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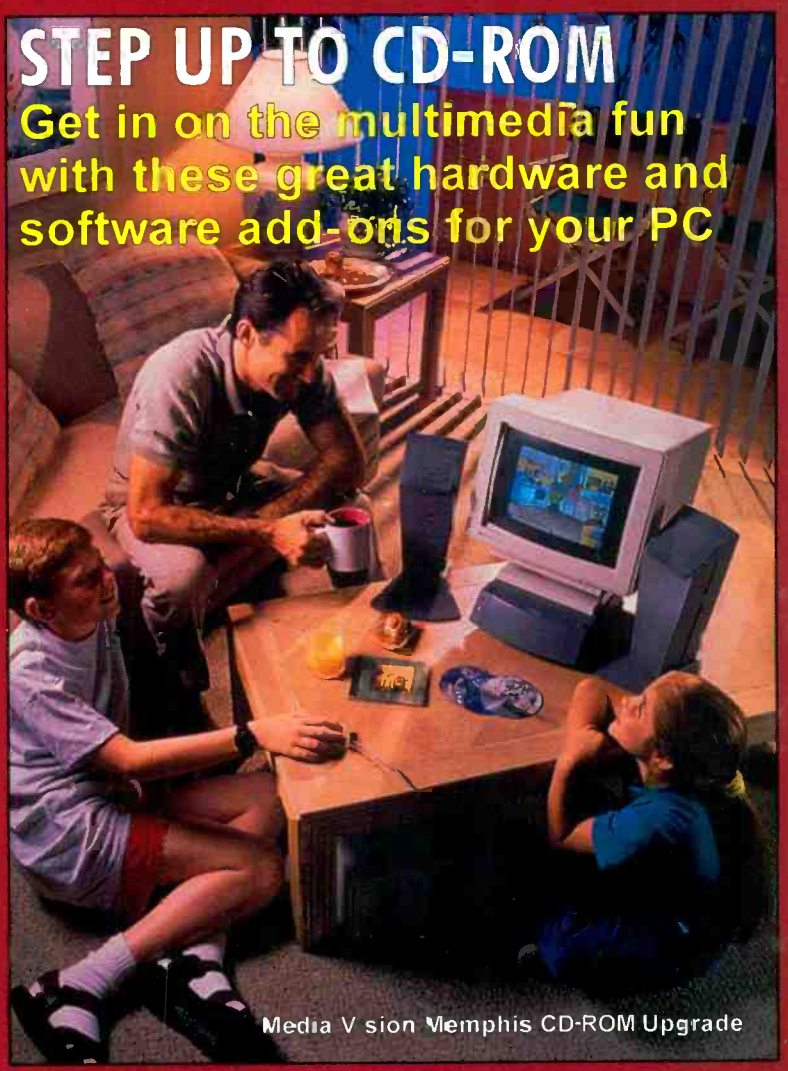

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EDITORIAL

THE AGE OF INFORMATION

In the 1800's, the face of this nation was changed forever by the start of the Industrial Revolution. Today, another revolution, the "Information Revolution," has begun and like every revolution, there will be winners and losers.

Information is power. Those with the most information, and the ability to access and use it effectively, will inevitably rise to the top of society. Unfortunately, it is also inevitable that the Information Revolution will have many casualties. The coming years may be difficult ones for those used to the "old ways" of doing things. To avoid becoming "obsolete," individuals will need not only to accept, but embrace the emerging information technologies.

One of the key elements of the information revolution is the so-called "Digital Highway." It will be here soon, and, in fact, parts of it are already in place. In the meantime, many computer users are getting a jump on the rest of society. Dial-up databases such as CompuServe, smaller corporate and university databases that are interconnected via the Internet (which will likely make up part of the digital highway), and the like already give computer users nearly instant access to vast amounts of information.

Now there's CD-ROM. That technology is revolutionizing the way students and professionals can assemble and access information. As an example, in New York, attorneys can obtain CD-ROM's containing the complete N.Y. State statutes, case law, etc. This means the research that once could have taken days to complete can now be done in hours, and perhaps even in minutes. That's what we mean by power.

For those who want to learn more, this month **Popular Electronics** presents "Step Up to CD-ROM." It's a feature story that examines what to look for when adding a CD-ROM to your PC. It also samples some of the hardware and software products that are available today. The story begins on page 31.

Carl Laron
Editor

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LETTERS

THANKS, AND A TIP

I have comments about two articles that appeared in the November issue of **Popular Electronics**.

First, thanks for "Where to Find Electronics Parts," which listed many sources for parts and services. I seldom see advertising by most of the companies listed, and have not been aware of most of them. The list will be valuable to me. I have business for one of them already.

My second comment is about the telephone-line tester that appeared in *Circuit Circus*. It certainly can be of great financial benefit to any capable person to do some testing before calling in the phone company. Besides testing for line voltage and seeing it drop under off-hook conditions, it is valuable to have a known working telephone set with a standard plug that can be connected to the line at the protector box where the cable meets up with the house. Here, at least, the telephone company provides a test jack in that box for such test purposes. You can listen for noise and verify that you get a dial tone when going off-hook.

However, the article repeats a common error (almost a universal error), in saying that there should be about 48 volts between tip and ring conductors in the idle condition. It is true that in the trade that voltage is called 48 volts, but in reality it almost never is. To the best of my knowledge, you will almost always find it to be within half a volt of 52 volts. If you build the circuit in the article and calibrate the meter for 50 volts full scale, the needle will go off scale high under normal circumstances. This might be a minor point, but a lot of people might wonder if something is wrong when they see a reading that is four volts higher than the article says they should see.

K.E.S.
Cherryvale, KS

RELOCATED SUPPLIER

Star-Tronics was mentioned in the article "Where to Find Electronics Parts" (**Popular Electronics**, November 1993). We have just moved to Las Vegas, and the address shown in the article is no longer applicable.

Please note that we are still providing fine parts at low prices, as we have for the past 20 years. Our new mailing address is Star-Tronics, P. O. Box 98102, Las Vegas, NV 89193. Our physical address is 4640 South Valley View Blvd., Suite E, Las Vegas, NV 89103. Our new phone number is 702-795-7151.

BRUCE STELLER, OWNER
Star-Tronics
Las Vegas, NV

HAVES & NEEDS

I have a set of red, green, and blue guns for an A-1 ceiling or wall projection TV monitor. Each gun is 5½ inches in diameter. They have been tested and are in working order.

I will ship the set to anyone who might be interested, for the price of shipping and handling.

KENNETH SOMERS
5717 SE Riverside Drive
Vancouver, WA 98661

I am looking for an owner's manual as well as a service manual for a Hitachi model V-1050F oscilloscope. I will gladly pay for copying or postage costs. Thank you.

PHIL DENNING
865 Globe Ave.
Fort Worth, TX 76131

I'm looking for a used, or unwanted, low-cost home electronics training course. I'm hoping that a fellow **Popular Electronics** reader might be able to help me out. I'll gladly pay for any postage costs.

CLAYTON CAMPBELL
31b Argyle Road
St. Pauls
Bristol BS2 8UY
Avon, United Kingdom

I've seen other readers get lucky, and now I'm hoping it's my turn. I'm trying to locate an audio amplifier chip that was used in the old Cobra and President radios that used the 858 PLL. any of the following will work: UPC 156 H, SK 3484, or NTE/ECG 1194. I have checked all my sources and was told that it is discontinued and can't be found. But I'd hate to trash a good radio.

TOM WILSON
71 Woodland Ave.
Mantua, NJ 08051

I am searching for a frequency-synthesis IC, part #15-3015689-1, for a 12-year-old Sylvania TV, chassis #E51-06. The IC is no longer available from Sylvania. I will accept a used or a new IC. Thank you!

JAMES P. KOCH
3867 Kelley Circle South
Memphis, TN 38111

I have a working H.H. Scott LK-30 stereo amplifier, which is, I believe, about 30 years old. I would very much like to find an instruction book for it.

If anyone has any suggestions, I would love to hear them. Many thanks.

THOMAS BLALOCK
113 East Housatonic Street
Pittsfield, MA 01201

WRITE ON

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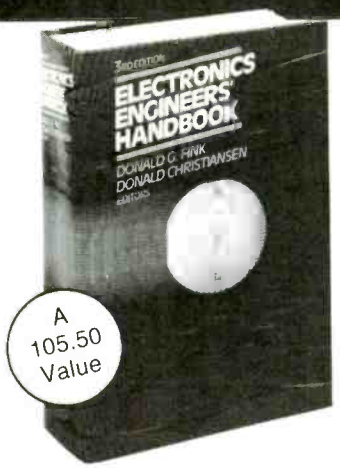

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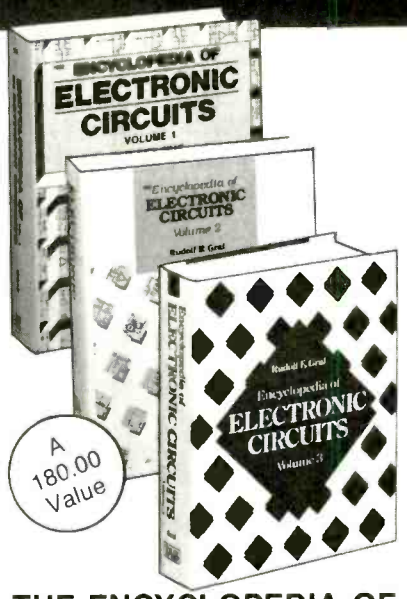

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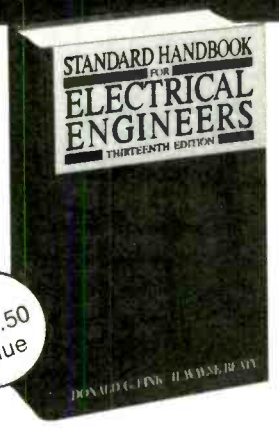

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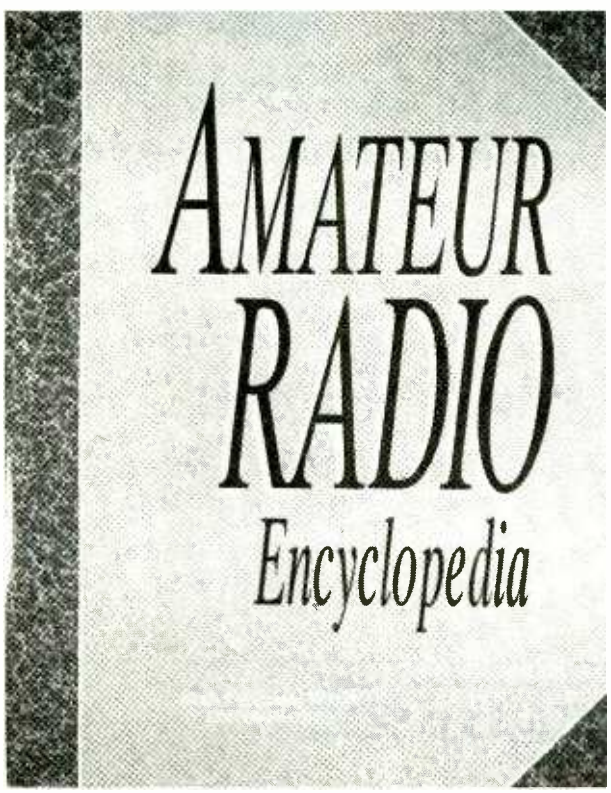

From "absorption wavemeter" to "Zurich sunspot number," this fully-illustrated encyclopedia provides a practical overview of every topic related to amateur radio. Aimed at ham-radio operators, shortwave listeners, CB'ers, and electronics enthusiasts, the one-volume reference presents detailed information in a format that is easily accessible even to beginners and would-be hobbyists. The book's 600 pages of alphabetically arranged, cross-referenced articles cover more than 1000 topics. Included are comprehensive listings on packet radio, antennas and wave propagation, modulation and repeaters, amateur satellite communications, radioteletype, amateur television, Military Affiliated Radio Service (MARS), power supplies and test equipment, and hundreds of other amateur-radio-related subjects.

Amateur Radio Encyclopedia costs $29.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 800-233-1128.

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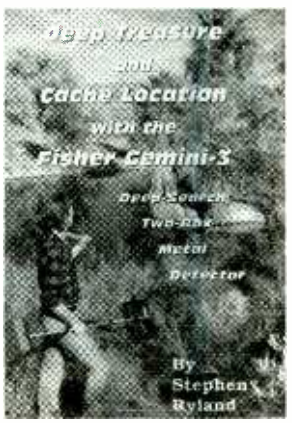
DEEP TREASURE AND CACHE LOCATION WITH THE FISHER GEMINI-3

by Stephen Ryland



Buried treasure isn't found only in old pirate movies—there are plenty of valuables hidden underground just waiting to be found. For those who are interested in taking up the search, this book explains how to put the Fisher Gemini-3 two-box, deep-search metal detector to work. The 60-page, illustrated book provides valuable tips for anyone with an interest in deep-cache treasure hunting, from generating treasure leads to recovering buried treasure.

The book explains everything you'll need to pack up and take off on the trail of hidden treasure. It teaches the difference between cache and treasure, and how to generate leads for both. It covers planning the hunt, developing a search strategy, and searching for gold. Also included are a history of deep-cache treasure hunting, and chapter full of recent case histories. The book also contains a detailed discussion of the Gemini-3 metal detector, with separate chapters devoted to theory of operation and in-depth operating instructions.

Deep Treasure and Cache Location with the Fisher Gemini-3 costs $8 plus $2 shipping and handling (California residents must ad 7.25% sales tax) from Fisher Research Laboratory, Department PE, 200 West Willmott Road, Los Banos, CA 93635.

CIRCLE 85 ON FREE INFORMATION CARD

WORLD SATELLITE TV AND SCRAMBLING METHODS
The Technician's Handbook: Third Edition

by Frank Baylin, John McCormac, and Richard Maddox

Containing a wealth of practical information for technicians, satellite professionals, and curious do-it-yourselfers, this book covers all components of home satellite systems with an emphasis on their design, operation, and repair. The book contains chapters on troubleshooting and setting up a test bench, as well as a chapter on specialized electronic components. Expert guidance on testing, servicing, and tuning is complemented by detailed illustrations. Circuit and block diagrams of most components are presented and clearly explained throughout the book.

Almost a third of the book is

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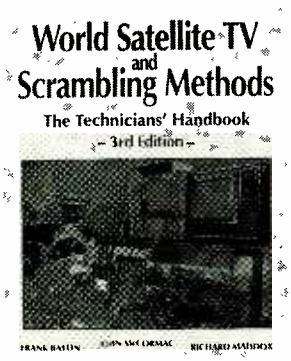

devoted to an in-depth study of broadcast formats including NTSC, PAL, SECAM, and MAC; digital-audio techniques; and basic scrambling and encryption methods. Complete circuit descriptions of the Chaparral Cheyenne, The General Instrument 2400R, the Maspro 90R, and the Sakura receivers are included. That material serves as a backdrop to a discussion of all American and European scrambling technologies.

The third edition has been revised and updated to include expanded information on LNB design and construction, flat-plate antennas, feedhorns, and smart cards. It also contains updates to case studies of several current encryption methods.

World Satellite TV and Scrambling Methods: The Technician's Handbook, Third Edition is available for $40 plus $4 shipping and handling from Baylin Publications, 1905 Mariposa, Boulder, CO 80302.

CIRCLE 86 ON FREE INFORMATION CARD

A BEGINNERS GUIDE TO CMOS DIGITAL ICS

by R.A. Penfold

Because many of the basic concepts of logic circuits seem rather abstract and remote from obviously useful applications, beginners often have trouble getting started. This book covers the fundamental theory of digital electronics and the use of CMOS integrated circuits, but it never loses sight of the fact that digital electronics has many real-world applications. The book discusses the basic concepts of logic circuits and explains the functions of gates, inverters, and other logic build-

ing blocks. It describes CMOS logic IC characteristics and the advantages of using CMOS logic IC's in practical circuit design. The book also covers oscillators and monostables, flip-flops, binary dividers and binary counters, decade counters, and display drivers. Several circuits that demonstrate the use of CMOS logic IC's in practical applications are also included.

A Beginners Guide to CMOS Digital ICs (order number BP333) is available for $6.25 plus $2.50 shipping and handling from Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.

CIRCLE 97 ON FREE INFORMATION CARD

POWER SUPPLIES, SWITCHING REGULATORS, INVERTERS, AND CONVERTERS: Second Edition

by Irving M. Gottlieb

Although regulated power supplies are an indispensable part of every electronic system, they remain a mystery even to many professionals. This book provides all the technical data and hands-on guidance that professional and amateur circuit designers need to build power supplies for demanding applications, from TV sets and radio transmitters to computers. State-of-the-art theory and practice are covered in detail, with a bare minimum of math. Hundreds of helpful schematics and diagrams are included. The book covers transistor and thy-

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ristor inverter and converter applications, switching-type power-supply applications, high-performance regulated power supplies, low-power and low-voltage regulated power supplies. The second edition has been updated to present the latest developments in regulated power supplies, including new IC technology, low-voltage logic devices, and one-watt power supplies for ISDN equipment. Solid-state devices, including transistors, controllers, MOSFET's, thyristors, and the SIDAC, also are covered.

Power Supplies, Switching Regulators, Inverters, and Converters, Second Edition, costs $21.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 800-233-1128.

CIRCLE 98 ON FREE INFORMATION CARD

DOS FOR BEGINNERS: "No Experience Required!"

by Udo Bretschneider

Written for the newcomer who needs to know DOS basics right away, this book anticipates the reader's questions and presents the answers in an easy-to-understand style. The book opens with thorough explorations of the keyboard, the computer, the display, hard- and floppy-disk drives, and what to expect from MS-DOS. It goes on to explain how to create directories, work with files, using diskettes, set the computer's calendar and clock, create and use macros, back up your data, use the MS-DOS Shell and the MS-DOS Editor, change the AUTOEXEC.BAT and CONFIG.SYS files, install new software, and deal

with error messages. The book also points out things that the beginner shouldn't mess with, such as formatting the hard drive, and things that are unwise for anyone to do—removing a diskette while the drive is still working, switching off the computer while programs are still running, working directly from a diskette, and the like. Finally, the book provides a command reference, two glossaries, and a companion diskette. The disk contains two programs: an icon-oriented, Windows-like graphical user interface called Desktop that gives the user simple, intuitive control of the system and programs; and Cannonade, a futuristic game of skill and strategy.

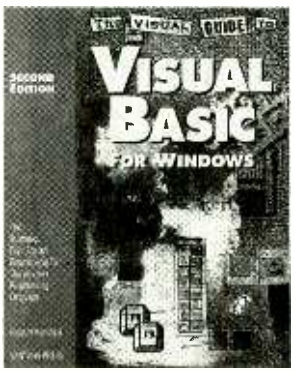
DOS for Beginners costs $22.95, including diskette, and is published by Abacus, 5370 52nd Street SE, Grand Rapids, MI 49512.

CIRCLE 87 ON FREE INFORMATION CARD

THE VISUAL GUIDE TO VISUAL BASIC FOR WINDOWS: For Version 3, Second Edition

by Richard Mansfield

Visual BASIC for Windows takes a visual approach to Windows programming, and this book takes the same approach to explaining the popular Windows programming tool. The language's more than 400 commands, tools, and techniques are arranged in easy-to-use, alphabetic listings, accompanied by more than 600 illustrations. The book reveals how to create customized Windows applications to meet specific needs, design animated controls, make Windows programs communicate with each other, and build powerful database managers with the new Data Control. It shows readers how to tap into the 600-plus powerful commands that are built into Windows itself, and uncovers techniques used by the experts to make their programs visually exciting and easy to use.



The Visual Guide to Visual BASIC for Windows Version 3 costs $29.95 and is published by Ventana Press, P. O. Box 2468, Chapel Hill, NC 27515; Tel. 919-942-0220; Fax: 919-942-1140.

CIRCLE 88 ON FREE INFORMATION CARD

TURBOCHARGE YOUR MAC! Make any Mac Faster & Smarter

by Carla Rose

Regardless of the type of Mac you use—whether it's a Plus, the Quadra 900, or anything in between—this book-and-diskette package shows you how to make it work faster and more efficiently. Mac users of all skill levels will find in its pages information and advice, illustrated by helpful screen shots, diagrams, and car-related icons that highlight important do's and don'ts. Lively automotive analogies appear throughout this guide for would-be Macintosh power users. The diskette contains powerful productivity tools.

The book explains how to speed up operations with RAM disks, cache utilities, coprocessors, clock cards, and disk optimizers. Also covered are removable drives, optical drives, floptical drives, SCSI, and virtual memory. The book presents a variety of software-based speed- and efficiency-boosters, including command keys and macros, shareware utilities, network monitors, print spoolers, OCR scanners, and DiskTop. Readers also learn how to secure data with commercial anti-virus and file-recovery programs, fail-proof power supplies, surge protectors, tape-backup systems, and anti-theft devices.

Turbocharge Your Mac! Make Any Mac Faster & Smarter costs $32.96, including diskette, and is published by Windcrest/McGraw-Hill, Blue Ridge Summit, PA 17294-0850; Tel. 800-233-1128; Fax: 717-794-2103.

CIRCLE 96 ON FREE INFORMATION CARD

BUILD YOUR OWN LOW-COST PC AND SAVE A BUNDLE

by Aubrey Pilgrim

For anyone who's looking for a inexpensive but full-featured computer that runs today's most popular software products, this book shows how easy, satisfying, and fun it can be to build your own PC. Newly upgraded to include the latest information on hardware sources, components, and prices, the book provides all the guidance needed to assemble an AT-compatible 286 or 386SX for a fraction of the market cost. Featuring step-by-step instructions, close-up photographs, and a lay-flat binding, the book is intended as a hands-on tool. It tells readers what to look for

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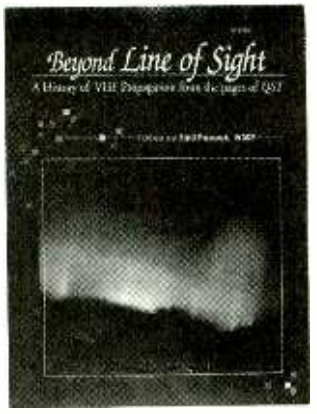
and what to avoid in today's disk drives, display monitors, keyboards, mice, plug-in boards, printers, modems, and on-line services. The book explains how the components work once they're connected, and describes a variety of word-processing, database, spreadsheet, and disk-management programs, including the latest versions of DOS and Windows.

Build Your Own Low-Cost PC and Save a Bundle costs $18.95 and is published by TAB Books, Division of McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850; Tel. 800-822-8138.

CIRCLE 98 ON FREE INFORMATION CARD

BEYOND LINE OF SIGHT: A History of VHF Propagation from the pages of QST

The belief that radio waves could never travel beyond the line of sight led DX'ers to coin the phrase "What you see is what you work." Today, however, it's common knowledge that VHF radio waves can travel thousands of miles in various propagation modes. That knowledge came about largely through the efforts of early amateur radio experimenters, beginning back in the 1930's. This book relates the story of



the exciting developments in VHF propagation, as told in the pages of *QST* magazine. The chapters, arranged chronologically in the approximate order in which amateurs became aware of each propagation mode, each contain several technical articles from that magazine. The articles were chosen either because they represent important turning points in propagation history or because they impart information vital to the understanding of the field. In addition to the articles, excerpts from "The World Above 50 MHz" and other station reports are reprinted, providing a first-hand taste of some exciting sessions.

Beyond Line of Sight: A History of VHF Propagation from the pages of QST costs $12.00 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111.

CIRCLE 89 ON FREE INFORMATION CARD

MAINTAINING AND REPAIRING VCRS: Third Edition

by Robert L. Goodman

If you've ever comparison-shopped for VCR repairs, you know that the diagnosis and the price of the repair varies dramatically from shop to shop. In fact, many common VCR troubles can easily be avoided by proper maintenance, or remedied at home. This book provides all the professional guidance you need to service and repair VCR's. Completely upgraded and expanded to include state-of-the-art VCR technology and troubleshooting techniques, the book is packed with hundreds of helpful pinout diagrams and exploded-view photographs that illustrate how to locate and fix any malfunction. The book provides in-depth coverage of every mechanical system and electronic circuit used in Betamax and VHS VCR's, including servo and control systems. It explains the use of test equipment, including Sencore's VC93 all-format VCR analyzer and SC61 waveform analyzer. Camcorders and special VCR circuits, including high-quality (HQ) video and stereo-audio circuitry, also are covered.

Maintaining and Repairing VCRs: Third Edition costs $19.95 and is published by TAB Books, Division of McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850; Tel: 800-822-8138.

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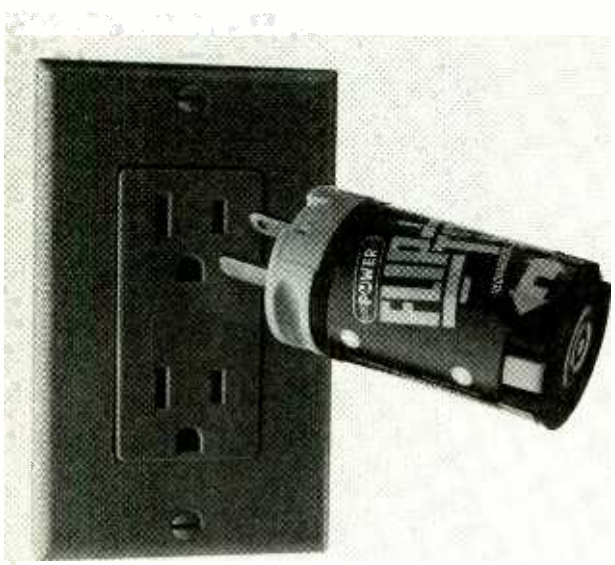
NEW PRODUCTS

Flip-Top Rechargeable Battery

There's no question that using rechargeable batteries instead of disposable ones makes economical and ecological sense. Yet there is still consumer resistance to rechargeables, due primarily to the cost and inconvenience of component systems that require separate charging devices. The *Power FlipTop*, a D-size, 1.25-volt, 1600-mA, nickel-cadmium battery from *Power Battery Holdings Corporation* addresses both those complaints. It plugs directly into a wall socket for recharging, allowing recharging anywhere there is an AC socket.

The device's patented FlipTop feature allows a pair of AC blades to be housed within the battery casing. For recharging, the user pulls up the top to



expose the blades, and then plugs the cell into any standard AC wall socket. When charging is complete, the top flips back down, concealing the blades, and the FlipTop is ready for use in any D-cell-powered appliance. It is said to work best in high-drain devices such as portable audio equipment and electric toys.

Guaranteed for a minimum of 500 recharges, the FlipTop replaces approximately 200 disposable batteries, saving the consumer approximately $400 and eliminating some 52 pounds of solid waste that would otherwise go into landfills. The company is currently developing C- and AA-sized versions, as well as portable-appliance applications.

A pair of Power FlipTop D cells costs $12.99. For more information, contact Power Battery Holdings Corporation, 16301 N.E. 8th St., Suite 250, Bellevue, WA 98008; Tel. 206-641-7155; Fax: 206-643-4216.

CIRCLE 100 ON FREE INFORMATION CARD

HANDHELD DIGITAL MULTIMETERS

Three rugged, general-purpose, handheld digital multimeters from *Tektronix* are designed and manufactured to comply with safety standards established by UL and IEC and to conform to Mil-T028800, Class-2 standard for shock and vibration. The *DM255* features a 3½-digit display, 0.7% accuracy, autoranging or manual selection, data-hold, and current measurements. Where current measurements are not needed, the *DM256* offers testing of voltage, capacitance, resistance, and diodes, with 0.5% accuracy, a fast continuity beeper, and memory offset. The *DM257* offers current and capacitance measurements with 0.5% accuracy, autoranging and manual selection, and a low-battery indicator.

The *DM255*, *DM256*, and *DM257* handheld DMM's cost $65, $75, and $85, respectively. For additional information, contact Tektronix Electronic Service Tools, Tektronix, Inc., P. O. Box 1520, Pittsfield, MA 01202; Tel. 1-800-426-2200, extension 183.

CIRCLE 101 ON FREE INFORMATION CARD

AFFORDABLE 486

The *Tandy 2100* 486-based personal computer provides the power and performance of a business-level PC at the price you'd expect to pay for a home system. The 25-MHz PC-compatible system is flexible and expandable, with 4 MB of standard memory (expandable to 32 MB), a 130 MB hard drive, four open expansion slots, and three

open device bays. The system includes a 101-key enhanced keyboard, a two-button mouse, Super VGA graphics, one game port, one parallel port, and two serial ports.

The Tandy 2100 comes with Microsoft Windows 3.1, Microsoft Works for Windows, and America Online software preinstalled. The software provides word processing, including a 120,000-word spell checker and a thesaurus; custom-designed business or personal databases; spreadsheets, forms, and financial statements; standard or scientific calculations; graphs and charts, including 31 chart templates; and the ability to combine draw and chart files with word processed documents to design letterheads, maps, or

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flyers. America Online allows the user to access on-line entertainment, business, and educational information; monitor stock quotes, news, weather, and sports; and send and receive electronic mail.

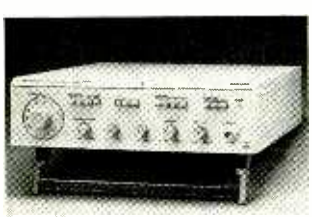
The Tandy 2100 is available at a suggested retail price of $1099 at Radio Shack stores nationwide. For more information, contact Radio Shack, 700 One Tandy Center, Fort Worth, TX 76102.

CIRCLE 102 ON FREE INFORMATION CARD

FUNCTION GENERATOR

With its clean, logical front-panel design, easily adjustable settings, and versatile sweep functions, the *Fluke PM 5135* function generator is well suited for a variety of general-purpose applications, including education and training, audio and electronics service, production testing, and development. The unit's output is completely protected against short circuits, ensuring constant reliable service even under difficult operating conditions.

During setup, frequency is selected using pushbuttons in four decade ranges along with a large logarithmic dial and a Vernier control with a range of ±20% of the dial setting. Pushbuttons are also used to easily select the standard sine, triangle, and square waveforms. Duty cycle is a standard 50%. DC offset, if needed, can be added with a ±10V range. Offset DC voltage can also be produced without any AC component.



Sweeps can be single or continuous, with a logarithmic characteristic and a continuously variable sweep ratio from 1 to 2000. There is a sweep range of 3.5 decades, and the sweep period is continuously adjustable over a range of 10 to 50 seconds. Triggering can occur manually, with a pushbutton, or through an external source.

The attenuation range can also be selected using pushbuttons, covering a 0–60-dB range in 10-dB increments, or it can be continuously varied over a 0–20-dB range.

The PM 5135 function generator costs $795. For more information, contact Fluke Corporation, P. O. Box 9090, Everett, WA 98206; Tel. 800-44-FLUKE; Fax: 206-356-5116.

CIRCLE 103 ON FREE INFORMATION CARD

PORTABLE MINIDISC PLAYER

Aiwa's latest entry in the portable digital-audio marketplace is the *AMD-50* portable MiniDisc player, an extremely compact unit that will play back prerecorded optical MiniDiscs. Just larger than a deck of playing cards, and weighing only 10.6 ounces, the AMD-50 provides the clear, distortion-free sound, and the convenience, of the optical disc-based format. It offers nearly instant random access to any selection on a disc, as well as repeat play and

random play. A full-function wired remote control module, located on the headphone cord, includes an LCD panel that displays the track, play mode, and the chosen DSL (Dynamic Super Linear Bass) and PLSS (Private Listening Sound System) settings. PLSS headphones minimize sound leakage that might disturb others nearby.

For uninterrupted portable playback, the AMD-50 features a shock-resistant memory circuit that prevents skipping by storing audio information for three seconds in a RAM chip before it's passed along to the listener. That delay allows the player to find its place in the

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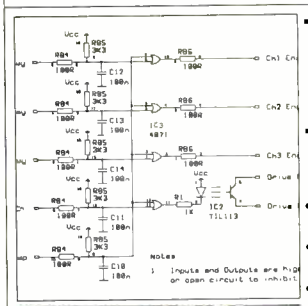

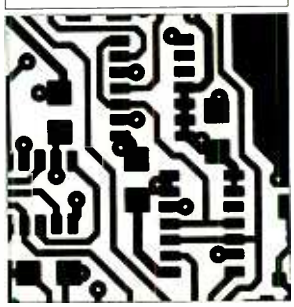

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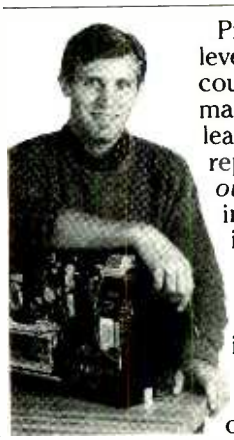

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event of a mistrack, and resume play before the three seconds have elapsed.

The AMD-50 MiniDisc player has a suggested retail price of $550. For further information, contact Aiwa America, 800 Corporate Drive, Mahwah, NJ 07430; Tel. 201-512-3600.

CIRCLE 104 ON FREE INFORMATION CARD

TINY SINGLE-BOARD COMPUTER

Intended for embedded applications such as industrial control, data acquisition, and interfacing, the *BASIC Stamp* from *Parallax, Inc.* is a single-board computer that measures just 1 × 2 inches. Programs for the Stamp can be developed on a PC with the Stamp editor. At the press of a key, the user's program is converted into tokens, downloaded to the stamp through a 3-pin cable, and executed. The easy-to-learn PBASIC language includes instructions for high-speed digital, analog, and serial I/O, as well as power control, sound, debugging, table look-up, and on-board EEPROM access. The maximum program size is about 80 PBASIC instructions.

The Stamp consists of an 18-pin RISC microcontroller, which interprets PBASIC and manages the I/O lines, and an 8-pin EEPROM, which stores the PBASIC tokens. A small prototyping area is available for adding circuitry to the Stamp's eight general-purpose I/O lines. The Stamp is powered by a clip-on 9-volt battery or externally supplied 5–12 VDC. Using a single line and ground, multiple Stamps can be connected together, and large tasks can be subdivided across several Stamps.

The Stamp development kit, including one BASIC Stamp, a 3-pin downloading cable, the editor software, and a manual, costs $129. Each BASIC Stamp is priced at $39. PBASIC interpreter chips, for use in custom circuits, are available for $6 each, with a 25-piece minimum. For more information, contact Parallax, Inc., 3805 Atherton Road, #102, Rocklin, CA 95765; Tel. 916-624-8333; Fax: 916-624-8003; BBS: 916-624-7107.

CIRCLE 105 ON FREE INFORMATION CARD

SOLDERING STATION

The built-in temperature sensor in *Extech's* soldering station ensures that the iron tip is always within 10° of the setpoint temperature, eliminating the problems of cold solder joints or burned flux. The tip temperature can be changed from 300 to 790°F without changing the iron

tip. The soldering station is available in Fahrenheit (320–900°F), as *Model 385030*, and in Centigrade (160–480°), as *Model 385031*. The front panel features a bright, three-digit LED display and a switch that allows the user to display either the setpoint or the actual tip temperature. Both models are powered from 110 VAC and come complete with a 1/32-inch copper tip, a heat-resistant cable, a tip grounding terminal, a cleaning sponge, an iron holder, and a 1-amp fuse. Optional tips are available.

The temperature-controlled soldering stations each cost $149; replacement tips, available in 1/32-, 1/64-, and 1/16-inch sizes, cost $4 each. For additional information, contact Extech Instruments Corp., 335 Bear Hill Road, Waltham, MA 02154; Phone: 617-890-7740; Fax: 617-890-7864.

CIRCLE 106 ON FREE INFORMATION CARD

FULL-MOTION VIDEO PC CARD

Based on the MPEG (Motion Picture Experts Group) compression standard, *Sigma Designs' ReelMagic* multimedia playback controller card allows CD-ROM-equipped PC's to play back full-screen, full-motion, full-color video and CD-quality digital stereo sound. The card is compatible with MPEG-based multimedia software, and its MPEG capabilities will allow

standard PC's to take advantage of the upcoming VideoCD standard. VideoCD, which will allow movies, TV shows, and other videos to be played from a standard CD-ROM, is a multiplatform standard backed by companies including Philips, Sony, JVC, Matsushita, Goldstar, Samsung, and 3DO. Twelve entertainment and multimedia titles will be introduced by the end of 1993, and the first VideoCD titles are expected to be out by the 1993 Christmas season. The card supports Windows multimedia applications and is DOS Game compatible.

ReelMagic plays 32K color video at resolutions up to 1024 × 768 at 30 frames per second. Its VGA feature connector allows all 32,768 colors to be seen even on a standard 16-color VGA card. ReelMagic also contains a 16-bit sound card that allows fully orchestrated soundtracks to run simultaneously with full-motion video.

The ReelMagic MPEG playback card, complete with installation program, a full array of drivers and system software, utilities, and Activision's "Return to Zork" MPEG game, costs $449. For more information, contact Sigma Designs, Inc., 47900 Bayside Parkway, Fremont, CA 94538; Tel. 510-770-0100; Fax: 510-770-2640.

CIRCLE 107 ON FREE INFORMATION CARD

VIDEO TITLER

The *ColorWriter Magic* video titler from *Sima* offers amateur and intermediate videomakers color titles and 14 special effects. Titles are created beforehand, stored in a 12-page memory bank, and inserted onto the video in a variety of exciting ways as the videotape is copied. Users can select one or more of eight colors, including black and white, and can present titles on a colored background or overlay them on their actual video. Other options include a colored border around letters, and a boxing-in of letters or words with a contrasting color. A touch of the reverse button yields a solid background with the video playing through the letters of the title. Users can

move entire titles across the screen, converge alternate title lines, crawl titles onto the screen line by line, or have titles pop up typewriter style (letter by letter). The ColorWriter Magic titler also allows users to zoom in or out, fade titles in or out, scroll at any one of four speeds, and combine a stationary headline with scrolling. The unit features a full-size keyboard that includes international characters and symbols. Function keys are arranged in logical groups, making it fun, not frus-

(Continued on page 16)

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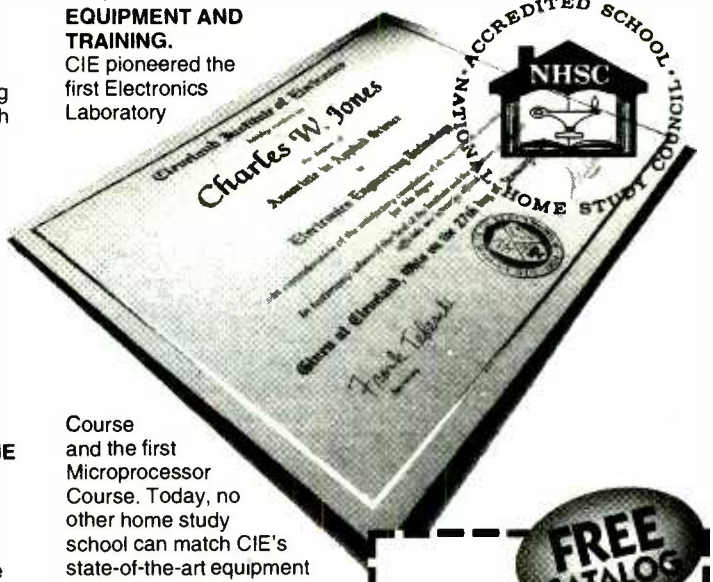

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NEW PRODUCTS

(Continued from page 12)

trating, to create, correct, and rearrange titles.

The ColorWriter Magic video titler has a suggested retail price of less than $300. For more information, contact Sima Products Corporation, 8707 North Skokie Boulevard, Skokie, IL 60077; Tel: 708-679-7462; Fax: 312-286-7227.

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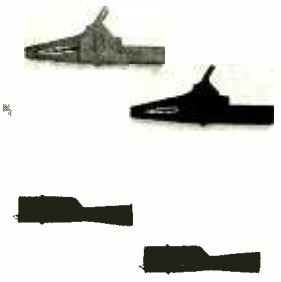
ALLIGATOR CLIP DMM ACCESSORIES

Two alligator clips for *Fluke* digital multimeters, the *AC85A* and *AC70A* offer improved features including a 600-volt rating for the AC85A and new probe-tip receptacles for secure probe connections in the AC70A.

The AC85A is a pair of fully insulated alligator clips with a ¾-inch jaw opening. Extra strong teeth and a spring design provide superior grip. Connection is made via a standard banana jack. Rated for use at 600 volts,



the clips are suitable for use in marine, aviation, electrical, and HVAC applications. The AC85A clips are recommended for use with the Fluke TL24 flexible test leads, and are also compatible with all test leads that have standard, 4mm-diameter banana plugs.

The beryllium-copper springs of the AC70A alligator clips offer a secure grip, and work with digital multimeters from a wide variety of manufacturers. The probe-tip receptacles are gold-plated. The clips are rated for voltage to 1000 volts and current to 10 amps. The jaw opening of the clip is a standard 0.313-inch, and its sharp, well-aligned teeth make it suitable for use in virtually all electronics applications.

The AC85A and AC70A alligator clip pairs cost $9 and $7, respectively. For further information, contact John Fluke Mfg. Co., Inc., P. O. Box 9090, Everett, WA 98206; Tel. 800-87-FLUKE.

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COMMERCIAL TELEPHONE DECODER

The *Digit Snatcher II* from *International MicroPower* is a handheld tester that can be used for decoding scanners and amateur radios as well as telephone lines. It also features Caller I.D. capture. An Intel microprocessor allows the unit to store thousands of digits, offer self-help messages on the LCD screen, and send and receive

data via an RS-232 serial port. The Digit Snatcher II features a built-in microphone with electronic automatic level control and noise filter that allows users to acoustically capture DTMF (touch-tone) dialing as well as Caller I.D., with no electrical connection between the source and the decoder. If you can hear DTMF on the radio or TV, Digit Snatcher II will decode and store the digits as you hear them. A built-in day/date/time stamp can be used to mark each series of digits with the current date and time. Stored information will be retained for up to 5 years, even while the unit is turned off, so the device can be taken in the field and later connected to a PC for data retrieval.

The Digit Snatcher II with 1000-digit storage capacity costs $179; the 2000-digit version with Caller I.D. and serial port costs $289. For further information, contact International MicroPower Corporation, 65 Palm Drive, Camarillo, CA 93010; Tel: 805-482-2870.

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NO-INSTALLATION CAR ALARM

AMCAMEX's CarGuard car-security system requires no installation. The unit simply slips into a car-stereo cassette slot. To arm it, the driver turns the key and then removes it. A solid-steel deadbolt locks the CarGuard securely in place. The unit beeps and flashes during a 30-second exit delay to allow the driver time to get out of the car. (No beeping indicates

that a new 9-volt battery is required.) Upon returning to the car, the driver has ten seconds to turn the key in the ignition, which disarms the alarm. If the key isn't turned within ten seconds, a 130-dB alarm sounds and continues as long as motion is detected. The siren stops 20 seconds after the movement ceases. That setup offers a significant improvement over those car alarms that continue to wail away for long periods of time, disturbing the entire neighborhood. The CarGuard's piercing siren sounds inside the car, where it will scare the thief without annoying the neighbors. The unit automatically rearms itself after 20 seconds.

The CarGuard comes in "wide load" and "long load" versions. Each comes with two warning decals for the car windows and costs $59.95. For further information, contact AMCAMEX Electronics Corp., P. O. Box 50775, Amarillo, TX 79159-0775; Tel. 806-354-2690; Fax: 806-354-8800.

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900-MHZ SPREAD-SPECTRUM PHONE

Frequency-hopping spread-spectrum technology, first used by the military to ensure communications security, is put to use by *Cincinnati Microwave* in their *Escort 9000* 900-MHz digital cordless telephone. By using spread-spectrum technology with digital transmission in a 900-MHz phone, the Escort 9000 achieves up to four times

the range of conventional, 46–49-MHz cordless phones and has the added advantages of clarity and security. Conversations are digitized and encoded between the base and the handset; the phone features more than 100,000 digital security codes. In addition, the voice data "hops" over 100 channels Other features include a concealed handset antenna, 3 ways to mount the handset in the base (upright, horizontal, or wall mount), user-replaceable battery, and handset-speaker volume control.

The Escort 9000 costs $399. For additional information, contact Cincinnati Microwave, Inc., 5200 Fields-Ertel Road, Cincinnati, OH 45249; Tel: 800-433-3487. ■

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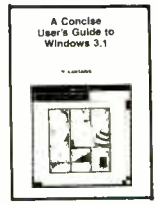

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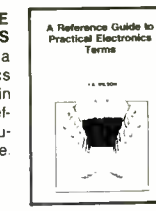

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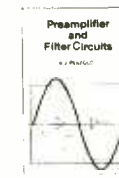

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A Hands-on Electronics® REPORT

ELENCO SP-1 SOLDERING PRACTICE KIT

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Learn to how solder the right way with the Elenco Electronics SP-1 Soldering Kit.

The key to successfully completing any electronics project is good soldering skills. Sloppy soldering will most likely cause some kind of circuit failure, whether it be upon initial power up of the device or after it has been functioning for awhile. Surprisingly, beginners in electronics aren't the only people who have trouble soldering, or just have no experience doing it. There are people who have studied lots of electronic theory, but have seldom had their hands on a soldering iron.

That's not a good thing, because soldering is not just for technicians. Certainly any good hobbyist or engineer should be able to put a circuit together or repair one without causing damage. Besides, soldering is an acquired skill that must be mastered if one is to fully enjoy the world of electronics.

If you're one of those people who really need to brush up on your soldering skills, or if you know someone who would like to get into electronics, then the Practical Soldering Project Kit Model SP-1 from Elenco Electronics, Inc. (150 W. Carpenter Ave., Wheeling, IL 60090; Tel. 708-541-3800) is worth taking a look at. It's a simple project that exposes the builder to various soldering techniques. While the project's warbling alarm and flashing LED's might not be something everybody needs, it might be the perfect first-time electronic project for any soon-to-be enthusiast. Especially at the low price of $8.25.

Shorts, Bleeps, and Blunders. We know from years of experience that most circuit failures are caused by bad soldering. Certainly that's the culprit a lot more often than a defective component. When a project doesn't work, the first thing to look for is poor solder connections; next, wiring mistakes; and then defective components. So what exactly are bad solder joints?

The most common soldering error is a short. Solder just loves to "jump" over to other solder or nearby foils. Sometimes those shorts are very noticeable "blobs," and other times they are hairline shorts that are very difficult to find and hard to see with the naked eye. That's why good soldering can save you hours of troubleshooting.

