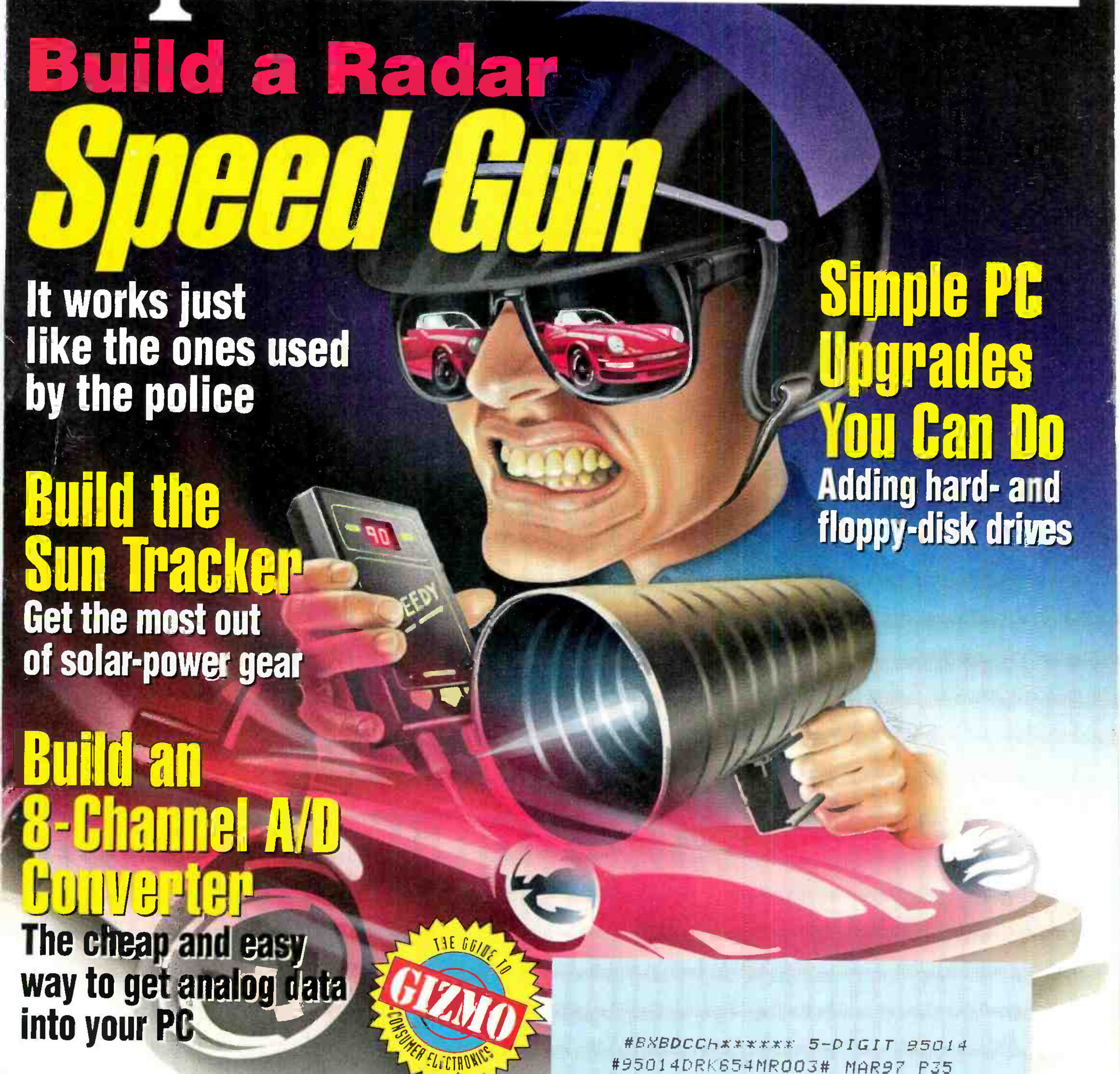
AUTOMOTIVE ELECTRONICS FOR THE 21ST CENTURY

# Popular Electronics®

June 1995




## Build a Radar Speed Gun

It works just like the ones used by the police

## Simple PC Upgrades You Can Do

Adding hard- and floppy-disk drives

## Build the Sun Tracker

Get the most out of solar-power gear

## Build an 8-Channel A/D Converter

The cheap and easy way to get analog data into your PC

THE GUIDE TO GIZMO CONSUMER ELECTRONICS

**Plus:** Computer Bits, Ham Radio, Scanner Scene, Circuit Circus, and More!

A GERNSBACK PUBLICATION

$3.50 U.S.
$3.95 CAN.

#BXBDCCH****** 5-DIGIT 95014
#95014DRK654MR003# MAR97 P35
LLOYD DARKWELL RESP 115
6540 MYRTLEWOOD DR
CUPERTINO CA 95014

# MIXED-MODE POWER

## Design & Verify Faster with Electronics Workbench®


### Analog, Digital & Mixed Circuits

Electronics Workbench® Version 4 is a fully integrated schematic capture, simulator and graphical waveform generator. It is simple to mix analog and digital parts in any combination.

### Design and Verify Circuits… Fast!

Electronics Workbench's simple, direct interface helps you build circuits in a fraction of the time. Try 'what if' scenarios and fine tune your designs painlessly.

### More Power

Simulate bigger and more complex circuits. Faster. On average, Electronics Workbench Version 4 is more than 5 times faster than Version 3.

### More Parts

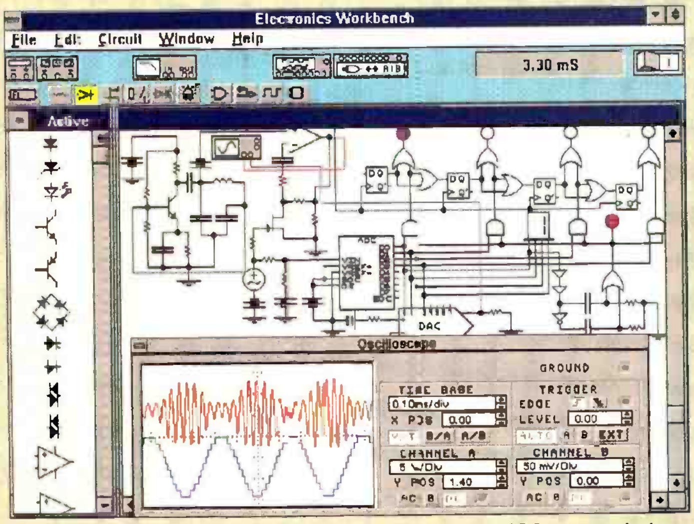
Multiple parts bins contain over twice the components of Version 3.

### More Models

Over 350 real world analog and digital models are included free with Electronics Workbench. And, if you need more, an additional 2,000 models are available.

Electronics Workbench delivers the power you need to design and verify analog, digital and true mixed mode circuits. Over 20,000 customers have already put Electronics Workbench to the test. The result: Better designs… Faster. And over 90% would recommend it to their colleagues.

Electronics Workbench will save you time and money. We guarantee it.*




True mixed-mode simulation: Simultaneous AM transmission, digitization and pulse-code modulation of a signal.

## Call Now: 800-263-5552

**Just $299 + $15 S/H** For Windows, DOS or Macintosh

*30 day money-back guarantee
Free unlimited technical support

Yes, I'm interested in Electronics Workbench.

Name: ____________________

Title: ____________________

Organization: ____________________

Address: ____________________

Phone: ____________________

I prefer to be contacted by e-mail/fax at: ____________________

INTERACTIVE IMAGE TECHNOLOGIES LTD. 9EA1FE2
908 Niagara Falls Blvd. #068, North Tonawanda, NY 14120-2060
Telephone: 416-977-5550 FAX: 416-977-1818
E-mail: ewb@interactiv.com
CompuServe: 71333,3435 BBS: 416-977-3540

INTERACTIVE

Trademarks are property of their respective holders. Offer is in U.S. dollars and valid only in the United States and Canada.

Australia: 2-519-3933 • Brazil: 11-453-5588 • Cyprus: 262-1068 • Denmark: 33-25-0109 • Finland: 0-297-5033 • France: 14908-9000 • Germany: 711-62-7740 • Greece: 1-524-9981 • Hungary: 1-215-0082 • India: 11-544-1343 • Israel: 3-647-5613 • Italy: 11-437-5549 • Japan: 3-3382-3136 • Malaysia: 3-774-2189 • Mexico: 5-396-3075 • Netherlands: 18031-7666 • New Zealand: 9-267-1756 • Norway: 22-16-7045 • Portugal: 1-814-6609 • Singapore: 462-0006 • Slovenia: 61-317-830 • South Africa: 331-6-8309 • South Korea: 2-2-222-3431 • Spain: 1-553-3234 • Sri Lanka: 1-86-5970 • Sweden: 8-740-5500 • Thailand: 66-2-398-6952 • UK: 203-23-3216

CIRCLE 164 ON FREE INFORMATION CARD

# Popular Electronics®

JUNE 1995
Vol. 12, No.6

## COVER STORY

**37 Build a Radar Speed Gun**
Radar speed guns are the police's most valuable ally in keeping the highways safe for everyone. In this article we show you how they work, and how to build your own unit—*Marc Spiwak*

## CONSTRUCTION

**45 Build an Eight-Channel A/D Converter**
You can connect virtually any analog sensor to your computer with this versatile interface circuit—*James J. Barbarello*

**54 Build the Sun Tracker**
Get the most from your solar panels and other solar-power gear with this precision tracking circuit—*Jack Wright*

## FEATURES

**43 Automotive Electronics for the 21st Century**
See one manufacturer's vision of the car of tomorrow, and how its features along with other developments could make driving a dream-come-true—*William D. Siuru, Jr.*

**57 Upgrading and Maintaining your Personal Computer**
These tips can make replacing or adding a hard- or floppy-disk drive a breeze—*Marc Spiwak*

**61 Limited-Space Antennas for SWL's**
Who says you need lots of space to set up a top-notch receiving antenna—*Karl T. Thurber*


Page **37**

Page **43**

Page **57**

POPULAR ELECTRONICS (ISSN 1042-170-X) Published monthly by Gernsback Publications, Inc. 500-B Bi-County Boulevard, Farmingdale, NY 11735. Second-Class 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 $3.50. 

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

# JUNE 1995

## PRODUCT REVIEWS


### 9 Gizmo
Goldstar 8mm/VHS dubbing VCR, First Sounds prenatal listening kit, Quasar laserdisc player, Mountain Network Software computer back-up systems, and much more

### 26 Hands-On-Report
A K Peters Mobile Robot Kit


## COLUMNS


### 23 Multimedia Watch
Some great game controllers—*Marc Spiwak*

### 29 Think Tank
A few observations from our readers—*John Yacono*

### 68 Antique Radio
More on the Minerva restoration—*Marc Ellis*

### 74 Computer Bits
Find it with askSam—*Jeff Holtzman*

### 76 Circuit Circus
An assortment of circuits—*Charles D. Rakes*

### 81 DX Listening
A legend pulls the switch—*Don Jensen*

### 83 Ham Radio
NE-602 oscillator circuits—*Joseph J. Carr*

### 85 Scanner Scene
Frequencies to go—*Marc Saxon*


## DEPARTMENTS


**3 Editorial**

**4 Letters**

**6 New Products**

**79 Electronics Market Place**

**87 Electronics Library**

**91 Popular Electronics Market Center**

**134 Advertiser's Index**

**135 Free Information Card**



# Popular Electronics

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

**EDITORIAL DEPARTMENT**
**Carl Laron,** editor
**Dan Karagiannis,** associate editor
**Teri Scaduto,** assistant editor
**Evelyn Rose,** editorial assistant
**Marc Spiwak,** editorial associate
**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
**John Yacono,** contributing editor

**PRODUCTION DEPARTMENT**
**Ruby M. Yee,** production director
**Karen S. Brown,** production manager
**Kathy Campbell,** production assistant

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

**Jacqueline P. Cheeseboro,** circulation director

**Michele Torrillo,** POPULAR ELECTRONICS bookstore

**BUSINESS AND EDITORIAL OFFICES**
Gernsback Publications, Inc.
500-B Bi-County Blvd.
Farmingdale, NY 11735
1-516-293-3000
FAX: 1-516-293-3115
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 134**

Composition by Mates Graphics

Cover by Loewy Design
Cover Illustration by John Edwards

ABC AUDITED

# EDITORIAL

## A BALANCED VIEW

If you have spent any appreciable amount of time in a car, you've undoubtedly seen "smokey" at work. Part pop-culture icon, part big brother, smokey's job is to keep the highways safe.

The police serve an important role on our highways. While no one likes being stopped for speeding, I think we'd all be a lot more unhappy if they were not out there making the highways and interstates much safer for everyone. One of the most important tools the police have for that task is the radar speed gun. In this month's issue of **Popular Electronics**, we examine how radar guns work, and show you how to build a demonstration unit that works just like the real thing. That story begins on page 33.

Speaking about cars and highways, this month we also offer a sneak peak at what you could be driving in the next century. In "Automotive Electronics for the 21st Century" we look at one car-maker's vision of the future, and how its car, along with developments like the Intelligent Vehicle Highway System (IVHS), could completely change the way we drive. That story begins on page 43.

Also this month, we continue our occasional series on upgrading and maintaining personal computers with a look at how to replace or add a hard- or floppy-disk drive to your PC. In addition to providing you with all the information you need to successfully complete the job, we offer some common-sense advice to make the task go easier.

Of course there's also much more. A sun-tracking circuit for use with solar-power gear; a rundown on limited-space antennas for shortwave listeners; a versatile, multi-channel A/D converter; **Gizmo**, and its look at the latest in consumer electronics; and all of the regular columns and features that you've come to expect each and every month. It's all part of our mission to provide the most comprehensive and complete coverage of the electronics hobby.

Carl Laron
Editor

# LETTERS

## VACUUM-TUBE AMPLIFIER CONSIDERATIONS

I was pleased to see a phase-splitting transformer used in Larry Lisle's article, "Build A Vacuum-Tube Amplifier" (**Popular Electronics**, January 1995). A high-quality transformer is a component that never has to be replaced, as do tubes, and is much more reliable than transistors. A higher-turns-ratio transformer could have been used, because tubes with negative grids have a practically infinite input impedance. But check out the frequency response specification before giving it consideration in the design stage. A high turns ratio, because of the winding capacitance, usually gives a lower frequency response. The transformer that Mr. Lisle used is apparently equivalent to Stancor part number A53C, which has a frequency response of 100–10,000 Hz.

Mr. Lisle states, "The push-pull arrangement of the tubes tends to cancel the even harmonics." But that is true only if the tubes have *identical* characteristics and equal cathode resistors. In this case, the cathode resistors might not be equal. They also impart a small amount of negative feedback. With cathode resistors there is no possible instability as with feedback loops. The trade-off is some wasted DC power in the resistors.

Even harmonics are not discordant because they are octaves of the fundamental—but only for harmonics that are powers of two, for example, the second, fourth, eighth, etc. The sixth, tenth, twelfth, etc. harmonics are discordant because they are multiples of odd numbers. Amateur amplifier builders might give consideration to the single-ended output stage as the sixth and higher harmonics might be a good trade-off for the second and fourth harmonics, which have the effect of giving audio a brighter sound. People who pay high prices for matched output tubes should also consider that. I've seen prices around $100 for a matched pair.

Amateur amplifier builders and "tube-philes" should be aware of vertical JFET (V-JFET) transistors. Those transistors are constructed with the gate configured as parallel fingers somewhat like the grid of a vacuum tube. Because of that, the characteristics are much like those of the triode vacuum tube. One such V-JFET was the 2SK60, which was manufactured by Siliconix Inc. but is no longer available. The characteristics of the 2SK60 can be found on page 262 of the book, *Designing with Field-Effect Transistors* by Siliconix Inc. (McGraw-Hill).

C.W.
*San Francisco, CA*

## ERRONEOUS SCREEN SHOT

I find Jeff Holtzman's *Computer Bits* columns to be both informative and entertaining. But, after reading the February 1995 issue of **Popular Electronics**, I found a few things that didn't seem right in the screen shot of Landmark Version 2.0.

In the article, Mr. Holtzman said that the upgraded system is tolerable. However, I think he would really be pleased with the performance once he pushed in the turbo switch. The Landmark speed test showed typical values for a 486 DX2-50 running in "un-turboed" mode. With the turbo switched on, you should get values around 165 MHz for the CPU and 400 MHz for the FPU.

The video speed also seemed very slow (and shouldn't be affected by the turbo setting). I have an older Genoa 1-megabyte AT Bus video card that landmarks at about 8000 ch/ms. I also tested a Genoa 8500 VESA Local Bus card (it costs about $100) that landmarks in excess of 11.000 ch/ms. ATI is supposed to make pretty good video cards, so I find it odd that Mr. Holtzman's landmarks so slowly.

R.O.
*Fresno, CA*

*Sharp eyes! Actually, the turbo switch was pressed, but during testing I had used keyboard commands (Ctrl-Alt-+ and Ctrl-Alt- –) to switch speeds and compare. I must have inadvertently done the screen capture in slo-mo mode. The low video score is mysterious to me. I cannot reproduce it. The score on that system runs a little over 7000 ch/ms.—Jeff Holtzman*

## HAVES & NEEDS

As a young man, when I worked for the U.S. Postal Service as an electronics technician, I used to drool over the Heathkit catalog. Now that I am retired and can afford the time and money to build their kits, I find that they are no longer available.

I wonder if someone has the Heathkit Engine Analyzer Oscilloscope that worked on 12-volts DC. I would pay a fair price for a kit, whether or not it was completed. Any help in locating such a kit would be greatly appreciated.

DAVID L. HOLT
*20 Garden Drive*
*Colorado Springs, CO*
*80904-4414*

I am in need of the schematic and parts list for a Panasonic RF-4900 ten-band communications receiver. A repair manual would also be helpful. I will cover the costs of copying and mailing, if necessary.

I also need three oscilloscopes to be modified for a project I'm working on. They need not work (junkers are okay), but I also need the schematics. One scope should have a three-inch round tube. I am willing to pay a reasonable price for such scopes.

Finally. I am interested in starting up a club for folks who collect. restore. and repair vacuum-tube test equipment.

CRAIG KENDRICK SELLEN
*Box 1038. 58-B. RR-1*
*Waymart. PA 18472*

# NEW PRODUCTS

## Keyboard-Enhanced Personal Digital Assistant

*Sharp's Zaurus ZR-5000* keyboard-enhanced personal digital assistant (K-PDA) is a handheld personal communications tool that offers speedy access to information, powerful integrated software, and months of battery life. Unlike PDA's that rely primarily on handwriting recognition for inputting information, Zaurus offers both the convenience of the pen for note-taking, drawing, and accessing information, and the productivity of a keyboard for text-intensive applications. The K-PDA has one megabyte of internal memory, 750K of which is available for user data and add-on software programs.


Aimed primarily at mobile professionals, Zaurus can send and receive e-mail, send faxes, access on-line services, exchange information with local and remote PC's, take notes on an electronic note pad, create maps and drawings, generate documents with an intelligent word processor, and manage their time and information anytime, anywhere. Adding to its communications capabilities, Sharp's optional Zaurus Mail system allows small work groups to exchange messages and data using a single Windows-based PC as an electronic post office. Employees of small companies, or individual departments within larger corporations, can keep in contact with each other and with the home office.

A PCMCIA Type II slot allows users to expand both the memory and the communications capabilities of the Zaurus. Users can add additional memory using up to 2-megabyte SRAM cards or 16-megabyte FLASH cards. The K-PDA also supports many PCMCIA Type II devices, including cellular-capable fax/modems and pager cards. To leave the PCMCIA slot open for other devices, Sharp's ultra-compact, low-power CE-FM4 9600/2400-bps fax/modem can be attached directly to the serial port of the Zaurus.

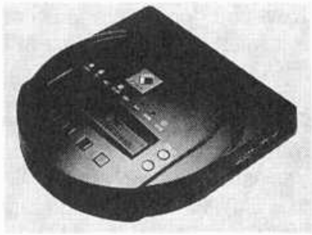
The Zaurus uses Sharp's proprietary 16-bit processor to provide both fast performance and low power consumption, with up to two months of battery life. The Synergy operating system is hidden from the user, freeing him or her from mundane system-management tasks. Synergy is "data-centric," with the ability to relate to different types of information. A graphical user interface provides elements that Windows and Macintosh users will find familiar, such as check boxes, radio buttons, scroll bars, and pop-up menus. In addition, pen-enabled features, such as text selection and drag-and-drop, provide fast and intuitive operation.

The Zaurus ZR-5000 has a suggested retail price of $749. The ZR-5000FX, which includes the CE-FM4 fax/modem, has a suggested retail price of $849. For more information, contact Sharp Electronics Corporation, Sharp Plaza, Mahwah, NJ 07430-2135; Tel. 1-800-BE-SHARP.

**CIRCLE 100 ON FREE INFORMATION CARD**

## EXTERNAL FAX/MODEM

The *Bullet 100E* 28.8-kilobyte-per-second (Kbps) external modem with integrated fax from



*E-Tech* complies with all the specifications of the recently adopted ITU V.34 standard. It is also V.23-compatible for European and other videotext users. A 16-bit CPU, along with an enhanced controller code, maximizes data throughput. The modem can operate at all conventional line speeds from 28.8 Kbps to 300 bps. The integrated fax operates at 14.4 Kbps and can communicate with Group 3 send and receive fax machines. Free fax software for DOS and Windows is included; Mac software is available as an option.

The Bullet's sleek, attractive design resembles a CD-ROM player. Its LCD panel displays line conditions and throughput speeds so that the connection can be easily checked. The LCD and Smartkeys make it easy for users to set and change their modem configurations. Other high-end features include lease-lined operation with auto-dial backup, caller ID, distinctive ring, built-in Flash-ROM for easy upgrades, local and remote configuration, and password and callback security.

The Bullet 100E external fax/modem costs $499. For additional information, contact E-Tech Research Inc., 1800 Wyatt Drive, Suite 2, Santa Clara, CA 95054; Tel. 1-800-EBULLET; Fax: 408-988-8109.

**CIRCLE 101 ON FREE INFORMATION CARD**

## POCKET DMM WITH BARGRAPH

*B + K Precision's* first pocket digital multimeter, *Model 2700*, measures AC and DC volts and resistance, and offers data hold, range hold, audible continuity test, diode test, a bar-graph display, and a 3200-count LCD readout. Data hold freezes the display to hold a reading, while range hold allows users to defeat autoranging and select one specific voltage or resistance range for all their measurements.

The Model 2700 is aimed at electronic technicians, electricians, home handymen, college students, and hobbyists. The pocket DMM measures up to 450 DC volts in five ranges with 1.3% accuracy (0.7% on the 3-volt range). It measures AC volts to 450 volts in four ranges, and resistance to 30 megohms in six ranges.

The Model 2700 pocket digital multimeter, complete with test leads that store conveniently in its carrying case, an instruction manual, and two 2.5-volt button cells, has a suggested retail price of $33. For additional information, contact B + K Precision, 6470 West Cortland Street, Chicago, IL 60635; Tel. 312-889-1448.

**CIRCLE 102 ON FREE INFORMATION CARD**

## AMPLIFIED TV/FM ANTENNA

*Recoton* recommends its *Bullseye* amplified TV/FM antenna for general use as well as in homes equipped with the new Digital Satellite System (DSS), which does not deliver local broadcast channels 2 through 13. Bullseye can provide DSS subscribers who live a considerable distance from TV

transmitters with a cost-efficient way of receiving those programs.

The antenna's built-in, ultra-low-noise amplification circuitry improves reception of TV programs broadcast from up to 125 miles away, as well as enhancing AM and FM broadcasts. Using the antenna results in VHF signal gains of up to 24 decibels, UHF signal gains of up to 29 decibels, and up to 12-dB FM-signal gains.

Bullseye also features circuitry to reduce RFI, which causes signal interruptions from sources such as CB radio transmissions. The antenna's omnidirectional reception pattern, achieved through the use of a sophisticated quad-yagi circuit, eliminates the need to aim the antenna toward station transmitters.

With its circuitry enclosed in a sealed copolymer housing that is resistant to ultraviolet rays and hostile weather, the Bullseye is suited for outdoor mounting on rooftops or chimneys. It can also be tucked out of the way indoors in attics, closets, lofts, or garages.

The Bullseye omnidirectional TV/FM antenna has a suggested retail price of $139.95. For further information, contact Recoton, 46-23 Crane Street, Long Island City, NY 11101; Tel. 800-742-3438 or 718-392-6442; Fax: 718-784-1080.

**CIRCLE 103 ON FREE INFORMATION CARD**

## CARBON MONOXIDE DETECTOR

A malfunctioning furnace or household appliance can fill a poorly ventilated room with carbon monoxide, an odorless, colorless, and tasteless gas that can poison the air in a home without warning. The *Radio Shack Carbon Monoxide Detector* can warn your family of the potentially deadly fumes.

The detector continuously monitors the air in your home to warn of dangerously high concentrations of carbon monoxide, sounding an 85-dB alarm when high levels are reached. Meeting UL-approved safety standards, the device automatically compensates for temperature changes for maximum sensitivity and reliability.

The Carbon Monoxide Detector installs by simply plugging into an AC wall outlet. An optional DC adaptor allows it to be used in recreational vehicles, travel trailers, and boats. Detectors should be placed near appliances or equipment that use combustible fuel, including clothes dryers, stoves, fireplaces, and furnaces. The Federal Consumer Product Safety Commission recommends that multilevel homes should be equipped with a UL-listed detector on each level.

The Carbon Monoxide Detector is available for $79.99 at Radio Shack stores nationwide. For more information, contact Radio Shack, 700 One Tandy Center, Fort Worth, TX 76102; Tel. 817-390-3300.

**CIRCLE 104 ON FREE INFORMATION CARD**

## DIGITAL MULTIMETER

The *WP3910* portable digital multimeter from *Windward Products* measures capacitance from 2000 pF to 20 µF, so users don't need a separate capacitance tester. The 3½-digit, ¾-inch LCD readout, which has a maximum reading of 1999, is updated two to three times each second. The DMM reads the standard measurements: AC/DC voltage to 700 VAC/1000 VDC, AC/DC current to 20 A, and resistance to 200 megohms. Overload protection is provided for both voltage and current measurements. The portable meter also offers a transistor hFE tester, an audible continuity tester, and a diode tester. The DMM's auto power shut-off feature extends the life of its single 9V battery.

The WP3910 digital multimeter, including probes, operating instructions, and one-year warranty, costs $54.95. For further information, contact Windward Products, 2089B Walsh Avenue, Santa Clara, CA 95050; Tel. 408-987-7733; Fax: 408-987-7735. ■

**CIRCLE 105 ON FREE INFORMATION CARD**

# GIZMO®

## *Double Deck-er*

**VH8 8mm/VHS VCR DUBBING DECK MODEL GVR-DD1. From Goldstar Electronics International, Inc., 1000 Sylvan Avenue, Englewood Cliffs, NJ 07632; Tel. 201-816-2000. Price: $899.95.**

CIRCLE 59 ON FREE INFORMATION CARD

The 8mm format has become the most popular camcorder format in this country. In fact, more than 8-million Americans now own 8mm camcorders. The benefits are obvious—8mm camcorders are small, lightweight, and easy to carry along on vacations and to family gatherings. The one major drawback is that you can't play back an 8mm tape on your VHS VCR. Viewing your 8mm video productions requires connecting a cable from the camcorder to your television.

That is not ordinarily considered a difficult task for most people. However, we have heard of one severely technically-challenged family who proudly showed off their family-reunion video at Christmas dinner—by passing the camcorder around the table from guest to guest, making each of them watch the entire tape through the camcorder's black-and-white viewfinder!

In general, though, connecting the camcorder to a television for playback, or to a VCR for dubbing and editing, is merely an inconvenience, especially if your television does not offer front-panel jacks.

*Goldstar* offers a way to sidestep that inconvenience, with its *Model GVR-DDI VH8™* dual-deck video cassette recorder. With separate tape wells for 8mm and VHS tapes, the VH8 allows you to simply pop in an 8mm tape and play it back on your TV. The 8mm portion plays either standard or Hi8 tapes, but Hi8 tapes are played back with normal 8mm resolution. Insert a blank VHS tape in the other well, and you're ready to make copies or do some post-production work.

The VH8 is a standard-size VCR with a flip-down door that hides virtually all of its front-panel features. The only exceptions are two icons labeled "8" and "VHS," which will light to indicate that either the 8mm or the VHS deck is currently in use. With the door pulled open, the VH8's split personality is revealed. To the left of the unit is the 8mm tape well, with the basic controls (STOP/EJECT, REWIND, PLAY, FAST FORWARD, PAUSE) arrayed in a row beneath it. The right side of the unit features the larger VHS tape well with the same array of controls, as well as the POWER button, audio/video in and microphone jacks, and the RECORD button. Between the two sets of control buttons is found the display.

The VH8's remote control is anything but standard size or shape. Roughly square, made for two-handed use, the remote control also features separate sets of basic controls for the 8mm and the VHS portions of the VCR. Those controls, found along the bottom of the remote, are always visible. The rest of the controls, including those for the unit's special editing features, are hidden under a flip-up door.

The VH8 offers a host of impressive dubbing and editing functions, as well as the requisite support features. The VHS portion offers four double-azimuth video heads, a flying erase head, and a (very basic) titler. You can do one-touch copying, assemble editing, or insert editing from the 8mm portion to the VHS portion of the VH8. A programmable assemble editor lets you simply enter the start and stop points for up to five scenes, and the VH8 will automatically assemble them. The front-panel microphone input allows you to easily record over or add to the original soundtrack.

The VHS Index Search System (VISS) makes it easy to find the beginning of each new recording on your tapes. The VH8 automatically places an index mark at the start of each recording, and manual VISS allows you to mark any place on the tape during recording, playback, or insert editing. To find the index marks, you press the VISS button before pressing either FAST FORWARD or REWIND. The tape will move quickly to the next signal marked, and then go into play mode for about five seconds before searching for the next VISS mark. Pressing PLAY stops the searching.

For simple copying from 8mm to VHS, the deck offers one-touch editing. Locate the starting points on each tape and press the A.EDIT/ONE TOUCH COPY button on the remote control to begin copying. Press the STOP/EJECT button on the VHS deck to finish. To copy more than one scene, press the A.EDIT/ONE TOUCH COPY BUTTON, or the 8mm STOP/EJECT button, to put the 8mm deck into still mode and the VHS deck into record-pause mode. When you've found the second scene on the 8mm tape, begin one-touch copying again.

Although audio and video dubbing requires both decks to be taken out of the pause mode at the same time—just as when using two discrete decks—that's easier to do with the VH8 than when dubbing from deck to deck (or camcorder to deck), because all the necessary controls are found on one remote control.

An on-screen menu facilitates assemble editing by directing the user to enter the start and stop times for up to five scenes. When the start of a desired scene is located on the 8mm tape, a press of the BEGIN button indicates the starting point to the VH8. Similarly, a press of the END button indicates the end point. When those steps have been repeated for as many as five scenes, a touch of the A.EDIT/ONE TOUCH COPY button puts the automatic process in motion.

The title generator, which can be used only during VHS operation, is quite basic, though effective. By selecting "titling" from an on-screen menu, several small white blocks appear on-screen. Those blocks represent the size, shape, and position of the letters in your finished title. Each of those factors can be manipulated using certain numeric keys on the remote control. The number 7 selects the letter height, for instance, and the number 9 selects width. Choosing the actual letters involves a somewhat clumsy procedure, requiring that you scroll through the alphabet for each letter, until the entire title is inserted. To record the title, press the REC/ITR button.

Copying and editing using the VH8 is quite easy. The dual-deck provides 8mm camcorder owners with a headache-free way to make VHS copies of 8mm tapes for friends and relatives, and to perform the post-production tasks that make those tapes more interesting.

Of course, when the VH8 isn't pressed into 8mm/VHS dubbing duty, it will be expected to serve as the family VCR. Despite its other capabilities, it will probably be used most often for viewing prerecorded movies, and also for recording shows from cable or broadcast TV.

The VH8 serves well in both those capacities, with two regrettable exceptions. First, it offers only monaural sound. We consider Hi-Fi stereo to be a prerequisite for any VCR that will be used for playing back movies on a home-theater system. We hope that Goldstar will make a future version of this deck that includes stereo capability.

The second problem was probably a glitch in our review unit, but in this case, "remote" control was a misnomer. Ours only worked within about three feet of the VCR, making it anything but remote. We replaced the batteries a couple of times, with no discernible improvement in performance. In fact, the only thing that seemed to help was when the remote control was accidentally knocked from the coffee table to the floor three times in one evening. *Then* it seemed to work correctly—but the fix lasted only for that one evening, unfortunately.

Gizmo is published by Gernsback Publications, Inc., 500-B Bi-County Blvd., Farmingdale, NY 11735. Senior Writers: Chris F. O'Brian and Teri Scaduto. 

The remote control is essential for using the VH8 for anything other than playing back tapes, because only the most basic controls are found on the front panel of the unit. We were tempted to replace it with a universal remote for the duration of our testing, but we know of no manufacturer that makes a replacement remote with the editing features offered on the original supplied with the unit.

Along with the editing controls, the timer-recording controls are located under the flip-up panel on the remote, as are the buttons used for setting the clock and calendar. On-screen menus make it easy to set the time and date, and to program timer recordings. The VCR offers eight-event/one-year timer recording.

Also found on the remote control are buttons for automatic channel programming and tracking. Automatic channel programming is a one-touch feature that scans and stores available TV and cable-TV channels in memory; channels can also be added or deleted manually. Digital auto tracking automatically monitors and adjusts 8mm and VHS tracking to maintain the optimum playback picture. Besides SP, LP, and EP modes, VHS playback options include variable slow motion, still/freeze frame, frame advance, double-speed play, and several search functions.

As a playback VCR, with the exception of its lack of Hi-Fi sound, the VH8 offers average to good performance. Playback controls are conveniently located on both the front panel and the remote control, picture quality is good, and the on-screen menus make it easy to time-shift recordings.

Of course, you won't be buying the VH8 just to play back the tapes you rent at Blockbuster, or to tape this week's episode of "Seinfeld" while you go bowling. It's the ability to play back 8mm tapes recorded on a camcorder, and to copy and edit those tapes into VHS format for distribution to friends and relatives, that will attract buyers to the VH8.

And, in those capabilities, the VH8 stands alone in the field. Watching an 8mm tape is as easy as popping in and watching any VHS tape—and copying and editing aren't much harder. Editing performance is good, with clean, accurate scene marking. The addition of a built-in titler and mic-mixing capability provides some post-production finesse for the amateur videographer.

If you frequently use an 8mm camcorder, and have accumulated a library of rarely watched 8mm tapes, (thanks to the nusiance and inconvenience of hooking up a camcorder to your monitor), the VH8 was designed with you in mind. For that type of user it is a good investment. Check it out! ■

# *Video Killed the Radio Star*

**REEL-TALK RT-101 RADIO RECORDER. From: Reel-Talk, Inc., 4790 Irvine Blvd, Suite 105-406, Irvine, CA 92720. Tel. 714-544-6725. Price: $99.95.**

When radio was first introduced, newspaper publishers became very nervous that it would supplant the public's need for newspapers. A similar fear struck radio broadcasters when TV was introduced. Of course, it turned out that the three media were able to co-exist quite well.

There is no question, though, that video is king. There is some indication that radio still wields some power—witness the attention paid to talk-show host Rush Limbaugh and shock-jock Howard Stern, not to mention the Congressional uproar over government funding of "liberal" National Public Radio broadcasts. However, there are more indications that a lot of people don't really take radio seriously, relegating it to background music while commuting, working, or relaxing.

Even consumer-electronics companies don't treat radio with much respect. For example, stereo receivers—even ones with high-quality amplifiers—often seem to treat the tuner as an afterthought. That's especially true of the AM section. Perhaps a better indication is that while video time-shifting capability is built into virtually every VCR, it is almost impossible to find a stereo receiver that permits the same. The clock has virtually disappeared from stereo equipment.

There is, however, at least one company that respects the value of radio programming and the needs of serious radio listeners: *Reel-Talk, Inc.*, which manufactures the *Reel Talk RT-101*—what the company calls "The Talk Show Recorder." The Reel-Talk operates like a VCR for the radio, and allows the time-shifting.

For many people, the thought of time-shifting radio programming seems a bit odd. Tune into most stations, and there's little difference between what they are doing at 1 AM and what they are doing at 1 PM. Serious radio listeners, however, know that it is possible—but not necessarily easy—to find some diversity on the radio dial. Some of the better, more interesting programs, however, are broadcast when it's not necessarily convenient to listen. For instance, "Selected Shorts," an NPR program of short-stories read by celebrities before a live audience, airs locally on Saturday afternoon—a time generally relegated to family activities or chores. It would be fine entertainment during the morning or evening commute, perhaps instead of listening to an audio book.


CIRCLE 60 ON FREE INFORMATION CARD

In the past, we've gotten along by recording radio programs on a VCR set up for timer recording. It's a cumbersome arrangement, because we must string the cables each time we want to record, and we must leave the radio on and tuned to the station we want to hear. Reel-Talk is a much more elegant solution.

Reel-Talk is a combination radio receiver and cassette recorder. What makes it special is its ability to record up to three hours of programming on one side of a standard 90-minute cassette tape. It doesn't do it by magic, but simply by slowing the tape speed dramatically.

The receiver is a rather odd-looking component; it has a reasonably small square footprint 6¼ inches on a side, and it is 12 inches tall. The bottom half of the front panel houses the speaker. The top half contains a digital frequency and clock display and an assortment of 18 pushbuttons and slide switches. The top of the Reel-Talk contains the cassette well and the standard cassette-function pushbuttons.

A detachable AC power cord allows the receiver to be powered from the power lines. It can also, however, be powered by six "D" cells for portable operation. Three "AA" cells can be installed to back up the clock and tuner memory.

Although Reel-Talk has only five memory pushbuttons, up to ten AM and ten FM stations can be programmed into its memory. Not only can each memory button hold one AM and one FM station, but each also has a "shifted" position (accessed with a push of the SHIFT key), so that each memory position can store up to four station frequencies.

Up and down tuning buttons allow Reel-Talk to be tuned. Alternatively, a touch of the memory-scan button causes the receiver to skip through the preset radio stations in each band in five-second steps.

Taping radio programs off the air is simply a matter of tuning to the desired program, and pressing the RECORD and PLAY buttons on the cassette recorder. Time-shifting recordings is also rather easy. First, of course, the clock must be set for the correct time. That's done by holding down the memory buttons and then pressing the tuning buttons to set the time. The down-tuning button advances the hours, and the up-tune button advances minutes.

Then the start and stop times must be entered. That's accomplished by pressing the MODE button, which will cause the ON TIME annunciator on the LCD to flash. That indicates that Reel-Talk is ready to accept an input that sets the record-start time. Press the MODE button again, and the OFF TIME annunciator flashes. The time is entered in the same way.

Once the recording on and off times have been programmed, you must slide the Radio/Tape function switch to Radio, tune the station you want to hear, and set the volume at which the radio will come on (which doesn't affect the recording volume). Then the TM ON/OFF button must be pressed so that the TIMER annunciator appears in the LCD. Next, the TIMER slide switch on the back of the unit must be set to the Timer position. Finally, a tape must be inserted in the cassette well, and the RECORD and PLAY buttons must be pressed.

We found the unit to work flawlessly when recording programs—as long as we were careful about watching the AM and PM indicators on the LCD. Reel-Talk also makes a pretty good alarm clock.

The quality of the recordings leaves something to be desired. That's to be expected, however—it's a direct result of slowing the tape speed to less than half-an-inch per second. Still, it is definitely listenable, especially for talk radio. On playback, a bass-boost circuit can make it still more listenable.

Even though Reel-Talk isn't recommended for recording music, we used it for that rather often, although not the way you might expect. For the most part, we would have no desire to tape WXRK, a local classic-rock radio station. However, on Sunday nights, veteran disc-jockey Vin Scelsa hosts a show dramatically different from anything else the station broadcasts, often featuring live interviews and in-studio performances by relatively obscure, up-and-coming bands. When we couldn't be home on Sunday night, we let Reel-Talk record the show for us. We would play it back and listen to it, even with its less-than-high-fidelity performance, so that we could be introduced to music that we otherwise wouldn't get to hear. If we heard something we liked, we could go out and buy the CD, and get the high-fidelity performance that we like.

Similarly, we could tape "New Sounds with John Shaefer" and "Spinning on Air," two shows produced at WNYC, one of New York's public radio stations. Or we could tape some of the jazz festivals programmed at Columbia University's WKCR. We wouldn't want to listen to the music tapes more than once, but for identifying interesting artists or recordings, they were invaluable.

On the talk-radio front, we could tape such programs as the "Personal Computing Show," "Off the Hook," or "Earth Watch," three excellent talk shows produced at WBAI, a listener-sponsored station of the Pacifica Network. And we were finally able to catch some of the sci-fi stories, read by their authors, that are featured at 5 AM each Saturday on WBAI's "Hour of the Wolf."

Considering its diversity, New York's radio is more homogeneous than that of most cities in the U.S. However, between the interesting talk radio and music programming that the stations we mentioned produce, we found plenty of things to time shift—things that we'd have to otherwise pass up.

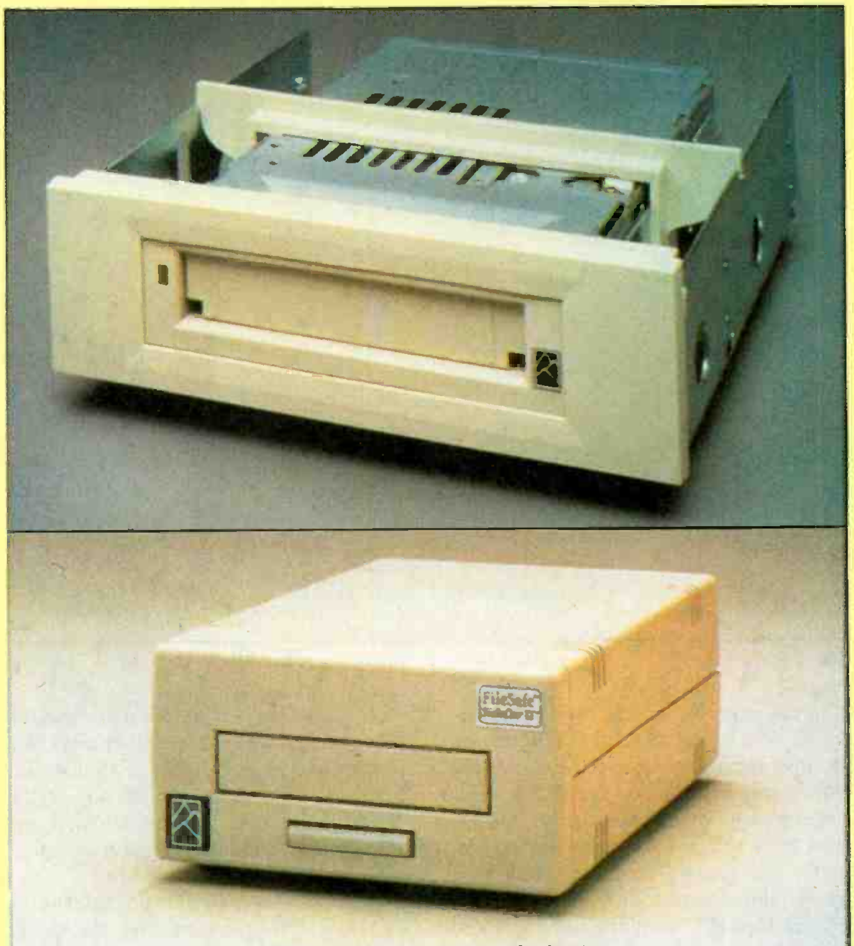
There are a couple of features we'd like to see added to Reel-Talk. First, we'd like to be able to listen to the radio even when the timer is set. That would require that the cassette deck be electronically controlled. Now, when the timer is set, the radio and cassette-player power must remain off, because the RECORD and PLAY buttons must be pressed. The second feature on our wish list would be the ability to record from multiple stations at multiple times without resetting the timer.

We'd also like to see jacks for external antennas, especially for the FM band. The built-in ten-inch whip is just not adequate to deliver the performance that we expect. The AM antenna, a built-in loopstick, does provide reasonable performance.

Even though Reel-Talk doesn't have all of the features that we'd like to see, we still think that it's a great product for anyone who loves radio. ■

# *Backing Up*

**FILESAFE FIRST BACKUP SOFTWARE, AND FILESAFE SIDECAR II AND FILESAFE TD-700 TAPE BACKUP SYSTEMS. From: Mountain Network Solutions, Inc., 360 El Pueblo Road, Scotts Valley, CA 95066-4268. Tel. 408-438-6650. Prices: FileSafe First, $79; SideCar II, $399.; TD-700, $399.**




CIRCLE 61 ON FREE INFORMATION CARD

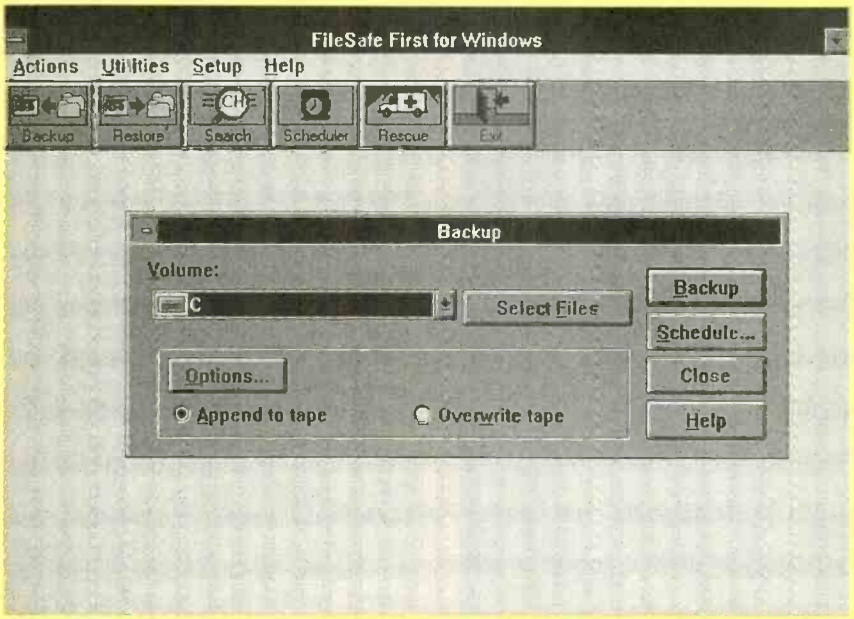
The reliability of hard-disk drives has improved dramatically in the past decade at the same time as their prices have dropped and storage capacities have increased. That is not, however, a good reason to forego backing up a drive. Eventually, a disaster will occur.

If you use your PC strictly for entertainment, a hard-drive failure is little more than a big inconvenience. It means that you'll have to pull out all of your installation disks and re-install all of your software. (On the plus side, that will allow you to get rid of all the junk that tends to accumulate on a big drive.)

But more and more people are using their PCs—even those bought for entertainment—for real-world applications such as banking from home or managing the household budget. Anyone who has invested the time and effort to record all the family's financial transactions into a program like Quicken, expecting their bill-paying, tax-preparation, investment, and budgeting chores to be handled automatically, will not appreciate having to recreate all that data in the event of a crash.

Computer manufacturers are doing consumers a disservice by not including tape backup drives as standard equipment in new systems. In today's cut-throat competitive computer marketplace, manufacturers strive to keep the price of their systems as low as possible. Because the addition of a backup drive would increase a system's price, manufacturers simply leave it out. Unfortunately, that gives consumers the wrong impression about the importance of backing up the hard disk. The truth is, however, that if you rely on the integrity of information on your hard-disk drive, you're making a big mistake if you're not backing it up regularly.

*Mountain Network Solutions*, a leading supplier of network backup subsystems and data-management software, has two products that provide PC users with sensible backup options: the *FileSafe Sidecar II* and *FileSafe TD-700* backup systems.




**Filesafe First software makes backing up a hard-disk drive a breeze.**

The FileSafe Sidecar II is the backup system to get for convenience and portability—it connects to a computer's parallel printer port, and no additional interface card is required. Thus, the Sidecar II is ideal for backing up the hard drive on a laptop computer. We found it most useful, however, for transferring data and program setups from one computer to another—for example, when setting up a new computer or getting ready to take a laptop on the road.

Mountain's FileSafe TD-700 addresses a problem that has come about only relatively recently—high-capacity hard-disk drives. Although we've all benefited from the hard-disk price reductions that have occurred, large-capacity drives are harder to back up. The TD-700, however, can store up to 700 megabytes of data on QIC-3010 tapes.

It would be difficult to imagine a backup system that was easier to install than SideCar II. Just plug its wall-mount transformer in, and connect the supplied cable to the computer's parallel port. (A pass-through connector allows a printer to be connected to the SideCar II, so that both devices share a single parallel port.)

The only potential problem is that careless users could connect the cable incorrectly. The SideCar II has two port connectors on its rear panel: one male and one female DB-25 connector. The male connector is intended to attach to the computer's parallel port via a 25-pin cable with a male connector on one side and a female on the other. If a user were to bypass the instructions, he or she could conceivably hook up the device to the computer's serial port and damage the SideCar II. The connectors are labeled clearly enough, however, that it shouldn't happen.

The Sidecar system is aimed primarily at laptop- and notebook-computer users, who don't normally have any expansion ports available on their machines. However, as portable computers are used for more mission-critical work, backing up their data becomes more important. The portable system also can be a real convenience for computer-support personnel when installing new computer systems or updating software.

SideCar II is compatible with Mountain's "format-on-the-fly" software feature, which permits tapes to be formatted as they are used, so pre-formatting tapes is not necessary. The SideCar II can read and write tapes that conform to the QIC-80 format standard. It can also read QIC-40-formatted tapes. It can read and write DC2080 and DC2120 data cartridges

The storage capacity on a 2120 cartridge is 305 megabytes with compression. The speed rating of the Sidecar II is up to 10 megabytes per minute—a speed that we never saw. According to Mountain, the lower speeds that we witnessed could be caused by the high capacitance of some parallel ports. On one of our test machines, the slow speed made the tape drive virtually unusable.

Although the SideCar II does a good job of meeting the needs of the laptop-computer user, it won't be the first choice for a computer user with a full-size system and a large hard drive. For them, there's the FileSafe TD-700 internal tape backup drive, which can store up to 700 megabytes of data on a DC2120 tape. The drive conforms to the QIC-3010 format.

The TD-700 is more difficult to install than the SideCar, but it's still relatively easy. It receives its data from the floppy-disk controller.

An empty drive bay is required to install the TD-700. Although the drive is supplied in a bracket that is designed to fit a half-height, full-width bay (such as a bay that would hold a 5¼-inch disk drive), it can be removed from the bracket and installed in a 3½-inch bay.

The drive is supplied with a tape-drive adapter cable. One end of it plugs into the tape drive, and the other side plugs into the floppy-disk controller, to the connector to which the floppy-disk drives are attached. Then the floppy-disk drives connect to a socket on the adapter cable. Power to the drive is supplied via a standard disk-drive power cable. That's all there is to it—the drive is ready to back up to 700 megabytes of data.

Both the SideCar II and the TD-700 are supplied with *FileSafe First* and *FileSafe First for Windows*. Both are easy-to-use products that attempt to simplify the backup process.

FileSafe First supports other tape drives as well, including the Colorado Jumbo 250 and Summit SE250. It runs on computers based on an 80386SX or higher and two megabytes of RAM. The Windows version requires Microsoft Windows 3.1.

FileSafe First's user menu offers four entries (Actions, Utilities, Setup, and Help) and six toolbar buttons (Backup, Restore, Search, Scheduler, Rescue, and Exit). Perhaps the most interesting of the functions is Rescue.

The Rescue utility provides one-step disaster recovery in the event of a hard-disk crash, or a stolen machine. The utility creates a rescue disk that tracks backups and can easily re-install data so that the drive matches its last state. The drive to be restored doesn't even need to have DOS or Windows installed—the rescue disk will restore it all, including the DOS boot volume.

The software contains a "librarian" that stores the file backup information every time a backup is performed. The name of the tape is stored along with the backup information, so finding a specific file is easy. For example, using the Search function, you can enter the file name (DOS wildcard characters are permitted) and the software will prompt you for the correct tape. A format-on-the-fly feature allows unformatted tapes to be used for backup—they are formatted as the backup is being made.

Although FileSafe First is extremely easy to use, it left us feeling that we didn't have as much control as we'd like. For example, the software has no facility to explicitly format a tape.

The greatest backup software in the world, however, is worthless if it isn't used. And FileSafe First's primary asset is that it is simple enough for people to actually use it. ■

CIRCLE 62 ON FREE INFORMATION CARD

# Baby Talk

**FIRST SOUNDS PRENATAL LISTENING KIT MODEL FS002. From Unisar Inc., 151 West 19th Street, New York, NY 10011; Tel. 212-675-7235; Fax: 212-691-1318. Price: $39.95.**

Ever since Adam and Eve begat Cain and Abel, or Lucy gave birth to our Neanderthal ancestors, human reproduction has been a decidedly non-technical affair. For centuries, women relied solely on each other—older friends and relatives, midwives, or medicine women—for advice about conception and contraception, prenatal care, and help during labor and delivery. Medical tools were limited to a pot for boiling water and a knife or scissor for cutting the cord.

It wasn't until the 20th century that doctors in industrialized countries began to get involved in pregnancy and childbirth. Advances in surgical techniques, anesthesia, and instrumentation soon gave rise to a whole new way of delivering babies. The methods of "natural childbirth" that had been used for millions of years were discarded—practically overnight, when viewed in an historical perspective—in favor of modern medicine. The shift culminated in the 1950's, when mothers were put under anesthesia, fathers were kept in waiting rooms, and their babies were delivered under the harsh glare of operating-room lights. The only active participants were the doctors and nurses.

Gradually, the pendulum has swung back the other way, and pregnant women now have available the best of both worlds—the safety and reassurance of high-tech medical equipment, anesthetics, medicines, and techniques (should they be necessary), and the option to choose to remain awake and aware throughout. Pregnancy and childbirth are now considered a family affair, with fathers—and, to some extent, older siblings—encouraged to participate for the nine months of pregnancy as well as during labor and delivery.

Recent medical advances also have added a new dimension to the nine months preceding birth, and make it easier for family members to feel as if they are part of the process. Fathers, and sometimes siblings and grandparents, are encouraged to be present for the mother's sonograms, in which ultrasound is used to project a picture of the baby in the uterus onto a video monitor. And beginning in the early weeks of pregnancy, and at each subsequent prenatal examination, the doctor uses a Doppler fetal heart monitor to amplify the sound of the baby's heartbeat so that anyone in the examining room can hear it.

That sound is both thrilling and comforting to the prospective parents and other family members. It's proof that there's really a baby in there (something that first-time parents, in particular, often have trouble coming to terms with early in the pregnancy), and that he or she sounds healthy.

Now those expectant parents don't have to wait for monthly doctor's visits to hear the sound of their unborn baby's heart—or his or her kicks, punches, hiccups, and other movements. *FirstSounds* from *Unisar* is an external fetal monitor designed by a neonatal nurse specifically for at-home use. FirstSounds amplifies the sounds made by an unborn child, allowing the parents to listen in on the included headphones, or to record the sounds on a cassette tape.

Along with the monitor itself, the headphones, and a cable for recording the sounds on an audio cassette, the kit includes an instructional audio tape intended to help users "train their ears" to recognize the various sounds that the monitor will pick up. Perhaps some patient folks will actually listen to the tape *before* listening to their own baby, as the manual strongly suggests.

Patience, however, is not a virtue that's normally associated with couples in their eighth month of pregnancy. We are probably not the only FirstSounds users who just stuck in a 9-volt battery (not included) and, after a cursory glance at the manual, began using the monitor immediately.

The monitor is a disc-shaped unit with a grip on top that resembles a computer mouse. At the top of the grip is a rotary power/volume control, a large round button that activates the amplification, and a red LED to indicate that the power is turned on. On the underside of the monitor is a foam-covered "listening cone." To use FirstSounds, volume should be turned to a low level and the listening cone pressed firmly against the mother's bare abdomen before the activation button is pressed. The volume can then be adjusted to a comfortable level. (FirstSounds has a very-high level of amplification, so a high volume level can be very uncomfortable. It's also a good idea to turn off any back-

TECHNOLOGY UPDATE

# 500 miles from nowhere, it'll give you a cold drink or a warm burger...

*NASA space flights inspired this portable fridge that outperforms conventional fridges, replaces the ice chest and alternates as a food warmer.*

*By Charles Anton*

Recognize the ice cooler in this picture? Surprisingly enough, there isn't one. What you see instead is a Koolatron, an invention that replaces the traditional ice cooler, and its many limitations, with a technology even more sophisticated than your home fridge. And far better suited to travel.

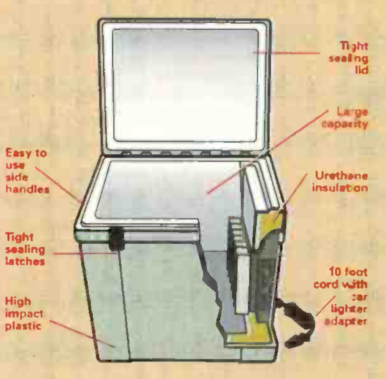
What's more, the innocent looking box before you is not only a refrigerator, it's also a food warmer.

**NASA inspired portable refrigerator.** Because of space travel's tough demands, scientists had to find something more dependable and less bulky than traditional refrigeration coils and compressors. Their research led them to discover a miraculous solid state component called the thermo-electric module.

Aside from a small fan, this electronic fridge has no moving parts to wear out or break down. It's not affected by tilting, jarring or vibration (situations that cause home fridges to fail). The governing module, no bigger than a matchbook, actually delivers the cooling power of a 10 pound block of ice.

**The refrigerator from outer space.**

*The secret of the Koolatron Cooler/Warmer is a miniature thermo-electric module that effectively replaces bulky piping coils, loud motors and compressors used in conventional refrigeration units. In the cool mode, the Koolatron reduces the outside temperature by 40 degrees F. At the switch of a plug, it becomes a food warmer, going up to 125 degrees.*




**From satellites to station wagons.** Thermo-electric temperature control has now been proven with more than 25 years of use in some of the most rigorous space and laboratory applications. And Koolatron is the first manufacturer to make this technology available to families, fishermen, boaters, campers and hunters– in fact anyone on the move.

Home refrigeration has come a long way since the days of the ice box and the block of ice. But when we travel, we go back to the sloppy ice cooler with its soggy and sometimes spoiled food. No more! Now for the price of a good cooler and one or two seasons of buying ice, (or about five family restaurant meals), all the advantages of home cooling are available for you electronically and conveniently.

**Think about your last trip.** You just got away nicely on your long-awaited vacation. You're cruising comfortably in your car along a busy interstate with only a few rest stops or restaurants. You guessed it... the kids want to stop for a snack. But your Koolatron is stocked with fruit, sandwiches, cold drinks, fried chicken... fresh and cold. Everybody helps themselves and you have saved valuable vacation time and another expensive restaurant bill.

**Hot or cold.** With the switch of a plug, the Koolatron becomes a food warmer for a casserole, burger or baby's bottle. It can go up to 125 degrees.

And because there are no temperamental compressors or gasses, the Koolatron works perfectly under all circumstances, even upside down. Empty, the large model weighs only 12 pounds and the smaller one weighs just seven. Full, the large model holds up to 40 12-oz. cans and the smaller one holds six.

**Just load it up and plug it in.** On motor trips, plug your Koolatron into your cigarette lighter; it will use less power than a tail light. If you decide to carry it to a picnic place or a fishing hole, the Koolatron will hold its cooling capacity for 24 hours. If you leave it plugged into your battery with the engine off, it consumes only three amps of power.

**Limited time offer.** Because Comtrad is bringing this offer to you directly, you save the cost of middlemen and retail mark-ups. For a limited time only, you can get this advanced, portable Koolatron refrigerator at the introductory price of $99. Call today to take advantage of this special promotional pricing. Most orders are processed within 72 hours.

**Try it risk free.** We guarantee your satisfaction with any product from Comtrad Industries. With the Koolatron you get our complete "No Questions Asked" 30 day money-back guarantee. Plus you get a full one year manufacturer's limited warranty. If you are not satisfied for any reason, just return the product for a complete refund.

*The versatile Koolatron is available in two sizes. The P24A holds 30 quarts and the smaller P9 holds seven quarts. An optional AC adaptor lets you use them in your rec room, patio or motel room. They plug into any regular outlet.*

| | | |
|---|---|---|
| Koolatron (P24A) holds 30 quarts | $99 | $16 S&H |
| Koolatron (P9) holds 7 quarts | $79 | $8 S&H |
| Optional AC Adapter (AC 10) | $49 | $6 S&H |

Please mention promotional code 025–PL1117.

