

## WE HAVE IT ALL! Surveillance

Infinity Transmitters  
FM Wireless Transmitter Kits  
Vehicle Tracking Systems  
Bug Detectors • Caller I.D.  
Telephone Register with Printer  
Long-play Recorders  
Wired Mikes • Shotgun Mikes  
Telephone Recording Adapters  
Alcohol Testers • Drug Testers  
Telephone Scramblers  
Hidden Video Cameras  
Telephone Tap Detectors  
**MUCH, MUCH, MUCH MORE.**

Our 27th Year!

Small catalog FREE. Larger catalog send \$5.

Mail Order only. Visa, MasterCard and C.O.D. accepted for equipment only.

Inquire for dealers' prices.

**A.M.C. SALES, INC.**

193 Vaquero Dr. • Boulder, CO 80303

Mon.-Fri. 8 a.m.-5 p.m. Mtn. Time

800-926-2488

(303) 499-5405 • Fax (303) 494-4924

Internet: <http://www.siteleader.com/catalogdepot/AMCSC-home.html>

E-mail: [amc-sales@siteleader.com](mailto:amc-sales@siteleader.com)

## Debco is a Kit Builders Paradise

Electronic Kits • Plans • Parts • Computers • Amateur Radio

Call Debco today for your FREE copy of

The Electronic Experimenter's Journal

**1 800 423 - 4499**

Debco Electronics 4025 Edwards Rd. Cincinnati, OH 45209

## CABLE TV CONVERTERS

Equipment & Accessories

Wholesalers Welcome

Call **C&D ELECTRONICS**

1-800-310-1153 M-F 10a-6p

## ADVERTISING INDEX

Popular Electronics does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
—	A&A Engineering .....84	151	MCM Electronics .....73
25	Ace Communications .....76	—	Mega Electronics .....99
—	Aegis Research, Canada .....76	147	Mendelson's.....88
—	AES .....75	174	Mental Automation .....7
26	Alfa Electronics.....74	171	MicroCode Engineering.....3
28	All Electronics.....81	157	MicroCode Engineering .....CV4
137	Allison Technology.....85	—	Millennium Enterprises .....101
—	Allstar Electronics .....96	—	Modern Electronics .....99
—	AMC Sales.....101	—	Mondo-tronics.....100
—	American Innovations.....98	—	National Control Devices .....82
—	Andromeda Research.....75	—	NRI Schools.....53
—	Acron .....96	—	Oldaker Mfg. Corp.....98
—	Base 2 Computer .....75	43	Optoelectronics .....11
—	Basic Electrical Supply .....78	—	Orion Electronics.....88
—	Bell Merit .....99	156	Parallax .....CV3
32	C&S Sales, Inc. ....94	146	Parts Express .....92
—	Cable Discount.....97	175	Pioneer Hill Software .....16
—	Circuit Specialists .....86	47	Prairie Digital Inc. ....78
—	Cleveland Institute of Electronics .19	144	Print .....97
—	Command Productions .....80	46	Print .....85
—	Comtrad Industries.....9, 13, 21	—	Quality Electronics .....82
—	Consumertronics.....79	—	School of Electronics .....88
150	Dalbani .....77	—	School of PC Repair .....75
173	Digi-Key Corp.....5	—	Silicon Valley Surplus .....96
—	EDE Spy Outlet .....96	—	Smithy Company .....98
148	Electronic Rainbow .....83	—	Solutions Cubed.....98
—	Electronic Technology Today.....71	—	Tab Books.....15, 37
—	EMAC.....82	—	T.C. Tronics .....80
—	Foley-Belsaw .....91	143	Telulex.....78
—	Forest Electronics .....80	—	Transtronics .....88
—	Fotronic Corporation .....90	136	UCANDO Videos.....90
—	General Device Instruments.....75	—	US Cyberlab.....84
—	Grantham College of Engineering 4	—	Vision Electronics .....88
—	Greenleaf Electronics Inc. ....76	—	Visual Communications .....101
—	Home Automation Systems.....97	—	Weeder Technologies .....84
—	Information Unlimited .....72	—	Weka Publishing .....93
13	Interactive Image Technologies CV2	172	Windjammer Barefoot Cruises ....70
—	Intronics, Inc. ....75	—	WPT Publications.....88
—	KDE Electronics .....90	134	Xandi Electronics .....89
—	Mana .....85		