You've probably read at one time or other in this magazine to check for "cold-solder joints." A cold-solder joint is just what it sounds like: the solder wasn't hot enough when applied to properly adhere to and bond with any surfaces. The joint will usually appear to be dull. Quite often a joint like that will function for awhile and then fail, which is more of a pain in the neck than an immediate failure. Avoiding cold solder joints will help prevent premature breakdown.

Too much heat when soldering causes other problems. For example you can overheat a pad right off a PC board. Then you can botch things up further in an attempt to repair the damage. A pad on a printed-circuit board can usually be reheated many times over, but only for brief periods. It's just one of those things where practice makes perfect.

The SP-1. So, sometimes solder is too hot, sometimes too cold, and other times it's just right. Let's see what the SP-1 Soldering Practice Kit has to offer to help you heat your solder just right every time.

As mentioned, the SP-1 circuit is a warble alarm with flashing LED's. The kit is like any other, except that the manual places more emphasis on soldering technique than it does on the circuit itself. More than two thirds of the manual are devoted to explaining the steps involved in proper soldering.

Practice pads are provided on an unpopulated area of the PC board. They allow the builder to try out the soldering hints before beginning construction on the actual circuit. Large and small test pads are included, as

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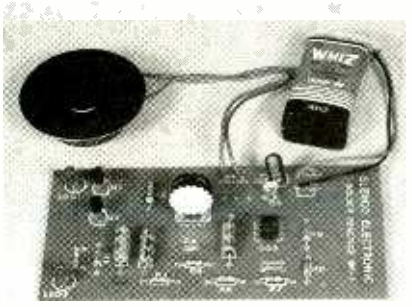

The assembled unit will warble and flash to let you know you've done everthing just right. It's a great incentive for kids to complete the project.

well as tack-soldering pads. The larger pads give the builder a feel for the amount of heat required for soldering large areas, while the small, closely spaced pads provide practice for avoiding shorts.

The rest of the PC board—the functional part—is also well-designed for soldering practice. Most of the traces and pads are spaced to provide plenty of room. The only exception is the area for a 555 timer IC, which has standard 0.1-inch spacing.

Not only does the SP-1 provide soldering practice, it also teaches the builder all other aspects of kit building. The first thing a builder must do is identify the parts, and the kit does have a handful of parts that have to be identified by their appearance, color codes, or other markings. Some information has to be obtained from the parts list, which teaches the builder to consult that valuable source of documentation. Finally, some of the components (such as the IC) have to be installed with a certain polarity, which helps familiarize the builder with such components.

You Can't Lose. In all, the SP-1 provides a good introduction to kit-building for the beginner, but it doesn't introduce the pressure of getting some fancy gadget to work. Once completed, should there be any problems in getting the circuit to work, a brief troubleshooting section is included. For anyone who would someday like to build very complicated projects or repair intricate circuitry, the Elenco SP-1 is a good place to start. If you think so too, or just want more information, contact Elenco directly, or circle No. 119 on the Free Information Card. ■

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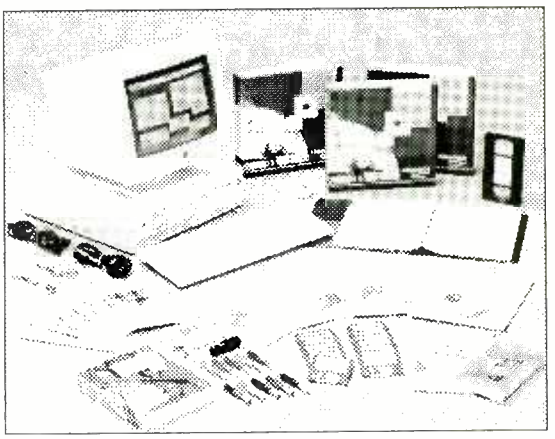

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PRODUCT TEST REPORTS

By Len Feldman

Kodak Model PCD 5870 Photo-CD Player

When Sony and Philips introduced compact discs more than a decade ago, they made it clear that the storage capacity of these optical discs could be used for many other purposes besides musical recording and playback. Since then, we have seen the emergence of CD-ROM (for use with computers) CD-I (or CD Interactive), CD-V (short video clips plus audio-only music), and CD-G (CD plus graphics), to name but a few formats.

Perhaps one of the most novel uses to which CD's have been put is for storaging ordinary photo prints or slides. Kodak, the originators of this technology, call such discs "Photo CD's." This month, we will take a look at one of Kodak's line of Photo-CD players, the model PCD 5870.

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The Kodak PCD 5870 Photo CD player plays both Photo CD's and conventional audio CD's.

The Kodak PCD 5870 is a "carousel" player that will accommodate five audio or photo CD's at once. Photo CD's and audio-only CD's can be intermixed and the player is able to identify which is which, but that's only the beginning. The features associated with this photo-CD player are incredible. You can frame a portion of a viewed picture and then enlarge it. You can pan from left to right or up and down on a given picture or show the entire picture on screen, surrounded by a black border. Pictures can be changed automatically at 2-, 4- or 8-second intervals, or you can change them manually at your own pace. You can teach the machine to insert certain pictures in an out-of-numerical-order sequence, and every time that disc is played, the machine will display the pictures in the sequence you've requested. You can rotate pictures on screen, clockwise or counterclockwise—a handy feature for those photos that were taken with the camera rotated 90 degrees. You can have the machine skip certain photos on a disc (e.g. shots that were out of focus or poorly lighted) and have the machine skip those same shots every time that the disc is played. Once you've done all these things to a disc, your selections are memorized in the machine in what's called an FPS (favorite picture selection) program, and the machine will play those pictures in the order selected, as edited or cropped, and so forth. (Of course, since the FPS list is stored in the player, if the same disc is played in another machine, the picture display will revert to normal.) An on-screen display can be brought up to show you the status of a given disc and, when you first load one or more discs into the player, your connected TV set shows which "slots" are empty, which contain photo CD's, and which contain audio-only CD's.

CONTROLS

Pushbuttons on both the player and the supplied remote control are of three types: those used in the photo-CD mode only, those used in the audio mode only, and those that are used either in photo-CD or audio modes. A power on/off switch is found at the lower left of the front panel. Above it are an open/close button for the disc tray, a play button, previous and next (track or photo) buttons, a pause button, and a stop button.

A display area is centered near the top of the front panel. It shows the current and next photo numbers (or, in the case of audio CD's, track number and time elapsed), disc-tray status (how many discs are loaded into the five available slots), and other useful audio or picture-status information, depending upon which type of disc is currently being played or shown.

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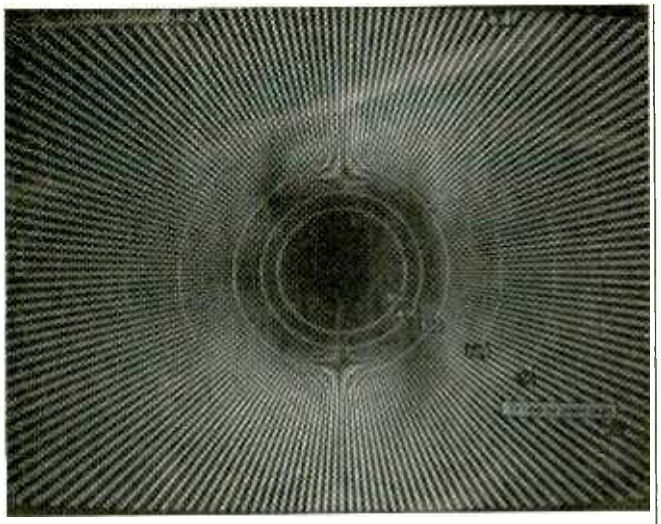

The horizontal video resolution measured 330 lines, which is the maximum one can expect from broadcast TV under ideal conditions.

To the right of the display area are the FPS button, an autoplay button (used only with photo CD's), a shuffle-play button (used only with audio CD's to randomize track selection), scan and repeat buttons (that work for both types of discs), fast-search buttons (used with audio discs), a reverse button (for showing pictures in reverse order), and a pair of disc-selection buttons. A stereo phone jack at the lower right corner completes the front panel layout.

The rear panel of the Kodak PCD-5870 is equipped with video and left and right audio-output jacks, as well as with an S-video connector for use

TEST RESULTS—KODAK PCD 5870 PHOTO-CD PLAYER

Specification	Manufacturer's Claim	PE Measured
Video Section		
Horizontal resolution	325 lines	330 lines
Video signal-to-noise		
Red field chroma AM/PM	N/A	72.5/58.8 dB
Luminance (re: 100 IRE)	N/A	62.9 dB
Audio Compact-Disc Section		
Output level	2.0 volts	2.142 volts
Signal-to-noise ratio	95 dB	95.2 dB
Max. deemphasis error	N/A	–0.19 dB
Harmonic Distortion		
1 kHz/10 kHz/16 kHz	0.008% (1 kHz)	0.0048/0.0122/0.22%
Linearity error to –50 dB	N/A	–0.01 dB to +0.03 dB
Frequency response		
20 Hz to 20 kHz	± 0.15 dB	+0.09 dB to –0.2 dB
Additional Data		
Power requirements	15 watts	15.5 watts
Random access time		
Track 1 to 21	N/A	1.66 seconds
Track 20 to 21	N/A	0.72 seconds
Scan time		
Track 1 to 21	N/A	1.26 seconds
Track 21 to 1	N/A	3.32 seconds
Dimensions		
(H × W × D, inches)	4.7 × 17.1 × 15.0	Confirmed
Weight	N/A	14.75 lbs.
Suggested retail price	$549.00	

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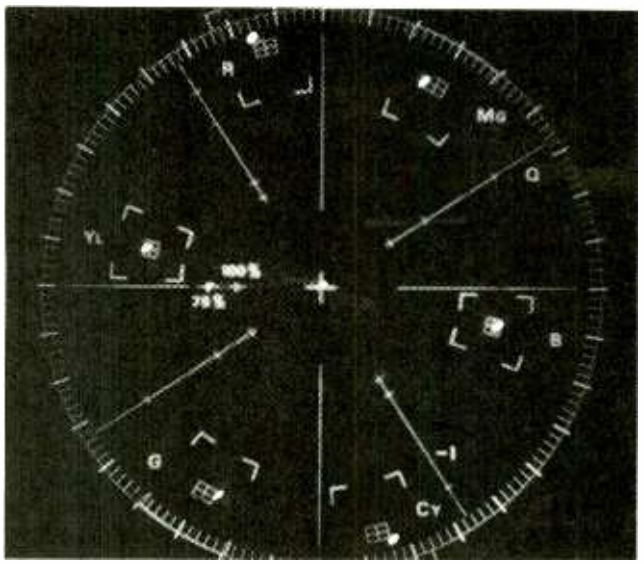

As this vectorscope photo shows, the color purity was as close to perfect as we have seen on any consumer product.

with TV sets or TV monitors so equipped. For those who own TV sets that do not have composite video and audio inputs of any kind, RF antenna-in and -out connectors are provided. Associated with the RF connectors is a small Channel-3/4 switch that allows you to choose an unused channel in your area.

In addition to duplicating most of the controls on the front panel (with the exception of the open/close button and the power switch), the remote control that comes with this player is used to access some of the special features referred to earlier. For example, there are four pan buttons, a button that permits you to change the interval between photos during autoplay, buttons associated with the various viewing modes, buttons for rotating pictures, and buttons for skipping pictures and for "keeping" the order and viewing mode of the pictures on a given disc. Also included are numeric buttons for direct access to tracks on an audio CD or to picture numbers on a photo CD.

For audio CD's, fast-search buttons are provided as well programming, favorite-track selection, and an A-B button used to select a specific segment of audio to be repeated over and over again. An On Screen Display (OSD) button on the remote activates on-screen messages that provide information about the disc in the player. Finally, a time-edit button allows you to select a length of time to record sound from a disc to tape. shTEST RESULTS The lab measurements made by APEL on this unit involved both video and audio performance. Special test discs supplied by Kodak were used for many of the tests. The horizontal video resolution measured 330 lines, which, coincidentally, is the maximum one can expect from broadcast TV under ideal conditions. The color purity was as close to perfect as we have seen on any consumer product. The AM and PM chroma (color) signal-to-noise ratios measured 72.5 dB and 58.8 dB respectively, or far better than we usually measure for the very best VCR's or videodisc players. The

(Continued on page 91)

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THINK TANK

By John J. Yacono

Displays and Discrepancies

Like last time, this month's letters will present projects that have displays of one sort or other. But before we'll get to them, let's continue discussing some of the little know aspects of the 7400 series.

MIXED OUTPUTS AND INPUTS

Last time out, I mentioned the variety of special inputs and outputs that a logic chip may have. However, what I didn't reveal is that while two chips may have the same designation, they can have different input or output styles. The most common examples are listed in Table 1. Take the 7401, for example. It can come with ordinary open-collector (OC) outputs, 15-volt OC outputs, or low-leakage outputs (see *Think Tank*, January 1994 if you've forgotten the meanings of those terms). With such a chip, the only safe way to determine its output style is to check the chip manufacturer's specifications.

Basically then, what Table 1 shows is that the 7401 comes in 3 output "flavors," the 7402 in 2, the 7403 in 3, the 7405 in 3, and the 7409 in 2. (Frustrating, isn't it?) The 7400 and the 7404 both have totem-pole outputs, but can be purchased with plain or 15-volt inputs (again check the manufacturer's specifications). Furthermore, the confusion doesn't stop there; next month I'll present a whole bunch of 7400-series chips with alternate pinouts. That's enough controversy for one day, let's get to the letters.

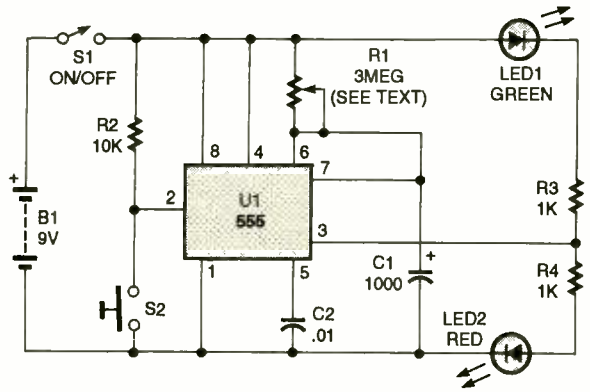

Fig. 1. Smokers trying to quit might find this device useful, provided they're more willing to listen to it than there own conscience.

ELECTRONIC WILLPOWER

Do you know any smokers that are trying to cut down or quit? Here's a simple circuit, essentially a monostable 555-timer circuit that may help (see Fig. 1). In use, the green LED indicates "go ahead and have one," but the red LED means "don't even think about it." When the indication changes from red to green, just push the momentary switch to start the timing cycle over again. The circuit gives a certain finality to the "smoke/don't smoke" decision process; electrons, after all, have immense willpower!

Potentiometer R1 is used to adjust the time period. When R1 is set at maximum resistance (1 megohm), the time is about 25 minutes. If R1 is set at 2 megohms, the time is 55 minutes. If R1 is set at 3 megohms, the period is 90 minutes. I used a 3-megohm potentiometer for R1 to make the timing adjustable. Since the 555's output can sink or source current, both LED's are controlled by the chip's output. With a little creativity, a single dual-color LED can be used too! Other uses for the circuit include timing for slowpoke chess tournaments, and hardboiling ostrich eggs.

—Nick Cinquino, Schaumburg, IL

What a coincidence, I was in the middle of boiling an ostrich egg when I got your letter! Seriously, I like the circuit, and I'm sure it has many uses.

Those wishing to use a dual-color, two-lead LED should short the connections for LED1 and LED2, and insert the new LED between pin 3 and the junction of R3 and R4.

LED FLASHER

This circuit (see Fig. 2) provides a low-cost way to

TABLE 1—MORE THAN ONE INPUT OR OUTPUT STYLE

Chip	Totem Pole Outputs	Plain OC Outputs	6.5V OC Outputs	15V OC Outputs	Low Leakage OC Outputs	15V Inputs
7400	•					•
7401		•		•	•	
7402	•		•			
7403		•		•	•	
7404	•					•
7405		•		•	•	
7409		•		•		

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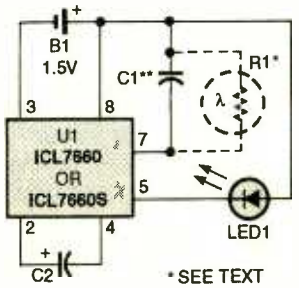

Fig. 2. Need a flashy LED display? This one is inexpensive, very portable, and sparing on batteries.

flash an LED from a single 1.5-volt source. Based on the ICL7660 DC-to-DC voltage converter, the circuit makes use of an external capacitance (C1) on the oscillator rate-control pin to decrease the charge/dump time to the desired flash rate. A DC resistance (R1) on the same pin can also be used to disable the oscillator and extend the power-cell's life. That optional DC resistance (in the form of a photoconductive cell) will shut off the oscillator in daylight.

The component values are not critical. Timing capacitor C1 determines the flash rate. Capacitor C2 determines the charge transferred to the LED and thus determines the flash brightness and duration. Photocell R1 should have a dark resistance in excess of 15 megohms. That can be facilitated by painting the photocell window with dark paint. A series resistor (2 to 10 megohms) can be used with the photocell to implement light-sensitive flash-rate modulation. For best results, use a high-brightness LED and keep the value of C2 to less than 220 µF.

—Brian McKean, San Diego, CA

I can think of two good uses for the circuit right away. One, if placed at strategic points around the home, a set of them could make excellent light beacons for late night trips to the kitchen or bathroom. Second, one would make an eye-catching fake car alarm to scare would-be theives.

nine and counts down to zero with each clock pulse. When the counter hits zero, the output from the 74193 goes low, turning off the relay and the light. The light can be turned back on by pressing the reset button again.

The binary output from the 74193 can be seen on an LED 7-segment display when it is connected to the input of a 7447 seven-segment decoder/driver and the output of the 7447 is connected to the display.

Before starting the timed

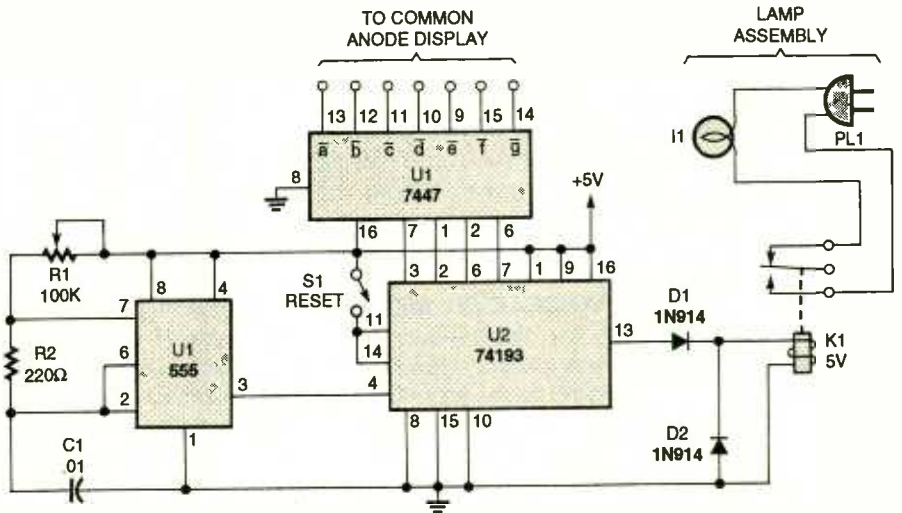

Fig. 3. I'll be using this count-down to lights-out timer in my own workshop. It certainly can be modified for wide versatility in a number of other applications.

LIGHT TIMMER

Have you ever awakened in the middle of the night to find that your roommate has fallen asleep with a book on his chest, and the light is still on? Well, I have; and during one of the many trips to the other side of the room, I realized that a simple timed switch would be a great way to keep from having to shut the light off for my roommate.

The timed switch (see Fig. 3) uses a 555 oscillator/timer wired to operate in the astable mode. The timer supplies a positive pulse to the clock input of a 74193 4-bit binary up/down count every five minutes. Since the 74193 is set to operate in the count-down mode, the output of the 555 is connected to the count-down input of the 74193.

As the binary counter is reset, it starts counting at

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switch, the 555 should be adjusted, via R1, to emit a pulse every five minutes from its output at pin 3. As the circuit is set up, the switch will be on for 45 minutes (five times nine) when the 555 has an interval of five minutes between each pulse. To set different total times, adjust the 555 to any time, measure how much time it takes to go through one cycle, and multiply the time by nine.

Extra digits can be added by using the same 74193/7447 configuration and tying the borrow output from the first 74193 to the count-down input of the second 74193. The output to the relay would come from the output of the second 74193. Remember that the first 74193/7447 configuration will be the ones digit and the second will be tens digit.

Since the timed switch has only a few parts, it can be placed into a small enclosure and fastened directly onto most small bed lamps.

—David Markun, Jociet, IL

This circuit is going into my workshop. When I transport parts out of my attached garage so I can work indoors at night, I almost always forget to shut the light after the last trip. This timer would do that for me and give me an indication of how many more trips I could make for those last-minute items as my work progresses.

VOICE-LEVEL METER

The circuit shown in Fig. 4 was specially designed to indicate the sound level of a student speaking in a classroom in order to help an English teacher obtain the same volume from each student. It consists mainly of a 10-LED VU meter, a microphone, and a preamp to improve its sensitivity. It is very, very easy to build.

When switch S1 is closed, it supplies power to the circuit, and LED1 (if used) will indicate that the power is on. Transistor Q1 and Zener diode D3 make up a 5-volt regulator from which an electret microphone and 10 LED's derive their power.

The microphone picks up sound and produces an audio signal that is fed to the non-inverting input (pin 3) of U1-a, the first half of a dual low-noise operational amplifier (type TL072), through a 0.022-µF ceramic capacitor. The output signal of U1-a is passed to 10k linear potentiometer R17, the level control. Now, the audio signal is coupled through R8 and C6 to the input (pin 5) of U1-b, the other half of the amplifier IC. Using the actual values shown in the circuit, the voltage gain of the first stage will be about 69, and the second stage will be approximately 213, making a total voltage gain that is very high indeed.

The audio signal at pin 7 of U1-b is rectified by D1 and D2, and the resulting DC voltage is filtered by C9 and then applied to pin 5 of U2, an LM3915 bargraph VU-display driver. The cathode leads of the 10 LED's are connected directly to pins 1 and 10–18 of the LM3915, while their anodes are all connected to +5 volts. The pulsating DC voltage on pin 5 of U2 varies from 200–1500 mV, and is proportional to the level of the sound picked up by the electret microphone. So, the 10-LED bargraph driven by the outputs of U2 will give the user a reasonably exact idea of the sound variation. For a more informative display of the voice level, you should use green LED's for LED2–LED6, yellow LED's for LED7–LED9, and red LED's for LED10 and LED11.

To set the unit for the correct sensitivity, the teacher should ask a student to read some text at a normal voice level, and then adjust R17 so that the indication ranges from the first to the third yellow LED. Once the correct setting is found, there's no need for further adjustment; the unit is ready for use.

—Evandro Luiz Duarte Madeira, Contagem, Brazil

Wow, that's some design work.

Well, those are the letters for this month. Remember to write to *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735, if you want your circuits to appear here and to receive a *Think Tank II* book. ■

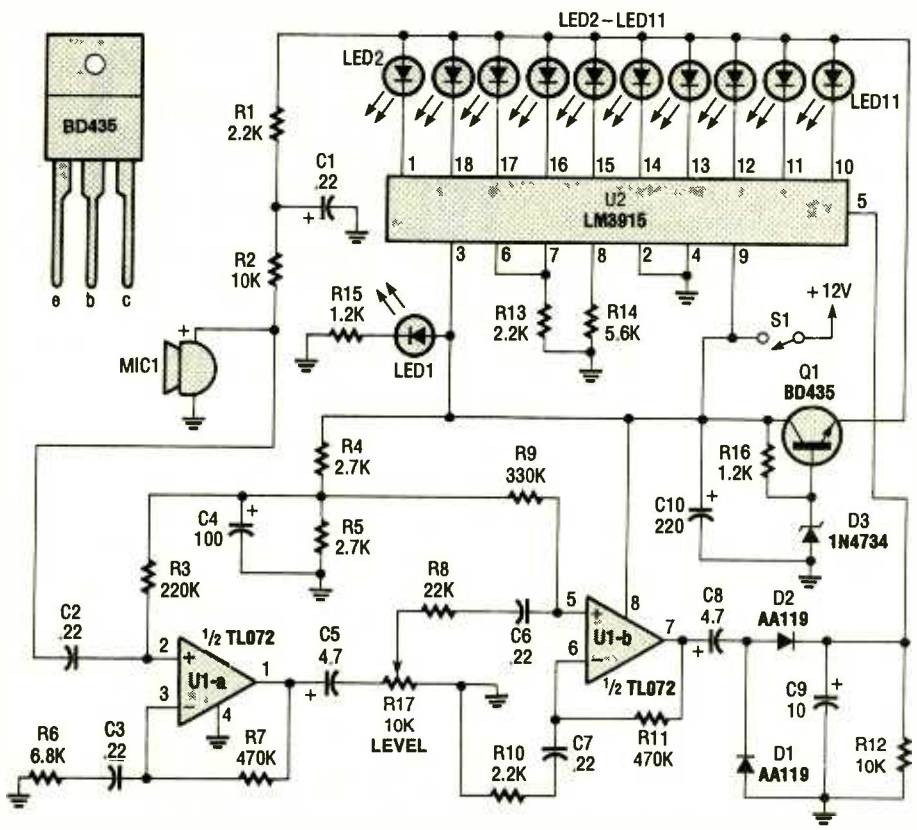

Fig. 4. This volume meter can be handy anywhere you need to measure the relative sound level in a room. It is readily adjustable to increase its usefulness.

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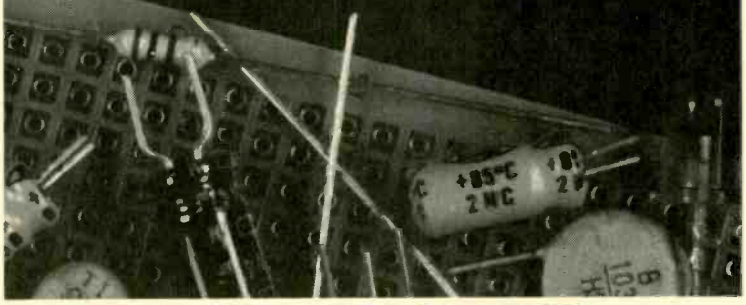

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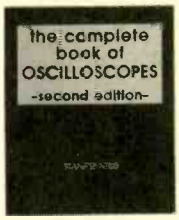

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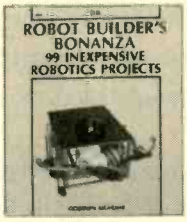

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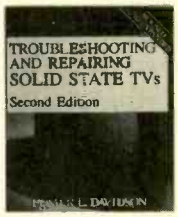

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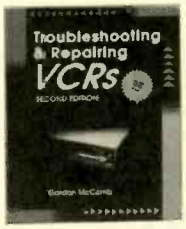

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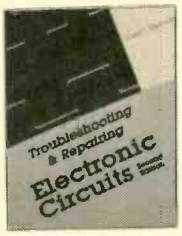

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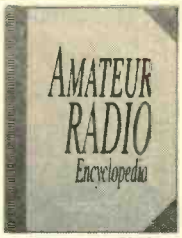

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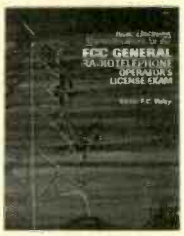

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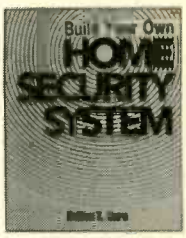

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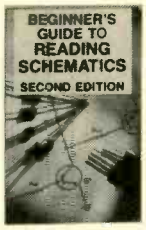

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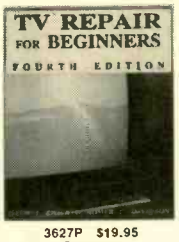

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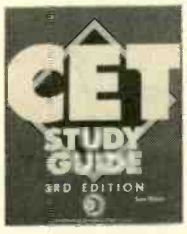

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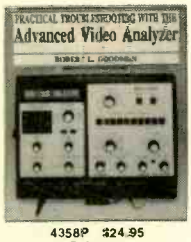

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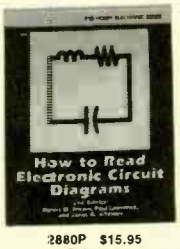

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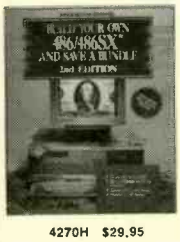
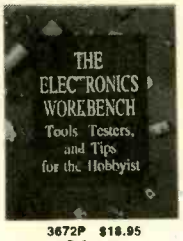


4270H $29.95



3672P $18.95
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3795P $19.95
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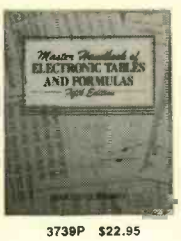

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Step Up to CD-ROM

Catch a CD-ROM drive—coming to a PC near you!

BY MARC SPIWAK

If you're the proud owner of a fire-breathing (read that powerful) PC, but you haven't yet installed a CD-ROM (Compact Disc Read-Only Memory) drive in it, then it's time to consider getting one. Even if the thousands of reference and multimedia applications don't interest you, the fact that many future multi-megabyte software packages will be available only on CD-ROM might force you to get a drive. In addition, many software packages are already available on both floppy disk and CD-ROM. The CD-ROM versions are generally preferable, because bulky items (such as clip art and help files) can be left off your hard disk, saving you many valuable megabytes.

CD-ROM is going to catch up to all of us, and soon. The reasons for that are numerous, but the main one—and one that's not by choice—is that software keeps on growing and Growing and GROWING in size. Many software packages now require ten or more distribution diskettes, and those disks cost money. Depending on the number of copies produced, and the size of the package, it can actually be cheaper to distribute software on CD-ROM, which can cost less than $2.00 apiece to manufacture in bulk. In addition, many individual software packages can be bundled on one disk. That will surely lead to some interesting marketing tactics, and better values for consumers. Also, disk errors are much less likely to occur on one CD-ROM than on several floppies.

There are many other reasons for CD-ROM's growing popularity. For the manufacturer, there's less bulk, which means lower packaging and shipping costs. There's also better copy protection, because you can't simply copy a CD-ROM for a friend—not yet anyway. CD-ROM also benefits the user by eliminating the need for disk swapping when installing software. Last, but certainly not least, CD-ROM drives are getting cheaper and faster, with entry-level drives available for about $200. The cheaper the drives get, the more drives end up in user's hands, and the more discs will be sold. The more discs sold, the cheaper they will get, and so on, until CD-ROM drives are as popular as floppy drives. It's just a matter of time before every new PC, or workstation if you prefer, comes with a CD-ROM drive.

Mass Storage. A CD-ROM's storage capacity of 680 megabytes makes it the perfect choice for distributing tons of data. Entire encyclopedia and dictionary volumes fit on one disc. Telephone books are available on CD-ROM, and one set of discs contains every phone number in the country. That uses up much less space, paper, or (more important) trees than the equivalent number of paper phone books.

Although the capacity of a CD-ROM may be impressive, the real beauty of using a CD-ROM lies in the computer's swift searching capabilities. With an encyclopedia on CD-ROM, you could have your computer search for every occurrence of the word "shoe," for example—or anything else you want to look up. You'll have the information at your fingertips in a matter of seconds. Imagine how long it would take to search visually through several encyclopedia volumes for the word "shoe."

Depending on the disc, CD-ROM's can cost tens or hundreds of dollars. However, when you consider that their paper-bound counterparts can cost thousands of dollars (sets of encyclopedias and dictionaries do cost that much), they can be a bargain.

While resource discs are the librarian's "knights in shining armor," some of the most impressive CD-ROM discs are the multimedia titles. Such discs combine audio, video, and graphics to create new kinds of computing experiences. While nearly any computer can be used as a search engine for a reference CD-ROM, you'll need at least a 386 SX (for level 1 compatibility; more on that later)—but more realistically a 486—and one of the newer, faster CD-ROM drives to squeeze the most out of the multimedia titles. You'll also need some kind of sound card if you don't want to be confined to a pair of headphones.

Formats. There is a lot of confusion as to which type of CD-ROM can be read in which drive, and which drive is suitable for so-called "MPC" applications, and so on. Let's try to cut through the confusion and explain what the different formats are.

To begin with, there are "book" specifications for CD's. These specifi-

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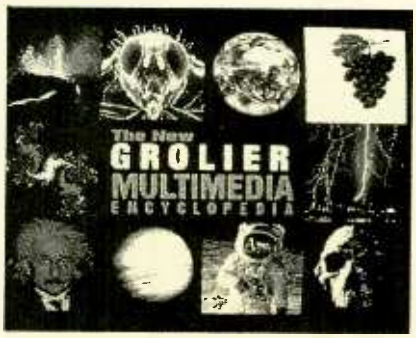

The New Grolier Multimedia Encyclopedia *CD-ROM contains 33,000 articles. It has 3000 color and black and white images, audio clips, maps, timelines, and so on. Also included are various animations and video clips.*

cations lay down the basic rules of how information is stored and laid out on a CD. For example, all CD-ROM drives can play plain audio CD's; they are of the Red Book format.

The basic standard for all CD-ROM's is the ISO 9660 or the Yellow Book specification. Any CD-ROM drive can read an ISO 9660-spec disc, of which there are thousands of titles in circulation.

Philips' effort to interleave text, sound, and video on a CD led to the Green Book specification, or CD-I (which stands for CD interactive). The only way to be completely compatible with all CD-I discs is to buy one of Philips' home CD-I players. However, CD-I compatibility should not be a concern when buying a CD-ROM drive (at least not for the moment).

The CD-ROM XA (for Extended Architecture) spec, while not very popular yet, is basically CD-I with audio compression and interleaved text, audio, and video. The audio compression allows storage of 16 hours of audio, versus about the 72 minutes of a Red Book CD. Even though CD-ROM XA is based on CD-I, an XA drive may not be able to read CD-I discs. But, as we said, CD-I compatibility should not be a concern yet.

Because the information on an XA disc must be decoded differently than on a regular CD-ROM, a drive must be specifically stated as being XA-compatible in order to read an XA disc. There are many CD-ROM XA drives on the market, and XA-compatibility is rapidly becoming important.

The Orange Book spec applies to CD-R, or recordable CD's. Yes, there are several CD recorders now on the market that let you make your own CD's but the blank discs can cost $40 apiece. Many of these CD-R systems can be had for under $10,000. While that price might be out of your reach, companies that continually have to store vast amounts of data might be able to justify it. Software companies wanting to make beta copies of new CD-ROM's also find such prices reasonable. Like everything else in the computer business, the prices are sure to come down to more affordable levels in the future.

Which brings us to the concept of single- and multi-session discs. When a CD-ROM is manufactured, only one directory is written to the disk, making it a "single session" disc. However, if you were to record, say, 100 megabytes onto a CD-R disc in one session, and another 100 megabytes in another, there would be two directories written on the disc, and it would then be called a "multisession" disc. To then read such a disc, you would need a multisession CD-ROM drive.

One good reason to look for multisession capability is Kodak's new Photo CD system. You can now take your exposed rolls of film to a developer and have them put your pictures onto a Photo CD. You then view the pictures on your TV using Kodak's Photo CD player. You can store several rolls of film on one Photo CD, and you can bring a disc back to the developer to add new rolls to it until it's full. Each time you have the disc updated, a new session is added, resulting in a multisession disc. Photo CD's could become a desktop-publisher's dream, because they allow inexpensive storage of high-resolution color photos, which are known to gobble-up hard-disk space. Note that many Photo-CD compatible CD-ROM drives do *not* have multisession capability; they can only read single-session discs. So read the ads carefully!

MPC—Ready or not? In discussing all of the various formats and specifications, we haven't yet mentioned what it means for a piece of hardware to be MPC-compliant. The Multimedia PC (MPC) Marketing Council used to specify that a CD-ROM drive must have an average seek time of less than 1 second and be able to sustain a data-transfer rate of 150 kilobytes per second, all while using less than 40 percent of the CPU's resources. However, those specifications are already somewhat outdated, as most current CD-ROM drives have seek times under half a second. Even so, that half a second can be unbearable when you're used to hard-disk access times of less than 15 milliseconds.

In response to the changes in technology, a second set of recommended specs (called "level 2") has been issued by the MPC Council. They call for a double-speed (300-kilobyte-per-second data-transfer rate) with

Double-speed drives like that provided with the Fusion 16 upgrade package (shown here) are fast enough to meet the new level-2 MPC standards.

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XA and multisession compliance. As their name implies, these drives spin the disc at double speed when accessing data, and at normal speed for CD audio. That yields access times under 300 milliseconds and transfer rates of 300 kilobytes per second.

Still though, for the drive to be part of an MPC system, the computer should only need to devote less than 40 percent of its resources to operating the multimedia system. That's why slow PC's have a tough time with multimedia, even with a fast drive installed; multimedia over-taxes their resources. A true MPC system can play audio and video without being choppy, and look up information from vast resources without putting you to sleep.

If you were to try to run a multimedia CD-ROM on a non MPC-compliant system, you might possibly see just video stills and hear only sound snippets instead of the smooth animation and audio that's possible on a faster system. It's always to your advantage to have the fastest possible equipment—if not for today, then certainly for tomorrow.

In light of that, the MPC level-2 standard calls for a 486 microprocessor, at least 4MB of system memory, a 160-MB hard disk, and 64k color at 640 × 480 resolution. Contrast that with the old level-1 standard which called for a 386SX microprocessor, 2MB of system memory, a 30-MB Hard disk, and VGA color. Note that while most software currently available will run acceptably on a level-1 system, that is certain to change in the near future.

Sound Advice. PC's have never been blessed with much of a sound system, just that internal speaker that's capable of reproducing beeps and crude sounds. So, if you want to play with multimedia software, you're going to need a sound card and speakers. The Ad Lib card was the first such device to provide PC users with good sound to go along with great games. Soon the Soundblaster came along, which was compatible with the Ad Lib card, had a built-in synthesizer, and allowed digital audio recording and playback. The problem was that they were 8-bit, "mono" cards, and the sampling rate was limited to 22 kHz. That provided a very unimpressive frequency response—in other words, rather dull, or flat sound.

Meeting the Level-2 sound requirements means purchasing a 16-bit sound card like this one. With built-in word recognition and a MIDI interface, you'll probably use it for more than just hearing CD ROM's.

Today, 16-bit sound cards (which are required in the level-2 standard; 8-bit cards are level-1 compliant) are available, in stereo, with sampling rates up to 44 kHz. That gives you CD-quality sampled sound, which is what any audio enthusiast wants. To record sound with any sound card, you do, of course, need a microphone, which usually comes bundled with a complete multimedia package, or upgrade.

Most sound cards require that you add an amplifier and speakers, or just amplified speakers. There are many different models of amplified speakers on the market intended for use with a PC. In some cases they are specially shielded to protect your computer monitor from magnetic interference. While the smallest amplified speakers are adequate, you'll want plenty of power once you hear how good your PC can sound.

Get a Bundle. Because of the confusion surrounding CD-ROM drives and which one works with which controller, and which controller works with which sound card, it's probably best if you purchase everything you need all at once in one multimedia-upgrade package. They contain a CD-ROM drive, a controller card, a sound card, usually a few CD-ROM discs to get you started, and sometimes speakers and a microphone. The CD-ROM drive controller is often built into the sound card, which saves you some bucks and a slot in your computer.

Included with any multimedia upgrade, you'll also receive the necessary Windows and DOS software drivers for the CD-ROM drive and sound card. Software-installation disks make installing multimedia upgrades a breeze, compared to the tedious job of getting mix-and-match components to work peacefully with one another in a system. Buying a multimedia upgrade is also one way of ensuring that all of the components will form an MPC-compliant system. Look for the MPC logo on any multimedia upgrade you buy, and check to see whether its the level-1 or level-2 logo (they look different).

There are multimedia upgrades to fit every budget. If you're on a tight budget, you can buy an upgrade that has stereo sound and a single-speed CD-ROM drive for less than $500—and even less if you want to settle for mono sound. To get a double-speed drive in your upgrade you'll have to spend more. But, as they say, if you want to play you gotta pay. A company called Media Vision puts together some very nice MPC-compliant upgrade packages to fit every budget, and they include hardware of all levels from many different manufacturers.

Because we're seeing such a rapid

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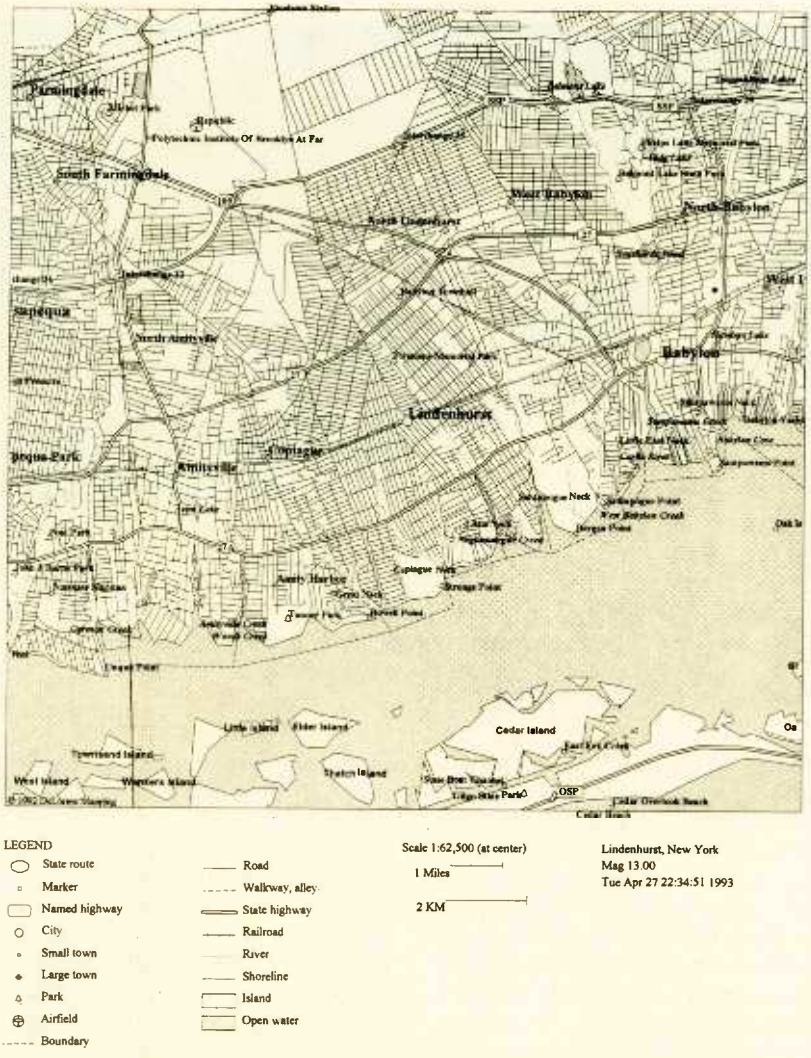

Map Expert with Street Atlas USA *is a map maker's dream come true. The disc contains the entire Street Atlas USA and color and black-and-white map-printing capabilities.*

evolution of multimedia hardware, we can't recommend any single piece of equipment or package, as there's bound to be a better, cheaper one out "next week." The best advice we can give you is take your time and shop around. Research the upgrade packages that are within your price range and find out exactly what components are included in each. Then research the individual components so you know exactly what you're getting. Taking your time when buying multimedia equipment can save you literally hundreds of dollars. That's because new equipment rolls out almost every week and last week's equipment drops in price accordingly.

CD-ROM Software. We'll have to assume that if you're still with us at this point then you must be interested in CD-ROM drives. And if you're interested in CD-ROM drives, then you must be at least curious as to what sort of stuff you can get on CD-ROM. We were, so we contacted several software companies to see what we could come up with. Here is a small sample of what we found:

Encyclopedias and Atlases. Encyclopedias and atlases are good applications for CD-ROM's and the amount of data they can hold. Applied Optical Media Corporation's *Multimedia Animal Encyclopedia* contains color illustrations and photos; descriptions of range, habitat, physiology, behavior, and conservation status; pronunciation of common and scientific names; and classification of nearly 2000 different animals. You can also hear the sounds that many of the animals make—we liked listening to the different bird calls. Any piece of information is easy to search for. The disc retails for $79.95.

Two other discs from Applied Optical Media, *American Vista* and *World Vista*, are multimedia atlases containing all kinds of information including maps, pictures, and audio. The discs are like talking social-studies books on American and world culture, and with them you can travel all around the globe without leaving your PC. The discs retail for $79.95 each.

The New Grolier Multimedia Encyclopedia can be a valuable tool for any computer owner. The CD-ROM contains 33,000 articles on subjects from A to Z and can provide the user with information on nearly any topic in a matter of seconds.

The disc contains over 3000 color and black-and-white images to peruse through, audio clips, maps, timelines, and so on. Also included are various animations and video clips. We were reminded of how far the PC has come as we watched Neil Armstrong taking his one small step and listened to his famous quote. For research purposes, it's hard to beat the New Grolier Multimedia Encyclopedia. That plus hours of entertainment make this $395 disc a good investment.

When you think of beautiful color images of animal, vegetable, mineral, or whatever, the National Geographic Society might come to mind. While they're best known for their magazines and TV programs, they haven't overlooked CD-ROM's potential either. *Mammals: A Multimedia Encyclopedia*, contains an interactive look at over 200 mammals. The disc contains 45 film clips from TV documentaries, 700 pictures, and 155 sounds that animals make. Mammals sells for $99.00.

Not to be left out of the encyclopedia business, Microsoft offers *Encarta*, a great multimedia resource containing pictures, sounds, music, readings, animations, and more. With the complete text of the 29-volume *1992 Funk and Wagnall's New Encyclopedia*, as well as over 1000 articles exclusive to Encarta on CD, information on any topic is available in seconds. Encarta will cost you $395.

