

**SPOTLIGHT ON HOME THEATER**

# Popular Electronics<sup>®</sup>

JANUARY 1993

## **BUILD AN AVIATION-BAND RECEIVER**

Listen-in to dramatic radio communications from pilots, ground controllers, and more

## **BUILD A DOG-BARK INHIBITOR**

Give yourself and your neighbors some peace and quiet with this training aid that humanely curbs your dog's barking

## **NAVIGATION SYSTEMS FOR YOUR CAR**

Learn about on-board navigation systems, satellite positioning, roadside beacons, and more

## **UNDERSTANDING MICROPROCESSORS**

We all know what microprocessors do, but how many of us understand how they work?

3 NEW FactCards  
IN THIS ISSUE



\$3.50 U.S.  
\$3.95 CANADA



A  
**GERNSBACK**  
PUBLICATION

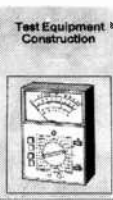


- Also: ● Product Reviews  
● Scanner Scene ● Computer Bits  
● Antique Radio ● Think Tank  
● Ham Radio ● DX Listening  
● And A Whole Lot More!

# Electronics Paperback Books

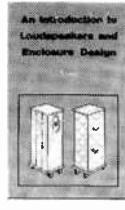
GREAT PAPERBACKS AT SPECIAL PRICES

**BP248—TEST EQUIPMENT CONSTRUCTION** ..... \$5.95. Details construction of simple, inexpensive, but extremely useful test equipment. AF Gen, Test Bench Ampl, Audio Millivoltmeter, Transistor Tester and six more.



**BP267—HOW TO USE OSCILLOSCOPES AND OTHER TEST EQUIPMENT** ..... \$6.95. Mastering the oscilloscope is not really too difficult. This book explains all the standard controls and functions. Other equipment is also described.

**BP265—MORE ADVANCED USES OF THE MULTIMETER** ..... \$5.95. Use these techniques to test and analyze the performance of a variety of components. Also see how to build ad-ons to extend multimeter capabilities.



**BP256—INTRO TO LOUDSPEAKERS AND ENCLOSURE DESIGN** ..... \$5.95. We explore the variety of enclosure and speaker designs in use today so the reader can understand the principles involved.

**CMOS1—CMOS POCKET GUIDE 1** ..... \$18.95. Works like the TTL Guides but covers all commonly used CMOS standard devices. Six major sections. The first shows the device schematic. Next is a brief description of the component and is followed by full operating details. The fourth section lists major applications, while the 5th and 6th sections present essential data for that device and a list of the relevant manufacturers. The final two sections are a valuable cross-reference.



**BP299—PRACTICAL ELECTRONIC FILTERS** ..... \$6.95. Presents a dozen filter-based practical projects with applications in and around the home or in the constructor's workshop. Complete construction details are included.



**BP249—MORE ADVANCED TEST EQUIPMENT CONSTRUCTION** ..... \$6.95. Eleven more test equipment construction projects. They include a digital voltmeter, capacitance meter, current tracer and more.



Digital Audio Projects

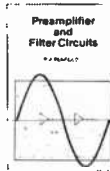
**BP245—DIGITAL AUDIO PROJECTS** ..... \$5.95. Practical circuits to build and experiment with. Includes A/D converter, input amplifier, digital delay line, compander, echo effect and more.



**BP247—MORE ADVANCED MIDI PROJECTS** ..... \$5.95. Circuits included are a MIDI indicator, THRU box, merge unit, code generator, pedal, programmer, channelizer, and analyzer.



**BP257—INTRO TO AMATEUR RADIO** ..... \$6.95. Amateur is a unique and fascinating hobby. This book gives the newcomer a comprehensive and easy to understand guide to the subject.

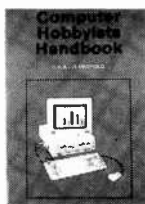


**BP309—PREAMPLIFIER AND FILTER CIRCUITS** ..... \$6.95. Provides circuits and background info for a range of preamplifiers, plus tone controls, filters, mixers and more. All are high-performance circuits that can be built at a reasonable cost.

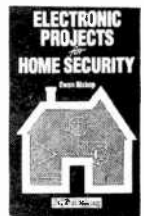
**BP303—UNDERSTANDING PC SOFTWARE** ..... \$6.95. This book will help you understand the basics of various types of business software in common use. Types of software covered include word processors, spelling checkers, graphics programs, desktop publishing, databases, spreadsheets and utilities.



**BP251—COMPUTER HOBBYISTS HANDBOOK** ..... \$8.95. A wrapup of everything the computer hobbyist needs to know in one easy to use volume. Provides a range of useful reference material in a single source.



**PCP115—ELECTRONIC PROJECTS FOR HOME SECURITY** ..... \$10.00. 25 projects ranging from a single-door protection circuit that can be completed in an hour or two, to a sophisticated multi-channel security system. Each project is described in detail with circuit diagrams, explanations of how it works, instructions for building and testing, and how to adapt circuits to meet special requirements.



**BP195—INTRODUCTION TO SATELLITE TV** ..... \$9.95. A definitive introduction to the subject written for the professional engineer, electronics enthusiast, or others who want to know more before they buy. 8 x 10 in.

**BP190—ADVANCED ELECTRONIC SECURITY PROJECTS** ..... \$5.95. Includes a passive infra-red detector, a fiber-optic loop alarm, computer-based alarms and an unusual form of ultrasonic intruder detector.

**BP235—POWER SELECTOR GUIDE** ..... \$10.00. Complete guide to semiconductor power devices. More than 1000 power handling devices are included. They are tabulated in alpha-numeric sequence, by technical specs. Includes power diodes, Thyristors, Triacs, Power Transistors and FETs.

**BP234—TRANSISTOR SELECTOR GUIDE** ..... \$10.00. Companion volume to BP235. Book covers more than 1400 JEDEC, JIS, and brand-specific devices. Also contains listing by case type, and electronic parameters. Includes Darlingtons transistors, high-voltage devices, high-current devices, high power devices.

**BP99—MINI-MATRIX BOARD PROJECTS** ..... \$5.50. Here are 20 useful circuits that can be built on a mini-matrix board that is just 24 holes by ten copper-foil strips.

**BP117—PRACTICAL ELECTRONIC BUILDING BLOCKS—Book 1** ..... \$5.75. Oscillators, Timers, Noise Generators, Rectifiers, Comparators, Triggers and more.

**BP184—INTRO TO 68000 ASSEMBLY LANGUAGE** ..... \$6.95. The 68000 is a great new breed of microprocessor. Programming in assembly language increases the running speed of your programs. Here's what you need to know.

**BP179—ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS** ..... \$7.50. Data and circuits for interfacing the computer to the robot's motors and sensors.

**BP239—GETTING THE MOST FROM YOUR MULTIMETER** ..... \$5.95. Covers basics of analog and digital meters. Methods of component testing includes transistors, resistors, capacitors and other active and passive devices.

**BP97—IC PROJECTS FOR BEGINNERS** ..... \$5.50. Power supplies, radio and audio circuits, oscillators, timers, switches, and more. If you can use a soldering iron you can build these devices.

**BP37—50 PROJECTS USING RELAYS, SCR'S & TRIACS** ..... \$5.50. Build priority indicators, light modulators, warning devices, light dimmers and more.

**RADIO—100 RADIO HOOKUPS** ..... \$3.00. Reprint of 1924 booklet presents radio circuits of the era including regenerative, neutrodyne, reflex & more.

**BP42—SIMPLE LED CIRCUITS** ..... \$5.50. A large selection of simple applications for this simple electronic component.

**BP122—AUDIO AMPLIFIER CONSTRUCTION** ..... \$5.75. Construction details for preamps and power amplifiers up through a 100-watt DC-coupled FED amplifier.

**BP92—CRYSTAL SET CONSTRUCTION** ..... \$5.50. Everything you need to know about building crystal radio receivers.

**BP255—INTERNATIONAL RADIO STATIONS GUIDE** ..... \$7.95. Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed to guide him or her around than ever more complex radio bands.

## CHECK OFF THE BOOKS YOU WANT

**ELECTRONIC TECHNOLOGY TODAY INC.**  
P.O. Box 240, Massapequa Park, NY 11762-0240

SHIPPING CHARGES IN USA AND CANADA

**SORRY** No orders accepted outside of USA & Canada

Number of books ordered

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

|                    |       |        |
|--------------------|-------|--------|
| \$0.01 to \$5.00   | ..... | \$1.50 |
| \$5.01 to \$10.00  | ..... | \$2.50 |
| \$10.01 to \$20.00 | ..... | \$3.50 |
| \$20.01 to \$30.00 | ..... | \$4.50 |
| \$30.01 to \$40.00 | ..... | \$5.50 |
| \$40.01 to \$50.00 | ..... | \$6.50 |
| \$50.01 and above  | ..... | \$8.00 |

|                            |       |          |
|----------------------------|-------|----------|
| Total price of merchandise | ..... | \$ _____ |
| Shipping (see chart)       | ..... | \$ _____ |
| Subtotal                   | ..... | \$ _____ |
| Sales Tax (NYS only)       | ..... | \$ _____ |
| Total Enclosed             | ..... | \$ _____ |

All payments must be in U.S. funds

PE193

# Popular Electronics®

THE MAGAZINE FOR THE ELECTRONICS ACTIVIST!

## CONSTRUCTION ARTICLES

|   |                        |    |
|---|------------------------|----|
| <b>BUILD AN AVIATION RECEIVER</b> .....   | Fred Blechman          | 31 |
| <i>Join a growing throng of listening enthusiasts who tune in to the drama of aircraft communications</i> |                        |    |
| <b>BUILD A DOG BARK INHIBITOR</b> .....   | Robert J. Gaffigan Jr. | 36 |
| <i>Give yourself and your neighbors some peace and quiet with this humane training aid</i>                |                        |    |
| <b>A TELEPHONE LINE-IN-USE INDICATOR</b> .....  | Michael A. Covington   | 43 |
| <i>Keep others from barging in on your telephone conversations with a simple line-monitor circuit</i>     |                        |    |
| <b>BUILD A WIRE TRACER</b> .....  | Charles D. Rakes       | 45 |
| <i>Cut those tough home-repair and remodeling jobs down to size with this wire-tracing circuit</i>        |                        |    |

## FEATURE ARTICLES

|  |                    |    |
|--|--------------------|----|
| <b>ON-BOARD NAVIGATION SYSTEMS FOR YOUR CAR</b> .....  | Bill Siuru         | 39 |
| <i>Satellite positioning, roadside beacons, and other new developments to help drivers stay on course</i>    |                    |    |
| <b>TRACKING DISTANT SIGNALS</b> .....  | Laura Quarantiello | 47 |
| <i>By monitoring the VHF low-band for skip, you could easily make some wonderful long-distance contacts</i>  |                    |    |
| <b>ALL ABOUT MICROPROCESSORS</b> .....   | Timothy D. Green   | 59 |
| <i>We explore what makes these powerful chips tick in an informative but intuitive style</i>                 |                    |    |
| <b>THE CODE MAKERS</b> .....   | Larry Lisle        | 63 |
| <i>Trace the history of code and code-sending gear from the early days to today's computerized equipment</i> |                    |    |

## PRODUCT REVIEWS

|   |             |    |
|---|-------------|----|
| <b>GIZMO</b> .....  |             | 5  |
| <i>Spotlight on home theater: Sharp Sharpvision LCD Projector; Carver AV Receiver; Cerwin-Vega Sensurround Speaker Systems; and much more</i> |             |    |
| <b>HANDS-ON REPORT</b> .....  |             | 22 |
| <i>Heath/Reflex Wireless Doorbell</i>   |             |    |
| <b>PRODUCT TEST REPORT</b> .....  | Len Feldman | 26 |
| <i>Cannon UC1 8mm Camcorder</i>   |             |    |

## COLUMNS

|  |                  |    |
|--|------------------|----|
| <b>ANTIQUE RADIO</b> .....               | Marc Ellis       | 65 |
| <i>The Sky Buddy: All together again</i> |                  |    |
| <b>COMPUTER BITS</b> .....               | Jeff Holtzman    | 67 |
| <i>The XT syndrome</i>                   |                  |    |
| <b>CIRCUIT CIRCUS</b> .....              | Charles D. Rakes | 70 |
| <i>UJT circuits</i>                      |                  |    |
| <b>THINK TANK</b> .....                  | John Yacono      | 72 |
| <i>RF bulbs</i>                          |                  |    |
| <b>DX LISTENING</b> .....                | Don Jensen       | 75 |
| <i>Targeting the world</i>               |                  |    |
| <b>HAM RADIO</b> .....                   | Joseph J. Carr   | 80 |
| <i>Some more potpourri</i>               |                  |    |
| <b>SCANNER SCENE</b> .....               | Marc Saxon       | 82 |
| <i>A couple of winners</i>               |                  |    |

## DEPARTMENTS

|  |            |     |
|--|------------|-----|
| <b>EDITORIAL</b> .....                         | Carl Laron | 2   |
| <b>LETTERS</b> .....                           |            | 3   |
| <b>FACTCARDS</b> .....                         |            | 49  |
| <b>POPULAR ELECTRONICS MARKET CENTER</b> ..... |            | 50A |
| <b>FREE INFORMATION CARD</b> .....             |            | 51  |
| <b>1992 ANNUAL INDEX</b> .....                 |            | 53  |
| <b>ELECTRONICS LIBRARY</b> .....               |            | 84  |
| <b>NEW PRODUCTS</b> .....                      |            | 87  |
| <b>ELECTRONICS MARKET PLACE</b> .....          |            | 95  |
| <b>ADVERTISER'S INDEX</b> .....                |            | 98  |

**Popular Electronics** (ISSN 1042-170X) 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 \$2.95. © 1992 by Gernsback Publications, Inc. All rights reserved. **Hands-on Electronics** and **Gizmo** trademarks are registered in U.S. and Canada by Gernsback Publications, Inc. **Popular Electronics** trademark is registered in U.S. and Canada by Electronics Technology Today, Inc. and is licensed to Gernsback Publications, Inc. Printed in U.S.A.

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

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

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

Larry Steckler

*EHF, CET*

*Editor-In-Chief and Publisher*

## EDITORIAL DEPARTMENT

Carl Laron

*Editor*

Robert A. Young

*Associate Editor*

John J. Yacono

*Associate Editor*

Byron G. Wels, K2AVB

*Associate Editor*

Teri Scaduto

*Assistant Editor*

Kathy Terenzi

*Editorial Assistant*

Marc Spiwak

*Editorial Associate*

Joseph J. Carr, K4IPV

Marc Ellis

Len Feldman

Jeffrey K. Holtzman

Don Jensen

Chris F. O'Brian

Charles D. Rakes

Marc Saxon

*Contributing Editors*

## PRODUCTION DEPARTMENT

Ruby M. Yee

*Production Director*

Karen S. Brown

*Production Manager*

Marcella Amoroso

*Production Assistant*

Lisa Rachowitz

*Editorial Production*

## ART DEPARTMENT

Andre Duzant

*Art Director*

Injae Lee

*Illustrator*

Russell C. Truelson

*Illustrator*

Jacqueline P. Cheeseboro

*Circulation Director*

Michele Torrillo

*P-E 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

Customer Service/Order Entry

1-800-827-0383

7:30 AM - 8:30 PM EST

## Advertising Sales offices listed on page 98

Cover photography by Denny Bailly/Unicorn Stock  
Photos and Diversified Photo Services

Composition by  
Mates Graphics



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

## A MIXED BAG

Since deregulation, cable-TV companies have pretty much had their way. In most communities, they enjoy a monopoly. If consumers don't like the pricing structure, programming choices, or have other complaints, they have had little recourse except not to subscribe. And while local governments could threaten a poorly performing cable company with franchise revocation, such actions were essentially impractical. The cable industry could operate as it saw fit, and without fear.

That situation changed somewhat with the passage of the cable-TV bill this past October. Passed over the veto of President Bush the bill helps level the playing field a little. Unfortunately, the key words here are "a little."

Furthermore, the bill is far from perfect. For instance, the new bill provides some limited rate relief. It allows the FCC to regulate only the most basic tier of programming; the FCC has no input on other rates unless it receives complaints from consumers, municipalities, etc.

Also important is a provision calling for cable systems to be technically compatible with all TV's, VCR's, etc. Except where off-premises descrambling is used (and currently few operators use that technology), most scrambling techniques render features such as picture-in-picture essentially useless (unless additional descramblers are rented). Unfortunately, it is unclear how this provision will be interpreted (perhaps it will give life to the EIA's multiport standard?), and it is vague enough to give operators the leeway they need to skirt it with little imagination.

Somewhat troubling is a provision that allows TV broadcasters to charge cable companies for use of their signals. It ignores the fact that broadcasters already receive value for their signals in terms of higher viewership and, hence, higher advertising revenues. Worse, intertwined with modified must-carry regulations, it could tax the channel capacity of older, smaller systems, or deprive viewers of channels they desire. This provision was unnecessary, and could be a source of trouble in the years to come.

In short, all the sound and the fury aside, the bill appears to be a mixed bag. Its benefits will largely depend on how, and how vigorously, the FCC chooses to implement and enforce its provisions. But at least it's a start.

Carl Laron  
Editor



## MUDDLED MESSAGE

I'm writing concerning a minor problem with the "Personal Message Recorder" project (*Popular Electronics*, October 1992). As described on page 40, the electret microphone must be tied to analog ground, but according to Fig. 2 (schematic diagram) of the article, there is no such connection. The correct connection is shown in Fig. 1 here. There is

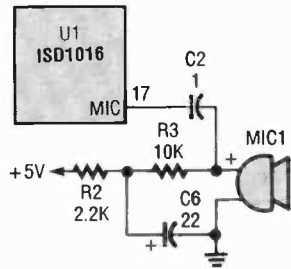


Fig. 1

also a problem with the parts-placement diagram (Fig. 4). The designations for the three

0.1- $\mu$ F capacitors have been interchanged. The part designated C1 is actually C2, C2 is C3, and C3 is C1. C.B.  
Brooklyn, NY

## HIGH-ENERGY, HIGH-RISK IGNITION

Charles Ball's article, "Build A High-Energy Ignition System For Your Car" (*Popular Electronics*, September 1992) appears to be a good article in general, but makes a few risky assumptions that must be pointed out to your readers.

First, retrofitting a high-output ignition on an older car requires that the *entire* ignition system be capable of handling all that

extra energy that the old point/Kettering ignitions weren't intended or designed to handle. In any ignition that has a 40kV or higher peak output voltage, the distributor cap, rotor, plug wires, and plug-wire boots must be designed with sufficient insulation and high dielectric strength materials, to withstand the high voltages at automotive under-hood temperatures. To prevent problems with ionization and crossfire between adjacent terminals, most late-model high-energy ignitions use distributor caps with wider spaced terminals, many are vented, and most are made of better insulating material. The rotors are correspondingly redesigned and made of high dielectric strength

materials. The plug wires have thicker, better insulation and thicker boots (8mm plug wires are used in the late-model ignition systems, compared to 7mm wires with thinner boots that are usually used on point/Kettering systems).

On cars having OEM suppression plug wires, those wires should be replaced after about four years or 35,000 to 40,000 miles, as the carbon core in them doesn't last much longer than that. When the wires go bad, the electricity may find a path to ground through the insulation. You should use high-quality plug wires of suppression core, wire-wound suppression type, or (where legal) copper-core wires made

# LETTERS

## Train at HOME to be an Electronics Technician!

As the demand for computers and microprocessors in business, manufacturing and communications continues to grow, so does the need for qualified technicians. It's not unusual for experienced technicians to earn from \$30,000 to more than \$40,000 a year.\* Now through Peoples College of Independent Studies you can train for this exciting field without interrupting your job or home life.

### Choose From Five Programs of Study

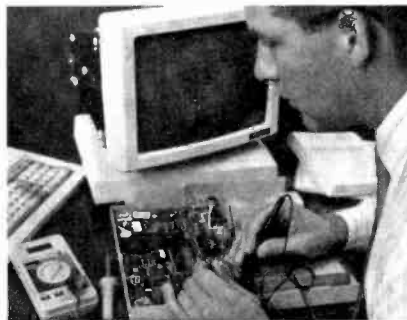
- Electronics & Microprocessor Technology
- Industrial Electronics & Microprocessor Technology
- Communications Electronics with Microprocessor Technology
- Computer Servicing & Electronics Technology
- Specialized Associate Degree In Electronics Technology

### Professional Equipment Is Included

Depending on the program you select, you'll perfect your skills using this advanced equipment, included in the price of tuition:

- IBM-Compatible Personal Computer
- Digital Multimeter
- Digital Logic Probe
- Elenco Oscilloscope
- Portable Cellular Telephone

(\* Source: U.S. Bureau of Labor Statistics)



### Exclusive Extras That Enhance Your Training

Peoples College introduces some training firsts to make your learning experience more complete:

- Accelerated Learning System — a scientifically proven study system that helps you learn faster and easier than ever before.
- Video Tutor Training Tapes — give you a permanent, visual record of informative lectures and close-up demonstrations.
- Experience Labs — professionally designed experiments that give you hands-on "bench" experience.
- Industry Certification Training Guide — provided with four of our programs. Prepares you for examinations you may take for your professional license or certification.

### Easy Payment Plans — No Finance Charges

To help you get started on your education, Peoples College has reduced tuition rates and offers low monthly payment plans with no finance fees. So don't delay, call or write for more information today!

### For COLOR CATALOG Mail Coupon or Call TOLL FREE 1-800-765-7247

Programs offered only in United States, Canada, Puerto Rico and Virgin Islands. No Obligation. No sales person will call.

Our programs are accredited by the Accrediting Commission of the National Home Study Council

YES! I would like to know more about your training programs. Send a catalog to:

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

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

Phone # \_\_\_\_\_

**PEOPLES COLLEGE**  
OF INDEPENDENT STUDIES  
233 Academy Drive • P.O. Box 421768  
Kissimmee, FL 34742-1768  
Member, D.L. Peoples Group E193

CIRCLE 10 ON FREE INFORMATION CARD

by "hot rod" after-market ignition makers such as Accel, Mallory, Jacobs, Moroso, or MSD. The distributor cap and rotor should be similarly upgraded to high-quality after-market parts.

Second, Mr. Ball assumes that higher spark energy automatically reduces emissions, but the degree of emission reductions really depends on many variables such as ignition timing-advance settings, carburetor air/fuel ratio, cam-shaft timing, etc. The air/fuel ratio should be set with the aid of an emission analyzer for best results.

Third, ignition energy may not necessarily improve from the addition of a capacitive-discharge ignition box alone if the original coil is not up to handling the job. Most ignition coils designed for point/Kettering or conventional (non-capacitive discharge) electronic ignitions have higher inductance, especially primary winding inductance, than coils specifically designed to give maximum output with capacitive-discharge (or CD) ignition boxes. To ensure maximum output you should use a CD-compatible ignition coil with a CD ignition unit. Those after-market ignition coils have better insulation to protect against internal coil shorts at very high output voltages for which OEM coils aren't usually designed.

Fourth, while CD ignitions boast extremely fast voltage rise time and high output voltage, you must consider the impedance through which that voltage is measured. Voltage measured on a high secondary side impedance can be very high, but current delivered to the plugs will be low. Spark plugs and wires with lower resistance or impedance will "load" the coil's output and lower the voltage output measurement, but plug current will be higher. Total energy output is voltage  $\times$  amperage  $\times$  time, and many CD ignitions produce sparks of shorter duration than conventional point/Kettering or electronically switched ignitions. In fact, some conventional electronically switched ignitions with suitable high-performance coils can produce sparks of sufficient voltage, current, and duration

time to rival some capacitive-discharge ignitions.

J.M.N.  
Donora, PA

## A TESLA COIL ADDICT

I really enjoyed the "Circuit Circus" column entitled "Fun With Tesla Coils" (October 1992). I built the Tesla coil oscillator and was surprised that the coil actually produced a significant ( $\frac{1}{2}$ -inch arc) output with such a small input signal. I am currently modifying the circuit to drive the primary circuit of my standard Tesla coil, with the intent of using the solid-state circuit to help me optimize capacitor/inductor values in my Tesla coil's primary/secondary circuit.

Because I used open construction when I breadboarded the oscillator circuit, using no RF shielding, I managed eventually to fry all my in-stock 567 chips, as well as two or three voltage regulators. I am going to go to a 555 timer chip circuit because that chip is more readily available at my local Radio Shack store. You can be sure that I am also going to shield this thing!

My biggest surprise was just how sensitive these coils are when it comes to setting them to resonant frequency. They are very, very touchy.

I have been building Tesla coils since 1965 (prompted by, coincidentally, a Tesla-coil project in the July 1965 issue of *Popular Electronics*). I have yet to build that one special "big one" that most coil builders dream about, although I really gave it a good try several years ago.

That attempt was a Tesla coil that had a primary nine feet in diameter and a secondary 18 inches in diameter. The 52-inch tall coil was space wound with over 4700 feet of 24-gauge wire, sprayed with 24 cans of acrylic plastic. The primary coil was tapped, of course, but I could also precisely tune it by a mechanical arrangement that varied the spacing between turns—no mean feat on a coil the width of my garage!

The capacitor was an oil-filled glass-plate job, which weighed almost 700 pounds. The transformer was a 4-kva, 300-pound,

oil-filled monster that I had rebuilt at a local transformer company. The transformer was originally from a surplus ground-based military radar: 18,000 volts, 220 milliamps. I had to use a 3000-watt clothes dryer as a current limiter because the 100-amp circuit breakers I used as "on/off" switches could not handle the primary current of the transformer!

All that work, time, and money, and I was never able to achieve resonance! I was more disappointed in the failure of that Tesla coil than I was in the failure of my first marriage! A couple of years later, a water leak in a storage building ruined the secondary—a very sad sight, indeed.

I am currently trying to locate as much "practical" information on Tesla coil tuning, construction, etc., as possible.

Anyone who has spent any time building Tesla coils knows that they are addictive, and that they can be the most challenging, frustrating, yet exciting projects that a person can build. I think the article will help in future Tesla-coil projects, and I encourage **Popular Electronics** to publish more Tesla-related articles. In fact, if you were to start a Tesla project construction magazine, I'd become a charter subscriber!  
B.P.  
Irving, TX

## DOWN MEMORY LANE

Reading the article, "Build the Idiot Box" (*Popular Electronics*, September 1992), sent me hunting through the attic for a similar device that I made in 1952. I found it, and it still works.

I made mine with 100 lamps mounted in shallow holes in a square of plexiglass. It was made to be hung like a picture from the wall and was AC powered. It served as a night light and for entertainment for two small children.

In 1952 you could buy bags of surplus components at a very low cost. I believe I purchased 200 capacitors for less than \$3, and I got the same number of 10-megohm resistors for even less. The circuit is identical to the one shown in the article,

including a potentiometer for adjusting the flicker rate. I probably still have a few of the lamps and other components in my junk box.

Serving as the Electronics Officer on board the USS Saratoga, I made a flashing symbol of an electron to hang over my desk. First I made two loops of #12 wire with the largest dimension being 8 inches. I soldered the body of an NE51 lamp to the loop. I soldered a capacitor in parallel with the lamp and used the resistor to complete the circuit to the other loop. I used #32 wire to support the loops from a battery lying in the cables in the overhead. It looked like it was floating in the air and blinking at the same time. After I had it wired and working, I sprayed the components with gold-colored spray paint, masking the lamps first, so nobody could see what the values of the parts were.

R.A.N., LCDR USN, Ret.  
Brunswick, GA

## HAVES & NEEDS

I am looking for a schematic of a Model 700 DF-AF crystal marker/TV generator made by the Electronic Measurements Corporation. I am also looking for a VN10K MOSFET transistor. Thanks.  
David L. Murphy  
4948 Caribee Drive  
St. Louis, MO 63628

I own a Sansui SR-838 turntable. Last year it lost speed control and strobe. I have tried several "so-called" Sansui service centers in the local area for repairs. All claim to provide prompt and professional service of Sansui products; however, I have had no success.

Please help me find someone in my area that will service this turntable. I am willing to pay the cost of shipping, if necessary, since I am not ready to trash the turntable.

As a final alternative, I'd appreciate if someone could send me a copy of the schematic and parts list for the SR-838, and I will attempt to repair it myself.  
Arthur Alston  
1468 Key Parkway, Apt. 302  
Frederick, MD 21702

# GIZMO

JANUARY 1993

VOLUME 6,  
NUMBER 1

A CHRONICLE OF CONSUMER ELECTRONICS

## Spotlight on Home Theater

We have to admit that we love poring through the glossy pages of *Audio/Video Interiors* and other high-end magazines, ogling custom A/V installations that are as expensive as they are visually, audibly, and aesthetically pleasing. Ten-foot screens gracefully descend from the ceiling, motorized panels slide back to reveal a huge back-projection TV, speakers are recessed into the walls, touch-screen computer monitors control a dozen different A/V "zones." One recent issue featured a custom installation in which the equipment included 97 in-wall speakers plus three other pairs, two amplifiers, a receiver, two tuners, a CD player, a cassette deck, assorted remote equipment to route the audio and video throughout the house, four VCR's, a seven-foot front projection TV, a 50-inch rear-projection set, and 18 (yes, eighteen) 20-inch TV's!

Time for a reality check: If we tried to put all that equipment into our house, there would be no room left for the family, let alone furniture, clothing, and other basic necessities. In fact, it's unlikely that our house is worth as much as was paid for that custom installation!

That's not to say that average people can't incorporate *some* of the ideas and technology represented in that "dream installation" in their own relatively modest homes, keeping within their own relatively modest budgets. In this month's *Gizmo*, we'll take you on a tour of home theater—what it means, what's required, what's optional, and how you can make it work in your home. Then we'll take a look at several products that you might consider integrating into your own home-theater setup.

The goal of any home theater, of course, is to recreate the video and audio sensations experienced in a movie theater (or concert hall, or sports arena, depending on your viewing tastes) as closely as possible in the home. Doing so requires, at the very least, a large-screen stereo television, a stereo VCR, some sort of surround-sound



processor, and speakers. Sounds simple enough, right? The problem is that between that basic installation and the custom dream job described above, there lies a whole world of options and a wide range of prices. Deciding what sort of components would work best for you is no easy task.

There are several factors to be considered *before* you venture out shopping and get even more confused by fast-talking sales people. Money, of course, is a major concern. But "bargain" and "value" are totally different concepts. What might be a real deal for someone—grabbing up a sale-priced low-end A/V receiver, or skimping on the speakers, for instance—could ruin the whole home-theater experience for someone with more sophisticated ears. That's not a good value at any price. In a similar vein, you might decide to go all out and splurge on the biggest screen available ("If I'm going to do it, I'll do it right!"), only to get it home and discover that it's much too large for comfortable viewing in your home theater.

### WHO, WHAT, WHEN, WHERE?

It's easy to imagine all the things you'd like your home theater to have. But it's important not only to determine what you want from a home-theater system—but also to make sure that your dreams are compatible with your home, your family, and your wallet. Ask yourself the following questions before making any purchase decisions:

*Who is going to be using the home-theater system?* If you're an electronics enthusiast, and no one else will be touching the controls, then simplicity won't be a high priority. Chances are, however, that everyone in the family will want to use the system. If no one can figure out how to switch functions, there will be a lot of grief—for you as well as everyone else.

*When are they going to be watching it?* Daylight conditions adversely affect front-projection systems and, to a lesser extent, rear-projection sets; a direct-view set would be a better choice for those who watch TV during the day, or who prefer to keep some lights on in the room.

TURN PAGE FOR CONTENTS



# This month in GIZMO®

|   |        |
|---|--------|
| Spotlight on Home Theater. . . . .                        | pg. 5  |
| Sharp XV-H30U SharpVision LCD Projector. . . . .          | pg. 12 |
| Carver HR-894 A/V Receiver with Dolby Pro Logic . . . . . | pg. 14 |
| Cerwin-Vega Sensurround 7-Piece Speaker System. . . . .   | pg. 16 |
| Toshiba CD/CDV/LD Disc Player Model XR-W70A. . . . .      | pg. 17 |
| Bose Home Theater System . . . . .                        | pg. 20 |
| Mitsubishi Pro-Logic Surround-Sound System. . . . .       | pg. 20 |
| Panasonic Rear Projection TV. . . . .                     | pg. 20 |
| Zenith/Bose Surround-Sound TV. . . . .                    | pg. 20 |

Gizmo is published by Gernsback Publications, Inc., 500-B Bi-County Blvd., Farmingdale, NY 11735. Senior Writers: Chris F. O'Brian and Teri Scaduto. Contributor to this issue: Frank Barr, APEL. ©Copyright 1992 by Gernsback Publications, Inc. Gizmo is a registered trademark. All rights reserved.

*Where is the system to be placed?* Do you have a room available that can be used solely for home theater? Most of us don't have that luxury. If the system will be set up in the living room, there probably will be restrictions due to decorating concerns. If it's in the family room, keep in mind the other activities carried out there—doing homework or school projects, listening to music, paying bills, reading the paper, playing board games. Again, keep in mind the lighting required for those other activities.

*What size is the room?* A screen that's too small can get lost in a large room; a screen that's too large can be even worse.

We'll discuss component, speaker, and furniture placement later in this article.

*What will you be watching?* Do you prefer live performances of opera and symphonies, or action films like *Terminator II*? Sporting events, or foreign films? Network sitcoms, or nature shows? All of the above, and then some?

*How can your existing components be integrated in the new system?* It's often not necessary to buy all new gear. Use your existing TV or hi-fi VCR and put the money you would have spent toward a better A/V receiver; you can always upgrade the other pieces later.

*What wiring/installation skills do you possess?* Will you have to call in a pro to set up your home theater, or can you handle the connections on your own? If you decide that you need help with all or part of the job, or with selecting the components, you might want to consult an audio/video installer (who should ask you some of the same questions we are).

*How much can you comfortably afford to spend on a home-theater system?* A well-planned home-theater can provide your family with hours of inexpensive entertainment. But if you have to take a second job to pay for it, you won't have any time to enjoy it!

## THE HOME-THEATER ENVIRONMENT

Although home theaters can come in all shapes and sizes, there are some basic rules that should be followed, although they aren't written in stone. Figure 1 illustrates the recommended arrangement of furniture and components. If there are plenty of windows, special curtains or shades might be required to give you better control over the room lighting. Carpeting is recommended to minimize the reflection of sound. The minimum distance from the couch (or recliner) to the screen should be 2–3 times the screen size (measured diagonally). If, for instance, your sofa is 12 feet from the television, the ideal screen size would be 48–72-inches. In general, projectors need to be placed at a distance of about 1½ times the diagonal screen size. (One exception to that rule is the SharpVision reviewed in this issue, which requires somewhat less space between projector and screen; be sure to follow the manual's recommendations.) Chairs and couches should be set up so that the viewing angle doesn't exceed 30°. Speaker placement requires the center speaker to be as close as possible to the screen; magnetic shielding is essential to avoid distortion to direct-view screens. The front speakers should be placed to either side of, and at an equal distance from, the screen; again, shielded speakers will likely be required. The surround speakers go behind the viewers—preferably

the same distance behind the viewers as the front speakers are forward, although time-delay circuitry in a surround processor lets you mount the rear speakers closer. A second set of surround speakers might be necessary in very deep rooms; they should be placed at the sides of the room. The subwoofer can be placed anywhere in the room, and many are designed to slide out of view under a couch or chair. For room-shaking bass, you'll probably want a separate amp to drive the subwoofer.

That much equipment can overtake a small room, and push other activities to the background. To avoid conflicts with decor and retain the use of the family room or living room for more than watching movies, you might consider converting a previously unused area of your home for use as a home theater. A basement, attic, or attached garage that you wouldn't consider prime living space due to lack of windows and/or lower than normal ceilings just might be ideal for a home theater. The natural dimness is a plus, and because you'll spend virtually all your home-theater time seated, the only worry with low ceilings is speaker placement. And if you're handy with tools, finishing a previously unfinished space would also give you the chance to create your own custom installation.

Instead of using a separate space, it might be possible to use the same space at different times for different purposes. Front-projection setups are particularly well-suited for home theaters that must disappear when not in use. It's often possible to mount the projector unobtrusively on the ceiling (in custom jobs, you can even have the projector recessed into the ceiling on a motorized lift), and some manufacturers offer projectors that have been factory-mounted in coffee tables. Ceiling-mounted screens roll up and out of sight when not in use. Today's in-wall speakers are almost invisible, and a subwoofer can be easily tucked out of sight. Such a set-up allows you to use your living room or family room for everyday activities, until it's time to "raise the curtain" on your home theater.

A friend of ours built an innovative home-theater setup (shown in the opening photo) in a room that measures about 14 × 22, with only one small window on one of the short walls. He replaced that one with an 8-foot-wide picture window. Flanking the window, he built floor-to-ceiling, 18-inch deep shelving units; under the window is an upholstered window seat—a feature that his wife had always wanted. Ceiling mounted in front of the window is a video screen. A Vidikron projector is mounted on the ceiling above the couch. Assorted components—VCR, Pioneer laserdisc player, Fosgate Pro-Log-



## WHAT TO LOOK FOR IN HOME-THEATER COMPONENTS

**Televisions and Monitors.** First, make sure the stereo TV or monitor you choose is the right size for your room. Keep in mind how big that 27-incher looked when it replaced your old 21-inch set—TVs seem to shrink with time. At the same time, you might want to bring along a tape measure to make sure that that huge rear-projection set will fit through your door, and not take up too much floor space once it's in. Some manufacturers, Mitsubishi, for one, are now making slim-line rear-projection sets that take up surprisingly little space.

The overriding factor in determining the largest screen size you should use is how far away from it you're going to sit. You want to see the picture, but you don't want to be able to see all of the elements that make up the picture. If you sit too close to a screen—no matter what its size—you'll start to see the horizontal line structure of the TV picture. (Some display devices, the Sharp LCD projector that we review in this issue, add their own visible structure as well.)

If you want to get that true movie-theater feeling—where the screen fills a large percentage of your field of view—you might be able to ignore the line structure and sit closer than the recommended 4–8 times the picture height. Usually, though, you'll have to move back. You don't want a *bigger* picture, you want a *better* one.

Let's look at what this means in real numbers. A 50-inch (diagonal) screen has a picture height of 30 inches. (Remember: the aspect ratio of a TV screen is 4 × 3, so the diagonal measurement is the hypotenuse of a 3-4-5 triangle. If you can remember some high-school geometry, you can calculate the picture height once you know the diagonal measurement.) A viewing distance of 10 feet would be required for best viewing of the 50-inch monitor.

Some projection sets suggest that you can sit at 1½ to 2 times the picture height from the screen. They usually have a "soft-focus" setting that exaggerates the width of the horizontal lines. If you can afford the \$20,000 price, Faroujda Laboratories has a line-doubling system that lets you get as close as you would to a movie-theater screen.

A laserdisc, which produces the highest-resolution images of any consumer video device, has a horizontal resolution of about 450 lines. Think twice before you consider a monitor or projector that offers less. You'll likely see many projectors and direct-view sets touting much higher resolution.

But the picture on a projector—front or rear—with a horizontal resolution of 500 lines won't look the same as the one on a direct view set with a 500-line horizontal resolution. That's because the contrast and brightness will vary.

For the largest picture, you'll need a front-projection unit. For the brightest,

highest-contrast picture, you'll want a direct-view monitor. Rear-projection sets are a compromise between the two. LCD projectors can't match the three-tube projectors—yet. But if you need huge-screen portability, they're the only way to go.

Don't forget to *listen* to your display device, too. Many sets provide good enough sound that you might be willing to forgo a separate audio setup. Some provide traditional surround sound. Others might use two-speaker "surround" systems, such as Carver's Sonic Holography or Hughes Sound Retrieval System.

**VCR's.** VHS, stereo, and hi-fi are the three most important things to look for in a home-theater VCR. Yes, we know that the S-VHS format will provide better resolution. But if you can't rent tapes—and if you don't have a S-VHS camcorder—who cares?

Do you use a VCR to watch scenes in slow motion or to watch still pictures? You need a four-head deck for those special effects. Otherwise, a two-head deck should do you fine, and merely provide a somewhat worse picture when you're fast-scanning over all those commercials. Do you edit tapes? A flying erase head will help you obtain seamless edits, and audio/video dubbing will let you add something to your edits. Do you use a VCR extensively for time shifting, including when you travel? Easy but sophisticated programming features are what you should be looking for.

Don't forget the little things that can make a VCR special. A 30-second skip feature makes bypassing commercials a breeze. Timer backup lets you laugh at intermittent power outages. And you might consider buying the same brand TV/monitor and VCR, for the matching remotes that many brands offer.

**A/V Receivers.** An A/V receiver can be the nerve center of your home-theater system and will provide a convenient link to your audio components. Make sure your A/V receiver provides sufficient switching capability. You'll want an easy way to dub audio and video sources, and you'll want everyone in your home to be able to use it as well. Many people find that on-screen displays make the setup easier.

Good sound can draw you into a movie even faster than a terrific picture. For most applications, Dolby Pro-Logic capability is what you want. The added center channel of a Pro-Logic amplifier, and the active sound-steering circuitry, provides a more realistic theater-like sound.

If you must stay on a small budget, consider a standard Dolby Surround (not Pro-Logic) amplifier. It won't compare favorably to a Pro-Logic amplifier in accurately placing and tracking some of the sound, but you might well be happy with it—especially since you

should be able to find one at a bargain price these days.

If money is not an issue, you'll want equipment that has Home THX certification. Such equipment must receive an official OK from Lucasfilm, Ltd., the same people who certify THX movie theaters. In short, Home THX certification is a sort of performance guarantee.

**Speakers.** Speakers are arguably the most difficult components to choose for a home-theater system. The only feature that counts is how they sound. That means that only *you* can choose the speakers that sound best to you. Making your decision more difficult is the fact that speakers sound dramatically different depending on their placement and your home-theater acoustics. Nevertheless, there are some general things to keep in mind as you shop.

If your home theater will use a direct-view screen, your front speakers *must* be magnetically shielded. The purpose of Pro-Logic decoding is to place sounds accurately. Your front speakers should be directive, so they won't muddy the directional information. The surround speakers are meant to provide "fill" sound. They should provide wide dispersion of the sound.

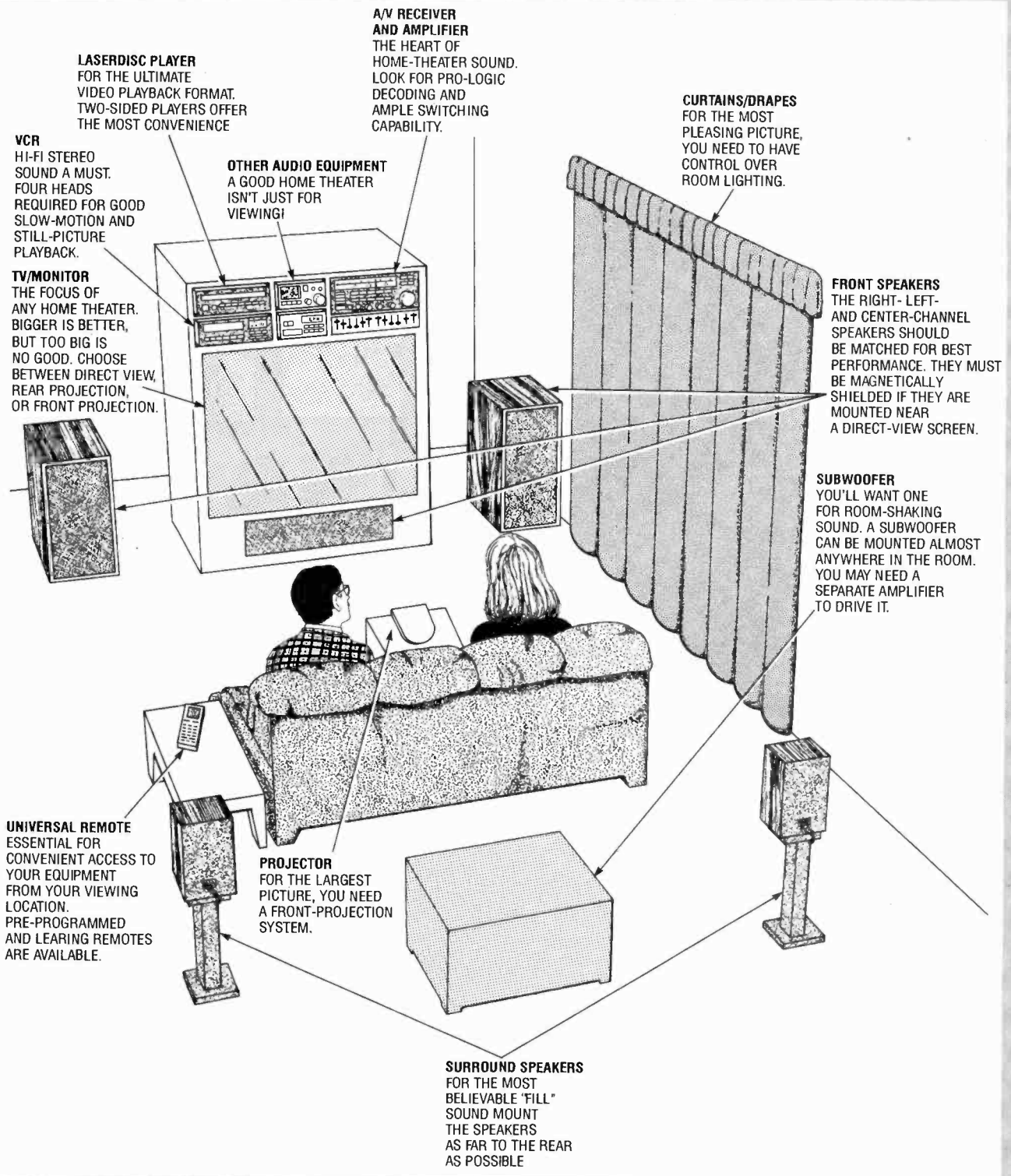
We generally prefer using three matched speakers for the front. If you must scrimp, get a cheaper center-channel speaker. You might also be able to economize on the rear speakers. Many speaker manufacturers have made things easier by selling complete surround-sound speaker packages.

**Laserdisc Players.** For the highest-quality video and audio playback, you need a laserdisc player. Don't forget that video quality becomes more important with a large-screen home theater. The relatively recent growth of large-screen sales might be why it's taken about fifteen years for laserdiscs to catch on.

Are videodiscs for you? Since videodiscs are still difficult to rent (but generally becoming less difficult), you might be disappointed with a player that sits idle most of the time. But if you like the idea of a video library—and one that will last, presumably, forever—then laserdiscs are tough to beat. Here are a few things to keep in mind as you shop.

If you plan to use your home theater for audio as well as video, a combi player—which also plays CD's—is important. Almost all videodisc players you'll find will offer that capability. Most will play only a single disc. Others provide a 5-disc CD changer.

A feature we think is important is automatic side-changing. Having to get up to flip over a disc reminds us too much of the days of the LP! Digital effects, available on most higher-priced units, can add usable scan and still modes to CLV discs. (CLV discs have longer playing times than do CAV discs, but they require digital effects if pictures are to be scanned.) ■



Shopping for a home-theater system can be intimidating if you're confused about the basics. This illustration, which shows the principle elements of any home theater, provides a starting point.

ic surround amplifier —fit neatly on a built-in component rack. Infinity speaker fit n the new shelves; the center channel is mounted inside the window seat, with only the grille showing. The subwoofer is mounted under the floor—a heating grate lets the bass into the room.

The first time we saw the room, we weren't aware that it doubled as a home-theater. But later, watching a football game and a few scenes from *Robin Hood: Prince of Thieves*, we realized that it was one of the best setups we've ever seen. The design represents the best of both worlds—

excellent audio and video reproduction, and comfortably attractive surroundings. When it's not used as a home theater, the room benefits from added light, extra storage space, improved proportions, and attractive new seating—all thanks to a thoughtful home-theater design.

# Graduate as a Fully Trained Electronics Professional!

If you want to learn about electronics, and earn a good income with that knowledge, then CIE is the best educational value you can receive.

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 like yourself for nearly sixty years and we're the best at our subject....ELECTRONICS...BECAUSE 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 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.

## 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 YOUR CIE COURSE CATALOG AND WE'LL SEND YOU A FREE 24-PAGE CIE ELECTRONIC SYMBOLS HANDBOOK.

# FREE!

SEND FOR YOUR CIE HOME STUDY COURSE CATALOG AND RECEIVE A FREE 24 PAGE CIE ELECTRONIC SYMBOLS HANDBOOK!

Includes hundreds of the most frequently used electronic symbols. Published exclusively by CIE for our students and alumni. Yours free when you request a CIE Course Catalog.

electronics



**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.)

AH36

Please print clearly

Name \_\_\_\_\_

Address \_\_\_\_\_

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

Zip \_\_\_\_\_ Age \_\_\_\_\_

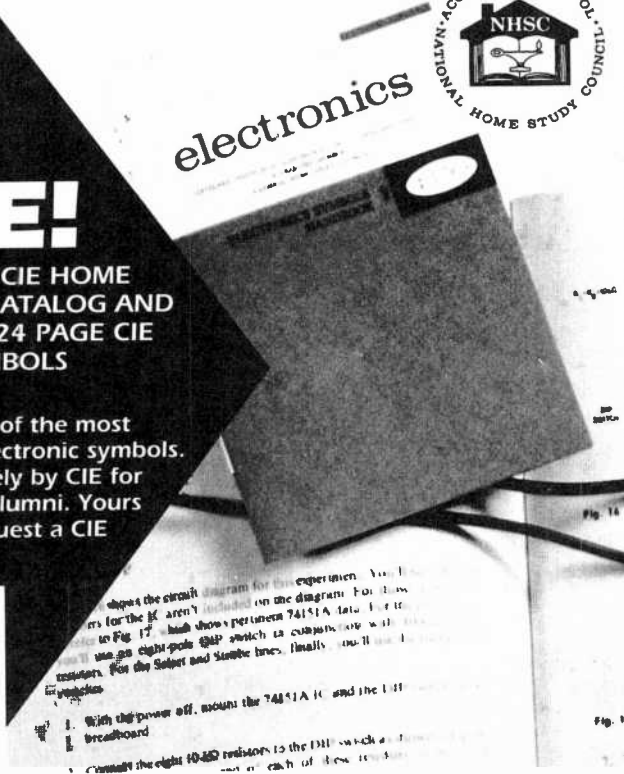
Phone No. (\_\_\_\_) \_\_\_\_\_

Check box for G.I. Bill Benefits

Veteran       Active Duty

**CIE** 1776 East 17th Street  
Cleveland, Ohio 44114

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



January 1993, Popular Electronics



## CALL IN THE PRO'S

If you're not handy with wiring or with tools, or if you want a system with a ceiling-mounted projector and a motorized screen, it might be wise to call in a specialist. CEDIA, the Custom Electronic Design & Installation Association, can supply a list of professionals in your area (1-800-CEDIA30). They don't work only for millionaires; in fact, according to a responses to a recent CEDIA poll of its members, the "average" job for a custom installation company can range from \$400 to \$60,000. You can hire a professional to do it all—select the components, design the installation, hire and supervise cabinetmakers and electricians, and calibrate the finished system. Many custom-installed home-theaters are just a small part of whole-house, multi-zone audio-video systems (which is a topic that we'll cover in a future issue of *Gizmo!*). But you can also hire a custom installer to consult on a small project, and some will even come in just to properly set up the components you've purchased.

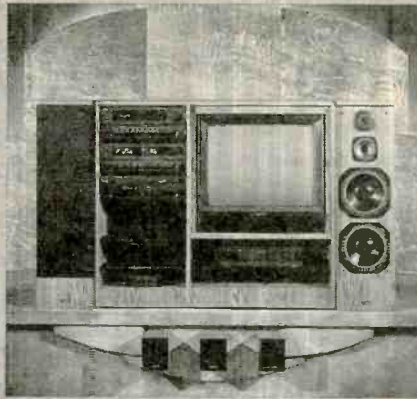
## FOOTING THE BILL

So, what can you realistically expect to spend on a home-theater system? The high-quality setup that we review in this issue—Sharp LCD projector, Carver Dolby Pro-Logic A/V receiver, Cerwin-Vega seven-piece Sensurround speaker system, and Toshiba laserdisc player—has a total suggested retail price of \$6958.95, not counting the screen. (We used our own VCR and an extra amplifier to drive the subwoofers.)

Of course, no one who shops carefully ever pays the full suggested retail price; it pays to shop around. Learn what features on each component are essential, and which are just icing.

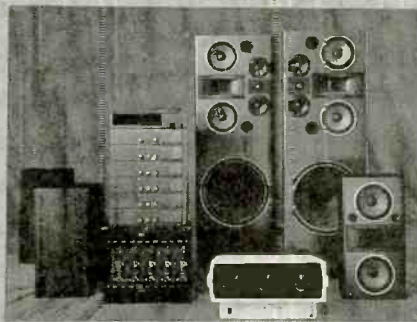
Shopping is made that much easier if you decide to go with a pre-packaged system that includes all or most of the required audio and video components. For instance, Fisher's 9235AVX A/V component system includes a 27-inch television, a 120-watts per channel receiver with Dolby Pro Logic, a five-disc CD changer, a double cassette deck, and five speakers. Also included for a suggested price of \$2199.95 is a unified remote control that can also operate Fisher VCR's, and a light-oak-finished cabinet. Similar systems are available from several manufacturers; most include TV's that have a relatively small screen size—generally, 26 or 27 inches.

At the opposite end of the pre-packaged spectrum is JBL's Synthesis One, which includes a front projector, a screen, a video controller, signal-processing equipment, multi-component loudspeakers, crossovers, equalizers, a surround-sound processor, dual 18-inch subwoofers, six am-



Fisher A/V Component System

plifiers for a bone-rattling total of more than 1400 watts, direct radiators for music playback, and a compression driver horn combination for video playback. JBL's aim is to provide a complete home-theater experience that accurately reproduces movie soundtracks, but not compromise music listening. To that end, the system offers two modes. For home-theater use, Synthesis is THX licensed and approved and offers Dolby Pro Logic and ten supplementary surround settings. Switching to the music mode disconnects the center and surround loudspeakers and replaces them with components specifically designed for audio sound systems. The suggested price, which doesn't include a video source (VCR or laserdisc player) or installation (which must be done professionally) is \$47,900.



JBL Synthesis One Home-Theater System

Whether you decide to go the pre-packaged route, or purchase individual components, good shopping skills are important. Determine precisely what features you expect from each component, and then look for products in your price range that offer those features. Scan the circulars that come in your Sunday paper and read consumer magazines. Then go out to each of the electronics stores in your area to compare shop.

That's just what we did, and we found some affordable. And some interesting, home-theater alternatives—including a

(Continued on page 17)

## Look Sharp!

**SHARPVISION XV-H30U HIGH-BRIGHTNESS LCD PROJECTOR.** From: Sharp Electronics Corporation, Sharp Plaza, Mahwah, NJ 07430-2135. Price: \$3995.

Dedicated *Gizmo* readers might recall our May 1991 review of the *Sharp XV-100* LCD front-projection TV. To recap: The XV-100, weighing just over 31 pounds, had the advantages of portability and easy set up. We put it through its paces, bringing it with us to a ski house in Vermont, and making it the "guest of honor" at an impromptu Super Bowl party. The large-screen experience was vivid enough to make up for a picture that, while quite impressive for a portable projection system, left some room for improvement.

At the last Consumer Electronics Show, demonstrations of Sharp's latest LCD projectors suggested that some major improvements had been made in the past couple of years. We arranged to try out the *XV-H30U* in a home-theater setup.

Physically, the XV-H30U somewhat resembles its predecessor. It's even easier to carry around or store out of sight when not in use, now that close to ten pounds have been knocked off—the XV-H30U weighs only 23 pounds. At the top of the unit is a carrying handle; an on/off button; indicators for power, temperature, and lamp replacement; and a cover that flips open to reveal controls for the adjustment of the projector's picture and audio. That's one major improvement—unlike the XV-100, the new SharpVision is equipped with its own audio amplifier and matched stereo speakers built in. In some installations, those top-panel controls can be difficult to access. But that's not a problem, since the XV-H30U comes with a remote control, another convenience missing from its predecessor. Jacks at the rear of the unit provide audio inputs from two sources, audio output, one S-Video and two video inputs, and a video output. The back of the unit also has a cooling fan; the air intake fan is located on the side of the projector.

The XV-H30U still uses basically the same LCD technology, with some refinements. The projector uses three LCD panels, a series of mirrors, a bright, metal-halide bulb, and a quality lens to project the image. One LCD is provided for each color component of a TV picture: red, green, and blue. The LCD panels themselves provide no color information. They transmit or block the colored light that is fed to them. The light from the metal-halide bulb is separated into the red, green, and blue components by dichroic mirrors, which are special mirrors that re-





CIRCLE 50 ON FREE INFORMATION CARD

flect light of one color while transmitting all others.

Each LCD panel contains 112,320 pixels (for a total of 336,960 pixels). That translates to a horizontal resolution of 400 lines, compared to the XV-100's 300.

In addition, the SharpVision XV-H30U's high-intensity metal-halide lamp generates up to 800 lux of projected brightness at a 40-inch screen size. That brightness level decreases slightly as the picture size is increased. And you can do quite a bit of increasing—the maximum screen size is 150 inches diagonally, compared to the XV-100's 100-inch maximum. The XV-H30U also offers viewers the option of using it as a rear projector—or using a mirror to reflect the image to the screen—simply by flipping the reverse-image switch.

The differences between new and old models are immediately obvious. With no external audio source required, hookup is even easier. All that's required is connection to a video source (laserdisc player or VCR) via the supplied audio and video cables. While that's perfect for large-screen portability, you wouldn't be happy with the sound in a home-theater installation, where you'd want to connect the projector to an A/V amplifier, surround-sound speakers, a second video source, etc. (The projector's manual, which details various possible setups, is another drastic improvement over the XV-100.) By twisting the zoom lens, the screen size can be adjusted from 25 to 150 inches, depending on the amount of space between the projector and the screen and the size of your room. Actually, room size isn't quite as critical as it was with previous models,

because a close-focus lens lets you view a 150-inch picture from just over 18 feet away, or a 100-inch picture from about 12 feet. And once the unit is connected and the screen size selected, the remote control allows you to conveniently adjust the picture without leaving your seat.

Front-projection systems do demand darkened viewing conditions, and Sharp wisely supplies a lighted remote control. The buttons don't remain lighted at all times; pressing any button or the illumination switch located on the side of the remote causes all the buttons to light for about five seconds. The remote can be used to control power and volume, select the video input source, and adjust the video and audio. On-screen displays make it easy to adjust the picture, brightness, color, tint, sharpness, treble, bass, and balance. The remote control also can be used to mute the sound, and to set a sleep timer to turn the projector off after 30, 60, 90, or 120 minutes.

We got a lot of use out of the remote picture-adjustment capability because the displayed image never seemed to be consistent. We found ourselves continually changing the brightness, sharpness, and color to get a watchable picture depending on both the room brightness and the particular movie we were watching.

Audio and video adjustments, as well as input selection, also can be done using the top-panel controls on the projector. The top-panel controls include one that's missing from the remote—a focus-pattern display button. Pressing that button causes a pattern to be displayed on the screen for about 15 seconds, while you make adjustments using the focus ring around the lens.

Using the pattern makes accurately focusing the projector much easier.

Our home-theater system—the SharpVision Projector, a Carver A/V receiver with Dolby Pro-Logic, Cerwin-Vega's Sensurround speaker system, and a Toshiba laserdisc player—was installed in a room measuring just 16×14 feet. The room was pretty crowded *before* we unpacked the screen provided by Sharp (sold separately from the projector). On a tripod stand, the screen stood out a couple of feet from the wall, while the projector was set up about a foot from the opposite wall. That left a space of about 13 feet—too short to use the projector to its full 150-inch picture potential. In fact, in such a small room, we were more comfortable with the picture size set to about 70 inches or smaller, although the manual said that 100 inches would be fine at that distance. The screen does make a difference in picture quality, but it simply took up too much space. Because of that, we found ourselves frequently watching videos on a bare white wall instead of bothering with the screen.

Watching movies on the large screen (or on the white wall) was a treat once the picture was adjusted properly. As with any large projection TV, you have to be careful not to make the image too large or you'll see the line structure of the picture. (Large-screen projectors are one reason we "need" HDTV.) With the Sharp projector, you can also see the individual pixels that make up the image. The only real complaint we had with our sample unit, however, was that the picture brightness was not consistent over the entire screen—there were a couple of "hot spots" that we found disturbing.

For everyday "background" television viewing, we found ourselves switching back to our 27-inch set that happened for a couple of reasons: First, viewing the smaller set doesn't require a darkened room, and we like to read the paper or do crossword puzzles while watching. Second, most network-TV shows just don't have enough substance to warrant such a big picture. After all, Rosanne and Dan Connor and family are bigger than life even on the small screen! (And their whining is not enhanced by surround sound, either.)

But when it came to movie-watching, the large picture lent a whole new dimension, surrounding us with video. And, best of all, SharpVision's bigger and better picture is not accompanied by a bigger price tag! We don't think that LCD projection is ready to take over the home-theater market—yet. But as LCD manufacturing technology improves—and the dramatic improvements in the last couple of years are likely to continue—SharpVision projectors are going to be tough to beat. ■



## A (Pro-) Logical Choice

**CARVER HR-895 AUDIO/VIDEO RECEIVER.** From: Carver Corporation, P.O. Box 1237, Lynwood, WA 98046. Price: \$1199.95.

We've always maintained that the true heart of a home-theater system is not the video screen. Rather, it's a good audio system that pulls a viewer into the action. We find a small-screen system with big-screen sound far more enjoyable than a big-screen with small-screen sound. The true heart of a home-theater sound system is an A/V receiver, which not only provides the Dolby Pro-Logic sound that's so important, but also serves as a command center for video and audio equipment. This month, in our quest for sensible home theater, we tried *Carver's HR-895 Dolby Pro Logic Audio/Video Receiver*.

The HR-895 is Carver's first Pro-Logic receiver. It features a five-channel surround-sound amplifier, a "learning" type remote, and multi-room capability that allows a user in a second room to use the amplifier to listen to a CD, for example, while the receiver is used in the main room to watch a videodisc.

The front-left and front-right amplifiers provide power outputs of 110 watts per channel. The center-channel amplifier provides 75 watts, and two 35-watt amplifiers provide the surround outputs.

Seven audio inputs, four composite video inputs, and three S-video inputs provide convenient switching capability. Front-panel audio and video inputs are provided for easy accessibility when hooking up a camcorder.

The tuner section of the HR-895 provides a total of thirty FM and AM presets. (If you receive FM-band stations over your cable-TV system, a separate antenna input is available for those stations; that input and the available stations can also be stored in presets.) An auto-preset mode scans through the selected band and automatically stores received stations in the preset memories. While it's possible to let the receiver handle the entire function automatically, we preferred to customize the settings as they were stored. As each received station is tuned, scanning stops for five seconds. During that time, you can set the tuning mode (to mono, for example) and set the IF bandwidth (to narrow, for example). If you do not want to store a particular station, pressing the tuning up control causes it to be skipped.

If you're like us, you might have trouble remembering more than a few preset stations. The tuner, however, includes a function that lets you set the station name so

that it is shown in the display each time the station is tuned. Up to five alphanumeric characters can be stored for each memory. Stations can be tuned directly by entering the preset number on either the remote control or the front-panel keypad. It's also possible to scan through the presets, or to change stations by tuning in the conventional manner.

A Carver feature called ACCD (for asymmetrical charge-coupled FM detector) is provided to reduce multipath distortion. ACCD, which is switchable, is said to be able to transform a multipath signal into a clear signal by separating the stereo sum and difference signals and rejecting up to 80% of the distortion-filled stereo signal. Then, "the 15-20% of the signal which is clean is used to accurately recreate the rest of the stereo signal." Because our suburban location is not typically plagued by multipath problems, we can vouch for ACCD's success only by noting that the feature seemed to quiet some noise from marginal signals, without degrading strong signals.

Besides the tuner, the HR-895 offers other purely audio functions; CD player inputs and audio tape inputs and outputs are provided. We're thankful that Carver also included a phono input for connecting a turntable. Primarily intended for use with those functions, Carver's "Sonic Holography" is also provided. The intent of Sonic Holography is to "restore the 3-dimensionality of a live performance through special signal-cancellation and time-delay circuitry." It attempts to correct the problems of traditional stereo that occur because your ears hear the output of both stereo speakers. It works by injecting some degree of out-of-phase right-channel information into the left channel signal and *vice versa*. Theoretically, with the

right time delay, the out-of-phase right-channel information will arrive at the left ear at the same time the signal from the right speaker does, and the signals will cancel. With proper speaker setup—which is very critical for the processing to work—we found that Sonic Holography dramatically widened the soundstage of stereo recordings, and produced excellent imaging. Sonic Holography is not, of course, intended to replace Dolby Pro Logic.

The HR-895 provides rear-panel inputs for a laserdisc player and two VCR's. A front-panel input is provided, primarily for connecting a camcorder. S-video connectors are provided for the laserdisc input and VCR1 inputs and outputs. The second set of VCR connectors provides only composite-video jacks. Why, we wondered, did Carver provide an S-video input for a videodisc player, where it provides little benefit, and not for a second VCR where S-video can be very beneficial? Whatever the reason, we should note that the front-panel inputs do provide for S-video, so tape dubbing between S-video-equipped video recorders is possible, although not necessarily convenient.

Two tape-dubbing options are provided on the amplifier. Pressing the TAPE-VCR1 button lets you dub audio from your audio tape deck to your VCR. (If you haven't discovered that your hi-fi VHS VCR can play the part of a high-quality audio recorder—with the distinct advantage of 6-hour tapes—do yourself a favor and give it a try.) A second, VCR1-VCR2 button lets you dub video tapes. Dubbing can be done even while you're watching a laserdisc. Remember, however, that the VCR2 connections don't support S-video. You'll have to use the front-panel camcorder-input jacks for that; whatever source you



CIRCLE 51 ON FREE INFORMATION CARD

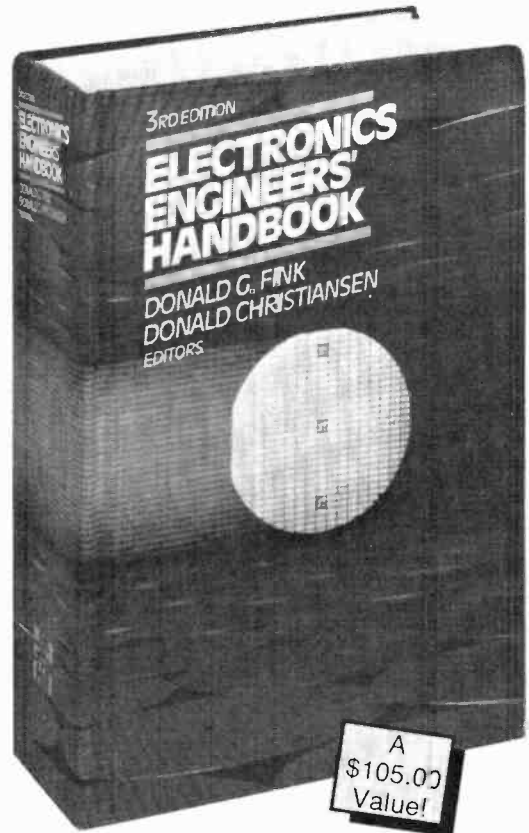
# Take this GIANT Handbook for only \$9.95

when you join the *Electronics Engineers' Book Club*

## ELECTRONICS ENGINEERS' HANDBOOK, Third Edition

Edited by D.G. Fink  
and D. Christiansen

Completely revised, expanded, and updated, this third edition of the desktop reference is widely considered the definitive work in its field, covering all aspects of today's electronics engineering. Written and compiled by more than 170 experts, this giant handbook shows you how to use the latest design and cost-cutting solutions at work in the industry today. You'll find a wealth of new material on electronic systems design, computer systems and digital recording, telecommunications, process control, laser technology, and CAD of electronic circuits. It deals with the full range of theory and practice, covering essential principles, data, devices, components, assemblies, circuits, functions, and applications.



2,624 pages 1,800 illustrations **Book No. 9255H Hardcover**

If coupon is missing, write to: Electronics Engineers' Book Club, Blue Ridge Summit, PA 17294-0860

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

. . . you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off of regular publishers' prices. If you want the Main Selection do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll always have at least 10 days to decide. Your only obligation is to purchase 3 more books during the next 2 years, after which you may cancel your membership at any time.

Publishers' prices shown. ©1992 EEBC

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

Blue Ridge Summit, PA 17294-0860

**YES!** Please send me *Electronics Engineers' Handbook, 3rd Ed.* (9255H), billing me \$9.95 plus shipping/handling & tax. Enroll me as a member of the **Electronics Engineers' Book Club** according to the terms outlined in this ad. If not satisfied, I may return the book within 10 days and have my membership cancelled. A shipping/handling charge & sales tax will be added to all orders.

Name \_\_\_\_\_

Address \_\_\_\_\_

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

Zip \_\_\_\_\_ Phone \_\_\_\_\_

Valid for new members only, subject to acceptance by EEBC. Canada *must* remit in U.S. funds. Applicants outside the U.S. and Canada will receive special ordering instructions. PPIF193



choose as the main signal source is also output to all video and audio outputs (unless one of the amplifier's dubbing buttons is pressed).

Four surround-sound modes are offered. The Dolby mode is the one to use if your source is Dolby encoded. Most recent movies you're likely to rent will have a Dolby-encoded soundtrack; with proper speaker placement, the results that can be achieved at home will be at least as good as you're likely to hear in most movie theaters. It's likely to be *better*, in fact, because you can adjust the level and location of the speakers to perfectly suit your seating position.

"Hall" and "matrix" surround modes are also provided for non-Dolby sound sources. The hall mode adds what we perceived as time-delay and echo effects to give a feeling of spaciousness. The matrix mode, we assume, passively extracts the difference between the left and right signals and feeds it to the rear speakers. Neither mode can compete with Dolby Pro Logic (to our ears, they simply distort the sound), but we can imagine some instances where they would prove to be useful. A simulated stereo mode is provided to create a stereo effect from monaural sources.

The amplifier also offers four center-channel modes that are switchable. Normally, Dolby Pro Logic requires a center-channel speaker so that on-screen sounds appear to come from the screen. A "normal" mode is provided for that. A "phantom" mode creates a center-channel effect using just the left- and right-channel speakers. A "wide" mode electronically processes the front-channel audio to create a wider soundstage; it's useful if you must place your speakers very close together. The center channel can also be turned off if you wish.

The HR-895 features a clock that can display time in either the 12- or 24-hour format. The clock provides sleep-timer and program-timer capability as well. We think that a program timer is very important in an audio system. (Some of us record more programming from the radio than from television.) While we're happy to see Carver provide a program timer, which many manufacturers ignore, we're not satisfied with the single-event capability.

Our experience with the Carver HR-895 makes us think that it could be a sensible source of terrific home-theater sound. Its multi-room capability will keep the video watchers and audiophiles on speaking terms—or let you keep track of what's happening on the screen when you can't be there to see it. But, the funny thing is, we didn't find ourselves leaving the room very often when the HR-895 was doing its thing. ■

## Sound Decisions

**SENSURROUND HOME-THEATER SPEAKER SYSTEM.** From Cerwin-Vega, 555 East Easy Street, Simi Valley, CA 93065; Price: \$1660.

There was a time, not long ago, when we would base our movie-going decisions on sound alone. If we thought a film demanded the depth and drama of Dolby Surround or THX sound systems, we would see them in a good theater. Films whose soundtrack we didn't consider crucial to our enjoyment would be relegated to "let's wait until it comes out on video" status.

Using that selection process, we decided to see *The Commitments*, a film about a group of working-class young Dubliners who form a soul band, at an expensive theater on Manhattan's Upper East Side. We certainly didn't get our \$7.50's worth—the theater's outdated sound system didn't do justice to the film's wonderful soundtrack, and since the music made the movie, the whole experience was disappointing.

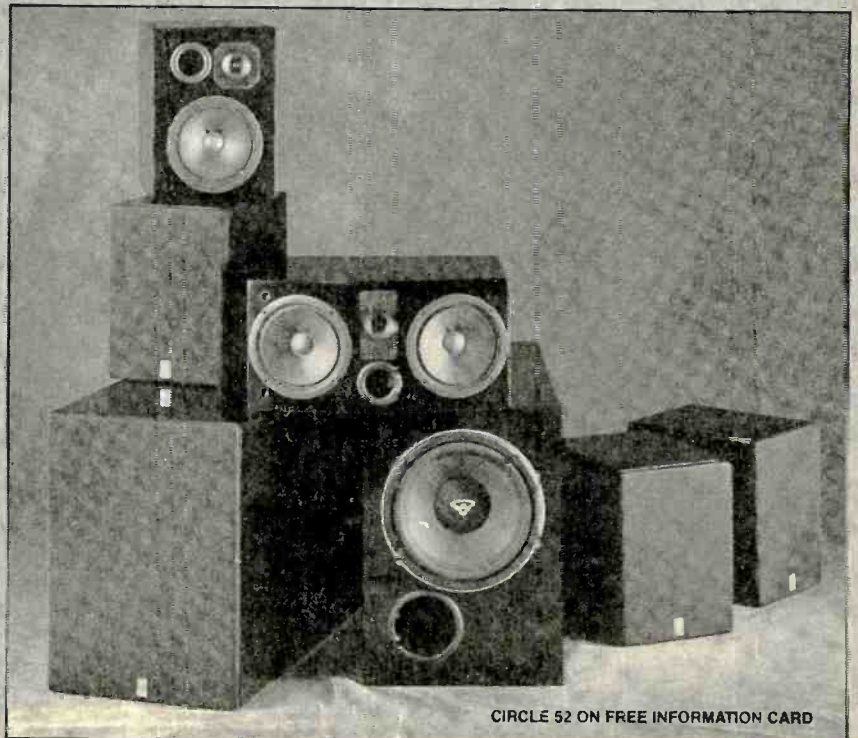
We finally got to hear the *Commitments* the way the director intended them to sound. No, we didn't shell out another \$7.50 each, or buy the soundtrack on CD. We rented the film on laserdisc, and listened to it through *Cerwin-Vega's Sensurround* seven-piece home-theater speaker system, connected to a Carver Dolby Pro-Logic A/V receiver. We quickly dis-

covered what a difference the right sound system can make!

Sensurround technology was developed by Cerwin-Vega and Universal Studios. It was first used in the movie *Earthquake*, and with such success that its developers were honored with an Academy Award.

That same technology is now available for home use, in a pre-packaged seven-piece system or as separate components. The seven-piece system that we tried out is intended for use with "big-screen" home-theater setups—those using front- or rear-projection TV's. It consists of the *HT-CTR* shielded center-channel speaker, two *HT-100* shielded subwoofers, and four *HT-S6* satellite speakers. For home theaters centered around direct-view televisions, Cerwin-Vega recommends a five-piece Sensurround setup that includes the same four satellite speakers (sold for \$380 a pair) and one *HT-210C* "dual subwoofer/center-channel system" (\$320). That unit integrates two 10-inch subwoofers and center-channel speakers into a single, fully-shielded cabinet that doubles (or should we say triples?) as a pedestal for the television or monitor. It's also possible to use the *HT-210C* and a pair of *HT-S6* satellites along with a pair of your own speakers, as long as the center speaker matches the left and right ones. (The excellent manual supplied with the speakers explains how to calibrate the system, regardless of the configuration.)

Now that you've heard all the options that are available, we'll get back on track and tell you about the seven-piece setup that we actually tested.



CIRCLE 52 ON FREE INFORMATION CARD



Our first reaction upon seeing the six large boxes in which the system was packed was that we'd be spending an entire day simply unpacking and wiring the system. In reality, the process wasn't that bad—and our pre-production Sensurround arrived two weeks before the manual did!

The HT-S6 left, right, and surround speakers feature a 6½-inch midrange and 1-inch polycarbonate dome tweeter. (Our pre-production models were not shielded). The direct-radiating speakers are housed in bass-reflex (vented) enclosures that measure 11¼ × 8½ × 11 inches. Their frequency response is rated at 80 Hz–20 kHz, ± 2dB.

The HT-CTR center-channel speaker features two 6½-inch midrange drivers and a 1-inch polycarbonate dome tweeter. The speaker system is also housed in a bass-reflex enclosure, but not in a standard rectangular box. Instead, the enclosure is a trapezoid that measures about 16½ × 8¼ × 11¾ inches. The tweeter and port are located between, and slightly forward of, the midrange drivers. The midrange drivers are angled out from the center. The idea is to eliminate an on-axis hot spot for smoother, more realistic sound that corresponds better to the on-screen action. The frequency response of the HT-CTR is rated at 80 Hz–20 kHz, ± 2dB.

The HT-110 subwoofers are what really make Sensurround work. They consist of a 10-inch driver mounted in a bass-reflex enclosure that measures 17½ × 13 × 24½ inches. The HT-110 can handle inputs up to 250 watts. Although not on our pre-production models, the HT-110 offers a defeatable passive crossover. If you were to use a single amplifier to drive the speakers, you would feed the left, right, and center-channel amplifier outputs to the subwoofer, and then feed the left, right, and center speakers from the subwoofer's wiring panel. The crossover switch would be in, or on, for this setup.