For fastest service call toll-free 24 hours a day

**800-992-2966**

To order by mail send check or money order for the total amount including S&H (VA residents add 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

ground-noise sources, such as the TV, before using the monitor.)

We followed those instructions—and were confronted with a barrage of unintelligible noises. To our untrained ears, it sounded a lot like a summer storm, with heavy rain and occasional claps of loud thunder. Moved to a different location (the manual suggests moving the monitor around in one-inch increments), the sounds resembled one of those tapes of whales in the ocean. It was quickly apparent why the instructional tape was included.

About 10 minutes long, the tape explains how to use FirstSounds and what factors influence what you hear. Although you'll definitely hear *something*, wherever the monitor is placed—even if you're not pregnant—whether you actually hear the baby's heartbeat depends on the stage of the pregnancy, the baby's weight and position, and the mother's weight. Early in the pregnancy, you can expect to hear the baby moving and kicking. The heartbeat is only audible during the latter stages of pregnancy, and is clearest in the last few weeks as the baby grows larger and stronger. If the baby is lying with his spine toward the mother's bellybutton—a common position toward the end of the pregnancy—the heartbeat is easier to hear, particularly if the monitor is placed a couple of inches below and several inches to the right of the mother's navel. (Of course, up until the last few weeks when the baby simply runs out of room, he or she still moves around a lot, and his or her position can be hard to gauge.)

The tape demonstrates how to differentiate between sounds and provides sample recordings of various sounds. The placenta makes its own swishing noise, kicking can be rhythmic or random thumps, and the mother's own digestive system makes rumbling noises. The baby's hiccups are often mistaken for his or her heartbeat; even after listening to the tape a few times, the sounds are difficult to tell apart. The softest sound of all—and the hardest for the untrained ear to detect—is the baby's heartbeat.

Further clouding the issue is the fact that the heartbeat heard using FirstSounds doesn't sound anything like what is heard on the Doppler fetal heart detector that the doctor uses, or even like an adult heartbeat. The baby's heartbeat is rhythmic and quite a bit faster than that of an adult—as fast as 190 beats per minute, although 140 is considered average. We thought the sample on the tape sounded a lot like a train clanking down the tracks.

**Family members, as well as the expectant mother, can use FirstSounds to listen in on the sounds made by the unborn baby. (In actual use, the device should be placed against bare skin.)**

After listening to the tape—and playing back the sample sounds section a few times—we felt confident enough to give FirstSounds another try. Although we were now able to identify the sound of kicking, it took several more sessions before we became reasonably skilled at interpreting all the sounds. And the first time we actually managed to find the heartbeat was right after a doctor's visit, by placing the monitor in the same position that he'd placed his Doppler monitor.

Even when you don't hear the heartbeat, it's fun to listen to the baby's movements. For expectant parents who already enjoy feeling and watching the baby's movements, using FirstSounds adds a whole new dimension to the experience. And, we must admit, the first time we heard the baby's heartbeat using the monitor, right in the privacy of our home, was truly a thrill.

The included recording cable allows users to make audio cassettes of the baby in the womb. Such a tape would make a nice addition to the usual baby mementos—bronzed shoes, locks of hair, and the like. It could also be sent to long-distant grandparents to make them feel more a part of the pregnancy. And truly ambitious parents might want to dub the sounds from the audio tape to the videotape of the sonogram that many obstetricians are now supplying. FirstSounds can also be used to record the mother's heartbeat, which has been proven effective in calming a fussing newborn.

What FirstSounds *cannot* be used for—as emphasized in disclaimers found in the manual and on the packaging—is as a substitute for prenatal care from a medical professional. It isn't meant to serve as a diagnostic tool, or for any other medical purposes.

Besides allowing us to feel closer to our unborn baby, using FirstSound taught us a couple of things that new parents should probably know about infants. First, you can't count on an infant to cooperate with your wishes. Just when you tune in a heartbeat, he or she is likely to decide it's playtime, and the sound of the resulting kicks will drown out everything else. In fact, the baby seemed to become more active every time we used FirstSounds, probably due to the pressure of the listening cone as we moved it around the abdomen. Second, once the baby's born, he or she won't require absolute quiet at nap time. We never understood how infants could sleep through loud music, fighting siblings, or even on a crowded subway train—until we learned firsthand what a noisy environment they'd spent their first nine months in! ■

# *Low-Cost Laserdisc Player*

**MODEL LD510 LASERDISC PLAYER. Manufactured by Quasar Company, 1707 North Randall Road, Elgin, IL 60123-7847; Tel. 708-468-5600; $499.95.**

CIRCLE 63 ON FREE INFORMATION CARD

Have you taken the home-theater plunge? Do you spend a good portion of your leisure time watching movies? Have you begun to buy your favorite movies to avoid repeat rental costs? Does the quality of the video you watch measure up to your expectations?

If you answered "yes" to any of the first three questions, and "no" to the fourth, you're probably ready for a laserdisc player. Forget its 1980s image as a high-priced, unreliable white elephant with no software support—it's the 90s now, and laserdisc is making a big comeback. While still a drop in the bucket compared to VCR sales, according to the Consumer Electronics Group of the Electronic Industries Association, unit sales of laserdisc players were expected to total more than 300,000 in 1994. That's close to double the figure for 1990.

There are several factors behind the resurgence of the laserdisc format. Today's laserdisc players are more affordable than ever before. Any kinks associated with first-generation players and discs have long since been worked out. There are a lot more movies now available on laserdisc, primarily for sale through mail-order specialty firms, but increasingly at local video stores. And virtually all modern laserdisc players are actually combi-players—capable of playing CDs, laserdiscs, and other types of discs—giving them more bang for the buck.

Perhaps most importantly, the explosive growth of home theater has fueled the demand for high-quality video that your typical VHS VCR simply can't deliver. Standard VHS displays about 240 lines of horizontal resolution, compared to just over 400 lines for Super-VHS and Hi-band 8mm, and about 425 lines for laserdisc players. To get the optimum performance from either S-VHS or high-band 8mm, your TV must have S-video jacks (Y-C inputs). But even when connected via direct video or standard antenna jacks, they will deliver a slightly better picture than standard VHS. The full-frequency digital stereo audio provided by laserdisc is far superior to that from VHS VCRs, particularly when the home theater includes a surround-sound system.

When we finished setting up the home-theater system reviewed in the April issue, at about 6:00 on a cold, rainy winter evening, we immediately set out to rent some videodiscs to watch that night. The closest video store that also carries laserdiscs—although not a wide selection—is a 10- or 15-minute drive from here. That's not too far to travel for a movie rental, except when you consider that, within a half-mile radius of the house, there are three places that rent videotapes and a library with a decent selection of free tapes. And Blockbuster is only a mile away.

Unfortunately, since the last time we'd rented videodiscs, the shop that rents them had closed. The two other "local" stores carrying laserdiscs were each an hour's drive round trip. Considering the weather, we gave up and rented a couple of tapes at Blockbuster instead.

The lack of convenient disc availability is probably the worst problem plaguing the laserdisc format today. After all, we live in the suburban Northeast, an area much more likely to house videodisc stores than, say, the rural South or Midwest. Although supply will grow to meet rising demand, you now stand the best chance of finding a large selection of laserdisc rentals close to home if you live in a large city.

Laserdisc players and software are based on technology similar to that used in CD players and discs (although laserdiscs are generally recorded on both sides), and offer the same advantages and drawbacks. The player uses the light from a low-power, solid-state laser to read information encoded in pits embedded in the reflective surface of the disc. As on CDs, the information is encoded in tracks that are listed in a table of contents, allowing the user to quickly skip to any desired portion of the program. And the discs are incredibly durable; they won't wear out with repeated play, as will videotapes. On the down side, as with CDs, laserdiscs are for playback only; they are not a recordable medium. And laserdisc prices, for both hardware and software, are still higher than you'd expect to pay for VCRs and videotapes.

But the price gap is narrowing. For instance, *Quasar's Model LD510* combi-player carries a suggested list price of only $499.95—not significantly different from many Hi-Fi, four-head VHS VCRs. The LD510 plays all five types of disc formats: five-inch compact discs, three-inch CD singles, five-inch Compact Disc Video (CDV), and both eight- and twelve-inch laserdiscs, in either CAV (constant angular velocity) or CLV (constant linear velocity) formats.

A CAV, or standard-play, disc rotates at a constant speed of 1800 rpm, while the laser reads from the innermost band to the outer edge of the disc at one track per revolution. Because each track holds one video frame, it's possible to view a CAV disc frame-by-frame without loss of video quality.

A CLV, or long-play, disc gradually decreases its rotational speed from 1800 rpm near the center to 600 rpm near the outer edge to maintain a constant linear velocity. A twelve-inch CLV laserdisc stores a maximum of 60 minutes on each side (double the capacity of a CAV disc), allowing a full-length motion picture to be recorded on a single, two-sided disc.

The LD510 resembles a CD player both in appearance and in operation. Most of the front panel houses the disc tray, with the power button, headphone jack and level control, multifunction display, and an array of numeric buttons beneath it. To the right of the front panel can be found the STOP, PAUSE, and PLAY buttons, the OPEN/CLOSE TRAY button, the SKIP (forward and reverse) buttons, and a large jog/shuttle dial. To watch a movie from beginning to end (or to play the tracks on a CD in the order recorded), you would simply load a disc, close the tray, and hit PLAY.

Also like a CD player, the LD510 offers several play options. You can access particular tracks, program tracks in any order desired, select random-access playback, or opt for repeat playback in either random or programmed modes. When playing a laserdisc or a CD, you can select a track by number, using the numeric keypad on the front panel or the remote control, or you can use the SKIP buttons to move forward or backward through the tracks.

When playing laserdiscs only, the LD510 offers "last-memory function:" If you stop a disc during play, the stop position is memorized, and when playback is resumed the player automatically returns to that position. And with CAV-format laserdiscs only, it's possible to view single frames of video, either in still mode or in frame-by-frame increments, using the STILL/STEP button on the remote control.

A number of search functions are provided. The front-panel shuttle dial can be rotated clockwise or counterclockwise to scan forward or reverse at a higher speed than normal. The SCAN buttons on the remote have the same purpose. When playing CAV laserdiscs, you can search by frame number, and CLV discs can be searched using the time number (for instance, you can start 15 minutes from the start of the disc). If you're not sure where you left off, you can use intro scan to play the first 10 seconds or so of each chapter on the disc.

The front-panel display keeps you informed of the playback mode selected, the chapter or track number, the program number, the frame number (for CAV LDs) or time number (for CLV LDs), the audio channel selected, and editing information. In addition, a message portion of the display lets you know if the disc tray is open or being closed, when playback starts, and when the power is turned off. The display itself can be turned off and on by pressing the front-panel or remote-control FL DISP button.

When the television is turned on, and a disc with a table of contents is inserted into the LD510, on-screen displays are also provided. Two on-screen display modes (display and time) provide information about the total number of tracks, total playing time, and elapsed and remaining time on the disc or the current track.

All of the above-mentioned features are fairly standard on today's laserdisc/combi players. The LD510 is missing one feature that is common to most higher-priced laserdisc players: double-sided play. Instead of automatically playing the second side on a laserdisc, the user must get up and manually turn the disc over. Although that provides a good excuse to also microwave a bag of popcorn, get something to drink, or take a rest stop, we would prefer not to have to get up in the middle of a film to flip the disc.

Many people would consider that inconvenience a worthwhile tradeoff for the LC510's small price tag. After all, they are getting the high-quality audio and video associated with videodiscs at a price not much higher than that charged for many of mid-line VCRs.

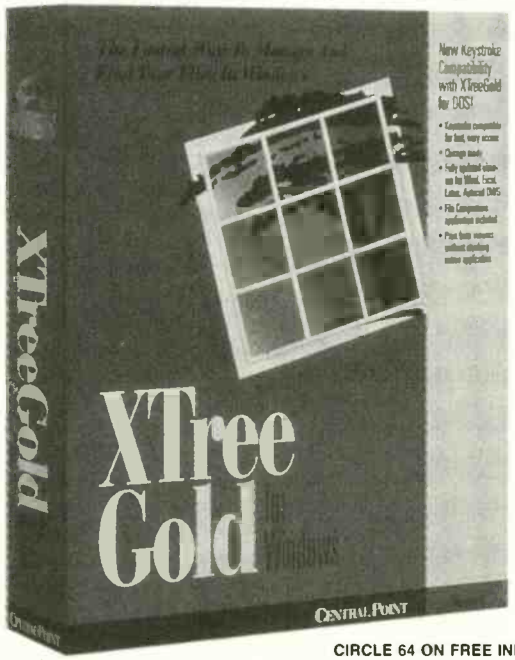
As we mentioned earlier, we settled for rented videotapes the first night we had our home theater set up, and "settled" is the operative word. A large-screen monitor (and we were using a projector with a 100-inch screen) magnifies any defects in the video source, and the previously viewed tapes had plenty of distracting problems, even when played on a decent, four-head, hi-fi VHS VCR.

Laserdisc-quality audio and video, particularly when coupled with a large-screen TV and surround-sound decoder and speakers, translates into a superb home-theater experience. The next day, we took the long trek to the laserdisc rental shop and borrowed a couple of action films. Although we'd already seen *Jurassic Park* in a THX-equipped theater, the home-viewing experience was still quite impressive—and frightening. *The Fugitive* was another good choice, with both outdoor action (like Harrison Ford's leap over a raging waterfall) and indoor investigative scenes achieving a sense of realism that can't be reproduced on videotape.

Having to manually flip the disc seemed a small price to pay for the home-theater experience generated by the less-than-$500 LD510 laserdisc player. ■

# *Utility Usefulness*

**XTREEGOLD 4.0 FOR WINDOWS. Central Point Software, Symantec Corp., 175 W. Broadway, Eugene, OR 97401. Price: $99.95.**




CIRCLE 64 ON FREE INFORMATION CARD

Every software reviewer cringes at the thought of reviewing a software utility program. What could be more boring? However, when the latest version of *XTreeGold for Windows* from *Central Point Software* crossed our desk, we were more than happy to put it through its paces.

XTreeGold has been our favorite DOS utility package for more years than we care to remember. Although the program took a little time to learn, it provided so many benefits that it was well worth the trouble. Of course, back when XTreeGold was introduced, DOS needed all of the utility help it could get. XTree allowed you to tag files so that a group of files could be copied, moved, or deleted in a single step. It allowed you to rename directories, sort files by size, date, or name. It allowed you to view the contents of files either as text or as dumps of hexadecimal characters, and to do other things now considered commonplace.

Today, of course, Windows is king, and utility programs have to do things better than the Windows File Manager. XTreeGold for Windows does it better—better even than previous versions of XTreeGold for Windows because version 4.0 is completely keystroke-compatible with the venerable DOS product.

Unfortunately, there is no way that a short review such as this can highlight all of the features in a product such as XTreeGold. We'll instead try to give an overview of the product and mention our favorite features that make XTreeGold stand out from the rest.

TECHNOLOGY UPDATE

# New device turns your car stereo into a CD player... *with no installation!*

*Breakthrough adapter plugs in, instantly transmitting sound from your portable CD player to your car stereo.*

*by Walker B. Hindelang*

Do you ever wish your car had some of the amenities of those expensive luxury cars? Be honest. While some of them are unnecessary (like miniature wipers on your headlights), there are others that we would all appreciate. If I could choose just one luxury-car option, it would have to be an in-dash CD player. But did you know there is an easier, less expensive way to get CD sound in your car? It's called Sound Feeder.

**How does it work?** Sound Feeder is a unique car CD adapter that allows you to play music from a portable CD or cassette player through your car's existing stereo speaker system. Sound Feeder contains a miniature FM modulator that broadcasts the audio signal from your CD player to a blank channel on your FM radio.

**Take it anywhere.** With Sound Feeder, you can use your existing portable CD player in your car. This eliminates the need for the purchase and installation of an expensive in-dash system. Plus, because it is portable, you can unplug it and take it with you when you leave your car; this reduces the risk of theft.

Sound Feeder also has an adapter that will supply most portable CD players with power. Because they needn't rely on batteries to operate, they will run longer and be more cost-efficient. Your car doesn't have to have a cassette deck—any AM/FM radio will do.

**The Sound Feeder advantage:**

- **No installation.** *Forget about the hassle of installing an in-dash system—Sound Feeder simply plugs in!*
- **Theft-proof.** *Because you can easily disconnect your CD player and take it with you, there's nothing in your car to tempt a would-be thief.*
- **Universal.** *Sound Feeder will work with any AM/FM car stereo... even if you don't have a cassette deck!*
- **Convenience.** *Leave Sound Feeder plugged into your car and take your portable CD player with you.*
- **Value.** *You could pay up to $400 to purchase and install an in-dash CD player in your car. With Sound Feeder, you spend $39 and use your own portable CD player.*

[illegible]

**The first of its kind.** The company that makes Sound Feeder, Arkon Resources, has a 10 year history of electronic innovation. They pioneered the consumer market for cordless headphones for use with TVs. Other innovations include camcorder battery chargers, compact video lights for camcorders, universal AC/DC chargers and battery dischargers. It's no surprise, then, that they have produced the first transmitter-type car CD adapter that provides stereo sound and voltage conversion technology. In addition, Sound Feeder meets FCC regulations.

**Just plug it in.** Playing a portable CD player in your car is simple. Just plug Sound Feeder into your cigarette lighter, connect the audio input wire to your portable CD or cassette player and set it to the desired FM station. You can enjoy the amplified stereo sound of your portable CD player without the dangerous or illegal use of headphones.

*Sound Feeder and its carrying case both fit discreetly into your car interior.*

**How does it work?**

Sound Feeder contains a miniature FM modulator that broadcasts the signal from your CD player to a blank channel on your car stereo. It can also provide power to many models, preserving battery life.

Connect Sound Feeder's audio input cord to the headphone or line-out jack of your portable CD player. Set the FM Band selector switch on the Sound Feeder for the portion of the FM radio band you wish to access. Once set to the desired station, it's ready to play!

Sound Feeder is guaranteed to work with any car stereo—old or new, cassette deck or no. Simply put, if your car has an AM/FM radio, with Sound Feeder and your own portable CD player it can have CD sound!

**Factory-direct savings.** Because we're bringing this offer direct from the manufacturer, you save the cost of middlemen and retail mark-ups. For a limited time, you can buy Sound Feeder for just $39. How else can you get CD sound in your car for so little? In addition, if you act now, buying Sound Feeder qualifies you for a $10 discount on the soft-side carrying case!

**Try it risk-free.** Sound Feeder is backed by Comtrad's exclusive risk-free home trial. Try it, and if you're not completely satisfied, return it within 30 days for a full "No Questions Asked" refund. The Sound Feeder unit is also backed by a one-year manufacturer's limited warranty. Most orders are processed within 72 hours and shipped via UPS.

| | | |
|---|---|---|
| Sound Feeder | $39 | $6 S&H |
| Carrying case | ~~$19~~ | $4 S&H |
| Case when you buy Sound Feeder | $9 | $4 S&H |

*If you are interested in this product but do not own a portable CD player, ask your Comtrad representative about our special offer on a portable non-skip CD player!*

*Please mention promotional code* 771-PL-1118.

**For fastest service, call toll-free 24 hours a day**

**800-992-2966**

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, enclosing your account number and expiration date.

**COMTRAD INDUSTRIES**
2820 Waterford Lake Drive, Suite 106
Midlothian, Virginia 23113

XTreeGold is, above all, a fully customizable file manager. When launched, it provides a window that is split into two main sections. On the left is a directory tree, and on the right, the list of files in the highlighted directory. The tree list can be expanded from one to five levels, or fully expended. The files list can display the file names, sizes, dates, types, extensions, or attributes.

Those file properties can be displayed in any order you want. For example, if you want the first column to be the file size, then just click on the Size heading, and drop it up front where you want it. Sorting files on a heading is even easer—just click on the heading. So if you want to sort files by the date they were created, just click on the Date/Time heading and it's done.

XTreeGold makes custom sorting very easy by allowing you to save custom sorting options. Let's say, for example, that you normally like to clean out your hard drive once in a while by deleting data files that are more than a month old. With XTreeGold, you could easily save a custom file-display configuration "Cleanup" that displays files in reverse date order, while hiding program files (.EXE, .COM, etc.), Windows group files, and other non-data files that you normally wouldn't want to delete.

The feature that a good file manager is used for most, of course, is simply examining the contents of files. XTreeGold lets you do that with ease, and it supports more file types than any other viewer that we've ever used.

One of the real benefits of XTreeGold is that it allows you to view, copy, and print files without accessing—or even knowing about—the program that created the file. Let's say, for example, that you download a .TIF image from a bulletin board system that shows the latest launch from Cape Canaveral. You don't need to know how the file was created, or whether it was touched up in a photo-paint program, or even that it's an image at all. Just press V for View (or click on the appropriate viewer icon) and the file is displayed just as it would be if you had imported it into a graphics program. If you like the way it looks, just click on the printer icon, and it will be sent the printer—no special image editing or conversion program is needed.

The viewing feature works not only with images, but with a host of word-processing, spreadsheet, and database formats as well. A partial sampling of the fourteen supported raster image formats include .GIF (Compuserve) .EPS (encapsulated PostScript with TIFF header), .JPG (JPEG or Joint Photographic Experts Group compressed), and .BMP (Windows bitmap). Ten Vector formats are supported, including .DWG (AutoCAD drawing), .CDR (Corel Draw), .EPS (encapsulated PostScript with metafile header), and .WPG (WordPerfect).

Text can also be displayed—formatted the way it was in the original document. Supported word-processor formats include Lotus AmiPro, Multimate 3.3 and 4, Rich Text Format, Microsoft Word for DOS and Windows, WordPerfect for Dos and Windows, WordStar, and XyWrite.

Spreadsheet formats can also be displayed in popular flavors including Excel and Excel Chart, Lotus 1-2-3, Lotus Symphony, and Quattro Pro. The databases Clipper, dBase, FoxBase, and Paradox, as well as most dBase clones, are supported as well.

As if that isn't enough, XTreeGold also displays valuable information about files even if it can't display the file itself in a meaningful way. For example, the program will display statistics for a Microsoft Video for Windows file, including its run length, its resolution in pixels, its frame rate, its audio-sampling rate, the number of bits per sample, and more. Similar statistics are displayed for Autodesk animation, MIDI files, waveform audio files.

Click to view an executable (.EXE) file, and you're provided with a list of statistics. The same is true for dynamic link libraries (.DLL), and Windows font files (.FOT, .FON, .TTF., and .FOR), where a sample of the font is also shown.

The contents of file archives—including those in the .ARC, .LZH, .PAK, .ZIP, and .ZOO formats—can be displayed. Plus, XTreeGold supports ARC, PAC, and PKZIP compression to become an all-in-one file-management utility.

A SmartFind command automates file searches—especially handy for users on large networks who misplace files on occasion. You can narrow down a search by telling XTreeGold the file type, date, size, or drives where it might be located. You can even search for files containing a specific text string.

As a sort of added bonus, XTreeGold includes File Companions that make *other* software more convenient to use. File Companions are dialog-box add-ons that let you perform additional operations in Open and Save-As dialog boxes for any application. Let's say that you create a new document in Microsoft Word, and want to save it in a new directory. That option—normally not available in Word—becomes available via a small icon when "Save As" is selected from Word's File menu.

We've just touched on our favorite, most used features of XTreeGold—but there's more! For example, you can easily restore files and directories that you have accidentally deleted, and you can synchronize two directories so that their contents match—useful for keeping a laptop and desktop in sync and up-to-date. ■

# GIZMO NEWS

## Digital Video Discs

Although there is little doubt that digital video discs are coming, it's far from certain what the format will be like when it finally arrives. Right now, two camps are going head to head: an alliance of Toshiba and Time Warner, and the Sony/Philips collaboration.

Last summer, seven major movie studios formed an ad hoc digital video disc (DVD) advisory group to "encourage public and industry discussion concerning the development of the five-inch digital video disc." The group outlined seven major goals that it saw as "necessary for success of the next home entertainment format."

Those goals include: 1. The ability to accommodate a full-length feature film, about 135 minutes on a single disc. 2. Picture quality ideally superior to that of current high-end consumer video-playback systems, such as laserdisc. 3. Audio compatibility with matrixed surround and other high-quality presentation systems. 4. The ability to accommodate three to five languages on one disc. 5. Some kind of copy-protection system. 6. Multiple aspect ratios to allow for future widescreen markets. 7. Multiple versions of the same program on one disc, and a parental lockout feature to restrict access to adult versions.

The Sony/Philips system relies on a single-sided, five-inch, high-density CD that can store 135 minutes of MPEG-2-quality video plus multiple tracks of compressed digital audio and subtitles. The disc could store 3.7 gigabytes of data, more than five times that on a conventional CD or CD-ROM.

The Sony/Philips system could be developed as a dual-layer format, in which the capacity could be doubled. In the dual-layer version, the data would be stored on

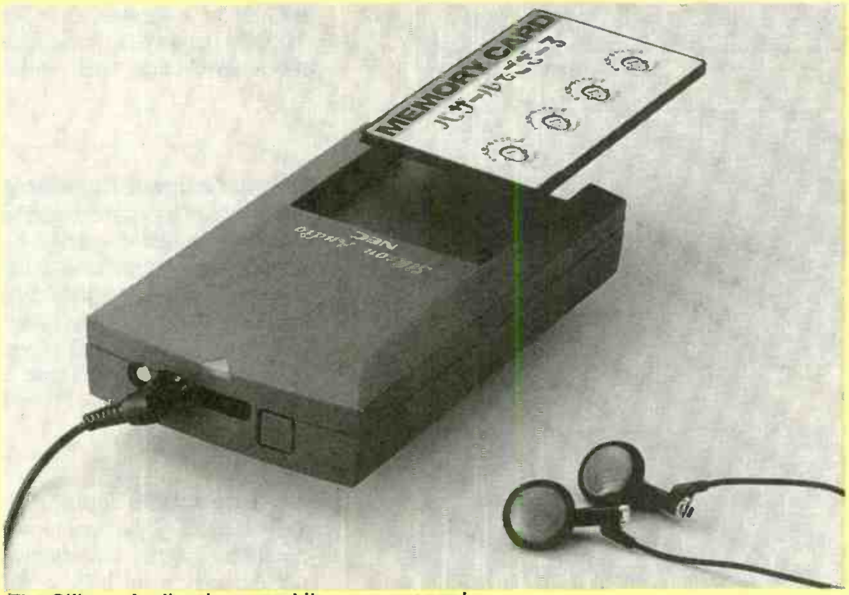
Sony's prototype DVD player.

two distinct layers, the first of which would be both reflective and transparent. The data on the second layer would be accessed by focusing the reading laser at a different depth.

The double-sided discs proposed by Toshiba/Time Warner are manufactured by bonding two 0.6-mm platters together in a process similar to the way that laserdiscs are made. The discs can store 4.8 gigabytes on each side, more than the 4.5 gigabytes that Toshiba sees as the "minimum required to realize quality pictures and sound." The discs could also hold a Dolby AC-3 digital sound track, three language channels, and four subtitle channels.

So far, the Toshiba/Time Warner camp seems to be winning the format war. Those in the movie business expressing support include MCA, MGM/UA, Turner Home Entertainment, and Warner Brothers. Hardware manufacturers supporting the format include Matsushita, Thomson Consumer Electronics, Pioneer, Hitachi, and JVC.

Both camps admit that a format war similar to the one waged between the VHS and Betamax videocassette formats would be devastating to the launch of a new digital video disc. Right now, even though it appears that the Toshiba-Time Warner system has the upper hand, it's too early to predict a certain winner. Even so, Toshiba promises to have players for the new discs on the market in early 1996 for about $500—a significantly low price for a brand-new format. Warner promises to sell discs at the same price as current videocassettes.



The Silicon Audio player and its memory card.

### Voice-mail Protection

One of the latest fads among techno-pranksters is invading business voice-mail systems. However, according to the Voice Messaging Educational Committee (VMEC), most such pranksters can be deterred through common-sense system management and subscriber education.

Most unauthorized entry to voice mail systems occurs when pranksters simply guess passwords for individual mailboxes. Therefore, passwords should be longer—six digits or more for voice mailbox access, and from 10 to 20 digits for system-level access.

The committee also suggests being diligent about system administration and to check for signs of abuse. Another technique is to control the number of mailboxes that are available for abuse—don't set up mailboxes before they are needed, and close mailboxes when they're no longer in use.

### Whole lotta CD-ROMs

The worldwide installed base of CD-ROM readers reached 27-million units in 1994, up 137% from 1993, according to InfoTech, an international CD-ROM and multimedia market-research firm. The U.S. accounted for the largest overall increase, followed by Britain, Germany, and Japan. Much of the increase was driven by the widespread bundling of CD-ROM drives with new desktop PC systems.

For the first time, in fact, more CD-ROM readers were sold in desktop systems than as multimedia upgrade kits—by a margin of more than 2 to 1.

Worldwide revenue from CD-ROM-based software was up 65% in 1994, which is less than half the increase in worldwide units. For the first time, the worldwide, average retail price of consumer titles dropped to just over $50.

### Silicon Audio

If you've given up on tape, and you have your eyes open for the next audio technology, you're not alone. NEC Corporation has announced the development of Silicon Audio, a portable music player that reproduces what the company calls CD-quality sound from data stored on a semiconductor memory card.

The advantage of Silicon Audio is that it is a solid-state device with no moving parts. Thus, problems such as skipping caused by vibrations are a thing of the past. Plus, the device and the memory cards are lighter and more compact than conventional or digital audio cassettes.

The prototypes compress audio by a factor of eight, so that a 32-megabyte memory card can hold 24 minutes of audio. ■

# ELECTRONICS WISH LIST

Virtual Head-Mounted Displays

### *TV for your Head*

How do you wear an 80-inch video screen on our head? With the *i-glasses* from *Virtual i-O* (1000 Lenora Street, Suite 600, Seattle, WA 98121). The i-glasses contain two full-color 0.7-inch LCD screens with a resolution of 138,000 pixels per LCD (46,000 each for red, green, and blue). Stereo headphones are integrated into the head unit. Yet, the total weight of the headset is only eight ounces. The displays are fixed focused to appear as an 80-inch display floating eleven feet from the user. The i-glasses can accept a standard NTSC video input and line-level audio inputs. Price: N/A

CIRCLE 65 ON FREE INFORMATION CARD

Video CD Changer

### *CD Player for your Eyes*

Anyone who was worried that the Video CD standard would mean having to get up in the middle of a movie to change discs can rest easy. *Technics* (One Panasonic Way, Secaucus, NJ 07094) has introduced its *SL-VM500* Video CD changer. The unit is a five-disc carousel changer that is compatible with video CD's, music CDs, graphics CD (CD + G), and three-inch CD singles, as well. The Video CD format can store up to 74 minutes of digital audio and VHS-quality video on a disc the size of a standard CD. The changer is compatible with Version 2 of the MPEG-1 standard, so it can search discs by track number and chapter number, and it can provide title, artist, and chapter names on-screen. Price: N/A.

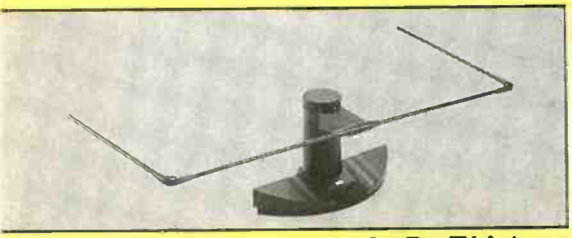
CIRCLE 66 ON FREE INFORMATION CARD

Travelling Compact-Discs

### *Jewel of a Jewel-Box Replacement*

Because of its convenience and the protection it offers, we've always considered the compact-disc jewel box one of the best product-packaging systems available. However, it's not always the most practical way to carry a large number of discs. That's where the *PDM-24 ProFile CD Traveler* from *Case Logic Inc.* (6303 Dry Creek Parkway, Longmont, CO 80503) comes in. The mobile carrying case holds a portable CD player and 24 discs and liner notes in the company's ProSleeve CD holders. Those holders can be transferred to other Case Logic ProFile storage systems. Price: $36.95

CIRCLE 67 ON FREE INFORMATION CARD



Set-Top TV Antenna

### *Over the Air, On Top of the Set*

Despite all of the hoopla surrounding new satellite-TV reception technology, traditional over-the-air-reception of terrestrial broadcasts is still one of the most popular ways to watch TV. *Terk Technologies* (65 East Bethpage Road, Plainview, NY 11803) claims to have made a major step in the evolution of indoor TV-antenna technology with its *TV15*. Thanks to the application of what the company calls "advanced frequency matching technology," the new antenna is said to offer exceptional performance on all TV broadcast frequencies from Channel 2 to 83. The antenna contains tuned circuits to vary the effective length of the antenna elements, thus simulating the benefits of a multi-element array. A five-position switch on the antenna's base allows it to be pre-tuned to the frequency of interest. Plus, a two-position source selector makes it easy to switch between off-air reception and other video sources. Price: $39.95

CIRCLE 68 ON FREE INFORMATION CARD


Powered Massager

### *Oh My Aching Back*

Everyone needs a good massage once in a while, especially after a strenuous workout. The handheld *G5 Pro Power Massager* from *General Physiotherapy* (13222 Lakefront Drive, Earth City, MO 65045) promises to stimulate circulation within muscles, flushing out such byproducts as lactic acid that cause pain. The Pro Power Massager is said to meet the standards of hospitals, clinics, and sports-medicine professionals. Five applicators are supplied for the massage of specific muscles, and the massager is equipped with a variable speed control. Price: $299

CIRCLE 69 ON FREE INFORMATION CARD

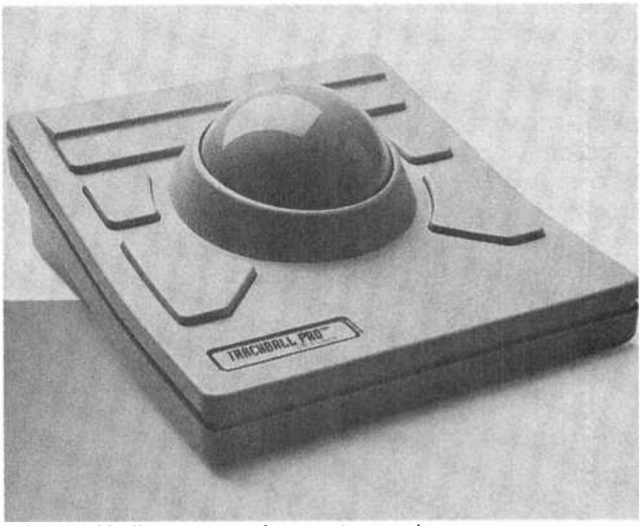
# MULTIMEDIA WATCH

By Marc Spiwak

## Game Controllers, And More

A mouse and joystick are the most popular controllers for general work and play. But sometimes a more specialized controller is better suited for a particular task. This month I've got two new, more-specialized controllers from CH Products.

The *Trackball Pro* can make certain arcade-type games easier to play and more authentic. Remember "Missile Command?" That game has always been the most fun to play with a trackball. The Trackball Pro is as sturdy as controllers come, and it's styled so that it looks natural placed next to a keyboard.



*The Trackball Pro can make certain arcade-type games more authentic. It is as sturdy as controllers come.*

Trackball Pro features a heavy, full-size, 2.25-inch phenolic ball supported on stainless-steel shafts and five-point ball bearings for a silky smooth feel. After a quick snap of the fingers, the ball will spin freely by itself for several revolutions. That allows you to quickly move a cursor from one part of the screen to another using the inertia of the ball. It's like the old flywheel tuning dials on radio receivers.

The trackball comes in three different models so there's one that will work with nearly every kind of computer. Four buttons are situated on top of the trackball. Switches on the bottom of the unit allow it to emulate different kinds of mice. When emulating a Microsoft Mouse, the two larger buttons provide the primary and secondary mouse button functions, while two smaller buttons provide a click-lock function. That lets you click and lock onto an object, and drag it somewhere without holding down the button. A second click unlocks the object. That makes the trackball easy to use for work as well as fun.

While the trackball Pro is probably best suited for games, it also makes a fine substitute for a desktop mouse. It can work in a smaller area than a mouse, and doesn't need a pad. Suggested retail prices for the Trackball Pro start at $119.95.

Second from CH Products is the *Pro Pedals* rudder control system. That sturdy device lets you control flight and driving games with your feet. The unit has a pedal with a heel cup for each foot. Each pedal can be slid forward and back like an aircraft rudder control system, and each pedal also pivots like an automobile gas pedal for use as accelerator and brake controls in driving games and for toe brakes with compatible flight-simulation software. A switch selects between plane and car modes.

A seven-foot cable attaches Pro Pedals to your PC's game port. The cable also has built-in joystick connectors so you can leave both Pro Pedals and your favorite joystick connected to your PC permanently. Something that is to be controlled by your feet has to be strong, and Pro Pedals is. The device seems rugged enough to provide a lifetime of foot-pedal action. With a list price of $139.95, Pro Pedals will probably be bought only by avid simulator pilots, but at least it's nice to know that this kind of stuff is out there for people who want it.

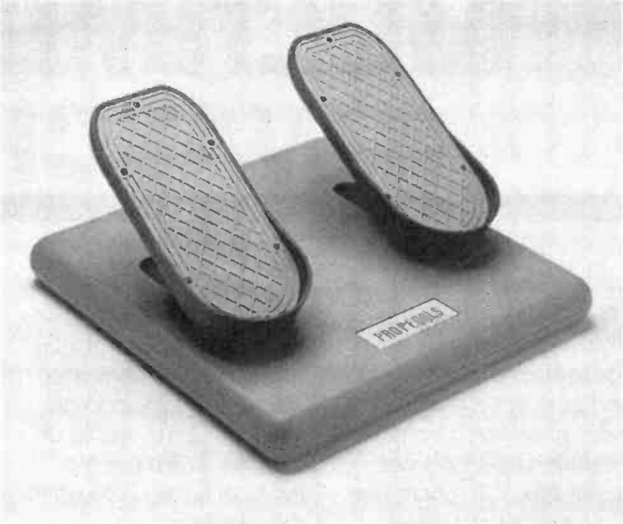
### NEW STUFF

I'm seeing a lot of new CD-ROM's that are packed with more than one game. Not the shareware-loaded ones, but ones with a smaller collection of games from one company. Two such discs from Activision, *PowerHits Movies* and *PowerHits BattleTech*, are good examples.

*Movies* contains four games, The Rocketeer, Hair Raising Havoc, Die Hard, and GhostBusters II. The Rocketeer comes straight from the movie, where you strap on your rocket pack to stop the Nazis and save your girlfriend. Hair Raising Havoc lets you be Roger Rabbit in a crazy baby-sitting adventure. Die Hard pits you against the terrorists in a high rise where you must save the hostages and your wife. GhostBusters II lets your rid the city of unwanted spooks. *BattleTech* contains Activision's BattleTech action/adventure trilogy of 31st-century power struggles. The disc includes BattleTech: The Crescent Hawk's Inception, BattleTech: The Crescent Hawk's Revenge, and MechWarrior.

Epic MegaGames has some similar compilations out on CD-ROM. *Epic Pinball CD* contains all 12 Epic pinball tables on one disc, and a bonus African Safari table available only on the disc. You can play all of the pinball tables using up less than 100K of hard disk space. Pinball is one game that takes really well to a PC, especially if the computer is nice and fast. Anyone who hasn't played a modern PC pinball game doesn't know what they're missing. The action is as fast as a real pinball table. Epic Pinball CD costs $64. *Jazz Jackrabbit CD* features three new episodes and over 90 levels of you playing the little rabbit with a big gun aiming to save the rabbit princess, Eva Earlong. Jackrabbit will run you $49.

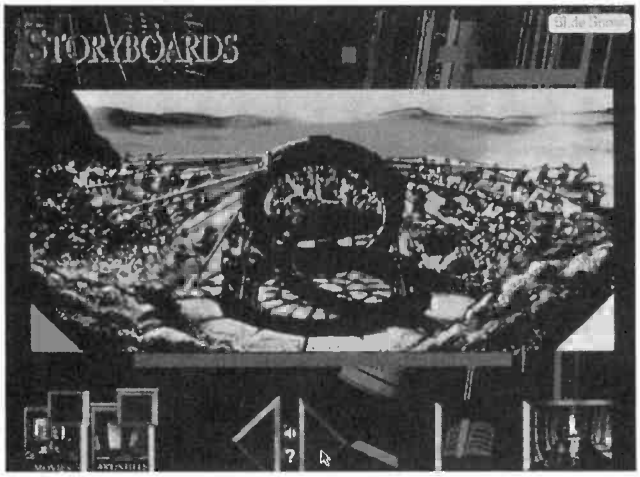
Amtex is also getting into the pinball action with two new pinball CD-ROM's. *Eight Ball Deluxe* puts a spin on the game of pool with one of the original Bally pinball tables adapted to the PC. *Royal Flush*, the 1976 Gottlieb classic, is PC pinball poker at its best. Those discs sell for $49.95. Another fun game from Amtex is *Gone Fishin*, the complete PC freshwater-fishing expedition. You plan a fishing trip from scratch, including the type of bait, the best spot to fish, the type of cast and reel, and so on. You base your decisions on variables such as weather and fish behavior. There's lot's of different kinds of fish to catch, and plenty of unmapped hot spots.



*Pro Pedals rudder control system lets you control flight and driving games with your feet.*

Two new titles from Turner Home Entertainment are *The Pagemaster* and *NFL's Greatest Plays*. The Pagemaster is a multimedia game based on the movie of the same title that starred Macaulay Culkin. NFL's Greatest Plays includes 75 of the most remarkable plays in the history of the NFL. Scenes can be played a different speeds and viewed from different angles. The disc honors the NFL's 75th anniversary season.

Everybody's getting into multimedia, including Nickelodeon, with two new discs geared toward—who else?—the younger generation, ages 8 and up. Viacom New Media, in collaboration with Nickelodeon, has introduced *Director's Lab* and *Are You Afraid of the Dark?: The Tale of Orpheo's Curse*. Director's Lab lets kids produce their own multimedia videos by drawing, composing music, creating animations, recording their own voice, and weaving the pieces together into a video. Creative elements from an included archive can also be used. Are You Afraid of the Dark?: The Tale of Orpheo's Curse lets kids unlock a ghost story through a series of multimedia puzzles.



*The Secrets Of Stargate CD-ROM shows much of the work that went into producing the movie, including storyboards such as the one shown here.*

New from Microsoft this

### WHERE TO GET IT

**Activision**
11440 San Vincente Boulevard
Los Angeles, CA 90049
**CIRCLE 50 ON FREE INFORMATION CARD**

**Amtex Software Corporation**
P.O. Box 572
Belleville, Ontario K8N 5B2
Canada
**CIRCLE 51 ON FREE INFORMATION CARD**

**CD-ROM Imports LLC**
7351 Washington Avenue South
Edina, MN 55439
**CIRCLE 52 ON FREE INFORMATION CARD**

**CH Products**
970 Park Center Drive
Vista, CA 92083
**CIRCLE 53 ON FREE INFORMATION CARD**

**Compton's New Media**
2320 Camino Vida Roble
Carlsbad, CA 92009
**CIRCLE 54 ON FREE INFORMATION CARD**

**Epic MegaGames, Inc.**
3204 Tower Oaks Blvd.
Rockville, MD 20852
**CIRCLE 55 ON FREE INFORMATION CARD**

**Microsoft Corporation**
One Redmond Way
Redmond, WA 98052
**CIRCLE 56 ON FREE INFORMATION CARD**

**Viacom New Media**
1515 Broadway
New York, NY 10036
**CIRCLE 57 ON FREE INFORMATION CARD**

**Turner Home Entertainment**
One CNN Center, Box 105366
Atlanta, GA 30348
**CIRCLE 58 ON FREE INFORMATION CARD**

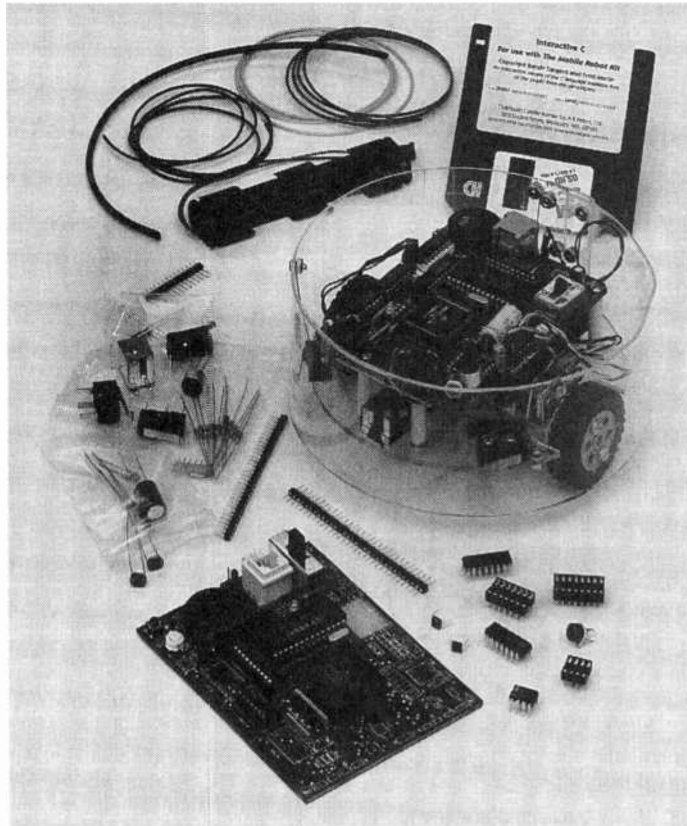
month are *Ençarta '95* and *Composer Collection*. Encarta '95 is the latest update to the now well known multimedia encyclopedia. Encyclopedias are another good application of multimedia, and anybody who doesn't have a multimedia encyclopedia yet might want to consider this one. It's loaded with information in the form of maps, music, timelines, photos, video, politics, history, games, and more. Composer Collection is a value pack of sorts, with three discs covering the life and work of Mozart, Beethoven, and Schubert in a multimedia fashion—over 15 hours of entertainment in all.

Some CD-ROM's are so frustrating to get to work that they provide a lesson in multimedia just by using them. But it's nice to see a disc like *Basics & Beyond* that is intended to teach people about multimedia. Basics & Beyond is an encyclopedia of multimedia personal computers on CD-ROM. Included is information on the basics, hardware, memory, CPU, floppy and hard drives, CD-ROM, power supplies, ports, and more. Beginner PC users who want to know more about their system will want to check out this relative bargain from CD-ROM Imports—it has a suggested list price of only $29.95.

Last this month is *Secrets Of Stargate* from Compton's New Media. The Secrets Of Stargate CD-ROM was released simultaneously with the movie. The disc includes multimedia coverage of the movie's visuals, special effects, sets, costumes, and more. It details much of the work that went into making the movie, and contains interviews with both the stars and the filmmakers. The disc retails for $39.95. ■

A Hands-on Electronics® REPORT

# A K PETERS MOBILE ROBOT KIT



CIRCLE 119 ON FREE INFORMATION CARD

*Learn all about robotics while building the Rug Warrior.*

Who can think of *Star Wars* without remembering the beeps and whistles of R2-D2 or the prim and proper behavior of C-3P0? The antics of those and other fictional robots through the years have established in the minds of many exactly what a robot should be. However, when the seemingly lifeless and stationary robotic "arms" of industry are compared to the "droids" of fiction, the "real-life" robots seem boring and lifeless. *The Mobile Robot Kit* from A K Peters will change all of that.

Available for $289.95, the kit contains all the processing, memory, and sensor circuitry needed to build the *Rug Warrior*—an educational and entertaining robot that was featured in the book *Mobile Robots: Inspiration to Implementation* (available from A K Peters for $39.95). To get the most out of the kit, and to make building the robot a lot easier, that book should be read beforehand.

**What's Included.** Before we go on, it's important to mention that The Mobile Robot Kit we received is not the only version available. The kit we reviewed does not contain any of the mechanical components that facilitate movement (motors, gears, wheels, etc.). That is because some robotics experimenters like to build their Rug Warriors out of pre-existing toy cars or even Lego construction kits (as recommended in the *Mobile Robots* book). A complete kit that contains the mechanical parts, along with a body for the robot, should be ready by publication time, and will retail for $450. For those who already have the first kit, the mechanical parts will be made available for about $160 (the difference in price between the two kits).

Now that we said what wasn't in our kit, let's look at what was. The "brain" of the robot is a Motorola MC68HC11 microcontroller, which comes pre-installed on a single-sided, printed-circuit board. The only other board used in the robot is the tiny one onto which the two-line, alphanumeric LCD module is pre-installed.

Along with the microcontroller, the main circuit board also contains a MAX233 serial-port driver, which allows the robot to be programmed by either a PC or Mac, as well as a jack that makes interfacing with a computer possible. In addition, a 32K static-RAM chip (the HY62256), an HC10 latch, and some supporting circuitry were installed. Those components are somewhat delicate, and having them already on the board makes building the project much easier.

The sensors that let the robot interact with its environment have to all be mounted on the circuit board. Those include photoresistors, infrared obstacle detectors, a microphone, a pyroelectric sensor, and collision-detector bump switches. Also, the motor-driving components and dual-shaft encoders (which tell the robot how far it travels) are included.

As you can see, quite a few components make up the Rug Warrior's circuitry (not including the various resistors, capacitors, and switches in the kit). To keep track of all of them, and to help determine if any parts are missing, the kit comes with a handy checklist.

The manual that comes with the kit is well-written and concise. It serves two purposes: First of all, it contains a lot of helpful hints on building the robot, which should make the project easier to complete for those new to electronics (we still recommend that you read the *Mobile Robot* book before building the project).

Secondly, the manual contains a guide to the *Interactive C* programming language that the Rug Warrior operates with. That software is included on a floppy disc (specify PC or Mac when ordering). Those familiar with the C programming language should have no trouble understanding the software. But for those who are new to programming, there is some good news. The software comes with some pre-installed programs, so you can have the Rug Warrior actually do something while you're busy learning Interactive C. We'll look at those demo programs a little later.

Because our kit did not come with the necessary parts to give our robot mobility, we can't say what it's like to build the robot from start to finish. However, we can say this: the printed-circuit board is clearly labeled, making parts-placement relatively simple. Also, sockets are provided for the IC's, which ensures that the sensitive components will not be damaged by heat.

**How the Robot Works.** To make our review of the robot kit complete, A K Peters sent us a working prototype of the Rug Warrior to "play" with. But before we take a look at how it performed, let's briefly examine how the robot works.

The Rug Warrior was designed around the MC68HC11 microcontroller so that every pin of that chip is connected to a sensor or actuator. Also, all of the internal hardware features of the microcontroller (such as the A/D converter and timer-counter) were used, which helped to keep the parts count low. That efficient design is what enabled the robot to be built on a single board.

But what does all of the computational and interfacing hardware allow the robot to do? Well, the Rug Warrior can be programmed, using the Interactive C language, to interact with the physical world in a number of ways. Each of its sensors (mentioned earlier) can avoid, detect, or follow (or all three) a particular stimulus. For example, the robot can be programmed to avoid collisions by using its built-in, IR proximity sensors.

What makes the robot fascinating, however, is its capability of multitasking and operating on a subsumption program. Multitasking allows the robot to seemingly perform several "behaviors" at once, by engaging in each in rapid succession, and then repeating the behaviors in a loop. The triggering of those behaviors can also be set by using subsumption programming, which assigns an order of importance to the stimuli that the robot can react to. For example, the Rug Warrior can be programmed to roll around the room avoiding collisions until it senses a person (using its pyroelectric sensor). If that occurs, the robot will start following the "intruder" for a preset amount of time, and will then resume its random wandering.

Of course, the preceding example is a simple one. With all of the sensors on the Rug Warrior, much more complex programming can be carried out by the robot. But if you feel like getting your robot rolling immediately, you can also use the demo programs that come on the disc. They might not be particularly exciting, but they are a good way to test if your robot is working properly.

**Demo Mode.** The Rug Warrior we got to review came with three installed demo programs: seek light, seek darkness, and wait for whistle. Let's look at each:

In the "seek light" mode, the robot moves around trying to find the brightest area in a room (or, if you shine a flashlight at it, the robot will follow the beam). At the same time, the subsumption programming lets the robot use its IR collision detectors to avoid crashing into anything. However, if for some reason the robot does bump into an obstacle (its sensors might be pointing too high, for example), then the bump-detecting switches will make the robot move out of the way.

The next mode, "seek darkness," is similar to the previous one. In the second mode, however, the robot looks for the darkest area in the room, while avoiding collisions, as described. We found the robot's ability to determine the darkest spots in a room quite interesting. We doubt any human could be that sensitive to shades of darkness.

Finally, we put the robot into its "wait for whistle" mode. That mode is a test of the robot's sound-detection capabilities. Whenever the robot detects any loud sound (not just a whistle, contrary to the program's name), it plays a 3-note tune. We think it would be fun to experiment with trying to make the Rug Warrior produce an R2-D2-like sound every time it "hears" a noise.

With the Mobile Robot Kit, and some ordinary electronics tools, you can have a little Rug Warrior running around your house in no time. For more information on the kit, contact A K Peters directly at the address given in the box below, or circle no. 119 on the Free Information Card. ■

**FOR MORE INFORMATION**

**A K Peters, Ltd.**
289 Linden Street
Wellesley, MA 02181
Tel. 617-235-2210

# What Do These Prestigious Companies Have In Common?

Aerovox

DC Film and RFI Suppression Capacitors, Aluminum Electrolytic and AC Oil Capacitors, EMI Filters

AMP

Electrical/Electronic Connectors, IC Sockets, PCB Switches

AM RAD Engineering, Inc.

Motor Run Capacitors, HID Lighting Capacitors, Power Factor Correction Capacitors

AEP

Miniature and Subminature Coaxial Connectors and Cable Assemblies.

AVX CORPORATION

A KYOCERA GROUP COMPANY

MLC, Tantalum and Thin Film Capacitors, Resistors, Networks, Integrated Passive Components, Trimmers, Oscillators, Resonators, Filters, Piezo Devices, and Connectors

BERG ELECTRONICS

High Density and Industry Standard Connectors/Subsystems

CAROL

CAROL CABLE COMPANY INC

Electronic and Electrical Wire and Cable and Power Supply Cords

COLE FLEX

Tubing, Conduits, Hose, Sleevings, Splices, Insulation and Cable Harness Products, Power Cords and Cordsets

CII Communications Instruments, Inc.

CII Midtex

Relays and Solenoids

COOPER Bussmann

Fuses, Fuseholders, Fuse Blocks, and Fuse Accessories

CORNELL DUBILIER

Capacitors-Aluminum Electrolytics, Mica, AC Oil, Film, MICA Paper and Relays

A COMPANY OF VISHAY

DALE

Dale Electronics, Inc.

Resistors, Networks, Oscillators, Displays, Inductors, Thermistors, Connectors, & Transformers

DI DANTONA INDUSTRIES, INC.

Batteries: Computer, Cordless Phone, Laptop, Scanner, Alarm and Medical

Antennas: Cordless Phone and Scanner

DEARBORN WIRE AND CABLE L.P.

EATON

Eaton Corporation, Commercial & Military Controls Operation

Switches, Relays, Displays and Keyboards

FOX ELECTRONICS

Quartz Crystals, Clock Oscillators, Surface Mount Products, Programmable Devices

A GERNSBACK PUBLICATION

Popular Electronics

Electronics Now Magazine

GUARDIAN

Relays and Solenoids

KEMET

Electronics Corporation

Multilayer Ceramic and Solid Tantalum Capacitors

KOA SPEER

Resistors, SMT Tantalum Capacitors Inductors, Resistor Networks, SMT Thermistors

MALLORY

North American Capacitor Company

Tantalums, Aluminums, SonaltertsR Ceramics, Films and AC's

M-tron

Quartz Crystal Hybrid Oscillators

muRata®

Fixed Ceramic Capacitors, Variable Capacitors and Resistors, Crystal Oscillators, Ceramic Filters, Resonators, EMI Filters, Hybrid Circuits and more.

Panasonic Industrial Company

Resistors, Resistor Networks, Ceramic, Film, Electrolytic, Double Layer Capacitors, Potentiometers, Switches, Inductors, Filters, Resonators, Varistors, Thermistors

Philips Components

Philips Electronics North America Corporation

Resistors, Ferrite Components

Alluminum Electrolytic, Film & Ceramic Capacitors

They sell through distributors.

They belong to the E.I.A.

They belong on your vendor list.

Quam

Loudspeakers and Commercial Sound Products

ROHM

Rohm Electronics Division

Resistors, Ceramic Capacitors, Transistors/Diodes, Opto Components and IC's

SELECTA

Switches, Relays, Terminals, Indicator/Pilot Lights, LED Indicators, Test Clips, Test Leads, Cable Ties and Heat Shrinkable Tubing

A COMPANY OF VISHAY

SPRAGUE

Tantalum Capacitors, Wet & Foil Capacitors, Resistor Networks, Resistor Capacitor Networks, Filters

Switchcraft

A Raytheon Company

Switches, Connectors, Jacks, Plugs, Jackfields & Audio Accessories, Cable Assemblies

Leadership in electronics is not just a matter of designing products better and manufacturing them better, but also of marketing them better. And the sponsors of this message understand that better service to customers requires effectively involving distributors as part of their marketing teams.

Distributor involvement means lower prices, quicker deliveries, better service over-all. The Buyer wins...the Seller wins.

Distributors help achieve marketing leadership. So does the manufacturer's involvement in the Components Group of the Electronic Industries Association. EIA fosters better industry relations, coherent industry standards, and the sharing of ideas, which helps one another and serves customers better.

In choosing your component supplier, look for the marks of leadership--

availability through distribution
membership in E.I.A.

ELECTRONIC INDUSTRIES ASSOCIATION EIA EST 1924

Our 70th Anniversary Year

Electronic Industries Association/Components Group
2001 Pennsylvania Avenue, N.W., 11th Floor
Washington, D.C. 20006
Phone: (202) 457-4930
Fax: (202) 457-4985

*Committed to the competitiveness of the American electronics producer.*

# THINK TANK

By John J. Yacono
Technical Editor
Windows Magazine

## Readers Observations

We'll resume our basic-electronics tutorial theme this month, and look at some letters from readers who have examined the work of their peers. It never ceases to amaze me how carefully the work on these pages is scrutinized by avid hobbyists. It's also interesting that many people come up with nearly identical circuits, as two of the letters will indicate. But first, the tutorial.

So far we've looked at voltage, current, and the qualities of resistors. Let's bring all that together with an example of how a resistor can be used to protect a component from excessive current. As we discussed, resistors limit current flow. Excessive currents can damage light-duty components, so often times a resistor is placed between them and a source of current to limit the current flow to an acceptable level. Appropriately, a resistor used in such a fashion is called a "current-limiting resistor."

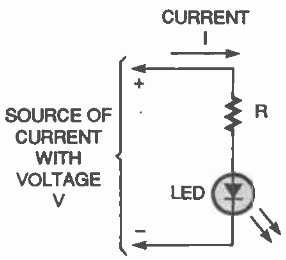



*Fig. 1. Perhaps the most common use of a resistor is as a current limiter. Here one is shown keeping the current (I) produced by the voltage (V) to a safe value for LED1.*

A common example of current limiting is shown in Fig. 1. There, a resistor (R) is limiting current to a light-emitting diode (LED). You needn't understand how an LED works to understand the function of the resistor. Suffice it to say, LED's typically cannot withstand much current; anything over 0.015 amperes will usually cause one to overheat and probably fail. The resistor's current-limiting nature will protect the LED by limiting the maximum current through it, provided that the resistor's value is chosen wisely. If the maximum current allowed by the LED is "I" and the applied voltage is "V," the resistor's value in ohms should be:

$$R = V/I$$

You can increase the resistor's value a little to provide a safety margin for the LED. Note that the LED could really be any component in need of protection from heavy current; that is one of the most fundamental applications of a resistor.

If the current to be modulated is large in value, it's likely that a resistor could heat up. So determining the resistor's wattage rating would be important. For that, use:

$$P = I^2R$$

where P is the power in watts. Remember, go a little higher than the calculated value to provide a margin of safety.

### SENSOR FOIL PATTERNS

My sincere thanks to Roger W. Hamel of Cedarville, MI for the freeze-sensor circuit in the January 1995 *Think Tank*. Roger's circuit maintains my mobile-home's water-closet temperature above freezing, without inflating my electric bill. In building the unit, I fabricated two PC boards: one for the sensor and one for the power supply.

Enclosed are the PC layouts I used for Roger's freeze-sensor circuit (Fig. 2A) and 12-volt power supply (Fig. 2B). The foil patterns are well-annotated and should be self-explanatory for most hobbyists. However, I need to describe a few changes that I found necessary.

The power-supply PC board uses a VS048 full-wave bridge-rectifier; a 2200-µF, 50-WVDC, axial-lead, electrolytic capacitor; and a 7812CV voltage regulator. I substituted a 4-pin DIP PS2501-1 for the AN25 and used a 2N4401 for Q1 (I couldn't find the AN25 but already had the 2N4401). I also used a 10-amp solid-state relay that is switched by a 12-volt DC signal (again from my parts stock).