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Sources

Applied Optical Media Corporation
1450 Boot Road, Bldg. 400
West Chester, PA 19380
215-429-3701

Aris Entertainment, Inc.
4444 Via Marina, Suite 811
Marina Del Rey, CA 90292
310-821-0234

DeLorme Mapping
Lower Main Street, PO Box 298
Freeport, ME 04032
207-865-1234

Dr. T's Music Software
124 Crescent Road
Needham MA 02194
617-455-1454

Ebook, Inc.
32970 Alvarado-Niles Road, Suite 704
Union City, CA 94587
510-429-1331

Electronic Arts
1450 Fashion Island Blvd.
San Mateo, CA 94404
415-571-7171

Grolier Electronic Publishing, Inc.
Sherman Turnpike
Danbury, CT 06816
800-356-5590

HyperGlot Software Company, Inc.
PO Box 10746
Knoxville, TN 37939-0746
615-558-8270

InterOptica Publishing Ltd.
300 Montgomery Street
Suite 201, 2nd Floor
San Francisco, CA 94104
415-788-8788

Interplay Productions
3710 S. Susan, Suite 100
Santa Ana, CA 92704
714-549-2411

LucasArts Games
PO Box 10307
San Rafael, CA 94912
415-721-3342

Media Vision
3185 Laurelview Court
Fremont, CA 94538
510-770-8600

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399
206-882-8080

National Geographic Society
Educational Media Division
1145 17th Street, NW
Washington, DC 20036-4688
800-368-2728

Virtual Reality Laboratories, Inc.
2341 Ganador Court
San Luis Obispo, CA 93401
805-545-8515

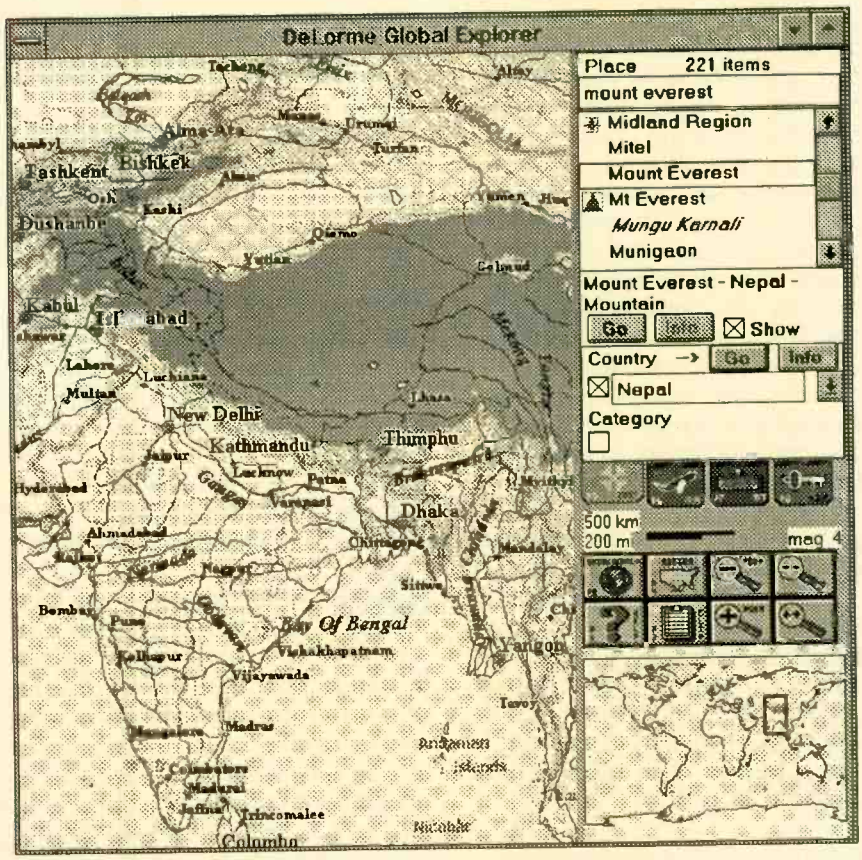
Sights and Sounds. Since a CD-ROM can hold lots of megabytes, it's the perfect place for things like clip art that would otherwise soak-up precious hard-disk space. Aris Entertainment has a series of multimedia clip-art discs under the titles of *Business Backgrounds; Full Bloom; Island Designs; Jets and Props; Majestic Places; Money, Money, Money; Wild Places;* and *World View*. Each title includes 100 photos and 100 sounds. The professional-quality images and sound clips can be used royalty-free and are perfect for sprucing up any presentation—business or otherwise. The discs sell for $39.95 each.

Another disc from Aris, *MPC Wizard*, contains 50 sample images and audio tracks, and also contains diagnostic utilities to test and fine-tune MPC systems. The MPC Wizard lets you measure the data-transfer rate of your CD-ROM drive, perform a 256-color test on your video system, and test and troubleshoot sound cards. The disc also includes over 80 megabytes of Windows sound and video drivers, and helps you install them in your system. At $14.95, this disc is a good investment for any multimedia-PC owner.

Music-related software is a logical application for CD-ROM, and *Composer Quest* from Dr. T's Music Software is a good example. The program lets you browse through music history using a time-line screen that displays all of the major musical periods. You can jump into any period and learn about different composers, the work they did, and the times they lived in. And, of course, you can listen to over 60 musical performances. Anyone with an interest in music from the year 1600 on will find this $99 disc both amusing and educational.

Microsoft has all bases loaded with CD-ROM's covering a wide variety of topics. One of them, *Multimedia Beethoven: The Ninth Symphony*, contains a fully digital, stereo-audio track of the four movements of Beethoven's Ninth Symphony. Also included is a measure-by-measure commentary on what is being heard, as well as a pop-up window that displays the score as the music plays. This disc is $79.95.

Another musical disc from Microsoft



Global Explorer *contains the major roadways of the entire world. With it, you can search for anything you like (not just streets) anywhere in the world.*

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is entitled *Musical Instruments*, and it's a multimedia catalog of musical instruments from A to Z. Photos and diagrams of all instruments are included in addition to audio samples of how the instruments sound alone and in an ensemble. This disc is also $79.95.

Super Maps. One truly fascinating disc we looked at is *Street Atlas USA*, from DeLorme Mapping. When you start this program you see a map of North America with all 50 of the States labeled. From there you can zoom down to street level anywhere in the country and see all the street labels. You can actually see the block you live on! Not only that, but extensive searching capabilities let you locate cities, towns, and streets by name, zip code, and telephone-area and exchange codes. Because this is a Windows program, you can easily copy a map to the clipboard for use in other programs. This program has a retail price of $169.

While any PC user will find Street Atlas USA both interesting and quite useful, another disc from DeLorme called *Map Expert with Street Atlas USA* is without a doubt a map maker's dream come true. Not only does this disc contain the entire Street Atlas USA material, it also contains extensive color and black and white map-printing capabilities. Using a common laser printer, you're able to print out stunning maps of wherever, and you can add your own custom labels to it as well. A Muralmaker function lets you produce wall maps. This $495 package is the perfect gift for anyone who's always planning road trips.

Another disc from DeLorme, *Global Explorer*, is similar to Street Atlas in its operation, However, it contains the roadways of the entire world—not all of them, though. While Street Atlas lets you zoom in and see the smallest of streets, Global Explorer can zoom in only to the point where you can see major roadways. Of course you can search for anything you like (not just streets) anywhere in the world. We went on a trip to Mount Everest and studied the surrounding geography! Global Explorer is a $169 travel ticket around the world.

Books. As you might be able to guess, Ebook publishes books on CD-ROM. Not only can you read a book on your screen or from a printout, you can also listen to a narrator tell the story as you look at the pictures. It's a whole new way of listening to *A Christmas Carol* during the holiday season, which is just one of Ebook's "books." And the power of CD-ROM lets you search the Ebooks for specific words, chapters, phrases, and so on.

The game Putt Putt Joins the Parade *lets kids explore many different locations and activate hundreds of sounds and animations. There's enough fun here to keep young kids busy for hours.*

Some of Ebook's other titles include *Twelve Roads to Gettysburg, Renaissance Masters I, Don Quixote, Aesop's Fables, Goferwinkel's Adventures, The White Horse Child*, and there are many more. The Ebooks we've mentioned range in price from $24.95 to $79.95.

We looked at two discs from InterOptica Publishing Ltd.: *Great Wonders of the World Vol. 1*, and *Great Cities of the World Vol. 1*. Both contain collections of history, photos, video, facts, maps, and so on. A timeline helps you to pinpoint moments in history and see the events surrounding them.

One thing we found on the InterOptica discs that we very much liked is a guided tour of the features. We found that to be very helpful in getting off to a quick start, and it makes it easier to get the most out of each disc. The InterOptica discs list for $49.95 each.

Games. From Electronic Arts we looked at two game CD-ROM's. For kids ages 3–7 there's a cute game called *Putt Putt Joins the Parade*. Putt Putt is a car who lives in the interactive, animated world of Cartown. The game lets kids explore many different locations and activate hundreds of sounds and animations. There's enough fun here to keep young kids busy for hours—not to mention giving them a familiarity with computers from a very young age.

For older kids and adults as well, there's *Sherlock Holmes, Consulting Detective Volume II*. This game lets you solve three different cases as you walk through the interactive streets of London. If solving mysteries is your bag of tricks, then this is $69.95 well spent.

If you like to play Chess, then you'll surely like to see *Battle Chess* in action with over 30 megabytes of animation and graphics in a 3-D Chess game. An unusual, animated 25-minute tutorial is educational for the beginner at Chess, yet still entertaining for the aficionado.

For the graphics to run as fast as possible, it's recommended that you install Battle Chess on your hard drive, although you can play it solely, albeit slowly, from the CD-ROM. While 30 megabytes is a large chunk of anybody's hard drive, it's also 30 megabytes worth of floppy disks that don't have to be shuffled during installation. Battle Chess costs $79.95.

It seems as though adventure games with long twisty plots have benefited quite a bit from CD-ROM, as the subtitles and still images are finally gone; all words are spoken and real-time animation takes place, in addition to everything being point-and-click. We looked at two games of this type from LucasArts: *Loom* and *The Secret of Monkey Island*. In *Loom*, the player follows the hero Bobbin Threadbare as he battles good versus evil in the Age of the Great Guilds. *The Secret of Monkey Island* involves Guybrush Threepwood and his quest for pirate treasure. An added bonus of CD-ROM is that Monkey Island can be played in five different languages.

LucasArts' *Secret Weapons of the Luftwaffe* on CD-ROM is an exciting flight-simulator game with very realistic graphics and endless numbers of flight options, including being able to take the wheel of many of the Luftwaffe's secret weapons. There's hours of entertainment on this disc.

More from Microsoft. Down another road of entertainment is Microsoft's *Cinemania*, an interactive movie guide. This disc will hold anyone's interest, as it is hard to find someone who does not like movies. Not only is it easy, but it's also very tempting

(Continued on page 92)

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Build a Low-Cost Motorcycle Alarm

Build and install a professional quality motorcycle alarm system, and sleep easier knowing that you wheels are well protected

BY DEAN KASPER

No matter how concerned you are on the street, if you have more than one cycle in your household, the of installing an alarm system in each vehicle can be cost prohibitive. Commercial units can go for between $60 and $400. But, with the *Motorcycle Alarm System* described in this article (which can be built for about $20.00), price need no longer be a stumbling block.

The Motorcycle Alarm has all the standard features of the commercial units on the market, such as delayed arming, it's affordable, simple, reliable, and small in size. Alarm triggering is accomplished through a built-in motion sensor. The alarm system can be selected to drive the cycle horn or an external siren.

To Toot or Scream? The Motorcycle Alarm has provision for either of two sounders: the cycle's own horn or a piezoelectric siren. The motorcycle's own horn is the most common sounder used in alarm systems, and provides the loudest multi-directional alert. In using the vehicle's own horn, the only space required is for the system's printed-circuit board. However, there is a drawback to using the vehicle's horn; the current drain on the battery is quite heavy when the alarm is activated. The average cycle horn will draw between 1 and 2 amps. On the plus side, our design reduces the drain by cycling the horn on and off through the alarm duration, thereby reducing the average current drain.

Using a piezoelectric siren is beneficial; the siren draws less power when the alarm is activated. However, there is a down side: you must find a convenient location for the siren. The size of your motorcycle and thus its battery size will determine which sounder best suits your situation.

Operation. Figure 1 is a schematic diagram of the Motorcycle Alarm. Power for the circuit is supplied through D2, which is used to protect the circuit in the event that power is applied to the circuit backwards during testing or installation. Capacitor C6 is used to decouple the power supply to circuit ground.

The sensor (SENS1) is comprised of alternate rows of ground- and sense-line traces etched onto the circuit's printed-circuit board. When the protected vehicle is disturbed, a stainless-steel ball bearing rolls across the alternate traces, shorting and opening the connections between the traces. A pull-up resistor (R5) pulls the trigger input high whenever the traces are not shorted by the bearing. The pulse created by the shorting and opening action triggers the alarm-circuit input. The size of the steel bearing can be varied for different degrees of sensitivity; a 3/16 or 1/4-inch diameter bearing was used in the author's prototype. A stainless-steel bearing must be used to ensure good electrical contact and avoid corrosion.

The heart of the alarm circuit is an LM556 dual oscillator/timer, U1. The trigger pulse is applied through C1 to U1-a (the first half of U1), which (configured as a one shot) controls the duration of the alarm output once triggered. The duration, about 52 seconds, is given by:

$$T_{ON} = (1.1 \times R2 \times C3)$$

The first timer circuit is held off momentarily by Q2, a 2N7000 N-channel enhancement FET, when the ignition is switched off. That gives the rider time to dismount before the alarm is armed. When the ignition switch is turned on, the ignition voltage forward biases D1. With D1 forward biased, Q2 turns on, disabling the alarm until the ignition is switched off.

Resistor R6 is used to limit the charge current applied to C8, and is necessary if a tantalum capacitor is used for C8 to produce longer hold-off times. When the ignition is turned off, power is removed from the anode of D1. Diode D1 blocks the current from C8, causing it to discharge through R7. During the time it takes for C8 to discharge, the timer is disabled. That hold-off time (about 20–30 seconds), is given by:

$$T_{OFF} = (3 \times R7 \times C8)$$

The second timer, U1-b (which is wired as a non-symmetrical squarewave generator) is enabled by the output U1-a. The squarewave generator controls the on/off time of

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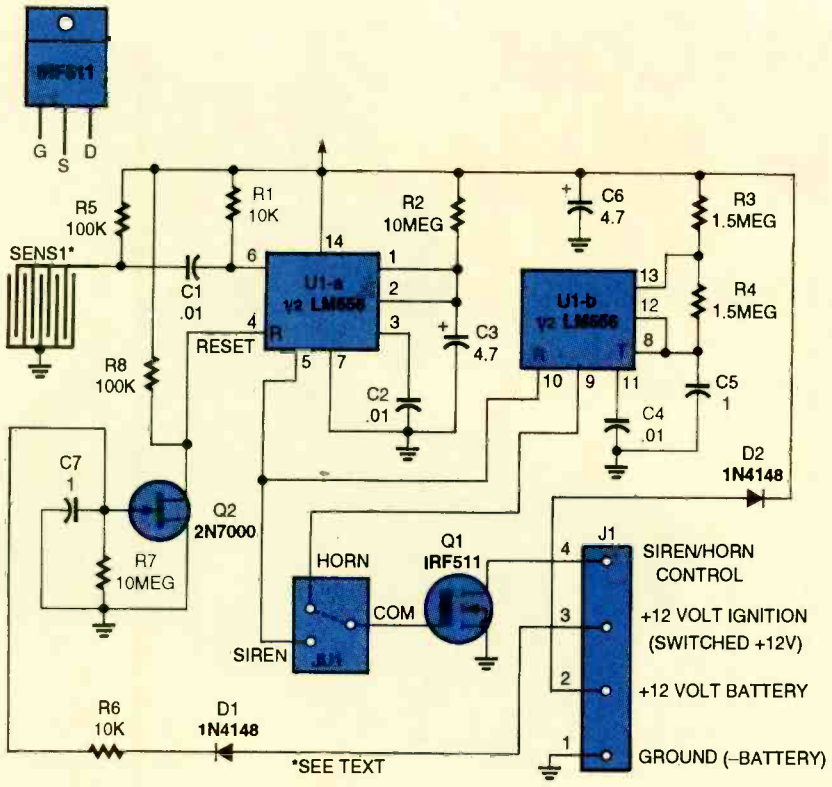

Fig. 1. At the heart of the Motorcycle Alarm is a LM556 dual oscillator/timer, a pair of FET's, and a rather unusual sensing unit (SENS1)—which is comprised of adjacent circuit board traces and a small stainless-steel ball bearing.

the horn driver. Cycling the horn on and off during alarm activation reduces battery drain when the cycle horn is used as the sounder. A typical cycle horn draws 1 to 2 amps. That on/off time (about 2-seconds on to about 1-second off) is given by:

$$T_{ON} = [0.693 \times (R3 + R4) \times C5]$$
$$T_{OFF} = (0.693 \times R4 \times C5)$$

The siren/horn driver circuit (built around Q1) functions as a switch, pulling the sound's negative lead to ground when enabled. A jumper connection (denoted JU1 in Fig. 1) is used to select either the vehicle horn or piezoelectric siren as a sounder.

Construction. The Motor Cycle Alarm was assembled on a small double-sided, printed-circuit board, measuring about 2 by 1 1/16 inches. Templates for both sides of that printed-circuit board are shown in Fig. 2 (A is the component side and B is the solder side). If you choose not to etch your own board, a pre-tinned, double-sided (without plate-through holes), printed-circuit board can be ordered from the supplier given in the Parts List.

When etching your own board, care must be taken to prevent shorting between the closely spaced senor (SENS1) traces. Once the board has been etched, it is recommended that an ohmmeter be used to verified that there are no shorts in the sensor traces before installing the parts. If there is a shorting problem, an Exacto knife can be run between adjacent traces to remove unwanted copper. The sensor area of the circuit board must also be very smooth. To avoid corrosion and to maintain consistency, it is recommended that the traces be tinned.

After etching but before installing the parts, you must decide on the type of sounder that will be connected to the circuit. That is done by either leaving or severing the a trace at JU1. If the vehicle's horn is to be used as the sounder, you need not do anything; the board is already set-up for that. But if you intend to use a siren, the small trace between the board's COM and HORN donut pads must be severed, and a jumper connection placed between the SIREN and COM donut pads.

Figure 3 gives the proper locations and orientation of the various parts that comprise the Motorcycle Alarm. When assembling the board, watch out for the polarities of C3 and C6. Note that the circuit is non-critical and component substitutions can be made freely.

When assembling the unit, be sure to solder all components on both the top (component side) and bottom (solder side) of the board; particularly R2, R3, R5, R6, R8, C1, C5, C6, Q1, D1, J1, and pin 5 and pin 10 of U1.

The ball bearing, which is used in the sensor portion of the circuit, can be purchased at most local hardware stores. You'll also need a 5/8 to 1 1/16-inch plastic pipe cap to house the ball bearing on the printed-circuit board. The cap can be secured to the board

PARTS LIST FOR THE MOTORCYCLE ALARM

SEMICONDUCTORS

U1—LM556 dual oscillator/timer, integrated circuit
Q1—IRF511 N-channel, enhancement power MOSFET
Q2—2N7000 N-channel, enhancement FET (Motorola)
D1, D2—1N4148 general-purpose silicon diode

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1, R6—10,000-ohm
R2, R7—10-megohm
R3, R4—1.5-megohm
R5, R8—100,000-ohm

CAPACITORS

C1, C2, C4—0.01-µF, ceramic-disc
C3, C6—4.7-µF, 50-WVDC, tantalum
C5, C7—1-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

SENS1—See text
J1—4-pin right-angle friction-lock connector
Printed-circuit materials, enclosure (see text), plastic pipe cap, stainless steel ball bearing, wire, solder, hardware, etc.

Note: A pre-tinned double-sided printed-circuit board without plate-through holes, part MC-Alrm-002, is available for $9.50 from Kasper Electronics, 400 West Hollow Lane, Fort Collins, CO 80524. Colorado residents please add appropriate sales tax.

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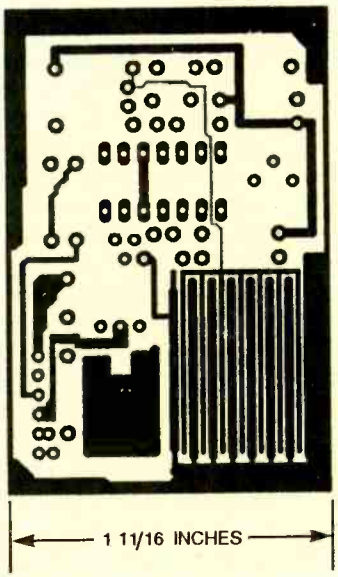

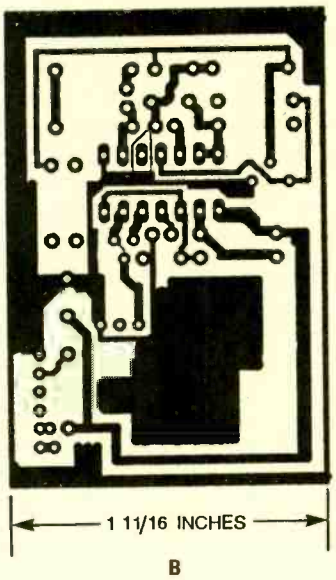

Fig. 2. The Motorcycle Alarm was assembled on a small double-sided, printed-circuit board, measuring about 2 by 1 1/16 inches: A is the template for the component side, and B is the solder side. The board can be ordered from the supplier given in the Parts List.

over the sensor traces (with the bearing in place) using hot glue.

Testing. Once the circuit has been completely assembled and checked for imperfections, it should be tested to ensure that it is working properly. Figure 4 shows a simple way to test the alarm circuit. Wire the circuit as shown. In that set-up, a 12-volt lamp is used in place of the horn, and single-pole single-throw switch is used to simulate the ignition switch. Connect a 12-volt power source to the circuit and power it up. When power is first turned on, the alarm triggers until the ignition switch (S1) is turned on and off for the first time. After to toggling S1 off and on, the alarm should go silent. Once silenced, tilt the circuit so the bearing breaks and makes the on-board circuit trace connection. At that point, the alarm (in this case, the light) should come on.

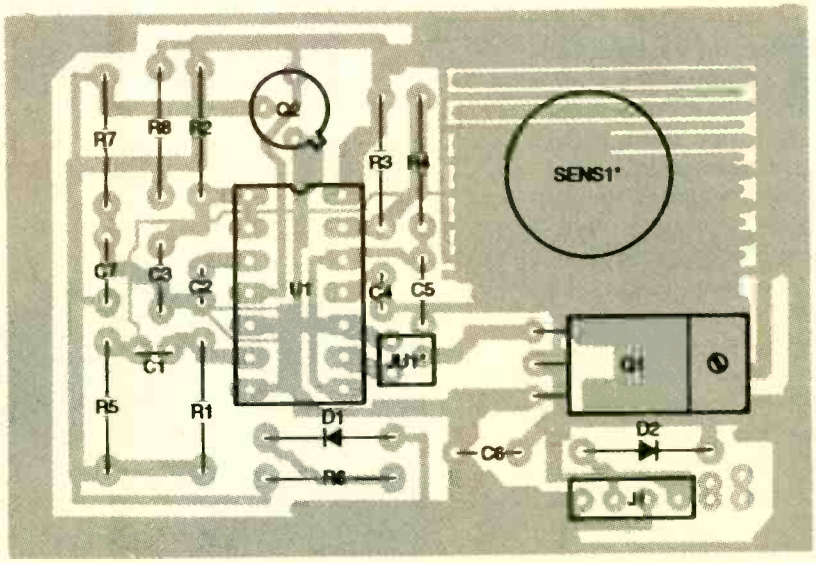

Fig. 3. Here are the proper locations and orientation of the various parts that comprise the Motorcycle Alarm. When assembling the board, watch out for the polarities of C3 and C6.

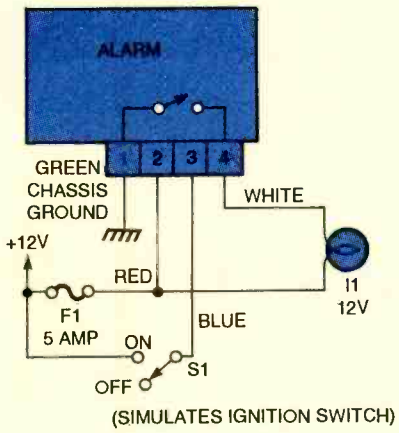

Fig. 4. In this simple test set-up, a 12-volt lamp is used in place of the horn.

Housing. Once the board's operation has been verified, the circuit can either simply be wrapped in plastic electrical tape, mounted in a project box, or potted in a non-conductive material. The author chose to pot the assembled board in hot glue. That is easily done by making a "form" around the board using wax paper or

(Continued on page 88)

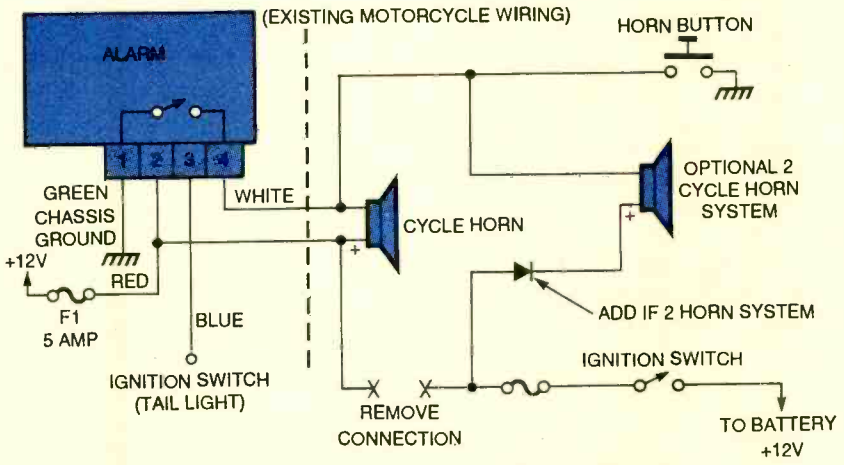

Fig. 5. While this illustration shows how to connect the circuit in a dual-horn arrangement, the same connection scheme is applicable to a single-horn setup.

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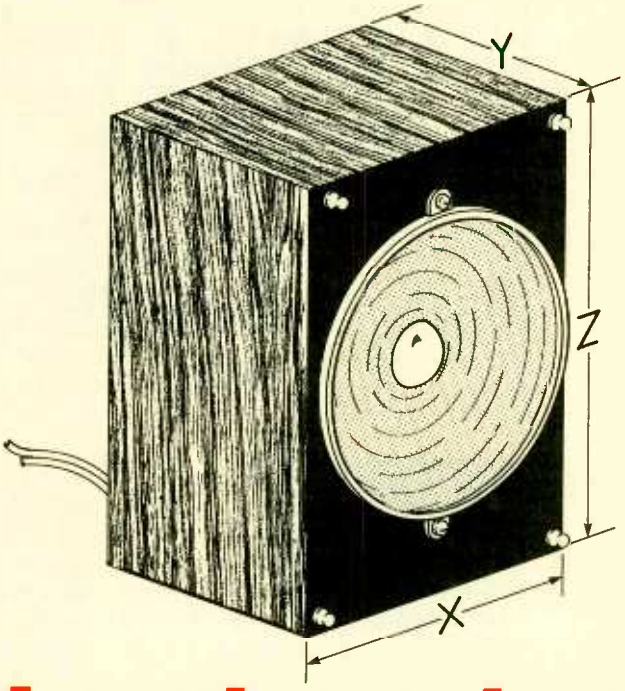
Design your own Loudspeakers



Three simple programs that will help you design your own speakers the right way.

BY WILLIAM R. HOFFMAN

To many **Popular Electronics** readers, loudspeaker design may seem more than a bit mysterious, what with all the talk of "Thiele/Small parameters," resonance, and various, more arcane terms. Indeed, for many, building a speaker simply means buying some "raw drivers" and putting them in any old cabinet they might have around, and hoping for the best. Too often, such haphazard work is a big disappointment.

In contrast, when a hardy soul goes hunting for some more substantial design theory, all they might find are some very specialized physics texts. All in all, it is a discouraging situation, to say the least.

However, all is not lost. Thanks to the work of two insightful engineers—A. N. Thiele and R. H. Small—the number of parameters you'll need to chose between to produce a good loudspeaker design has been reduced from hundreds to just three. Further, the three programs presented in this article will let your PC do the number crunching for you. Specifically they'll tell you the volume and dimensions of the enclosure, and design a crossover network for you.

To simplify this approach further, most driver manufacturers provide you with some of the necessary parameters to help you decide on a driver. Many even publish them right in their catalogs and brochures. That will allow you to do some useful trial-and-error work with your computer, instead of wasting many hours of hard work and dollars worth of wood and drivers.

The Cabinet. First we'll look at cabinet design. At this point you might be wondering if a cabinet is at all necessary. There are two reasons why you need a cabinet (more properly called an "enclosure"). The first is to prevent the sound radiated from the rear of the driver (which is in opposite phase to that from the front) from meeting and canceling the driver's forward output. Second, an enclosure serves to flatten and extend the driver's bass output. (Anyone who has ever propped up a driver without a cabinet and played some music through it knows what happens to the bass.)

Specifically, we'll discuss the design of a sealed acoustic-suspension cabinet. Of course, there are other types of enclosures—bass-reflex, ducted-port, passive-radiator, horn, and more. All of them could serve the same purpose, but are much harder to design and build. So we will only deal with a simple, acoustic-suspension system here.

The Basics. There are a couple of preliminary concepts of speaker design that we must first introduce. Let's start by defining the three parameters that Thiele and Small have given us. They are commonly abbreviated f_o, Q_{ts} (also referred to as Q_t or the "Q"), and V_{as}. As mentioned earlier, those parameters are commonly supplied by a driver's manufacturer.

Let's start with f_o, or the frequency of oscillation. That refers to the natural bass-resonance frequency of a loudspeaker driver without a cabinet. It will be used to determine how low in frequency our completed system (with a cabinet) will efficiently go, or f_{cab}.

Second, Q_t is the degree of peaking that occurs in the driver's response, again without a cabinet, at the bass-resonance frequency. That is related to the Q within a cabinet, which we'll call Q_{cab}. The parameter Q_{cab} can be decided more or less by the designer.

Last, V_{as} is the volume of air contained within a closed space that would have the same compliance or "springiness" as the suspension of the driver's moving part (the cone).

With the three manufacturer-supplied parameters (f_o, Q_{ts}, and V_{as}), a carefully chosen cabinet Q (Q_{cab}), and the help of our first design program, we can exactly specify the volume of a sealed acoustic-suspension cabinet. The enclosure will work with the chosen driver to give the best bass response possible.

Now that you know the parameters, there are a two things we need to mention about using them to design a loudspeaker. First, there's more than one possible enclosure for any given driver. The difference between the designs is a trade-off between how low we want the frequency response to extend (f_{cab}) and how sharply we want the response to fall off below that bass cut-off point (Q_{cab}).

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Second, we must understand that once we have selected our driver, we can only set one of those two parameters (bass frequency response or bass fall-off). Although it can be either one, once we decide the value of one parameter, the remaining parameter will be fixed by the laws of physics.

Realistic Bass Cutoff. It is important to recognize that a given size driver has a fairly well defined lower frequency limit (f_o). That is because the movement of the cone of a driver must quadruple (yes, quadruple) for every halving of frequency to maintain the same acoustic output. There comes a point at which the driver will simply run out of cone excursion (the distance the cone can move) and its sound output will fall off sharply.

There are many advertisements that claim miraculous bass reproduction from tiny speakers, but Table 1 gives us some practical values to shoot for in our design work. Attempting to push a driver much below those recommended frequency limits will usually result in weak or distorted output, or even driver damage.

The table also indirectly gives us a guide to our lower limit for the value of f_{cab}, your speaker's bass-output capability. That's because the driver in a cabinet can't produce bass response lower than it can in free air—a natural consequence of the loading effect of the volume of air trapped in the sealed cabinet behind the driver. It therefore sets a lower practical limit on one of our "designer-determined" parameters.

TABLE 1—LOWEST FREQUENCIES

Driver Size (inches)	Low Limit (H2)
4	90 – 95
5	85 – 90
6	65 – 70
8	40 – 45
10	30 – 35
12	25 – 30
15	20 – 25

The Q. Now, we must consider the "Q" of the system (Q_{cab}), the other parameter we can set ourselves. There are some things we need to know about Q. To begin with, the higher the Q, the stronger the bass output will be. You might be tempted to make the Q as high as possible, but

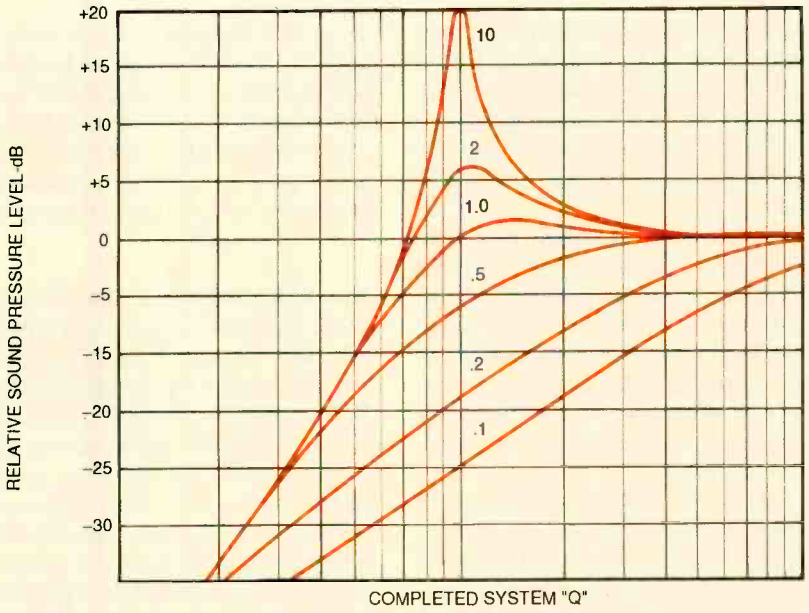

Fig. 1. If the Q is too high, there will be an undesirable peak in the frequency response. Thus the speaker will sound to boomy.

LISTING 1

```
9 PRINT:PRINT:PRINT:PRINT:PRINT
10 PRINT "          LOW FREQUENCY ACOUSTIC SUSPENSION LOUDSPEAKER"
11 PRINT:PRINT
12 PRINT "                                DESIGN PROGRAM"
13 PRINT:PRINT:PRINT
14 PRINT "                                By William R. Hoffman"
15 PRINT:PRINT:PRINT
17 PRINT "                                Copyrite 1993"
18 PRINT:PRINT:PRINT
20 INPUT "                                Proceed? (1=yes 2=no) and Enter ";P
22 PRINT:PRINT:PRINT:PRINT:
25 ON P GOTO 30, 990
30 INPUT "                                Free air resonance of driver (Hz) =";B
35 PRINT
40 PRINT "                                Air volume compliance equivalent of"
45 INPUT "                                driver (Vas) in cu. ft. =";C
46 PRINT
50 PRINT "                                Free air total Q of driver at"
55 INPUT "                                bass resonance (Qts) =";D
60 PRINT
65 PRINT "                                What is desired completed system  Q "
70 INPUT "                                at bass resonance (Qcab) =";E
75 PRINT:PRINT:
100 LET Z=(E/D)^2*(1.05)-1
110 LET Y=B*E/D
120 LET X=C/Z
130 PRINT"                                For an in cabinet bass driver Q of"E
135 PRINT
140 PRINT"                                The cabinet volume is ="X"cu. ft."
145 PRINT
150 PRINT"                                And the driver bass resonance frequency
155 PRINT"                                will be ="Y"Hz"
160 PRINT
165 PRINT"                                If you wish to print this information,"
170 PRINT"                                use <prn scr> key at this time."
172 PRINT
175 PRINT"                                Would you like to try another driver?"
180 INPUT"                                (1=yes 2=no) and Enter ";F
182 PRINT
185 ON F GOTO 30, 990
187 PRINT
990 PRINT"                                Good listening!"
999 END
```


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remember, the higher the Q the faster the speaker output will fall off below f_{cab}. Also, just as in an electrical circuit, too high a Q can cause ringing and oscillation, which means highly distorted (typically muddy or boomy) bass.

So then, what would be a good value? Figure 1 shows some Q curves possible with our completed speaker system. Notice, that for values much over 1, a large peak in the output occurs, growing with increasing Q. The peak is what you must avoid if you want good sound from the completed system.

For some guidelines, look at Table 2 where a range of Q values are suggested for various bass-driver sizes. The values are based on many factors, including the size of the driver itself. Notice that very small drivers should have rather high Q values, while larger ones have lower Q's. The reasons for those suggestions are very practical. A tiny 4–5-inch driver has so small a cone, and consequently such weak bass output, that the slight peak due to a high Q value actually makes the sound fuller and more satisfying. A very large driver, on the other hand, can produce so much bass output that a lower Q is required to control and smooth-out its response. So now, armed with some knowledge about f_{cab} and Q_{cab}, we are ready to begin some practical design work.

TABLE 2—POSSIBLE Q's

Driver Size (inches)	Q Value Range
4 – 5	0.9 – 1.2
6	0.8 – 1.0
8	0.7 – 0.9
10	0.6 – 0.9
12 – 15	0.5 – 0.8

Our First Program. To begin with, you need to enter the speaker-design program (see Listing 1) in a directory along with GWBASIC or BASICA, at least one of which you must have to run the program. We called our program LFSPKR-1.BAS. It's job is to calculate the volume of the enclosure and the bass resonance frequency of the system.

Be sure to carefully enter it as it is shown, including all punctuation and spaces. They are very important to the program. All the blank spaces found in the "input" and "print" statements bring the displayed lines in the program to a nicely centered place on the working screen, so be sure to include them. If anyone needs help, or has never entered or run a BASIC program, just find a friend or ask someone about how it is done: the process is very easy. Really!

Running LFSPKR-1. Once the program has been typed in and entered as LFSPKR-1.BAS, from the DOS prompt we can start it by typing GWBASIC LFSPKR-1.BAS if you are using GWBASIC, or BASICA LFSPKR-1.BAS if you are using BASICA. When the opening screen appears, the title, "Low Frequency Acoustic Suspension Loudspeaker Design Program" appears. The program then asks you, if you wish to proceed. After answering "1" (or yes), you will be asked for the values of f_o, V_{as}, and Q_{ts}, in that order. Then, you will be prompted for a value for Q_{cab}, the completed system Q at bass resonance. That value must always be higher than Q_{ts}.

Since we are only making trial-and-error calculations, we can search for a bass driver/f_{cab}/Q_{cab} combination that gives you the system a bass cutoff frequency/Q combination that you want based on the guidelines already given. Once you've entered the driver-based parameters, choose a Q value (Q_{cab}), from Table 2. Once that is entered, the program will automatically calculate the interior volume of a cabinet that will yield the Q_{cab} we specified.

Typically it's good to line an enclosure with at least a single 1–2-inch thick layer of material. Typically Fiberglas, which usually comes in a roll or in pillow form, is cut into batts that cover the size of each of the interior surfaces, and fastened to the walls using a staple gun. Applying it that way means you can probably expect to gain about 5% of the effective enclosure volume, something you can usually ignore. Don't add more material than that, or apply the material in any other fashion.

LISTING 2

```
10 PRINT:PRINT:PRINT:PRINT:PRINT
15 PRINT "                    SPEAKER ENCLOSURE DIMENSIONS"
16 PRINT:PRINT
17 PRINT "                         DESIGN PROGRAM"
18 PRINT:PRINT:PRINT
19 PRINT "                       By William R. Hoffman"
20 PRINT:PRINT:PRINT
21 PRINT "                          Copyrite 1993"
22 PRINT:PRINT:PRINT
23 PRINT "This is a program designed to calculate optimum"
24 PRINT "dimensions for a loudspeaker enclosure when only"
25 PRINT "the desired volume is known."
26 PRINT:PRINT:PRINT:PRINT
27 INPUT "Proceed? (1=yes 2=no) and Enter";P
28 PRINT:PRINT:PRINT:PRINT
30 ON P GOTO 40, 990
35 PRINT:PRINT:PRINT:PRINT
40 PRINT "The desired enclosure internal"
41 INPUT "  volume is (cu. ft.) =" ;A
43 PRINT:PRINT:PRINT:
45 ON A GOTO 50
50 LET X=A^(1/3)*(12)
55 LET Y=X*.62
60 LET Z=X*1.62
70 PRINT "The following are the INSIDE dimensions of a box"
71 PRINT "of"A"cubic feet that are optimized to provide the"
72 PRINT "least number of standing waves (or resonances)."
75 PRINT:PRINT:PRINT
80 PRINT "                        HEIGHT = "Z
85 PRINT "                        WIDTH  = "X
90 PRINT "                        DEPTH  = "Y
95 PRINT:PRINT
100 PRINT"Do you wish to try another volume?"
110 INPUT"(1=yes 2=no) and Enter";B
120 ON B GOTO 35, 990
990 PRINT:PRINT:
995 PRINT"                        Good listening!"
999 END
```


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The Second Program. Our second program is a simple one. It asks for the volume of enclosed empty air space we are looking for. In return, it gives us a set of inside (not outside) dimensions that offer the least opportunity for resonances or standing waves to develop within the enclosure. Also, it gives us a nice rectangular shape that is pleasing to the eye.

To use the program, ENCDES-1.BAS, first enter it as shown in Listing 2. Like the first program, be sure and enter it exactly as shown. Once this is done, you may access it along with your copy of BASIC by entering either GWBASIC ENCDES-1.BAS (if you are using GWBASIC), or BASICA ENCDES-1.BAS (if you are using BASICA) at the drive prompt.

Once the opening screen appears, respond to the prompt with a "1," and ENTER. Following that, another prompt will ask for the enclosure volume. Enter the value in cubic feet, but remember that the box volume must include an allowance for the driver(s), acoustic material, bracing, and crossover, if any. Once that is done, the program will calculate and display a set of values for the three inside dimensions, in inches. With these, then, we are ready to start building our new speaker system.

Now we need to talk about crossover networks and the last of the three programs to be presented. The program calculates the exact values of inductors and capacitors that you will need to complete your loudspeaker system.

Now the Questions. Looking at our calculated values, we can ask ourselves: is the frequency of f_{cab} low enough to ensure good bass response, but still within the limits suggested by Table 1? If it is somewhere near the limit shown in the table, then we will be getting all that we probably can from it. Then we can ask: is the size of the suggested enclosure too big or smaller than we want?

If the values are unsatisfactory, then you can simply try again. At the prompt, respond (1=yes), and then enter another value of Q_{cab} for the particular driver you are working with, or instead try the specifications of another driver that you might want to use. Because this is a computer program, you can easily try as many times as you want until you find the right set of specifications for your needs. If you wish, you can even have a printer (almost any printer will work) print out the entire screen with all the prompts and information contained. Simply use the PRNT SCR key on the keyboard.

What Volume? Now, the next logical step is to use the calculated volume and another small program to get the actual internal cabinet dimensions (height, width, and depth.) as indicated in Fig. 2. But before we introduce the next program, let's discuss a few points first.

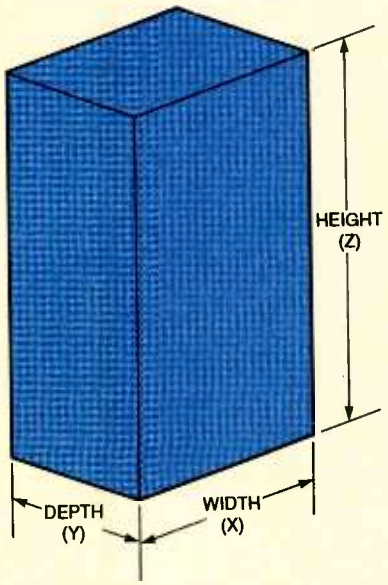

Fig. 2. The second program uses the three variables shown here to indicate the cabinet dimensions.

For one, the enclosure volume calculated in our first program (LFSPKR-1.BAS) was the *empty* cabinet volume. That is, no allowance was made for the space that would be occupied by the driver (or drivers), any extra bracing you might want to use, or the crossover network. If possible eliminate or reduce the volume they will occupy in the cabinet.

Alternatively, you can counter the volume change with acoustic damping material (Fiberglas, wool, or foam). Adding it will make the cabinet seem larger than it really is. (Yes, I said larger!) When the acoustic waves from the rear of the driver pass through these soft, absorptive materials, they are actually slowed down by a small amount—typically by about 20%—and are also partially absorbed. The result is that the enclosure seems "acoustically bigger" than it really is. For a typical material like Fiberglas, up to 40% larger. So, if you were to lightly "fluff" fill a box of 1 cubic foot in volume, it would acoustically look like about 1.4 cubic feet to the driver.

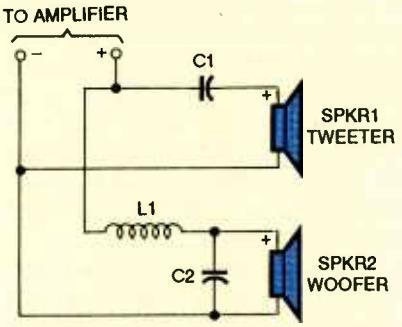

Fig. 3. A crossover network divides the frequency spectrum up so only the necessary sonic components are reproduced by each driver.

What is a Crossover? Most speakers have more than one driver. The reason for having multiple drivers is simple: a big driver will reproduce bass frequencies very well, but is very poor on the highs because its cone is too big and heavy to move very quickly. While on the other hand, a little driver can make its light little cone move very rapidly and reproduce the highs very well, but it cannot move enough air to reproduce deep bass in any quantity. Obviously, then, we must have at least two different types of drivers (one large and one small) to really be able to make a good, wide-range speaker with low distortion.

There are also speaker systems made with even more drivers. There are some with three or even four, each one covering only a very narrow and specific range of frequencies (for which it is optimized.) In such a system each driver is physically smaller than the last as we move up from the bass, through the midrange, and on to the highs. However, here we'll limit our scope to a two-driver, or two-way system.

To prevent large drivers (called "woofers") from distorting while trying to reproduce highs, and small drivers (the smallest of which are called "tweeters") from blowing out from lows, a crossover network is used. A

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crossover separates the sonic frequency spectrum into the ranges needed by each driver in a multi-way loudspeaker. More specifically, it is a combination of inductors and capacitors that form an electronic filter network.

The Crossover Components. Let's look at an example circuit to see just what a crossover does. The simple crossover circuit in Fig. 3 is applied to a speaker system that has a woofer and tweeter. Notice that there is an inductor wired in series with the woofer, and a capacitor wired in series with the tweeter. Those two elements divide the sound spectrum between the drivers.