We didn't get to try that wiring scheme, but instead used the line-level subwoofer output of our Carver A/V receiver, along with a separate amplifier, to drive the subwoofers. The results were outstanding. If you enjoy explosions in your home theater, of the sort so plentiful in *Terminator II*, then you won't be able to get enough of the HT-110's. Explosions, we must admit, aren't our thing. Even so, the subwoofers added tremendous enjoyment to the movie watching experience. Trucks sounded like real trucks. Unexpected thumps could make us jump.

Once the setup was complete, we were ready to give *The Commitments* a second chance. We were impressed with the accuracy of the positioning of the sound. Even more impressive, the balance of the sound was so even that we could not pick out the particular speaker from which a

given sound was emanating. In other words, we quickly forgot that we were listening to three front speakers—and seven speakers altogether. We were spending too much time enjoying the movie.

For the truly realistic sound reproduction that we experienced, it's crucial that the system is wired, arranged, and calibrated properly. Luckily, the manual that accompanies the speakers goes beyond the call of duty, explaining not just how to set up the system, but providing a thorough tutorial in home-theater concepts that reveals *why* each piece must be placed just so. Detailed drawings depict proper wiring for each configuration. The manual also provides the consumer with advice on improving room acoustics and incorporating existing speakers into the system—all in plain English.

Since we've had the Sensurround system in our living room, we've changed our movie-selection process. Now we prefer to watch even the epics, adventures, and music films on videotape or laserdisc in the comfort of home—where we can realistically expect our sound system to be significantly better than those we found in most local theaters. ■

## HOME-THEATER

(Continued from page 12)

46-inch GE rear-projection TV on sale for just \$1500, a center-channel speaker from Kenwood for \$129, a Fisher A/V receiver with Dolby Pro-Logic for \$300, a Panasonic four-head hi-fi stereo VCR for \$330, and a Pioneer laserdisc player for \$400. That's \$2329, and you'd just need to add speakers and perhaps a subwoofer to create a full-fledged home theater. A Sony rack system caught our eye also—sale priced at \$1299, it included a tuner, a 5-disc CD changer, a 5-cassette changer, an A/V amplifier with Dolby Pro-Logic, and center-channel, right, left, and two surround speakers. The same system with a dual cassette deck cost \$999. Either system would look nice next to an existing large-screen TV, and their racks even had two shelves conveniently available to accommodate a laserdisc player and a VCR.

The scouting around that we did took about the time we might have spent watching a movie. If we were actually about to buy a home-theater system, we'd be willing to spend quite a bit more time than that. We would have auditioned the systems to get a better feel for their capabilities, and we would have pressed the sales personnel with questions—or demanded to see the operating manuals to make sure that each component offered the functions we required. Because in home-theater installations, good planning will definitely pay off. ■

## Video Viewing in the 90's

CD/CDV/LD COMBINATION DISC PLAYER MODEL XR-W70A; from Toshiba America Consumer Products, Inc., 82 Totowa Road, Wayne, NJ 07470; Price: \$599.

When videodisc players were first introduced back in the 1970's, the format bombed. Video cassette recorders, on the other hand, caught on like wildfire. Considering that most people's home-video setups at the time consisted of a small-screen color TV, it's not surprising that more folks weren't leaping at the chance to buy the more-expensive videodisc players, despite their superior picture and audio quality. After all, the VCR offered consumers the ability to record prerecorded shows as well as to watch prerecorded movies—and the selection of films on videocassette was far greater than those available on disc. After a few years of sluggish sales, Philips, the inventor of the LaserVision, pulled their videodisc players off the market, and so did most other videodisc manufacturers.

The LaserVision format, however, was the only videodisc format that was never totally abandoned. Now, in the 90's, it has finally come into its own. In a way, the very success of the VCR, which pushed the videodisc player out of the market in the 70's, helped pave the way toward its increasing acceptance today. There's no question that the VCR changed the way we used our television sets. After all, with all those movies being watched at home, the next logical step was for consumers to try to duplicate the movie-theater experience using their home video and audio equipment. Manufacturers were quick to respond to (and inflame) that desire, introducing stereo TV's, increasingly large-screen direct-view sets, rear- and front-projection systems, surround-sound processors, A/V receivers, and speakers intended for use with audio and video equipment.

As consumers became more accustomed to sophisticated home-theater systems, a new niche was created for the laserdisc player. After all, once you've spent hundreds or thousands of dollars on A/V equipment, you're going to want the best possible source material. With good equipment, the flaws in VCR performance become obvious. That's why many serious A/V enthusiasts now consider the laserdisc player to be an essential ingredient in any home-theater installation—more important, even, than a VCR. The difference in quality is dramatic: Laserdisc players



## TEST RESULTS—TOSHIBA XR-W70A LASERDISC PLAYER

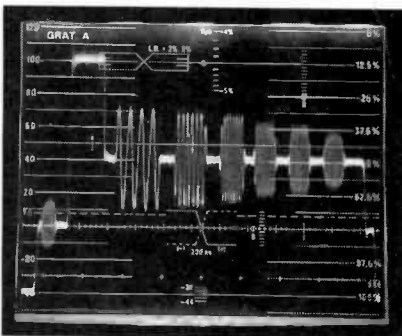
The video frequency response of a laserdisc player is a measurement of how accurately it can reproduce signals of different frequencies. It is measured by playing a special signal from a test disc that contains bursts of several specific frequencies and observing the output on a waveform monitor. The laboratory-measured frequency response of the Toshiba XR-W70A was not what we had expected from our subjective evaluations. At 4.2 MHz, the response was down 3.84 dB. That's a bit worse than we've seen from other, similar players.

The signal-to-noise ratio is a measurement of the amount of unwanted noise on a fixed, flat-field video signal. A red field, used in our lab tests, is usually preferred to measure the chroma signal-to-noise ratio. AM chroma measurements indicate the strength of the color signal, while PM chroma indicate the purity of the color signal. The AM chroma signal-to-noise ratio was measured at 44.8 dB, the PM signal-to-noise ratio was measured at 36.5 dB, both adequate, but not outstanding.

The luminance signal-to-noise measurements indicate the brightness and detail that you can expect to see in recorded videos. Such measurements indicate the amount of snow that you're likely to see in the picture. Depending on the reference luminance level used when making the measurement, the luma signal-to-noise ratio was measured at 45.1 dB, which is what we would expect. Using the S-video output improved the luminance signal-to-noise ratio by about 1.5 dB.

The audio section of the XR-W70A yielded better than average performance, as indicated by the tabulated results.

In summary, the lab results seemed to be a bit of a mixed bag. But the results are the same as with our subjective tests. The XR-W70A is not something that an audio/videophile is going to rush out and buy. But its deficiencies are small enough that a double-blind viewing test between the XR-W70A and some more expensive players would end in a draw.



Testing revealed a larger than expected drop-off at higher frequencies.

### TEST RESULTS—VIDEO SECTION

|                              |          |
|------------------------------|----------|
| <b>Frequency Response</b>    |          |
| (@0.5 MHz)                   | 0 dB     |
| (@2.0 MHz)                   | -0.78 dB |
| (@3.58 MHz)                  | -2.92 dB |
| (@4.2 MHz)                   | -3.84 dB |
| <b>Signal-to-Noise Ratio</b> |          |
| <b>Red Field Chroma</b>      |          |
| AM                           | 44.8 dB  |
| PM                           | 36.5 dB  |
| <b>Luminance</b>             |          |
| 100 IRE                      | 45.1 dB  |

### TEST RESULTS—ANALOG AUDIO SECTION

|                           |   |
|---------------------------|---|
| <b>Output Level</b>       |   |
| (1 kHz)                   | 1.53 volts (CX on), 0.52 volts (CX off) |
| <b>THD</b>                |   |
| (@75% modulation)         | 0.76% (CX on), 0.59% (CX off)           |
| <b>Signal/Noise Ratio</b> | 86.4 dB (CX on), 64.1 dB (CX off)       |

### TEST RESULTS—DIGITAL AUDIO SECTION

|                           |            |
|---------------------------|------------|
| <b>Output Level</b>       |            |
| (1 kHz)                   | 2.17 volts |
| <b>Signal/Noise</b>       |            |
| (De-emphasis in)          | 110.0 dB   |
| (De-emphasis out)         | 110.0 dB   |
| <b>Channel Separation</b> |            |
| left                      | 121.0 dB   |
| right                     | 126.9 dB   |
| <b>THD @0 dB</b>          |            |
| 20 Hz                     | 0.0031     |
| 1 kHz                     | 0.0028     |
| 10 kHz                    | 0.0045     |
| <b>Linearity Error</b>    |            |
| (0 dB to -50 dB)          | -0.01 dB   |
| <b>Frequency Response</b> |            |
| (20 Hz to 20 kHz)         | +0, -0.12  |

### ADDITIONAL DATA

|                                     |  |
|-------------------------------------|--|
| <b>Weight</b>                       | 19 pounds  |
| <b>Dimension (H x W x D)</b>        | 5¼ x 18⅞ x 17¼ inches  |
| <b>Power Requirement</b>            | 31.5 Watts   |
| <b>Random-Access time</b>           | 2.0 seconds  |
| <b>Scan Time (Side 1 to Side 2)</b> | 5.5 seconds  |
| <b>Notable Features</b>             | Flying erase head, Digital noise reduction, Timebase corrector, Bidirectional frame advance, Slow motion play ½X and ¼X, Auto indexing, Real-time counter with memory, 1-month/6-month program timer, Front-panel A/V jacks, Control-L editing interface, Control-S input. |



CIRCLE 53 ON FREE INFORMATION CARD

display twice the horizontal resolution (more than 420 lines) of VHS VCR's, and have the added advantage of providing CD-quality sound.

During those years when the laserdisc was floundering, the audio compact disc (which was introduced a couple of years after the LD), was making a big name for itself. Consumers who have become familiar with the sound quality and convenience features of the CD format now are quite willing to consider a similar format for video. Laserdisc players, like standard CD players, offer quick access to "tracks"—many videodiscs are arranged in sections to make it easy to "fast forward" to a specific scene in a movie or song on a concert video. And now that the price of laserdisc players has dropped and virtually all laserdisc players also play CD's, an LD/CD player represents an economical choice of an A/V component.

In our home-theater setup, we used a combination disc player from Toshiba. The Model XR-W70A CD/CDV/LD Player can play 3- and 5-inch CD's, 5-inch CDV's (CD with Video discs), CDV singles, 8- and 12-inch CD Video LD's, and 8- and 12-inch laserdiscs. It also adds a couple of convenience features to home-movie viewing.

The most important convenience feature is two-sided play. It's not necessary to manually flip the discs from side 1 to side 2 because the player automatically positions the pick-up carriage assembly from one side of a disc to another. That solves the only complaint we had with videodisc players. (Now, if we could only get disc manufacturers to end side 1 at some place other than the middle of a scene...)

Intro Scan is another convenience feature that lets you play the first eight sec-

onds of every laserdisc chapter or CD track so you can find what you're looking for. (It will automatically change to the second side of a laserdisc.) You can program the unit to play up to 24 chapters or tracks in any desired order; again, you can switch back and forth between laserdisc sides. (Of course, there aren't too many laserdiscs that we would like to watch in random order.) A random mode lets you play all songs on a CD in random order; on a laserdisc with a table of contents (such as a CD video laserdisc), you can play the chapters on one side of the disc in random order.

Another handy feature is automatically called into play if you turn the power switch off during playback of a laserdisc: when you turn the player back on, it will pick up where it left off. For dubbing CD's onto cassette tape, a peak-search function makes it a breeze to set your recording level: it will find the peak level, and output it for about eight seconds so you can properly set your recorder.

When you insert a disc into the XR-W70A, whether it's a CD, a CDV, or a laserdisc, the player will automatically detect what kind of disc it is—just as any other combi player will do. A special function, "Direct CD," tells the player that you are going to be playing a CD. That not only speeds its decision-making process, but it turns off the video circuitry to eliminate the possibility of interference with the audio.

An optical digital output terminal is provided for direct connection to amplifiers and other equipment with digital inputs.

Both the remote control and the front panel offer a rotary three-speed scan control. The clear-scan mode gives slow scan-

## MAIL-ORDER LASERDISCS

As laserdisc players have grown in popularity, the selection of movies and music videos available on disc has kept pace. Unfortunately for LD converts who don't live in big cities on the East and West Coasts, stores that sell laserdiscs are still few and far between, and those that offer a decent selection of LD's available as overnight rentals are even more scarce.

Some entrepreneurs have seen opportunity in that situation, and mail-order laserdisc shops are now flourishing. There are big companies, such as Columbia House Laserdisc Club (800-538-2233). Discount clubs include Ken Crane's in Westminster, CA (800-624-3978 or 800-626-1768 in CA); the LaserDisc Fan Club of Long Beach, CA (800-322-2285); Laser Craze in Boston (617-338-9820), Sight and Sound in Waltham, MA (617-894-8633); and Brooklyn-based SEM Video Products (800-247-6644 or 718-645-1663). Used laserdiscs are available from such companies as Video Brokers in Washington DC (202-328-0428) and Triton Video in New York City (212-243-3610).

ning; the low-scan mode steps scanning up to about 10× normal; and high-scan steps it up to 30× normal. The scanning was serviceable on CLV (constant linear velocity or extended-play) discs, but, of course, couldn't compare to that for CAV (constant angular velocity) discs.

A soft-picture function can filter some background noise from old vintage movies. We also found it useful to soften the image when we were sitting too close to a large screen.

The XR-W70A was a strong performer that doesn't offer any surprises. It didn't wow us with all kinds of high-tech, high-end features, but it certainly did a respectable job doing what it was supposed to. If you're a videophile who's been watching laserdiscs since the late 1970's, then look elsewhere for your next player. But if you're still wondering what all the laserdisc fuss is about, why not find out by giving the XR-W70A a try? ■

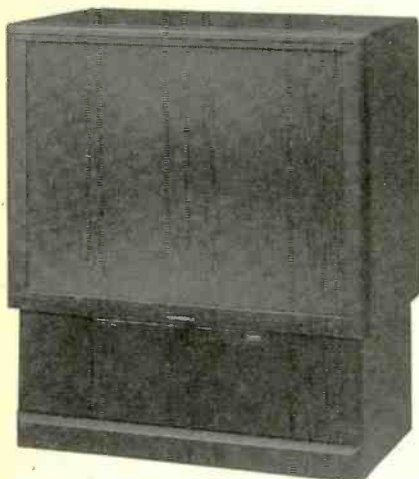


"Actually, it's made here—the manual just reads like it was made in Japan."



# ELECTRONICS WISH LIST

For more information on any product in this section, circle the appropriate number on the Free Information Card.



Panasonic Projection TV

## SuperFlat Rear-Projection TV

Incorporating much of the technology used in their SuperFlat direct-view TV's, *Panasonic Company's* (One Panasonic Way, Secaucus, NJ 07094) PTP-51XF20 also features a new screen and lens system developed for rear-projection sets. The 51-inch set is capable of more than 700 lines of horizontal resolution, and can deliver more than 300 foot-lamberts of brightness for a clear picture even in brightly lit rooms. The TV's audio specs include 20-watts-per-channel output (8 ohms, 60Hz-15kHz, 1% THD), MTS stereo with dbx noise reduction, and Dolby Surround Sound. Other features include picture-in-picture, Artificial Intelligence Control of image quality to maintain the proper contrast level, parental guidance control, built-in clock and sleep timers, dual on/off timers, favorite-channel and favorite-picture memories, and a remote that's capable of controlling most VCR's and cable boxes and all Panasonic laserdisc players. The set is just 27-inches deep, allowing it to fit through standard doorways. Price: \$2999.95.

CIRCLE 54 ON FREE INFORMATION CARD

## Small Speakers for Big Sound

If you believe that speakers should be heard but not seen, setting up a home theater can be a real challenge. *Bose Corporation* (The Mountain, Framingham, MA 01701-9168) presents an easy solution in the unobtrusive form of their *Acoustimass-7 Home-Theater Speaker System*. The matched, front-channel speaker system includes three dual-cube arrays (center, front, and right channels) and a bass module. The magnetically shielded front-channel speakers, which measure just  $6\frac{3}{4} \times 3\frac{1}{8} \times 4\frac{3}{4}$  inches, include hardware that allows several mounting options—wall and ceiling brackets, table stands, and floor stands. Each array includes a pair of 2½-inch wide-range drivers. Using a matched center speaker ensures that sound remains balanced and consistent from channel to channel. The bass module, which is small enough to be hidden anywhere in the room, launches sound waves from a pair of high-performance 5¼-inch low-frequency drivers into the room in the form of moving air masses. All connections are made through the bass module, and built-in protection circuitry guards the system components against excessive input levels. Price: \$899.

CIRCLE 55 ON FREE INFORMATION CARD

## Instant Home Theater

Intended to provide better sound without complex hookups, the *HTS-100* instant home-theater component from *Mitsubishi Electronics America, Inc.* (5665 Plaza Drive, Cypress, CA 90630) delivers Dolby Pro Logic Surround Sound as a function of normal television operation. Installation requires only one step and does not disrupt the normal connections between the TV and VCR or laserdisc player. Price: \$599.

CIRCLE 56 ON FREE INFORMATION CARD

## Video by Zenith, Sound by Bose

Bose Acoustimass speaker technology is also available built into several models of *Zenith* (1000 Milwaukee Avenue, Glenview, IL 60025) television sets, creating all-in-one home theaters featuring "Bose VideoStage Surround System." It might not be Dolby Pro-Logic, but for those interested in surround-sound without the fuss, the combination of front-channel speakers built into the TV, and two separate rear speakers works well. The *Model AB5285BG* is a 52-inch rear-projection set that features black level expansion, which expands the number of gray-to-black shades that can be displayed, leading to greater depth and richer colors. White compression reduces glare from bright white areas, for crisper edges of bright images. Lumina noise reduction decreases the "noise" that often occurs when sharpness levels are increased, and edge enhancement circuitry eliminates fuzzy edges in individual scenes. Price: \$3295.

CIRCLE 57 ON FREE INFORMATION CARD



Zenith/Bose Surround-Sound System



**START PACKING... You're going on a FREE trip!**



**W**here will it be? Hawaii? Las Vegas? Mexico? The Bahamas? It's up to you. We're going to send you a free coupon for up to six days and five nights of free lodging at the destination of your choice. Now did we get your attention?

Here's how it works: We sell books, and instead of advertising our program on TV (at great expense) we decided to pass the savings along to you.

When you decide to participate in our program, we'll send you a booklet of 40 coupons and a catalog listing our current book offerings. Purchase one book and include one of the coupons for your second book. In all, you'll get 40 books for your \$19.95 investment.

When we receive your fifth coupon, there's a bonus for you in the form of a free membership in the Grocery Savers of America. This will entitle you to save up to \$50 or more on your monthly grocery bill. And on receipt of your 15th coupon, you automatically get a free membership in The Great American Traveler, entitling you to receive a 50% savings on hotels, motels and car rentals. On receipt of your 20th coupon, Bingo! You get that big free lodging for six days and five nights at your choice of Hawaii, Mexico, Las Vegas or the Bahamas.

You're going to be very impressed with the book selections as well. These are not all paperbacks, but the same, high-quality volumes you see in bookstores at many times your own purchase price. Frankly, there just isn't enough room on this page

to outline all of the details, but don't pass this up! Send us your name, address and \$19.95 so we can send you all of the information, including your catalog and 40-coupon book today. MasterCharge and Visa are accepted.

**THE GREAT TWO FOR ONE**

**Readers Club of America**

**GIVE AWAY**

UP TO \$1,000 RETAIL VALUE

"If you find the same book or publication for less within 10 days Readers Club will refund double the difference!"

MEMBERSHIP PROGRAM

RECEIVE FREE GIFTS

MEMBERSHIP NO. 1007850

This coupon is redeemable for one book/publication in the Readers' Club Catalog when purchasing another book. NOT EXPIRATION DATE.

|                |                               |
|----------------|-------------------------------|
| MEMBERSHIP NO. | 000000                        |
| Author:        | Stephen King                  |
| Title:         | The Eyes of the Dragon        |
| Item No.:      | 1-0181                        |
| Price:         | 16.95                         |
| Author:        |                               |
| Title:         | COMPLETE DESKTOP PUBLISHERING |
| Item No.:      | 2-1093-P                      |
| Price:         | 21.95                         |
| Author:        | JACKIE COLLINS                |
| Title:         | HOLLYWOOD HUSBANDS            |
| Item No.:      | 1-0113                        |
| Price:         | 10.95                         |
| NAME:          | JOHN SMYTH                    |
| Address:       | 125 MAIN ST.                  |
| City:          | APT/THRU                      |
| State:         | NJ                            |
| Zip:           | 08001                         |
| FL Tax:        | ADDN Sales Tax                |
| Ship:          | INSR (Add per Order)          |
| Insured:       | DRWEN (Add per Coupon)        |
| Add:           | 15% of Canadian Funds         |
| TOTAL:         | ENCLOS                        |
|                | 26.40                         |

**CLAGGK Inc.**  
**P.O. Box 4099**  
**Farmingdale, New York 11735**

Gentlemen: I've enclosed \$19.95 in full payment. Please send my "The Great Two for One Give Away" booklet of 40 coupons and catalog.

Check Enclosed       Visa       MasterCard

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

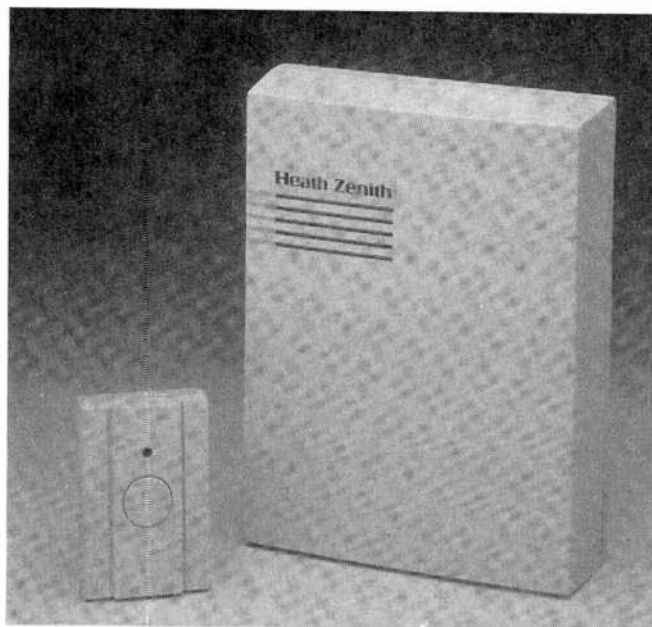
Credit Card No. \_\_\_\_\_ Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

*(Clip coupon and mail today! Do not send cash through the mail.)*



## HEATH/REFLEX WIRELESS DOORBELL



CIRCLE 119 ON FREE INFORMATION CARD

*A quick and easy way to add or replace a doorbell*

**M**ost of you are probably familiar with the Heath Company—or at least “Heath kits.” While Heath is no longer in the kit market, they have launched what they call the Reflex line of home electronics. That line of products is designed to allow the home do-it-yourselfer to install automated lighting, wireless light switches, auto-shut-off lighting, or a wireless doorbell. All at very affordable prices. This report will focus on their SL-6153 wireless doorbell.

**The Device.** The SL-6153 is a pre-built unit that allows you to install a doorbell anywhere without having to hook up any wires at all. Apart from the “doorbell button transmitter” and a “doorbell bell receiver,” a few mounting screws or some double-sided tape (both of which are included) are all you need to do the installation. The \$29.97 doorbell system has a maximum range of 50 feet and works for a year on one set of batteries. That range should provide plenty of suitable locations to place the receiver.

The transmitter, or button, is roughly the same size as a match box, and it's powered from a small 12-volt battery, which is included with the unit. The receiver, or bell, is powered from three “D” cells, which are not included.

The transmitter will look attractive mounted at any doorway, and the receiver looks much like a traditional doorbell chime box—both units are an off-white color.

The receiver unit offers three switch-selectable sound options. There's a traditional “ding dong” setting, a “ding ding” setting, and a single “ding” setting. Besides serving the purpose of user preference, the three sound options allow you to have a different sounding bell at each of up to three doors. That's the main reason why the wireless doorbell is available in three different RF frequencies. It is also useful in case your next-door neighbor has the same unit.

The most obvious need for a wireless doorbell is in cases where no doorbell exists at all. The user is then able to quickly install an “instant” doorbell. You may even want a wireless doorbell for your bedroom door. Many homes will have a doorbell at the front door only, in which case a wireless bell could come in handy for the side or back door.

**Installation.** When we first tested our wireless doorbell—with one person holding the bell and another holding the button—it did indeed have a range of at least 50 feet. However, when testing out the doorbell at its

approximate installation point, we learned the value of something mentioned in the installation manual: “Don't mount the receiver or transmitter directly on a metal surface, as the range will be drastically reduced.” If you must locate either the receiver or transmitter on a metal surface, it's suggested that you mount it on a piece of wood at least ¼-inch thick.

Our doorbell has been installed for a couple of weeks now and is still working perfectly. That shouldn't sound impressive to you—after all, two weeks isn't all that much time—but it is at the very least gratifying to this reviewer who had something to compare this new doorbell to; a wireless doorbell from another manufacturer. The receiver of this “other” wireless doorbell used only two “AA” cells for power, which lasted only a couple of days. Also, the chime on the Heath doorbell is much louder and realistic sounding than that other one. Even though that other doorbell cost ten dollars less than the Heath unit, it was certainly no bargain.

If the Heath/Reflex SL-6153 wireless doorbell sounds like something you could use, or if you're interested in any of the other Reflex products, contact Heath (PO Box 1288, Benton Harbor, MI 49023-1288) directly or circle No. 119 on the Free Information Card. ■



# No other training shows you how to troubleshoot and service computers like NRI!

## NEW! 386sx/20 MHz MINI TOWER COMPUTER!

Features 32-bit 80386sx CPU, 1 meg RAM, 64K ROM, 1.2 meg high-density floppy disk drive

## MONITOR

High-resolution, nonglare, 12" TTL monochrome monitor with tilt and swivel base

## NEW! 40 MEG HARD DISK DRIVE!

You install this 40 meg IDE hard disk drive internally, for greater data storage capacity

## DIAGNOSTIC HARDWARE AND SOFTWARE

R.A.C.E.R. plug-in diagnostic card and QuickTech menu-driven software, both from Ultra-X, give you hands-on experience with today's professional

## SOFTWARE

Train with MS-DOS, GW-BASIC, and popular Microsoft Works applications software

## DISCOVERY LAB

Complete breadboarding system lets you design and modify circuits, diagnose and repair faults

## DIGITAL MULTIMETER

Professional test instrument for quick and easy measurements

## DIGITAL LOGIC PROBE

Simplifies analyzing digital circuit operation

## LESSONS

Clear, illustrated texts build your understanding of computers step by step

**Only NRI walks you through the step-by-step assembly of a powerful 386sx computer system you train with and keep — giving you the hands-on experience you need to work with, troubleshoot, and service today's most widely used computer systems. Only NRI gives you everything you need to start a money-making career, even a business of your own, in computer service.**

No doubt about it: The best way to learn to service computers is to actually build a state-of-the-art computer from the keyboard on up. Only NRI, the leader in career-building at-home electronics training for more than 75 years, gives you that kind of practical, real-world computer servicing experience.

Indeed, no other training — in school, on the job, *anywhere* — shows you how to troubleshoot and service computers like NRI.

## Get inside the West Coast 386sx computer system ... and experience all the power and speed of today's computer technology!

With NRI's exclusive hands-on training, you actually build and keep the powerful new West Coast 386sx/20 MHz mini tower computer system.

You start by assembling and testing your computer's 101-key "intelligent" keyboard, move on to test the circuitry of the main logic board, install the power supply and 1.2 meg high-density floppy disk drive, then interface your high-resolution monitor.

What's more, you now go on to install and test a powerful 40 meg IDE hard disk drive — today's most-wanted computer peripheral — included in your course to dramatically increase your computer's data storage capacity while giving you lightning-quick data access. But that's not all!

## Professional diagnostic hardware and software makes troubleshooting fast and accurate

Your NRI training now includes a remarkable diagnostic package that allows you to quickly locate and correct defects in IBM XT, AT 80286/80386, and compatible computers.

You'll use your Ultra-X QuickTech diagnostic software to test the system RAM and such peripheral adapters as parallel printer ports, video adapters, and floppy and hard disk drives. You'll go on to use your R.A.C.E.R. diagnostic card, also from Ultra-X, to identify individual defective RAM chips, locate interfacing problems, and pinpoint defective support chips.

This ingenious diagnostic package is just one more way NRI gives you the confidence and the know-how for advancement, a new career, or a money-making business of your own.



## No experience necessary ... NRI builds it in

With NRI, you learn at your own pace in your own home. No classroom pressures, no night school, no need to quit your present job until you're ready to make your move. And all throughout your training, you have the full support of your personal NRI instructor and the NRI technical staff, always ready to answer your questions and give you help whenever you need it.

## FREE catalog tells more. Send today!

Send today for NRI's big, free catalog that describes every aspect of NRI's innovative computer training, as well as hands-on training in TV/video/audio servicing, telecommunications, industrial electronics, and other high-growth, high-tech career fields.

If the coupon is missing, write to NRI School of Electronics, McGraw-Hill Continuing Education Center, 4401 Connecticut Avenue, NW, Washington, DC 20008.

IBM is a registered trademark of International Business Machines Corp. QuickTech and R.A.C.E.R. are registered trademarks of Ultra-X, Inc.

## SEND TODAY FOR FREE CATALOG

**NRI Schools**

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



For career courses approved under GI Bill  
 check for details.

### Check one FREE catalog only

- |  |  |
|--|--|
| <input type="checkbox"/> MICROCOMPUTER SERVICING           | <input type="checkbox"/> Computer Programming            |
| <input type="checkbox"/> TV/Video/Audio Servicing          | <input type="checkbox"/> Security Electronics            |
| <input type="checkbox"/> Industrial Electronics & Robotics | <input type="checkbox"/> Electronic Music Technology     |
| <input type="checkbox"/> Telecommunications                | <input type="checkbox"/> Desktop Publishing              |
| <input type="checkbox"/> Basic Electronics                 | <input type="checkbox"/> PC Software Engineering Using C |

Name \_\_\_\_\_ (please print) Age \_\_\_\_\_

Address \_\_\_\_\_

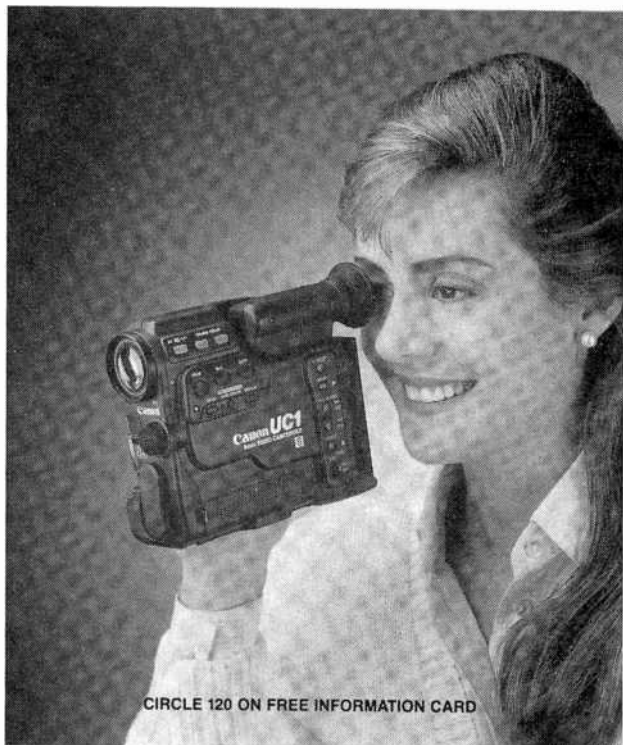
City/State/Zip \_\_\_\_\_

Accredited Member, National Home Study Council 18-013

# PRODUCT TEST REPORTS

By Len Feldman

## Canon UC1 8mm Camcorder



CIRCLE 120 ON FREE INFORMATION CARD

*The Canon UC1 compact 8mm camcorder.*

**M**ore and more camcorder enthusiasts are these days turning to the 8mm format. For reasons that remain something of a mystery, American video enthusiasts initially thought that "bigger is better" and opted for heavy, bulky, full-size VHS camcorders. Lighter and smaller compact VHS units, dubbed VHS-C, made some inroads when

introduced. But since recording time was limited to a maximum of 20 minutes, and later extended to 30 minutes, their success was limited. The introduction of the 8mm format solved both the size and weight and the recording-time

problems, offering 2 hours of recording time (and, more recently, 2½ hours on somewhat thinner tape).

Canon has been a major proponent of the 8mm format almost since it was standardized. That innovative company now offers three camcorders in their "UC" series. Of those, the UC1, which was tested for this report, is the least expensive, with a suggested list price of \$1499.00.

Billed as the world's lightest 8mm camcorder (at 1.28 pounds without tape, wireless controller, and battery), the UC1 features an 8× internal-focus zoom lens and six-layer ceramic circuit assemblies. A detachable, full-function, wireless remote control; an on-screen menu system; and a 2-page title superimposer with "shadow" letters and battery backup (for retaining titles) are a few of its many features. The titles are displayed in frames using an interlace method that prevents the broken diagonal lines that are usually apparent in other camcorders that use a field-memory method.

Other features include a 7-mode high-speed shutter, a "gain-up" switch for low-level (2-lux) light sensitivity, a 24-zone evaluated white-balance system, automatic wind screen, and a variety of power-supply options (including alkaline batteries). As is true of many 8mm-camcorder models, you can set time and date so that they may be displayed

at the beginning of a scene or at any time you choose.

More advanced features include "edit erase," a system for erasing up to a minute's worth of unsatisfactory recording and returning to the starting point of a scene that is to be re-recorded; backlighting compensation, which can be used when excessive background lighting occurs behind the subject being taped; fade-in and fade-out; and self-timer recording, a ten-second standby mode that allows you to get into the picture. Finally, if you are using a partially recorded tape, a blank-tape search function allows you to locate the end of the recorded section; that avoids having long blank, unrecorded sections on the tape.

### CONTROLS

As viewed from the rear, the left-side surface of the unit houses power-focusing buttons; an automatic-focus on/off button; the fade, backlight compensation, and date buttons; and buttons associated with tilting. Toward the rear of that surface, near the electronic viewfinder, are a counter-reset button, a menu/play button, fast-forward/record search and rewind/record search buttons, a select/record review/stop button, and an edit switch. The function of the buttons that have more than one purpose depends on whether you are in the record or play mode.



The right side panel of the camcorder body (again, viewed from the rear) houses the power on/off switch, a power-zoom rocker switch, the start/stop (record) switch, and a mode select switch that chooses camera or playback modes. A detachable wireless controller can be swung up (or detached) to uncover tape return, re-wind, play, fast forward, start/stop, zoom, stop, record, still-frame, and counter reset buttons. With the wireless controller swung out of the way and with the hand-grip section swung down, access is gained to the eject switch that is used to open the cassette compartment for loading and unloading of a cassette. As long as a battery or power adaptor is connected to the camcorder, the eject button will work even when power is off.

The audio and video input/output terminals are located up front, below the camcorder's lens and built-in microphone. Those terminals can be used to

playback recordings on a TV set equipped with audio/video inputs or to use the camcorder to record from another source, such as a VCR. A battery pack or an AC power adaptor (supplied) attaches easily to the rear of the camcorder.

### TEST RESULTS

Advanced Product Evaluation Labs (APEL) measured the performance of this camcorder. Using the "gain up" function, minimum illumination required to produce a full-amplitude video signal was 1.9 lux, which was slightly better than the 2.0-lux level claimed by Canon. White balance, or the amount of chrominance (color) that appears on a neutral object when the white-balance control is set for optimum was 12 IRE, which was a bit poorer than we would have expected.

While color contamination (color bursts appearing on a fine black and white pattern) measured 8 IRE when measured from the camera

### TEST RESULTS—CANON UC1 8mm CAMCORDER

| Specifications                 | Mfr's Claim    | PE Measured |
|--------------------------------|----------------|-------------|
| Minimum illumination           | 2.0 lux        | 1.9 lux     |
| White balance                  | N/A            | 12 IRE      |
| Color contamination            | N/A            | 8 IRE*      |
| Horizontal resolution          |                |             |
| Camera                         | N/A            | 330 lines   |
| Record/play cycles             | N/A            | 240 lines   |
| Video signal-to-noise ratio    |                |             |
| Camera                         |                |             |
| Chroma AM                      | N/A            | 43.9 dB     |
| Luminance                      | N/A            | 39.5 dB     |
| Record/play video out          |                |             |
| Chroma AM                      | N/A            | 40.1 dB     |
| Luminance                      | N/A            | 40.3 dB     |
| Lens                           | f/1.8, 8x zoom | Confirmed   |
| Minimum focal distance         | 36 inches      | 35 inches   |
| Microphone max. output         | N/A            | 0.41 volts  |
| Ext. microphone sensitivity    | N/A            | 3.1 mV      |
| Audio signal-to-noise ratio    | N/A            | 58.3 dB     |
| Power requirements             | 4.9 watts      | 6.5 watts   |
| Weight                         | 1.28 lbs.      | 2.0 lbs.*   |
| Dimensions (H x W x D, inches) | 5½ x 3½ x 6¾   | Confirmed   |
| Suggested list price           | \$1499.00      |             |

\*See text

## Earn Your B.S. Degree in ELECTRONICS or COMPUTERS



### By Studying at Home

Grantham College of Engineering, now in our 42nd year, is highly experienced in "distance education"—teaching by correspondence—through printed materials, computer materials, fax, and phone.

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

Our Computer B.S. Degree Program includes courses in BASIC, PASCAL and C languages — as well as Assembly Language, MS DOS, CADD, Robotics, and much more.

Our Electronics B.S. Degree Program includes courses in Solid-State Circuit Analysis and Design, Control Systems, Analog/Digital Communications, Microwave Engr, and much more.

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

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

Accredited by  
the Accrediting Commission of the  
National Home Study Council

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

## DIGITAL VIDEO STABILIZER ELIMINATES ALL VIDEO COPYGUARDS



While watching rental movies, you will notice annoying periodic color darkening, color shift, unwanted lines, flashing or jagged edges. This is caused by the copy protection jamming signals embedded in the video tape, such as Macrovision copy protection. THE DIGITAL VIDEO STABILIZER: RXII COMPLETELY ELIMINATES ALL COPY PROTECTIONS AND JAMMING SIGNALS AND BRINGS YOU CRYSTAL CLEAR PICTURES.

### WARNING

THE DIGITAL VIDEO STABILIZER IS INTENDED FOR PRIVATE HOME USE ONLY. IT IS NOT INTENDED TO COPY RENTAL MOVIES OR COPYRIGHTED VIDEO TAPES THAT MAY CONSTITUTE COPYRIGHT INFRINGEMENT.

### FEATURES

- Easy to use and a snap to install
- State-of-the-art Microchip technology
- 100% automatic
- Compatible to all types of VCRs and TVs
- The best and most exciting Video Stabilizer in the market
- Light weight (8 ounces) and compact (1x3.5x5")
- Uses a standard 9 Volt battery (last 1-2 years)
- Fast UPS delivery
- Air shipping available
- UNCONDITIONAL 30 day money back guarantee
- 1 year warranty

(Dealers Welcome)  
**FREE 20P Catalog**

To Order: \$59.95 ea + \$5 for p & h  
Visa, M/C, COD Mon-Fri: 9-6 EST

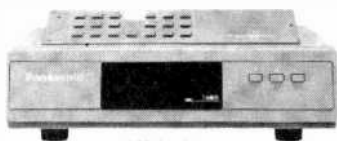
**1-800-445-9285**  
ZENTEK CORP. DEPT. CPE193  
3670-12 WEST OCEANSIDE RD. OCEANSIDE, NY 11572

CIRCLE 11 ON FREE INFORMATION CARD

## CABLE TV DESCRAMBLERS

How You Can Save Money on  
Cable Rental Fees

### Bullet Proof



1 Unit 5+

BEST Super Tri-Bi Auto/  
Var. Gain Adjustment \$119.95...\$85  
Jerrold Super Tri-Bi ... \$109.95...\$79  
Scientific Atlanta ..... \$109.....\$79  
Pioneer ..... \$109.....\$79  
Panasonic TZPC145.... \$99.95....\$79  
Stargate Converter..... \$95.....\$69  
Digital Video Stabilizer. \$59.95....\$29  
Wireless Video Sender..\$59.95....\$49.95

**US Cable'll Beat  
Anyone's Price  
Advertised in  
this Magazine!**

**30 Day Money Back Guarantee**  
FREE 20 page Catalog

Visa, M/C, COD or send money order to:  
**U.S. Cable TV Inc.** Dept. KPE193  
4100 N. Powerline Rd., Bldg. F-4  
Pompano Beach, FL 33073

**1-800-772-6244**

**For Our Record**

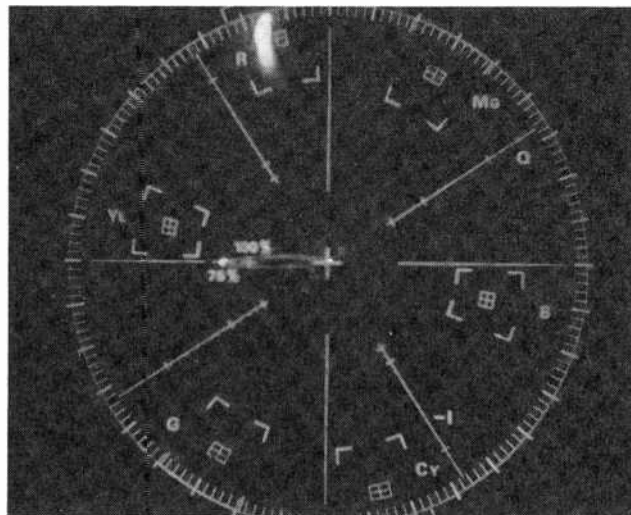
I, the undersigned, do hereby declare under penalty of perjury that all products purchased, now and in the future, will only be used on Cable TV systems with proper authorization from local officials or cable company officials in accordance with all applicable federal and state laws. FEDERAL AND VARIOUS STATE LAWS PROVIDE FOR SUBSTANTIAL CRIMINAL AND CIVIL PENALTIES FOR UNAUTHORIZED USE.

Date: \_\_\_\_\_

Signed: \_\_\_\_\_

**No Florida Sales!**

CIRCLE 12 ON FREE INFORMATION CARD



As shown in this vectorscope photo, color-phase accuracy and color saturation were just about perfect.

output itself, that figure decreased to a more than acceptable 2 IRE when the test was made for the complete record/playback cycle.

Color-phase accuracy and color saturation were just about perfect, as illustrated in the vectorscope photo of Fig. 1, which was taken by APEL from a red field. There was virtually no evidence of streaking, lag, or image retention when the camcorder was panned across bright light sources.

Resolution, or the maximum number of horizontal lines as viewed from a resolution test chart, measured 330 lines for the camera output, about equal to the best resolution obtainable from broadcast TV. When measured via the complete record/play cycle, however, resolution decreased to 240 lines, or about what we have come to expect from standard 8mm-format camcorders.

For the camera output, the video color (chroma AM) signal-to-noise ratio measured 43.9 dB, while the signal-to-noise ratio relative to the brightness signal (luminance) measured 39.5 dB. For the

complete record/play cycle, those signal-to-noise figures changed to 40.1 dB and 40.3 dB, respectively.

The built-in microphone delivered a maximum audio-output signal of 0.41 volts, while external-microphone input sensitivity measured 3.1 millivolts for full audio output. Audio signal-to-noise ratio measured a satisfactory 58.3 dB.

Additional data supplied by APEL indicated that the minimum focus distance for this camcorder was 35 inches in the normal mode, and 1/8 inch in the "macro" closeup mode. The camcorder consumed 6.5 watts of power when in the record mode. With its battery pack and wireless controller attached, and a 120-minute 8mm-cassette installed, the total weight of the camcorder approached 2 pounds. The overall dimensions of the unit were 5 1/2 (H) by 3 1/8 (W) by 6 3/8 (D) inches.

### HANDS-ON TESTS

Since so many of the controls are of the dual-function type and the unit is so compact, learning how to use the UC1's many features and special effects takes a bit of time and practice. However, it is well



worth the effort because this very compact unit is able to produce professional-looking video tapes that would have required the use of a much heavier and bulkier camcorder just a couple of years ago.

We should note that those seeking better picture resolution than is provided by the UC1 can choose Canon's UCS1. That unit is a slightly heavier but equally compact model that offers all the features of the UC1, plus Hi-Band 8mm-video recording and several additional features such as a 2-speed 10x power zoom and a built-in character generator with numerous digital title functions. For those who insist upon better sound, Canon offers still another camcorder—the UC20, which features hi-fi stereo and a 7-mode high-speed shutter. The UCS1 carries a suggested list price of \$2099.00 while the UC20 has a suggested list price of \$1849.00.

However, for the typical camcorder user seeking a lightweight, full featured 8mm camcorder to use for recording vacations, family events, and other memories, we can recommend the Canon UC1 without any reservations. For more information on the UC1 or other Canon camcorders, contact the company directly (Canon USA, Inc., Video Division, One Canon Plaza, Lake Success, NY 11042-1113), or circle No. 120 on the Free Information Card.

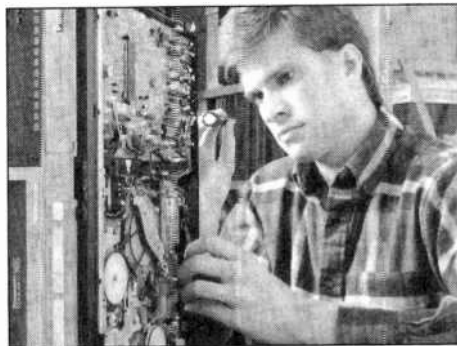


**NO COMPLICATED ELECTRONICS, NO EXPENSIVE INSTRUMENTS:**

## Home study course shows you how to make good money in VCR repair.

An amazing fact: you can do more than four out of five VCR repairs with ordinary tools and basic fix-it procedures. Our home study program shows you how.

Learn all of the systems, mechanisms, and parts of almost all brands of VCRs. With *no* expensive instruments. *No* complicated electronics. *No* fancy workshop. The step-by-step texts and close personal attention from your instructor make learning easy.



Texts, course materials, and tool kit are sent to your home. Graduate ready to make up to \$50.00 or more per hour in your own spare-time or full-time business.

**Send today for your free career booklet. Or call 800-223-4542**

Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

### The School of VCR Repair

2245 Perimeter Park, Dept. VA341, Atlanta, Georgia 30341

CIRCLE 9 ON FREE INFORMATION CARD

**THE UNCENSORED  
 CONTENT OF  
 THIS MAGAZINE IS  
 MADE POSSIBLE BY  
 THE CONSTITUTION  
 AND  
 THE BILL OF RIGHTS  
 OF THE  
 UNITED STATES.**

**THE CONSTITUTION. THE WORDS WE LIVE BY.**

To learn more about the Constitution write: Constitution, Washington, D.C. 20006. The Commission on the Bicentennial of the U.S. Constitution.



### SUPER 12 HOUR RECORDER CALL TOLL FREE

Modified Panasonic Slimline,  
 6 hrs per side  
 120 TDK tape furnished.  
 AC/DC Operation.  
 Quality Playback.  
 Digital Counter.  
 Durable Lightweight Plastic.



**\$119.00\***

### PHONE RECORDING ADAPTER

Starts & Stops Recorder  
 Automatically When  
 Hand Set is Used.  
 Solid State!  
 FCC Approved



**\$28.50\***

### VOX VOICE ACTIVATED CONTROL

Solid-state Adjustable  
 Sensitivity. Voices &  
 Sounds Activate Recorder  
 Adjustable Sensitivity  
 Provisions for Remote  
 Mike



**\$28.50\***

\* Add for ship. & handling. Phone Adapter & Vox \$2.00 each, Recorders \$5.00 each. Colo. Res add tax. Mail Order, VISA, M/C, COD's OK. Money Back Guar. Qty Disc. available. Dealer inquiries invited. Free data on other products.

AMC SALES INC. 193 Vaquero Dr.  
 Boulder, CO. 80303  
 Phones (303) 499-5405 1-800-926-2488  
 FAX (303) 494-4924  
 Mon-Fri 8-5 MTN, TIME

CIRCLE 5 ON FREE INFORMATION CARD

# Welcome to . . .

# SCIENCE PROBE!

The Amateur Scientist's Journal

Embark on an irresistible new journey into the realm of mystery, challenge, and exploration! The perfect magazine for the budding scientist, the serious amateur, the professional who would like to relax, and those who simply want to gaze at the stars.

Articles to appear in upcoming issues of Science PROBE! are:

**Inside Internet—A Scientific Computer Network**  
**Make your own Seismometer**  
**Operate a Solar-Powered Weather Station**  
**Assemble a Solid-State Portable Barometer**  
**The Bicycle—A Traveling Scientific Laboratory**

If you're fascinated by science in all its many forms, if you are compelled to experiment and explore, then Science PROBE! is your kind of magazine!

**For Faster Service—Call Today:**  
**1-800-777-5489**

**Science PROBE!** — the *only* magazine devoted entirely to Amateur Scientists! If you are fascinated by science in all its many forms . . . if you can't stay away from a microscope, telescope, calipers, or test tube — we invite you to share the wonders in every issue of **Science PROBE!** You will join a community of Amateur and Student Scientists who enthusiastically seek scientific knowledge or follow scientific pursuits for their own sakes and not merely as a profession.

Obtain your next issue of **Science PROBE!** by visiting a quality Newsstand, Convenience Store, or Supermarket or by reserving your personal copy through the mail by completing the coupon below.

From your very first issue of **Science PROBE!** you will be involved in a world of scientific facts, experiments, and studies pursued by amateur scientists who are university students, investors, academicians, engineers, or office workers, salesmen, farmers—whose *quest* is to probe into the mysteries of science and reveal them to all.

Plan to become a **Science PROBE!** reader!

Science PROBE!  
500-B Bi-County Boulevard  
Farmingdale, NY 11735

7PA31

Please forward my copy of Science PROBE! as soon as it comes off the press. I am enclosing \$3.50-U.S.A. (\$4.23-Canada-includes G.S.T.) plus \$1.00 for shipping and handling. Better still, please enroll me as a subscriber and send the next four (4) quarterly issues of Science Probe. I am enclosing \$9.95-U.S.A. (Canada: \$16.00—includes G.S.T.)

Next Issue Only       Next Four Issues (1 Year)

Offers valid in the U.S.A. and Canada only. No foreign orders.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

All Orders payable in U.S.A. Funds only.

**ON SALE AT QUALITY NEWSSTANDS, CONVENIENCE STORES AND SUPERMARKETS**  
**GET YOUR COPY TODAY—\$3.50-U.S.A.—\$3.95-Canada**





# Build an Aviation-Band Receiver

*Join a growing throng of listening enthusiasts who regularly tune in commercial air-to-ground and ground-to-air aeronautic communications.*

BY FRED BLECHMAN

If, like many scanner enthusiasts and ham operators, you are interested in listening in on all the excitement manifest in aeronautic communication, but lack the equipment to pursue your interest, then perhaps the *Aviation Receiver* described in this article is for you. The *Aviation Receiver*, designed to tune the 118–135-MHz band, features exceptional sensitivity, image rejection, signal-to-noise ratio, and stability. The receiver is ideally suited to listening in on ground and air communications associated with commercial airlines and general aviation.

Powered from a 9-volt transistor-radio battery, it can be taken along with you to local airports so that you won't miss a moment of the action. And even if you're nowhere near an airport, this little receiver will pick-up the air-to-ground and ground-to-air communications of any plane or ground facility within about 100 miles!

**Circuit Description.** Figure 1 shows a schematic diagram of the *Aviation Receiver*—a superhetrodyne AM (amplitude modulated) unit built around four IC's: an NE602 double-balanced mixer (U1), an MC1350 linear IF amplifier (U2), an LM324 quad op-amp (U3), and an LM386 audio amplifier (U4).

In operation, an antenna that plugs into J1 picks up the AM signal. That signal is then coupled through C1 to a three-section, tuned-filter network,

consisting of L1–L5 and C2–C6. Signals in the 118–135-MHz VHF (very high frequency) range are coupled through C7 to a VHF transistor (Q1), where the signals are amplified. From there, the signals are fed through C8 to the input of U1 (the NE602 double-balanced mixer), which in this application serves as a local oscillator. A variable inductor (L6) and its associated capacitor network set the local-oscillator frequency at 10.7-MHz higher than the incoming 118–135-MHz signals. A tuning network, consisting of varactor diode D1 and potentiometer R1, allows the local-oscillator frequency to be tuned across about 15 MHz.

The 10.7-MHz difference between the received signal and the local-oscillator frequency (*i.e.*, the intermediate frequency or IF) is output at pin 4 of U1 to a 10.7-MHz ceramic filter (FIL1). The filter is used to ensure a narrow pass band and sharp signal selectivity.

The output of FIL1 is amplified by Q2 and then fed through C16 to U2 (an MC1350 IF amplifier), which, as configured, also offers automatic gain control (AGC), as we'll see shortly. The amplified 10.7-MHz IF signal is peaked using variable transformer T1. The AM audio is then demodulated by diode D2. After that, the audio is fed in sequence through the four sections of U3 (an LM324 quad op-amp).

Note that a portion of U3-a's output signal is fed back through resistor R25 to the AGC-control input of U2 at pin 5.

That signal is used to automatically decrease the gain of U2 when strong signals are present or to automatically increase U2's gain for weak signals. That keeps the output volume of the circuit within a comfortable listening range regardless of the strength of the incoming signals.

The receiver circuit also contains a squelch circuit that is controlled by potentiometer R3, which is used to kill random noise below a selected threshold level. When properly set, the squelch control virtually eliminates background noise, so that all you hear are incoming signals that can be brought up to a usable level. Potentiometer R2 controls the overall volume fed through C26 to U4, an LM386 low-voltage audio-power amplifier. Due to the overall design and squelch control, the audio output is quite low in background noise, and yet it's capable of driving simple communications speakers or earphones to excellent volume levels.

**Construction.** The *Aviation Receiver* was assembled on a printed-circuit board, measuring about 4 × 4¾ inches. Figure 2 shows a full-size template of that printed-circuit board's layout. A kit of parts (which includes an etched and pre-drilled, printed-circuit board, but no case) is offered by the supplier listed in the Parts List.

Although most of the parts for this project are commonly available through conventional electronic-

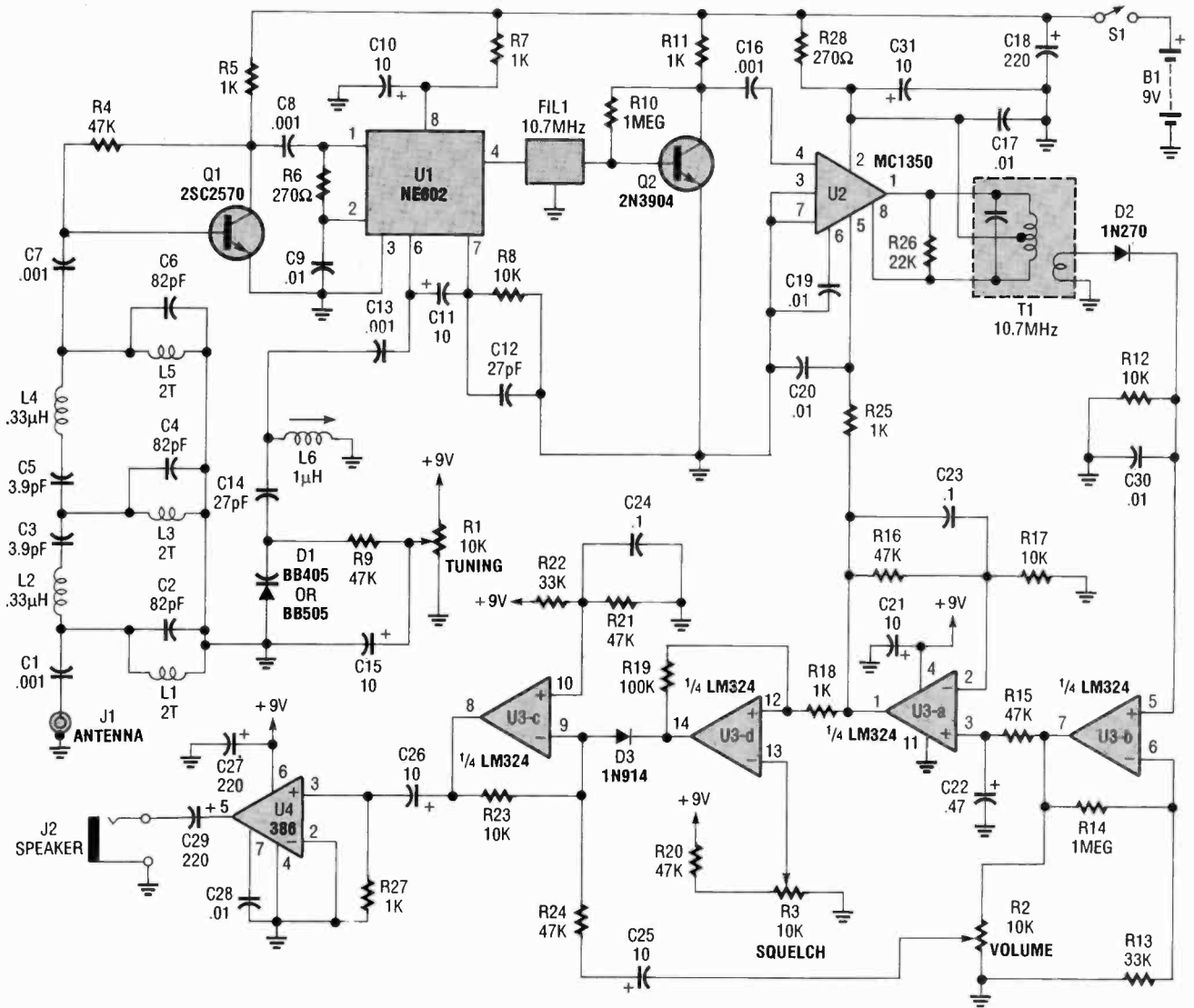
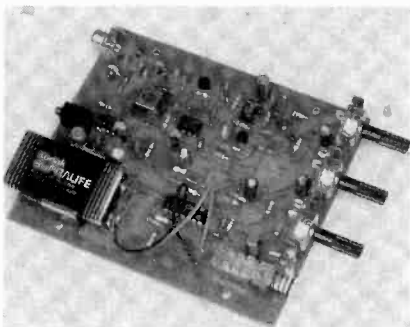


Fig. 1. The Aviation Receiver—a superheterodyne unit, built around four IC's—is designed to receive AM signals in the 118–135-MHz frequency range.



All of the components for the Aviation Receiver (including the 9-volt transistor-radio battery that powers the circuit) mount on a single printed-circuit board.

components suppliers, a source for some of the more difficult to find parts is given in the Parts List for those who prefer to do their own shopping. If you opt to gather your own parts or you

plan to use what you have on hand, keep in mind that the circuit-board layout was designed to accommodate components of specific dimensions in some cases; jacks J1 and J2, switch S1, transformer T1, and all three potentiometers, for example. To ease the pain of obtaining those parts, a "Special Parts Kit" is also available from the listed source.

Also note that either of the Siemens parts specified in the Parts List for varactor diode D1 will work, but both may be difficult to find from hobbyist sources. However, the second unit (BB505) is available from Allied Electronics.

However you go about collecting the parts for this project, don't even think about building the receiver circuit without the printed-circuit board.

At the frequencies involved, the placement of every wire and part, and every part value is critical for trouble-free performance.

Once you've obtained all of the components and the board for the Aviation Receiver, construction can begin. A parts-placement diagram is shown in Fig. 3. When assembling the project, take special care that polarity-sensitive components (electrolytic capacitors, diodes, and transistors) are installed properly. Just one part installed backwards can cause grievous harm!

Begin by installing the passive components (jumper wires, resistors, capacitors, and inductors). Follow that by installing the active components; diodes, transistors, and IC's. Once the active components have been in-



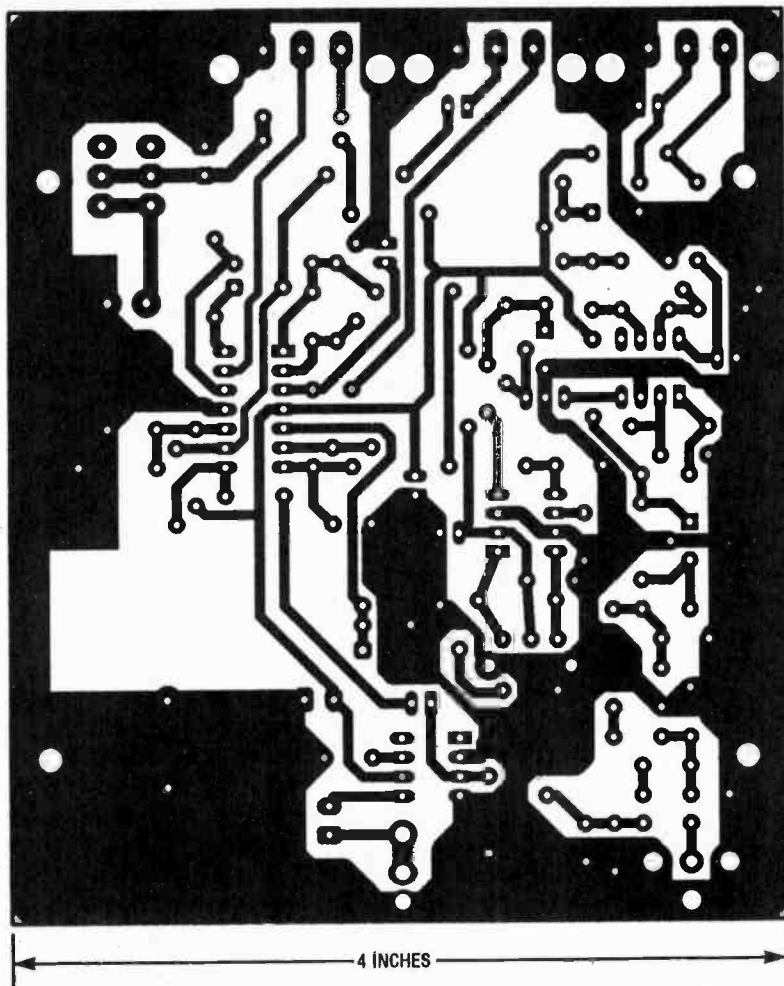
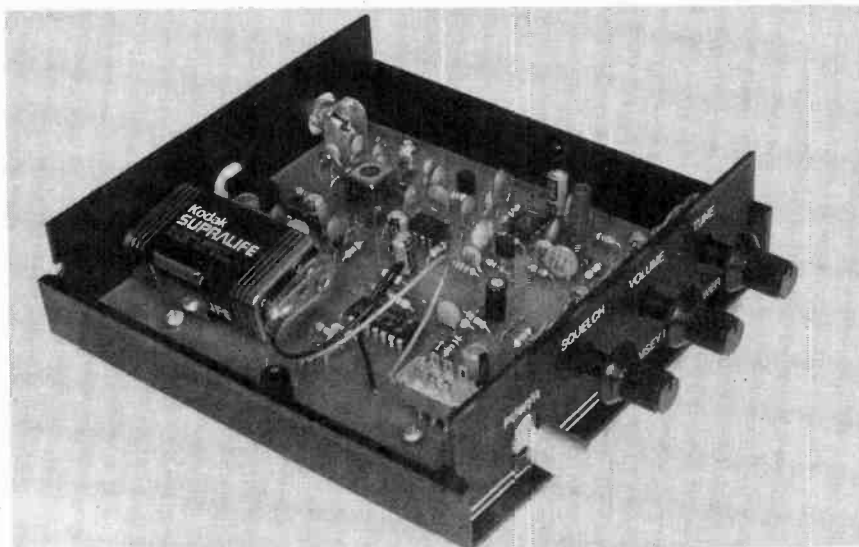


Fig. 2. Here's a full-size printed-circuit pattern for the Aviation Receiver. The printed-circuit board can be purchased as part of a full-blown kit or separately from the supplier listed in the Parts List.



The Aviation Receiver's printed-circuit board fits neatly into this optional 5- x 5.25- x 1.5-inch custom cabinet (which comes with knobs, hardware, silk-screened front and back panels, as well as rubber mounting feet).

stalled, check your work for the usual construction errors: cold solder joints, misplaced or misoriented compo-

nents, solder bridges, etc. Once you've determined that the circuit has been correctly assembled, it's time to

consider the enclosure that will house your receiver.

The receiver's circuit board can be housed in any enclosure that you choose. However, if you prefer, an optional case and knob kit for the receiver is available from the supplier listed in the Parts List. The optional case is supplied with neatly lettered front and rear panels, knobs, rubber feet, and mounting screws.

If you choose a case other than the one available from the listed supplier, it will be necessary to drill holes in the front and rear panels of the enclosure to accommodate the controls (S1, R1, R2, R3) and the jacks (J1 and J2). Once drilled, the front and rear panels of the enclosure can be labeled using dry-transfer lettering.

The antenna for the Aviation Receiver can be as simple as a 21-inch length of wire, or you can get a fancy roof-mounted aviation antenna. If you are near an airport, you'll get plenty of on-the-air action from the wire antenna, but if you're more than a few miles away, a decent roof-mount antenna offers a big improvement.

### Alignment and Adjustment.

Aligning the Aviation Receiver consists of nothing more than adjusting the slug in the local-oscillator coil (L6) for the center of the desired tuning range, and peaking the IF transformer (T1). The receiver can be calibrated using a VHF RF signal generator, frequency counter, or another VHF receiver by setting R1 to its mid-position; remember that you want to set the local-oscillator frequency 10.7-MHz higher than the desired signal or range to be received. Then, using a non-metallic alignment tool—a metal tool of any kind will drastically detune the coil, making alignment almost impossible—adjust L6 (the LO coil) until you hear aircraft or airport communications.

Once you are receiving aircraft or airport frequencies, adjust T1 for the best reception. Typically, T1 is adjusted 2–3 turns from the top of the shield can. If you don't have any signal-reference equipment for alignment, and are not yet hearing airplanes, your best bet is to pack up the receiver and the necessary alignment tools, and head for the nearest airport! If the airport has no control tower, visit a gen-

## WHAT YOU CAN EXPECT TO HEAR

No matter where you live, you will be able to receive at least the airborne side of many air-traffic communications. If you know where to tune, you can hear any aircraft that you can see, plus planes a hundred miles away and more, since VHF signals travel "line of sight." An airliner at an altitude of 35,000 feet and in the next state is probably still line-of-sight to your antenna.

Similarly, whatever ground stations you may hear are also determined by the line-of-sight character of VHF communication. If there are no major obstacles (tall buildings, hills, etc.) between your antenna and an airport, you'll be able to hear both sides of many kinds of aviation communication. Be prepared for them to be fast and to the point, and for the same airplane to move to several different frequencies in the span of a few minutes!

At most metropolitan airports, pilots communicate with the FAA on a "Clearance Delivery" frequency to obtain approval or clearance of the intended

flight plan, which is done before contacting ground control for taxi instructions.

From the control tower, ground movements on ramps and taxiways are handled on the Ground Control Frequency, while runway and in-flight maneuvers near the airport (takeoffs, local-traffic patterns, final approaches, and landings) are on the Tower Frequency. ATIS, or "Automatic Terminal Information System," is a repeated broadcast about basic weather information, runways in use, and any special information such as closed taxiways or runways. Such a broadcast offers an excellent steady signal source for initial adjustment of your receiver, if you are close enough to the airport to receive ATIS.

Approach Control and Departure Control are air-traffic radar controllers that coordinate all flight operations in the vicinity of busy metropolitan-airport areas. When you hear a pilot talking with "Jacksonville Center" or "Indianapolis Center," these are regional ATC (Air Traf-

fic Control) centers. The aircraft is really en route on a flight, rather than just leaving or approaching a destination. A pilot will be in touch with several different "Regional Centers" during a cross-country flight.

Airports without control towers rely on the local Unicom frequency for strictly advisory communications between pilots and ground personnel, such as fuel service operators. The people on the ground can advise the pilot what they know about incoming or outgoing aircraft, but the pilot remains responsible for landing and takeoff decisions. Typical Unicom frequencies are 122.8 and 123.0 MHz.

The FAA's network of FSS (Flight Service Stations) keeps track of flight plans, provides weather briefings and other services to pilots. Some advisory radio communication takes place between pilots and a regional FSS. If there is an FSS in your local area, but no airport control towers, the FSS radio frequency will stay interesting. ■

## PARTS LIST FOR THE AVIATION RECEIVER

### SEMICONDUCTORS

- U1—NE602 double-balanced mixer, integrated circuit (Digi-Key)
- U2—MC1350 linear IF amplifier, integrated circuit (Allied 858-3011)
- U3—LM324 quad op-amp, integrated circuit (Digi-Key)
- U4—LM386 low-voltage audio-power amplifier, integrated circuit (Digi-Key)
- Q1—2SC2570 or 2N5179 NPN UHF transistor (Allied 858-1041)
- Q2—2N3904 general-purpose NPN silicon transistor (Digi-Key)
- D1—BB405 or BB505 varactor diode (Siemens, Allied 586-0610)
- D2—1N270, 1N34, or similar germanium diode
- D3—1N914 silicon diode

### RESISTORS

- (All fixed resistors are 1/4-watt, 5% units.)
- R1—R3—10,000-ohm PC-mount potentiometer
  - R4, R9, R15, R16, R20, R21, R24—47,000-ohm
  - R5, R7, R11, R18, R25, R27—1000-ohm
  - R6, R28—270-ohm
  - R8, R12, R17, R23—10,000-ohm
  - R10, R14—1-megohm
  - R13, R22—33,000-ohm

- R19—100,000-ohm
- R26—22,000-ohm

### CAPACITORS

- C1, C7, C8, C13, C16—0.001- $\mu$ F, ceramic-disc
- C2, C4, C6—82-pF, ceramic-disc
- C3, C5—3.9-pF, ceramic-disc
- C9, C17, C19, C20, C28, C30—0.01- $\mu$ F, ceramic-disc
- C10, C15, C21, C25, C26, C31—4.7- to 10- $\mu$ F, 16-WVDC, electrolytic
- C11—10-pF, ceramic-disc
- C12, C14—27-pF, NPO ceramic-disc
- C18, C27, C29—100- to 220- $\mu$ F, 16-WVDC, electrolytic
- C22—0.47- $\mu$ F, 16-WVDC, electrolytic
- C23, C24—0.1- $\mu$ F, ceramic-disc

### INDUCTORS

- L1, L3, L5—1/2-turns #24 to #30 gauge wire
- L2, L4—0.33- $\mu$ H, inductor (Digi-Key M9R33-ND)
- L6—0.1- $\mu$ H, 3/2-turn, slug-tuned coil (Digi-Key TK2816)
- T1—10.7-MHz, shielded transformer (Mouser 42IF123)

### ADDITIONAL PARTS AND MATERIALS

- FL1—10.7-MHz ceramic filter (Digi-

Key TK-2306)

- S1—SPST switch, PC mount
  - J1—RCA jack, PC mount
  - J2—Subminiature phone jack, PC mount
  - B1—9-volt transistor-radio battery
- Perfboard materials, enclosure, AC molded power plug with line cord, battery(s), battery holder and connector, wire, solder, hardware, etc.

**Note:** The following items are available from Ramsey Electronics, Inc., 793 Canning Parkway, Victor, NY 14564; Tel. 716-924-4560: A complete kit of parts (AR-1BP), including printed-circuit board (but not the case or control knobs), \$24.95; an etched and drilled printed-circuit board only (AR-IPCBP), \$10.00; a Special Parts Kit (AR-ISPKBP) containing all semiconductors, R1-R3, all inductors, S1, J1 and J2, and FL1, \$14.50; Custom case and knob set (C-AR-1BP), \$12.95. Please add \$3 for orders under \$20. All orders are subject to a \$3.75 postage/handling charge. New York State residents, please add appropriate sales tax.



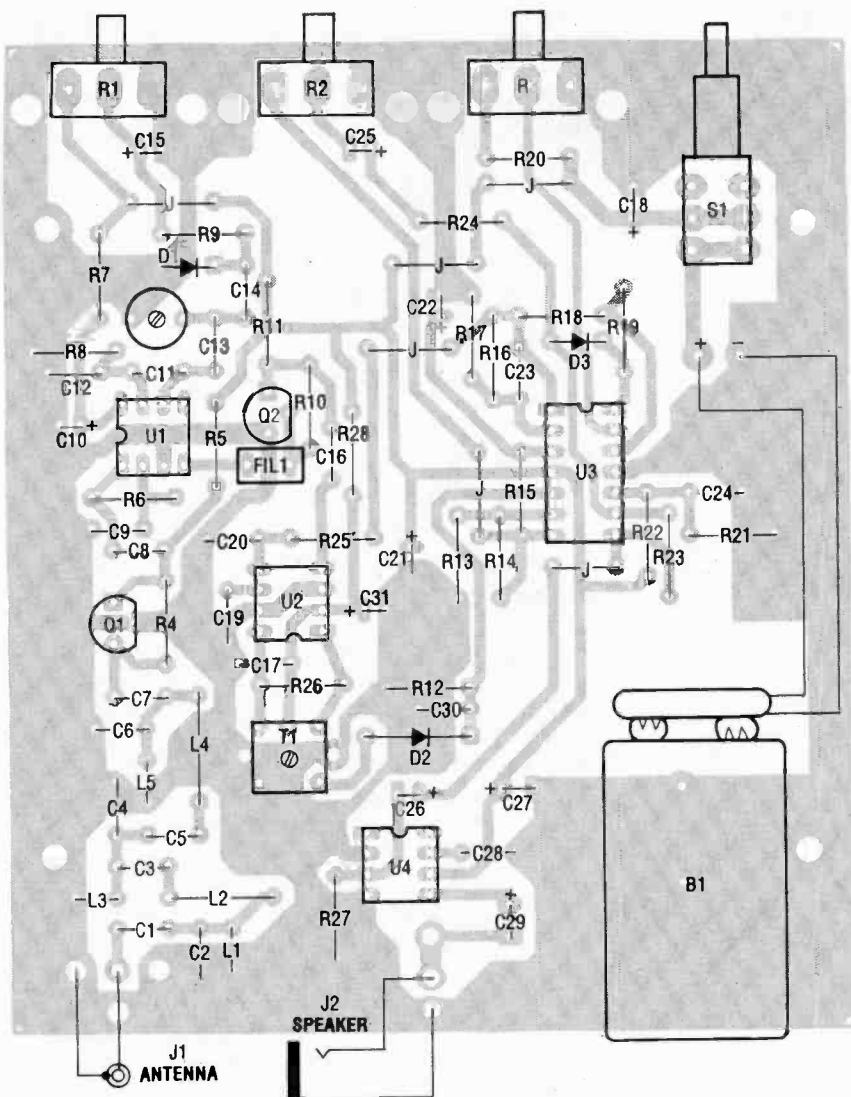


Fig. 3. Use this parts-placement diagram as a guide when assembling the printed-circuit board

eral aviation service center on the airport grounds, and ask which are the most active frequencies. Then adjust L6 and R1 until you hear the action.

A ground-service operator or private pilot may be willing to give you a brief test transmission on the 122.8 Unicom frequency. Remember, also, that if your airport has ATIS transmissions, you can get a steady test signal as soon as you are within line-of-sight of its antenna. (See the sidebar for explanation of Unicom and ATIS.)

**Use.** Plug an antenna into J1 and a 4- to 8-ohm speaker or earphone into J2. Turn on the Aviation Receiver by closing S1. You may or may not hear background noise. Turn R2 (the SQUELCH control) fully counterclockwise. Then rotate R2 clockwise until you hear a "pop" and some background noise;

then back it off slightly (counterclockwise) past the pop. You are now in squelch mode.

With pilots and controllers talking so briefly, you will need to get used to tuning your receiver. As you sweep across the band (via R1), listen for a sound, then rock back and forth slightly to tune it in clearly.

**Troubleshooting Suggestions.** If the receiver does not work at all, carefully check the obvious things first; battery polarity, soldering of the battery wires and switch, and the connections to the speaker jack. Also, be sure to check that you've correctly installed all of the jumpers. If the circuit's operation is erratic, a solder connection is usually the culprit, or there could be a break in the antenna or speaker wire.

Pay special attention to the orienta-

## PILOT AND CONTROLLER TALK

Don't blame the Aviation Receiver if all you hear are short bursts of words that don't make a lot of sense at first. Aviation communication is necessarily quick and brief, but clear and full of meaning. Generally, pilots repeat exactly what they hear from a controller, so that both know the message or instructions were correctly interpreted. If you are listening in, it's hard to track everything said from a cockpit, particularly in big city areas. Just to taxi, takeoff, and fly a few miles, a pilot may talk with 6 or 8 different air-traffic-control operations within a few minutes, all on different frequencies.

Here's the meaning of just a few typical communications:

"Miami Center, Delta 545 heavy out of three-zero for two-five." Delta Flight 545 acknowledges Miami Center's clearance to descend from 30,000 feet to 25,000 feet. The word "heavy" means that the plane is a jumbo jet, perhaps a 747, DC-10, or L-1011.