### 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, EHF/CET**  
President (ext. 201)  
e-mail [advertising@gernsback](mailto:advertising@gernsback)

**Christina Estrada**  
Assistant to the President (ext. 209)

**For Advertising ONLY**  
1-516-293-3000  
Fax 1-516-293-3115

**Larry Steckler**  
publisher

**Arline Fishman**  
advertising director (ext. 206)

**Michele Torrillo**  
advertising assistant (ext. 211)

**Adria Coren**  
credit manager (ext. 208)

**Subscription/  
Customer Service/  
Order Entry**  
1-800-827-0383  
7:30 AM - 8:30 PM EST

### ADVERTISING SALES OFFICES EAST/SOUTHEAST

**Stanley Levitan**  
Eastern Sales  
1 Overlook Ave.  
Great Neck, NY 11021-3750  
1-516-487-9357, 1-516-293-3000  
Fax 1-516-487-8402  
[slevitan26@aol.com](mailto:slevitan26@aol.com)

### MIDWEST/Texas/Arkansas/ Oklahoma, Colorado, Arizona

**Ralph Bergen**  
Midwest Sales  
One Northfield Plaza, Suite 300  
Northfield, IL 60093-1214  
1-847-559-0555  
Fax 1-847-559-0562  
[bergenrj@aol.com](mailto:bergenrj@aol.com)

### PACIFIC COAST/Mountain States

**Anita Bartman**  
Hutch Looney & Assoc., Inc.  
6310 San Vicente Blvd.  
Suite 360  
Los Angeles, CA 90048-5426  
1-213-931-3444 (ext. 227)  
Fax 1-213-931-7309



# BASIC STAMP<sup>®</sup> COMPUTERS

## Tiny computers run PBASIC<sup>™</sup> programs

BASIC Stamps are component-sized computers that run PBASIC programs. They have 8 or 16 I/O lines, which can be used for a variety of digital and analog purposes. And their language is both familiar and extensive; the language includes FOR...NEXT, IF...THEN, and GOTO, as well as XOUT, SHIFTOUT, DTMFOUT, and other special commands.

If you've heard about BASIC Stamps, but never took the plunge, now you can do so for less. We now offer a "Starter Kit" for just \$79. The kit contains everything you need to get your feet wet.

**New**  
**BASIC Stamp**  
**Starter Kit for \$79!**  
 Contains our original  
 BASIC Stamp rev. D,  
 plus software, cable,  
 and manual.



John McLean uses BASIC Stamps to gather data in Lechuguilla Cave (America's deepest cave, located in Carlsbad Caverns National Park).



Charles Walsh and his students in Great Falls, Montana, use BASIC Stamps in robotics projects.



Although it may be difficult to see here, that's a BS1-IC next to the white wires.

Issac Kurtz and John Bishop use BASIC Stamps in artificial hands at the Bloorview MacMillan Centre in Toronto, Canada.

**BS1-IC Module** **\$34**  
 8 I/O lines  
 80 instructions max.  
 2000 instructions/sec.  
 2400 baud serial I/O  
 14-pin SIP module



FaxBack #6002

I/O instructions for pushbuttons, potentiometers, pulse measurement, PWM, serial I/O, sound, etc.

**Programming Package** **\$99**  
 Contains programming materials needed to program BASIC Stamps; includes cables, PC software, manuals, and free technical support.

**Carrier Boards** **\$15-\$20**  
 Provide small prototyping area, 9-volt battery clips, and programming connector. Not absolutely necessary, but recommended to make programming and experimentation easy.

**BS2-IC Module** **\$49**  
 16 I/O lines  
 500 instructions max.  
 4000 instructions/sec.  
 50k baud serial I/O  
 24-pin DIP module

Same I/O instructions as BS1, plus touch-tones, frequency generation, pulse counting, serial shift registers, X-10 powerline control, etc. I/O functions common to both modules have a higher resolution on the BS2-IC, due to its faster clock speed.