The inductor when connected as in Fig. 3, forms a low-pass filter. That is, it allows the low frequencies to pass through it, but will block all high frequencies. The result is that only the bass is passed, which is fine since the woofer can only mechanically reproduce bass any way, and therefore it avoids wasting power from the amplifier uselessly. The action of the low-pass filter on frequency is shown graphically in Fig. 4A.

The capacitor, when it is connected to a tweeter as shown back in Fig. 3, performs a function that is the compliment to the inductor: It forms a high-pass filter. It will only allow high frequencies to pass, keeping the strong bass power out of the small high-frequency driver. That prevents possible distortion and damage. The effect the high-pass filter has is shown in Fig. 4B.

In addition, another capacitor is connected directly across the terminals of the woofer to perform another necessary function: compensation. The voice coil of the woofer is just that, a coil, so it has a substantial inductance just like the inductor we are using for the low-pass filter. If we didn't use C2, the voice-coil inductance would defeat the crossover inductor, and no crossover action would take place. The compensation capacitor nullifies the effects of the woofer's voice-coil inductance and allows the inductor to create the low-pass function we require.

The Crossover Program. Listing 3 shows the BASIC program, called XDES-1.BAS, which we will use to calculate the values of inductance and capacitance we need for our crossover network. As with the previous programs, carefully enter it in with your copy of GWBASIC or BASICA, being sure to get all spaces and punctuations correct. Once that is done, we can access the program like the others by typing GWBASIC XDES-1.BAS or BASICA XDES-1.BAS.

Once the opening screen appears, answer the prompt, and you will be prompted for the frequency (in Hz) that you want the crossover function to take place at. Then you will be asked for the impedance of the bass driver at the crossover frequency you have just selected. You can usually find that value from an impedance curve supplied by the driver manufacturer. If not, use an impedance bridge that you or someone you know might have to measure the driver's impedance. If neither of these sources of information are available, then use the nominal impedance of the driver (usually 8 ohms). This should get you fairly close, since our filter slope is quite shallow (as Fig. 4 shows, it's only 6 dB/octave.)

(Continued on page 88)

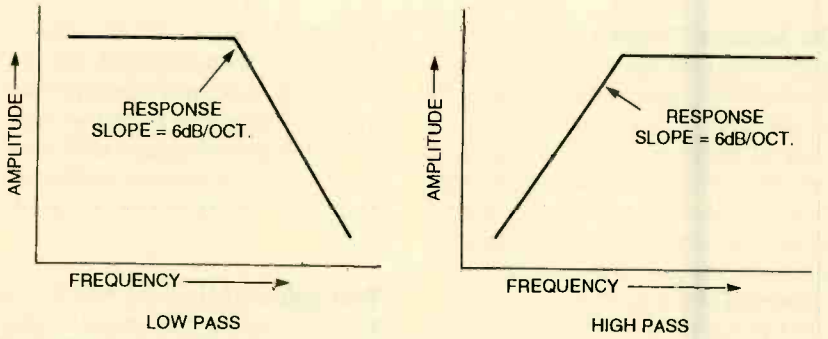

Fig. 4. The action of the woofer and tweeter outputs of the two-way crossover are shown here in A and B respectively.

LISTING 3

```
5 PRINT:PRINT:PRINT:PRINT:PRINT
10 PRINT "                    DESIGNING A LOUDSPEAKER "
11 PRINT:PRINT
12 PRINT "                    CROSSOVER NETWORK"
14 PRINT:PRINT:PRINT
15 PRINT "                    By William R. Hoffman"
16 PRINT:PRINT:PRINT
17 PRINT "                    Copyrite 1993"
18 PRINT:PRINT:PRINT
20 INPUT "                    Proceed? (1=yes 2=no) and Enter";P
22 PRINT:PRINT:PRINT
25 ON P GOTO 30, 990
27 PRINT:PRINT:PRINT
30 INPUT "                    Crossover frequency is (Hz) =";A
35 PRINT:PRINT
40 PRINT "                    Impedance of low frequency driver at"
45 INPUT "                    the crossover frequency is (ohms) =";B
46 PRINT:PRINT
50 PRINT "                    Impedance of high frequency driver at"
55 INPUT "                    the crossover frequency is (ohms) =";C
60 LET X=((B)/(6.28*A))*1000
65 LET Y=((1)/(C*6.28*A))*10^6
66 LET Z=((1)/(B*6.28*A))*10^6
70 PRINT:PRINT:PRINT
75 PRINT "                    L = "X"mHy"
80 PRINT:PRINT
85 PRINT "                    C1 = "Y"uF"
86 PRINT:PRINT
87 PRINT "                    C2 = "Z"uF"
90 PRINT:PRINT:PRINT
95 PRINT "                    Would you like to try another set of"
96 INPUT "                    values ? (1=yes 2=no) and Enter";Q
97 ON Q GOTO 27, 990
990 PRINT:PRINT
995 PRINT"                    Good listening!"
999 END
```


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A CHRONICLE OF CONSUMER ELECTRONICS

Slip Slidin' Away

COOLSCAN 35-mm SLIDE SCANNER. Manufactured by Nikon Electronic Imaging, 1300 Walt Whitman Road, Melville, NY 11747-3064. Phone: 800-52-NIKON or 516-547-4355. Price: $2495 (external), $2195 (internal).

The distinctions between traditional and desktop publishing are becoming more blurred with each passing year. It was easy even a couple of years ago to spot desktop-published material. It generally looked something like a patch-work ransom note because of the many different fonts used; poor-quality "clip-art" images were the rule. To make matters worse, it often was printed on a dot-matrix printer.

There is no shortage of poorly designed published material today. What's different is the availability of affordable hardware that now allows even the worst designs to be output at a professional level of quality—on the desktop, with a PC. Desktop-published documents can now be virtually indistinguishable from professionally printed material.

One of the latest innovations to help the desktop publisher is the *Coolscan 35-mm Film Scanner* from *Nikon Electronic Imaging*. The Coolscan can capture images from both color or black-and-white, positive or negative slides and film. The images can be imported into desktop-published documents. The scanned images can even find themselves in the pages of **Popular Electronics**. In fact, all of the images on this page were scanned by the Nikon Coolscan.

The Coolscan is a small device, measuring about 6 × 8 × 1¾ inches. Its small size and low price is made possible because it uses red, green, and blue LED's as a light source. It runs as cool as its name indicates.

We installed the Coolscan on our IBM-standard PC without a hint of trouble—it took us about two minutes to install the

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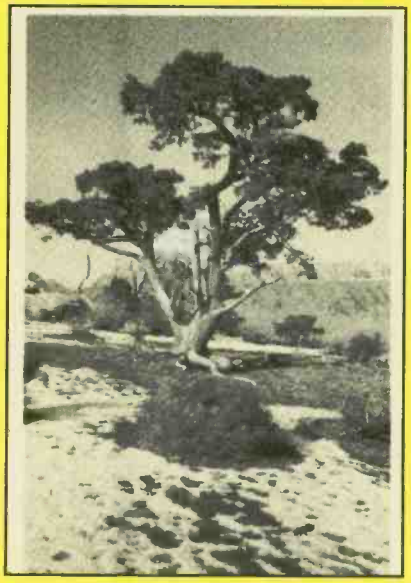

These five photographs were scanned by the Coolscan from color and black-and-white negative film, and color slides. The tree on the left had a file size of about 260 kilobytes. The tree on the right was scanned at maximum resolution for a file size of 10 megabytes.

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hardware, including opening our computer's case. All that was required was to set the SCSI ID of the interface card, insert it into our PC, and then to connect the Coolscan to the card with the supplied cable. An internal version, which mounts in a drive bay, is also available for IBM-standard PC's. The Coolscan is also compatible with Apple Macintosh computers.

The minimum system requirements suggested by Nikon are a PC running Microsoft Windows 3.0 or later with 8 megabytes of RAM, an 80 megabyte hard drive, and VGA graphics. For better performance, Nikon recommends Windows 3.1, 16–32 megabytes of RAM, a 300-megabyte hard drive, and a 24-bit true-color display.

Installing the supplied software, which runs under Microsoft Windows, was as simple as installing the hardware. The Coolscan comes with "plug-in" software that can be controlled by such graphics software as Adobe Photoshop or Aldus PhotoStyler. We chose to use only the included Coolscan Control software (which also makes use of the plug-in software) to control the scanner for our tests. A separate utility for ejecting slides from the Coolscan is also supplied.

The hardware and software installation went so smoothly that we were ready to try our first scan less than a half our after we opened the Coolscan shipping box. We didn't even have to search for a slide to scan. Nikon ships one with the scanner, and refers to it in the first chapter (Getting Started) of the excellent user's guide that accompanies the Coolscan.

A slide is inserted into the scanner in much the same way that a floppy disk is inserted into a disk drive. For proper orientation, the slide is inserted with one of its thin (24-mm) sides first. The emulsion side of the film must be facing up for the sharpest results. (The emulsion side is the side of the film that contains the dyes. The other side is called the base.)

A supplied film holder allows unmounted film to be scanned. In general, film strips can be up to five frames long.

After the slide or film is inserted into the scanner and the control program is launched, the next step is to tell the software what type of film you are scanning (black-and-white or color, positive or negative) and the orientation of the image (landscape or portrait). Then you are ready for a preview scan.

The preview scan is a fast, low-resolution scan of the entire frame of the film. When the preview image is on the screen, the parameters for the final scan can be set. The resolution, size, and cropping area can be adjusted, as can the contrast, brightness, and color balance.

The final resolution of the scan is selected once the other parameters are chosen. Selecting the best final resolution can be a tricky job, because it depends on the size of the enlargement and how the final output will be printed. The resolution determines how big the image file will be, and how long the final scan will take.

According to Nikon, the ideal final scanning resolution for printing in **Gizmo** is 266 pixels per inch, twice the line screen (133 lines per inch) used for our printing.

We scanned a black-and-white image of a tree in two resolutions. In the first, we ended up with a resolution of 266 dots per inch, and ended up with a file size of about 263 kilobytes. Then we scanned the same image at the maximum resolution of the scanner, which produced a file larger than 10 megabytes! Can you see a difference between the two? Well, we won't see the actual printed page until you do, but we are willing to bet that we wasted our time scanning at the higher resolution—our printing process limits the maximum resolution that can be shown on the page.

Some of the other images that we wanted to use could not be scanned for a final resolution of 266 dots per inch because the images were on a small portion of the frame, and had to be enlarged. The maximum resolution with which a frame of film can be scanned is 2700 dots per inch. Such a high-resolution scan can take about six or seven minutes.

All of the scanned images printed here were made with the Coolscan in its automatic mode. All exposure, color-balance, and focusing decisions were made by the scanner. There is, however, a rather sophisticated set of controls for manually adjusting all aspects of the scan. The controls unquestionably could have allowed us to make better scans. But they also could have allowed us to completely mess up all of the images. We experimented with the controls, but let Nikon take the blame for the images shown here.

Color-balance controls allow the scanner's red, green, and blue exposure times to be varied in a range from 25 to 100. Adjusting the controls can be tricky if an uncalibrated monitor is being used. One thing to keep in mind is that if one color is decreased, its inverse color is increased.

For more precise control, the scanner's gamma curves can be adjusted. Gamma is a measure of contrast in a photographic image. The gamma editor allows the master gamma curve, as well as the gamma curves for each of the colors, to be adjusted. (Black-and-white images have a master and monochrome gamma curves associated with them.) Custom curves can be saved.

The gamma curve can be thought of as an input/output transfer function. It represents how input color values are output in the final scan. It can be used, for example, to strengthen the color values in shadows, and reduce those in the highlighted areas of the image to create what is essentially a negative.

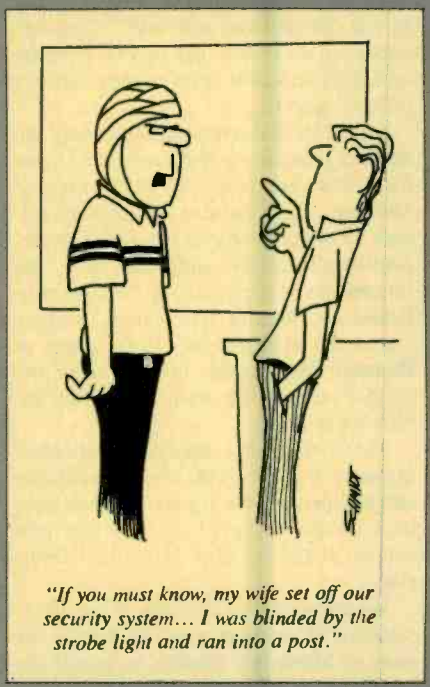
Viewing a histogram of the preview image is helpful in making intelligent gamma-editing decisions. It provides a graphical view of the brightness of an image, which is often easier to interpret than the on-screen preview image.

The black point and white point of the images can be adjusted to vary the tonal range in the image.

The Coolscan is ideal for low-volume scanning of images that will be printed at small sizes. High-resolution scans require about 5–7 minutes, which would not be acceptable at high volumes. The maximum size that a scanned image could be printed in this magazine at acceptable resolution is about 4 × 5 inches.

Most of the competitive products in the Coolscan's price class are slide adapters for flatbed desktop color scanners. However, the low resolution they produce, typically up to 600 dpi, makes them unacceptable for serious users.

The Coolscan is very convenient—especially when compared to sending an image to a service bureau to be scanned, or putting an image onto Photo CD. (Photo CD, however, provides better results and higher resolution, and for high-volume applications, probably a speed advantage.) For small-scale desktop publishing, for quick emergency scans in high-end publishing, and for desktop presentations, the Nikon Coolscan is one hot product. ■



"If you must know, my wife set off our security system... I was blinded by the strobe light and ran into a post."

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The Wave of the Future

BOSE ACOUSTIC WAVE RECEIVER/ ALARM CLOCK. Manufactured by Bose Corporation, The Mountain, Framingham, MA 01701-9168; Phone: 800-444-BOSE. Price: $349.

If you're like most adult Americans, the last thing you see before falling asleep at night, and the first thing to greet you each morning, is something you hate. If that description immediately calls to mind your spouse, you'd probably be better off reading Ann Landers, or seeking the aid of a marriage counselor or divorce attorney. Remember, this is *Gizmo*. We are, of course, referring to your clock radio.

No one enjoys being roused from peaceful slumber by a blaring alarm, especially if its main job is to make sure you get to work on time. It doesn't matter if the clock chimes, chirps, rings, buzzes, or plays tinny music,—you just want it to let you sleep a little longer. ("Aw, c'mon, just another five minutes...")

Bose makes it a little easier to get up in the morning with the *Wave Radio* stereo receiver/alarm clock. Not your typical clock radio by a long shot, the Wave is first and foremost a radio receiver that is suitable for real listening, and not just catching the morning traffic and weather reports. It also happens to have just about every feature you might want in an alarm clock, and is small enough to fit on your nightstand.

The Wave Radio is both unobtrusive—measuring just 4.5 inches high, 14 inches wide, and 8 inches deep—and attractive. Its gently curved, clutter-free front panel contains only the display, which is centered between two plastic speaker grilles. The control panel is conveniently located on top of the radio, so that you can reach out and slap down that snooze button. A credit-card-sized remote control duplicates most of the top-panel controls and adds a MUTE key. At the bottom of the unit is a compartment that holds three "AAA" batteries, which will maintain the time and station settings for as long as a week in the event of a power failure. An FM wire antenna and an AM loop antenna are also included.

The Wave Radio can stand alone as a radio or clock/radio or serve as the center of a stereo system. RCA-type phone jacks on the back of the unit allow a CD player, tape deck, or TV to be connected. We hooked up a portable CD player for which we've never had much use. (It turned out to be impractical while exercising, and we've since installed CD players in our home, office, and car.) The CD player now rests inconspicuously on top of the radio, and we're able to listen to our favorite discs in the bedroom. If our small bedroom TV set had audio outputs, we could imagine using the Wave Radio to improve the audio instead. Because audio outputs are provided on the Wave Radio, it's also possible to use Bose Acoustimass-3 or -5 powered speakers, or your own favorite stereo amplifier and speakers.

That's really not necessary in most applications, however. The Wave's built-in speakers use Bose's Acoustic Wave technology to provide deep, full bass from a small package. It features one 2.5-inch long-throw, full-range transducer and one 2.5-inch, long-throw, "wide-range" transducer in an Acoustic Wave enclosure. That enclosure is the key to the impressive audio that the radio delivers. A 34-inch single-ended waveguide is molded in a folded arrangement inside the unit behind the left speaker. The waveguide output is at the right-hand edge of the front panel. Remove the waveguide, and you have a clock radio that sounds like a clock radio.

Because only the left speaker feeds the waveguide, Bose feeds the low-frequency signals from both channels to that speaker. Low-frequency signals are non-directional, so stereo imaging isn't affected—not that we would expect good imaging from such closely spaced speakers. Although you might expect a waveguide to be resonant at only a single frequency, Bose engineered the transducer and waveguide to interact to extend the frequency response. The result is deep, full-bodied sound at any volume.

To our ears, Bose was not as successful with the Wave Radio as it has been with the Acoustic Wave in other products. The bass often struck us as being ill-defined and muddy, with a hint of being boomy. Nevertheless, the Wave Radio is the best-sounding small-package radio we've ever heard.

When it's put to work as a clock radio, the Wave Radio is truly in its element, providing almost as many sleep/wake options as you could possibly desire. Do you like to fall asleep to the radio (or a CD or tape), and wake to an alarm? Okay. Would you prefer waking up to a different radio station, or the same one at a different volume? No problem there! Do you and your spouse wake at different times? Two separate alarms can be set, and each of you can wake up to a different station.

Do you like your clock display to double as a night light, or do you prefer to sleep in a darkened room? It's easy to adjust the brightness of the Wave's display. Could you sleep through an earthquake, or do you wake if the next-door neighbor sneezes? You can adjust the volume accordingly. Whatever the volume, whether the Wave is set to the alarm or radio, the volume will gradually increase—no sudden piercing sound breaks the silence. Perhaps you'd like to wake to an alarm, hit the snooze bar for a 10-minute reprieve, and then wake to the radio. Again, that's no problem. In fact, the only falling-asleep/waking-up scenario that the Wave can't handle is waking to an external source, such as a compact disc.

All of the clock radio's functions are set from the top-panel keypad (and can be accessed using the remote control). The top row of the keypad contains the ALARM SET, CLOCK SET, and ALARM MODE(buzzer or music) keys. Just beneath those three are the up and down tuning arrows that are used to change the time when setting the alarm or the clock, and for tuning the radio. Holding down one of the arrow keys tunes up or down through the radio dial; a quick press tunes up or down through the station presets. Pressing both at once displays the current station. Six preset buttons can access six AM and six FM stations. Below the preset buttons are up and down volume keys, which are also used in conjunction with the CLOCK SET button to adjust the display brightness. The next row contains the AUX button, used to select CD or tape; the AM/FM key; and the ON/OFF key. The bottom row contains only the oversized SLEEP/SNOOZE bar, used to grab that extra 10-minute's sleep.

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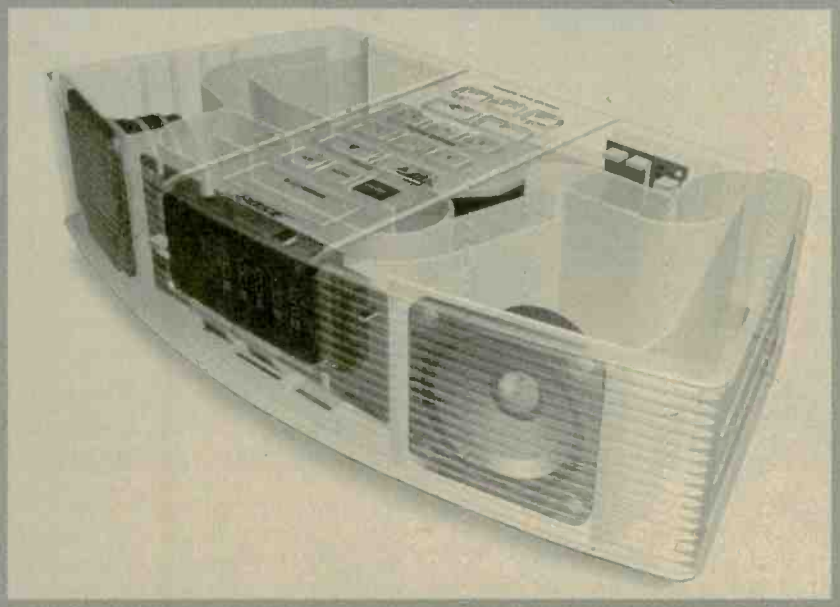

Inside the Wave Radio is a 34-inch folded acoustic waveguide that allows the 2½-inch drivers to produce amazingly deep bass. Note the open end of the waveguide to the right of the right speaker.

None of the functions are difficult to set; in fact, most are quite simple. Clock and alarm times are set by simultaneously holding down the ALARM SET or CLOCK SET key and the tuning up or down arrow. Radio stations are stored as presets by holding down a preset button while the station is playing, until a beep is heard. The alarm mode is set by pressing that button repeatedly while keeping an eye on the icons shown in the display: a blank display for no alarm, an increasing volume icon for buzzer, and a musical note for radio, and both icons for buzzer with radio. To wake to a station other than the last one selected, the new station's preset key is pressed while the ALARM SET key is being held down. To set the second alarm, the ALARM SET and ALARM MODE keys must be held down at the same time until the alarm 2 indicator begins to flash. Two sets of alarm signals are displayed when both alarms are set.

When the alarm rings, you have still more options. You can hit the SLEEP/SNOOZE bar—as many times as you like. If you've selected buzzer with radio, the two will alternate each time you press the bar. Should you finally decide to wake up, you can press the ON/OFF key to stop today's alarm and make sure it wakes you up at the same time tomorrow. Or you can press the ALARM MODE key, in which case you'll have to remember to reset the alarm the next time you need it. The alarm time, however, is retained.

After putting it through its clock-radio paces, we tried moving the Wave Radio into the kitchen, a room with tiled floors and backsplash, bare walls in the dining area, and curtainless windows. Although the manual warned that it might sound bright and shrill in such "hard" surroundings, we found the opposite to be true. The deep bass was quite obvious in that room, where the Wave Radio, backed into a corner, sounded a bit boomy. No tone controls are provided.

We do have a few complaints that don't reflect upon the Wave Radio's audio quality. First, we would have preferred to see (or feel) a larger ON/OFF button, perhaps with a different shape or texture from the other top-panel keys, so that we wouldn't be groping for it in the dark. We'd like to see the buttons backlighted as well. And we found it nearly impossible to keep track of the tiny remote control amidst the clutter of books, magazines, eyeglasses, photographs, etc. on the nightstand on the other side of the bed from the Wave. Granted, we have problems finding even standard-sized remotes, but this one, barely larger than a credit-card, never seemed to be in sight when we needed it. Finally, we can't understand why the radio doesn't support the expanded AM band.

We still don't like waking up in the morning (weekdays, that is!). But the Bose Wave radio makes the most out of the inevitable: It makes waking up pleasing to the ears and, well, almost bearable ■

The Marriage of A and V

ONKYO TX-SV717PRO A/V RECEIVER. From: Onkyo U.S.A. Corporation, 200 Williams Drive, Ramsey, NJ 07446; Phone: 201-825-7950. Price: $949.95.

Audio and video have become inseparable in the last ten years. If you've been shopping for a stereo receiver lately, you might have found that to be literally true. A/V receivers have taken over the stereo receiver market. But not many of them can match the quality of *Onkyo's TX-SV717PRO*.

The major features of the receiver are: a five-mode digital signal processor; full digital Dolby Pro Logic; on-screen displays; 85 watts per channel for front left, right, and center channels; multiple-room capability; four video and six audio inputs; and 40-station preset tuning.

The TX-SV717PRO is rather large (about 18 × 6¾ × 15¼ inches) and heavy (over 30 pounds). That's a natural result of putting five amplifiers, switching circuitry, and AM and FM tuners into a box. Besides, we've never known Onkyo to scrimp on power transformers, heatsinks, and chassis materials.

The amplifier section of the TX-SV717PRO can operate in either a stereo or a surround mode. In stereo mode, it can provide a minimum 110 watts per channel to the front left and right channels. In surround mode, it can provide 85 watts to each of the front channels, and 30 watts to each of the two surround channels.

The receiver supports multi-room operation by way of a set of remote-speaker terminals. A person in the second room can listen to a different source from that playing in the main room. An optional multiple-room remote system allows the receiver to be controlled from an infrared

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remote in the second room. However, when the TX-SV717PRO is in its multi-room mode, the surround modes will be turned off, and the power capability is reduced to 85 watts per channel.

The receiver offers four audio-only inputs (PHONO, CD, TAPE 1, and TAPE 2) and three audio/video inputs (VIDEO 1, 2, and 3) on the rear panel. A fourth A/V input (VIDEO 4) is provided on the front panel for the convenient connection of a camcorder. The VIDEO 1 and VIDEO 4 connections provide inputs only. VIDEO 2 and VIDEO 3 provide both inputs and outputs, so they can be used for VCR's or other recorders. The receiver's extensive signal-routing capabilities make recording very convenient. For example, it is possible to record one source while listening to another.

After amplifier power, perhaps the most important thing to consider when shopping for an A/V receiver is how easy it will be to operate—not only for you, but for other, less technically inclined members of your family. Remember, you are likely to have the receiver for many years.

One of the strengths of the TX-SV717PRO, and of other Onkyo A/V receivers we've seen, is the convenience of the user interface, despite the complexity of its switching functions. Most of the receiver's features can be controlled either from the front panel, the remote, or through a series of on-screen menus.

The on-screen menu system is ideal for setting up the receiver for video. The menus are easy to see from the viewing position, and provide positive feedback and pictorial guides. Five buttons on the remote, four cursor keys and an enter/escape key, control all menu functions, so setup is easy even in a darkened home theater. The main menu features four choices: Input Select, Record Output, Surround-Sound Setup, and Graphic Display.

The Input Select menu provides an easy way to choose the video and audio inputs. When the menu is first called up, the picture- and sound-select "buttons" (icons) are "locked together." Pressing the side-to-side cursor keys changes both the video and audio sources as one. Pressing the up or down cursor keys permits the video and audio sources to be adjusted independently, so, for example, you can watch a nationally televised baseball game while listening to the local radio commentary.

If the radio is selected as the audio source, the tuner memory presets can be adjusted from the Input Select menu. The surround mode (but not the surround parameters) can also be adjusted from that menu, and the tape monitor can be turned on or off.

The Record Output menu is used to select the recording source, and to route the outputs accordingly. If "source" is selected, the current source that you are listening to or playing back will be routed to any devices connected to TAPE 1, VIDEO 2, or VIDEO 3. It is possible, however, to select a source for recording other than what is being listened to. For example, you can record a radio broadcast can be while watching a videodisc. The output to TAPE 2 is always the current selected source (the one being listened to) and cannot be changed.

The Screen Setup menu gives a couple of easy choices. The first lets you choose between eight available the background colors, to be displayed on the video screen when no other video source is present. The second choice is whether the "immediate display" is turned on or off. When on, the mode of the receiver is displayed on-screen when the input or surround mode is changed.

The Surround Sound setup menu permits the surround mode and all relevant parameters to be adjusted. Five modes are available: Dolby Pro Logic, Hall, Theater, Studio, and Live. The surround mode can also be turned off.

When Dolby Pro Logic is selected, the center mode (normal, wideband, and phantom), center level, rear level, and delay time (15–30 milliseconds) can be adjusted from the on-screen menu. The test tone—which is useful in setting the levels properly—can also be turned on from the menu, and all settings can be returned to their initial, default values.

The theater menu is similar to that for Pro Logic, but an extra page is added so that the theater size, effect level, reverb level, and reverb time can be set. All settings can also be returned to their default values. The theater size and shape can be adjusted from 0.4 to 1.6, which is the ratio of the theater's width to its length. There's no need to calculate the kind of theater you wish to simulate. On-screen graphics depict the shapes and relative size of the theaters as you make the adjustment.

The effect level, reverb level, and reverb time are adjusted with another set of on-screen graphics that represent the initial sound reflections and reverb time. Each setting can also be set from 0.4 to 1.6. For these effect settings, however, we preferred to use our ears, rather than the graphics or numbers.

The Hall, Live, and Studio DSP modes also provide similar parameters to be set (but not the delay time for the rear speakers). The Hall mode is intended for recordings that already have a substantial amount of reverb—classical music for example. (Listening to speech in this mode can be disconcerting because of all of the echoes it creates.) The Studio mode is intended for studio recordings that contain little reverb, while the Live mode is intended for live recorded music. Of course, how the modes are used is entirely up to the taste of the listener. Just as some people prefer that all music be played with window-rattling bass, we assume that some people like to listen to newscasts that sound as if they are coming from a huge church.

The surround modes can be controlled from the front panel via five buttons. One selects the surround mode, two others are used to scroll through the parameters that can be adjusted (delay time, for example), and two more can be used to scroll through the parameter's possible values.

The remote control permits many of the settings to be accessed directly. For example, one key can be used to switch the surround mode, and other keys, the remote can be used to directly change the delay time and the main, center, and rear levels.

The remote control has sixty small buttons on its front panel. Thanks to the menu system, it's easy to perform most adjustments without too much trouble, even in a darkened home theater. Eighteen of the buttons are for controlling compatible Onkyo tape decks and compact-disc players. Ten additional buttons can be programmed to control a videodisc player and VCR.

The TX-SV717PRO contains a few other features that show how much thought Onkyo put into how the receiver will be used in real life. For example, the 40 tuner-memory presets can be grouped into six classifications, labeled A through F. Both AM and FM stations can be stored in a single classification. Some users might assign one category for each family member. Other users might assign stations by type—classical, jazz, news, etc. The number of stations that can be stored in each category is limited only by the total of forty stations that can be stored.

The only complaint we have about the receiver is a rather minor one. We were a little confused by the preset-station memory programming. Unfortunately, it's not possible to overwrite a memory location. Its contents must be deleted first. It's also difficult to assign a specific memory number to a given station. For example, when a station is stored in classification "A," it is automatically assigned to the lowest available number not already programmed in that category. We like to assign the same number to a station on all of our receivers (home, office, and car).

To sum things up, we can't think of any reason why we wouldn't want Onkyo's TX-SV717PRO in our home theater. It provides adequate power for even the most demanding source material, and its digital Pro Logic decoding provides accurate surround-sound steering and reproduction. The other DSP modes of the receiver, when used "properly," can provide a believable, enjoyable recreation of a wide variety of recordings. And everyone in the family can operate the receiver. ■

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CIRCLE 53 ON FREE INFORMATION CARD

A Perfect Match

PS-24 SHIELDED A/V SPEAKERS. Manufactured by Design Acoustics, and Audio-Technica Company, 1225 Commerce Drive, Stow, OH 44224. Phone: 216-686-2600. Price: $189.95 each.

Home theater is the bright spot of the 1990's for audio retailers. Born about 15 years ago, home theater owes its existence in good part to the 1976 release of *Star Wars*, which popularized Dolby Stereo in theaters and created public awareness of the important role played not by actors, but by the soundtrack. The first Dolby Surround decoders for home use followed about five years later.

Between the opening of *Star Wars* and the first consumer Dolby Surround decoders, home theater was quite a bit different from what it is today. The earliest setups used non-Dolby decoders, which extracted an "ambience" channel from the difference between the right and left channels (or the L − R signal). Next came the first Dolby-licensed Surround encoders. Those included a rear-channel delay, which, in effect, moved the rear speakers farther back in the room. Dolby Pro Logic—used in most modern home theaters—was a relative latecomer to the scene.

One of the main benefits of Pro Logic is that it provides a center channel, which draws attention to the screen. It also eliminates the "hole" in the middle of the soundfield that is often heard in setups without a center channel. With a center channel, on-screen action sounds as it is coming from the screen, while off-screen sounds still sound properly placed to the sides or rear of the room.

All Pro Logic equipment provides a "phantom" mode that tries to eliminate the hole in the middle when only two speakers are used. In that mode, the center-channel information is fed to both the left and right speakers. While the phantom mode works to eliminate the hole in the middle, it eliminates the main benefit of Pro Logic—improved imaging.

The gradual evolution of home-theater surround sound over the past 15 years has afforded consumers several different approaches to putting a system together. In the early days, most consumers assembled home theaters by adding a decoder and an extra pair of speakers to their existing audio and video equipment. For example, their existing stereo receiver or amplifier fed their existing front speakers, while the decoder fed the surround channel to the new speakers.

Although most consumers today are moving into surround sound with the help of a Dolby Pro Logic audio/video receiver (such as Onkyo's TX-SV717PRO reviewed elsewhere in this month's Gizmo), even now, they might use some of their existing equipment, especially their stereo speakers. With a Dolby Pro Logic system, they're more than likely to add the center-channel and surround speakers.

For the most part, we've been satisfied with the quality of the surround effect from such setups, particularly when the receiver can provide the same amount of power to the center channel as it does to the right and left channels. (That's something to keep in mind as you shop for an A/V receiver.) Fortunately, most A/V receivers can now do that, even though the center channel doesn't contain sound with frequencies under 100 Hz. (Most also include a "wideband" mode in which the full audio spectrum is fed to the center channel.)

Despite being satisfied with the sound of many home-theater setups, something always bothered us a little. We would never consider using different, mismatched speakers for listening to stereo music. We couldn't help but wonder what we were missing by using mismatched speakers for recreating surround sound.

Of course, in the best of all worlds, all five speakers in a Pro Logic setup should be matched. One good reason to consider using five identical speakers is that your home theater system won't always be used to listen to Dolby Pro Logic material. Most A/V receivers offer various digital signal processing (DSP) modes that feed sounds to the rear speakers in a way that Pro Logic doesn't. And tomorrow's consumer Dolby decoders will handle the multi-channel Dolby SR-D, which has full-range surround channels.

But this is the real, here-and-now world. In less-than-perfect circumstances, if there is one place to compromise, it's in the surround speakers. That's because they need to process signals in the relatively narrow bandwidth between 100 Hz and 7 kHz, and there is far less power contained in the surround channel (which is why most A/V receivers provide far less power to the surround speakers). It's still important, however, for the surround speakers to match the front speakers in the 100-Hz to 7 kHz bandwidth. Otherwise you might notice that sounds change abnormally as they move from the front to the surround channels.

To our ears, however, the effect of mismatched surround speakers is subtle. It's far less disturbing, for example, than an incorrect setting of the surround-channel volume level. Matching the front speakers is far more important because sounds are continually being passed between the right, center, and left speakers.

Don't take our word for it. Even Dolby Laboratories advises, "Three identical

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loudspeakers for left, center, and right . . . [give] the best results." We found that out when we set up our home theater with three *Design Acoustics PS-24* shielded A/V speakers.

The PS-24 speakers are a bass-reflex design and have a rated frequency response of 50 Hz–20 kHz, ±3 dB. (We installed them in a home-theater system along with the Design Acoustics PS-SW subwoofer, which was reviewed in the August 1993 issue of *Gizmo*.) The 20 × 5 × 10-inch cabinets house two 4-inch long-throw woofers and a ¾-inch metallized polycarbonate dome tweeter, and a crossover frequency of 10 kHz. The tweeter is ferrofluid-cooled, which maximizes its power-handling capability. It is mounted at the cabinet's center so that the acoustic center of the speaker is the same as the physical center. (That's important for a center-channel speaker, which is mounted to match the center of the screen.) The 6-ohm speakers are rated to handle up to 75 watts and have a sensitivity (1 kHz/1 watt/1 meter) of 89 dB. The PS-24 speakers are packaged in attractive black, composition cabinets with metal grilles.

The speakers are magnetically "shielded," which is essential for home-theater use. That's especially true for a center-channel speaker, which should be located either immediately above or below the center of the screen. If a speaker is not magnetically shielded, the field from its magnet will distort the picture. (This is not a concern with projection sets, however.)

Because of the thin width (5 inches) of the PS-24, and its magnetic shielding, in many entertainment centers the speakers can fit on the left and right of the screen. That's not an ideal placement, especially if the home theater is also used for listening to music, but it's a compromise that's made in many home theaters. Besides, that arrangement is better that than placing the speakers so far from the screen that off-screen sounds become so distracting that they pull attention away from the screen. (The center-channel speaker helps to reduce that by keeping the viewer/listener's attention focused on-screen.)

The result of using three PS-24 speakers in our home-theater setup bordered on being dramatic. During adventure films such as *Batman* and the ever-popular Indiana Jones series, the imaging was so realistic that our conscious thoughts about where the sounds were coming from disappeared. Rather than noticing and thinking about how the sound was panning from left to center to right (as we often do when we listen to surround sound on better, yet mismatched, speakers), we just listened and enjoyed what we were watching. That's just what we do in a good movie theater. And that's exactly what surround sound is all about. ■

CIRCLE 54 ON FREE INFORMATION CARD

Off to See the Wizard

OZ-9600II WIZARD PEN-BASED ELECTRONIC ORGANIZER. From Sharp Electronics Corporation, Sharp Plaza, Mahwah, NJ 07430-2135; Phone: 800-321-8877. Price: $649.

In our vocabulary, "organization" refers to an association or confederation—you know, like the Boy Scouts or the VFW—and "get organized" means to join Greenpeace or or some other protest group. Somehow, we never use either term when discussing our work habits or our record-keeping methods.

We tend to jot down notes on little scraps of paper, then scribble other notes on the backs of those scraps—and then lose the whole thing. There are more papers stacked on top of our file cabinet than stored alphabetically inside the drawers. Jumbled together in those file-top stacks are household bills, memos, press releases, technical papers, birthday cards that never got sent, research notes, magazines, and, of course, lots of those little lost scraps of paper. Each time we flip through our Rolodex, business cards come flying out—and those are just the ones that we remembered to "file" there in the first place! It's no wonder that we spend a good deal of our "work" time trying to get our hands on information that somehow got lost in the shuffle.

Because we're scribblers at heart, we've never had much use for those "electronic personal organizers" that require you to type information on a minuscule keyboard and read it on a tiny display. We've tried them, of course—it would be hard to avoid, in our line of work—but they've always been too awkward, too bulky, and just too much trouble to stick with for long. Furthermore, if you don't stick with them almost religiously, you're soon back to searching for those little scraps of paper again.

Obviously, we're not the only scribblers out there. There are enough of us that *Sharp* has come out with a version of their popular (among better organized folks) Wizard electronic organizer just for us. The *OZ-9600II* allows the user to input information using either the keyboard or "electronic ink." The latter method involves "writing" on the LCD screen using the included stylus or your fingertip. While it doesn't have any handwriting-recognition ability, the pen-based Wizard lets the user jot down notes and transcribe them to text later, or just use them as is. It's also possible to take your hand-written or drawn files and attach them to a text file, perhaps adding a picture to a telephone entry or attaching a hand-drawn map to an appointment.

Of course, the OZ-9600II Wizard is much more than an electronic note pad. Besides its "scrapbook" (electronic-ink) function, the Wizard offers the "notebook" word processor, which provides various fonts, formatting options, and page-layout previews; a "To Do" list that lets you assign due dates and priority levels

to various tasks; daily, weekly, monthly, and six-month calendars; and three telephone directories and three "user" files (business, restaurant, and other) that allow you to keep track of business and personal contacts. The Wizard also offers pop-up calculator and clock features, an "anniversary" function to help you remember birthdays and anniversaries, a scheduler; and its own "file cabinet."

Wait, we're not done. The Wizard comes with 512K of memory, but that can be upgraded by inserting another 512K RAM IC card into the slot on the side of the unit; a RAM card can also be used to back up the data in your Wizard, and cards can be swapped between some other Sharp organizer models for data sharing. (No card is needed to transfer data to another Wizard; that's done via direct infrared transmission.) There are application IC cards available that allow you to add, for instance, a dictionary, thesaurus, or an expense tracker. Sharp also offers optional peripherals including a wireless interface for printing, a data-transfer cable, a 1200-bps pocket modem, a wireless interface for linking to a personal computer, and an AC adaptor.

Measuring just over 7×4×1 inches when closed, and weighing in at 15 ounces, the Wizard can be comfortably carried in a purse or briefcase, and can fit in a large suit pocket. The top of the unit flips open to reveal an LCD screen under the lid and a QWERTY-style keypad surrounded by assorted function keys on the base. The stylus fits into a groove above the keypad.

Let's start at the top, literally and figuratively, with the Wizard's pen-based touch-screen. The 3×4-inch LCD is larger than is standard for personal organizers, and with 320×240 pixels it is fairly easy to read. Its contrast can be adjusted; however, it is not backlit, so some ambient light is required. Arranged just to the left of the display are 15 icons that represent the visible portion of the Wizard's graphical user interface. By touching an icon with the stylus or your fingertip, that function is opened for use.

It's hard to resist tapping the scrapbook icon first, to try writing with electronic ink. You can choose from three different stroke widths—thin, thick, and brush, and three different shades of "ink"—black, gray, or white. (We're not sure why you'd need the latter, but if you use the brush stroke to paint the screen bright, and then write in white, you can get the effect of chalk on a black board, without the squeak!) If you can't draw a straight line, the Wizard will do it for you, with a press of the ruler icon. And if you make a mistake, you can press the eraser icon and rub out what you've drawn, just as if you were using the eraser on the end of a pencil.

There's no question that writing and drawing on the touchscreen is novel and fun—but it is a bit awkward. First, even good handwriting comes out looking a bit shaky because of the low resolution of the "ink." Our everyday scrawl was illegible until we slowed ourselves down enough to write a bit more neatly. Second, because the screen is situated above the keypad, we found ourselves inadvertently pressing keys that affected our artwork or scribbles. Most notably, we kept hitting the ENTER key and storing whatever we were working on in mid-stroke. We experienced the same problem whether the Wizard was flat on a desk, held in one hand, or balanced on a laptop.

With touch-screen, stylus-input technology, Sharp's latest Wizard lets you jot down notes in "electronic ink."

We tried turning the Wizard sideways and holding it as if it were an open paperback book. We were then able to write on the right-hand "page" without touching the keypad. Of course, if we later wanted to copy what we'd written into another Wizard file, it would appear sideways there as well. We wouldn't want to transcribe sideways notes using the keypad.

Actually, we probably wouldn't want to transcribe anything using the keypad. It is larger than those found on most pocket organizers, but still difficult to use for touch-typing. With a bit of practice, we were able to pick up some speed—but continued to have trouble with accuracy, particularly with our right hand. That's because the punctuation keys that normally appear on the far right of the keyboard are abbreviated or missing. That leaves the right pinky finger (which normally rests on the colon/semi-colon key) hanging, and tends to throw the entire right hand off track. To the immediate right of the "L" key is the return key; next to the "M" the comma and apostrophe share one key, and the period, colon, and semi-colon share another. Shifting accesses the apostrophe or colon; the 2ND function key gets you to the semi-colon.

Despite those difficulties, the Wizard's keyboard is much easier to use than those on other pocket organizers that we've tried, and our typing did improve with practice. Of course, you can always switch to the scrapbook and hand write your documents, but you might not want to because the notebook function is a full-fledged word-processing program that allows you to set margins and tabs; define and move, copy, or delete blocks of text; use plain, underlined, italic, or bold type; and display a "dummy" of the page layout before transmitting the document to a printer. It's worth learning to use the keypad to access those features.

To help you get your thoughts organized before you start to write a letter or report, the Wizard offers the outline function. In effect, the outline is the electronic equivalent of that stack of blank index cards that you used to use when researching term papers, but it's a lot more flexible. You can type in a title and as many subtitles as you like, shuffle the topics to put your thoughts in a more logical order, merge two topics, or split one topic into two. You can also create subtopics of subtopics, or "children."

The telephone and user functions are almost identical, but they have different default file and field names to accommodate different types of information. There are three separate telephone files, each providing fields for name, address, and phone number. You might use one for personal numbers, another for service numbers (doctor, hairdresser, car mechanic, repairman, plumber, accountant, and the like), and the third for everyone on your Christmas-card list. The user application provides three separate directories. User File 1 is a business-card file that contains eight fields (company, name, position, extension, department, phone, fax, address, and a picture field for drawings from the scrapbook). User File 2 is a restaurant guide, in which you can list your favorite eateries by cuisine, and then note their names, addresses, phone numbers, prices, the appropriate attire, additional remarks, and add on a map drawn in the scrapbook. User File 3, with five unlabeled text fields, can be used as you see fit, perhaps for a listing of books to read, videos to rent, or travel-related numbers (hotels, airlines, car rentals).

We particularly liked the To Do function, which allows you to make lists. We're big list makers, but we usually lose the list long before we complete all the tasks on it. The To Do list lets you keep all your lists in one place, assign each task a priority level and a due date, cross them off when you're done, and place them in as many as five categories (a total of 32 different categories can be used in the To Do application). For instance, you might have

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to call Jane Smith of the ABC company regarding the XYZ project that you're working on. In the description field, you might write "Call Jane Smith." Then you might place the task under the categories of "phone calls," "ABC Company," and "XYZ Project." When you check your phone calls category, you might also find reminders to call your son's teacher, make a dentist appointment, and call your mother to say happy birthday. That comes in handy if you like to set aside some time each day to make all your calls.

When you assign a due date to a task, the task is automatically entered onto your calender on the appropriate day. Similarly, when you enter a birthday, anniversary, or other important annual event into the Anniversary file, it appears on your calendar. To add specific appointments or meetings, the Schedule function can be used.

Obviously, the Wizard provides the functions needed to help you get organized. But once you've entered information in your telephone and user files, made detailed To Do lists, made a note of mom's birthday, outlined a business report, and wrote a few letters, how do you ever find them again?

Don't worry: They won't get lost in the electronic equivalent of that stack of papers atop our file cabinet! You can search for information in the telephone and user functions by scrolling through their alphabetized indexes. Also, by pressing the search icon at the side of the LCD, you can quickly search for a key word in a specific application or in all applications.

Finally, virtually every Wizard function gives you the opportunity to file your work in an electronic file cabinet at the touch of a button (before it gets a chance to pile up with a bunch of unrelated files), without even leaving the application. You can even store a piece of data in more than one file, so that Jane Smith's phone listing could be filed under both "Business Contacts" and "XYZ Project."

Although the Wizard is not without its flaws, its attributes far outweigh them. The small keyboard and screen are can't really be considered flaws, but rather characteristics of pocket organizers as a product category—and the Wizard's are about as good as they get. Despite its extensive applications, the Wizard isn't difficult to use, but getting truly proficient takes some effort. The 300-plus-page manual is intimidating at first glance, but upon closer examination, is only slightly convoluted. Luckily, it opens with a quick-start guide that can help you get started, and on-screen help is available.