Also notice the two "JMP" markings on the sensor PC board. They call for a jumper wire to connect the two points (the PC board is single-sided and I couldn't avoid that jumper).

I believe all the other PC board markings concur with Roger's schematic and should be understood by most readers of your magazine.

*—Peter M Brenner III, Webb City, MO*

*With regard to Roger's bridge rectifier, any substitute (integrated or made of discrete diodes) that can handle one amp and 50 volts in reverse should work fine. As I always point out for AC circuits, firmly secure all*

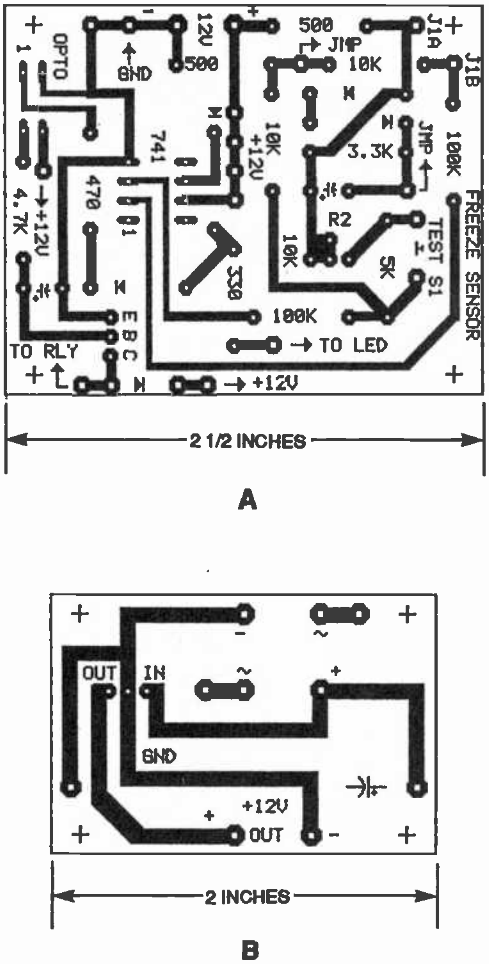



*Fig. 2. A helpful reader was so happy with the freeze-sensor circuit, he's provided us with foil patterns for it (A) and the power supply he uses (B).*

*AC connections and anchor any wires carrying line current.*

## WHOSE CIRCUIT?

I tried to fix a commercial test light a few years ago, but destroyed it trying to get the unit apart. The P-channel FET in it didn't have markings, so I tried using every FET Radio Shack had, in a circuit of my own design. After half a dozen tries, the transistor I found that worked was a BS170 MOSFET. The MOSFET (no longer sold at Radio Shack, but available from a number of sources including Thumb Electronics, P.O. Box, 344, Marysville, MI 48040) is in a small package (TO-92) and has a

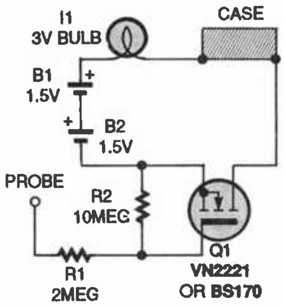



*Fig. 3. Apparently, this circuit is a favorite of more than one reader. It has appeared in this magazine twice already! Note that the BS170 used in the original version is easier to find than the VN2221.*

built-in diode to help prevent damage due to static electricity.

I figure that information would be of interest to *Think Tank* fans, because my circuit appeared not only in my first published article, *Cordless Car Test Probes* (**Popular Electronics**, January 1990), but with a variation in the MOSFET in a *Think Tank* letter submitted by Jay Hawthorne appearing in April 1994 as well (see Fig. 3). Anyway, the mechanics in my garage and I have been using my homemade cordless test lights daily for at least 5 years.

—*Mike Giamportone, Marysville, MI*

*I guess great minds do* think alike. Thanks for the part reference. I was having difficulty locating the MOSFET called for in the second circuit myself.

## CAR-AUDIO SUPPLY

I just received the December **Popular Electronics**. I was very interested in the Car-Audio Supply in *Think Tank*. I recently built a somewhat-similar unit, but it is limited to the one-amp capacity of the LM317T, and I was looking for a way to increase the current capacity. Because the unit I built is similar, including the dual-voltage switch (S2), I can offer a few tips on that type of circuit. First, with minor changes in the circuit, C2 can be eliminated (see Fig. 4).

In the circuit as it was originally drawn, I do not see any function for D2 and R3. If a connection dot is drawn where the line from D2 to R3 crosses the positive $V_{out}$ line, then R3 serves as a load resistor to draw a small amount of current—when the output is open—keeping the output voltage somewhat steady. With the extra connection, D2 serves to protect Q1. It also protects U1 to some extent.

Also, the text indicates a current output of 10 amps; to allow for the in-rush current for the large electrolytics as well, the values of F1 and F2 should be a little larger, say 6 or 7 amps. (I would probably have used a 2-amp fuse in the primary of T1 instead of F1 and F2.) Also, BR1 is shown as a 50-PIV unit. To allow a larger safety factor, that should be replaced with a 100-PIV unit. Transformer T1 is shown on the schematic as a 30-volt center-tapped unit, while the text says it's a 24-volt center-tapped one. The 24-volt rating is more than sufficient. The one-amp supply I built will output over 15 volts (with S2 in position 2) using an 18-volt transformer.

Last, the two potentiometers, R4 and R5, are shown as ¼-watt components. The actual current through them produces a dissipation of 0.16-watt, and if we follow the old rule of doubling the actual wattage, 1-watt potentiometers should be used. Fortunately, most potentiometers listed in catalogs are rated at 1 watt or more, so finding one should be no problem.

—*Bill Stiles, Hillsboro, MO*

*I welcome the input. I agree with the idea of a single fuse. It would protect the entire circuit from shorts (including line-current ones) if placed between PL1 and S1. However, I still feel comfortable with the 50-PIV rating of the bridge. By the way, the connection dot for the R3/D2/D1/Q1 junction literally fell off the artwork before the schematic made it to print.*

## BATTERY CHARGER

Regarding Joseph Gaskill's battery charger from the June 1994 *Think Tank*, I have used a current limiter (see Fig. 5) to provide a constant current (approximately 100 mA) to keep my car battery up during stor-

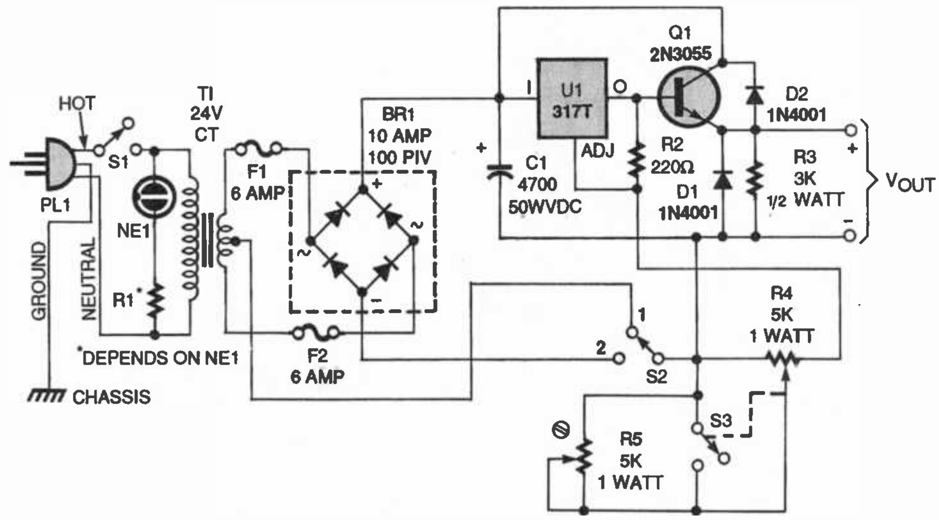



*Fig. 4. Reworking the car-audio power supply produces a unit that requires one less capacitor, a smaller transformer, but a beefier bridge and fuses.*

age. The value of R1 should be selected to limit current to the LED "charge" indicator. Resistor R2 should have a value of 10 ohms to set current limit to 120 mA according to:

$$I_{out} = 1.2/R2$$

where R2 can range from 0.8 to 120 ohms.

*—William E. Lahr, Compton, CA*

*I've used the same current limiter as a compliance circuit for testing components. However, I did not think to add the display LED. To calculate R1's value, use:*

$$R1 = (V_{in} - 14.75)/0.15$$

*which indicates that $V_{in}$ should be a bit higher than 15 volts (at least 17.25) to make R1 of a value that is reasonably easy to find. The extra voltage will also ensure a good trickle current.*

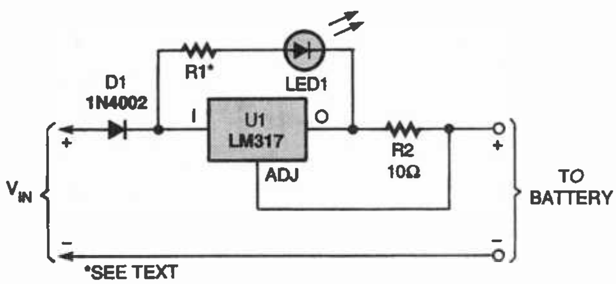



*Fig. 5. This current-limiting circuit is great for keeping lead-acid batteries on their toes. All it needs is an appropriate transformer to make it complete.*

## FRUSTRATED IN KANSAS

I just received my October issue of **Popular Electronics** and you have frustrated me again. On page 24, Fig. 1 shows a circuit with four connections, POWER, CONTROL, +5V, and GND. I will guess that I connect a five-volt power supply to the +5V and GND connections, but that is only a guess. I have no idea what to connect to POWER and CONTROL, nor do I have any idea how to use the circuit. I have ordered plans to build a model boat that I would like to radio control, so I think I could use your circuit if you would give me more information.

I don't consider myself a rank beginner in electronics. I teach computers at the high-school level, so obviously I have had some courses dealing with logic devices. This spring I took a three-hour credit course in beginning electronics at my local junior college and got an A. We studied things like Kirchhoff's laws, and built circuits with transistors, diodes, logic chips, etc.

Brad Tompkins, who submitted the circuit, might very well know how to hook it up and use it—you might very well know to hook it up and use it. If so, many of your readers probably also know how to hook it up and use it, so you don't feel the need to explain it to the few like myself who don't. If that is the case, then obviously I am subscribing to a magazine that is over my head. Could you recommend a simpler magazine to which I might subscribe instead?

*—Chuck Lynn, Overland Park, KS*

*I'm sorry you are having such trouble. One thing you've overlooked, which might be causing you some confusion, is the ground symbol (the "fifth connection") in the circuit. As with all the circuits in our magazine, the positive side of the voltage source is connected to the circuit at the point with the arrow, and the negative side is connected where the ground symbol is. That leaves us with three connections, all indicated by circles. Circles in our magazine sometimes indicate a connection with a circuit not shown. In this case, the circuit is a servo driver, so those points connect the circuit to a servo. The POWER and GROUND connections for the servo are self-explanatory because any motor obviously requires them. As to the control-signal connection, the author, Mr. Tompkins, explained it best when he said: "A servo's position depends on the pulse width of the control signal. That control signal is a high pulse that is one millisecond wide plus or minus 0.5 milliseconds."*

*Hopefully, that information on our connection designations will help you enjoy our magazine more. By the way, I really can't think of a single magazine that would take the time to answer questions on this level. I think if you look around you'll see that for yourself.*

Well, that rounds out another column. Thanks to everyone who participated. If you'd like to take a crack at sending in a circuit, and maybe getting a book, from our library, write to *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

*"It's rejecting your CD-ROM."*

# Graduate with an Associate Degree from CIE!

CIE INSTITUTE OF ELECTRONICS · 1934 ·

## Just like these Fully Trained Electronics Professionals

*"Thanks to CIE I have tripled my previous salary, and I am now in a challenging and rewarding new field where only the sky is the limit."*
*Daniel Wade Reynolds*
***Industrial Electrician***
*Ore-Ida Foods*

*"CIE was recommended to me by my boss. It was appealing since I could study at my own pace at home and during business travel."*
*Dan Parks*
***Marketing Manager/Consumer Products***
*Analog Devices, Inc.*

*"I loved the flexibility CIE offered. It was the only way I could continue both school and my demanding job."*
*Britt A. Hanks*
***Director of Engineering***
*Petroleum Helicopters, Inc.*

*"I liked the way the school was set up with laboratory assignments to enforce conceptual learning. The thing which impressed me the most about CIE's curriculum is the way they show application for all the theory that is presented."*
*Daniel N. Parkman*
***Missile Electro-Mechanical Technician***
*U.S. Air Force*

*"Completing the course gave me the ability to efficiently troubleshoot modern microprocessor based audio and video systems and enjoy a sense of job security."*
*Tony Reynolds*
***Service Manager/Technician***
*Threshold Audio & Video*

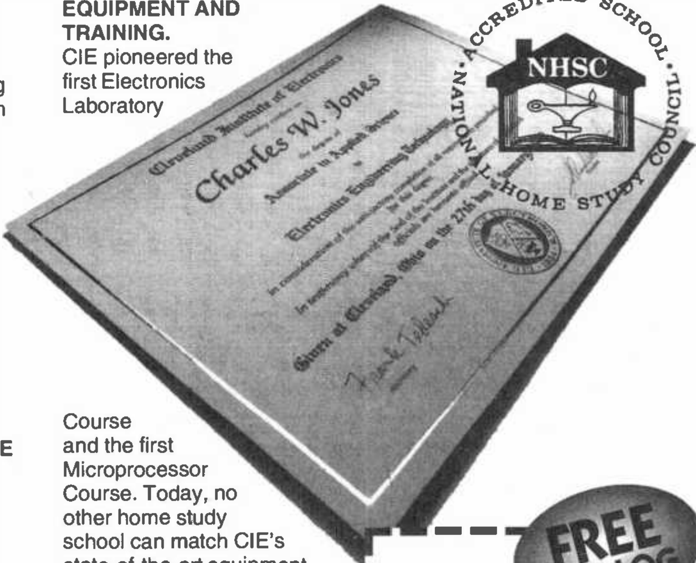
CIE is the best educational value you can receive if you want to learn about electronics, and earn a good income with that knowledge. CIE's reputation as the world leader in home study electronics is based solely on the success of our graduates. And we've earned our reputation with an unconditional commitment to provide our students with the very best electronics training.

Just ask any of the 150,000-plus graduates of the Cleveland Institute of Electronics who are working in high-paying positions with aerospace, computer, medical, automotive and communications firms throughout the world. They'll tell you success didn't come easy...but it did come...thanks to their CIE training. And today, a career in electronics offers more rewards than ever before.

**CIE'S COMMITTED TO BEING THE BEST...IN ONE AREA...ELECTRONICS.**
CIE isn't another be-everything-to-everyone school. CIE teaches only one subject and we believe we're the best at what we do. Also, CIE is accredited by the National Home Study Council. And with more than 1,000 graduates each year, we're the largest home study school specializing exclusively in electronics. CIE has been training career-minded students for nearly sixty years and we're the best at our subject... ELECTRONICS... IT'S THE ONLY SUBJECT WE TEACH!

**CIE PROVIDES A LEARNING METHOD SO GOOD IT'S PATENTED.**
CIE's AUTO-PROGRAMMED® lessons are a proven learning method for building valuable electronics career skills. Each lesson is designed to take you step-by-step and principle-by-principle. And while all of CIE's lessons are designed for independent study, CIE's instructors are personally available to assist you with just a toll free call. The result is practical training... the kind of experience you can put to work in today's marketplace.

**LEARN BY DOING...WITH STATE-OF-THE-ART EQUIPMENT AND TRAINING.**
CIE pioneered the first Electronics Laboratory Course and the first Microprocessor Course. Today, no other home study school can match CIE's state-of-the-art equipment and training. And all your laboratory equipment, books and lessons are included in your tuition. It's all yours to use while you study and for on-the-job after you graduate.




ACCREDITED SCHOOL · NATIONAL HOME STUDY COUNCIL · NHSC

**PERSONALIZED TRAINING....TO MATCH YOUR BACKGROUND.**
While some of our students have a working knowledge of electronics others are just starting out. That's why CIE has developed twelve career courses and an A.A.S. Degree program to choose from. So, even if you're not sure which electronics career is best for you, CIE can get you started with core lessons applicable to all areas in electronics. And every CIE Course earns credit towards the completion of your Associate in Applied Science Degree. So you can work toward your degree in stages or as fast as you wish. In fact, CIE is the only school that actually rewards you for fast study, which can save you money.

## Send for CIE's FREE Course Catalog and See How We Can Help Your Career Too!

**FREE CATALOG**

**YES!** I want to get started. Send me my CIE course catalog including details about the Associate Degree Program. (For your convenience, CIE will have a representative contact you - there is no obligation.)

**Please Print Clearly**

Name ____________________

Address ____________________

City ____________________

State _____ Zip __________ Age _____

Phone No. ____________________

Check box for G.I. Bill Benefits.
Veteran
Active Duty AH66

**Cleveland Institute of Electronics, Inc.**
**1776 East 17th Street**
**Cleveland, OH 44114**

***A School of Thousands.***
***A Class of One. Since 1934.***

# Build a RADAR SPEED GUN


*How fast was that car going? Build this inexpensive, microwave-radar speed gun and find out!*

**BY MARC SPIWAK**

Cars have speedometers built into their dashboards so that if you are the driver or a passenger, it's never a question as to how fast you're going. However, you can only guess just how fast a car is going when it simply zips by you. So what can you do if you're not a cop but are still curious about speeders? You can build this neat little radar gun in a couple of nights and start making those citizen's arrests—just kidding!

Seriously, though, *Speedy*, the radar speed gun described in this article, is a great project. You can accurately measure the speed of cars, airplanes, horses, bicycles, boats, radio-controlled models, and anything else that moves. Speedy "clocks" speeds with an accuracy of at least 1 percent, and gives a readout in miles-per-hour on two 7-segment LED displays. The radar gun can also be made to display kilometers-per-hour, meters-per-second, or feet-per-second instead of miles per hour, by replacing a single resistor. Its maximum range varies depending on what is being measured but is about ¼ mile for an average-sized car.

Speedy works on the principle of the Doppler effect, which is the same theory upon which all radar operate. By plugging an earphone into the earphone jack of the project, you can hear the Doppler frequency shift of moving objects. We'll talk more about the Doppler effect later on.

The unit operates on 12-volts DC, so it's easy to power it from batteries or the cigarette-lighter socket of any automobile. That means you can take Speedy with you anywhere. One of the best things about this project, though, is that even though sophisticated microwave circuitry is used, there's no critical tuning involved—just two potentiometers that are very easy to set.

You can build Speedy from scratch, but be warned that several of the components, including the microwave transistor and the hot-carrier diode in the project's oscillator board are virtually impossible to obtain from conventional hobbyist sources. Furthermore, several microstrips that are part of the oscillator board itself are critical to the operation of the circuit. Therefore, by far the easiest way to build the unit is to buy the kit available from the source given in the Parts List. The full kit includes everything you need except two coffee cans and a 12-volt power supply. Readers of this magazine can surely come up with a 12-volt supply, if not from their car battery, and coffee cans aren't hard to come by either.

**The Doppler Effect.** The Doppler effect can be observed in any kind of wave—sound, light, or radio. Basically, the perceived frequency of a wave will shift if the source of the wave is moving with respect to the point of observation. When a train goes by blasting its whistle, a change in pitch is heard as it goes by even though the actual frequency of the train's whistle is constant. As the train moves toward you, the frequency of its whistle will apparently increase, and as it moves away from you it will decrease.

The Speedy radar gun radiates a frequency of 2.6 gigahertz, and measures the shift in carrier frequency of the returned echo signal. The frequency shift is then used to calculate the speed of an object as it approaches or moves away. For every mile per hour that the object is moving, the frequency is shifted 7.76 hertz away from the original; the frequency will be shifted higher if the object is approaching and lower if it's moving away.

It doesn't matter if the object is accelerating or decelerating, because Speedy's display updates every ½ second. And even though the 2-digit display can't show anything higher than 99, it simply "rolls over" so that you just add 100 to the number you see. In addition to the display, Speedy's earphone jack outputs the Doppler-shift frequency in hertz. You can listen to that tone or have some other piece of equipment trigger off a particular frequency—which translates into a certain speed.

**Circuit Description.** The Speedy radar gun consists of two circuit boards interconnected by a two-conductor shielded cable. One of the boards is a microwave oscillator that

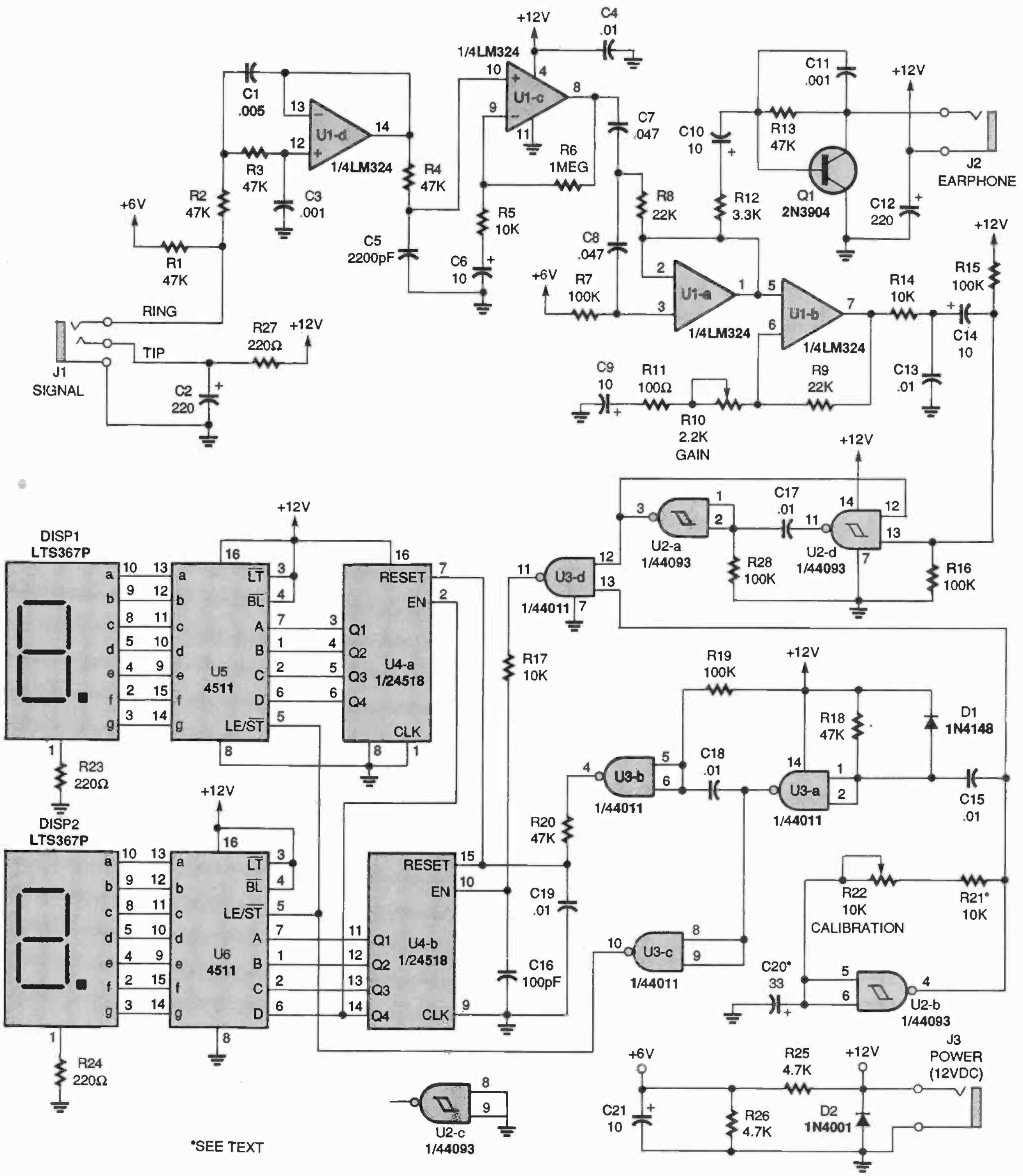



*Fig. 1. Here's the schematic of the Speedy display-board circuit. That part of the radar gun receives the signal from the microwave-oscillator circuit and displays the signal in miles-per-hour, with the value for R21 shown here. Replacing R21 (see text) will allow the project to give readings in kilometers-per-hour, or other units.*

mounts on a metal "gun" made from two steel coffee cans. The oscillator radiates a microwave signal and receives its "echo." One conductor of the shielded cable sends the difference between the echo signal and the original back to a hand-held readout unit that processes and displays the speed of a moving object. Power is supplied to the oscillator from the display unit by the other conductor in the shielded cable. The cable connecting the two sections together can be up to 300-feet long.

Figure 1 is the schematic of the LED speed-readout board. That part of the radar gun receives the difference signal from the microwave oscillator at the terminal marked "ring" on miniature stereo-jack J1. The J1 terminal marked "tip" supplies power to the oscillator section. The received signal is first low-pass filtered by U1-d, and then amplified by U1-c. A high-pass filter is formed by U1-a; at the output of U1-a, the signal is split into two paths: to transistor Q1, which drives an earphone plugged into jack J2 at an audio frequency, and to the display section. Potentiometer R10, in conjunction with op-amp U1-b, sets the gain of the unit, and is later on used to adjust the sensitivity of the radar gun.

The signal to the display section is squared up and has its pulse width adjusted by U2-d and U2-a (two quarters of either a CD4093 or MC14093 quad NAND gate IC), and ends up, via NAND gate U3-d, at U4, a dual synchronous decade counter. Then, U4-b "counts" the signal and outputs a binary-coded decimal signal for the miles digit shown by DISP2; U4-a is triggered by U4-b and outputs a BCD signal for the tens-of-miles digit shown on DISP1. Before those BCD's can drive the 7-segment displays, however, they have to be decoded by U5 and U6, which are both 4511 BCD-to-7-segment-LED decoders. Proper timing, with reset signals and clock pulses, is set by U3-b and U3-a.

Potentiometer R22 is used to calibrate the radar gun. The value of resistor R21, which is in series with R22, determines the format of the Speedy display (miles-per-hour, kilometers-per-hour, feet-per-second, or meters-per-second), but more on that later. Integrated circuit U2-b is a clock oscillator that gates the signal at 1/7 second, enabling the unit to count the pulses that occur in 1/7-second periods. Power for the entire radar gun (12-volts DC) is input at coaxial-jack J3. From there it is distributed to the rest of the circuit, and to the microwave oscillator via jack J1.

The microwave-oscillator circuit is shown in Fig. 2. Power for the oscillator comes from the center conductor of jack J1. The heart of the microwave oscillator is the NE021 microwave transistor, Q2. At the base of Q2 is a ¼-wave microstrip that sets the frequency to 2.6 gigahertz. The microstrip at the collector of Q2 couples the signal to the antenna in the can and to the anode of D2, a hot-carrier diode. Reflected signals from moving objects are also picked up by the antenna in the metal can. The reflected signal is mixed with the oscillator frequency by the hot-carrier diode, D2.

Sum and difference frequencies appear at the base of Q1. That transistor amplifies only the difference frequency, though; that's because the sum frequency is much too high for it to respond to. The signal is then fed to the top conductor of J1 (the one that connects to the jumper) and on to the

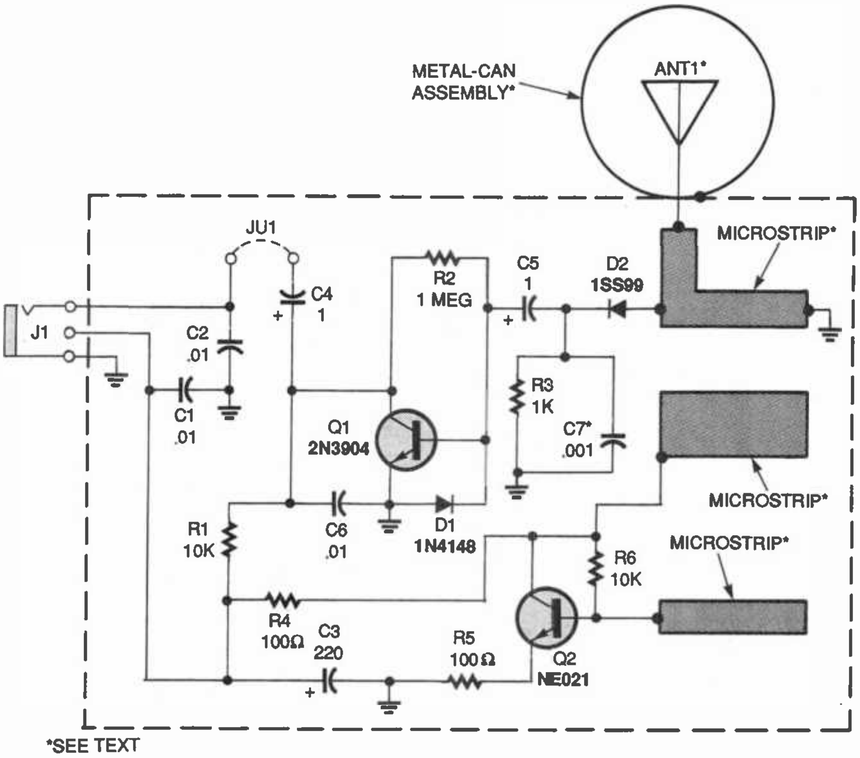
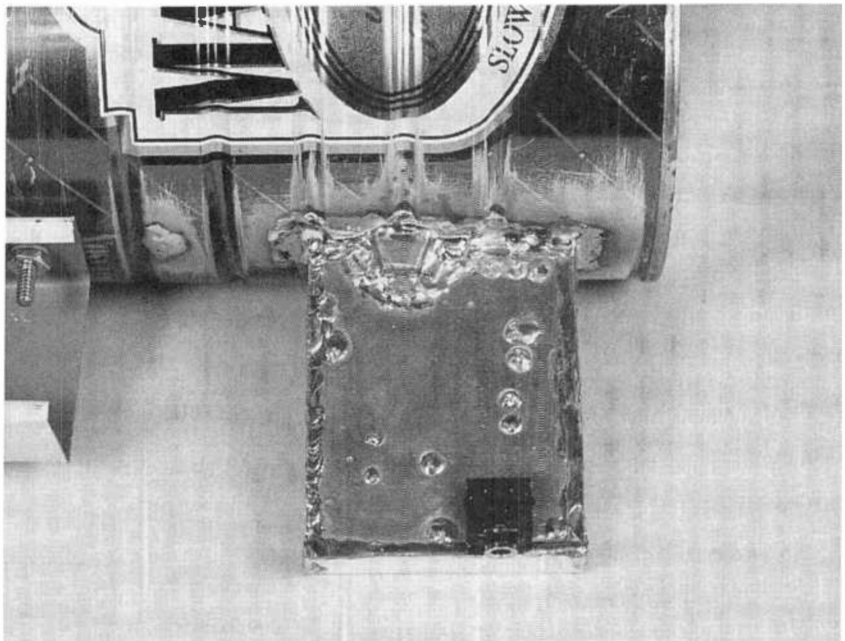



*Fig. 2. The microwave-oscillator circuit shown here radiates a frequency of 2.6 gigahertz and sends the shifted return signal to the display board for decoding. The microstrips indicated here are specific traces on the circuit board that are actually "components" of the circuit.*



*Center the oscillator-board antenna in the ¼-inch hole, 1⅞ inches from the closed end of the can, and solder it to the can assembly, completely filling the gap with solder.*

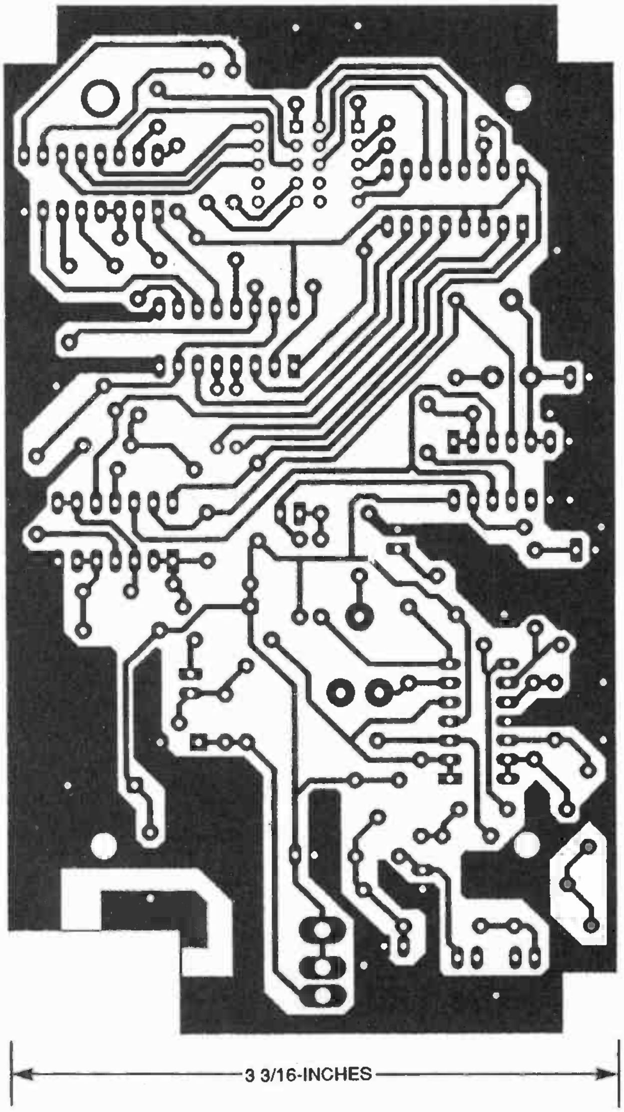



*Fig. 3. Use this actual-size foil pattern to make your own display board.*

## PARTS LIST FOR THE SPEEDY OSCILLATOR BOARD

**SEMICONDUCTORS**
Q1—2N3904 NPN transistor
Q2—NE021 microwave transistor
D1—1N4148 general-purpose silicon diode
D2—1SS99 hot-carrier diode

**RESISTORS**
(All resistors are ¼-watt, 5% units.)
R1, R6—10,000-ohm
R2—1-megohm
R3—1000-ohm
R4, R5—100-ohm

**CAPACITORS**
C1, C2, C6—0.01-µF, ceramic-disc
C3—220-µF, 16-WVDC, electrolytic
C4, C5—1-µF, 50-WVDC, electrolytic
C7—0.001-µF, surface-mount chip capacitor (see text)

**ADDITIONAL PARTS AND MATERIALS**
J1—Miniature stereo jack
Printed-circuit-board materials, miniature stereo plug, 22-gauge bus wire, tin shield (see text), two empty 1-pound coffee cans (or equivalent cans, see text), jumper wire, solder, etc.

**Note:** The following is available from Ramsey Electronics (793 Canning Parkway, Victor, NY 14564; Tel. 716-924-4560 or 800-446-2295): SG-7 Speedy Speed Radar Kit (includes all parts and case—does not include coffee cans and 12-volt DC supply)—$99.95.

## PARTS LIST FOR THE SPEEDY DISPLAY BOARD

**SEMICONDUCTORS**
U1—LM324 op-amp
U2—CD4093 or MC14093 quad Schmidt trigger NAND gate
U3—4011 quad NAND gate
U4—4518 dual BCD decade counter
U5, U6—4511 BCD to 7-segment LED driver
DISP1, DISP2—LTS367P 7-segment-LED-decoder display
D1—1N4148 general-purpose silicon diode
D2—1N4001 silicon rectifier diode
Q1—2N3904 NPN transistor

**RESISTORS**
(All fixed resistors are ¼-watt, 5% units.)
R1–R4, R13, R18, R20—47,000-ohm
R5, R14, R17—10,000-ohm
R6—1-megohm
R7, R15, R16, R19, R28—100,000-ohm
R8, R9—22,000-ohm
R10—2200-ohm, PC-mount potentiometer
R11—100-ohm
R12—3300-ohm
R21—10,000-ohm (see text)
R22—10,000-ohm, PC-mount potentiometer
R23, R24, R27—220-ohm
R25, R26—4700-ohm

**CAPACITORS**
C1—0.005-µF, ceramic-disc
C2, C12—220-µF, 16-WVDC, electrolytic
C3, C11—0.001-µF, ceramic-disc
C4, C13, C15, C17–C19—0.01-µF, ceramic-disc
C5—2200-pF, ceramic-disc
C6, C9, C10, C14, C21—10-µF, 25-WVDC, electrolytic
C7, C8—0.047-µF, ceramic-disc
C16—100-pF, ceramic-disc
C20—33-µF, 16-WVDC, electrolytic (see text)

**ADDITIONAL PARTS AND MATERIALS**
J1—Miniature stereo jack
J2—Subminiature phone jack
J3—Power jack
Printed-circuit-board materials, project enclosure, four ⅜-inch threaded standoffs, two miniature stereo plugs (should match J1), 12-volt DC power source with plug (should match J3), 2-conductor shielded cable, hardware, solder, jumper wire, etc.

unit's display board through the coaxial cable.

**Construction.** It is a good idea to build both parts of the radar gun on PC boards, but only the microwave oscillator *must* be built on a PC board. Traces on that board form actual components of the circuit (microstrips), which is the only way to go at such high frequencies.

The display board is single-sided, but the microwave-oscillator board is made from double-sided glass-epoxy material—the entire solder side is a ground plane. The foil patterns of those PC boards are shown in Figs. 3 and 4, respectively. Again, you can make your own boards and obtain your own parts, but it is strongly recommended that you build the project from the kit.

You will need a coaxial cable to test the unit, so you might as well build it now. The cable should have two different colored conductors and a shield surrounding them. A miniature stereo plug is connected to each end of the cable, with the shield soldered to the strain-relief lugs of the stereo plugs, and the conductors soldered to either of the other terminals; just keep the colors straight at both ends of the cable. You could even solder the cable to both boards directly, eliminating the need for the plugs and jacks, but that makes the radar gun less convenient to use.

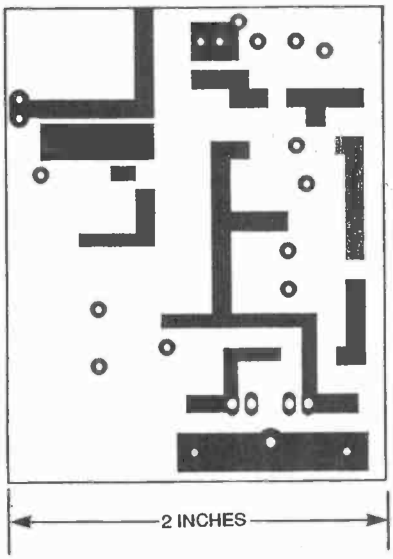



*Fig. 4. The microwave-oscillator board is double-sided, with the entire solder side being a ground plane. The component side is shown here.*

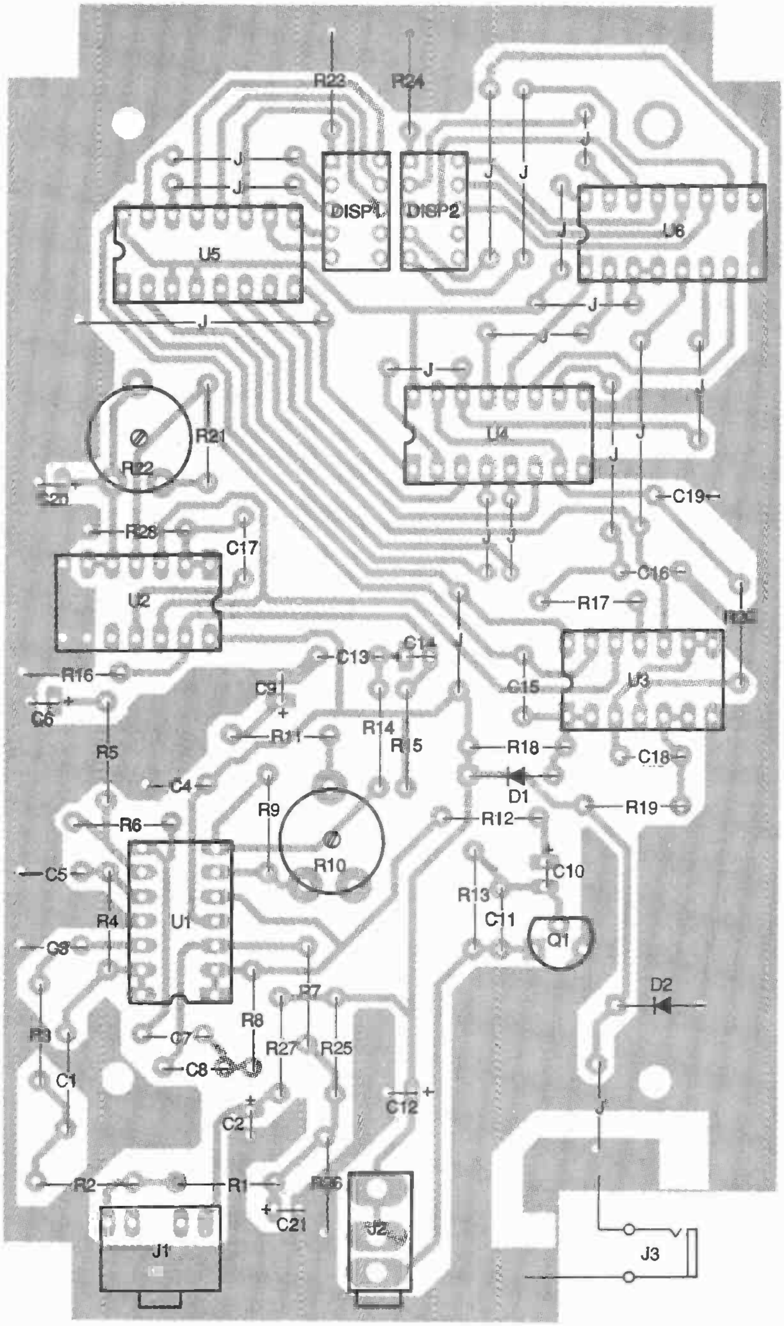



*Fig. 5. Use this parts-placement diagram when assembling the display board. You can install the parts in any order you like, although starting with the IC's makes it easier to locate the other components. The leads of J3 mount on the back of the board, and the jack is held in place off-board by them.*

A parts-placement diagram for the display board is shown in Fig. 5. You can install the parts in any order you like, although starting with the IC's makes it easier to locate the other components. You don't have to use sockets for the IC's, although they help prevent heat damage.

You will have to decide on certain parts values before beginning assembly. First of all, as mentioned earlier, the value of R21 determines that readout of the Speedy gun. If R21 is a 10,000-ohm unit, the readout will be in miles-per-hour; if it is a 4700-ohm unit, the readout is in kilometers-per-hour or feet-per-second; finally, a 15,000-ohm resistor will give a readout of meters-per-second. Second, the value of C20 will depend on what IC you use for U2. If it is a CD4093, then C20 should be a 22-µF electrolytic capacitor. If U2 is an MC14093 a 33-μF electrolytic unit should be used.

The two potentiometers are mounted on the solder side of the display board so that the circuit can be calibrated without completely removing it from the case. Also, any disc capacitors that are taller than the LED displays should be mounted on the back of the board and bent at an angle if you are installing the board in the case included with the kit. If you are building from scratch, you must decide on your own whether certain parts should be mounted on the back. The leads of power-jack J3 are tack soldered on the back of the board and the jack is held in place off-board so that the power plug can be plugged into the bottom of the finished unit.

A red plastic lens installs on the inside of the top half of the kit's case. The board then mounts to the case with four threaded spacers and eight screws. Again, if you're not using the case from the kit, you are on your own.

The parts-placement diagram for the microwave oscillator board is shown in Fig. 6. Surface-mount capacitor C7 comes pre-installed if you buy the kit, but observe caution soldering that part if you're doing it yourself. Other non-surface-mount parts

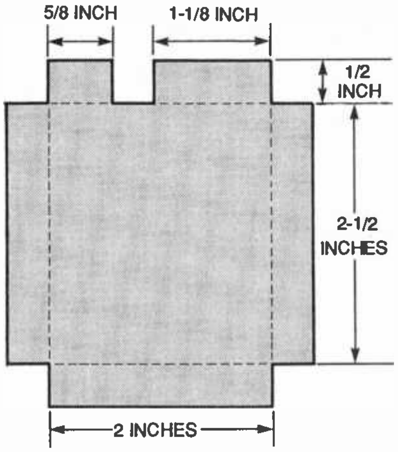



*Fig. 7. This is the template for the tin shield that covers the oscillator board. The sides of the shield are bent up at 90-degree angles (where dotted lines are shown) to form a cover. The opening is for the antenna.*

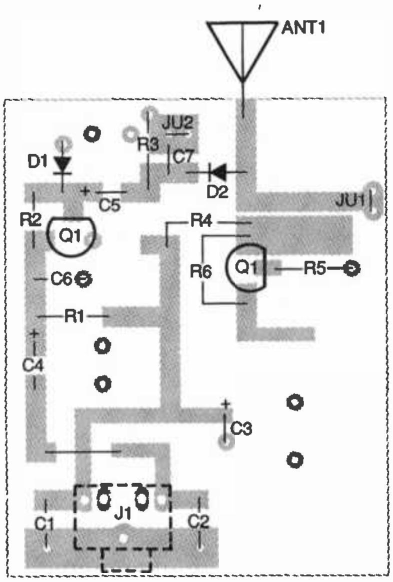



*Fig. 6. Careful soldering and the shortest possible lead lengths are important on the microwave-oscillator board. Any lead shown mounted over a circular pad goes through the board and is soldered on both sides, and all other leads are tack soldered on the surface. Note that J1 mounts on the solder side.*

have some or all of their leads tack soldered to the surface of the board and some or all passed through a hole and soldered on both sides of the board. How do you tell which is which? It's simple: Any lead shown mounted over a circular pad goes through the board and all other leads are tack soldered.

The electrolytic capacitors have wire straps soldered across them to hold them securely in place. Be careful when installing bare-wire jumper JU3; it should not make contact with the center trace shown below it in Fig. 6. Jack J1 mounts on the shield side of the board and ends up being on the outside of the shielded oscillator case when complete. To complete the ground plane, bare-wire jumpers JU1 and JU2 are soldered on both sides of the board. A piece of 22-gauge bus wire is soldered to the board to form ANT1. It is trimmed down to 1.1 inches in length from the edge of the PC board.

**Test and Final Assembly.** At this point you must check a few voltages on the oscillator board before soldering the shield to it; after the shield is in place, the board is difficult to service. Before checking the following voltages, inspect the oscillator board carefully for any faulty soldering or misplaced components.

Connect a 12-volt DC supply to power-jack J3 on the display board, and connect that board to the oscillator board with the coaxial cable you made earlier. The display will light up, but at this point, what it shows is meaningless. Now check for 8-volts DC on the oscillator-board microstrip that connects C3 to J1. There should be about 6 volts at the collector of Q2, and about 2.5 volts at the base of that transistor. If all is well, turn off power and remove the cable from the oscillator board.

Next, you are ready to solder the shield to the oscillator board. Shield dimensions are shown in Fig. 7, if you are making your own. Use tin to make the shield. The sides of the shield are bent (where dotted lines are shown) up at 90-degree angles to form a cover for the oscillator. Use a straightedge to help make sharp folds in the shield. The opening shown is for the antenna lead.

Next, fit the shield over the oscillator board so the edges of the shield are flush with the ground-plane side of the board. Apply a bead of solder around the entire perimeter of the oscillator assembly between the ground-plane of the board and the edges of the tin shield. You can also apply solder to the joints in the corners of the shield.

One-pound coffee cans have a diameter of 3.875 inches, and two of them soldered together at the ends are 11 inches in length. Remove both ends from the outer can and leave one end on the can that the oscillator will attach to. You can also use any combination of cans with the same diameter that equals 11 inches in length, give or take an inch or two. Solder the two cans together at the ends; you might want to line up the seams of the two cans for a neater appearance. It's easier to solder the two cans together if you tin the rims first.

Next drill a ¼-inch hole, 1⅞ inches from the closed end of the can assembly. Center the oscillator antenna lead in the hole and solder the oscillator assembly to the can assembly, completely filling the gap with solder. Be sure to first sand off any paint from the can where solder will be applied. You can also mount a tripod attachment or some other mounting scheme to the underside of the can at this time. Small screw heads protruding into the can will not affect the

(Continued on page 90)

# Automotive Electronics for the 21st Century

*While these features exist today only in a dream car from Buick, they likely will make driving a dream-come-true in the next century.*

BY WILLIAM D. SIURU, JR.

Automakers are constantly unveiling concept cars that provide a glimpse of the cars and trucks of the future. Those dream cars are used to try new styling and engineering ideas out on the public, generate excitement about a company's current products, and hint at what is being developed behind locked doors. On a few occasions, such as with the Dodge Viper, Oldsmobile Aurora, and Chevrolet Impala SS, the concept cars are put into production, with some changes, of course.

Automotive historians generally credit the 1938 Buick Y-Job as the first true American dream car. Today, dream cars are called concept cars. Over the years Buick has built many other dream cars like the LeSabre, Wildcat, Questor, Bolero, and Sceptre. Buick's latest concept car, the pearlescent silver-gold XP2000, not only features advanced styling but is really a showcase for the electronics expected on the cars of the 21st Century. Of course, the implementation of some of the technology will depend on the development of Intelligent Vehicles/Highway Systems (IVHS) and the Information Highway. Let's see what the car has to offer.

**Vehicle Navigation.** As expected on a car of the 21st Century, there is an on-board navigation system. The XP2000's "Smart Arrow Navigation System" uses a very user-friendly display to guide the driver. An arrow indicates recommended vehicle direction, while distance, time to destination, road names, and so forth are displayed nearby. The system also warns the driver of the presence of emergency vehicles or the color of the traffic-signal lights that he or she is approaching. The memory also contains a "Yellow Pages"-style directory of restaurants, services, and tourist attractions.

Information from the Smart Arrow Navigation System can be displayed on either the heads-up display (HUD) or the main color display on the instrument panel. The HUD projects data onto the base of the windshield just below the driver's normal line-of-sight. The advanced HUD in the car uses programmable, reconfigurable color displays to provide whatever information the driver chooses. Besides navigation information, the HUD can be reconfigured to allow the driver to check speed, fuel level, and other important information without taking his or her eyes off the road.

The instrument panel is a reconfigurable, flat-panel, full-color display. By selecting different screens, the driver can obtain route-guidance information from the navigation system or use it as a normal instrument cluster with a speedometer, tachometer, and various engine-status gauges. When the vehicle is parked or under fully automated control (more on that in a moment), the flat-panel screen can be a display for a personal computer or the entertainment system. An infrared remote link is used for the "hookup" between the display, and a notebook computer, TV, or VCR.

**Automatic Guidance Control.** The XP2000's Automatic Guidance and Adaptive Cruise System is designed to use wire-guidance systems proposed for the Intelligent Vehicle Highway Systems of the 21st Century. Sensors under the car can link the XP2000 to the wire-guidance system. While that hands-off "Automatic Guidance" might be farther in the future, "Adaptive Cruise Control" is a nearer term possibility. Here, the driver selects a speed and following distance; the cruise control automatically maintains that distance from the car ahead. The system will instantly slow the car and alert the driver if the vehicle ahead slows or stops suddenly.

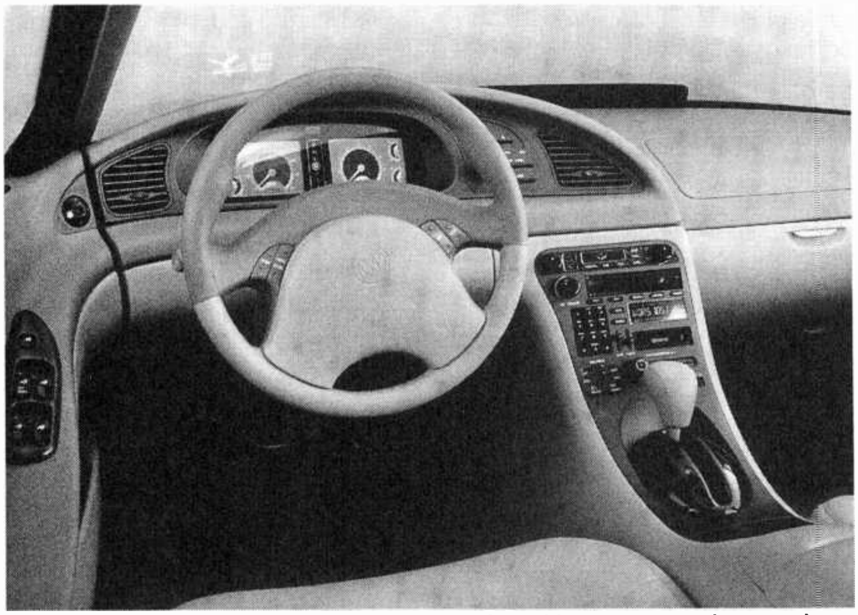
With completely robotic control, driver and passengers could use the car's extensive communications capabilities for work or entertainment during commutes and long trips. In the automated-guidance mode, the XP2000 reconfigures its color displays and other features, transforming the car's interior into an office or entertainment center.

**Safety and Convenience Features.** The navigation system, climate controls, entertainment system, and other features can be activated by a voice-recognition system. That allows the driver's hands to remain on the steering wheel at all times.

To make driving safer, especially at night or in poor visibility, a Near Obstacle Detection System uses radar to track objects near the XP2000 and predict their motion relative to the car. That information is graphically displayed on the head-up display. When the vehicle is shifted into reverse, the radar scans the space behind the XP2000 and warns the driver of any obstacle, using the heads-up display and an audible tone. When the car is in reverse, the system also adjusts the outside mirrors downward to improve rear visibility and reduce blind spots.

Each driver of the XP2000 will have a unique keyless fob, a more sophisticated version of the flat plastic encapsulated memory chips already in use. Like current ones, on approaching the vehicle, a signal from the fob unlocks the doors. Then, if it is dark, the fob turns on the car's interior lights plus the head lamps and backup lights, providing good visibility around the car. There are also "puddle lights" under the rocker panels to illuminate the area beneath the doors making ice or other hazards more visible.

A feature called "Customer's Choice" allows drivers to tailor many features of the car to their personal taste. Each driver is identified by an electronic code in their keyless fob. As the driver approaches the car, a digital signal from the fob tells the XP2000's computers to adjust the seat, steering column, outside mirrors, climate control, and entertainment system to the preferences of that driver. The dynamic response of the car, including steering effort, transmission-shift points, engine response, and suspension feel, can also be programmed using Customer's Choice. To start the car, the driver inserts the fob into a slot in the instrument panel and presses it momentarily. A security code in each fob allows the car to start only if an authorized fob is used. To stop the engine, the driver simply removes the fob from the slot.



*The XP2000's full-color, flat-panel display is configured here to present the normal information on speed, engine rpm, and status of the engine. Information from the Smart Arrow Navigation System is shown on the heads-up display just above the top of the steering wheel*

There are eight air bags to protect all the XP2000's occupants, one each in the steering and instrument panel, two in the backs of the front seats and one in each of the four doors for side-impact protection. In the event of an accident severe enough to deploy an air bag, the vehicle computers can be programmed to automatically call the police and ambulance.

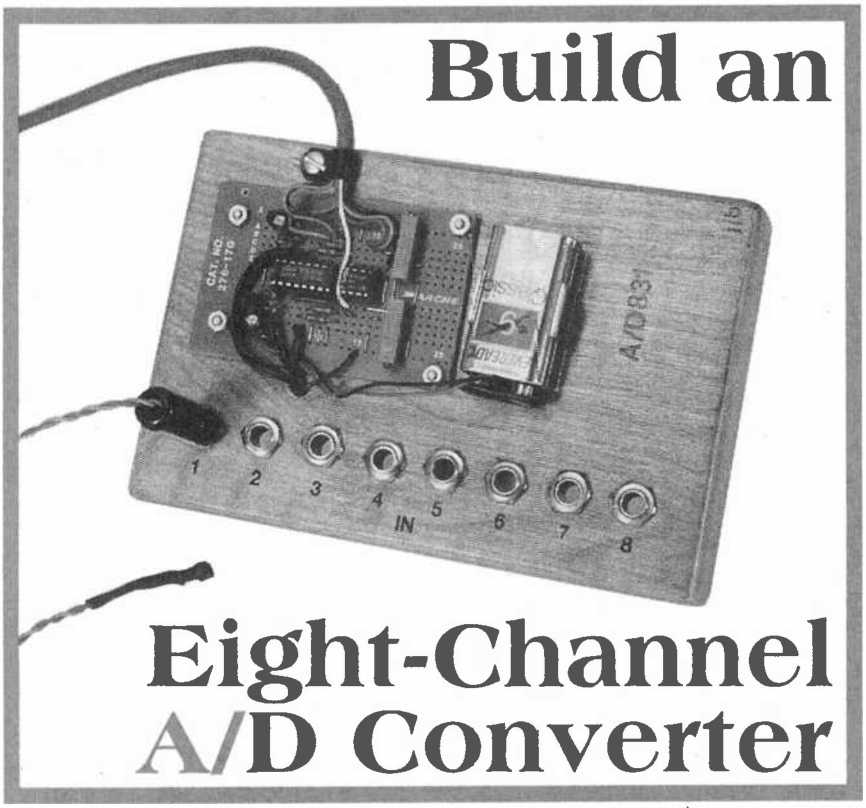
With the XP2000, you never have to worry about being short of cash for gas or tolls. A slot in the instrument panel accepts a GM "Smart Card" credit card with an integral computer memory. The Smart Card can pay for fuel, food, or other services. It can automatically pay tolls, so the car can pass through toll booths without stopping. Smart Cards could also carry the driver's medical records and personal history.

Sensors thoughout the XP2000 monitor all critical functions from the condition of the engine to the air pressure in the tires. If those sensors sense a problem, the driver will be alerted and the system could even be programmed to automatically notify Buick's Roadside Assistance service. In some cases, the malfunction might be fixed by software adjustments automatically transmitted from a Buick dealer.

While the 1938 Y-Job never became a real vehicle, many of its features found their way into the Buicks of the 1940's. Similarly, while the XP200 will also likely remain a dream car, many of its features will likely appear on real-world Buicks during the next few years. ■

BY JAMES J. BARBARELLO

# Build an Eight-Channel A/D Converter




*Let your computer interface with the physical world.*

Every now and then, you come across an electronic component that is easy to use in an application. Such a device is National Semiconductor's ADC0831—a single-input, 8-Bit, Serial Input/Output (I/O), Analog-to-Digital (A/D) Converter. For standard 0- to 5-volt-input applications, all you need is the ADC0831 and a 5-volt power supply; no additional components are required! The ADC0831 output can connect directly to any of your PC's available parallel ports.

Many applications, however, use multiple inputs that don't span the complete 0- to 5-volt range. For instance, temperature sensors spanning the −40 to +125°F range will typically vary their input by only one volt or so. With the addition of two potentiometers, the ADC0831 can be adjusted to provide the full 255 steps inherent in an 8-Bit A/D converter over a smaller input-voltage range, without the need for op-amps or other analog scaling devices. That range can also be adjusted to begin at a voltage other than zero volts. Then, by adding a single, common multiplexer IC, up to eight input devices can be connected.

The result of those preceding additions is the *A/D Converter* described in this article. It is a circuit that has a noncritical layout, so it can be built on a low-cost prototyping board. Also, what's great about the project is that it can be built for under $25. Even if you add eight temperature probes (as is done in an application that will be dealt with later), the cost can stay under $50! Don't think that the low price means low performance, however. Depending on the speed of your PC, the circuit can capture 1000 or more samples per second.

**The ADC0831.** One useful feature of the ADC0831 is that its analog, zero-input-voltage value can be offset; the voltage-reference input can be adjusted to allow encoding any smaller, analog voltage span to the full 8 bits of resolution (with a ±1 least-significant-bit error). As a result, it can operate ratiometrically or with a 5-volt-DC voltage reference; no zero or full-scale adjust is required. The ADC0831 is TTL/MOS-I/O compatible. It operates from a single 5-volt power supply over a 0°C to 70°C temperature range, consuming only 15 milliwatts. The conversion time of the chip is 32 microseconds.

As shown in Fig. 1, the ADC0831 is an 8-pin IC. Operation is enabled by placing a logic low on pin 1, the chip select ($\overline{CS}$). Data is sent out of pin 6 ($D_{out}$), and the IC requires a clocking signal at pin 7 (CLK). Power is applied to pins 8 ($V_{cc}$) and 4 (GND). The input signal is provided to $V_{in}+$, which is pin 2. The zero-conversion reference voltage is provided to $V_{in}-$ (pin 3). Finally, the voltage representing the range of the 8-bit conversion is provided to $V_{ref}$ (pin 5).