FaxBack #6004

**New! 4-line Serial LCD** **\$109**  
 New 4-line serial LCD display is fun and useful for projects that require interaction with people. The display only takes one I/O line to operate, and can be controlled using simple SEROUT instructions in your program.



3805 Atherton Road, #102 • Rocklin, CA 95765 • USA • Toll-Free Sales: (888) 512-1024 • Office/tech. support: (916) 624-8333  
 Fax: 624-8003 • FaxBack: 624-1869 • E-mail: info@parallaxinc.com • Ftp: ftp.parallaxinc.com • http://www.parallaxinc.com

Australia +61 39 720 5344, +61 67 722 777 • Austria +49 241 918 90 0 • Belgium +32 4 377 5151 • Bulgaria +359 2 72 77 50 • Brazil +55 11 453 5588, +55 11 801 0045 • Canada (514) 336 9426 • Czech Republic +42 49 5813 252 • Finland +358 31 266 1885 • France +33 3 20 52 98 52 • Germany +49 241 918 90 0 • Greece +30 1 902 0115 • Hong Kong +852 2720 0255 • Hungary +36 1163 2879 • India +91 422 232 561 • Ireland +44 1 977 683 665 • Israel +972 3 498 543 • Italy +39 0542 55400 • Japan +81 3 3251 1779 • Netherlands +31 10 450 4949 • New Zealand +61 39 720 5344, +61 67 722 777 • Poland +48 34 648 882 • Singapore +65 746 8182 • Slovak Republic +42 7 580 2574 • South Africa +27 11 493 6242 • Sweden +46 70 576 14 54, +46 431 41 00 88 • Switzerland +49 241 918 900 • Taiwan +886 2 647 1978 • United Kingdom +44 1 977 683 665 • United States (800) 344-4539 (Digi-Key), (800) 831-4242 (Jameco), (800) 538-5000 (JDR)

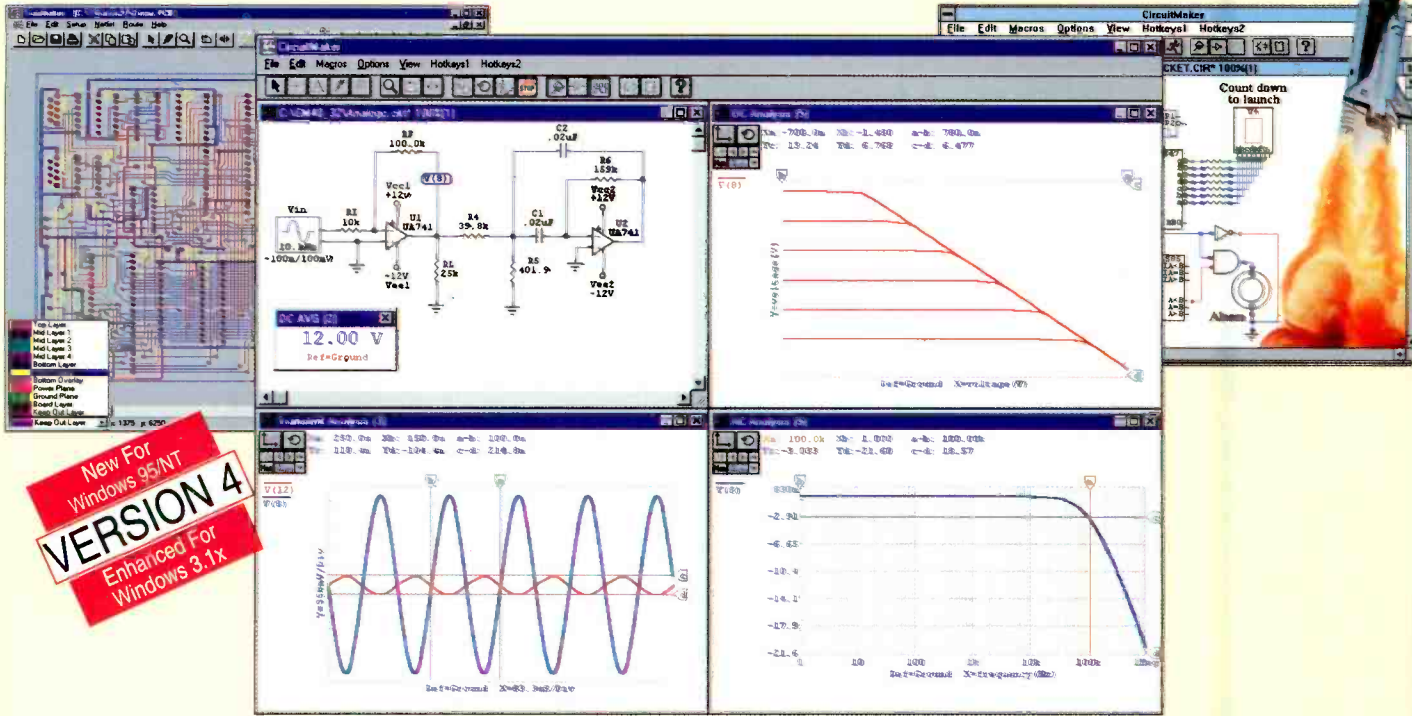
PBASIC, BS1-IC, and BS2-IC are trademarks and BASIC Stamp & the Parallax logo are registered trademarks of Parallax, Inc.  
 Prices do not include shipping and applicable sales tax • Features and prices subject to change without notice. • Prices are U.S. prices only; prices in other countries may vary.