The Wizard won't help a completely disorganized person get organized. But its touch-screen writing tablet is sure to lure some of those scribblers who previously shied away from electronic organizers. ■

Kid-Sized Zapper

FOXAPPER TV/CABLE REMOTE CONTROL. Manufactured by Fox Electronics & Technology, Inc., 265 Eisenhower Lane South, Lombard, IL 60148; Phone: 708-261-0661. Price: $15.

Have you begun to wonder if, after you've turned off all your audio/video gear and retired for the night, all your remote controls begin to multiply? We're pretty sure that's the case around here, where remotes currently outnumber viewers by about 4.5:1. After all, there's a certain resemblance among them all: The original remotes, the assorted universal remotes, and even the glow-in-the-dark and the voice-activated remote all are rectangular, black plastic boxes with keypads on the front.

Given what's going on behind our backs, why would we ever purposely add yet another remote to the current menagerie? *Fox Electronics* can name a few reasons to buy its *FoXapper*, an amoeba-shaped, brightly colored TV/cable remote control with a minimal number of buttons. At the top of the list is kid appeal. That's quickly followed by unique design, ease of use, and affordable price.

The FoXapper features a transparent case that is available in three neon colors—purple, orange, and lime—all sporting green buttons. Measuring approximately 4 × 2½ inches, the remote fits comfortably in a child's hand. With only six front-panel buttons, it's easy for even a child to use.

The FoXapper is preset to operate virtually any brand or model of TV and cable box. To set it to control your equipment, according to the back-of-the-package instructions (there is no user's manual other than that), you must enter the "set" mode by using the tip of a pen to press the SET button that is recessed on the back of the remote, and then press the TV button. With the remote aimed at the TV, the volume-up button is pressed repeatedly until the TV turns off. The set mode is then deactivated with your pen point. The process is repeated for your cable box.

Once it's programmed, the FoXapper can be used to control power, volume, and channel tuning. A mute button is also included, though we've yet to see a kid use that one! All the keys are easily reached even by those with small hands.

Upon first sight, we thought the FoXapper was nothing more than a silly gimmick. After playing around with it, though, we've discovered some redeeming qualities. It allows you to control the most-often used functions—volume, power, channel, and mute—so it can stand in for a full-sized remote for everyday viewing. Its bright purple case makes it stand out from the crowd, and from the rug, and from the sofa, so it's usually easy to spot. At a suggested retail price of $15, it's not going to break the family bank. Finally, kids do seem to like it. ■

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ELECTRONICS WISH LIST

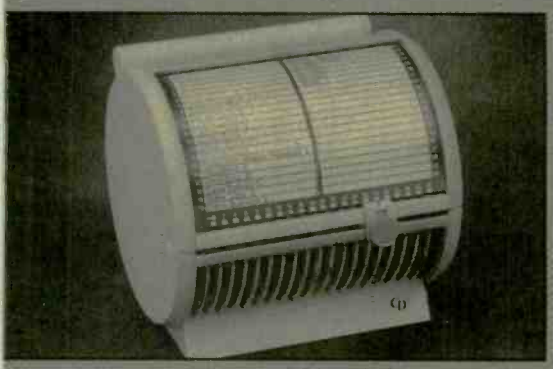
For more information on any product in this section, circle the appropriate number on the Free Information Card.

Bel-Tronics 900-MHz Cordless Phone

Pint-Sized 900-MHz Phone

With a flip-style handset that weighs less than 7.5 ounces—the smallest of its kind, according to *Bel-Tronics Limited* (8100 Sagi Parkway, Covington, GA 30209)—the *Micro 900 System* is one cordless phone that you can slip into your pocket and carry around the house and yard. When it comes time for recharging, you'll have your choice of charging stations. That's because the Micro 900 System consists of two separate units: the main 900M base/handset unit, and the 900MR remote handset/charger unit. When the base of the 900MR is plugged into an electrical outlet, its handset becomes an extra cordless extension. Up to three 900-MHz remote units can be used with one base unit, without the need for additional telephone jacks. The 900M base unit works independently of the remote unit, but the remote unit requires the base unit. The Micro 900 System also features a two-line LCD readout on each handset, 40-channel auto scanning, auto digital security, two-way intercom and paging functions, a 20-number alphanumeric memory, music on hold, programmable call blocking, and eight selectable ring tones. Price: 900M, $449.95; 900MR, $259.95

CIRCLE 56 ON FREE INFORMATION CARD

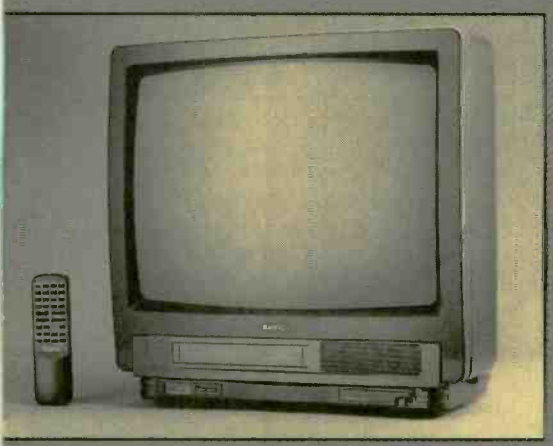


SC&T CD Storage System

CD Cylinder

Up to 40 compact discs can be stored safely and efficiently in the compact, flip-top *CD³* CD storage system from *SC&T International, Inc.* (3837 East LaSalle Street, Phoenix, AZ 85040). On the top of the unit is a title sheet with numbered spaces for the name of each disc. Each disc is assigned a number and placed in the appropriate position in the case, separated by spacers to protect the disc's recording surface. Across the front of the case is a row of numbers and a sliding indicator knob. To select a specific disc, the indicator knob is moved to the appropriate number before the case is opened. When the lid swings up, the desired disc is lifted for easy removal. By placing your finger through the CD's center hole and your thumb along its edge, you need never touch the surface. A convenient carrying handle locks the case shut and makes it easy to carry your CD collection around the house and in your car. Price: $34.95.

CIRCLE 57 ON FREE INFORMATION CARD



Sanyo Video Viewer

Video Viewers

Sanyo's (21350 Lassen Street, Chatsworth, CA 91311-2329) first entries into the combination-TV/VCR market are the 13-inch *TVR-1344* and the 19-inch *TVR-1944*, pictured here. Both sets feature bilingual on-screen programming in English and Spanish, a small footprint for viewing where space is at a premium, automatic TV and VCR power-on with tape insertion, and a special picture-quality selector with two settings: normal and rental. Selecting the rental mode enhances picture quality when viewing grainy, worn-out rental videos. Both TVCR's also feature easy setup, with no wires required between the TV and VCR; simple programming, using either one-touch timer recording or the "today timer," which automatically uses today's date for programming; and memory backup for picture control and TV channel settings, so that the sets can be moved about without losing that data. Prices: TVR-1344, $399.99; TVR-1944, $449.95.

CIRCLE 58 ON FREE INFORMATION CARD

Sherwood Receiver with Digi-Link III

Audio Link

The *RX4030R* audio receiver from *Sherwood Electronics'* (14830 Alondra Blvd., La Mirada, CA 90638) contains the latest version of the company's proprietary Digi-Link interactive data-bus. The receiver automatically switches to the appropriate input whenever a linked program source is activated. The 65-watts-per channel (with less than 0.05% THD) receiver features matrix surround sound, which permits the addition of small rear speakers to create a theater-like surround effect. Reception is enhanced with drift-free, quartz-reference digital tuning, dual-gate MOSFET front ends, and balanced-mixer stages. Other features include A/V integration, motorized volume control, A + B speaker switching, tape monitor, four audio inputs, 30 station presets, sleep timer, and headphone jack. Price: $225.

CIRCLE 59 ON FREE INFORMATION CARD

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

ELECTRONICS WISH LIST

Rock Steady Camcorder

Canon U.S.A., Inc. (One Canon Plaza, Lake Success, NY 11042), has introduced the *UCS5 with Shake Absorber*, their first Hi-Band 8mm camcorder to feature the optical image-stabilization technology that the company has been using in its full-sized UC Series models to prevent the shaky images caused by inadvertent camcorder movement. The optical stabilization technology causes no degradation of image quality or loss of field of view, common problems with electronic image-stabilization systems. Highly sophisticated sensors detect horizontal or vertical movement, and transmit data to a microprocessor. The microprocessor then sends signals to actuators that adjust the system's specially designed Vari-Angle Prism to the proper angle to refract light and compensate for camera movement. Numerous compensation programs are stored in the system's microprocessor, increasing the camcorder's stabilization performance by allowing it to adapt to a wider range of shooting situations. Other features of the UCS5 include digital signal processing with Hi-band circuitry, a 12× zoom lens and a 24× digital zoom function, autoexposure as well as five selectable exposure modes, stereo sound, wind-noise reduction, a 16:9 widescreen-format function, and a wireless remote control. Price: $1900.

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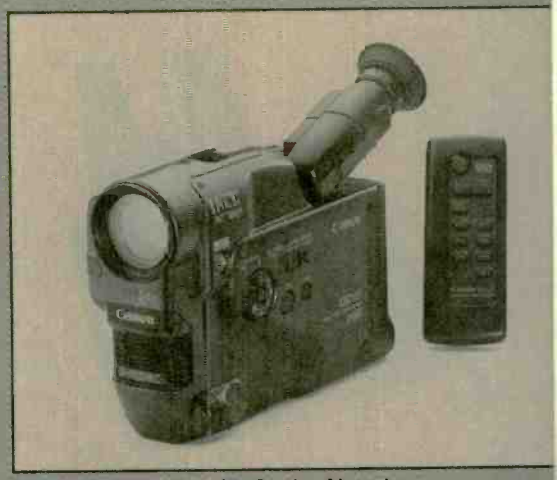

Canon Camcorder with Shake Absorber

Music to Go

Featuring larger speakers and a digital bass-recovery system (DBRS), *Fisher's* (21350 Lassen Street, Chatsworth, CA 91311-2329) *PH-D380* portable audio system puts big sound in a small package. The system contains a CD player, a dual cassette player, a digitally tuned AM/FM stereo radio, and a three-way detachable bass-reflex speaker system with matrix surround sound. DBRS synthesizes a bass signal one octave lower than the original playing octave, and adds that signal to the music to extend the bass signal. The portable music system features an electronic equalization system with the performance of a graphic equalizer and the convenience of one-touch presets. The PH-D380 offers 16-selection programmability, synchronized high-speed CD dubbing, sequential play, 24 station presets, and a 24-key remote control. Price: $349.95.

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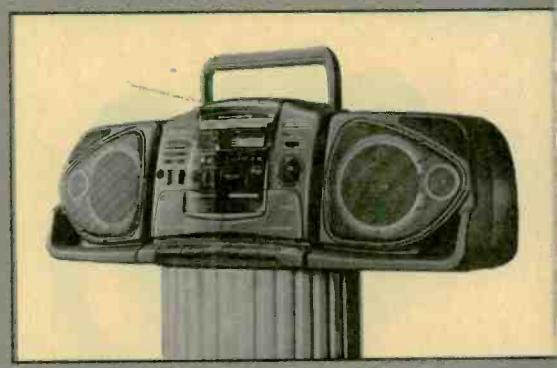

Fisher Portable Audio System

Clock Radio with Thermometer

How do you keep clutter off your nightstand? *Lloyd's Electronics* (6450 West Cortland, Chicago, IL 60635) would probably answer: with a *Model CR-500* analog clock radio, which can be mounted on the wall next to your bed. The compact, off-white clock radio measures less than ten inches wide and two inches deep, so it wouldn't take up much space if you decided to place it on the night table instead. Slated for use in the kitchen as well as the bedroom, the CR-500 features an easy-to-read, large quartz clock and something that we've never seen on a clock radio before—a built-in thermometer. Other features include wake to radio or alarm, AC or battery power, illuminated clock, oversized tuning and volume dials, and a snooze bar. Price: $39.95.

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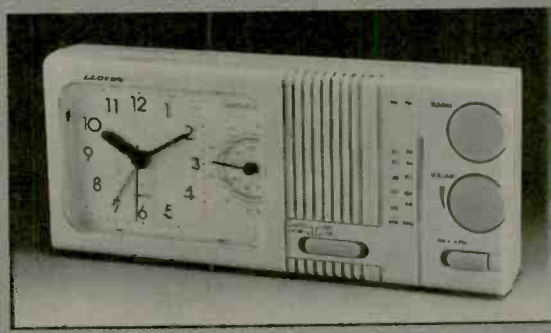

Lloyd's Wall-Mount Clock Radio

Motion-Sensing Entry Lights

Even if you live alone, you can be "greeted" at the front door when you come home at night, if you've installed one of *Heath Zenith's* (Reflex Brand Group, 455 Riverview Drive, Benton Harbor, MI 49022) entryway motion-sensing security lights. *Model SL-5610* has a cylindrical glass fixture, while *Model SL-5615* has a globe fixture. A sensor in the front of each durable, high-impact plastic fixture provides vertical and horizontal adjustments, allowing you to position the fixture to light the desired area. The lights are pre-wired for easy installation. During installation, a selectable test mode allows you to quickly aim and adjust the lights even in daylight. It's possible to adjust the sensitivity to motion, and pulse-count technology helps reduce the likelihood of false triggering by as much as 75%. You can also select the length of time before the lights shut off after motion has stopped. Manual override allows you to turn the light on from a standard wall switch. At daylight, a sensor resets the unit to the automatic motion-sensing mode. Price: $30 each.

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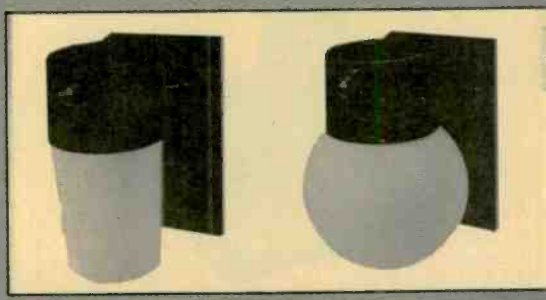

Heath Zenith Reflex Motion Sensor Lights

ELECTRONICS WISH LIST

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

Samsung Anti-Curl Fax Machine

Anti-Curl Fax

By applying heat and pressure, the *FX1505* fax machine is able to dramatically reduce the amount of paper curl, allowing users to read incoming faxes "without having to place paperweights on both ends of the page," according to *Samsung Electronics America, Inc.* (105 Challenger Road, Ridgefield Park, NJ 07660). The fax machine provides automatic switching between fax and voice calls, and has a jack for connecting an answering machine. It has a 10-sheet automatic document feeder, and each page is transmitted in 15 seconds. Convenience features include an automatic paper cutter, 10 one-touch fax numbers, 10 one-touch phone numbers, and 20 additional numbers for two-digit dialing. Measuring just 13⅛ × 3½ × 10⅜ inches, the fax machine should easily find a spot in small businesses and home offices where space is at a premium. Price: $599.95.

CIRCLE 64 ON FREE INFORMATION CARD

STD Entertainment GameGear Carrying Case

GameGear Carrying Case

Handheld video games are great to bring along on car and plane trips, but what if you want to bring your GameGear to the beach? What's to protect it from sand, salt water, and suntan lotion? *STD Entertainment* (110 Lakefront Drive, Hunt Valley, MD 21030) comes to the rescue with the *Handy Gear*, a water-resistant, shock-absorbing case specifically designed for Sega's GameGear system. A plastic outer casing provides an air-tight buffer between your GameGear and the elements (a bonus for those who become so wrapped up in the game that they forget to come in out of the rain, we suppose), yet allows full access to game controls while the unit is being protected. The case also features a magnifying lens that enlarges the screen for better visibility, and an adjustable screen protector that reduces glare from the sun. There's room to store a game cartridge within the case, which comes with a carrying strap for easy travel. Price: $24.95.

CIRCLE 65 ON FREE INFORMATION CARD

High-Tech Puzzler

Puzzle-solving with a twist is on the menu with *The Even More Incredible Machine*, the successor to the award-winning "The Incredible Machine" from *Dynamix, Inc.* (1500 Millrace Drive, Eugene, OR 97403). The game, available for Windows, DOS, and Mac environments, asks players to piece together convoluted, Rube Goldberg-style contraptions whose final movements solve stated puzzle goals. The game offers ascending levels of difficulty, allowing players of all ages to work through its 160 different puzzles by doing strange and outrageous things. To achieve each puzzle goal, players have to build strange trip-lever contraptions by placing an odd assortment of fixed and movable parts on the screen. When the parts are assembled correctly, the machine's final falling/spinning action completes the assigned mission. For example, to win a "puzzle solved!" message, players might have to blow up brick walls with bundles of dynamite, or knock bowling balls onto conveyor belts using spring-loaded boxing gloves. Furthermore, there's no need to feel guilty about playing: Rooted in the laws of gravity and physical science, The Even More Incredible Machine is said to help players develop logic, problem-solving, and spatial-relations skills. Price: $49.95.

CIRCLE 66 ON FREE INFORMATION CARD

Toshiba Cordless Phone/Digital TAD

Stand-Up and Be Answered

Combining an all-digital answering machine with a stand-up cordless phone, the *Model FT-9003* from *Toshiba America Consumer Products, Inc.* (82 Totowa Road, Wayne, NJ 07470) can record up to 40 incoming messages and boasts a high sampling rate for superior voice quality. Digital conveniences include high-speed playback and instant, random-access message retrieval. A special "silence detection" feature "shrinks" the blank spaces between words to make the most efficient use of the available recording time. The ITAD (integrated telephone answering device) offers a Help voice menu that provides all the information needed to operate the device. All major features can be accessed remotely from the handset. Price: $250.

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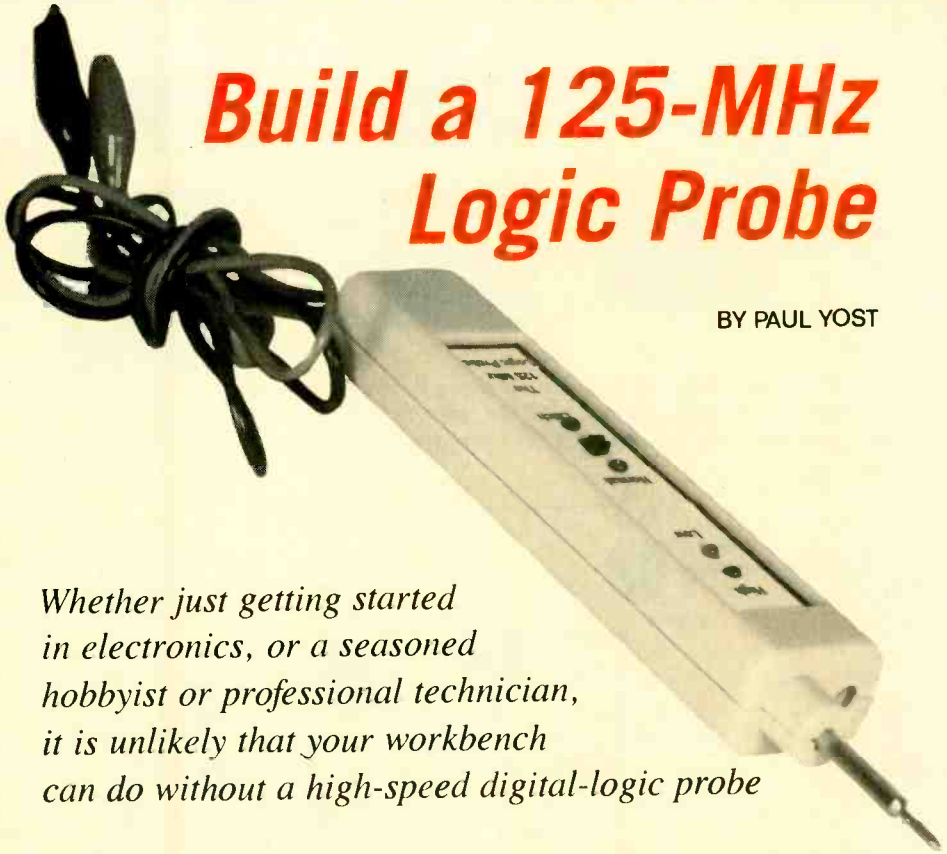
Build a 125-MHz Logic Probe

BY PAUL YOST



Whether just getting started in electronics, or a seasoned hobbyist or professional technician, it is unlikely that your workbench can do without a high-speed digital-logic probe

As an electronics service professional, it is vital that I keep current with the latest products and changes. However, because electronics is the most dynamic industry of all, that task is often easier said than done. In our field, what's new today can literally be obsolete by tomorrow. Electronic circuits have changed dramatically over the years. System speeds have increased, component sizes have decreased, and digital-logic IC's have become commonplace.

The main focus for any new design today is speed, speed, and more speed. Personal computers and other electronic devices that once operated in the 1- to 5-MHz range now work at speeds from 25 to 66 MHz; and manufacturers promise that future products will operate at 100 MHz and beyond.

Not surprisingly, as the technology advances, the skills and knowledge of the technician must advance as well and so too must the test equipment to service it. It is no longer sufficient to simply have functional test equipment. The test equipment must perform its functions at the very high speeds used by the new products. So as system speeds increase, test equipment that was once adequate no longer makes the grade.

Buying good test equipment doesn't necessarily mean buying expensive test equipment. Fortunately, the same technological advances that created the newer, faster products have also made possible newer and better test equipment, and at the same low prices. The *125-MHz Logic Probe* presented here can be built from readily available and inexpensive parts. It takes less than 30 minutes to assemble, requires no complicated setup or adjustment, and you don't need any complicated equipment or tools to build it.

When finished, the probe will do all the tests that any commercially made probe will do, but it will perform those tests at incredible speeds.

Theory of Operation. At the most basic level, all digital circuits—no matter how complicated—work by processing binary data composed of logic 1's and 0's. To properly troubleshoot such circuitry, the technician must be able to see the logic states and trace their paths. The simplest way to do that is by using a logic probe. A logic probe is a device that allows the technician a fast and convenient way to "look inside" a digital circuit and see exactly which paths are high, which are low, and which are pulsed.

The circuit, as shown in the block diagram of Fig. 1, consists of six sections: a switching transistor, the FAST NOR gates, a latching switch, a logic-low indicator (green LED), a logic-high indicator (red LED), and a beeper.

The schematic diagram of a circuit that encompasses those elements is shown in Fig. 2. The switching transistor (Q1) acts as an interface between the probe tip and the first NOR gate. Recall that for TTL a logic 1 is approximately a +5-volt DC potential and a logic 0 is about a 0-volt DC potential. When the probe tip touches a circuit that is at a logic-1 state, that signal is coupled through the 91k resistor (R4) to the transistor's base.

Since a positive voltage forward biases the base-emitter junction of an NPN transistor, the transistor turns on. When that occurs, the positive voltage at the transistor's collector is switched through to the emitter, which then effectively places a logic-high state on the pin-6 input of the first NOR gate, U1-b.

When a logic 1 is placed on either one or both inputs of a NOR gate, its output toggles to logic 0. In our circuit, the logic-0 output of the first NOR gate is fed along two paths. First, it travels to the green LED (LED2) and, because a logic 0 equals 0-volts DC, LED2 does not light. In the other path, the signal is fed to a second NOR gate (U1-a), which is wired as an inverter. When that gate receives a logic-0 input, it converts it to a logic-1 output, which then causes the red LED (LED1) to light and the beeper (BZ1) to sound. That indicates that the circuit under test is high.

When a logic-0 condition is present at the probe tip, the transistor is not biased on and a logic-low state remains at the input of the first NOR gate. That makes its output go high, which then lights LED2. Of course, that means that a logic high is also placed on the input of U1-a, which then inverts the signal, producing logic-low output, which extinguishes LED1 and turns off BZ1, indicating a logic-low condition.

To basically recap, when a logic 0 is present at the probe tip, LED2 lights and LED1 is off. However, when a logic 1 is present, LED2 is off, LED1 is on, and the beeper sounds.

Sometimes, a circuit has neither a continuous high or low state, but is pulsed. Usually, those pulses are

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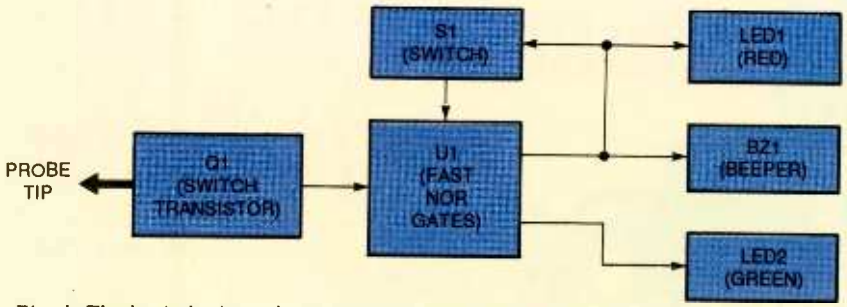

Fig. 1. The basic-logic probe circuit, as shown by this block diagram, consists of six sections: a switching transistor, FAST NOR gates, a latching switch, a logic-low indicator (green LED), a logic-high indicator (red LED), and a beeper.

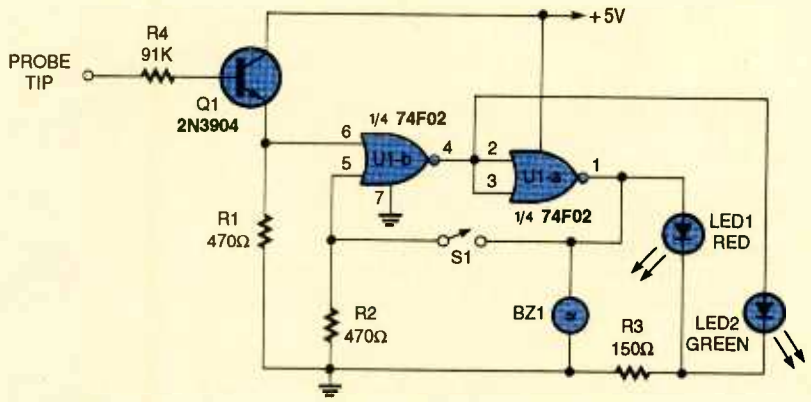

Fig. 2. The schematic diagram shows a circuit that encompasses all of the elements laid out in the block diagram of Fig. 1.

nanoseconds in duration, which is far too short a time for the red LED to light or for the human eye to catch. In such cases, a latch switch is used to perform a simple memory function to detect or "capture" those quick digital pulses.

When the latch switch (S1) is engaged, a logic 1 appearing at the probe input not only lights LED1, but is also coupled back (via the switch) to the second input of the first NOR gate (U1-b). That action, in turn, maintains a constant logic-1 indication on the probe. That means that, in the case of a pulse, the initializing input signal will activate the latch function and maintain a high indication. Even if the pulse is only a few short nanoseconds in duration, it will still be long enough to activate the probe and indicate that a pulse has occurred.

The technician can use that function to check for one shots or other logic-pulse operations. After S1 is engaged and the probe is armed, the technician knows that a pulse has been detected when the LED indication changes from green to red.

A Lesson in Logic. At this point, I'd like to explain how the probe is able to respond to pulse rates in excess of 100 MHz. The first part, the switching transistor, is easy. If you need a circuit to work at very high frequencies, simply select a transistor rated to work in the VHF range. Since the 2N3904 is rated to operate to at least 250 MHz, it fills that need quite well. However, that is but part of the story. What also makes the high speed possible is the type of digital IC used.

While digital chips are made by many manufacturers, they all share a common numbering system. For example, the IC used in this project is a 74F02. The first part, the "74," along with the "F" indicates that the IC is part of the 7400 TTL-series, commercial-grade digital family. The next part, the letter in the middle, designates the type of circuitry ued in the chip's construction, while the remaining two digits on the end represent the specific logic function of the chip.

In this particular case, the "F" stands for FAST a special subfamily of the TTL group. Other letters commonly used are C for CMOS, L for low power, H for high speed, and S for Schottky. Sometimes, the letters are combined in a number. For example, a chip with the number 74LS02 means that the IC uses low-power Schottky circuitry. A 74HC02 would mean a high-speed CMOS chip. Knowing the difference is very important. During a repair, you would not want to replace a high-speed CMOS device with a Schottky type since different power-supply voltages and clock speeds may be in use.

As mentioned, the last part of the number, the end digits, designate the logic function of the chip. In our part number, the "02" indicates a quad NOR -gate construction. Naturally, other numbers would represent other functions. (Check any IC data manual for further information about that or any other part number.)

Oftentimes, you will see other letters as well in part numbers, but those are manufacturer specific. For example, the "F" in an F74S00P would mean that the chip is manufactured by Fairchild,

PARTS LIST FOR THE 125-MHZ LOGIC PROBE

SEMICONDUCTORS

U1—74F02 FAST quad 2-input NOR gate, integrated circuit
Q1—2N3904 general-purpose NPN silicon transistor
LED1—3-mm, red light-emitting diode
LED2—3-mm, green light-emitting diode

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1, R2—470-ohm
R3—150-ohm
R4—91,000-ohm

ADDITIONAL PARTS AND MATERIALS

BZ1—Piezoelectric buzzer (Radio Shack 273-074, or similar)
S1—SPST switch
Printed-circuit materials, enclosure, front-panel decal sticker, red and black alligator clips, 18 inches of red and 18 inches of black wire, solder, hardware, etc.

Note: A complete kit of parts (including the case) is available for $18.95 plus $1.00 shipping and handling from Paul E. Yost, P.O. Box 32291, Louisville, KY 40232. Kentucky residents must add 6% sales tax ($1.14). (No credit card or foreign orders.)

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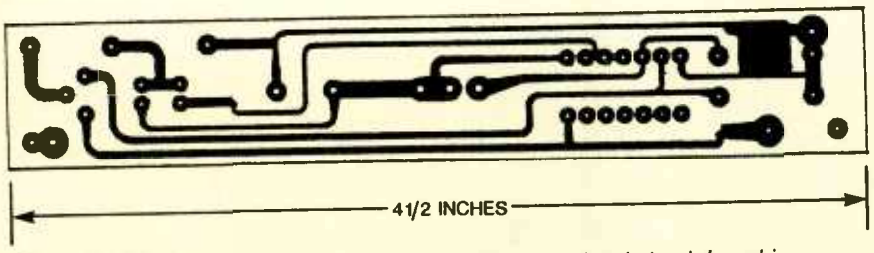

Fig. 3. This full-size template of 125-MHz Logic Probe's printed-circuit board is provided for the avid do-it-yourselfer.

while the "P" is their designation for a plastic DIP package.

The IC used in the 125-MHz Logic Probe is a 74F02. The "F" stands for FAST—shorthand for Fairchild Advanced Schottky TTL, which is a very high-speed, low-power logic family construction. The development of FAST was begun in the late 1970's by Fairchild with certain specific objectives in mind. Their main goal was to create a very high-speed, low-power IC family that would greatly out perform all the current TTL families. Their research led to a special new manufacturing process that produced internal transistors with incredibly high switching speeds and extremely small parasitic capacitances.

Eventually, their research resulted in logic chips with greatly enhanced speeds. Today, FAST logic chips work at clock speeds from 115 to 150 MHz with typical propagation delays of 3 to 4 nanoseconds. Considering that standard gates work from 10 to 20 MHz and other high-speed gates work up to about 40 MHz, that was a major breakthrough. That, then, is how the probe is able to obtain such an impressive frequency response—using a special combination of a VHF switching transistor and an advanced technology.

Other Features. There are two other circuit features that the technician needs to be aware of to properly understand the probe's operation. First, note the two 470-ohm resistors (R1 and R2) connected to the NOR-gate inputs. Theoretically, when a logic gate has no signal input, it "sees" a logic 0. However, in the real world, logic gates don't work that way.

In the real world, if a logic gate input is not specifically connected (or referenced) to either a logic 0 or ground condition, it floats high. That is partly due to all the electrical noise present in every circuit, but it can also be caused by small leakage currents in the high-impedance paths used by digital circuits. Whatever the cause, the net effect is the same.

If a gate input is not referenced properly, it "thinks" that it is high. Because of that, each NOR-gate input is referenced to ground via a 470-ohm resistor. That way, when the probe does not specifically have a logic 1 applied to its tip, the gate inputs are referenced to a logic-low state and the probe operates properly.

The next circuit feature to consider is the switching transistor. At first glance, that transistor may appear unnecessary for circuit operation. That is, why switch a logic 1 and 0 through a transistor when a directly coupled signal from the tip should operate the circuit just as easily? Well, as far as the logic probe is concerned, there is no need. The probe would work just as well without the transistor. However, the circuit under test may not.

Recall that the input to the NOR gate is coupled to ground via a 470-ohm resistor. That is a relatively low resistance. Without the transistor switch, any circuit that the probe touches would also be coupled to ground via the same resistance. In many cases, that would affect the circuit under test by loading it down, thus altering or "throwing off" the test results. By using the transistor switch as an interface, the circuit under test sees a 91k impedance instead of 470 ohms, thereby isolating the two circuits and ensuring the validity of the test results.

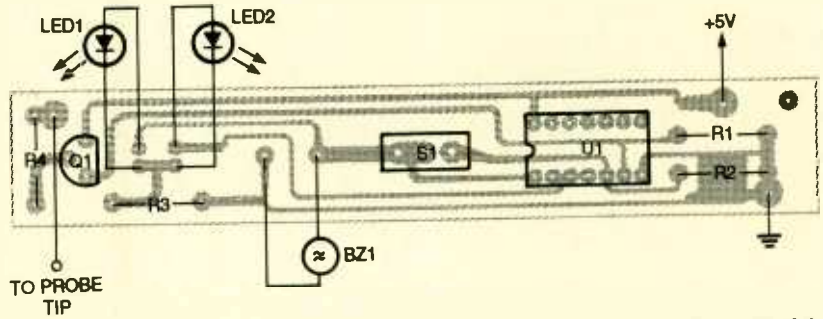

Fig. 4. Whether choose to purchase a kit or "roll your own," once you have all of the parts, you need only install the parts in the positions and with the orientations shown in rhis parts-placement diagram.

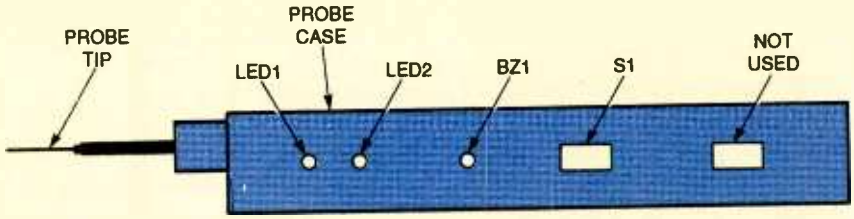

Fig. 5. Here is a graphic representation of enclosure and top-panel layout provided with the kit of parts offered in the Parts List. Even if you choose not to purchase a kit, you might still consider laying out your unit in a similar fashion.

Construction. Despite its incredible frequency range, the circuit is probably the easiest project you have ever built. Even people with little or no electronics experience can easily build it and get it to work. Despite its simplicity, though, it should be built it on a printed-circuit board. Point-to-point wiring works well for low-frequency devices, but the probe is designed to test for pulse rates beyond 100 MHz. At that frequency, interconnections and parasitic capacitances can quickly cause problems.

Figure 3 is a full-size template of the foil pattern for the 125-MHz Logic Probe's printed-circuit board for those who choose to etch their own. But, if you prefer, you can purchase a com-

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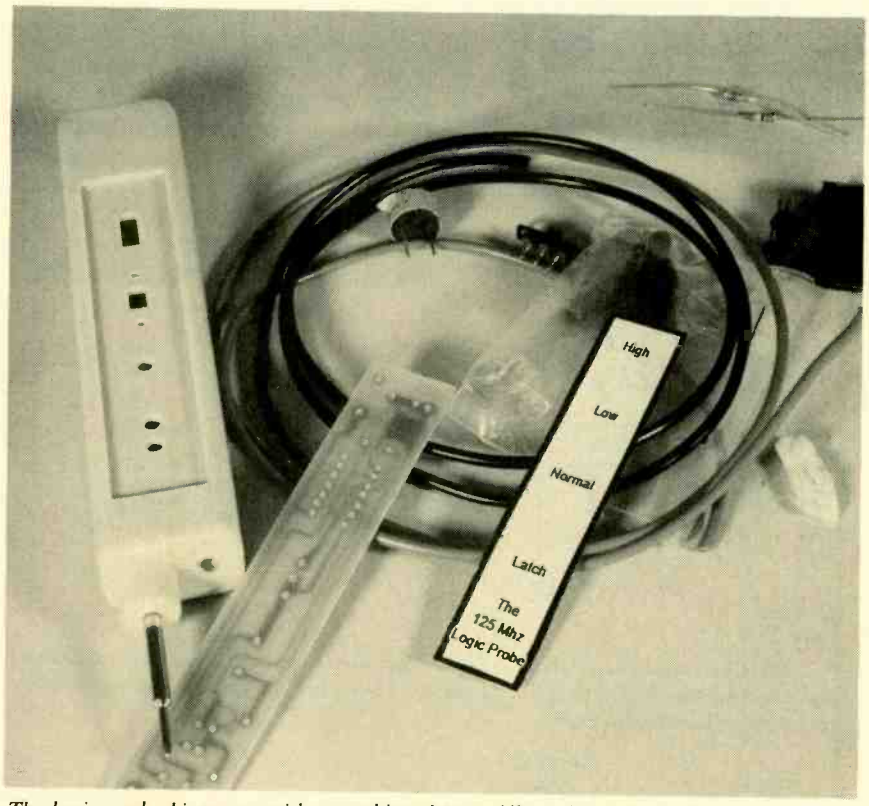

The logic-probe kit comes with everything that you'll need to put together a professional-looking probe, including the case and front-panel decal.

plete kit of parts (including the enclosure) from the source listed in the Parts List. Note that if you do not choose to purchase the kit, you'll have to come up with an enclosure of your own. One idea to try is a plastic toothbrush holder, which has roughly the same form as a logic probe. For the balance of this discussion, however, we will assume that you are using the enclosure that comes with the kit.

In either event, once you have all of the parts, you need only install the parts in the positions and with the orientations shown in Fig. 4. From an operational viewpoint, exact parts placement and lead lengths aren't critical for a stable operation, but those factors are crucial for a proper fit in the case. The LED leads, in particular, must be cut to the right length and positioned properly to fit through the case holes correctly. Also, the transistor and resistor leads must be cut short enough to fit inside the case as well. (Figure 5 gives the general layout of the case top.)

Referring back to Fig. 4, there are three wires that connect the board to the outside world. The first is the wire that connects the 91k resistor (R4) to the probe tip. That wire is soldered between the board and the tail of the probe tip. The other two wires are the red and black leads, which are used to connect the probe to the +5-volt supply and ground, respectively. To install those wires correctly, be sure to check the parts-placement diagram for their proper locations.

The board is held in place within the case via S1's mounting screws. During construction, you will find it easiest to physically mount the switch to the case top first (using the two mounting screws) then complete the assembly by soldering the now mounted switch to the board. You must save this procedure for the last step, though.

Next, run the red and black leads out the case's end hole and then solder the corresponding alligator clips (red to red and black to black) to the leads. Secure the rear cover in place and place the peel off decal sticker over the case front. Placing the sticker covers the unused case holes and gives the completed assembly a truly professional look.

Testing. Unless you have a defective part or have misplaced or misoriented something on the board, the probe should work as soon as power is applied. When power is applied to the circuit, the green LED should light while the red should not. When you connect the probe tip to a logic 1 potential, the green LED should extinguish, the red should light, and the beeper should sound.

For the next test, disconnect the probe from the logic-1 source and then arm the pulse test function by setting the latch switch. Initially, you should have a logic low indication (the green LED lit), but as soon as the probe tip "sees" a logic 1, it should change to a high indication (the red LED lights and the beeper sounds) and remain in that state until the latch switch is reset.

Troubleshooting Guide. If, at this point, you have any trouble, the following steps should help you to locate the cause and correct it.

1. First check the power supply connections. The incoming +5-volts DC should be on the collector of Q1 and pin 14 of U1. If the voltage is missing at either of those points, you probably have a bad solder connection at either the red clip lead or on the board.

2. Check for proper parts orientation and placement. The most common mistakes are the misorientation of the IC, the LED's, the transistor, and/or the beeper. Since each of those parts is symmetrical, it is quite easy to place any or all of them in backwards.

3. Check the voltage level at pin 6 of U1, with no input to the probe tip; that pin should have a 0-volt reading. With a logic high at the tip, pin 6 should read between 4- and 5-volts DC. If it does not have that response, then Q1 may be defective.

4. You can check the two gates in the IC as you would any NOR gate. That is, when the inputs (pins 5 and 6) are low, the output pin (4) should be high and when 5 and 6 are high, the output is low. (The same troubleshooting steps hold true for pins 3, 2, and 1 of the second gate as well.) Since a high and a low are +5- and 0-volts DC, respectively, you can use a standard voltmeter to make the test. If any of the readings are off, the IC may be defective.

5. If all the tests in the previous steps check out okay, then use a jumper wire to place a +5 volt DC potential directly on pin 4 of the IC. When you

(Continued on page 88)

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CAN YOU PASS THIS FCC EXAM?

Test your knowledge with this sample test that uses the actual questions used by the FCC.

Effective September, 1993, several private agencies have been authorized to manage Commercial Operators Examination testing. As a first step in this process, the FCC has issued question pools to be used by these independent agencies. This sample Element-3 test was assembled using the actual questions from that pool.

Passing an Element-3 examination proves that an individual possesses the operational and technical knowledge that is necessary to perform the duties required of a person holding a General Radiotelephone Operator License (GROL). To pass the test, an individual must answer at least 57 out of 76 questions correctly. Passing the Element-3 test is also a partial requirement for the Global Maritime Distress and Safety System Maintainer's License.

A general radiotelephone operation license must be held by any person who adjusts, maintains, or internally repairs a radiotelephone transmitter at a station licensed by the FCC in the aviation, maritime, or international fixed public-radio services. A GROL must also be held by the operator of (1) certain aviation and maritime land-radio stations; (2) compulsory equipped ship radiotelephone stations transmitting with more than 1500 watts of peak-envelope power; and (3) voluntarily equipped ship stations transmitting with more than 1000 watts peak-envelope power.

Each Element 3 examination is administered by a Commercial Operator License Examination Manager (COLE Manager). Just as we've done here, the COLE Manager constructs the examination by randomly selecting a total of 76 questions from the question pool, which consists of 8 subsets, following a specific FCC breakout.

If you are interested in finding out where you can take the FCC Commercial Operators test, see the box entitled "How to Take the FCC Exam" elsewhere in this article.

Now test yourself and see if you could pass the Element-3 exam!

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1) What is the modern standard scan rate for a facsimile picture transmitted by a radio station?

A. The modern standard is 240 lines per minute
B. The modern standard is 50 lines per minute
C. The modern standard is 150 lines per second
D. The modern standard is 60 lines per second

2) In facsimile, how are variations in picture brightness and darkness converted into voltage variations?

A. With an LED
B. With a Hall-effect transistor
C. With a photodetector
D. With an optoisolator

3) What is the period of a satellite?

A. An orbital arc that extends from 60-degrees west longitude to 145-degrees west longitude
B. The point on an orbit where satellite height is minimum
C. The amount of time it takes for a satellite to complete one orbit
D. The time it takes a satellite to travel from perigee to apogee

4) Which emission modes suffer the most from selective fading?

A. CW and SSB
B. FM and double-sideband AM
C. SSB and image
D. SSTV and CW

5) What happens to a radio wave as it travels in space and collides with other particles?

A. Kinetic energy is given up by the radio wave
B. Kinetic energy is gained by the radio wave
C. An Aurora is created
D. Nothing happens since radio waves have no physical substance

6) The bending of radio waves passing over the top of a mountain range that disperses a weak portion of the signal behind the mountain is:

A. Eddy-current phase effect
B. Knife-edge diffraction
C. Shadowing
D. Mirror refraction effect

7) What is a frequency-marker generator?

A. A device used to produce a highly

How to Take the FCC Exam

One of the COLE Managers authorized by the FCC is the International Society of Certified Electronics Technicians. They have a nationwide network of Test Administrators who can make all the arrangements necessary to enable you to take the FCC exam at a location convenient to you. For information on test locations, fees, or any other details you can contact ISCET at:

International Society of Certified Electronics Technicians
2708 West Berry Street
Fort Worth, TX 76109-2356
Tel 817-921-9101
FAX 817-921-3741

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accurate reference frequency
B. A sweep generator
C. A broadband white-noise generator
D. A device used to generate wideband random frequencies

8) What is the most the actual transmit frequency could differ from a reading of 462,100,000-hertz on a frequency counter with a time base accuracy of ±0.1ppm?

A. 46.21 Hz
B. 0.1 MHz
C. 462.1 Hz
D. 0.2 MHz

9) What types of coupling occur between a dip-meter and a tuned circuit being checked?

A. Resistive and inductive
B. Inductive and capacitive
C. Resistive and capacitive
D. Strong field

10) How can the frequency response of an oscilloscope be improved?

A. By using a triggered sweep and a crystal oscillator as the time base
B. By using a crystal oscillator as the time base and increasing the vertical sweep rate
C. By increasing the vertical sweep rate and the horizontal-amplifier frequency response
D. By increasing the horizontal sweep rate and the vertical-amplifier frequency response

11) How can intermodulation interference between two transmitters in close proximity often be reduced or eliminated?

A. By using a Class C final amplifier with high driving power
B. By installing a terminated circulator or ferrite isolator in the feed line to the transmitter and duplexer
C. By installing a band-pass filter in the antenna feed line
D. By installing a low-pass filter in the antenna feed line

12) What is resonance in an electrical circuit?

A. The highest frequency that will pass current
B. The lowest frequency that will pass current
C. The frequency at which capacitive reactance equals inductive reactance
D. The frequency at which power factor is at a minimum

13) What is the approximate magnitude of the impedance of a parallel R-L-C circuit at resonance?

A. Approximately equal to the circuit resistance
B. Approximately equal to XL
C. Low, as compared to the circuit resistance
D. Approximately equal to XC

14) Where does practically all of the RF current flow in a conductor?

A. Along the surface
B. In the center of the conductor
C. In the magnetic field around the conductor
D. In the electromagnetic field in the conductor center

15) What factors determine the capacitance of a capacitor?

A. Area of the plates, voltage on the plates, and distance between the plates
B. Area of the plates, distance between the plates, and the dielectric constant of the material between the plates
C. Area of the plates, voltage on the plates, and the dielectric constant of the material between the plates
D. Area of the plates, amount of charge on the plates, and the dielectric constant of the material between the plates

16) Why would the rate at which electrical energy is used in a circuit be less than the product of the magnitudes of the AC voltage and current?