Figure 2 shows the timing diagram for the ADC0831. In our application, the CLK (clock) signal will be derived from the PC's parallel port, and the Data Out will be sent to the parallel port. To begin, a conversion is initiated by first pulling the $\overline{CS}$ line low. That line must be held low for the entire conversion. The ADC0831 then waits for a start bit. Next, the clock is provided to the CLK input. On the falling edge of the first clock pulse, the Data Out ($D_{out}$) line comes out of its high-impedance state and provides a leading zero for one clock period. Each bit of the converted voltage level (beginning with the most significant bit, and proceeding through the least significant bit) is made available on the $D_{out}$ line, beginning with the falling edge of each succeeding clock period. After eight clock periods, the conversion is completed. The $D_{out}$ line goes into the high-impedance state again when the $\overline{CS}$ line returns to the high state.

While the ADC0831 can be used in the standard 0- to 5-volt input mode,

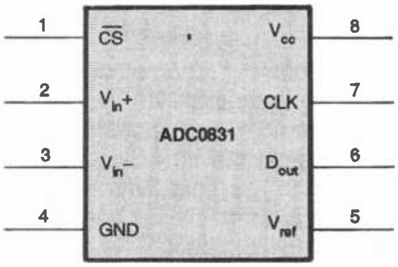



*Fig. 1. This is the pinout of the ADC0831, which is the heart of the A/D Converter.*

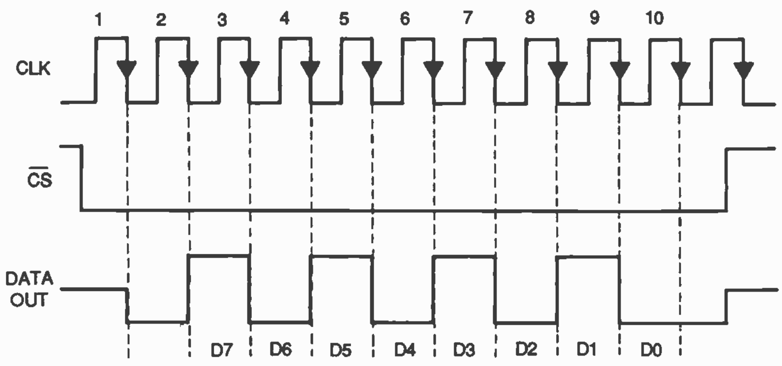
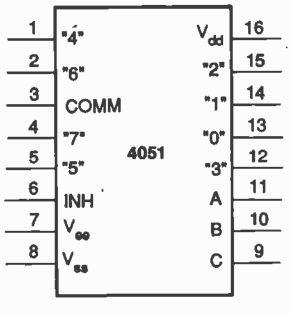



*Fig. 2. Here's the timing diagram of the ADC0831. In the application discussed in the article, the CLK signal is derived from a PC's parallel port, and the Data Out is sent to the same parallel port.*

both its minimum analog input-voltage and full-scale voltage values can be adjusted. When the $V_{in}-$ pin is biased to other than ground, the converter will output a 0000 0000 digital code for that minimum input-voltage value. The voltage value applied to $V_{ref}$ determines the analog input-voltage value that will produce the full-scale digital code (1111 1111). The sum of $V_{in}-$ and $V_{ref}$ must be less than or equal to 5 volts. For instance, by applying 2.3 volts to $V_{in}-$, and 1.28 volts to $V_{ref}$, an analog input voltage of 2.3 volts will produce a digital code of 0, and an input of 3.58 (2.3 + 1.28) will produce a digital code of 255. That provides an effective resolution of 1280 mV/256 counts, or 5 mV/count. That is four times the standard resolution of 19.53 mV/count (5000 mV/256 counts) that an 8-bit A/D converter would provide without the ratiometric capability.

**The 4051.** As mentioned earlier, for our application of the ADC0831, we will need to use an 8-channel multiplexer, the 4051. Figure 3A shows the pinout of that IC. Power is normally applied to $V_{dd}$ (pin 16), and ground to $V_{ss}$ (pin 8); however, in our application, we'll connect $V_{ee}$ (pin 7) to ground also.

Three inputs—A, B, and C—form a binary counting scheme (as indicated in the truth table in Fig. 3B). The binary number input to the A-B-C inputs selects the same-numbered channel in the chip. That selected channel is connected to the COMM terminal (pin 3) through the 4051's internal circuitry, which adds a few-hundred ohms of resistance in series between the selected channel and




A

| INH | C | B | A | "ON" |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 2 |
| 0 | 0 | 1 | 1 | 3 |
| 0 | 1 | 0 | 0 | 4 |
| 0 | 1 | 0 | 1 | 5 |
| 0 | 1 | 1 | 0 | 6 |
| 0 | 1 | 1 | 1 | 7 |
| 1 | X | X | X | NONE |

B

*Fig. 3. The pinout of the 4051 8-channel multiplexer (A) shows all of its inputs and output channels. As the truth table (3B) shows, three inputs—A, B, and C—form a binary counting scheme. The binary number input to the A-B-C inputs selects the same-numbered channel in the chip.*

pin 3. If the INH (inhibit) line (pin 6) is brought high, pin 3 is disconnected from all inputs, regardless of the A-B-C input.

**Temperature Sensors.** The A/D Converter described in this article will be put to use as a temperature measurer and data-logger. Let's take a look at the sensor that will make that possible: It is the LM335—a precision, easily calibrated, temperature-sensor integrated-circuit. Shown in Fig. 4, that three-terminal device comes in a plastic TO-92 package. Operating as a 2-terminal Zener, the LM335 has a breakdown voltage directly proportional to absolute temperature at +10 mV/°K, with the extrapolated output of the sensor going to a zero-volt output at 0°K (−273.15°C).

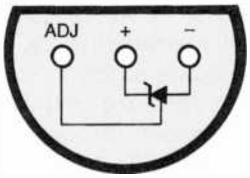



*Fig. 4. This is a bottom view of the LM335 temperature sensor, showing the pinout configuration of its internal circuitry.*

With less than a 1-ohm dynamic impedance, the device operates over a current range of 400 µA to 5 mA, with virtually no change in performance. When calibrated at 25°C the LM335 typically has less than a 1°C error over a 100°C temperature range. Unlike other sensors, the LM335 has a linear output. The sensor operates over a range of −40°C to +125°C.

Errors in output voltage versus temperature are only slope or scale-factor errors, so a slope calibration at one temperature corrects all temperatures. The output voltage of the device (calibrated or uncalibrated) can be expressed as:

$$V(t) = V(t_o) \times t/t_o$$

where V(t) is the output-voltage reading at an unknown temperature, $V(t_o)$ is the output voltage at the reference temperature, t is an unknown temperature in °K, and $t_o$ is the reference temperature in °K. By knowing three of the preceding variables, the other one can be easily solved for.

Knowing that °K = °C − 273.15, and °C = (°F − 32)/1.8, it is possible to figure out the output voltage of an LM335 for any given Fahrenheit temperature. That voltage would be equal to:

$$((x°F - 32)/1.8 + 273.15) \times .01$$

where x is the Fahrenheit temperature. The first term ((x°F − 32)/1.8) converts the Fahrenheit temperature to centigrade. The addition of 273.15 converts the centigrade temperature to Kelvin. Finally, the 0.01 multiplier (10 mV/°K) converts the temperature to

## LISTING 1

```
REM** ADC0831 with Up To 8 LM335 Temperature Probes
REM** V940126, c 1994 JJ Barbarello
REM*******************************
REM**    INITIALIZATION    **
REM*******************************
1      ON ERROR GOTO errortest
2      CLS : DEFINT A-S: DIM a(7), tempcorr(8)
3      FOR i = 0 TO 7: a(i) = 2 ^ i: NEXT
4      channel = 1
5      temp$ = " ###" + CHR$(248) + "F"
'++++++++++++++++++++++++++++++++++++++++++++++++++
       ++++
'GET SETUP DATA FROM FILE (If no file, error occurs. +
' Then execution jumps to errortest subroutine).  +
'++++++++++++++++++++++++++++++++++++++++++++++++++
       ++++
6      OPEN "ADC831.DAT" FOR INPUT AS #1
7      LINE INPUT #1, vinminus$: xsupply1 =
       VAL(vinminus$)
8      LINE INPUT #1, vinplus$: xsupply2 = VAL(vinplus$)
9      LINE INPUT #1, add$: add = VAL(add$)
10     LINE INPUT #1, numberchannels$: channels =
       VAL(numberchannels$)
11     LINE INPUT #1, delay$: delay! = VAL(delay$) /
       channels
12     FOR i = 1 TO channels
13       LINE INPUT #1, v$: tempcorr(i) = VAL(v$) - 2.732
14     NEXT i
15     datasource$ = "FILE ADC831.DAT"
16     jump.from.errortest.routine:
REM*******************************
REM**    SCREEN SETUP    **
REM*******************************
17     COLOR 15, 6: CLS : LOCATE 2, 15
18     PRINT "ADC-831 TEMPERATURE PROBE
       PROGRAM.  Press ESC key to End.";
19     COLOR 14, 6: LOCATE 3, 26: PRINT "Data Source:
       "; datasource$
20     VIEW PRINT 5 TO 24: COLOR 15, 1: CLS
21     LOCATE 6, 19
22     PRINT USING "Vin Range Is #.### to #.###v";
       xsupply1; xsupply1 + xsupply2
23     LOCATE 6, 48: PRINT USING "(##.##mV/Step)";
       xsupply2 / .256
24     LOCATE 7, 10: PRINT USING "# Active Channels";
       channels
25     LOCATE 7, 28: PRINT USING "Using Parallel Port at
       #### Decimal"; add
26     LOCATE 7, 64: PRINT "("; HEX$(add); "H)"
27     LOCATE 8, 24
28     PRINT USING "Channel Scan Time is ####.#
       seconds"; delay! * channels
29     COLOR 3, 1
30     FOR i = 1 TO channels
31     LOCATE 10, i * 8 + 2
32     PRINT USING "#.###v"; tempcorr(i);
33     NEXT i
34     LOCATE 9, 23: PRINT "TEMPERATURE PROBE
       CORRECTION FACTORS"
35     COLOR 7, 0
'++++++++++++++++++++++++++++++++++++++++++++++++++
       +++++++++++
'DRAW BOXES ON BLACK BACKGROUND FOR VOLTAGE &
       TEMP DATA   +
'++++++++++++++++++++++++++++++++++++++++++++++++++
       +++++++++++
36     LOCATE 11, 8: PRINT CHR$(201);
37     FOR j = 1 TO 8: PRINT STRING$(7, 205);
       CHR$(209); : NEXT j
38     LOCATE 11, 72: PRINT CHR$(187)
39     FOR i = 12 TO 16: LOCATE i, 8: PRINT CHR$(186);
40     FOR j = 1 TO 8: PRINT SPACE$(7); CHR$(179); :
       NEXT j
41                LOCATE i, 72: PRINT CHR$(186)
42     NEXT i
43     LOCATE 13, 8: PRINT CHR$(204);
44     FOR j = 1 TO 8: PRINT STRING$(7, 205);
       CHR$(216); : NEXT j
45     LOCATE 13, 72: PRINT CHR$(185)
46     LOCATE 15, 8: PRINT CHR$(199);
47     FOR j = 1 TO 8: PRINT STRING$(7, 196);
       CHR$(197); : NEXT j
48     LOCATE 15, 72: PRINT CHR$(182)
49     LOCATE 17, 8: PRINT CHR$(200);
50     FOR j = 1 TO 8: PRINT STRING$(7, 205);
       CHR$(207); : NEXT j
51     LOCATE 17, 72: PRINT CHR$(188)
52     FOR i = 1 TO 8: LCRINCATE 12, i * 8 + 2: PIT USING
       "CH #"; i; : NEXT
REM*******************************
REM**    SAMPLING CODE    **
REM*******************************
53     start:
54     begin! = TIMER
55     WHILE (TIMER - begin!) < delay! * .95: WEND
56     LOCATE 12, channel * 8 + 2: COLOR 0, 7
57     PRINT USING "CH #"; channel; : COLOR 7, 0
58     WHILE (TIMER - begin!) < delay!: WEND
59     activech = (channel - 1) * 4
60     OUT add, activech + 2: REM:  Select 4051 channel
       (1-8) which is input 0-7
61     FOR i = 1 TO 100: NEXT i
62     OUT add, activech , C+ 0: REM: SetCS* lowCLK low.
63     OUT add, activech ++ 1: OUT add, activecl 0: REM:
       Pulse Clk Hi/low, keep CS* low
64     OUT add, activech + 1: REM: Pulse Clk High
65     j = 7
66     WHILE j > -1
67     OUT add, activech + 0: OUT add, activech + 1
68     jsum = jsum + (INP(add + 1) AND 64) * a(j): REM:
       Get Bit J. Result is 64 or 0.
69     j = j - 1
70     WEND
71     jsum = jsum / 64: REM: Divide by 64 once, not each
       time in jsum calc.
72     LOCATE 14, channel * 8 + 2
73     voltreading = xsupply1 + jsum * (xsupply2) / 255
74     PRINT USING "#.###v"; voltreading
75     LOCATE 16, channel * 8 + 1
76     tempreading = (voltreading + tempcorr(channel) -
       2.332) / (.01 / 1.8) - 40
'voltreading-tempcorr(channel)-2.332 is voltage diff. from -40F
' .01/1.8 is C to F conversion of 10mV/degC
77      IF tempreading < -40 THEN
78       PRINT CHR$(32); STRING$(5, 25);
79       ELSEIF tempreading > 125 THEN
80       PRINT CHR$(32); STRING$(5, 24);
81       ELSE
82       PRINT USING temp$; INT(tempreading + .9)
83      END IF
84      COLOR 7, 1
85      LOCATE 18, channel * 8 + 3: PRINT USING "###";
        jsum
86      COLOR 7, 0
87      jsum = 0: REM: Clear Jsum
88      LOCATE 12, channel * 8 + 2
89       PRINT USING "CH #"; channel;
90      channel = channel + 1: IF channel = channels + 1
        THEN channel = 1
91      a$ = INKEY$: IF a$ = "" THEN GOTO start
92      IF ASC(a$) <> 27 THEN BEEP: GOTO start
93      VIEW PRINT: CLS : LOCATE 18, 1: END
REM*******************************
REM**    ERROR HANDLER    **
REM*******************************
94      errortest:
95      IF ERR = 53 THEN
96       xsupply1 = 2.332
97       xsupply2 = 3.248
98       add = 888
99       channels = 8
100      FOR i = 1 TO 8: tempcorr(i) = 0: NEXT i
101      datasource$ = "DEFAULT VALUES"
102      RESUME jump.from.errortest.routine
103   END IF
104     LOCATE 12, 20: PRINT "UNDEFINED ERROR.
        Unable to continue"
105     LOCATE 18, 1: END
```

an output voltage. So, if we want to measure temperature between −40°F and +125°F, we would have to figure out the associated output-voltage range. The voltage associated with −40°F is:

$$((-40 - 32)/1.8 + 273.15) \times .01$$

which equals 2.332 volts. The voltage associated with the upper end of the range, +125°F, is:

$$((125 - 32)/1.8 + 273.15) \times .01$$

which equals 3.248 volts.

If we set the ADC0831's $V_{in}-$ to 2.332 volts, and its $V_{ref}$ to 0.916 volts (the difference between 3.248 volts and 2.332 volts), the ADC0831 will be able to sense a voltage difference as small as 3.58 mV (because 0.916 V/256 steps = 3.58 mV/step). That will allow the chip to resolve between −40°F and +125°F (a 165°F temperature span) with at least a 1°F resolution, because a 1°F change will produce a voltage difference of 0.916 V/165°F or 5.5 mV/°F.

Further, if we limit the temperature span to a smaller range, the resolution will increase. For instance, if we limit the range to 25°F, the output-voltage range will be 0.139 volts. That will create an ADC0831 resolution of 0.543 mV/step (0.139 mV/256 steps), which is more than ten times smaller than the 5.5 mV/°F response of the LM335. Therefore, the ADC0831 will be able to resolve 0.1°F over that smaller range. As you can see, the ratiometric capability of the ADC0831 allows us to trade off range for greater resolution.

**Circuit Description.** The schematic of the A/D Converter is shown in Fig. 5. It is powered from a 9-volt battery, B1, the output of which is regulated by a 78L05, U1, to 5 volts. If a 5-volt source of regulated DC is available, U1, C1, and C2 can be eliminated.

The functions of the ADC0831 (U2) and 4051 (U3) IC's, were looked at earlier. Potentiometer R1 allows the user to set the minimum input voltage. The setting of potentiometer R2 determines the desired voltage span (which effectively sets the maximum input voltage).

The A/D Converter interfaces with a PC through a DB25 plug, PL1. Note that the numbers shown in PL1 relate to the pin numbers of the DB25 plug, and of course, the parallel port of the computer. The Converter circuit contains eight phone jacks, J1–J8, to interface with eight temperature probes. Those probes each contain one LM335 (U4–U11) and a phone plug (PL2–PL9). Of course, in other applications, and with the appropriate external circuitry, J1–J6 can be used to interface with virtually any other type of analog sensor or signal.

**Construction.** The author's prototype was built on a perforated prototyping board. Any other appropri-

## PARTS LIST FOR THE A/D CONVERTER

**SEMICONDUCTORS**

U1—78L05 5-volt regulator, integrated circuit
U2—ADC0831 8-bit serial I/O A/D converter, integrated circuit
U3—4051 analog multiplexer, integrated circuit

**ADDITIONAL PARTS AND MATERIALS**

R1, R2—10,000-ohm, ¾-watt, 10- or 15-turn PC-mount potentiometer
R3–R10—2200-ohm, ¼-watt, 5% resistor
C1, C2—1-µF, 15-WVDC (or greater), electrolytic capacitor
PL1—DB25 male connector and hood
J1–J8—phone jack (see text)
B1—9-volt battery
Perforated-board materials, project enclosure or wooden base, IC sockets, 22-gauge wire, 7-conductor wire, screws and nuts, solder, hardware, etc.

**Note:** The following are available from James J. Barbarello (817 Tennent Road, Manalapan, NJ, 07726). The A/D Converter Kit (ADC0831), consisting of all parts listed above—$25.00. Enhanced software (ADC0831S), containing source and executable code for temperature-sensing (and other) analog-input devices, and providing data logging, data storage, and data plotting—$12.00.

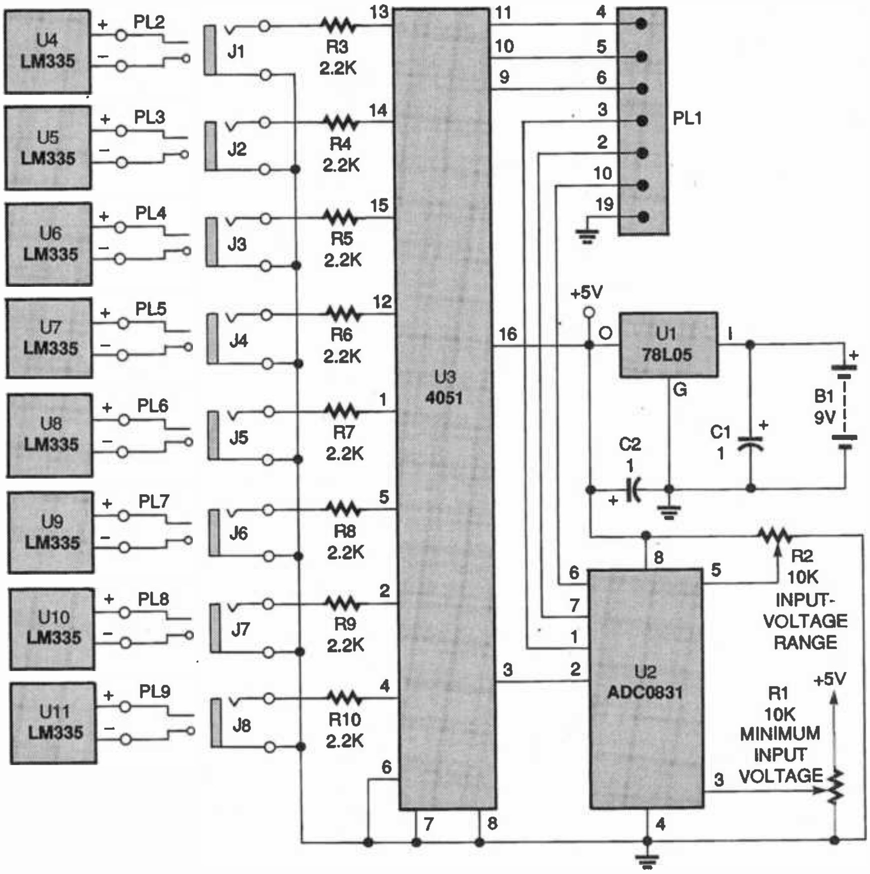



*Fig. 5. The actual processing circuitry of this A/D Converter consists of only four parts: U2, U3, R1, and R2. As you can see, eight temperature probes are used with the circuit; however, they can be replaced with other types of sensors, as long as resistors R3–R10 are removed.*

## PARTS LIST FOR THE TEMPERATURE PROBES (8)

U4–U11—LM335AZ temperature sensor, integrated circuit
PL2–PL9—phone plug (see text)
Twisted-pair wire (22-gauge), heat-shrink tubing (1/16-, 1/8-, and 3/16-inch diameter), solder, etc.

**Note:** The following are available from James J. Barbarello (817 Tennent Road, Manalapan, NJ, 07726). A kit of parts for a single temperature probe (TP831)—$5.00. A four-probe kit (4TP831)—$17.50; and eight-probe kit (8TP831)—$32.50; are also available.

ate construction technique can, of course, be used. Regardless of the technique used, when installing the components in the circuit, be sure to check their orientation (except for R3 through R10, of course).

If you have difficulty finding either the ADC0831 or the 4051 locally, they are both available from Digi-Key (P.O. Box 677, Thief River Falls, MN 56701-0677; Tel. 800-344-4539). Use IC sockets for those IC's, and install them last.

As shown in the photo at the beginning of this article, the author's completed prototype board was attached to a block of wood using screws and nuts (as spacers). Any project enclosure can be used, however. Phone jacks J1–J8 can be of any size; just make sure you use matching plugs for the temperature probes. The jacks were mounted through holes in the wood base in the prototype, but if you use a project enclosure, the jacks can be mounted on its cover. Connect the jacks to the circuit with individual pieces of 22-gauge wire, and attach the ground points of the jacks together and to the common ground on the circuit.

Use a 7-conductor cable to make the connections between the circuit board and pins 2, 3, 4, 5, 6, 10, and 19 of the DB25 plug, PL1. To attach the battery to the circuit, use a battery connector with leads.

The next step is to build a temperature probe, or probes. Remember, the A/D Converter can accommodate up to eight probes. To begin, hold an LM335 with its flat side facing up and

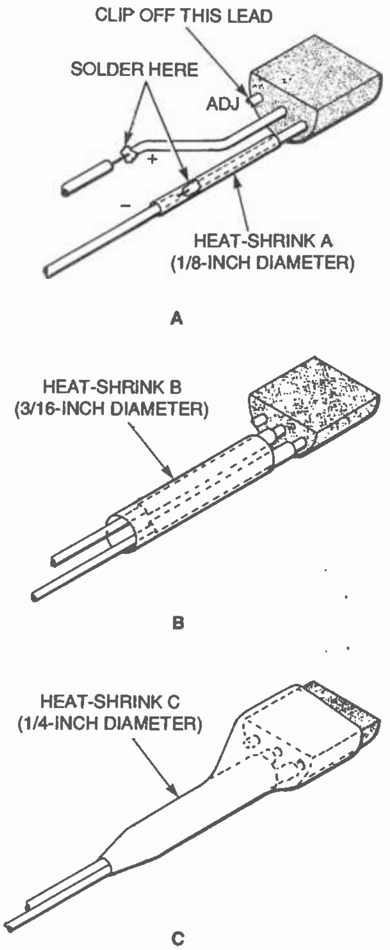



*Fig. 6. To protect the temperature probe connections, three pieces of heat-shrink tubing must be used. Heat-shrink A prevents the negative lead from coming into contact with the positive one (A), heat-shrink B protects both leads (B), and heat-shrink C covers the entire probe (C).*

the leads facing you (see Fig. 6A). Clip off the left (ADJ) lead and bend the center (+) lead to the left, as shown.

Next, strip about 1/4-inch of insulation from the ends of both wires in a twisted pair. That twisted-pair wire, which will connect the probe to the Converter, can be as long as 50 feet without affecting the probe's accuracy. Insert a 1/2-inch length of 1/8-inch-diameter heat-shrink sleeving over one of the stripped wires (heat-shrink A in Fig. 6A). Solder that wire to the right (−) lead of the LM335. Then, solder the other wire to the center (+) lead of the LM335.

As an initial checkout, strip about 1/4-inch of insulation from each of the wire's free ends. Connect the wire from the center lead of the LM335 through a 2200-ohm resistor to a 5-volt-DC source. Then, connect the wire from the right lead of the LM335 to the power source's ground. Using a digital multimeter, measure the voltage across the signal and ground leads. In a normal environment (around 70°F), the DMM should read around 2.95 volts. Place an ice cube in contact with the LM335. The voltage reading on the DMM should begin to decrease. If you don't obtain those results, check the probe's wiring and solder joints.

If the probe works, remove the power source and resistor. Push heat-shrink A over the solder joint and LM335 lead (see Fig. 6A). Using a portable hair dryer, or a match (be careful not to actually touch the tubing), heat the tubing until it shrinks around the joint and lead. Push the two LM335 leads together, making sure heat-shrink A keeps them from making contact.

Push a 1-inch-long piece of 3/16-inch-diameter heat-shrink tubing, heat-shrink B, up the free end of the twisted pair wire, and push it as close to the body of the LM335 as possible (see Fig. 6B). Apply heat as before to heat-shrink B until it shrinks around the two leads.

Push a 1½-inch-long piece of 1/4-inch-diameter heat-shrink tubing (heat-shrink C) over the LM335 and down past the previously installed tubing on the LM335 leads. Leave about 1/16-inch of the LM335 body protruding (see Fig. 6C). Apply heat to heat-shrink C. The last step in the preparation is to connect the wires to the plug. Make sure that the polarity matches that shown in the schematic.

**The Program.** Listing 1 presents a QBasic program that performs ADC0831 control, data-capture, data-display, and data-conversion operations. It also uses a text setup file that lets you customize operation without having to change the actual program. An enhanced version of the program, which makes it easier to use the Converter with other analog-input devices, is available on disk from the source given in the A/D Converter Parts List. To better understand how to use the Converter, let's examine the lines of the program.

Line 1 activates the error-trapping routine. That is used to define default

**LISTING 2**

| LINE CONTENTS: | | EXAMPLE: |
|---|---|---|
| [Vin- | ] | 2.345 |
| [Vref | ] | 3.567 |
| [Parallel Port Address | ] | 888 |
| [Number of Active Channels | ] | 4 |
| [Total Scan Time (The time it takes to begin at channel 1, sample all active channels, and then come back to channel 1) | ] | 0.8 |
| [Temp Correction for Channel 1 | ] | 0.014 |
| [Temp Correction for Channel 2 | ] | 0 |
| ... | | -0.005 |
| [Temp Correction for highest active channel | ] | 0.03 |

values in case the setup data file is not present. Line 2 dimensions the A array, and the TEMPCORR array, which will hold the temperature-probe correction factors. In line 3, the A array is filled with the powers of 2 (which we'll use later). Lines 4 and 5 initialize variables.

Line 6 accesses the setup file and lines 7 through 14 retrieve the data. The variable XSUPPLY1 corresponds to $V_{in}-$, the zero offset, and XSUPPLY2 corresponds to $V_{ref}$, the voltage span. The variable ADD is the address of the parallel port being used. CHANNELS is the number of channels to be used (between 1 and 8), DELAY! is the delay-time-per-channel, and TEMPCORR(I) is the temperature-probe correction factor for the different probes. That value is used to correct for any small variations in the responses of individual LM335's. Lines 17 through 52 simply do housekeeping on the screen.

If the setup file is not available (we'll deal with that file later), an error in line 53 will result, and execution will proceed to line 94. In that instance, the variables needed for the program to execute are defined in lines 96 through 100, and execution returns to the main program from line 102. If an undefined error occurs, lines 104 and 105 identify that fact and end the program.

The heart of the program is between lines 53 and 93. Lines 54 and 55 create a delay loop that suspends execution until most of the time identified by DELAY! has elapsed. Line 57 displays the active channel, and line 58 completes the delay processing.

The active channel is used to set a mask that will control U3, the 4051 multiplexer. For instance, if channel 4 is active, we want to access U3's "3" input, because the channels are 1 to 8, and U3's inputs are 0 to 7 (channels 1 to 8 correspond to jacks J1–J8). Thus, the variable ACTIVECH is set to 12, or 00001100 binary (shown as bit 7 through bit 0). That value can then be used to send a 1 to pin 4 of PL1 (bit 2 to U3 "A"), a 1 to pin 5 of PL1 (bit 3 to U3 "B"), and a 0 to pin 6 of PL1 (bit 4 to U3 "C"). Referring back to Fig. 4, that bit pattern (or multiplex mask) selects U3's "3" input.

Line 60 uses the multiplex selection mask and adds 2 (binary 10) which also keeps pin 3 of PL1 ($\overline{CS}$) high. Line 61 provides some settling time, and then line 62 brings the $\overline{CS}$ line low. Line 63 keeps $\overline{CS}$ low, and pulses the CLK line (pin 2 of PL1) high and then low again by bringing bit 0 high and then low. Line 64 brings the CLK line high again.

At that point in the program, we've selected the input channel, connected it through U3 to the input of U2, activated U2 by bringing its $\overline{CS}$ line low, and pulsed the CLK line one-and-a-half times. Referring back to Fig. 2, the next time the CLK line goes low, data bit D7 will be available at the $D_{out}$ pin.

A counter is set to 7 in line 65. Line 66 and 70 form a WHILE/WEND loop that will count back from 7 to 0, performing the commands in lines 67 through 69 each time through the loop (retrieving data bits D7 through D0 in the process). Line 67 pulses the CLK line low and then high again. Even though we could read the data when the CLK is brought low, pulsing it high again (the middle of the clock cycle) ensures the data has settled before we read it. Line 68 gets bit j and determines if it is high (returning a 64) or low (returning a 0). The results of the eight data reads are stored in JSUM. Because the actual value should be a 1 or 0 (not 64 or 0), line 71 divides the sum by 64 to arrive at a final value between 0 and 255. Line 72 positions the cursor at the correct area on the screen to display the data for the selected channel.

Line 73 converts the 0–255 value into the appropriate voltage using the $V_{in}-$ (XSUPPLY1) and $V_{ref}$ (XSUPPLY2) zero reference and voltage span. Line 76 converts the voltage reading to the appropriate temperature reading, using the temperature-correction factor for the selected temperature probe. Lines 77 through 83 format the temperature reading, printing up arrows if the reading is above the maximum allowed, and printing down arrows if the reading is below the minimum allowed, or the actual reading.

Line 90 increments the channel and resets it to 1 if the highest channel has just been read. Line 91 allows the operator to press any key to end the program (if so, line 93 ends the program). If no key is pressed, line 92 loops execution back to line 53.

**The Setup File.** Creating the setup file can be done with a word processor, from DOS, or better yet, from QBasic (which you'll use to RUN the program in Listing 1). The file contains a number of text lines, each ending with a line feed and carriage return. The contents of the lines are given in Listing 2.

Note that if you have more than one parallel port available in your PC (LPT2, LPT3, or LPT4), you can specify its address. That way you can still use your primary parallel port (LPT1) for regular printing.

**Calibration.** To calibrate the temperature probe, you have to compare the probe's output to a known temperature. If you have an existing, calibrated temperature-sensing device, place the probe next to that device's temperature-sensing element and record the probe's output voltage. Then, to determine the theoretical output voltage based on the temperature-sensing device's temperature reading, use the formula that was given earlier:

$$((x°F - 32)/1.8 + 273.15) \times .01$$

*(Continued on page 93)*

# Make money in electronic music technology!

**NRI's breakthrough training gives you everything you need to build your own computer-controlled music studio, then start a new career or business of your own!**

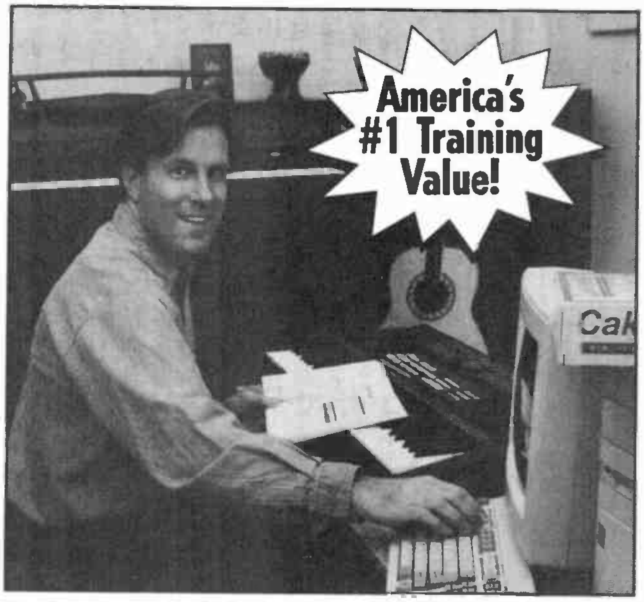
## Prepare for an exciting, multifaceted career

In the booming music industry, NRI training opens up unlimited opportunities. You can work as a sound engineer, recording engineer, or road technician ... even start your own business selling and servicing today's MIDI-based systems. Or unleash your own musical creativity, writing and composing music with the extraordinary digital instruments NRI provides.

## Learn state-of-the-art music synthesis

Build your own electronic music center with all this real-world equipment:

- Complete IBM-compatible 486SX2/50 MHz computer featuring mini-tower design, Pentium Overdrive-ready motherboard, 4 meg RAM, 420 meg hard drive, Super VGA color monitor with .28 dot pitch, fax/modem, and more
- High-end Kawai X50-D General MIDI synthesizer with touch-sensitive keyboard, digital effects with reverb and chorus built-in, one finger ad-lib, mixing, and more
- Sound Galaxy NX Pro sound card with built-in MIDI interface and speakers to accommodate interactive multimedia applications
- Your own desktop recording studio — the critically acclaimed Cakewalk 256-track MIDI sequencer software that helps you record, edit, and play back multiple tracks of music
- SoundSculptor software that visually demonstrates the operation of FM music synthesis
- Electronic components you use to build up live circuits, including sound generating ones




*Hands-on course includes a 486SX2/ 50 MHz computer — the most powerful computer in home study today — plus a Kawai X50-D professional-level synthesizer, Cakewalk MIDI sequencing software, Sound Galaxy NX Pro sound card, and more!*

You discover how to use, program, and service this professional equipment through hands-on projects that make learning both fun and challenging — *regardless of your experience in electronics or music.*

## Gain expertise and confidence, step by easy step

Study at your own pace, with the committed support of NRI's instruction team just a letter or phone call away. You begin with detailed lessons that move from electronics fundamentals and music notation to sound generation routines, digital logic, microprocessors, and sampling and recording techniques. Then move on to get first-hand experience with MIDI, waveshaping, patching, sequencing, mixing, special effects, and much more.

## Find out about NRI's unique, groundbreaking training in electronic music technology

NRI's free, full-color catalog has all the details — send for yours today! If the coupon is missing, write to: NRI Schools, McGraw-Hill Continuing Education Center, 4401 Connecticut Avenue, NW, Washington, DC 20008.

**Complete lessons, top-notch equipment, hands-on projects — NRI training doesn't miss a beat!**

**SEND TODAY FOR FREE NRI CATALOG!**

**NRI Schools**

McGraw-Hill Continuing Education Center
4401 Connecticut Avenue, NW, Washington DC 20008

McGraw-Hill

☑ **Check One FREE Catalog Only**

- ☐ **Electronic Music Technology**
- ☐ Microcomputer Servicing
- ☐ TV/Video/Audio Servicing
- ☐ LAN Specialist
- ☐ Basic Electronics
- ☐ Multimedia Programming
- ☐ Computer Programming
- ☐ Desktop Publishing & Design
- ☐ Fiction/Nonfiction Writing
- ☐ PC Applications Specialist

Name ______________________ Age ________

Address ______________________

City ______________ State ______ Zip ________

Accredited Member, National Home Study Council 18–0695

# Build a Sun-Tracking Circuit

BY
JACK WRIGHT

*Get the most out of your solar panels or other solar-powered equipment with this precision tracking circuit that will follow the sun around all day.*

Here is a circuit which, with your own drive creation, will track the sun with an accuracy of better than half a degree. It is called the *Sun Tracker*, and you can use it to direct a payload of solar (photovoltaic) modules, or to track the sun for other purposes, such as measuring ultraviolet intensity.

To be truly useful as a sun-tracking circuit, the Sun Tracker had to possess five elements: First, the circuit had to know where the sun was to direct the payload in that direction. Second, it would have to know whether the sun was available to track or not—that is, the circuit couldn't go off searching for the sun every time a cloud passed overhead. Third, a dawn or sunrise sensor would be necessary to tell the tracking circuit to swing around to the east in the morning. Fourth, a darkness sensor would be necessary to shut the tracking circuit off for the night. Fifth, and finally, if the payload were solar modules, the tracking circuit would have to have low-energy consumption, so that the benefit of tracking (solar power) would not be consumed by the circuit.

**Circuit Description.** The schematic for the Sun Tracker is shown in Fig. 1. Because of its low parts count, it can be built for about $12. The quiescent current of the circuit is low, in the 6-7 milliamp range, (2-3 milliamps at night). The current consumption when the Tracker is turning is about 230 milliamps, but the duty cycle is less than ½ percent.

Photoresistor cells R7, R8, and R9 have a value of 160 ohms in full sunlight and 480 ohms in the shade, but that is not absolutely critical. The author's prototype used the smaller units in a five-piece assortment that was purchased at Radio Shack for $2.29. As described later, R7 is mounted in a "well" with a narrow slit so that sunlight falls upon it only when the photoresistor is pointed directly at the sun. When that occurs, the resistance of R7 drops. That photoresistor and potentiometer R4 form a voltage divider at the base of the Darlington transistor, Q1. When R7's resistance is low, Q1 will be kept off.

When the sun swings a little westward, R7 will no longer be in sunlight, causing its resistance to go up, which raises the base voltage of Q1 and turns that Darlington on. That in turn closes the relay, K1, providing current to the drive motor, MOT1, which is a 1.5-volt DC, low-torque hobby motor. The motor then turns slowly (resistor R6 limits the maximum current to the motor and keeps it from running too fast), putting R7 in direct sunlight again; Q1's base voltage then drops and the Tracker stops. That is repeated again and again as the sun moves across the sky.

Now, what happens when the sun is not available to track? Photoresistor R8 is mounted on the outside of the well so that it receives a wide angle of

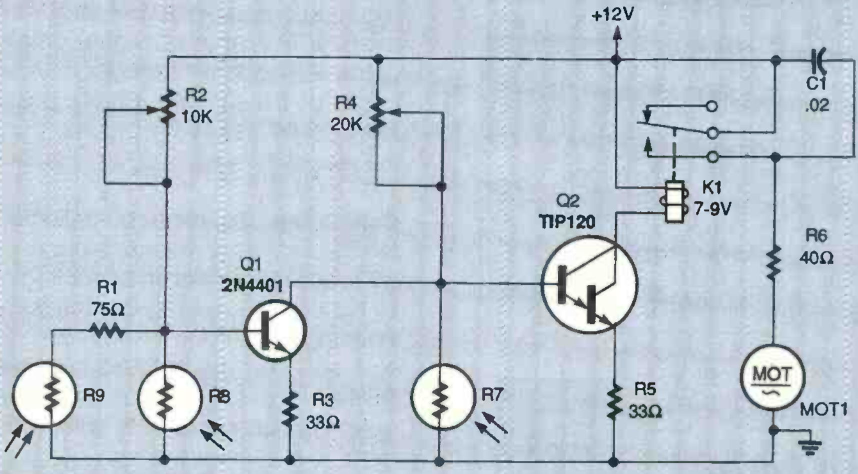



*Fig. 1. The Sun Tracker uses a combination of three photoresistors, R7, R8, and R9, to ensure that the circuit will follow the sun during the day, but not look for it at night.*

full sunlight. When the sun is shining, R8's resistance is low, keeping Q2 turned off, and allowing the Tracker to act as described, without interference. But if the sun "slips" behind a cloud, R8's resistance goes high, producing a forward bias on the base of Q2. That turns that transistor on, and sinks the base of Q1 to near ground, so that Q1 then remains off. That immobilizes the Tracker drive; that also keeps the drive shut down in the dark of night.

Photoresistor, R9, is the dawn sensor. It is mounted on the back of the Sun Tracker. When the Tracker stops at sunset, pointing towards the west, R9 is pointing towards the east. When the sun rises the following morning and shines on R9, its resistance goes low, turning Q2 off and allowing Q1's base to go high (remember R7's resistance will be high because it is in the dark of the well, pointing west). That presents current to the relay and therefore to the drive motor, causing the Tracker to swing around to the east.

An application circuit for the Sun Tracker is shown in Fig. 2. That circuit provides a rechargeable, 12-volt power source for the Tracker and for a connected electronic device that also uses 12-volts DC. Recharging is accomplished by two photocell modules, PC1 and PC2. In the author's prototype, those modules are made from broken photocell fragments purchased from Edmund Scientific Company (101 E. Gloucester Pike, Barrington, NJ 08007; Tel. 609-573-6250). A 3-ounce bag was sufficient to make a module with an output of 18 volts (open circuit) and about 150-200 milliamps (short-circuit) at 30°C. If you obtain your photocells from a different source, experiment with them to get a similar output. As the module warms up in the sunlight, the output will drop to 15-16 volts or so, which is still sufficient to charge a 12-volt battery.

The germanium diodes in the circuit, D1–D5, prevent the battery from discharging back through the photocell modules during darkness. Germanium diodes are used instead of

## PARTS LIST FOR THE SUN TRACKER

**SEMICONDUCTORS**

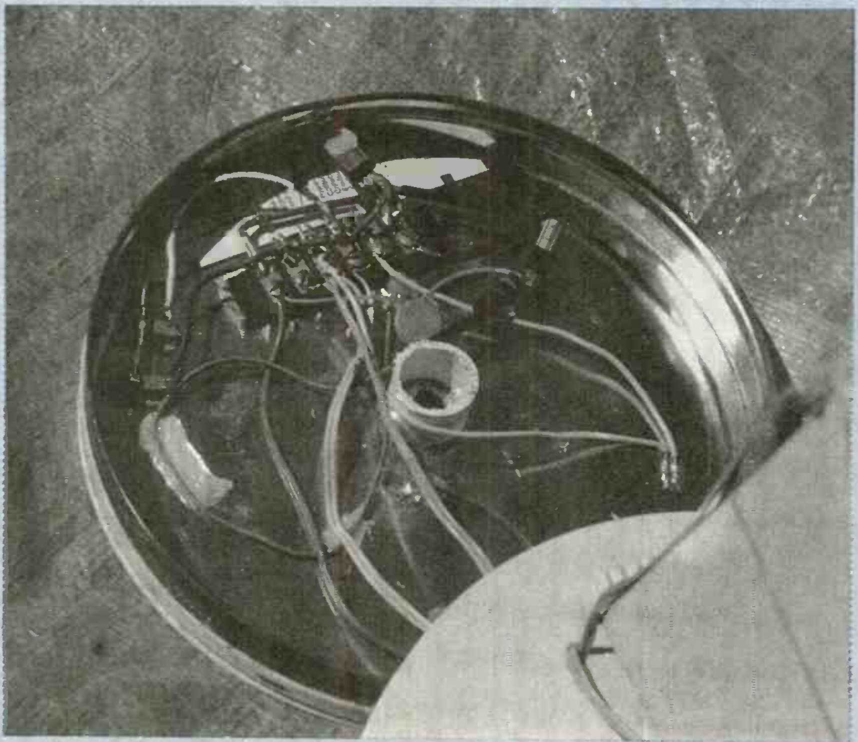
Q1—2N4401 NPN switching transistor
Q2—TIP120 Darlington
D1–D5—1N34A, germanium diode

**RESISTORS**

(All fixed resistors are ½-watt, 5% units, unless otherwise noted.)
R1—75-ohm
R2—10,000-ohm potentiometer
R3, R5—33-ohm
R4—20,000-ohm potentiometer
R6—40-ohm, 5-watt (see text)
R7, R8, R9—Photoresistor cells (see text)

**ADDITIONAL PARTS AND MATERIALS**

C1—0.02-µF, ceramic-disc capacitor
PC1, PC2—Photocell modules (see text)
MOT1—1.5-volt DC, low-torque hobby motor
K1—Micro relay, 7- to 9-volt, 2-amp contacts (Radio Shack 275-005 or equivalent)
S1—SPST switch
S2—SPDT switch
B1—12-volt motorcycle battery
F1—1-amp fuse
Project enclosure (see text), wood, terminal strip, screws, gear materials, wire, solder, hardware, etc.



*The author's prototype was built using a nut can. The components shown here are mounted on a terminal strip.*

silicon ones in order to reduce the voltage drop (0.3 volts for germanium, compared to 0.6 volts for silicon) when charging, because power from the photocells is at a premium. The diodes are grouped in parallel to increase current handling.

Most of the time, the Tracker is powered by the photocell modules and does not drain the battery—except, of course, at night, but the standby current drawn is very low. You can use the energy generated to operate a reading lamp or sometimes a fan. If you would like some indication as to whether the meter is charging, connect a meter in parallel to the circuit between the negative (ground) lead of the Tracker and the battery.

**Construction.** Because of the low parts count and the need for physical separation of the parts when they are mounted, the Tracker circuit can be built using terminal strips and insulated wire leads. As for the mechanical construction of the Tracker's drive train, that can vary depending upon the materials you have on hand, and your space limitations. The author's prototype shown in the photo at the beginning of this article was constructed from odds and ends that were found around the shop. Here is how to build your own Sun Tracker.

Photoresistor R7 has to be nested at the bottom of a thin well with a narrow slit at its end, so that sunlight falls on photoresistor R7 only when the well is pointed directly at the sun. That tracking well should be made of wood, and painted flat black on the inside. The angle of the well should span from the horizon to the maximum distance the sun will move above the horizon at your latitude. The formula for that is:

Angle = 90 − latitude + 23.5

At Salt Lake City, where the author lives, the latitude is 41 degrees, so the angle of the well shaft is 72.5 degrees. The depth of the well and the narrowness of the slit determine how precise your tracker will be, but the more precise the tracking the greater the problem with overshoot of the drive.

That brings us to our next consideration—the gear drive. The design for that will pretty much depend on you—the author's prototype drive is a Rube Goldberg contraption made

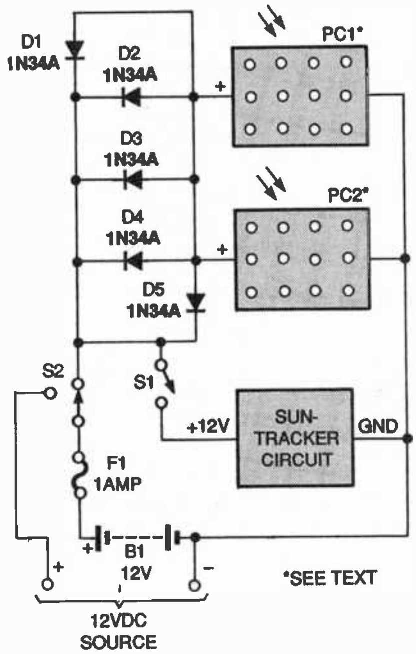
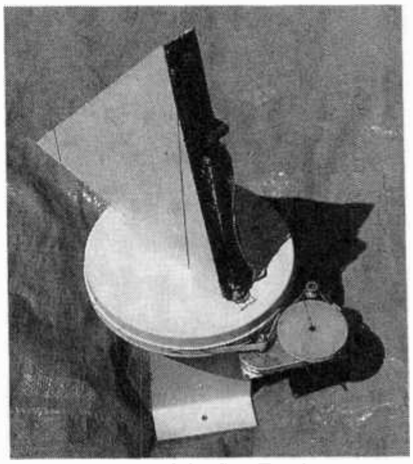



*Fig. 2. This application circuit provides rechargable solar power for the Sun Tracker, as well as for another 12-volt device.*

from pirated parts out of other equipment. The final drive belt is an elastic band from a fabric shop. Using a large-ratio of gear reduction will help eliminate any overshoot problems the Tracker might have. The author's prototype uses a 21,300:1 overall reduction.

The main platform for the Sun Tracker prototype was a can of Christmas nuts. The knurled edge of the bottom of the nut can, along with the same type of edge on the lid, forms an excellent channel for the drive belt. With the exception of the photoresistors, all other electronic components were mounted inside that can. The well is



*Here is a view of the Sun Tracker showing the improvised drive mechanism used.*

mounted on top of the can, and photoresistor R8 is mounted on the outside of the well so that it receives a wide angle of full sunlight. Finally, photoresistor R9 should be mounted on the rear of the well.

**Calibration.** Adjusting potentiometers R2 and R4 can be a bit tricky, and will require some trial and error. Begin by turning R4 to mid-range and then covering the slit in the well to keep any light out. Next adjust R2 so that the Tracker stops when you cast a shadow over the sun sensor, R8, with your hand, but resumes turning when you move your hand aside.

To adjust the tracking circuit, remove your hand from the slit in the tracking well. Turn R4's resistance down to the point where the Tracker slows down but does not quite stop when swinging past the sun, then turn R4's resistance up 1" turn, making certain the Tracker stops when it points at the sun.

You can get up early and see if the Tracker starts moving when the sun shines on the dawn sensor, R9. You might have to play with the potentiometers a bit to get the sensors working properly. Don't turn the potentiometers all the way down to zero, as that will overheat R3 and R5.

**Troubleshooting.** The Tracker might sometimes stop halfway around on the return trip towards the east because both the sun sensor and the dawn sensor are at right angles to the weak morning sun. As the sun rises higher, the Tracker should then complete its swing and begin tracking. You can assist the return trip by directing power directly to the drive motor (however, be sure to use a resistor to limit the current to the motor).

The inexpensive photoresistors used in the prototype are not perfectly temperature stable. Occasionally in the heat of the afternoon, the author's prototype would suddenly "kick in" and rotate all the way around. If that happens to you, some re-adjustment of R4 should correct the problem.

Also, you might find that the Tracker will not stay pointed at the sun in windy conditions. Under those conditions, it is perhaps best to merely shut the Tracker down and leave the photocell modules pointed toward the south. ■

# Upgrading and Maintaining your Personal Computer


*Our series on upgrading PC hardware focuses this month on how to install floppy- and hard-disk drives.*

BY MARC SPIWAK

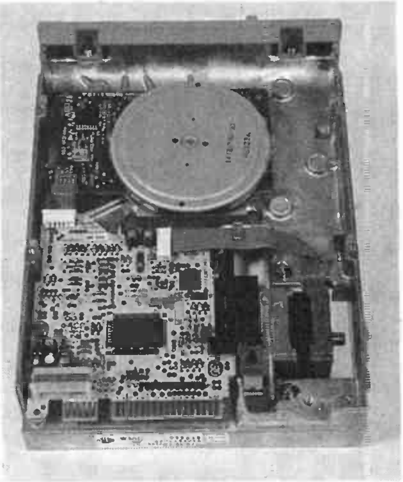
Anyone who uses the same PC for many years will inevitably have to replace one of the disk drives, either due to failure or the need to increase drive capacity. Fortunately, it is usually fairly easy to replace a drive. There are, however, a few pitfalls to avoid. In this article, we will point those out, and go over the basic procedures to follow when replacing, adding, or upgrading a drive. Let's get started.

**A Little Advice.** Before we get too far along, I'd like to offer a bit of free advice. Although upgrading and replacing PC hardware is not all that difficult, it can be costly and very time-consuming. Swapping a worn-out component for an identical new one is a simple matter; installing additional hardware is always more work. But no matter how simple the job at hand might appear, problems can and usually do arise—some that can keep even a pro confused for hours.

That in mind, you should carefully consider performing upgrades on older, now-obsolete equipment. If you are using an old machine that just needs a new part, go ahead and replace the part if you can find an exact replacement at a reasonable price. But don't try to add new features to an XT, 286, or anything like that. You'll spend more time and money on it than it's worth, and likely be less than satisfied with the results. In short, don't waste your time with old, outdated hardware—if it works, great, if not, it is probably time to get a new system.

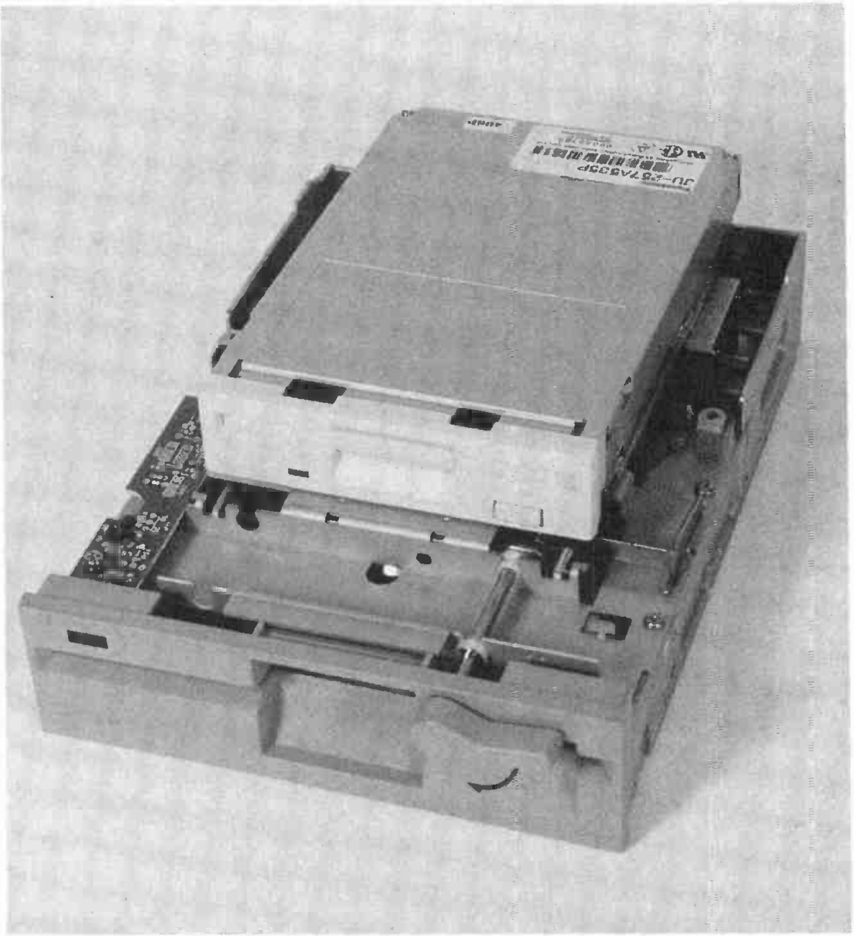
For instance, let's consider the troubles you might encounter in doing something like adding a 1.2MEG drive to an XT. That type of upgrade, where you are adding modern hardware to a PC that was built before that type of hardware existed, is usually difficult and frustrating. In this case, problems occur because the machine's floppy-disk controller won't know how to control a high-density drive, and the machine's BIOS (Basic Input Output System) won't know how to work with the right controller. The way around that problem is to replace the BIOS—a PROM that's permanently programmed with the most basic operating instructions—and the controller. Unfortunately, you will probably have a tough time finding a BIOS upgrade for an old PC, and that's *if* the company that made your machine is still in business. If you are enthusiastic enough, it can't hurt to try and upgrade your computer's BIOS. But be warned again that it might be more trouble and expense than it's worth.

**Floppy-Disk Drives.** A well-used floppy drive is often the first thing to go on an older PC. That is due to both wear and tear, and because the inside of a floppy drive is exposed to contaminants and accumulates dust every time a disk is inserted. A hard disk, on the other hand, is sealed in an airtight enclosure.



*A 5¼-inch drive has a 34-pin card-edge connector on the back end along with one or more power connectors.*

In the past, it was likely that a floppy upgrade would involve going from a 360K to 1.2MEG 5¼-inch drive, or adding a 3½-inch 1.44MEG drive to a computer that lacked one. Today, however, the tides have turned, and it is more likely that someone would add a 5¼-inch drive to a PC that came with only a 3½-inch drive. That's what I will be doing to the Heathkit trainer PC that is being used as the basis for this series of articles (see the box copy elsewhere in this story for more information). I get disks from many different people and places, and not having a 5¼-inch drive is an inconvenience for me.



*A 3½-inch floppy drive takes up a fraction of the space that a 5¼-inch drive does.*

Most computers house no more than two floppy drives, and usually just one of each type. Multiple floppy drives of the same type never became popular for several reasons. For one, floppy drives take up a lot of space. Many of the latest PC's come with only a 3½-inch floppy drive mounted vertically in a small space intended for it, and no 5¼-inch drive. That way, no full-size drive bays are taken up by floppy drives. Another reason is that even entry-level machines come with enough memory for single-pass disk copying. (Remember having to swap floppies back and forth to copy them?) Also, with bigger hard drives, fewer people are using floppies for permanent storage. And software is rarely, if ever, run from floppies anymore.

A 5¼-inch drive fills a bay completely, while a 3½-inch drive needs a mounting adapter kit to fit in the same bay. That's the way my regular home computer came when I bought it; the 3½-inch drive took up a whole bay, as did the 5¼. After adding a tape backup, all the external bays were full. When I needed to free up a bay for a CD-ROM drive, I had to install a combination floppy drive that fits both 5¼- and 3½-inch drives in a single bay. That is a good solution for anyone in the same situation.

Because all PC's have different chassis layouts, it is impossible to explain the mechanical procedure involved in adding and removing floppy drives for all of them. But once you get the cover off, you should be able to figure out what to do.

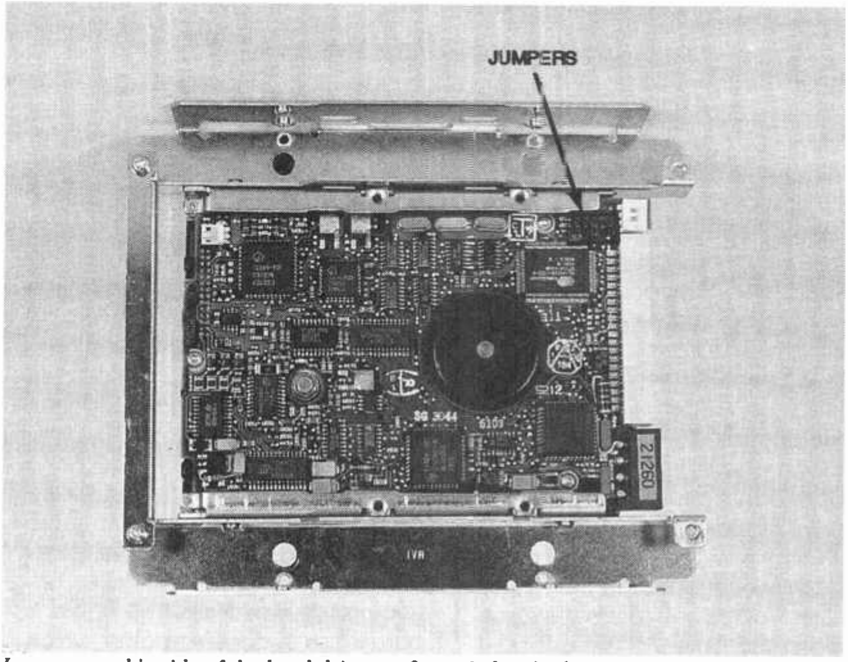
Older PC's usually have mounting rails that attach to the sides of a drive and the rails then slide into slots in a bay. However, there are other, different methods of holding the drive in place. The newer, more compact machines have the drives screwed in without rails, and other hardware is often in the way of the mounting screws. As every configuration varies, you'll have to figure out for yourself how to get at the mounting screws. If your machine came with good documentation, you might find some help there.

The Heathkit trainer PC has a very compact chassis, and rails have been done away with altogether. The machine has two free drive bays, and I will be installing the floppy drive in the top one. A plastic panel pops out of the front of the case for the new drive to protrude through. To get at the holes for the mounting screws, the existing 3½-inch drive and the hard drive must be removed. The fixtures that hold them in place are held in with one screw each and slide-out tabs.

Before installation, the drive's ID must be set. A PC can have up to four floppy drives: 0–3, or sometimes 1–4. By convention, I set the new drive's jumpers to Drive 1, which is the same setting as the 3½-inch drive already installed. They are both set to Drive 1 because a twist in the ribbon cable between the two floppy-drive connectors makes the last drive (the 3½) appear as drive zero, or A: when set as Drive 1. The second drive, the 5¼, also set to drive 1, will appear as drive 1, or B:. After setting the drive ID, the drive is fitted into the bay and mounted in place with screws on each side. Anything removed to install the drive has to be replaced before the computer is turned back on.