"Seneca 432 lima cleared to outer marker. Contact tower 118.7." The local Approach Control is saying that the Piper Seneca with the N-number, or "tail number" ending in "432L" is cleared to continue flying an instrument approach to the outer marker (a precision radio beacon located near the airport), and should immediately call the airport radio control tower on 118.7 MHz. That message also implies that the controller does not expect to talk again with that aircraft.

"Cessna 723, squawk 6750, climb and maintain five thousand." A controller is telling the Cessna pilot to set the airplane's radar transponder to code "6750," climb to and level off at the altitude of "5000 feet."

"United 330, traffic at 9 o'clock, 4 miles, altitude unknown." The controller alerts the United Airlines flight of radar contact with some other aircraft off to the pilot's left at a "9 o'clock" position. Since the unknown plane's altitude is also unknown, both controller and pilot realize that it is a smaller private plane not equipped with altitude-reporting equipment. ■

tion of all IC's, transistors, diodes, and electrolytic capacitors. Also, be sure that C11 and C12 in U1's oscillator circuit are of the right values. Local-oscillator operation can be verified with a simple VHF receiver or frequency counter. Remember that the local oscillator should be set to a frequency 10.7 MHz above the desired listening range. If the oscillator works, only a defective or incorrectly installed part can prevent the rest of the receiver circuit from functioning. ■

**A**lthough it may seem quite distant now, summer is approaching with the anticipation of backyard games, barbecues, and the dog next door barking incessantly. If you happen to be the owner of the irritating, barking dog next door, then neighborhood harmony is at risk. But, worry not... for in this article, we're going to show you how to build a *Dog Bark Inhibitor* that will restore neighborhood harmony by humanely stopping your dog from barking.

Commercially available dog bark inhibitors (electronic devices built into a dog's collar) that are currently on the market are both expensive and can in some circles be considered inhumane. With such devices, every time the dog barks an electrical charge is sent to the dog's neck. While that stops the dog from barking, it can also turn a dog into a cowering animal afraid of its own shadow.

However, the Dog Bark Inhibitor described here is inexpensive and humanely stops the dog from barking by actuating a buzzer every time the barking begins. The buzzing is used to give the dog negative feedback that he'll associate with his barking, causing him to refrain from that annoying tendency.

**Circuit Description.** Figure 1 shows a schematic diagram of the Dog Bark Inhibitor. At power up, a one-shot multivibrator, consisting of one-third of a 40106 hex Schmitt trigger (U4-c and U4-d), resets U2 and U3, keeping the buzzer (BZ1) cut off. At the same time, resistors R1 and R2 set the trigger level of U1-a, U1-c, and U1-d ( $\frac{3}{4}$  of an LP324 quad op-amp) to 2.5 volts. Op-amps U1-a and U1-d are configured as inverting comparators with hysteresis, while U1-c is configured as a voltage follower.

The voltage follower (U1-c) provides a standing DC bias voltage for an electret microphone (MIC1). When MIC1 picks up the dog's barking (see the waveform diagram in Fig. 2A), the bias voltage applied to MIC1 fluctuates, and the output of U1-c follows. Fluctuations in the microphone's bias voltage are applied to U1-d, which amplifies the signal and feeds its output to U1-a. The overall sensitivity of

# Build a



# Dog - Bark Inhibitor

*Give yourself and your neighbors some peace and quiet with this training aid*

BY ROBERT J. GAFFIGAN JR.

the circuit is determined by the gains provided by U1-a and U1-d. The hysteresis provided by those two op-amps helps to keep background noise out of the signal applied to U1-b, which is setup as a low-pass filter. That low-pass filter is used to remove frequencies from the signal that are not in the range of a dog's bark.

From the filter, the signal (see Fig. 2B) is made compatible with digital circuitry by U4-a ( $\frac{1}{2}$  of a 40106 hex inverting Schmitt trigger), which also inverts the input signal. That signal is again inverted by U4-f and output to the following circuitry as a train of negative-going pulses. Those pulses are produced each time that the sound picked up by the microphone falls within the low-pass range of the filter (see the waveform in Fig. 2C).

The output of U4-f divides along two signal paths: in one path, the signal is fed to the clock input of U2 (a 4040 12-stage ripple carry binary counter); in the other path, the signal is applied to the trigger input of U3-a ( $\frac{1}{2}$  of a 556 dual oscillator/timer). The negative pulses trigger U3-a, whose output, in turn, enables U2, causing it to count the number of times that the sound falls within the low-pass range of the

filter. The purpose of U2 and U3-a is to reject spurious sounds that fall within the filter's range and to allow the dog a period of free barking.

If the counter (U2) counts 256 bark pulses within eight seconds, its output goes high. That high is inverted by U4-b and applied to the trigger input of U3-b at pin 8, forcing its output at pin 9 high. The high output of U3-b is applied to the base of Q1 (an MPSA12<sup>1</sup> Darlington transistor), causing it to conduct. With Q1 conducting, BZ1 (a 6-volt electronic buzzer) activates for about half a second. At the same time, the ripple counter (U2) is reset via an OR gate, made up of D1, D2, and R11.

If, on the other hand, U2 counts fewer than 256 pulses within that 8-second period, the counter resets, and awaits the next barking session.

The circuit is powered by a 9-volt transistor-radio battery. Because of that, the semiconductors used for this circuit were chosen for their low-current requirements—the circuit draws approximately 0.9 microamps of quiescent current, and 15 mA with the buzzer on—and should not be substituted unless swapped for lower-power components.

**Construction.** Although the author's prototype was built on a section of perfboard, using point-to-point wiring to interconnect the circuit elements, the final version was assembled on a printed-circuit board, measuring about 3 x 2 inches. A template of the printed-circuit layout is shown in Fig. 3. You can etch your own printed-circuit board from the template shown in Fig. 3, or you can order a printed-circuit board and the parts (separately) to populate it from the supplier listed in the Parts List.

Once you have obtained the board and the parts that go with it, construction can begin. Figure 4 shows the parts-placement diagram for the author's printed-circuit layout. It is recommended that IC sockets be provided for all of the DIP units (U1-U4). The regulator, U5, is housed in a TO-92 style package. Begin construction by installing the DIP sockets and the jumper wires. Once that is done, install





## PARTS LIST FOR THE DOG BARK INHIBITOR

### SEMICONDUCTORS

- U1—LP324 micropower quad op-amp (National), integrated circuit  
 U2—CD4040 12-stage ripple carry binary counter, integrated circuit  
 U3—LM556 dual oscillator/timer, integrated circuit  
 U4—CD40106 hex inverting Schmitt-trigger, integrated circuit  
 U5—LM2931A 5-volt series, low-dropout, voltage regulator, integrated circuit  
 Q1—MPSA12 Darlington NPN silicon transistor  
 D1, D2—1N914 general-purpose, small-signal silicon diode

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)

- R1, R2, R11, R16—100,000-ohm  
 R3—1000-ohm  
 R4, R9—39,000-ohm  
 R5—75,000-ohm  
 R6—2200-ohm  
 R7, R8—11,000-ohm  
 R10—56,000-ohm  
 R12—10,000-ohm  
 R13—R15—1-megohm

### CAPACITORS

- C1—2.2- $\mu$ F, 16-WVDC, tantalum  
 C2—0.047- $\mu$ F, monolithic  
 C3—0.1- $\mu$ F, monolithic  
 C4, C5—0.01- $\mu$ F, monolithic  
 C6—8.2- $\mu$ F, 16-WVDC, tantalum  
 C7, C8—1- $\mu$ F, 16-WVDC, tantalum  
 C9—22- $\mu$ F, 16-WVDC, miniature electrolytic

### ADDITIONAL PARTS AND MATERIALS

- S1—SPST slide switch  
 MIC1—Electret microphone  
 BZ1—6-volt electronic buzzer (RS #273-054)  
 B1—9-volt transistor-radio battery  
 Printed-circuit materials, enclosure, 3/4 x 24-inch web strap, adhesive backed cushion feet, battery holder and connector, wire, solder, hardware, etc.

**Note:** The following items are available from Futronics, 22524 Millenbach, St. Clair Shores, MI 48081. A complete kit of parts, \$29.95; printed-circuit board only, \$9.95. Please add \$3.00 for shipping and handling. Michigan residents please add appropriate sales tax.

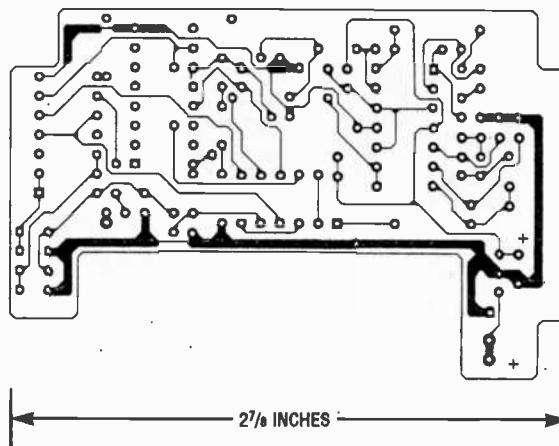


Fig. 3. The final version of the circuit was assembled on a printed-circuit board, measuring about 3 x 2 inches. A template of that layout is shown here full size.

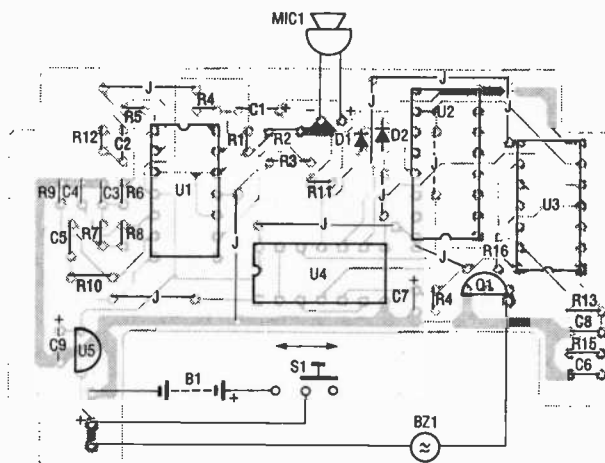


Fig. 4. Once you've obtained the board and the parts that will populate it (either on your own or by ordering them from the supplier listed in the Parts List), use this parts-placement diagram to locate and install the components in their proper positions.

other approximately 5/16 x 1/4 inches for the slide switch.


Connect short lengths of hook-up wire to the buzzer and the switch, connect the wires from the off-board components to the appropriate points on the printed-circuit board. Mount the printed-circuit board, switch, and buzzer to the enclosure, and then secure the nylon web strap to the side of the enclosure using a pair of 4/40 screws and nuts. The strapping used to secure the project to the dog's neck is available at most sports and army surplus stores.

Cut off any excess strap length after sizing it to the dog's neck; the free end of the strap should be melted to avoid fraying. Finally, install the IC's in their respective sockets, install a 9-volt battery, and close up the project box.

**Operation.** Using the circuit is easy. Simply strap the Dog Bark Inhibitor to your dog's neck (be sure to orient the unit so that the microphone is up), turn the unit on using S1. Any long duration or repeated barking by the dog will cause the buzzer to sound for one half second. If greater sensitivity is desired, increase the value of R5.

A longer free-barking period can be achieved by increasing the number of counts U4 allows before turning on the buzzer (that can be done by cutting the trace to pin 13 of U2 and moving the wire to the Q9 output pin 12 or the Q10 output pin 14). The project has been used on the author's dog for more than a year and has stopped the dog's nuisance barking and has restored neighborhood harmony.





# On-Board Navigation Systems for your Car

*On-board navigation systems, satellite positioning, roadside beacons, and many more developments may dramatically change the relationship between man and his car.*

BY BILL SIURU

It's your first trip to this city and you have much business to conduct. You don't have any time to spare, especially driving around lost. Therefore, you spring for a deluxe rental car complete with an on-board navigation system and cellular phone.

Slipping behind the wheel, you immediately notice the small CRT screen in the center of the dashboard. After reading the brief user-friendly instruction pamphlet, you flip on the ignition switch and the screen lights up with a monochromatic map of the city's streets. An icon on the screen displays your current location. Pressing one of the buttons along the side of the CRT, the map changes to a menu. Scrolling through the menu, you enter your first destination. Switching back to the map display, you see another icon at the destination plus the streets you have to travel highlighted. Also shown is the current com-

pass direction and the mileage to your destination. This trip is going to be a piece of cake!

Moving out of the parking garage, you glance to your right and see the map moving with the vehicle as you turn right or left, or even back up. To help keep your orientation, the top of the screen represents "straight ahead." Halfway to your destination, the system starts "beeping" quietly to get your attention. Without taking your eyes off the road, you notice a "congestion" warning and a new route is suggested to avoid the problem. As you near your destination, you press another side button to zoom-in on the display so the local streets are shown in greater detail.

After parking, but before leaving the car for your appointment, you remember you need to make a hotel reservation. Pressing another button brings up a menu that gives you a

listing of motels and hotels in a familiar *Yellow Pages* format. You choose one and then use the cellular phone to make the reservation. As you go through this menu, you note for later reference that there are also listings of restaurants, entertainment attractions, towing services, and even local happenings with dates, locations, and times.

Sounds like a bit of science fantasy? Well, in-car navigation systems with at least most of these capabilities are starting to appear on the market in Europe, Japan, and even the U.S. For instance, some 50,000 navigation systems are already in operation in Japan. In Europe and the U.S., navigation equipment is starting to appear in police cars, fire trucks, ambulances, express delivery vans, and other time-critical vehicles. "Civilian" aftermarket units are now on sale in the U.S. as well.

**How They Work.** Let's look at the Blaupunkt Travelpilot by the Robert Bosch Corporation, which is already offered in the United States as well as in Europe with a suggested retail price of \$2,495. The Travelpilot uses "dead-reckoning" navigation, a technique first used by mariners and aviators, combined with map matching.

Dead reckoning uses speed, time, and compass direction to continuously compute the vehicle's estimated location with respect to a known position. Dead reckoning is sometimes referred to as "deduced reckoning." That is because you are deducing where you must now be given that you have, for example, traveled for 15 miles (determined by an odometer or a speedometer and a clock) due east from a known starting position.

In simple dead reckoning, you would plot your course on a map with a pencil. That roughly corresponds to map matching in a navigation system like the Travelpilot. Here the path being driven (determined from dead reckoning) is compared, or technically called "cross-correlated," with the available paths that are on the map. That is like tracing your path on a piece of paper, putting it over a map and moving it around until it matches up with the roads on the map. Of course, in a computerized navigation system, this correlation is done using hundreds of algorithms (computerized equations) and a digitized-map database. Therefore, if you have driven a path on existing roads, it will correspond to a particular path in the map database. Even if you drive off roads and into parking lots, the algorithms look at the "bigger picture" to find out where you probably are.

Speaking of maps, Etak Inc. in Menlo Park, California is the major producer of digitized maps for use in on-board navigation systems as well as many other applications from taxi and ambulance dispatchers to public utilities and travel agents. Some 75-percent of the U.S. is covered by at least one version of an EtakMap digitized map, as are extensive areas of Germany, France, and the Netherlands.

Travelpilot uses an electronic flux-gate compass and dual wheel sensors to measure direction and distance traveled, respectively (See Fig.

1). The two wheel sensors determine when the car is turning and moving at different speeds. The heart of the Travelpilot system is the "black box" located in the car's trunk or under the seat in commercial vehicles. Inside is a 600-megabyte CD-ROM player and a navigational Computer. The compact disc stores the EtakMap digitized maps of the required geographic region used for map matching. The Travelpilot computer consists of a 16-bit processor with 8k SRAM, 64k EPROM, and 512k DRAM.

The Travelpilot's real-time moving map display (see Fig. 2) shows current location and the alternate routes to

get from point A to point B. The distance and compass direction to the selected destination is also shown. The map display scrolls and rotates under the fixed cursor placed over the ever-changing current location. Car movement corresponds to the car's movement on the map and the road. Destinations can be selected by city locale, street address, or the intersection of two streets. Up to 99 user-programmed destinations can be stored in the memory. According to Blaupunkt, a vector-type video display was chosen for the system because it is easier to read than a TV-style raster-scan display. The driver

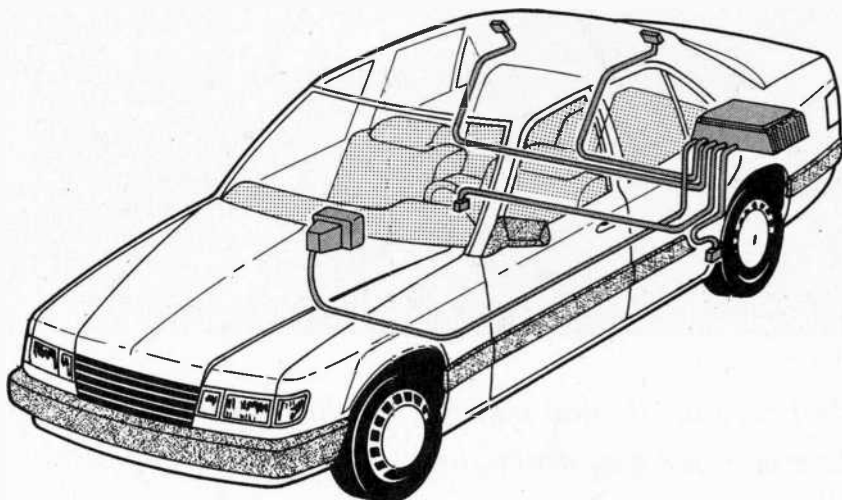
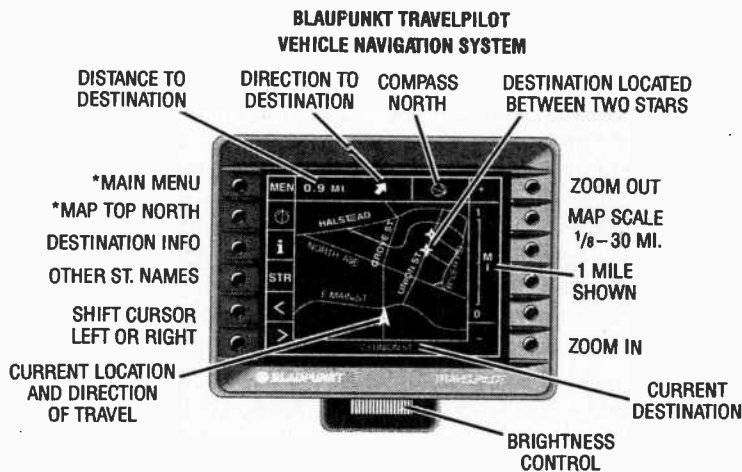


Fig. 1. The computer and CD ROM of the Blaupunkt Travelpilot are located in the trunk. The electronic flux-gate compass is located over the rear window, and speed sensors are located in the rear wheels.



\*NO ACCESS WHEN VEHICLE IS MOVING.

Fig. 2. This is the display CRT for the Blaupunkt. Control buttons are located along either side, as shown.



can zoom the display in or out for more or less detail as is needed.

**Obtaining More Accuracy.** In the simplest case, you could dead reckon with nothing more than a compass and odometer, plus a map and pencil. However, these "sensors" are pretty crude and location errors can quickly accumulate. Even precision wheel-speed sensors and flux-gate compasses are not perfect. Therefore, while on-board navigation systems like Travelpilot can be completely self-contained and give good results, many on-board navigation systems use external and/or internal methods to further improve their accuracy. External sources involve interfacing with the Global-Positioning System (GPS) satellites in space (for more on this, see the July, 1992 issue of **Popular Electronics**), Loran transmitters, or roadside and overhead beacons. The downside is that these interfaces usually require user fees or, for example in the case of beacons, major investments in infrastructure. Internal methods, on the other hand, require additional inertial-guidance components. However, map matching is still a necessary ingredient to precisely locate the vehicle on the map in just about every system.

The prototype Motorola In-Vehicle Navigation System uses position data from GPS satellites to enhance the accuracy of the vehicle's current location. Besides GPS data, the navigation computer receives measurements from a differential odometer and magnetometer to provide dead reckoning. A digital map stored in the CD ROM is used for map matching, route planning, and route guidance. Drivers are provided instructions via both a simplified dashboard video display and synthesized voice commands.

Germany's Siemens Automotive Ali-Scout navigation system (see Fig. 3) communicates with infrared beacons mounted on existing traffic lights. An infrared transmitter/receiver mounted on the back of the rear-view mirror receives information from the beacons. Infrared communication was chosen because IR diodes emit incoherent beams eliminating interference problems caused by multipath propagation or when several transmitters are operating in mutually overlapping regions. Being an in-

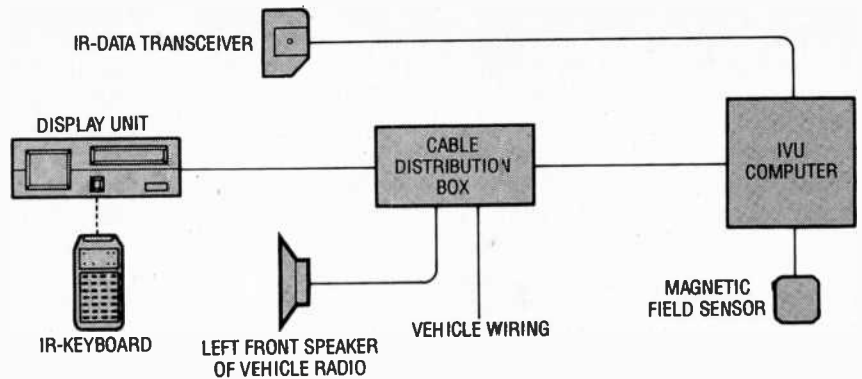


Fig. 3. These are the in-vehicle components for the Ali-Scout navigation system. Note the IR remote keyboard used for entering data and controlling the system.

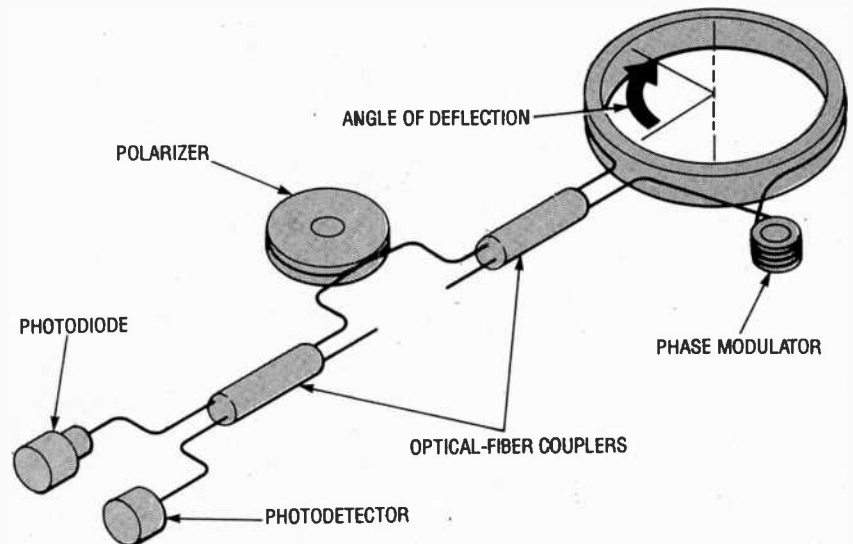


Fig. 4. This is a depiction of the optical-fiber gyroscope used in Nissan's new on-board navigation system available in Japan. Any angular deflection of the large disk results in a variation of angular velocity in the fiber.

coherent radiation source, simultaneous infrared flashes can never extinguish each other, only amplify each other. Even the most complicated intersections pose no problems with IR. The IR signal is transmitted at a 125k baud rate at a maximum range of 60 meters (200 feet) so that the vehicle is only within the transmission range when passing near the beacon.

The Ali-Scout's dead reckoning navigation computer uses measurements from a magnetic-field sensor that measures the earth's magnetic field. Distance travelled is determined using a speed sensor attached to the odometer or transmission.

One potential problem with on-board navigation systems is that complex map displays can overtax driver attention especially when trying to cope with demanding urban-traffic conditions. Therefore rather than

using somewhat more distracting map displays, the Ali-Scout uses a dashboard display with simplified graphic symbols for instructions. For example, arrows show turn directions and a bar graph decreases in size as the corner approaches. The visual display is augmented by audible instructions as well. A 36-key handheld alphanumeric keyboard is used for inputting destinations either in the form of street names or map coordinates. The memory has the capacity for 100 destinations. Some other navigation systems allow both maps and symbolic instructions by changing displays on the screen.

Several navigation systems are already coming into routine use in Japan. For example, Nissan has just introduced its third-generation vehicle-navigation system that is optional on its Cedric, Gloria, and Cima models sold in their home market. The sys-

tem uses a new optical-fiber gyroscope (shown in Fig. 4) to accurately sense the direction of vehicle motion. The gyroscope uses 100 meters of 0.3-mm optical fiber coiled into a 130-mm diameter loop. The gyroscope measures angular velocities by determining the difference in the time of light traveling clockwise versus counterclockwise in the circular optical-fiber path. The time differences, which are actually frequency shifts, can be correlated with the rate of angular motion. Bumpy roads are no problem because this type of gyro is not affected by shock in the horizontal plane.

Nissan also uses roadside electronic beacons that broadcast their specific location coordinates via digital broadcasts at 2.5 GHz. They are deliberately weak to limit the reception area to approximately 35 meters before and after the beacon in a strip that is only about 15 meters wide. This avoids any possibility of cross-beacon interference. Beacons are already being set up along major roadways in Tokyo, Osaka, and Nagoya, with even more beacons to be installed in the future. Data broadcast by the beacons include intersection names and coordinates, distances from a

central point, destinations of roads leading from the intersections, road restrictions, and more. The optical-fiber gyroscope and roadside beacons are used with dead reckoning and a digital-map database to provide greater accuracy than previous Nissan systems, which relied only on position updates from GPS satellites.

Nissan uses a dual-system map-matching logic. In the micromatching mode, the calculated vehicle location is matched every second to roads in the internal map database. Here the searching is done in a small zone by detecting the angular velocity of the vehicle. In the macromatching mode, matching is done about every 50-meters of travel to compare vehicle direction with roadway shapes. Searching in the macromatching mode is done in a wider zone using 5-kilometer segments. The map database is stored on a single CD ROM. According to Nissan, vehicles can be located within five meters.

### More Than Finding Your Way.

Probably the greatest contribution navigation systems can make to society is helping to reduce urban-traffic

congestion and its byproducts: wasted fuel, additional pollution, wasted time, and frayed nerves. There are several major Intelligent Vehicle/Highway System (IVHS) demonstration projects underway in several countries that mate on-board navigation equipment with centralized traffic-management systems.

The \$12 million TravTek (which stands for Travel Technology) experimental program in Orlando, Florida probably represents the most ambitious IVHS demonstration project underway in the U.S. today. For this one-year demonstration program, 100 Oldsmobiles have been fitted with an in-dash CRT monitor, TravTek navigation hardware and software, plus radio gear for two-way communication with the Orlando Traffic Management Center. Seventy-five of these specially equipped cars are part of Avis' rental-car fleet in Orlando. The rest will be evaluated by high-mileage drivers. TravTek is a joint program with the American Automobile Association, General Motors, the Federal Highway Administration, Florida Department of Transportation, and the City of Orlando.

For navigation, TravTek uses computerized dead reckoning and map matching with updates from the GPS satellites to pinpoint vehicle location within a 1200 square-mile area that includes 10,000 roadway miles. After the driver enters the desired destination, TravTek computes the best route and then guides the driver to the destination using both visual and synthesized voice commands.

TravTek is much more than an on-board navigation system. It also advises drivers of traffic congestion and delays (see Fig. 5). Besides warnings, the system automatically provides reroutings to avoid the problems using advisories transmitted from the Traffic Management Center. The in-vehicle TravTek processor receives the advisories, then determines if the driver's selected route is affected, calculates a new route and informs the driver that an alternate route is available. These advisories are generated using data from several sources including the city's centralized traffic signal system, the Florida Department of Transportation's freeway-management system, the AAA TravTek Information and Ser-

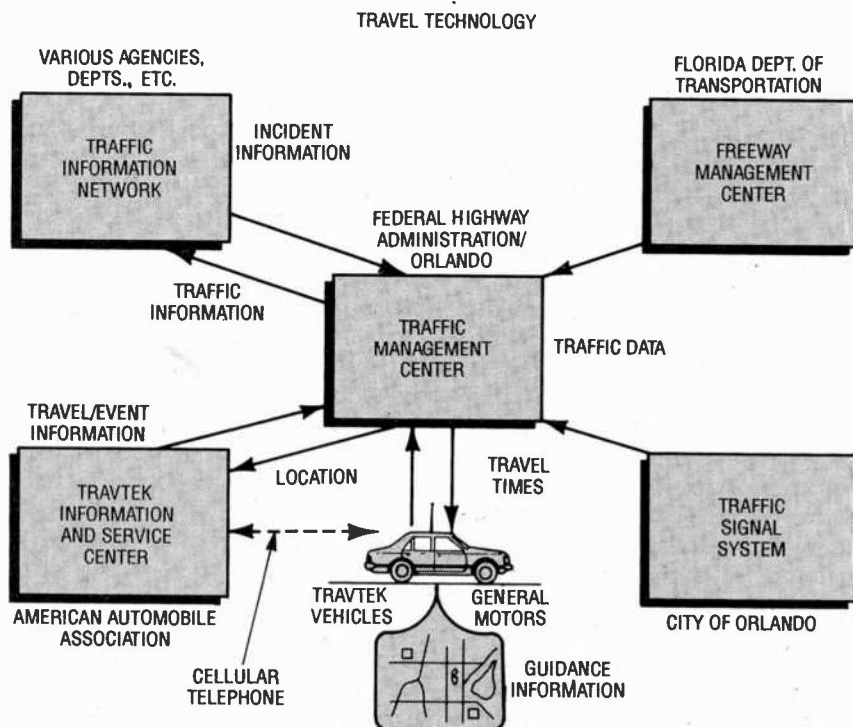


Fig. 5. This block diagram shows the interfaces between on-board equipment, information sources, and the Traffic Management Center that is being used in Orlando's TravTek system.

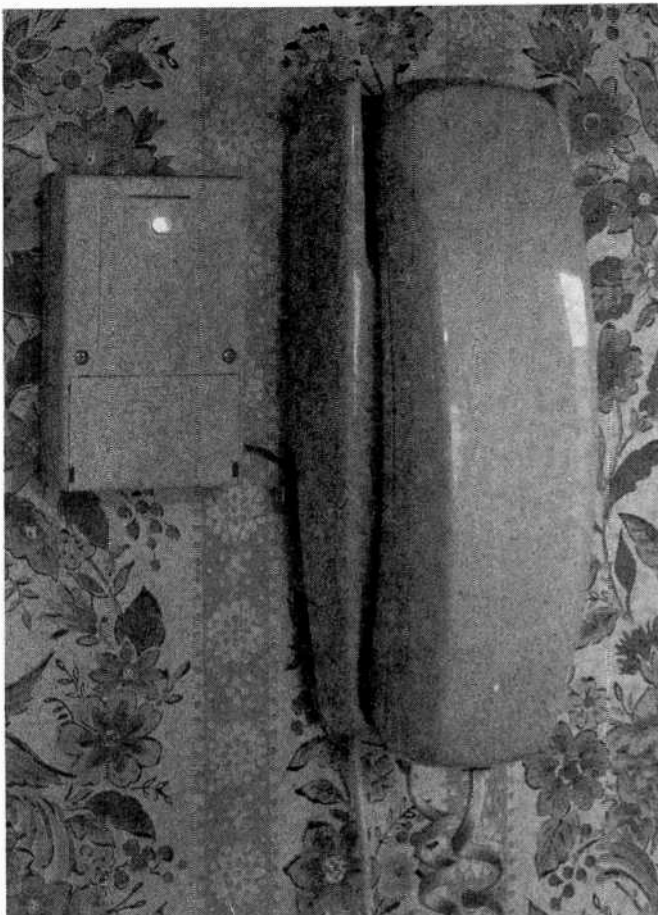
(Continued on page 92)

# A Telephone-Line

**H**ow many times have you lifted the telephone receiver from the hook, in a vain attempt to make an important call, only to find that the phone is in use. Or, what about those times when you're involved in a confidential call and somebody lifts the receiver off hook just in time to hear just enough of the dialogue to misconstrue the meaning of your conversation. Or maybe while you're trying to upload or download a time-dependent, critical computer document, someone takes a remote receiver off hook, allowing noise (which can lead to glitches) to get into the transmission. Such events can lead to inter-family conflicts.

Wouldn't it be nice if your home telephone contained circuitry that would let you know when the line is being used (a feature that is readily available in most office environments). Well, with the *Line-In-Use Indicator* described in this article, you can add such a feature to your present home-telephone network. The circuit—which uses a bright, blinking LED to indicate whether the line is in use—can be installed next to any telephone to warn other family members not to interrupt your modem connections or private conversations.

**How It Works.** The indicator works by sensing the voltage across the telephone line. The line voltage is normally 48 volts DC when the phone is on hook, and drops to about 2 to 10 volts when a telephone is off hook. When the voltage across the telephone line drops below 15 volts, an LED begins to blink. While many circuits of this ilk pirate power from the phone line for their operation, this one doesn't... it is powered from a 9-volt transistor radio battery. The reason is that there isn't always enough power



## In-Use Indicator

*Keep others from barging  
in on your telephone  
conversations*

BY MICHAEL A. COVINGTON

available to light an LED brightly. The power supply arrangement used for the project ensures that the LED is always bright and prominent.

Figure 1 shows a schematic diagram of the Line-In-Use Indicator. At the heart of the circuit is a CD4001B quad CMOS NOR gate. Two of the gates from that chip—U1-c and U1-d—are configured as a low-frequen-

cy oscillator; the other two gates (U1-a and U1-b) are used to buffer the output of the oscillator, which is used to drive LED1.

Resistors R1–R3 sample the phone line voltage and divide it to one third of its original value. When the voltage across R2 exceeds 5 volts, (indicating a phone line voltage of at least 15 volts), the oscillator is gated off and LED1 remains dark.

When the telephone rings, the line voltage goes to 100 volts AC, which puts 33 volts across R2. That is beyond the maximum rating of the CMOS IC, not to mention that the polarity is backward half the time. So why doesn't the IC fry? The answer has to do with the input protection diodes built into every B-series CMOS logic chip (see Fig. 2). Because R1, R2, and R3 are so large, the input current is tiny even when the voltage is very high. The diodes inside the chip shunt the excess voltage to the battery, which absorbs it. Since the current is only a couple of microamps, it has no effect on the battery.

**Construction.** The author's prototype was assembled on a small section of perfboard. As always, it is recommended that an IC socket be provided for U1. Begin construction by first mounting a 14-pin IC socket to the perfboard. Flip the board over and then mark the pin 1 terminal of the socket, which will serve as a reference point. Now, guided by Fig. 1, wire the circuit together using point-to-point wiring techniques.

When it comes to the LED, there are a couple of ways to handle it. The LED can be wired to the board using hook-up wire, or it can be installed with its leads left long enough so that LED lens protrudes through the enclosure's front panel.

After the circuit has been as-



## PARTS LIST FOR THE TELEPHONE LINE-IN-USE INDICATOR

### SEMICONDUCTORS

U1—CD4001B (or MC14001B) quad CMOS NOR gate, integrated circuit  
LED1—Light-emitting diode, any color

### RESISTORS

(All resistors are 1/8-watt, 5% units.)  
R1, R2, R3—22-megohm  
R4, R5—4.7-megohm  
R6—270-ohm

### ADDITIONAL PARTS AND MATERIALS

C1—0.04- $\mu$ F or 0.05- $\mu$ F, ceramic-disc capacitor  
B1—9-volt alkaline, transistor-radio battery  
Perfboard materials, enclosure, 14-pin IC socket, battery connector, wire, solder, hardware, etc.

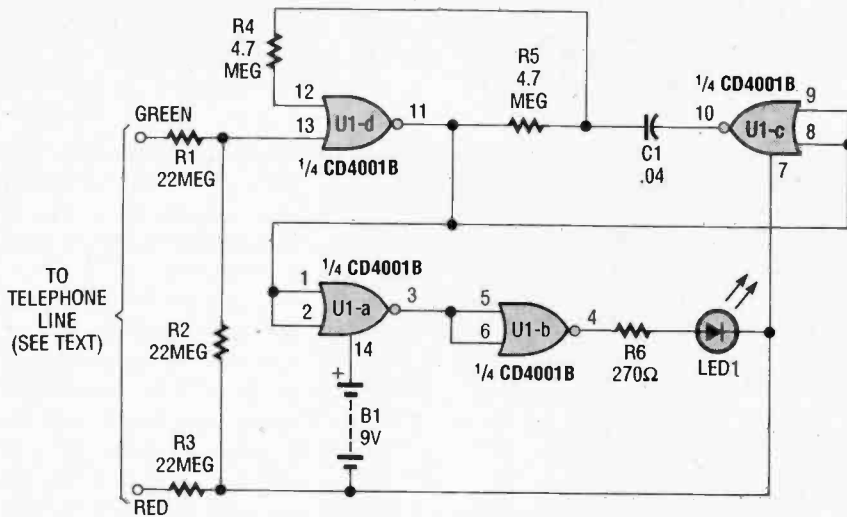
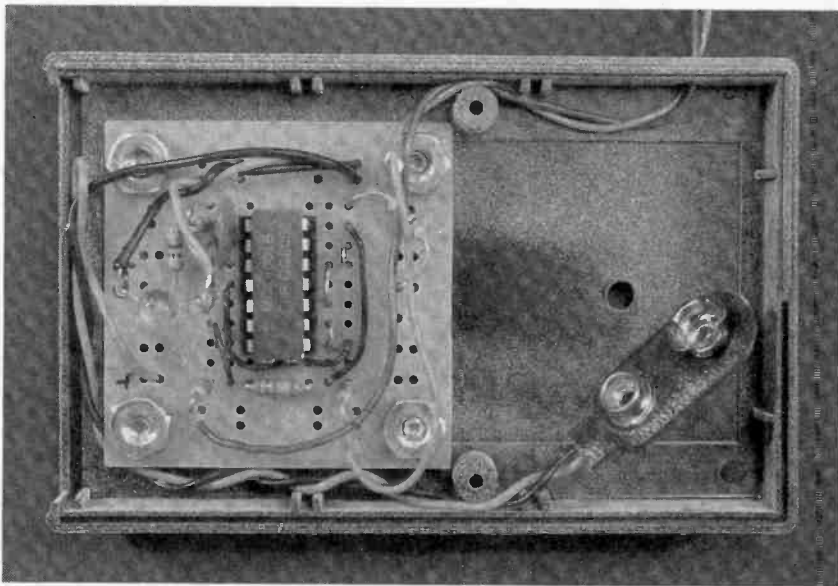


Fig. 1. At the heart of the Line-In-Use Indicator is a CD4001B quad CMOS NOR gate. Two of the gates (U1-c and U1-d) are configured as a low-frequency oscillator; the other two gates (U1-a and U1-b) are used to buffer the output of the oscillator, which is used to drive LED1.



The author's prototype was assembled on a small section of perfboard and housed in a plastic enclosure that comes complete with a built-in battery compartment.

telephone line through the appropriate hole in the enclosure and connect it to the circuit. The type of wire and the termination used for that will be determined by the terminal block used in your phone installation. The author used two lengths of wire that he twisted together (as in "twisted pair"). However, if your home-telephone network has modular jacks, modular cable is the way to go; in that case, simply connect the red and green wire of a modular telephone cable as shown in Fig. 1. Once the cable is connected, the LED can be press-mounted in the front panel LED hole.

**Installation.** Installation is a simple procedure; just connect the cable from the project across the telephone line, as indicated in Fig. 1. Resistor R1 should go to the positive (green) wire and R3 to the negative (red) wire. In normal operation, the LED will be off if the line is idle; the LED will blink if a telephone is off hook, a ringing signal is present, or the line is dead (0 volts). If the LED never stops blinking, try swapping the connections.

Don't install the battery until you're ready to connect the indicator to the phone line; if you do, the LED will blink constantly and run the battery down. Conversely, don't leave the indicator attached to the line without a battery installed; it relies on the battery for overvoltage protection. ■

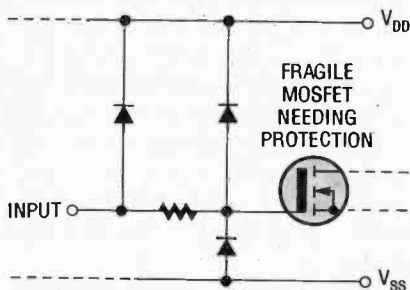


Fig. 2. When the telephone rings, the line voltage rises to 100 volts AC, placing 33 volts across R2. That voltage, which is applied to the input of U1-d, would normally fry the chip, but because the CD4001B has input protection diodes (as shown here) built into it, that doesn't happen in our circuit.

sembled, check your work for construction errors, particularly around the IC socket. If all is well, install the IC in its socket.

The author's prototype was housed in a plastic enclosure with battery compartment (available from Radio Shack as part 270-293). The only enclosure preparation required is to drill two holes in the enclosure; one in the front panel of the enclosure through which LED1 will protrude, and the other in the side of the enclosure for a telephone line cord for connection to the board.

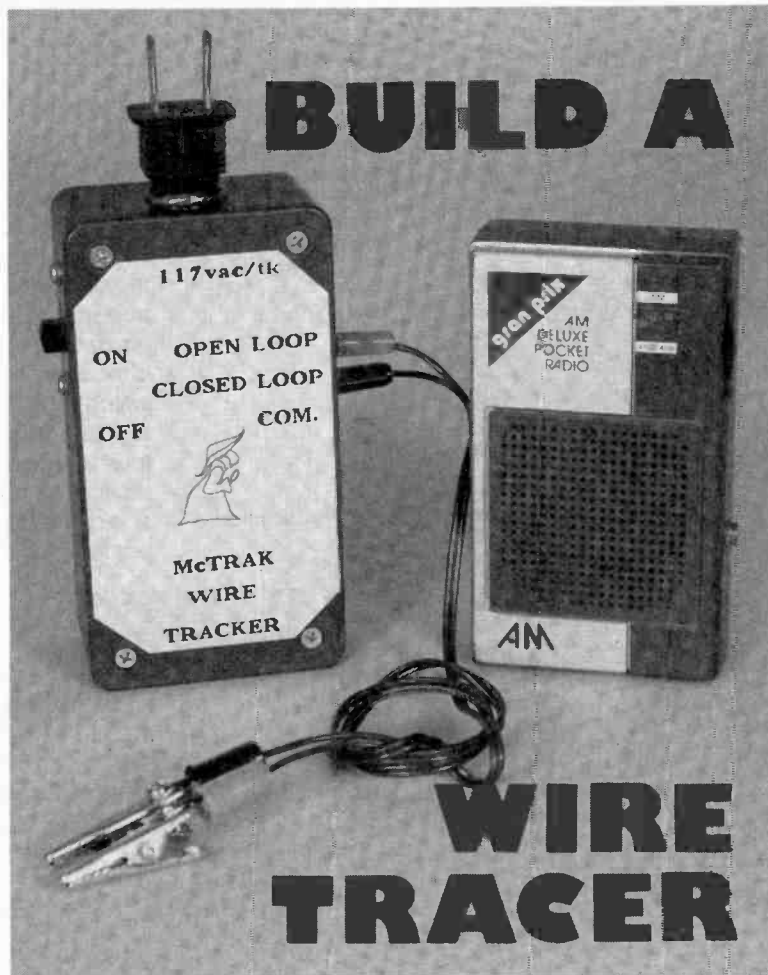
Once the holes are drilled, feed the wire that will connect the circuit to the

In these difficult economic times, many home owners are opting, whenever possible, to do their own home repairs and remodeling. Do-it-yourself home repairs often entail spending many hours trying to trace the AC wiring through walls and junction boxes. Remodeling, such as adding a new window or door to your home, often requires that you cut a section out of a wall. When hacking through a wall, you had better know the location of the electrical wiring or it's lights out.

A simple solution to those and other similar wire-tracing dilemmas—such as tracing a signal through your automobile's electrical system—can be found in the *McTrak* wire-tracing circuit described in this article. The *McTrak* can turn a job that might otherwise require hours of cutting, whacking, and pulling into child's play (well almost), cutting your work time from a few hours to only a few minutes.

The *McTrak* is easy and inexpensive to build, and best of all, there is nothing difficult about using the unit. All you have to do is connect the *McTrak* to the wire of interest and, using a portable AM receiver, trace a signal (put out by the *McTrak*) to its final destination.

**How It Works.** A schematic diagram of the *McTrak* is shown in Fig. 1. At the heart of the circuit is a 567 tone decoder. The tone decoder (U1) is configured as a simple astable, square-wave oscillator, operating at about 250 Hz. The 250-Hz output of the squarewave oscillator, at pin 5, is fed to the base of Q1 (a 2N3904 general-purpose NPN transistor), which in this application, functions as a buffer stage. The alternating output of U1



## *Cut those seemingly insurmountable wire-tracing jobs down to size*

BY CHARLES D. RAKES

causes Q1 to switch on and off in time with the drive signal.

The output of Q1, taken from its collector, is fed through capacitor C2 to Q2 and Q3—a second 2N3904 NPN unit and its companion 2N3906 PNP transistor, respectively—which form a complementary pair. Together, those transistors alternately amplify both halves of the applied signal; e.g., when one transistor is off the other one is on. That pair of transistors provides a low output-impedance-signal source that can be used to drive either an open- or closed-loop circuit.

The output of the complementary pair (Q2 and Q3) splits along two paths; in one path, the output of the complementary pair is applied to C5, causing the 250-Hz output of the complementary pair to be induced into the AC wiring and radiated

throughout the wiring system. The circuit's 250-Hz squarewave output, which is rich in harmonic signals that reach into the AM broadcast band, allows the signal to be traced through the house or other wiring with an inexpensive AM transistor radio. The radiated signal, when detected by an AM receiver, produces a buzzsaw-like sound in the receiver's speaker.

In the other path, the signal goes through C4 and is delivered to output jack J1 (the open-loop output); the signal also continues on through 47-ohm current-limiting resistor R6 (which is used to protect the tracker's output from overload) to J2 (the closed-loop output). Those output jacks, along with J3 (common), are used when conditions are less than optimum. (We'll give examples of how and when to use those jacks at the appropriate time later in this article.)

**Construction.** Building the *McTrak* is simple and the parts layout is not critical, so just about any construction scheme will suffice. However, the author's prototype of the circuit was assembled on a printed-circuit board. A template for that printed-circuit layout is shown in Fig. 2. If you opt to go the printed-circuit route, follow the parts-placement diagram shown in Fig. 3.

As usual, start by installing the passive components (resistors, capacitors, etc.) followed by the semiconductors, double-checking all part locations and their orientations as they are installed on the board. Once the electronic components have been installed, connect a 9-volt battery connector to the board at the points indicated in Fig. 3. Be sure that the proper polarity is observed.

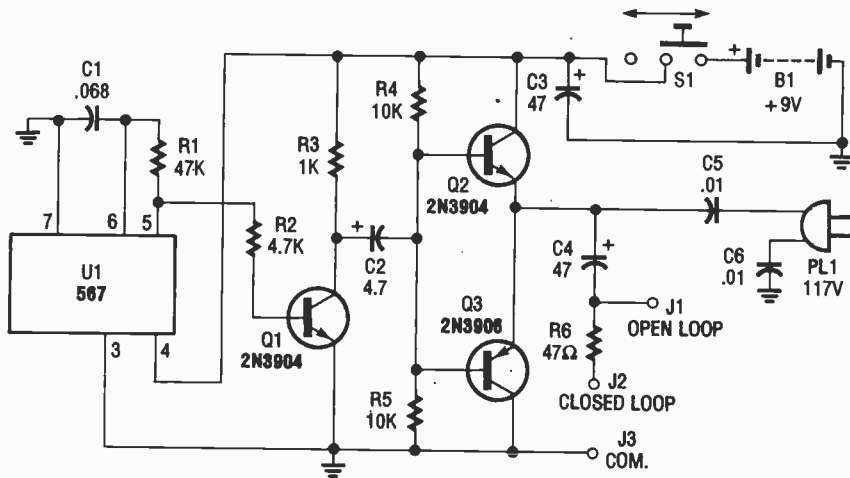


Fig. 1. At the heart of the McTrak is a 567 tone decoder, configured as a simple squarewave oscillator, operating at about 250 Hz.

side and prepare the enclosure.

The author's prototype was housed in a 4½ × 2¾ × 1½-inch plastic project box (available from Radio Shack and other sources) that is slotted to hold small circuit boards in place. The circuit board was sized to fit the case's internal slots.

It will be necessary to drill holes in the enclosure for the off-board components: S1 (along with its mounting hardware), J1–J3, and PL1. Note that although the author used a slide switch for S1, there is no reason that a toggle or even a locking pushbutton (push on/push off) switch could not be substituted. Mount switch S1 to one side of the cabinet, and the three output jacks on the opposite side. Then

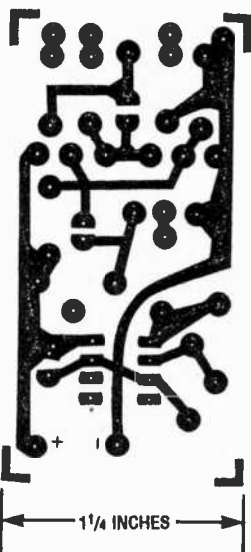


Fig. 2. The author's prototype of the circuit was assembled on a printed-circuit board, the template for that printed-circuit layout is shown here full size.

### PARTS LIST FOR THE MCTRAK

#### SEMICONDUCTORS

- U1—LM567 tone-decoder, integrated circuit
- Q1, Q2—2N3904 general-purpose NPN silicon transistor
- Q3—2N3906 general-purpose PNP silicon transistor

#### RESISTORS

- (All fixed resistors are ¼-watt, 5% units.)
- R1—47,000-ohm
  - R2—4700-ohm
  - R3—1000-ohm
  - R4, R5—10,000-ohm
  - R6—47-ohm

#### CAPACITORS

- C1—0.068-μF, 100-volt Mylar
- C2—4.7-μF, 16-WVDC, electrolytic
- C3, C4—47-μF, 16-WVDC,

- electrolytic
- C5, C6—0.01-μF, 500–1000-WVDC, ceramic-disc

#### ADDITIONAL PARTS AND MATERIALS

- B1—9-volt transistor-radio battery
- S1—SPST slide switch
- J1–J3—See text
- Printed-circuit materials, enclosure (Radio Shack #270-222), molded AC power plug with line cord, 9-volt battery holder and connector, wire, solder, hardware, etc.

**Note:** The circuit board and all of the parts that mount on it are available for \$14.95, plus \$1.00 shipping and handling from: Krystal Kits, P.O. Box 445, Bentonville, AR 72712. Arkansas residents please add appropriate sales tax.

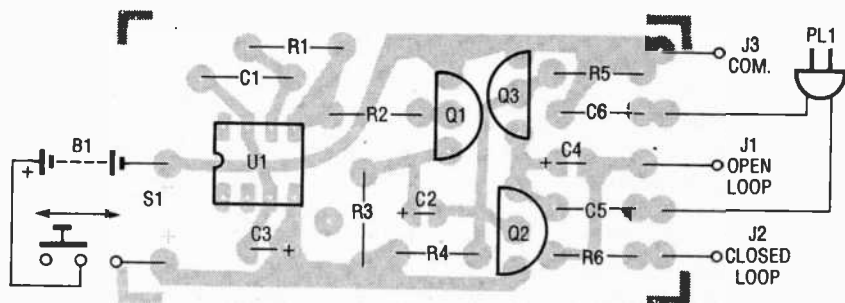


Fig. 3. Follow this parts-placement diagram when assembling McTrak's printed-circuit board. As usual, start with the passive components, followed by the semiconductors, double-checking the part's location and orientation as it is installed.

using hook-up wire, connect the switch and the three jacks to the circuit board at the appropriate points.

Once that is done, mount an AC plug with line cord to one end of the enclosure. That can be accomplished by first passing the plug's line cord through a ½-inch hole in one end of the enclosure, and then clipping off the excess cord length and connecting the line cord to the circuit board as shown in Fig. 3. After that is done, the plug can be secured to the enclosure using hot-melt glue.

**Check Out and Use.** To check the operation of the McTrak, first install a  
(Continued on page 98)

After all of the on-board components have been installed, check your work for potential problems—solder bridges, cold solder joints, and so on.

When you are satisfied that the circuit board contains no errors (of the nature usually associated with hobbyist projects), place the board to the





# TRACKING DISTANT SIGNALS

*By monitoring the VHF low-band for skip, you could easily make some wonderful long-distance contacts.*

BY LAURA QUARANTIELLO

**T**he transmissions were weak, scratchy and, more often than not, lost behind the other voices on the frequency. I'd been listening to 33.7 MHz for two days now and still had failed to hear any information that would help me to identify the station speaking. It had become a minor obsession over the past couple of hours to positively identify the distant fire-department dispatches.

Unfortunately, given the changing nature of the atmosphere, it was likely that when I woke up the next morning and turned on the radio, 33.7 MHz would be silent and the transmissions gone. To understand how a long-distance transmission can appear and disappear like that, we'll have to do a quick study of radio-wave propagation—the near magic of what happens to a radio wave once it heads off into the atmosphere.

**One Little Wave.** When a radio signal or wave leaves the antenna of a transmitter, it becomes, in theory, two distinct parts: a ground wave that travels along the surface of the Earth and a sky wave that travels out into the sky. The ground wave travels a

short distance before it becomes absorbed by the Earth, but the sky wave is much more resilient and that's the wave low-band, distant-transmission listeners tune-in to.

The sky wave travels on its merry way, high up into the wild blue yonder, until it encounters the ionosphere. That layer of the Earth's atmosphere, some 150 to 200 miles high, is constantly bombarded by the Sun, which charges the ionized gases of the ionosphere. When a sky wave hits that layer of charged gas, it is partially reflected. Some of the part of the wave that is not reflected is absorbed by the gas, and the remainder flies into deep space. The portion that is reflected returns to Earth at an angle, which means that it comes down many thousands of miles from its point of origin. That phenomenon is known as "skip."

Skip is almost a mystical thing, affected by sunspots, weather, and even the time of year. It can also be a scanner enthusiast's best friend if you know how to take advantage of it.

**Equipment.** You don't need a control room full of radios in order to re-

ceive VHF skip transmissions. In fact, any scanner that will search the range of 30–50 MHz will do nicely. Having a search feature is important, because you'll definitely want to program-in short ranges of frequencies and let the scanner do the work.

An outdoor antenna is not mandatory, but it will improve your chances of hearing transmissions tenfold. A good all-band ground-plane antenna does nicely, but a beam antenna can have advantages if you are searching for transmissions from a specific direction. Since the prevailing atmospheric conditions have the most to do with reception, whatever you use should pull in some signals, so give it a try.

Frequency guides are a great resource if you're serious about identifying the stations heard. For example, a complete set of *Police Call* magazine's frequency directories is invaluable for tracking down domestic public-safety stations. For military stations, try a federal frequency directory such as Tom Kneitel's *Top Secret Registry of US Government Frequencies*. A good map book of the United States is also handy.

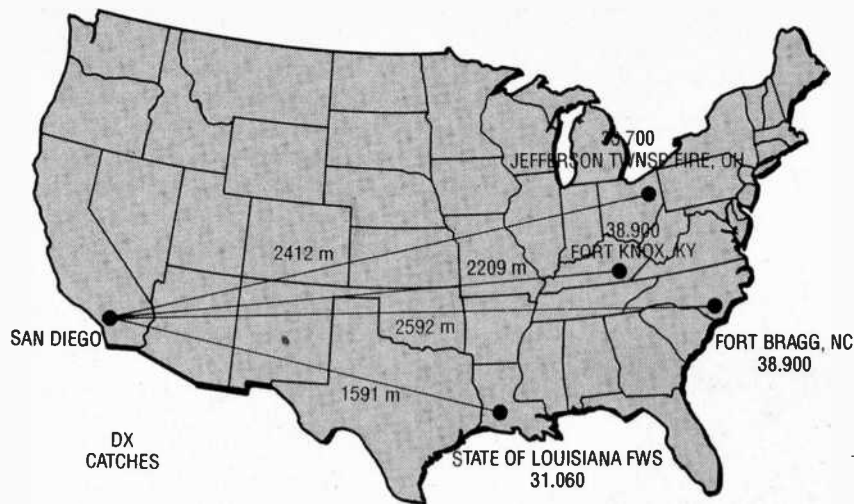


Fig. 1. As you can tell from these catches logged by the author, skip can really help you pull-in transmissions from all over the country.

**Finding Skip.** Frequencies on the low band—30 to 50 MHz—are most affected by skip because of their long wavelengths. Frequencies on the higher VHF bands tend to skip less. I don't consider 50 MHz the absolute top of the possible skip range. Occasional forays above 50 MHz have netted some interesting catches, but for the best results, "go low."

Searching through the basement of the VHF band, your chances improve drastically. On a good day, it isn't unusual to hear communications from thousands of miles away, sometimes even from Central America, Canada, or overseas. The key to hearing all this is knowing when and where to listen.

Since skip is affected primarily by the actions of the sun, it almost goes without saying that daytime is the best time to listen. Try between 9 A.M. and 7 P.M., or whenever local dusk occurs. If you're shortwave equipped, listen at 18 minutes past each hour for propagation reports from WWV on 2.5, 5, 10, 15, or 20 MHz. The solar flux number they give reflects the amount of ionization of the ionosphere's F2 layer, and so the possibility of picking up long-distance transmissions.

Target specific frequencies, which I check for communications. For instance, 38.9 MHz is a popular military range-control frequency that I have programmed into my regular scan bank. If I hear communications on this channel, I know that skip is present and set-up search ranges to see what other frequencies might be active.

Try programming in the range from 30.0 to 31.0 MHz and set your scanner

to scan between these two values. This is about as low as typical scanners will receive and is a good place to start. Here you'll come across business communications, forestry reports, power and water utilities, and some public safety and military communications. If you find active distant stations here, work progressively higher. On some days only a small swath of frequencies will be affected, and on others you won't know where to tune first because of all the activity.

The region between 31 and 33 MHz is a super place to look for military communications, as are the 38–39 MHz and 40–42 MHz areas. Fire departments can be found primarily between 33–35 and 37–38 MHz. Highway patrol, a good target for beginners, can be found operating between 42–43 MHz. These ranges will get you started. Take a look at the back of an issue of *Police Call* for their Consolidated Frequency List, which will further guide you.

Don't be afraid to experiment and seek ranges beyond the norm for skip. I frequently scan from 49.0 to 49.7 MHz, just below the cordless telephone/baby monitor band, which yields up such catches as military-range communications (like Camp Pendleton, California at 49.0 MHz), and tactical operations (such as Army Explosives Ordnance Disposal on 49.7 and 49.8 MHz). You never know what you'll find: I occasionally even hear live horse-race announcements on 41.725 MHz.

During the Gulf War, scanner monitors reported heavy communi-

cations activity all across the low band from American and foreign troops in Saudi Arabia. Voices from Central American stations, Panama, Honduras, and the Dominican Republic are regularly heard engaged in US military operations. Furthermore, lots of counter-drug missions take place on the low band, as well as a large amount of fire communications. Fish and Wildlife officers, whose activities often take them far from normal radio range, can often be heard talking on frequencies between 31 and 32 MHz.

**Identifying Stations.** The first order of business when you come across an active frequency is to take down some of the information you hear coming across the speaker. Call signs, place names, and unit ID's are all helpful. More than once I've tracked down a frequency user by tracing city names through a map book.

Here's an example: say, 42.12 MHz is active with a dispatcher calling herself "San Diego." Looking up San Diego in a map book will reveal a California location. Drag out volume nine of *Police Call*, check all the licenses under 42.12 MHz and you'll find a listing for the California Highway Patrol San Diego Office.

Military stations can be difficult if call signs such as "Alpha Six Echo" are used, but if you listen long enough you might hear the base name or a unit number. When that happens, check a federal frequency book for active stations on the frequency to get you closer to a positive ID.

**DX'ing Low Band.** Searching for distant signals (DX'ing) can be an engrossing, frustrating, exciting, and highly variable hobby.

As I predicted, the 33.7-MHz signal I mentioned did fade away by the time I listened again the next morning. It was three weeks before I finally heard the signal strong enough to warrant some serious listening. With a little more attention I had my catch in no time: Jefferson Township Fire Department, Ohio.

If local communications are getting too routine and you'd like to explore how other services across the country handle their communications, "go low" and give low-band skip monitoring a try. ■

# 235 Popular Electronics FactCard

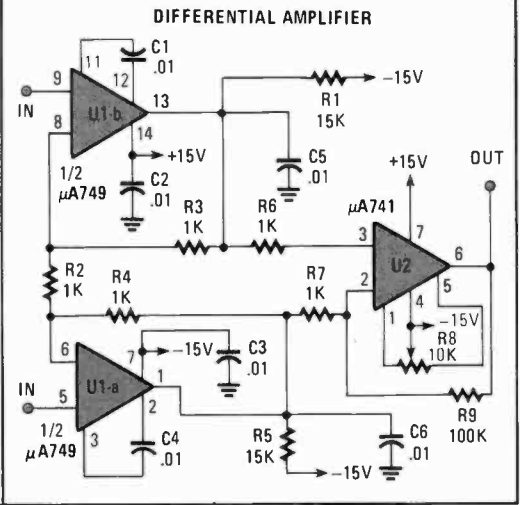
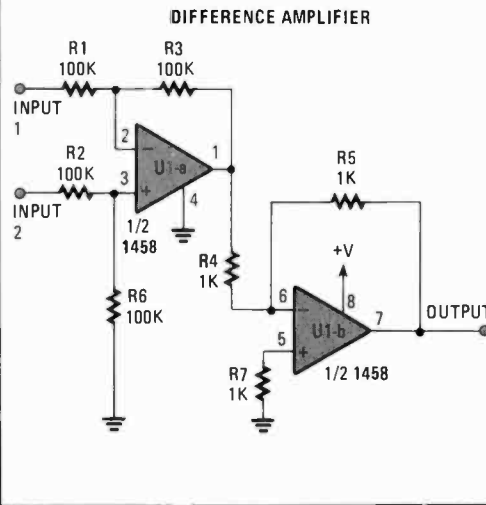
## APPLICATION CIRCUITS

Here are your free FactCards!

Introducing Popular Electronics FactCards.

Each issue, Popular Electronics will present 3 new FactCards, each dealing with one of a variety of electronics topics. Some will deal with electronics basics, some will deal with discrete components, some will deal with IC's, and some will deal with circuits and applications.

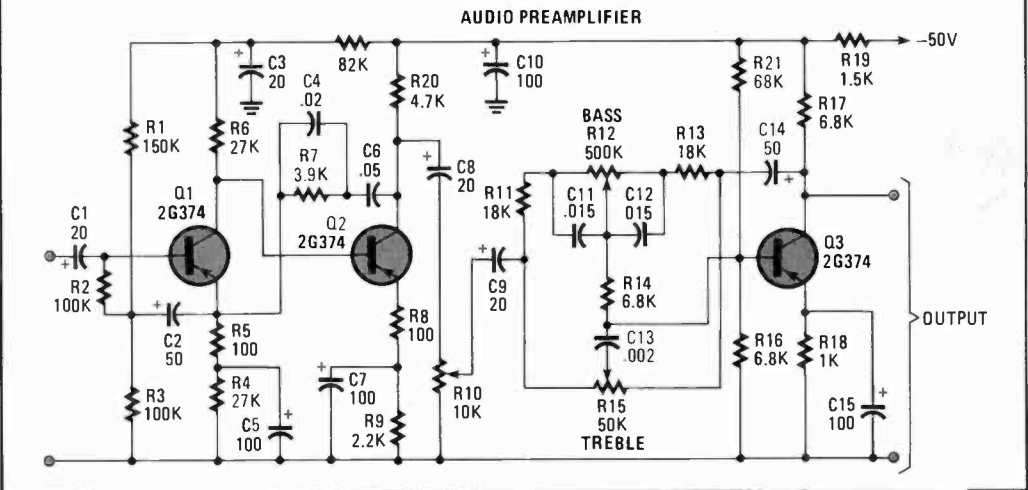
All will contain the type of information electronics hobbyists need, but sometimes must search to find. With FactCards, you can find that information in a hurry.



# 236 Popular Electronics FactCard

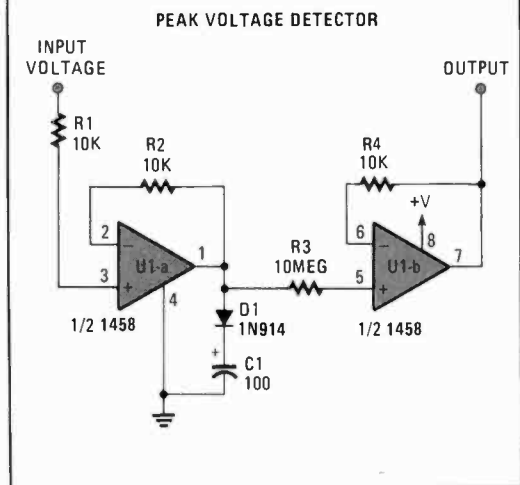
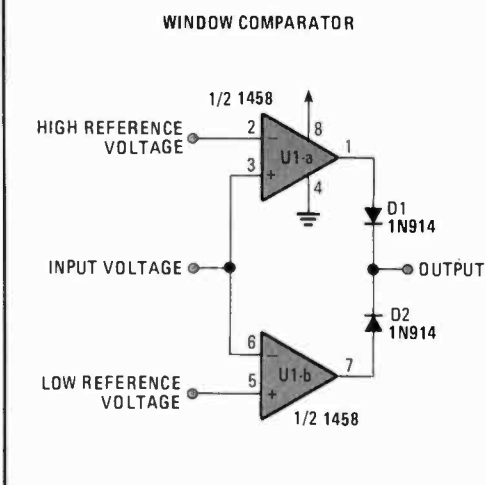
## APPLICATION CIRCUITS

Clip your cards, save them, and start building your FactCards library today!



# 237 Popular Electronics FactCard

## APPLICATION CIRCUITS



Popular Electronics





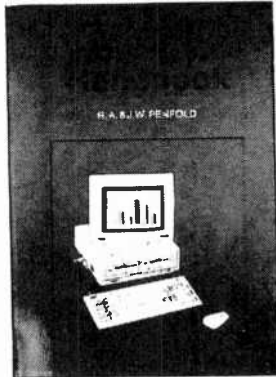
# Popular Electronics<sup>®</sup> Market Center<sup>™</sup>

## Paperback Books

GREAT PAPERBACKS AT SPECIAL PRICES

**COMPUTER HOBBYISTS  
HANDBOOK—BP251—  
\$8.95**

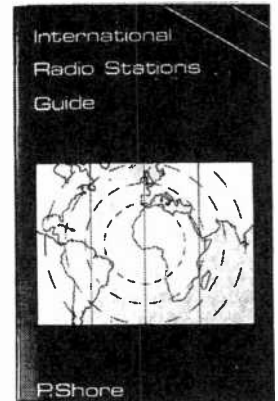
Subjects covered include microprocessors and their register sets; interfacing serial, parallel, monitor, games and MIDI ports; numbering systems, operating systems and computer graphics. While the book is aimed at the computer hobbyist, it should also prove useful to anyone who intends to use a computer to follow their interests.



**INTERNATIONAL RADIO  
STATIONS GUIDE—  
BP255—\$9.95**

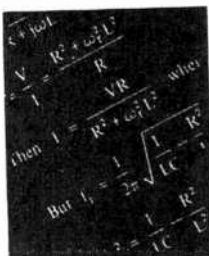
Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed as a guide for the complex radio bands.

Includes coverage on Listening to Short Wave Radio, ITU Country Codes, Worldwide Radio Stations, European Long Wave and Medium Wave Stations, Broadcasts in English and more.



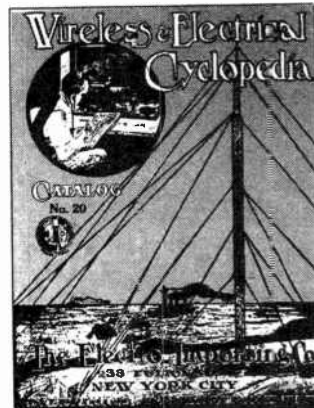
**Further  
Practical  
Electronics  
Calculations and  
Formulae**

F.A. WILSON



**FURTHER PRACTICAL  
ELECTRONICS  
CALCULATIONS—  
BP144—\$9.00**

450 pages crammed full of all the formulae you are likely to need. Covers Electricity, Electrostatics, Electromagnetism, Complex Numbers, Amplifiers, Signal Generation and Processing, Communications, Statistics, Reliability, Audio, Radio Systems, Transmission Lines, Digital Logic, Power Supplies. Then there's an appendix of Conversion Factors, Mathematical Formulae and more.



**WIRELESS &  
ELECTRICAL  
CYCLOPEDIA—ETT1—\$5.75**

A slice of history. This early electronics catalog was issued in 1918. It consists of 176 pages that document the early history of electricity, radio and electronics. It was the "bible" of the electrical experimenter of the period. Take a look at history and see how far we have come. And by the way, don't try to order any of the merchandise shown, it's unlikely that it will be available. And if it is, the prices will be many times higher.

**ELECTRONIC TECHNOLOGY TODAY INC.**  
P.O. Box 240, Massapequa Park, NY 11762-0240

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**SHIPPING CHARGES IN  
USA AND CANADA**

|                   |       |        |
|-------------------|-------|--------|
| \$0.01 to \$5.00  | ..... | \$1.50 |
| \$5.01 to \$10.00 | ..... | \$2.50 |
| \$10.01 to 20.00  | ..... | \$3.50 |
| \$20.01 to 30.00  | ..... | \$4.50 |
| \$30.01 to 40.00  | ..... | \$5.50 |
| \$40.01 to 50.00  | ..... | \$6.50 |
| \$50.01 and above | ...   | \$8.00 |

**SORRY** No orders accepted  
outside of USA & Canada

|                            |       |          |
|----------------------------|-------|----------|
| Total price of merchandise | ....  | \$ _____ |
| Shipping (see chart)       | ..... | \$ _____ |
| Subtotal                   | ..... | \$ _____ |
| Sales Tax (NYS only)       | ..... | \$ _____ |
| Total Enclosed             | ....  | \$ _____ |

Number of books ordered

All payments must be in U.S. funds

# FCC LICENSE PREPARATION

General Radiotelephone  
Radiotelegraph  
Amateur Radio Licenses

We offer the most up-to-date study materials available. Our formats include: tests, audio programs, and video programs. Q & A Disks



## WPT PUBLICATIONS

7015 N.E. 61st Ave.  
Vancouver, WA 98661  
(206) 750-9933

CIRCLE 31 ON FREE INFORMATION CARD

# ADVERTISERS INDEX

| Free Information No. | Page                             | Free Information No. | Page                               |
|----------------------|----------------------------------|----------------------|------------------------------------|
| 35                   | Ace Communications ..... 50U     | —                    | Internt'l Micropower ..... 50V     |
| 41                   | Alfa Electronics ..... 50L       | —                    | Inverter Scientific ..... 50R      |
| 25                   | All Electronics ..... 50W        | —                    | JP Video ..... 50X                 |
| 26                   | Alltronics ..... 50S             | 38                   | Kelvin ..... 50E                   |
| —                    | C&C Specialties ..... 50P        | 29                   | Mark V ..... 50V                   |
| 32                   | C&S Sales ..... 50J              | 43                   | MD Electronics ..... 50O           |
| 28                   | Consumertronics ..... 50F        | 27                   | MWK ..... 50F                      |
| —                    | Datak ..... 50P                  | 39                   | Ocean State Electronics ..... 50Q  |
| —                    | Design Computation ..... 50V     | 42                   | Optoelectronics ..... 50M          |
| —                    | EDE ..... 50P                    | —                    | P.C. Boards ..... 50R              |
| 37                   | EKI ..... 50N                    | 33                   | Prairie Digital ..... 50N          |
| —                    | Electronic Tech. Today ..... 50A | —                    | Silicon Valley Surplus ..... 50R   |
| —                    | Greenleaf ..... 50F              | —                    | Spy Supply ..... 50D               |
| —                    | H.T. Orr ..... 50R               | 36                   | United Electronic Supply ..... 50C |
| —                    | Information Unlimited ..... 50G  | 31                   | WPT ..... 50B                      |
| 40                   | Interactive Images ..... 50H     | 34                   | Xandi ..... 50B                    |

# XANDI Electronics

SATISFACTION  
GUARANTEED!