A. Because there is a phase angle that is greater than zero between the current and voltage
B. Because there are only resistances in the circuit
C. Because there are no reactances in the circuit
D. Because there is a phase angle that is equal to zero between the current and voltage

17) How many watts are being consumed in a circuit having a power factor of 0.6 when the input is 200 VAC and 5 amperes is being drawn?

A. 200 watts
B. 1000 watts
C. 1600 watts
D. 600 watts

18) What is the effective radiated power of a repeater with 100 watts of transmitter power output, a 5-dB feedline loss, 4-dB duplexer and circulator loss, and 10-dB antenna gain?

A. 800 watts, assuming the antenna gain is referenced to a half-wave dipole
B. 126 watts, assuming the antenna gain is referenced to a half-wave dipole
C. 12.5 watts, assuming the antenna gain is referenced to a half-wave dipole
D. 1260 watts, assuming the antenna gain is referenced to a half-wave dipole

19) What is the effective radiated power of a repeater with 150 watts of transmitter power output, a 4-dB feedline loss, 3-dB duplexer and circulator loss, and 7-dB antenna gain?

A. 946 watts, assuming the antenna gain is referenced to a half-wave dipole
B. 37.5 watts, assuming the antenna gain is referenced to a half-wave dipole
C. 600 watts, assuming the antenna gain is referenced to a half-wave dipole
D. 150 watts, assuming the antenna gain is referenced to a half-wave dipole

20) What happens to the resistance of a photoconductive material when light shines on it?

A. It increases
B. It becomes temperature dependent
C. It stays the same
D. It decreases

21) What is the term for the time required for the capacitor in an RC circuit to be charged to 63.2% of the supply voltage?

A. An exponential rate of one
B. One time constant
C. One exponential period
D. A time factor of one

22) After two time constants, the capacitor in an RC circuit is discharged to what percentage of the starting voltage?

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A. 86.5%
B. 63.2%
C. 36.8%
D. 13.5%

23) What is the time constant of a circuit having two 100-microfarad capacitors and two 470-kilohm resistors, all in parallel?

A. 470 seconds
B. 47 seconds
C. 4.7 seconds
D. 0.47 seconds

24) How long does it take for an initial charge of 20 VDC to decrease to 7.36 VDC in a 0.01-microfarad capacitor when a 2-megohm resistor is connected across it?

A. 12.64 seconds
B. 0.02 seconds
C. 1 second
D. 7.98 seconds

25) How long does it take for an initial charge of 20 VDC to decrease to 0.37 VDC in a 0.01-microfarad capacitor when a 2-megohm resistor is connected across it?

A. 0.08 seconds
B. 0.6 seconds
C. 0.4 seconds
D. 0.2 seconds

26) How long does it take for an initial charge of 800 VDC to decrease to 14.8 VDC in a 450-microfarad capacitor when a 1-megohm resistor is connected across it?

A. Approximately 900 seconds
B. Approximately 1,350 seconds
C. Approximately 1,804 seconds
D. Approximately 2,000 seconds

27) What is the impedance of a network comprised of a 1.0-millihenry inductor in series with a 200-ohm resistor, at 30 kHz? (Specify your answer in rectangular coordinates.)

A. 200 - j188
B. 200 + j188
C. 188 + j200
D. 188 - j200

28) What special type of diode is capable of both amplification and oscillation?

A. Point-contact diodes
B. Zener diodes
C. Tunnel diodes
D. Junction diodes

29) What is the principal characteristic of a varactor diode?

A. It has a constant voltage under conditions of varying current
B. Its internal capacitance varies with the applied voltage
C. It has a negative resistance region
D. It has a very high PIV

30) What is the meaning of the term beta with regard to bipolar transistors?

A. The change of collector current with respect to base current
B. The change of base current with respect to emitter current
C. The change of collector current with respect to emitter current
D. The change in base current with respect to gate current

31) What is the meaning of the term alpha-cutoff frequency with regard to bipolar transistors?

A. The practical lower frequency limit of a transistor in a common-emitter configuration
B. The practical upper frequency limit of a transistor in a common-base configuration
C. The practical lower frequency limit of a transistor in a common-base configuration
D. The practical upper frequency limit of a transistor in a common-emitter configuration

32) What are the elements of a unijunction transistor?

A. Base 1, base 2, and emitter
B. Gate, cathode, and anode
C. Gate, base 1, and base 2
D. Gate, source, and sink

33) When an SCR is in the triggered or on condition, its electrical characteristics are similar to what other solid-state device (as measured between its cathode and anode)?

A. The junction diode
B. The tunnel diode
C. The hot-carrier diode
D. The varactor diode

34) What technique can be used to construct low-cost, high-performance crystal-lattice filters?

A. Splitting and tumbling
B. Tumbling and grinding
C. Etching and splitting
D. Etching and grinding

35) What is a depletion-mode FET?

A. An FET that has a channel with no gate voltage applied; a current flows with zero gate voltage
B. An FET that has a channel that blocks current when the gate voltage is zero
C. An FET without a channel; no current flows with zero gate voltage
D. An FET without a channel to hinder current through the gate

36) What determines the gain of a closed-loop op-amp circuit?

A. The external feedback network
B. The collector-to-base capacitance of the PNP stage
C. The power supply voltage
D. The PNP collector load

37) What do the initials TTL stand for?

A. Resistor-transistor logic
B. Transistor-transistor logic
C. Diode-transistor logic
D. Emitter-coupled logic

38) A permanent magnetic field that surrounds a traveling-wave tube (TWT) is intended to:

A. provide a means of coupling
B. prevent the electron beam from spreading
C. prevent oscillations
D. prevent spurious oscillations

39) Electromagnetic coils encase a traveling wave tube to:

A. provide a means of coupling energy
B. prevent the electron beam from spreading
C. prevent oscillation
D. prevent spurious oscillation

40) What is one major advantage of CMOS over other devices?

A. Small size
B. Low current consumption
C. Low cost
D. Ease of circuit design

41) What is a linear electronic voltage regulator?

A. A regulator that has a ramp voltage as its output
B. A regulator in which the pass transistor switches from the "off" state to the "on" state
C. A regulator in which the control device is switched on or off, with the duty cycle proportional to the line or load

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conditions
D. A regulator in which the conduction of a control element is varied in direct proportion to the line voltage or load current

42) What is a three-terminal regulator?

A. A regulator that supplies three voltages with variable current
B. A regulator that supplies three voltages at a constant current
C. A regulator containing three error amplifiers and sensing transistors
D. A regulator containing a voltage reference, error amplifier, sensing resistors and transistors, and a pass element

43) What is a Class AB amplifier?

A. Output is present for more than 180 degrees but less than 360 degrees of the signal input cycle
B. Output is present for exactly 180 degrees of the input signal cycle
C. Output is present for the entire input signal cycle
D. Output is present for less than 180 degrees of the input signal cycle

44) Which class of amplifier has the highest linearity and least distortion?

A. Class A
B. Class B
C. Class C
D. Class AB

45) What is an L-network?

A. A network consisting entirely of four inductors
B. A network consisting of an inductor and a capacitor
C. A network used to generate a leading phase angle
D. A network used to generate a lagging phase angle

46) Which type of network offers the greater transformation ratio?

A. L-network
B. Pi-network
C. Constant-K
D. Constant-M

47) What are the three general groupings of filters?

A. High-pass, low-pass, and band-pass
B. Inductive, capacitive, and resistive
C. Audio, radio, and capacitive
D. Hartley, Colpitts, and Pierce

48) What are the distinguishing features of a Butterworth filter?

A. A filter whose product of the series- and shunt-element impedances is a constant for all frequencies
B. It only requires capacitors
C. It has a maximally flat response over its passband
D. It requires only inductors

49) How is the positive feedback coupled to the input in a Hartley oscillator?

A. Through a neutralizing capacitor
B. Through a capacitive divider
C. Through link coupling
D. Through a tapped coil

50) What is the major advantage of a Pierce oscillator?

A. It is easy to neutralize
B. It doesn't require an LC tank circuit
C. It can be tuned over a wide range
D. It has a high output power

51) Why is the Colpitts oscillator circuit commonly used in a VFO?

A. The frequency is a linear function of the load impedance
B. It can be used with or without crystal lock-in
C. It is stable
D. It has high output power

52) What is a reactance modulator?

A. A circuit that acts as a variable resistance or capacitance to produce FM signals
B. A circuit that acts as a variable resistance or capacitance to produce AM signals
C. A circuit that acts as a variable inductance or capacitance to produce FM signals
D. A circuit that acts as a variable inductance or capacitance to produce AM signals

53) What is a balanced modulator?

A. An FM modulator that produces a balanced deviation
B. A modulator that produces a double sideband, suppressed-carrier signal
C. A modulator that produces a single sideband, suppressed-carrier signal
D. A modulator that produces a full-carrier signal

54) How is the efficiency of a power amplifier determined?

A. Efficiency = (RF power out/DC power in) × 100%
B. Efficiency = (RF power in/RF power out) × 100%
C. Efficiency = (RF power in/DC power in) × 100%
D. Efficiency = (DC power in/RF power in) × 100%

55) What order of Q is required by a tank-circuit sufficient to reduce harmonics to an acceptable level?

A. Approximately 120
B. Approximately 12
C. Approximately 1200
D. Approximately 1.2

56) What is the principle of detection in a diode detector?

A. Rectification and filtering of RF
B. Breakdown of the Zener voltage
C. Mixing with noise in the transition region of the diode
D. The change of reactance in the diode with respect to frequency

57) What is the mixing process?

A. The elimination of noise in a wideband receiver by phase comparison
B. The elimination of noise in a wideband receiver by phase differentiation
C. Distortion caused by auroral propagation
D. The combination of two signals to produce sum and difference frequencies

58) What are the advantages of the frequency-conversion process?

A. Automatic squelching and increased selectivity
B. Increased selectivity and optimal tuned-circuit design
C. Automatic soft limiting and automatic squelching
D. Automatic detection in the RF amplifier and increased selectivity

59) What is the primary purpose of the first IF amplifier stage in a receiver?

A. Noise figure performance
B. Tune out cross-modulation distortion
C. Dynamic response
D. Selectivity

60) What is a bistable multivibrator circuit?

A. An AND gate
B. An OR gate

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C. A flip-flop
D. A clock

61) What is a monostable multivibrator?

A. A circuit that can be switched momentarily to the opposite binary state and then returns after a set time to its original state
B. A "clock" circuit that produces a continuous square wave oscillating between 1 and 0
C. A circuit designed to store one bit of data in either the 0 or the 1 configuration
D. A circuit that maintains a constant output voltage, regardless of variations in the input voltage

62) What is a NOT gate?

A. A circuit that produces a logic 0 at its output when the input is logic 1 and vice versa
B. A circuit that does not allow data transmission when its input is high
C. A circuit that allows data transmission only when its input is high
D. A circuit that produces a logic 1 at its output when the input is logic 1 and vice versa

63) What is facsimile?

A. The transmission of tone-modulated telegraphy
B. The transmission of a pattern of printed characters designed to form a picture
C. The transmission of printed pictures by electrical means
D. The transmission of moving pictures by electrical means

64) What type of emission is produced when an amplitude-modulated transmitter is modulated by a television signal?

A. F3F
B. A3F
C. A3C
D. F3C

65) How can an FM-phone signal be produced?

A. By modulating the supply voltage to a class-B amplifier
B. By modulating the supply voltage to a class-C amplifier
C. By using a reactance modulator on an oscillator
D. By using a balanced modulator on an oscillator

66) How can a single-sideband phone signal be produced?

A. By producing a double sideband signal with a balanced modulator and then removing the unwanted sideband by filtering
B. By producing a double sideband signal with a balanced modulator and then removing the unwanted sideband by heterodyning
C. By producing a double sideband signal with a balanced modulator and then removing the unwanted sideband by mixing
D. By producing a double sideband signal with a balanced modulator and then removing the unwanted sideband by neutralization

67) What is meant by the term deviation ratio?

A. The ratio of the audio modulating frequency to the center carrier frequency
B. The ratio of the maximum carrier frequency deviation to the highest audio modulating frequency
C. The ratio of the carrier center frequency to the audio modulating frequency
D. The ratio of the highest audio modulating frequency to the average audio modulating frequency

68) What is meant by the term modulation index?

A. The processor index
B. The ratio between the deviation of a frequency-modulated signal and the modulating frequency
C. The FM signal-to-noise ratio
D. The ratio of the maximum carrier-frequency deviation to the highest audio-modulating frequency

69) What are electromagnetic waves?

A. Alternating currents in the core of an electromagnet
B. A wave consisting of two electric fields at right angles to each other
C. A wave consisting of an electric field and a magnetic field at right angles to each other
D. A wave consisting of two magnetic fields at right angles to each other

70) When the electric field is perpendicular to the surface of the earth, what is the polarization of the electromagnetic wave?

A. Circular
B. Horizontal
C. Vertical
D. Elliptical

71) What is the period of a wave?

A. The time required to complete one cycle
B. The number of degrees in one cycle
C. The number of zero crossings in one cycle
D. The amplitude of the wave

72) What is meant by the term antenna gain?

A. The numerical ratio relating the radiated signal strength of an antenna to that of another antenna
B. The ratio of the signal in the forward direction to the signal in the back direction
C. The ratio of the amount of power produced by the antenna compared to the output power of the transmitter
D. The final amplifier gain minus the transmission line losses (including any phasing lines present)

73) What is the principle of a trap antenna?

A. Beamwidth may be controlled by non-linear impedances
B. The traps form a high impedance to isolate parts of the antenna
C. The effective radiated power can be increased if the space around the antenna "sees" a high impedance
D. The traps increase the antenna gain

74) What is a driven element of an antenna?

A. Always the rearmost element
B. Always the forwardmost element
C. The element fed by the transmission line
D. The element connected to the rotator

75) Why is the physical length of a coaxial cable transmission line shorter than its electrical length?

A. Skin effect is less pronounced in the coaxial cable
B. RF energy moves slower along the coaxial cable
C. The surge impedance is higher in the parallel feed line
D. The characteristic impedance is higher in the parallel feed line

76) What factors determine the receiving antenna gain required at a station in earth operation?

(Continued on page 92)

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Accessories For Radio Listening

BY KARL T. THURBER, JR.

Stand by for a high-tech audio tour through the contemporary radio listening post! In this article we'll examine a variety of audio accessories and add-ons including speakers, headphones, tape recorders, automatic recorder controls, active and passive audio filters, "smart" filters and signal decoders, and specialized add-ons for the mobile listening post. In fact, we'll cover just about anything you can hook onto your radio's audio-output jack. If you're a radio amateur, you might also pick up some useful audio-related ideas and tips for your hamshack.

Why Listening Post Accessories? A high-quality station receiver with good selectivity, sensitivity, stability, image and spurious-signal rejection, and accurate readouts forms the heart of any radio installation, whether for the SWL, radio amateur, or scanner buff. However, no radio is perfect, and few, if any, come complete with all the possible bells and whistles to satisfy every listening need. To narrow the gap between needs and reality, and to help enhance and tailor radio performance, there are many receiver audio add-ons that you can buy. These include external speakers, headphones, tape recorders, automatic recorder controls, audio filters, high-tech accouterments like "smart" audio filters and signal decoders, and even specialized accessories for mobile listening posts. Indeed, if you look through the various radio-hobby publications, you'll find many advertisements for such gear. But how does one separate the gold plating from the gold? Which accessories are truly necessary, which are nice to have, and which are frivolous? While you're the final judge, in the pages that follow we'll focus on a wide range of listening-post audio accessories to help make you more knowledgeable of what's out there to really improve and enhance your reception.

External Speakers. Most pieces of contemporary radio equipment are small and contain minimal internal speakers. Typically, the audio quality is poor, which results in overall poor performance from an otherwise excellent transceiver or receiver. Fortunately, most equipment has a provision for an optional external speaker, and I recommend you obtain the matching external speaker when you buy the radio as you may be unable to obtain one later once models change. If you can't obtain the matching speaker, you can use almost any communications speaker with your radio as long as the impedance roughly matches that of your set's output, which is usually 8 ohms or so.

Generally you should use communications-type speakers, as their restricted frequency response is preferred for speech. High-fidelity speakers, though perhaps of superior quality, may unduly accentuate low-frequency hum as well as high-frequency noise and hiss. However, in certain instances—such as listening to very strong, "armchair copy" shortwave-broadcast stations or scanner channels—you might opt for high-fidelity performance. Sometimes, with hi-fi speakers, you can understand previously unintelligible background scanner conversations and enjoy the full fidelity with which shortwave broadcasts usually are transmitted.

In that case, consider routing your radio's audio to your stereo system. One ready-made accessory, the Electron Processing AFBOX-1 hi-fi connection adapter, lets you do just that. Connections to the external speaker jack of the receiver and the hi-fi auxiliary input jacks are made with supplied connectors; an isolation transformer and passive attenuator are included. The AFBOX-1 also can be connected to a VCR for up to 6 hours of audio recording. It sells for $30 from Electron Processing, Inc.

Radio headphones. Using good communications-type headphones has advantages, too. Many DX (distant) signals are too obscured and weak for solid copy on a loudspeaker. Headphones will help to pull such signals "out of the mud." Buy a good pair of communications-type headphones at the start since you probably will use the same pair for your entire listening career.

Switching from speaker to headphones can materially improve the readability of received signals and keep distracting room noise out—weak signals can get lost in the ambient noise that exists between a speaker and your ear. A headset isolates you from your environment, directing your attention to the signal.

By bringing the sound directly to your ear, a headset adds definition. It's easier to separate two Morse-code signals or distinguish voices in a headset than in a speaker. Also, a headset can give you the extra "oomph" needed to hear weak stations because of typically high sensitivity.

Many beginners grab the closest set of stereo phones for their radios, but monaural headphones are usually best. While most stereo phones can be used (because they are designed for hi-fi reproduction) their wide frequency response may elevate internally generated receiver hum and noise to objectionable levels. Also, some lead-switching needs to be done, or an adapter pur-

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chased, to convert them for monaural use.

Headphone Requirements. Several manufacturers sell communications-type phones, including JRC, Kenwood, Yaesu, ICOM, and Radio Shack. Such headphones have a narrow frequency response, are sensitive, can be adjusted easily, and have comfortable earmuffs. Several other considerations emerge. The input impedance should roughly match the output impedance of the receiver's audio stage. In most solid-state gear this is in the 4-to-16-ohm range, though some tube sets have a higher output impedance. Most military-surplus headphones, often attractive because of their rugged construction and oversize earmuffs, are 600-ohm units, but they sometimes are found in higher- and lower-impedance versions.

Sitting by your radio for hours at a stretch is fatiguing. Doing it while wearing an uncomfortable set of headphones with a tight headband is torturous. It's important to purchase earphones having good earmuffs; the muffs keep the signal in and distractions out. Thick, but soft and flexible pads are needed. These should fit snugly against the head, though not so tightly as to be uncomfortable. Other desirable features include a coiled cord, individual headset volume controls, easily-replaced earmuffs, and a way to adjust the headband for a comfortable fit.

Tape Recorders. Tape recorders are very useful listening-post adjuncts; many listeners wouldn't be without one. Small cassette recorders have a wide range of applications in the radio listening post. Recorders can be used for such diverse purposes as taping important local and DX signals for later playback, compressing listening sessions (especially sleepy overnight ones), "live" signal reporting, documenting equipment settings, and code practice; indeed, their use is limited only by the user's imagination.

Taping signals for later playback is the most common, obvious use of the recorder. The machine is simply connected to the receiver's output jack, either through a Y-plug across the external speaker output or to an auxiliary jack. The tapes can serve both as documentation for rare finds and as a logging aid. You can record a reference time at the beginning of the tape, or continuously on the second channel of a stereo recorder, to later determine logbook-entry times.

Going hand-in-hand with that use is saving tape, your time, and your sanity by recording a given radio channel or frequency only when there's activity on it. A voice-actuated control switch lets you watch for a particular channel or frequency to become active overnight or when you're not home. That saves tape by automatically activating your recorder only when voice or other sounds are transmitted to the unit by a scanner or radio—more on that later.

Take a guided tour with us as we explore the various speakers, headphones, decoders, and other audio accessories that are an important part of the contemporary hi-tech radio listening post.

Another common use is to provide "live" signal reporting to radio amateurs and shortwave broadcast or utility stations. Most are genuinely surprised to learn how they sound over the air, particularly at a far-distant location. They often view an opportunity to hear their signal as more meaningful than a simple readability-and-strength report. The recognition may help you land a QSL (confirmation) card in exchange.

It's often handy to use a tape recorder to verbally document equipment settings and alterations, antenna tuning or selection, signal-strength readings, and the like. You describe what's happening as you do it, with the recorder doing the "writing." Subsequent playback and written transcription to a notebook or log may be helpful in interpreting and analyzing the results you obtain.

If you're headed toward obtaining your amateur-radio license, you can make code-practice tapes using a straight key or keyer and audio oscillator. Your recorder also can be used to tape the on-the-air code practice sessions broadcast by W1AW, the American Radio Relay League (ARRL) headquarters station at Newington, CT, for later playback and practice. See the ARRL's monthly journal, QST, for information on their over-the-air practice sessions.

Recorder Technical Considerations. True hi-fi sound reproduction isn't a necessity, but a few other requirements do exist. The recorder should be of good quality, feature low distortion, boast low wow and flutter, have an auxiliary audio input for direct receiver connection, and include a recording-level meter and tape counter.

A pause or edit control also is desirable. Other nice-to-have features include a monitoring or auxiliary speaker jack, automatic shutoff or auto reverse, fast forward and rewind. A monophonic unit is fine; there is little advantage in using a stereo unit, although as mentioned earlier, some listeners find it useful to record time or verbal-annotation information on the second channel.

A standard-play cassette recorder is adequate for most uses. However, a long-playing recorder can be very useful. One vendor, AMC Sales, offers a $119 modified Panasonic 12-hour long-playing recorder, the Model 2712, that records 6 hours on each side of a standard C-120 audiocassette. Features include cue and review, pause control, tape counter, one-touch recording, and separate volume control. AMC Sales also offers a customized 3-hour, voice-activated Panasonic microcassette recorder, the Model 180 LP, for $69. It features automatic voice level control, cue and review, LED level indicator, and pause control.

A heavy-duty, 10-hour recorder is offered by Viking International. It's $139 and features a metal chassis, 5 hours of recording time per side with a C-120 tape, AC/DC operation, switch-

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able automatic level control (ALC), a digital counter, and internal voice-controlled activation (as a $25 option). Accessories include an automatic telephone-recording adapter that starts and stops the recorder, as well as a dialed-number decoder that plugs into the recorder's earphone jack and displays Touch-Tone telephone numbers from tape.

You may need various patch cords, connectors, switches, and jumpers to use a recorder with your equipment. Use shielded cable, especially with high-impedance audio interconnections, to minimize RF noise, and hum pickup. The radio's output may need to be attenuated to avoid overloading the recorder's audio input. AMC Sales also offers a 6-ft. attenuator cord, the ATC-24. It allows direct connection to the recorder from the receiver or scanner.

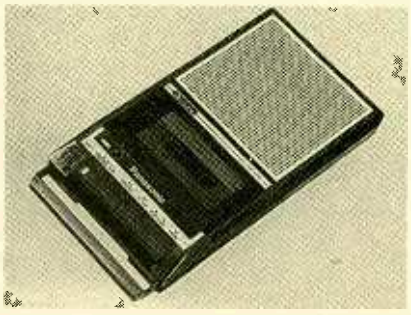
Automatic-Recorder Controls. A few receivers have a feature of special interest to SWL's: a built-in timer used to turn on the radio and accessories for scheduled listening or to control a tape recorder. Lacking such a feature, you may be able to use a simple AC light timer to achieve a similar result. .

Another useful device is a voice-actuated control switch to record overnight as it waits for a particular channel or frequency to become active. Such devices save tape by activating your recorder only when voice or other sounds are transmitted to the unit, either via a VOX (voice-operated transmit) microphone or a direct-wired source, such as a scanner or receiver.

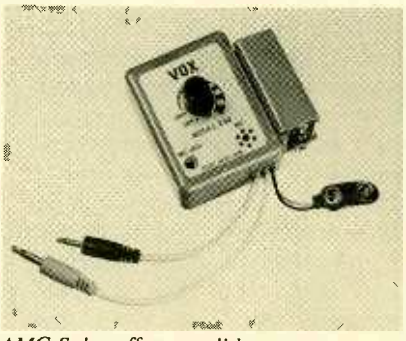
AMC Sales offers a solid-state VOX control switch, the Model 250, for $28.50 that serves that purpose. It features a built-in voice-actuated microphone, a VOX sensitivity-level control, and a delay circuit that shuts off the recorder 2–3-seconds after the last sound is heard by the unit. It's designed to work in concert with AMC's long-play recorder, described previously.

A tape-saving device is also offered by Electron Processing. It saves dead time on overnight scanner tapes, letting you listen to an entire night's scanning in minutes. The TS-1 Tape Saver is connected between the scanner and a cassette recorder. It switches the recorder on when it detects activity and off when the scanner is silent. A built-in speaker lets you listen to scanner activity; you can switch off the speaker for silent recording. Connection is made with plugs that hook to most scanners and recorders. It's $60 from Electron Processing.

The AFBOX-1 connects your radio to a hi-fi system; by doing so, scanner listeners can often understand previously unintelligible conversations and SWL's can enjoy the full fidelity of shortwave broadcasts.



The uses for a tape recorder in the radio listening post are legion. AMC Sales offers a modified Panasonic recorder, the Model 2712, to capture up to 12 hours on tape.



AMC Sales offers a solid-state miniature, voice-actuated switch, the Model 250. It features a built-in VOX-actuated microphone, a VOX sensitivity control, and a time-delay feature that shuts off the recorder a few seconds after the last sound.

Audio Filters. The congestion on the high-frequency (HF) radio bands has placed a premium on receiver selectivity. Simple fixed-bandwidth intermediate-frequency (IF) crystal filters were good enough in the 1940's and 1950's, but may be inadequate to handle crowded, present-day spectrum conditions. Densely-packed and overlapping AM and SSB stations, closely-spaced CW signals, and RTTY and digital-mode reception through potentially obliterating heterodynes demands complex, sharp-skirt selectivity, IF filters, or other means of achieving high radio selectivity.

It's difficult to beat an external audio filter when it comes to an inexpensive and easily installed means of improving the selectivity of shortwave receivers, especially low-end older radios. Even in sets having adequate IF filtering, an audio filter can significantly enhance performance. The filter cuts down on the noise and hiss generated by the set's IF chain, and it flexibly narrows the receiver's overall response curve, often allowing true single-signal reception. Both characteristics aid reception under heavy interference and weak-signal conditions.

Whether you opt for a simple or complex audio filter, you'll be glad you made the investment. An audio filter is one of the most cost-effective accessory aids you can buy for your radio. There are two main types we're concerned with here: passive and active.

Passive Audio Filters. A fixed-tuned passive (non-amplifying) audio filter, though inherently simple, can markedly improve receiver selectivity, especially one without adequate IF filtering. In some very inexpensive radios, an audio-stage filter is the primary selectivity-determining device. Many listeners have found that surplus "radio range" filters in their headphone leads separate closely-spaced CW signals, though they also found that receiver tuning and stability became critical when using narrow band-pass filters.

Passive filters are brute-force devices, and they are lossy, especially noticeable if the radio drives a speak-

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er rather than headphones. Though simple and inexpensive, passive filters rely on cumbersome and hard-to-find inductors. Also, there is no flexibility in setting the center frequency and band-pass curve or changing these characteristics during operation.

While they can't make a poor receiver into a razor-sharp set, passive filters can do much to improve the wide response of lesser radios. Realistically, however, a far more satisfactory and flexible approach to enhancing receiver selectivity lies in the use of active audio filters.

Active Audio Filters. An active audio filter can yield surprising reception results. Assuming the filter is used with a receiver or transceiver with sharp-skirt IF selectivity, weak and interference-plagued signals can appear to jump out of the noise when an active filter is switched in.

The MagicNotch interference filter is an automatic notch filter that requires no tuning or user intervention. When it detects a heterodyne signal, it immediately filters it out using a sharp rejection filter. Audio of other frequencies, such as speech, is passed through without attenuation.

Several firms market these effective interference-reducers, including Autek Research, MFJ Enterprises, Palomar Engineers, and others. Some filters are designed for CW, others for AM and SSB, and some for all modes. Most are self-contained, include their own power supply, and are simply connected to the receiver's audio output. A few include an audio amplifier and speaker.

Most of the filters allow you to vary audio selectivity from just a few hertz for super-sharp CW single-signal work, up to a completely "flat" response for hi-fi broadcast reception. Some also have high-pass and low-pass modes, while others can notch-out an interfering signal or heterodyne while passing the desired signal with little attenuation. Many fancier units allow you to notch and peak signals at the same time.

Using the active filter on AM and SSB is a gratifying experience, especially if used with a modest set. By proper adjustment, you can dramatically improve readability under conditions of QRM (interference), QRN (static), splatter, and the like—reducing operator fatigue and making listening more enjoyable. While radio amateurs are the biggest users of active audio filters, SWL's and CB operators can benifit greatly from them as well.

As usefuls as these devices can be for AM and SSB communication, the real thrill comes when using these filters on CW, where before-and-after comparisons can be dramatic. With the active filter, the desired signal can be peaked with an effective bandwidth measured in tens of hertz, even in the presence of close-by strong signals that sneak through the set's IF stages. It's often possible to tune through the IF passband with the audio filter and discover several copyable CW signals—signals that were unreadable or even barely detectable without the filter.

Communications Headphone Operating Tips

Here are some headphone operating tips you may find useful:

- Use earplugs under the headphones. Desired signals come through the earplugs well, while noise is suppressed. Using earplugs is particularly effective when working on a noisy band for long periods, or if your listening post is in a noisy area of the house. You'll also find that earplugs reduce fatigue.
- "Ride gain" on your set's RF- and AF-gain controls. Avoid audio blasting, which has the effect of desensitizing your ears. Usually, the best CW and SSB copy is obtained by running with the AF gain wide open and controlling signal level with the RF-gain control, keeping overall levels low to avoid overloading.
- Try reversing audio leads to one headphone. The ear tries to cancel out noise which is presented in-phase. Sometimes headsets produce a substantial readability improvement while letting the signal of interest through with little impediment if the leads to one phone are reversed. Don't be afraid to experiment.
- When receiving CW signals, adjust the set's main tuning or beat-frequency oscillator (BFO) for a pleasant audio tone. But don't opt for a too-low pitch: 750 Hz is usually "about right" for most people, give or take 100 Hz or so.
- Use FM radio cordless headphones for cord-free operation. Such headphones have a built-in FM radio inside the headphone shell; you feed your radio's output to an FM wireless-broadcaster module to create a cordless system. Doing so offers flexibility by doing away with entangling headphones cords. The approach also lets you monitor your radio anyplace in your home or yard by tuning to the rebroadcaster frequency on any FM broadcast receiver.

Ramsey Electronics, Inc. sells several inexpensive FM wireless-microphone and signal-rebroadcaster kits for as little as $5.95. They even offer a $29.95 stereo FM transmitter kit that you can adapt to rebroadcast two monitor receiver calls—one on the right channel and the other on the left. This feature lets you monitor more than one radio at a time.

For the user who prefers a complete cordless system, RCA offers a lightweight, rechargeable, cordless stereo-headphone ensemble at $149; it include a stand that functions as a transmitter and battery recharger. The RCA phones are available from NBO Distributors, Inc. NBO also offers a Sony infrared, wireless, stereo-headphone system for $129, and your local Radio Shack sells a battery-operated monaural wireless headphone system for $59.95.

The Microdec decoders let you decode radio transmissions without a computer. They sport an 8-character LED display with intensity controls, a built-in code-practice oscillator, an internal speaker, and pushbutton operation. An optional display adapter, the VIP50 adapter interface (also shown here), offers an expanded display for use with your TV, computer monitor, or VCR.

New-Age "Smart" Audio Filters. Several high-tech take-offs on active-filtering techniques have surfaced lately. These devices are revolutionary and definitely deserve a close look.

A very promising device is the J-Com MagicNotch automatic notch filter that installs between your radio and external speaker or headphones.

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The filter requires no tuning or user intervention. When it detects an interfering carrier, it immediately removes it with a very narrow and deep, digitally tuned notch.

When the unit is in the off or bypass positions, audio is fed directly to the speaker. In the on position, the switched-capacitor active filter (SCAF) scans the audio spectrum continually for interference. A control circuit monitors the filter output and stops the scanning when the output drops. The filter phase locks to the interfering signal and tracks any variations in its frequency until it disappears. The filter has a notch depth of 40 dB over a range of 200–4000 Hz. It costs $109.95.

Advanced Digital Signal-Processing (DSP) filter techniques are being increasingly used. DSP makes use of microprocessor technology to simulate analog filter circuits. DSP-filter performance is typically excellent, with filters possessing very good skirt characteristics. The filters are "virtual:" they're of a soft nature and so exist only in a microprocessor. This allows the construction of adaptive filters that vary characteristics to react to changing conditions. Thus, DSP filters provide superior performance in reducing interference on voice, CW, and RTTY.

An impressive DSP-based filter is the JPS Communications NIR-10 (*N*oise and *I*nterference *R*eduction unit), a spin-off of the firm's government and commercial signal-enhancement equipment. The NIR-10 quickly and automatically senses and removes multiple tones from communications, allowing reception of difficult signals and reducing listener fatigue. Unlike conventional audio filters, the $349.95 NIR-10 can remove heterodynes and various types of noise that occur in the presence of speech—without corrupting the speech itself or reducing the audio bandwidth.

The NIR-10 has three main operating modes, the NIR mode, which automatically enhances voice; the NF (Notch Filter) mode, which removes multiple heterodynes; and the BP (Band-Pass) mode, where the unit operates as a digital audio filter with adjustable center frequency and switch-selectable bandwidths, which is especially useful for CW and RTTY. A bypass mode feeds unprocessed audio through to the output.

Names and Numbers

AMC Sales, Inc.
193 Vaquero Drive
Boulder, CO 80303
Tel. 1-800-926-2488.

Autek Research
P.O. Box 302
Odessa, FL 33556
Tel. 1-813-920-5810.

Electron Processing, Inc.
P.O. Box 68
Cedar, MI 49621
Tel. 1-616-228-7020.

Grove Enterprises, Inc.
P.O. Box 98, 140 Dog Branch Road
Brasstown, NC 28902-0098
Tel. 1-800-438-8155.

J-Com
P.O. Box 194Y
Ben Lomond, CA 95005
Tel. 1-408-335-9120.

JPS Communications, Inc.
P.O. Box 97757
Raleigh, NC 27624-7757
Tel. 1-919-790-1011.

MFJ Enterprises, Inc.
P.O. Box 494
Mississippi State, MS 39762;
Tel. 1-800-647-1800.

MoTron Electronics
310 Garfield St., Suite 4
Eugene, OR 97402
Tel. 1-800- 338-9058.

NBO Distributors, Inc.
5631 Palmer Way
Carlsbad, CA 92008
Tel. 1-800-346-6466.

Palomar Engineers
P.O. Box 462222
Escondido, CA 92046
Tel. 1-617-747-3343

Ramsey Electronics, Inc.
793 Canning Parkway
Victor, NY 14564
Tel. 1-716-924-4560.

Somerset Electronics, Inc.
1290 Highway A1A
Satellite Beach, FL 32937
Tel. 1-800-678-7388.

Viking International
150 Executive Park Blvd. #4600
San Francisco, CA 94134
Tel 1-415-468-2066.

A single-mode DSP-based automatic notch filter, the NF-60, is also available for $149.95. Unlike ordinary analog units, the NF-60's filter algorithm automatically provides as many extremely narrow notch filters as there are tones, simultaneously removing them. When no tones are present, the NF-60 has a negligible effect on received audio.

Signal Decoders. There's a lot of high-tech gear that you can hook to your radio's audio output or headphone jack besides speakers, headsets, tape recorders, and filters. We're talking about decoders of various types—let's look at some of them.

You can use decoders with your shortwave radio to decode Morse, RTTY, AMTOR/SITOR, and ASCII transmissions—without a computer. An impressive multimode decoder add-on is the Microdec series of decoders from Somerset Electronics. The Microdecs, offered in three different models with distinct demodulation-mode capabilities, let you decode many Morse, digital, and RTTY transmissions with ease.

The Microdec units sport an 8-character LED display with intensity controls, a built-in code practice oscillator, an internal speaker, and simplified pushbutton operation. An optional display adapter offers an expanded display (32 characters/line × 16 lines) for use with your TV, computer monitor, or VCR. Three models range from $229.95 to $429.95, depending on features.

An interesting scanner add-on is the MoTron TM-16 Tone-Master Touch-Tone decoder display ($229) that not only lets you hear the tones, but also see the numbers. It features a 16-digit LCD readout with an 80-character scrollable memory, a built-in amplifier and speaker, and a high-speed decoder that displays up to 25 digits per second. The TM-16 Plus ($299) includes an RS-232 serial output and software for optional automatic date, time, and number logging using a PC. Besides scanner monitoring, the units are useful for monitoring cordless telephones and testing handheld autodialers.

MoTron also offers the Auto-Kall AK-10 DTMF selective-calling decoder, for people who don't want to constantly monitor a busy frequency or channel but who want to remain available. When placed in the decode position, your radio remains si-

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ANTIQUE RADIO

By Marc Ellis

A Trip to Mecca!

Last month I led you to believe that this column would be devoted to constructional details on a "Quaker Oats Container" crystal set. However, like about 1000 other antique-radio enthusiasts from all over the United States and some foreign countries, I've just returned from a week-long trip to Mecca—otherwise known as the Antique Wireless Association (AWA) annual conference in Rochester, New York.

Prospective buyers pore over some of the wares offered at the three-acre flea market.

For me, the decision to make the pilgrimage was a last-minute one. I'd never attended before, and figured it was high time. But as a result of playing hooky from the immediate concerns of the column, I didn't get enough work done on our crystal set to discuss it on these pages. What I *am* in a position to do is tell you a little bit about the conference, which ought to be just as interesting, if not more so!

THE HIGH SPOTS

How do I get into describing what amounted to five days of total immersion in our fascinating hobby? Maybe the best way would be to hit the high spots first, then go back and fill in some details. The conference was held in and around the Rochester Thruway Marriott, a large motor hotel just outside the Rochester metropolitan area. Officially, the proceedings began on Wednesday, September 22 and concluded on Saturday, September 25. However, many of us who couldn't find the time during the conference proper stayed on an extra day to visit the amazing AWA museum, located a short distance away in Bloomfield, New York.

Among the activities that kept me glued to the Marriott during the four-day period were several major auctions, a host of talks and seminars, the old-equipment contest, the books and magazines show, a flea market encompassing the better part of the Marriott's paved parking area (someone estimated three acres), and last, but certainly not least, the Grand Banquet and associated farewell ceremonies.

Many of the seminars, talks, and activities were related to the Westinghouse Company, which was designated as the central thread of this year's conference. Quoting from the Antique Wireless Association conference literature: "Thinking of major U.S. electrical companies, Westinghouse comes immediately to mind. It touched nearly every field related to communications from the alternator to broadcasting ..."

SEMINARS AND TALKS

The seminars and talks offered to the 1993 conference attendee included: News for SWL's; Key and Telegraph; DX'ing With the Westinghouse RC Receiver; Radio Collector's Slide Show; Entertainment for All (a presentation of "On the Air," a film on Westinghouse's station KDKA); Amateur Radio Seminar, including a film on the laying of the Atlantic Cable; The Life of Frank Conrad; The Early History of Collins Radio; Electrical and Wireless Apparatus, Pre-1910; and The Charles Herrold Story.

Among the more engrossing of the presentations that I attended were those on Conrad (sponsored by the Pittsburgh Antique Radio society) and Herrold. Conrad was a famous Westinghouse inventor and the founder of pioneer broadcasting station KDKA. Herrold was relatively unknown outside his San Jose, California home town, but is a legitimate contender to the title (usually assigned to Conrad) of "Father of Radio Broadcasting." The Herrold story was presented via a rough-cut video by Mike Adams, producer of the award-winning PBS video program *The Radio Collector*. Mike gave us all the opportunity to fill out an evaluation sheet on the video so that he could consider our comments for incorporation into the final version.

I was also thoroughly en-

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Auctioneer Ed Gable (right), about to knock down an early battery set, while a classic Philco cathedral waits its turn.

tertained and edified at the Key and Telegraph seminar moderated by key collector Murray Willer, VE3FRX. After a short introductory slide show, the meeting became an exchange of information on such concerns as the non-destructive removal of oxidation and corrosion from brass parts and the cutting of screw threads to obsolete specifications.

As I understand it, this seminar (repeated yearly) is one of the few organized opportunities for key collectors to get together in person. I'm not a key collector myself but, through some networking accomplished during the seminar, I'm well on my way toward identifying an old key-and-sounder combination that happens to be in my possession. I may also be able to figure out how to replace a missing sounder-limit screw having a thus-far-unidentifiable thread.

I had another good time at the pre-1910 electrical apparatus program, which was moderated by the dynamic Bruce Kelley, curator of the Antique Wireless Association Museum and one of AWA's founding fathers. This was essentially a show-and-tell session. Anyone who cared to bring in and talk about a piece of ancient electrical apparatus could enter the friendly competition to determine which piece was the most unique. The winner, as determined by a representative of the Smithsonian institution, was a medical spark coil judged to date from the time of Joseph Henry. If I'm lucky enough to get out to Rochester next year, maybe I'll enter my Tiffany Never-Wind clock!

THE AUCTIONS

When auction time rolls around, most other conference activities slow down or grind to a halt. Exhibit areas are deserted, seminar attendance tapers off, buyers—and even sellers—desert the flea market. The auction room fills to capacity with folks hoping to make the buy of a lifetime, preferably at a once-in-a-lifetime price.

This year's conference was unusual in that there was a special estate auction of communications receivers on Thursday, the day before the main auction. Containing 250 lots, the special auction was almost half the size of the main auction—at which some 600 lots changed hands.

An unusual feature of the communications-receiver auction was the accompanying printed catalog, a feature heretofore unknown in the antique-radio field. I attended with hopes of achieving my fond dream of acquiring a Hammarlund Super Pro—until I got a really good look at one. After seeing how large and heavy it was, discretion ruled and I kept my bidding paddle firmly ensconced in my lap.

The main auction on Friday was divided into three sub-auctions: tubes, paper, and "general." I spent some time at all of these, but (maybe this is heresy) never did buy anything! Prices seemed to run higher than those of similar items in the outdoor flea market, and I prefer not to have to compete for the things I purchase. It's a matter of personal taste, I guess.

Other people definitely were buying, however. The AWA tells me that sales at the four auctions totted up to a hefty $53,000. If you're curious, the highest priced lot was a blue Fada "Bullet" (Model 1000) Catalin—which fetched $2,400. That sale brought a round of applause, in honor of either the buying power of the purchaser or the selling power of the radio—I'm not sure which.

OTHER ATTRACTIONS

The Old Equipment Contest is open to those wishing to submit outstanding examples of equipment in specific categories. One group of categories centered around products of Westinghouse, the conference theme company. Another group, "The Standard Categories," is the showcase for receivers and transmitters of various designs. The final group, "The Craftsmanship Categories," encourages submissions showing restoration of appearance, restoration of operation, and "new for old" (replicas of old equipment or demonstrations of old technology).

Spotted at the Old Equipment Contest was this shortwave receiver newly made from a set of early plans.

The Old Equipment contest is set up as a permanent, conference-long display in one of the Marriott ballrooms. Among the wonders that caught my eye were an unbelievably perfect replica of a large Federal battery set; a newly-built shortwave receiver, constructed following plans in a 1930's shortwave manual; a display of rare, perfectly-restored Aerola Grand receivers; a battery-operated "station in a suitcase" ham

(Continued on page 87)

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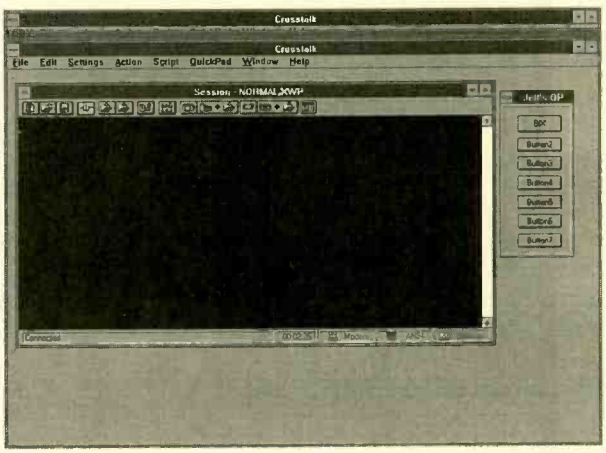
COMPUTER BITS

By Jeff Holtzman

Crosstalk for Windows

Telecommunications is one of the most exciting and useful activities that can be performed using a computer. Other than the computer, all you need are a modem and a telecommunications (telcom) program. What you'll find, once you get connected, is a wild and woolly frontier filled with places to explore, people to meet, and things to do.



Multiple simultaneous communications sessions and network support define the high-end capabilities, but CrossTalk for Windows also offers plenty for everyday BBS and on-line service browsing.

Some services (e.g., Prodigy and America Online) provide their own dedicated telecom programs. Others (CompuServe for one) provide access via both general-purpose and dedicated programs. Yet others, such as electronic bulletin boards (BBS's), depend mostly on general-purpose programs. Thus, to do almost anything, you need a general-purpose program.

There are lots of products in this category, among both commercial and shareware programs; and almost any program will be good enough. I've tried numerous packages over the years, but the one I keep coming back to is CrossTalk, made by Digital Communications Associates (DCA). My favorite is release 2.0 of the Windows version (XTALK2). It is a powerful program that eases many of the repetitive chores involved in telecommunicating, and does so through a user interface that is second to none.

The program is easy to get started with, and it provides plenty of power as your needs increase and your skill grows. It supports just about every modem ever produced, likewise with file-transfer protocols (Xmodem, Ymodem, Zmodem, ASCII, Kermit, and more), terminal emulations, and programming capabilities.

SESSIONS

XTALK2 is built around the concept of a session. Each on-line service or BBS that you call has an associated session file, which contains information like the telephone number, user ID, password, terminal emulation, and so on. Each session may in addition be associated with three things: a keyboard map, a script, and a QuickPad.