A standard four-pin power connector plugs into the back of the drive. The drive also has a 34-pin card-edge connector on the back with a slot in it near pin-1. (3½-inch drives have a 34-pin header connector.) The ribbon cable going from the PC's floppy controller to the 3½-inch drive has a free connector on it for a 5¼-inch drive; that should be the case for all PC's. Some floppy cables have connectors for four drives (two of each), with the twist between the pairs. If the connector for a floppy drive doesn't have a key to match the slot in the card edge, as was the case with the test PC, just be sure to line up the pin-1 stripe on the ribbon cable to pin-1 on the drive.

At this point the computer can be turned on. It should indicate that something is not right with the CMOS setup when it senses the new drive. Most computers will give you the option of entering setup at that point—if not, you have to anyway. If your computer does not tell you how to enter CMOS setup during boot up, then you have to consult its documentation. Once in the CMOS setup menu, changing the setting simply involves toggling the drive B: menu item from "Not Installed" to "5¼, 1.2MEG" (or whatever is appropriate for your situation). The newly installed drive is now ready for use.



*Jumpers on this side of the hard drive configure it for single, master, or slave operation.*


*A mounting kit adapts the hard drive to fit in a 5¼-inch drive bay.*

**Hard drives.** It is quite common nowadays to want or need a bigger hard drive. But as long as your original hard drive is working properly, and it's fast enough, it's much simpler to add a second drive. Disk-compression software sales have surely dropped with 540-megabyte drives selling for under $200. I ran with a "stacked" 200-megabyte drive for over a year with no problems, but always felt "unsure" about it. When a friend gave me a 540-megabyte drive he didn't need, I dumped the compression on the 200.

Here we will discuss how to install a new IDE-type drive in a machine that already has an IDE interface. The only other type of drive easily obtainable today is SCSI, but they are more complicated to deal with and will not be covered here. Note again that if you have an older machine that uses a different type of interface, this type of upgrade becomes very difficult. If you want to use IDE drives, as discussed earlier, you will need to replace the controller and the machine's BIOS (if you can), and you will have a tough time finding anything but IDE or SCSI drives for sale.

Though you supposedly don't have to, I feel that it is best to use the same brand of IDE drives in a machine. I have never had a compatibility problem, but they can occur.

Getting to the task at hand, I'm adding an 85-megabyte IDE drive to the Heathkit trainer PC, which already has a 210-megabyte drive. Today, one would certainly buy a drive bigger than 85 megabytes, but this one was available to me for free and it is fine for the purpose of this article. The procedure is the same for installing any hard drive.

The documentation for a hard drive explains how to set its jumpers. The jumpers set the operating mode and sometimes other options. Hard drives have three operating modes: single, master, and slave. Single is when it's the only drive in a system, master is when it controls a second drive, and slave is when it's the second drive. The master hard drive is usually C: and the slave D:. When you add a second drive, you also have to reset the jumpers on the existing drive to change it from single to master.

If the new drive is significantly faster than the old drive, then you should make the new drive C: and the old one D: so that the machine boots and runs the operating system off the faster drive. Otherwise it's much simpler to just add a new D: drive (we'll discuss how to make your new drive the boot drive shortly). Note that if you already have a CD-ROM drive set up as D:, the new hard drive will disable it. You will have to edit your system files or reinstall the CD-ROM software to correct that problem.

After setting the jumpers on the new drive, and resetting the ones on the old drive if necessary, the drive can be installed in a free bay. The trainer PC has space dedicated to one hard drive; the second drive will be installed with an adapter kit that allows it to fit in a 5¼-inch bay. The hard drive will be installed in the bay underneath the floppy drive installed earlier. That fills the one remaining bay in this PC—one disadvantage, and a major one, to a small case. In this case (literally), a snap-out metal plate must be removed from the bottom bay to gain access.

Hard drives are connected to the controller by a 40-pin ribbon cable and header connectors. The hard-drive ribbon cable should have connectors for two drives. The cable is parallel so it doesn't matter which connector goes to which drive. You will need a new cable with two hard-drive connectors if the cable going to your present drive has only the one connector, which was the case with the trainer PC. If the connector doesn't have a key to match a missing pin on the hard drive, just be sure to line up the pin-1 stripe on the ribbon cable to pin-1 on the drive. A four-pin power connector also plugs into the drive. If there is an unused connector available, you are home free; otherwise you will need a Y adapter to share the connection with another device.

After all connections are made to the new drive, and all other hardware is reinstalled, turn on power and enter the CMOS setup menu. You need to change the CMOS settings to alert the computer to the presence of the new drive, and provide configuration information (number of heads, cylinders, sectors per track, etc.). Your computer's setup menu will give you a list of common configurations; there's also a user-defined setting that lets you manually enter the drive's configuration. Sometimes there is an automatic setting where the computer will try to figure out for itself the configuration of the drive. When setting the drive's configuration in CMOS, be careful not to exceed the physical specifications and maximum capacity of the drive.

If you wish, your drive can be divided into partitions that behave as individual drives. Versions of DOS earlier than 4.0 limited the capacity of the drive, so partitioning had to be done. Each partition is assigned a different letter, for example, C:, D:, E:, and so on. The FDISK utility (part of DOS) lets you partition a drive. If you partition or format a drive at any level you erase all data, so back up the drive first if that could be a problem for you. The FDISK menu is self-explanatory and easy to use. But it's best to keep things simple. Newer versions of DOS don't have drive-capacity limitations and you should probably just leave the drive as one big partition; that is what most users do.

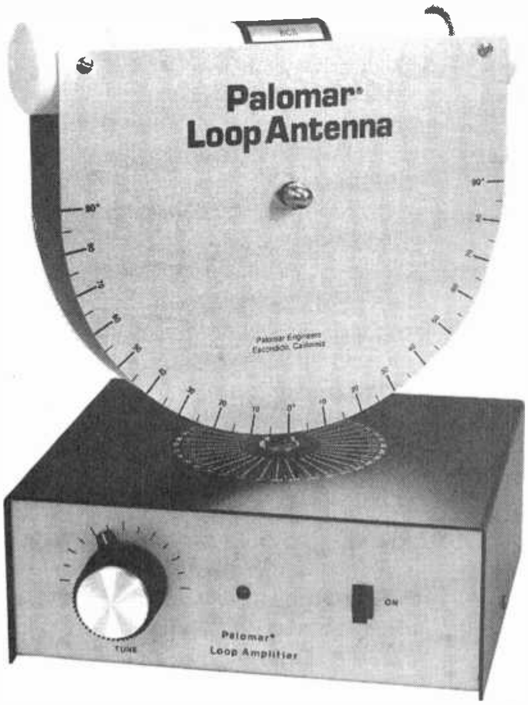
IDE drives are low-level formatted at the factory—it can't be done by the user. While not always necessary with a new drive, high-level formatting verifies the information written to the disk in the factory low-level format, and also establishes drive access information used by the system. It also creates the file-allocation table (FAT) used by DOS for drive access. A high-level format is initiated by the FORMAT command (FORMAT D:, for example). Refer to your DOS manual for details. You can verify the newly formatted capacity using the DOS CHKDSK utility (once again, see your DOS).

If you want to make the drive bootable, you must boot from floppy, set the new drive's primary DOS partition to active in the CMOS setup menu, copy all system files to the boot sector, and then rearrange and/or reinstall all of your software. Once all of that is done, the new hard drive is ready for use.

**Next Time.** That's all for now. In the next installment of this occasional series on upgrading and maintaining personal computers we'll delve into a subject that can give even the most experienced user fits—adding multimedia components to an existing machine. Watch for it! ■

### COMPUTER SERVICING COURSE

This series of articles on PC servicing follows, in part, the Personal Computer Servicing Course offered by Heathkit. The $2495 course includes a 486 SX25 PC trainer, full documentation, software, tools, books, upgrade parts, and more. Contact Heathkit (The Heath Company, Benton Harbor, MI 49022; Tel. 800-253-0570) for more information. ■




# Limited-Space Antennas for SWL's


*These designs and ideas can help even the most space-challenged shortwave listener.*

**BY KARL T. THURBER, JR.**

Squeezing the maximum results from minimum antenna space is a problem that faces many shortwave listeners. While the problems faced in reception are nowhere near as difficult to overcome as those for transmission, there are still many challenges to be faced, and many ways to face them. In this article we will present practical solutions for the space-challenged shortwave listener (SWL) who has no place for a large, conventional receiving antenna. We'll cover both indoor and outdoor set-ups, and deal with many of the topics associated with antenna design and construction. There's a lot to cover, so let's get right to it.

**Some Basics.** Whatever the antenna, you seek to do two things: maximize the signal to the receiver and minimize the pickup of noise or interference. Usually, you can obtain good reception with a very modest antenna. Often, the built-in antenna on a portable receiver is adequate. However, most portable radios and practically all communications receivers have an external antenna jack—ideally for an outdoor antenna, if local restrictions don't prevent you from erecting one.

**Homebrew Solutions.** You can usually fabricate your own shortwave antenna for considerably less than the cost of a commercial kit or ready-to-install antenna. Another reason for building your antenna yourself is that you can learn more from the process.

We'll sample a few basic antenna types here, but bear in mind that there is no overall "best" antenna. Each type has its advantages and disadvantages; those pluses and minuses are magnified with limited space and hidden antennas.

The first thing we'll consider are some makeshift and temporary antennas. For instance, many SWL's simply attach a 15- to 30-foot length of insulated wire to the set's external antenna jack, stretching the wire across the room. If the radio doesn't have an antenna jack, you can clip the end of the antenna to the whip using an alligator clip.

One alternative to whips and clipped-on singlewires is the "window-screen antenna." You can run a short length of wire from the radio's whip to your screen. If there is no screen, or if the screen and frame are grounded, you can tape a large square of window screen onto the glass and run a wire connection directly to the radio. Another idea is to fasten a rod antenna to a windowsill with a suitable bracket; a CB whip antenna and mount sometimes can be used for that.

While those solutions are fairly simple, the improvement they provide will likely be only marginal. You'll obtain much better reception if you string your wire outdoors: An external antenna is one of the best things you can do for your receiver to improve reception. You can use practically any hunk of wire as a random length shortwave antenna, even a very short one, but the best results will be obtained with one between about 25 and 100 feet and strung as high in the air as possible (see Fig. 1). You can bend the antenna horizontally or vertically as needed to fit your lot with little reduction in reception effectiveness.

The far end of the antenna is simply attached to any convenient, non-grounded support (a side of a build-

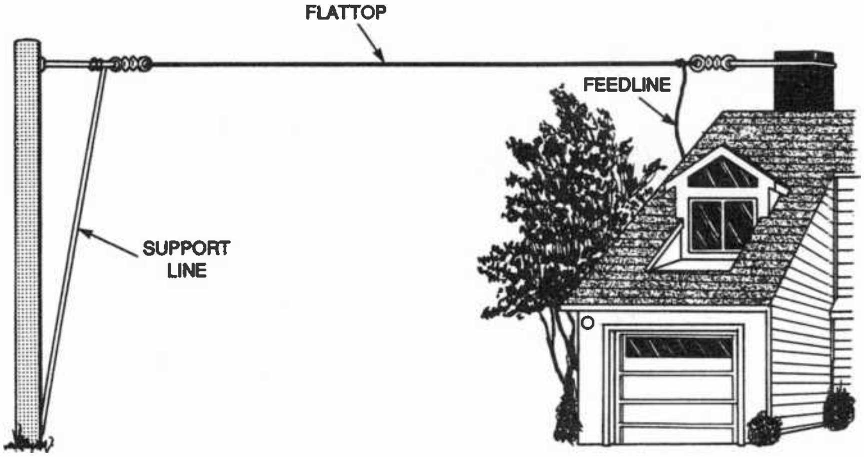


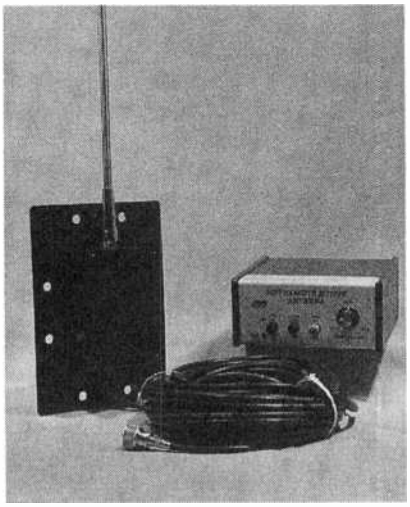

*Fig. 1. A random length of wire is the simplest of horizontal antennas. You can use practically any length of wire, even a very short one, but lengths between 25 and 100 feet and strung as high and in the clear as possible work best.*

ing, a tree, etc.). The near end of the antenna is soldered to an insulated wire that serves as the downlead, and the downlead is brought indoors and connected to the receiver. Note that the single-wire downlead is actually part of the antenna and therefore care should be taken to prevent its touching metallic objects. Also, keep it away from noise-producing appliances.

Incidentally, frequently you'll see random-length wire antennas referred to as "longwires." That usually is a misnomer, since an antenna isn't long unless it's several wavelengths long at the frequency of interest. You'll also see references to the "Zepp," so named in honor of the Zeppelin airships with which they were used. The Zepp is an end-fed antenna, often one-half wavelength long, that's a cross between a dipole and a longwire antenna. It's normally fed with twinlead or ladderline, and so requires an antenna tuner.

The single- or multi-band dipole antenna probably is the most commonly used shortwave antenna; it's normally cut to one-half wavelength at the lowest frequency, but it can be much shorter or bent to fit your yard and still work well. Normally you cut the dipole in the middle, resulting in two, quarter-wavelength wires that are insulated from each other but which are connected to the feedline. The feedline can be coax, open-wire line, ladderline, or twin-lead.

For transmitting, antenna efficiency and feedline matching is very important, so the dipole should be of the proper resonant length. For reception, those factors are much less important. If space is at a premium, you can obtain satisfactory reception with even a very short dipole.



*The MFJ-1024 is a popular active antenna with listeners. Covering 50 kHz to 30 MHz, it's mounted outdoors for maximum signal and to keep it away from electrical noise.*

Many SWL's obtain good results in limited space by shortening the span without shortening the antenna. You can bend the dipole around corners, keeping the length of wire in the air as great as possible. You can make the dipole in the shape of a "V" or inverted "V", or run it vertically. If room is lacking, you can still get good results with the dipole tacked up along the roof eaves, with the center insulator at the peak.

A Sloper is a semi-vertical variation on the dipole that can save you space and often can be made to fit where a full-length dipole won't fit. The classic Sloper is an ordinary dipole with one end attached high up on a building or other support and the other end staked down to the ground; see Fig. 2.

Some hobbyists install multiple Slopers cut to different bands or oriented in different directions because they take up little space. The Sloper is a good DX (distance) antenna, and is directional from where the lower end of the antenna is pointing.

Another way to get dipoles to fit in physically limited spaces is to use traps. Traps are resonant tank circuits inserted into the antenna's radiators to make the antenna electrically longer than its physical length. Another use for traps is to electrically separate or isolate segments of an antenna to allow a single dipole to be resonant over several frequency bands.

While they will certainly work best outdoors, dipoles can also be mounted indoors, in an attic. Of course, you will want to get the radiators as close to the appropriate length as possible. You can "cheat" by bending the wire as required to fit, or by using one of the reduced-space designs such as the "folded" dipole (made from TV-type twin lead). Some SWL's have even reported success with two stretched-out Slinky toys fed as dipoles. The use of traps, however, is not recommended for indoor dipoles.

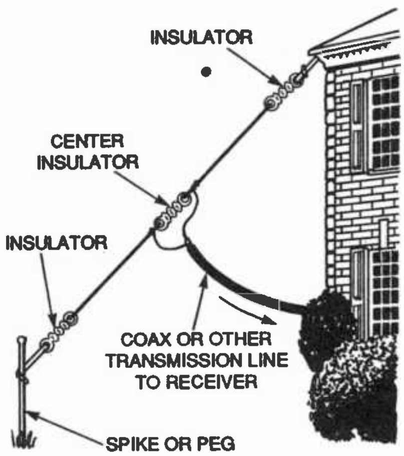



*Fig. 2. Semi-vertical Slopers save you space because of their geometry; they often fit where a horizontal dipole won't. The classic Sloper is a dipole with one end attached high up on a building or other support, and the other end staked down near the ground.*

## FURTHER READING

*The ARRL Antenna Book*, by the ARRL staff, 1994, 736 pages, $30, American Radio Relay League. ISBN: 0-87259-473-4. This is an authoritative resource on antenna and transmission-line theory, construction, and safety. The 1994 edition contains about 1000 illustrations, an index, a glossary, and a diskette of software. While primarily for amateur antennas, the principles apply equally to shortwave antennas.

*Easy Shortwave Antennas*, by Frank P. Hughes, VE3DQB, 1992, 52 pages, $9.95, Tiare Publications. ISBN: 0-936653-29-9. If you are dissatisfied with the antenna you're using, or if you enjoy experimenting, you'll like this collection of more than 50 shortwave antennas and variations. The book covers longwires, Slopers, verticals, beams, squares, and indoor antennas.

*The Easy Wire Antenna Handbook*, by Dave Ingram, K4TWJ, 1992, 112 pages, $9.95, Universal Electronics, Inc. This user-oriented book offers facts on wire antennas, tuners, accessories, and hints, providing details on many inexpensive skywires. The book includes information on transmission lines, hidden and disguised antennas, BALUNS, and antenna tuners.

*Hidden Ham Antennas*, by Frank P. Hughes, VE3DQB, 1994, 50 pages, $12.95, Tiare Publications. ISBN: 0-936653-54-X. Outdoor, indoor, HF, and VHF/UHF antennas are all discussed—along with ways to disguise them. Also covered are antenna tuners, grounds, and commercial antennas. The focus is on amateur antennas, but SWL's will also get some useful suggestions.

*Joe Carr's Receiving Antenna Handbook*, by Joe Carr, K4IPV, 1994, 200 pages, $19.95, HighText Publications, Inc. ISBN: 1-878707-07-8. This cookbook of easy-to-build antenna recipes for SWL's covers theory, construction, safety, grounding, lightning protection, and more. Space also is devoted to active antennas and other solutions for limited space. Accessories, including antenna tuners and preamplifiers, are covered.

*Limited Space Shortwave Antenna Solutions*, by Frank P. Hughes, VE3DQB, 1988, 52 pages, $10.95, Tiare Publications. ISBN: 0-936653-13-2. Condo and apartment solutions including randomwire, vertical, dipole, loop, and indoor antennas are covered here, along with balcony antennas, window and attic installations, helical dipoles, commercial antennas, and modified CB antennas. Grounds, wire, insulators, connectors, and masts are discussed as well.

*Shortwave Antennas, Second Edition*, by Andrew Yoder, 1994, 208 pages, $16.95, Tab Books/McGraw-Hill. ISBN: 0-07-076534-0. Yoder tells you how to obtain best performance from your radio by building your own antennas. His easy-to-follow instructions and diagrams show how to build a variety of inexpensive antennas.

*Simple, Low Cost Wire Antennas*, by William I. Orr, W6SAI and Stuart D. Cowan, W2LX, 1993, 188 pages, $11.95, Radio Amateur Callbook, a division of BPI Communications, Inc. ISBN: 0-8230-8707-7. This classic tells all about building wire antennas, including horizontals, verticals, beams, and traps. It also covers antenna tuners, baluns, matching, radials, grounds, and lightning protection. It also includes "invisible" antenna ideas.

*The WireBook II*, by Press Jones, N8UG, 1993, 56 pages, $2, The Wireman, Inc. This concisely written booklet is an excellent how-to-do-it mini-manual. It's full of hints, tips, and advice on antenna wire, coax, connectors, baluns, lightning protection, grounding, and antenna accessories. While primarily for amateurs, the booklet is also invaluable for SWL's. ■

Also, when mounting indoors, keep your antenna away from telephone, cable-TV, power, and other wiring.

Another solution where space is at a premium is the vertical antenna as shown in Fig. 3. Both single-and multiband vertical antennas take up little horizontal real estate and give good results when antenna space is small: quarter-wave verticals require only half the length of comparable horizontal antennas.

With a vertical antenna, you connect the center conductor of the coax transmission line to the vertical portion of the antenna and the coax shield to ground. Traps can also be used with verticals, allowing for multiband operation.

A good ground is important for the vertical since a ground for RF effectively takes the place of "the missing half" of the dipole. Vertical antennas that are elevated above ground level and use a system of radials are called ground-plane verticals.

**Hidden Antennas.** Any of the solutions presented thus far will work if space is the only limitation that the SWL must face. Unfortunately, many SWL's also face significant antenna restrictions in their neighborhoods or in their apartment or condo complex. They're always looking for ideas for hidden and disguised antennas the neighbors or the landlord won't complain about simply because they don't know they're there.

Inventive SWL's have come up with lots of ideas for camouflaged and hidden antennas. Those include disguising an antenna to look like a powerline run to a backyard shed, using a tall birdhouse or a basketball-hoop support pole as a vertical antenna, running a V-shaped dipole under roof eaves, making the antenna look like a clothesline, running a thin wire on the outside of an apartment building, and tossing a random length of wire out of an apartment window into nearby trees.

One popular approach when outdoor antennas are prohibited is to use the building's rain gutter as a receiving antenna. To do that, run a length of insulated wire out of your window and clip it to the gutter downspout. That type of antenna is not a great performer, and might not work at all if the downspout is grounded.

A balcony often provides opportunities for mounting antennas in ways that they won't be easily noticed, and balcony mounting allows the antenna to be located outdoors. The steel

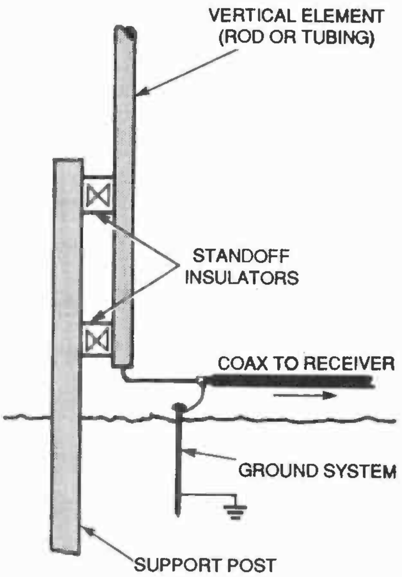
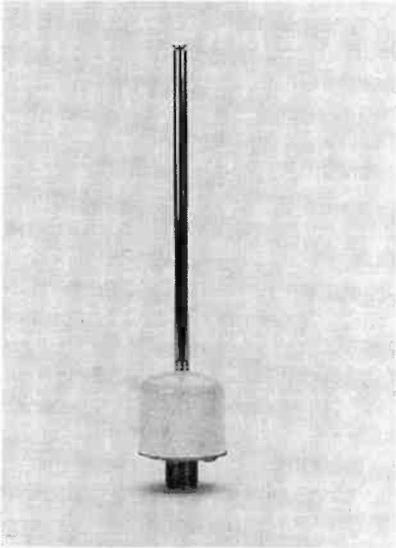



*Fig. 3. Verticals take up little real estate and give good results. With a vertical, you connect the center conductor of the coax transmission line to the vertical portion and the coax shield to ground. Note that a good RF ground is important.*



*This miniature receiving antenna, the PA-355 Super Snooper from Palomar Engineers, comes in a waterproof PVC case for outside use where a full-sized outdoor antenna is not possible or an amplified outdoor antenna is not desirable.*

railings on most balconies are usually grounded and sturdy enough to support a base- or center-loaded, amateur-style mobile antenna. Some "fish" for signals on their balcony by using a fishing rod or a broomstick supporting an antenna carrying a weight on the end.

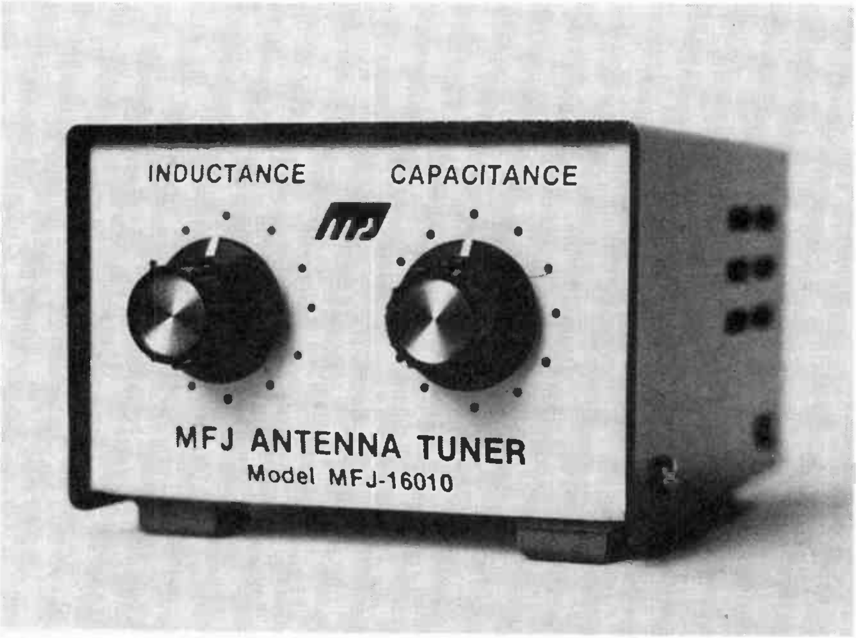
You might have to be highly creative in setting up your antenna. For example, at least one state, Florida, has a law permitting condominium owners to display a U.S. flag, regardless of any local rules or regulations. One Florida amateur, living on an upper floor of a condo that had an outside-antenna prohibition, used a mobile whip on a quick disconnect clip, placed outside of the window in a horizontal position with a small flag attached to the tip. That letter-of-the-law arrangement let him get on the air. A similar trick might also work for you if you're an SWL.

**Commercial Solutions.** Although commercial antenna kits and ready-made antennas are usually more expensive than building your own, you have the advantage of knowing that the antenna is of a proven design and that all the accessories and parts you'll need are there. A wide variety of SWL antennas are available commercially.

While you can use practically any length of wire as a random-length wire antenna in a pinch, several firms offer complete kits of simple antennas. For instance, Radio Shack sells an inexpensive ($9.99) single-wire antenna kit (catalog no. 278-758), consisting of a 70-foot radiator, 50 feet of lead-in, a window feedthrough, and insulators. Generally the performance of such antennas will be improved if you use a small antenna tuner or coupler at your radio to match impedances.

Palomar Engineers also offers a complete, fully assembled shortwave wire antenna packaged with a noise-reducing BALUN, two ceramic insulators, 40 feet of copper antenna wire, and nylon support cord. The antenna can be placed horizontally, or positioned semi-vertically, like a Sloper. Known as the Model WB-1 White Box (TM), it costs $59.95.

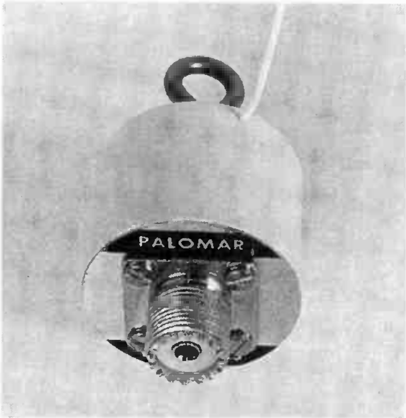
Speaking of Slopers, Alpha Delta Communications, best known for its lightning-surge suppressors and amateur-band Slopers, also offers two excellent long-haul SWL antennas: the 60-foot DX-SWL Sloper (mediumwave through 13 meters) and the limited-space 40-foot DX-SWL/S Sloper, for 90 through 13 meters. Prices range from $59.95 up, depending on the design.




*The go-anywhere MFJ-16010 Randomwire Antenna Tuner is small enough to carry in your pocket or briefcase and covers all bands from 1.8 to 30 MHz continuously.*

Available from Antenna Supermarket is a 67-foot, end-fed, coil-loaded Sloper covering the AM broadcast bands and 120 through 13 meters. That company also offers their "Eavesdropper" 8-trap, 42-foot-long dipole that covers the shortwave broadcast bands from 11 to 75 meters with one feedline; twinlead and coax feedline versions of that antenna are available. Each antenna is $79.95.

As you might imagine, indoor- and attic-antenna products are plentiful. For instance, Radio Shack offers the Inverted "V" Antenna (catalog no. 20-181). It's a ready-to-install, 65-foot dipole for general-purpose shortwave use. That versatile, simple anten-




*The Palomar Engineers MLB-1 Magnetic Longwire BALUN is a high-impedance receiving BALUN that's placed at the end of a singlewire or longwire to allow the use of coax feedline. There's also an eyebolt for convenient mounting. The BALUN also is available packaged in a complete, fully assembled shortwave wire antenna, the WB-1 White Box.*

## ANTENNA RESOURCES

**Alpha Delta Communications, Inc.**
P.O. Box 620
Manchester, KY 40962

**American Radio Relay League**
225 Main St.
Newington, CT 06111

**Antenna Supermarket**
P.O. Box 563
Palatine, IL 60078

**AntennasWest**
P.O. Box 50062
Provo, UT 84605

**THE ANT FARM**
P.O. Box 3196
Wescosville, PA 18106

**The Bilal Company**
137 Manchester Drive
Florissant, CO 80816

**C. Crane Co.**
558 10th Street
Fortuna, CA 95540-2350

**FLYTECRAFT**
P.O. Box 3141
Simi Valley, CA 93093

**Gilfer Shortwave**
52 Park Avenue
Park Ridge, NJ 07656

**Grove Enterprises**
P.O. Box 98
Brasstown, NC 28902-0098

**HighText Publications, Inc.**
P.O. Box 1489
Solana Beach, CA 92075

**KILO-TEC**
P.O. Box 10
Oakview, CA 93022

**MFJ Enterprises, Inc.**
P.O. Box 494
Mississippi State, MS 39762

**Multi-Band Antennas**
7131 Owensmouth Avenue
Suite 263C
Canoga Park, CA 91303

**Palomar Engineers**
P.O. Box 462222
Escondido, CA 92046

**Radio Amateur Callbook**
P.O. Box 2013
Lakewood, NJ 08701

**Radio Shack**
1500 One Tandy Center
Fort Worth, TX 76102

**The Radio Works**
P.O. Box 6159
Portsmouth, VA 23703

**Radioware Corporation**
P.O. Box 1478
Westford, MA 01886

**Spi-Ro Manufacturing, Inc.**
P.O. Box 5500
Lakeland, FL 33807

**Tab Books**
P.O. Box 5445
Blacklick, OH 43004-0545

**Tiare Publications**
P.O. Box 493
Lake Geneva, WI 53147

**Universal Electronics, Inc.**
4555 Groves Road, Suite 12
Columbus, OH 43232

**Universal Radio, Inc.**
6830 Americana Pkwy.
Reynoldsville, OH 43068

**W9INN Antennas**
P.O. Box 393
Mt. Prospect, IL 60056

**The Wireman, Inc.**
261 Pittman Road
Landrum, SC 29356

**Worldcom Technology**
P.O. Box 3364
Ft. Pierce, FL 34948

na can be mounted in an attic or under roof eaves, space permitting, or it can be installed outdoors on a single mast. It's $29.99.

The C. Crane Company offers several indoor shortwave antennas. Those include a portable, 21-foot "longwire" antenna with a universal clip attachment ($13.95); the Micro Matcher amplified indoor AM/FM/shortwave antenna, to be clipped to any metal mass such as a window frame ($64.95); and an indoor AM/shortwave shielded loop you can mount indoors or outdoors, up to 100 feet from your receiver ($59.95). C. Crane also offers several indoor AM broadcast-band antennas.

A fancier approach is taken in the FLYTECRAFT Model SFZ "Indoor Multi-band HF Transmitting and Receiving Antenna." It operates as an end-fed "Hertz" antenna having a center loading coil. The antenna offers continuous amateur or SWL coverage from 40 through 10 meters with no gaps, when used with an antenna tuner. Its height is adjustable between 7 and 12 feet and installs vertically between the floor and the ceiling. It uses counterpoise radials that you simply place on the floor, either stretched out or coiled up. It costs $179.95.

Another popular indoor receiving antenna is the "active" antenna. An active (amplified) antenna is one that has a built-in preamplifier. The antenna is usually a short whip installed indoors or atop a mast, connected to the remote preamplifier by coax and possibly a control cable.

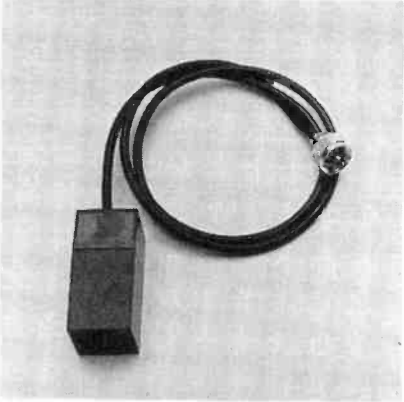
Outdoor active antennas are often good bets when wire antennas are not permitted or desirable. High-rise apartment dwellers find the active antenna a practical antenna solution if they can mount the active antenna's small whip outdoors. Even if you have the space for a full-size antenna, it might prove more practical and simpler to use an active antenna.

If the preamplifier or preselector is tunable, it also can enhance reception by simultaneously peaking in-band signals and rejecting out-of-band signals. Active antennas and preamps are offered by MFJ, Radio Shack, Worldcom, Grove Enterprises, and many other firms.

One of the simplest and least expensive ($29.99) active antennas is Radio Shack's Amplified Indoor Antenna (catalog no. 20-280). That compact antenna is ideal for apartment dwellers and travelers. It delivers up to 20-dB gain; a preselector peaks signals in the 3- to 30-MHz range and helps reject unwanted signals. A gain control helps prevent overloading by strong signals.

Grove Enterprises offers an amplified indoor/outdoor antenna system centered on the Grove TUN-4 Mini-Tuner Plus. That is a 20-dB-gain preamp covering 100 kHz to 30 MHz; it can be used either with the ANT-6 hidden indoor antenna (a thin profile, short flexible wire antenna you can run inconspicuously along molding) or the ANT-2 Skywire outdoor antenna (a 66-foot off-center-fed antenna). Grove also offers an unamplified reel-out antenna for portables, the ANT-16; it clips to the whip antenna of your portable radio.

Loop antennas are another popular alternative. Most wire-type, outdoor, receiving loop-antennas require but a single element; both sides



*No external antenna jack on your radio? The Loop Coupler from Palomar Engineers magnetically couples the output of an external antenna to your receiver's built-in loop antenna.*

of the transmission line are connected to opposite ends of the element. That type of loop is somewhat directional and usually requires a good deal of space because its element typically is a full wavelength long.

Other loops are small coils of wire on a ferrite form. That type of loop is very popular because it's highly directional, it can be used to deeply "null out" unwanted signals on the same frequency, but coming from different directions, and it is quite suitable for indoor use.

While you can use a ferrite loop on HF, they come into their own on MF, LF, and VLF. At those frequencies, a horizontal dipole is almost useless because it's almost always too close to the ground (relative to the signal's wavelength), and vertical antennas are noisy from interference from computers, TV sets, light dimmers, automobile ignitions, and other devices. The loop rejects much of that noise. Several firms, including Palomar Engineers, Worldcom, and others, offer receiving loops.

For example, the NXL-1000 Noise-Canceling Indoor Shortwave Antenna from Worldcom Technology offers high gain, sensitivity, and noise-rejection. It rejects noise by using an electrostatically-shielded Faraday loop antenna atop the unit; the loop cancels most noise. The loop is mounted on a tiltable turntable mount to allow further nulling of noise sources as well as nulling of interfering stations. The antenna costs $89.95

A different approach is taken by MFJ Enterprises. Their MFJ-1782 Super Hi-Q Loop Antenna offers a relatively large (26-inch diameter) magnetic loop that can be used for receiving and transmitting over 10-30 MHz. The $269.95 antenna is quiet and has a narrow bandwidth that helps reduce receiver overloading and interference from out-of-band signals. It's suitable as a portable antenna used from hotels, motels, and motor homes. It's also effective in apartments and condos where the antenna can be mounted on a balcony or in the attic.

Several firms make unusual compact antennas; some are for receiving only, while others are designed for transmitting. Here are two intriguing antenna systems to consider, especially if you like to DX the ham

*(Continued on page 89)*

## ANTENNA CATALOGS

Besides their convenience, mail-order radio catalogs and product information sheets extend your horizons, providing access to equipment and supplies that might not be available locally. Fortunately, there is an abundance of catalogs you can obtain offering a wide selection of SWL antennas and receiving accessories. Here are some of them:

**Antenna Supermarket.** Antenna Supermarket offers several HF SWL antennas, including the popular "Eavesdropper," gas-tube lightning-surge arrestors, and various SWL accessories. Besides the product sheet there's a short but useful beginner's tutorial on receiving-antenna selection, installation, lightning protection, and weather protection.

**AntennasWest.** AntennasWest offers some novel amateur and SWL antennas and accessories. Those include an "invisible" 300-ohm indoor twinlead on transparent tape that can be stuck to walls and run through closed doors. They also carry "Slinky"-based indoor antennas for apartment, motel, attic, and portable use. Their products emphasize casual, on-the-go antenna needs.

**ANT FARM Antennas.** That Pennsylvania firm offers several wire-antenna kits for radio amateurs and SWL's. Those include a 43-foot long SWL antenna that covers 2.4–30 MHz and a high-performance all-band 47-foot amateur HF antenna for restricted space. New products include loaded dipoles and Slopers for 160, 80, and 40 meters, and a very compact HF antenna.

**Gilfer Shortwave.** Gilfer's 30+ page catalog makes a good sourcebook. Numerous accessories are featured, including passive and active antennas, lightning arrestors, surge protectors, and cables. Offerings include HF dipoles, longwires, and Slopers; active antennas for VLF through UHF; and indoor receiving loops.

**Grove Enterprises.** The Grove catalog has many hints and tips for the listener, including tutorials on choosing shortwave receivers, scanner radios, antennas, and accessories. The catalog has a number of antennas and antenna accessories of interest to SWL's, including an amplified indoor SWL antenna system, the 66-foot ANT-2 Skywire dipole, various lightning protectors, and many other items.

**KILO-TEC.** That company sells a variety of antenna parts and accessories, including four HF dipoles. Accessories include center connectors, weather-boot kits, pulleys, Dacron rope, lightning arrestors, stainless eyebolts, BALUNS, antenna wire, openwire feedline, twinlead, tuners, and filters.

**Radioware.** Various antennas and RF accessories are offered. Included are amateur, SWL, and scanner antennas; antenna and grounding wire; antenna traps and BALUNS; relays and switches; transmission line; lightning-protection accessories; insulators; and other antenna components and accessories. Almost everything sold is illustrated with a photo.

**The Radio Works.** Their General Catalog's focus is on HF wire-antenna systems and components such as coax, antenna wire, and connectors. Also offered is a Reference Catalog. It contains detailed features on designing and installing wire antennas. The General Catalog is free; the Reference Catalog is $4. The two catalogs make good sourcebooks on wire (including limited-space) antennas for shortwave and amateur radio.

**Spi-Ro Manufacturing.** Spi-Ro is a good source of antenna accessories and parts. They offer several amateur and SWL antennas, including limited-space dipoles, multiband-trap dipoles and Slopers, and a variety of single-band antennas. Their flyer also shows BALUNS, center connectors, coax, ladderline, insulators, lightning protectors, support rope, surge protectors, antenna traps, and other parts and accessories.

**W9INN Antennas.** Proprietor Bill Fanckboner, W9INN, focuses on amateur multiband Slopers and dipoles; he also manufactures shortwave receiving antennas sold by other vendors. The W9INN antennas are custom assembled complete with center connector, Dacron line, spreaders, and other needed accessories except for coax, which you supply. The W9INN catalog includes many useful sketches and configuration suggestions and ideas. ■

# 1 9 9 0 was a Great Year for Popular Electronics®

The twelve 1990 issues of *Popular Electronics* reveal many fascinating articles. There's a bonanza of build-it project plans, informative theory articles and timeless feature stories. Check out the partial list of titles packed into the 1990 issues and you'll agree that 1990 was a banner year. If you see an article about a project, theory topic or newsworthy feature, you can have that article, with the entire issue for only $6.50. To get your 1990 issue(s) of *Popular Electronics*, place a ✓ in the box that indicates the month you want and complete the coupon below. Note that ordering six or more copies reduces the price per issue! Tear out this page, or make a photo copy of it, and mail or FAX it today! Just follow the directions below.

## TOPICS FROM THE PAST

### Selected Projects

Audio Ambiance Ditherizer, **April**
Bit Grabber for Parallel I/O Testing, **December**
Car-Radio Silencer, **October**
Cordless Test Probes, **January**
CW and SSB, Add to a SW Receiver, **May**
Digital Entry Switch, **November**
Economy Portable SW Receiver, **August**
Exhaust Monitor for Car, **June**
Experimental AC Hum Sniffer, **September**
Game Reaction Timer, **April**
Headphone Output for Your CD Player, **July**
Hot-Wire Glass Bottle Cutter, **December**
Indoor Burglar Alarm, **December**
IR-Triggered Sound-Effects Generator, **October**
Lie Detector, Simple, **January**
Microphone Preamp, Simplest, **March**
Mobile Battery Charger, **March**
NiCd Battery Tester, **August**
Plasma Display, Custom, **February**
Receiver Circuits You Can Build, **March**
Remote-Control FAX Switch, **August**
Serial Cable Tester, **January**
Telephone Toll Totalizer, **August**
Tesla's Lightning Generators, **September**
The Lepton Candle, **October**
Ultrasonic Morse-Code Transceivers, **July**
Universal 3-Terminal Power Supply, **November**
Video Titler, Super Simple, **September**
Vision System for Robotic Toys, **March**
VLF Receiver and Transmitter, **July**
Water Leak Alarm, **January**

### Special Features

Antenna Installation, **September**
Capacitors, Choosing and Using, **June**
Classic Amateur Receivers, **November**
Drying Out Flood-Damaged Equipment, **January**
Early Radio Transmitters, **May**
External Drive for Laptop, **June**
First Electric Motor Project, **October**
Ground Fault Technology, **November**
Keeping Up with Pacemakers, **July**
Living with Lightning, **October**
Make Your Own Iron-on PC Patterns, **July**
Old-time Radio Circuits, **March**
Oliver Lodge: Radio's Forgotten Pioneer, **July**
Restoring a Classic SW Receiver, **April**
Solar Power, Experimenting with, **June**.
St. Elmo's Fire, **September**
Surface Mount Technology, **November**
Television Night, a Look Back, **July**
Tune-in to Satellite Radio, **May**
Using Appliances Overseas, **January**

### Theory for Everyone

3-Terminal Voltage Regulators, **May**
200,000-volt van de Graaff Generator, **October**
All About Batteries, **August**
All About Thermistors, **December**
CCTV Installation Guide, **November**
Connect Anything to Your Computer, **August**
Designing Power-supply Circuits, **February**
Digital Electronics Introduction, **April**
Experiments in Electrophotography, **March**
Fiber-Optic Communications, **April**
Galvanometer, Build and Learn, **September**
Lasers, All About, **September**
Printer Technology, **October**
Signal Generator Circuits Cookbook, **November**
Stepping Motors Introduction, **March**
Troubleshooting Computer Disk Drives, **May**
Troubleshooting Your Printer, **December**
Typing Practice Program, **August**
Sideband Amplifiers, **January**
Wimshurst Machine, **December**
WW1 Long Island Spy Station, **December**

## Popular Electronics 1990 Issues

| January | February | March | April | May | June | July | August | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

✓ Check the issue(s) you want.

**How to Determine Cost per Copy**

| Quantity | Price per copy: United States | Canada | Foreign |
|---|---|---|---|
| 1-5 | $6.75 US | $7.75 US | |
| 6-12 | 5.75 | 6.75 | $8.50 US |

**Prices include handling and shipping costs. Prices subject to change. All Canada and foreign orders payable in U.S.A. funds only, via international money order, check drawn on a U.S. bank, or acceptable credit card (Visa, MasterCard) in U.S.A. funds. Allow 6-8 weeks delivery. Minimum foreign order--6 issues. Foreign orders may take longer.**

☐ Visa ☐ MasterCard ☐ USA Bank Check ☐ US or Internnational Money Order

Credit Card Number ______________________ Exp. Date ___/___
(If used)

Signature ______________________ Total No. of Copies ________

Print Name ______________________ Total Amount $ ________

Address ______________________

City ____________ State ____________ ZIP ________

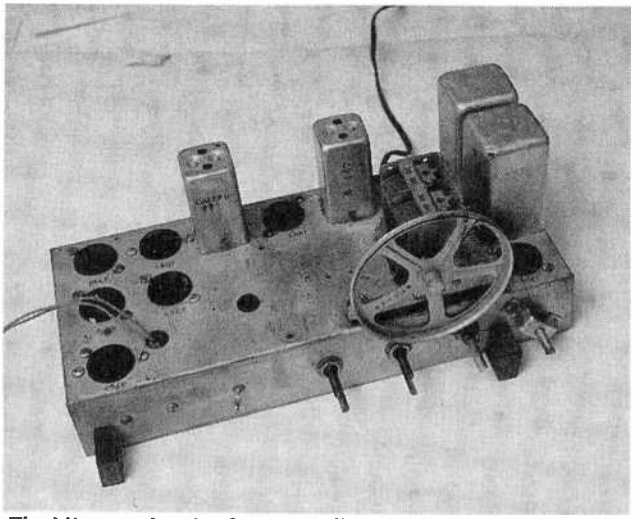
Send orders to: CLAGGK, Inc. P.O. Box 4099, Farmingdale, NY 11735. No COD orders.
Credit Card user may telephone or FAX order. Telephone 516-293-3791 or FAX 516-293-3115.

# ANTIQUE RADIO

By Marc Ellis

## The Minerva Gets a Re-Capping

This month, we'll be continuing the Minerva Tropicmaster restoration project that we began in the April column. If you've just joined us, the Tropicmaster is a basically an upgraded version of the AC-DC "All-American Five" circuit used so widely in inexpensive table sets just before, and for several years after, World War II.



*The Minerva chassis after reinstallation of the oscillator can (upper right corner), followed up by cleaning and mild polish.*

Though the eight-tube Tropicmaster has circuit refinements that make it much more of a radio than its more mundane five-tube relatives, the really interesting thing about the set is its battleship-like physical construction.

The radio is built more like a communications receiver than a broadcast set and, in its heavy-duty steel case (complete with drop-front panel to cover controls and speaker grille), it looks as if it would be more at home in an army barracks than in a living room. As a matter of fact, because this radio appeared immediately after World War II, it seems likely to be a surplus military morale set from a canceled army contract. Not much is known about the Tropicmaster's history or that of its manufacturer, and anyone who can enlighten us is definitely invited to write in!

### FIRST, A BIT OF HOUSEKEEPING

As this month's progress photo shows, the Tropicmaster has temporarily lost its imposing appearance. Cabinet, front panel, speaker, and dial have been removed to facilitate cleaning and restoration. Those of you who have been following the work to date will notice that the oscillator shield can, removed at the beginning of the project for straightening (and assessment of possible damage to the coil inside) has been reinstalled. That was the first thing to be done during this month's session, because I didn't want to risk damaging the unprotected coil as the restoration work proceeded.

Just as its removal had been originally, the re-installation of the cover was an annoying, but not really difficult, project. The can definitely wasn't intended to be removed and re-installed after the coil had been wired into the set. However, there was enough slack in the leads to allow the coil-mounting studs to be manipulated through the matching holes in the can. A small screwdriver was (very gently!) inserted up through the coil form from the underside of the chassis (via the lead "pass-through" hole) to serve as a handle for manipulating the coil.

With coil-mounting washers and nuts reinstalled, the studs on the bottom of the can could now be passed through their holes in the chassis, and their mounting nuts refastened.

The next item to be tackled was the removal of encrusted grime from the top and sides of the chassis. Unfortunately, the chassis will never look new again—that is, unless it is stripped of components and re-plated. There are too many pitted and corroded areas, caused by extended storage in a damp environment. However, a good surface cleaning would definitely result in a fresher appearance.

To do the job, I employed my usual technique—gentle rubbing with a damp rag wet with a small amount of Brasso. The metal cleaner helped to remove some of the surface corrosion along with the dirt, providing a smoother finish. Because it contains very little abrasive, it is not damaging to chassis details such as stencilled-on tube numbers.

However, even with a gentle polish such as Brasso, it doesn't pay to rub too hard. You will inevitably create amateurish-looking "overpolished" areas that don't match the overall look of the finish and—to my eye—are more unsightly than the original grime.

I wish I could have done an equally good job of cleaning the bottom of the chassis, which is not as dirty as the top was, but has its share of dust and powdery

mold. It would have been nice to swish the whole thing around in warm detergent, followed up by a rinse and gentle oven-dry (a technique often used on certain commercial electronic equipment).

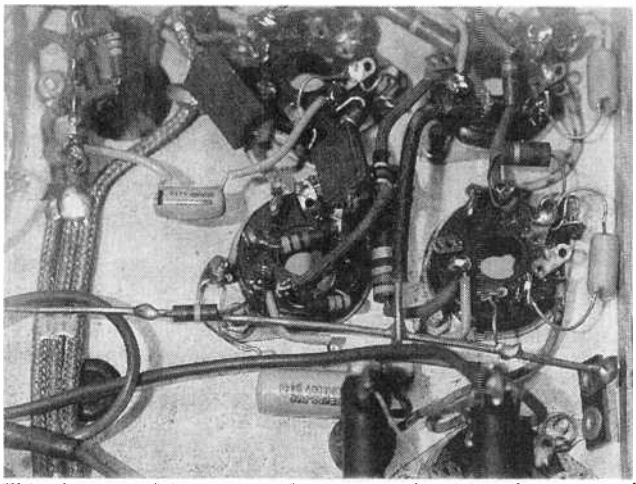
However, the fiber coil forms used in the set's front-end and IF circuits would probably be destroyed by that treatment. So I'll have to content myself with gentle brushing of the wiring and components, followed up with a "blow-out" using the pressure side of a vacuum cleaner. I'll do that some time after replacing the paper and electrolytic capacitors—which have most of the mold deposits.

## RECAPPING: OVERKILL OR NECESSITY?

My attitude on wholesale re-capping has changed considerably since the "Sky Buddy" project, which was the last receiver restoration described in these pages. First of all, I've always been conservative about removal of authentic old components. Second, it seemed to spoil the challenge of troubleshooting to replace—at the outset—most of the parts likely to cause problems. I felt it was more sporting to pin-point trouble by shrewd analysis of data obtained from measurements and/or signal tracing.

I've also been pretty lucky in the past. Sets that I've repaired have remained stable, even though I'd replaced only the specific components that had failed. However, I've done enough reading, now, about the experiences of others to take the advice of the old timers in this business a bit more seriously.

The paper capacitors of the 1930's, '40's, and part of the '50's (generally, until molded plastic cases had replaced the old wax-coated plastic ones) absorb appreciable dampness from the atmosphere over the years. Eventually, the insulating ability of the paper dielectric becomes compromised and the capacitors will leak or short out—perhaps taking with them components that are much more difficult to replace, such as audio or IF transformers.



*This close-up of the audio and power-supply wiring shows several of the new caps (they appear as small, light-gray cylinders).*

Electrolytic capacitors never were intended to be a permanent part of a radio, of course. Most dried out and failed at least once during the time the radio was originally in service.

I don't plan to go back, now, and recap all of the sets I happen to own. But I believe I would completely recap any set that I plan to use regularly—and I certainly plan to completely recap any set that is the subject of a restoration such as the current one.

## RECAPPING THE TROPICMASTER

With that in mind, I ordered a couple of fresh electrolytics and a complete set of Sprague "Orange-Drop" capacitors in the sizes and quantities of the paper capacitors listed on the Tropicmaster's parts list. When they came, I was glad that a previous **Popular Electronics** restoration project had been a capacitor checker. While the caps were certainly orange and *looked* like the Spragues illustrated in the catalogue I'd bought from, they weren't marked as to make and capacitance (at least not in plain text).

Perhaps the units had been made by Sprague, with proprietary markings for use by another manufacturer. Whatever the reason for the coded markings might have been, I was glad to have the checker so that I could verify that the capacitors I had received were the sizes I had ordered. It would have been quite appropriate for the supplier to have included a reassuring data sheet verifying that the units were indeed Spragues, and to have provided a code-number vs. capacitance reference list. But, unfortunately, he didn't!

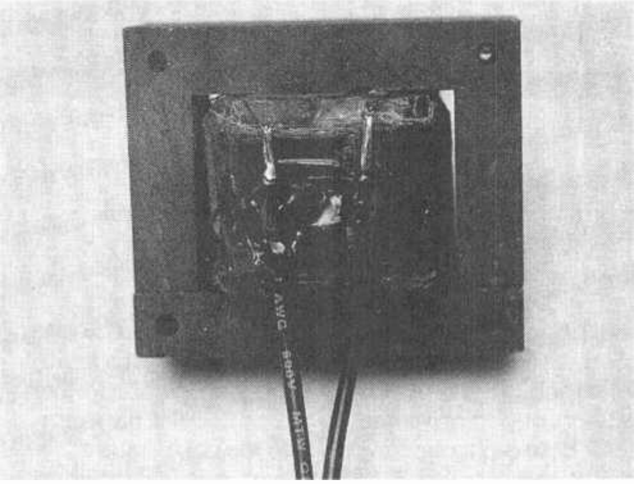
The old capacitors were changed out, one at a time, with the leads of the new units spaghetti-equipped to match the old ones and dressed as much like the old leads as possible. Each of the solder connections involved was separately analyzed to determine the extent to which it should be disturbed.

Solder lugs on RF coils were left untouched; those are usually lightweight and easily broken, and also usually carry fine, easily-broken wires from the coil windings in addition to heavier leads from other components. Capacitor leads from such lugs were clipped, leaving an inch and a half or so of slack. The end of such a lead was formed into a tight spiral by coiling a few turns around a stiff wire. The lead from the new capacitor was inserted into the spiral, which held it in place until it could be soldered.

If the lug was on a tube socket, terminal strip, or other more substantial component, and if the lug wasn't jammed full with too many leads, a majority of the solder was removed using desoldering braid and a hot iron. If the lead from the capacitor could then be separately uncrimped and removed from the lug, that was done. Otherwise it was clipped close to the lug.

In either case, a hole for the entry of the new lead was made by poking a stiff wire into the lug's "lead space" while keeping the lug hot with the soldering iron. Once the hole was established, it was kept from filling in by removing the soldering iron and moving the wire back and forth until the solder had cooled down.

Sometimes a lug already had an extra hole not filled with solder, making it unnecessary to go through the desoldering exercise. The desoldering-and-hole-making technique was also not attempted on a lug carrying a great many leads. In such cases, the old lead was clipped long and



*The new choke leads are firmly attached to the coil by a glob of epoxy cement (center) so that the solder joints (at the top of the coil) will not break again.*

pigtailed, as previously described, so that a new connection could be made without disturbing the old one.

I've found a "prick punch" from an old drafting kit (it's like a heavy needle with a cylindrical handle and is used to make tiny holes at precise locations on drafting paper) to be an excellent aid for this work. The tool is quite strong and stiff, yet fine enough to be used as a form for pigtailing and for poking holes in solder lugs. It can also be used to get under old leads to "uncrimp" them from their lugs.

## FINISHING UP

After the recapping was completed, progress was made on a couple of other fronts before ending the work session. Temporarily removing the mounting nuts from the volume and tone controls, I pulled those units back as far as their leads would allow so that I could spray in control lubricant/cleaner through the lug openings. After remounting the controls, I worked them back and forth through their ranges of movement several times to get the cleaner/lubricant well worked in. Hopefully, they'll now be noise free. The bandswitch contacts got the same treatment but, being well-exposed, it wasn't necessary to loosen the control to make them accessible.

Having previously located the two ends of the winding of the crudely "repaired" filter choke (see last month's installment of "Antique Radio" for more on that), I was able to solder new lead wires to them. Those new wires were securely attached to the body of the choke with epoxy cement so that they would not tear loose as they had done before. After the cement has thoroughly set, I plan to wrap the core with black masking tape for a neater appearance.

Finally, having noticed that the frame of the tuning capacitor was not attached to the chassis (the only thing holding it in place was the ground strap!), I added some screws, decorative washers, and lock nuts to snug the assembly down against its rubber-grommet shock absorbers.

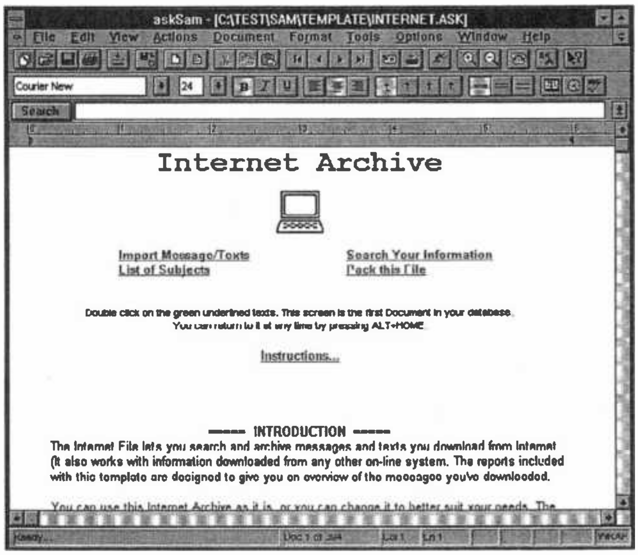
Well, that all for now. We'll be back next month with more news on the restoration of this most interesting set. Goodbye until then! ■

# COMPUTER BITS

## Can't Find It? Just askSam

By Jeff Holtzman

A hard product to categorize, *askSam 2.0* for Windows is a cross between a database manager, a word processor, and a full-text indexing system. It has been around in one form or another since the mid-1980's. Back then it was a DOS-only product with lots of promise. Recently, I took a new look at the Windows version, and I am impressed. I had several potential applications, the most immediate of which was to provide some organization for tons of UseNet and List Serve files I had been downloading from the Internet.




*askSam can help you get a handle on unstructured text information, including downloads from Internet sites.*

Before we continue, let me digress for a moment. In case you're wondering what happened to our discussion of object-oriented technology, I've decided that the book I originally recommended, David Taylor's *Object-Oriented Technology: A Manager's Guide*, does a better job than I could ever hope to do in explaining the basics. If you're new to o-o, buy, beg, or borrow a copy of that book. It'll change your (computing) life. If you're interested in more o-o discussion, or perhaps some talk about o-o tools, e-mail me at jkh@acm.org. If enough people are interested, we'll do more in the magazine. Now, though, let's get back to askSam.

### USING ASKSAM

You can use askSam to build a traditional fielded (but not relational) database, or you can just type or import text at will. What you end up with is a file containing multiple documents. A document in askSam is what most database programs would call a record. You can then perform traditional database sorts and extracts on the documents. You can also search the entire file as if it were just one big text document.

For example, I was able to import megabytes of raw ASCII text files into an askSam database, apply its automatic field recognition tools, and get back a "table of contents" to my information. That's a good first step toward truly managing that conglomeration of stuff. askSam can import not only ASCII text, but also standard word-processing (Word, WordPerfect, etc.) and database files. It can also export information in similar formats. Further, it can be used as a powerful word processor in its own right.

askSam includes extensive capabilities for finding stuff once you get it into a database: Boolean searches, proximity searches, field-level searches, and others. A Boolean search allows you to combine search terms using the logical operators AND, OR, and NOT. For example, you could issue a search that said to find all articles containing the words "computer" and "electronics," but not the word "Macintosh." A proximity search allows you to specify how near the specified terms must be to one another to count as a "hit." A field search allows you to retrieve all documents in which a field contains a specific value (*e.g.*, last name contains Smith). Wildcards are also supported (*e.g.*, find all documents that contain words beginning with "electr"). In addition, search types can be combined, and search criteria can be saved in what askSam calls a Report, and subsequently reused. You can even search across multiple files.

An easy-to-use hyperlinking facility allows both inter- and intra-document cross-referencing, as well as the ability to execute program commands. The document-linking feature works somewhat like that in the Windows Help System. If you double-click on green underlined text, the screen then displays a new document, a new file, or executes a command, such as running or printing a report.

A read-only run-time version of the program is available at (a reasonable) extra cost for distributing askSam databases.

## SOME FINAL THOUGHTS

Installation is easy, and the documentation is fairly good, although incomplete. askSam does not document itself using itself, and there is no full-text search of the WinHelp file. So, for example, there is no direct way to find out how to use wildcards, because the word does not appear in the WinHelp Search index. On the other hand, there is an entry on wildcard searching in the printed index.

As currently implemented, askSam has several gaps and lacks one crucial feature. Gaps include the lack of word-processing-like styles, non-standard windows keyboard usage, and the aforementioned documentation hiccups.