The use of surface mount technology makes this the smallest FM transmitter you can buy! This is not a toy, it out performs most units on the market today. Our E-Z-kit has all the surface mount parts pre-assembled to the circuit board.  
XST500(E-Z) E-Z Kit ..... \$39.95



The Use of surface mount technology makes this the smallest telephone transmitter you can buy. Powered by the phone line, it can transmit a phone conversation up to 1/4 mile. Our E-Z kit has all the surface mount parts pre-assembled to the circuit board.  
XSP250(E-Z) E-Z Kit ..... \$29.95



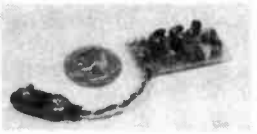
The XTR100 Tracking Transmitter transmits a continuously beeping tone that can be received by any FM receiver. Can be used for games, contests, or as an anti-theft device.  
XTR100(C) Kit ..... \$39.95



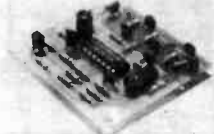
The XFM100 FM transmitter has a range of up to 1 mile. It works with any standard FM receiver. It contains a built in high gain two stage audio amplifier for maximum sensitivity.  
XFM100(C) Kit ..... \$35.95



The XTT100 is a battery powered phone transmitter with a range of up to one mile. It only transmits when the phone is being used in order to conserve battery life.  
XTT100(C) Kit ..... \$35.95



The XBD200 quickly locates hidden transmitters from 1 to 2000 MHz by emitting an audio output proportional to the transmit level.  
XBD200(C) Kit ..... \$44.95



Use the XPS100 to call your home from any other phone and listen in using the built in microphone and amplifier.  
XPS100(C) Kit ..... \$45.95



The XPB1 is a telephone transmitter capable of transmitting to any FM receiver up to a 1/4 mile away. Powered by the telephone line it requires no batteries.  
XPB1(C) Kit ..... \$29.95



WE ACCEPT VISA, MC, CK, MO  
COD PLEASE ADD \$6.00  
CALL 1-602-829-8152 OR  
WRITE FOR A CATALOG

TOLL FREE  
PHONE ORDERS  
1-800-336-7389

MAIL ORDERS TO:  
XANDI ELECTRONICS  
BOX 25647  
TEMPE, AZ 85285-5647

CIRCLE 34 ON FREE INFORMATION CARD

AmericanRadioHistory.Com



# WHOLESALE SPECIALS

LIMITED QUANTITIES

## CABLE CONVERTERS

### Blow Out!!

### XL - 103

550 MHZ - 86 Channel **\$89.95** each

TOP CHANNEL ROLLOVER,  
LAST CHANNEL MEMORY, SUB-  
CHANNEL 0+1 CAPABILITY,  
FAVORITE CHANNEL, SURGE  
PROTECTION, 4 db AMP,  
DECODER COMPATABLE,  
STD/HRC SWITCHABLE, ONE  
YEAR REPLACEMENT  
WARRANTY, A/B TWINLINE  
OPTIONAL

**\$70.00** each - 5 Lot

**\$65.00** each - 10 Lot

**\$57.00** each - 20 Lot

**\$52.00** each - 50 Lot

**\$50.00** each - 100 Lot

### VIEWSTAR IS HERE

MXC-2520-525 MHZ remote volume  
remote volume control  
Audio/video Baseband **\$119.95** ea.  
Output, decoder loop **\$90.00** 5 lot  
Parental Lockout **\$85.00** 10 lot  
Favorite channel **\$80.00** 20 lot  
Remote Fine tuning  
'Universal' Decoder Compatible

### NEW "NORTH COAST"

'Excel' 66 channel remote **\$99.95** ea.  
Fine tune remote,  
60 min. Sleep timer **\$80.00** 5 lot  
Display dimmer  
Favorite channel **\$75.00** 10 lot  
Parental Lockout,  
HRC/STD Remote **\$70.00** 20 lot  
Selectable Twinline A/B Select Optional  
*AMERICAN MADE* Keep *OUR* People Working

## UNITED ELECTRONIC SUPPLY

P.O. BOX 1206 PE • ELGIN, ILLINOIS 60121

24 Hour Service

**(708) 697-0600**

Mon - Fri 8:30 - 5 pm - CST

# CELLULAR TELEPHONE MODIFICATION HANDBOOK

## *How do you reprogram a cellular phone?*

- Descriptions of cellular phones' vulnerabilities !
- Techniques for decoding and changing cellular phones' NAMS and ESN's
- Where to buy programming devices
- Chip supplier's phone numbers
- Instructions on how to change phone numbers on all models
- Cellular phone manufacturer's ESN codes

**Complete Manual only  
\$79.95**

M.O. or C.O.D. to

**SPY Supply**

7 Colby Court Suite 215  
Bedford, NH 03110  
(617) 327-7272



*Sold for educational purposes only*

FROM

**\$19<sup>95</sup>**  
Standard



**\$199<sup>95</sup>**  
High Performance

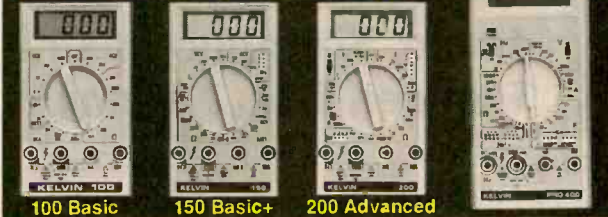
**GREAT  
VALUE!**

**Standard Features - Models 100, 150, 200 & 400**

- AC & DC VOLTAGES ● DC CURRENT ● RESISTANCE
- CONTINUITY TESTER - Buzzer ● DIODE TEST ● 3 1/2 Digit LCD
- LOW BATTERY INDICATOR ● ACCURACY +/- 0.5% RDG

**Kelvin Meters backed by a  
2 Yr Warranty - Parts & Labor**

PRO 400



|                           |                                |  |  |
|---------------------------|--------------------------------|--|--|
| <b>100 Basic</b>          | <b>150 Basic+</b>              | <b>200 Advanced</b>                            | <b>PRO 400</b>   |
| BATTERY TEST              | TRANSISTOR hFE<br>BATTERY TEST | TRANSISTOR hFE<br>CAPACITANCE<br>AC/DC CURRENT | 20MHz FREQ<br>COUNTER<br>AC/DC CURRENT<br>CAPACITANCE<br>LOGIC TEST<br>TRANSISTOR hFE<br>LED TEST -<br>VERIFY GOOD/BAD |
| <b>KELVIN</b><br># 990087 | <b>KELVIN</b><br># 990090      | <b>KELVIN</b><br># 990091                      | <b>KELVIN</b><br># 990092  |
| <b>\$19<sup>95</sup></b>  | <b>\$29<sup>95</sup></b>       | <b>\$39<sup>95</sup></b>                       | <b>\$69<sup>95</sup></b>   |

**Protective Cases**

For Models 100, 150, 200 ..... \$4.<sup>95</sup> (#90088)  
Case For Model Pro 400 ..... \$9.<sup>95</sup> (#90094)



**Model 92 PERFORMANCE PLUS**    **Model 93 DIAGNOSTIC PLUS**    **Model 95 ENGINE ANALYZER PLUS**

**Standard Features - Models 92, 93, 94 & 95**

- DC/AC VOLTMETERS ● AC/DC CURRENT ● OHM METER
- FREQUENCY COUNTER to 4 MHz ● AUDIBLE CONTINUITY TESTER
- DIODE TESTER ● MAX/MIN AVERAGE MEMORY RECORD
- RELATIVE MODE ● 10A HIGH-ENERGY FUSE PROTECTION
- DATA HOLD ● AUTO SLEEP & AUTO POWER OFF

**PERFORMANCE PLUS** Complete with above *Standard Features* plus WATER RESISTANT (92 & 94 Models only), 2 YEAR WARRANTY, YELLOW HOLSTER, PROBES, BATTERY, FUSE STAND  
Model 92 # 990109  
**\$119<sup>95</sup>**

**DIAGNOSTIC PLUS** Complete with *Standard & Model 92 Features* plus LOGIC PROBE, CAPACITANCE TESTER, TRANSISTOR TESTER, TEMPERATURE TESTER & K-TYPE PROBE, HIGH VOLTAGE WARNING BUZZER  
Model 93 # 990110  
**\$149<sup>95</sup>**

**ENGINE ANALYZER PLUS** Complete with *Standard & Model 92 Features* plus TEMPERATURE, TACHOMETER & DWELL ANGLE TESTER, DUTY CYCLE, 10 MEGA OHM IMPEDANCE, ANALOG BAR GRAPH, K-TYPE TEMP PROBE, ALLIGATOR CLIP TEST LEADS, INDUCTIVE PICKUP CLIP, 6' TEST LEADS & CARRY CASE  
Model 95 # 990112  
**\$199<sup>95</sup>**

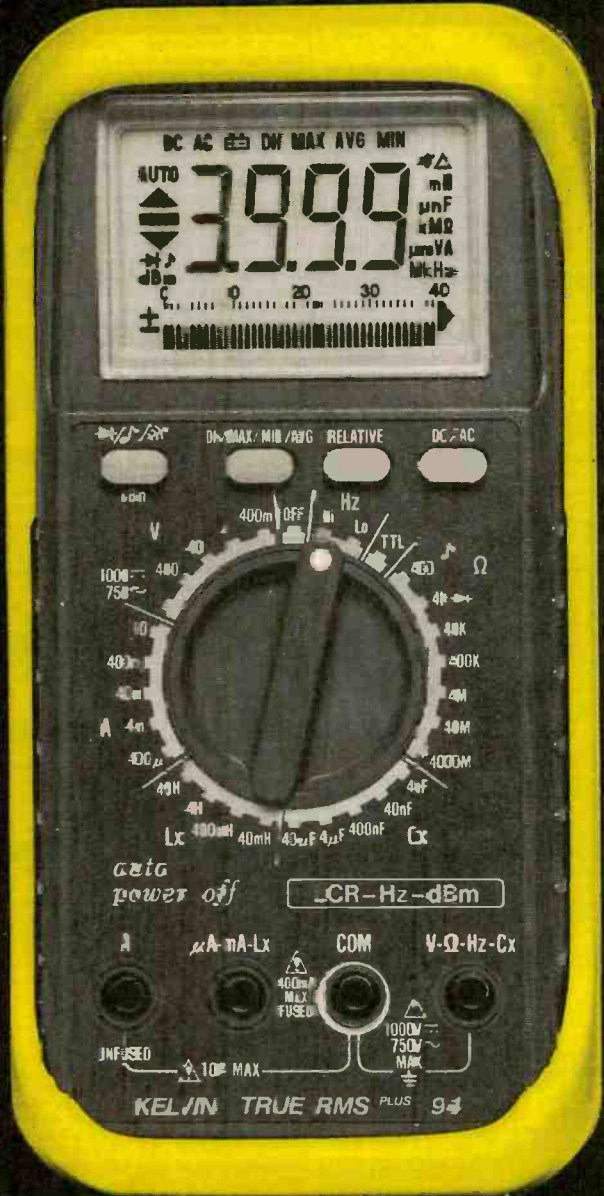
**KELVIN**  
ELECTRONICS

10 HUB DRIVE  
MELVILLE, NY  
11747

(800) 645-9212    Established 1945  
(516) 756-1750    (516) 756-763/FAX

CIRCLE 38 ON FREE INFORMATION CARD

**The Ultimate Meter**  
**TRUE RMS - LCR - Hz - dBm**



12 INSTRUMENTS IN ONE - DC VOLT METER, AC VOLT METER, OHM METER, AC CURRENT, DC CURRENT, DIODE TESTER, AUDIBLE CONTINUITY TESTER, dBm, FREQ COUNTER, CAPACITANCE METER, INDUCTANCE METER, LOGIC PROBE  
**\$199<sup>95</sup>**

0.1% ACCURACY on DC Voltages    Water Resistant

10 MEGA OHM IMPEDANCE  
RELATIVE MODE / DATA HOLD  
MAX/MIN AVERAGE MEMORY RECORD  
10A HIGH-ENERGY FUSE PROTECTION  
AUTO SLEEP & AUTO POWER OFF with Bypass

COMES COMPLETE WITH YELLOW HOLSTER, PROBES, BATTERY, FUSE, STAND

**Freq Counter to 20 MHz**

**Cases for 30 Series Meters**

Regular Padded Zippered ... \$9.<sup>95</sup> (#990116)  
Deluxe Padded Zippered ... \$14.<sup>95</sup> (#990115)

This meter is designed in accordance with relevant safety requirements as specified in IEC-348, UL-1244 and VDE 0411.

January 1993, Popular Electronics



# TOP SECRET



## CONSUMERTRONICS

2011 Crescent Dr. P.O. Drawer 537  
Alamogordo, NM 88310

Add \$4.5H (USA, Canada). All items in stock. COD (UPS cash only), VISA, MasterCard. New Catalog is \$2 with order, \$4 without. In business since 1971. As seen on TV, etc. John Williams - former Lockheed Senior Engineer, NMSU Professor of Computer Science, NIH Health Physicist. *Educational purposes only.*

\*All software supports all IBM-PC compatible systems (8085 - 80486)

**VOICE LINES:** 8AM - 9PM MST, Mon - Sat  
**FAX (orders only):** 24-hour, 7 days/week

**(505) 434-0234, 434-1778**

**FAX: (505) 434-0234** (if you get answering machine press \*#, then \*1 any time)

### Off-The-Shelf HARDWARE

Van Eck Systems, Automated Tempest Module, KX Radar Emitter, Voice Disguiser, Shriek Module, Hearing Assistor, EM Countermeasure, TENS, 6th Sense Communicator, Bumper Beeper, Subliminal Mixer/Amp, Super MWO, Hieronymus Machine, Neurophone, MU Magnetometer, Dwelling Security System, Levitator, Stealth Point - more! See details in new Catalog.

### SPECIAL PROJECTS

We design, build, repair, modify, maintain and/or consult on any device, system, process, project (electrical, electronic, computer, phone, mechanical, optical, automotive). Invention prototyping. Confidentiality guaranteed. Describe and include \$25 fee (does not obligate you). Time and cost estimates in 7-10 days.

### CELLULAR PHONE MANUAL

How cellular phones are designed, operated, re-programmed. How cellular systems are vulnerable to hack attacks, and countermeasures. Comprehensively describes modifying NAMs and ESNs (includes specific info. on 30+ popular models), scanning, scanner restorations (includes UHF TV method), freq and channel allocations, roaming, tracking, ECPA - more! \$39.

### VOICE MAIL BOX HACKING

How Voice Mail Box (VMB) systems are used and the specific ways they are hacked. Includes ASPEN, MESSAGE CENTER, BIX, EZ, SYDNEY, PHONE MAIL, AUDIX, etc. Absolutely required for all users and sysops! \$29

### PHONE COLOR BOXES

As designed by Phone Phreaks! 15 phone color boxes described. Dozens of circuits, simulator programs. Plus call forwarding, conferencing, phreak history, 50 useful and legal phone circuit plans - more! \$29.

### COMPUTER PHREAKING

TROJAN HORSES, VIRUSES, WORMS, etc. and countermeasures. Includes disk with 360K of hacker text files and utilities, and legendary FLUSHOUT+ protection system (Ed. Choice, PC Magazine). Dozens of computer crime and abuse methods and countermeasures. How systems are penetrated. BBS advice, password defaults, glossary - much more! Manuals + Disk\* \$39.

### BEYOND VAN ECK PHREAKING

Eavesdropping on VDT and TV video signals using an ordinary TV! Documented in security industry literature. Range up to 1KM. Plans include both the CONSUMERTRONICS and the original TOP SECRET VAN ECK designs! \$29.

### CRYPTANALYSIS TECHNIQUES

Five powerful menu-driven crypto programs (in .COM and their .BAS sources) to analyze, decrypt "secure" ciphertexts. Worked-out examples. Recommended in prestigious COMPUTERS & SECURITY. Manual + Disk\* \$29.

### ABSOLUTE COMPUTER SECURITY

Dozens of simple, versatile, secure methods and tips. Plus our invulnerable Cipher Program (in .COM and its .BAS source). Plus \$1,000 CIPHER CONTEST ciphertext and rules. Manual + Disk\* \$24.

### HARD DRIVE MANUAL

Covers all hard drive and controller implementations (emphasis on PCs). How to select, interface, initialize, set up, use, maintain, troubleshoot and repair them. How to protect them from mistakes, sabotage, prying eyes and sticky fingers. How to recover damaged and lost files. How to prevent crashes to begin with. Includes software reviews. Loaded with information, advice, tips. \$29.

### DISK SERVICE MANUAL

Maintain, troubleshoot, repair, adjust, align floppies Without special equipment or software. 3.5"/5.25"/8", PC/XT/AT/386/486 - Apple, Commodore, etc systems. All floppies need regular upkeep. \$29. **DISK DRIVE TUTORIAL:** Theory, practical facts on floppy drives, disks, including many tips, recommendations, formatting, interfacing, FDC, etc. \$19. Both \$39.

### 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, spooling, inside job, super-cool, vibration, pulser, 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 and 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

Cons & scams fleece Americans of \$100+ Billion per year! The most comprehensive survival manual on cons & scams of all kinds - from the classic to the high-tech. Details on 100s and their many variations. Protect yourself! \$29.

### STOPPING POWER METERS

As reported on CBS "60 MINUTES": How certain devices can slow down - even stop - wathour 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. \$19. **THE I.G. MANUAL:** External magnetic ways (applied to the meter itself) to slow down and stop wathour meters while drawing full loads. Plans. \$19. **KW-HR METERS:** How wathour 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, \$33. All 3, \$47.

### 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, moral Shocking! \$29.

### UNDER ATTACK!

Electromagnetic Interference and Electronic Weapon Attacks can 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 ON PEOPLE (we investigated) - more common than believed! 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, insensitiles. Comprehensive. \$29.

### RADIONICS MANUAL

Exciting electrical, electronic and electromagnetic therapeutic, diagnostic and preventive devices (mostly experimental). History, descriptions, plans (dozens), availabilities of Radionics Devices from early to modern. While drugs cost \$ Hundreds, electricity costs pennies! \$29.

### 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.

### SOFTWARE PROTECTION SYSTEM

Unique system that highly discourages costly software piracy while not interfering with legit archival copies. No known way to defeat. No special equipment required. Simple and automatic to install on your distributed software. Compatible with all other copy-prevention systems. Manual + Disk\* \$59.

### 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, fiberoptic and Infrared commo. 70+ circuit plans, tables. \$29.

### 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.

### 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.



# CABLE TV Converters & Descramblers

Compatible with

**Jerrold, Scientific Atlanta, Pioneer, Oak, & Hamlin Equipment**

**BRAND NEW!**

**90-DAY GUARANTEE**

**LOWEST PRICES**

*Volume Control & Parental Lockout Available*

**Greenleaf Electronics**

**1-800-742-2567**

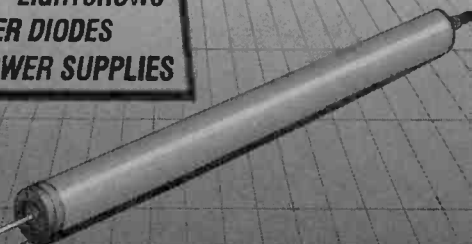
**NO ILLINOIS SALES**

It is not the intent of Greenleaf Electronics to defraud any paying television operator and we will not assist any company or individual in doing the same.

# LASERS

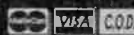


**HELIUM NEON FROM \$19  
ARGON \* BOOKS  
CO<sup>2</sup> \* PLANS  
OPTICS \* LIGHTSHOWS  
LASER DIODES  
LASER POWER SUPPLIES**



**LASER USES:  
HOLOGRAPHY \* LIGHTSHOWS  
PRINTING \* COMMUNICATION  
WEAPON SIGHTS \* ALIGNMENT  
ALARMS \* POINTERS  
CUTTING \* CONSTRUCTION**

**FREE CATALOG 1-800-356-7714**



198 LEWIS COURT  
CORONA, CA 91720

CIRCLE 27 ON FREE INFORMATION CARD

CIRCLE 28 ON FREE INFORMATION CARD

# AMAZING ELECTRONIC PRODUCTS and KITS

## NEW CONCEPT! Mystery Levitating Device



**Remember War of the Worlds?** Objects float in air and move to the touch. Defies gravity, amazing gift, conversation piece, magic trick or great science project.  
ANT1K Easy to Assemble Kit / Plans ..... \$19.50

## Combination Solid State Tesla Coil & Variable 100,000VDC Generator

Operates 12-19 VDC for Field Use or 115 VAC For Laboratory Use



**Experiments Using Tesla Coil:**

- Plasma in a Jar/Tornado, Furnace
- Kirlian Photography
- Wireless Energy Transmission
- Induction Fields • Pyrotechnic Effects
- Corona and Brush Discharge
- Energizer for Neon Plasma Tubes

**Experiments Using Hi Volts DC:**

- Plasma Blaster Driller/Cutter
- Anti-Gravity/Force Fields
- Ion Reaction Motors
- Lightning Generation
- High Ion Source
- Ozone For Air Purification
- Electrification of People & Objects
- Particle Accelerators/Atom Smashing
- High Energy Capacity Charging

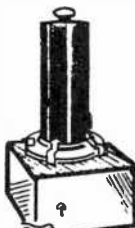
HVM7 Plans Complete System ..... \$15.00  
HVM7K Complete System Kit/Plans ..... \$174.50  
TCL4K Tesla Coil Only Kit/Plans ..... \$99.50  
115/19AC Wall Adapter for 115AC ..... \$15.50

## Table Top Tesla Coil

**Spectacular - A Real Attention Getter!**

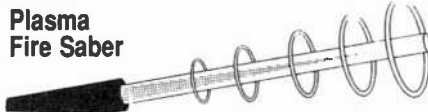
- 250,000 Volts! • 7-10' Sparks!

Energy even passes through windows. Great for science projects, displays, advertising.



Highly spectacular devices produces visible, audible bolts of lightning appearing to flash in the air. Causes certain materials to burn from within and glow, lights bulbs without wires, produces induction fields, St Elmo's fire corona. Clearly demonstrates high frequency high voltages yet terminal may be touched by user during operation with a metal object. 115VAC operation only.  
BTC3 Plans .. \$15.00 BTC3K Kit/Plans \$299.50  
BTC30 Assembled and Tested ..... \$399.50

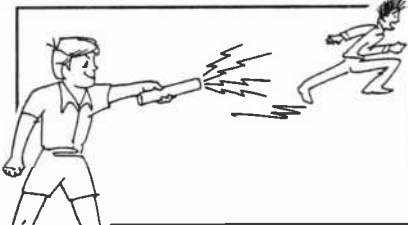
## Plasma Fire Saber



Produces the spectacular effect that captured the fantasy of millions of movie fans. Visible plasma field is controlled by grip pressure and adjusts saber length. Active energy field produces weird & bizarre effects. Excellent for special effects. Specify photon blue, neon red, phasor green, or starfire purple.  
PFS2 Plans .... \$8.00 PFS2K Kit/Plans \$49.50  
Special Offer PFS20 Assembled reg \$89.50, \$59.50

## Solar Power Devices

Build a fence shocker, solar motor, light, bug zapper, batt charger, etc. SOL1 4", 2 Amp Cell w/Plans .. \$8.50  
SOL2 6x12", 14 V Cell w/Plans ..... \$7.50



## Shocker Force Field / Vehicle

**Electrifier** - Neat little device allows you to make hand and shock balls, shock wands and electrify objects, charge capacitors. Great pay back for those wise guys who have wronged you!  
SHK1KM Easy To Assemble Electronic Kit . \$24.50

## 100,000V Intimidator / Shock Wand Module

Build an electrical device that is affective up to 20 feet. May be enclosed for handheld, portable field or laboratory applications.  
ITM2KM Easy to Assemble Electronic Kit ... \$49.50  
ITM2 Plans Only; Credit-able to Kit ..... \$10.00

**Ion Ray Gun** - Projects charged ions that induce shocks in people & objects without any connection! Great science project as well as a high tech party prank.

IOG3 Plans ..... \$10.00 IOG3K Kit/Plans \$69.50

## Invisible Pain Field Generator

Shirt pocket size electronic device produces time variant complex shock waves of intense directional acoustic energy capable of warding off aggressive animals, etc.  
IPG7 Plans .... \$8.00 IPG7K Kit / Plans \$49.50  
IPG70 Assembled ..... \$74.50



## Homing / Tracking Transmitter

Beeper device, 3 mile range.  
HOD1 Plans .... \$10.00 HOD1K Kit/Plans \$49.50

## Listen Thru Walls, Floors

Highly sensitive stethoscope mike.  
STETH1 Plans .... \$8.00 STETH1K Kit/Plans \$44.50

## 3 Mile FM Wireless

**Mike - Subminiature!**  
Crystal clear, ultra-sensitive pickup transmits voices and sounds to FM radio. Excellent security system, warns of intrusion. Become your neighborhood disk jockey! Monitor children and invalids.  
FMV1 Plans ..... \$7.00 FMV1K Kit/Plans . \$39.50



## Telephone Transmitter - 3 Miles!

Automatically transmits both sides of a telephone conversation to an FM radio. • Tunable Frequency  
• Undetectable on Phone • Easy to Build & Use  
• Up to 3 Mile Range • Only transmits during phone use  
VWPM7 Plans .... \$7.00 VWPM7K Kit/Plans \$39.50



## ElectroMagnetic Coil Gun

Projects a metal object over a considerable distance. Become part of and perhaps contribute to this exciting new concept of weaponry.  
EML2 Plans ..... \$8.00 EML2K Kit/Plans \$99.50



## NEW! Amazing GlowTron!

Projects visible energy. Operates on safe, low voltage to produce spectacular lighting effects. Neon & fluorescents glow without wires!  
GTRON Ready to Use ..... \$29.50



**TV & FM Joker / Jammer** - Shirt pocket device allows you to totally control and remotely disrupt TV or radio reception. Great gag to play on family or friends. Discretion required.

EJK1KM Easy to Assemble Electronic Kit . \$19.50

## Visible Beam Laser

High brightness red HeNe laser visible for miles. Produce your own light show! Projects a beam of red lite clearly visible under most circumstances. Can be used to intimidate by projection of a red dot on target subject. Also may be used to "listen in" utilizing our laser window bounce method #LLIS1 below. Easy to Build Modules Produce A Working Visible Laser:  
LAS1KM Kit w/1mw Laser Tube, Class II . \$69.50  
LAS3KM Kit w/2.5mw Laser Tube, Class IIIA \$99.50



## "Laser Bounce" Listener System

allows you to hear sounds from an area via a lite beam reflected from a window or other similar object. System uses our ready-to-use LATR1 Laser Terminator gun site as the transmitter. The receiver section is supplied as an easy-to-build kit, including our cushioned HS10 headsets. Order # LLIST20 System, includes our LATR1 Ready-to-Use Laser Gun Site, LLR1K Special Receiver Kit, and HS10 Headset, all for only \$299.50

## 5mw Visible Red Pocket Laser

Utilizes our touch power control!  
VRL3KMX Kit / Plans ..... \$119.50

## See In The Dark Viewing

Device uses invisible infrared illumination for seeing in total darkness. Excellent for low cost night vision, along with observing lasers and other IR sources. Functional unit, many useful applications.  
SD5 Plans ..... \$10.00  
SD5K Kit / Tube / Plans ..... \$299.50  
GPV10 Ready to Use Viewer ..... \$499.50  
6032A Tube / Plans to build your own ... \$99.50



## INFORMATION UNLIMITED

Dept PEM10, Box 716, Amherst, NH 03031  
Phone: 603-673-4730 FAX 603-672-5406  
MC, VISA, COD, Checks Accepted. Please Add \$5.00 Shipping & Handling

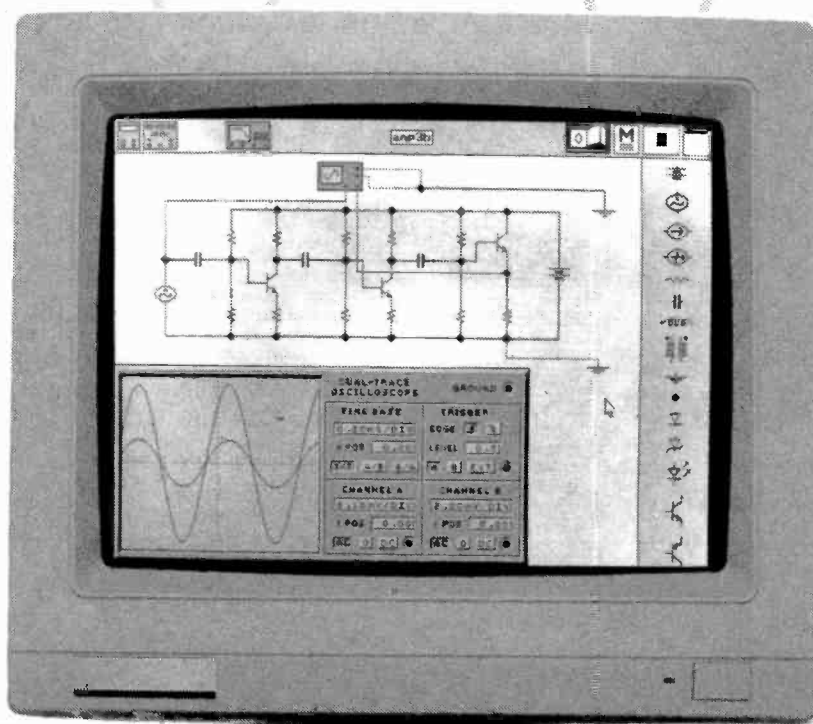
## Catalog

with many more items  
FREE with Order,  
Or Send \$1 P&H



Order by Mail,  
or by 24 Hour  
Orders-Only Phone:  
**800-221-1705**

# The Electronics Lab in a Computer!



*Testing an analog three-stage amplifier with the simulated oscilloscope.*

CIRCLE 40 ON FREE INFORMATION CARD

AmericanRadioHistory.Com



# Electronics Workbench<sup>®</sup>

Powerful software to build and simulate  
analog and digital circuits.

Building and testing circuits is fast and easy with *Electronics Workbench*. Just click-and-drag with a mouse to add parts, run wires, and adjust instruments. The traces on the simulated instruments are the same as you'd get on real equipment.

*Electronics Workbench* really is an electronics lab in a computer. It's ideal for learning about electronics, experimenting, and prototyping circuits.

#### Includes:

- **Analog Module** with passive and active components including transistors, diodes, and op-amps; a function generator, an oscilloscope, a multimeter and a Bode plotter.
- **Digital Module** with gates, flip-flops, adders, a word generator, a multimeter, a logic analyzer and a unique logic simplifier.

DOS Professional Version - \$299

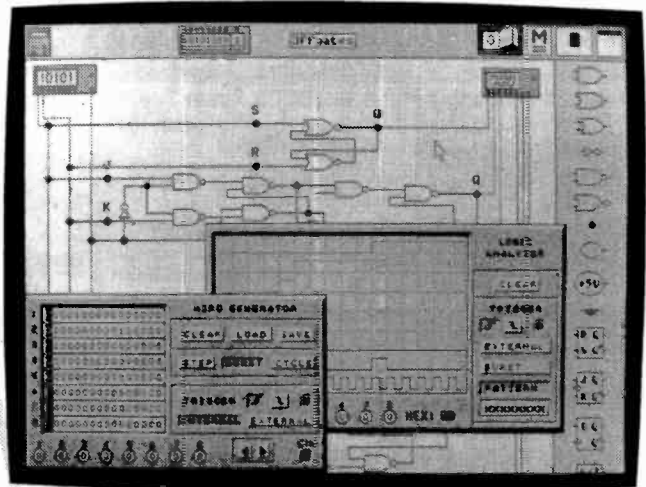
Macintosh Version - \$199

## (416) 361-0333

Interactive Image Technologies Ltd.

908 Niagara Falls Boulevard,  
North Tonawanda,  
NY 14120-2060

Fax (416) 368-5799



Testing a gate implementation of three different flip-flops.

**"Electronics Workbench is pretty amazing."**

- Jerry Pournelle, Ph.D., InfoWorld

**"... Electronics Workbench is a marvelous learning and teaching tool for the study of electronics."**

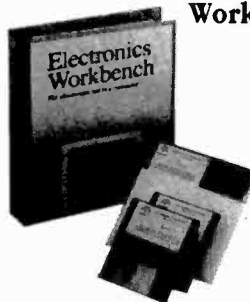
- Art Salsberg, Editor-in-Chief,  
Modern Electronics Magazine

**"Building a circuit is simple and intuitive."**

- Jeff Holtzman, Computer Editor,  
Radio-Electronics Magazine

**"... if you're trying to learn electronics, you can do 10 times as many experiments with Electronics Workbench ..."**

- Jerry Pournelle, Ph.D., BYTE



Electronics Workbench Professional Version runs on any IBM AT or PS/2 or true compatible with 640 KB RAM; Microsoft-compatible mouse; EGA/VGA graphics; hard disk; MS-DOS 3.0 or later. Monochrome version also available. Macintosh Version (monochrome only) runs on Macintosh Plus or greater. All trademarks are the property of their respective owners. Prices are in US dollars. Offer valid in the USA and Canada only.

CALL TOLL FREE

1-800-292-7711  
1-800-445-3201 (Can.)

# TEST EQUIPMENT AT DISCOUNT PRICES

48 HOUR  
SHIPPING

## DIGITAL METERS



**Dual-Display LCR Meter w/ Stat Functions B+K Model 878**  
**\$239.95**  
Auto / Manual Range  
Many Features with Q Factor  
High Accuracy



**Digital Multimeter w/ Inductance & Capacitance**  
**\$75.00**  
LCM-1850  
Ten Functions  
*by Elenco*



**Digital Capacitance Meter**  
**CM-1550B**  
**\$58.95**  
9 Ranges  
.1pf-20,000ufd  
.5% basic accy.  
Zero control w/ Case  
Big 1" Display  
*by Elenco*



**The Survivor Model 2860**  
**\$89**  
B+Ks Best DMM  
Large 3-1/2 Digit  
Rugged Construction  
Full Featured

**Fluke Multimeters**  
Model 12 ..... \$79.95  
Model 7011 ..... \$65.00  
Model 7711 ..... \$145.00  
Model 7911 ..... \$169.00  
Model 87 ..... \$289.00  
Model 93 ..... \$1,095.00  
Model 97 ..... \$1,695.00  
**All Models Available - Call**

## QUALITY AMERICAN MADE POWER SUPPLIES



**Digital Triple Power Supply**  
**XP-765**  
**\$289**  
0-20V @ 1A  
0-20V @ 1A  
5V @ 5A  
Fully regulated, Short circuit protected with 2 limit control, 3 separate supplies  
**XP-660 with Analog Meters \$195**



**12A DC Power Supply**  
**B+K 1686**  
**\$169.95**  
3-14V @ 12A  
Fully regulated & protected  
Separate Volt & Current Meters  
Current Limiting, Low Ripple



**Quad Power Supply XP-580**  
**\$69.95**  
2-20V @ 2A  
12V @ 1A  
5V @ 3A  
-5V @ .5A  
Fully regulated and short circuit protected



**Triple Power Supply XP-620**  
**Assembled \$75**  
**Kit \$49.95**  
2 to 15V @ 1A,  
-2 to -15V @ 1A  
(or 4 to 30V @ 1A  
and 5V @ 3A  
All the desired features for doing experiments.  
Features short circuit protection, all supplies.

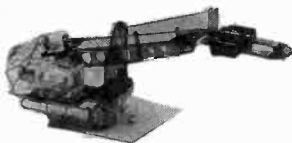
## GENERATORS & VIDEO PRODUCTS

## EDUCATIONAL KITS - FUN & EASY TO BUILD



**Function Generator**  
**Blox**  
**#9600**  
**\$28.95**

Provides sine, triangle, square wave from 1Hz to 1MHz  
AM or FM capability  
**Kit \$26.95**



**Robotic Arm Kit**

**Model Y-01 \$48.95**  
Teaches basics of robotics. Arm grabs & releases, lifts & lowers, & pivots from side to side

**AM/FM Transistor Radio Kit**  
with Training Course  
Model AM/FM 108  
**\$27.95**

14 Transistors ♦ 5 Diodes  
Easy to build because schematic is printed right on the PCB  
Makes a great school project  
Model AM 550 AM Only \$17.95

**Learn to Build and Program Computers with this kit**



Includes: All Parts, Assembly and Lesson Manual

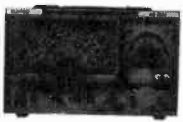
Model **MM-8000**  
**\$129.00**

Starting from scratch you build a complete system. Our Micro-Master trainer teaches you to write into RAMs, ROMs and run a 8085 microprocessor, which uses similar machine language as IBM PC.



**Color Convergence Generator**  
**SG-250**  
**\$89.95**

Kit **\$69.95**  
Finest in the industry  
10 rock steady patterns  
RF & Video output



**Wide Band Signal Generators**  
**SG-9000**

**\$129**  
RF Freq 100K-450MHz AM Modulation of 1KHz Variable RF output  
**SG-9500 w/ Digital Display & 150MHz built-in counter \$249**



**Sweep/Function Generator with Freq. Counter**  
**\$259**

Model **GF-8026**

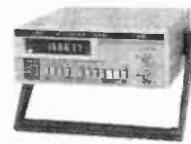
Int/Ext Operation,  
Sine, Square, Triangle, Pulse, Ramp, .2 to 2MHz, Freq Counter .1-10MHz



**Digital Multimeter Kit**  
with Training Course  
Elenco Model **M-2665K**  
**\$49.95**

Fun & Easy to Build  
Ideal School Project

Full Function 34 Ranges, Includes Capacitance, Transistor/Diode Testing  
20amp AC/DC, Extra Large Display



**Multi-Function Counter**  
Elenco **F-1200**  
1.2GHz  
**\$229**

Measures Frequency, Period, Totalizer  
8 LED digits, Crystals Oven Oscillator  
.5ppm Accuracy

### XK-500 Digital / Analog Trainer

A complete mini-lab for building, testing, prototyping analog and digital circuits  
Elenco's Digital/Analog Trainer is specially designed for school projects, with 5 built-in power supplies. Includes a function generator with continuously variable, sine, triangular, square wave forms. All power supplies are regulated and protected against shorts.

**Power Supplies \$159.95 Assembled \$129.95 Kit**

- Variable Power Supply
- +1.25 to 20VDC @ 5 Amp (+1.25 to 15VDC @ 1 Amp)
- 1.25 to -20VDC @ 5 Amp (-1.25 to -15VDC @ 1 Amp)
- +12VDC @ 1 Amp
- 12VDC @ 1 Amp
- +5VDC @ 1 Amp
- 30VAC Center tapped @ 15VAC at 1 Amp

#### Analog - Section

- Function Generator Sine, Triangular, Square wave forms
- Frequency adjustable in five ranges from 1 to 100KHz
- Fine frequency adjust
- Amplitude adjust
- DC offset
- Modulation FM-AM

#### Digital - Section

- Eight data switches
- Two no bounce logic switches
- 8 LED readouts TTL buffered
- Clock frequency 1 to 100KHz
- Clock amplitude 5VPP square wave

#### Breadboards

- 2 breadboards, each contain: 840 tie points (total 1,680)



WE WILL NOT BE UNDERSOLD  
UPS SHIPPING: 48 STATES 5%  
IL RES 7.5% TAX (\$3 min \$10 max)  
OTHERS CALL

**C&S SALES INC.**  
1245 ROSEWOOD, DEERFIELD, IL 60015  
FAX: 708-520-0085 • (708) 541-0710



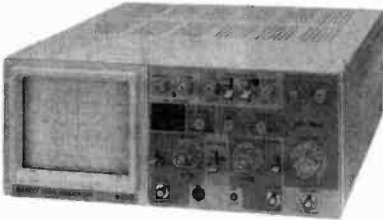
**15 DAY MONEY BACK GUARANTEE**  
**FULL FACTORY WARRANTY**  
**WRITE FOR FREE CATALOG**  
PRICES SUBJECT TO CHANGE

**LOWEST  
PRICES  
GUARANTEED**

# ELENCO & HITACHI & B+K SCOPES AT DISCOUNT PRICES

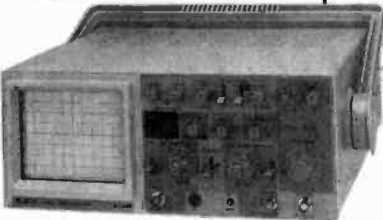
**48 HOUR  
SHIPPING**

## ELENCO S-1325



25MHz  
2 Channel **\$349**

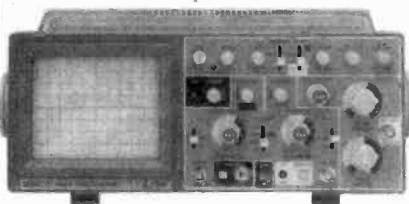
**S-1340 40MHz  
Dual Trace Oscilloscope**



- High luminance 6" CRT
- 1mV Sensitivity
- 10KV Acceleration Voltage
- 9ns Rise Time
- X-Y Operation

**\$495**

**S-1360 60MHz  
Dual Trace - Delayed Sweep**



- Automatic Beam Finder
- Built-in Component Tester
- 1mV Sensitivity
- Dual Time Base
- Illuminated Internal Gradicule

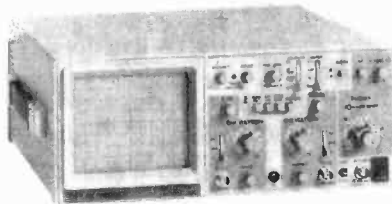
**\$775**

**DS-203 20MHz, 10MS/s  
Digital Storage Oscilloscope**

- 2K Word Per Channel
- Plotter Output
- 8 Bit Vert. Resolution
- 2048 Pts Hor. Resolution
- Much More

**\$775**

## B+K 2120



20MHz \$395 Model 2125 \$539.95  
2 Channel Delayed Sweep

**40MHz DUAL-TRACE  
Model 1541B**

**749.95**

- 1mV/div sensitivity
- Video sync separators
- Z axis input
- Single sweep
- V mode-displays two signals unrelated in frequency

**60MHz DUAL-TRACE  
Model 2160**

**949.95**

- 1mV/div sensitivity
- Sweep to 5 ns/div
- Dual time base
- Signal delay line
- V mode-displays two signals unrelated in frequency
- Component tester

**100MHz THREE-TRACE  
Model 2190**

**1,395.95**

- 1mV/division sensitivity
- Sweeps to 2ns/division
- Dual time base
- Calibrated delay time multiplier
- Signal delay line
- 19kV accelerating voltage

**20MHz ANALOG  
WITH DIGITAL STORAGE**

**Model 2522**

- 20MHz analog bandwidth
- 10MS/s sampling rate
- 2k memory per channel
- 20MHz equivalent time sampling
- Pre-trigger capture

**869.95**

**1.0GHz PORTABLE  
SPECTRUM ANALYZER**

**Model 2610**

- AC/DC operation (battery included)
- 70dB dynamic range
- Resolution bandwidth of 10kHz
- 50Ω and 75Ω input impedance (switch selectable)
- Fixed bandwidth setting for viewing TV signals
- Field calibratable with internally generated 100MHz, 80dB signal

**2,595.95**

## SPECIAL BUY HITACHI V-212



20MHz  
2 Channel **\$409**

**Hitachi Popular Series**

|                              |       |
|------------------------------|-------|
| V-525 - 50MHz, Cursors       | \$975 |
| V-523 - 50MHz, Delayed Sweep | \$949 |
| V-522 - 50MHz, DC Offset     | \$849 |
| V-422 - 40MHz, DC Offset     | \$749 |
| V-222 - 20MHz, DC Offset     | \$625 |

**Hitachi Compact Series Scopes**

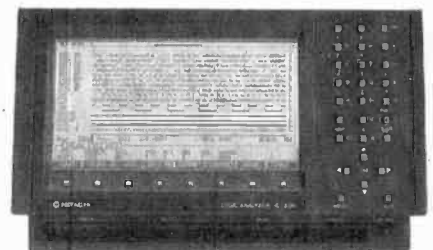
|                                |         |
|--------------------------------|---------|
| V-660 - 60MHz, Dual Trace      | \$1,095 |
| V-665A - 60MHz, DT, w/cursor   | \$1,325 |
| V-1060 - 100MHz, Dual Trace    | \$1,375 |
| V-1065A - 100MHz, DT, w/cursor | \$1,649 |
| V-1085 - 100MHz, QT, w/cursor  | \$1,995 |
| V-1100A - 100MHz, Quad Trace   | \$2,195 |
| V-1150 - 150MHz, Quad Trace    | \$2,695 |

**Hitachi RSO Series**

RSO's feature; roll mode, averaging, save memory, smoothing, interpolation, pretriggering, cursor measurements.

|                           |         |
|---------------------------|---------|
| VC-6023 - 20MHz, 20MS/s   | \$1,650 |
| VC-6024 - 50MHz, 20MS/s   | \$1,950 |
| VC-6025A - 50MHz, 20MS/s  | \$2,350 |
| VC-6045A - 100MHz, 40MS/s | Call    |
| VC-6145 - 100MHz, 100MS/s | Call    |

**Logic Analysers**



- 32 channels (VC-3120) or 48 channels (VC-3130)
- 25MHz synchronous operation on all channels
- 100MHz asynchronous operation (8 or 12 channels)
- 5ns glitch capture capability
- Multi-level trigger sequencing
- Non-volatile data and set-up memories
- Disassembler options for popular uPs
- Very low cost - Call
- 9 inch LCD screen

**C&S SALES INC.**

1245 ROSEWOOD, DEERFIELD, IL 60015  
FAX: 708-520-0085 • (708) 541-0710



**CALL TOLL FREE 1-800-292-7711**

1-800-445-3201 (Can)

PROBES INCLUDED IN ALL SCOPES & METERS

**15 DAY MONEY BACK GUARANTEE**

**FULL FACTORY WARRANTY**

**WRITE FOR FREE CATALOG**

CIRCLE 32 ON FREE INFORMATION CARD

AmericanRadioHistory.Com

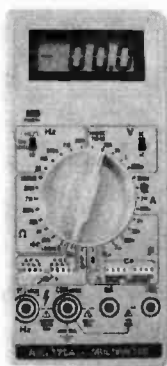


# ALFA ELECTRONICS

QUALITY TEST EQUIPMENT  
AFFORDABLE PRICE



**DMM 2360**  
**\$129.95**  
**DMM + LCR Meter**  
**Most Versatile DMM**  
Inductance: 1 $\mu$ H-40H  
Capacitance: 1pF-40 $\mu$ F  
Frequency: 1Hz - 4MHz  
Temperature: -40 - 302°F  
Logic Test: 20MHz  
Diode, Continuity  
Volt, Amp, Ohm  
3999 count display  
Peak Hold  
Auto power off



**DMM 175A \$67.95**  
**DMM with 20 MHz**  
**Frequency Counter**  
**Most popular DMM**  
Freq. Counter 1Hz-20MHz  
DCV .1mV-1000V  
ACV .1mV-750V  
ACA/DCA .1mA-10A  
R .1 $\Omega$ -2000M $\Omega$   
Cap 1pF-20 $\mu$ F  
TTL Logic test 20 MHz  
Transistor HFE test  
Diode test  
LED test  
3 1/2 digit display  
10 M $\Omega$  impedance



**Fluke Multimeter**

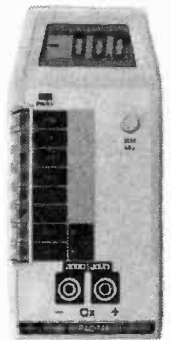
|                     |       |
|---------------------|-------|
| Fluke 70 II         | \$62  |
| Fluke 73 II         | \$87  |
| Fluke 75 II         | \$125 |
| Fluke 77 II         | \$145 |
| Fluke 79 II         | \$165 |
| Fluke 83            | \$215 |
| Fluke 85            | \$255 |
| Fluke 87 True RMS   | \$285 |
| Fluke 86 Automotive | \$359 |
| Fluke 88            | \$419 |



**LCR Meter 814**  
**\$199.95**  
**The Best Handheld**  
**LCR**  
Inductance: 0.1 $\mu$ H-200H  
Capacitance: 0.1pF-20,000 $\mu$ F  
Resistance: 1m $\Omega$ -20M $\Omega$   
1% basic accuracy  
Dissipation factor indicates leakage in capacitor and Q factor in inductor  
Zero adjustment to reduce parasitics from test fixture  
Very good for high frequency RF and surface mount components.

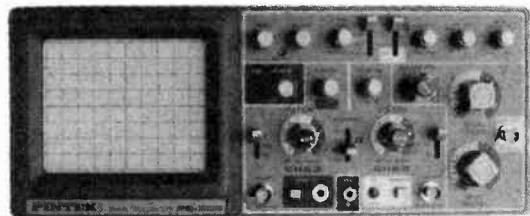


**LCR Meter 195**  
**\$119.95**  
**Very popular LCR**  
Inductance: 1 $\mu$ H-200H  
Capacitance: 0.1pF-200  $\mu$ F  
Resistance: 0.01 $\Omega$ -20M $\Omega$   
Basic accuracy: R:1%, C:2%, L:3%  
Test frequency 1 kHz



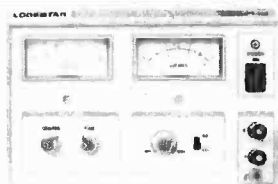
**Capacitance Meter**  
**7705 \$57.95**  
0.1 pF-20,000 $\mu$ F in 9 ranges  
0.5% basic accuracy  
Zero adjustment  $\pm$  20pF to compensate parasitics from test fixture

**Also Available:**  
Heavy duty DMM  
AC/DC clamp meter  
Thermometer, lux meter  
pH meter, Logic probe  
High voltage probe  
RC oscillator  
Electronic scale  
Frequency counter

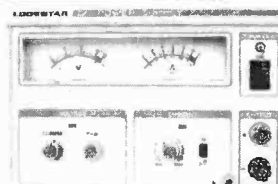


**20 MHz Oscilloscope with Delay**  
**Sweep PS-205 \$429.95**  
Dual Trace, Component test, 6" CRT, X-Y Operation, TV Sync, Z Modulation, CH2 Output, Graticule Illum, 2 probes x1, x10. Best price with delay sweep.  
**PS-200 20MHz DUAL TRACE \$339.95**  
**PS-405 40MHz DELAY \$569.95**  
**PS-605 60MHz DELAY \$769.95**

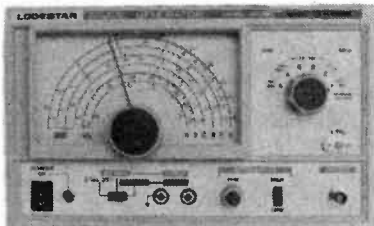
**20 MHz Digital Storage**  
**Oscilloscope DS-203 \$769.95**  
Switchable between digital and analog  
2 K word per channel storage  
Sampling rate: 10 M sample /sec  
8 bit vertical resolution (25 Levels/div)  
Expanded Timebase 10ms/div - 0.5 s/div  
Refresh, Roll, Save all, Save CH2, Pre-Trig  
Plotter Control



**Power Supply**  
**PS-303 \$169.95**  
**0-30 VDC, 0-3A output**  
0.02% + 2mV line regulation  
0.02% + 3mV load regulation  
1 mVrms noise and ripple  
Short circuit and overload protected



**Power Supply**  
**PS-1610 \$299.95**  
**0-16 VDC, 0-10A output**  
Constant voltage & constant current mode  
0.2%+2mV line regulation  
0.04%+2mV load regulation  
1mVrms noise and ripple  
Short circuit and overload protected



**RF SIGNAL**  
**GENERATOR**  
**SG-4160B \$124.95**  
100 kHz-150MHz sinewave in 6 ranges  
Output 100mVrms to 35 MHz  
Internal 1kHz, External 50Hz-20kHz modulation

**AUDIO GENERATOR**  
**AG-2601A \$124.95**  
10Hz - 1MHz in 5 ranges  
Output: 8Vrms sine, 10Vp-p squarewave  
Synchronization:  $\pm$ 3% of oscillation frequency per Vrms  
Output distortion: 0.05% 500Hz - 50kHz  
0.5% 50Hz - 500kHz  
Output impedance: 600 ohm

**FUNCTION GENERATOR**  
**FG-2100A \$169.95**  
0.2 Hz - 2 MHz in 7 ranges  
Sine, square, triangle, pulse and ramp  
Output: 5mV-20Vp-p  
1% distortion, DC offset  $\pm$  10V  
VCF: 0-10V control frequency to 1000:1



**RF SIGNAL**  
**GEN./COUNTER**  
**SG-4162AD \$234.95**  
Generates RF signal same as SG-4160B  
Frequency counter 1Hz -150MHz  
Sensitivity  $\leq$ 50mV  
For internal and external sources

**AUDIO GEN./COUNTER**  
**AG-2603AD \$239.95**  
Generates audio signal same as AG-2601A  
Frequency counter 1Hz-150MHz  
Sensitivity  $\leq$ 50mV  
For internal and external sources

**FUNCTION GEN./COUNTER**  
**FG-2102AD \$234.95**  
Generates signal same as FG-2100A  
Frequency counter 4 digits  
Feature TTL and CMOS output

**SWEEP FUNCTION**  
**GEN./COUNTER 329.95**  
0.5MHz to 5 MHz  
Sweep: Lin 10:1/Log 10:1 20mS to 2S  
AM Modulation  
Gated Burst, Voltage Control Generator,  
Generator Control Voltage & 6 digit Counter.

**ALFA ELECTRONICS**  
P.O. BOX 8089 Princeton, NJ 0854

(800) 526-ALFA/(609) 275-0220  
FAX: (609) 275-9536  
Visa, Master Card, American Express, COD, Purchase Order Welcome

15 DAY MONEY BACK GUARANTEE. 1 YEAR WARRANTY  
WRITE FOR FREE CATALOG. PRICES SUBJECT TO CHANGE

# ELIMINATES SEARCHING, SCANNING, TUNING INTERCEPTOR™

INTERCEPT, DETECT & CAPTURE  
Near Field Transmissions with  
Optoelectronics' New  
**INTERCEPTOR™**



MADE IN THE U.S.A.

## NEW TECHNOLOGY

- Follows & Locks on even when frequency changes.
- Intercepts ALL FM Two-Way Transmissions without gaps in coverage.
- *Does Not* have to tune through RF Spectrum to find signals.

## FCC Classified as Communication Test Instrument for:

- Deviation, FM, FMN
- Relative Signal Strength
- Signaling Tones (CTCSS)
- Modulation Monitor
- Great for testing VHF, UHF & Cellular transmitters

## A New Dimension in Recreational Monitoring – Intercept the Two-Way Communication that Surrounds You.

Increase Your RF Security.



Hand Held/Shirt Pocket Size

INTRODUCTORY OFFER  
Interceptor™ R10 FM Communications  
Interceptor (Includes NiCads, AC/Charger  
Adapter, Antenna, Earphone).....\$359.

### OPTIONS

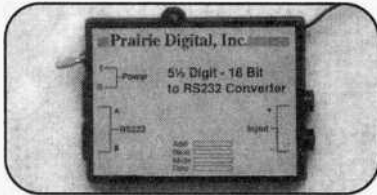
|  |         |
|--|---------|
| Headphones (Lightweight personal headphones).....                    | \$ 15.  |
| Antenna Pak 2 (Five assorted rubber duck antennas – save \$32.)..... | \$ 99.  |
| TC200 Tone Counter (CTCSS signalling tones).....                     | \$ 179. |
| APS-104 (Extends RF detection distance 10x).....                     | \$ 995. |
| CF800 Cellular Band Pass Filter/Amplifier.....                       | \$ 299. |

# OPTOELECTRONICS

FACTORY DIRECT ORDER LINE **1-800-327-5912**

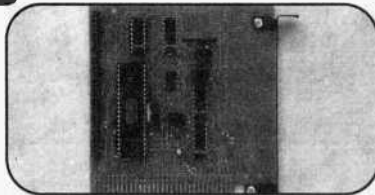
305-771-2050 • FAX 305-771-2052 • 5821 NE 14th Ave., Ft. Lauderdale, FL 33334  
5% Ship/Handling (Max\$10.) U.S. & Canada. 15% outside continental U.S. Visa & Master Card accepted

# Prairie Digital, Inc.



**MODEL 70 18 BIT (5.5 DIGIT)  
A/D WITH RS232 INTERFACE \$239**

- ★ Inexpensive: Equivalent resolution of 5 1/2 digit DVMs costing over \$1000! FAST - - 16.7 to 133 ms/conversion depending on resolution and mode.
- ★ Multi-Channel Capability - Up to 32 model 70's can be daisy chained together off of 1 serial port
- ★ Software: Virtual instrument software features easy pull down menus, mouse support, CGA, EGA, VGA support. Will log to screen, printer, or disk data file for easy import to spreadsheets and graphic programs. Source code included (Quick Basic).
- ★ \$239 Complete: Includes software on 360K 5.25" floppy, PC cable, 9 volt wall mount power supply and manual.
- ★ \$199 Without Software and cable



**PC DATA ACQUISITION SYSTEM - \$79**  
Includes software on 5.25" Floppy  
Model 30-for 386's, XT's, AT's PS2  
Model 25 & 30's.

**FEATURES:**

- ★ 24 lines of programmable input/output
- ★ 8 bit analog to digital converter
- ★ 8 channel analog multiplexer
- ★ 12 bit CMOS counter
- ★ Easy interface to all popular languages
- ★ Optional 7 channel 50V driver available for additional \$5

**APPLICATIONS:**

- ★ Control relays, lights and motors
- ★ Measure temperature, pressure, light levels and humidity
- ★ Input switch positions, thermostats and liquid levels
- ★ Great for robotics, servo control loops

*We can customize for use  
in your product!*



**MODEL 150  
TRUE RMS DMM W/RS232 PORT**  
Software includes RS232 cable and  
software on 5.25" Floppy

- ★ Large 3 3/4 digit display (3.999 vs. 1.999 for 3 1/2 digit meters)
- ★ RS232 serial interface communicates with computers and printers
- ★ Measures AC-DC voltage and current, frequency, resistance
- ★ 20 amp current range, 30 hz to 40 khz frequency range
- ★ Diode test and audible continuity

Send CHECK, MO, VISA, MC, AX  
Include \$8 for shipping and handling

**MODEL 30 ACCESSORIES:**

- ★ Schooner software - Real time displaying and plotting of data from the board. Up to 1K sample/s, 8 channels simultaneously. Basic digital input and output to a DAS port. Stores up to 8 channels of data to disk. Software calibration of each channel can be stored to disk and retrieved - \$39.95 with purchase of Model 30; \$59.95 if purchased separately.
- ★ Ribbon Cable - 3 ft. cable with connectors - \$19, 6 ft. cable with connectors - \$28
- ★ High Current Driver IC - 7 channel, .5 amp, 50V, open collector - \$5

**Prairie Digital, Inc.**

846 Seventeenth Street, Industrial Park  
Prairie du Sac, Wisconsin 53578 U.S.A.  
Tel:(608) 643-8599  
Fax:(608) 643-6754

CIRCLE 33 ON FREE INFORMATION CARD



**CHILD FIND  
OF AMERICA INC.®**

Together we can locate missing children

1-800-I-AM-LOST



PO Box 277, New Paltz, New York 12561-9277

**EKI**

Electronic Kits International Inc.



**FULL-COLOR PACKAGING!**

**OVER 100  
Fun & Challenging  
KITS!**

- \* Thief Catcher - Burglar Alarm
- \* Alien Zapper
- \* Fisherman's Secret
- \* Robot Blinker
- \* Mini Holiday Tree
- \* Space Age Metronome
- \* Hold-The-Phone Button
- \* Digital Roulette
- \* Mini Metal Detector
- \* Digital Slot Machine
- \* Dinosaur Bird Sound Generator
- \* FM Transmitter w/ Microphone
- \* Color Organs
- \* Power Supplies

**.....AND MANY MORE!!!**

**SEE THEM AT  
YOUR LOCAL  
HOBBY/CRAFT**

**AND  
ELECTRONIC STORES !**

**1-800-453-1708**

16631 Noyes Ave., Irvine, CA 92714  
CALL TOLL-FREE FOR THE STORE NEAREST YOU

CIRCLE 37 ON FREE INFORMATION CARD



# Are Cable Companies Sucking You Dry?

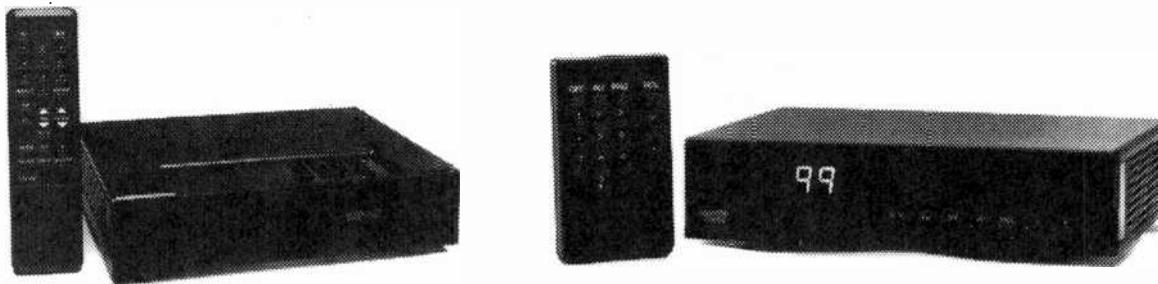


**All Major  
Brands!**

**FREE  
Catalog!**

Take a Bite out of High Rental Fees  
with your own

## Converters & Descramblers



Everquest • Panasonic • Jerrold • Zenith • Pioneer  
Scientific Atlanta • Oak • Eagle • Hamlin • Tocom



Order  
Toll-Free **1 800 624-1150**

Call today  
for a FREE  
catalog!

**MP** *Electronics*

Call today  
for a FREE  
catalog!

P.O. Box 241296 • Omaha, NE 68124

CIRCLE 43 ON FREE INFORMATION CARD

# PE MARKET CENTER CLASSIFIEDS

## MISCELLANEOUS ELECTRONICS FOR SALE

**GOVERNMENT SURPLUS** test equipment and parts. Free catalog. EF Electronics, Box 326, Aurora, IL 60507.

**USED "Sweet Art" computer cake decorating machine.** Can reproduce photos using edible food color on cakes. **Widow must sacrifice. Make offer. (619) 944-7244.**

**SAMS PHOTO Facts.** Complete folders, #1000 to #2291. \$8.00 each plus postage. (914) 562-2805.

**SOLAR \$20W 4V 5A \$65.00.** 100p CAT \$5.00 refundable. Dallas Solar, POB 611927, San Jose, CA 95161. 1 (800) 345-4913.

## HAM GEAR FOR SALE

**HARD TO find special purpose integrated circuits, GaAs FETs, low cost FM telephone bug & FM microphone kit, FM crystal controlled transmitter chip MC2833. Digital voice recorder chip. 900 MHz down converter chip, etc. Automatic audio volume controllers. Low cost test equipment. Easy-PC, schematic and PCB CAD. Free demo with manual. Send \$5.00 for shipping and handling deductible from your order. Quick Plot: Plotter Screen Dump utility program. Call or write for free catalog. C & S Electronics, PO Box 2142, Belden Station, Norwalk, CT 06852-2142. Phone/Fax: (203) 866-3208.**

## PLANS-KITS-SCHEMATICS

**FM STEREO BROADCASTER kit.** This kit outperforms the competition. Transmitter will broadcast any audio signal from a CD player, VCR, or cassette player to FM stereo radios throughout your home and yard. All the complex circuitry is in the unique BA1404 integrated circuit. Tunable across the FM band, runs on 1.5 to 12 volts DC. Complete kit of PC board and components for \$24.00. Visa/MC. **TENTRONIX**, Dept. PM193, 3605 Broken Arrow, Coeur d'Alene, ID 83814. (208) 664-2312.

## PRINTED CIRCUIT KIT

**ER-4 PHOTO ETCH™** kit lets you copy art from this magazine onto your PC board. Includes everything but exposure bulbs. Shipped UPS to your street address for \$43.00.

**ER-19 EXPOSURE BULB SET FOR ER-4.** Contains 3400°K reflector flood and 4800°K long wave UV lamp for ordinary 120V socket. Shipped UPS to your street address for \$18.45.

**FREE CATALOG** of dry transfers and PC supplies. Write or phone **BATAM**, 55 Freepost Blvd, Sparks, NV 89431. 702-359-7474 FAX: 702-359-7494.

**NI-CAD ZAPPER** can rejuvenate those unchargeable NI-CAD batteries. Instructions, schematic and parts list to construct NI-CAD Zapper: \$5.00. **TENTRONIX**, Dept. PM193, 3605 Broken Arrow, Coeur d'Alene, ID 83814.

**MAGNETIC AMPLIFIER.** Solid state amplifier without semiconductors or vacuum. Amplifies through the use of magnetic fields. Plans \$10.00, kit (plans + one amplifier) \$20.00. **ELECTROMAN**, Dept. PE, PO Box 24474, New Orleans, LA 70184.

**68HC11 MICROCONTROLLER** design manual. Interfacing, schematics, software algorithms, PCB artwork. Rush \$10.00. AJR Circuits, 42073 Addison, Canton, MI 48187.

**RADIO-SCANNER MODIFICATIONS.** Over 180 different models \$12.00 for (3) IBM 5.25 disks. J. Worthington, Box 1953, Eugene, OR 97401.

**VOCAL REMOVER** Plans to build a simple circuit for less than ten dollars, which removes vocals from tapes, records, and C.D.'s. Send five dollars to EIC, PO Box 184, Belleview, FL 34420.

## SURVEILLANCE

**COUNTERSURVEILLANCE Electronic Devices**  
Miniature Transmitter Kits.. \$29.95  
Voice Changers, Phone Scramblers, Vehicle Tracking, Phone Recording Systems, Bug & Phone Tap Detectors, & More!

**CALL IDENTIFIER device** • displays callers phone number before you answer with date & time of call...\$49.95

**FOR CATALOG SEND \$5.00 TO...**  
RDP P.O. Box 337, Buffalo, NY 14226 (716) 891-3476

**CHRISTMAS PROJECTS.** Electronic fun for the holidays. Ten festive plans only \$7.00. **CAMP-BELL ENTERPRISES**, 27955 Terrace, Dept. PE, North Olmsted, OH 44070.

**SALVAGE RECHARGEABLE NICAD BATTERIES** from defunct battery packs. Complete information and spacer slug. \$4.00 **BUILD A CHARGER** that won't harm nicad batteries, and keep them fresh, ready for use. Illustrated plans, \$4.00. **BOTH BOOKLETS FOR \$7.00**, NV residents add 7% tax. Money back guarantee. Day by Day Publishing, Box 490, Overton NV 89040.

**NEVER NEED A JUMP START AGAIN!** Build a circuit that automatically disconnects your battery before it discharges. Send \$14.95 for "PROTECTING YOUR CAR BATTERY" containing theory, methods, circuits, diagrams and clear explanations. Grayze El, 230A Burkehaven Hill Road, Sunapee, NH 03782.

**FLAME SPEAKER.** Finally, a speaker with no moving parts! Omnidirectional sound, with higher frequency response than conventional loudspeakers. No diaphragm or voice coil. Plans, \$10.00. **ELECTROMAN**, PO Box 24474, Dept. PE, New Orleans, LA 70184.

## COMPUTER HARDWARE

**PC PARTS**, Mbs, disk drives, hard drives etc. Overstocks, reconditioned. Multiwatt Systems, Box 1147, Burlington, MA 01803. Fax: (617) 229-9798.

## COMPUTER SOFTWARE

**THOUSANDS OF IBM SHAREWARE PROGRAMS.** \$3.00 S&H for 2 disks full plus catalog disk. American Software, PO Box 509, Suite M6, Roseville, MI 48066-0509.

**ELECTRONICS SOFTWARE.** From \$2.00 per disk. IBM 5.25". Free catalog on disk. **GENERIC SOFTWARE**, POB 502, Dayton, OH 45401.

**ELECTRONICS TUTORIAL** software program. Over 1000 screens, 48 modules, of interactive information, schematics and help on DC, AC, analog and digital. Menu driven. Ideal for job preparation, reference, or for use as a study aid. IBM format. (Specify monochrome, EGA or VGA.) Tutor-Tech, 5591 Kimberly St., San Jose, CA 95129. (408) 252-3223.

**IBM SHAREWARE PROGRAMS, DATABASES AND INFORMATIVE ARTICLES ALL RELATING TO ELECTRONICS, RADIO, SCANNING ETC.** \$2.50 S&H FOR CATALOG DISK. **RIGHT BYTE COMPUTING LTD., 724 HUNTS CR. NW, CALGARY, AB. CANADA T2K 4H9.**

**AMIGA, MACINTOSH, ATARI ST/XL/XE** Amateur radio, astronomy, MIDI, and electronics PD/shareware software, \$4.00 per disk full. Send SASE with 2 stamps for catalog. Please specify which computer! **KD Software**, Box 1646, Orange Park, FL 32067-1646.

## CB-SCANNERS

**COMMUNICATION AT ITS BEST.** AR-900 \$219.00, AR-1000XC \$399.00, AR-2500 \$439.00, AR-3000A \$969.00, BC-200XLT \$249.00. Guaranteed lowest prices on AOR radios. We carry a variety of CBs, scanners, radar detectors and more. **FREE SHIPPING.** Visa/MC/Amex. Turbo Electronics, 366 N. Broadway, Suite 310, Jericho, NY 11753. Questions: (516) 938-1946. Orders: 1 (800) 33-TURBO.

## ANTIQUE ELECTRONICS

**TUBES, PARTS** (Old stock from closed or bankrupt Radio-TV stores). Extensive listings in 16 page illustrated catalog: \$2.00. Don Diers, 4276 North 50th Street #MC4, Milwaukee, WI 53216-1313.

## SATELLITE EQUIPMENT

**REVOLUTIONARY DIGITAL DIRECT BROADCAST SATELLITE SYSTEM** Ground floor marketing opportunities. For information write: P-Systems, 7640 Cherry Tree, Willowbrook, IL 60514.

## TELEPHONE

**YOUR OWN 800 number for only \$3.75 a day?** Yes! Information and application: Send \$3.00 to Phone, PO Box 185P, Hemingford, NE 69348-0185.

## Cable Test Aids Information

Orders only 1-800-452-7090  
Test chips for JERROLD, TOCOM, ZENITH, S.A. & more. Puts cable boxes in full service mode. Easy installation. Zenith only \$39.95. Most others under \$50ea. Quantity prices available.  
No Ch. min. Not for use in cable do. owned equip. For use in a test aid only.

## TEST EQUIPMENT

**QUICK-SHOOTER.** Fix problems FAST. Find bad components in seconds. For information send S.A.S.E. or \$1.00 and your FAX#. **LYNN JOHNSON**, Box 51268, San Jose, CA 95151-1268.

**TEKTRONIX R564B** 10 meg storage oscilloscope with 3A6 dual trace and 3B3 delaying timebase \$350.00 (813) 746-4479.

## EDUCATION

**LEARN TO EARN.** Increase your income with electronic skills. Courses written for easy learning. Most courses \$49.50 or less. Electronic parts and equipment also sold. Send \$2.00 for catalog to A&A Products, Rt 1, Box 482-L, Rockdale, TX 76567.

**BARCODES BARCODES BARCODES** they're everywhere you look! Now you can get in on an industry that is growing by 20% each year with **THE BARCODE COURSE.** This course comes complete with a detailed barcode textbook, portable barcode reader, RS232 interface and barcode printing software for only \$149.95 + \$7.00 S&H. OBR Inc., RR3 Box 47-7, Carbondale, IL 62901. (618) 549-7100.

# OCEAN STATE ELECTRONICS

PROFESSIONAL, AMATEUR, OR COMMERCIAL — WE'RE YOUR ONE STOP ELECTRONIC SOURCE  
CALL OR WRITE FOR OUR FREE 112 PAGE CATALOG 1-401-596-3080

## DELUX CODE KEY



Adjustable, heavy duty brass base with ball bearing pivots. Designed for hard usage. 316" plated contacts.

\$10.75

## MASTERING THE MORSE CODE

This book teaches the beginner how to learn the Morse Code. Some of topics covered are Rules for practicing the Morse Code, the code alphabet, how to send and receive code, how to build and hook up a code practice oscillator. 32 pages.

\$2.50

## CODE PRACTICE OSCILLATOR & MONITOR IN KIT FORM OR WIRED

A solid-state code practice oscillator and monitor that uses the latest IC circuitry. It contains a 3" built-in speaker, headphone terminals, a volume control and a tone control. It is a attractively packaged with a two color panel. With the addition of a few parts, the unit can easily be converted into CW monitor. It can there fore be used as an operating aid after the code has been learned.



Kit ..... \$19.95  
Wired ..... \$24.95

## LINEAR IC'S

|        |      |
|--------|------|
| NE555  | .25  |
| NE564  | 1.75 |
| LM733N | .65  |
| LM741  | .30  |
| UA7805 | .39  |
| UA7812 | .39  |
| UA7820 | .49  |
| UA7824 | .49  |
| UA7912 | .75  |
| LM317T | .69  |

## TRANSISTORS

|         |      |
|---------|------|
| PN2222A | .07  |
| 2N2222A | .35  |
| 2N3055  | .69  |
| 2N3563  | 2.75 |
| 2N3563  | .35  |
| 2N3866  | 1.00 |
| 2N3904  | .10  |
| 2N3906  | .10  |
| 2N4401  | .15  |
| MPF102  | .29  |



## MAGNET WIRE

Plain enamel. Solid bare copper. For winding coils, transformers and toroids. Prices for 1/4 lb. spools.

|     |      |     |      |     |      |
|-----|------|-----|------|-----|------|
| #14 | 3.25 | #24 | 3.70 | #34 | 4.80 |
| #16 | 3.30 | #26 | 3.75 | #36 | 4.90 |
| #18 | 3.35 | #28 | 3.85 | #38 | 4.95 |
| #20 | 3.55 | #30 | 4.00 | #40 | 5.10 |
| #22 | 3.65 | #32 | 4.40 |     |      |

## TOROIDS

| IRON    |      | FERRITE  |      |
|---------|------|----------|------|
| T-25-2  | 40   | FT37-43  | 60   |
| T-25-6  | 40   | FT37-61  | 60   |
| T-37-6  | 45   | FT37-77  | 60   |
| T-37-12 | 45   | FT50-43  | 75   |
| T-50-2  | 55   | FT50-61  | 75   |
| T-50-3  | 55   | FT50-77  | 75   |
| T50-6   | 55   | FT82-43  | 1.00 |
| T68-0   | 75   | FT82-67  | 1.00 |
| T68-2   | 75   | FT82-68  | 1.00 |
| T68-6   | 75   | FT114-61 | 2.15 |
| T80-2   | 85   | FT140-43 | 4.10 |
| T200-2  | 4.00 | FT240-61 | 8.00 |

WE STOCK A COMPLETE LINE OF TOROIDS AND BEADS.

## Q-DOPE

Solution of pure polystyrene in solvents. Dries fast and leaves a clear, protective coating on toroids, coils and transformers, with no or minimal effect on inductive values. May also be used as a cement for molded or fabricated items made of polystyrene. (Bottle with Brush 2 fl. oz. 59 ml) ..... \$3.75



## CD22402E

CMOS LSI Sync Generator  
\$9.95



## MAKE CIRCUIT BOARDS THE NEW, EASY WAY WITH TEC-200 FILM

JUST 3 EASY STEPS:

- Copy circuit patterns on TEC-200 film using any plain paper copier
- Iron film on to copper clad board
- Peel off film and etch



Convenient 8 1/2 x 11 size  
With Complete Instructions

|           |              |
|-----------|--------------|
| 5 SHEETS  | .....\$6.25  |
| 10 SHEETS | .....\$10.75 |
| 20 SHEETS | .....\$16.25 |

## REGULATED POWER SUPPLIES 13.8 VDC

Perfect for ham equipment, CB's, car stereos and other 13.8 VDC items. LED on indicator, short-circuit protection. Blending post output. 2 year warranty.



|        |               |
|--------|---------------|
| 3 AMP  | .....\$29.50  |
| 4 AMP  | .....\$39.50  |
| 6 AMP  | .....\$46.50  |
| 10 AMP | .....\$79.50  |
| 20 AMP | .....\$119.50 |
| 30 AMP | .....\$139.95 |

## MINI-CIRCUITS SBL-1 DIODE RING MIXER



Double balance Mixer  
LO/RF - 1-500MHz  
RF DC - 500 MHz  
\$6.75

## MINIATURE TOGGLE SWITCHES

3A 125V Solder Terminals

|      |       |             |
|------|-------|-------------|
| SPDT | ON-ON | .....\$1.25 |
| DPDT | ON-ON | .....\$1.50 |



## DIGITAL CAPACITANCE/INDUCTANCE METER



DIGITAL LCR METER measures inductance, capacitance and resistance. At Last! An LCR meter that everyone can afford. Now you can measure coils, transformers, chokes from 1µH to 200H. Capacitors from 1 pfd to 200 mfd and resistors from 1 ohms to 20 meg ohms. All in one handheld instrument.  
MODEL LCR-1801 ..... \$119.95



## VERNIER DIALS

1-1/2" Diameter 0-10 Marking \$8.25  
1-1/2" Diameter 0-100 Marking \$9.25  
2" Diameter 0-100 Marking \$10.25



## SIGNETICS NE602AN

Balanced Mixer/OSC. Popular IC among experimenters for building DC and super-het receivers  
\$2.49 ..... BUY 3 OR MORE ..... \$2.25

## 200 WATT INVERTER

Plugs into your lighter and runs:



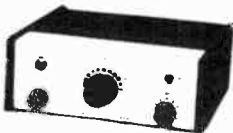
- Ham Equipment
- Lights
- Soldering Iron
- Computer
- Power Tools
- Shaver
- 13" TV with VCR
- MUCH MORE

Model: POW 200  
Input: 10 to 15 volts DC  
Output: 115 volts AC true RMS  
Power: 400 Watts peak  
200 Watts for 2 minutes  
140 Watts continuously  
5" x 2.6" x 1.7"  
Weight: 15 ounces  
Warranty: 3 year

\$99.95

## QRP CW TRANSCEIVER KIT

- Covers 14.0 MHz to 14.1 MHz on 20 M or covers 7.0 MHz to 7.150 MHz on 40M
- Available on 20M or 40M band
- Superior Superhet
- Single signal receiver
- CW crystal ladder filter
- VFO tuning with vernier dial
- RIT w/center detent control
- Very effective AGC
- Selectable audio filter
- Sidetone Oscillator
- 2-3 watts of RF output
- Semi break-in
- 12VDC operation
- Custom pre-painted, punched & silkscreened cabinet
- 100% complete kit with instructions. Nothing else to buy!
- Measures (HWD): 2 1/4" x 6 1/4" x 6"
- Weight 24 oz.



|        |             |               |
|--------|-------------|---------------|
| QRP-20 | 20M VERSION | .....\$149.95 |
| QRP-40 | 40M VERSION | .....\$149.95 |

## SIGNAL INJECTOR/TRACER KIT

This handy tester is both a signal generator and receiver. As a generator use it to check out an amplifier, stage by stage. Also tests AM radio IF and RF stages. As a receiver you can pin point where a defective part exists. Will transmit and receive simultaneously.



\$18.95

## LOGIC PROBE KIT

Hand held Digital Logic Probe provides convenient and precise use in the measurement of logic circuits. It displays logic levels (high or low), pulses and voltage transients down to 300 nanoseconds. High intensity LED readouts provide instant response to the logic state.



\$18.95

## TRIMMER CAPACITOR ASSORTMENT

Top Quality. May contain some two and three gang as well



10 pcs. .... \$1.50

## VERNIER DRIVE

American made 6:1 vernier drive. Has dual plate mounting flange with two tapped holes (2-56) for dial mounting. Input & output mate with 1/4" shaft.

\$10.75

## 6146B POWER TUBE

Most Popular Power Tube  
Used in HF Transmitters  
MFG. PENNSYLVANIA ..... \$16.95 Each



CALL US FOR ALL YOUR TUBE NEEDS

## EDGEWISE MOUNT S-METER/SWR

200µA movement. Scale reads signal 0-60db. Has two ear flanges with holes for mounting.  
Measures approx. 1 1/2"W x 1 1/4"D x 7/8"H. \$4.00



200µA movement. Scale reads both signal (0-30db) and SWR. Same mounting as above.  
Measures 1 3/8"W x 1 1/4"D x 3/4"H. \$4.00

## MULTIVOLTAGE AC ADAPTER

Rated 500MA  
Input 117VAC  
Output 3V, 4.5V, 6V, 7.5V, 8V, 12V DC  
Polarity switch  
Universal plug



\$5.95

## RECTIFIER DIODES

|        |         |
|--------|---------|
| 1N4001 | .....09 |
| 1N4002 | .....09 |
| 1N4003 | .....10 |
| 1N4004 | .....10 |
| 1N4005 | .....12 |
| 1N4006 | .....15 |
| 1N4007 | .....17 |
| 1N5400 | .....20 |
| 1N5401 | .....20 |
| 1N5402 | .....20 |
| 1N5404 | .....25 |
| 1N5406 | .....25 |
| 1N5407 | .....25 |
| 1N5408 | .....25 |

## COPPER CLAD PC BOARDS

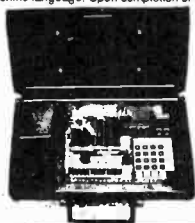
One oz. copper, phenolic base. Single sided

|         |             |
|---------|-------------|
| 7" x 5" | .....\$1.50 |
| 8" x 7" | .....\$2.00 |

## LEARN COMPUTER THEORY BY BUILDING THIS KIT DIGITAL TRAINER MODEL MM-8000

Starting from scratch you build a complete computer system. Our Micro-Master trainer teaches you to write into RAMs, ROMs and run a 8085 microprocessor. You will write the initial instructions to tell the 8085 processor to get started and store these instructions in permanent memory in a 2816 EPROM. Teaches you all about input and output ports, computer timers. Build your own keyboard and learn how to scan keyboard and display. No previous computer knowledge required. Simple easy to understand instruction teaches you to write in machine language. Upon completion of this course you will be proficient in computer technology.