The keyboard map allows you to customize every key on your keyboard on a per-session basis. Thus, you could, for example, set up one hot key to send the correct codes to log you in to your favorite service, another to download all current messages, and a third to get an updated list of downloadable files. The keyboard editor is fully graphical: it displays a representation of your keyboard. To customize a key, you simply double-click on its representation. Then a dialog box comes up in which you can enter a series of keystrokes, a series of script-language commands, or the name of an external script file. Subsequently, whenever you press that key in that session, it sends the corresponding keystrokes or runs the associated script.

The script language is something like BASIC, so it's easy to learn and use. You can create a script file from scratch using the built-in text editor, or you can record it live, during an on-line session, and touch it up later. The script language is extremely powerful, and includes extensive support for Windows' Dynamic Data Exchange (DDE) protocol. DDE allows you to establish a "conversation" between two Windows applications. A sample DDE script establishes a link between CrossTalk and Excel, allowing CrossTalk to supply real-time stock updates to a spreadsheet file.

A QuickPad is a customizable tool box that appears on-screen in front of any other open windows. A graphical editor allows you to place icons, images, and pushbuttons on the QuickPad; as with the keyboard map, each button may be associated with a series of keystrokes, an internal script, or an external script.

I've used those features to increase the convenience and efficiency of my telecommunications

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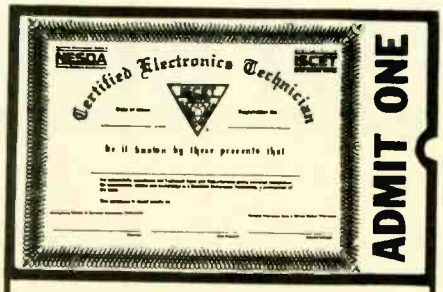

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Gary Hinton, Jr.
7th grade

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sessions in several ways. I've set up my system so that whenever I start the program, it loads a QuickPad that contains a set of buttons for initiating sessions with my favorite on-line services. Each of those sessions has an associated set of keyboard maps and QuickPads that ease the process of session navigation. For example, I've built one fairly elaborate script that downloads current news items in several categories related to computers and electronics from one on-line service, automatically, at the push of a button. I used to browse those items on-line at tremendous cost. Now I can download half a megabyte of information in fifteen minutes, peruse it at my leisure, plus have the full text available (via a text-indexing program) for future research projects.

Here's another example of a system I'm currently working on for a client. The client uses a custom Windows application to gather applications data from a manufacturing process, but then must re-enter that data by hand into the company's corporate minicomputer. When my system is complete it will allow the company to write data from the source application to a standard ASCII file, and then use CrossTalk's script language to read the data from the file, establish a connection via a built-in terminal emulator, and upload the data semi-automatically after review by manufacturing personnel.

Writing a program like that from scratch would probably have taken months. Buying an off-the-shelf telecommunications program and customizing it allows us to get a better job done in a fraction of the time. The program has a number of rough edges, including inconsistent keyboard support, an incomplete and buggy on-line help system, and some arbitrary limitations in the script language. Despite those problems, I believe XTALK2 still offers a better balance among power and ease of use than its competition. If you would like to learn more about it, use the telephone number or address in the box entitled "Vendor Information" to receive more complete information. ■

VENDOR INFORMATION

CrossTalk for Windows, version 2.0 ($195.00)
Digital Communications Associates
1000 Alderman Drive
Alpharetta, GA 30202-4199
800-348-3221
or 404 442-4930

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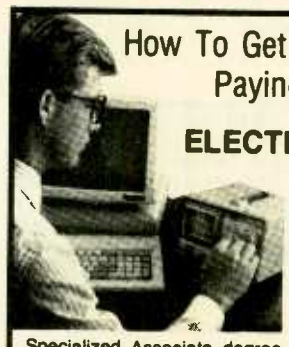

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CIRCUIT CIRCUS

By Charles D. Rakes

Plenty of Oscillators

This outing, we're going to look over a number of oscillator circuits. Even if you do not anticipate needing an oscillator anytime soon, it is still worthwhile to see how some these often-used electronic building blocks work. Oscillators can be found in electronic watches (which contain crystal oscillators that keep the digital display or analog dial on time), in computers, calculators, portable telephones, stereos, TV's, radios, remote controls, and in just about everything else electronic.

UJT OSCILLATOR

Our first circuit, see Fig. 1, is an unusual 100-kHz oscillator built around a unijunction transistor (UJT). The operating frequency of that circuit is determined by crystal XTAL1. That simple crystal-controlled oscillator can be used as a marker generator to calibrate the analog dial of a communications receiver, or its output can be fed to a divider counter to produce a stable lower-frequency output for use as a clock generator.

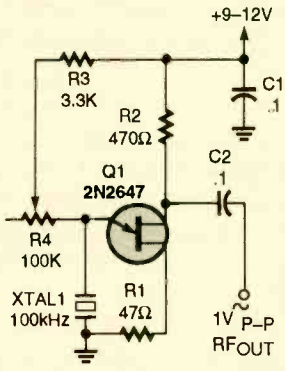

Fig. 1. This unusual 100-kHz oscillator (whose frequency is determined by XTAL1) can be used as a marker generator to calibrate the analog dial of a communication receiver, or its output can be fed to a divider counter to produce a stable lower-frequency output for use as a clock-signal generator.

Most UJT-based oscillators depend an RC timing circuit to set the oscillator's frequency. That method is fine for many applications where frequency stability is not too important. Where frequency stability is important, using a quartz crystal is the simplest and least expensive path to follow.

The output of the Fig. 1 oscillator should be adjusted for a fairly good sinewave. To do so, you'll need an oscilloscope. Simply connect the oscilloscope to the output of the circuit and adjust R4 for the best looking waveform. If an oscilloscope isn't handy, an AM radio can be used with acceptable results. Simply turn the AM radio on and set the dial to pick up a station near the low-frequency end of the dial. Set the radio next to the oscillator and adjust R4 until a heterodyne (beat signal) is heard.

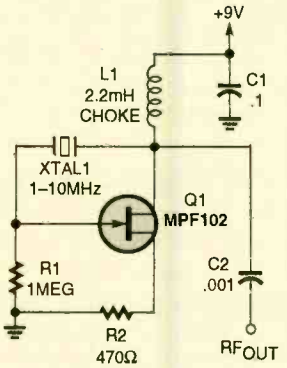

Fig. 2. The unijunction oscillator shown here allows higher frequency operation, and like the previous circuit, uses a quartz crystal (XTAL1) to set its operating frequency.

FET OSCILLATOR

The FET-based oscillator shown in Fig. 2 is every bit as simple as the unijunction oscillator, but this one is capable of higher frequency operation. That circuit is built around an MPF102 N-channel JFET (junction field-effect transistor) Q1. Like the previous one, it uses a quartz crystal (XTAL1) to set the oscillating frequency. The circuit oscillates because of the drain-to-gate feedback path through the quartz crystal.

With the component val-

PARTS LIST FOR THE UJT OSCILLATOR

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—47-ohm
R2—470-ohm
R3—3300-ohm
R4—100,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS

Q1—2N2647 N-channel UJT
C1, C2—0.1-μF, ceramic-disc capacitor
XTAL1—100-kHz quartz crystal
Perfboard materials, 9–12-volt power source, wire, solder, hardware, etc.

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ues shown and depending on the crystal selected for XTAL1, the circuit can be made to oscillate from about 1 to 10 MHz. To make the circuit operate at the lower end of its frequency range, use a large value of inductor for L1; for higher frequency operation go to a smaller value. Using a 10- to 22-mH choke allows the circuit to operate down to 100-kHz; with a 100-μH unit, the circuit can operate at frequencies above 10 MHz.

TTL OSCILLATOR

In our next circuit, three inverters (from a 7404 TTL hex inverter) along with crystal XTAL1 are used to form an oscillator that is capable of operating at frequencies of up to 10 MHz. In that circuit (see Fig. 3) two of the inverters (U1-a and U1-b) are used to produce the 180-degree phase shift that is necessary for oscillation. At its series-resonant frequency, XTAL1

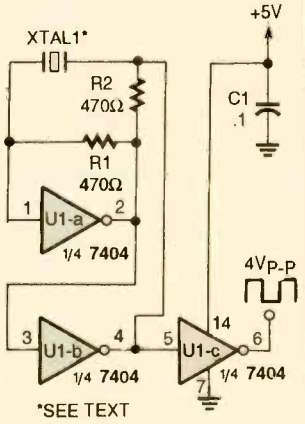

Fig. 3. In this circuit, three inverters along with XTAL1 are used to form an oscillator circuit capable of operating at up to 10 MHz.

provides a low-resistance path between the two inverters to maintain oscillation. The third inverter, U1-c, is used to provide isolation and drive current for any circuit connected to its output.

PARTS LIST FOR THE FET OSCILLATOR

RESISTORS
(All resistors are ¼-watt, 5% units.)
R1—1-megohm
R2—470-ohm

CAPACITORS
C1—0.1-μF, ceramic-disc capacitor
C2—0.001-μF, ceramic-disc capacitor

ADDITIONAL PARTS AND MATERIALS
Q1—MPF102 N-channel JFET
L1—2.2-mH RF choke
XTAL1—1- to 10-MHz crystal
Perfboard materials, enclosure, 9-volt power source, wire, solder, hardware, etc.

PARTS LIST FOR THE TTL OSCILLATOR

U1—7404 hex inverter TTL IC
R1, R2—470-ohm, ¼-watt, 5% resistor
C1—0.1-μF, ceramic-disc capacitor
XTAL1—Quartz crystal, see text.

ADDITIONAL PARTS AND MATERIALS
Perfboard materials, IC socket, 5-volt power source, wire, solder, hardware, etc.

PARTS LIST FOR THE VXO

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—1-megohm
R2—470-ohm

CAPACITORS
C1, C2—680-pF, mica or NPO ceramic-disc
C3—0.01-μF, ceramic-disc
C4—0.1-μF, ceramic-disc
C5—365-pF tuning variable

ADDITIONAL PARTS AND MATERIALS
L1—10-μH RF choke
L2—22-μH RF choke
Q1—MPF102 N-channel JFET
XTAL1—3.579-MHz crystal
Perfboard materials, 12-volt power source, wire, solder, hardware, etc.

VXO

The oscillator circuit shown in Fig. 4 is known in the ham community as a VXO (variable crystal oscillator). Normally a quartz crystal is selected for its fixed-frequency stability, but in some cases, it is necessary to shift the crystal's frequency slightly to achieve a more precise oscillator frequency. That is accomplished in the Fig. 4 circuit by adding a fixed inductor and a variable capacitor in series with the crystal.

Operating at about 3.5 MHz, the oscillator's frequency may be adjusted by about 1 kHz. The actual frequency shift possible depends mostly on the cut

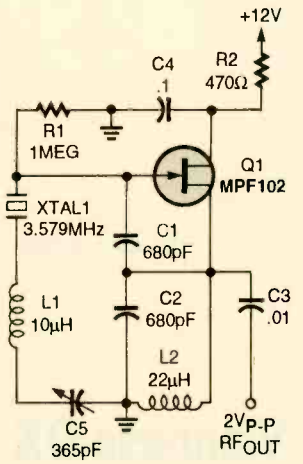

Fig. 4. This FET-based crystal oscillator, known in the ham community as a VXO (variable crystal oscillator), can be made to shift the crystal's frequency slightly to achieve a more exact frequency.

and type of crystal used. Experimenting with different crystals and values of L1 will help determine what combinations work best for a given oscillator.

The oscillator will operate from about 2 MHz to 10 MHz as shown. To operate at higher frequencies, reduce the values of L1, L2, C1, and C2. Increase the values of those components to obtain lower frequencies. Note that as you move the crystal's frequency near its maximum shift, the circuit's stability can suffer, and in some cases the operating frequency goes off into never-never-land. If that happens, re-adjust C5 for stable operation.

DBM OSCILLATOR

Our next oscillator relies on the oscillator section of an NE602 double-balanced mixer for operation. The circuit in Fig. 5, like its predecessors, is also a crystal-controlled oscillator. The output of this circuit is taken at pin 5 of U2. The double-balanced mixer circuit is unbalanced by tying one

(Continued on page 90)

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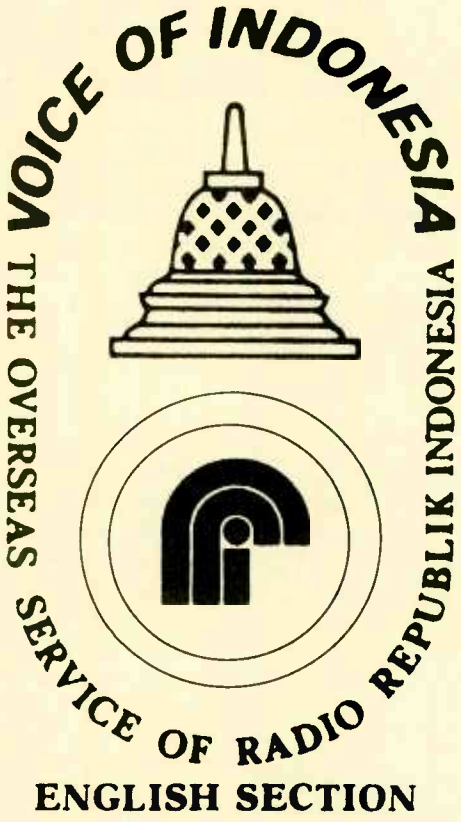
DX LISTENING

By Don Jensen

Viennese DX

Austria is famous for its towering Alpine scenery, its beautiful blue Danube, and its Viennese pastry. It's also the "musical" birthplace of famed composers Mozart, Haydn, and Schubert. But shortwave listeners know it as the home of *Radio Austria International.* It's not the biggest, but it is one of the better international broadcasters in Europe.



The stylized letters RRI, for Radio Republik Indonesia, form part of the identification logo of the station's overseas SW service, the Voice of Indonesia.

While SW transmissions from Vienna were on the air as early as 1929, it wasn't until the 1950's, when Austria was still occupied by the four allied powers (the U.S., Great Britain, France, and the former U.S.S.R) that a modern, domestic, shortwave operation began. An international shortwave service aimed at listeners elsewhere in Europe and overseas arrived in the 1960's, according to Edgar Sterbentz, deputy director of Radio Austria International.

Sterbentz, interviewed by Ian Macfarland on a *Radio Japan* "Media Roundup" DX'ers program, says that Radio Austria International has two 100-kilowatt and two 500-kilowatt transmitters at its Moosbrunn broadcasting site. However, the station is temporarily barred from using both of its high-powered units pending a decision by that nation's highest court in a lawsuit brought by local environmentalists.

Radio Austria International—which has an agreement with *Radio Canada International* to relay its shortwave programming—also has new equipment being added to its Vienna studios, where programs are prepared in six languages: English, German, French, and Spanish, and once a week in Arabic and the "international language," Esperanto.

According to Sterbentz, Radio Austria International has 60 full-time employees, including programmers, studio technicians, and transmitter engineers. In addition, there are another 50 to 60 freelance contributors and part-timers.

Because of the country's centuries of musical tradition, Radio Austria International prides itself on its coverage of that important aspect of Austrian culture. The Vienna Opera Ball and the New Year's Eve concert by the Vienna Philharmonic Orchestra are broadcast to the world on shortwave.

As of this writing, Radio Austria International could be found with English programming at 0130 and 0330 UTC on 9,870 kHz; at 0530 and 0630 UTC on 6,015 kHz; and at 1130 UTC on 13,730 kHz.

Reception reports can be sent to Radio Austria International, A-1136 Vienna, Austria, or, according to the annual "Passport To World Band Radio" reference publication, may be faxed to the station by first dialing the standard international access code, plus the Vienna Austria country-city code, 43-1, then the number 87-878-3630.

REPORT FROM BRAZIL

Reader Delio F.R. Coelho writes from Rio de Janeiro, Brazil to say that although he has been listening to shortwave radio since he was a boy, he thinks that SW is not as popular in his country as it might be. He goes on to say that he is part of a group of listeners working to encourage Brazilians to tune in to shortwave broadcasts. "We are having some success here in Rio de Janeiro," he notes.

Delio (who is 41 and works for an international airline, a job that regularly brings him to the U.S.), says "When I'm in Florida, I carry my Sony ICF-SW1 portable

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radio. I listen to Brazilian stations when propagation conditions permit so that I can have news from home. I've been trying to keep a list of those stations and I'm enclosing a copy to help you answer questions from readers with questions about radio stations in South America." Here are some of them:

Radio Brasil—4,875. Evenings.

Radio Gazeta—5,995. 24 hours.

Radio Globo—6,120. 24 hours.

Radio Record—9,505. 24 hours.

Radio Aparecida—9,630. Mornings.

Radio Bandeirantes—9,645. Mornings.

Radio Nacional—11,780. 1300–0100 UTC.

Radio Brasil Central—11,815. 24 hours.

Radio Anhanguera—11,830. 24 hours. Delio notes that the programs are in Portuguese, and offers to provide more information on Brazilian stations if our readers would like.

"They are not widely known by DX listeners, but there are a wide range of SW stations broadcasting music, culture, and sports."

WHOZAT?

"I'm puzzled, Don," writes Dale Smith of Fresno, CA. "The other day on 11,715 kHz, I tuned in to a station that seemed to be programming continuous reading of Bible verses, repeated over and over, as well as some hymns. What station is this?"

It seems that you heard KJES, perhaps the most unusual U.S. shortwave voice on the air. Recently, some information about that religious broadcaster appeared in Fred Waterer's "Listening In" (a column in DX Ontario, the bulletin of the Ontario DX Association). KJES Radio, which broadcasts from The Lord's Ranch in Mesquite, NM, is operated by Our Lady's Youth Center, located in El Paso, TX.

Of the repetitive programing, the Rev. Richard M. Thomas says, "This is the way we pray before evangelizing to prisoners in jail or patients in the mental hospital. Our intent in broadcasting this type of prayer is similar—to penetrate and dissipate the darkness that envelopes the world."

KJES is scheduled to broadcast from 1300 to 1600 UTC on 11,715 kHz and from 1800 to 2100 UTC on 9,510 kHz. Reception reports can be sent to KJES, The Lord's Ranch, Mesquite, NM 88048.

INFORMATION CENTRAL

For those DX'ers who favor the lower so-called "tropical" shortwave bands, one of the best sources of information about stations, frequencies, and schedules is the "Tropical Bands Survey," which is published annually by the Danish Shortwave Club International (Tavleager 31, DK2670, Greve, Denmark). The survey covers SW broadcasting stations between 2,310 and 5,900 kHz and is priced at 7 International Reply Coupons; 9 IRC's if you want it sent airmail. IRC's are available at your post office.

Smaller SW stations do not always reply to reception reports. That's the sad truth. But sometimes, with the "toughies," your odds of getting a QSL reply improve if you can direct your letter to a specific person at the station who is known to have already replied to other SWL's. That's when a list of current verification signers is of use.

QSL signers, compiled by DX'er Al Quaglieri, is the most comprehensive and up to date list of verification signers and station addresses available. It can be ordered for $3.00 postpaid from the NASWA Company Store, 45 Wildflower Road, Levittown, PA 19057.

DOWN THE DIAL

Why not drop me a line. What are you logging? Questions? Comments about SWL'ing? How about a photo of you listening to your favorite SW station? You can write me at *DX Listening*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735.

Here are some of the stations being reported lately.

EGYPT—9,475 kHz. *Radio Cairo* has been heard at 0207 UTC with Islamic readings from the Koran, translated into English. That is followed by a news broadcast and identification.

INDONESIA—9,675 and 11,755 kHz. The *Voice of Indonesia* is scheduled on those two frequencies at 0030–0400, 0800–1300, and 1730–2100 UTC. English programs are aired at 0100–0200, 0800–0900, and 2000–2100 UTC.

JAPAN—11,865 kHz. *Radio Japan* has been reported at 1910 UTC, in English, with a program on sumo wrestling.

KENYA—4,935 kHz. The *Kenya Broadcasting Corp.* has been noted on this frequency at 0249 UTC with pop music, followed at 0300 by the station ID and the news in English. ■

*Credits: Mark Anderson, MI; Jim Clar, NY; Richard D'Angelo, PA; James Gagliano, NY; Marie Lamb, NY; Kevin Murray, OR; Tony Orr, VA; Dan Unruh, WA; North American SW Association; Ontario DX Association, P.O. Box 161, Station A, Willowdale, Ont. M2N 5S8, Canada.

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Radio and the Solar Eclipse

By Joseph J. Carr, K4IPV

In the December, 1993 column, we introduced you to the idea of using your radio skills in scientific experiments. That type of effort may especially appeal to high school students who need science-fair topics, but it also appeals to "students" of all ages and persuasions. In the December issue (as well as in a note in the January, 1994 issue), the topic was looking for random events such as sudden ionospheric disturbances (SID's).

This month, however, we are going to give you an opportunity to use the radio solar-observation idea on a real and predictable event: the annular solar eclipse coming up on May 10, 1994.

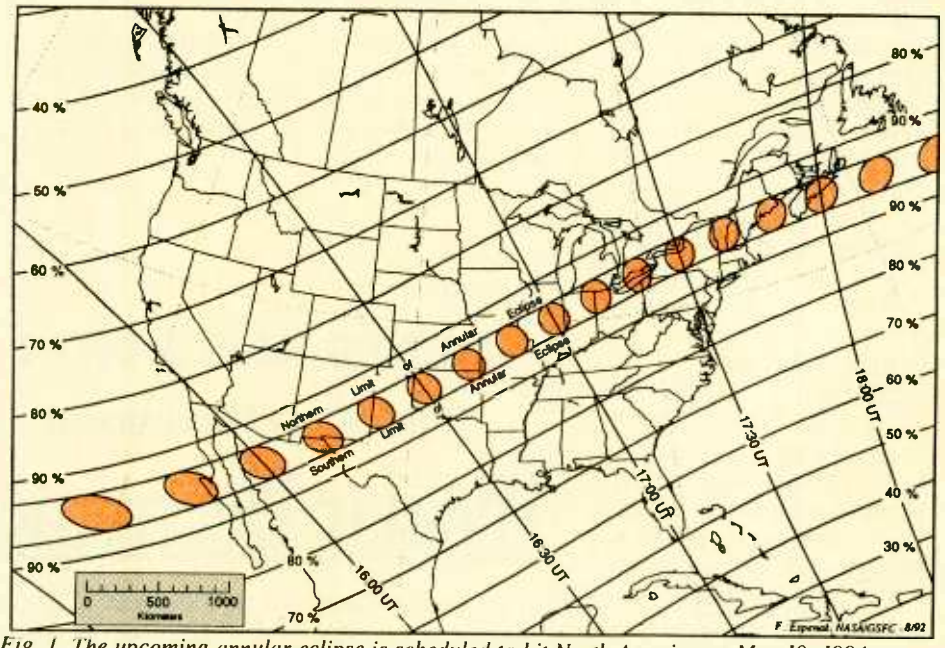

Fig. 1. The upcoming annular eclipse is scheduled to hit North America on May 10, 1994, entering the USA about where Texas, Mexico, and New Mexico share common borders, continue in a northeasterly direction (passing over the Oklahoma panhandle, into Kansas, Missouri, and central Illinois, across Indiana, Ohio, New York, and the New England states), and exit the continent at Nova Scotia.

SOLAR ECLIPSE

A solar eclipse occurs when the Moon passes between the Earth and the Sun during daylight hours, thereby preventing Sun light from reaching the Earth. The solar eclipse of March 7, 1970 passed in totality over Norfolk, Virginia where I was attending Old Dominion University. It was one of the "thrills of a lifetime" to be on Ocean View Beach to watch the event. Because that was a total eclipse, the Sun was totally obscured, except for the brilliant corona.

An annular solar eclipse (like the one that will occur in May), on the other hand, is not the same as the total eclipse that we experienced in 1970 and again two years ago for those in the Baja California area. In an annular eclipse, the perceived size of the lunar disk is smaller than the solar disk, so the Sun appears as a blackened ring of fire in the sky. One source claims that this event will be the last of its type to be seen over so much of the USA and Canada until 2017 AD.

Warning! Direct viewing of a solar eclipse is always dangerous. Looking at the eclipse with the naked eye can cause permanent spotting of the retina (you'll always see that eclipse!) or blindness. Furthermore, attempting to view an eclipse through a telescope without knowing how to project the image onto a blank sheet of paper will result in immediate irreversible blindness!

RADIO PROPAGATION

Radio propagation effects can be seen during solar eclipses. Radio propagation is seriously affected by the presence of the Sun, which accounts for the difference in performance of the HF bands between day and night. During the day, the upper layers of the ionosphere (*F1* and *F2*) are heavily ionized. As a result, during the daytime, the frequencies from 9 or 10 MHz and up "see" the ionosphere as a "radio mirror" that reflects signals back to Earth. That's the origin of "skip" communications, and all that luscious daytime DX. At lower frequencies during the day, the lowest region of the ionosphere is also ionized, but acts somewhat differently: it absorbs low-frequency energy, preventing skip. As a result, during the daytime, D-layer absorption renders the

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frequencies below 9 MHz or so either short skip or ground-wave only. Monitor the 160-, 75/80-, and 40-meter bands during the daylight hours and you will hear only "locals" out to several hundred miles.

At night, the Sun's energy is on the other side of the Earth, so the ionization of the ionosphere begins to collapse. Starting in the early evening, first 10-meters, then 15-meters, and 20-meters will become deionized, and the *F*1 and *F*2 layers contract into one zone. The bands above 9–10-MHz begin to drop off until they no longer support any skip at all. At the same time, the lower frequencies come alive with DX (indicating skip). The 40-meter band is especially interesting because it is close to the transition region between the two sorts of behavior.

In all of that activity, the maximum usable frequency (MUF) is generally controlled by the F-layer, while the lowest usable frequency (LUF) is controlled by the D-layer. For a brief period during a partial or total eclipse of the Sun, the energy from the Sun is unavailable to ionize the Earth's atmosphere. During that period, along the path of the eclipse, there is a sudden return to night time conditions. Strange propagation is noted, especially in those bands most affected by D-layer absorption.

The upcoming annular eclipse on May 10 is predicted to hit North America (see the map in Fig. 1) in about the middle of Baja California at about 15:45 hours Universal Time. (UT is GMT—"Zulu" time—*i.e.*, 5 hours ahead of EST.) The "totality" track will enter the USA about where Texas, Mexico, and New Mexico share common borders; continue northeast over the Oklahoma panhandle about 16:30 UT; into the midwestern states of Kansas and Missouri, and into central Illinois by 17:00 UT. It will continue across Indiana, Ohio, New York and the New England states, exiting the continent at Nova Scotia. All of the USA, most of Canada, and nearly all of Mexico will be within at least the 50 percent bands of the eclipse pathway.

SOME EXPERIMENTS FOR HAMS

In the December, 1993 column, I mentioned a high-school science fair student who monitored WWV to study solar activity. Hams can do that trick as well, but there is also another approach: use your transmitters to study the effects. Most such studies in the past have used the 75/80-meter bands because they are most affected, although some experiments can also be run on 40-meters and up. I suspect that the best results can be found on 75/80-meters, where D-layer effects are seen best, and also on the ham band closest to the MUF for that day. With the WARC-79 bands in full operation, hams have opportunities that didn't exist in previous eclipses.

Several different scenarios present themselves. The simplest is to just monitor the bands and log the callsigns and locations of stations (found in Callbook) heard over a narrow (say, 25-kHz) region of the band. Another method is to form a group of friends around the country and to pick a frequency to test. A small number of ham stations spaced at various distances along and across the path of the eclipse, but not more than about 1000 miles between the two most distant, could transmit in rotation for ten seconds at a time (keeping required ID's in mind!), while a dozen or more others monitor the signal strengths on an S-meter.

If you don't like CW, then try using 400-Hz modulated CW on the SSB/AM portions of the band. In that case, an AC multimeter could be used to measure signal strength. The experiment should be done for several consecutive days, not just to test the synchronization between stations transmitting in rotation, but also to establish a baseline of data.

Another method is to select just one station, and set up a schedule. In that type of experiment, try the same 10-second-at-a-time transmissions, back and forth so that you can see bidirectional effects. Again, make the same measurements several days in advance in order to establish averages.

The time of the trials, no matter which method is selected, should cover three or four hours centered on the time when the eclipse passes over, or as close as it will come, to your location. Odd effects are seen as the eclipse approaches or recedes. Also, keep very good time records. A quartz controlled clock set to WWV or WWVH just before the trials begin usually will yield close enough time data.

If you participate in monitoring the eclipse, you'll have the satisfaction of monitoring one of Nature's more spectacular shows. I would appreciate hearing about the results of any experiments that you conduct. Send details to me at PO Box 1099, Falls Church, VA, 22041. ■

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SCANNER SCENE

By Marc Saxon

Underground Chatter

The *Realistic PRO-44* is a new handheld that offers 50 memory channels in the following bands: 30–54 MHz, 108–174 MHz, and 380–512 MHz. It features one-hour memory backup without batteries, a special battery-saver circuit, and scan/search function. There is also an extra memory channel that temporarily saves a frequency that you locate during a search. The unit operates at 16 channels per second in scan and search modes.

Realistic's PRO-44 handheld offers 50 memory channels.

The PRO-44 has IF frequencies of 10.7 and 455 kHz, and uses a crystal and ceramic filter. The selectivity is ±10 kHz at −6 dB; ±20 kHz at −50 dB. The sensitivity is 1.0 μV on all bands except the VHF aeronautic band (108–137 MHz), where it is 2.0 μV. The unit operates from six "AA" batteries or an external 9VDC source.

The Realistic PRO-44 exhibits the modern, rounded-case styling that the company has been using in some of its handhelds. See it at any Radio Shack store.

UNDERGROUND RADIO

Communications enthusiasts who venture into any metropolitan subway system invariably wonder how two-way radios work in such an environment. Think about it: A subway system extends over a wide geographic area, and it is sealed underground in a metal framework that contains electrified tracks.

In this place, two-way communications for various services must be operated, and the need to cover the entire subway system. A single subway system could have separate two-way networks for police operations; train dispatching; and the maintenance of tracks, towers, and yards.

Getting VHF radios to work effectively throughout a system is seldom easy, and may require the use of a large number of remote receive sites to pick up the signals from the portable units used by the employees. The New York City Transit Authority Police use more than 65 miles of special radiating cable strung through the subway tunnels to provide communications in that system's many "dead spots."

Frequencies used by the New York City Transit Authority Police include 160.305, 160.50, 160.695, 160.905, and 160.965 MHz.

TRUNKING TALK

Scanner monitors have observed that some trunked two-way systems have an especially annoying feature. At the end of each transmission, a series of tones that form a musical jingle are played. That wastes about three seconds, hanging up the scanner so it can't go on to search out the channel with the next part of the conversation.

That effect is entirely intentional and is done for the express purpose of thwarting attempts at unauthorized monitoring. The tune played is GE's "it brings good things to life" jingle because that is the distinctive signature of the Ericsson/GE trunked system.

One way to foil that system is with the *Comsec SA 78-E*. This device, when hooked to a scanner, senses when a message has ended, mutes the scanner, then lets it ignore the tones to immediately resume searching for another transmission. It's all automatic, and it ignores signals other than the Ericsson/GE trunked ones. Models are presently available for the Realistic PRO-2005 and

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PRO-2006, with others in development.

Installation requires soldering four wires to easily accessible points on top of the radio's upper circuit board. Instructions are provided. For more information, contact Comsec Associates, Inc., 2219 West Olive Avenue, Burbank, CA 91506, or phone 818-502-0000.

ACARS, ANYONE?

Monitoring the portion of the VHF aeronautic bands reserved for airline-company communications (128.825–132.0 MHz), one often hears the term "Acars" used by pilots. Acars refers to a non-voice communications system used to carry operational data between the airline ground stations and airliners. The incoming information comes up on video screens, and it is sent by keyboard.

This data is sent in abbreviated form, and might cover such things as weather information, gate assignments, cargo loading weights, fuel needs, special passenger requirements, and other operational concerns. The data is sent out in quick bursts, and has a sound like a "ping." it seems to go out continuously, day and night.

Acars signals can be picked up on any scanner that will receive the VHF aeronautic band. Listen for Acars transmissions on 131.555 MHz, with 130.025 MHz also used in busy areas. In Canada, 129.125 MHz is used.

Decoding the Acars transmissions requires special equipment fed data by the audio output of a scanner tuned to an Acars frequency. This equipment, most notably, includes the *Universal M-400* or *M-1200* produced by Universal Electronics, 6830 American Parkway, Reynoldsburg, OH 43068.

PHONE HOME

A letter from Ed, who lives somewhere in New Jersey, mentioned that he put an all-band scanner antenna on a mast mounted on the chimney of his two-story home. The top of the antenna is about 30 feet above ground level. Using this antenna with his Realistic scanner, he put some effort into seeing what could be heard on the cordless-telephone channels.

Ed told us that he was amazed to find that he was able to pick up calls from miles away. He knows this because one of the units he can regularly receive is a real-estate agency that has a sales agent who uses a cordless phone, and mentions the company name all the time. Ed reported that this agency and its location are well known, and it's a good five miles from his home.

The bulk of the calls Ed told us he heard by tuning the cordless frequency band were, as he put it, "an earful." He recommends it highly. Specifically, he mentioned the large number of dingbats and troublemakers he was able to monitor. Ed, is that a nice way to speak about your neighbors?

If you haven't yet put an ear there, the band runs form 46.61 to 46.97 MHz. You might find it of interest, as have many other scanner owners.

KEEP IN TOUCH

You are invited to send us your questions, comments, and frequencies. Write to *Scanner Scene*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. Your input helps make this column the best that it can be! ■

ANTIQUE RADIO

(Continued from page 74)

rig of 1930's vintage; and a group of sinister-looking Nazi "people's radios" done in gleaming black Bakelite. I have to admit that I don't have good notes on the contest winners, but will try to include that information in the next column.

Another run-of-the-conference feature was the book fair, set up in an alcove next to the registration area. Here, the interested attendee could browse through and purchase most of the books and pamphlets currently available to the antique-radio hobbyist. Antique Radio Supply, Antique Radio Classified, Antique Radio Club of America, and Vestal Press, not to mention the Antique Wireless Association itself, all showcased their publications. In addition, there were a few used-book dealers offering nice selections of early titles relevant to our hobby.

THE FLEA MARKET

I've been to many antique-radio swap meets and hamfest flea markets in my time, but I've never seen any vintage-equipment marketplace as extensive as the bazaar that was spread out over the Marriott parking lot during the AWA conference.

It should be noted right away that this was not the place to steal a nice old wood-cabinet table model or an early three-dialer for a couple of bucks. Both the sellers and the buyers who were competing to purchase their offerings were too sophisticated for that. And, of course, many of the sellers were professional marketers who had trucked their wares for many miles to take advantage of the high concentration of serious collectors. Unlike the private sellers, these folks regularly move their stock from event to event. They weren't about to drop their prices—even at the end of the show.

What the flea market definitely did offer the collector was variety and shopping convenience. Here was the opportunity to find that elusive set needed to fill a special niche. Here, too, could be found a complete selection of such restoration aids as reproduction knobs and grille cloths.

I was most startled at the prices being asked for small table-model sets—even those brown Bakelite jobs we used to be able to pick up for just a few bucks. This reflects, I'm sure, the interests of the new collectors entering our hobby. Many of them seem to be attracted to the smaller pieces that are easier to restore and to display in today's smaller living spaces. It seemed easier to find realistic prices on the larger 1920's battery sets; many were priced at fair, if not modest, levels.

Test equipment was priced better, however. I picked up several items that had been on my want list for some time, including a Sprague capacitor checker, a Rider Chanalyst, and the rare military-surplus BC221-AK heterodyne frequency meter—the only model offering a modulated signal.

Well, it looks like I've run out of space before I could get to the AWA museum. If you will be patient with me for just a little longer, we'll discuss the museum next month! In the meantime, for more information about the Antique Wireless Association, write to Joyce Peckham, Secretary, Box E, Breeseport, NY 14816. ■

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MOTORCYCLE ALARM

(Continued from page 39)

cardboard, then applying hot glue to both sides of the board. Care should be taken that hot glue does not get inside the ball-bearing housing. Repair or modification can still be done later by heating up the module in the oven until the hot glue runs off the board.

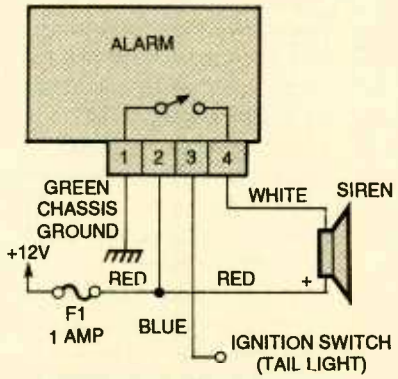

Fig. 6. The Radio Shack #49-489A piezoelectric siren (which draws about 0.2 amps and is very directional) is a prime candidate for use in the Motorcycle Alarm. This arrangement is recommended for use in motorcycles with unusually small batteries.

Installation. The location of the alarm is important. It should be in a secure place. The most common place is under the seat. That placement also has the convenience of being close to the battery and cycle wiring. On most modern motorcycles, whenever the ignition switch is on, the lights are turned on as well. If that is true of your cycle, it maybe easier to locate and use the hot taillight wire in place of the ignition switch.

For best results, the board should be laying slightly off level when the motorcycle is in its parked position. When the cycle is on the kick stand, the alarm will be tilted slightly with the cycle. Adjusting the tilt angle will affect the sensitivity of the alarm; less tilt gives more sensitivity. Adjust the tilt to your liking, keeping in mind that you don't want a small gust of wind to set off the unit.

Figures 5 and 6 illustrate two options for installation. Figure 5 shows an option (a second horn) that is available on some cycles, but that installation scheme also applies to single-horn cycles. It is recommended that only one horn be enabled via the alarm to limit the current drain. That is easily done by adding a diode in the +V line of the second horn. That is necessary to prevent current from flowing through the second horn when the ignition switch is off.

Figure 6 shows the Motorcycle Alarm used with a siren. The Radio Shack #49-489A piezoelectric siren (which draws about 0.2 amps and is very directional) is a prime candidate for this application. The only problem with that configuration is that space will have to be found for the siren. However, it is well worth it if the motorcycle has an unusually small battery, as do some smaller motorcycles that do not have electric starters.

Protecting your favorite set of wheels makes good sense. The project that was presented in this article can provide you with that protection at a reasonable price. Why not build one today! ■

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LOUDSPEAKER DESIGN

(Continued from page 44)

Finally, you will be prompted for the tweeter's impedance at the selected crossover frequency. To find that value, use the same strategy mentioned above for the woofer, using the nominal impedance of the driver if necessary.

Once all the above information has been entered, the program will automatically calculate the inductor/capacitor values and display them for you. Copy the values down for future reference.

Now that we have completed this last in our series of loudspeaker design programs, I hope that you all have begun to feel a little more at home with speaker systems, and can start to do a little designing and building for yourselves without undo fear of failure. Admittedly, the speakers you can design using these programs are fairly basic, but they are surprisingly good performers that can give you years of enjoyable listening. ■

125-MHz LOGIC PROBE

(Continued from page 60)

do that, the green LED should light. Next, place a +5 volts on pin 1. Now the red LED should light and the beeper should sound. If neither of those event occur, check the solder connections on the board.

Using the Logic Probe. Basically, there are no special instructions or techniques needed to use the probe. Simply use it as you would any other logic probe. The only difference between it and other probes is its superior frequency response.

I have used my probe for many digital applications and can personally testify to both its accuracy and reliability. For those of you who want to know, yes, I have used it at frequencies up to 100 MHz (the limit of my calibration equipment) and seen it capture pulses consistently every time.

A logic probe is a valuable and time-saving piece of gear. Every serious technician has one. ■

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input (pin 1) to ground. That allows the RF to appear at the mixer's output (pin 4 and 5), isolating the RF output from the oscillator circuit.

The NE602's oscillator is designed to operate at a maximum frequency of 200 MHz. So just about any crystal that you might have should be okay. The values of C1 and C2 are fine for crystal frequencies between 3 and 10 MHz. The values of those two capacitors can be reduced to operate the circuit at frequencies above 10 MHz; increase the value of those capacitors for frequencies below 3 MHz.

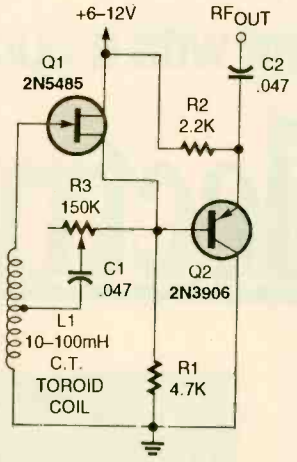

Fig. 6. The VLF oscillator uses a large toroid coil as the frequency-determining component and a 2N5485 FET as the active device.

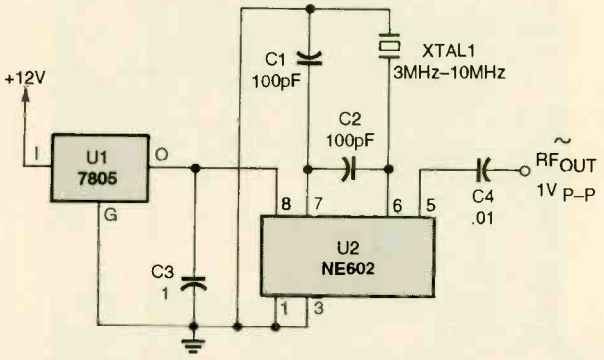

Fig. 5. Built around the oscillator section of an NE602 double-balanced mixer, the operating frequency of this is also crystal controlled.

PARTS LIST FOR THE DBM OSCILLATOR

SEMICONDUCTORS
U1—7805 5-volt, 1.5-amp voltage regulator, integrated circuit
U2—NE602 double-balanced mixer, integrated circuit

CAPACITORS
C1, C2—100-pF mica or NPO ceramic-disc
C3—0.1-μF, ceramic-disc
C4—0.01-μF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
XTAL1—3- to 10-MHz crystal
Perfboard materials, 12-volt power source, IC socket, wire, solder, hardware, etc.

As long as the NE602's power supply voltage is kept below 8 volts, the 7805 voltage regulator isn't necessary. In fact, the oscillator functions fine from a 4- to 8-volt supply voltage and draws less than 10 mA of current.

VLF OSCILLATOR

The VLF oscillator shown in Fig. 6 uses a large toroid coil as the frequency-setting component and a 2N5485 FET as the active device. Inductor L1 and its distributed capacitance sets the oscillator's frequency to about 50 kHz.

The circuit's feedback control (R3) allows for a very fine adjustment of the circuit's gain. Potentiometer R3 can be adjusted so that the circuit just breaks into oscillation. In that condition, the circuit can be used as a

PARTS LIST FOR THE VLF OSCILLATOR

SEMICONDUCTORS
Q1—2N5485 general-purpose N-channel JFET
Q2—2N3906 general-purpose PNP silicon transistor

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—4700-ohm
R2—2200-ohm
R3—150,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS
C1, C2—0.047-μF, Mylar capacitor
L1—10- to 100-mH toroid coil
Perfboard materials, 6–12-volt power source, wire, solder, hardware, etc.

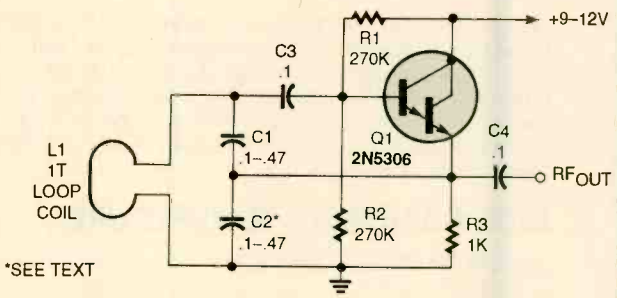

Fig. 7. This Darlington-based oscillator uses a very large capacitance-to-inductance ratio to achieve oscillation.

PARTS LIST FOR THE LC OSCILLATOR

RESISTORS
(All resistors are ¼-watt, 5% units.)
R1, R2—270,000-ohm
R3—1000-ohm

CAPACITORS
C1, C2—0.1- to 0.47-μF, Mylar
C3, C4—0.1-μF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
Q1—2N5306 NPN Darlington transistor
L1—See text
Perfboard materials, 9–12-volt power source, wire, solder, hardware, etc.

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proximity detector. Any capacitive loading of L1 will reduce the oscillator's output, which can be monitored at the output to indicate a near-by object. Transistor Q2 is used as a buffer amplifier to prevent the connected circuit form loading the oscillator.

LC OSCILLATOR

The LC oscillator shown in Fig. 7 uses a very large capacitance-to-inductance ratio to set the circuit's operating frequency. The tuning circuit is comprised of a 12-inch single-turn loop of No. 12 copper wire, and a pair 0.1-μF capacitors. The series-connected capacitors are wired across the loop to resonate the circuit at about 500 kHz.

A high-gain, high input impedance, Darlington transistor is used to match and isolate the tuned circuit from the output. The oscillator can be tuned to a lower or higher frequency by changing the values of C1 and C2. Larger capacitance values lower the oscillator frequency, while smaller values increase the frequency.

A larger or smaller loop can also be used to produce similar results. Larger loops produce lower frequencies and smaller loops generate higher frequencies.

That's all the room we have for this month. Until next time we meet, have fun. ■

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AMERICAN CANCER SOCIETY

PRODUCT TEST REPORT

(Continued from page 22)

luminance signal-to-noise ratio was also superb, measuring 62.9 dB for a reference level of 100 IRE.

As for the audio performance of this player, it certainly equaled or surpassed that of many audio-only CD players in the same price category. The maximum audio-output level was 2.142 volts. The A-weighted signal-to-noise ratio measured 95.2 dB, while stereo separation between channels measured between 101.1 dB and 104.0 dB for a 1-kHz test signal, depending upon which channel was being measured. The total harmonic distortion at 1 kHz, for a maximum recorded signal, was an insignificant 0.0048%. The frequency response was never off by as much as 0.1 dB over the range from 10 Hz to 20 kHz.

The Kodak PCD 5870 consumed 15.5 watts of power in the play mode. The random-access time from track 1 to 2 was 1.66 seconds, while from track 20 to track 21, random-access time was 0.72 seconds. The scan time from track 1 to 21 was 1.26 seconds, while scan time from track 21 to track 1 measured 3.32 seconds. There is a delay after the first button on the remote is pressed when entering a track number directly; that is to allow for a 2-digit number to be entered. If two buttons are pushed one after another, this delay is defeated. That accounts for the discrepancy between the random-access time and the scan time.