The crucial feature I would love to see implemented is the ability to group documents in related sets, with a drag-and-drop visual interface for moving set members around. What I'm getting at is a hierarchical database in which any given set could have one parent and multiple children. It would be possible to simulate that type of structure using askSam's hyperlinking capabilities, but I'm looking for something that works at a more fundamental level.

Anyway, if you're an Internet surfer, a CompuServe-forum lurker, or for any other reason end up with lots of text files, askSam can be a big help. Likewise if you're looking for a simple-to-use fielded database, and don't want to become an expert in SQL. ■

### FOR MORE INFORMATION

**askSam Systems**
P.O. Box 1428
Perry, FL 32347
Tel. (800) 800-1997, (904) 584-6590

# CIRCUIT CIRCUS

By Charles D. Rakes

## Assorted Circuits

This visit we're going to toss around a number of simple, but useful, circuits. Also included are a couple of circuits to help out our faithful readers.

### IR DETECTOR

Not too long ago, I had a VCR that would not respond to its remote-control unit, but would operate manually. Because I obviously could not see the remote's infrared output, I couldn't tell if the unit was working or not. The circuit shown in Fig. 1 solves that dilemma.

The circuit uses an IR phototransistor, Q1, to detect a remote control's IR output signal. A PNP transistor, Q2, then amplifies Q1's output and lights LED1. That indicates that an infrared signal has been detected by the phototransistor, or in other words, that your remote works.

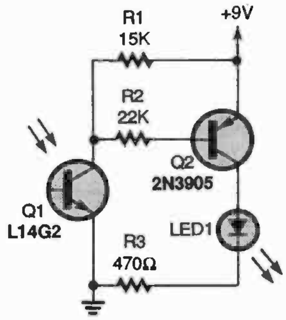



*Fig. 1. Find out if your IR remote control is working with this simple tester.*

### AUDIBLE IR DETECTOR

Another IR-detector circuit is shown in Fig. 2. It offers an audible as well as a visual output, and also stretches the on time of the detected pulse to make the output easier to see.

**PARTS LIST FOR THE IR DETECTOR (Fig. 1)**

**SEMICONDUCTORS**
Q1—L14G2 phototransistor (Mouser 570-L14G2 or equivalent)
Q2—2N3905 PNP transistor
LED1—Light-emitting diode, any color

**RESISTORS**
(All resistors are ¼-watt, 5% units.)
R1—15,000-ohm
R2—22,000-ohm
R3—470-ohm

**ADDITIONAL PARTS AND MATERIALS**
Wire, solder, etc.

Phototransistor Q1 detects a remote's IR output pulse and sends a negative-going pulse to the trigger input (pin 2) of the 555 IC, U1. The 555 is connected in a one-shot timer circuit; the output (pin 3) on time is set by the values of C3, R3, and R5. When an input pulse is detected, pin 3 goes high, lighting LED1 and activating the piezo buzzer, BZ1.

For longer output pulses, set R5 to its maximum resistance value. To lengthen the circuit's on-time range, increase the value of C3, and to shorten the on-time range lower the value of C3.

### TRAFFIC-LIGHT CONTROLLER

John, an electrician friend of mine, came by the other day to show me his newly acquired flea-market bargain, a traffic light, which he wanted to operate with an electronic light-sequencer circuit. Also, John wanted the lights to turn on (and shut off) in the following sequence: Red, yellow, green, yellow, and back to red. The sequence would then have to repeat over and over as long as the sequencer circuit received power.

The circuit shown in Fig. 3 fits the bill perfectly. It uses

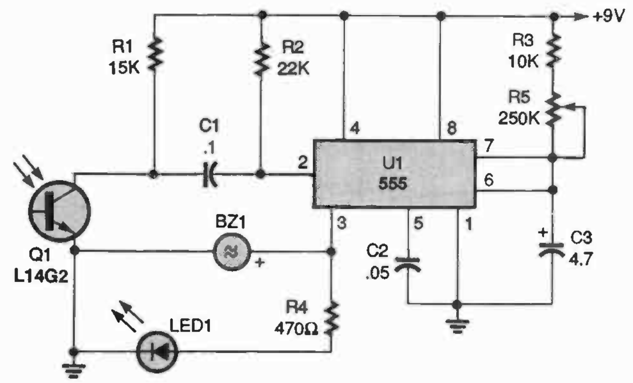



*Fig. 2. With this audible tester, you can see and hear if your remote is transmitting or not.*

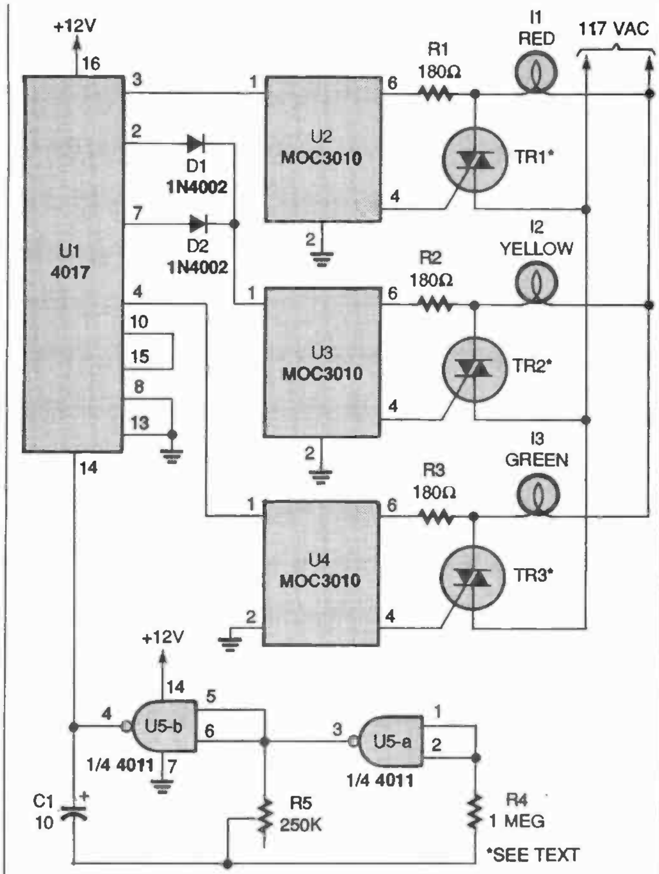



*Fig. 3. Although this traffic light does not follow the standard sequence of lighting, the effect sure looks great on a wall.*

the ever-versatile 4017 divide-by-ten counter IC (U1), which is set here to count to four and repeat over and over as long as clock pulses are present at pin 14. Two gates of a quad 2-input NAND-gate IC (U5) are connected in a low-frequency oscillator circuit that supplies the clock pulses for the counter IC.

The first output of U1 appears at pin 3, which supplies a positive voltage to U2, a MOC 3010 optocoupler/Triac-driver IC, turning it and Triac TR1 on. That lights I1, the red lamp. The second output appears at pin 2 and passes through D1 to the second MOC 3010, U3, thereby lighting the yellow lamp, I2. The third output at pin 4 turns on U4 and the green lamp, I3. The fourth output at pin 7 travels through D2 and into U3 to light the yellow lamp, I2, again.

If you would like the traffic-light system to follow the normal sequence of green, yellow, and red, make the following circuit changes: Disconnect pins 10 and 15 of U1 from each other. Remove D1 and D2 and connect pin 2 of U1 to pin 1 of U3. Then connect pins 7 and pins 15 of U1 together. Use U2 to drive I3 (the green light) and U4 for I1 (the red light).

Our next two circuits go out to a reader named Don, who wrote about a flashing string of neon Christmas lights he built more than 25 years ago. Don noted that he would like something similar, but more modern, that didn't require a high-voltage source to light the neon lamps.

## NEON CHRISTMAS LIGHTS

The circuit shown in Fig. 4 is probably similar to the circuit that Don built many years ago. It's still a fun

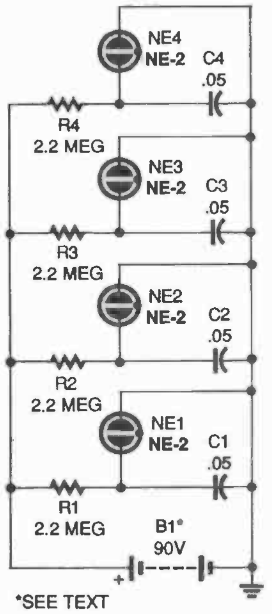



*Fig. 4. This flashing set of neon Christmas lights will make an attractive decoration for any time of year.*

## PARTS LIST FOR THE TRAFFIC-LIGHT CONTROLLER (Fig. 3)

**SEMICONDUCTORS**

U1—4017 divide-by-ten counter, integrated circuit
U2–U4—MOC3010 optocoupler/Triac driver, integrated circuit
U5—4011 quad 2-input NAND gate, integrated circuit
TR1–TR3—6-amp, 400-volt-AC Triac (Radio Shack 276-1000 or equivalent)
D1, D2—1N4002 silicon rectifier diode

**RESISTORS**

(All fixed resistors are ¼-watt, 5% units.)
R1–R3—180-ohm
R4—1-megohm
R5—250,000-ohm potentiometer

**ADDITIONAL PARTS AND MATERIALS**

C1—10-µF, 16-WVDC, electrolytic
I1–I3—120-volt-AC, 60- to 150-watt lamps (red, yellow, and green)
Lamp sockets, traffic light housing, wire, solder, etc.

## PARTS LIST FOR THE AUDIBLE IR DETECTOR (Fig. 2)

**SEMICONDUCTORS**

U1—555 timer, integrated circuit
Q1—L14G2 phototransistor (Mouser 570-L14G2 or equivalent)
LED1—Light-emitting diode, any color

**RESISTORS**

(All fixed resistors are ¼-watt, 5% units.)
R1—15,000-ohm
R2—22,000-ohm
R3—10,000-ohm
R4—470-ohm
R5—250,000-ohm potentiometer

**CAPACITORS**

C1—0.1-µF, ceramic-disc
C2—0.05-µF, ceramic-disc
C3—4.7-µF, 16-WVDC, electrolytic

**ADDITIONAL PARTS AMD MATERIALS**

BZ1—Piezo buzzer
Power source, wire, solder, etc.

## PARTS LIST FOR THE NEON CHRISTMAS LIGHTS (Fig. 4)

R1–R4—2.2-megohm, ¼-watt, 5% resistor
C1–C4—0.05-µF, Mylar capacitor
NE1–NE4—NE-2 neon lamp
B1—90 volts (see text)
Wire, solder, etc.

## PARTS LIST FOR THE SEMICONDUCTOR LIGHTS (Fig. 5)

U1–U4—3909 LED-flasher/oscillator, integrated circuit
LED1–LED4—Light-emitting diode, any color
C1–C4—220-µF, 16-WVDC, electrolytic capacitor
Wire, solder, etc.

circuit to use today because obtaining the high-voltage source for the lamps is not only easy, but cheap as well. Go down to your local discount store and buy ten of the cheapest 9-volt batteries you can find and connect them in series. That 90-volt battery, B1, will keep the four neon bulbs flashing for months on end.

The neon lamps, which are all NE-2 types, will blink on and off several times a second in a random fashion. Increasing the resistor

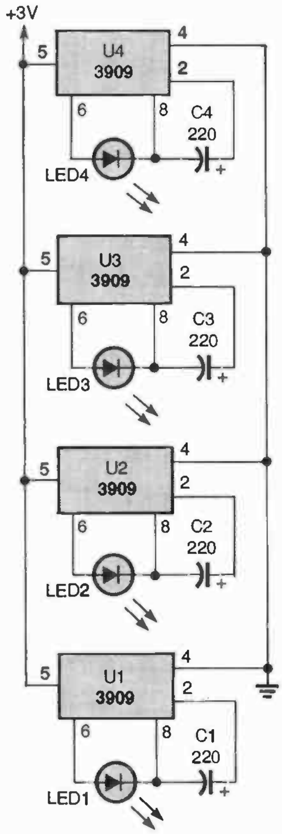



*Fig. 5. Using LED's and 3909 IC's, you can make a flashing-light circuit that runs for months on two AA batteries.*

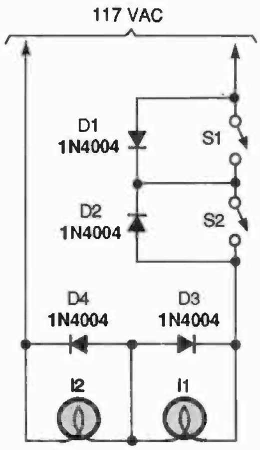



*Fig. 6. Mystify more than a few people with this circuit of illusion. If the diodes are hidden under the components they are connected to, it looks as if a series circuit works with one switch open.*

values will slow down the flash rate and add to the battery life.

### SEMICONDUCTOR LIGHTS

Okay, Don, the circuit in Fig. 5 will answer your request for a more modern version. That circuit uses four 3909 LED-flasher/oscillator IC's to drive four LED's instead of neon lamps. The circuit randomly flashes the four LED's and only requires a 3-volt power source. It will operate for several months on two AA batteries.

If you would like larger and brighter flashing lamps, you might consider combining part of the circuitry in Fig. 3 with this circuit. The LED's in Fig. 5 can be removed and the 3909's connected to pins 1 and 2 of the MOC 3010 IC to drive 120-volt AC lamps. Now that would be bright!

## PARTS LIST FOR THE CIRCUIT OF ILLUSION (Fig. 6)

D1–D4—1N4004 silicon rectifier diode
S1, S2—SPST knife switch
I1, I2—120-volt-AC, 60- to 100-watt lamp
Wire, solder, etc.

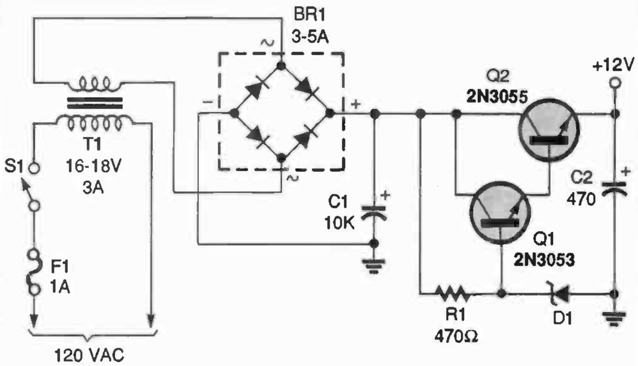



*Fig. 7. Here's a 12-volt power supply that is easy-to-build while producing a smooth output.*

## PARTS LIST FOR THE 12-VOLT POWER SUPPLY (Fig. 7)

**SEMICONDUCTORS**
Q1—2N3053 NPN transistor
Q2—2N3055 NPN transistor
BR1—3- to 5-amp, full-wave bridge rectifier
D1—14-volt, ½-watt, Zener diode

**ADDITIONAL PARTS AND MATERIALS**
R1—470-ohm, ¼-watt, 5% resistor
C1—10,000-µF, 35-WVDC, electrolytic capacitor
C2—470-µF, 35-WVDC, electrolytic capacitor
T1—16- to 18-volt-AC, 3- to 5-amp transformer
S1—SPST switch
F1—1-amp fuse
Fuse holder, aluminum heat-sink material, wire, solder, etc.

### CIRCUIT OF ILLUSION

Our next entry is in response to a display a friend remembered seeing many years ago where two knife switches and two AC lamps were displayed on a board with the components all wired in series. By closing either of the switches, one of the lamps would light even with the other switch open. How did the lamp light with one switch open and one closed? That was

(Continued on page 86)

# ELECTRONICS MARKET PLACE

## FOR SALE

**CABLE test chips. Jerrold, Tocom, S.A., Zenith. Puts cable boxes into full service mode! $29.95 to $59.95. 1 (800) 452-7090, (310) 902-0841.**

**CABLE test chips.** Put your cable box in full test mode. Call (303) 731-9400.

**DESCRAMBLE** cable with simple circuit added to Radio Shack RF modulator and using VCR as tuner. Instructions $10.00. **TELCOM,** PO Box 832-P6, Brusly, LA 70719.

**VCR** repair illustrated. 4 hour video $19.95, $3.00 shipping. **DAVID'S ELECTRONICS,** 546 Gainesville, Memphis, TN 38109.

**SURVEILLANCE** privacy security protection. Catalog $5.00. **SPY EMPORIUM,** 6065 Hillcroft 414, Houston, TX 77081. (713) 774-1000.

### CLASSIFIED AD ORDER FORM

**To run your own classified ad, put one word on each of the lines below and send this form along with your check to:**

**Popular Electronics Classified Ads,** 500-B Bi-County Boulevard, Farmingdale, N.Y. 11735

**PLEASE INDICATE** in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of **$11.00.**

( ) Plans/Kits ( ) Business Opportunities ( ) For Sale
( ) Education/Instruction ( ) Wanted ( ) Satellite Television
( ) ____________________

Special Category: $11.00

**PLEASE PRINT EACH WORD SEPARATELY, IN BLOCK LETTERS.**
(No refunds or credits for typesetting errors can be made unless you clearly print or type your copy.) Rates indicated are for standard style classified ads only. See below for additional charges for special ads. **Minimum: 15 words.**

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 ($23.25) |
| 16 ($24.80) | 17 ($26.35) | 18 ($27.90) | 19 ($29.45) | 20 ($31.00) |
| 21 ($32.55) | 22 ($34.10) | 23 ($35.65) | 24 ($37.20) | 25 ($38.75) |
| 26 ($40.30) | 27 ($41.85) | 28 ($43.40) | 29 ($44.95) | 30 ($46.50) |
| 31 ($48.05) | 32 ($49.60) | 33 ($51.15) | 34 ($52.70) | 35 ($54.25) |

We accept MasterCard and Visa for payment of orders. If you wish to use your credit card to pay for your ad fill in the following additional information (Sorry, no telephone orders can be accepted.):

Card Number ____________________ Expiration Date ____________

PRINT NAME ____________________ / SIGNATURE ____________________

**IF YOU USE A BOX NUMBER YOU MUST INCLUDE YOUR PERMANENT ADDRESS AND PHONE NUMBER FOR OUR FILES. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.**
**CLASSIFIED COMMERCIAL RATE:** (for firms or individuals offering commercial products or services) $1.55 per word prepaid (no charge for ZIP code)...**MINIMUM 15 WORDS.** 5% discount for same ad in 6 issues within one year; 10% discount for 12 issues within one year if prepaid. **NON-COMMERCIAL RATE:** (for individuals who want to buy or sell a personal item) $1.25 per word, prepaid....no minimum. **ONLY FIRST WORD AND NAME** set in bold caps at no extra charge. Additional bold face (not available as all caps) 30¢ **per word additional.** Entire ad in boldface, $1.85 per word. **TINT SCREEN BEHIND ENTIRE AD:** $1.90 per word. **TINT SCREEN BEHIND ENTIRE AD PLUS ALL BOLD FACE AD:** $2.25 per word. **EXPANDED TYPE AD: $2.05 per word prepaid.** Entire ad in boldface, $2.45 per word. **TINT SCREEN BEHIND ENTIRE EXPANDED TYPE AD:** $2.55 per word. **TINT SCREEN BEHIND ENTIRE EXPANDED TYPE AD PLUS ALL BOLD FACE AD:** $2.95 per word. **DISPLAY ADS:** 1" × 2⅛"—$225.00; 2" × 2⅛—$450.00; 3" × 2⅛"—$675.00. **General Information:** Frequency rates and prepayment discounts are available. **ALL COPY SUBJECT TO PUBLISHERS APPROVAL. ADVERTISEMENTS USING P.O. BOX ADDRESS WILL NOT BE ACCEPTED UNTIL ADVERTISER SUPPLIES PUBLISHER WITH PERMANENT ADDRESS AND PHONE NUMBER. Copy to be in our hands on the 13th of the fourth month preceding the date of issue (i.e.; Sept. issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure. Circle Number 49 on the Free Information Card.**

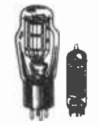
**FREE ★ 1995 CATALOG ★ FREE**
**OF THE WORLD'S MOST FAMOUS CB ANTENNAS & ACCESSORIES**
**— FIRESTIK CB ANTENNAS —**
2614 E. Adams · Phoenix, AZ 85034
Write or Call, 602-273-7151

**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. (602) 428-4073. Visa/MC.

**T.V.** notch filters, free brochure, **MICROTHINC,** Box 63/6025, Margate, FL 33063. (305) 752-9202.

**SECRET cable descramblers!** Build your own descrambler for **less** than $12.00 in **seven easy steps! Radio Shack** parts list and **free** descrambling methods that **cost nothing** to try, included. Send $10.00 to: **INFORMATION FACTORY,** Dept. 5, PO Box 669, Seabrook, TX 77586. For COD's (713) 922-3512 any time.

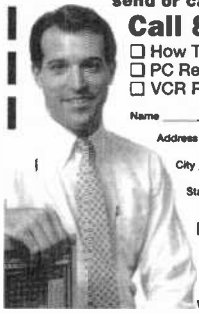
**"LOW** Frequency Radio & Lightning Detector Projects: Second Edition." Build lightning detectors! Broadcast on 160 KHz-190 KHz with one watt! VLF radio! Talk on ultrasound! Much more! 106 pages, 11 photographs! Published by McCallie Mfg. Corp. Send $18.95 + $3.50 S/H to: **McCALLIE MFG. CORP.,** Department 3, PO Box 77, Brownsboro, AL 35741-0077. Phone: (205) 776-2633. No foreign orders: For sale only to residents of USA or Canada.



**RECEIVING TUBES**
***OVER 3000 TYPES IN STOCK!***
Also hard-to-find transformers, capacitors and parts for tube equipment.
*Send $2.00 for our 36 page catalog.*
**ANTIQUE ELECTRONIC SUPPLY**
6221 S. Maple Ave.•Tempe, AZ 85283•602-820-5411

**Train at home for great careers!**

Check *only one* home study course below. Find out how you can train at home to start a better career—and make more money! Accredited nationwide. **Free career literature: send or call 24 hours a day.**



**Call 800-223-4542**

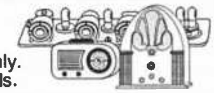
❑ How To Use A Computer
❑ PC Repair ❑ Home Inspection
❑ VCR Repair ❑ Electrician

Name ____________ Age ____
Address ____________
City ____________
State ______ Zip ______

**Professional Career Development Institute**
6065 Roswell Road
Dept. XXG341
Atlanta, Georgia 30328

## ANTIQUE RADIO CLASSIFIED

**Free Sample!**



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

**6-Month Trial: $17.95. 1-Yr: $34.95 ($51.95-1st Class).**
**A.R.C., P.O. Box 802-L14, Carlisle, MA 01741**
Phone:(508) 371-0512 VISA/MC Fax:(508) 371-7129

**CABLE T.V. Installers Manual.** Single dual cable systems. Telephone poles, houses, apartments, explained! Send $14.95 to **INFOTEK,** PO Box 71072, Milwaukee, WI 53211.

**300 Experimenters Circuits** — Complete in 6 practical books using diodes, relays, FET's, LED's, IC 555's, and IC CA3130's for building blocks. Only $33.00 plus $5.50 for shipping. USA and Canada only. US funds. **ETT, INC.,** PO Box 240, Massapequa Park, NY 11762-0240.

**PARTS for $1.00.** Resistors .25W 12, .5W 8. Capacitors .001uF 5, .01uF 5, .1uF 4, 1uF 3, 10uF 2, 100uF 1. Semiconductors 1N4004 4, 2N2222 1, 2N3904 2, 2N3906 2, TIP31A 1, TIP32A 1, LM741 1, LM555 1, LEDS red 3, green 2. Catalog $1.00, foreign add $1.00. **ZIPFAST,** Box 12238, Lexington, KY 40581-2238.

**HOME** automation & computer control: Two-way IR, two-way X-10, & hardwire. Control devices from serial computer link or stand-alone operation. **COMPCO,** (615) 436-5189 BBS, (615) 436-6333 evenings.

**CABLE** descramblers. Bargain headquarters, below wholesale prices. Absolutely the lowest prices! Money-back guarantee. Nobody beats us! **RP ELECTRONICS,** 1 (800) 304-3604.

**CABLE** converters, descramblers. Lowest prices available. 2 year warranty, money back guarantee. Visa/MC/C.O.D. 1 (800) 848-3049 **C&C SUPPLY.**

**CABLE descramblers** and test turn-on kits available for most makes and models. No catalog, no 800 number equals your lowest prices. Call others, then compare our prices! We pay cash for unwanted cable boxes. No Florida sales. (305) 425-0751.

## INVENTIONS

**FREE Invention package: DAVISON & ASSOCIATES** offers customized development, patenting, and licensing for new products and ideas. Proven results: 1 (800) 677-6382.

## BEST BY MAIL

**Rates: Write National, Box 5, Sarasota, FL 34230**

### EDUCATION

**HIGH SCHOOL DIPLOMA** Private School, Fast, Credit For Experience. 1-800-470-4723.

### FINANCIAL

**GUARANTEED LOANS WITHIN** two weeks! No income, credit checks! PLUS! $1,000 credit card! GUARANTEED APPROVAL! Limit increased $300.00 annually! Reports, PRE-APPROVED applications, $5.00. NEWSOM, 3352 Broadway, Garland, TX 75043.

**STAY HOME MAKE $145.00 DAILY** Processing Mail For Local Company In Your Area! Work Dropped Off! Paid Daily. Call Processing 1-313-458-6161 Ext.64.

**$1,000s POSSIBLE MONTHLY WRITE: MailOrder Express,** 80550, Memphis, TN 38108.

### OF INTEREST TO ALL

**LASER SAFETY LIGHT has 2,500 feet of visibility for biking,** camping, horseback riding, jogging, roller-blading or tending to auto emergencies. Send $17.45 to: BEACO Inc., P O Box 1168-(EEH), Glenside, PA 19038. MUST SEE TO BELIEVE!

**MEXICO TRADE DIRECTORY** $15.00 Postpaid. Box 661, Dallas, GA 30132.

**RECYCLE PERSONAL COPIERS Cartridges. Instructions** $14.95. Charles Bruns, Box 543, Applegate, CA 95703.

**PROFESSIONAL SECURITY SYSTEMS.** Free catalog. Security, PO Box 2933, West Monroe, LA 71294.

**ORDAINED MINISTER, $10.00** Registry Fee: The One True Church, 461 Uvalde #208, Houston, TX 77015.

**WHOLESALE SUPPLEMENTS FREE** Membership Ask For FREE Infopacket #56021. 1-800-423-8365.

## PROGRAMMABLE LOGIC

**LOW**-cost FPGA training kit teaches you FPGA design for only $165.95. Includes textbook, programming software, experimenter's board, and reuseable 3500-gate FPGA chip. Money-back guarantee. Contact **XESS CORP:** 1 (800) 549-9377 or devb@ vnet.net.

## EDUCATION/INSTRUCTION

**FCC** General Radiotelephone Operator's license. Answers, solutions to latest 889 for elements 1,3 examinations. Prepared by professional engineer. To receive this publication, send $20.00 to **UNIVERSAL COMMUNICATIONS,** PO Box 11646, Palm Desert, CA 92255-1646.

**ELECTRICITY**/Electronics training series used by U.S. military. 24 volumes, other courses available. Free catalog. **FEDERAL TECNICAL PUBLISHERS,** Box 1218 E Glen Lake, MN 55345.

## BUSINESS OPPORTUNITIES

**EASY** work! Excellent pay! Assemble products at home. Call toll free 1 (800) 467-5566 ext. 5730.

**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. (602) 428-4073. Visa/MC.

**GET paid $268.20** per roll taking easy snapshots! No experience. Film supplied. **PHOTOTEK,** Box 2457, Dept. 2, Pinecove, CA 92549. Recorded information: (909) 659-9757 ext. 8.

**COMPUTERS Electronics.** We can your idea into a business using new technologies. Free startup kit. **VIRTUAL,** Box 55063, Santa Clarita, CA 91385.

## PLANS & KITS

**60 Solderless Breadboard Projects** in two easy-to-read pocket books. Complete with circuit descriptions, schematics, parts layouts, component listings, etc. Both books (BP107 & BP113) only $11.90 plus $3.50 for shipping. USA and Canada only. US funds. **ETT, INC.,** PO Box 240, Massapequa Park, NY 11762-0240.

**SURVEILLANCE**/countersurveillance, bugging/phone tapping detector, telephone/fax encryption, vehicle tracking, covert video, transmitter kit, and more...**A.B. ELECTRONICS,** 1 (800) U-ANTI-BUG.

**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 $3.50 for shipping and handling. **CLAGGK INC.,** PO Box 4099, Farmingdale, NY 11735. US funds only! USA and Canada — no foreign orders.

**FIBER optics experimenters parts, supplies and tools:** Fiber, cable, connectors, splices, detectors, lasers, kits, plans, newsletter. Send $2.00 for catalog. **LIGHTLINE ENGINEERING,** PO Box 24, Mullica Hill, NJ 08062.

**MINIATURE** transmitters! Low to high power! Voice changers! Many applications! Catalog: $2.00 **PARSEC ELECTRONICS,** PO Box 34594, Phoenix, AZ 85067.

## NEW DESCRAMBLER TECHNOLOGY REVEALED

**REVEALED** Halcyon's new universal 4000 descrambler! My manuals/kits perfects all universal descramblers guaranteed. **SNOW,** POB 22048, Lansdowne, St. John, Canada E2K 4T7.

# BUY BONDS

## TIPS FOR MAIL ORDER PURCHASE

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

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

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

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

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

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

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

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

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

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

**Be sure to include copies of all correspondence.**

# DX LISTENING

By Don Jensen

## The End of an Era

"The control room is dark, transmitters are silenced, it is as quiet as a tomb." With those words, Fred Haney, station manager of the Voice of America's Bethany relay station in Ohio, described the shutdown of the venerable worldwide transmitting facility. "After over 50 years of continuous international broadcasting, Bethany relay station no longer exists. We pulled the 'big switch' at 1800 UTC on Nov. 14, 1994."

**BETHANY RELAY STATION**
**VOICE OF AMERICA**
**September 23, 1944**
**November 14, 1994**

*This is the QSL card issued for receptions on the last day of operation by the Voice of America's Bethany transmitter site in Ohio, marking a half century of airing VOA programs to the world.*

The U.S. government concluded that the transmitting facility near Mason, OH, was no longer needed. The decision was part of a $400 million, four-year plan to consolidate VOA broadcasting. The VOA continues to operate from Stateside facilities at Greenville, NC, and Delano, CA, and a number of overseas relay sites.

The station's plant supervisor, David Snyder, in his shutdown report, noted that broadcasting began in the area in the early 1920's, with Crosley Radio stations WSAI and WLW. "The oldtimers tell of the Crosley engineers driving around the Cincinnati area with a receiver," Snyder recounts, "looking for a spot with the best radio reception."

Those radio pioneers had concluded that a "hot" spot for reception also would be best as a transmitter site. Both Cincinnati's WLW medium-wave transmitter and two shortwave outlets were located there.

Even before Pearl Harbor, Crosley engineers were operating a 75-kilowatt SW transmitter, WLWO, then the most powerful in the nation. The U.S., at the start of the war, had only 14 shortwave transmitters, compared to some 68 under Nazi control and 42 operated by the Japanese. "In a drastic effort to remedy this situation," Snyder said, "the Board of War Communications called a conference in Washington, DC . . . at which plans were made for . . . the design and construction of six 200-kilowatt transmitters."

The job of designing, manufacturing, and installing those units was given to the Crosley Corp. It was a tremendous undertaking, because there were no vacuum tubes, no output circuits, and no antennas in existence that were capable of such power. But by Sept. 23, 1944, three of the new 200-kW units were operating at the Bethany site, beaming VOA programming around the world.

By the early 1960's, the transmitting facility had been taken over from Crosley by the U.S. government. There were two major modernizations, one in the mid-60's, the other in 1989. When broadcasting ceased last November, there were six 250-kW transmitters on the 625-acre Ohio broadcasting site. Signals went out from 22 directional antennas. Those antennas, and the connecting transmission lines, were supported by 300-foot steel towers and more than a thousand wooden poles, ranging in height to 150 feet.

On the last day of transmission, the station's staff, most of whom lost their VOA jobs, gathered in the control room for a short ceremony and prayer. Then the assembled staffers sang the National Anthem, Haney said.

The Bethany station now is surplus government property. Some local radio enthusiasts would like to see at least part of the now-silent VOA site used as a museum in honor of its half century of serving as America's "Voice" to the world.

"What a haunting experience," Haney said after the shutdown, "to walk around here without those sounds that excited us with a sense of mission, the babble of languages launched around the world that sowed seeds of liberty, freedom, democracy, and hope in countless minds. Bethany made a difference that still remains as history's witness. Hopefully this national resource will not be forgotten."

### ALFRESCO DX'ING

Doing your shortwave listening in the great outdoors can be fascinating and fun, especially now that we're getting into the warmer summer months. SWL's commonly refer to those outings as DXpeditions. They usually are held at some semi-remote rural location far from the electrically "noisy" urban sites where many of us city dwellers usually listen.

For a firsthand report, I recently talked with veteran listener Rich D'Angelo of Wyomissing, PA, who had just returned from a long weekend SWL outing at Gifford Pinchot State Park in eastern Pennsylvania. Rich, together with a group of SWL'ing buddies, have taken their receivers and other listening gear to this site on some 11 or 12 of those weekend retreats during the past several years.

I posed some questions and Rich replied:

What makes a shortwave DXpedition enjoyable?

"It offers a chance to get away for a period of concentrated shortwave listening, probably more solid DX'ing time than most of us can find time for during the usual weekend at home. Also, a DXpedition to an electrically 'quiet' area usually means less static and electrical noise to interfere with SW reception. These getaways give us a chance to share listening opportunities. Sometimes one of our group will stumble upon some exciting new DX catch. He tells the rest what he's hearing, giving us a chance to make a rare logging, too. Multiple sets of ears, listening to the SW bands simultaneously, can cover more of the radio spectrum in a given amount of time than can just a single pair. DXpeditions are fun, too, because we socialize and have a lot of fun with other people who share our crazy hobby."

What sort of locations should one look for when planning a shortwave DXpedition?

"Ideally, it should be a place that has less electrical noise than you usually experience at home. Otherwise, why bother? You'd like to hear stations that are difficult to log back home in the city. Your DXpedition site also should have enough room for stringing long antennas. Unless you plan to operate your equipment on batteries, a reliable source of AC power is important. We look for comfort, too, such as a comfortable cabin. Yes, the adventuresome types may choose to pitch a tent on a mountaintop, but that's not for us."

Next month, Rich will continue, detailing how to plan and prepare for an SWL'ing expedition. And if you're heading out on your own DXpedition this summer, why not drop a line and tell us about your experiences.

## DECALCOMANIA?

Do you like to collect radio-station decals, pennants, and other promotional items. What about "aircheck" recordings of AM/FM stations around the country or SW signals from around the world?

There's a club for people like you. It's called DecalcoMania and it's open to anyone in the world who is interested in collecting this sort of radio ephemera. For more information on this hobby club, founded in 1987, drop a line to DecalcoMania's publicity chairman, Paul Richards, P.O. Box 126-PE, Lincroft, NJ 07738. Include a stamped, self-addressed envelope for a reply.

*CREDITS: Walter Fair, TX; Harold Frodge, MI; Pete Grenier, NV; Scott Jerris, WV; Rufus Jordan, PA; Bob Montgomery, PA; Ed Newberry, NE; Ed Rausch, NJ; Doug Robertson, CA; Giovanna Serra, Italy; North American SW Association, 45 Wildflower Rd., Levittown, PA 19057

## DOWN THE DIAL

Here are some SW stations being logged these days. What are you hearing? Let me know? The address of this monthly column is "DX LISTENING," **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735.

**DOMINICAN REPUBLIC**—6,235 kHz. *Radio Quisqueya* is a Spanish-language station noted around 2300 UTC with up-tempo Latin music and identifications announcements.

**FINLAND**—15,400 kHz. *Radio Finland* has been heard at 1330 UTC with an English news broadcast and ID.

**MOLDOVA**—9,620 kHz. *Radio Dniester International* has been reported broadcasting in English at 2130 UTC from this corner of the former USSR.

**PAKISTAN**—15,625 kHz. *Radio Pakistan* was logged on this frequency at 1100 UTC with international news, then cricket scores and other sports news in English. After station announcements, it continued with an English news report at slow dictation speed.

**RUSSIA**—5,930 kHz. *Murmansk Radio* programming is mostly in Russian, but there are occasional English ID's during the 1500- to 1530-UTC time slot.

**SOUTH AFRICA**—4,810 kHz. *Radio 2000* broadcasts during our evening hours, around 0230 to 0400 UTC, with easy-listening music, some news and sports, mostly in the Dutch-like Afrikaans language, but also some English. ■

# HAM RADIO

By Joseph J. Carr, K4IPV

## NE-602 Oscillator Circuits

This month we'll wrap-up our three-part discussion of the NE-602 single-chip receiver "front-end" by looking at local-oscillator (LO) circuits. Those circuits are used in both superheterodyne and direct-conversion receivers. In the superhet, the LO is either higher or lower than the desired RF by the amount equal to the IF frequency. For example, for a 455-kHz receiver tuning 7.0 to 7.3 MHz, the LO must be either 6,545 to 6,845 kHz, or 7,455 to 7,755 kHz. In direct-conversion receivers, the LO tunes to either the same frequency as the desired RF (SSB or AM), or 500 to 1000 Hz higher or lower (CW).

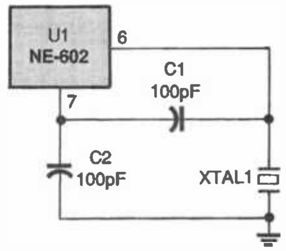



*Fig. 1. This basic Colpitts crystal oscillator will work with fundamental-mode crystals up to 20-MHz.*

### LOCAL-OSCILLATOR CIRCUITS

There are two general methods for controlling the frequency of the LO in any oscillator circuit: inductor-capacitor (LC) resonant tank circuits or piezoelectric crystal resonators. We will consider both forms, but first let's cover crystal oscillators. Incidentally, a more in-depth treatment of crystal-oscillator circuits in general can be found in my article "All About Crystal-Oscillator Circuits" that appears elsewhere in this issue.

Figure 1 shows the basic Colpitts crystal oscillator. It will operate with fundamental-mode crystals on frequencies up to about 20 MHz. The feedback network consists of a capacitor voltage divider (C1/C2). The values of those capacitors are critical, and should be approximately:

$$C1 = 100\sqrt{f_{MHZ}}\ \text{pF}$$
$$C2 = 1000\sqrt{f_{MHZ}}\ \text{pF}$$

The values predicted by those equations are approximate, but work well under circumstances where external stray capacitance is small relative to the total. However, the practical truth is that capacitors come in standard values and those might not be exactly the values found using the equations. In those cases, use the next-higher standard value.

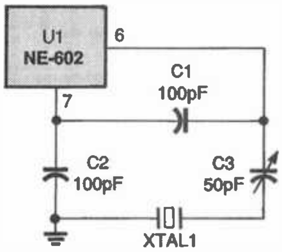



*Fig. 2. Here, a variable capacitor is added to the circuit of Fig. 1 to make it easier to obtain the desired frequency.*

When the capacitor values are correct, the oscillation will be consistent. If you pull the crystal out, and then reinsert it, the oscillation will restart immediately. Alternatively, if the power is turned off and then back on again, the oscillator will always restart. If the capacitor values are incorrect, however, the oscillator will either fail to run at all, or will operate intermittently. Generally, increasing the capacitances will make operation consistent, hence the recommendation above.

A problem with the circuit of Fig. 1 is that the crystal frequency is not controllable. The actual operating frequency of any crystal depends, in part, on the circuit capacitance seen by the crystal. The calibrated frequency is typically valid when the load capacitance is 20 or 32 pF, although you can specify a different load capacity to the crystal manufacturer at the time of ordering.

The shortcoming of the previous circuit is overcome in the circuit of Fig. 2. In that circuit, a variable capacitor is placed in series with the crystal in order to set the frequency. That trimmer capacitor can be adjusted to set the oscillation frequency to the desired frequency.

The two previous crystal oscillators operate in the fundamental mode of crystal oscillation. The resonant frequency in the fundamental mode is set by the

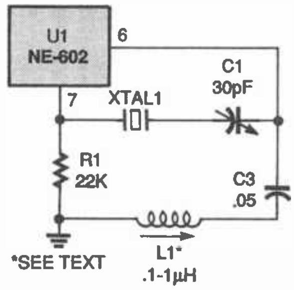



*Fig. 3. For higher frequencies, use an overtone crystal oscillator like the one shown here.*

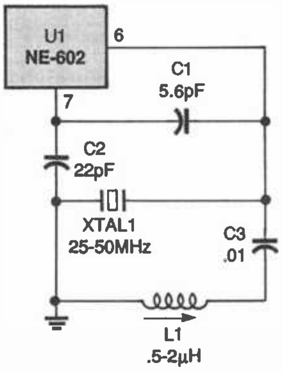



*Fig. 4. This overtone crystal oscillator uses third-overtone crystals and will work from 25 to 50 MHz.*

dimensions of the slab of quartz used for the crystal; the thinner the slab, the higher the frequency. Fundamental-mode crystals work reliably up to about 20 MHz, but above 20 MHz the slabs become too thin for safe operation; that is, they fracture easily at those higher frequencies. An alternative is to use overtone-mode crystals. The overtone frequency of a crystal is not necessarily an exact harmonic of the fundamental mode, but is close to it. The overtones tend to be close to odd-integer multiples of the fundamental (3rd, 5th, 7th). Overtone crystals are marked with the appropriate overtone frequency, rather than the fundamental.

Figures 3 and 4 are over-

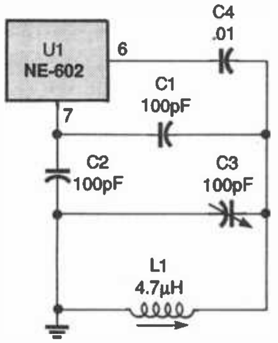



*Fig. 5. In this Colpitts variable-frequency oscillator (VFO) an inductor/capacitor combination is used to set the frequency.*

tone-mode crystal-oscillator circuits. The circuit in Fig. 3 is a Butler oscillator. The overtone crystal is connected between the oscillator emitter of the NE-602 (pin 7) and a capacitive voltage divider that is connected between the oscillator base (pin 6) and ground. There is also an inductor in the circuit (L1), and that inductor must resonate with C1 to the overtone frequency of crystal XTAL1. The circuit can use either 3rd- or 5th-overtone crystals up to about 80 MHz. The circuit in Fig. 4 is a third-overtone crystal oscillator that works from 25 to about 50 MHz

A pair of variable-frequency-oscillator (VFO) circuits are shown in Figs. 5

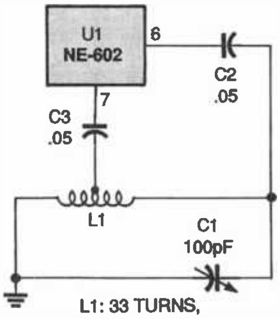



*Fig. 6. In this Hartley VFO, feedback is provided via a tap on the inductor.*

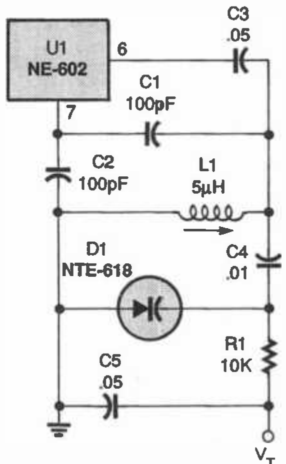



*Fig. 7. You can use a varactor diode (D1) to tune a VFO circuit electronically. This figure shows a parallel-resonant, voltage-tuned Colpitts oscillator.*

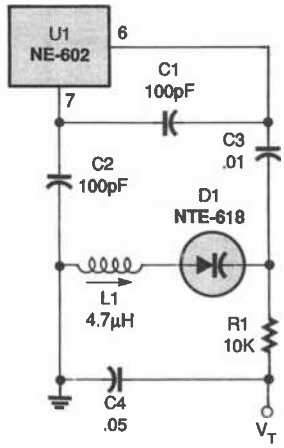



*Fig. 8. Here is a series-resonant, voltage-tuned Clapp oscillator circuit.*

and 6. The circuit in Fig. 5 is a Colpitts oscillator, while Fig. 6 shows a Hartley oscillator. In both oscillators, the resonating element is an inductor/capacitor-(LC) tuned resonant circuit. In Fig. 5, however, the feedback network is a tapped, capacitor voltage divider, while in Fig. 6 it is a tap on the resonating inductor. In both cases, a DC blocking capacitor at pin 6 is needed in order to prevent the oscillator from being DC-grounded through the resistance of the inductor.

## VOLTAGE-TUNED OSCILLATORS

Figures 7 and 8 show a pair of VFO circuits in which the capacitor element of the tuned circuit is a voltage-tuned variable-capacitance diode, or varactor (D1). Those diodes have a junction capacitance that is a function of the reverse bias voltage applied across the diode. Therefore, the oscillating frequency of those circuits is a function of tuning-voltage $V_T$. The circuit in Fig. 7 is a parallel-resonant Colpitts oscillator, while that in Fig. 8 is a series-resonant Clapp oscillator.

That concludes our coverage of the NE-602. We hope you've found our discussions useful. ■

# SCANNER SCENE

By Marc Saxon

## Fast-Food Frequencies

Radio Shack's new *PRO-62* handheld scanner is upon us just in time for summer activities. It's a piece of gear with 200 memory channels that pulls in a wide range of frequencies.

Look for the PRO-62 to cover 30–54 MHz, 137–174 MHz, 380–512 MHz, and 806–960 MHz, as well as the 118–136-MHz aeronautics band. As with all new scanners covering 800–900 MHz, there's no coverage of the cellular bands. They were locked out during the manufacturing process and are now almost certainly beyond retrieval (due to recently implemented FCC regulations).

*Radio Shack's PRO-62 handheld scanner offers 200 memory channels and covers a wide range of frequencies.*

The PRO-62 is set up with ten 20-channel memory bands. It also offers a bonus of 10 separate, additional monitor channels in a special bank designed to store new frequencies found while in search mode. The unit scans at 25 channels per second, but will search at a jaunty 50 channels per second. It can receive AM and NFM signals.

Inside, it's triple conversion, which makes the PRO-62 extremely resistant to interference. The IF frequencies are 455 kHz, 21.4 MHz, and 257.5 MHz. Spurious rejection (FM at 154 MHz) is 40 dB. Selectivity is rated at −6 dB at ±10 kHz and −50 dB at ±20 kHz. FM sensitivity, −20 dB (S+N)/N at 3 kHz deviation, is 1.0μV to 512 MHz, then 2.0μV above 806 MHz. AM sensitivity, −20 dB (S+N)/N at 60% modulation is 2.0 μV below 512 MHz and 4.0 μV above 806 MHz.

The Radio Shack PRO-62 will hold its memory without batteries installed, or another DC source, for as long as an hour. A large and easy-to-see LCD readout provides all the information. Operation is straightforward and uncomplicated. It looks good, does a fine job, and is well built. What more could you want in a handheld?

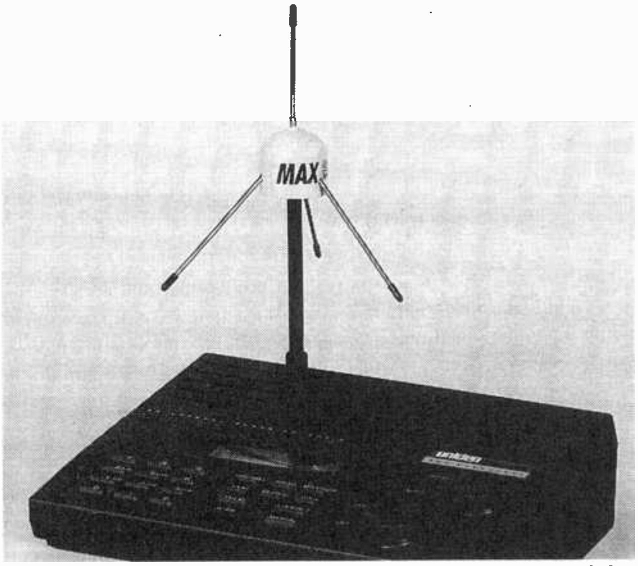
### FREQUENCIES TO GO

Drive-throughs at fast-food emporiums have always been a source of fascination to scanner owners. It was only after several years of receiving mail asking for or offering drive-through frequencies that one reader finally let me in on what the excitement is all about.

Apparently, the comments that employees make to one another about the drive-through customers aren't always very complimentary. In fact, it's said that they can be gross, and are often hilarious. Every word they say is picked up and broadcast over their headpiece short-range communication units.

From what I can discern, many different channels are in use, even within the various national and larger regional fast-food chains. There do seem to be certain favored frequencies that are used at more of a chain's locations than others. At each drive-through location, one frequency is used for the customer to place the order, while the other is used by the employees. The employee channel is the one to monitor.

Here's a sampler of the more widely encountered frequencies of several




*The MAX-CMP ground-plane antenna for base stations (and the MAX-HH, for handheld scanners) helps capture weak signals in the 800–900-MHz range, and also provide improved local reception on other VHF/UHF bands.*

larger chains. There's no guarantee that the following are in use in your local fast-food eateries, but you can give a try whenever you get in close range to one of those places.

Arby's often uses 154.57 MHz, as does Hardy's. See if your nearest Wendy's can be heard on 154.54 MHz. McDonald's has been reported on 151.895, 154.60, 170.245, and 171.105 MHz in the U.S., and in Canada on 151.67 MHz. Try for Burger King on 465.8875 and 467.7875 MHz. Listen for Taco Bell on 465.8875 MHz.

Why not pass along specific fast-food drive-through frequencies that you have confirmed? If enough come in, they'll appear here! (If you intend to conduct an in-depth study of fast-food frequencies, better take along some Tums!)

## OIL BE SEEING YOU SOON

It's unpleasant to see in the media how our harbors, waterways, and larger lakes are sometimes marred by accidental oil spills. As soon as I learn about one of those ecological accidents, I flip on certain channels that will put me behind the headlines.

There are special frequencies reserved for coordinating oil-spill cleanup operations. They are used by private firms as well as by government agencies. They provide a chance to listen in on a lot of interesting things that never make it to the nightly television news or the morning paper. To me, it's one of the best uses of a scanner. And I can stay home without getting oil all over my shoes!

Check out these frequencies: 36.25, 41.71, 122.925, 150.98, 154.585, 156.75, 157.075, 158.445, 159.48, 454.00, and 459.00 MHz.

## FROM THE MAIL

Peter Rafferty, of Bar Harbor, Maine, asks for a list of the channels used by the new 900-MHz cordless telephones. Those phones all operate in the 902–928-MHz band, but they aren't assigned specific channels (as are 46-MHz cordless phones). They are allowed to operate on channels anywhere in the available band. Furthermore, the 900-MHz phones use a transmission method that cannot be copied by the current generation of scanners.

From Harris Wahls, of San Diego, California, comes a letter expressing a serious interest in 800–900-MHz band reception, but pointing out that rubberized and many other all-band antennas are "inadequate" out there. He asks for suggestions.

CRB Research offers a scanner ground plane (Model MAX-HH) specifically designed to help handhelds with BNC antenna connectors capture weak signals in the 800–900-MHz range. Another version, Model MAX-CMP, mounts directly to the BNC fitting on desktop scanners for indoor use. Both can also be attached to preamplifiers or 800-MHz converters. At a base station, the mounting method eliminates the high signal losses at 800-MHz in runs of coaxial cable between a scanner and a roof antenna. Though peaked for the 800-MHz band, the antennas also provide local reception on other VHF/UHF bands, which is an added benefit to purchasing one.

Both models are precision manufactured with stainless-steel elements, silver solder, and PVC. The MAX-HH costs $31.95, and the MAX-CMP costs $35.95. Shipping and handling for each unit are $5 ($6 to Canada). New York State residents must add $3.14 sales tax for the MAX-HH and $3.48 for the MAX-CMP. Both are available from CRB Research, Box 56, Commack, NY 11725-0056; Tel. 1-800-656-0056 (516-543-9169 from Canada, Alaska, and Hawaii). Visa and MasterCard are accepted. ■

## CIRCUIT CIRCUS

*(Continued from page 78)*

the mystery produced by the display.

Like most mysteries or magic events, something important must be hidden from view to effectively produce an illusion. That "something" is exposed in the circuit diagram in Fig. 6. Four diodes are connected, as shown, one across each of the components, and are hidden from view under the components.

Here's how the illusion works: Closing S1, with S2 open, causes negative current to flow through S1, D2, D3, and I2. Lamp I2 then lights at about half its full brilliance, and I1's voltage source is blocked by D3. With S1 open and S2 closed, positive current flows through D1, S2, I1, and D4, lighting I1 at about half of its full brilliance. Lamp I2 is then blocked from lighting by D4. Closing both switches lights both lamps.

## 12-VOLT POWER SUPPLY

Our last entry goes out to Matt, a 13-year-old reader, who would like a circuit for a simple, but dependable 12-volt DC power supply. Well, Matt, take a look at the circuit in Fig. 7 and see if it will do the job.

A 16- to 18-volt, 3- to 5-amp transformer, T1, supplies voltage to a 3- to 5-amp bridge rectifier, BR1. The rectifier's DC output is smoothed out by C1 and fed to a simple regulator circuit made up of transistors Q1 and Q2, resistor R1, and Zener diode D1. The 14-volt Zener supplies a fixed-voltage reference at the base of Q1. Transistor Q1 supplies a slightly less than 14-volt reference to the base of the 2N3055 power transistor, Q2. ■

# ELECTRONICS LIBRARY

## U.S. Repeater MapBoook 1995/96

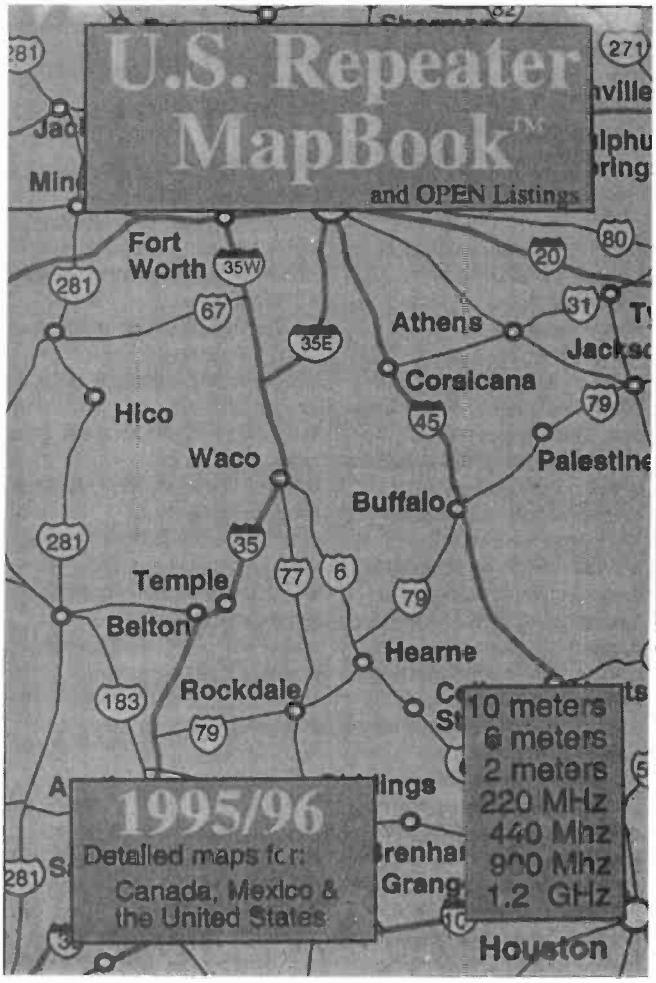
*by Bill Smith, N6MQS, and John Mitchell*

Designed as a travelling companion for the radio enthusiast, this book of maps contains the locations of thousands of open repeaters throughout the United States, Canada, and Mexico. Full-page, detailed maps show all highways and major cities in each state, and local repeaters are shown right on the map page, in easy-to-read type.

The fifth edition (1995/96) contains updated maps and table listings of every known open repeater in each state. Frequencies are shown for every city with an open repeater. The tables are organized alphabetically by city to make it easy to find new radio contacts while on the road. For each city that is shown, 10-, 6-, and 2-meter, 220- and 440-MHz, and 1.2-GHz repeaters are shown. The book also presents sub-audible (PL) tones and autopatch information.

*U.S. Repeater MapBook 1995/96 is available for $9.95 plus $4 shipping and handling (California residents add 8.25% tax) from Artsci, Inc., P. O. Box 1428, Burbank, CA 91507; Tel. 818-843-4080; Fax: 818-846-2298.*

**CIRCLE 89 ON FREE INFORMATION CARD**




## USING PAGEMAKER 5 FOR WINDOWS

*by Martin Matthews & Carole Matthews*

Aimed at new or upgrading *PageMaker* users, this bock-and-disk package provides all the information needed to create everything from simple forms and flyers to newsletters, catalogs, and annual reports. The book covers all the latest features of PageMaker 5 for Windows, including expert kerning and extensive color manipulation with four-color separations, spot color, and process color. Users will learn how to work with professional tools such as Aldus Additions, Control Palettes, and True Type fonts. The disk contains all the sample projects in the book, along with additional text and graphics files from Word for Windows, Word for DOS, WordPerfect, CorelDRAW!, Micrografx Designer, Excel, and dBASE that can be imported into PageMaker 5.

The book is divided into three distinct sections. The first provides an overview of desktop-publishing concepts, Windows, and basic PageMaker features. In the second section, readers


are guided through three common desktop-publishing projects: business forms using the Table Editor, an advertising brochure that introduces users to importing graphics, and an in-depth introduction to color concepts. The third section shows how to "dress up" multi-page documents, including a financial report, a catalog, and a newsletter, while learning how to import files found on the companion disk.

*Using PageMaker 5 for Windows costs $39.95 and is published by Osborne McGraw-Hill, 2600 Tenth Street, Berkeley, CA 94710; Tel. 510-649-6600; Fax: 510-549-6603.*

**CIRCLE 96 ON FREE INFORMATION CARD**

## SIMPLIFIED DESIGN OF SWITCHING POWER SUPPLIES

*by John D. Lenk*

This all-inclusive, one-stop guide to switching power-supply design describes the operation of each circuit in detail. Aimed at students and experimenters as well as design professionals, no previous design experience is required to use the techniques presented in step-by-step instructions and detailed diagrams.

The book concentrates on the


use of IC regulators and examines a selection of external components that modify the IC-package characteristics. All popular forms of switching supplies—including DC-DC converters, inverters, buck, boost, buck-boost, pulse-frequency modulation, pulse-width modulation, current-mode control, and pulse skipping—are covered. The design examples can be put to immediate use or can be modified to meet a specific design goal.

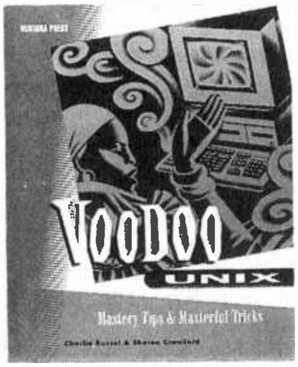
*Simplified Design of Switching Power Supplies costs $39.95 and is published by Butterworth-Heinemann, 225 Wildwood Avenue, Woburn, MA 01801; Tel. 1-800-366-2665.*

**CIRCLE 90 ON FREE INFORMATION CARD**

## VOODOO UNIX: Mastery Tips & Masterful Tricks

*by Charlie Russel & Sharon Crawford*

Filled with timesaving tricks and insider tips, and purposely devoid of unnecessary detail and technical jargon, this book is designed to help ordinary UNIX




users become faster and more efficient at their work. It offers practical advice and solutions for a variety of challenging UNIX tasks. Beginning with the basics, it explains how to get going and get help, covering shells, security, and keeping track of your files. It goes on to cover moving around and moving text, describes the differences between the command mode and the edit mode, and helps users master macros. X Windows is covered in detail, including opening windows, designing the desktop, using the mouse, and exploring existing X programs. The book shows readers how to use UNIX utilities, and how to avoid common UNIX pitfalls. It also explains communicating with non-UNIX computers, sharing files, logging in remotely, and using network commands.

*Voodoo UNIX: Mastery Tips & Masterful Tricks costs $27.95 and is published by Ventana Press, P. O. Box 2468, Chapel Hill, NC 27515; Tel. 919-942-0220; Fax: 919-942-1140.*

**CIRCLE 91 ON FREE INFORMATION CARD**

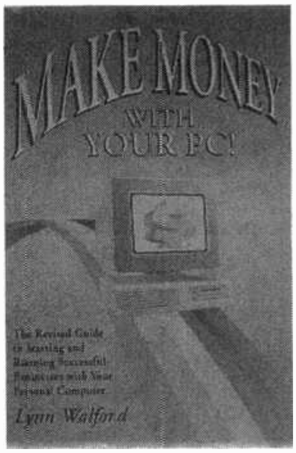
## MAKE MONEY WITH YOUR PC!