- Uses the 8085 Microprocessor
- Uses the 2816 EPROM, electrically erasable programmable ROM
- Uses the 8156C, 2048 Bit static MOS RAM with I/O ports and timer
- Memory expandable option
- Built in 5V power supply
- 28 key keyboard
- Complete with lesson manual, instructions and experiments



\$119.95

## circuit™ works CONDUCTIVE PEN

## NEW MICRO TIP FOR THINNER TRACE

- Use where conductive electronic traces are needed
- For designing Prototype circuits
- Pen tip redesigned to draw more narrow traces
- Offers improved conductivity, better trace adhesion, and a reduced settling in the pen
- Dries in 3-5 minutes at room temperature
- Spring loaded tip for smooth flow



\$10.95

## TO ORDER

Call 1-800-866-6626 ORDERS ONLY  
(Catalog requests can not be taken on toll free number.)

8 a.m. - 5 p.m. EST  
Monday through Friday

OR WRITE TO:

Ocean State Electronics,  
P.O. Box 1458, Westerly, R.I. 02891

OR FAX TO: CATALOG REQUESTS  
(401) 596-3590 (401) 596-3080

If paying by CREDIT CARD include Card No. and Expiration Date

Mail in orders please include \$4.00 shipping  
CANADA \$7.00 - OVERSEAS \$12.00  
Minimum order \$10.00

R. I. Residents add 7% Sales Tax

ORDERS RECEIVED BY 1:00 PM EST—  
SHIP SAME DAY!

FREE SHIPPING ON ALL MAIL IN ORDERS  
OVER \$25.00.

NOT VALID WHEN COMBINED W/CAT. ORDERS.  
Applies to UPS Ground in Continental U.S. Only.

PRICES SUBJECT TO CHANGE



**PRINT T-SHIRTS FOR FUN OR PROFIT!**



With your computer!  
**FAST, EASY with Heat Transfer Printer Ribbons!**

1. Put Ribbon into your printer
2. Print message or design onto regular paper but print it in a mirror image. (Print Shop and other programs have this capability.)
3. Place paper face down on T-shirt and iron the back of paper to transfer the image.

Available in red, green, blue, or black at \$9.95 each for the following printers (specify make and colors wanted):  
 Panasonic 1060/1180/1090/1190/1123/1124; IBM Proprietary; Epson MX/FX/RX90/95/96/ LX900/L0500/L0510/L0570/L1000; Star NX/NL/NP10/NX2400/2410/2415/2420/LC2410/2415; Seiko/Sharp SP800/1000; Tandy DMP130; Epson AP80; Apple Imagewriter; Citizen 120D/180D/GS140; Okidata 182/192/320/390.

\$10.95 each for Epson MX/FX-100/266e, LQ 1000/1050, LQ2500/2550/EX600/1000/LQ850 \$4.95 each for Okidata 82/92/63/93/Gemini IX/15X.

Available in BLACK only at \$9.95 each for Panasonic 1625/1525, Star NX1000, NEC P2200, Commodore MPS-801.

Available in 4 Color Heat Transfer for Imagewriter II \$11.95; Star NX1000 \$14.95; Star NX1020 \$24.95; Star NX2420 \$29.95; Citizen GSX140 \$29.95; Epson LQ2500,2550 \$14.95; Fujitsu DX2100/2200/2300/DL3300/3400/3600 \$27.95.

**HEAT TRANSFER MARKING PENS**  
 Add colors to the computerized design or use alone. Set/5 Colors (red, orange, yellow, green, blue) wide pens \$15.00, narrow pens \$14.00.

**HARD-TO-GET PRINTER RIBBONS**

Over 200 different ribbons in stock. All ribbons new, not re-inked. Fully guaranteed. Order directly or send SASE for complete list.  
 Add \$2.00 per order shipping. California residents add 7.75% sales tax. On ribbon orders over \$30.00 deduct 10% discount.

**H.T. ORR Computer Supplies**

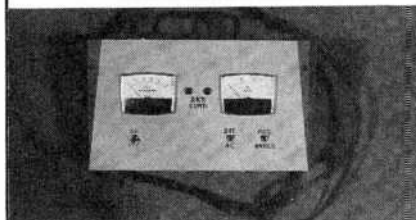
249 Juanita Way, Placentia, CA 92670



714-528-9822  
 800-377-2023

FAX 714-993-6216

**BUILD THIS REGULATED 12VDC TO 120VAC INVERTER**



**SELECT THE WATTAGE YOU NEED—200W to 1000W**  
 Perfect for Campers or Emergencies  
 Send \$29.95 for Complete Set of Plans & Theory of Operation to

**INVERTER SCIENTIFIC**  
 Box 778, Suffern, N.Y. 10901

**PE MARKET CENTER CLASSIFIEDS**

**CABLE TV**

**"BULLET" BUSTER.** Protect your cable box against the infamous "bullet." The "Bullet" Buster acts as an electronic shield. Installs in-line in seconds. Don't wait until it's too late! \$19.95 plus \$3.00 S&H. **ELECTROMAN**, Dept. RE, PO Box 24474, New Orleans, LA 70184.

**TOCOM MAPPER** chip. Align those channels! One chip — no soldering 20 @ \$110.00 ppd. UPS COD. Jerrold Starcom remotes SCR II 20 @ \$6.50 + ship. Call Stan — Apex, (414) 554-8618 phone-fax. Also for sale cable encoders. SA, Jerrold.

**COMPUTER EQUIPMENT WANTED**

**TEACHER WANTS** Tandy color computer junk! Charles Scanlon, 2 Eagle, Simsbury, CT 06070. Keep trying! (203) 657-8373.

**BUSINESS OPPORTUNITIES**

**CASH FOR TRASH.** Hams/hobbyists turn electronic scrap into CASH. Extra money or start a new career. VHS video shows all, \$19.95 plus \$3.00 S&H. **LYNN JOHNSON**, Box 51268, San Jose, CA 95151-1268.

**PUBLICATIONS**

**MARCONI SALAD and Tesla Taters!** ElectroMeals Cookbook, available just in time for holiday gift giving. The perfect present for the Ham's mate. 125+ recipes, \$12.00 plus \$3.00 S&H. **ELECTROMAN**, Dept PE, Box 24474, New Orleans, LA 70184.

**You Need Tree City USA**



City trees add the soft touch of nature to our busy lives. Support Tree City USA where you live. For your free booklet, write: Tree City USA, The National Arbor Day Foundation, Nebraska City, NE 68410.

**The National Arbor Day Foundation**

**PCBoards**

**PCB ARTWORK MADE EASY!**

*"Are you tired of laying down tape or wire wrapping to make printed circuit art? End the nightmare with the PCBoards CircuitLayoutProgram for just \$99.00! Easily create single or double-sided circuit boards with professional results."*

- Herc, CGA, EGA, VGA, & SuperVGA
- Use mouse and/or keyboard
- Built-in help screens
- Dip and Sip footprint libraries
- Build custom parts easily
- Copper flood for building ground planes
- Block move, copy, rotate, save, etc.
- Comes with dot-matrix & laser output
- Make your own films with 1x laser art
- Gerber and Excellon output available

Requirements: DOS 3.0 or later, 1 disk drive, 384k of RAM, IBM-PC or compatible

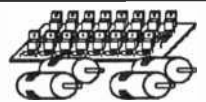
Download Demos from our 24hr BBS at (205) 933-2954

| PCBoards Software Prices:   |       | Add on Software:    |        |
|-----------------------------|-------|---------------------|--------|
| PCBoards Layout             | 99.00 | PCRoute Autorouter  | 99.00  |
| Gerber and Excellon Drivers | 49.00 | PCRoute+ Autorouter | 149.00 |
| Plotter Drivers             | 49.00 | SuperCAD Schematic  | 99.00  |
| Demo Package (all software) | 10.00 | SuperCAD+ Schematic | 199.00 |

Use PCBoards, PCRoute, and SuperCAD as a "system" to create pcb art from a schematic!

PCBoards - 2110 14th Avenue South, Birmingham, AL 35205 / Ph. (800)473-PCBS Fax (205)933-2954

**\$49**  
 Four motor kit with computer interface



**\$99**  
 High speed Closed loop Galvo kit Squares to 180 hz, & Circles to 900 hz

**FREE catalog of Kits**

**Silicon Valley Surplus**

1273 Industrial Prkwy West  
 Bldg 460

Hayward, Ca .94544-7025

**510-582-6602**



**ADJUSTABLE REGULATED POWER SUPPLY**  
2 - 28 VDC at 1A continuous  
1% regulation.  
**\$69.95 each**

**BREVEL DC GEAR MOTOR**

24 to 130 RPM, reversible, 12V to 120VDC with thermal overload, 0.375" shaft x 2.25" long.  
**\$19.95 each**



**TRANSFORMER**  
12 VAC, 1A, with power cord and secondary wires.  
**\$4.95 each**

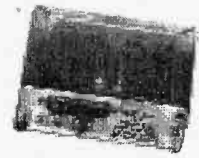
**AUTOMOTIVE POWER CORD**

Room for fuse inside heavy-duty plug. 6" cord included.  
**\$1.49**



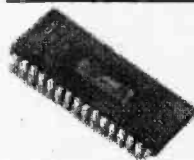
**COLLINS PRECISION CRYSTAL CONTROLLED OSCILLATOR**

100 KHz and 500 KHz outputs. Diagrams included.  
**\$12.95 each**



**DTS413 NPN SILICON TRANSISTOR**

Similar to NTE162. Commonly used in TV vertical deflection. 500V, 1A.  
**\$2.00 each - 12 for \$10.00**



**4 MB EPROM**  
Brand new! Toshiba No. TC574000D-150.  
**\$37.95 each**

**27C512 EPROM**

Erase and save!  
**\$1.99 each**



**PHILMORE ANTENNA KIT**

For improved broadcast and shortwave reception. The perfect starter antenna.  
**\$7.95**

Also visit:

**ASCII Electronics**  
1020 Marietta Way  
Sparks, NV 89431  
(702) 355-8822

*For Holiday Giving . . .*



**ROBOT PUPPY**

A fun canine with an internal microprocessor control system is a marvel of state of the art technology, featuring DUAL DC DRIVE MOTORS with GEAR REDUCTION and two-inch diameter RUBBER TREAD DRIVE WHEELS that provide excellent mobility and traction. Special integrated sound analysis and recognition circuitry allow you to command your Robot Puppy with simple hand claps. When your Robot Puppy hears your commands, it moves, whines and barks, and its eyes light up! If you ignore it, it will "go to sleep" and then awaken at your command. Original retail price over \$100.00! **\$29.95**

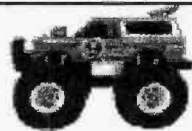
**MUMBLEY BEAR 12" Tall Teddy Bear**

Talk and it imitates your voice in "bear talk." Soft and cuddly.  
**\$19.95 each**



**BIG RED 4 x 4 TRUCK**

Radio controlled (2 channel), 12.0 x 8.0 cm pneumatic rubber tires, range up to 100 ft, removable camper shell, climbs 40°-45° angle, dual proportional radio control, dual speeds, recharging jack, full power to all 4 wheels, reinforced front bumper, fun for all ages. This is not a cheap toy!  
**\$49.95**



**PRECISION OBJECTIVE LENS**

21mm f:3.5. Four coated glass lenses in black aluminum case measuring 1-5/32" long by 1-1/16" diameter. Excellent correction of all aberration for an angle of 35° without vignetting (obstruction of view at edge), or 45° angle with slight vignetting. Linear resolution in focus is very near the theoretical limit of 385 lines/mm when the image of object is in focus (D=6mm), or 500 lines/mm when object is in focus (numerical aperture=1.41). Possible applications include: objective lens for scanners; photographic objective enlarging linearly 10X; objective for a hand-held microscope, enlarging from 30X to 120X (numerical aperture=1.41); lens working with light sensor or emitter as a precise focusing element; or lens for shaping a laser beam.  
**\$12.50**



**SCANNER PACKAGE**

386 DX 20 MHz system, 3 MB RAM, 360K 5.25" floppy, 20MB hard drive, Hercules-compatible mono monitor. Canon flatbed scanner with J Laser AT-3 interface, drivers and software.  
**\$899.00**



**CANON FULL PAGE DESKTOP SCANNER**

300 x 300 DPI. With I/O card, cable, software and documentation.  
**\$349.95**

**WE BUILD CUSTOM SYSTEMS!**  
Call or Fax for price quote.



**BARE BONES SYSTEM**

XT type motherboard with 8 slots, slide-in cabinet, power supply, 256K RAM, upgraded BIOS, NEC V-20 CPU. Expandable. New. Accessories and upgrades are available. Call or FAX for quote. (Monitor and keyboard not included.)  
**\$99.95**

**1200 BAUD INTERNAL MODEM**

For PC's and compatibles. With software.  
**\$19.95 each**



**14" MONITOR**

Brand new, boxed, open frame hi-res TTL monochrome monitor. Standard pin-out. Diagrams for power supply and connections included.  
**\$14.95**

**3-BUTTON MOUSE**

For PC's and compatibles. Microsoft and Mouse Systems compatible, 350-700 DPI dynamic resolution. With software and instructions.  
**\$14.95 each**



**AT RLL DRIVE CONTROLLER**

2 hard drives, 4 floppies.  
**\$19.95**

**IDE CONTROLLER CARD**

JP3: HDD LED. JP1: FDC enable/disable. JP2: HDC enable/disable. J3: I/O channel ready.  
**\$14.95**

**MINICIRCUITS LABORATORIES PRODUCTS**

- PSC2-1 10.95
- PSC3-1 20.50
- PSC3-1W 32.00
- PSCQ-2-50 18.00
- PSCQ-2-180 18.00
- SRA-1 10.00

**ALLTRONICS**  
2300 Zanker Road • San Jose, CA 95131

VISA - MC - AMEX cards accepted. Minimum order \$15.00.

California residents add 8.25% sales tax. Shipping additional on all orders.

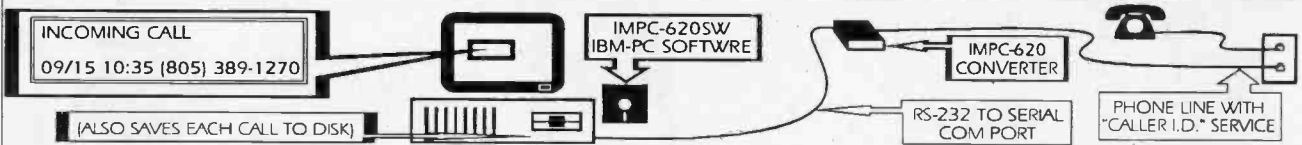
**Phone (408) 943-9773 • Fax (408) 943-9776**

Retail Store Hours:  
M - F 9 - 6  
Sat 10 - 3

**GRABS SIGNALS FROM PHONE LINE:**

# CALLER I.D. - COMPUTER Interface

**CHEAP SOFTWARE SAVES CALLS**



THIS PRODUCT WILL NOT WORK IN ALL AREAS YET. YOU MUST HAVE "CALLER I.D." SERVICE (FROM YOUR LOCAL PHONE COMPANY).

CONVERTER - PHONE LINE IN / RS-232 OUT. INCL. 3-FT PHONE PLUG, 3-FT RS232 CABLE, SCHEMATIC AND PARTS LIST  
**IMPC-620 \$59.00**

"STRIPPED" VERSION, BRAND NEW BUT SLIGHTLY OLDER DESIGN, NO COVER, NO RS-232 CONN. HOOD. PERFORMS EQUALLY WELL AS NEWER DESIGN. TESTED, SCHEM. AND ALL CABLES INCL. - BARGAIN.  
**IMPC-320 \$48.00**

"KIT" VERSION - ALL SURFACE MOUNT PRE-ASSEMBLED. SPEND 15 MINUTES SOLDERING CABLES AND SAVE \$\$  
**IMPC-320K \$42.00**

YOU MUST RUN SOFTWARE (YOURS OR OURS) TO GET SERIAL DATA TO THE SCREEN AND DISK FILE. OUR POP-UP WINDOW "TSR" SOFTWARE FOR IBM-COMPATIBLES  
**IMPC-620SW \$7.50**

BOOKLET - 56 PAGES: THEORY, MESSAGE-TYPES W/EXAMPLES - INCL  
**IMPC-BK \$19.50**  
 (W/PURCH OVER \$20 \$14.50)



CHECKSUM CALC. NAME DELIVERY INCLUDES SCHEM. FOR 3 DECODERS AND A CALLER I.D. GENERATOR (REQ I200)

## YOU'VE HEARD ABOUT THEM WE'VE GOT THEM HERE!

**BOOSTER FOR MINIATURE TRANSMITTERS**  
 RF POWER AMP BOOSTS 88-108MHz MINIATURE FM TRANSMITTERS' RANGE - GUARANTEED!  
 COMPLETE KIT W/SCHEMATICS **IMPC-RE2 \$26.00**

E-Z TUNE (25 TURN) STABLE HI-FI FM MIC - SURF. MNT. (MEDIUM RANGE, SUPER SENSITIVE) **IMPC-RM5 \$44.00**

LONG RANGE FM MIC - SMALL BUT VERY POWERFUL 1" SQ., NON-SURFACE-MOUNT KIT **IMPC-RM52 \$38.00**

**TOUCH TONE DECODER** DISPLAYS PHONE NUMBERS AS HEARD FROM RADIO TAPE OR PHONE LINE. BUILT-IN 200 DIGIT MEMORY **IMPC-TDD \$169**

**International MicroPower Inc.**  
 65 Palm Drive  
 Camarillo, CA 93010 +\$3.50 S.H.  
**1-805-389-1270 (\$7.00 I.F.C.O.D.)**  
 MC or VISA Accepted | CA residents add Sales Tax

# Enter A World Of Excitement with a Subscription to Popular Electronics®

Get the latest electronic technology and information monthly!

Now you can subscribe to the magazine that plugs you into the exciting world of electronics. With every issue of Popular Electronics you'll find a wide variety of electronics projects you can build and enjoy.

Popular Electronics brings you informative new product and literature listings, feature articles on test equipment and tools—all designed to keep you tuned in to the latest developments in electronics. So if you love to build fascinating electronics, just fill out the subscription form below to subscribe to Popular Electronics... It's a power-house of fun for the electronics enthusiast.

### EXCITING MONTHLY FEATURES LIKE:

- CONSTRUCTION
- FEATURES
- HANDS-ON-REPORTS
- SPECIAL COLUMNS

**PLUS: ALL OUR GREAT DEPARTMENTS!**

**FOR FASTER SERVICE CALL TODAY**  
**1-800-827-0383**  
 (7:30AM-8:30PM)  
 EASTERN STANDARD TIME



**Save 55% OFF The Regular NEWSSTAND Rate**

## Popular Electronics SUBSCRIPTION ORDER FORM

**YES!** I want to subscribe to Popular Electronics for 1 Full year (12 Issues) for only \$18.95. That's a savings of \$23.05 off the newsstand price. (Basic Subscription Rate—1 yr/\$21.95)

Payment Enclosed  Bill me later  
 Please charge my:  Visa  Mastercard

Acct. # \_\_\_\_\_

Signature \_\_\_\_\_ Exp. Date \_\_\_\_\_

P.O. Box 338, Mt. Morris IL. 61054  
 PLEASE PRINT BELOW:

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

Allow 6 to 8 weeks for delivery of first issue. U.S. Funds only. In Canada add \$5.00 Postage. All other Foreign add \$7.50 Postage.





800 445 7717  
317 842 7115

COMMUNICATIONS  
ACE Communications Monitor Division  
10707 East 106th Street Fishers, IN 46038

## Scanner & Shortwave

### AOR AR1000XLT

**\$429.00**  
AM Broadcast to  
Microwave  
1000 Channels



500KHz to 1300MHz coverage in a programmable hand held. Ten scan banks, ten search banks. Lockout on search and scan. AM plus narrow and broadcast FM. Priority, hold, delay and selectable search increment of 5 to 995 KHz. Permanent memory. 4 AA ni-cads and wall plus cig charger included along with belt clip, case, ant. & earphone. Size: 6 7/8 x 1 3/4 x 2 1/2. Wt 12 oz. Fax fact document # 205.

### AR2500

**\$399.00**  
2016 Channels  
1 to 1300MHz  
Computer Control



62 Scan Banks, 16 Search Banks, 35 Channels per second. Computer control for logging and spectrum display. AM, NFM, WFM, & BFO for CW/SSB. Priority bank, delay/hold and selectable search increments. Permanent memory. DC or AC with adaptors. Mtng Brkt & Antenna included. Size: 2 1/4H x 5 5/8W x 6 1/2D. Wt. 11lb. Fax fact # 305

### AR3000

**\$1095.00**  
400 Channels  
100KHz to 2036MHz



Extreme coverage, excellent sensitivity, plus processor controlled band pass filtering and attenuation to eliminate interference. Top rated receiver in its class, offers AM, NFM Wide FM, LSB, USB, CW modes. RS232 control. Lockout in search. 4 priority channels. Delay & hold & Freescan modes. AC/DC pwr cord and whip ant. included. Size: 3 1/7H x 5 2/5W x 7 7/8D. Wt 2lbs., 10oz. Fax fact document #105.

### Free Stuff

Demo disk of SCS (scanner control system) software for AR 3000 & AR2500. Call toll free to order. Also, Free with AR2500: Control software, a \$49.95 value. Allocation chart of all voice frequencies. Dial Fax Facts for doc. #999.



Dial 317 849 8683 to get instant tech information FREE from your Fax!

You can obtain specs and info on these products and more by dialing our Fax Facts automated service. Call our number from your fax, then request the document as listed below. Start your fax and the document will start printing immediately on your fax!



## Mobile Scanners

### Bearcat

**760XLTM**  
**\$249.95**

100 Channel  
800 MHz



Five banks of 20 channels each. Covers 29-54, 118-174, 406-512 and 806-954MHz (with cell lock). Features scan, search, delay, priority, memory backup, lockout, service search, & keylock. Includes AC/DC cords, mtng brkt, antenna. Size: 4 3/8 x 6 15/16 x 1 5/8. Wt: 4.5lbs. Fax fact document #550.

### Bearcat

**590XLTX**  
**\$199.95**

100 Channel  
11 Band



Five banks of 20 channels each. Covers 29-54, 118-174, and 406-512MHz. Features scan, search, delay, priority, memory backup, lockout, service search, & keylock. Includes AC/DC cords, mtng brkt, antenna. Size: 7 3/8 x 6 15/16 x 1 5/8. Wt: 4.1lbs. Fax fact document #570.

### Bearcat

**560XLTZ**  
**\$99.95**

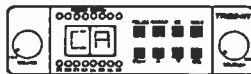
16 Channel  
10 Band



Compact, digital programmable unit covers 29-54, 136-174, and 406-512MHz. Features scan, WX search, delay, priority, memory backup, lockout, review, & auto delay. Includes AC/DC cords, mtng brkt, antenna. Size: 7 3/8 x 2 1/2 x 1 5/8. Wt: 2.5lbs. Fax fact document #560.

### Trident

**TR-2C**  
**\$89.95**



Scan/CB with optional laser detector scans pre-programmed by state channels in low, high, UHF & T bands. Weather, 40 ch. CB receive plus mobile relay. Size: 5 5/8 x 4 7/8 x 1 3/4. Wt: 1.5lbs. Fax fact document #580.

Mag Mount Antenna. Easy to install whip antenna with 20' of coax & heavy duty magnet BNC MA 100 \$19.95  
Base Antenna. 25 to 1000MHz coverage with 50' of coax.  
All mounting hardware included. BNC AS 300 \$59.95  
External Speaker. Base or mobile mount. MS190 \$19.50  
Wide Band Pre-Amp. Variable gain up to 20dB covers 100 KHz to 1500MHz. 9Vbatt included. BNC. GW-2 \$89.00  
Interference Filter. Filters and eliminates common causes of interference to scanners. BNC. Model MPIP-1. \$59.00  
Downconverter. Converts 800MHz freqs to 400MHz for 3 band scanners. Quartz locked, 9V batt. DC99. \$89.00  
Extended Warranties & Service. Extended warranties available for most models. Call for quote. Out of warranty service by ex-Bearcat/Regency factory techs. Call for quote.

## Hand Held Scanners

### AOR 900 \$199.95

100 Channel 800 MHz  
Five scan banks 5 search  
banks. Covers 29-54, 118-  
174, 406-512 and 830-950



MHz (no cell lock). Features scan, search, delay, priority, permanent memory, lockout, backlight, & keylock. Includes AC/DC adaptor, belt clip, antennas. Size: 5 3/4H x 2W x 1 1/2D. Wt: 12oz. Fax fact document #650.

### Bearcat 200XLTN

**\$219.95** 200 Channels 800MHz

Ten scan banks plus search. Covers 29-54, 118-174, 406-512 and 806 956MHz (with cell lock). Features scan, search, delay, 10 priorities, mem backup, lockout, WX search, & keylock. Includes NiCad & Chrg. Size: 1 3/8 x 2 11/16 x 7 1/2. Wt. 32 oz. Fax Facts # 450



### Bearcat 100XLIN Now \$159.95

100 Channels, Keyboard Programmable.  
Similar to 200XLTN above without 800MHz. Fax facts #460

### Bearcat 70XLTP Only \$139.95

20 Channels Keyboard Programmable.  
10 Band Hand Held with Ni-Cads & Charger. Fax facts #470

### Bearcat 55XLTR Now \$99.95!

10 Channels Keyboard Programmable.

## Table Top Scanners

### Bearcat 855XLTE Now \$179.95!

50 Channels Keyboard Programmable with 800MHz. LCD display, lock, priority, Search, WX, Fax facts #655

### Bearcat 142XLM Only \$87.95

16 Channels with 10 bands. LED display, lockout, priority, WX scan, review key and memory backup. Fax facts #660.

### Bearcat 147XLJ Now \$89.95

16 Channels with 10 bands. Track tuned, LED display, priority, WX search, review, memory backup. Fax facts #670.

### Bearcat 172XLM Only \$124.95

16 Channels with 10 bands. Track tuned, LED display, priority, WX search, review, memory backup. Fax facts #680.

### Bearcat

**800XLX**

**\$239.95**



12 bands and 40 channels with 800MHz and nothing cut out. AC or DC. Fax facts #690.

## 2 Way Radios

VHF hi band programmable mobiles as low as \$299.95. Call for quotes or Fax Fact #755

Call Toll Free, 24 Hours a Day! Dial 1-800-445-7717. Fax Toll Free, 1-800-448-1084

800 numbers operational in all 50 states, plus Canada. For international voice lines, dial 317-842-7115 or fax 317-849-8794

ACE Communications 10707 East 106th Street, Fishers, IN 46038

Service & Support hours: Mon. - Fri. 9 A.M. to 6 P.M., Sat. 10-4 EST. MasterCard, Visa, Checks, Approved P.O.'s & C.O.D. (add \$5.00) & AMEX (add 5%) Prices, specifications and availability subject to change. Flat rate shipping & handling charge, \$4.95 per unit. Express shipping available, no express C.O.D. One week trial, no returns accepted two weeks after original receipt without substantial restocking charge. All units carry full factory warranty. Indiana residents add sales tax.



**MARK V ELECTRONICS, INC.** IN CA 1-800-521-MARK (orders only)  
 OUTSIDE CA 1-800-423-FIVE (orders only)  
 ORDER BY FAX (213) 888-8888  
 CATALOG & INFORMATION (213) 888-8988

▲ indicates the level of difficulty in the assembling of our Products.  
 Special offer will be given to the purchase of Amplifier + Metal Cabinet + Power Transformer!  
**300W HI-FI POWER AMPLIFIER (MONO)**



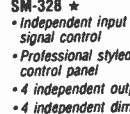
**TA-3600 ▲▲▲**  
 Power output: 300 watts RMS into 8 ohms. 540 watts music power into 8 ohms • Frequency response: 10Hz to 20KHz • Total harmonic distortion: Less than 0.05% • Intermodulation distortion: Less than 0.05% • Sensitivity: 1 V rms at 47K • Power requirements: 60 to 75 VDC at 8 amp • Dimensions: 8" x 7 1/4" x 2 1/4"



**TA-477 ▲▲**  
 T. H. D.: Less Than 0.007% • Power output: 120 watts into 8 ohms RMS • Frequency response: 8Hz to 20KHz, +0-0.4 dB • Sensitivity: 1V • Power requirements: 55 VDC @ 3 amps. May use Mark V Model 003 Transformer.



**SM-302 ▲▲▲**  
 Frequency response: 20Hz to 20KHz • Total harmonic distortion: < 0.1% • Power output: 60W per channel into 4 ohm load • 33W per channel into 8 ohm load • Input sensitivity: Mic 10mv • Hi 380mv • Lo 640mv • Signal to noise ratio: Better than 70 dB • Power consumption: 100W. Dimensions: 360 mm x 75 mm x 200 mm.



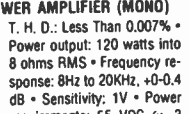
**SM-328 \***  
 • Independent input signal control  
 • Professional styled control panel  
 • 4 independent outputs  
 • 4 independent dimmer controls  
 • Chaser speed controls  
 • Automatic chaser operation  
 • 4 preset chaser programs  
 • Clockwise chaser control  
 • Anti-clockwise chaser control  
 • Match with any stepdown transformer from 12 to 24V AC.

**PROFESSIONAL COLOR LIGHT CONTROLLER**

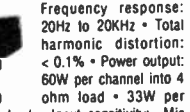
**SM-328 \***  
 • Independent input signal control  
 • Professional styled control panel  
 • 4 independent outputs  
 • 4 independent dimmer controls  
 • Chaser speed controls  
 • Automatic chaser operation  
 • 4 preset chaser programs  
 • Clockwise chaser control  
 • Anti-clockwise chaser control  
 • Match with any stepdown transformer from 12 to 24V AC.

**SM-328 \***  
 • Independent input signal control  
 • Professional styled control panel  
 • 4 independent outputs  
 • 4 independent dimmer controls  
 • Chaser speed controls  
 • Automatic chaser operation  
 • 4 preset chaser programs  
 • Clockwise chaser control  
 • Anti-clockwise chaser control  
 • Match with any stepdown transformer from 12 to 24V AC.

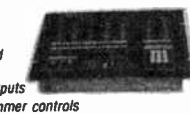
**100W + 100W NEW CLASS A DC STEREO PRE AND MAIN AMP**  
**TA-1500 ▲▲▲**  
 Power output: 80 watts per channel into 8 ohms 100 watts per channel into 4 ohms • Total harmonic distortion: Less than 0.03% • Frequency response: Aux input: 5 to 50,000 Hz +0.2dB. -2dB • Frequency response: Power amplifier section: DC to 200KHz • Sensitivity: Phono: 2.5 mV @ 47K Aux: 150 mV @ 47K Mic: 6 mV @ 10K Output: Tape: 150 mV @ 47K Preamp: 1V @ 60C ohms • Power transformer: 26V to 32V AC x 2 @ 6 A (Mark V Model 001) • P.C. Board Dimensions: 10.5 x 6.13 x 2.25 • Heat sink: 5.13 x 2.63 x 3" (Each) Use rack mount cabinet LG 1924 or LG 1925.



**TA-802 ▲▲**  
 Power output: 80 watts per channel into 8 ohms • Total harmonic distortion: Less than 0.05% at rated power • Intermodulation distortion: Less than 0.05% at rated power • Frequency response: DC to 200KHz. -0 dB. -3dB. @ 1 watt • Power requirements: 30 VAC x 2 @ 6 amp. May use Mark V model 001 transformer P. C. Board: 8-1/2" x 5" x 1-1/8" Heat sink: 5-1/8" x 2-5/8" x 3" (Each)



**SM-333 ▲▲▲▲**  
 Frequency response: 20Hz to 20KHz • Total Harmonic distortion: 0.05%  
 Front channel: Less than 0.25% • Input signal voltage: 0.1 to 3.5V • Output: Front channel: 0.1 to 3.5V • Rear channel: 6.6V • Delay time: 5 to 50 milliseconds • Input impedance: 47K • Power requirements: 100-120 VAC. 60Hz • Dimensions: 14.2" wide, 4.82" deep, 2.1" high.



**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**120W + 120W AC/DC STEREO HI-FI & PA AMP.**

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**100W + 100W NEW CLASS A DC STEREO PRE AND MAIN AMP**  
**TA-1500 ▲▲▲**  
 Power output: 80 watts per channel into 8 ohms 100 watts per channel into 4 ohms • Total harmonic distortion: Less than 0.03% • Frequency response: Aux input: 5 to 50,000 Hz +0.2dB. -2dB • Frequency response: Power amplifier section: DC to 200KHz • Sensitivity: Phono: 2.5 mV @ 47K Aux: 150 mV @ 47K Mic: 6 mV @ 10K Output: Tape: 150 mV @ 47K Preamp: 1V @ 60C ohms • Power transformer: 26V to 32V AC x 2 @ 6 A (Mark V Model 001) • P.C. Board Dimensions: 10.5 x 6.13 x 2.25 • Heat sink: 5.13 x 2.63 x 3" (Each) Use rack mount cabinet LG 1924 or LG 1925.

**80W + 80W PURE DC STEREO MAIN POWER AMPLIFIER**  
**TA-802 ▲▲**  
 Power output: 80 watts per channel into 8 ohms • Total harmonic distortion: Less than 0.05% at rated power • Intermodulation distortion: Less than 0.05% at rated power • Frequency response: DC to 200KHz. -0 dB. -3dB. @ 1 watt • Power requirements: 30 VAC x 2 @ 6 amp. May use Mark V model 001 transformer P. C. Board: 8-1/2" x 5" x 1-1/8" Heat sink: 5-1/8" x 2-5/8" x 3" (Each)

**VIDEO/AUDIO SURROUND SOUND PROCESSOR**  
**SM-333 ▲▲▲▲**  
 Frequency response: 20Hz to 20KHz • Total Harmonic distortion: 0.05%  
 Front channel: Less than 0.25% • Input signal voltage: 0.1 to 3.5V • Output: Front channel: 0.1 to 3.5V • Rear channel: 6.6V • Delay time: 5 to 50 milliseconds • Input impedance: 47K • Power requirements: 100-120 VAC. 60Hz • Dimensions: 14.2" wide, 4.82" deep, 2.1" high.

**120W + 120W AC/DC STEREO HI-FI & PA AMP.**

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**SM-720 ▲▲**  
**SPECIFICATIONS**  
 Output Power: 120W x 2 (P.M.P.D.)  
 Input Sensitivity: Tape 300 mV • Aux 300 mV • Phono 3 mV • Mic 3 mV  
 Tone Control: Treble ± 8dB • Bass ± 8dB  
 Frequency Response: 20Hz-20KHz  
 Power Requirements: AC 110/60Hz • DC 12-16V  
 Dimensions: 10-5/8" x 8-1/8" x 3-1/8" (W x D x H)

**DC/CAD**  
*introducing...*

**THE TERMINATOR**

Super High Density Router  
 (Complete with Schematic & PCB EDITOR)

Features the following powerful algorithm & capability:

- Rip - up and Retry
- Pre-routing of SMT components
- Real-Time via minimization
- Real-Time clean up passes
- User defined strategies
- Window 3.0 capability as DOS Task
- 1-mil Autoplacer and Autopanning
- Two-way Gerber and DXF
- Automatic Ground Plane w/ Cross-Hatching
- Complete w/ Schematic & Dolly Libraries
- Optional simulation capability & protected mode for 386 users

Call for  
**FREE DEMO DISK**  
 price range:  
**\$295 - \$1495**

\* PCB LAYOUT SERVICE AT LOW COST \*

LEASE PROGRAM & SITE LICENSE AVAILABLE



Design  
 Computation

1771 State Highway 34  
 Farmingdale, NJ 07727  
 (908) 681 - 7700 • (908) 681 - 8733 (FAX)

" DC/CAD . . . The focal point of future CAD market "

**ALL THE PARTS  
 YOU'LL EVER NEED AT  
 MCM ELECTRONICS**



Because needs in the electronics industry are constantly changing, MCM Electronics continually researches the market and reacts to the market's changing needs.

MCM is constantly in touch with national and international manufacturers to bring both commonly used and hard-to-find products to its customers.

There are over 20,000 items stocked and ready to ship, including: Semiconductors, connectors, audio and VCR parts and accessories, television parts, hardware, test equipment, chemicals, tools and many name brand items.

For A FREE Catalog Call:  
**1-800-543-4330**

To Order By Fax:  
**1-513-434-6959**  
 For Product Questions Call:  
**1-800-824-TECH (8324)**



**MCM ELECTRONICS**  
 650 CONGRESS PARK DR.  
 CENTERVILLE, OH 45459-4072  
 A PREMIER Company

POP-02

Popular Electronics, January 1993

QUALITY PARTS • DISCOUNT PRICES • FAST SHIPPING

# ALL ELECTRONICS CORP.

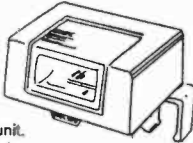
## Small Neodymium Magnet

Small, powerful neodymium magnet. Irregular shape approx. 0.64" X 0.7" X 0.1" thick. Strong for its size. **CAT# MAG-5** \$1.50 each



## Electronic Flash

ITT Magiclflash Originally designed for Polaroid One-Step and Pronto cameras. Nice bright flash can be triggered by external 3 Vdc pulse. Operates on 6 Vdc, 4 AA cells (not included). Useful for special effects of flash lighting. Circuitry includes a very desirable 600 uF 330V photoflash capacitor which is, by itself, worth the price of the unit. **CAT# FSH-2** \$6.00 each

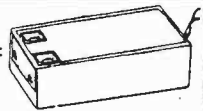


## A.C. Line Cord

6' Black 18/2 A.C. power cords. SPT-1 insulation. Polarized plug. **CAT# LCAC-7** 2 for \$1.00 • 100 for \$45.00 • 1000 for \$400.00

## LASER POWER SUPPLY

Epoxy encapsulated power supply for up to 2 mW lasers. 4 1/2" X 1 1/2" X 1 7/16". Input: 9 Vdc @ 1 amp. Output starting voltage: 7 to 8 kV. Operating voltage: 1.1 to 1.5 kV. Operating current: 4 to 5 mA. Recessed 0.250 quick connect terminals for output. Color coded wire leads for input. **CAT# LPS-1** \$35.00 each



## Piezo Element

3 Wire Piezo Element. Taiyo Yuden Co. # CB358BK4. Self-excited piezo electric diaphragm. 1.40" diameter x 0.021" thick. Resonant resistance: 400 ohms. 5" color-coded leads. **CAT# PE-12** \$1.00 each 10 for \$8.50 • 100 for \$65.00



## L.E.D.'s

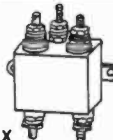
### Surface mount LED chip

Clear when off, green when lit. Very tiny - whole unit is 0.115" X 0.055" X 0.05" thick. 1mm (0.04") lens diameter. Gold-plated mounting surfaces for superior conductivity. **CAT# SMLED-2** 10 for \$2.00 100 for \$18.00 1000 for \$140.00



## 20 Amp RF/EMI Filter

Corcom # 2086 20 amp RF/EMI general purpose common-mode filter. Controls line-to-ground noise. Small size, low leakage. 3.46" X 1.16" X 2.81". UL and CSA listed. Threaded stud terminals on input and output. **CAT# RFI-201** \$8.50 each



## D.C. Wall Transformers (120 Vac INPUT)

| Volts   | Amps    | Plug Style   | Center negative | Cat#      | Price  |
|---------|---------|--------------|-----------------|-----------|--------|
| 4 Vdc   | 70 ma.  | 2.5 mm co-ax | negative        | DCTX-470  | \$2.00 |
| 6 Vdc   | 300 ma. | 2.1 mm co-ax | positive        | DCTX-632  | \$2.75 |
| 8.3 Vdc | 10 ma.  | battery snap |                 | DCTX-8310 | \$1.50 |
| 9 Vdc   | 300 ma. | 2.1 mm co-ax | positive        | DCTX-932  | \$3.00 |
| 12 Vdc  | 100 ma. | 2.1 mm co-ax | negative        | DCTX-1210 | \$2.50 |
| 12 Vdc  | 500 ma. | 2.1 mm co-ax | negative        | DCTX-125  | \$4.50 |
| 12 Vdc  | 800 ma. | 2.5 mm co-ax | positive        | DCTX-1281 | \$5.25 |
| 12 Vdc  | 1 Amp   | none         |                 | DCTX-121  | \$6.50 |
| 14 Vdc  | 700 ma. | 1.3 mm co-ax | negative        | DCTX-1470 | \$5.25 |
| 15 Vdc  | 400 ma. | 2.5 mm co-ax | negative        | DCTX-1540 | \$4.50 |

## RECHARGEABLE Gell Cell Batteries

12 VOLTS @ 10 AHOURS

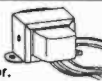


Two 6 volt 10 AH batteries, assembled as a single 12 volt package. Package size: 6" X 3.94" X 3.75"

**CAT# GC-1210** \$35.00 each

## 12 Volt 2 Amp Transformer

Same as Mouser # 41FG020. 12 VCT, 2 Amp power transformer. 2" X 2.35" X 2.10". 2.90" mounting centers. Pigtail leads. **CAT# TX-122A** \$4.00 each 10 for \$37.50



## Standard JUMBO

Diffused T 1-3/4 size (5 mm)

**RED CAT# LED-1** 10 for \$1.50 • 100 for \$13.00  
**GREEN CAT# LED-2** 10 for \$2.00 • 100 for \$17.00  
**YELLOW CAT# LED-3** 10 for \$2.00 • 100 for \$17.00

## REDUCED PRICES FLASHING LED

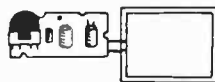
W/ built in flashing circuit 5 volt operation. T 1-3/4 (5mm)

**RED** 50¢ each  
**CAT# LED-4** 10 for \$4.75  
**GREEN** 75¢ each  
**CAT# LED-4G** 10 for \$7.00  
**YELLOW** 75¢ each  
**CAT# LED-4Y** 10 for \$7.00

## LED HOLDER

Two piece holder. **CAT# HLED** 10 for 65¢

## ELECTROLUMINESCENT BACKLIGHTS



At last! A low cost electroluminescent glow strip and inverter. These brand-new units were designed to backlight small LCD TVs made by the Citizen Watch company. The inverter circuit changes 3 or 6 Vdc to approximately 100 Vac, the voltage required to light the glowstrip. Luminescent surface area is 1.7" X 2.25". The strip is a salmon color in its off state, and glows white when energized. The circuit board is 2.2" X 1". Glow strip and circuitry can be removed easily from plastic housing. Ideal for special lighting effects.

**CITEN# 92TA** operates on 3-6 Vdc  
**CAT# BLU-92** \$3.50 each  
**LARGE QUANTITY AVAILABLE**  
10 for \$32.00 • 100 for \$275.00

## VERY SPECIAL DEAL 7 Vdc 210 ma. WALL TRANSFORMERS

New 17 Vdc, 210 ma wall transformers. 6 ft. cord. Unusual co-axial device on end of cord can be cut off and used for another application. Large quantity available. **CAT# DCTX-1721** \$1.50 each 100 for \$1.25 each 1000 for \$1.00 each



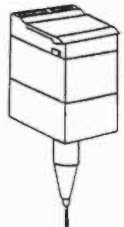
## 10 AMP SOLID STATE RELAY

(USED) 10 amp solid state relays, removed from equipment and tested. Control voltage: 250 volts AC at 10 amps. Standard "hockey-puck" size: 2.27" X 1.72" X 0.95". UL and CSA listed. **CAT# SSRLY-11U** \$8.25 each • 10 for \$80.00



## RADIOSONDE WEATHER INFORMATION TRANSMITTER

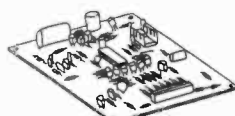
Viz(r) Radiosonde A "radiosonde" is a weather instrument, usually released at high altitudes, designed to transmit temperature, humidity, winds and pressure at various heights above the ground. These are new units, discontinued from NOAA National Weather Service. Contains lots of interesting parts: a solid state transmitter, barometric pressure sensor, humidity sensor and a 24 volt battery which is activated when submerged in water. Great for school science demonstrations or as a source for parts. **CAT# WIT-1** \$4.75 each Case of 16 for \$64.00



## Rechargeable Batteries (nickel-cadmium)

| Size                 | Volt | Amp      | Case    | 1-8    | 10      |
|----------------------|------|----------|---------|--------|---------|
| AAA                  | 1.20 | 180 mAh  | NCB-AAA | \$1.50 | \$13.50 |
| AA                   | 1.20 | 500 mAh  | NCB-AA  | \$2.00 | \$18.50 |
| AA w/ Solder Tabs    | 1.20 | 500 mAh  | NCB-SAA | \$2.20 | \$20.00 |
| Sub C w/ Solder Tabs | 1.20 | 1200 mAh | NCB-SC  | \$4.25 | \$40.00 |
| C                    | 1.20 | 1200 mAh | NCB-C   | \$4.25 | \$40.00 |
| C Heavy Duty         | 1.25 | 1800 mAh | HDNCB-C | \$5.25 | \$42.50 |
| D                    | 1.20 | 1200 mAh | NCB-D   | \$4.50 | \$42.50 |
| D Heavy Duty         | 1.25 | 4000 mAh | HDNCB-D | \$7.00 | \$65.00 |

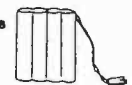
## Motor Speed Controller And Timer



With a minimum of external wiring, this PC board will control the speed and duration of a 120 Vac motor or other load up to 300 watts. When activated, motor will operate for 10, 20 or 40 minutes or continuously at high, medium or low speed. To simplify hook-up we recommend using our membrane keypad, (CAT# KPM-12 \$1.25 each) which, with slight modification, works well with this device. Instructions included. **CAT# MSC-5** \$3.00 each

## 4 AAA RECHARGEABLE BATTERY PACK (USED)

Battery pack with 4 AAA nickel-cadmium batteries in series to make a 4.8 volt pack. Batteries can be separated and reconfigured if desired. Terminated by 4 pin female connector (0.1" centers) on 4" leads. **CAT# NCB-43U** \$3.00 per pack



# ORDER TOLL FREE 1-800-826-5432

Call Or Write For A Free 64 Page Catalog Outside the U.S.A. send \$2.00 postage.

FAX (818) 781-2653 • INFORMATION (818) 904-0524

Minimum Order \$10.00 • All Orders Can Be Charged To Visa, Mastercard Or Discover Card • Checks and Money Orders Accepted By Mail • California, Add Sales Tax • No C.O.D. • Shipping And Handling \$3.50 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.

DISCOVER

VISA

MasterCard

MAIL ORDERS TO: ALL ELECTRONICS CORP • P.O. BOX 567 • VAN NUYS, CA 91408



# HOT! NEW!

- DESCRAMBLERS
- CONVERTERS
- COMBINATION UNITS

**SCIENTIFIC ATLANTA 8590**  
*Features*  
 • Wireless Remote Control  
 • Favorite Channel Recall  
 • Parental Lockout  
 • Volume Control

**BRAND NEW  
1 YEAR  
WARRANTY**



**\$259<sup>00</sup>** 6-10 **\$275** 1-5

**SCIENTIFIC ATLANTA 8580**

*Features*  
 • Wireless Remote Control  
 • Favorite Channel Recall  
 • Parental Lockout

**BRAND NEW  
1 YEAR  
WARRANTY**



**\$199<sup>00</sup>** 6-10 **\$225** 1-5

**WE'LL BEAT ANY PRICE!**

**ADD ON DESCRAMBLERS**

|                  | 1-5   | 6-10  |
|------------------|-------|-------|
| FTB-3            | 49.00 | 39.00 |
| TVT OR TBI       | 55.00 | 47.00 |
| SA -3            | 59.00 | 49.00 |
| KN12-3           | 59.00 | 49.00 |
| P IO-3 OR PIO-3+ | 59.00 | 47.00 |
| MLD1200-3        | 49.00 | 39.00 |



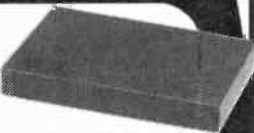
**CONVERTERS**

|                 | 1-5   | 6-10  |
|-----------------|-------|-------|
| PANASONIC 1453G | 75.00 | 65.00 |
| JERROLD DQN7-3  | 75.00 | 65.00 |
| JERROLD 400     | 49.00 | 39.00 |



**LATEST DESCRAMBLER MODELS**

Add On Descrambler for all JERROLD Systems (Except Base Band) Guaranteed to Work Anywhere Coast to Coast. (Model JD-3) **\$125** 6-10 **\$159** 1-5



Add On Descrambler For All PIONEER Systems. Guaranteed to Work Anywhere Coast to Coast. (Model PD-3) **\$125** 6-10 **\$159** 1-5

Add On Descrambler For All SCIENTIFIC ATLANTA Systems (Except 8570, 8590, 8600). Guaranteed to Work Anywhere Coast to Coast. (Model SAD-3) **\$89** 6-10 **\$119** 1-5



1470 OLD COUNTRY ROAD,  
SUITE 315 - P.E.  
PLAINVIEW, NY 11803  
NO NY SALES

**FREE COLOR CATALOG!**  
**1-800-950-9145**

# Popular Electronics®

# ANNUAL INDEX 1992 VOLUME 9

The Magazine for the Electronics Activist!

© Gemsback Publications, Inc.

Abbreviations: (AR)Antique Radio, (C)Construction, (CB)Computer Bits, (CC)Circuit Circus, (D)Department, (DX)DX Listening, (ED)Editorial (FS)Fun Software, (HOR)Hands-On Reports, (HR)Ham Radio, (G)Gizmo (LTR)Letters, (PTR)Product Test Report, (SS)Scanner Scene, (TT)Think Tank

3x3 Visual Continuity Tester (Hampton)(C) Feb 53  
555-Based Alarm (Rakes)(CC) Feb 65  
555 and Alarm Circuits, More (Yacono)(TT) Oct 72  
Finale (Yacono)(TT) Nov 75  
Timer, The (Yacono)(TT) Sep 73  
300-MHz Digital Cordless Telephone Tropez 900 DX (O'Brian and Scaduto)(G) Jul 8

## A

ABC Sports Golf: Palm Springs Open Fathom Pictures (O'Brian and Scaduto)(G) Feb 11  
AC Line Monitor (Rakes)(CC) Jul 70  
AM/FM/Shortwave Stereo Cassette Receiver Philips DC777 (O'Brian and Scaduto)(G) Jun 14  
ASAP Fax Command Communications (O'Brian and Scaduto)(G) Aug 20  
A/V Amplifier, Sansui AV-7000 (Feldman)(PTR) May 27  
Receiver, Onkyo SV70 Pro (Feldman)(PTR) Jan 73  
Ace Communications AR-2800 Scanner (Saxon)(SS) Mar 82  
Trident CB/Scanner/Radar Detector (Saxon)(SS) Dec 80  
Action-Packed Issue, An (Laron)(ED) Jan 2  
Adjustable Voltage Monitor (Rakes)(CC) Sep 70  
Voltage Current Regulator (Rakes)(CC) Mar 70  
Air Traffic on SW (Jensen)(DX) Feb 74  
Alarm Circuit (Yacono)(TT) Nov 75  
Clocks (Rakes)(CC) Jan 78  
Circuit/Chronometer Kit, TSM 6-Digit (HOR) Jul 26  
/Sounder Circuits (Rakes)(CC) Feb 65  
Alexander Popov: Russia's Radio Pioneer (Rybak) Aug 59

ALL ABOUT Electrical Noise (Eggleston) Jul 62  
Military Electronics (Hansen) Aug 47  
Optoisolators and Optocouplers (Carr) Oct 53  
Parallel-Port Signals (Yacono) Jan 38  
Proper Input Termination (Hansen) Feb 58  
All-Purpose Insulation (Yacono)(TT) Jun 70  
Alpine 5951 Car CD Remote Changer System (O'Brian and Scaduto)(G) Jun 12  
Alternate Sensor (Rakes)(CC) Feb 65  
America Power Conversion Back-UPS 250 (HOR) Sep 26

Ameritron ICP-120 In-Rush Current Protector (Carr)(HR) Aug 79  
ICP-240 In-Rush Current Protector (Carr)(HR) Aug 79  
QSK-5 External QSK Switch (Carr)(HR) Aug 79  
Answering System Telephone AT&T 1532 (O'Brian and Scaduto)(G) Aug 13  
ANTENNA Build A Precision Antenna-Rotor Control System (Hocking)(C) Jun 34  
Design and Build Loaded Dipoles (Carr)(HR) Mar 80  
Dipoles, Loaded: Design and Build (Carr)(HR) Mar 80  
For DX'ing the Low Bands, An (Carr)(HR) Nov 78  
Quick & Dirty Qued, A (Deupree)(C) Sep 48  
Radio Shack Amplified VHF/UHF/FM (Saxon)(SS) Jun 76  
Receiving Loop (Carr)(HR) Jun 74  
-Rotor Control System, Build A Precision (Hocking)(C) Jun 34  
Why Not Try A Folded Dipole? (Carr)(HR) Jan 87  
Wire Beams: Gain On The Cheap (Carr) May 45

ANTIQUÉ RADIO (Ellis)(D) Jan 76, Feb 63, Mar 68  
Apr 65, May 66, Jun 63  
Jul 66, Aug 68, Sep 66  
Oct 65, Nov 65, Dec 64  
Cleaning Up the Sky Buddy Collectors Contest Encore Coming: A New Restoration Project Getting Started on the Sky Buddy Oct 65  
Jun 66  
Apr 65  
Apr 65  
Jun 63

Housekeep Before You Troubleshoot! Mail Call Mar 68  
Mail Call Mar 68  
Reassembling the Sky Buddy Sky Buddy Saga, The Therman Plays Again, The Tips and Tidbits With The Collectors Contest Results Sep 66  
Aug 68  
Mar 68  
Dec 64  
May 66  
Jan 76  
Nov 65  
Feb 63

Archer Wireless Audio/Video Distribution System Radio Shack (O'Brian and Scaduto)(G) Jan 45  
Artisoft Lantastic Network Starter Kit Aug 12  
AT&T Answering System Telephone 1532 (O'Brian and Scaduto)(G) Aug 13  
Audible Memo Alert (Rakes)(CC) Sep 70

AUDIO (SEE ALSO CD) Ace Communications' Trident CB/Scanner/Radar Detector (Saxon)(SS) Dec 80  
Alarm (Yacono)(TT) Feb 68  
Amplifier (Rakes)(CC) Jul 70  
AudioSource SS Three/II Pro-Logic Surround-Sound Processor (O'Brian and Scaduto)(G) Oct 18  
Audio-Technica SM-502 Audio Mixer (Feldman)(PTR) Dec 26  
Bang & Olufsen Beosystem 2500 Music System (Feldman)(PTR) Mar 23  
Bass and Treble Booster Controls (Singmin)(C) Apr 34

Build A 49-MHz FM Transmitter (Becker)(C) Nov 39  
A Speaker Protector (Flynn)(C) Mar 41  
An Eight-Channel Audio Switcher (Goebel)(C) Dec 31  
the "Tiny Tuner" (Salas)(C) Jun 45  
Carver DPL-33 Surround-Sound Processor/Amplifier (Feldman)(PTR) Jul 27  
Choosing and Using Audio and Video Tape (Spiwak) Nov 35  
Citizen T530 Color LCD Pocket TV with AM/FM Radio (O'Brian and Scaduto)(G) Jul 16  
Cobra Model 39 Plus S.O.S Portable CB Radio (O'Brian and Scaduto)(G) Jan 47  
-Frequency Meter (Rakes)(CC) Apr 66

How to Choose Audio Equipment (Spiwak) Apr 35  
Electronically Tune Pianos and Other Instruments (Brown)(C) Feb 29  
Indicators and Acoustics (Martin) May 56  
Installing and Troubleshooting Car-Audio Systems (Gipson) Dec 35  
Magnavox CD-ROM Drive/CD Player Model GDD461RS (O'Brian and Scaduto)(G) Feb 18  
Mazda RX-7 with Bose Audio System (O'Brian and Scaduto)(G) Sep 5  
Memorex CDX-605 Extended-Play Personal Stereo (O'Brian and Scaduto)(G) May 18  
Triumph TS-5 Three-Piece Speaker System (O'Brian and Scaduto)(G) Mar 5  
Onkyo SV70 Pro Audio/Video Receiver (Feldman)(PTR) Jan 73  
PA-System Primer, A (Allen) Feb 55  
Philips DC777 AM/FM/Shortwave Stereo Cassette Receiver (O'Brian and Scaduto)(G) Jun 14  
Power Amplifier (Rakes)(CC) Apr 66  
Radio Shack Archer Wireless A/V Distribution System (O'Brian and Scaduto)(G) Jan 45  
Ramsey FX-146 Two-Meter FM Transceiver Kit (Kanter) Dec 39  
Sansui Audio Note A-4 Notebook Stereo (O'Brian and Scaduto)(G) Jul 10  
Model AV-7000 A/V Amplifier (Feldman)(PTR) May 27  
Sanyo MCD-Z85 Portable Audio System (O'Brian and Scaduto)(G) Dec 12  
Sharp Bookshelf Stereo System/CD Changer Model CD-C900 (O'Brian and Scaduto)(G) Apr 16  
Sherwood SS-1500 Compact Stereo System (O'Brian and Scaduto)(G) Mar 6  
Sony MDP-605 CD/CDVLP Player (Feldman)(PTR) Oct 27  
Sound Master II PC Sound Board Covox (O'Brian and Scaduto)(G) Jan 49  
Subwoofer, Build A (Whitehead)(C) Jan 31

Technics RS-BX606 Stereo Cassette Deck (Feldman)(PTR) Sep 27  
Videonics Boing Box Sound-Effects Mixer (O'Brian and Scaduto)(G) Mar 8  
Zenith-Base Color TV Model ZB2794BG (O'Brian and Scaduto)(G) May 10  
AudioSource SS Three/II Pro-Logic Surround-Sound Processor (O'Brian and Scaduto)(G) Oct 18  
Audio-Technica SM-502 Audio Mixer (Feldman)(PTR) Dec 26  
AutoMap (O'Brian and Scaduto)(G) Nov 5

## AUTOMOTIVE

Alpine 5951 Car CD Remote Changer System (O'Brian and Scaduto)(G) Jun 12  
Blaupunkt Travelpilot Vehicle Navigation System (O'Brian and Scaduto)(G) Jun 7  
High-Energy Ignition System For Your Car (Ball)(C) Sep 31, (LET) Dec 3  
Voltage Adapter For Your Car (Yacono)(C) Jun 47  
Circuits, More (Yacono)(TT) Apr 70  
Cobra Trapshooter Solar Stealth Radar Detector (O'Brian and Scaduto)(G) Jun 18  
Electronic Tracking Foils Car Theives (Angus) Mar 57  
Installing and Troubleshooting Car-Audio Systems (Gipson) Dec 35  
Mazda RX-7 with Bose Audio System (O'Brian and Scaduto)(G) Sep 5  
Philips DC777 AM/FM/Shortwave Stereo Cassette Receiver (O'Brian and Scaduto)(G) Jun 14  
Projects (Yacono)(TT) Mar 73  
Race Remote Key Car-Control System (O'Brian and Scaduto)(G) Jun 10  
Road to Tomorrow, The (O'Brian and Scaduto)(G) Jun 5  
Access Touch-Screen Personal Organizer Oregon Scientific (O'Brian and Scaduto)(G) Sep 15

## B

Baby Monitor, Build A (Caristi)(C) Oct 31  
Back-UPS 250, America Power Conversion (HOR) Sep 26  
Bad Videotapes (Feldman) Nov 31  
Balun Transformer, Whats A (Carr)(HR) Feb 76  
Bandpass Filter (Rakes)(CC) Jun 67  
Bang & Olufsen Beosystem 2500 Music System (Feldman)(PTR) Mar 23  
Bass and Treble Booster Controls (Singmin)(C) Apr 34  
BATTERY Charger (Yacono)(TT) Apr 70  
-Charger Probe (Yacono)(TT) Mar 73  
Clips (Yacono)(TT) Jun 70  
Super-Simple NiCd-Battery Rejuvenator (Blechman)(C) Sep 63  
Beckman DM10XL Multimeter (HOR) Oct 22  
Big League Baseball Encyclopedia Franklin Electronics (O'Brian and Scaduto)(G) Nov 16  
Bit of Mediterranean DX, A (Jensen)(DX) Apr 74  
Blaupunkt Travelpilot Vehicle Navigation System (O'Brian and Scaduto)(G) Jun 7  
Block-Heater Minder (Yacono)(TT) Mar 73  
Boing Box Sound Effects Mixer Videonics (O'Brian and Scaduto)(G) Mar 8  
Booster Controls, Bass and Treble (Singmin)(C) Apr 34  
Bose Mazda FX-7 Audio System (O'Brian and Scaduto)(G) Sep 5  
Brazilian DX on a Rollercoaster Ride (Jensen)(DX) Jun 72  
Breakout Box, Build A (Yacono)(C) May 61  
Bridging Touch-Plate Sensor (Rakes)(CC) Aug 72  
Britannica Software's Compton's Concise Encyclopedia (O'Brian and Scaduto)(G) Feb 13  
British Boston's Interpreter II Five-Language Talking Translator (O'Brian and Scaduto)(G) Sep 13  
BUILD A/AN/THE (SEE CONSTRUCTION)

**C**

|  |   |  |   |  |   |
|--|---|--|---|--|---|
| CB Radio<br>Cobra Model 39 Plus S.O.S.<br>(O'Brian and Scaduto)(G)               | Jan 47  | All About Parallel-Port Signals (Yacono)   | Jan 38  | Holograms (Iovine)(C)  | Aug 31, Sep 43  |
| <b>CD</b><br>Alpine 5951 Remote Changer<br>System (O'Brian and Scaduto)(G)       | Jun 12  | Ameca Power Conversion<br>Back-UPS 250 (HOR)   | Sep 26  | Negative Ion Generator (Iovine)(C)                                     | Jan 29  |
| EuroSon America NSM CD3101 100-Disc<br>CD Changer (O'Brian and Scaduto)(G)       | Dec 5   | Artisoft Lantastic Network<br>Starter Kit (O'Brian and Scaduto)(G)                       | Aug 12  | PC-Based Stepper-Motor Controller<br>(Antonuk)(C)                      | Jun 41  |
| Gefen Systems CD Sound<br>Music Manager Software<br>(O'Brian and Scaduto)(G)     | Dec 5   | Build<br>a Quickie Breakout Box (Yacono)(C)  | May 61  | Protect Your Equipment With The<br>Power Block (Yacono)(C)             | Feb 37  |
| Sharp Model CD-C900 CD Changer<br>Bookshelf Stereo (O'Brian and Scaduto)(G)      | Apr 16  | the Printer Sentry (Yacono)(C)   | Mar 59  | Quick & Dirty Quad, A (Deupree)(C)                                     | Sep 48  |
| <b>CD-I Player Model CD1910</b><br>Philips (O'Brian and Scaduto)(G)              | Feb 11  | the Universal RS-232 Connector<br>(Tarchinski)(C)  | Oct 62  | Simple Remote-Control Analyzer,<br>A (Yacono and Spiwak)(C)            | Jun 38  |
| <b>CD-ROM</b><br>DeLorome Mapping's Street Atlas<br>USA (O'Brian and Scaduto)(G) | Nov 5   | Covox Sound Master II<br>PC Sound Board (O'Brian and Scaduto)(G)                         | Jan 49  | Super-Simple NiCd-Battery<br>Rejuvenator (Blechman)(C)                 | Sep 63  |
| Grolier Electronic Encyclopedia<br>The New (O'Brian and Scaduto)(G)              | Feb 18  | DynaPulse 200M Blood-Pressure Pulse<br>Monitor, Pulse Metric<br>(O'Brian and Scaduto)(G) | Sep 20  | Telephone Ring Converter, The (Poeth)(C)                               | Apr 38  |
| Magnavox CD-ROM Drive/CD Player Model<br>CCD461RS (O'Brian and Scaduto)(G)       | Feb 18  | Logitech Fotoman Digital<br>Camera (O'Brian and Scaduto)(G)                              | Jul 18  | Consumer Alert (Laron)(ED)   | Nov 2   |
| Microsoft Bookshelf (O'Brian and Scaduto)(G)                                     | Feb 18  | NEC Ultralite III Notebook Computer<br>(O'Brian and Scaduto)(G)                          | Apr 12  | <b>CONSUMER ELECTRONICS (SEE ALSO GIZMO,<br/>PRODUCT TEST REPORTS)</b> |   |
| PC Globe Electronic Atlas<br>(O'Brian and Scaduto)(G)                            | Feb 18  | PC-Interlink File and Printer Sharing<br>System, Softworx (O'Brian and Scaduto)(G)       | Aug 21  | Bad Videotapes (Feldman)   | Nov 31  |
| PC-SIG Library (O'Brian and Scaduto)(G)  | Feb 18  | Plug'n Power Computer Interface<br>Radio Shack (O'Brian and Scaduto)(G)                  | May 16  | Choosing and Using Audio<br>and Video Tape (Spiwak)                    | Nov 35  |
| <b>CDTV Interactive Multimedia Player</b><br>Commodore (O'Brian and Scaduto)(G)  | Feb 9   | Printer Spooling—Hardware<br>and Software (Blechman)                                     | Aug 40  | <b>CONSUMER ELECTRONICS SHOW</b>                                       |   |
| <b>CABLE</b><br>Rack (Yacono)(TT)  | Jun 70  | Troubleshooting Parallel Connections (Yacono)  | Feb 41  | Summer (O'Brian and Scaduto)(G)  | Oct 5   |
| Tester, Build A (Recklies)(C)  | Apr 53  | <b>COMPUTER BITS (Holtzman)(D)</b>   | Jan 81, Feb 72, Mar 76,<br>Apr 72, May 68, Jun 65,<br>Jul 68, Aug 71, Sep 68,<br>Oct 67, Nov 68, Dec 66 | Winter (O'Brian and Scaduto)(G)  | May 5   |
| <b>CAMCORDER</b><br>Canon  |   | Buying Your First (or Next) PC<br>Computer Evolution                                     | Aug 71<br>Sep 68  | Convenience Light for Remote Controls<br>(Spiwak)(C)                   | Aug 37  |
| E40 8mm (Feldman)(PTR)   | Feb 22  | Integrated Software Tools<br>Modem Mania   | Oct 67<br>Mar 76  | Cool Oldies Jukebox, PIMA<br>(O'Brian and Scaduto)(G)                  | Feb 11  |
| Canovision 8 UCS1 High-Band 8mm<br>(O'Brian and Scaduto)(G)                      | Apr 6   | <b>Norton</b>  |   | Cop Talk: Understanding Police<br>Communications (Cuarrantiello)       | Jan 61  |
| JVC GR-AX50U Compact VHS<br>(O'Brian and Scaduto)(G)                             | Sep 6   | Desktop for Windows<br>Utilities Version 6.0   | Feb 72<br>Jan 81  | Cordless-Telephone Lock,<br>Build A (Sokolowski)(C)                    | Jul 44, (LET) Oct 3   |
| Sony   |   | Secret Life of a Computer Products<br>Reviewer, The                                      | Jun 65<br>Jul 68  | Courier Procom UHF-FM Transceiver (Saxon)(SS)                          | Sep 80  |
| CCD-F501 (O'Brian and Scaduto)(G)  | Jan 50  | Sizing Up Your PC Needs<br>Tuning Up   | Jun 68<br>May 68  | Covox Sound Master II PC Sound<br>Board (O'Brian and Scaduto)(G)       | Jan 49  |
| CCD-FX510 8mm (O'Brian and Scaduto)(G)   | Oct 17  | <b>Word</b>  |   | Create a High-Voltage Miniature<br>Tornado (Ford)(C)                   | May 55  |
| Canaries, The Incredible Hot (Clarke)(C)   | Jan 42  | BASIC  | Nov 68  | Cross-Reference Software, Philips ECG (HOR)                            | Dec 62  |
| <b>Canon</b>   |   | BASIC II   | Dec 66  | Current Injector, One Amp (Johnson)(C)                                 | Nov 46  |
| 8mm Camcorder, Canovision 8 UCS1<br>High-Band (O'Brian and Scaduto)(G)           | Apr 6   | Wizardry   | Apr 72  |  |   |
| E40 8mm Video Camcorder (Feldman)(PTR)   | Feb 22  | Concise Columbia Encyclopedia EC-7000  | Mar 12  | <b>D</b>   |   |
| Capacitor-Discharge Driver (Rakes)(CC)   | Nov 72  | Franklin Electronics (O'Brian and Scaduto)(G)  | Mar 12  | dB or Not dB (Honeycutt)   | Aug 65  |
| Car Alarm (Yacono)(TT)   | Oct 72  | <b>CONSTRUCTION</b>  |   | DC Motor Controller (Rakes)(CC)  | Mar 70  |
| Car-Audio Systems, Installing and<br>Troubleshooting (Gipson)                    | Dec 35  | 3 x 3 Visual Continuity Tester (Hampton)(C)  | Feb 53  | DIT Telephone Security Device,<br>Phone Guard (O'Brian and Scaduto)(G) | Jul 8   |
| Carver DPL-33 Surround-Sound<br>Processor/Amplifier (Feldman)(PTR)               | Jul 27  | Bass and Treble Booster Controls (Singmin)(C)  | Apr 34  | DX LISTENING (Jensen)(D)   | Jan 85, Feb 74, Mar 78,<br>Apr 74, May 78, Jun 72,<br>Jul 75, Aug 77, Sep 76,<br>Oct 75, Nov 80, Dec 76 |
| Changing Face of Russian DX, The (Jensen)(DX)                                    | Mar 78  | <b>Build A</b>   |   | Air Traffic on SW  | Feb 74  |
| Choosing and Using Audio and Video Tape<br>(Spiwak)                              | Nov 35  | 49-MHz FM Transmitter (Becker)(C)  | Nov 39  | Bit of Mediterranean DX, A   | Apr 74  |
| Circuit Grab Bag (Rakes)(CC)   | Jul 70  | Baby Monitor (Caristi)(C)  | Oct 31  | Brazilian DX on a Rollercoaster Ride                                   | Jun 72  |
| <b>CIRCUIT CIRCUS (Rakes)(D)</b>   | Jan 78, Feb 65, Mar 70,<br>Apr 66, May 73, Jun 67,<br>Jul 70, Aug 72, Sep 70,<br>Oct 69, Nov 72, Dec 68 | Breakout Box (Yacono)(C)   | May 61  | Changing Face of Russian DX, The                                       | Mar 78  |
| Alarm  |   | Cable Tester (Recklies)(C)   | Apr 53  | Exploring the Lower Shortwave Bands<br>Into The Mailbag                | Oct 75<br>Sep 76<br>Jul 75  |
| Circuits   | Jan 78  | Compass, Talking (Mitschke)(C)   | Dec 42  | Just "Chill" Out   | Jan 85  |
| Sounder Circuits   | Feb 65  | Cordless-Telephone Lock (Sokolowski)(C)  | Jul 44  | Programming For SWLs   | Jan 85  |
| Circuit Grab Bag   | Jul 70  | Geiger Counter (Iovine)(C)   | Jul 41  | Radio Polonia is Gone; Polish Radio is Back                            | Aug 77  |
| Electronics Potpourri  | Sep 70  | High-Energy Ignition System<br>For Your Car (Ball)(C)                                    | Sep 31, (LET) Dec 3   | Shortwave Revival, The   | Nov 80  |
| Experimenters' Test-Bench Helpers  | May 73  | Holiday-Light Tester (Yacono and Spiwak)(C)  | Dec 59  | United Nations Radio   | Dec 76  |
| Extended On-Time Timer   | Dec 68  | Low-Cost Morse-Code Transmitter (Lisle)(C)   | Aug 45  | WWW and WWWH Offer More Than You Think!                                | May 78  |
| Filter Circuits  | Jun 67  | Miniature Tracking Transmitter (Vollono)(C)  | Jun 29  |  |   |
| Fun With Tesla Coils   | Oct 69  | One-Amp Current Injector (Johnson)(C)  | Nov 46  |  |   |
| MC14538 Monostable Applications  | Dec 68  | Personal Message Recorder (Williams)(C)  | Oct 39  |  |   |
| <b>More</b>  |   | Pop-Up Outdoor Lighting<br>System (Schmiedeberg)(C)                                      | May 38  |  |   |
| High-Voltage Circuits  | Nov 72  | Portable 2-MHz Frequency Counter<br>(Caristi)(C)   | Jul 53  |  |   |
| Intruder-Detector Circuits   | Aug 72  | Precision Antenna-Rotor Control<br>System (Hocking)(C)                                   | Jun 34  |  |   |
| Op-Amp Based Circuits  | Apr 66  | Precision Darkroom Timer<br>(Graf and Sheets)(C)   | Aug 53  |  |   |
| Regulator Applications   | Mar 70  | Quickie Breakout Box (Yacono)(C)   | May 61  |  |   |
| Citizen T530 Color LCD Pocket TV<br>with AM-FM Radio (O'Brian and Scaduto)(G)    | Jul 16  | Soldering-Iron Controller<br>(Yacono and Spiwak)(C)                                      | May 53  |  |   |
| Classic Induction Coil, The (Czarnik)(C)   | Mar 35  | Sonic Kaleidoscope (Ray)(C)  | Oct 58  |  |   |
| Cleaning Up the Sky Buddy (Ellis)(AR)  | Oct 65  | Speaker Protector (Flynn)(C)   | Mar 41  |  |   |
| Closed-Loop Alarm (Rakes)(CC)  | Jan 78  | Subwoofer (Whitehead)(C)   | Jan 31  |  |   |
| <b>Cobra</b>   |   | Voice Disguiser (Vollono)(C)   | Dec 53  |  |   |
| Model 39 Plus S.O.S. Portable<br>CB Radio (O'Brian and Scaduto)(G)               | Jan 47  | Voice-Mail Alert (O'Kelley)(C)   | Nov 53  |  |   |
| Trapshooter Solar Stealth<br>Radar Detector (O'Brian and Scaduto)(G)             | Jun 18  | Voltage Adapter For Your Car (Yacono)(C)   | Nov 47  |  |   |
| Collectors Contest Encore (Ellis)(AR)  | Jul 66  | <b>Build An</b>  |   |  |   |
| Colorburst SV1000 Video Digitizer (HOR)  | Jun 22  | Automatic Porch-Light Control (Ponting)(C)   | Mar 46  |  |   |
| Coming: A New Restoration Project (Ellis)(AR)                                    | Apr 65  | Automatic Power Switch<br>For Your TV (Vaughn)(C)  | Nov 43  |  |   |
| Command Communications' ASAP Fax<br>(O'Brian and Scaduto)(G)                     | Aug 20  | Eight-Channel Audio Switcher, (Goebel)(C)  | Dec 31  |  |   |
| Commodore CDTV Interactive<br>Multimedia Player (O'Brian and Scaduto)(G)         | Feb 9   | Emergency Telephone Dialer (Caristi)(C)  | Sep 39  |  |   |
| Compass, Talking (Mitschke)(C)   | Dec 42  | <b>Build The</b>   |   |  |   |
| Compton's Concise Encyclopedia<br>Britannica Software (O'Brian and Scaduto)(G)   | Feb 13  | "Tiny Tuner" (Salas)(C)  | Jun 45  |  |   |
| <b>COMPUTER (SEE ALSO CD-ROM, COMPUTER BITS,<br/>HARDWARE, SOFTWARE)</b>         |   | Idiot Box (Head)(C)  | Sep 53  |  |   |
| ASAP Fax, Command<br>Communications (O'Brian and Scaduto)(G)                     | Aug 20  | Printer Sentry (Yacono)(C)   | Mar 59  |  |   |
|  |   | Universal RS-232 Connector (Tarchinski)(C)   | Oct 62  |  |   |
|  |   | Classic Induction Coil, The (Czarnik)(C)   | Mar 35  |  |   |
|  |   | Convenience Light for Remote<br>Controls (Spiwak)(C)                                     | Aug 37  |  |   |
|  |   | Create a High-Voltage Miniature<br>Tornado (Ford)(C)                                     | May 55  |  |   |
|  |   | Electric Waves and the Hertz<br>Oscillator (Czarnik)(C)                                  | Oct 45  |  |   |
|  |   | Electromagnetic Ring Launcher (Vollono)(C)   | Oct 42  |  |   |
|  |   | Enlarging Light Meter for Photographic<br>Printing, An (Graf and Sheets)(C)              | Apr 31  |  |   |
|  |   | Experiment With Plasma Acoustics (Iovine)(C)   | Oct 37  |  |   |
|  |   | Good Vibrations Printed-Circuit Board<br>Workstation (Yacono)(C)                         | Apr 62  |  |   |
|  |   | How To Electronically Tune Pianos<br>and Other Instruments (Brown)(C)                    | Feb 29  |  |   |
|  |   | Incredible Hot Canaries, The (Clarke)(C)   | Jan 42  |  |   |
|  |   | <b>Make Your Own</b>   |   |  |   |
|  |   | High-Voltage Capacitors (Charlton)(C)  | May 31  |  |   |