0996PESR

CIRCLE 156 ON FREE INFORMATION CARD

# CircuitMaker<sup>®</sup>

## The Virtual Electronics Lab™



### Professional Schematic Layout

CircuitMaker's schematic capabilities are unmatched and include many advanced editing features not found in similar programs. These powerful features minimize the time and task associated with drawing a schematic and insure a professional looking final product. Printout and export options are numerous and results are of the highest quality. But that's what people have come to expect from CircuitMaker.

### Unlimited, Indestructible Devices

CircuitMaker ships with over 1500 devices. That's more (at no additional cost) than any competing product. If you need a device that is not included, CircuitMaker provides industry standard SPICE import and a powerful macro capability. These indestructible devices accurately emulate actual devices and enable the user to try all those "what if" scenarios with no risk and at no additional cost.

### Accurate Simulation & Advanced Analysis

CircuitMaker features analog, digital and mixed-mode simulation. Obviously, simulation is of no value if the results are not accurate. CircuitMaker's simulation engine is based on Berkeley SPICE3, which is renowned for its accuracy. That's why we can factually state that CircuitMaker provides its user with the most accurate simulation available. Furthermore, CircuitMaker provides a wealth of analysis capabilities not found in other products in its class. No other product offers this much simulation muscle at such a reasonable price.

### Printed Circuit Board Output

CircuitMaker's PCB output capability helps you complete your design cycle, by generating a netlist that can be imported into any compatible PCB program. This is not a costly "add-on module", it comes standard with every copy of CircuitMaker. MicroCode Engineering also offers TraxMaker, a professional level, PCB layout and autorouting program for just \$299. Used in conjunction with CircuitMaker, TraxMaker completes a powerful end-to-end circuit design system.

Advanced Schematic Capture  
 Digital, Analog, and Mixed-Mode Simulation  
 Full SPICE Compatibility  
 SPICE Export/Import  
 PCB Export  
 Retail Price

CircuitMaker	YES	YES	YES	YES	YES	YES	\$299
Electronics Workbench version 4	YES	NO	YES	NO	NO	NO	\$299
Electronics Workbench Engineer's Pack	YES	NO	YES	NO	YES	YES	\$599

**"CircuitMaker Shocks The Competition, With An Unbeatable Bottom-line"**

### Total Customer Satisfaction

At MicroCode Engineering we are committed to total customer satisfaction. When you purchase CircuitMaker you have the confidence of knowing that a trained staff of professionals is available to serve you after the sale. Our free unlimited customer service is second to none! Whether you have general or technical questions they will be answered promptly by a knowledgeable representative.

### FREE Functional Demo

A free functional demo is available on the Internet at <http://www.microcode.com> on CompuServe (GO MICROCODE) and on America Online by doing a file search for CircuitMaker.

Call now to order or request additional information  
**800-419-4242**