*by Lynn Walford*

This thought-provoking book can help make your dream of starting your own business from your home or office a reality. It presents the facts on how to choose, plan, market, and manage a computer-based business for both Macintosh and IBM-compatible PC's.

The book explains how to decide whether you have the entrepreneurial spirit needed to start your own business and how to determine the right business for your skills. Several tried-and-true business ideas are presented, along with the information needed to market and manage a business. The book explains how to price, bill, and get paid for your services; how to set up your business; and where to go for help.

Exercises at the end of the chapter are designed to help readers develop self-discipline; create business, marketing, and management plans; and set




and accomplish goals. Brainstorming sessions are included to inspire readers to have similar sessions with their friends, colleagues, or family members to stimulate new ideas.

The book also contains real-life success stories, including illustrations of common mistakes to avoid. The sections on hardware and software include questions to ask before you buy anything.

*Make Money With Your PC! costs $7.95 and is published by Ten Speed Press, P. O. Box 7123, Berkeley, CA 94707; Tel. 800-841-2665; Fax: 510-524-4588.*

**CIRCLE 92 ON FREE INFORMATION CARD**

## "HOW IT WORKS" BOOKS

*from Jensen Tools*

The four volumes in the "How it Works" series of books for computer users are patterned after a technical-help column that debuted in *PC/Computing* magazine. *How Computers Work* and *How Software Works* are both written by Ron White, an original contributor to the magazine column. All four books aim to render the technology of computers, software, and networks understandable even to the non-technical user.

*How Computers Work* is organized by the six identifiable components and/or operations of IBM-compatible PC's—the boot-up process, the microchip, data-storage devices, input/output devices, networks, and printers. Other chapters in the book discuss transistors, microprocessors, keyboards, serial and parallel ports, scanners and OCR's, pen-based computers, LAN topologies, fonts, and printer types.

*How Software Works* takes the mystery out of computing, explaining in simple terms how hardware and software work together. The presentation is organized by types of software—database, spreadsheet, word-processing, graphics, communications, and Windows-based. An additional section covers programming languages.

*How Macs Work*, by John Rizzo and K. Daniel Clark, begins with a look inside the Macintosh, dealing separately with the Mac Classic, the Modular Mac, the Quadra, and the PowerBook. It includes chapters on the Mac system, the use of binary numbers and transistors, the CPU, RAM, virtual memory,


disk storage, SCSI, the Apple desktop bus, NuBus, Mac sound and video elements, networks, printing, and publishing.

In *How Networks Work*, Frank J. Derfler, Jr. and Les Freed take an historical approach, using the development of modern communications to help explain and illustrate the underlying technology of modern networks. The book moves on to cover the relationship between computer and telecommunications equipment and the network operating software that helps to integrate it. Individual chapters cover the use of computers as terminals, modems, cabling, interface cards, LAN types and topologies, linking, and workgroup applications.

*For pricing and ordering information on the "How it Works" books, contact Jensen Tools Inc., 7815 South 46th Street, Phoenix, AZ 85044; Tel. 800-426-1194.* ■

**CIRCLE 93 ON FREE INFORMATION CARD**

## LIMITED-SPACE ANTENNAS

*(Continued from page 66)*

bands and frequencies adjacent to them:

The Bilal Isotrons are very small amateur-band HF antennas designed for portable and restricted-space applications where larger antennas are impractical. Some users mount them out in the open, such as on a chimney, since they are smaller than a TV antenna and really don't look like an antenna at all. Most of the Bilal antennas are small enough to fit in an attic.

Despite their small size, the antennas have reasonably large areas and are made electrically resonant using large coils in series with the antennas' capacitive plates. Six single-band versions cover the 160-, 80-, 40-, 20-, 15-, and 10-meter amateur bands. Other models cover various ranges in the regions from 1.8-7.3 MHz and 14.0-30.0 MHz. Prices range from $32.95 to $149.95.

The Spider antennas, from Multi-Band Antennas, are loaded amateur-mobile antennas that automatically change bands without changing resonators; they don't need an antenna tuner. The four-band Spiders are good candidates for installation on vans, campers, motor homes, and fresh-water boats. The antennas offer good operating bandwidth and low SWR. Three additional resonators can be installed for seven bands.

The Spiders also are suitable for use in mobile home parks, apartments, and condominiums; balcony-railing and vent-pipe mounting is popular. A special dipole version also is available, as are models tuned to commercial HF marine bands. A selection of resonators, mounts, and accessories is available. A complete Spider system typically costs $150 or more, plus mount; dipoles are $170 and up, depending on the number of bands covered.

**Antenna Tuners and Couplers.** Strictly speaking, you really don't use an antenna tuner to "tune" an antenna. Instead, tuners (sometimes known as couplers or transmatches) allow you to get the most from certain antennas by adjusting the impedance match between your receiver and antenna system.

While in amateur work tuners usually are adjusted using an SWR bridge, you can adjust them very simply by merely adjusting their controls for the strongest received signal. Another, more "high tech" way is to use an instrument such as an antenna bridge, dip meter, resistance analyzer, antenna noise bridge (ANB), or similar device that has a built-in signal source.

Those instruments let you determine antenna resistance, standing-wave ratio (SWR), resonant frequency, and other parameters without a transmitter. You can monitor changes as you tweak your antenna, lengthening or shortening it or adjusting its tuner to see the effect, without transmitting.

Antenna tuners also perform a second useful function by rejecting unwanted, out-of-band signals and preventing them from getting through to your radio. Many firms, including MFJ, Grove Enterprises, Palomar Engineers, and others, offer SWL tuners.

**Some Final Thoughts.** Just the fact that your antenna is physically smaller than usual does not exempt it from any of the usual concerns that surround antennas. That is especially true of safety concerns.

If your antenna is outdoors, protect it from lightning. If it normally requires a parallel-conductor transmission line, consider placing a BALUN at the antenna to allow coax feeder to be used instead. The BALUN also connects both sides of the antenna to the cable shield (at DC and low AC frequencies). That reduces static-charge buildup on the antenna; charges flow to ground, not through your radio.

Also protect your vertical ground-plane antenna, even if it's at DC ground potential. When that type of antenna is elevated above ground, run a direct ground wire to its radial system. Don't rely on the coax feedline shield alone for grounding.

Get a good ground. The best way to do that is to have a good, short connection between your antenna system and ground, both for lightning protection and for good antenna performance. If you can, install outdoor ground rods, preferably several six-foot or longer rods connected together with heavy wire. Don't use hot-water pipes, gas lines, electrical conduit, or insulated plastic pipes.

You might have to settle for a wire run to a cold water pipe. Sometimes, even that's hard to find in homes and apartments built with plastic piping. Inside steel-frame buildings, a ground connection to the building's frame can be effective.

During an electrical storm, the only safe conductor is a grounded one, so ground or disconnect all antennas when a storm threatens. Use an antenna switch that automatically grounds all antennas except the one in use and that has enough positions so you can turn the antenna selector to an unused position when not using the equipment. Your best bet might be to remove all of your equipment from power and transmission lines during storms, or disconnect them whenever you're not using them.

We won't dwell further on antenna safety in this article. More information can be found in my article "Antenna Safety for Hams and SWL's," which appeared in the May 1995 issue of **Popular Electronics**. Also, there is an informative, four-page "Antenna Safety Advisory" pamphlet available free from Universal Radio. ■

## SPEED GUN

*(Continued from page 42)*

radar gun's performance. If you are comfortable with your work, you can paint the gun now. Otherwise, you might wait until the unit is fully tested before painting it.

**Calibration and Use.** At this time you can connect the gun to the display unit, apply power, and calibrate it. Calibration is as simple as pointing the gun at a fluorescent light and adjusting R22 for a reading of 18 on the LED display. Any other indoor measurement will be inaccurate due to AC interference. Next go outdoors, point the gun at the sky, and adjust R10 for a reading of 3 or 4. That sets the unit to just below the maximum unstable point and achieves the best range.

You're now ready to catch those speeders. You can try to better calibrate the gun with steadily moving cars, but the fluorescent-light calibration method is pretty accurate. ■

## A/D CONVERTER

*(Continued from page 50)*

Subtract the theoretical value you calculate from the actual voltage value to determine the probe's temperature-correction factor.

As an example, say you have a digital thermometer. Connect the probe to be calibrated to J1. Place the probe element (LM335) next to the thermometer and use a digital voltmeter to read the voltage between pins 2 and 4 of U2. Let's say the thermometer's reading was 71.2°F, and the probe's voltage reading was 2.96 volts. Use the thermometer reading of 71 in the formula to calculate the theoretical voltage:

$$((71°F - 32)/1.8 + 273.15) \times .01$$

which equals 2.948 volts. Subtract the theoretical voltage from the actual voltage of 2.96 volts to obtain the probe's temperature-correction factor of 2.96 − 2.948, or 0.012 volts.

If a calibrated device is not available, you can use an ice cube made from distilled water, which should have a temperature of 32°F. Place the probe element on the ice cube and record the voltage between pins 2 and 4 of the U2. Subtract the theoretical value of 2.732 volts from that reading to obtain the probe's temperature-correction factor.

**Checkout and Use.** To use the A/D Converter and temperature probe(s), type Listing 1 into the QBasic application provided with DOS. Save the file as ADC831.BAS. Connect your first probe to J1, second to J2, and so on. Apply power to the A/D Converter and set R1 for the minimum input voltage ($V_{in}-$) and R2 for the voltage span ($V_{ref}$). Create your setup file and store it in the same subdirectory that ADC831.BAS is in. Now, any time you want to use the Converter, simply load and RUN AD831.BAS from QBasic.

To use the A/D Converter with other analog input devices (for example, light, pressure, distance, and other types of sensors), disconnect the 2200-ohm resistors (R3–R9) before connecting the other devices. ■

Popular Electronics

Supplement to Popular Electronics
June 1995

# Market Center™

## DIGITAL READY STEREO AMPLIFIED SPEAKERS

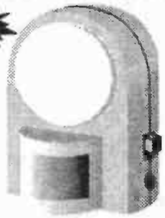
SALE

**G6411** ~~was $16.95~~ **$12.99**

Great for computers, CD players and headphone radios! These compact amplified speakers produce high quality room filling sound from any of the above! Features bass boost, treble boost volume control and red indicator light on each speaker. Very high quality. These attractive 4 3/4" x 3 1/4" speakers are black with gold lettering. Require 4 "C" size batteries (not included). Has a 6VDC adaptor jack (adaptor not included). These are new but not in original factory cartons so they may have slight marks or scratches on case. These marks do not affect the performance or general appearance as you have to inspect them closely to see them!

## PEOPLE DETECTING LIGHT

SALE



**G6145** ~~was $14.95~~ **$11.95**

Portable light detects you up to 10 ft. away using a sensitive PIR (passive infrared) detector and lights up for 20 seconds. No more bumping into objects when you get up at night! Requires only 4 AA batteries (not included). Features attractive white case with a 3" diameter light. Can be mounted anywhere in house- hallways, bathroom, stairs, bedroom, kitchen, etc. Completely automatic and it even has a sensor to prevent daytime operation. Size about 5 1/2" x 3 5/8" x 2 5/8". In retail box.

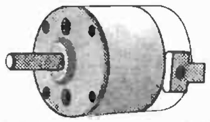
## FLAT PANCAKE SPEAKER

**G6553** **99¢**

Super thin speaker is about 1/8" thick and 1 5/8" square. Good sound. Rated 8Ω, 0.4W

PLEASE NOTE: *All sale prices are valid only until the end of the cover date of this magazine.*

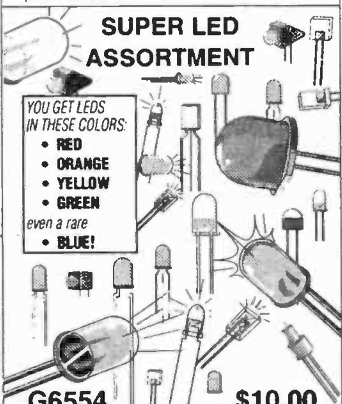
## HEAVY DUTY 12VDC MOTOR



**G6441** **$1.79**
**8/$12.00**

Great for larger robots or other heavy duty applications. Made by Brevel Motors, these motors feature 5/8" long x 3/16" diameter shaft and a body size of 2 1/8"L x 1 5/16"Dia. Very good torque even at 6VDC. These have been in storage for a while and may have slight corrosion or rust on body and shaft, however, it is only cosmetic and in no way effect the mechanical performance of the motor.

## SUPER LED ASSORTMENT



*YOU GET LEDS IN THESE COLORS:*
- **RED**
- **ORANGE**
- **YELLOW**
- **GREEN**

*even a rare*
- **BLUE!**

**G6554** **$10.00**

Assortment of all types, colors, sizes and shapes of prime high quality LEDS. This large assortment even contains a clear LED that lights up blue! Our largest and most spectacular assortment contains 250 pieces.

## PIR MINI ALERT

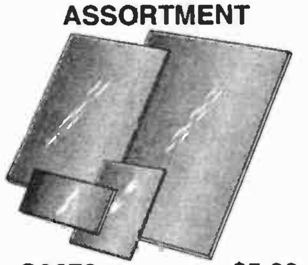
SALE

**G6153** ~~was $14.95~~ **$12.95**

Passive Infrared alarm and anouncer is activated whenever anyone enters its field of view. Features exit delay, switchable "chime" or alarm modes. Wall mounting swivel can be used or removed for portable operation. Great for mounting near front door, back door windows, hallways, etc. Alarm mode output is a loud 80dB. Can be used as a visitor announcer by just selecting "chime" mode. Now, as someone enters, you will hear just a pleasant chime. Unit resets itself in the alarm mode after sounding for about one minute. Operates on 3 AA batteries (not included). Size of unit only 4" x 2 3/4" x 1 5/8". In retail box.

**IF YOU CAN'T FIND WHAT YOU ARE LOOKING FOR, CALL FOR A FREE COPY OF OUR LATEST CATALOG. THIS CATALOG CONTAINS OUR ENTIRE PRODUCT LINE OF OVER 3,000 ITEMS AND IT IS STILL GROWING!**

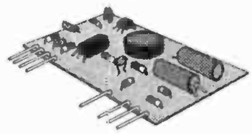
## COPPER CLAD ASSORTMENT



**G2679** **$5.00**

Our best assortment ever. Contains 25 pieces of various size copper clad circuit board blanks. Each is double sided and you will receive thickness types from ultra thin to standard thickness. Minimum size 2" square to a maximum of 6" square. A PC board makers delight.

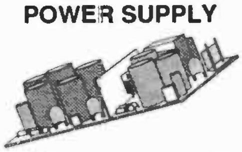
## TDK VOLTAGE CONVERTER



**G6546** **$2.00**

Brand new voltage converter converts 3VDC to 9VDC. Size only 1 7/8" x 1 3/16" x 1/4". Made by TDK for a major manufacturer. Output current is 60 ma at 9VDC. Use 2 penlight batteries to operate transistor radios, calculators, etc, or any electronic device that can operate on 9VDC at up to 60ma. With hookup diagram (only 3 leads are used).

## REJECT POWER SUPPLY



**G5543** **$1.69**

5VDC, 1 amp and 12VDC, 1 amp outputs with 120VAC input. These look new but have something wrong Size: only 6" x 2". Has a great assortment of high quality parts on PC board-Sold "as is" only.

## SUPER POWER MINIATURE IR TRANSMITTER UNIT

SALE

**G5535** **$1.25**
12/$12.00 • 120/$100.00

Make all kinds of IR remote activated projects with this transmitter and an IR receiver module. These were originally designed to activate a burglar alarm system (which we don't have) by remote control. The transmitter features a red activation button, a dip switch inside to change output code, operation from 9V battery (not included), red LED transmit indicator to show when IR energy is being transmitted and a compact 4 1/4" x 1 3/16" x 3/4" black stylish case. Brand new in blister pack with 2 peel and stick "premise protected" stickers. We also supply an info sheet that shows how to convert this transmitter unit into a programmable IR receiver so a pair of these transmitter units could cover both transmit and receive functions.

## THE AMAZING RADIOSONDE

SALE

~~WAS $8.95~~
**$6.95**

**G5058** **2/$12.00**

Very late model Radiosonde made for tracking all types of weather data. These were to be sent aloft attached to a weather balloon (not included). Each is about 10 1/2" long x 3 3/8" thick x 8" wide. Inside of the removable cardboard sleeve is a styrofoam chamber housing a sophisticated 8 IC circuit board which has sensors attached to measure atmospheric pressure, temperature and humidity. As it gathers the information, it transmits the data at about 1.677 gigahertz (GHZ). These are prime, brand new units that were waiting shipment from the manufacturer (Space Data Corporation) to the government when the contract ended. These are complete except for the 24V battery (we connected two 9V batteries in series and the unit worked perfectly from them). Sorry, no schematic available. These cost the government a bundle to have made but we are selling them at a giveaway price. Hurry, get your Radiosonde today!

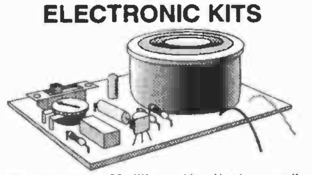
## TRANSISTORS BY THE SCOOP

Less than 1¢ each!

**G5071**
**1 scoop** **$5.00**
**10 scoops**(about 5,000) **$40.00**

We just purchased close to a 1/2 million prime house numbered transistors made for an OEM. Each is house numbered and has full length leads. They are absolutely first quality - not rejects. We think there are Darlingtons and small signal NPN transistors. We do know that there is at least 4 different house numbers. Most are regular size T092 cases however, there are also a few 1 watt T092 cases. Tremendous value as we are selling them by the scoop. Each scoop holds at least 500 transistors! Sorry we can't separate them, but at this price you can and you'll save a bundle!

## POPULAR ELECTRONIC KITS



We have about 150 different kits. Here's a small sampling.

| | | |
|---|---|---|
| Insanity Alarm Kit | C6240 | $6.20 |
| Wheel of Fortune Kit | C3806 | $13.75 |
| SMD IR Detector Kit | C6489 | $7.20 |
| Burglar Alarm Kit | C6280 | $8.75 |
| Phaser Sound Kit | C6406 | $7.25 |
| Portable Filtered Black Light Kit | C6471 | $23.95 |
| 20W + 20W Car Stereo Amp Kit | C6442 | $24.95 |

*For **Phone** Orders Call (602) 451-7454*
*Or **Fax** Your Orders To (602) 451-9495*


*Minimum Order: $10.00 plus $4.00 Shipping and Handling. We accept MasterCard, Visa and Money orders. Canadians and orders that need US MAIL send minimum $5.00 S&H.*

**ELECTRONIC GOLDMINE**
*P.O. Box 5408*
*Scottsdale, AZ 85261*

CIRCLE 139 ON FREE INFORMATION CARD

# CircuitMaker® vs. Electronics Workbench®

# A NEW STANDARD HAS JUST BEEN SET !

## State-Of-The-Art Analog Simulation

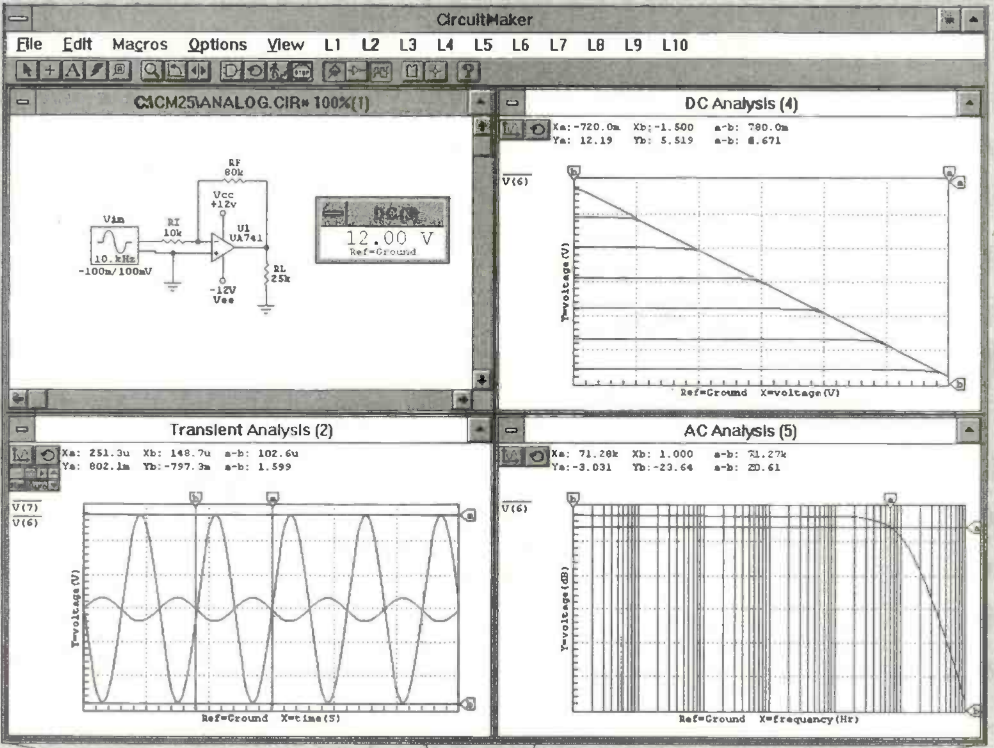
CircuitMaker's analog simulation results are shown in graph windows that provide powerful, interactive analysis options. You can plot multiple waveforms by clicking on the desired nodes and can select linear or logarithmic axes. Horizontal and vertical cursors facilitate quick and accurate measurements. You can also zoom in on any portion of the graph to obtain additional detail.

Electronics Workbench offers a single, small scope or Bode plot instrument window. The windows are not sizeable and only two waveforms can be plotted at a time. EWB has a single measurement cursor and provides no direct way to read results from the instruments.

## Superior Digital Simulation

CircuitMaker has an exclusive Trace feature where the state of every node is indicated in color as the simulation runs. You can monitor as many waveforms as your screen will allow, set edge or level breakpoints for analysis, and interactively see the state of any node by touching the logic probe to it. The data sequencer provides 1024 words of pattern data. Additional digital instruments include ASCII and HEX input keys and an ASCII display. CircuitMaker includes tri-state devices and devices have programmable propagation delays.

Electronic Workbench has no interactive logic probe or Trace capability and no Hex or ASCII keys. Their "word generator" is limited to 16 words. EWB does not have tri-state devices and digital devices do not have programmable propagation delays.




## Comprehensive Device Libraries

CircuitMaker includes libraries containing programmable, TTL, CMOS, generic analog and digital devices, and many powerful I/O devices. With CircuitMaker's macro function you can quickly and easily create your own functional devices and symbols. Now that's giving you the tools you need to get the job done right!

Electronics Workbench ships with only 17 digital devices. If you want additional devices you pay extra.

## Competitive Upgrade Offer

You deserve the best. Upgrade from any competing product for only $149 (Call for details). For new users CircuitMaker is a tremendous value at just $299.

## High-Performance Schematic Capabilities

CircuitMaker puts you in control of your schematic with SmartWires™, bussing, page connectors, and rubberbanding. You can label devices and pins, add fully stylized multi-line text, and create a parts list or netlist. With the Macro feature you can add user defined symbols to your device library.

Electronics Workbench dictates wire placement to you. EWB limits your overall "workbench" layout to 2 by 1 pages. EWB has no bussing, page connectors, pagebreaks, print scaling, labeling, free text fields, netlisting, zoom, undo, and no Toolbar or Toolbox.

## Technical Support

MicroCode Engineering offers free phone support from knowledgeable engineers. And, you won't find yourself listening to music when you call for help.

Interactive Image Technologies offers 3 free calls and then you have to pay for all subsequent calls.

Comparison based on CircuitMaker 2.6 for Windows and Electronics Workbench 3.0 for Windows. All products and company names are trademarks of their respective owners.

FREE FUNCTIONAL DEMO VERSION
available on most major BBS's or sent direct for $10 s&h

# CALL 800-419-4242

Product satisfaction is guaranteed.

**MicroCode Engineering**
1943 N. 205 W. Orem, UT 84057
Fax (801) 226-6532
Phone (801) 226-4470

CIRCLE 42 ON FREE INFORMATION CARD


CIRCLE 132 ON FREE INFORMATION CARD

# NEW PRODUCTS

## Electronic Equipment Bank...Nation's Largest Radio Outlet!

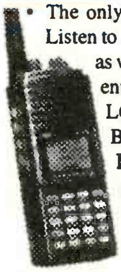
### AOR AR2700(A) .5-1300MHz(1-4)

• Replaces older AR1000/TR1200 models w/Hi Quality surface mount technology, many advanced features, cloning, computer I/O (opt. RS232 converter), 1000 memory 50ch x 20 bank, AM/FM/FMW auto band.

List $499.95

**Introductory $...CALL**

### AOR AR8000 .5-1900MHz(1-4)



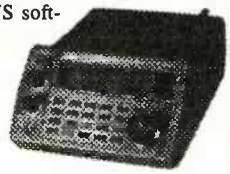
• The only TRUE SSB scanner on the market. Listen to AM/SSB voice from around the world as well as local signals. Several new-patented features. Alpha-Numeric, 4 level LCD read out, bar graph "S" meter, Band scope spectral display, computer I/O (opt. RS232 & Software), 1000 memory 50ch. x 20 banks.

List $799.00

**Special Sale $599.95**

### AOR AR3000A .1-2036MHz(1-4)

• Compact, Professional quality, a favorite with many agencies that want Hi-Performance at a low cost. All mode, including SSB, one small unit does it all. 400 memory 100ch. x 4 banks, RS232 computer ready (opt. DOS & WINDOWS software) EEB offers many options to satisfy any special need...CALL

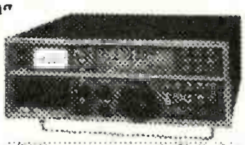


List $1195.00

**EEB $1029.00**

### AOR AR3030 30kHz-30MHz(opt. VHF)

• Superior Performance & value, leading edge technology in an HF receiver design. Compare features with receiver costing over $1000. Collins Filter, AMW 6kHz opt, .5, 2.4 & 4kHz. DDS tuning, 3 ant. inputs, 10Hz step tuning Sync AM, RIT. RS232 ready (opt, Software).



List $949.00

**EEB $799.95**

***FREE CW filter or VHF converter (till July)***

IBS ☆☆☆☆

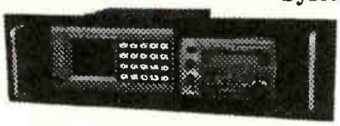
### AOR SDU5000

• Imagine "seeing" the spectrum up to ±5MHz from the station you're tuned to. A Spectral Display Unit (SDU) allows just that. Input 10.7MHz (ICOM 7000, 7100, 9000, mod AR3000A PRO2006, digital control AR3000 or ICR7100). Color LCD readout, freq, signal, store to computer, RS232, Video output NTSC or PAL...Unlock your imagination! Space does not allow many details here...Write, CALL, FAX or use our new BBS (Call).

**SDU5000A (AOR) $995.00**

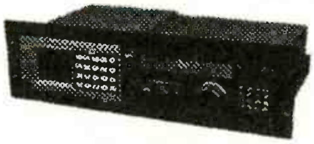
**SDU5000I (ICOM) $1095.00**

### AOR SDU5000A/AR3000A System(1-4)



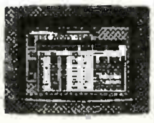
• SDU digitally operates AR3000A. By a push of only one button receive hops to signal of interest. Add a PC computer & software, you'll have an advanced intercept system, with unlimited storage on disc. Optional software available. The system is also offered in a briefcase configuration.

### AOR SDU5000I R7100 System(3-4)

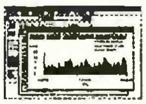


• Similar in operation to above. R7100 does not require a CT. 17 converter. Rack mount hardware available for both above systems.

### AOR SOFTWARE

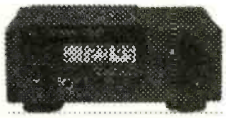


• Your PC & AOR Software will open new horizons to signal interception. Menu driven, Hypertext helper, audio w/ sound card, log/record for later analysis, unlimited disc storage, 10 bank view onscreen, spectrum analyzer, clip board, histogram of band activity. Demo disc $10 refundable with purchase. **Priced from $99.95**



(A) Pending FCC certification (1) Cellular Block (not restorable)
(2) Cellular Block, but can be restored
(3) Blocked, 800 - 900MHz.
(4) Un-Blocked O.K. to qualified buyers (Govt., Export, etc.)

### LOWE HF 150



• Rated ★★★★ by IBS PASSPORT. Don't let this small sized, rugged, reliable and sophisticated radio fool you. This is a serious radio, 30kHz - 30MHz, 60 memories, multi-mode AM/AMN/LSB/USB/CW, power 10-15VDC, 120VAC incl, synchro detection. **Options:** Key pad, RS232 computer control, Preselctor, External speaker

LIST $699.00 **EEB $599.00**

### Bearcat Scanners

**BC3000XLT 25-550/760-1300MHz(1)**

• Scan 100ch/sec, search 300ch/sec, 400 memory channels, 20 x 20 banks.

LIST $499.95 **EEB $369.95**

**BC9000XLT 25-550/760-1300MHz(1)**

• Alpha numeric LCD on all 500 memory ch. Scan 100 ch/sec, search 300 ch/sec, data skip, attenuator 15dB, Cor recorder control.

LIST $769.95 **EEB $389.95**

**BCT-7 All Band 26-956MHz(1)**

• A must for the frequent highway travellers. 7135 pre-programmed channels, search by state & service. Police, HP, DOT, Fire, News, WX, CB, plus 100 User memories, scan 100 ch/sec.

LIST $319.95 **EEB $199.95**

**Other BEARCAT Scanners**

| | | | |
|---|---|---|---|
| BC120XLT | $144.95 | BC760XLT(1-2) | $229.95 |
| SC150Y/B(1) | $194.95 | BC860XLT(1) | $189.95 |
| BC148XLT-1(1) | $99.95 | BC890XLT(1-2) | $244.95 |
| BC220XLT(1) | $229.95 | | |

**REALISTIC SAVE!!!**

***CALL EEB before you buy***
...the latest scanners at discounted prices, fast, friendly service.

### FREE Catalog...

☆ **By now you should have our 95 Catalog.**

**If not...CALL/FAX/Write today!**

☆ **96 Pages • SWL Scanners • Amateur 2-way • GPS • Enlarged book section**

__FREE__ in the U.S., 3rd class (4 weeks). $2 1st class (1 week). $2 Can/Mex. $5 elsewhere.

**EEB**

ELECTRONIC EQUIPMENT BANK
323 Mill Street NE
Vienna, VA 22180

•We accept VISA/MasterCard/American Express/Discover

ORDERS: 800-368-3270
Local Tech: 703-938-3350
FAX: 703-938-6911

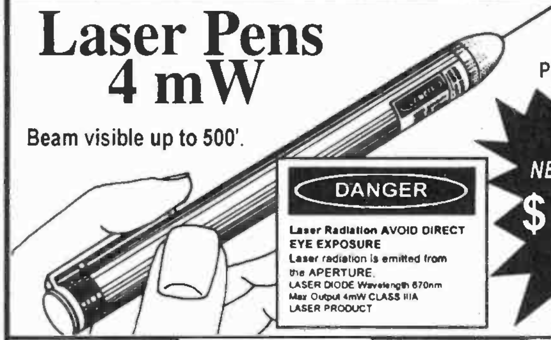
•We ship via UPS, Federal Express and Mail

•Sorry, no COD's
•Free Catalog in USA
•Prices Subject to change
•Prices do not include freight
•Returns subject to restock fee up to 20%

# RAINBOW KITS

## Laser Pens 4 mW

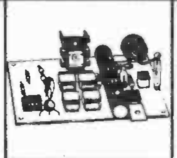
Beam visible up to 500'.




INCLUDES
2 AAA Batteries
Pen Size: 5 1/2" x 1/2"

SUPER NEW LOW PRICE
$59.95

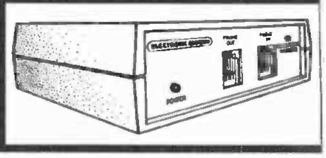
## STROBE LIGHT



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. Size 3.5"x1.8" operates on 6 or 12v DC only.

ST-1 **$9.95**

## The Exciting New TELEPHONE MONITOR



*Monitors your phone system, See how accurate your phone company really is!*

1. **RECORDS OUTGOING CALLS :**
   - Date & time of each call.
   - Length of the call.
   - What number was dialed.
   - If you use a credit card it records the card number.
2. **RECORDS INCOMING CALLS :**
   - Date & time of call.
   - How many times phone rings.
   - If answered the length of call.
3. **RECORDS ANY DTMF TONE :**
   - Detects any tone on line sent by phone company or any other source.

*Records to Screen or Floppy Disk*

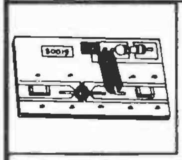
*EASY TO INSTALL*
- Connects to parallel port
- Phone line in.
- Phone line out to telephone.

**All software included!**

TM-1 ONLY $99.95 KIT

BUILT $169.95

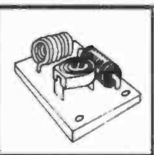
## WIDE BAND PREAMP



The ideal preamp for scanners, hand held radios, frequency counters. Amplifies low level (weak) signals. If the signal is extremely low 2 amps can be used in series. 1MHz to 2.5MHz @ 2.8dB nf 1dB compression = +0 dBm gain: 1MGHz-20dB to 2.5Hz-6dB Requires 12vDC @ 16Ma

WBA-6 **$19.95**

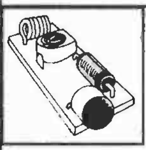
## MICRO-MINIATURE PHONE TRANSMITTER



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 **$29.95**

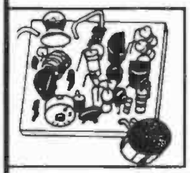
## MICRO-MINIATURE WIRELESS MIKE



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 & 9v it transmits about 1 mile. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. Can operate on 6 to 12v DC. Size .35"x.9"

MMWM5 **$34.95**

## WIRELESS FM MICROPHONE

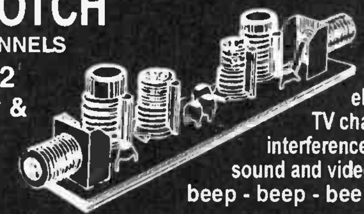


Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-1 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM , the frequency of any broadcast FM radio. Includes a mini-electret mike. SIZE: .8"x1" 6 to 12vDC

WM-2 **$14.95**

## TV NOTCH FILTERS

FOR CHANNELS
2 thru 22
SNOOP &
BULLET

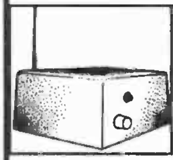


Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep - beep - beep.

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**

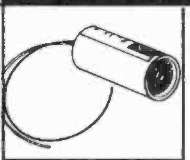
## FM STEREO TRANSMITTER



Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable 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, aprox. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls , & crystal for stereo separation. 9v battery operation

FMST-100 $29.95 / FMSTC cabinet $8.95

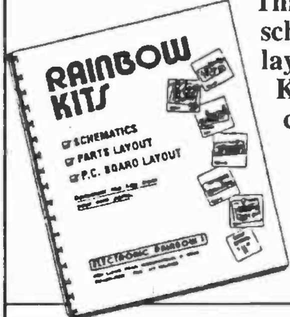
## 5.0 mW Laser Diode



Great for making a gun sight, use as a transit, makes a super experimenters project. The beam is visible with a wavelength of 670 nm. Size of beam is 6mm at 5 meters. Operates on 3 volts DC at 85mA. Size: 10.5mm x 18.5mm with an adjustable collimating lens.

LDM-5

NEW LOW PRICE $59.95



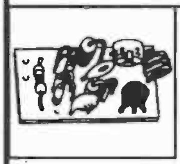

**This Manual contains all schematics, parts lists , P.C.B., layouts for most of the Rainbow Kits. Use your own parts to construct any of our kits.**

## KIT BOOK $14.95

**$9.95** with the purchase of any kit.

4G

## PHONE TRANSMITTER

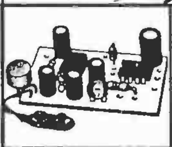


Small but mighty,it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz to 130MHz FM. You can also use it as a speaker phone. SIZE .5"x1"

TEL-B1 **$12.95**

BUILT **$29.95**

## 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. SIZE: 1"x.75" 6 to 12vDC .

AA-1 **$10.95**

BUILT **$29.95**

*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*

MasterCard **To Order Call 317-291-7262** VISA

**ELECTRONIC RAINBOW INC**

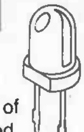
**6254 LaPas Trail • Indianapolis, IN 46268**
**FAX 317-291-7269**

CIRCLE 147 ON FREE INFORMATION CARD

# ALL ELECTRONICS CORP.

**QUALITY PARTS • DISCOUNT PRICES • FAST SERVICE • HUGE SELECTION**

## JUMBO LEDs

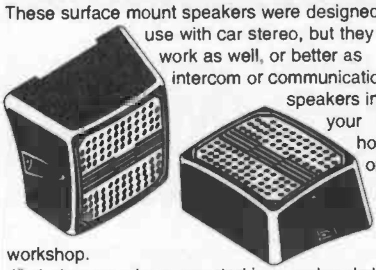


Liton # LTL 327C - 8MM
Ideal for eye-catching indicators and displays. A recent quantity purchase of these BIG, 8mm diameter, red diffused LEDs enables us to provide some very special pricing. The leads on these devices are 0.325" long with plenty of room for soldering.

**5 for $1.00** CAT# LED-23
100 for $ 15.00
1000 for $ 120.00

## GREAT DEAL! SURFACE MOUNT SPEAKERS

These surface mount speakers were designed for use with car stereo, but they will work as well, or better as intercom or communications speakers in your home or workshop.

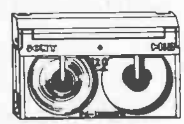


4", 4 ohm, speakers mounted in an unbreakable black plastic, slant-faced enclosure. They are rated 5 watts. Enclosure measures 4.82" X 4.5" X 2.45"h. Each pair is boxed and includes two short pieces of hook-up wire.

CAT# SK-411 **$3.75 per pair**

## "HI-8" VIDEO CASSETTE (USED)

*8 mm Video Camcorder Users!.*

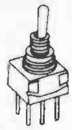


SONY Hi-8
Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box. Satisfaction Guaranteed.

**$3.00 each**
CAT # VCU-8
10 for $28.00 • 100 for $250.00

## MINIATURE SWITCHES

### D.P.D.T. (ON-ON)



ALCOSWITCH # MTM206NPC
Short bat handle,,0.25" long.
PC terminals
CAT # MTS-82PC **$1.25 each**
25 for $25.00 • 100 for $90.00

### S.P.D.T (ON-ON) LOCKINGTOGGLE

ALCOSWITCH #ALOLKWB
Locking toggle handle prevents accidental switching. Wirewrap pins.
**$1.50 each** CAT # MTS-43
25 for $ 21.25

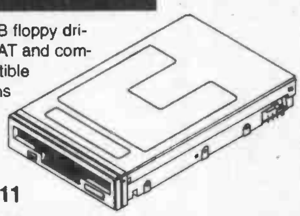
### MINIATURE D.P.D.T. PUSH/ON PUSH/OFF

REDUCED PRICE!

Augat/Alcoswitch # MPE206N
Miniature DPDT, push/on push/off switch. Splashproof: O-ring on shoulder and inside movable shaft provides moisture seal. Rated 6 amps @ 125 Vac. RED 0.4" dia. cap. 0.25" diameter threaded bushing. 0.8" behind panel depth. Solder lug terminals. UL and CSA listed.
**$1.75 each** CAT# MPB-20
25 for $37.50

## SONY 720KB 3.5" INTERNAL FLOPPY DRIVE

Sony # MP-F11W-10 SMM

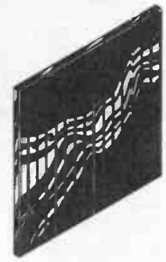


Brand new 720KB floppy drives. IBM PC/XT/AT and compatibles. Compatible with DOS versions 3.2 or higher. Black faceplate 6" X 4" X 1".
CAT # MPF-11
**$17.50 each** 10 for $ 160.00

### INSTALLATION KIT for MPF-11

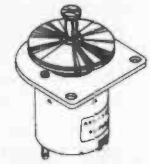
allows for installation into 5.25" drive bays. Includes beige bezel, power and control adapters and hardware.
CAT# FDD-3.5 $3.50 each

## 9 VOLT 60 MA SOLAR PANEL



These 6" X 6" glass enclosed photovoltaic panels produce 9 Vdc at 60 ma. Ideal for charging batteries and powering small devices. Put two or more together for more current and voltage. Includes hook-up instructions.
CAT # SPL-960
**$5.25 each**

## 7 Vdc MOTOR



Matsushita
# MMX- 7AC O 8A
1.25" diameter x 1.25" high motor. Prepped with 1.61" diameter flywheel, pulley and fiberglass mounting board.
**$1.00 each** CAT# DCM-54
10 for $9.00
100 for $80.00

## A.C. LINE CORDS

### 6 INCH IEC POWER CORD

*THATS RIGHT! 6 INCHES...*Standard 3 prong grounded male one end and 3 prong IEC receptacle on other end. CSA listed. Large quantity available.
**2 for $1.00** CAT # LCAC-36
10 for $4.50
100 for $35.00

### ROUND 4' BLACK 16/3 CORD

0.32" od, SJT insulation. Standard 3 prong grounded plug one end, moulded strain relief on other end. Pigtail leads. CSA listed. Large quantity available
CAT # LCAC-35 **$1.75 each**
100 for $150.00

*MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write or Fax YOUR LIST.*

CALL, WRITE or FAX For A Free 64 Page CATALOG. Outside the U.S.A. send $2.00 postage.

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

VISA • MasterCard • DISCOVER

Minimum Order $10.00 • All Orders Can Be Charged to Visa, Mastercard 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 $4.00 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.

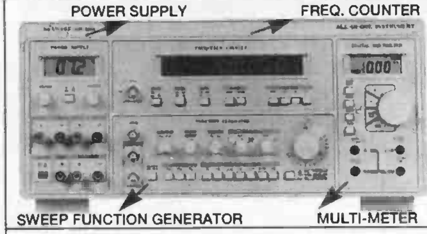


CIRCLE 28 ON FREE INFORMATION CARD

# Solutions for the Test Instrument

1 YEAR WARRANTY
15 DAY MONEY BACK GUARANTEE

POWER SUPPLY — FREQ. COUNTER



SWEEP FUNCTION GENERATOR — MULTI-METER

**MT-100**
*Reg. $599.*
**$399.00**

## Four Instruments in One Instrument

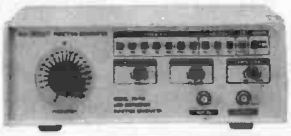
1 **Function Generator**
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- 0.2 Hz ~ 2MHz

2 **Frequency Counter**
- 8 Digit LED
- 1 Hz ~ 100MHz
- ± (1 Hz + 1 dgt. + Time Base Error)

3 **Power Supply**
- 3-1/2 Digit LCD
- Triple output: #1. 0~50V, 0.5A MAX #2, 15V, 1A #3. 5V, 2A

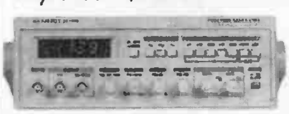
4 **Digital Multimeter**
- 3-1/2 Digit LCD
- DCV, ACV, Ω, DCA, ACA
- ± (0.5% + 2 dgts)

**FG-140 — 2MHz Function Generator**
*Reg. $249.* **$149.00**



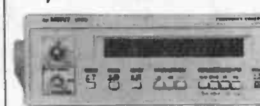
- 0.2 Hz ~ 2.0 MHz, 7 Decades
- Sine, Square, Triangle, Pulse, Ramp, Skewed Sine
- VCF, Symmetry
- Variable DC Offset Control

**2MHz Sweep Function Gen. w/Freq. Counter**
**FG-150**
*Reg. $399.* **$229.00**



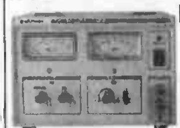
- 4 Digit LED Display
- Sine, Square, Triangle, TTL, Pulse, Ramp, Skewed Sine
- Linear/Logarithmic Sweep
- 10 MHz Freq. Counter

**1.0GHz Frequency Counter, High Resolution**
**FC-200**
*Reg. $399.* **$219.00**

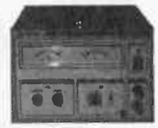


- 1.0 Hz ~ 1.0 GHz
- 8 Digit LED Display
- Auto & Manual Range
- 4 Selectable Gate Times
- 1MΩ & 50Ω Input Impedance

**GoldStar O'scopes**
Cursor Readout & Digital Storage
*Call for* BMC Unbeatable Prices



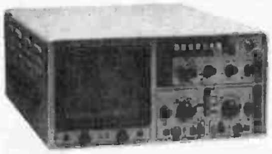
**PS-500 — DC Power Supply**
*Reg. $249.* **$159.00**
- 0 - 30 VDC
- 0.1 ~ 3A
- Short & Overload Protection



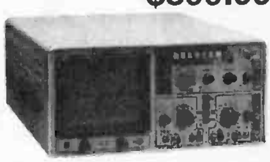
**PS-540 — DC Power Supply**
*Reg. $399.* **$289.00**
- 0 - 16 VDC
- 0.1 ~ 10A
- Short & Overload Protection

## Deluxe O'scopes w/Phillips CRT. 2 yr. Parts/Labor Warranty

**OS-3304** *Reg. $499.* **$339.00**



**OS-3324** *Reg. $599.* **$399.00**



**OS-3344** *Reg. $899.* **$649.00**

### OS-3304 25MHz, Dual Trace

1
- DC to 25 MHz. Dual Channel
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 14n Sec. or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 2kV
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

### OS-3324, 3 Function

1 • OS-3304

2 • Dual Component Tester/Comparator

3 • Triple DC Power Supply 5VDC, +12 VDC, -12VDC

### OS-3344, 5 Function

1 + 2 + 3 • OS-3324

4 • Frequency Counter 100MHz, 7 Digit LED Display

5 • Function Generator 0.02 Hz to 2.0 MHz

### OS-3315 40MHz, Dual Trace Sweep Delayed

*Reg. $799.* **$549.00**

- DC to 40 MHz. Dual Channel
- Delayed Sweep 100nS to 1.0S 7 decade
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 8.5nS or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 12kV
- Variable Hold Off
- 16ns ~ 1.0s Time Base
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

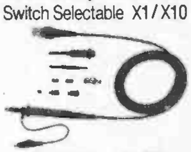
**BelMERIT DM5050C DM5100**
*Reg. $149.*
**$89.00**
*including Deluxe Holster*

### Features (DM5050C/DM5100)
- Basic DCV Accuracy: ± 0.25%
- AC/DC Volt & Amp, Ohm
- Diode, Continuity Beeper
- Alligator Clip Test Leads
- Lead Holders/Velcro Strap Holster

### DM5050C, DMM + Capacitance
- 9 Function / 42 Range
- Multimeter
  Ohm: Up to **2000MΩ**
  Amp: AC/DC 2 Amp
- Extended Capacitance Meter (9 Range)
  **0.1pF - 20,000μF**
  Zero Adjust Knob
- Trig Lamp

### DM5100, Wide Range w/Logic
- 11 Function / 45 Range
- Auto Power Off
- Data Hold & Peak Hold
- Freq: Up to **20MHz**
- Amp: Up to **20A AC/DC**
- Ohm: Up to **200MΩ**
- Capacitance: **1p - 200μF**
- Logic: TTL, TR hFE

**Oscilloscope Probe Kit**
Switch Selectable X1/X10

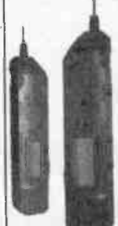


HP-9060, 60MHz *Reg. $29.* **$19.00**
HP-9150, 150MHz *Reg. $49.* **$29.00**
HP-9250, 250MHz *Reg. $59.* **$39.00**

**Capacitance Meter**
*Reg. $79.* **$49.00**

**CM210**
- 3 1/2 Digit LCD
- 0.1p-20,000μF 9 Ranges
- 0.5% basic Accu.
- Zero Adjust Knob
- Test Leads & Built in Socket

**Pen-Type DMM w/Logic**
*Reg. $79.* **$59.00**



**DM150**
- 3 1/2 Digit
- Dual Display
- Auto & Manual
- DCV, ACV, ACA, DCA, Ω
- Logic CMOS/TTL
- Data Hold
- Diode
- Continuity

**Multifunction DMM**
*Reg. $89.* **$59.00**

**DM3050**
- 3 1/2 Digit
- 1.5" Big LCD
- Heavy Duty, 20A AC/DC
- Capacitance
- Frequency
- TR-hFE
- Diode
- Continuity
- Holster

**BMC** *Your Best Source for High Standard Electronics*
20 Highpoint, Dove Canyon, CA 92679

*Order & Free Catalog*
**800-532-3221**
(714) 586-2310 Fax (714) 586-3399

VISA. MasterCard

CIRCLE 30 ON FREE INFORMATION CARD

ELECTRONICS 123

A DIVISION OF MING E&P, INC.

818-913-6735

ORDER TOLL FREE

# 1-800-669-4406

**24 hr. Fax: 818-912-9598**

## IC TESTER/IDENTIFIER

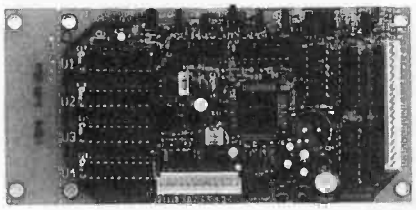
The Data Genie HT-28 is a portable, stand-alone IC tester and identifier. It can test and identify most TTL 74 and CMOS 40/45 series of IC's as well as being able to test 4164-411000 and 4416-44256 series of DRAM's. Powered from the included AC adapter or alkaline batteries (optional).

- Up to 600 hours of operation on four "AA" alkaline batteries.
- Automatic power shut-off to conserve battery life.
- Lightweight, easy to use and carry, weighs only 14 oz.


#MI-12-2800 $189.95

## DIGITAL VOICE MODULE

The DVM-58D has variable length message capabilities and can store up to 16 individual messages for immediate playback. Use it to add real voice prompting or instruction to any project, via the mic. input. Standard 1Mb DRAM on-board (32 sec.@ 32K bps) with options to expand up to 16Mb (8 min.@ 32K bps). ADM recording with selectable 16/32/44K bps sampling rates and very low power consumption.



| | |
|---|---|
| #MI-10-5858 | $89.95 |
| 1Mb DRAM | $5.15 |
| 4Mb DRAM | $21.95 |

## RF TRANSMITTER + ENCODER MODULES

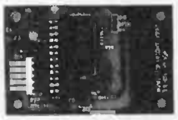
The TX-99 interfaces with the TX-01 as the RF carrier module. 300 MHz AM with a typical range of 100' line-of-sight. (Key-chain transmitter is also available, model TX-99K $15.95)

#MI-10-9903 $5.95

The TX-01 Motherboard can encode a 12-bit address code with 4096 possible code combinations or can be used to encode an 8-bit address code with a 4-bit data code.

#MI-10-001E $9.95

+



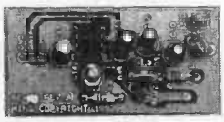
## RF RECEIVER + DECODER MODULES

The RE-99 interfaces with the RE-01 as the RF carrier's receiver module and requires only a few solder connections to mate the two. 300 MHz AM.

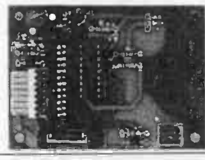
#MI-10-9904 $6.95

The RE-01 Motherboard will decode a 12-bit address or 8-bit address with 4-bits of data, depending on which of the two included IC's is installed into the board.

#MI-10-001D $14.95

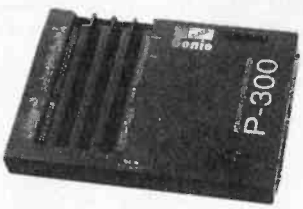


+



## PC INTERFACE CARD PROTECTOR

The Data Genie P-300 is a device that allows quick and easy installation of add-on cards or prototype circuits for testing externally on your PC without having to turn off the computer. Maintains complete protection for your motherboard via the built-in protection circuitry & current limit fuses. Adds 3 expansion slots.




#MI-12-P300 $349.95

## PIR DETECTOR

The Medusa Passive Infrared Detector has been tested at 20V/m over the frequency range 20 to 1000 MHz, proving that the unit has ultra-high RFI protection and reliability. With N.C contacts including tamper, plus selectable pulse counts of 1,3 or 5, Medusa makes for confident installations.

Detects ambient body heat and movement to trigger your connected security system, announcement buzzer, or warning device.

#MI-11-3300 $24.95 3+ at $19.95 each.

## LASER POINTER

The Infiniter "210" Laser Pointer's high-tech, lightweight aluminium housing, incorporates a mode switch which allows you to select between a solid beam or flashing beam to enhance any presentation. Projects over 150' and even works well on overhead projection screens. Great for the conference room, exhibition hall, construction site, museum, etc.

#MI-16-0007 $59.95

## Now Available

## '95 SPRING/SUMMER Catalog

- Digital Voice Products
- RF Remote Control Products
- Syntax Prototyping Boards
- Holtek Encoder/Decoder IC's & other components.
- Data Genie Test Equipment and much, more!

If you are a past or current customer, you will soon be receiving your copy by mail.

*For Technical Support Call:*

**(818) 912-9864**

*ORDER BY MAIL:*

**ELECTRONICS 123**
**17921 ROWLAND ST.**
**INDUSTRY, CA 91748**

**S&H Charges Continental US, up to 3 lbs. Add:**

| | |
|---|---|
| UPS Ground | $ 6.00 |
| UPS 3-Day | $ 8.00 |
| UPS Blue | $10.00 |
| UPS Red (Next Day) | $20.00 |
| **COD's Add:** | **$4.50** |
| *Calif. Orders Add:* | *8.25% Sales Tax* |

**S&H Charges Canada, up to 3 lbs. Add:**

US Postal, First Class $ 10.00

**Prepayment by credit card required.**

*Sorry No COD orders.*

(S&H Charges INTERNATIONAL: Call/Fax for quote.)

All prices subject to change without notice.

EAD0002A.pm5

# CELLULAR SOFTWARE AND MODIFICATION GUIDES

## *Call Spy Supply for all of your Cellular needs!*

### *We Carry:*


**CELLULAR SOFTWARE**
(We have the software to do **New Motorola Phones**)

**CELLULAR CABLES**
(For the Motorola, Panasonic, and Nokia Phones)

**CELLULAR MODIFICATION GUIDES**
(Covers all cellular manufacturers)

**CELLULAR PHONES**
(We carry a complete line of cellular phones)

## FREE TECHNICAL SUPPORT!

We now offer Cellular Phones cloned with your existing number! Buy a handheld, transportable or car mounted phone ready to go and have only one monthly bill!

***Don't Get Ripped Off!***

Before you buy our competitor's manual, call and ask if they offer **FREE TECHNICAL SUPPORT**

**SPY SUPPLY**
Find out why the
CIA – FBI – DEA –
SECRET SERVICE
Have ordered from our catalog
To receive yours, send $5.00 to:
**SPY SUPPLY**
1212 Boylston St. #120
Chestnut Hill, MA 02167

**SPY SUPPLY**, 1212 Boylston St. #120, Chestnut Hill, MA 02167
**(617) 327-7272**
***Sold for educational purposes only***

# Are Cable Companies Sucking You Dry?

FREE Catalog!

All Major Brands!

Take a Bite out of High Rental Fees

with your own

# Converters & Descramblers

Everquest • Panasonic • Jerrold • Zenith • Pioneer
Scientific Atlanta • Oak • Eagle • Hamlin • Tocom

DISCOVER VISA MasterCard

Order Toll-Free **1 800 624-1150**

Call today for a FREE catalog!

**MD Electronics**

875 S. 72 Street • Omaha, NE 68114

NCCA Member of National Consumer Cable Association

NCCA Member of National Consumer Cable Association


CIRCLE 27 ON FREE INFORMATION CARD

## PE MARKET CENTER CLASSIFIEDS

### CABLE TV

**"BULLET" BUSTER.** Protect your cable box against the infamous cable "bullet." The "Bullet" Buster acts as an electronic shield. Installs in-line in seconds. Don't wait until it's too late! $19.95 +$3.00 S&H. Visa/MC. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

**CABLE — SAFE.** Guarantee cable privacy. The one way valve for your cable TV signal. Cable signals come in, but they don't go out! $29.95, + $3.00 S&H. Visa/MC. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

**DESCRAMBLER SCHEMATICS REVEALED.** A powerful guide to descrambling schemes. $10.00. Visa/MC. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

**CABLE UNSCRAMBLED.** Everything you want to know about cable, but are afraid to ask. $10.00. Visa/MC. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

**UNIVERSAL DESCRAMBLER.** Unscramble signals using your VCR as the tuner. Works with virtually any system, this is the only one you need. Declare cable box independence! $129.95 + $5.00 S&H. Visa/MC. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

**ATTN. CABLE** box owners. Get your Bullet and ID stopper before it's too late. Send $20.50 to R.R. Enterprise, Box 3532, Easton, PA 18043.

**SAVE $100'S** Facts, information, products, kits, descramblers **CABLE COMPANIES DON'T WANT KNOWN!!** Complete package, $10.00 **SATISFACTION GUARANTEED!** ART, PO Box 5552PE, Hollywood, FL 33083-5552. (305) 537-3153.

**DESCRAMBLING. NEW** secret manual. Build your own descramblers for cable and subscription TV. Instructions, schematics for SSAVI, gated sync, sinewave, (HBO, Cinemax, Showtime, UHF, Adult) $12.95, $2.00 postage. **CABLETRONICS,** Box 30502PE, Bethesda, MD 20824.

### MISCELLANEOUS ELECTRONICS WANTED

**TEST EQUIPMENT WANTED.** I will buy your late model test equipment, electronic components, commercial and military connectors. Small quantities or entire inventories. Bob Morgan, Test Equipment Sales, Ph/Fx (717) 842-1534.

**DON'T THROW** that broken VCR away! We'll pay you $25.00 for it! Must not be modified. Call (910) 869-2720 weekdays for details.

**VIDEO TELEPHONES** I will buy working Panasonic or Mitsubishi models. Call (317) 742-5909 daytime with your price.

### SECURITY

**SECURITY SYSTEMS** Devices of all types, control panels, motions, sirens, CCTV, more. **SPECIAL PACKAGE** DSC 6 zone control with remote keypad fully programmable digital communicator for monitoring back-up battery siren contacts motion **ONLY** $195.00. Catalog with order 1 (800) 335-2296, fax (519) 541-1277. Check/Visa: A-1, 2-1200 London Rd., Suite 274, Sarnia, Ontario N7S-1P4 Canada.

**HI-TECH. ELECTRONICS,** The best for less, (spy, security, laser), catalog $5.00 postage: F & P Enterprises, Box 51272, Palo Alto, CA 94303-A.

**ELECTRONIC SALES,** installation, of INTRUDER ID security systems for home, apartment, or business. Call (812) 295-4240.

# CABLE TV DESCRAMBLERS

**Best Wholesale Prices in the U.S.A.!**

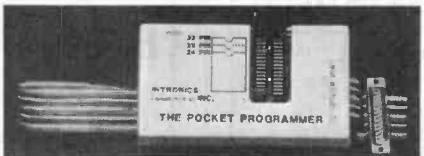
| | 1-4 | 5-9 | 10-19 | 20-49 | 50+ |
|---|---|---|---|---|---|
| *For Jerrold Systems* | | | | | |
| **TNT+** | 59 | 55 | 49 | 45 | 40 |
| **Stealth+** | 55 | 49 | 44 | 39 | 34 |
| **FTB3** | 49 | 39 | 35 | 32 | 30 |
| *For Scientific Atlanta Systems* | | | | | |
| **M80** | 69 | 62 | 55 | 45 | 40 |
| **SA3** | 55 | 45 | 40 | 36 | 33 |
| *For Pioneer Systems* | | | | | |
| **Super-PIO+** | 69 | 62 | 55 | 45 | 40 |
| *Panasonic Converter* | | | | | |
| **TZPC1003** | 75 | 67 | 62 | 59 | 57 |

**1-800-818-9688**

**U.S. Cable TV Inc. M-F: 9-6 EST**

**4100 N.Powerline Rd., Bldg.F4 Pompano Beach, FL 33073**

U.S. Cable will only sell the cable equipment to authorized cable subscribers. It is illegal to operate this equipment without paying for the basic and the premium services. U.S. Cable will not sell to anyone who will not comply with Federal and State laws. *No Florida Sales.*




## The Pocket Programmer

The portable Eprom programmer that uses the printer port of your PC instead of an internal card. The software has 24 easy to use functions and programs 27/25/28/68764 & Cmos from 16K (2K × 8)—2M (256K × 8) Eproms (32 pin socket, UpGradeable to 8Meg). Adapters available for MCU's, 40-Pin Eproms, 5-Gang and Eprom Emulator to 32K × 8.