|  |                        |   |               |   |                        |
|--|------------------------|---|---------------|---|------------------------|
| Made in Japan  | May 2                  | AudioSource SS Three/II Pro-Logic Surround-Sound Processor                    | Oct 18        | Whistler Interstate Tripmate Highway Travel Planner               | Apr 10                 |
| Multimedia Madness   | Feb 2                  | Blaupunkt Travelpilot Vehicle Navigation System                               | Jun 7         | Zenith-Bose Color TV Model ZB2794BG                               | May 10                 |
| Old Gear, New Lives  | Oct 2                  | Bose Mazda RX-7 Audio System  | Sep 5         | <b>Global Positioning System</b>                                  |                        |
| Positioning Ourselves  | Jul 2                  | Britannica Software's Compton's Concise Encyclopedia                          | Feb 13        | GPS Navigation System, The (Fenton) GPS Receiver                  | Jul 31                 |
| Edmund Scientific Optivisor  |                        | British Boston's Interpreter II Five-Language Talking Translator              | Sep 13        | Sony Pyxis (O'Brian and Scaduto)(G)                               | Jul 5                  |
| Magnifying Glass (Carr)(HR)  | Aug 79                 | Canon 8mm Camcorder, Canovision 8 UCS1 High-Band                              | Apr 6         | Good Vibrations Printed-Circuit Board Workstation (Yacono)(C)     | Apr 62                 |
| Eight-Channel Audio Switcher (Goebel)(C)                                     | Dec 31                 | Citizen T530 Color LCD Pocket TV with AM-FM Radio                             | Jul 16        | Grand Piano Kit, The OWI (HOR)                                    | Jan 72                 |
| Electric Waves and the Hertz Oscillator (Czarnik)(C)                         | Oct 45                 | Cobra   |               | Grolier Electronic Encyclopedia, The New (O'Brian and Scaduto)(G) | Feb 9, Feb 18          |
| Electrical Noise, All About (Eggleston)                                      | Jul 62                 | Model 39 Plus S.O.S Portable CB Radio   | Jan 47        | Guglielmo Marconi (Rybak)   | Apr 43                 |
| Electricity and Medicine in the 19th Century (Czarnik)                       | Sep 58                 | Trapshooter Solar Stealth Radar Detector                                      | Jun 18        |   |                        |
| <b>Electromagnetics</b>  |                        | Command Communications' ASAP Fax Commodore CDTV Interactive Multimedia Player | Aug 20        |   |                        |
| Electromagnetic Ring Launcher (Vollono)(C)                                   | Oct 42                 | Consumer Electronics Show   | Feb 9         | HDTV Update (Laron)(ED)   | Mar 2                  |
| David Hughes: Electromagnetic Pioneer (Rybak)                                | Nov 60                 | Summer 1992   | Oct 5         | <b>HAM RADIO (Carr)(D)</b>  | Jan 87, Feb 76, Mar 80 |
| Electronic Tracking Foils  |                        | Winter 1992   | May 5         | Apr 76, May 76, Jun 74  | Jul 77, Aug 79, Sep 78 |
| Car Thieves (Angus)  | Mar 57, (LET) Jul 3    | Covox Sound Master II PC Sound Board  | Jan 49        | Oct 78, Nov 78, Dec 77  | Nov 78                 |
| Electronically Tune Planos and Other Instruments, How To (Brown)(C)          | Feb 29                 | DeLorme Mapping's Street Atlas USA  | Nov 5         | Design and Build Loaded Dipoles                                   | Mar 80                 |
| <b>ELECTRONICS LIBRARY (D)</b>   | Jan 6, Feb 80, Mar 84  | DIT Telephone Security Device, Phone Guard                                    | Jul 8         | Digital Sawtooth Generator, The                                   | May 76                 |
|  | Apr 80, May 82, Jun 78 | EuroSon America's NSM CD3101 100-Disc CD Changer                              | Dec 5         | Ol' Sol—Friend or Foe   | Jul 77                 |
|  | Jul 82, Aug 84, Sep 82 | Fathom Pictures' ABC Sports Golf: Palm Springs Open                           | Feb 11        | Receiving Loop Antennas   | Jun 74                 |
|  | Oct 83, Nov 84, Dec 82 | Franklin Electronics  |               | Some  |                        |
| <b>ELECTRONICS</b>   |                        | Big League Baseball Encyclopedia  | Nov 16        | More Spectrum Analyzer Stuff                                      | Oct 78                 |
| and the Automobilia (Laron)(ED)  | Jun 2                  | Concise Columbia Encyclopedia   | Mar 12        | New Products and Some Questions Answered                          | Aug 79                 |
| Potpourri (Rakes)(CC)  | Sep 70                 | Funex's Motion-Converter Exercise-Gear Interface                              | Jan 46        | Thoughts on Radio Propagation                                     | Apr 76                 |
| Technicians Day (Steckler)   | Apr 40                 | Gelen Systems' CD Sound Music Manager Software                                | Dec 5         | Tools for Elmers and Emees  | Sep 78                 |
| Elenco Micro-Master MM-8000 Basic Systems Course (HOR)                       | Aug 26                 | Grolier Electronic Encyclopedia, The New                                      | Feb 5, Feb 18 | What's A Balun Transformer?                                       | May 76                 |
| Emergency Telephone Dialer, Build An (Caristi)(C)                            | Sep 39                 | Home-Office Round-Up (O'Brian and Scaduto)(G)                                 | Aug 5         | Why Not Try A Folded Dipole?                                      | Jul 77                 |
| End of a Legend, The (Laron)(ED)   | Aug 2                  | Instant Replay's Image Translator   | Nov 12        | Handheld That Won't Break the Bank, A (Saxon)(SS)                 | Aug 82                 |
| Enlarging Light Meter for Photographic Printing, An (Graf and Sheets)(C)     | Apr 31                 | Standards Converting VCR  | Nov 12        | <b>HANDS-ON REPORT (D)</b>  | Jan 72, Feb 61, Mar 65 |
| Etch Your Own PC Boards (Young)  | Jan 68                 | JVC GR-AX50U Compact VHS Camcorder  | Sep 6         | Apr 28, May 22, Jun 22  | Jul 26, Aug 26, Sep 26 |
| EuroSon America's NSM CD3101 100-Disc CD Changer (O'Brian and Scaduto)(G)    | Dec 5                  | Logitech Fotoman Digital Camera for Computers                                 | Jul 18        | Oct 22, Nov 22, Dec 62  | Dec 62                 |
| Experiment With Plasma Acoustics (Iovine)(C)                                 | Oct 37                 | Magnavox's CD-ROM Drive/CD Player Model CDD461RS                              | Feb 18        | America Power Conversion Back-UPS 250                             | Sep 26                 |
| Experimenter's Test-Bench Helpers (Rakes)(CC)                                | May 73                 | Mazda RX-7 with Bose Audio System   | Sep 5         | Beckman DM10XL Multimeter   | Oct 22                 |
| Exit Delay (Rakes)(CC)   | Aug 72                 | Memorex   |               | Colorburst SV1000 Video Digitizer                                 | Jun 22                 |
| Exploring the Lower Shortwave Bands (Jensen)(DX)                             | Oct 75                 | CDX-605 Extended-Play Personal Stereo   | May 18        | Elenco Micro-Master MM-8000 Basic Systems Course                  | Aug 26                 |
| Extended On-Time Timer (Rakes)(CC)   | Dec 68                 | Triumph TS-5 Three-Piece Speaker System                                       | Mar 5         | Fluke Series-10 Digital Multimeters                               | Apr 28                 |
|  |                        | Microsoft   |               | Heathkit IM-2410 Digital Frequency Counter                        | May 22                 |
|  |                        | Bookshelf   | Feb 18        | Mental Automation SuperCAD Electronics Design Software            | Mar 72                 |
| <b>FACTCARDS (D)</b>   | Jan 51, Feb 49, Mar 53 | Multimedia Beethoven: The Ninth Symphony                                      | Feb 20        | OWI Grand Piano Kit, The  | Jan 65                 |
|  | Apr 49, May 49, Jun 48 | Multi-Link's SR2 Selective Ring Processor                                     | Aug 15        | Philips ECG Cross-Reference Software                              | Dec 62                 |
|  | Jul 49, Aug 49, Sep 49 | Multimedia Madnest (O'Brian and Scaduto)(G)                                   | Feb 5         | Protel Schematic Circuit-Design Software                          | Feb 61                 |
|  | Oct 49, Nov 49, Dec 49 | NEC Ultralite III Notebook Computer   | Apr 12        | TSM   |                        |
| Fathom Pictures' ABC Sports Golf: Palm Springs Open (O'Brian and Scaduto)(G) | Feb 11                 | Oregon Scientific Axxess Touch-Screen Personal Organizer                      | Sep 15        | Function-Generator Kit  | Nov 22                 |
| Filter Circuits (Rakes)(CC)  | Jun 67                 | Panasonic PT-10L Compact Video Projector                                      | Apr 5         | 6-Digit Alarm Clock/Chronometer Kit                               | Jul 26                 |
| Fluke Series-10 Digital Multimeters (HOR)                                    | Apr 28                 | PC Globe Electronic Atlas   | Nov 5         | <b>HARDWARE</b>   |                        |
| FM Transmitter, Build a 49-MHz (Becker)(C)                                   | Nov 39                 | PC-SIG Library  | Feb 18        | Buying Your First (or Next) PC (Holzman)(CB)                      | Aug 71                 |
| Folded Dipole, Why Not Try A? (Carr)(HR)                                     | Jan 87                 | Philips   |               | Elenco Micro-Master MM-8000 Basic Systems Course (HOR)            | Aug 26                 |
| Fotoman Digital Camera for Computers   |                        | CD-1 Player, Model CD1910   | Feb 11        | America Power Conversion Back-UPS 250 (HOR)                       | Sep 26                 |
| Logitech (O'Brian and Scaduto)(G)  | Jul 18                 | DC777 AM/FM/Shortwave Stereo Cassette Receiver                                | Jun 14        | Hayes Microcomputer Products, Optima 96 (Holzman)(CB)             | Mar 76                 |
| <b>Franklin Electronics</b>  |                        | PIMA Cool Oldies Jukebox  | Feb 11        | Headlights Reminder (Yacono)(TT)                                  | Mar 73                 |
| Big League Baseball Encyclopedia (O'Brian and Scaduto)(G)                    | Nov 16                 | Psygnosis' Lemmings   | Feb 9         | Heathkit IM-2410 Digital Frequency Counter (HOR)                  | May 22                 |
| Concise Columbia Encyclopedia (O'Brian and Scaduto)(G)                       | Mar 12                 | Pulse Metric's DynaPulse 200M Blood-Pressure/Pulse Monitor                    | Sep 20        | Hertz Oscillator, The, and Electric Waves (Czarnik)(C)            | Oct 45                 |
| Frequency Counter, Portable 2-MHz (Caristi)(C)                               | Jul 53                 | Race's Remote Key Car-Control System  | Jun 10        | High-Energy Ignition System For Your Car (Ball)(C)                | Sep 31, (LET) Dec 3    |
| Fridge Alarm (Yacono)(TT)  | Nov 75                 | Radio Shack   |               | High-Power Alarm Driver (Rakes)(CC)                               | Jan 78                 |
| Fun Software (Blechman)(D)   | Jan 83                 | Archer Wireless A/V Distribution System                                       | Jan 45        | <b>High-Voltage</b>   |                        |
| Real REC. A  | Jan 83                 | Deskmate Automatic House Software   | May 16        | Capacitors  |                        |
| <b>Fun With</b>  |                        | Duofone Outgoing Call Restrictor  | Mar 13        | Make Your Own (Chariton)(C)                                       | May 31, (LET) Aug 3    |
| Analog Tachometer Circuits (Carr)  | Jul 59                 | Plug'n'Power Computer Interface   | May 16        | Circuits, More (Rakes)(CC)  | Nov 72                 |
| Op-Amps (Yacono)(TT)   | Jan 22                 | Pocketvision-26 LCD Color TV  | Apr 8         | Miniature Tornado, Build A (Ford)(C)                              | May 55                 |
| Tesla Coils (Rakes)(CC)  | Oct 69                 | <b>Road to Tomorrow, The</b>  | Jun 3         | <b>HISTORY</b>  |                        |
| Funai TVCP 9T 9-Inch TV/Video Cassette Player (Feldman)(PTR)                 | Nov 27                 | Rolodex Personal Planner Model EO-100   | Oct 20        | Alexander Popov:  |                        |
| Function-Generator Kit, TSM (HOR)  | Nov 22                 | Sansui Audio Note A-4 Notebook Stereo   | Jul 10        | Russia's Radio Pioneer (Rybak)                                    | Aug 59                 |
| Funex's Motion-Converter Exercise-Gear Interface (O'Brian and Scaduto)(G)    | Jan 46                 | Sanyo   |               | David Hughes:   |                        |
|  |                        | MCD-Z85 Portable Audio System   | Dec 12        | Electromagnetic Pioneer (Rybak)                                   | Nov 60                 |
|  |                        | Pulse Meter HRM-5520 Heart-Rate Monitor                                       | Jan 48        | Electric Waves and the Hertz Oscillator (Czarnik)(C)              | Oct 45                 |
|  |                        | Sharp Bookshelf Stereo System/CD Changer Model CD-C900                        | Apr 16        | Electricity and Medicine in the 19th Century (Czarnik)            | Sep 58                 |
|  |                        | Sherwood SS-1500 Compact Stereo System  | Mar 6         | Guglielmo Marconi (Rybak)   | Apr 43                 |
|  |                        | Softworx PC Interlink File and Printer Sharing System                         | Aug 21        | Magnetic Light (Czarnik)  | Apr 57                 |
|  |                        | Sole Control Universal Replacement Remote Control                             | May 12        | Holiday-Light Tester (Yacono and Spiwak)(C)                       | Dec 59                 |
|  |                        | Sony  |               | Holograms, Make Your Own (Iovine)(C)                              | Aug 31, Sep 43         |
|  |                        | CCD-F501 Video Camcorder  | Jan 50        | <b>HOME CONTROL</b>   |                        |
|  |                        | CCD-FX510 8mm Camcorder   | Oct 17        | Radio Shack   |                        |
|  |                        | Data Discman Model DD1-EX   | Feb 13        | Deskmate Automatic House Software (O'Brian and Scaduto)(G)        | May 16                 |
|  |                        | EV-S3000 Hi8 VCR  | Dec 7         | Plug'n'Power Computer Interface (O'Brian and Scaduto)(G)          | May 16                 |
|  |                        | Pyxis GPS Receiver  | Jul 5         | One For All 4 Universal Remote Control (O'Brian and Scaduto)(G)   | Nov 20                 |
|  |                        | Tandy 2500SX/20 Multimedia PC   | Feb 20        | <b>HOME OFFICE</b>  |                        |
|  |                        | Tropez 900 DX Digital 900-MHz Cordless Telephone                              | Jul 8         | AT&T Answering System Telephone 1532 (O'Brian and Scaduto)(G)     | Aug 13                 |
|  |                        | Universal Electronics One For All 4 Home Control Remote Control               | Nov 20        | Artisoft Lantastic Network Starter Kit (O'Brian and Scaduto)(G)   | Aug 12                 |
|  |                        | Videonics   |               | ASAP Fax (O'Brian and Scaduto)(G)                                 | Aug 20                 |
|  |                        | Boing Box Sound-Effects Mixer   | Mar 8         |   |                        |
|  |                        | Video Titlemaker  | Sep 12        |   |                        |
|  |                        | VidiPax International Video Conversion Service                                | Nov 13        |   |                        |

Home-Office Round-Up (O'Brian and Scaduto)(G) Aug 5  
 Multi-Link SR2 Selective Ring Processor (O'Brian and Scaduto)(G) Aug 15  
 Softwax PC-Interlink File and Printer Sharing Sharing System (O'Brian and Scaduto)(G) Aug 21  
 Housekeep Before You Troubleshoot! (Ellis)(AR) Sep 66  
**How to**  
 Choose Audio Equipment (Spiwak) Electronically Tune Pianos and Other Instruments (Brown)(C) Feb 29  
 Hughes, David: Electromagnetic Pioneer (Rybak) Nov 60

**I**

**IR**  
 Decoder (Yacono)(TT) Jan 22  
 Op-Amp (Yacono)(TT) Jan 22  
**ISCRET Certification Tests**  
 Electronics Technicians Day (Steckler) Apr 40  
 Idiot Box, Build the (Head)(C) Sep 53  
**Ignition System For Your Car**, Build a High-Energy (Ball)(C) Sep 31  
**Image Translator Standards Converting VCR**, Instant Replay (O'Brian and Scaduto)(G) Nov 12  
 Importance of Perspective, The (Laron)(ED) Sep 2  
 Incredible Hot Canaries, The (Clarke)(C) Jan 42, (LET) Apr 3  
 Induction Coil, The Classic (Czarnik)(C) Mar 35  
 Input Termination, All About Proper (Hansen) Feb 58  
 In-Rush Current Limiter (Rakes)(CC) Mar 70  
**Installing and**  
 Maintaining Telephone Systems (Young) Nov 55  
 Troubleshooting Car-Audio Systems (Gipson) Dec 35  
**Instant Replay's Image Translator Standards Converting VCR** (O'Brian and Scaduto)(G) Nov 12  
**Integrated Software Tools** (Holtzman)(CB) Oct 67  
**Interpreter II Five-Language Talking Translator** British Boston (O'Brian and Scaduto)(G) Sep 13  
**Interstate Tripmate Highway Travel Planner Whistler** (O'Brian and Scaduto)(G) Apr 10  
**Into The Mailbag** (Jensen)(DX) Sep 76  
**Intruder-Detector Circuits, More** (Rakes)(CC) Aug 72  
**Intrusion-Indicator Circuit** (Yacono)(TT) Oct 72

**J**

JVC GR-AX50U Compact VHS Camcorder (O'Brian and Scaduto)(G) Sep 6  
 Just "Chill" Out (Jensen)(DX) Jul 75

**K**

Kaleidoscope, Sonic (Ray)(C) Oct 58  
 Kit Building Lives (Laron)(ED) Dec 2

**L**

LCD Technology (Katznelson) Jun 61  
 Lamp-Switching Circuit (Rakes)(CC) Dec 68  
**Lantastic Network Starter Kit** Artisoft (O'Brian and Scaduto)(G) Aug 12  
**Lemmings, Psynopsis Ltd.** (O'Brian and Scaduto)(G) Feb 9

**LETTERS (D)**  
 Apr 4, Feb 3, Mar 3  
 Apr 3, May 3, Jun 3  
 Jul 3, Aug 3, Sep 3  
 Oct 3, Nov 3, Dec 3

**Light**  
 -Dependent Sensor (Rakes)(CC) Aug 72  
 Sources For Projects and Instruments (Carr) Mar 49  
 Sources, Solid-Slate (Carr) Jun 31  
 Lights-On Reminder (Yacono)(TT) Apr 70  
 Logical Turn Signal (Yacono)(TT) Mar 73  
**Logitech Fotoman Digital Camera for Computers** (O'Brian and Scaduto)(G) Jul 18  
**Long-Period Monostable** (Yacono)(TT) Oct 72  
 Look at the Mailbag, A (Saxon)(SS) Feb 78  
 Low-Frequency Antenna (Carr)(HR) Nov 78  
 Low-Level Sounder (Rakes)(CC) Feb 65

**M**

MC14538 Monostable Applications (Rakes)(CC) Dec 68  
 Made In Japan (Laron)(ED) May 2  
**Magnavox's CD-ROM Drive/CD Player** Model CDD461RS (O'Brian and Scaduto)(G) Feb 18  
**Magnetic Light** (Czarnik) Apr 57  
**Mail Call** (Ellis)(AR) Aug 68  
**Mail Call!** (Ellis)(AR) Mar 68

**Make Your Own**  
 High-Voltage Capacitors (Charlton)(C) May 31, (LET) Aug 3  
 Holograms (Iovine)(C) Aug 31, Sep 43

Making the Connection (Carr) Dec 45  
 Marconi, Guglielmo (Rybak) Apr 43  
 Mazda RX-7 with Bose Audio System (O'Brian and Scaduto)(G) Sep 5  
 Medicine, and Electricity, in the 19th Century (Czarnik) Sep 58  
**Mediterranean DX, A Bit of** (Jensen)(DX) Apr 74

**Memorex**

CDX-605 Extended-Play Personal Stereo (O'Brian and Scaduto)(G) May 18  
 Model 87 Video Cassette Recorder (Feldman)(PTR) Apr 26  
 Model 153 8mm Camcorder (Feldman)(PTR) Aug 26  
**Triumph TS-5 Three-Piece Speaker System** (O'Brian and Scaduto)(G) Mar 5  
**Mental Automation SuperCAD Electronics Design Software** (HOR) Mar 65  
**Micro-Master MM-8000 Basic Systems Course, Elenco** (HOR) Aug 26  
**Microclips and More** (Yacono)(TT) May 70  
**Microphone Amplifier** (Rakes)(CC) Jul 70

**Microsoft**

Bookshelf (O'Brian and Scaduto)(G) Feb 18  
 Multimedia Beethoven (Holtzman)(CB) Aug 71  
 O'Brian and Scaduto)(G) Feb 20  
 Word for Windows 2.0 (Holtzman)(CB) Oct 67, Nov 68, Dec 66  
 Word for Windows (Holtzman)(CB) Apr 72  
**Military Electronics, All About** (Hansen) Aug 47  
**Miniature Tracking Transmitter, Build A** (Vollono)(C) Jun 29  
**Modern Mania** (Holtzman)(CB) Mar 76  
**Modified Squarewave Oscillator** (Rakes)(CC) Jul 70

**Monitoring**

Motion-Picture Sets (Saxon)(SS) Mar 82  
 Remote News Crews (Saxon)(SS) Dec 80  
**More**  
 558 and Alarm Circuits (Yacono)(TT) Oct 72  
 Automotive Circuits (Yacono)(TT) Apr 70  
 Fun With Op-Amps (Yacono)(TT) Feb 68  
 High-Voltage Circuits (Rakes)(CC) Nov 72  
 Intruder-Detector Circuits (Rakes)(CC) Aug 72  
 Tips (Yacono)(TT) Jun 70  
**Morse-Code Transmitter, Build A Low-Cost** (Lisle)(C) Aug 45  
**Motion-Converter Exercise-Gear Interface Funex** (O'Brian and Scaduto)(G) Jan 46

**Multi**

-Loop Parallel Alarm (Rakes)(CC) Jan 78  
 -Point Intrusion Detector (Yacono)(TT) Oct 72  
**Multi-Link's SR2 Selective Ring Processor** (O'Brian and Scaduto)(G) Aug 15

**MULTIMEDIA**

Britannica Software Compton's Concise Encyclopedia (O'Brian and Scaduto)(G) Feb 13  
 Commodore CDTV Interactive Multimedia Player (O'Brian and Scaduto)(G) Feb 9  
**Fathom Pictures ABC Sports Golf: Palm Springs Open** (O'Brian and Scaduto)(G) Feb 11  
**Madness** (Laron)(ED) Feb 2  
**Madness!** (O'Brian and Scaduto)(G) Feb 5  
**Magnavox CD-ROM Drive/CD Player** Model CDD461RS (O'Brian and Scaduto)(G) Feb 18  
**Microsoft**  
 Beethoven (Holtzman)(CB) Aug 71  
 Beethoven: The Ninth Symphony (O'Brian and Scaduto)(G) Feb 20  
**Philips CD-I Player** Model CD1910 (O'Brian and Scaduto)(G) Feb 11  
**Software Roundup** (O'Brian and Scaduto)(G) Mar 14  
**Tandy 2500 SX-20 PC** (O'Brian and Scaduto)(G) Feb 20  
**Multimeter, Beckman DM10XL** (HOR) Oct 22

**N**

NE602 Circuits One-Chip Receiver (Carr) Jun 53  
**NEC Ultralite III Notebook Computer** (O'Brian and Scaduto)(G) Apr 12  
**NSM CD3101 100-Disc CD Changer** EuroSon America (O'Brian and Scaduto)(G) Dec 5  
**Navigation System, The GPS** (Fenton) Jul 31  
**Negative Ion Generator** (Iovine)(C) Jan 29  
**New Kid on the Block** (Saxon)(SS) Jan 89  
**NEW PRODUCTS (D)**  
 Jan 14, Feb 86, Mar 88  
 Apr 83, May 85, Jun 81  
 Jul 84, Aug 86, Sep 88  
 Oct 85, Nov 86, Dec 85

NiCd-Battery Rejuvenator, Super-Simple (Blechman)(C) Sep 63  
**No-Doze Alarm** (Rakes)(CC) Dec 68  
**Non-Inverting Amplifier** (Yacono)(TT) Jan 22  
**Norton**  
 Desktop for Windows (Holtzman)(CB) Feb 72  
 Utilities Version 6.0 (Holtzman)(CB) Jan 81  
**Not Another Op-Amp Article!** (Dougherty) Dec 57  
**Notch Filter** (Rakes)(CC) Jun 67  
**Null-Modem Cable** (Yacono)(TT) Dec 72

**O**

Ol' Sol—Friend or Foe (Carr)(HR) Jul 77  
 Old Gear, New Lives (Laron)(ED) Oct 2  
**On-Delay Monostable** (Yacono)(TT) Oct 72  
**One-**  
 Chip Receiver Front-End, A (Carr) -Way Voice-Activated Intercom (Rakes)(CC) Jun 53  
 Apr 66  
**Onkyo SV70 Pro Audio/Video Receiver** (Feldman)(PTR) Jan 73  
**Op-Amp**  
 Article, Not Another (Dougherty) Based Circuits (Rakes)(CC) Dec 57  
 Apr 66  
**Op-Amps**  
 Fun With (Yacono)(TT) Jan 22  
 More Fun With (Yacono)(TT) Feb 68  
**Optima 96, Hayes Microcomputer Products** (Holtzman)(CB) Mar 76  
**Optoisolators and Optocouplers, All About** (Carr) Oct 53  
**Oregon Scientific Access Touch-Screen Personal Organizer** (O'Brian and Scaduto)(G) Sep 15  
**Oscilloscopes, Buyer's Guide to Low-Cost** (Spiwak) Jul 35  
**Outdoor Lighting System, Build A Pop-Up** (Schmiedeberg)(C) May 38, (LET) Aug 2  
**OWI Grand Piano Kit, The** (HOR) Jan 72

**P**

**PA-System Primer, A** (Allen) Feb 55  
**PC-**  
 Based Stepper-Motor Controller (Antonuk)(C) Jun 41, (LET) Sep 3  
**Board Workstation, The "Good Vibrations"** (Yacono)(C) Apr 62  
**Boards, Elch Your Own** (Young) Jan 68  
**Globe Electronic Atlas** (O'Brian and Scaduto)(G) Feb 18  
**Interlink File and Printer Sharing System** Softwax (O'Brian and Scaduto)(G) Aug 21  
**Nov 5**  
**Maps** (O'Brian and Scaduto)(G) Feb 18  
**SiGLibrary** (O'Brian and Scaduto)(G) Feb 18  
**Panasonic PT-10L Compact Video Projector** (O'Brian and Scaduto)(G) Apr 5  
**Parallel**  
 Connections, Troubleshooting (Yacono) -Loop Alarm (Rakes)(CC) Feb 41  
 -Port Signals, All About (Yacono) Jan 78  
 Jan 38  
**Personal**  
 Message Recorder, Build A (Williams)(C) Oct 39  
**Planner Model EO-100, Rolodex** (O'Brian and Scaduto)(G) Oct 20  
**Stereo, Memorex Extended Play** (O'Brian and Scaduto)(G) May 18  
**Philips**  
**CD-I Player**  
 Model CD1910 (O'Brian and Scaduto)(G) Feb 11  
**DC777 AM/FM/Shortwave Stereo Cassette Receiver** (O'Brian and Scaduto)(G) Jun 14  
**ECG Cross-Reference Software** (HOR) Dec 62

**PHONE (SEE ALSO TELEPHONE)**

Guard Telephone Security Device, DTI (O'Brian and Scaduto)(G) Jul 8  
 Line "Tester" (Yacono)(TT) Aug 75  
 -Line Interface (Yacono)(TT) Sep 73  
 -Use Indicator (Yacono)(TT) Sep 73

**PHOTOGRAPHY**

Build A Precision Darkroom Timer (Graf and Sheets)(C) Aug 53  
**An** (Graf and Sheets)(C) Apr 31  
**Logitech Fotoman Digital Camera for Computers** (O'Brian and Scaduto)(G) Jul 18  
**Plasma Acoustics, Experiment With** (Iovine)(C) Oct 37  
**Plug'n'Power Computer Interface** Radio Shack (O'Brian and Scaduto)(G) May 16  
**Polarity Indicator** (Yacono)(TT) Apr 70  
**Poor Man's Spectrum Analyzer** (Carr)(HR) Oct 78  
**Popov, Alexander: Russia's Light Pioneer** (Rybak) Aug 59  
**Porch-Light Control, Build An Automatic** (Ponting)(C) Mar 46  
**Positioning Ourselves** (Laron)(ED) Jul 2, (LET) Sep 3

**Power**

Block, Protect Your Equipment With The (Yacono)(C) Feb 37, (LET) May 3  
 Supply (Rakes)(CC) May 73  
 Switch For Your TV, Automatic (Vaughn)(C) Nov 43  
**Printer**  
 Sentry, Build the (Yacono)(C) Mar 59  
 Spooling—Hardware and Software (Blechman) Aug 40  
**PIMA Cool Oldies Jukebox** (O'Brian and Scaduto)(G) Feb 11  
**PRODUCT TEST REPORTS (Feldman)(D)**  
 Feb 22, Mar 23  
 Apr 26, May 27, Jun 26  
 Jul 27, Aug 26, Sep 27  
 Oct 27, Nov 27, Dec 26  
 Dec 26  
 Bang & Olufsen Beosystem 2500 Music System Mar 23  
 Canon E40 8mm Video Camcorder Feb 22

|   |                    |
|---|--------------------|
| Carver DPL-33 Surround-Sound Processor/Amplifier        | Jul 27             |
| Daewoo DVP-1060N Video Cassette Player                  | Jun 26             |
| Funai TVCP 9T 9-inch TV/Video Cassette Player           | Nov 27             |
| Memorex Model 87 Video Cassette Recorder                | Apr 26             |
| Model 153 8mm Camcorder                                 | Aug 28             |
| Onkyo SV70 Pro Audio/Video Receiver                     | Jan 73             |
| Sansui Model AV-7000 A/V Amplifier                      | May 27,(LET) Oct 3 |
| Sony MDP-605 CD/CD/VLP Player                           | Oct 27             |
| Technics RS-BX606 Stereo Cassette Deck                  | Sep 27             |
| Programming For SWLs (Jensen)(DX)                       | Jan 85             |
| Protect Your Equipment With The Power Block (Yacono)(C) | Feb 37,(LET) May 3 |
| Protel Schematic Circuit-Design Software (HOR)          | Feb 61             |
| Psychosis' Lemmings (O'Brian and Scaduto)(G)            | Feb 9              |

**Q**

|                                    |        |
|------------------------------------|--------|
| Quick & Dirty Quad, A (Deupree)(C) | Sep 48 |
|------------------------------------|--------|

**R**

|   |                |
|---|----------------|
| RS-232 Connector, Universal (Tarchinski)(C)                                       | Oct 62         |
| Race Remote Key Car-Control System (O'Brian and Scaduto)(G)                       | Jun 10         |
| <b>RADAR DETECTOR</b>   |                |
| Ace Communications' Trident CB/Scanner/Radar Detector (Saxon)(SS)                 | Dec 80         |
| Cobra Trapshooter Solar Stealth (O'Brian and Scaduto)(G)                          | Jun 18         |
| <b>RADIO (SEE ALSO ANTIQUE RADIO, DX LISTENING, HAM RADIO, SCANNER SCENE)</b>     |                |
| Ace Communications' Trident CB/Scanner/Radar Detector (Saxon)(SS)                 | Dec 80         |
| Build A Low-Cost Morse-Code Transmitter (Lisle)(C)                                | Aug 45         |
| 49-MHz FM Transmitter (Becker)(C)   | Nov 39         |
| Cobra Model 39 Plus S.O.S Portable CB Radio (O'Brian and Scaduto)(G)              | Jan 47         |
| Guglielmo Marconi (Rybak)   | Apr 43         |
| Making the Connection (Carr)  | Dec 45         |
| Phillips' DC777 AM/FM/Shortwave Stereo Cassette Receiver (O'Brian and Scaduto)(G) | Jun 14         |
| Radio Polonia is Gone; Polish Radio is Back (Jensen)(DX)                          | Aug 77         |
| Radio Propagation, Some Thoughts on (Carr)(HR)                                    | Apr 76         |
| <b>Radio Shack</b>  |                |
| Amplified VHF/UHF/FM Portable Antenna (Saxon)(SS)                                 | Jun 76         |
| Archer Wireless A/V Distribution System (O'Brian and Scaduto)(G)                  | Jan 45         |
| Deskmate Automatic House Software (O'Brian and Scaduto)(G)                        | May 16         |
| Duofone Outgoing Call Restrictor (O'Brian and Scaduto)(G)                         | Mar 13         |
| Plug'n'Power Computer Interface (O'Brian and Scaduto)(G)                          | May 16         |
| Pocketvision-26 LCD Color TV (O'Brian and Scaduto)(G)                             | Apr 8          |
| <b>Realistic</b>  |                |
| PRO-41 Scanner (Saxon)(SS)  | Feb 78, Aug 82 |
| PRO-58 Scanner (Saxon)(SS)  | Jul 79         |
| PRO-59 Scanner (Saxon)(SS)  | May 80         |
| <b>Ramsey FX-146 Two-Meter FM Transceiver Kit (Kanter)</b>                        | Dec 39         |
| Readers' Requests (Yacono)(TT)  | Jul 73         |
| Real REC, A (Blechman)(FS)  | Jan 83         |
| Reassembling the Sky Buddy (Ellis)(AR)  | Dec 64         |
| Receiver Front-End, A One-Chip (Carr)   | Jun 53         |
| Receiving Loop Antennas (Carr)(HR)  | Jun 74         |
| Regenerative Capacitor-Discharge Driver (Rakes)(CC)                               | Nov 72         |
| Regulator Applications (Rakes)(CC)  | Mar 70         |

**Remote**

|  |        |
|--|--------|
| -Control Analyzer, A Simple (Yacono and Spiwak)(C)       | Jun 38 |
| Control, Sole Control Universal (O'Brian and Scaduto)(G) | May 12 |
| Controls, Convenience Light for (Spiwak)(C)              | Aug 37 |
| Key Car-Control System Race (O'Brian and Scaduto)(G)     | Jun 10 |
| Resettable Shutdown Circuit (Rakes)(CC)                  | May 73 |
| Resistor Calculations Made Easier (Axelson)              | Jun 58 |

**Ring**

|  |        |
|--|--------|
| Indicator (Yacono)(TT)                 | Aug 75 |
| Launcher, Electromagnetic (Volonno)(C) | Oct 42 |

**Rotodex Personal Planner**

|                                       |        |
|---------------------------------------|--------|
| Model EO-100 (O'Brian and Scaduto)(G) | Oct 20 |
|---------------------------------------|--------|

**S**

|  |                        |
|--|------------------------|
| SR2 Selective Ring Processor Multi-Link (O'Brian and Scaduto)(G)   | Aug 15                 |
| <b>Sansui</b>  |                        |
| Audio Note A-4 Notebook Stereo (O'Brian and Scaduto)(G)  | Jul 10                 |
| Model AV-7000 A/V Amplifier (Feldman)(PTR)   | May 27,(LET) Oct 3     |
| <b>Sanyo</b>   |                        |
| MCD-Z85 Portable Audio System (O'Brian and Scaduto)(G)   | Dec 12                 |
| Pulse Meter HRM-5520 Heart-Rate Monitor (O'Brian and Scaduto)(G)   | Jan 48                 |
| <b>SCANNER SCENE (Saxon)(D)</b>  | Jan 89, Feb 78, Mar 82 |
| Apr 78, May 80, Jun 76   |                        |
| Jul 79, Aug 82, Sep 80   |                        |
| Oct 80, Nov 82, Dec 80   |                        |
| A Look at the Mailbag Drive-Through Sermons Getting to the Bottom of the Mailbag Give Your Handheld A Boost! Handheld That Won't Break the Bank, A Monitoring Motion-Picture Sets Remote News Crews New Kid on the Block Scanning A Soviet Space Station the Friendly Skies Tuning In the GMRS Vacation Scanning Schematic Circuit-Design Software, Protel (HOR) Secret Life of a Computer Products Reviewer, The (Holtzman)(CB) Self-Triggerring Timed-On Generator (Rakes)(CC) Series/Parallel Loop Alarm (Rakes)(CC) Sharp Bookshelf Stereo System/CD Changer Model CD-C900 (O'Brian and Scaduto)(G) Sherwood SS-1500 Compact Stereo System (O'Brian and Scaduto)(G) Shinwa Communications SR-001 Scanner (Saxon)(SS) Shocking Facts About Surge Suppressors, The (Angus) Shortwave Revival, The (Jensen)(DX) Shutdown Circuit (Rakes)(CC) Signal Detectors (Yacono)(TT) Signetics NE602 One-Chip Receiver (Carr) Silent Alarm (Rakes)(CC) Simple Remote-Control Analyzer, A (Yacono and Spiwak)(C) Simulator Software (Blechman)(FS) Sinewave-to-Squarewave Converter (Rakes)(CC) Single-Plate Touch Sensor (Rakes)(CC) Sizing Up Your PC Needs (Holtzman)(CB) Sky Buddy Saga, The (Ellis)(AR) <b>SOFTWARE</b> AutoMap (O'Brian and Scaduto)(G) Britannica Software Compton's Concise Encyclopedia (O'Brian and Scaduto)(G) Buying Your First (or Next) PC (Holtzman)(CB) Jul 70 | Feb 35                 |
| Nov 80   |                        |
| May 73   |                        |
| May 70   |                        |
| Jun 53   |                        |
| Jan 78   |                        |
| Jun 38   |                        |
| Jan 83   |                        |
| Jul 70   |                        |
| Aug 72   |                        |
| Jul 68   |                        |
| May 66   |                        |
| Nov 5  |                        |
| Feb 13   |                        |
| Aug 71   |                        |
| Nov 5  |                        |
| Feb 11   |                        |
| Dec 5  |                        |
| Feb 9, Feb 18  |                        |
| Oct 67   |                        |
| Mar 65   |                        |
| Feb 18   |                        |
| Feb 20   |                        |
| Dec 66   |                        |
| Apr 72   |                        |
| Dec 66   |                        |
| Feb 72   |                        |
| Jan 81   |                        |
| Feb 18   |                        |
| Nov 5  |                        |
| Feb 18   |                        |
| Dec 62   |                        |
| Feb 11   |                        |
| Feb 61   |                        |
| Feb 9  |                        |
| May 16   |                        |
| Jun 65   |                        |
| May 68   |                        |
| Aug 21   |                        |
| May 70   |                        |
| May 53   |                        |

|  |        |
|--|--------|
| Sole Control Universal Replacement Remote Control (O'Brian and Scaduto)(G) | May 12 |
| <b>Solid-State</b>   |        |
| Driver (Rakes)(CC)   | Nov 72 |
| Light Sources (Carr)   | Jun 31 |
| <b>Some</b>  |        |
| More Spectrum Analyzer Stuff (Carr)(HR)                                    | Oct 78 |
| New Products and Some Questions Answered (Carr)(HR)                        | Aug 79 |
| Thoughts on Radio Propagation (Carr)(HR)                                   | Apr 76 |
| Sonic Kaleidoscope, Build A (Ray)(C)                                       | Oct 58 |
| <b>Sony</b>  |        |
| CCD-F501 Video Camcorder (O'Brian and Scaduto)(G)                          | Jan 50 |
| CCD-FX510 8mm Camcorder (O'Brian and Scaduto)(G)                           | Oct 17 |
| Data Discman Model DD1-EX (O'Brian and Scaduto)(G)                         | Feb 13 |
| EV-S3000 Hi8 VCR (O'Brian and Scaduto)(G)                                  | Dec 7  |
| Pylxis GPS Receiver (O'Brian and Scaduto)(G)                               | Jul 5  |
| Sound Master II PC Sound Board Covox (O'Brian and Scaduto)(G)              | Jan 49 |
| Soviet Space Station, Scanning A (Saxon)(SS)                               | Apr 78 |
| Speaker Protector, Build A (Flynn)(C)                                      | Mar 41 |
| <b>Spectrum Analyzer</b>   |        |
| Digital Sawtooth Generator, The (Carr)(HR)                                 | May 76 |
| Poor Man's (Carr)(HR)  | Oct 78 |
| Spectrum Analyzer Stuff, Some More (Carr)(HR)                              | Oct 78 |
| Squarewave Oscillator (Rakes)(CC)  | Jul 70 |
| Stac Electronics' Stacker (Holtzman)(CB)                                   | Jun 65 |
| Stepper-Motor Controller, PG-Based (Antonuk)(C)                            | Jun 41 |
| Stereo Cassette Deck Technics RS-BX606 (Feldman)(PTR)                      | Sep 27 |
| Street Atlas USA DeLorme Mapping (O'Brian and Scaduto)(G)                  | Nov 5  |
| Subwoofer, Build A (Whitehead)(C)  | Jan 31 |
| Sump Alarm (Yacono)(TT)  | Sep 73 |
| Super Bandpass Filter (Rakes)(CC)  | Jun 67 |
| Super-Simple NiCd-Battery Rejuvenator (Blechman)(C)                        | Sep 63 |
| SuperCAD Electronics Design Software (HOR)                                 | Mar 65 |
| <b>Surge Suppressor</b>  |        |
| Protect Your Equipment With The Power Block (Yacono)(C)                    | Feb 37 |
| The Shocking Facts About (Angus) Feb 35,(LET) Jul 3                        |        |
| <b>Surround-Sound Processor</b>  |        |
| (Amplifier, Carver DPL-33 (Feldman)(PTR)                                   | Jul 27 |
| Audio Source SS Three/II (O'Brian and Scaduto)(G)                          | Oct 18 |

**T**

|   |        |
|---|--------|
| Tachometer Circuits, Fun With Analog (Carr)                                       | Jul 59 |
| Talking Compass (Mitschke)(C)   | Dec 42 |
| Tandy 2500SX/20 Multimedia PC (O'Brian and Scaduto)(G)                            | Feb 20 |
| Technics RS-BX606 Stereo Cassette Deck (Feldman)(PTR)                             | Sep 27 |
| <b>TELEPHONE (SEE ALSO PHONE)</b>   |        |
| AT&T Answering System Telephone 1532 (O'Brian and Scaduto)(G)                     | Aug 13 |
| Amplifier (Yacono)(TT)  | Feb 68 |
| Build A Cordless-Telephone Lock (Sokolowski)(C)                                   | Jul 44 |
| A Voice-Mail Alert (O'Kelley)(C)  | Nov 53 |
| An Emergency Telephone Dialer (Caristi)(C)  | Sep 39 |
| Circuit Parade (Yacono)(TT)   | Aug 75 |
| Duofone Outgoing Call Restrictor Radio Shack (O'Brian and Scaduto)(G)             | Mar 13 |
| Intercom (Yacono)(TT)   | Aug 75 |
| Phone Guard Telephone Security Device DTI (O'Brian and Scaduto)(G)                | Jul 8  |
| Recording Control (Yacono)(TT)  | Aug 75 |
| Ring Converter, The (Poeth)(C)  | Apr 38 |
| SR2 Selective Ring Processor Multi-Link (O'Brian and Scaduto)(G)                  | Aug 15 |
| Systems, Installing and Maintaining (Young)                                       | Nov 55 |
| Tele-Timer (Rakes)(CC)  | May 73 |
| Tropez 900 DX Digital 900-MHz Cordless Telephone (O'Brian and Scaduto)(G)         | Jul 8  |
| <b>TELEVISION (SEE ALSO VIDEO)</b>  |        |
| Citizen T530 Color LCD Pocket TV with AM/FM Radio (O'Brian and Scaduto)(G)        | Jul 16 |
| Funai 9-inch TV/Video Cassette Player (Feldman)(PTR)                              | Nov 27 |
| Instant Replay Image Translator Standards Converting VCR (O'Brian and Scaduto)(G) | Nov 12 |
| Radio Shack Pocketvision-26 LCD Color TV (O'Brian and Scaduto)(G)                 | Apr 8  |
| Sony EV-S3000 Hi8 VCR (O'Brian and Scaduto)(G)                                    | Dec 7  |
| TV Answer: What's the Question? (Angus)   | Sep 64 |
| Zenith-Boise Color TV Model ZB2794BG (O'Brian and Scaduto)(G)                     | May 10 |
| <b>TESLA COILS</b>  |        |
| Fun With (Rakes)(CC)  | Oct 69 |
| Make Your Own High-Voltage Capacitors (Charlton)(C)                               | May 31 |
| Test-Bench Helpers, Experimenter's (Rakes)(CC)                                    | May 73 |
| <b>TEST EQUIPMENT</b>   |        |
| 3 x 3 Visual Continuity Tester (Hampton)(C)                                       | Feb 53 |





# ALL ABOUT MICRO PROCESSORS

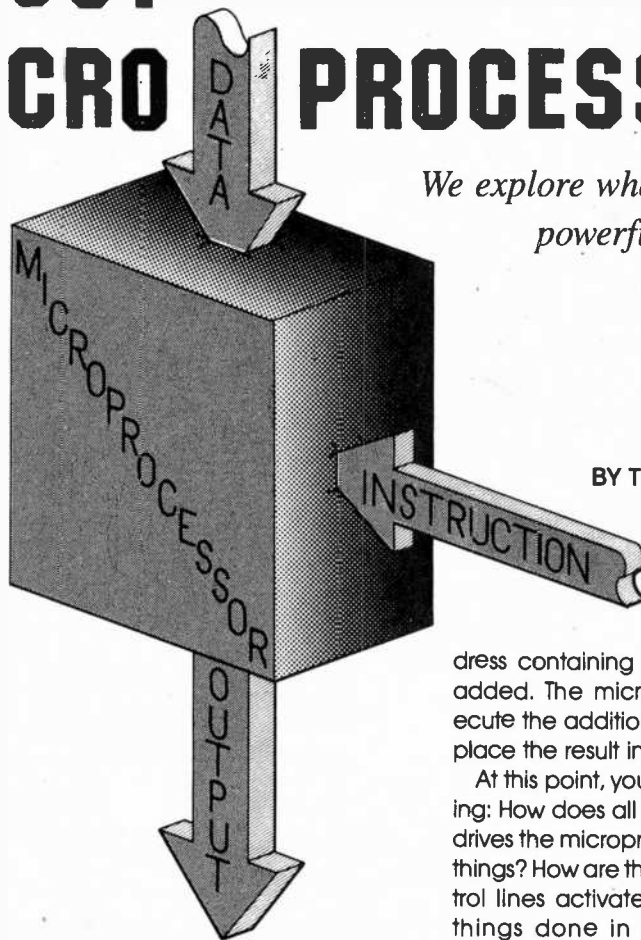
**T**he most common complaint I hear from old-world hams and technicians about microprocessors is that there is no convenient way to visualize how they work. They make that assumption because most books treat microprocessors as black boxes. They ask the user to memorize what a given microprocessor does rather than try to explain how the microprocessor works. Few introductory books, if any, give the user a way to visualize and understand how a microprocessor works.

The lack of information is due in part to the fact that microprocessors are internally complex devices that require the user to juggle many facts about their hardware and software. However, although they are "messy" to use in practice, they are built out of simple logic devices and can be easily explained in a block-diagram fashion.

In this article, we will break-down the microprocessor into simple logic building blocks such as counters, latches, and read-only-memories. That will make it easier to show you how and why a microprocessor works. However, for the sake of brevity it will be assumed that you more or less know what those building blocks do.

**A Microprocessor System.** Figure 1 shows a small microprocessor system. The microprocessor can get its program instructions from the Read-Only Memory (ROM). It can get data from or place data in the Random-Access Memory (RAM), and it might get or send data through the ports. The control-lines, "read," "write," "input/output," and "memory" go to the ROM, RAM, and input/output ports as shown.

The microprocessor directs the ROM, RAM, and the ports with its control and address lines according to the microprocessor's internal controls and according to the instructions it receives. The ROM, RAM, and ports are enslaved through the control- and address-line signals that come



*We explore what makes these powerful chips tick in an informative but intuitive style.*

BY TIMOTHY D. GREEN

from the microprocessor. Each of these devices are given unique address codes. As far as the microprocessor is concerned, the sole function of each device is to send data to or accept data from the microprocessor on the data-bus lines when it is selected by the microprocessor.

For example, assume that the microprocessor is about to execute an "add to memory" instruction. This instruction consists of the "ADD" instruction code and two halves of a 16-bit address in RAM. The microprocessor will get the instruction code by setting the address lines to the address of the "ADD" instruction in ROM and activating the "read" and "memory" control-lines. This will select the ROM and allow the instruction code to fill the data bus so that the microprocessor can read the ADD instruction. Then the microprocessor will set-up and read from the next sequential address and read the ROM two more times to get the two halves of the 16-bit RAM ad-

dress containing the number to be added. The microprocessor will execute the addition just after that and place the result into memory.

At this point, you might be wondering: How does all of this occur? What drives the microprocessor to do those things? How are the address and control lines activated? How are these things done in sequence? What causes the microprocessor to get its own instructions from the ROM? How are these instructions interpreted and translated into action?

To help explain, look at the internal-view of a typical microprocessor shown in Fig. 2. It shows several registers, which the microprocessor uses to keep track of data and address information, the arithmetic-logic-unit (or ALU), which performs math and logic operations, and the internal data bus, which allows the transfer of information within the microprocessor. It also shows an instruction register tied to a "control-unit," which is the source of several control-lines. Although the control-lines shown only point in the direction of the external devices they control, every part of the microprocessor is connected to and manipulated by the control-unit.

The control-unit runs the microprocessor, sequences and commands its internal parts, and interprets and executes the instructions in full. Completely understanding exactly how the control-unit works is the key to

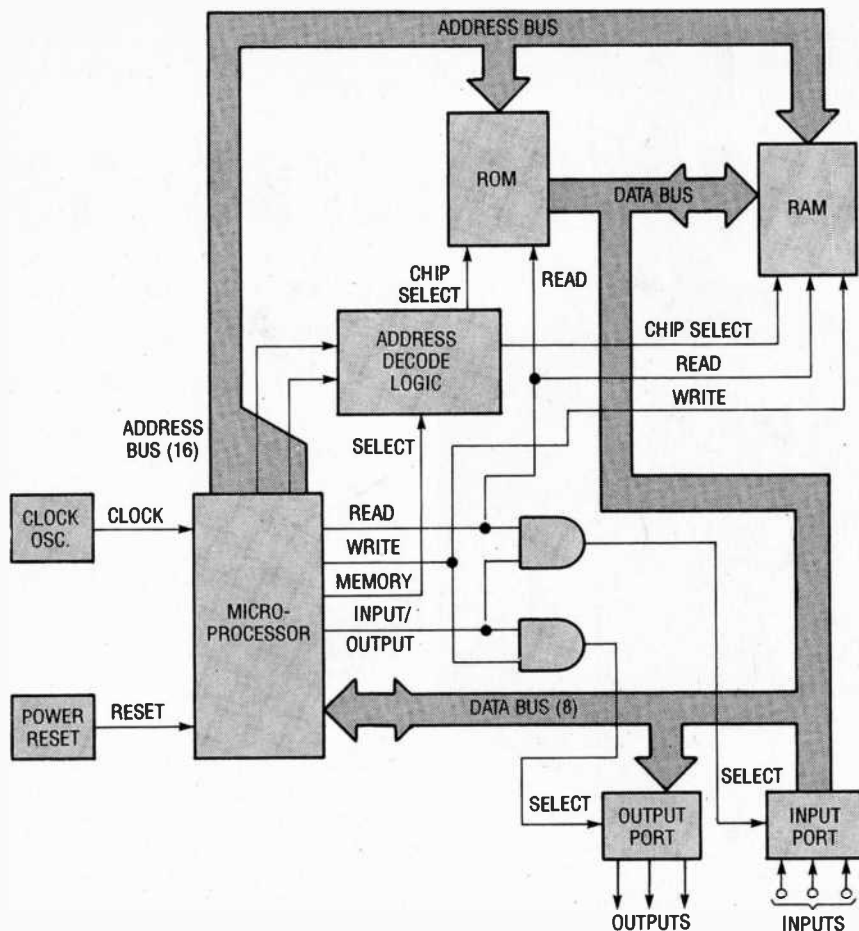


Fig. 1. In a microprocessor system, the microprocessor treats all the other system components as devices to give data to and receive data from.

understanding how and why a microprocessor works.

**A Controller.** The controller circuit shown in Fig. 3 is not a true control unit, but it has the feel of one and contains most of the essentials of a control unit. Ignoring the dashed portion of the circuit and the instruction latch for now, a binary counter counts clock pulses and sends its count to the address lines of a programmable ROM (PROM). The PROM looks at the address and sends the value of the data located in the address to the input of the octal latch that's connected to the control lines. That latch captures and holds this data at its outputs, thus manipulating the control lines.

Notice that the binary counter clocks on the falling-edges of the clock, while the latch clocks on the rising-edges. That is done for making clean, stable transitions in the latch-output data and for synchronization.

The latch-output lines can be used as a set to represent a number or value. They can also be used individually as controlling signals to other logic

devices. For example, when used individually, these lines can drive other gates, flip-flops, counters, latches, PROM's, RAM's, and other devices.

As the counter counts, it provides new addresses to the PROM, which sends out the pre-programmed data from each requested address. One of these lines is fed back to the "clear" input of the counter as shown in Fig. 3. That allows a fixed-length process to run in a continuous loop provided the data and instructions needed for the process are stored in the PROM.

More PROM's can be added to provide more control lines, as indicated by the parts with the dashed outlines. The outputs of the counter would feed the same corresponding address lines of each new PROM.

**Some Examples.** Figure 4 shows a controller without an instruction latch running a data-acquisition system. The user of this system would program the PROM to select an analog channel to be sent through the analog multiplexer, start and read the analog-to-digital-converter, and latch the

output data. This sequence of instructions or steps would then be repeated over and over again as part of an instruction loop. That can be done for a schedule of 100 channels, 200 channels, or any number of channels.

Figure 5 shows another such simple controller running a beacon transmitter and sending Morse code. A fixed-length, repeating message in Morse code would be programmed into the PROM with the sequence to turn on the transmitter and the keyer.

Both of the circuits in Figs. 4 and 5 could have been controlled by the microprocessor system back in Fig. 1. The ROM in the microprocessor system would just have to contain a sequence of instructions to manipulate the output-port lines, which would in turn control the external devices. Both the simple controller and the microprocessor system solve similar control problems and allow the user to program simple, arbitrary-length control sequences with great flexibility. However, the microprocessor can do mathematical and logic operations on its data as well.

The reason that a simple controller lacking an instruction latch cannot serve as the control-unit in a microprocessor is that it would only be capable of running one sequence of instructions located in the PROM. A microprocessor's control-unit must be able to run many different control sequences, therefore it must be able to accept input from the outside world to select the desired control sequence from those in the PROM. That input is received by the control-unit's instruction latch.

**The Instruction Latch.** To help point out the importance of the instruction latch look back at Fig. 3. Note that the binary-counter outputs only set the lowest six address lines of the PROM. That allows the counter to count out up to 64 sequence steps at a time rather than stepping through the whole PROM.

The instruction latch supplies the PROM with eight, additional, higher-address lines. The input latch and the counter, together, are used to index 256 separate sequences of up to 64 steps each. In a microprocessor, each of the 256 possible latch codes are used as instruction or operation codes. Each instruction code is a sin-



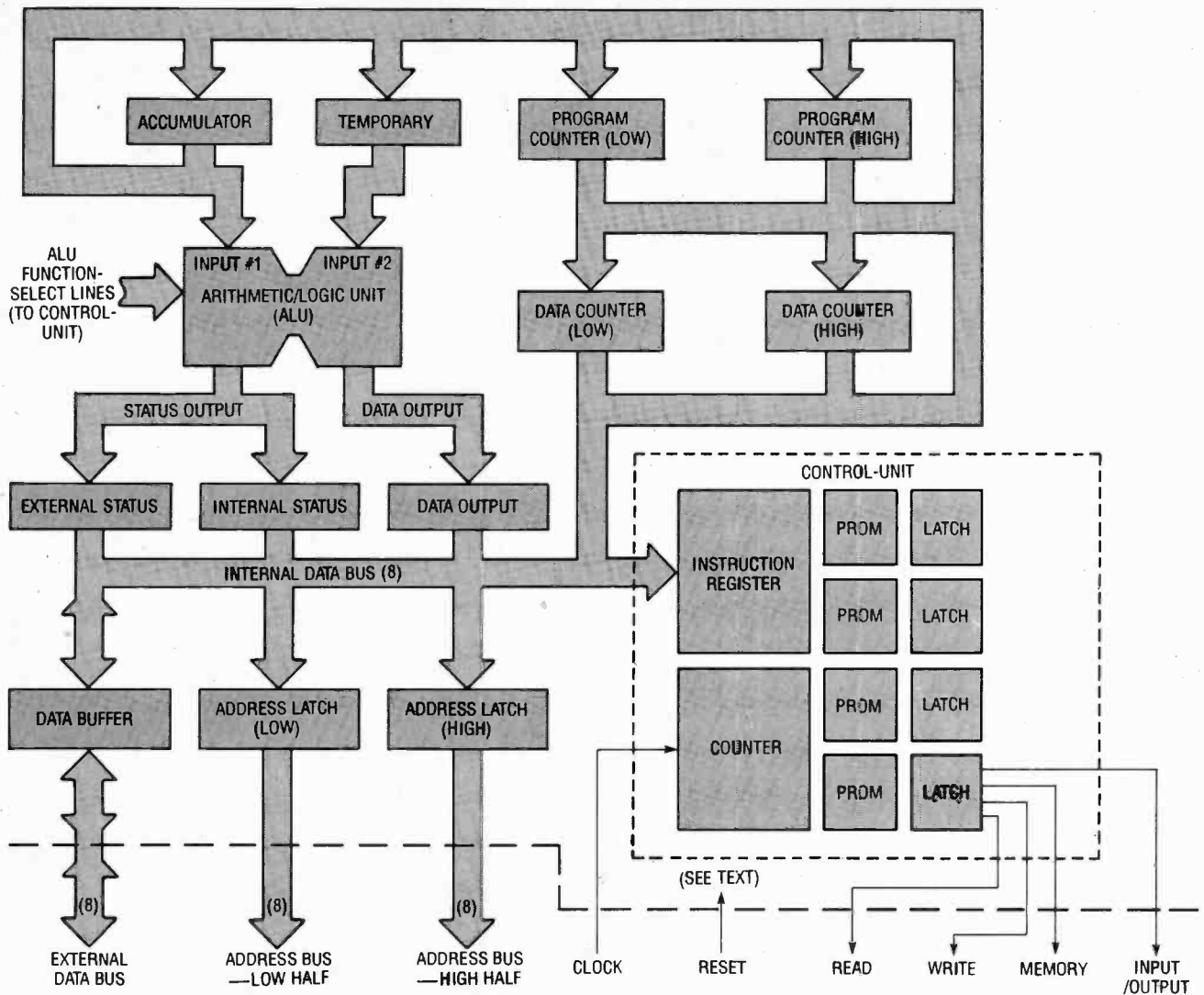


Fig. 2. The inside of a microprocessor is much like the system the microprocessor sits in; there's a data bus for communication between the components.

gle code that indexes a whole sequence of sub-operations within the microprocessor. A sub-operation may be used to manipulate the controls of a latch, a counter, or the ALU. Each sequence of sub-operations will perform one complete microprocessor operation (such as ADD).

As mentioned earlier, more PROM's may be added to the control-unit, so that the new PROM's share the same address bus as the first PROM. It is not uncommon for a microprocessor's control-unit to have more than 80 control lines (or, more than ten PROM's).

Two of the control lines from the output latches of the PROM's go to the "clear-counter" input of the counter and to the "latch" control of the instruction latch. The PROM must be

programmed to activate those two lines at the same time to get a new instruction at the end of a sequence, which might be smaller than 64 steps long.

The control-unit shown in Fig. 3 must be modified in two ways to enable it to handle some special instructions and features. These will be discussed later, as they are needed.

### Microprocessors vs. Controllers.

The operation of a microprocessor is directly parallel to the operation of the simple controller. However, since the microprocessor itself contains a control unit, the microprocessor operates at a "higher level" than a controller. In this higher level, the microprocessor controls the external system in "indirect" instruction steps, at a

lower speed than a simple controller. However, a microprocessor can perform many different operations as is, while a controller would require a PROM for each sequence that it must perform.

Back in Fig. 4 for example, we showed how a simple controller would operate a data-acquisition system "directly" from a PROM. There is a one-to-one correspondence between a PROM's latched data and the operation it performs. However, if the data-acquisition system were controlled by the microprocessor system of Fig. 1, the microprocessor system would manipulate the output-port lines to control the same devices using a series of "indirect" instructions from the ROM. There would be no one-to-one correspondence be-

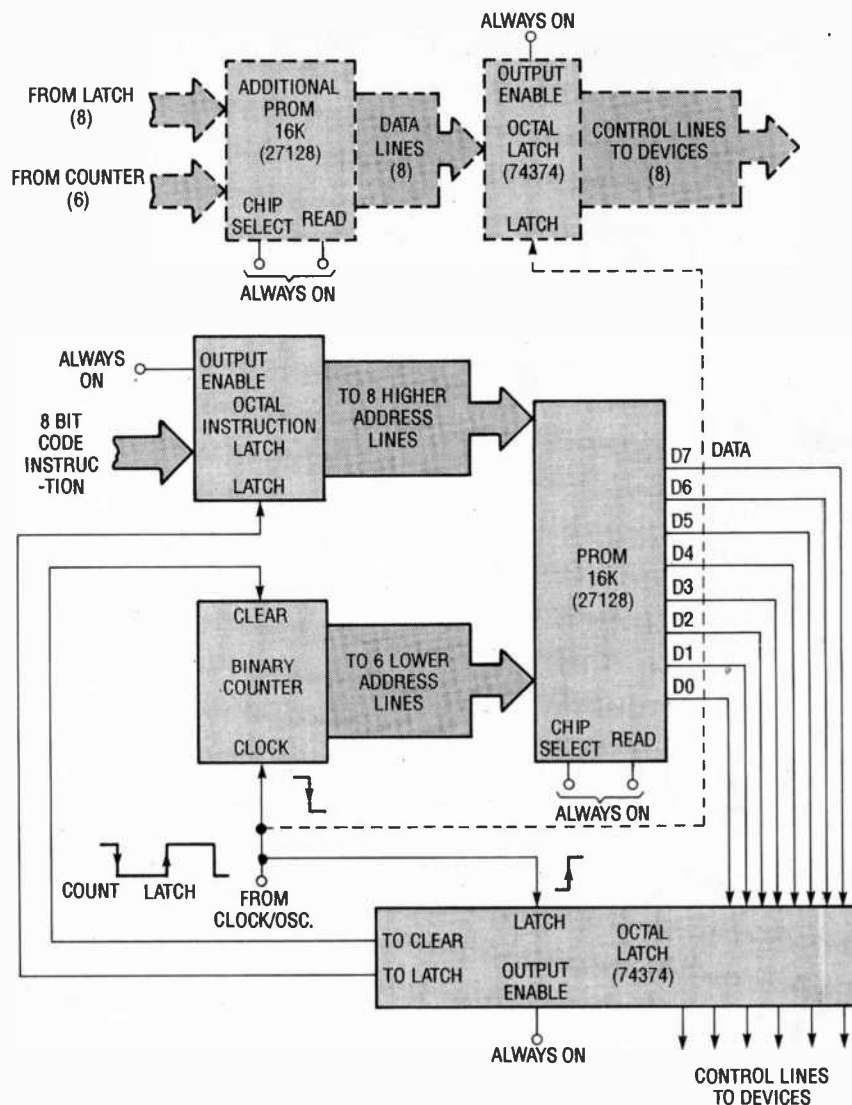


Fig. 3. The control unit is the key to how a microprocessor processes data and performs operations. There are simple discrete controllers available that lack the instruction latch shown here.

tween the instruction codes in the ROM of Fig. 1 and the controlling signals on the output-port lines.

Furthermore, the simple controllers suitable for Figs. 4 and 5 will run their control sequences exactly at the clock speed. The slowest device that these controllers control is the only thing that limits their operating speed. A microprocessor, on the other hand, will run its control-instruction sequence at a lower speed than the clock speed. That is because the microprocessor must run a few sub-operations at the clock speed for each control operation it must perform.

Another key difference is that if the simple controller had a lot of devices to control, it would need several PROM's. However, the microprocessor needs only one PROM for its instruc-

tions since the instructions are decoded by the microprocessor's control-unit.

To summarize, although the microprocessor does its controlling "indirectly" and more slowly than the simple controller, it uses a fixed set of instructions which are easily coded into a single PROM. In general, a microprocessor is a compromised controller. Instead of building a separate and complete control-unit to perform each complex task, a microprocessor is used to perform each task with a sequence of instructions selected from a fixed set of instructions. The complete freedom that comes with using a control-unit is traded for the restricted freedom of using a given microprocessor's structure and instruction set.

**A Simple Microprocessor.** Looking back at Fig. 2 as a guide, let's discuss the intended functions of each of the microprocessor sub-components. A detailed explanation of these sub-components is essential for programming the control-unit.

The microprocessor's internal, eight-line data bus connects the outputs of each register to its own input and to the inputs of the other registers to allow data to be transferred to and from the registers, the ALU, the data buffer, and the address latches. Any register, latch, or device that sends data onto the internal data bus must have three-state (low/high/high-impedance) logic outputs so that it can "disconnect" itself from the bus when it is not needed, as only one device may place data on the bus at any one time.

Each register in Fig. 2, including both the low and high halves of the program-counter and the data-counter, is an octal latch. Each register, or latch, has two control lines to be connected to the control-unit's output latches: one to "latch" or capture the data at the inputs and the other to "three-state" its outputs. The "three-state" control is also called the "output enable."

The arithmetic/logic unit (ALU) performs such operations as addition, subtraction, incrementing, decrementing, and logical operations on the data present at its inputs. The selection of each operation and which input or inputs to operate on is made by giving a binary code to the ALU's control lines. These control lines are, of course, connected to the control-unit.

The ALU can accept data from the temporary register and any other register except the instruction register. The temporary register is used as a temporary holding place for ALU input data.

The accumulator register is used only for the programmer's data. The control-unit must not disturb its contents unless an instruction tells it to do so.

The ALU has outputs for data results and the "status" of the results. The data-output register is a temporary holding place for the results of the ALU's operations. The ALU's status information indicates whether or not there was a bit carried during addition,

(Continued on page 93)

Nearly everyone knows that the ability to send messages from one place to another in the form of an electrical code has been around for about 150 years. But relatively few realize that the instruments, and even the code itself, have undergone many changes in that time. In this article I'd like to take a look at some of the devices that opened the age of electrical communication, and then trace the development of the Morse code and code-sending devices to the present time.

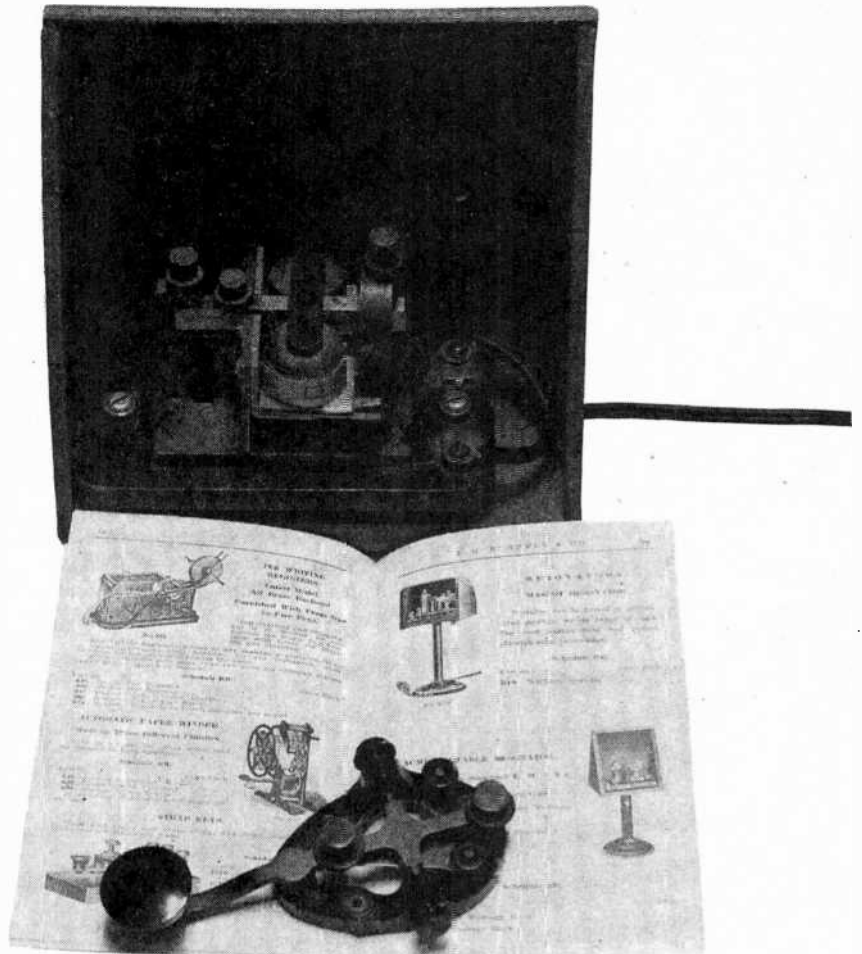
**The First Telegraph.** Samuel Morse didn't use either a key or a letter code for his first telegraph. Instead he used a "portrue," a number code and a "register." The portrue was a wooden stick with a groove designed to hold small lead blocks. (Similar devices were used in printing.) Each of the lead blocks had protrusions arranged to represent the numbers zero through nine. In use, the portrue was pulled past an electrical contact and the protrusions closed the circuit in a sequence corresponding to the number.

At the receiving end, a strip of paper was automatically inscribed by the register with marks corresponding to the protrusions and numbers. An operator would then look up the numbers in a code book and write down the appropriate letter, word, or phrase. There are a few holdovers of that system still in use—the familiar "73" or "best regards" of ham operators and the "30" used to mark the end of newspaper and wire-service stories are two examples of that.

The system worked—but slowly. Unlike others who were experimenting with electrical telegraphs at the time, Morse didn't stop inventing when he had a system that barely functioned. With the help of his assistant and partner, Alfred Vail, Morse improved his telegraph until it was simple, reliable, and convenient to use. The portrue and number code were the first to go.

**Enter the Telegraph Key.** The first telegraph key was a strip of brass fastened to a block of wood and a wire at one end, and bent upwards at an angle over a contact at the other. Pushing down on a knob at the free end of the strip closed the circuit.

The key used by Morse in his 1844



# THE CODE MAKERS

*Trace the history of code and code-sending gear from its earliest days to today's computerized equipment.*

BY LARRY LISLE, K9KZT

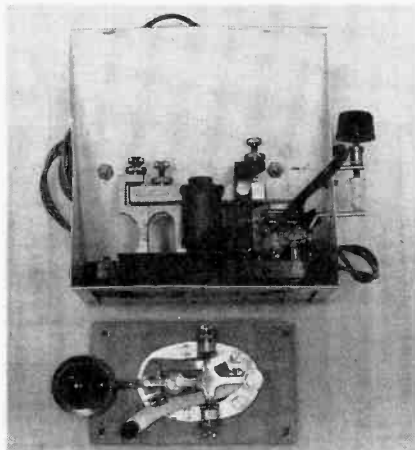
demonstration between Washington and Baltimore was more elaborate, with a pivoting wooden lever and screw adjustments. Conventional or "straight" keys have changed very little since then.

Morse and Vail also dropped the number and code-book idea. After several false starts, they came up with the system of dots and dashes for letters, numbers, and punctuation that became known as the American Morse Code. In 1851 the code was modified in Europe and called the Continental or International Morse

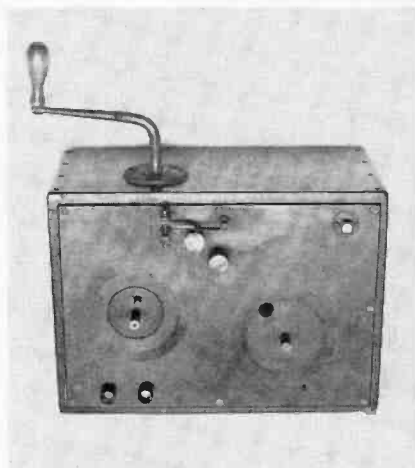
Code. That is the version of the code that was adopted for use when wireless (radio) telegraphy was developed.

As operators became more experienced, it was found they could understand the sound of the register as easily as they could the marks on the moving strip of paper. That led to the invention of the "sounder" by Vail in the early 1850's. The sounder consisted of an electromagnet and a lightweight, movable arm that clicked when the current flowed and the circuit was closed, and clicked again





A Signal Electric key and sounder in a homemade metal resonator.



A spring-powered Morse-code sending machine. A perforated paper tape was pulled past the electrical contact and operated a sounder hooked to the binding posts. The speed control is located at the opposite corner.

when the current was turned off. A short interval between the clicks was a dot; a long interval was a dash.

Trying to copy a sounder in a noisy office could be difficult, especially if there were several other sounders going at the same time. The usual practice was to mount the sounder in a wooden or sheet-metal box, open on one side, which was called a resonator. That made the clicking seem louder and gave each sounder a distinctive tone.

Learning the code in the wire-telegraph days usually meant hanging around the telegraph office and doing odd jobs. During the slack periods, the operator might then be persuaded to teach the code on a practice set. Another way, if you could afford it, was to rent a code-sending machine. These devices used a pa-

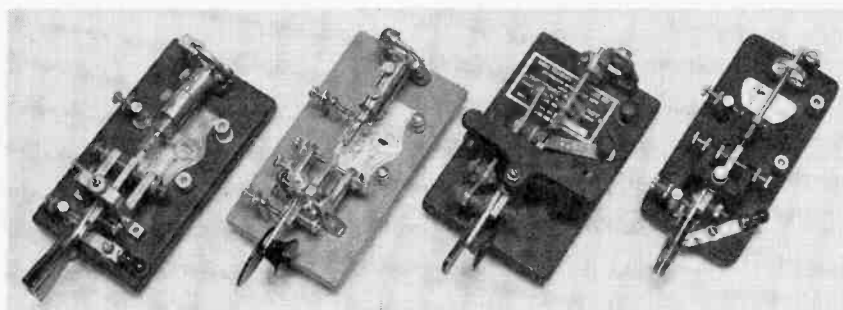


An Instructograph AC-powered code-practice machine. This model had a built-in oscillator. The knobs were used to control volume and speed.

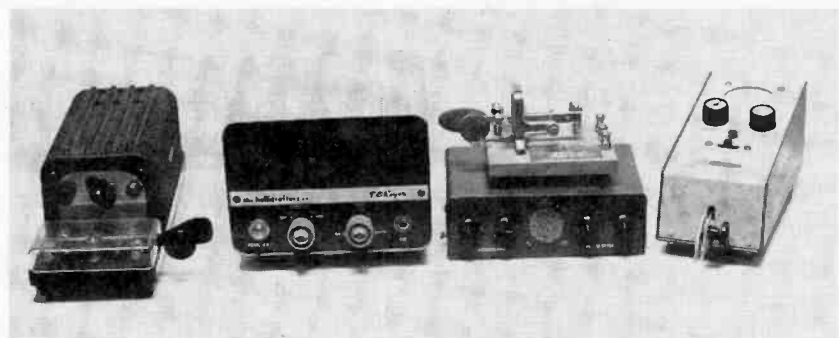
wired for electricity, code-practice machines were built to run with electric motors, and later ones had built-in code oscillators. Incidentally, should you pick up one of these old devices from a flea market, etc., be very careful. Some were built to poor standards of safety, and even in the better ones the insulation may have deteriorated. If the earphones, key, or cabinet is connected directly to the power line, you might receive a deadly shock.

### Improved Sending Devices.

Sending high-speed messages for hours at a time with a straight key could be very tiring. Many operators had their careers cut short by a condition called a "glass arm." That was caused by the constant switching of opposing sets of muscles in the fore-



Here's an assortment of semi-automatic keys or "bugs." From left to right they are an old and new Vibroplex, a McElroy, and a Johnson Speed-X.



An assortment of electronic keys: From left to right they are A Mon-Key (the first electronic key), the "TO" by Hallicrafters, and models made by Hammarlund and Heath. A "Vibro-keyer" bug sits on top of the Hammarlund unit.

per tape punched with holes to represent the dots and dashes of the code. A spring-wound motor pulled the tape past a contact, which operated a sounder. When wireless came in, a buzzer was substituted for the sounder. These machines could be adjusted for whatever speed you wanted—something not always possible when a live operator was doing the sending!

As more and more homes were

arm from full on to full off and back again.

The earliest remedy was the "double-speed key" also known as the "double-action key" or more commonly, the "sideswiper." The sideswiper key moves from side to side instead of up and down. There are contacts on either side and the operator holds the key against one of them longer for dashes than for dots.

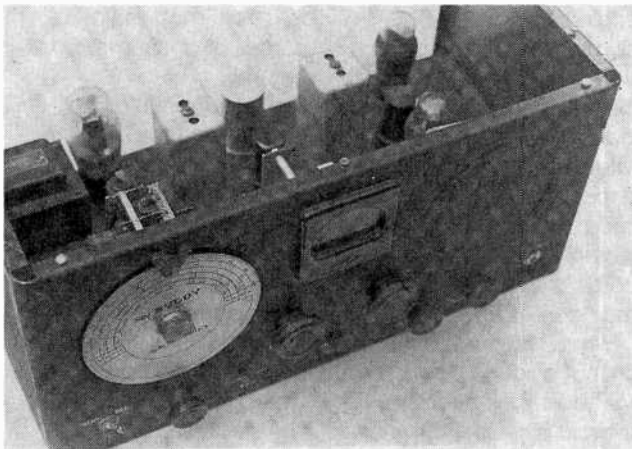
(Continued on page 89)

# ANTIQUE RADIO

By Marc Ellis

## The Sky Buddy: All Together Again!

Last month, we began reassembling our Sky Buddy model S-19R receiver, which had been partly dismantled for cleaning and dial-cord restringing. In this column, we'll be completing the job and testing the set for operation. For those who have just joined us, the Sky Buddy was Hallicrafters' "low-end" shortwave receiver during the late 1930's. As such, it was quite a popular starter set for shortwave listeners



The front view of the Sky Buddy—all together again and ready to try out.

and newly-licensed hams.

This series of articles began in the May, 1992 issue, with a discussion of the Sky Buddy's history. Restoration work started the following month, and has been continuing at intervals ever since.

### THE DIAL CORD HASSLE

Last month's column chronicled the disassembly, cleaning, reassembly, and reinstallation of the subchassis containing the main tuning/bandspread capacitor and associated drive pulleys. In the process, both

the main tuning and bandspread control drives were restrung with new cord. And that cord had better last quite a long time! There's no way to restring those controls without disconnecting the subchassis (an arduous job indeed) and removing it from the main chassis.

The removal (not to mention the subsequent reinstallation) was almost as difficult as the disconnection. The subchassis is virtually locked in place by the radio's front panel, which must have been installed after the subchassis was. And the front panel is not now removable because it was fastened to the main chassis by some type of a spot-welding process.

Taking out the subchassis with the front panel in place requires a bit of ingenuity and a bit of forcing, as I described in last month's column. And if anyone out there in reader-land has figured a method for restringing the Sky Buddy's dial cords without going through this exercise, I'd certainly like to hear about it!

### THE LOUDSPEAKER HASSLE

With the tuning subassembly back in place, the only major component still to be installed was the loudspeaker. That took a little longer than necessary because of uncertainties about the lead connections. And while I can probably blame the Hallicrafters design engineers for the previously described hassle, I can blame only myself for the difficulty I had with the speaker. The moral:

Take the time to make good clear notes when disconnecting wiring.

The speaker in the S-19R has six leads: two to the field coil (which also serves as the power-supply filter choke), two to the primary of the output transformer (which is mounted on the speaker frame), and two from the voice-coil circuit to the closed-circuit telephone jack (which mutes the speaker when phones are plugged in).

In a hurry to get on with the restoration work, I had made only a few rough sketches to indicate where those leads were connected. When reinstallation time rolled around, I found that I hadn't adequately differentiated between a pair of terminal lugs where a couple of the wires were to be connected. (I'd carefully marked one "top" and one "bottom," but now I wasn't sure whether "top" referred to the terminal that would be uppermost with the set in operating position or to the terminal that was uppermost with the chassis upside down for servicing.)

I had also indicated the wrong tube socket as the connection point for a third lead. And just to add to the complication, the color coding on the grimy and time-faded wires no longer seemed as clear to me as it did when I removed them.

"Big deal," you may think. "Ellis has a schematic of the set. What's so hard about finding the connection points for six speaker leads?" In actuality, however, that was more of a problem than it seemed. Set designers of the era

were not as concerned about keeping interconnecting leads short as they were about cabling them neatly together. So I found myself attempting to trace circuit pathways from one side of the chassis to the other via wires obscurely bundled up in harnesses.

The confusion I created for myself extended what should have been a 10-minute job into one that lasted for more than an hour. So don't make the mistake I did! Take the time to sketch accurate diagrams showing the locations of all the connections that you remove. In the long run, that will save you time and possibly even prevent you from damaging irreplaceable parts by wiring them incorrectly.

switch terminal that it didn't look disconnected.

I ran into a similar problem with an Echophone set that I restored on these pages a few years ago and I know why, in all likelihood, those wires were cut. During World War II, in a security-related move to restrict shortwave listening, our government apparently encouraged radio service shops to disable certain shortwave bands on sets that were brought in for repair.

I've heard of cases where the zealous service man crushed the shortwave coils, damaging them beyond all hope of repair. Luckily this radio (and the Echophone) were disabled in far gentler fashion, so that all functions could easi-

but perhaps someone will now. If you have information about this issue, how about contacting me? I'll be delighted to print your recollections in this column.

## FINAL ASSEMBLY AND TEST

After cleaning and re-installing the knobs, tuning dial, and dial pointer, all I had left to do before the S-19R could be tried out was to add a line cord. The old one, dangerously cracked and deteriorated, had been removed early in the restoration project.

I wish I could tell you that I'd been able to dig up a perfect period replacement for the cord, but I'm not even sure what the original looked like. The clumsy solder joints and shreds of previous wiring at the set's cord connections indicated that the deteriorated cord had itself been a replacement. So I satisfied myself by installing a length of modern black zip-cord having an innocuous molded plug.

When I first turned the set on, not a sound came forth. My heart sank because the set had played a bit when I tried it out prior to disassembly. I figured that I must have messed up the speaker wiring after all, perhaps burning out the unit in the process. Then I realized that the problem could just as well be dirty contacts on the phone jack's speaker-muting switch.

That hunch was correct, since shorting out the switch with a clip lead immediately brought the Sky Buddy back to life. I could hear activity on all bands and, since I was hooked up to a good antenna, I even pulled in several foreign shortwave stations.

Performance was lackluster, however, particularly on the broadcast band—

where I definitely was not receiving the full complement of local stations. The tuning in that band also seemed a little broad, and signals were weak. A bad IF stage maybe? Only further testing will tell!

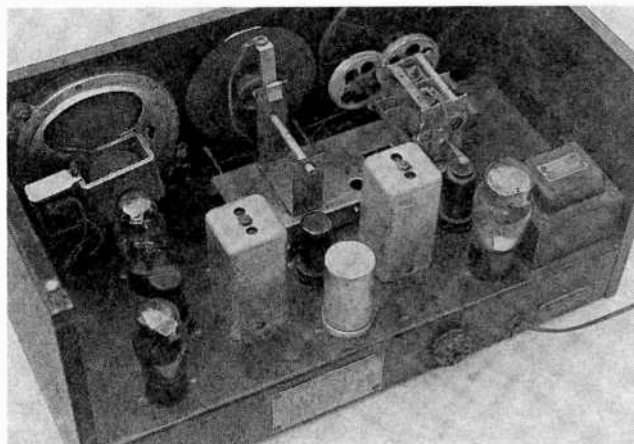
## READER COMMENTS

Now that the Sky Buddy restoration has been running for a while, some reader comments have started to come in, and I have room for a couple of the letters here. To start off, I was pleased to receive a note from Alan Douglas, author of the very important three-volume reference set, *Radio Manufacturers of the 1920's* (published by Vestal Press, Vestal, NY, and available from most major sources of antique-radio literature).

In his communication (which was typed on a reproduction of Atwater Kent Manufacturing Works stationary dating from the early 1900's!), Alan pointed out that the yellow deposit I had reported cleaning from the S-19R's IF transformers and other metal parts (October, 1992 issue) could very well have been a compound of cadmium. Cadmium plating of steel parts, he went on to point out, began about 1930 and has been common ever since.

Cadmium plating normally has a bright metallic look, but after long-term exposure to the atmosphere, cadmium oxide (brown) and/or cadmium sulfide (yellow) deposits can form on the surface. When cleaning off such deposits during restoration projects, extreme caution should be used because cadmium is a poisonous substance and inhaling its dust can be quite dangerous.

Many thanks to Alan for  
(Continued on page 91)



The newly reassembled Sky Buddy as seen from the rear. The tuning control subchassis (behind the IF cans) was a bear to get back in!

## ECHOES OF WWII

I have to admit, though, that being forced to rummage around tracing wires did have its up-side! I accidentally discovered that one of the wires from the oscillator coil to the band-switch had been neatly severed, effectively disabling band 2 (1.7–5.5 MHz). It would have otherwise taken me quite a bit of time to find that problem because the wire was cut so cleanly and so close to the

ly be restored after the war. But I doubt that either of the folks who cut those wires would have imagined that half a century would pass before the severed connections were found and soldered back in place!

In one of the Echophone articles, I invited readers who might know something about those wartime government guidelines for disabling shortwave sets to write and enlighten us. No one responded back then,



# COMPUTER BITS

By Jeff Holtzman

## The XT Syndrome

In past columns, I have recommended buying as much computing muscle as you can possibly afford. However, in a letter that I recently received, reader T. G. chides me for being too *gung-ho* with those recommendations. Perhaps he is right. It is possible to get by with less. But getting by is not the issue. I don't recommend purchasing powerful computers for the sake of ownership. I'm not advocat-

And because said user has undoubtedly paid significant dues in mastering a program or two (DOS Word-Perfect or 1-2-3, for example), he or she resists change in direct proportion to the effort expended in paying those dues—not to mention the status earned thereby.

There's a significant problem with that world view. It assumes that computers are here simply to improve the efficiency of common procedures—such as writing letters to the editor. Of course they do that, but they also open up a whole new world of experience that has no analog in past experience. Think about video games. Think about the kind of show that you get at a good planetarium. Think about the effects that you see in movies like *Roger Rabbit* and *Terminator 2*. Think about what composers like Todd Rundgren and Philip Glass are doing. Think about fractal graphics. Think about desktop publishing (which didn't exist ten years ago). Think about desktop-video production (coming in a big way in the next few years).

Those phenomena have one thing in common: They're all built around rich data: gobs of formatted text, high-resolution true-color graphics, animation, recorded and synthesized sound, and full-motion video. Like it or not, rich data is here to stay. The "MTV generation" simply demands it.

Those demands are tearing down the wall that's dividing education and entertainment. Some use the term "infotainment" to de-

scribe these rich new forms of information.

### A DIGITAL WORLD

We're already living in a digital world; it's only going to become more so. Technologies including High Definition Television (HDTV) and ISDN are going to make a big difference during the next decade. You may have heard of ISDN. Officially, the acronym stands for Integrated Services Digital Network, but due to interminable delays, wags have for years supplied alternate expansions: e.g., *It Still Does Nothing*.

However, that is changing. Some analysts think that ISDN will be available to more than 50% of telephone subscribers by the end of 1993—little more than a year from now. We'll have to buy new phones, and they'll be expensive at first. But we'll be able to throw away our modems, install a cheap digital port (somewhat like an RS-232 card), and get 27 times better performance than a 2400 bps modem. We'll also get videophones, cheap. Talk to Grandma during the holidays, let her see the kids.

We're going to need even greater bandwidth than ISDN can provide to purchase and download videos on demand. Pilot sites on both coasts already provide that type of service. In the business environment, presentations have evolved rapidly over the past few years to include fancier and fancier graphical elements. That trend is likely to continue by adding sound, simple animations (e.g.,

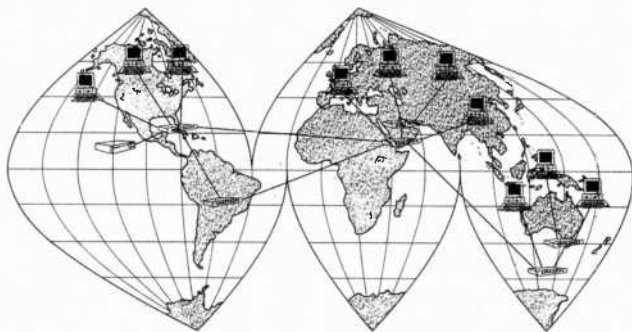


Fig. 1. In just a few years, all-digital global communications networks and high-powered personal computers will totally dwarf the already tremendous changes of the past 30 years in the fields of communications, consumer electronics, computers, and entertainment.

ing some high-tech form of conspicuous consumption. My reason is simple: It takes a lot of power to deal with what I'll call "rich data."

### RICH DATA

Computer users who have never used a Macintosh, an Amiga, a NeXT station, a workstation running Motif or Open Look, or a plain old PC running Windows may have trouble imagining computer screens displaying anything but  $80 \times 25$  screens of text. Consequently, that type of user has trouble imagining why anyone would want to.

# GET SMART

Quick & Cheap With Books!

Order Today!



## TALK!

Now you can get a ham license without a Morse code test! **All About Ham Radio** by Harry Helms tells you how. It covers what hams do... how to select equipment and antennas... using packet radio and ham satellites... operating procedures... and contacting hams in foreign countries! Also includes an introduction to radio theory and electronics. Start talking to the world today! Only \$19.95.

Helms tells you how. It covers what hams do... how to select equipment and antennas... using packet radio and ham satellites... operating procedures... and contacting hams in foreign countries! Also includes an introduction to radio theory and electronics. Start talking to the world today! Only \$19.95.



## LISTEN!

Listen to history as it happens via shortwave radio! **Shortwave Listening Guidebook** by Harry Helms tells

you all about the shortwave bands, when and where to listen, reception patterns, and how to select the shortwave radio that's right for you. It also profiles major world broadcasters. Includes hundreds of frequencies for stations worldwide and times to hear them. Just \$16.95.



## BUILD!

**The Forrest Mims Engineer's Notebook** by Forrest Mims (who else?) includes hundreds of

applications circuits using today's most popular linear and digital ICs! Forrest includes complete data for each IC, such as pin connections, logic tables, waveforms, & more! *If you experiment with ICs, you gotta get this book!* A steal at \$14.95.

You can get HighText books at your favorite technical bookstore, electronics parts dealer, or radio equipment dealer. Or order direct from HighText! Include \$3 per book for shipping (\$4 Canada, \$5 elsewhere). CA please add sales tax. U.S. funds only please.

**HighText**  
publications inc.

7128 Miramar Road, Suite 15L  
San Diego, CA 92121

projected sales growth), and video clips. Clearly, that environment demands powerful computers to accomplish anything beyond mindless data entry.

Factories need to collect data, predict and schedule maintenance activities, and alert management to inventory and manufacturing problems. Workers need on-demand video training. A 30-second video (available instantaneously across the network) detailing a complex assembly procedure is infinitely more effective than five pages of dense prose and static diagrams. Imagine receiving a VHS tape or interactive CD-ROM instead of printed assembly instructions when buying your child's (or grandchild's) next bike.

Schools have unique needs that far exceed the capabilities of the Apple II's and C64's that once promised salvation.

### TEACHER'S PEST

Reader T. G. mentions "many middle-aged school teachers... who only want to write letters and perhaps look at CompuServe," and then goes on to imply that they don't need big 486's with lots of RAM and hard disk space. That's probably true.

It is also regrettable. It is regrettable both for the teachers themselves and for our society. I have several school-age children, and frankly I don't want them to have those kinds of teachers. I want my kids to be taught by war-scarred veterans who've been tried by fire, who've lived to tell about it, and who are eager for more. I want my kids to experience, first-hand, the new possibilities that these technologies are opening up. I want my kids to experience the frustrations and the joys of using

these tools. It's good training, both professionally and personally.

That "middle-aged school teacher" type of complacency is on the way out. Businesses like GM, IBM, Digital, and countless others are trimming the fat. Companies large and small are releasing those who never showed enough initiative to learn new things, to reinvent themselves, to improve their worth to the company. I only wonder how they'll get new jobs when their skills are five, ten, and even twenty years old.

Nonetheless, education will follow, and soon. If the public institutions don't get with the program, expect greater and greater numbers of private institutions to take over. Washington is already talking about education credits that can be applied to both public and private schools.

The U.S. has supported a "secure," complacent way of life for the past 60 or so years. However, that ostrich attitude has come back to haunt us. The old ways were good enough, so we didn't modernize our steel plants, our semiconductor fabrication, or our educational systems. Now we're paying the price. We didn't modernize, so the Pacific Rim countries surged ahead.

The solution is not to try to regain dominance in particular industries. The world is much too complex for that. But that's a topic for another time. For now, don't let anyone fool you. The world is going digital. Everything will be available in digital form. You need lots of computer power to retrieve, create, and manipulate rich data.

It's scary, and it's hard. But even the smallest successes are satisfying. And a big success will let you leave your mark on the world. ■



# Give a Friend a Year of Electronics Fun this Christmas...

Does fighting the crowds at Christmas short-circuit your holiday fun? Don't blow a fuse this year. . . for the friend who shares your love of project-oriented electronics — or a youngster who may need only a spark to ignite a life-long interest — give a gift subscription to Popular Electronics.

Popular Electronics readers get the know how they need to build exciting, educational, and useful projects like these . . . a touch light dimmer. . . a traveler's theft alarm . . . an economy NiCd battery charger. . . a voice synthesizer. . . a portable frequency counter. . . a shortwave converter. . . a stereo graphic equalizer. . . even a robot!

PLUS. . . Gizmo, our honest and straight-shooting review of the latest consumer-electronics gear. . . Market Center, featuring mail-order merchants that are ready to help you in all your hobby activities. . . articles and columns covering every aspect of the electronics hobby — including antique radio, shortwave listening, ham radio, computers, scanners, circuit design, and more!

**SAVE MONEY.** . . A great gift to receive, Popular Electronics is also a great gift for *you* to give! The Special Holiday Rate saves you \$23.05\* off the newsstand price on each gift. You can save another \$23.05\* when you start or extend your own subscription at the same time. It's our "thank-you" for sharing Popular Electronics with a friend this Christmas.

Send no money, unless you prefer. We'll be glad to bill you in January, next year. Just take a brief moment to go over your gift list and make sure you haven't forgotten anyone who might appreciate the many benefits of Popular Electronics. Then write the names on the attached Gift Certificate and mail it back in the postage-paid reply envelope. . . we'll take it from there!

Your friends will receive a handsome gift announcement card signed with your name just before Christmas. And all through the new year they'll remember and appreciate your thoughtful gift! So don't blow a fuse. . . take it easy and enjoy the holidays. Give Christmas gifts of Popular Electronics!

## Popular Electronics<sup>®</sup>

\*Basic sub rate—1 yr/\$21.95



# CIRCUIT CIRCUS

By Charles D. Rakes

## UJT Circuits

This visit, we are featuring several circuits built around the unijunction transistor (or UJT as it is commonly called). The UJT is a two-layer, three-terminal PN device that has two bases (B1 and B2) and a single emitter (known as the gate). If you're relatively new to electronics or just haven't crossed paths with the UJT, then the following circuits just may spark an interest in using this device in some future circuit or project.

### RELAXATION OSCILLATOR

Figure 1 shows a UJT configured as a relaxation oscillator. In that circuit, the positive supply voltage is connected to B2, while the negative side of the supply is connected to B1. The emitter terminal is connected to the junction formed by timing capacitor

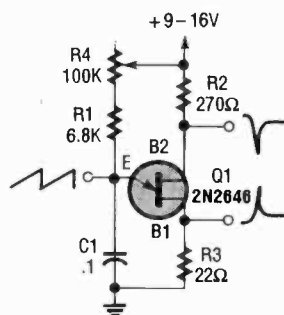


Fig. 1. In the relaxation oscillator, B2 is connected to the positive supply rail through R2, while B1 is connected to the negative side of the supply, and its emitter terminal (commonly known as the gate) is connected to the junction formed by timing capacitor C1 and potentiometer R4 (which ties the emitter to the positive-supply rail).

C1 and potentiometer R4; R4 ties the emitter to the positive-supply rail. When the emitter voltage is below the trigger level of the UJT, the impedance between its emitter and B1 is very high. But when the emitter voltage rises to the trigger level, the impedance between the emitter and B1 drops dramatically.

At the instant that power is applied to the circuit, the voltage across C1 is near ground. As time passes, the voltage across C1 rises. When the charge on C1 reaches the UJT's trigger level, Q1 turns on, discharging C1's stored energy into B1's negative-return resistor, R3, producing a fast-rising pulse at B1. At the same instant, the resistance between B2 and ground is lowered, causing a similar but opposite (negative) pulse at B2. After C1 has discharged, the cycle starts over.

The basic UJT circuit in Fig. 1 can supply output signals for a number of applications. It may be used as a clock generator, a timer circuit, a sawtooth generator, or a positive- or negative-pulse generator.

### MODIFIED RELAXATION OSCILLATOR

Our second UJT circuit, shown in Fig. 2, is a slightly modified version of the basic relaxation circuit shown in Fig. 1. A small 8- or 16-ohm speaker replaces B1's ground return resistor (R3), while a three-position switch (S1) and three capacitors (C1-C3) replace

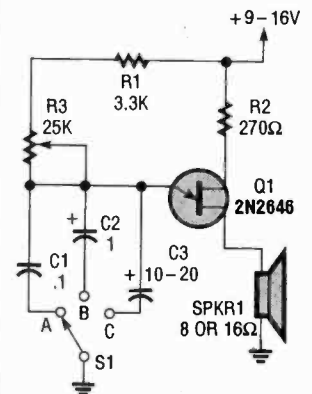


Fig. 2. In the modified relaxation oscillator, an 8- or 16-ohm speaker replaces R3, while a three-position switch (S1) and three capacitors (C1-C3) replace C1.

C1 in Fig. 1. The switch/capacitor combination is used to set the oscillator to operate in one of the three

### PARTS LIST FOR THE RELAXATION OSCILLATOR

#### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)

R1—6800-ohm

R2—270-ohm

R3—22-ohm

R4—100,000-ohm potentiometer

#### ADDITIONAL PARTS AND MATERIALS

C1—0.1-μF, ceramic-disc capacitor

Q1—2N2646 or similar unijunction transistor

Perfboard materials, enclosure, 9-16-volt power source, wire, solder, hardware, etc.

## PARTS LIST FOR THE MODIFIED RELAXATION OSCILLATOR

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)

- R1—3300-ohm
- R2—270-ohm
- R3—25,000-ohm potentiometer

### CAPACITORS

- C1—0.1- $\mu$ F, ceramic-disc
- C2—1- $\mu$ F, 25-WVDC, electrolytic
- C3—10-20- $\mu$ F, 25-WVDC, electrolytic

### ADDITIONAL PARTS AND MATERIALS

- Q1—2N2646 or similar unijunction transistor
- S1—SP3T switch
- SPKR1—8- or 16-ohm speaker
- Perfboard materials, enclosure, 9-16-volt power source, wire, solder, hardware, etc.

frequency ranges offered by this circuit. That switch/capacitor combination serves as a coarse frequency adjust. Fine-frequency adjustments for this circuit are made via R3, a 25k potentiometer.

When S1 is in either the A or B position, the circuit functions as a variable, audio-frequency oscillator. When S1 is placed in the C position, the circuit operates as a metronome. The circuit's frequency of operation can be reduced by increasing the values of either C3 or R3.

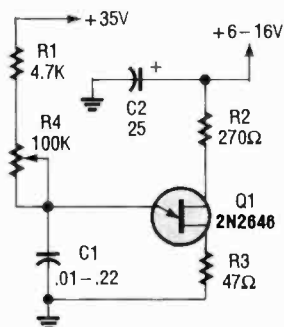


Fig. 3. Linearity in this version of the relaxation oscillator has been improved by adding a separate charging source. By using a higher source voltage to charge the timing capacitor, the entire sawtooth waveform period occurs during a smaller percentage of the total charging voltage.

## IMPROVED-LINEARITY RELAXATION OSCILLATOR

Our next UJT entry, see Fig. 3, takes the basic Fig. 1 circuit a bit further—adding a separate charging source to improve output waveform linearity. In any RC charging circuit that's not driven by a constant-current source, linearity is always better at the beginning and deteriorates as charging progresses.

By using a higher source voltage, the timing capacitor charges more rapidly, thereby improving the linearity of the output sawtooth waveform. The higher voltage won't damage the UJT because the voltage at the emitter never exceeds the UJT's trig-

## PARTS LIST FOR THE IMPROVED-LINEARITY RELAXATION OSCILLATOR

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)

- R1—4700-ohm
- R2—270-ohm
- R3—47-ohm
- R4—100,000-ohm potentiometer

### ADDITIONAL PARTS AND MATERIALS

- Q1—2N2646 or similar unijunction transistor
- C1—0.01-0.22- $\mu$ F, ceramic-disc capacitor
- C2—25- $\mu$ F, 25-WVDC, electrolytic capacitor
- Perfboard materials, enclosure, 6-16-volt and 35-volt power sources, wire, solder, hardware, etc.

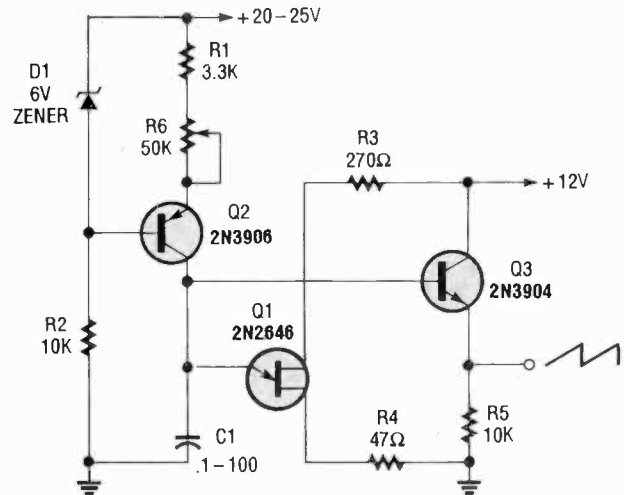


Fig. 4. In addition to the constant-current charging source used in the previous circuit, this one throws a buffer stage into the game, allowing the circuit to drive low-impedance loads.

## PARTS LIST FOR THE CONSTANT-CURRENT RELAXATION OSCILLATOR

### SEMICONDUCTORS

- Q1—2N2646 or similar unijunction transistor
- Q2—2N3906 general-purpose PNP silicon transistor
- Q3—2N3904 general-purpose NPN silicon transistor
- D1—6-volt, 1/2-watt Zener diode

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)

- R1—3300-ohm
- R2—10,000-ohm
- R3—270-ohm
- R4—47-ohm
- R5—10,000-ohm
- R6—50,000-ohm potentiometer

### ADDITIONAL PARTS AND MATERIALS

- C1—0.01-100- $\mu$ F, see text
- Perfboard materials, enclosure, 12- and 20-25-volt power sources, wire, solder, hardware, etc.

ger voltage, which is always less than the operating voltage applied to B2.

## CONSTANT-CURRENT RELAXATION OSCILLATOR

The circuit in Fig. 4 adds a constant-current charging source and a buffer stage to the basic UJT circuit in Fig. 1. In the Fig. 4 circuit, Q2, D1, R1, and R6 form a simple constant-current regulator. The level of regulated current is set by the values of R1 and R6. Transistor Q2's collector supplies the constant charging current to C1, whose value is selected for the desired frequency range. The value of C1 can range from .005 to

(Continued on page 90)

# THINK TANK

By John J. Yacono

## RF Bulbs

The topic for this month, about a new light-bulb technology, was inspired by a letter that I'll present shortly. It just goes to show you there will always be a better "mouse trap" waiting to be invented. Perhaps we should re-think the wheel?

After we discuss the functioning and features of the new light, we'll explore a general mix of correspondence, including the

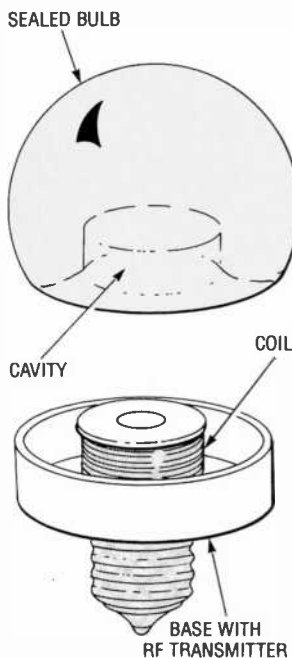


Fig. 1. The small coil transfers RF energy from the transmitter in the base to the gas in the bulb.

"simplest, simplest" headlight reminder, a request from one reader answered by yet another, and advice about circuits that have appeared here before. Now let's discuss this new light under the sun.

### A BRIGHT IDEA

Just yesterday, I saw an interesting new product on

TV. It was a "radio" light bulb. The globe of the bulb was removed (apparently it wasn't hot) during the show to reveal a thread-spool-like inductor made from heavy-gauge wire (see Fig. 1). I would like to know how this device works and would appreciate any help on this.

—Lloyd J. Crisp, Metairie, LA

I'd be glad to pass along what I know about the new bulbs. However, it is important to point out that these bulbs are in the prototype stage and may never be commercially available. As to the bulb, it consists of an RF transmitter (located in the unit's base) and a sealed bulb of gas with an internal fluorescent coating. The sealed bulb has a depression on one side (kind of like a finger-hole in a bowling ball) to accommodate an inductor on a cylindrical form that protrudes from the base, as you mentioned. The coil couples the RF energy produced by the transmitter to the gas within the bulb. The RF frequency, the gas mixture, and the coating have been selected so that the RF energy ionizes the gas, causing the coating to radiate light.

The bulb has some great advantages over other fluorescent designs, let alone incandescent units. Since there are no filaments to burn out, the bulb's estimated lifetime is about 30 years. As they don't require the slightly inefficient step-up transformers used in other fluorescent schemes, they conserve energy and are less expensive to oper-

ate. By virtue of the coating and gas mixture, the bulbs emit a more complete spectrum of light, reducing (perhaps eliminating) eye strain for those sensitive to other forms of fluorescent lighting. To summarize, they are a nearly 100% efficient, longer-lasting, healthier, cost-effective alternative to anything else we have.

As for me, I have only one concern about these "super bulbs:" it regards the RF radiation they emit. With all the fuss people are making lately about being incidentally radiated (by power-distribution lines, household wiring, and appliances), how safe are these small RF-transmitters? I don't know myself, and I would appreciate hearing from anyone with input on the matter.

By the way, this idea is not totally new. It was originally conceived by Nicola Tesla who thought it might be possible to beam energy directly to bulbs and other devices without wires.

### A WINNER

A recent issue told of "one of the simplest" and also the "simplest" headlight reminder. Well, here is an even simpler "simplest" (see Fig. 2). To install it, simply tap into the driver-side, dome-light switch (which is a grounding switch) and into a positive parking-light line and connect a mechanical buzzer to them. To make the connection you will probably need a couple of feet of wire and a couple of connector clamps.

While I have used this circuit for years, my 1990



Nissan pickup had this warning system from the factory.

—Walt Wheelock, Glendale, CA

I've received dozens of headlight-reminder circuits in response to the column that you've mentioned. Yours has been chosen to appear because it is the simplest one with the highest number of good features. Among its distinguishing characteristics are: one-part design, it turns off when the door closes to further preserve battery life, and it warns you even if just the parking lights are on.

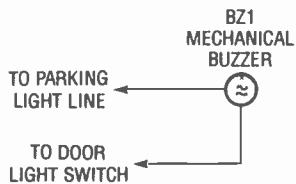


Fig. 2. Can a headlights-on reminder get any simpler than this? If you think so then write in.

The other circuits I've received had one or two of those features, but not all of them at once. Since you were able to distinguish yourself from such a large group of readers I've decided to send you a little something extra with your book. It's the special MC1010 chip mentioned in the first Think Tank column I wrote. They are hard to find since Motorola no longer supports them, so I thought you might like to have the little novelty to add to your junkbox. You've earned it.

### IMPROVING CONDITIONS

First I'd like to thank you for providing me and many other readers with information and projects that have often proved to be just what I needed.

Winter may now be here, but the air-conditioning

season will be upon us before you know it. And as those who live in two-level dwellings (as I do) know, when you use air conditioning, the upstairs is often warmer than the downstairs due to hot air rising and cool air sinking. In my own case, that situation is aggravated by the thermostat, which is located downstairs. As the lower level cools more rapidly than the upper level (with lower-level temperature causing the air-conditioner to shut down prematurely), the upper level is always unbearably warm.

In an attempt to preempt that annoying situation, I have concluded that what I need is a way to automatically control a circulating fan so that it cycles on for perhaps ten to fifteen minutes every hour, thereby maintaining a consistent temperature throughout the structure. And if a variable on/off cycle were to be designed into the control circuit, so much the better! Unfortunately, I'm not the designing kind. But, my guess is that such a circuit could be built around a pair of 555's and a relay(?). If you think this circuit could be of interest to your readers, I'd look forward to your reply in a future installment of *Think Tank*.

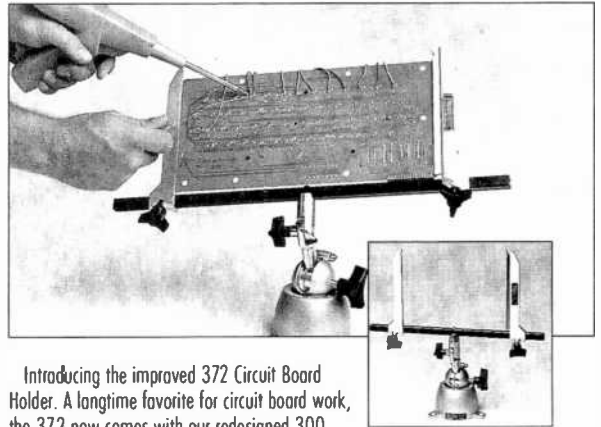
—Jon Hauko, Acworth, GA

One alternative is to use something based on the 558 quad monostable timer (see the November and December installment of *Think Tank* for more information on that chip). Another way to go is to use a limited version of the circuit presented by this next reader.

### IN THE DOG HOUSE

This circuit (shown in Fig. 3) can be used in almost any situation to keep the temperature within a cer-

# Go ahead, put on some weight



Introducing the improved 372 Circuit Board Holder. A longtime favorite for circuit board work, the 372 now comes with our redesigned 300 base. A new, patented, internal modification to the 300 split ball locking mechanism allows it to hold twice as much weight as its predecessor. Of course, the 372 still comes with the industry's best circuit board holder, the PanaVise 315, which can hold PCBs up to 12 inches wide (up to 28" with 30" 316 Accessory Cross Bars.) You can even handle multiple boards when you use additional 316 Circuit Board Arms. The new PanaVise 372 Circuit Board Holder. When circuit boards are your business.



1485 Southern Way • Sparks, NV 89431 • (702) 353-2900 • FAX (800) 395-8002

CIRCLE 6 ON FREE INFORMATION CARD

| STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION   |  |  |
|--|--|--|
| 1. TITLE OF PUBLICATION<br>POPULAR ELECTRONICS   |  |  |
| 2. FREQUENCY OF ISSUE<br>MONTHLY   |  | 3. DATE OF FILING<br>10/15/92                                |
| 4. COMPLETE MAILING ADDRESS OF KNOWN OFFICE OF PUBLICATION (Street, County, State and ZIP+4 only (See instructions))<br>500-B BI-COUNTY BLVD. FARMINGDALE, NY 11735  |  | 5. NUMBER OF COPIES PUBLISHED ANNUALLY<br>12                 |
| 6. COMPLETE MAILING ADDRESS OF THE HEADQUARTERS OF GENERAL BUSINESS OFFICES OF THE PUBLISHER (See instructions)<br>500-B BI-COUNTY BLVD. FARMINGDALE, NY 11735   |  | 7. ANNUAL SUBSCRIPTION PRICE<br>\$21.95                      |
| 8. FULL NAMES AND COMPLETE MAILING ADDRESSES OF PUBLISHER, EDITOR, AND MANAGING EDITOR (This form MUST NOT be blank)   |  |  |
| PUBLISHER (Name and Complete Mailing Address)<br>LARRY STECKLER 500-B BI-COUNTY BLVD. FARMINGDALE, NY 11735  |  |  |
| EDITOR (Name and Complete Mailing Address)<br>CARL LARON 500-B BI-COUNTY BLVD. FARMINGDALE, NY 11735   |  |  |
| MANAGING EDITOR (Name and Complete Mailing Address)  |  |  |
| 9. OWNER: If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given. If the publication is published by a proprietor, his name and address must be stated; if there are other proprietors, their names must be completed. |  |  |
| 10. FULL NAME COMPLETE MAILING ADDRESS<br>GERNSBACK PUBLICATIONS, INC. 500-B BI-COUNTY BLVD. FARMINGDALE, NY<br>LARRY STECKLER 500-B BI-COUNTY BLVD. FARMINGDALE, NY   |  |  |
| 11. BONDHOLDERS, MORTGAGEES, AND OTHER SECURED PARTIES OWNING OR HOLDING 1 PERCENT OR MORE OF TOTAL AMOUNT OF BONDS, MORTGAGES OR OTHER SECURITIES (If none, so state)   |  |  |
| FULL NAME COMPLETE MAILING ADDRESS   |  |  |
| 12. FOR COMPLETION BY NONPROFIT ORGANIZATIONS AUTHORIZED TO MAIL AT SPECIAL RATES (Section 4212 (2) (B) only)<br>The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes (Check one)<br><input type="checkbox"/> HAS NOT CHANGED DURING PRECEDING 12 MONTHS <input type="checkbox"/> HAS CHANGED DURING PRECEDING 12 MONTHS (If changed, publisher must submit explanation of change with this statement.)  |  |  |
| 13. EXTENT AND NATURE OF CIRCULATION (See instructions on reverse side)  |  | 14. AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS |
| A. TOTAL NO. COPIES (Net Press Run)  |  | 157,684  |
| B. PAID AND/OR REQUESTED CIRCULATION (1. Sales through dealers and carriers, street vendors and counter sales. 2. Mail Subscriptions (Paid and/or requested))  |  | 37,772   |
| C. TOTAL PAID AND/OR REQUESTED CIRCULATION (Sum of B. (1) and B. (2))  |  | 49,204   |
| D. FREE DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS (Samples, complimentary, and other free copies)   |  | 86,976   |
| E. TOTAL DISTRIBUTION (Sum of C and D)   |  | 4,311  |
| F. COPIES NOT DISTRIBUTED (1. Office use, left-overs, unsold, uncollected, returned after prepayment. 2. Return to News Agents)  |  | 91,287   |
| G. TOTAL (Sum of E, F, and G—should equal net press run shown in A.)   |  | 5,949  |
| H. TOTAL (Sum of E, F, and G—should equal net press run shown in A.)   |  | 60,448   |
| I. TOTAL (Sum of E, F, and G—should equal net press run shown in A.)   |  | 157,684  |
| J. TOTAL (Sum of E, F, and G—should equal net press run shown in A.)   |  | 155,855  |
| 15. I certify that the statements made by me above are correct and complete  |  |  |
| SIGNATURE AND TITLE OF EDITOR, PUBLISHER, BUSINESS MANAGER, OR OWNER   |  | EDITOR   |

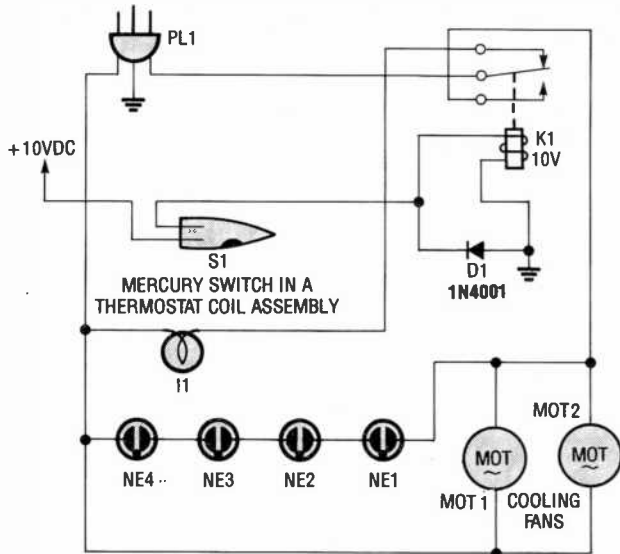


Fig. 3. Here's a complete cycling heating and venting system for any small enclosed space.

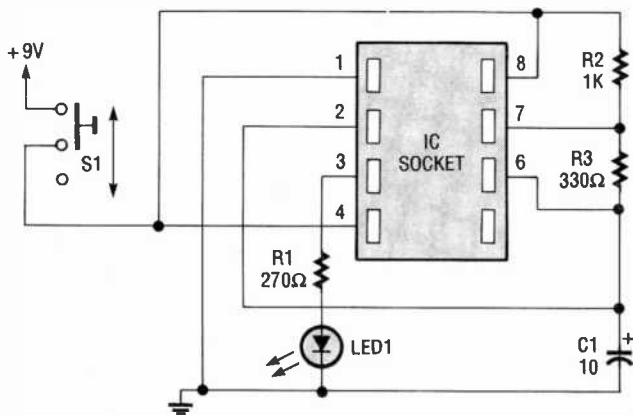


Fig. 4. This circuit can be used to test 555 timer IC's for proper functioning. However, does the circuit need to be modified for its own proper operation?

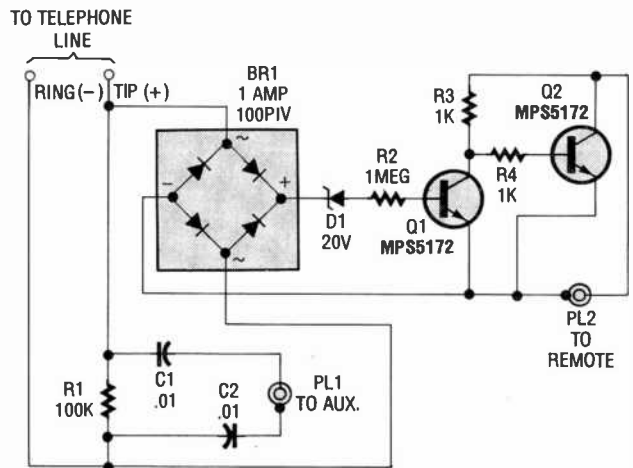


Fig. 5. This recording control relies on the doubled minimum saturation voltage of the Darlington pair to keep from turning off.

tain range. I use it in a doghouse for year-round temperature control. (My

wife made me do it.) It can be easily reconfigured to meet many needs.

Switch S1 is a mercury switch located in an old thermostat assembly that mounted in the dog house. You can adjust the temperature range by adjusting the angle of the bulb on the coil.

When building your own control units, make sure the contacts of relay K1 exceed the current draw of the fan(s) and lamp that you use. Mine were old computer-cooling AC fans that were on hand. Neon lamps were used instead of noise-suppressing capacitors for no special reason. It just looks neat when the fans go off and the neon bulbs flash. Just be sure to use enough neon lamps for your fan motor(s) or the counter EMF will burn them up.

The heating lamp, a regular 60-watt light bulb, should be mounted in relation to the thermostat coil to give the desired time you want the area to receive heat. Mounting it far away from the thermostat will allow more heat to escape into the area; mounting it closer will cause the relay to switch on and off more frequently.

—Jim Austin, Arlington, TX

You shouldn't feel awkward about your circuit. Your wife had a good idea that another reader will benefit from. Your book is on the way.

### SOME MODIFICATIONS

I built the 555 timer tester (Think Tank, October 1991) shown in Fig. 4, but could not make it work until I changed R3 from 330-ohms to 9500 ohms. All other parts in my unit are very close to the indicated values. It now works quite well and is very useful.

I really enjoy Think Tank! Keep it up.

—Howard Fogle, Katonah, NY

Thanks for the information. The problems you've experienced could be due to the fact that you used parts other than those originally specified in other places in the circuit.

### DOUBLE TROUBLE

I found Andy Barfield's Telephone Recording Control circuit (from August, 1992, and shown in Fig. 5) and your comments about it interesting. The reason that Q2 "doesn't shut itself off by reducing current flow through R3" is that the Q2 collector-emitter junction does not achieve full saturation. The saturation voltage will remain just above the minimum base-emitter forward barrier potential of Q2 (about 0.6V). That's because the saturation voltage is slightly greater than the sum of the 2 base-emitter forward barrier potentials (about 1.2V). The circuit is thus a stabilized self-limiting linear amplifier.

This phenomenon usually presents a common problem when using Darlington-pair transistors. For example, in low-voltage motor-control circuits, such as in a microcassette recorder, which uses only 3 volts, the high saturation voltage of Q2 could result in a slowing of the motor, and distorted sound on playback. It may be possible to give Q2 a little extra "boost" to reduce the collector-emitter saturation voltage by connecting a large-value resistor between the positive output of the bridge, and the collector of Q1.

The value of the resistor should be low enough to provide Q2 with the extra base-emitter current required for collector-emitter saturation of about 0.1 volt with a bridge output of 5 volts. However, it should not

(Continued on page 91)

# DX LISTENING

By Don Jensen

## Targeting the World

There's an easy way, and a hard way, to do most things. And there is something to be said for each approach. As a shortwave listener, doubtless you have your goals. It may be to hear as many different stations as you can. Or, perhaps, the challenge is to tune in a certain as-yet unheard broadcaster half a world away.



This station sticker is sent, along with a QSL card, to those SWL's who report hearing WJCR, a new US shortwave station.

For many beginning SW DX listeners, the self-selected target is to tune in, and then collect QSL-card verifications from at least one world-band station on each of the continents. While an interesting goal, it's not too difficult to achieve in this age of super-high-powered shortwave transmitters. With a bit of effort and some time, one can accomplish that even with a fairly unsophisticated receiver.

But logging all continents—Africa, Antarctica, Asia, Australia/Oceania, Europe, and North and South America—can also be a very difficult task if you limit yourself to other stations in those areas, such as low-powered, domestic, or home-service shortwave broadcasters.

When it comes to HAC (Heard All Continents), there's an easy way, and a hard way. So, for beginning SWL and veteran DX'er alike, here are some different ways to accomplish that HAC goal. There are, of course, many other stations that would fit the bill, as well. The following is just a sampling:

#### AFRICA:

**Egypt**—*Radio Cairo* shouldn't be difficult as a starter. For years, this North-African SW'er has been a regular on 9,475 kHz during the evening hours. You will find it easily if you tune in shortly before 0300 UTC, when its Arabic-music programming is a dead giveaway. English programming begins on the hour.

**Angola**—*Emissora Provincial do Lobito*, a difficult catch, is one of the seldom-heard regional stations from this southern African country. It has been logged with Portuguese-language programming in the eastern U.S. on 7,151 kHz at around 2230 until 2304 UTC sign off. It relays the *Radio Nacional* service, but has been heard with a local identification for Radio Emissora Regional Lobito at about 2240 UTC.

#### ANTARCTICA:

Well, there are only two shortwave stations that

have operated from this frozen "bottom-of-the-world" continent, so the choices are limited. The easier of the two is clearly the Argentine Army's *Radio Nacional Arcangel San Gabriel*, LRA36, at *Base Antartida Esperanza* (which translates from Spanish as Antarctic Base "Hope"). When it is on the air, which it is periodically, it can be heard with quite good signals at times on 15,475 kHz, in Spanish from 2100 to 2300 UTC.

The other Antarctic SW station, which has been logged even more sporadically in North America, is the *American Forces Antarctic Network* station at the U.S. research station at McMurdo. Programming is mostly local-deejay pop-music shows. The frequency is 6,012 kHz, and seems best heard from around 100 to 1200 UTC when it is active.

#### ASIA:

**China**—*Radio Beijing* is hard not to hear. This is one of the world's major shortwave broadcasters, and it operates many transmitters on many different frequencies. Look for their English programming, which is beamed to eastern North America at 0000–0100 UTC on 9,770 and 11,715 kHz; and to western North America on 0300–0400 UTC, on the same two frequencies, plus 9,690 kHz.

**Bhutan**—*Bhutan Broadcasting Service*, from Thimpu (the capital city of this tiny Himalayan kingdom), is a prize catch for any DX'er. It has been heard as far east as Ontario, however, at around 1300 to 1345 UTC, or later,



on 5,025 kHz.

#### AUSTRALIA/OCEANIA:

**Australia**—*Radio Australia* is a good choice, since it operates with decent power from about 0000 to 0400 UTC on 21,740 kHz; 0400 to 0830 UTC on 15,240 kHz, and 0830 to 1500 UTC on 9,580 kHz.

**Bougainville**—Site of a bloody battle during WW2, Bougainville is part of the far-flung island nation of Papua, New Guinea. But the local inhabitants are in a state of rebellion against the distant government. The clandestine SW station, *Radio Free Bougainville* has been heard with some difficulty by North American DX'ers on 3,880 kHz, between about 0800 and 1100 UTC.

#### EUROPE:

**Italy**—The choices for an easy European logging are many. I've selected Italy's

RAI, *Radiotelevisione Italiana*, whose English programming is beamed to North America at about 0100 UTC on 9,575 or 11,800 kHz.

**Scotland**—There are no licensed shortwave stations in this northern part of the United Kingdom, but there are a couple of now-and-then illicit "pirates" on the air. One whose low-power signal has been known to jump the Atlantic is *Weekend Music Radio*, which uses different frequencies at different times. One frequency that you might try is 15,044 kHz on the weekends at around 0100 UTC.

#### NORTH AMERICA:

**United States**—While there are a number of different shortwave voices that could qualify as easily heard, one of the newest on the air is a relatively

small religious broadcaster with a big signal, *WJCR World Wide* in Upton, Kentucky. Try for this one at almost anytime on 7,490 kHz.

**Canada**—*CKFX* in Vancouver, British Columbia, operates on 6,080 kHz with a mere 10 watts of power. It is a tough log in most of North America. Your best chance for hearing this one would be during the wee hours of the morning between midnight and dawn.

#### SOUTH AMERICA:

**Ecuador**—Flat out, the easiest way to log South America is *HCJB* in Quito. There is a good chance that HCJB will be for most beginning SWL's what it was for me nearly 46 years ago, the first shortwave station we ever heard. But if you haven't found it yet, try tuning 9,745 or 15,155 kHz between 0030 and 0500 UTC.

**Surinam**—*Radio Apintie* on 5,006 kHz has been an extremely tough logging for more than a few years. It has been running a mere 50 watts of power in a noisy area of the 60-meter band. But it was heard not too long ago in the eastern U.S. at around 0400 UTC.

It's up to you whether you want to try the easy or hard path to HAC.

#### IN THE MAIL

Your letters are always welcome. What are you hearing on the shortwave bands? What are your favorite stations or QSL's? Do you have questions or comments about SWL'ing? Drop me a line in care of *DX Listening, Popular Electronics*, 500-B Bi-County

\*Credits: Dan Ferguson, VA; Bob Padula, Australia; Fred Barkley, Richard Langley, Canada; Art Magnussen, MN; North American SW Association, 45 Wildflower Road, Levittown, PA 19057.

Blvd., Farmingdale, NY 11735.

Jack DeAntonio of Coral Gables, FL, has an opinion question for me. "What," he asks, "do you think is the most significant thing that has happened to SWL'ing in the past few years?"

Unquestionably, Jack, it is the drastic and dramatic changes that have occurred in shortwave broadcasting within the former Soviet Union. With the disappearance of the old monolithic USSR, with its huge, centrally directed broadcasting apparatus, shortwave radio has been turned on its ear.

Within the new "commonwealth," there remain hundreds of high-powered SW transmitting facilities and no central controlling organization. What we now are seeing are all sorts of new broadcasting operations, using the existing stations. Some have been leased to western religious broadcasters. Some have come on the air as fledgling commercial stations. There are all sorts of new stations coming on the air.

It's a fun time to be SWL'ing!

#### DOWN THE DIAL

Here are a couple of eastern European stations to tune for:

**BULGARIA**—*Radio Sofia* has been reported with English programming from 0300 to 0400 UTC on 9,850, 11,720 and 15,160 kHz.

**CROATIA**—Zagreb's *Croatian Radio* features English-language news shortly after 0600 and at 0800 UTC. Try 9,830 kHz. They've also been noted on 21,480 kHz at about 1200 UTC.

**UKRAINE**—The *Radio Ukraine World Service*, formerly "Radio Kiev," can be heard at various times between 0200 and 0730 UTC on 15,195 and 17,690 kHz. ■



*All About Ham Radio* by Harry Helms, AA6FW, tells how to get your *codefree* ham license and talk to the world. In over 300 pages, you'll learn about:

- packet (computer-to-computer) radio
- ham television
- using ham radio satellites
- contacting stations in foreign countries

and many other exciting topics explained in a friendly, humorous style without a lot of math and or technical jargon. If you've been wanting a ham license, this is the book you've been waiting for!

Only \$19.95 at bookstores and radio equipment dealers. Or order direct from HighText! Add \$3 shipping (\$4 to Canada, \$5 elsewhere). CA please add sales tax. U.S. funds only please.

**HighText**  
publications inc.

7128 Miramar Rd., Suite 15L  
San Diego, CA 92121



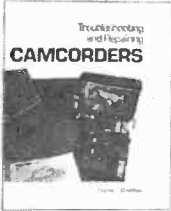
1367P \$29.95  
Softcover



3550-XX \$34.95  
Counts as 2



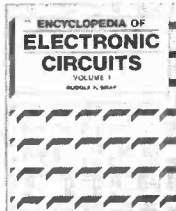
2790P \$15.95  
Softcover



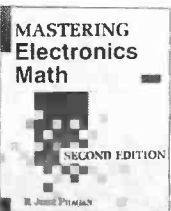
3337-XX \$35.95  
Counts as 2



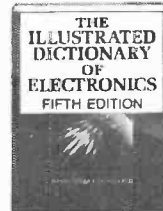
2613P \$17.95  
Softcover



1938-XXX \$60.00  
Counts as 3



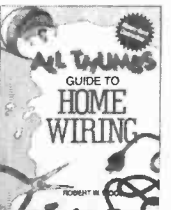
3589 \$27.95



3345P-XX \$26.95  
Counts as 2/Softcover



3475P \$17.95  
Softcover



4000P \$9.95  
Softcover



3777-XX \$32.95  
Counts as 2



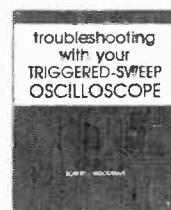
2867P \$18.95  
Softcover



3258 \$28.95



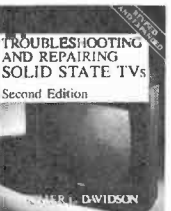
2980P \$19.95  
Softcover



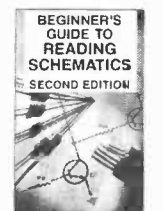
3665 \$27.95



3671 \$29.95



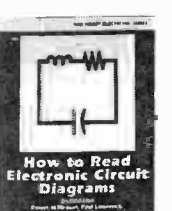
3700-XX \$36.95  
Counts as 2



3632P \$10.95  
Softcover



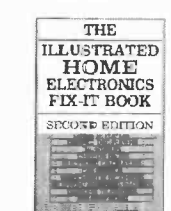
585928 \$24.95



2480P \$14.95  
Softcover



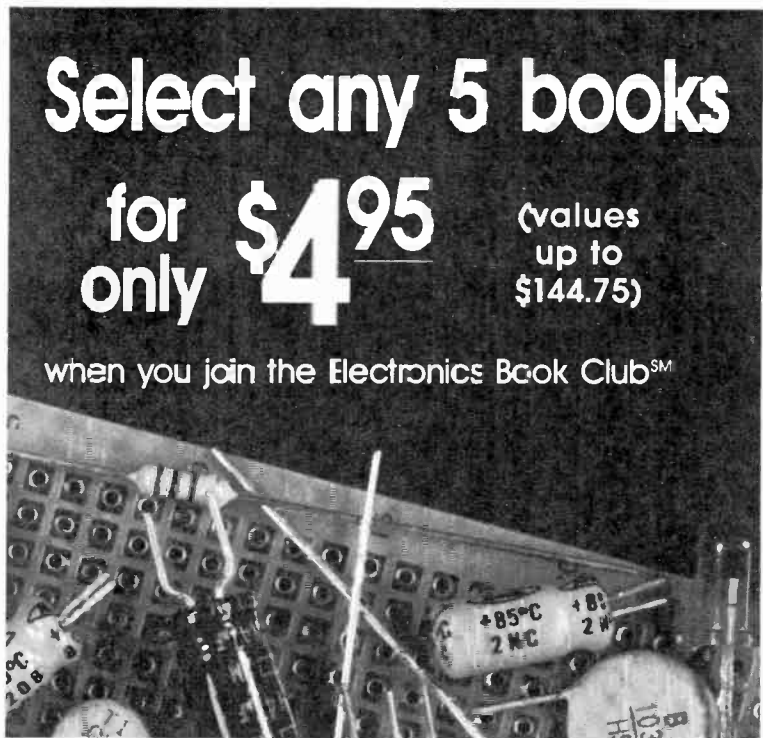
3627P \$19.95  
Softcover



2883P \$18.95  
Softcover



3886 \$22.95



# Select any 5 books

# for only \$4.95

(values up to \$144.75)

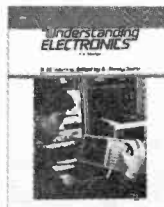
when you join the Electronics Book Club<sup>SM</sup>

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

. . . you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off of regular publishers' prices. If you want the Main Selection do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. And you'll be eligible for **FREE** books through the **NEW** Bonus Book Program. Your only obligation is to purchase 3 more books during the next 12 months, after which you may cancel your membership at any time. PE193

A shipping/handling charge and sales tax will be added to all orders. All books are hardcover unless otherwise noted. (Publishers' Prices Shown) If you select a book that counts as 2 choices, write the book number in one box and XX in the next. If you select a Counts as 3 choice, write the book number in one box and XXX in the next 2 boxes. ©1992 EBC

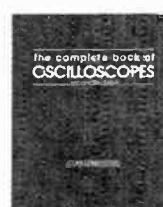
**Your most complete and comprehensive source for the finest electronics books.**



3044P \$12.95  
Softcover



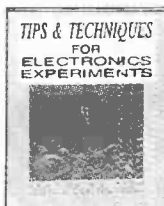
4143 \$22.95



3825 \$26.95



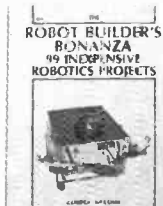
3114-XX \$39.95  
Counts as 2



3145P \$12.95  
Softcover



3362 \$22.95



2800P \$16.95  
Softcover



3540 \$26.95

If card is missing, write to: Electronics Book Club, Blue Ridge Summit, PA 17294-0810

# HAM RADIO

By Joseph J. Carr, K4IPV

## Some More Potpourri

From time to time, I like to take a look at my mail bag and answer some questions posed by readers. This "potpourri" usually rambles from one topic to another, as does the actual mail. But first, however, let me say thank you for all of the mail that I've received. With only a couple of exceptions, the mail has been running very positive. I am

station (88- to 108-MHz band). It seems that he lived only a few blocks from the FM "blowtorch," and it overloaded the front end of his receiver. Many modern receivers do not have terribly selective front ends. They use a wide bandpass filter rather than peaked, resonant circuits (which was the former way of doing the job). As such, some of those "wonder-boxes" seem eager to overload in the presence of strong local signals.

The solution to the problem is the same as I've harped on for many years: use a lowpass filter (LPF) with a cut-off frequency ( $F_c$ ) that's above the 10-meter band, but sufficiently below the frequency of the offending signal that it is way down the roll-off curve. All hams should use some sort of lowpass filter in the antenna line in order to prevent TVI from your transmitter (the "good neighbor policy" is best).

However, I've seen some cases where a lowpass TVI filter messes up the bandpass filters that are used in the output circuits of modern solid-state rigs. As long as both the output and input have impedances of 50-ohms, and as long as the entire system is impedance matched, then the filter should cause no harm. But that ideal is seldom reached in practical cases.

There have been some problems when certain brands of LPFs are used with some transmitters. The problems seem aggravated when certain antenna-tuning units are used in the line as well. If

you want the receiver to be less sensitive to all forms of VHF signals (including channels 2-5 TV, FM BCB, 6-meter hams, and "low-band" landmobile VHF-FM communications stations), then use a TVI filter in the output of your transceiver.

However, if you are not able to use such a filter because of mismatch problems in your rig, or if you use a separate receiver, then try one of the circuits in Fig. 1. Those circuits are 10-meter-plus LPF's, and will probably do the job. You can make them small enough to fit inside many transceiver cabinets on the receiver side of the T/R relay.

Of course, with a separate receiver that's not a problem. Build them in an outboard shielded box and be happy. The LPF in Fig. 1A is a two-section LC filter that has a cut-off frequency in the 32-MHz region. The capacitors (C1-C4) should be silvered mica or NPO ceramic-disc units. The inductors can be either store-bought (try Digi-Key, P.O. Box 677, Thief River Falls, MN, 56701-0677; Tel. 1-800-344-4539) or made from Amidon Associates (P.O. Box 956, Torrance, CA 90508) toroidal cores. Try Amidon's T-37-6 (yellow) core wound with ten turns of #26 enameled wire.

The other filter is simpler, but has a less steep roll-off characteristic above the cut-off frequency. It will nonetheless work for attenuation of FM signals. The small 7.7-pF capacitors should be either ceramic-disc or tubular-ceramic units. The inductor can be

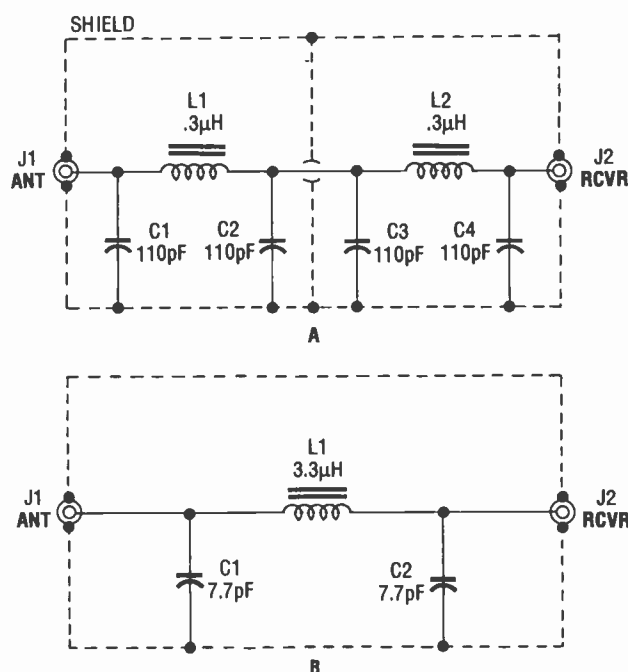


Fig. 1. These two 10-meter-plus LPF circuits, which are designed to remove VHF signals that can cause receiver front-end overload, can be made small enough to fit inside many transceiver cabinets. The LPF in A is a two-section LC filter that has a cut-off frequency in the 32-MHz region. The one in B is simpler, but has a less steep roll-off characteristic above the cut-off frequency.

glad that shortwave listeners, monitor buffs, and general electronics enthusiasts all find this column so useful.

### LOW-BAND VHF SIGNAL'S

One reader complained that the 15- and 10-meter bands were compromised by a local FM broadcasting

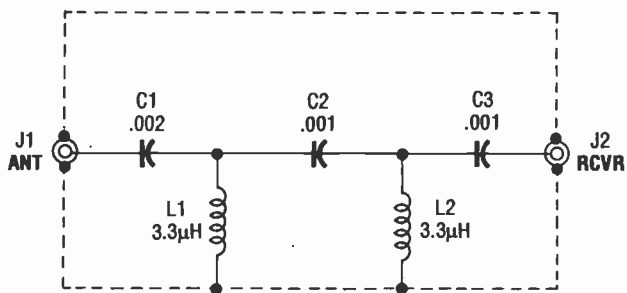


Fig. 2. This HPF filter circuit can be used in cases where AM broadcast-band interference is a problem.

wound on the same core as above (Amidon T-37-6), but requires 33 turns of wire. That's a lot of turns for a T-37-size core, so use #30 wire. Alternatively, use a T-50-6 (yellow) core, wound with 29 turns of #26 wire.

In cases of AM broadcast-band interference, you can use the circuit of Fig. 2 (which I've mentioned before in this column). I've had good results using both the T-50-2 (red) and T-50-6 (yellow) cores. In the case of the T-50-2 core, only 26 turns of #26 wire are needed.

By the way, when I give wire sizes for filters, the wire size is for reference only. The filter will work the same with other wire sizes if you can get the right number of turns on the form. It's the turns count that counts, not the size of wire (except in transmitters, where high power is involved).

Remember, these filters are for receiver applications only. The higher power filters needed for transmitters use heavier duty capacitors and much heavier inductors.

### WHAT'S THE "LAW OF RECIPROCALITY?"

Well, it's not some flaky New Age concept (George Gurdieff notwithstanding), but rather a property of antennas. The "Law of Reciprocity" concept means that an antenna works on receive exactly as it works on transmit. In other words,

if it has 5.5-dBi gain on transmit, it will also have 5.5-dBi gain on receive. The transmit and receiver azimuthal and elevation patterns remain the same in both modes.

There is no known case where the Law of Reciprocity for Antennas is violated. The only case where it looked like such an Earth-shaking breakthrough might have occurred turned out to be a hoax. It appeared in the April issue of a popular ham-radio magazine.

The Law of Reciprocity does not, however, imply that all antennas are "created equal" in regards to the receive and transmit modes. It can be argued that the major antennas (dipoles, yagis, quads, and verticals) are pretty nearly matched with respect to receiving and transmitting. But that is not universally the case: For example, the small loop antenna is great for small-space reception of low frequencies (75-meters down to VLF), but transmits for squat. I've used a 24-inch square loop to cut down the crud on 75-meters by nulling out some of the interference. That scheme works well when the interference is arriving from an angle that's different from the desired station (it doesn't work well at all if your location lies in a line that also passes through both the interfering and the desired station).

Another "dyn-o-mite" receive antenna that doesn't work as well on transmit is the Beverage antenna. This claim may seem contradictory because a Beverage is similar to a long-wire beam antenna. But the Beverage works best on receive over poor ground, and is thus somewhat lossy for transmitting. It's not a total bust, however, and may have more gain than a dipole, but it doesn't work quite as well on transmit as receive.

### SECOND RECEIVER

A little earlier, I mentioned that some hams use a second receiver on the HF bands. Why, you ask? Well, there are several reasons. DX'ers like to keep track of other DX opportunities on the band while waiting their turn in a pile-up. The second receiver

also makes sense when the pile-up is on one frequency (you eavesdrop on the competition) and the DX quarry is on a slightly different frequency.

To be maximally effective the second receiver must be at least as good as the receiver in the transceiver. One recent model that is a very good radio is the R.L. Drake (P.O. Box 3006, Miamisburg, OH, 45342; 513-866-2421) Model R8. That American-made radio receiver walks with the best of them, and is a pleasure to operate. I recently test drove one and was most pleased.

We welcome your letters, comments, suggestions, etc. Send all correspondence to *Ham Radio*, c/o **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radiotelephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

**No Need to Quit Your Job or Go To School** This proven course is easy, fast and low cost! **GUARANTEED PASS**—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

#### COMMAND PRODUCTIONS

FCC LICENSE TRAINING, Dept. 100  
P.O. Box 2824, San Francisco, CA 94126  
Please rush FREE details immediately!

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_



# SCANNER SCENE

By Marc Saxon

## A Couple of Winners

**R**adio Shack's *Realistic Patrolman PRO-2026* kicks off the new year with a field goal. It consists of an attractive mobile scanner that reprises a feature we always liked when it was available—service search. Pressing one of the five front-panel buttons marked POLICE, FIRE, AIR, WEATHER, and MARINE, instantly causes the scanner to begin searching (at 19 channels per second)



The new Radio Shack Realistic PRO-2026 offers service search.

all frequencies assigned to the selected service. You don't have to program search frequency limits for those services on any bands.

The PRO-2026 has 100 memory slots, arranged in five banks of 20 channels each. The frequency range is 29 to 54 MHz, 108 to 174 MHz, 406 to 512 MHz, and 806 to 956 MHz. The cellular bands are locked out at the factory. The IF frequencies are 10.8 and 450 kHz. Scan speed is 14 channels per second, with an optional two-second delay for each channel. There's also a priority channel that's sampled every two seconds.

This new mobile scanner sells for \$199.95, and can be seen at your nearest Radio Shack. We were very impressed with the PRO-2026 and found that the service-search feature was a much used function at our installation. We also liked that the light in the backlit LCD could be turned off, which we appreciated while driving at night. Good set!

### ANOTHER INTERESTING PRODUCT

For the many readers who are deeply into monitoring the 800–900-MHz band, we stumbled across something really useful—a powerful, 11-element, rear-mount 800–900-MHz (only) loop yagi beam antenna for base station use. It's fully assembled, so all you need do is attach a coaxial cable with a Type N connector to the beam, and feed the signals into your scanner.



Try this 800-MHz yagi on those distant stations!

If the 800-MHz band stations that you most want to hear are in only one direction, then stick it on your roof aimed in that direction for long-range reception. Or you can mount the yagi on any TV antenna rotor and then aim it in the many directions that suit you. This antenna really pulls them in from far away.

The 800-MHz-band yagi costs \$75 (plus \$4 shipping), from the Cellular Security Group, 4 Gerring Road, Gloucester, MA 01930. Their toll-free number is 1-800-487-7539.

### CALLING DR. SCANNER!

We have always been of the opinion that the least monitored local emergency services relate to medical communications. People load up on police and fire communications channels, but somehow don't take good advantage of this third partner in local emergency service providers.

Frequencies 155.325, 155.355, 155.385, and 155.40 MHz are designated in the U.S. for hospitals communicating with approaching ambulances. Communications on those channels most often consist of the ambulance personnel advising the hospital of their expected arrival time, the nature of the medical problem of the patient being transported, the patient's symptoms and vital signs, plus any special medical conditions that exist.



Scanner owners tend to overlook the exciting medic frequencies.

Among the frequencies commonly used to dispatch ambulances are 155.28, 155.34, 460.525, and 460.55 MHz, although others might be used in specific communities. Sometimes fire departments have their own medical vehicles, and those might be dispatched on fire-agency frequencies.

Ambulance crews, as well as medic teams using portable equipment, often need to send bio-medical telemetry data. Most often, that consists of an EKG sent to a hospital for quick medical evaluation by a physician who can advise on medication to be immediately administered. Those communications take place on any of eight channels, known as "MED-1" to "MED-8," that run from 463.000 to 463.175 MHz (with 25-kHz spacing), with the mobile and portable units operating on paired frequencies from 468.000 to 468.175 MHz.

Some ambulance crews have low-power handheld transceivers that offer short range. Those units are able to communicate with hospitals only via mobile repeaters installed in the ambulances. The handhelds generally use 150.775 and 150.79 MHz to input to

the mobile repeaters.

Hospitals with helipads often have 123.05 or 123.075 MHz available (in Canada, 129.275 MHz is popular) for communicating with arriving medevac helicopters.

All of those frequencies should be entered into your scanner and checked for activity local to your area. There are other medic frequencies as well. You should check for activity on 33.02 to 33.10, 37.90 to 37.98, 45.92 to 46.04, 47.46 to 47.66, 155.175, 155.205, 155.22, 155.235, 155.265, and 155.295 MHz. Some frequencies below 38 MHz are shared with stations in the Highway Maintenance Radio Service.

Although not precisely medical, communications connected with search and rescue activities are related to this area of monitoring. Good frequencies to monitor for those communications include 122.9, 123.1, 148.15, 155.16, 156.30, 157.05, 157.175, 282.8, and 381.8 MHz.

Also remember that 47.42 MHz is the primary American Red Cross frequency.

### MOVE OVER, BATMAN!

It's been no secret in recent years that in many

metropolitan areas, unlicensed two-way radio users abound on the business and other VHF frequencies. The FCC is too understaffed to adequately crack down on the problem, and, besides, FCC personnel say they don't get paid enough to go into some of the rough neighborhoods where the bootleg stations are located in order to pinpoint their locations and shut them down. Licensed two-way radio users, nevertheless, complain about their communications being disrupted by the bootleg stations.

In Los Angeles, Van Williams (who played The Green Hornet on TV more than 25 years ago) got fed up with the abuses on the frequency of his business radio system so he took

matters into his own hands. He got into his van, which was equipped with direction-finding equipment, and tracked down the guy who was chopping up his frequency with unlicensed chatter.

After turning in the bootlegger, Williams said that it was the first time in years that he was able to use the channel without interference. Maybe we need the Green Hornet in every large city.

### WRITE TO US

Don't forget, we always look forward to hearing from you. Our address is **Scanner Scene, Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. Send us your scanner questions, frequencies, photographs, comments and news clippings. ■

## Enter A World Of Excitement with a Subscription to Popular Electronics

Get the latest electronic technology and information monthly!

Now you can subscribe to the magazine that plugs you into the exciting world of electronics. With every issue of Popular Electronics you'll find a wide variety of electronics projects you can build and enjoy.

Popular Electronics brings you informative new product and literature listings, feature articles on test equipment and tools—all designed to keep you tuned in to the latest developments in electronics. So if you love to build fascinating electronics, just call toll free the number below to subscribe to Popular Electronics . . . It's a power-house of fun for the electronics enthusiast.



Save 55% Off The Regular NEWSSTAND Rate

1 yr \$18.95 2 yrs \$36.95  
(Basic Subscription Rate—1 yr/\$21.95; 2 yrs/\$42.95)

FOR FAST SERVICE CALL TODAY

1-800-827-0383

APEA3

(7:30 AM-8:30 PM—EASTERN STANDARD TIME)

# ELECTRONICS LIBRARY

## 1992-93 Educational Systems Catalog

from Heathkit Educational Systems

Edited by: Teri Scaduto

This two-in-one catalog is aimed at electronics enthusiasts as well as vocational and technical teachers and industrial training managers. Half the catalog is devoted to individual learning products, the other half to classroom courses.

The "Individual Learning Products" section of the catalog offers courseware, training hardware, computer software, software applications training, and other high-tech learning products. Subject areas include Electronics, Computer-Aided Instruction; Lasers, Fiber Optics, and Data Communications; IC

to laser, microprocessor, and telecommunications technologies for advanced students. Each course is designed to lay a foundation of basic theory and hands-on experience on which students can build as they learn new concepts and take on real-life applications.

Highlighted is Heathkit's new Version 2.0 of their computer-aided instruction series of electronics training courses. Using the power of PC's to make learning electronics easier and faster than ever, the courses are available in the topics of DC Electronics, AC Electronics, Semiconductor Devices, and Electronic Circuits; soon-to-be-released computer-aided courses include Digital Techniques and Troubleshooting.

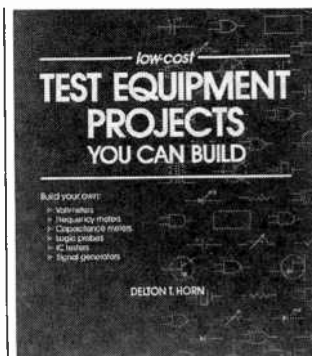
The 1992-93 Educational Systems Catalog is free upon request from Heath Company, Marketing Department, P.O. Box 1288, Benton Harbor, MI 49023; Tel: 1-800-44-HEATH.

**CIRCLE 91 ON FREE INFORMATION CARD**

### LOW-COST TEST EQUIPMENT PROJECTS YOU CAN BUILD

by Delton T. Horn

Budget-minded hobbyists and technicians—in fact, anyone who works with electronic circuitry—will appreciate the money-saving projects presented in this book. Included are easy-to-follow plans and practical instructions for building more than two dozen inexpensive analog and digital test instruments. Projects include equipment for monitoring/measuring voltage, resistance, capacitance, conductance and frequency. Specialized modifications for many of the projects are possible, allowing readers to customize the equipment to di-



rectly suit their specific applications. The book shows how to build a voltage range detector, a digital frequency meter, a logic probe, an audio sine wave oscillator, a sweep signal generator, and several other essential pieces of test equipment. All of the projects can be built using readily available components, at a fraction of the cost of buying equipment.

*Low-Cost Test Equipment Projects You Can Build* costs \$13.95 and is published by TAB Books, Division of McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-822-8138.

**CIRCLE 98 ON FREE INFORMATION CARD**

### YOUR QRP OPERATING COMPANION

by Brad Wells, KR7L

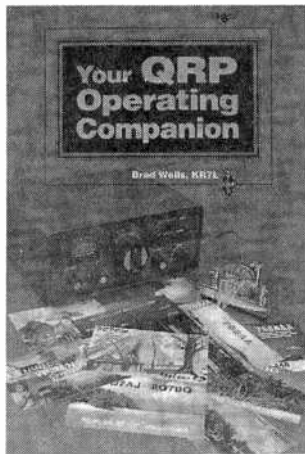
The hobby of QRP—ham operating with an output power of 5 watts or less—is both challenging and exciting. Most amateur radio contests have a QRP entry class, and hundreds of hams from around the world participate. In fact, many hams have managed to work more than 100 countries QRP to QRP.

This book is designed to help QRP'ers get the most from their hobby. No special rig or expensive and complicated equipment is needed. Taking a firm stance



Electronics and Op-Amps; and Beginning Electronics. Also offered are instructional video tapes; software; test equipment and tools; weather instruments and clocks; and assorted Heathkit projects.

The "Classroom Learning Products" section covers a wide range of subjects, from fundamental electronics for beginners



that skill is more important than equipment in QRP, the author shares the wealth of his many years of QRP experience to help readers make more contacts and have more fun. The opening chapter deals with the basics of QRP, including its history and various tests and contests. Subsequent chapters cover operating techniques and explain how to maximize your signal, followed by an in-depth look at propagation. Appendixes list QRP clubs and nets, and contests that include QRP categories.