**$129.95**

**INTRONICS, INC.**
Box 13723
Edwardsville, KS 66113
(913) 422-2094

*Add $4.00 for shipping.*
*Add $4.50 for COD.*
*Visa/Master Charge*

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**

## Satellite-TV

**SAVE 40% - 60%**
800-334-6455
218-739-5231 Int'l
218-739-4879 Fax

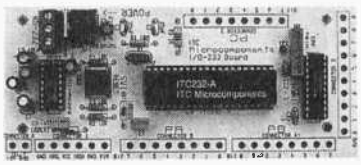
FREE Catalog

**Skyvision Inc.**
1048 FRONTIER DRIVE • FERGUS FALLS, MN 56537

See full page ad in *The Market Center*

# CONTROL AND DATA ACQUISITION FROM A COMPUTER SERIAL PORT (RS232 or RS485)

**I/0-232 SMART BOARDS DO NOT REQUIRE PROGRAMMING!** *These boards connect directly to your computer serial port. Commands are very simple e.g. PRA [Enter] reads Port A. Results are sent back to the computer as an ASCII string allowing the use of PROCOMM, MAC240, or your own programs. In addition to interfacing, the I/O-232 boards have the following embedded functions:*




- Uses ITC232-A IC.
- All standard Baud rates (300-115KB) supported.
- Bin, Hex or Dec formats.
- 24 I/O lines configurable individually as Inputs or latched Outputs.
- 8, 10 or 12 bit, 10 channel Analog to Digital converter.
- 10-10,000 Hz, 0-100% Pulse Width Modulation output.
- 3 EASY to use stepper motor logic interfaces (Muxable to more).
- Relative resistance or capacitance measurements using an RC network (ideal to read temperatures using a thermistor).

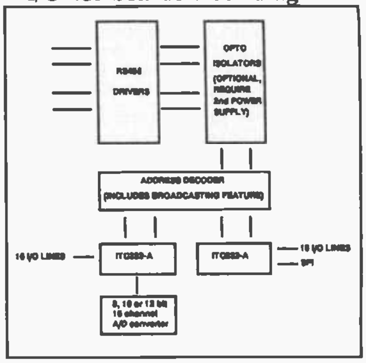
| DESCRIPTION | KIT | ASSEMBLED |
|---|---|---|
| I/O-232-12 (12 bit ADC) | $ 109 | $ 119 |
| I/O-232-10 (10 bit ADC) | $ 99 | $ 109 |
| I/O-232-8 ( 8 bit ADC) | $ 79 | $ 89 |

Enclosure: $14, Serial cable: $9 (specify connector), Power Supply: $11
Add $10 for manuals, diskette containing program examples and Shipping & Handling. Pay by cheque, M. Order, VISA or Master Card.

**ITC MICROCOMPONENTS INC.**
814 West 15th St. Unit 206, North Vancouver, B.C. Canada.
V7P-1M6. PHONE US TOLL FREE AT: (800) 474 7644
Fax: (604) 985 6417. Explore our BBS: (604) 985 1380

**THE I/O-485 BOARDS** *are multiple addressable units containing 2 ITC232-A chips and a 10 channel, 8,10 or 12 bit Analog/Digital converter each. The ITC232-A chips used ensure great simplicity of commands. 32 of these units can be ganged-up on a single RS485 line attached to a computer. A smaller board which plugs onto the computer serial port allows for RS232/RS485 conversion.*

**I/O-485 boards block diagram**




- 32 I/O lines configurable individually as Inputs or latched Outputs organized in 4 x 8 bit ports.
- 10 analog inputs, 8, 10 or 12 bits resolution.
- 32 different addresses plus broadcasting which allows commanding all the boards at once.
- Individual stations or the entire network is software resetable
- Direct or optoisolated link
- Speeds of up to 115200 Bauds.
- All the stations can be hooked onto a single 4 wire cable up to 1 mile long using standard phone jacks.

**All of the following boards are pre-assembled and tested.**

| | | |
|---|---|---|
| I/O-485-8 | (8 Bit ADC) | $ 139 |
| I/O-485-10 | (10 Bit ADC) | $ 159 |
| I/O-485-12 | (12 Bit ADC) | $ 179 |
| 432/485 | Converter | $ 49 |

**For optoisolated option: Add $19 to each item.**

NEW!

# DESKTOP MANUFACTURING!

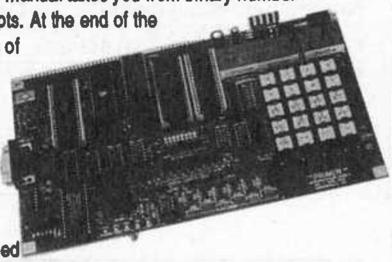

## THIS IS THE MACHINE YOU'VE BEEN WAITING FOR!

Have you ever dreamed of letting your computer manufacture products directly from your CAD drawings? If so, the Neuractor CNC-4+ Desktop Manufacturing System may be just the edge you need! This fourth-generation CNC machining center can automatically drill, mill and route three-dimensional products in wood, plastic and light metals DIRECTLY FROM YOUR CAD DRAWINGS! You've seen the rapid-prototyping and "Santa Claus" machines that cost thousands of dollars, but did you know that as an electronic technician you can assemble one yourself from this inexpensive kit? Utilizing patent pending technology the Neuractor CNC-4+ kit provides you with everything you need to machine products in three dimensions with a resolution of .001". All mechanical components are pre-fabricated, pre-machined, plated and painted. Includes four 83 oz/in digital CY-MOTORs, interface card, 5 amp power supply, 10 pitch steel lead screws, 4 proprietary Slide Block actuator mechanisms, 4 aluminum linear actuator channels, polished steel guide-rods, Dremel bracket, hardware, etc. (You provide Dremel MotoTool(tm) or flex-shaft router and work surface.) It's a complete kit! All you do is put it together and calibrate it! IF THAT'S NOT ENOUGH, WE'RE THROWING IN A FREE FULL-FEATURED 3D CAD/CAM SOFTWARE PACKAGE WITH EACH UNIT! Large 18"x18"x4.6" cutter travel for crafts, electronics and printed circuit board drilling and routing, not to mention model-making, mold-making and even painting!. Get started by ordering your own Neuractor CNC-4+ today! ACT NOW! Kit $595 + $24.95 UPS S/H. (For heavy-duty upgrade add $149) Allow 4-8 weeks for delivery. U.S. CYBERLAB, 14786 Slate Gap Rd., West Fork, AR 72774 (501) 839-8293.

***Free Info! X-Y Power/Rotary Tables and larger CNCs now available!***

# * THE BEST * 8085 MICROPROCESSOR TRAINING SYSTEM JUST GOT BETTER

Are you interested in Single Board Computers and Microprocessor-based systems? If the answer is yes and you want to know more about these fascinating subjects the PRIMER Trainer is the place to start. The PRIMER teaches more and is easier to use than other comparably priced trainers. The over 100 page Self Instruction manual takes you from binary number systems to processing interrupts. At the end of the manual are working examples of using a photocell, a temperature sensor, making a waveform generator, a programmable timer with alarm, and a *new* motor speed control lab using back EMF. The PRIMER comes with everything you need to start programming in machine language. Continue on to program in Assembler, Forth or BASIC with optional upgrade and software. Upgrade includes: RS232 serial port, a serial cable and, 32K of battery backed RAM. Picture shown with upgrade option and optional heavy-duty keypad installed.



THE PRIMER IS ONLY $119.95 QUANTITY 1 IN KIT FORM. THE PRIMER ASSEMBLED & TESTED BY EMAC IS $169.95. ORDER NOW AND RECEIVE ONE FREE POWER SUPPLY WHEN YOU MENTION THIS AD. PLEASE ADD $5.00 FOR SHIPPING WITHIN THE U.S.

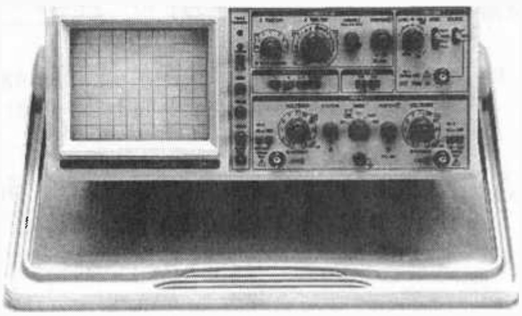
**EMAC, inc.**
618-529-4525 FAX: 457-0110 BBS: 529-5708
P.O.BOX 2042 CARBONDALE, IL 62902

# New and Pre-Owned Test Equipment

## Substantial SAVINGS on New & Pre-Owned Fluke, Hewlett-Packard, Goldstar, Leader, Tektronix, and more ...

### GoldStar Precision

### New Oscilloscope Specials



**Model OS-9100P**
**Full 100 MHz Bandwidth!**

## SUPER SALE! $999.00

**Model OS-904RD**
**On-Screen Measuring Cursors & Readout!**
**40 MHz Bandwidth $699.00**

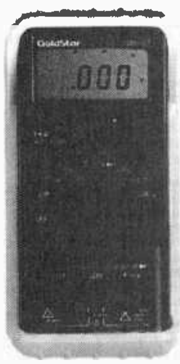
- TV Synchronization Trigger
- Dual-Channel, High Sensitivity
- Calibrated Delayed Sweep
- Two Probes included
- 2 Year Warranty

**FREE SHIPPING! ON ALL GOLDSTAR EQUIPMENT ANYWHERE IN THE U.S.**
Excluding AK & HI

### Pre-Owned Oscilloscope Specials

| | | |
|---|---|---|
| Tektronix 465 | 100 MHz | $499.00 |
| Tektronix 465B | 100 MHz | $599.00 |
| Tektronix 475 | 200 MHz | $749.00 |
| Tektronix 475A | 250 MHz | $849.00 |

- Professionally Refurbished
- Calibrated to Original Specifications
- Dual Channel, Calibrated Delayed Sweep
- 90 Day Warranty




### Professional Quality DMM's at Affordable Prices!

**Model DM-334 $99.00**

- 3.75 Digits, 4000 Count, Auto Range
- DC/AC Volts (1000/750V)
- DC/AC Current (10 A)
- Resistance (40 Meg Ohm)
- Bar Graph, Min/Max, Data Hold
- Frequency Counter (1 MHz)
- Safety Holster & Test Leads Included
- 1 year Warranty

**Model FG-2002C, Sweep/Function Generator $299.00**
**with Built-In Frequency Counter**

- Wide .02 Hz - 2 MHz Frequency Output, 20 Vp-p (open circuit)
- Sine, Triangle, Square, Ramp, Pulse, & Sawtooth
- Built-In 4 MHz Frequency Counter, Bright 4 Digit Display
- Switchable 50 or 600 ohm Output Impedance
- TTL/CMOS Output
- 1 Year Warranty

*Full line of Oscilloscopes, RF, Video & Audio Test Equipment, Power Supplies, Meters, Probes and Accessories.*

## FOTRONIC CORPORATION

## TOLL FREE 1-800-99-METER

1-800-996-3837

P.O. BOX 708
Medford, MA 02155
FAX (617) 665-0780

VISA | MasterCard | AMEX | C.O.D.

# TOP SECRET

**CONSUMERTRONICS**
2011 Crescent Dr., P.O. Drawer 537
Alamogordo, NM 88310

**Voice:** (505) 439-1776, 439-8551;
8AM - 8PM MST, Mon - Sat
**Fax:** (505) 434-0234, 434-1778 (orders only; if you get voice, enter "#11 #11" any time); 24-hr
**Free Tech Support** (relates directly to your order or prospective order): **Tues.** and **Thurs.** only.
**10% Off on orders $100+. 15% Off over $200+**
Add $5 total S/H (US, Canada). All items in stock. VISA, MCard OK. No CODs or "bill me"s. New Catalog (200+ offers) $2 w/order, $5 w/o (check or MO) - NO free catalog. NO dealers. Since 1971. As seen on CBS "60 Minutes," Forbes, etc. By John Williams - former Lockheed Senior Engineer, NMSU Computer Science Professor, NIH Health Physicist. **Wanted:** 9 MAC IIci, PC386, better - buy, trade.
***All software supports all IBM-PC compatible x86 systems (8086 - Pentium)**

**Off-The-Shelf HARDWARE**
**Van Eck Systems, Data Card Reader/Writers, ATM2, RF/EM/Radar/Ultrasonic/IR Jammers/Detectors/Receivers/Xmitters, Security/Surveillance Devices, EM Lab/Weaponry/Countermeasures, Neurophone/Rife/Hieronymus/Resonant Crystal Radionics, Voice Disguisers, Phone Color Boxes, Lineman's Handsets, DTMF Decoder, Bug & Tap Detector/Blaster, Carjack/Kidnap Foiler, Hearing Assistor, Shriek Module, TENS, 6th Sense Communicator, Subliminal Mixer/Amp, Levitator, Vortex Generator, Noise Cancelling System, Unknown Presence Detector, Electronic Dowser, Bacteria Detection Kit - many, many more devices. See our New Catalog.**

**CELLPHONE MODIFICATIONS**
See our Catalog for our infamous cellphone modification guide ($59) - detailed, comprehensive, covers all makes - 10 times more info than competitor's "guide"). (Do Special Projects (below) for up-to-date hardware/software).

**SPECIAL PROJECTS**
We design/build/obtain/repair/modify/maintain/consult on any device/system/process/project - electrical/electronic/phone/computer/mechanical/optical/automotive for business/personal/invention need. Confidentiality guaranteed. Describe and include $30 pre-engineering fee (does not obligate you). Time and cost estimates in 7-10 days.

**The HACKER FILES**
Compilation of 100s of the best articles written (in ASCII) by top hackers & phreakers. Covers every major topic in hackerdom! 3 HD Disks* $59.

**VOICE MAIL HACKING**
How Voice Mail Box (VMB) systems are used and the specific ways they are hacked. Includes ASPEN, MESSAGE CENTER, BIX, GENESIS, EZ, SYDNEY, PHONE MAIL, AUDIX, CINDY, CENTAGRAM, SPERRY LINK, RSVP, etc. Absolutely required for all users, sysops and security personnel! $29.

**PBX HACKING**
1,000s of PBXs are hacked to the tune of $ Billions/yr! While "VOICE MAIL HACKING" details how VMSs are hacked for "phun" and profit - including VMS methods for hacking PBXs themselves - "PBX HACKING" addresses ALL issues relating to PBX hacking, including countermeasures! Can your business or agency afford a $90,000 phone fraud loss (the average loss due to hacked PBXs)? As described in Forbes Magazine. $29

**PHREAKING CALLER ID & ANI**
Details on how they work and dozens of effective ways of defeating Caller ID, ANI, *69, *57, and Call Blocking and *67. Also describes Caller ID, Orange, Beige, Cheese and CF Boxes, ESS, SS7, E-911, various CLASS services, CNA, NON PUB DA, CAMA, DNR, 800-ECR, Diverters, Extenders, Centrex - more. $29.

**Beyond PHONE COLOR BOXES**
Dozens phone color boxes 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. $39.

**ROBOFONE AUTODIALER**
Powerful, versatile, menu-driven "Wargames" autodialer lets you dial any quantity (up to 10K) or mix of local/long distance numbers in any order, over any length of time, whether busy or answered (your choice) and log the times, commands and results to monitor, printer and-or disk. Quick-dial directory of up to 600 numbers. BUSY redial options. Direct modem command and control. All Result Codes, including VOICE and RINGING. Optional shell to terminal program upon CONNECT. Exit to menu or DOS (for batching). Manual + Disk* $29.

**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 FLU-SHOT+ protection system (Ed. Choice, PC Magazine). BBS advice, password defeats, glossary - much more! Manual + Disks* $39.

**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! $29.

**Bold for educational purposes only**

**STOPPING POWER METERS**
As reported on CBS "60 Minutes": How certain devices can slow down - even stop - watthour meters - while loads draw full power! Device simply plugs into one outlet and normal loads into other outlets. Also describes meter creep, overload droop, etc. Plans $29. **I.D. MANUAL:** External magnetic ways (applied to the meter itself) to slow down and stop watthour meters while drawing full loads. Plans. $19. **KW-HR METERS:** How watthour meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow and stop meters by others. $19. Any 2, $38. All 3, $59.

**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! Recent $350,000 ATM crime spree still unsolved! $39.

**CREDIT CARD SCAMS**
Cardholders, merchants, banks suffer $ Billions in losses annually because of credit card fraud. Describes every known means of credit card fraud and scams. Protect yourself! $29.

**CONS, SCAMS & SWINDLES**
Cons & scams and related swindles fleece Americans of $100+ Billion per year! The most comprehensive survival manual on cons & scams of all kinds - from the classic to hi-tech. Details on 100s and their many variations, and countermeasures. Protect yourself! $39.

**STEALTH TECHNOLOGY**
Police radar is fascinating! It also has error rates of 10-20%! Every known error mode - stealth method and material used to minimize radar reflections - tactic and strategy to fight unjust radar tickets (that cost you $100s in insurance and risk cancellation) - methods to detect and jam signals - fully described! $29.

**SECRET & SURVIVAL RADIO**
Optimum survival and security radio equipment, methods, freq allocations and voice/data scrambling/encoding. Includes small receivers/transmitters, telemetry, antenna optimizations, remote monitoring and control, security, surveillance, and ultrasonic, fiber-optic and infrared commo. 70+ circuit plans, tables. $29.

**HIGH VOLTAGE DEVICES**
HV devices plans: Stun Gun, Taser, Prod, Cane, **Flasher, Blaster, Zapper, Audio/RF/Radar Jammer, Jacob's Ladder, Plasma & Van de Graaff Gens., Fence Charger, Geiger Counter, Ozone Gen., Fish Stunner, Plant Stim., Kirlian,** more! All plans for only $29.

**UNDER ATTACK!**
**Electromagnetic Interference and Electronic Weapon Attacks** cause: Cancer, birth defects, and profound psychological, neurological, cardiovascular and immune system disorders! Destructive to people, animals, plants, equipment! Includes **ACTUAL CASES OF EM ATTACKS** (we investigated)! Includes how to verify and pinpoint EMI and electronic attack sources, and specific countermeasures. $29. **EM BRAINBLASTER:** Tutorial and plans for powerful **ELECTROMAGNETIC WEAPONS and LAB DEVICES.** Optimum circuits, freqs, waveforms, duty cycles, intensities. Thorough. $29. Both $49.

**RADIONICS MANUAL**
Exciting electrical, electronic, electromagnetic therapeutic, diagnostic & preventive devices (mostly experimental). History, descriptions, plans (dozens), availabilities of **Radionics Devices** from early to modern. While drugs cost $ Hundreds, electricity costs pennies! $29. **HEAL THYSELF:** Plans for 3 major electronic therapeutic devices of types approved by FDA. $19. Both $39.

**CRYPTANALYSIS TECHNIQUES**
Five powerful menu-driven crypto programs (in .COM and .BAS source code) to analyze, decrypt "secure" ciphertexts. Worked-out examples. Recommended by prestigious "Computers & Security." Manual + Disk* $29.

**By an ORDER of the MAGNITUDE**
**The most comprehensive, hard-hitting, hi-tech survival book ever written!** Topics include electronics, computers, energy, weapons, concealment, revenge, alarms, etc to survive today's dangerous world. We all face increasingly financially and physically brutal times! Field-expedient use of technology in various threat and conflict environments and scenarios. $49.

**ROCKET'S RED GLARE**
How to design and build solid-propellant amateur and survival rockets. Emphasis on formulation, manufacture, installation of propellants, motors, igniters, etc. Includes list of commonly available materials, and the design of launch pads and test beds and their electronics. $29. **FIREWORKS:** How firecrackers (M-80s, blockbusters, cherry bombs), small rockets, volcanos, fountains, sparklers and safety fuses are made and colored. Simple, cheap, common ingredients. $9. Both $36.

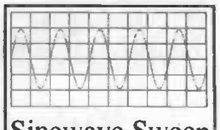
**NATURAL BEAUTY SECRETS**
Legendary beauties Cleopatra, Helen of Troy, Brunhild, others augmented beauty with natural preparations. Describes in detail how many personal care products (ex: skin care, hair care, makeup, soaps, grooming preparations and fragrances) are made from safe, natural, inexpensive substances. For all skin colors, shades. Also includes theatrical, ceremonial, warpaint makeup. $29.

**ULTIMATE SUCCESS MANUAL**
**Underpaid, overworked, harassed or abused? Victim** of office politics? Stuck in a dead-end job? Can't find a good job? Expect to be laid off, fired or transferred soon? The ultimate no-holds-barred, looking-after-#1 Machiavellian techniques to find, obtain, optimize and keep top jobs, pay and benefits. THE RULES OF THE GAME FOR A GAME WITHOUT RULES! From resume to CEO. $29.

# Digital Storage Oscilloscope For $169.95 ???

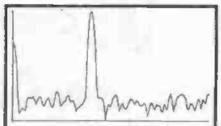
**And much, much more!**

O-Scope I turns PC-ATs into DSO, spectrum analyzer, frequency counter, DVM. DC-50KHz

Sinewave Sweep

Actual O-Scope Signal Traces



Spectrum

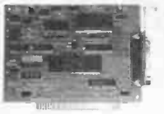
For Orders and Inquiries Call: 1-800-980-9806
For Technical Assistance: 1-713-777-0401

**Allison Technology Corporation**
8343 Carvel, Houston, TX 77036
FAX and BBS 1-713-777-4746

# Data Acquisition

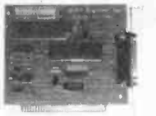
## & Control Hardware for PC's

**ANA100 Analog I/O .......... $ 99**



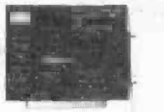
- 8 Channel 8-Bit 0 to 5 Volt input
- 14 TTL I/O lines
- Analog output
- 400 Khz sampling

**DIG100 Digital I/O.......... $ 39**



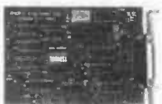
- 8255 PPI
- 24 or 48 TTL I/O Lines
- Selectable Base Address

**ANA150 Analog/Counter... $ 89**



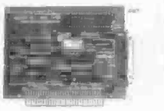
- 8 Channel 8-Bit 0 to 5 Volt input
- 3 16-Bit Counters
- 400 Khz sampling

**DIG200 Counter I/O........ $ 79**



- 3 16-Bit Counters
- 8-Bit input port
- 8-Bit output port
- Selectable Clock frequency input

**ANA200 Analog I/O............ $ 79**



- 1 Channel 12-Bit 0 to 5 Volt input optional bi-polar
- 100 Khz sampling
- 24 TTL I/O lines

**ANA201 Analog ............ $ 129**

- 8 Channel 12-Bit
- x1, x5, x10, x50 Programmable channel gain
- 100 Khz sample

# Engineering Software - PC/MSDOS

| | | |
|---|---|---|
| Analyser III - | Linear Circuit Analysis | $ 149 |
| AutoSkem - | Schematic Drawing program | $ 29 |
| CompDes - | Circuit Design program | $ 29 |
| EasyPC - | PCB Layout and Circuit Drawing | $ 149 |
| Filtech - | Filter Circuit Design and Analysis | $ 229 |
| PC-Scope - | Digital Storage Oscilloscope for ANA100 ANA150 or ANA201 board | $ 39 |
| Pulsar - | Logic Circuit Analysis | $ 149 |

*More Hardware and Software items available*

*Ask for our current catalog*

*MasterCard/Visa accepted*

**BSOFT Software, Inc.**
PHONE 614-491-0832 * FAX 614-497-9971
444 COLTON ROAD * COLUMBUS, OHIO * 43207

## PE MARKET CENTER CLASSIFIEDS

### AUDIO-VIDEO-LASERS

**LASERS, LIGHTSHOWS,** Holography. Lowest prices. For free catalog write: Midwest Laser Products, PO Box 2187, Bridgeview, IL 60455. Or call: (708) 460-9595.

### SATELLITE EQUIPMENT

**SATELLITE RADIO BOOK AND GUIDE.** New book covers all audio services, SCPC, subcarriers, FM squared, facsimile, press services, weather services. Simple how-to-receive instructions. $16.95 plus $3.00 Priority Mail. UNIVERSAL ELECTRONICS, 4555 Groves Road, #12, Columbus, OH 43232. (614) 866-4605.

**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.

### TEST EQUIPMENT

**CATV TEST CHIPS** aslow as$8.95 for testing converter boxes infull service modes. Jerrold, Tocom, Scientific Atlanta. Pioneer BA5XXX — BA67XX cubes clears E2-E5 **Micro Masters, 1 (800) 360-7654.**

**RCA TV** test eqpt. Sweep, WR514A, marker, WR99A, scope WO505A, manuals, adapters, all accessories, $650.00. (410) 857-0784 or first certified check.

**SURPLUS ELECTRONIC** test equipment sold at deep discounts. Request price list by phone or fax (908) 685-2296.

### 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. (602) 428-4073. Visa/MC.

**GREAT EXTRA** income! Assemble craft products at home. Easy/fun! Program guaranteed! Call: 1 (800) 377-6000 ex7930.

**EARN COMPUTER $$$$$** Start a home computer business or enhance **ANY** business with computer business needs. Complete packages! Manuals, video tapes, business software, turnkey computer systems. **FREE** brochure. The Harsin Company, 8681-F West New Bethel Road, Lexington, IN 47138. (812) 866-4076 (24 hr. message)

**MAKE $19,550** with your IBM-PC computer! Send S.A.S.E. to: Brian Medford, 5829 Zapata Pl., Alta Loma, CA 91737-2934.

**SPECIAL FCC** rule allows this new and unique marketing tool to now be sold. Needed by huge customer base left untapped until now! Excellent opportunity. Microcaster, PO Box 221440-A, Cleveland, OH 44122.

**ASSEMBLE TEDDY** bears at home! No sewing! For info send $4.00 & self addressed stamped envelope to: S.H.C., PO Box 97683, Pearl, MS 39288.

# PE MARKET CENTER CLASSIFIEDS

## 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. (602) 428-4073. Visa/MC.

**TURBO CHARGE your amplifier.** Guide to increase wattage of existing power amplifiers. Send $7.50 for complete book. JAM Electronics, 7391 St. Hwy 78, Gratiot, WI 53541.









## PLANS-KITS-SCHEMATICS

**BUILD — FIVE**-digit, ohms, capacitance, frequency, pulse, multimeter. Board and instructions $9.95. Bagnall Electronics, 179 May, Fairfield, CT 06430.

**ALL-IN-ONE catalog. AM/FM/ham/spy,** transmitters, amplifiers, receivers. Voice scramblers/disguisers, audio, TV, Tesla coils, plans, "secret" books, kits, imports, exports and more. Start your own licensed or unlicensed radio station, 60 full pages for $1.00. **PAN-COM INTERNATIONAL,** PO Box 130-H6, Paradise, CA 95967.



**FM STEREO TRANSMITTER** kit broadcasts any audio signal to FM stereo radios throughout your home. Uses unique BA1404 IC. Complete kit: PC board/components — $24.00. Visa/MC. **TENTRONIX,** 3605 Broken Arrow, Coeur d'Alene, ID 83814. (208) 664-2312.

**HOBBYIST CIRCUITS** — Remote room monitor, tone decoder, long distance circuit control and more. Simple experiments for the beginner. **CATALOG** $2.00 — Garrett Plans, Box 155, Jamesburg, NJ 08831.

**SURVEILLANCE TRANSMITTER kits.** 65 to 305 MHz. **Quick & Easy.** Partially assembled units. Five minutes completion. 110-volt duplex receptacle, room battery types, and telephone. Countersurveillance. Catalog: $2.00. **SHEFFIELD ELECTRONICS,** PO Box 377940-B, Chicago, IL 60637-7940.

**FASCINATING DEVICES! FREE** plans with parts special! Super spy microphone $19.50! Super FM transmitter varactor tuned $22.50! Vocal truth detector $39.50! Bug detector 10 GHz bargraph, audible $47.50! Universal IC tester tests any IC $24.50! Hypersonic dazer defend yourself $34.50! Radar cloaker electronic shield $29.50! Laser jammer $39.50! PC Boards $10.00 each. Package of all 8 plans $25.00! S&H $5.00, catalog $4.00 (creditable) or included with order! **QUANTUM RESEARCH,** 17919 - 77th Avenue, Edmonton, Alberta, Canada T5T 2S1.

**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 $3.50 for shipping and handling. CLAGGK Inc., PO Box 4099, Farmingdale, NY 11735. US funds only! USA and Canada — no foreign orders.

**SPY EQUIPMENT!** Transmitters! Surveillance, countersurveillance! Scramblers! Catalog, free plan $5.00. **KDT WHOLESALES,** 2219 Paliswood Place SW, Calgary, Alberta, Canada, T2V 3R3.

**SCHEMATICS, PARTS,** equipment — can't find? Arnold Enterprises, 1218 Dandridge Drive, Lynchburg, VA 24501.

**CIRCUITS! CIRCUITS!** The very best in plans, kits, schematics, and books. Too many to list. Satisfaction guaranteed! Send for free listing. HOBBYTECH, Dept. PE1, 1748 SE Alder, Hillsboro, OR 97123.

**EASILY MODIFY** your tape recorder for long play operation. Plans reg. $69.95, NOW $15.00! **FREE FM TRANSMITTER SCHEMATIC** with order! **HURRY!** RJJ, Box 6555 Stn. D, London, Ontario N5W 5S5 Canada. Sorry no cheques.

**MINIATURE TRANSMITTERS!** Low to high power! Voice changers! Many applications! Catalog: $2.00. **PARSEC ELECTRONICS,** PO Box 34594, Phoenix, AZ 85067.

## COMPUTER SOFTWARE

**COMPLETE IBM-PC shareware catalog on disk!** It contains over 600 shareware programs! Programs sell for as little as .99 cents. Send $5.00 for catalog disk to: Brian Medford, Dept. PE, 5829 Zapata Pl., Alta Loma, CA 91737-2934.

# C & L ELECTRONICS

★ 90 DAY GUARANTEE ★
10 Day Inspection Period

## BUY — SELL — TRADE

| | | |
|---|---|---|
| Assoc. Research 5040 AT | Hy Pot Tester | 500.00 |
| Bertan Assoc. Model 215 | H.V. Supply, 3000 Volt, 5 M.A.D.C. | 500.00 |
| Datapulse 101 | Pulse Generator | 75.00 |
| E.S.I. SR1 | Standard Resistor, 100 Kilo Ohm | 90.00 |
| Fluke 332B | DC Voltage Calibrator | 800.00 |
| Fluke 540B-110 | Transfer Standard | 2,000.00 |
| Fluke 721A | Lead Compensation | 500.00 |
| Fluke 895A | Differential Voltmeter | 300.00 |
| Fluke 1953A | Frequency Counter | 450.00 |
| Fluke 6160A | Frequency Synthesizer | 600.00 |
| HP 141T | Display Section | 500.00 |
| HP 334A | Distortion Analyzer | 600.00 |
| HP 606B | Signal Generator | 350.00 |
| HP 1725A | Scope, 275MHZ | 700.00 |
| HP 1740A | 100MHZ Scope | 500.00 |
| HP 3320B | Automatic Synthesizer | 400.00 |
| HP 3330B | Automatic Synthesizer | 800.00 |
| HP 3467A | Logging Digital Multimeter | 900.00 |
| HP 3551A | Transmission Set | 750.00 |
| HP 3581A | Wave Analyzer | 900.00 |
| HP 3581C | Selective Voltmeter | 995.00 |
| HP 3722A | Noise Generator | 1,250.00 |
| HP 4800A/4801A | Vector Impedance Meter | 450.00 |
| HP 4815A w/Probe | Vector Impedance Meter | 800.00 |
| HP 5245L | 50MHZ Frequency Counter | 75.00 |
| HP 5328A w/OPT 011 | Counter, DC to 100MHZ, 9 digit | 450.00 |
| HP 5340A | Frequency Counter, 10HZ to 18GHZ | 1,000.00 |
| HP 5345A | Frequency Counter, DC to 500MHZ | 1,000.00 |
| HP 6111A | Power Supply, 0-20V, 0-1A | 275.00 |
| HP 6112A | Power Supply, 0-40V, 0-5A | 275.00 |
| HP 7004B | X-Y Recorder | 400.00 |
| HP 7044A | X-Y Recorder | 500.00 |
| HP 8405A | Vector Voltmeter | 600.00 |
| HP 8443A | Generator (less cable) | 300.00 |
| HP 8552A | IF Section | 500.00 |
| HP 8552B | IF Section | 600.00 |
| HP 8553B | RF Section | 600.00 |
| HP 8620A | Sweep Oscillator Frame | 400.00 |
| HP 8620C | Sweep Oscillator Frame | 500.00 |
| Krohn-Hite 3500 | Wideband Amplifier | 400.00 |
| Krohn-Hite 7500 | Wideband Amplifier | 700.00 |
| Keithley 225 | Current Source | 375.00 |
| Keithley 247 | P.S., 0-3KDVC, 6MA | 500.00 |
| Rockland 5100 | Synthesizer, 2MHZ | 600.00 |
| Rod-L M25 | Ground Tester | 700.00 |
| TEK C59 | Camera Scope | 200.00 |
| TEK P6042 | Current Probe, 50 MHZ | 500.00 |
| TEK S-4 | Sampling Head | 600.00 |
| TEK S15010 | Programmable Scanner | 500.00 |
| TEK SC504 | Scope Module, 80 MHZ | 600.00 |
| TEK TM503 | Mainframe | 175.00 |
| TEK TM504 | Mainframe | 175.00 |
| TEK TM506 | Mainframe | 200.00 |
| TEK 465 w/DM44 | Scope, 100 MHZ | 650.00 |
| TEK 465B | 100MHZ Scope | 650.00 |
| TEK 520A | Vectroscope NTSC | 600.00 |
| TEK 7A13 | Differential Comparator LED | 400.00 |
| TEK 7A18 | 75MHZ Amp Dual Trace | 100.00 |
| TEK 7A22 | Differential Amplifier | 500.00 |
| TEK 7A24 | Amplifier | 500.00 |
| TEK 7A26 | 200MHZ Amp Dual Trace | 100.00 |
| TEK 7A29 | Plug-In, 1GHZ | 750.00 |
| TEK 7B15 | Time Base | 650.00 |
| TEK 7B53A OPT05 | Plug-In | 300.00 |
| TEK 7CTIN | Curve Tracer, 0.5W | 450.00 |
| TEK 7D15 | Counter/Timer | 200.00 |
| TEK 7D20* | Programmable Digitizer | 1,500.00 |
| TEK 7L5/L3 | Spectrum Analyzer | 2,000.00 |
| TEK 7L13 | Spectrum Analyzer, 1KHZ to 1.8 GHZ | 2,850.00 |
| TEK 7S12 | Sampling Plug-in | 700.00 |
| TEK 7T11 | Sampling Sweep Unit | 600.00 |
| TEK 1480R | Waveform Monitor | 800.00 |
| TEK 2901 | Time Mark Generator | 350.00 |
| TEK 5111A | Storage Scope, 2 MHZ | 600.00 |
| TEK 7104 | Scope 1GHZ | 6,000.00 |
| TEK 7603 | 100MHZ Scope Mainframe | 250.00 |
| TEK 7844 | Dual Beam Scope, 400MHZ | 750.00 |
| TEK 7904 | 500MHZ Scope Mainframe | 450.00 |

*SELLERS! Cash Paid Within 24 Hours!*

P.O. Box 52153
Philadelphia, PA 19115 **(215) 426-0177** Fax (215) 464-5856

VISA

DISCOVER

MasterCard

# CABLE TV

*Universal Descrambler*

NEW PRODUCT

**UNIVERSAL 5000** **$199.95**

Our fully assembled product is factory tested and *GUARANTEED* to work on your system.

**MODEL 4000 KIT** **$ 79.95**

The 4000 KIT comes with all the electronic parts and our Cad designed PC board. We provide parts list, full schmatic, wiring diagram and tutorial.

**MODEL 4000A Enclosure** **$ 44.95**

The 4000A Enc. Package will provide the hobbyist, who has our 4000 Kit, a custom enclosure, AC adaptor and finish accessories to enclose their kit.

**MODEL 4000 And 5000 Features**

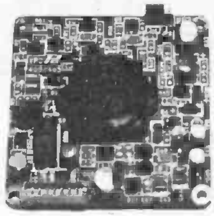
- **The latest in Video Amplification Technology.**
- **New clocking circuits to stabilize color and picture performance.**
- **The most advanced picture locking circuitry.**
- **Inverted Video Option is available.**
- **NO CONVERTER BOX is necessary.**

*The Halcyon Group* 1-800-664-6999

From Canada Call 1-508-643-4102

# MICRO CAMERA

***Sees an entire room through an 1/8" hole***



**$215** introductory price

Only 1.65 x 1.65 x .5 inches
90° field of view
operates on 12 volts DC
380 lines of resolution
built in electronic iris
low light .5 lux
standard video output

NortheastMicro

1-201-794-9766
ext. 828

Po box 175 Elmwood Park NJ 07407


**HOW FAR YOU GO DEPENDS ON WHERE YOU GET YOUR START.**

1-800-854-CLUB

*The Positive Place For Kids*

# EPROM+

## PROGRAMMING SYSTEM USES PARALLEL PORT

*EPROMS* (24,28,32 & 40 PIN*) PLUS 27CXXX
1702*,2708,TMS2716*,32,32A,64,64A,128,128A
256,512,513,011,010,101,1001,1000,1024,210,020
2001,220,2048,4001,040,240,4096,25XX,68764/66
*FLASH EPROMS* 28F256, 28F512, 28F010
28F020, 29C257, 29C010, 29F010
*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)
ER1400,M58657,2401,02,04,08,16,2444,59C11
9306, 46, 56, 66, 8572, 82, 92
*BIPOLAR PROMS** (16 THROUGH 24 PINS)
74SXXX AND 82SXXX FAMILY
*MICROCONTROLLERS** 8741, 42, 48, 49, 8751
C51,8752,87C52,87C5XXX,87C751,87C752,68705
68HC705, 68HC711E9, PIC16C5X, TMS7742
*ADAPTER REQ'D - 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 60 SEC
*RUGGED* (8"X7"X3")ENCLOSURE W/HANDLE
*MADE IN USA* - 1 YEAR WARRANTY

SYSTEM INCLUDES:
PROGRAMMING UNIT
PRINTER PORT CABLE
POWER PACK, MANUAL
AND SOFTWARE.

**$289**

ADD $5.00 SHIPPING
$5.00 C.O.D.
*VISA/MASTERCARD*

*ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150*
(513) 831-9708 FAX (513) 831-7562

# Get the Best Meter ...........for your Dollar

## An Engineering Workhorse for...$29.95

***Dealer List***

Sunex Electronic Supply
4 Locations in FL
(813) 885-4074

Lynntronics
Phoenix, AZ
(602) 841-3900

Minute Man Electronics
Fremont, CA
(510) 791-5036

Gateway Electronics
3 Locations
(314) 427-6116

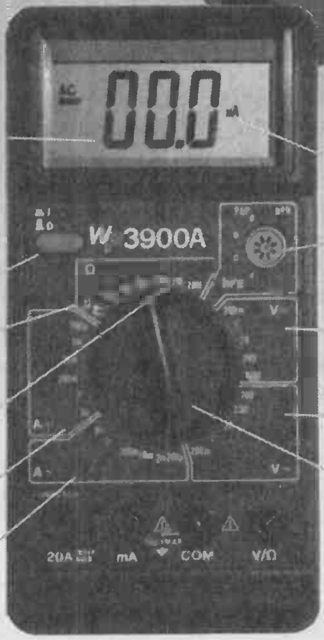
ACE Electronics
San Jose, CA
(408) 297-1383

Alltronics
San Jose, CA
(408) 943-9773

Weirdstuff
Sunnyvale, CA
(408) 746-1100

***Additional Dealers Welcome***

Large 13/16' LCD Display
1 Yr Warranty
Auto PWR Off
Diode Test with Buzzer
Resistance 200 Ohms to 20M Ohms
DC Current 200µA to 20A
AC Current 200µA to 20A
Gray Colored Case 3.5"W x 6.75"H



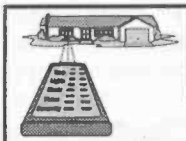

Engineering Unit Display
Transistor Tester
DC Volts 200mV to 1000V
AC Volts 200mV to 700V
Precision Rotary Switch
Easy Access Battery Compartment
Tilt Stand

*See Your Local Dealer or Call*
9am to 5pm Pacific Std. Time
**800-470-WIND** *(9463)*
Fax: 408-987-7735

Item# X3900 ***$29.95***
Item# X3910 with Capacitance........................***$39.95***
Item# X3920 with Capacitance & Temp. .......***$44.95***
Note: Add $4.00 for Shipping and Handling

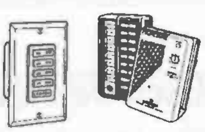
# Windward Products

*We Stand Behind our Products..Satisfaction Guaranteed*
P.O. Box 378 , Moffett Field, CA. 94035



# AUTOMATE YOUR HOME

Hundreds of hard-to-find home automation and wireless control products. Computer control of your home, security systems, surveillance cameras, audio/video control, HVAC, pet care automation and much more. Easy do-it-yourself installation on most products. Affordable, systems start at about $20.



*Largest Selection of X10 Compatible Products in the World*
Call for our Free 64 page Color Catalog
**800-SMART-HOME** (800-762-7846)
**HOME AUTOMATION SYSTEMS, INC.**
151 Kalmus Dr., Ste L4, Dept. PE2, Costa Mesa, CA 92626
Questions 714-708-0610 Fax 714-708-0614

# DESCRAMBLERS

## $$$$ SAVE $$$$

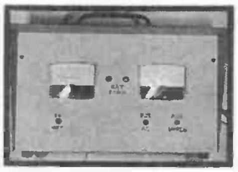
***Specializing in CANADIAN MARKET***

Call us for all your Electronic needs

**Jolly R. Electronics**
**Visa, Mastercard, C.O.D.**

**1-800-279-0614**

YOU CAN BUILD THIS 12VDC to 120VAC
200W to 1000W or MORE
## INVERTER



**Complete Set of Plans includes Theory of Operation & more.**
**Operates most electronic equipment**
**Send $34.95 for Inverter Plans to:**

INVERTER SCIENTIFIC
P.O. BOX 778
SUFFERN, NY 10901

Don't be caught in the dark...
What will you do the next time the lights go out due to an emergency?

INVERTER SCIENTIFIC has the answer...

Camping or Emergencies
You'll have the right size
INVERTER

# USE PE MARKET CENTER CLASSIFIEDS

## READ BY 87,877 BUYERS OF ELECTRONIC EQUIPMENT ACCESSORIES AND PARTS

## INSTRUCTION FOR PLACING YOUR AD!

**HOW TO WRITE YOUR AD**

**TYPE or PRINT** your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

**WHAT WE DO**

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

**RATES**

Our classified ad rate is $1.00per word. Minimum charge is $15.00 per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

**CONTENT**

All classified advertising in the **PE Market Center** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

**DEADLINES**

Ads received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March, 1995 issue that is on sale January 17. The PE Market Center is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

**AD RATES:** $1.00 per word, Minimum $15.00.

Send your ads with payment to:
**Popular Electronics Market Center, 500-B Bi-County Blvd. Farmingdale, NY 11735**

## CATEGORIES

| | | | |
|---|---|---|---|
| **100** — Antique Electronics | **270** — Computer Equipment Wanted | **450** — Ham Gear Wanted | **630** — Repairs-Services |
| **130** — Audio-Video-Lasers | **300** — Computer Hardware | **480** — Miscellaneous Electronics For Sale | **660** — Satellite Equipment |
| **160** — Business Opportunities | **330** — Computer Software | **510** — Miscellaneous Electronics Wanted | **690** — Security |
| **190** — Cable TV | **360** — Education | **540** — Music & Accessories | **710** — Telephone |
| **210** — CB-Scanners | **390** — FAX | **570** — Plans-Kits-Schematics | **720** — Test Equipment |
| **240** — Components | **420** — Ham Gear For Sale | **600** — Publications | |

## CLASSIFIED AD COPY ORDER FORM

**Ad No. 1—Place this ad in Category # ______**

| | | | |
|---|---|---|---|
| 1 - $15.00 | 2 - $15.00 | 3 - $15.00 | 4 - $15.00 |
| 5 - $15.00 | 6 - $15.00 | 7 - $15.00 | 8 - $15.00 |
| 9 - $15.00 | 10 - $15.00 | 11 - $15.00 | 12 - $15.00 |
| 13 - $15.00 | 14 - $15.00 | 15 - $15.00 | 16 - $16.00 |
| 17 - $17.00 | 18 - $18.00 | 19 - $19.00 | 20 - $20.00 |
| 21 - $21.00 | 22 - $22.00 | 23 - $23.00 | 24 - $24.00 |
| 25 - $25.00 | 26 - $26.00 | 27 - $27.00 | 28 - $28.00 |
| 29 - $29.00 | 30 - $30.00 | 31 - $31.00 | 32 - $32.00 |
| 33 - $33.00 | 34 - $34.00 | 35 - $35.00 | 36 - $36.00 |
| 37 - $37.00 | 38 - $38.00 | 39 - $39.00 | 40 - $40.00 |

Ad No 1—Total words ______ × $1.00 per word = $ ______

All Caps words ______ × .20 per word = $ ______

Bold words ______ × .20 per word = $ ______

Bold Cap words ______ × .40 per word = $ ______

**TOTAL COST OF AD No. 1 $ ______**

Total classified ad Payment $ ______ enclosed.

[ ] Check [ ] MasterCard [ ] Visa ($15.00 minimum credit card order)

Card # __ __ __ __ __ __ __ __ __ __ __ __ __ __

Expiration Date __ __ / __ __

Signature ______________________

Name ______________________ Phone ______________________

Address ______________________ City State Zip ______________________

# PE MARKET CENTER CLASSIFIEDS

## PUBLICATIONS

**HISTORIC AND Classic** hardware support magazine. *The Computer Journal* provides how-to information on keeping S-100, Kaypro, Z80, 6809, CP/M, and PC/XT systems running. Over **TEN** years of hardware, software projects. 6 issues $24.00. Free sample. 1 (800) 424-8825. TCJ, PO Box 535, Lincoln, CA 95648.

**FIX MOST** TV's under $10.00! Spot lemons — get results. Free information. (916) 344-2572 or send L.S.A.S.E.: Sunburst Publishing, 5223-E Hackberry, Sacramento, CA 95841.

## EDUCATION

**LEARN IBM PC ASSEMBLY LANGUAGE.** Disk $5.00, Book $18.00. ZIPFAST, Box 12238, Lexington, KY 40581-2238.

**ULTIMATE ELECTRONIC** handbook. Theory, technique, formula made simple. Its easy and fun. Send $10.00 plus $2.00 shipping to S.P. Murchison, 5 Steward Street, Apt. 2, Moncton, N.B. Canada E1E-3P8.

# ADVERTISING INDEX

**POPULAR ELECTRONICS magazine does not assume any responsibility for errors that may appear in the index below.**


| Free Information No. | | Page |
|---|---|---|
| — | A&D Electronics | 129 |
| — | A-Plus Electronics | 129 |
| 125 | Ace Communications | 109 |
| 153 | Advantage Instruments | 99 |
| — | Agrelo Engineering | 116 |
| 26 | Alfa Electronics | 100 |
| 28 | All Electronics | 104 |
| — | Allen Engineering | 113 |
| — | Allison Technology | 126 |
| — | Allstar Electrtonics | 133 |
| 27 | Alltronics | 112 |
| 140 | AMC Sales | 129 |
| — | Andromeda Research | 131 |
| — | Antique Electronics Supply | 77 |
| — | Antique Radio Classified | 73 |
| — | Basic Electrical Supply | 118 |
| 30 | Bel-Merit | 106 |
| — | Bsoft | 126 |
| — | C&C Electronics | 129 |
| — | C&C Specialties | 127 |
| — | C&L Electronics | 130 |
| 132 | C&S Sales | 94 |
| — | Cellsoft | 114 |
| — | CLAGGK, Inc. | 25, 90 |
| — | Cleveland Inst. of Electronics | 5, 31 |
| — | Command Productions | 120 |
| — | Communication Specialists | 129 |
| — | Computer Business Services | 133 |
| — | Comtrad Industries | 8, 15, 19 |
| — | Consumertronics | 126 |
| — | Copyright Clearance Center | 84 |
| 151 | Dalbani | 105 |
| — | EDE Spy Outlet | 128 |
| — | EMAC | 124 |
| — | Electronic Equipment Bank | 96 |
| 139 | Electronic Goldmine | 92 |
| 147 | Electronic Rainbow | 102 |
| — | Electronics Software Solutions | 119 |
| — | Electronics Tech. Today | 73, 82 |
| — | Firestik II | 76 |
| 154 | Foley-Belsaw Institute | 27 |
| — | Forest Electronics | 122 |
| — | Fotronic Corporation | 125 |
| — | Gateway Products | 101 |
| — | Get-Tech Inc. | 122 |
| — | Grantham College | 3 |
| — | Great Southern Security | 97, 128 |
| — | Greenleaf Electronics Inc. | 120 |
| — | Halcyon Group | 130 |
| — | Home Automation Systems | 131 |
| — | Howard Electronics | 127 |
| — | Information Unlimited | 115 |
| 164 | Interactive Image Technologies | CV2 |
| — | Intronics | 123 |
| — | Inverter Scientific | 131 |
| 144 | Island LogiX Inc. | 117 |
| — | ITC Microcomponents | 124 |
| — | Jolly R Electronics | 131 |
| — | KDE Electronics | 113 |
| 38 | Kelvin ELectronics | 103 |
| — | M&G Electronics | 91 |
| 160 | MCM Electronics | 117 |
| — | MD Electronics | 111 |
| — | Mega Electronics | 127 |
| 149 | Mendelsohn's | 133 |
| 42 | MicroCode Engineering | 93 |
| — | Ming Engineering | 108 |
| — | Modern Electronics | 127 |
| — | Mondo-tronics | 129 |
| 163 | Mouser Electronics | 4 |
| — | Northeast Micro | 130 |
| — | NRI Schools | 53 |
| — | Nu-Tek Electronics | 7 |
| 43 | Optoelectronics | CV4 |
| — | Orion Electronics | 133 |
| 148 | Parts Express | 128 |
| — | Phillips Tech | 128 |
| 145 | Prairie Digital Inc. | 114 |
| 46 | Print | 101 |
| 159 | Print | 116 |
| — | Progressive Concepts | 128 |
| — | Project Solution | 133 |
| — | Professional Career Devel. Inst. | 79 |
| — | Self-Reliance Co. Inc. | 114 |
| — | Sescom, Inc. | 118 |
| — | Show Time | 119 |
| — | Silicon Valley Surplus | 129 |
| — | Skyvision | 98 |
| — | Skyvision (Small) | 123 |
| — | Software Science | 128 |
| — | Spy Supply | 110 |
| — | Tab Books | 31 |
| — | Tri Star Satellite Systems | 133 |
| 136 | UCANDO Videos | 122 |
| — | Universal Electronics | 120 |
| — | US Cable (Zentek) | 123 |
| — | US Cyberlab | 119, 124 |
| — | Video Communication Systems | 121 |
| — | Vision Electronics | 128 |
| — | Weeder Technologies | 91 |
| — | Weka Publishing | 107 |
| — | Windward | 131 |
| — | WPT Publications | 123 |
| 134 | Xandi Electronics | 113 |



**ADVERTISING SALES OFFICE**

**Gernsback Publications, Inc.**
**500-B Bi-County Blvd.**
**Farmingdale, NY 11735**
**1-(516) 293-3000**

**Larry Steckler, EHF/CET**
President

**Christina Estrada**
Assistant to the President

**For Advertising ONLY**
**516-293-3000**
**Fax 1-516-293-3115**

**Larry Steckler**
publisher

**Arline Fishman**
advertising director

**Denise Mullen**
advertising assistant

**Kelly Twist**
credit manager

**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
1-516-487-9357, 1-516-293-3000
Fax 1-516-487-8402

**MIDWEST/Texas/Arkansas/ Oklahoma, Colorado, Arizona**

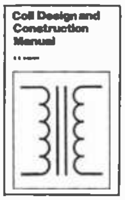
**Ralph Bergen**
Midwest Sales
One Northfield Plaza, Suite 300
Northfield, IL 60093-1214
1-708-446-1444
Fax 1-708-559-0562

**PACIFIC COAST/Mountain States**

**Anita Bartman**
Hutch Looney & Assoc., Inc.
6310 San Vicente Blvd.
Suite 360
Los Angeles, CA 90048
1-213-931-3444
Fax 1-213-931-7309

# Hobbyist's Paperback Budget Books


☐ **BP80/98—Popular Electronic Circuits-Books 1 and 2...$11.90.** Contains a wide range of circuits which are accompanied by text giving a brief introduction, circuit description and special notes on construction and setting-up that may be necessary.




☐ **#160—Coil Design and Construction Manual...$5.95.** A complete book for the home builder on how to make RF, IF, audio and power chokes and transformers. Practically every possible type is discussed and calculations are explained in detail.

☐ **BP271—How to Expand, Modernize and Repair PC's and Compatibles...$7.75.** All the practical information you are likely to need to upgrade your PC and compatible. Also contains useful information and illustrations to help you with repairs.

☐ **BP276—Shortwave Superhet Receiver Construction...$6.95.** Provides construction details, including coil winding, of a number of advanced-design receivers which should have performance levels at least equal to commercial sets of similar complexity.


☐ **#223—50 Projects Using IC CA3130...$5.00.** One of the more practical and useful operational amplifiers (opamp), the CA3130 integrated circuit chip is the heart of several easy-to-assemble projects covered in the book. The projects are divided into five categories: audio projects, RF projects, test equipment, household projects and a catch-all miscellaneous group. Ideal for all skill levels.

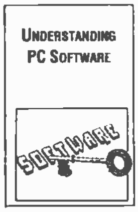

☐ **BP122—Audio Amplifier Construction...$5.75.** Practical designs are featured and include circuit diagram and description, Veroboard or printed-circuit board layout and construction notes. The text is divided into two parts. The first deals with many types of preamplifiers. The second covers power amplifiers from a simple low-power battery type to a 100-watt DC-coupled amplifier using four MOSFETs in the output stage.


☐ **BP107—30 Solderless Breadboard Projects-Book 1...$5.95.** Each project is designed to be built on a "Verobloc" breadboard and is presented with a brief circuit description, circuit diagram, component layout diagram and components list. Notes on construction and applications are provided. Wherever possible, the components are common to several projects to keep project costs down.

☐ **BP266—Electronic Modules and Systems for Beginners...$7.25.** Shows the reader how to build a number of simple analog and digital circuit modules, all suitable for battery operation, and all based on only 1 or 2 transistors or ICs.


☐ **BP329—Electronic Music Learning Projects...$6.25.** A beginner's book that will assist you in assembling such projects as the Elexylophone, Gildaphone, Melody Ranger, Cordmaker, Appealing Handbells, Electronic Sol-Fa, Tune-up Box and more.


☐ **BP319—Making MS-DOS Work for You—$6.50.** What you need to know first, comes first, however the text is written in a circular style so that the reader can start anywhere in the text. This book is relevant to all versions of both MS-DOS and PC-DOS.

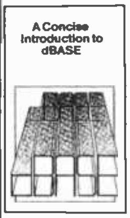



☐ **BP303—Understanding PC Software...$6.95.** Covers main types of PC software, giving details of typical uses, the basics of how they are used and their limitations. Each chapter covers popular software and programs of a similar type.


☐ **BP105 Aerial (Antenna) Projects...$5.50.** In this book the author has considered practical antenna designs, including active, loop and ferrite antennas which perform well and are relatively simple and inexpensive to build. The complex theory and mathematics of antenna design have been avoided. Also included are construction details of a number of antenna accessories including a pre-selector, attenuator and filters.

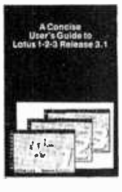

☐ **BP33—Electronic Calculator Users Handbook...$5.75.** The book eliminates the mysteries of the calculator and offers unique ideas for the simplest to most complex calculators. Covers the basic functions plus trigonometric, hyperbolic, logarithms, square roots and powers. Included are formulas and data for VAT. discounts, and mark up, currency conversion, interest, binary and octal numbers, and much more!


☐ **BP125—25 Simple Amateur Band Antennas...$5.50.** Plans to build antennas that are simple and inexpensive to construct and perform well. From the simple dipole to beam, triangle and even mini-rhombic types made from four TV masts and about 400 feet of wire. After the antenna discussion you will find a complete set of dimension tables that will help you "tune" an antenna on a particular frequency.

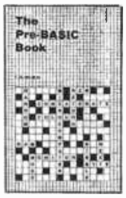



☐ **BP263—A Concise Introduction to dBASE ...$6.95.** The most popular data-base program, dBASE, is difficult to master without help. This book helps you spend your time using dBase, not setting it up. A user's guide that covers all the basics up to dBase IV.


☐ **PCP104—Electronics—Build and Learn... $9.95.** Construction details are given to build a circuit demonstrator that is used throughout the book to introduce common electronic components and how these components are built up to useful circuits.




☐ **BP302—A Concise Users Guide to Lotus 1-2-3 Release 3.1... $6.25**. Written to help existing spreadsheet users upgrade to 1-2-3 Release 3.1, which has the ability to work 3-dimensionally with both multiple worksheets and files.




☐ **BP146—The Pre-BASIC Book...$6.95.** Another book on BASIC but with a difference. It concentrates on introducing technique by looking in depth at the most frequently used and more easily understood computer instructions.

## Just What the Project Builder Is Looking For!

☐ #160—Coil Design and Construction Manual ........ $5.95
☐ #219—Solid State Novelty Projects ........ $4.95
☐ #222—Solids State Shortwave Receivers for Beginners ........ $5.50
☐ #223—50 Projects Using IC CA3130 ........ $5.00
☐ #225—Practical Introduction to Digital ICs ........ $5.25
☐ PCP111—Electronic Test Equipment Handbook ........ $13.95
☐ 1596T—24 Silicon-Controlled Rectifier Projects ........ $9.95
☐ BP58—50 Circuits Using 7400 Series ICs ........ $5.50
☐ BP69—Electronic Games ........ $5.50
☐ BP71—Electronic House Projects ........ $5.00
☐ BP84—Digital IC Projects ........ $5.50
☐ BP93—Electronic Timer Projects ........ $5.50

**ELECTRONIC TECHNOLOGY TODAY INC.**
P.O. BOX 240, Massapequa, NY 11762-0240

Name ______________________
Address ______________________
City__________ State ________ Zip________
PE5 Allow 6-8 weeks for delivery

**SHIPPING CHARGES IN USA AND CANADA**

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

**SORRY No orders accepted outside of USA & Canada**

Number of books ordered ☐

Total price of merchandise ........ $________
Shipping (see chart) ........ $________
Subtotal ........ $________
Sales Tax (NYS only) ........ $________
Total Enclosed ........ $________

**All payments must be in U.S. funds!**

# Another bright idea from OPTOELECTRONICS

## But don't just take our word for it...

"I purchased the Scout... WHAT A UNIT! VERY IMPRESSED !!"
Allen Wilde - Littleton, MA

"I take my Scout with me everywhere - it's very effective in mobile use, either in the car or on foot. I recommend a Scout over another scanner when adding to your collection... the most effective device so far from Opto for the Scannist."
Steve Dawkins - Pensacola, FL

"This is a breakthrough product in everyway... KUDOS!"
Robert Caron - DesMoines, IA

"The Scout is AWESOME-the folks at OPTO keep coming up with winners, and this is their best yet!"
Gordon West
Gordon West Radio School

"Scantastic"
Brad Schroeder - Omaha, NE


- 400 Frequency Memory with 250 Hit Counter
- Sleep Mode to prevent data loss when battery dies
- Reaction Tune - will tune a reciever with CI-V port in .01 seconds
- Beeper and Vibrator Signal indicator
- Digital Filter and Auto Capture
- CI-V Serial Data Port
- Software for uploading Frequencies to a PC included
- 16 Segment Signal Level Bargraph
- 10MHz to 2.8GHz Frequency Range
- 7 Hour Battery Operation
- Maximized Sensitivity for maximum antenna pick-up

**SCOUT............$449.00**

**OPTIONS:** Option 1: Mini DB32 Ant....$29.00 Option 2: AC100 Rapid Charger....$39.00 Option 3: Spectrum-CD ROM....$39.00

### Scout SPECTRUM-CD ROM


# The SCOUT

### Scout Reaction-Tune

**ORDER LINE: 800-327-5912**

TEL: (305) 771-2050 FAX: (305) 771-2052
5821 NE 14TH AVE, FORT LAUDERDALE, FL, 33334
VISA,MC,C.O.D.,CASH OR MONEY ORDER-SHIPPING ADDT'L
ALL SPECIFICATIONS & PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE OR OBLIGATION.

CIRCLE 43 ON FREE INFORMATION CARD