*Your QRP Operating Companion costs \$6.00 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111.*

**CIRCLE 92 ON FREE INFORMATION CARD**

### PETER NORTON'S ADVANCED DOS 5

*by Peter Norton, Ruth Ashley and Judi Fernandez*

In this book, Peter Norton, acclaimed authority on DOS and the creator of the award-winning Norton Utilities, provides DOS 5 users with vital information needed to reach peak productivity. This follow-up to *Peter Norton's DOS Guide* reveals insider's tricks to squeezing the most out of DOS 5. The secrets to building effective batch programs with color and graphics are placed at the readers fingertips. In Norton's distinctive style, the best techniques for efficient memory management, data recovery, anti-virus protection, and correcting hardware and software malfunctions are explained. In addition, the book

contains thorough explanations of DOSKEY macros, GW-BASIC, and BASICA programming.

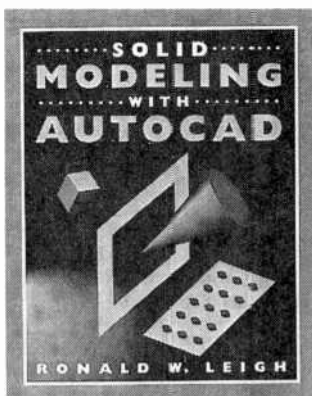
*Peter Norton's Advanced DOS 5 costs \$29.95 and is published by Brady, Division of Prentice Hall Computer Publishing, 11711 North College Avenue, Suite 140, Carmel, IN 46032; Tel: 1-800-428-5331.*

**CIRCLE 99 ON FREE INFORMATION CARD**

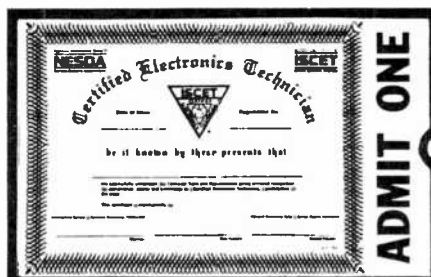
### SOLID MODELING WITH AUTOCAD: Second Edition for AME 2.0 & 2.1

*by Ronald W. Leigh*

Just in time for AutoCAD Release 12, the second edition of this book focuses solely on Autodesk's Advanced Modeling Extension (AME) version 2.1—the feature that joins the advantages of wireframe and surface models with descriptive data about the “insides” of the object. Complete with an eye-catching full-color section, the easy-to-read book enables design professionals to exploit the improvements in AME 2.1 to create vivid three-dimensional



models with simple 3D shapes. After explaining the advantages of solid modeling, the book introduces the building blocks of AME: 3D “primitives”—boxes, cylinders, spheres, wedges, cones, and other simple forms that can be joined to create complex solid models. Given a shaded outer shell, such solid models are realistic-looking 3D drawings that can be edited, scaled, taken apart, reassembled, and used to calculate volume, center of gravity, and other mass properties. The book is arranged as a series of



## Your Ticket To SUCCESS

Over 28,000 technicians have gained admittance worldwide as certified professionals. Let your ticket start opening doors for you.

ISCET offers Journeyman certification in Consumer Electronics, Industrial, Medical, Communications, Radar, Computer and Video. For more information, contact the International Society of Certified Electronics Technicians, 2708 West Berry Street, Fort Worth, TX 76109; (817) 921-9101.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_  
State \_\_\_\_\_ Zip \_\_\_\_\_

Send material about ISCET and becoming certified.

Send one "Study Guide for the Associate Level CET Test." Enclosed is \$10 (inc. postage).

# 41,361 ELECTRONIC COMPONENTS

Whether you order 1 part or all 41,361...MOUSER stocks and...can ship today!!

CALL...  
**(800) 992-9943**

for your  
**FREE CATALOG**

2401 Hwy 287 N.  
Mansfield, TX 76063



**MOUSER ELECTRONICS**  
Sales & Stocking Locations Nationwide

**CIRCLE 8 ON FREE INFORMATION CARD**



## SPECIAL FROM ETT

TTL1 —  
TTL POCKET GUIDE,  
Volume 1,  
7400 — 74200  
..... \$18.95.



TTL2 —  
TTL POCKET GUIDE,  
Volume 2,  
74201 — 74640  
..... \$18.95.



TTL3 —  
TTL POCKET GUIDE,  
Volume 3,  
74641 — 7430640  
..... \$18.95.



TTLX —  
ALL THREE GUIDES,  
Vols 1, 2, & 3  
(save \$6.00)  
..... \$50.85.

Each volume provides a comprehensive listing of all commonly used TTL integrated circuits within the range of types noted. The combination of three volumes covers 7400 through 7430640 TTL products from all major manufacturers. All current families are covered: standard, low power, Schottky, low power Schottky, advanced Schottky, advanced low powered Schottky, high speed and fast Schottky. There are eight sections to the book. Section 1 illustrates the device schematic using a clear and simple logic diagram. Next a brief description of the components, providing quick reference to the internal structure. The next section details input signals or levels at individual pins. The fourth section lists major applications and is followed by a summary of essential data. Below this, a table indicates the TTL families in which the device is available, and finally, device description and type number are highlighted for easy reference. A manufacturer's index at the back of the book shows in tabular form which companies manufacture each package.

MAIL TO: Electronic Technology Today, Inc.  
P.O. Box 240  
Massapequa Park, NY 11762-0240

### SHIPPING CHARGES IN USA AND CANADA

|                               |                           |
|-------------------------------|---------------------------|
| \$0.01 to \$5.00 . . . \$1.50 | \$30.01 to \$40.00 \$5.50 |
| \$5.01 to \$10.00 . . \$2.50  | \$40.01 to \$50.00 \$6.50 |
| \$10.01 to \$20.00 \$3.50     | \$50.01 and above \$8.00  |
| \$20.01 to \$30.00 \$4.50     |                           |

**SORRY, No orders accepted outside of USA and Canada**

|                                      |          |
|--------------------------------------|----------|
| Total price of merchandise . . . . . | \$ _____ |
| Shipping (see chart) . . . . .       | \$ _____ |
| Subtotal . . . . .                   | \$ _____ |
| Sales Tax (NYS only) . . . . .       | \$ _____ |
| Total Enclosed . . . . .             | \$ _____ |

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

exercises that illustrate the concepts and procedures of solid modeling in progressive levels of complexity.

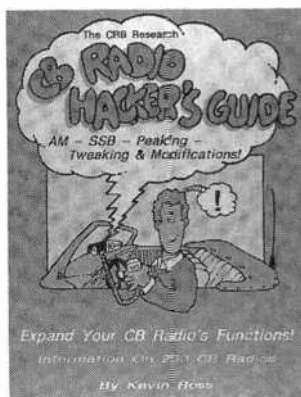
*Solid Modeling With AutoCAD, Second Edition, costs \$29.95. A companion diskette, which includes sample drawings from the book, AutoLISP programs for AME, and batch files that reduce various commands to single-keystroke operations, is available for \$49.95. Both are available from Ventana Press, P.O. Box 2468, Chapel Hill, NC 27515; Tel: 919-942-0220; Fax: 919-942-1140.*

**CIRCLE 93 ON FREE INFORMATION CARD**

## THE CB RADIO HACKER'S GUIDE

by Kevin Ross

This book tells readers exactly which screws to turn, which wires to cut, and which components to add to help substantially improve the performance of their CB's and add updated controls, features, and capabilities. It also reveals methods of unlocking those hidden functions that were never activated at the factory and methods of adding new features that the factory forgot to include.



Charts show how to tweak and peak existing circuits so that they perform at their maximum potential for best power output, full modulation, best AGC and squelch action, and finest all-around operation. The book shows how to add RF and microphone gain controls, a noise blanker, bright/dim control, switchable audio tone, high/low transmitter power, a modulation meter, and more. Also

included is practical advice on how to diagnose CB problems, how to test microphones and wire microphone plugs, and other useful information to enhance your CB station and operations.

*The CB Radio Hacker's Guide costs \$18.95 plus \$3.50 shipping (NY residents must add \$1.61 sales tax) and is published by CRB Research Books, Inc., P.O. Box 56, Com-mack, NY 11725.*

**CIRCLE 90 ON FREE INFORMATION CARD**

## 1992-93 EQUIPMENT, TOOLS & SUPPLIES CATALOG

from Print Products International

This catalog contains 68 pages of discount test and measurement equipment for electronic production, maintenance, and service. Featured are items from such major manufacturers as B + K, Fluke, Avcom, Hitachi, Leader, Pace, Kenwood, Philips, and more. Product categories include oscilloscopes, power supplies, meters, EPROM systems, static-control products, spectrum analyzers, and surface-mount equipment. Also featured are replacement parts and new lines of closed-circuit TV systems.



*The 1992-93 Equipment, Tools & Supplies Catalog is free upon request from Print Products International, 8931 Brookville Road, Silver Spring, MD 20910; Tel: 1-800-638-2020 or 301-587-7824; Fax: 1-800-545-0058 or 301-585-5402.*

**CIRCLE 100 ON FREE INFORMATION CARD**

# NEW PRODUCTS

## Video Information System

Radio Shack has entered the multimedia interactive market with the *Memorex MD-2500 Video Information System*, or *VIS*. The *VIS* unit, which connects to any TV set and can also be hooked up to a stereo system, plays interactive *VIS* discs that provide electronic access to reference books, instructional materials, learning and action games, and a variety of educational programs. A wireless controller allows users to interact with the pictures, voice, music, and animation sequences contained in *VIS* applications. The system pro-



vides high-quality pictures with color resolution of up to 16 million colors. Its audio system, which can be connected to a home stereo system using optional cables, is digitally synthesized and provides digital stereo sound from both *VIS* discs and audio CD's.

The *MD-2500* comes with a *VIS* version of Compton's *Multimedia Encyclopedia*, which includes all 26 volumes plus a complete Webster's *Intermediate Encyclopedia* on one disc. A "Save-It" cartridge is included for saving game scores or preserving electronic "bookmarks" in reference books. Options include a second, wired, hand controller, and a modem for connecting to on-line information services.

The *Memorex MD-2500 VIS* system (Cat. no. 16-376) is

available for \$699 at Radio Shack stores nationwide. *VIS* software titles range in price from \$29.95 to \$79.95. For more information, contact Radio Shack, 700 One Tandy Center, Fort Worth, TX 76102.

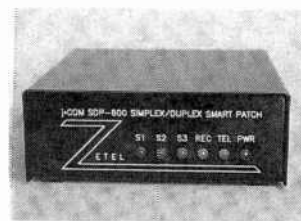
**CIRCLE 102 ON FREE INFORMATION CARD**

### PERSONAL AUTOPATCH

*J-Com's Model SDP-600 Simplex/Duplex Smart Patch* is a microprocessor-controlled interface between a VHF/UHF transceiver and a telephone line that allows the user to make and receive telephone calls from any H/T or mobile rig within range of the base station. Installation consists of connecting the autopatch to the rig's microphone and speaker jacks and plugging in an RJ-11 telephone jack. Control and programming is done by DTMF tones issued from the remote. Separate user-programmable access password codes can be set up for local and long-distance dialing. An external logic output, which can be used to control a repeater or to drive a relay for the control of any hamshack accessory, is provided. An automatic CW (Morse code) identification transmission occurs at the beginning and end of each call.

The *SDP-600* can be used in full duplex mode with a dual-band transceiver. Using full duplex, both parties can hear each other at the same time. Simplex mode may also be used with VOX control based on sampling both the telephone and receiver audio signals or with optional carrier detection. Turn-around beeps indicate the end of each transmission.

With the reverse patch option enabled, incoming calls will cause a short ring-out over the air. The user then can answer the call using his access password code. Ring-out activation can be adjusted from one to nine rings.

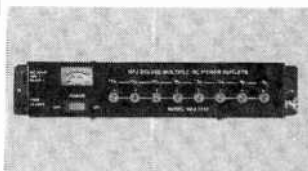


The *Model SDP-600* autopatch is available at an introductory price of \$199.95. For more information, contact *J-Com*, Box 194, Ben Lomond, CA 95005; Tel: 408-335-9120; Fax: 408-335-9121.

**CIRCLE 103 ON FREE INFORMATION CARD**

### DC POWER OUTLET

If you need a neat and easy way to distribute 12VDC to various transceivers and accessories, the *MFJ-116 Deluxe DC Power Outlet* might be the solution. The multiple DC power-outlet strip features eight terminals for connecting rigs and keyers, TNC's, tuners, and other gear.



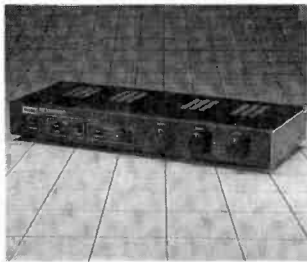
Output voltage is continuously monitored on its built-in voltmeter, making it a handy power outlet for electronics hobbyists, too. The *MFJ-116*, which can be installed at the rear of a desk to eliminate the tangle of "hairy-wires," features eight outlets with heavy-duty, five-way binding posts with standard spacing for dual banana jacks. The outlets are also RF bypassed. The strip also has a master power switch and a 15-amp fuse.

The *MFJ-116 Deluxe DC Power Outlet* costs \$44.95. For additional information, contact *MFJ Enterprises, Inc.*, P.O. Box 494, Mississippi State, MS 39762.

**CIRCLE 104 ON FREE INFORMATION CARD**

## SOUND-ENHANCEMENT COMPONENT

The *Retriever* is a lower-priced version of *Hughes Aircraft Company's* SRS three-dimensional sound-enhancement component for home audio and video systems. The stand-alone unit uses a new VLSI chip that produces a realistic surround-type sound from conventional recorded or broadcast sources. The chip uses Hughes' patented Sound Retrieval System (SRS) technology, which expands the sound signal so that it appears to emanate from outside the physical limits of the usual two



loudspeakers. The *Retriever* retains the same user-control features and stereo enhancement effect of the original model AK-100, but lacks the three-way LED display that is found on the earlier model. At 2 $\frac{3}{8}$  x 16 $\frac{1}{2}$  x 7 inches, the *Retriever* also is smaller than the AK-100.

The *Retriever* sound-enhancement component has a suggested list price of \$179. For further information, contact Hughes Audio Products, Division of Hughes Aircraft Company, P.O. Box 7000, Rancho Santa Margerita, CA 92688; Tel: 1-800-2HEAR3D (1-8000-243-2733).

**CIRCLE 105 ON FREE INFORMATION CARD**

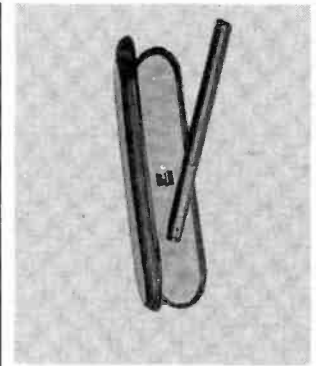
## HANDHELD LASER POINTERS

Harnessing the power of micro-laser technology, the *Laser PowerPointers* are the smallest, brightest handheld lasers available to consumers today,

according to *Lyte Optronics*. The line includes the *Laser PowerPoint* (pictured) and the *PointWrite Laser Pen*, which combines a laser pointer with a writing instrument—the *Space Pen* from Fisher. Both *PowerPointers* use laser light to produce a brilliant orange/red dot that can be seen from 150 to 300 yards away.

The *Laser PowerPoint* is available in black anodized aluminum, 24-carat gold plate, and titanium; custom finishes and laser engraving also are available. Weighing just one ounce and measuring five inches in length and one-third of an inch in diameter, the pointer fits conveniently in a shirt pocket. Power is provided by two 1.5 volt batteries.

Laser pointers have many applications other than as presentation tools. Engineers and architects use them to point out specific features of a structure without climbing ladders; police officers to survey a crime scene without disturbing evi-

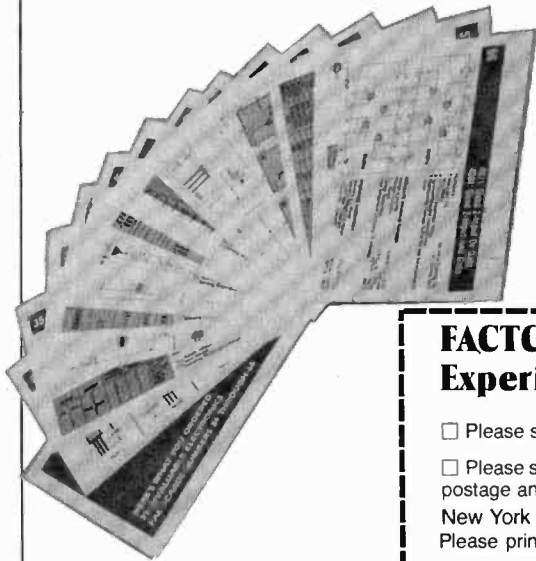


dence; doctors and medical sales consultants to identify anatomical structures and surgical tools in a sterile field; and plumbers, electricians, and contractors to illustrate where a pipe or wire will be installed.

The *Laser PowerPointers* have retail prices starting at under \$200. For more information, contact *Lyte Optronics*, 3015 Main Street, Suite 450, Santa Monica, CA 90405; Tel: 310-450-8551; Fax: 310-392-1754.

**CIRCLE 106 ON FREE INFORMATION CARD**

# FACTCARDS



**Jampacked with information at your fingertips**

■ ALL YOU NEED to know about electronics from transistor packaging to substitution and replacement guides. FACTCARDS numbers 34 through 66 are now available. These beautifully-printed cards measure a full three-by-five inches and are printed in two colors. They cover a wide range of subjects from Triac circuit/replacement guides to flip-flops, Schmitt triggers, Thyristor circuits, Opto-Isolator/Coupler selection and replacement. All are clearly explained with typical circuit applications.

■ WANT TO EXPAND your knowledge of electronics? Do it the easy way

by studying the *Electronics Fact Cards*. Do you travel to and from your job each day? Drop a handful of cards in your pocket before you leave, and the bus becomes a 'schoolroom! At home, you can build some of the projects and not only have fun building and using them, but learn how they work at the same time.

■ YOU'LL BE AMAZED both at how rapidly you learn with these cards, and how easy it is to understand. These new cards are available right now. Don't miss out. Send your check or money order today.

## FACTCARDS—Facts at your fingertips for Experimenters and Project Builders!

Please send one copy of FACTCARDS at \$3.50. Shipping \$1.00 (U.S. and Canada only).

Please send \_\_\_\_\_ copies of FACTCARDS. Total cost is sum of copy price and First Class postage and handling cost multiplied by number of card sets ordered.

New York residents add sales tax to total cost of each order.

Please print

Allow 6-8 weeks for the material to arrive.

(Name) \_\_\_\_\_

(Street Address) \_\_\_\_\_

(City) \_\_\_\_\_

(State) \_\_\_\_\_

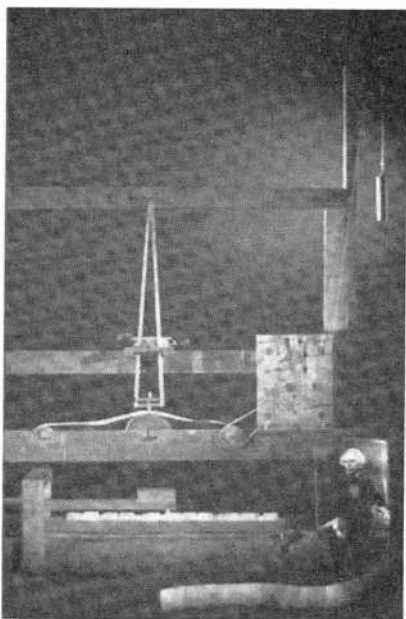
(Zip) \_\_\_\_\_

Detach and mail today:  
CLAGGK Inc.  
P.O. Box 4099  
Farmingdale, NY 11735

All Payment must be in U.S. Funds!

## THE CODE MAKERS

(Continued from page 64)



The first Morse telegraph of 1835 didn't use a key! Instead it used a "portrule," which was a wooden stick with a groove designed to hold small lead blocks.

Before long, telegraphers were adding hacksaw blades and additional contacts to make dots automatically when the handle was pulled to the right. Horace Martin refined the idea and patented the famous Vibroplex. That semi-automatic key or "bug" was the standard for high-speed telegraphy from the 1890's until the end of World War II. They're still popular, and in recent years old units have become something of a collector's item. However, if you are not a collector, and don't wish to pay collector's item prices, the Vibroplex Company is still very much in business.

The development of vacuum-tube logic circuits in World War II made electronic keyers practical. These keyers would make automatic dots or dashes depending on which way the lever was pushed and their speed could be adjusted by a knob. The earliest models were crude but soon self-completing dots and dashes, memories, iambic keying, and many other features became commonplace. Today, many operators are using computers and keyboards to send Morse, or a variety of other codes, with speed, code type, and more selectable at the touch of a key. ■

## BUILD A WIRE TRACER

(Continued from page 46)

9-volt battery, then connect a clip lead to the closed-loop output, J2, and power up the circuit. Turn on a small AM receiver and position it close to the clip lead. Tune the radio until you hear a buzzsaw-like sound, and then adjust the tuning for maximum signal strength. (The maximum transfer of energy occurs when the radio's internal ferrite loop is positioned perpendicular to the wire.)

Once that is done, connect the opposite end of the clip lead to the common output, J3, and note the increase in signal strength. The increase in signal strength is due to circulating current within the closed loop. (Anytime a closed loop can be used, the signal will be greater and, in most cases, easier to track.)

Now plug the McTrak into a 117-volt AC outlet and try to trace the McTrak signal through the AC wiring using the AM receiver. If the wiring happens to go behind a metal panel in the wall or is run through a metal conduit, the metal will attenuate the signal, possibly making it too weak to follow. When that happens (or if the signal is diminished for some other reason), try connecting the open-loop output (J1) to the conduit and see if the signal can be traced along the conduit.

Using McTrak to trace your auto's electrical wiring is just as easy. With all of the electronics in today's cars, it's almost impossible to visually trace a wire from one location to another without going through a maze of cables, and possibly becoming sidetracked. But McTrak can handle that task as well.

To trace your auto's wiring, connect the McTrak's J2 output to the wire you want to follow. Then track the signal by moving the radio along the path that produces the strongest signal. If the receiver's signal is too weak, connect the common lead (J3) to the car's ground system (negative battery terminal or chassis in most vehicles) to increase the signal strength. Since there are some circuits in a car's electrical system that could be effected by the full output of the Tracker, it would be better to always use the closed-loop output when working with automotive electronics. ■

## FUN WITH ELECTRONICS



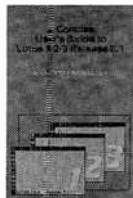
- ◀ □ 160—COIL DESIGN & CONSTRUCTION MANUAL .... \$5.95. How to make RF, IF, audio and power coils; chokes and transformers. Practically every possible type is discussed.

- PCP113—THE PC MUSIC HANDBOOK .... \$13.95. Learn the basics of computer music systems. For the professional musician, gifted amateur or just plain curious.



- ◀ □ BP297—LOUDSPEAKERS FOR MUSICIANS .... \$6.25. Loudspeaker design from the musician's point of view! All you need to know, and you should be able to design your own after reading this.

- BP277—HIGH POWER AUDIO AMPLIFIER CONSTRUCTION .... \$6.25. Here's background and practical design information on high power audio amplifiers capable of 300 ± 400 watts r.m.s. You'll find MOSFET and bipolar output transistors in inverting and non-inverting circuits.



- ◀ □ BP302—A CONCISE USER'S GUIDE TO LOTUS 1-2-3 RELEASE 3.1 .... \$6.25. If you are a PC user and want to upgrade to Lotus 1-2-3 release 3.1, this book can teach you how to do that in the shortest and most effective way.

- BP298—A CONCISE INTRODUCTION TO THE MACINTOSH SYSTEM AND FINDER .... \$6.25. This introduction for those new to the Mac, this book also serves as a quick refresher for experienced owners that have not used the machine in some time.



MAIL TO: Electronic Technology Today, Inc.  
P.O. Box 240  
Massapequa Park, NY 11762-0240

### SHIPPING CHARGES IN USA AND CANADA

|                    |            |                    |            |
|--------------------|------------|--------------------|------------|
| \$0.01 to \$5.00   | ... \$1.50 | \$30.01 to \$40.00 | ... \$5.50 |
| \$5.01 to \$10.00  | ... \$2.50 | \$40.01 to \$50.00 | ... \$6.50 |
| \$10.01 to \$20.00 | ... \$3.50 | \$50.01 and above  | ... \$8.00 |
| \$20.01 to \$30.00 | ... \$4.50 |                    |            |

**SORRY, No orders accepted outside of USA and Canada**

Total price of merchandise ..... \$ \_\_\_\_\_  
Shipping (see chart) ..... \$ \_\_\_\_\_  
Subtotal ..... \$ \_\_\_\_\_  
Sales Tax (NYS only) ..... \$ \_\_\_\_\_  
Total Enclosed ..... \$ \_\_\_\_\_

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_



## CIRCUIT CIRCUS

(Continued from page 71)

over 25  $\mu\text{F}$ . Frequencies greater than 50 kHz are possible when using smaller capacitor values for C1.

Transistor Q3, configured as an emitter-follower amplifier (which provides a voltage gain of 1) is used to buffer the output signal, so that the circuit can be used to drive a low-impedance (under 1 megohm) load. Only very high impedance loads may be connected directly to the sawtooth output at the UJT's emitter. Almost any loading at Q2 will cause the output level and frequency to drop, or

oscillation to cease altogether.

### TIME-DELAY CIRCUIT

Our next entry, shown in Fig. 5, places the UJT in a time-delay circuit. With S1 and S2 in the normally closed position, Q1's emitter and C1 are tied to circuit ground through the two switches and R2, a 100-ohm resistor. Switching either S1 or S2 to an open condition allows C1 to begin charging through R1 and R6. If the switch remains open longer than the RC time period, Q1's emitter will reach the trigger point and fire. When that happens, the positive output pulse at B1 turns on the SCR and the

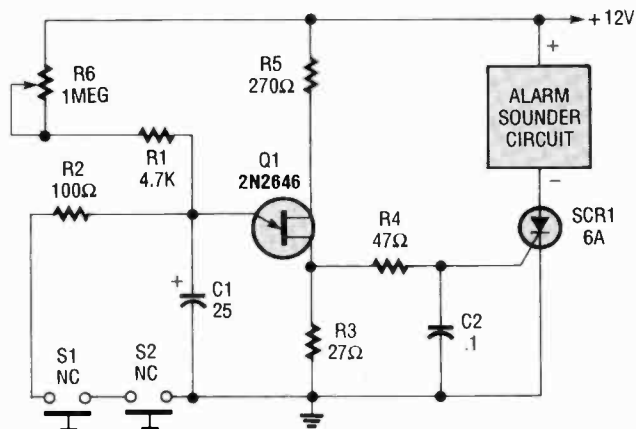


Fig. 5. Here the UJT is used in a time-delay circuit. The time delay afforded by this circuit can be varied from about one second to over 30 seconds by adjusting R6.

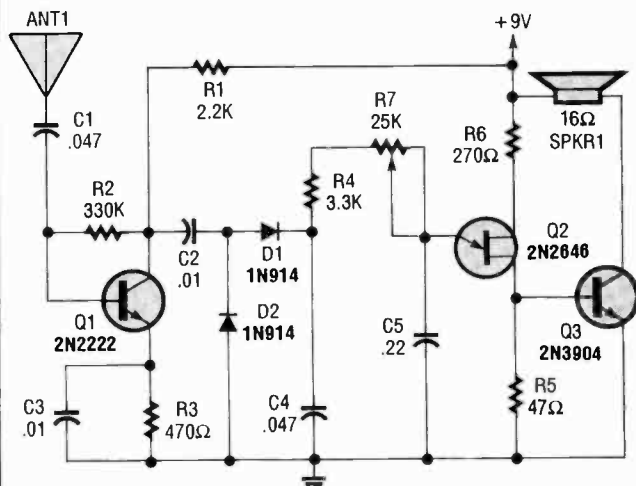


Fig. 6. In this handy little RF snooper, the UJT is configured as a voltage-controlled oscillator. As the RF signal strength increases, the output frequency of the voltage-controlled oscillator increases.

## PARTS LIST FOR THE TIME-DELAY CIRCUIT

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)

- R1—4700-ohm
- R2—100-ohm
- R3—27-ohm
- R4—47-ohm
- R5—270-ohm
- R6—1-megohm potentiometer

### ADDITIONAL PARTS AND MATERIALS

- Q1—2N2646 or unijunction transistor
- SCR1—6-amp, or less, silicon-controlled rectifier
- C1—25- $\mu\text{F}$ , 25-WVDC, electrolytic capacitor
- C2—0.1- $\mu\text{F}$ , ceramic-disc
- S1, S2—Normally closed sensor switch
- Perfboard materials, enclosure, alarm sounder, 12-volt power source, wire, solder, hardware, etc.

## PARTS LIST FOR THE RF SNOOPER

### SEMICONDUCTORS

- Q1—2N2222 general-purpose NPN silicon transistor
- Q2—2N2646 or similar unijunction transistor
- Q3—2N3904 general-purpose NPN silicon transistor
- D1, D2—1N914 small-signal silicon diode

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)

- R1—2200-ohm
- R2—330,000-ohm
- R3—470-ohm
- R4—3300-ohm
- R5—47-ohm
- R6—270-ohm
- R7—25,000-ohm potentiometer

### CAPACITORS

- C1, C4—0.047- $\mu\text{F}$ , ceramic-disc
- C2, C3—0.01- $\mu\text{F}$ , ceramic-disc
- C5—0.22- $\mu\text{F}$ , ceramic-disc

### ADDITIONAL PARTS AND MATERIALS

- SPKR1—Miniature 16-ohm speaker
- ANT1—19-inch or longer telescoping antenna
- Perfboard materials, enclosure, knob, 9-volt power source, wire, solder, hardware, etc.

alarm sounder is activated. Even if the switch is returned to its normally closed position, the alarm sounder will remain activated until the circuit's power is interrupted.

The time delay can be varied from about one second to over 30 seconds by adjusting R6. If a good quality low-leakage 100- $\mu\text{F}$ , electrolytic capacitor is sub-

stituted for C1, the time period can be increased to well over one minute. The alarm sounder may be replaced with a relay or optoisolator/coupler to control just about anything.

### RF SNOOPER

A handy little RF snooper, using the UJT as a voltage-controlled oscillator (VCO), is shown in Fig. 6. In that

circuit, an antenna (ANT1) picks up RF signals. That signal is coupled through C1 to the base of Q1, which is configured as an amplifier. Transistor Q1 amplifies the RF signal, and the resulting output signal (at Q1's collector) is fed to a two-diode (D1 and D2) voltage-doubler circuit, which outputs a positive pulsating DC output at the cathode of D1 that varies with the level of detected RF.

The DC output of the doubler is fed to the UJT-based VCO. As the RF increases in strength, the output frequency of the VCO increases. The VCO output is fed to Q3, which amplifies the signal to a level sufficient to drive SPKR1. Potentiometer R7 allows you to adjust UJT-based VCO's frequency range.

The antenna may be any 19-inch or longer telescoping antenna. The snooper's sensitivity may be increased by increasing the value of R6. That's a good place to experiment to obtain the best overall circuit performance.

Here we are again at the end of our monthly visit. So, until we meet next time, good circuitry. ■



Let's close the book on forest fires.

Ad Council A Public Service of This Magazine & The Advertising Council

## ANTIQUe RADIO

(Continued from page 66)

the tip. Those brown films are quite common on early radio equipment, and I've always assumed that they were grease or tar deposits from household cooking or smoking activities. When removing them, Alan points out, one should always use a wet process (rubbing with steel wool dampened in Brasso, as I did, would qualify) so as to trap the dust. Dry sanding or rubbing processes should definitely be avoided.

Reader Duane Buell (Seattle, WA) responded to my musings (September, 1992 issue) about the large circular opening under the Sky Buddy's main tuning dial. That hole had been punched, for no apparent reason, then subsequently filled, during the manufacture of the cabinet. Duane theorizes that the cabinet was manufactured for Hallicrafters by a metal cabinet specialist such as Bud or Par-Metal. The same cabinet was sold, in slightly different configurations, to other radio manufacturers. One of those required the large hole; Hallicrafters didn't.

If you have some Sky Buddy lore that you'd like to share, be sure to write! Contact me *c/o Antique Radio, Popular Electronics*, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■



"His New Year's resolution this year is to finish the project he resolved to finish last New Year."

## THINK TANK

(Continued from page 74)

be low enough to significantly load the telephone line at the on-hook voltage (48 volts). I would start with a 5-megohm potentiometer, adjust for the desired results, then replace it with a fixed resistor. (Note that the saturation voltage of Q2 is also affected by re-corder-motor load current.)

What was the purpose for resistor R4? It could be eliminated, (shorted) and that might improve saturation of Q2. A 100K resistor should be connected across the base-emitter junction of Q1. That would shunt the small leakage current of D1 when the bridge output drops to 5 volts, and shunt the reverse leakage current of the Q1 collector-base junction. Cutoff would then be assured for Q1.

I have not had the op-

portunity to experiment with this circuit. The preceding analysis was based upon my industry experience.

I was impressed by the simplicity, and usefulness of Andy's circuit. I became interested in electronics myself at about his age. I hope Andy chooses to pursue electronics. It has been a rewarding career for me for the past 24 years.

—Charles Hardin, San Clemente, CA

Thank you for the excellent analysis. While examining the circuit myself, I forgot to double the junction potential to get the minimum saturation voltage for the pair (oops).

That's all the room for now. If you have a circuit, request, or comment you feel might earn you a "Think Tank II" or other book, please write to *Think Tank, Popular Electronics*, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

## BIG PROFITS IN VIDEO REPAIR!

WORK FROM HOME—EARN \$85 HR!

With the tens of millions of VCRs and Camcorders in use, there currently is a **serious shortage** of trained techs to perform cleaning and repair jobs on these popular devices...

Learn how you can start your own highly profitable, Home-Based video servicing business...

And since up to 95% of all VCR and Camcorder malfunctions are due to a simple **mechanical** or **electro-mechanical** failure, you need not spend months or even years of complicated study before starting paid, professional service work!

Let Viejo's Training Program show you how!

CALL TOLL FREE

1-800-537-0589  
or mail coupon today!

VIEJO PUBLICATIONS, INC.

4470-107 Sunset Blvd., Suite 600  
Dept. VK Los Angeles, CA 90027

Yes! Rush me your **FREE OPPORTUNITY KIT** today!  
(Check appropriate box)

- VCR Repair
- Camcorder Repair
- Advanced VCR Repair
- Fax Machine Repair

Name \_\_\_\_\_

Address \_\_\_\_\_

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

Dept. PE

CIRCLE 15 ON FREE INFORMATION CARD

## NAVIGATION SYSTEMS

(Continued from page 42)

vice Center, police agencies, and various agencies doing highway maintenance and construction. Trav-Tek cars themselves provide data by transmitting their speed and location, which can be used to infer when and where the vehicle encounters congestion or a traffic incident.

Travtek also offers an extensive information database of services and attractions and on-line emergency help with the ability to communicate via cellular phone. These include service stations, hotels, motels, restaurants, and tourist attractions. The driver is provided information in several formats. First, there are simplified maps of the Orlando area graphically showing routes plus traffic congestion locations, incidents, and services information. A push of a button brings up another format with information about traffic incidents or available services in text form. Another option provides guidance instructions via simple graphical cues such as directional arrows.

On the other side of the continent, the Pathfinder demonstration program is already underway in Los Angeles. Pathfinder also uses an on-board navigation system that includes a CRT map display that presents traffic advisories and optimal routes sent to it via radio. Alternatively, information can be conveyed by synthesized voice messages over the car radio's loudspeakers.

The on-board system interfaces with the Los Angeles Traffic Management Center that includes the Los Angeles Traffic Management system. Testing is being done on a 13-mile segment along the Santa Monica Freeway, considered to be one of the most heavily used roadways in the country. The "Smart Corridor" used in the demonstration not only includes the freeway, but also freeway feeder roads and five major arterial streets that can be used as alternate routes to the freeway. Besides sensors like existing induction loops embedded in the roadway that measure traffic flow, the Los Angeles TMS uses police accident reports and information on locations where maintenance is underway. Finally, sensors in Pathfinder-

equipped vehicles measure position, heading, speed, and number of stops, which is transmitted back by radio to the TMC. The California Department of Transportation (Caltrans), the Federal Highway Administration (FHWA), and GM are jointly sponsoring the Pathfinder Demonstration Project using 25 specially equipped Oldsmobiles.

An even larger MHS demonstration project is planned for Chicago starting in 1993. Motorola navigation/route guidance system could eventually be installed in as many as 5,000 vehicles in the Advanced Driver and Vehicle Advisory Navigation ConcEpt (ADVANCE) program. These will be tied-in with a Traffic Information Center via RF data-communication links. The Illinois Department of Transportation, Federal Highway Administration, and the Illinois University's Transportation Research Consortium are involved in the project. The field-operation tests will encompass a 200-square-mile area in the Northwest suburbs of Chicago. Incidentally, for about two decades the Illinois Department of Transportation has operated a very extensive and quite successful freeway-surveillance and control system in the Chicago area. Traffic advisories from this system are transmitted to individual drivers via updatable overhead and roadside signs, and reports on cable TV and radio including low-power roadside transmitters.

Over in Germany, the Siemens' Ali-Scout was tested as part of the Guidance and Information System, Berlin, or LISB for short in German. This is one of many "Smart Cars and Smart Highway" projects in the very ambitious Programme for European Traffic with the Highest Efficiency and Unprecedented Safety (PROMETHEUS) project that involves virtually every European automaker, many suppliers, universities, and research institutes. LISB used 700 vehicles, 250 traffic lights, over 2,000 infrared beacons and covered 1500 kilometers (932 miles) of Berlin streets. In the Ali-Scout system, data is transmitted between cars and the Central Computer via the IR link. The degree of traffic congestion is inferred by comparing actual versus nominal travel times between beacons. Information sent from cars is fused with other data such as historical congestion profiles, whether schools are

in session, weather conditions like fog or ice, traffic accidents, construction delays, and so forth. In the Ali-Scout setup, the up-date map is contained in the central computer rather than in individual cars. The Central Computer continually calculates a minimum trip-time route and transmits that information to the in-vehicle unit. If an Ali-Scout equipped vehicle is on the path to a traffic snarl, the Central Computer would guide the driver through another route that avoids this slowdown. The Ali-Scout system also adjusts traffic-light timing to smooth overall flow throughout the system. (We will be looking at the Prometheus Project in more depth in a future issue of **Popular Electronics**.)

The Japanese are also prototyping major systems such as the Advanced Mobile Traffic Information and Communication System (AMTICS). Like equivalent projects in the U.S. and Europe, AMTICS uses elements like on-board navigation systems, traffic-management centers, congestion re-routing, and even telephone directories for services and such.

On-board navigation systems could help all drivers, even those without vehicles so equipped. For example, Blaupunkt points out an important fact about advanced driver-information systems: Only a small percentage of the vehicles have to be equipped with the systems to have a noticeable effect. For example, if only 1% of all vehicles in a major metropolitan area were equipped with Ali-Scout, overall traffic flow would be noticeably smoother. A 10% installation would result in a major reduction in congestion. ■



## MICROPROCESSORS

(Continued from page 62)

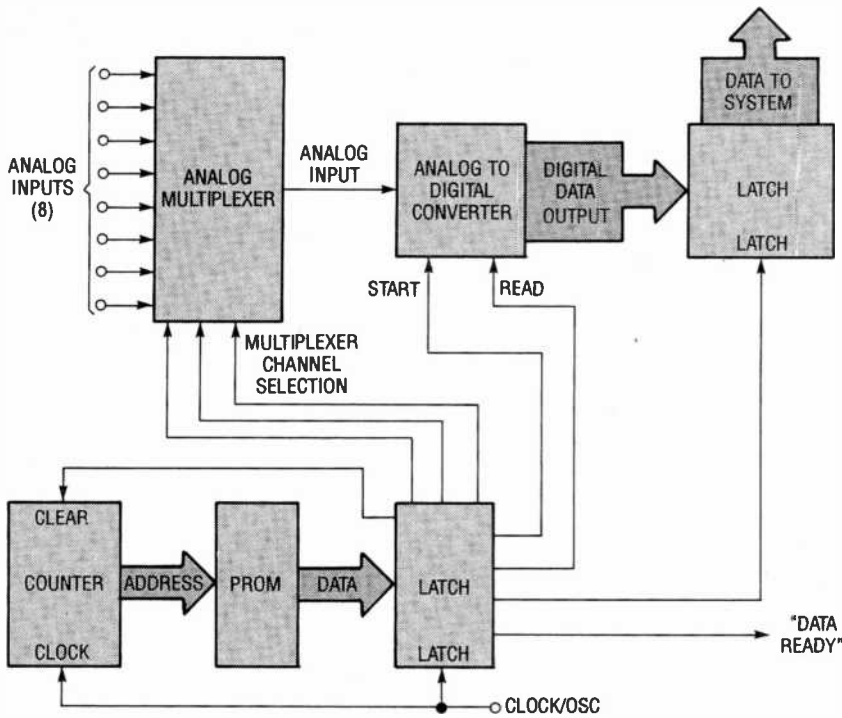


Fig. 4. A simple controller could even run an analog-to-digital data-acquisition system. That is because the task is limited to a series of steps that gets repeated over and over.

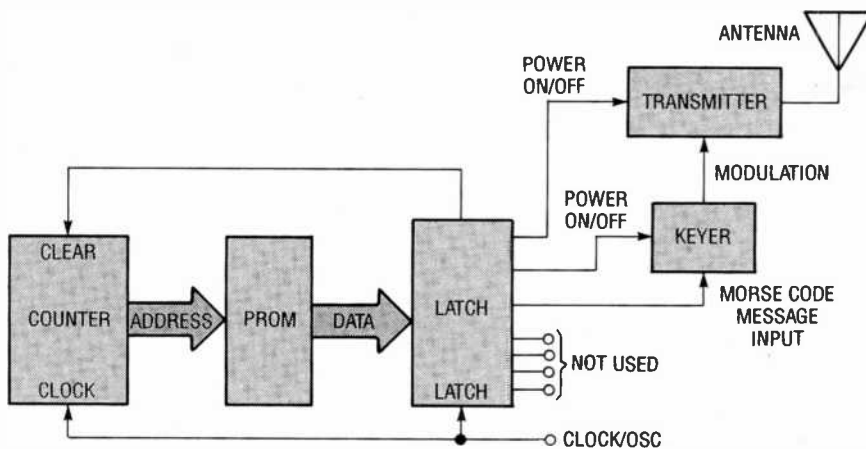


Fig. 5. Since broadcasting a repeating message from a beacon transmitter is a repetitive task, a simple controller could operate such a transmitter. The PROM just needs to be programmed with the right sequence of steps to perform.

whether the result was a positive or negative value, and/or if the result is zero. The external status register provides these mathematical results for use by a program, while the internal status register is used for the microprocessor's internal operations.

The outputs of the address latches are connected to the microprocessor's address bus. The address infor-

mation that is sent here is presented to the ROM, the RAM, and the ports prior to reading or writing data to these devices.

The data buffer is a bidirectional, non-inverting, three-state buffer that connects the microprocessor's internal data bus to the external data bus. That allows the microprocessor to send data to and receive data from

the devices on the external data bus. The data buffer has three-state controls and data-direction controls that are connected to the control-unit.

The low and high halves of the program-counter are registers that contain the address of the current instruction being processed. The control-unit increments the program-counter registers and sends its contents to the address latches when the next instruction is to be read or when more information on the current instruction is needed.

The low and high halves of the data-counter are registers that contain the address where data is located in external memory. They may also be used as temporary registers.

The external control lines "Read," "Write," "Memory," and "Input/Output" come directly from the control-unit's latches.

Next month, we'll look at some instruction examples and some special instructions. That should show how all these separate blocks function together to process instructions. ■

\*\*\* NOW PRESENTING \*\*\*  
 All Available Television Channels!  
 with **CABLE TV**  
**DESCRAMBLERS**  
 Featuring: *Scientific Atlanta, Oak, Jerrold, Hamlin, Stargate*

- Overnight Delivery
- Competitive Pricing
- Long-Term Warranties
- Visa and Mastercard Accepted

**Video Dimensions**  
**1-800-952-5197**  
 401 Fairmount Ave., Ste. 208 Oakland, CA 94611

**IT'S A TRAGEDY**  
**BEYOND DESCRIPTION.**

96,000 acres of irreplaceable rain forest are being burned every day. Join The National Arbor Day Foundation and support Rain Forest Rescue.

**Rain Forest Rescue**  
 Call Rain Forest Rescue.  
**1-800-255-5500**

The National Arbor Day Foundation



# GET THE LATEST ADVANCES IN ELECTRONICS

WITH A SUBSCRIPTION TO

# Electronics

Radio Combined with  
**Electronics**<sup>®</sup>

# NOW

<sup>®</sup>

Electronics Now gives you exciting articles like:

- Buyer's Guide to Digital Oscilloscopes
- Build A Scanner Converter
- Single-Chip Voice Recorder
- Build A MIDI Interface for your PC
- Troubleshoot Microprocessor Circuits
- Build A High-Power Amplifier for your Car
- Add Music On Hold to your Phone
- All About Binaural Recording
- VGA-to-NTSC Converter

ENJOY THE WORLD OF ELECTRONICS EACH MONTH!

Subscribe to the best electronics magazine—the one that brings you the latest high-tech construction projects, feature articles on new technology, practical troubleshooting techniques, circuit design fundamentals, and much more.

Electronics Now looks to the future and shows you what new video, audio and computer products are on the horizon. What's more you'll find helpful, monthly departments such as Video News, Equipment Reports, Hardware Hacker, Audio Update, Drawing Board, Computer Connections, New Products, and more. All designed to give you instruction, tips, and fun.



FOR FASTER SERVICE CALL TODAY  
**1-800-999-7139**

# DON'T DELAY SUBSCRIBE TODAY!

Just fill out the order card in this magazine and mail it in today.

# ELECTRONICS MARKET PLACE

## FOR SALE

**JERROLD, Tocom and Zenith "test" chips.** Fully activates unit. \$50.00. Cable descramblers from \$40.00. Orders 1 (800) 452-7090. Information (310) 867-0081.

**LASER & solar energy products** Lasers from \$9.95. We specialize in laser and solar energy products for commercial, and hobbyist applications. Free catalog: **DESIGN IMAGES**, Dept. P7, Box 292125, Lewisville, TX 75029. (214) 221-9711.

**SECRET Cable Descramblers!** Build your own descrambler for less than \$12.00 in seven easy steps. Complete instructions \$10.00. Radio Shack parts list and FREE descrambling methods that cost nothing to try included. **HARRYWHITE**, PO Box 1790, Baytown, TX 77520.

**FREE electronics catalog.** Transistors, IC's, electronic components, etc. Call **INTERNATIONAL MICROELECTRONICS** (817) 561-2244. PO Box 170415, Dept. PE, Arlington, TX 76003.

## 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" x 2 1/4"—\$205.00; 2" x 2 1/4"—\$410.00; 3" x 2 1/4"—\$615.00. 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 18th of the fourth month preceding the date of issue (i.e.: Sept. issue copy must be received by May 18th). 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.

**CABLE TV DESCRAMBLERS**  
★ **CONVERTERS** ★  
and ACCESSORIES.

**SAVE MONEY.  
DON'T RENT!**

**PANASONIC,  
PIONEER, JERROLD, OAK,  
SCIENTIFIC ATLANTA**  
AND MORE. LOWEST PRICES.  
FREE CATALOG.

**(800) 234-1006**  
**CABLE READY COMPANY**

**SITELINE LASERS, INC.** is offering its 5 — 8 milliwatt He-Ne lasers and power supplies for sale at manufacturers pricing. Supplies can be purchased in Do-it-Yourself kits. Send SASE and phone number for free catalog, or call (206) 481-9490.

**HUGE 100 page communications catalog** of shortwave, amateur and scanner equipment. Antennas, books, and accessories too. Send \$1.00 to: **UNIVERSAL RADIO**, 6830 Americana Pkwy., Dept. PE, Reynoldsburg, OH 43068.

**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.

**Quality Microwave TV Antennas**

**WIRELESS CABLE - IFTS - MMDS - Amateur TV**  
Ultra High Gain 50db(+) • Tuneable 1.9 to 2.7 Ghz.

- 55-Channel Dish System \$199.95
- 36-Channel Dish System \$149.95
- 20-Channel Dish System \$124.95
- Optional Commercial Grid Antenna (not shown) Add \$50.00
- Vag Antennas Components, Custom Tuning Available
- Call or write (SASE) for "FREE" Catalog

**PHILLIPS-TECH ELECTRONICS**  
Dish System P.O. Box 8533 • Scottsdale, AZ 85252  
LIFETIME (602) 947-7700 (\$3.00 Credit all phone orders)  
WARRANTY MasterCard • Visa • American Express • C.O.D.'s • Quality Pricing

**MORSE CODE MUSIC?** Powerful-breakthrough! 43 Morse Code characters sent with a rhythmic beat. Easy way to learn or retain Morse Code skills. Now the secret is yours! Order "The Rhythm of the Code" cassette today! Send \$9.95 to: **KAWA RECORDS**, PO Box 319-PE, Weymouth, MA 02188.

## FREE CATALOG

FAMOUS "FIRESTIK" BRAND CB ANTENNAS AND ACCESSORIES. QUALITY PRODUCTS FOR THE SERIOUS CB'er. SINCE 1962

FIRESTIK ANTENNA COMPANY  
2614 EAST ADAMS  
PHOENIX, ARIZONA 85034

GENERAL Instrument DPV-7's \$250.00. Tocom, Zenith, Scientific Atlanta, \$150.00 to \$250.00. Call CABLE WORLD, 1 (800) 234-7193.

TOCOM-Jerrold Impulse-Scientific Atlanta converters, two year warranties, also test modules for your converters. Contact NATIONAL CABLE, (219) 935-4128 full details.

## CB RADIO OWNERS!

We specialize in a wide variety of technical information, parts and services for CB radios. 10-Meter and FM conversion kits, repair books, plans, high-performance accessories. Thousands of satisfied customers since 1976! Catalog \$2.

CBC INTERNATIONAL  
P.O. BOX 31500PE, PHOENIX, AZ 85046

CABLE T.V. descramblers, converters, lowest prices. Guaranteed, best quality, free catalog. CNC CONCEPTS, Box 34503, Minneapolis, MN 55434. 1 (800) 535-1843.

USED "Sweet Art" computer cake decorating machine. Can reproduce photos using edible food color on cakes. Widow must sacrifice. Make offer. (619) 944-7244.

## PLANS & KITS

HOBBY/broadcasting/ham/CB/surveillance transmitters, amplifiers, cable TV, science, bugs, other great projects! Catalog \$1.00 PANAXIS, Box 130-H1, Paradise, CA 95967.

FASCINATING Electronic Devices! Dazers! Lasers! Transmitters! Detectors! Free energy! Tesla! Kits/Assembled! Catalog \$4.00. (refundable) QUANTUM RESEARCH, 17919-77 Avenue, Edmonton, Alberta T5T 2S1.



GREAT Project. Silent Sam reminds you when you forget. SSTS (Turn Signal Reminder) beeps 3 seconds after 15 seconds. Cycle repeats until cancelled. Unobtrusive, recycles when braking. Compact kit mounts atop flasher. Parts, case, PCB, schematic, instructions \$15 PPD; 2/\$25; 3/\$30. Visa/MC. Free brochure 1-800-398-5605. Prewired \$20 PPD; 2/\$35; 3/\$45 Silent Sam, 1627 Basil Dr., Columbus, OH 43227.

DESCRAMBLER kits. Complete cable kit \$44.95. Complete satellite kit \$49.95. Add \$5.00 shipping. Free brochure. No New York sales. SUMMIT PE, Box 489, Bronx, NY 10465.

SURVEILLANCE transmitter kits tune from 65 to 305 MHz. Mains powered duplex, telephone, room, combination telephone/room. Catalog with Popular Communications, Popular Electronics and Radio-Electronics book reviews of "Electronic Eavesdropping Equipment Design," \$2.00. SHEFFIELD ELECTRONICS, PO Box 377785-A, Chicago, IL 60637-7785.

BUILD 0-50 volt regulated dual tracking power supply. Complete schematics and instructions \$5.95. SMS ENGINEERING 5932 West Bell Road, Suite D106, Glendale, AZ 85308.

AUTOMOTIVE electrical monitor. Complete kit \$6.95. Assembled \$9.95. \$3.00 S/H. NY residents add tax. VR ELECTRONICS CORPORATION, 47-30 196 St., Flushing, NY 11358.

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 — Counterspy equipment! Guaranteed low prices! Catalog \$5.00. SURVEILLANCE COUNTERMEASURE TECHNOLOGIES, Box 520013-B, Salt Lake City, Utah 84152.

## REMOVE LEAD VOCALS

From Records & CD's

Build this kit which removes lead vocals from standard stereo records, CD's, tapes or FM broadcasts. Sing along with the background music. Use with any home component stereo. Additional kit adds reverb to your voice, then mixes it with music. Pre-assembled boards also available. Write for free info. Weeder Technologies, P.O. Box 421, Batavia, Ohio 45103.

SILENT submarine drive, MHD plans send \$11.95 to DNS RESEARCH, 2314 W. Harrison, Chandler, AZ 85224.

ETCH PCB's yourself, new technique, no chemicals, easy, cheap, full instructions, sharefare, \$1.00, SASE, NICKNAP PRODS., Suite 297, CN 1907, Wall, NJ 07719.

CABLE descramblers, build your own, SSAVI, Gated Sync, Sinewave. \$14.95. CABLETRONICS, Box 30502PE, Bethesda, MD 20824.

TEST-Aids for testing units in full service mode. Starcom VII, \$40.00; Starcom VI, \$30.00; Starcom DPBB, \$50.00; Pioneer clears error codes E2-E5, \$60.00; Pioneer cubes, will not alter internal serial #, \$125.00; Tocom VIP 5503/5507, \$25.00; Tocom mapping, \$40.00; S.A. 8500, \$25.00; 8550, \$30.00; 8580, \$40.00; 8570/90, \$50.00; Zenith, \$25.00; security bits and remotes. N.E. ENGINEERING, (617) 770-3830.

BUGGED? Phonetapped? Free catalog counter-surveillance equipment tells you fast! 1 (800) 732-5000.

SUPER electronic and scientific devices. Some never seen before by the public. T-lasers, alarms, surveillance devices, H. voltage devices, electronic projects, tubes, plans, and etc. at low prices. Catalog \$3.00. CM FALCO, Box 217, Rahway, NJ 07065.

## BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

### OF INTEREST TO ALL

YOU TOO CAN import from Taiwan and Hong Kong. Free information. Box 661, Dallas, GA 30132.

ELECTRONIC ENGINEERING. 8 volumes complete. \$109.95. No prior knowledge required. Free brochure. BANNER TECHNICAL BOOKS, 1203 Grant Ave., Rockford, IL 61103.

AUTO COMPASS \$3.95 GUARANTEED. TREVKE, 70A Greenwich Avenue, #129-PE, New York, NY 10011.

ELECTRONIC PROJECTS CONSTRUCTION Manuals, Catalog \$1.00: EEC Services, RR1, Priceville, Ontario, M0C 1K0 Canada.

### TRAVEL

FREE HAWAII. ORLANDO ACCOMMODATIONS!!! FOR DETAILS SEND \$2: DREAMLAND VACATIONS, BOX 56, FORTLEE, NJ 07024.

50% OFF — TRAVEL & HOTELS! Send \$1.00. Travelers, 372 Florin Rd., #223A, Sacramento, CA 95831.

## T.V. FILTERS

T.V. notch filters and bullet stopper, free brochure. MICRO Thinc., Box 63/6025, Margate, FL 33063. (305) 752-9202.

## ANTIQUE RADIO CLASSIFIED

Free Sample!

Antique Radio's  
Largest Circulation Monthly.  
Articles, Ads & Classifieds.  
6-Month Trial: \$15. 1-Yr: \$27(\$40-1st Class).  
A.R.C., P.O. Box 802-L8, Carlisle, MA 01741



## BUSINESS OPPORTUNITIES

YOUR own radio station! Licensed/unlicensed. AM, FM, TV, cable. Information \$1.00 BROADCASTING, Box 130-H1, Paradise, CA 95967.

MAKE \$75,000.00 to \$250,000.00 yearly or more fixing IBM color monitors. No investment, start doing it from your home (a telephone required). Information, USA, Canada \$2.00 cash for brochure, other countries \$10.00 US funds. RANDALL DISPLAY, Box 2168-H, Van Nuys, CA 91404, USA. Fax (818) 990-7803.

HOME assembly work available! Guaranteed easy money! Free details! HOMEWORK-P, Box 520, Danville, NH 03819.

FEDERAL loans for small businesses now available. 1 (800) 777-6342 for free details.

FREE information! Research engineer earns living with stocks safely. HILL, PO Box 48194, Niles, IL 60648.

START your own burglar alarm company. Be your own boss! Info packet \$10.00. JCE ENTERPRISES, 205 Maplewood, Hot Springs, AR 71913.

BIG Money Now in home-based business! Free new report gives easy how-to tips. Rush LSASE to: MBM-PE0193, Box 431648, Miami, FL 33143.

EASY work! Excellent pay! Assemble products at home. Call toll free 1 (800) 467-5566 ext. 5730.

## WANTED

PROTECT and market your new product ideas! Call THE IDEA EXCHANGE — Fast, professional, confidential: 1 (800) 272-6875.

INVENTORS. Do your own patent searches at no cost. The Patent Office has provided this for decades. The Guide to Patent Searches. \$19.95. CSC, Box 1729, Massapequa, NY 11758.

## SATELLITE TV

FREE — Catalog — Do-it-Yourself save 40%-60% Lowest prices world wide, systems, upgrades, parts. All major brands factory fresh and warranted. SKYVISION, 1048 Frontier, Fergus Falls, MN 56537. 1 (800) 334-6455.

SATELLITE TV — Do it Yourself, major brands discounted, We'll beat everyone's price. Discount LARRY, (609) 596-0656.

SUPER low satellite prices. Free U.S. and International catalog. SATMAN, (309) 692-4140 (Int'l.), 1 (800) 472-8626 in U.S.

VIDEOCIPHER II descrambling manual. Schematics, video and audio, \$18.95. Videocipher II 032, \$15.00. Videocipher II plus, \$20.00. Software, \$25.00. CABLETRONICS, Box 30502PE, Bethesda, MD 20824.

## PERSONAL CODE EXPLORER

NEW! Exciting! Easy-to-use Personal Code Explorer copies digital radio signals — fax, morse, RTTY, ASCII, SITOR, packet and more on your IBM/PC screen. Free brochure. Call, write, MC/VISA. \$129.00 plus \$4.00 shipping. MICRO-CRAFT, Box 513PE, Thiensville, WI 53092. (414) 241-8144.

## EDUCATION/INSTRUCTION

**LEARN IBM PC assembly language.** Disk \$5.00. Book \$18.00. ZIPFAST, Box 12238, Lexington, KY 40581-2238.

**VCR repair.** Save money — make big profits! Learn how from *How to Keep Your VCR Alive*. "This detailed, step-by-step manual enables anyone with no previous knowledge or experience to fix most VCR problems easily, quickly, and inexpensively with a few simple tools." — *Small Press Review*. Highly recommended by *Electronic Servicing and Technology*, *Modern Electronics*, *Popular Electronics*, *Popular Communications*, *Videomaker*, *Video*, *Nuts and Volts*, and many other electronics and video magazines "Far better than Viejo at 1/7 the cost." 403 page book, with 704 illustrations, plus professional head-cleaning tool. Obtain from B. Daltons or send \$24.95 to **WORTHINGTON PUBLISHING**, 6907-202H Halifax River Drive, Tampa, FL 33617. Publisher pays S&H. Money-back satisfaction guarantee!

**LEARN computers.** Tutorials and software. Programs sampler \$11. Catalog \$1.00. Complete IBM software line — education, business, scientific, games, Windows. State disk size. **VISTA-PE SOFTWARE**, 95106 Huaala Place, Mililani, HI 96789.

**ESP, Bioelectricity, Microwave hearing.** Introduction, comprehensive booklist... \$1.00. **RESEARCH ASSOCIATES**, PO Box 3583, Boynton Beach, FL 33424-3583.

**"PERMANENT Magnet Materials Short Course."** Complete history, materials listing, glossary, specifications, applications, design criteria, sources. Details \$2.50, order refundable. **SJL PUBLISHING**, Dept. A004PE, Hanna, IN 46340-0152.

## TELECOMMUNICATIONS

**CORDLESS phone scandal!** Long-range eavesdropping secrets exposed. Millions unaware! Protect your privacy. \$12.00. **AIRWAVES**, 5319 University, Suite 300PE1, Irvine, CA 92715. (Hurry! Limited offer.)

## GET OUT OF THE DARK.

Open your eyes and see just how many subjects are covered in the new edition of the Consumer Information Catalog. It's free just for the asking and so are nearly half of the 200 federal publications described inside. Booklets on subjects like financial and career planning; eating right, exercising, and staying healthy; housing and child care; federal benefit programs. Just about everything you would need to know. Write today. We'll send you the latest edition of the Consumer Information Catalog, which is updated and published quarterly. It'll be a great help, you'll see. Just write:

**Consumer Information Center  
Department TD  
Pueblo, Colorado 81009**

U.S. General Services Administration



**LEARN COMPUTERS!**  
Home study: become an expert with the personal computer for home or business use. Free literature: call 800-223-4542.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
School of Computer Training, Dept. KA341  
2245 Perimeter Pk., Atlanta, Georgia 30341

**Cable TV  
DESCRAMBLERS**

30-day  
Money Back  
Guarantee



➤ The Most Complete Line of Descramblers  
➤ Friendly, professional service  
➤ FREE Catalog

**ORDER NOW!**

  
**1-800-228-7404**  
 Go to the Source  
**NU-TEK ELECTRONICS**  
 3250 Hatch RD  
 Cedar Park TEXAS 78613

**FREE CATALOG!**  
**1-800-648-7938**

**JERROLD HAMLIN OAK ETC  
CABLE TV  
DESCRAMBLERS**

- Special Dealer Prices!
- Compare our Low Retail Prices!
- Guaranteed Prices & Warranties!
- Orders Shipped Immediately!

**REPUBLIC CABLE PRODUCTS, INC.**  
4080 Paradise Rd. #15, Dept. PE193  
Las Vegas, NV 89109  
For all other information (702) 362-9026

★★★★PRESENTING★★★★

**CABLE TV  
DESCRAMBLERS**

★★★★ STARRING ★★★★★

**JERROLD, HAMLIN, OAK**  
AND OTHER FAMOUS MANUFACTURERS

- FINEST WARRANTY PROGRAM AVAILABLE
- LOWEST RETAIL / WHOLESALE PRICES IN U.S.
- ORDERS SHIPPED FROM STOCK WITHIN 24 HRS
- ALL MAJOR CREDIT CARDS ACCEPTED

FOR FREE CATALOG ONLY **1-800-345-8927**  
FOR ALL INFORMATION **1-818-709-9937**

**PACIFIC CABLE CO., INC.**  
7325 1/2 Reseda Blvd., Dept. 2022  
Reseda, CA 91335

**Popular  
Electronics®**

WE  
**HAVE  
THE  
RIGHT  
ANSWER**

Advertisers who want to place their print ads in a quality publication ask the question: "Is your circulation audited?"

We're very proud to answer "Yes."

We are a member of the Audit Bureau of Circulations because we share ABC's belief that circulation audits are an essential assurance of value.

ABC is the premier circulation auditing organization in the world, and has been since 1914. Each year, ABC auditors test and verify that our circulation figures are facts, not claims. An ABC audit is the sign of a sound investment for advertisers.

Not all publications are audited, but they should be. Because when advertisers ask "Is your circulation audited?" there's only one answer.

"Yes."

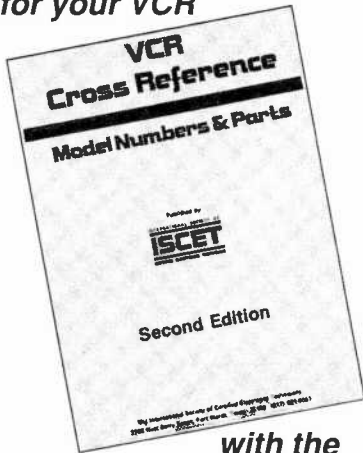


Audit Bureau of Circulations



# VCR Cross Reference

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



**with the  
ISCET VCR**

## CROSS REFERENCE

This 272-page reference contains both model and part-number cross-references and now includes the FREE 56-page 1991 updates.

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

The ISCET VCR Cross Reference and 1991 Update pages are pre-punched for standard loose-leaf binding....\$38.00 plus \$3.00 for shipping for each reference.

Electronics Technology Today Inc.  
VCR CROSS REFERENCE OFFER  
P.O. Box 240,  
Farmingdale, New York 11735

Name \_\_\_\_\_

Business \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

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

Phone \_\_\_\_\_

Enclose \$38.00 for the ISCET VCR Cross Reference and 1991 Update Reference and \$3.00 for shipping for each reference.

I have ordered \_\_\_\_\_ ISCET VCR Cross Reference(s).

The total amount of my order is \$ \_\_\_\_\_.

Check enclosed—do not send cash.

or please charge my credit card:

Visa  MasterCard Exp. Date \_\_\_\_/\_\_\_\_/\_\_\_\_

Card No. \_\_\_\_\_

Signature \_\_\_\_\_

New York State residents must add applicable local sales tax to total.

## ADVERTISING INDEX

POPULAR ELECTRONICS magazine does not assume any responsibility for errors that may appear in the index below.

| Free Information No. | Page                                   |
|----------------------|--|
| 5                    | AMC Sales ..... 29                     |
| —                    | Antique Radio Classified ..... 96      |
| —                    | CBC International ..... 96             |
| —                    | CIE ..... 11                           |
| —                    | CLAGGK, Inc. Book Club ..... 21        |
| —                    | CLAGGK, Inc. Video Offer ... CV3       |
| —                    | Cable Ready Company ..... 95           |
| —                    | Command Productions ..... 81           |
| —                    | Electronic Tech. Today ..... CV2       |
| —                    | Electronic Tech. Today ..... 83, 89    |
| —                    | Electronics Book Club ..... 15, 79     |
| —                    | Firestik II ..... 96                   |
| —                    | Grantham College ..... 27              |
| —                    | HighText Publications, Inc. ... 68, 76 |
| —                    | ISCET ..... 85                         |
| 8                    | Mouser ..... 85                        |
| —                    | NRI Schools ..... 25                   |
| —                    | Nu-Tek ..... 97                        |
| —                    | Pacific Cable ..... 97                 |
| 6                    | Panavise ..... 73                      |
| 10                   | People's College ..... 3               |
| —                    | Phillips Tech ..... 95                 |
| —                    | Popular Electronics ..... 69           |
| 13                   | Radio Shack ..... CV4                  |
| —                    | Republic Cable ..... 97                |
| —                    | Silent Sam TSR Co. .... 96             |
| 12                   | U.S. Cable ..... 28                    |
| —                    | Video Dimensions ..... 93              |
| 15                   | Viejo Publications ..... 91            |
| —                    | Weeder Technologies ..... 96           |
| 11                   | Zentek Corp. .... 28                   |

## ADVERTISING SALES OFFICE

Gernsback Publications, Inc.  
500-B Bi-County Blvd.  
Farmingdale, NY 11735  
1-(516) 293-3000

Larry Steckler  
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 McQuade  
credit manager

**Customer Service/Order Entry**  
1-800-827-0383  
1-800-892-0753  
7:30 AM - 8:30 PM EST

## SALES OFFICES

### EAST/SOUTHEAST

Stanley Levitan

Eastern Sales Manager  
1 Overlook Ave.  
Great Neck, NY 11021  
1-516-487-9357  
Fax 1-516-487-8402

### MIDWEST/Texas/Arkansas/ Oklahoma, Colorado, Arizona

Ralph Bergen

Midwest Sales Manager  
One Northfield Plaza, Suite 300  
Northfield, IL 60093-1214  
1-708-446-1444  
Fax 1-708-559-0562

### PACIFIC COAST/Mountain States

Mike Brooks

Pattis/3M  
1800 North Highland Avenue  
Suite 717  
Hollywood, CA 90028  
1-213-462-2700  
Fax 1-213-463-0544

### PE Market Center

Nicki Van Suydam

Pattis/3M  
1800 North Highland Avenue  
Suite 717  
Hollywood, CA 90028  
1-213-462-2700  
Fax 1-213-463-0544

# Countersurveillance

**Never before has so much professional information on the art of detecting and eliminating electronic snooping devices—and how to defend against experienced information thieves—been placed in one VHS video. If you are a Fortune 500 CEO, an executive in any hi-tech industry, or a novice seeking entry into an honorable, rewarding field of work in countersurveillance, you must view this video presentation again and again.**



**CALL NOW!**

**1-516-293-3751**

**HAVE YOUR  
VISA or MC CARD  
AVAILABLE**

*Wake up!* You may be the victim of stolen words—precious ideas that would have made you very wealthy! Yes, professionals, even rank amateurs, may be listening to your most private conversations.

*Wake up!* If you are not the victim, then you are surrounded by countless victims who need your help if you know how to discover telephone taps, locate bugs, or "sweep" a room clean.

There is a thriving professional service steeped in high-tech techniques that you can become a part of! But first, you must know and understand Countersurveillance Technology. Your very first insight into this highly rewarding field is made possible by a video VHS presentation that you cannot view on broadcast television, satellite, or cable. It presents an informative program prepared by professionals in the field who know their industry, its techniques, kinks and loopholes. Men who can tell you more in 45 minutes in a straightforward, exclusive talk than was ever attempted before.

## Foiling Information Thieves

Discover the targets professional snoopers seek out! The prey are stock brokers, arbitrage firms, manufacturers, high-tech companies, any competitive industry, or even small businesses in the same community. The valuable information they filch may be marketing strategies, customer lists, product formulas, manufacturing techniques, even advertising plans. Information thieves eavesdrop on court decisions, bidding information, financial data. The list is unlimited in the mind of man—especially if he is a thief!

You know that the Russians secretly installed countless microphones in the concrete work of the American Embassy building in Moscow. They converted

what was to be an embassy and private residence into the most sophisticated recording studio the world had ever known. The building had to be torn down in order to remove all the bugs.

## Stolen Information

The open taps from where the information pours out may be from FAX's, computer communications, telephone calls, and everyday business meetings and lunchtime encounters. Businessmen need counselling on how to eliminate this information drain. Basic telephone use coupled with the user's understanding that someone may be listening or recording vital data and information greatly reduces the opportunity for others to purloin meaningful information.

The professional discussions seen on the TV screen in your home reveals how to detect and disable wiretaps, midget radio-frequency transmitters, and other bugs, plus when to use disinformation to confuse the unwanted listener, and the technique of voice scrambling telephone communications. In fact, do you know how to look for a bug, where to look for a bug, and what to do when you find it?

Bugs of a very small size are easy to build and they can be placed quickly in a matter of seconds, in any object or room. Today you may have used a telephone handset that was bugged. It probably contained three bugs. One was a phony bug to fool you into believing you found a bug and secured the telephone. The second bug placates the investigator when he finds the real thing! And the third bug is found only by the professional, who continued to search just in case there were more bugs.

The professional is not without his tools. Special equipment has been designed so that the professional can sweep a room so that he can detect voice-activated (VOX) and remote-activated bugs. Some of this equipment can be operated by novices, others require a trained countersurveillance professional.

The professionals viewed on your television screen reveal information on the latest technological advances like laser-beam snoopers that are installed hundreds of feet away from the room they snoop on. The professionals disclose that computers yield information too easily.

This advertisement was not written by a countersurveillance professional, but by a beginner whose only experience came from viewing the video tape in the privacy of his home. After you review the video carefully and understand its contents, you have taken the first important step in either acquiring professional help with your surveillance problems, or you may very well consider a career as a countersurveillance professional.

## The Dollars You Save

To obtain the information contained in the video VHS cassette, you would attend a professional seminar costing \$350-750 and possibly pay hundreds of dollars more if you had to travel to a distant city to attend. Now, for only \$49.95 (plus \$4.00 P&H) you can view *Countersurveillance Techniques* at home and take refresher views often. To obtain your copy, complete the coupon or call.

|   |             |           |
|---|-------------|-----------|
| <b>CLAGGK INC.</b>  |             | <b>PE</b> |
| P.O. Box 4099 • Farmingdale, NY 11735   |             |           |
| Please rush my copy of the Countersurveillance Techniques Video VHS Cassette for a total cost of \$53.95 each (which includes \$4.00 postage and handling). |             |           |
| No. of Cassettes ordered  | _____       |           |
| Amount of payment \$  | _____       |           |
| Sales tax (N.Y.S. only)   | _____       |           |
| Total enclosed  | _____       |           |
| Bill my <input type="checkbox"/> VISA <input type="checkbox"/> MasterCard   |             |           |
| Card No.  | _____       |           |
| Expire Date   | ____ / ____ |           |
| Signature   | _____       |           |
| Name  | _____       |           |
| Address   | _____       |           |
| City  | State       | ZIP       |
| All payments in U.S.A. funds. Canadians add \$4.00 per VHS cassette. No foreign orders.   |             |           |

# THE PARTS PLACE

**TECHLINE™ Tools—The new standard in strength and precision!**



## NEW! Autoranging LCD Digital Multimeter

Convenient autoranging and auto-polarity at a low price. Select the function—meter does the rest. Diode-check mode. Measures to 1000VDC, 750VAC, 200mA DC current, 20 megohms resistance. Fuse protected, UL 1244 listed. #22-166 ..... 36.99



- Precision-crafted with top-quality materials
- Designed for long life and ease of use
- Backed by Radio Shack's 1-Year Limited Warranty

New TECHLINE tools represent Radio Shack's uncompromising dedication to quality. Each is precision-crafted of long-lasting, hard-working materials and employs the latest design innovations for comfort and ease of use. And, each is backed by our full 1-year limited warranty.

**Speedy service and low prices on thousands of parts and accessories!**

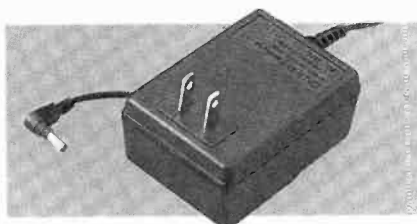


- FREE delivery to Radio Shack on orders \$5 and up
- Semiconductors and ICs ■ Hard-to-find batteries
- CB and scanner crystals ■ Long-life vacuum tubes
- Phono cartridges/styli ■ SAMS® service books

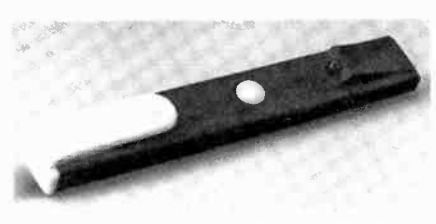
Why pay more for mail-order? Your Radio Shack stocks 1000 electronic components, and another 15,000 are available fast from our special-order warehouse. Ordering is easy! Bring in the exact part number (or old part). We'll check availability and order by phone. Delivery time to your nearby Radio Shack for most items is a week.



**TECHLINE Rechargeable Soldering Gun.** Great for autos, boats and campers—solder up to 250 joints on one charge. Trigger lock, light. UL listed AC charger, case. #64-2194 ..... 39.95



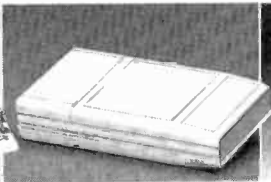
**CD Player AC-to-DC Voltage Adapter.** Saves batteries! Connect to your portable CD player's DC jack and plug into wall outlet to play from 120VAC. 3VDC regulated output. UL listed. #273-1659 ..... 16.95



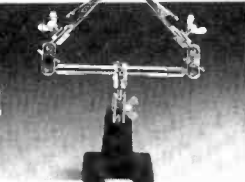
**AC Voltage Sensor.** Detects broken connections, blown fuses, defective grounds, open breakers, more. Indicates presence of AC voltages from 70 to 440VAC. Replaceable battery. #22-103 ..... 11.99



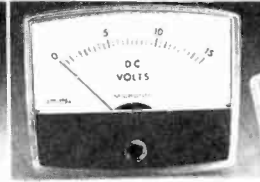
**TECHLINE 18-Piece Hex Key Set.** Ideal for engine and machinery work. Heavy-duty steel alloy. Standard sizes. #64-1816 ..... 4.99



**IR Transmitter Project Case.** For beeper or remote. 9V battery compartment. Molded 7/8 x 2 3/8 x 4 1/4" enclosure. #270-294 ..... 4.49



**Project Holder.** Alligator-type clamps adjust to hold work in any position. Solid cast-iron base prevents tipping. #64-2093 ..... 8.49



**DC Voltmeter.** Measure vehicle or power-supply voltage. Jeweled movement. Mounts in 1 7/8" diameter round hole. #270-1754 ..... 7.95



**Infrared Sensor Card.** Detects normally invisible infrared to confirm output from remotes, IR LEDs or lasers. #276-099 ..... 5.95

# Radio Shack® SINCE 1921

## AMERICA'S TECHNOLOGY STORE™

Prices apply at participating stores and dealers.

CIRCLE 13 ON FREE INFORMATION CARD