HANDS-ON TESTS

Kodak supplies an excellent "demo" disc with this product and, just by watching this disc, we were able to quickly learn how to use the many special Photo-CD features. The demo disc even allows you to choose among several languages for narration and instruction. If, after viewing the demo disc you still need help, there is, of course, a well written and well illustrated owner's manual that's also written in three languages (English, Spanish, and French). The pictures observed when playing the demo disc, as well as those viewed on other photo CD's, were crisp and had excellent color reproduction. Being able to pan and "crop" photos and to expand the size of a framed portion of a photo was extremely useful and was, of course, something that could not be done with the original prints or slides.

If you are an avid photographer (or even if you shoot a roll of film only when you go on vacation or attend an important family event), and if you have yet to choose a compact disc player, having the "best of both worlds" by selecting a photo CD player such as the Kodak PCD 5870 would seem like a very wise thing to do—especially at its suggested retail price of only $549.00.

For more information on the Kodak PCD 5870 contact the manufacturer (Eastman Kodak Co., 343 State St., Rochester, NY 14650) directly, or circle no. 120 on the Free Information Card. ■

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FCC EXAM

(Continued from page 67)

A. Height, transmitter power and antennas of satellite
B. Length of transmission line and impedance match between receiver and transmission line
C. Preamplifier location on transmission line and presence or absence of RF-amplifier stages
D. Height of earth antenna and satellite orbit ■

FCC-TEST ANSWERS

1 A	39 A
2 C	40 B
3 C	41 D
4 B	42 D
5 A	43 A
6 B	44 A
7 A	45 B
8 A	46 B
9 B	47 A
10 D	48 C
11 B	49 D
12 C	50 B
13 A	51 C
14 A	52 C
15 B	53 B
16 A	54 A
17 D	55 B
18 B	56 A
19 D	57 D
20 D	58 B
21 B	59 D
22 D	60 C
23 B	61 A
24 B	62 A
25 A	63 C
26 C	64 B
27 B	65 C
28 C	66 A
29 B	67 B
30 A	68 B
31 B	69 C
32 A	70 C
33A	71 A
34 D	72 A
35 A	73 B
36 A	74 C
37 B	75 B
38 B	76 A

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STEP UP TO CD-ROM

(Continued from page 36)

to search this disc for information by title, topic, cast, category, and so on. Over 19,000 movies are reviewed on this disc. This $79.95 disc is the perfect way to prepare for your next trip to the video store, in addition to being the perfect companion for any home-video collector.

With all of the unusual applications that can be found on CD-ROM, we still don't want to lose sight of everyday productivity applications. And neither does Microsoft with their *Word for Windows and Bookshelf* combination on CD-ROM. We were already familiar with Word for Windows' powerful word-processing capabilities, so we were eager to see what it's like when packaged with *Bookshelf*, which puts seven popular references right on Word's toolbar. Word is the same familiar program, except that one new button on the toolbar instantly brings up *The Concise Columbia Encyclopedia, The American Heritage Dictionary, Roget's II Electronic Thesaurus, The World Almanac and Book of Facts 1992, Bartlett's Familiar Quotations, and the Hammond Atlas.* The real beauty is that those references remain on the CD-ROM and don't clutter up your hard drive. This $595 package is a great reference tool for any writer.

Education. Another disc from National Geographic, *The Presidents: It All Started With George*, is a multimedia look at the presidency of the United States. More than 1200 photos, motion-picture footage, music, audio clips, and other facts illustrate the lives and times of the presidents. The disc sells for $99.00 to educators and $149.00 retail. The last National Geographic disc we looked at is their *Picture Atlas of the World*. This disc lets you jump from a map of anywhere in the world right into the sights and sounds of the streets and countrysides without calling a travel agent.

If stargazing is something you find interesting, then you'll probably feel the same way about Virtual Reality Laboratories' *Distant Suns* disc, the desktop planetarium for Windows. The program lets you see a display of the night sky from anywhere on earth, any day of any year, from 4173 B.C. to 10,000 A.D.—so you can only use this disc for another 8006 years.

The program can display thousands of stars, as well as galaxies, nebulas, and star clusters, so it's easy to find and identify celestial objects. You can also add custom objects to create your own personal night sky. If you have a printer, you can produce star charts to take with you on your next stargazing outing. If you're fortunate enough to have a laptop PC, you'll be able to bring the water to the horse—or so to speak. Distant Suns has a suggested price of $99.95.

While it's unlikely that CD-ROM's will ever replace *all* paper books, some books are more likely to be replaced than others. Language text books come to mind here. If that's so, the HyperGlot Software Company is onto something with their language software on CD-ROM. After all, what better way is there to learn a foreign language than to hear the words spoken properly. That's something that CD-ROM-based learning material can offer that paper books just can't. HyperGlot offers software-based help in languages ranging from French to Chinese to Russian.

We looked at two CD-ROM sets from HyperGlot, both on Spanish. The first one, *Berlitz Think & Talk Spanish*, contains 8 CD-ROM's, and is intended for a beginner in Spanish. The discs let you hear Spanish used in everyday situations presented via dialog, pictures, and music, all with the user having full interactive control. Fifty lessons are included and there's a 10,000-word on-line bilingual dictionary available at the touch of a button. *Think & Talk Spanish* has a suggested retail price of $199.00. The second set, *Learn to Speak Spanish*, contains 2 discs and 30 context-driven lessons, and a slimmer price of $99.00.

Conclusion. It has been our intention to interest you in CD-ROM. Because the faster the general public accepts and begins to use CD-ROM's in day-to-day tasks, the quicker new applications will come to market, and the cheaper they'll get. We've discussed only a sampling of what's out there, and there's probably hundreds of new applications on the horizon. So it's now up to you to keep-up with technology and take the multimedia plunge. ■

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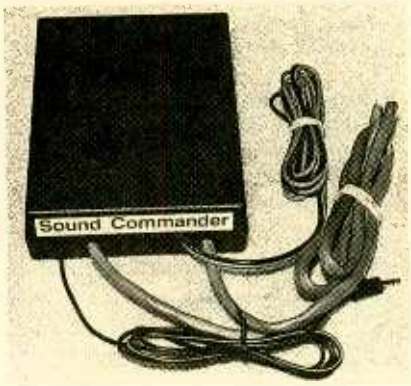
lent until someone sends a personal Touch-Tone code. When the proper code is received, the built-in speaker is turned on, allowing the call to be heard. A front-panel LED also illuminates, letting you know that someone called you while you were away from the radio.

The $99.95 MoTron DTMF (or Touch Tone) device can be used with any FM receiver, transceiver or scanner, including VHF/UHF amateur radio, business-band, marine-VHF, volunteer fire department, and AM CB radios. If the calling station doesn't have a built-in Touch-Tone pad, inexpensive memory tone dialers are available from many sources; you can place the dialer next to the microphone to send the calling code.



The Electron Processing Sound Commander's motto is, "never miss a scanner call again." The device allows mobile-scanner users to effectively monitor their car radio and scanner simultaneously. Connection to the car-radio speaker leads and scanner is simple. It's designed for use with car radios of up to four speakers and not more than 25 watts per channel.

Mobile-Rig Accessories Most mobile receivers, scanners, and transceivers have small internal speakers, and their harsh sound puts a crimp in the quality of reception. Although many radios have their speaker installed on top of the unit so that the user hears it best, many sets aim the speaker downward—the worst way. The set's audio output is directed where it's largely absorbed. Thus, an external speaker can be highly desirable. Extension speakers markedly improve signal intelligibility when positioned properly, and they're probably much more efficient than the sets' internal speakers.

Almost any mobile speaker, even CB types, will yield adequate results. However, you'll find the quality, lightweight units offered by manufacturers such as Kenwood, Yaesu, ICOM, and MFJ Enterprises better than CB style units. Those units can benefit any mobile installation.

In some cases where your radio has inadequate audio output and you're operating under high-noise conditions, consider an amplified speaker, such as the 10-watt SP-10 mobile amplified extension speaker offered by Grove Enterprises for $39.95. Grove also sells a $9.95 clip-on mini speaker for handheld radios that provides solid, concentrated sound when clipped to your lapel or collar.

What has priority, your mobile scanner or your car radio? Switching between communications radios, car radios, and tape players can be confusing. However, not switching, can lead to sensory overload, to say the least. The Electron Processing Sound Commander is a mobile scanner interface that eliminates missed radio calls caused when a car radio is used in conjunction with a mobile scanner. The unit switches the auto speakers to your scanner, muting the car stereo, whenever a call comes in. Connecting it to the car-radio speaker leads and the scanner is simple and provides sensitive VOX operation with any scanner. The 12 VDC unit is for use with car radios with up to four speakers and not more than 25 watts per channel. It's priced at $80.

Conclusion. In this article we've presented an audio tour through the contemporary radio listening post. We also examined a variety of audio accessories and add-ons including speakers; headphones; tape recorders; automatic-recorder controls; active, passive, and smart audio filters; signal decoders; and specialized add-ons for the mobile listening post.

In the final analysis, you must decide which, if any, audio accessories are valuable to you. Hopefully, the suggestions and observations we provided in this article will help make your accessory-related decisions both logical and wise. ■

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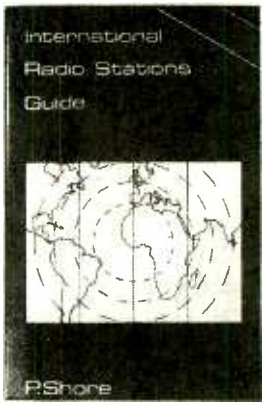

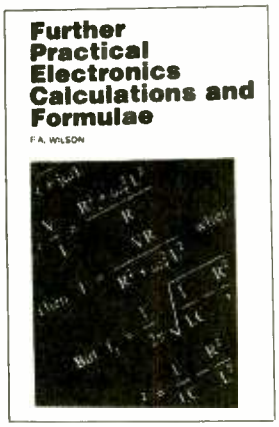

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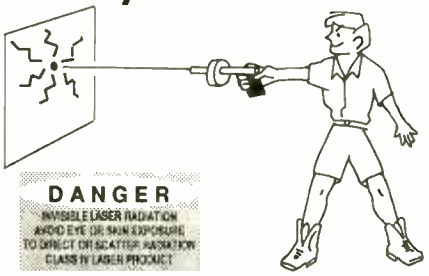


Advanced project produces a burst of light energy capable of burning holes in most materials. Hand-held device uses rechargeable batteries. 500 joules of flash energy excite either a neodynium glass, yag or other suitable 3" laser rod. This is a dangerous CLASS IV project (individual parts/assemblies available).

LAGUN1 Plans $20.00
LAGUN1K Kit / Plans ..... Price on Request

Extended Play Telephone Recording System

READY TO USE! Automatically controls and records on our X-4 extended play recorder, taping both sides of a telephone conversation. Intended for order entry verification. Check your local laws as some states may require an alerting beeper.

TAP20X Ready to Use System $129.50

Shocker Force Field/ Vehicle Electrifier

Neat little device allows you to make hand and shock balls, shock wands and electrify objects, charge capacitors. Great payback for those wise guys who have wronged you!

SHK1KM Easy to Assemble Electronic Kit $24.50

Blaster Pulser

Pocket-sized wand produces 100,000 watts of power for personal defense, field and lab use, etc. BLS3 Plans $10.00
BLS3K Kit / Plans $69.50

Homing / Tracking Transmitter

Beeper device, 3 mile range.

HOD1 Plans .....$10.00 HOD1K Kit / Plans $49.50

Listen Through Walls, Floors

Highly sensitive stethoscope mike.

STETH1 Plans.....$8.00 STETH1K Kit/Plans $44.50

NEW! Telephone Line Grabber / Room Monitor

ALL NEW! The Ultimate In Home or Office Security & Safety! Simple to Use! Call your home or office phone, push a secret tone on your telephone keypad to access either: A. On premises sounds and voices; or B. Existing telephone conversation with break in capability for emergency messages. CAUTION: Before assembly or use, check legalities with your state Attorney General's office as you may require "beepers" or other 3rd party alerts.

TELEGRAB1 Plans Only $10.00
TELEGRAB1K Kit / Plans $99.50

Ultrasonic Blaster

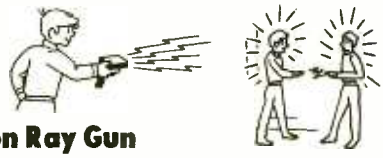
Laboratory source of acoustical shock waves. Blow holes in metal, produce "cold" steam, atomize liquids. Many cleaning uses for PC boards, jewelry, coins, small parts, etc.

ULB1 Plans.....$10.00 ULB1K Kit/Plans.....$69.50

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.

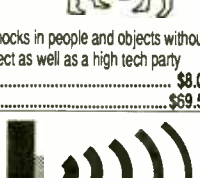
ITM2KM Easy-to-Assemble Electronics Kit $49.50
ITM2 Plans only, credit-able to kit $10.00



Ion Ray Gun

Projects charged ions that induce shocks in people and objects without any connection! Great science project as well as a high tech party prank. IOG3 Plans $8.00
IOG3K Kit/Plans $69.50

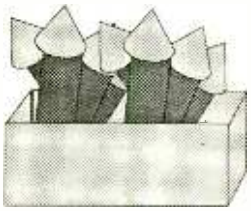
Invisible Pain Field Generator



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

SUPER GIANT SMOKE ASSORTMENT



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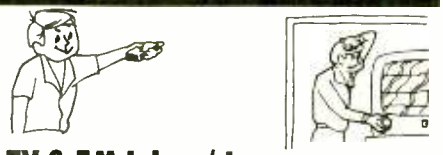

TV & FM Joker / Jammer

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 $24.50

Visible Beam Laser

High brightness red HeNe laser visible for miles.

Produce your own light show! Projects a visible beam of red lite clearly visible in most circumstances. Can be used to intimidate by projection of a red dot on target subject. Also may be used to "listen in" using our laser window bounce method #LLIS1 below. *Easy to build module makes 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

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LLIST1K Kit of Both Transmitter and Receiver $199.50
LLIST20 Assemble with Laser Gun Site $299.50

5mw Visible Red Pocket Laser

Utilizes our touch power control!

VRL5KMX Kit / Plans $119.50

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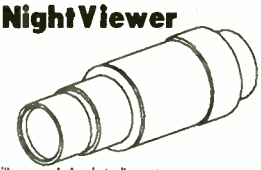

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Popular Electronics, February 1994

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ProGold is specifically formulated to improve conductivity and protect gold, base metals and other precious metal surfaces. Use on gold connectors and contacts for maximum performance and protection. A common problem with gold plated surfaces is that the base metals migrate to the surface due to gold's soft and porous nature (dendrite corrosion). Once exposed, base metals oxidize, adding unwanted resistance that impedes electrical performance. Since gold plated surfaces are thinly coated, they are susceptible to scratching & abrasion, further exposing the base metals.

ProGold is a one-step treatment that conditions gold connectors, contacts and other metal surfaces, enhancing the conductivity characteristics to efficiently transmit electrical signals. **ProGold** coats the entire contact surface and connection, providing superior protection from abrasion (insertion resistance), arcing, RFI, wear and atmospheric contamination.

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High Penetrating Anti-Corrosive Anti-Tarnishing Cleaner & Lubricant. Lubricates & Protects, Displaces Moisture, Stops Squeaks, Migrates & Coats Entire Surface.

ElectricALL™
Rejuvenating Solution For All Electrical Applications. Cleans, Preserves, Improves & Protects Connections, Removes Corrosion & Oxidation, Reduces Wear, Abrasion, Arcing & RFI.

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Continuous Coverage

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Bearcat 890XLTB mobile.....$279.00
29-1300MHz, 500 ch. in 8500, 400 in 2500. 890 has 200 ch.& 29-956MHz. All cell locked. Spring delivery. Fax Fact#420

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100 Channel
800 MHz

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Bearcat 560XLTZ
$99.95
16 Channel
10 Band

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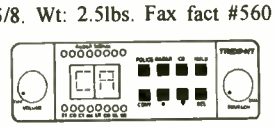

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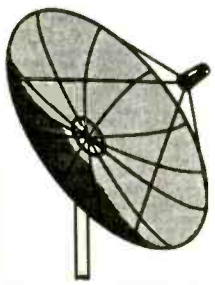

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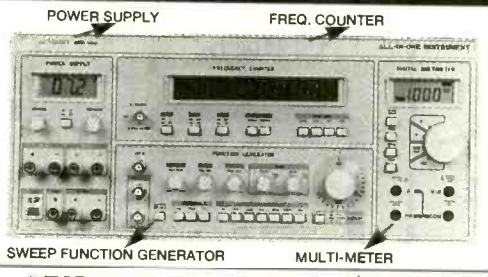

Four Instruments in One Instrument

MT-100
Reg. $595.
$399.00

1 Function Generator
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- 0.02 Hz ~ 2MHz

2 Frequency Counter
- 8 Digit LED
- 1 Hz ~ 100MHz
- ± (1 Hz + 1 dgt. + Time Base Error)

3 Power Supply
- 3-1/2 Digit LCD
- Triple output: #1. 0~50V, 0.5A MAX #2, 15V, 1A #3. 5V, 2A

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- DCV, ACV, Ω, DCA, ACA
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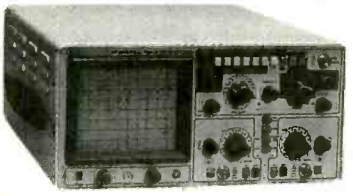

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25 MHz Dual
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Dual/Delay
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$499.00

OS-3304/3324, 25 MHz

- DC to 25 MHz. Dual Channel
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 20V/div X-Y modes, Z Axis (intensity modulation)
- Rise time 14n Sec. or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 2kV

OS-3315, 40 MHz Sweep Delay

- DC to 40 MHz. Dual Channel
- Delayed Sweep 100nS to 1 Sec.
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 20V/div X-Y modes, Z Axis (intensity modulation)
- Rise time 8.5nS or less.
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- Acceleration Potential 12kV

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OS-7020A. 20MHz Dual
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OS-9040D. 40MHz Delay
Reg. $695. **$575.00**
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Other Models *Call for Price*

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2MHz Sweep / Function Generator w/Built-in Frequency Counter

- 4 Digit LED Display
- 0.2 Hz ~ 2.0 MHz
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- Linear or Logarithmic Sweep
- Variable DC Offset Control
- 10 MHz Frequency Counter

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1.0 GHz Counter FC-200
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High Resolution Frequency Counter

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- 8 Digit LED Display
- Auto & Manual Range
- Measured Value Hold
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- 1mΩ & 50Ω Input Impedance
- 10:1 Input Switchable Attenuator

Reg. $199. **$119.00**

RF Signal Generator, SG-310 100KHz - 150MHz

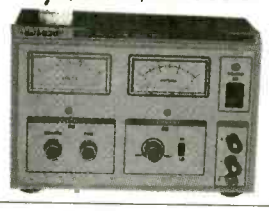
- 100KHz ~ 150MHz, 6 Ranges.
- Accuracy : ± 5%
- RF Output: 100 m Vrms (Up to 35MHz Unloaded)
- Modulation
  Int. 1KHz (AM) 30%
  Ext. 50Hz ~ 20KHz
- Audio Output: 1KHz Min 2 Vrms

Reg. $199. **$119.00**

Audio Generator, AG-350 10Hz ~ 1MHz

- 10Hz ~ 1MHz, 5 Ranges.
- Accuracy : 5% ± 2
- Output Inpedance : 600Ω
- Sine Wave Output
  - Range : 10Hz ~ 1MHz
  - Output Voltage : 8 Vrms
- Square Wave Output
  - Range : 10HZ ~ 100KHz
  - Output Voltage : 15Vp-p

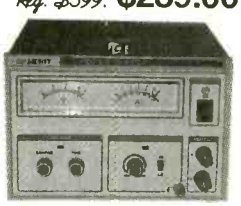
Reg. $249. **$159.00**



DC Power Supply, PS-500 0-30VDC, 0-3A

- 0 ~ 30VDC Continuously Variable
  - Regulation : ≦ 0.01% + 3mV
  - Ripple Voltage : p-p ≦ 2m Vrms; ≦ 1mV
- 0.1A ~ 3A Constant Current
  - Regulation : ≦ 0.2% + 3mA
  - Ripple Current : ≦ 3m Arms
- Short Circuit Overload Protection w/Indicating Lamp

Reg. $399. **$289.00**



DC Power Supply, PS-540 0-16VDC, 0-10A

- 0 ~ 16VDC Continuously Variable
  - Regulation : ≦ 0.01% + 3mV
  - Ripple Voltage : p-p ≦ 2m Vrms; ≦ 1mV
- 0.1A ~ 10A Constant Current
  - Regulation : ≦ 0.2% + 3mA
  - Ripple Current : ≦ 3m Arms
- Short Circuit Overload Protection w/Indicating Lamp

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- Prescaled Range from 10MHz to 2.8GHz for virtually all two way communications
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- Display Hold Switch Locks current Measurement

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(Actual Size Hand!)

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Made in USA by Elenco

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Assembled $75
Kit $49.95

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Provides sine, triangle, square wave from 1Hz to 1MHz
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Elenco GF-8026
Int/Ext Operation,
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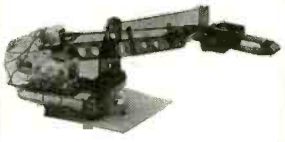
Robotic Arm Kit



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1.2GHz
$229

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

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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 continously variable, sine, triangular, square wave forms. All power supplies are regulated and protected against shorts.

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- -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
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- Two no bounce logic switches
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- 2 breadboards, each contain: 840 tie points (total 1,680)

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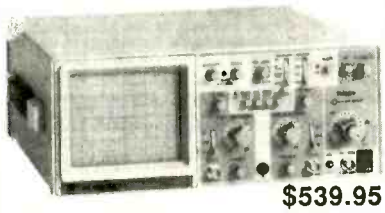

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2 Channel Delayed Sweep

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- Z axis input
- Single sweep
- V mode-displays two signals unrelated in frequency

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Model 2160

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- 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

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- Sweeps to 2ns/division
- Dual time base
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- Signal delay line
- 19kV accelerating voltage

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$875

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- 20MS/s sampling rate
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- 1mV Sensitivity
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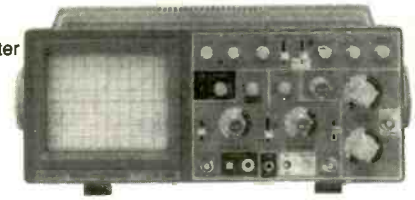
- Illuminated Internal Gradicule
- TV Sync



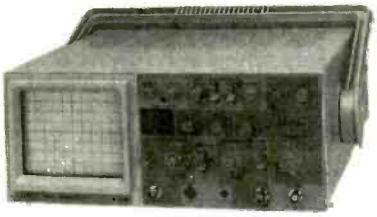
- Voltage, Time, + Frequency differences displayed on CRT thru the use of cursors.
- 1mV Sensitivity
- TV Sync

S-1345 Delayed Sweep $575

40MHz Dual Trace

S-1340 $495

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



- High luminance 6" CRT
- 1mV Sensitivity
- 12KV Acceleration Voltage
- 9ns Rise Time
- X-Y Operation
- TV Sync

S-1330 Delayed Sweep $449

25MHz Dual Trace

S-1325 $349

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

- High luminance 6" CRT
- 1mV Sensitivity
- 2KV Acceleration Voltage
- 18ns Rise Time
- X-Y Operation
- TV Sync

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20MHz
2 Channel

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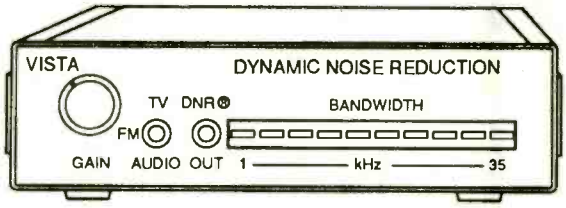

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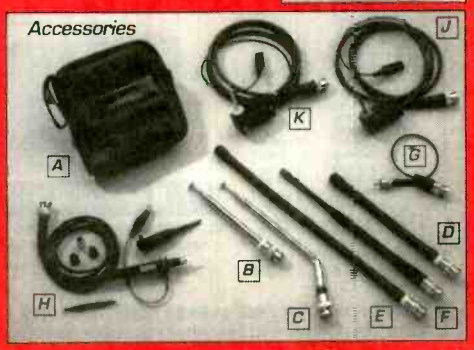

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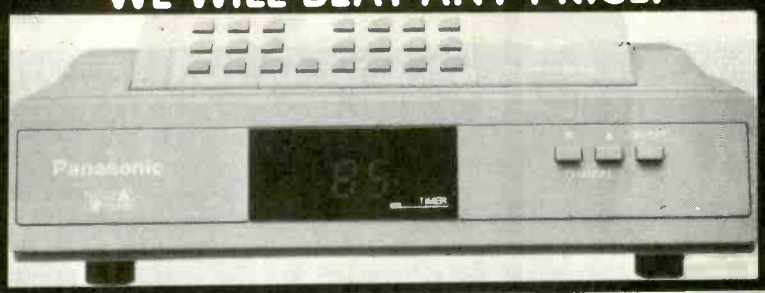

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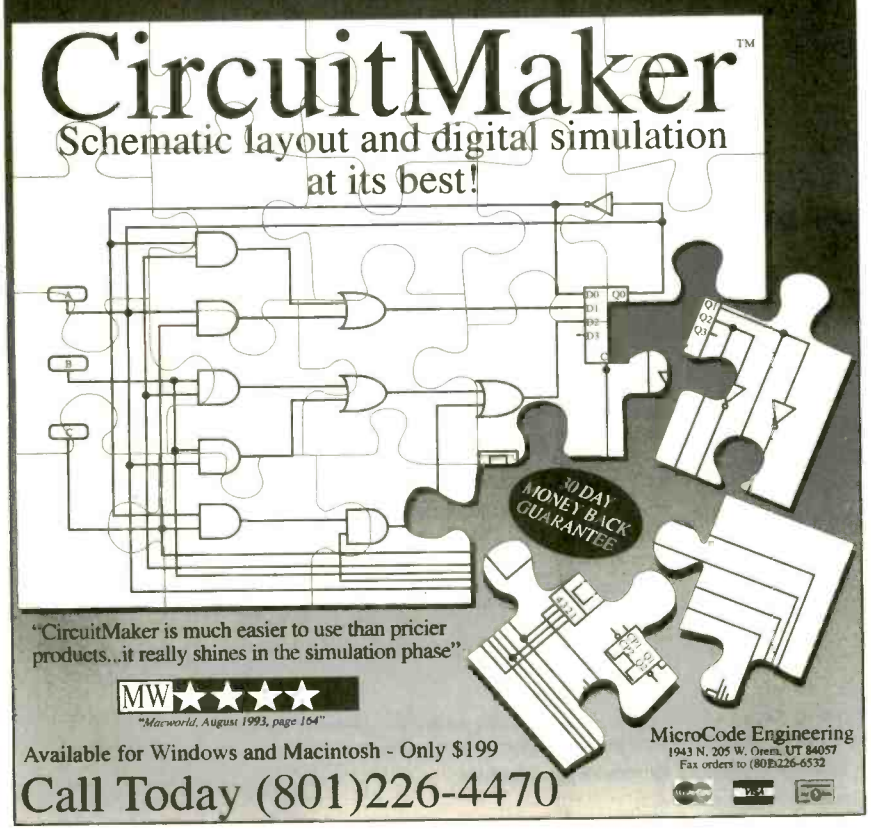

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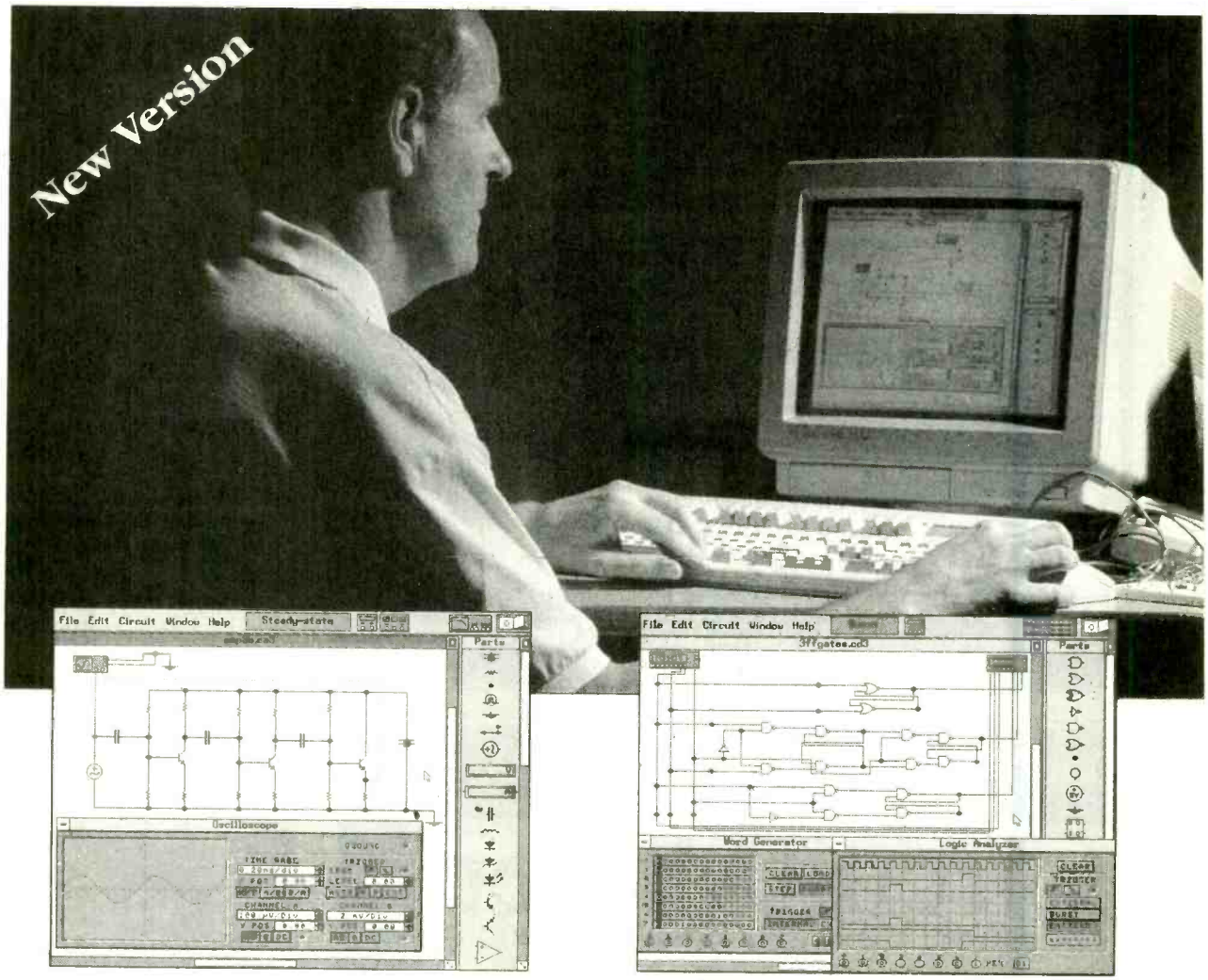

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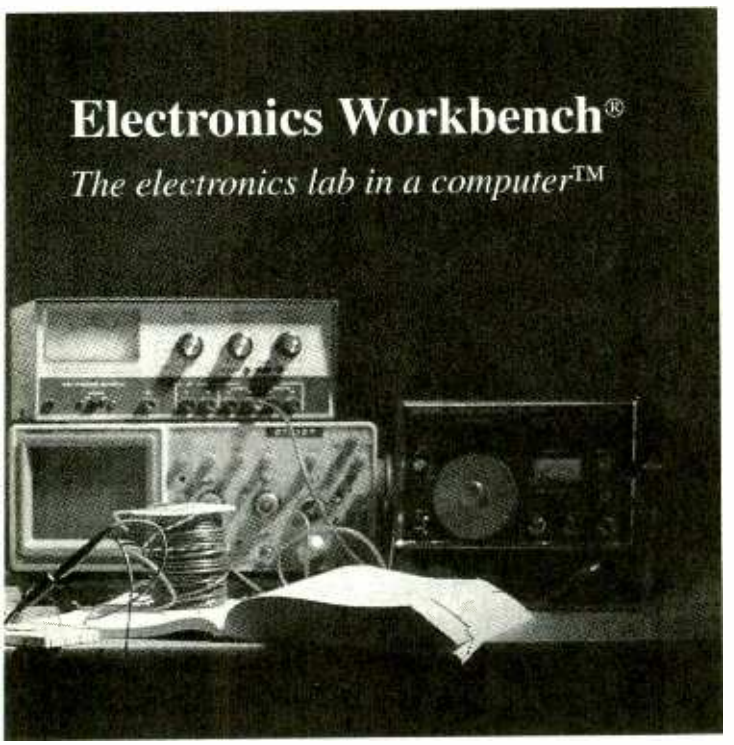

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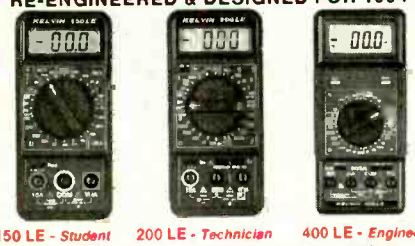

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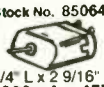

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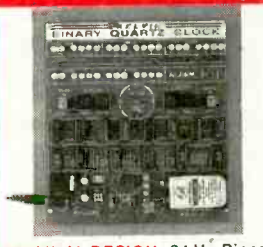

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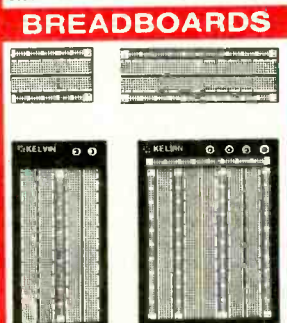

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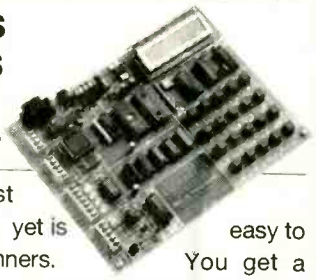

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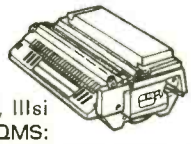

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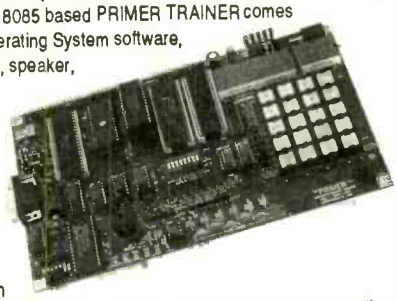

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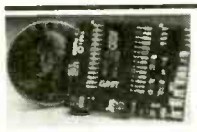

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We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

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CONTENT

All classified advertising in the **PE Market Center** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by November 15 will appear in the march, 1994 issue that is on sale January 18. The PE Market Center is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

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17 - $17.00	18 - $18.00	19 - $19.00	20 - $20.00
21 - $21.00	22 - $22.00	23 - $23.00	24 - $24.00
25 - $25.00	26 - $26.00	27 - $27.00	28 - $28.00
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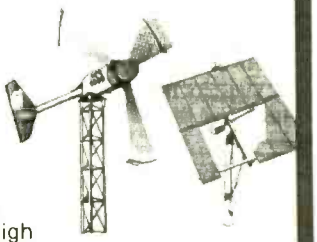

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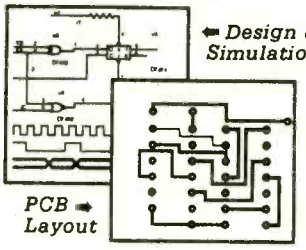

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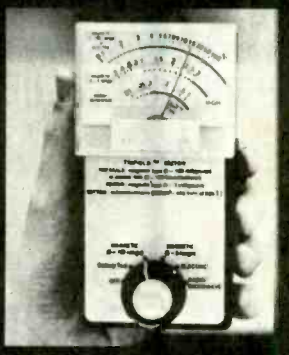

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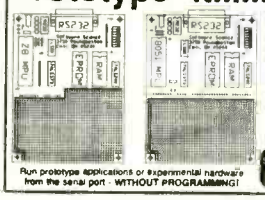

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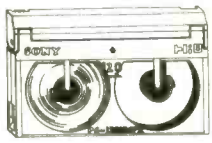

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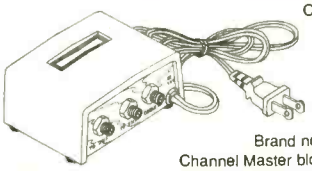

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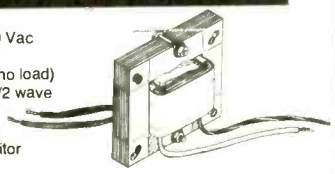

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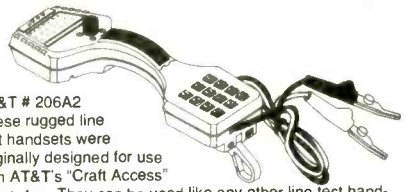

AT&T # 206A2
These rugged line test handsets were originally designed for use with AT&T's "Craft Access" computer. They can be used like any other line test handset, but they have special features which may or may not be useful. In addition to the touch-tone keypad, talk/monitor switch, alligator clip leads, 4 conductor modular jack and tool belt clip, these units have a LCD screen and function button/joystick for use with AT&T's "Craft Access" computer. For the average user, the extra features mainly allow you to adjust the volume and program in phone numbers. The main drawback to these units is that they contain batteries that require recharging, and the test set should be recharged when not in use. The size of the unit is 12.5" long X 4.5" wide. Brand new, in the box. They include 2 ni-cad battery packs, a charger and instructions.

CAT # PTS-206

$60.00 per set

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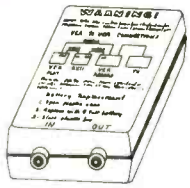

Eliminate color shifting screen flashing, jagged edges and unwanted lines copyguarding can cause. Ellminates copy guards and cleans up movies as you view them. Simply hook-up; just install 9 Vdc battery (not included) and watch crystal clear video without need for adjustment.

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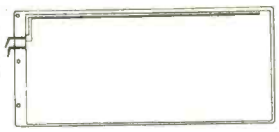
CAT# RX-11 **$29.95 each**

ELECTROLUMINESCENT "Glow Strip"



4.75" X 10.25" electrolumines cent glow strip operates on 80-120 Vac.

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CAT# GS-510

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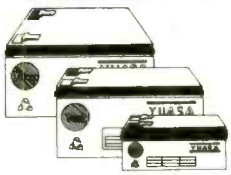

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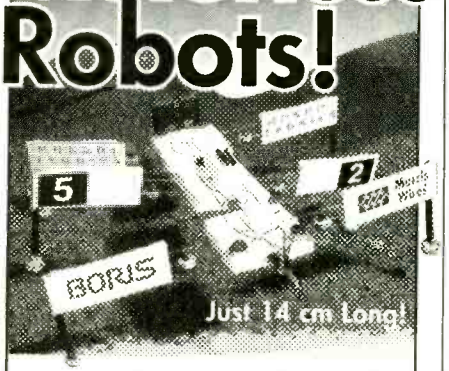

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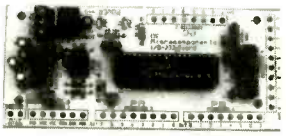

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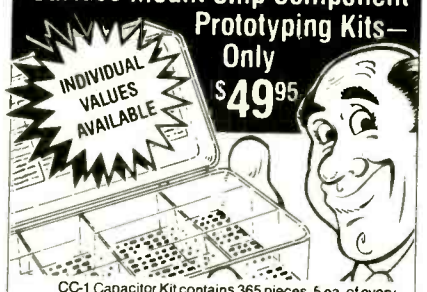

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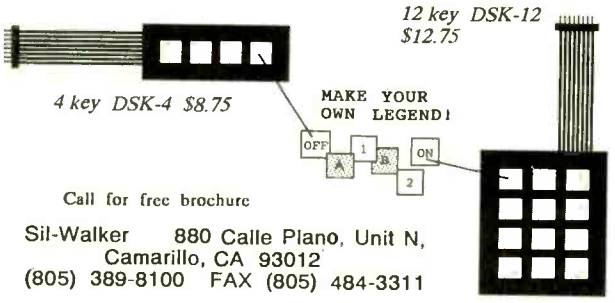

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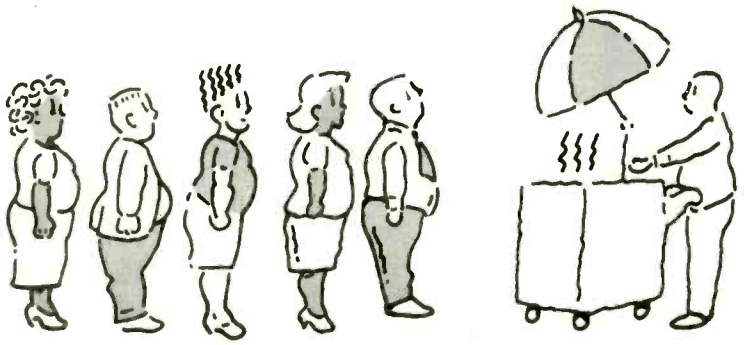

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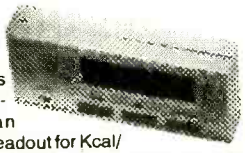
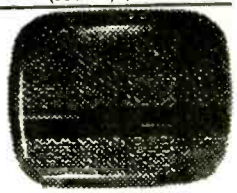
TREADMILL DISPLAY



LCD display offers speed, time, distance and scan modes as well as readout for Kcal/min. Operates on 5VDC. Uses +5V pulses to operate readout. Many applications.

(93U013) **$5.95 each**

BRIGHT RED STROBE



Intended to clip on the rear of a bicyclist's waistband as a safety device, it can be seen for blocks at night. Alternative uses may be as a signaling device, to attract bulls or as a simulated UFO encounter. Runs on two AA cells (not included).

(93L008) **$14.95**

AMBER LENS

16-pin DIP package; 8 LEDs 0.375" x 0.75"; I_{MAX}=25 mA/LED; diffuse white cover. HLMP 2785.

(93L010) **10 FOR $7.95**

FAMOUS BRAND SOLDER

Solid core, 0.25" diameter, 29T/70L. 5 lb. spool.

(92Z012) **$9.95**

SON OF A CHEAP SLIDE SWITCH!

DPDT, 12A rated. (93B004)

6 for $1.00

100 for $9.95

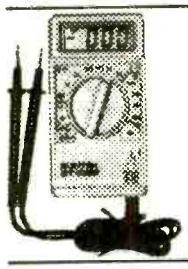
TVRO MOTHERBOARD

These defective units contain many useful parts including a 950-1450 MHz tuner, two NEC 5150 gain blocks, filters. etc. (92V002) **$24.95**

HELPING MAGNIFIER

Six ball joints for all angles. Nickel-plated fittings. Heavy cast-iron base. 2X 2.5" magnifying glass. Alligator spring clips. Locks at any angle.

(93U002) **$5.95 each**

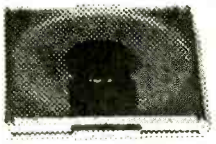


3.5 DIGIT MULTIMETER

Six functions, 14 ranges, AC/DC voltages up to 500V, diode and battery tests. Suntek ST1000.

(93Z023) **$19.95 each**

CD ROM CADDY



Fits Sony, Chinon, Toshiba, etc. Brand new. (93C018)

$4.50 each

SPECIAL! *Buy ten caddies before 2/28/94 and get a free case!* (93C018A)

BRAND "X" LENS

Eyepiece-type magnifier. Focal length = 50mm, f:3.2. Approx. dimensions: dia. = 38mm, length = 43mm. Excellent hand magnifier at approx. two power, or telescope eyepiece.. (93L009)

$9.95

EMERGENCY LAMP

Just add water! Send up attached to a balloon as a "UFO." Practical uses include hurricanes, earthquakes, tornadoes, camping, hunting, electrical outages, etc. Over one hour of light. Can also be used as a hand warmer. Battery type BA-292/AM, used by the military. Comes packed ten in a sealed can. (93E013) **$14.95/can**

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Autotrol model 200. Shaft 1/8" dia., 1" long. 6-2/3 RPM. Quality cast metal gearbox. (93M009)

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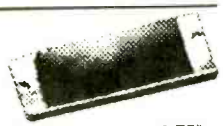
DOMINO SIZED SUPER MAGNET



Approx. 500 Gauss. Measures approx 0.75" x 1.75" x 0.625". Very strong for its size!

(93M011) **3 for $9.95**

BRIDGE RECTIFIER

300V @ 1A. DIP package. (93S029)

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Large quantities available.

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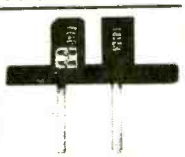

IR LED emitter/detector pair. Harris #017J-H21B1. (93B005) **$1.49 each**

POWER MOSFET

BUZ-80 (93S014) **$1.49 each**

EPROM BLOWOUT!

Erase and save $$$!			
2708	$ .25	27128	$1.29
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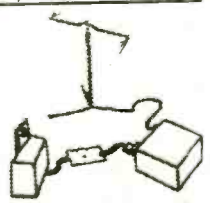
		27C010	$3.99

IR REMOTE CONTROL/ RECEIVER KIT

Your imagination is the only limitation for the uses of this device. The controller is new and fully assembled. It has thirty function buttons, each of which causes the transmitter to emit a unique infra-red pulse train. Originally, the receiver was mounted in a satellite receiver; the satellite receivers are all gone but we have reproduced the IR receiver and are offering it here in kit form. The IR RECEIVER KIT can be assembled in less than an hour. We also furnish the IC which served as the IR decoder and controller. A decoder can be breadboarded around this chip. To make life easier, we have all the schematic diagrams, including the diagram of the satellite receiver. (93V010) **All For $19.95**

ION DRIVE MOTOR



Rapidly rotating micropower ion drive motor is ideal for demonstrations of the theory of interstellar flight or simply as a decorative piece defying common sense. Guaranteed to arouse and challenge the mind for a long time. Not intended for young children. (92M034) **$19.95 each**

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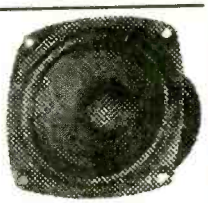

4 Ohm, 50W max., 5W nom. (93V011)

$7.95 each

2-20 KHz Speaker

4 Ohm, 30W max., 10W nom., 2.5" x 4". (93V012)

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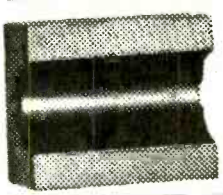
Package Deal!

Two pair of the above (93V011 & 93V012) with crossover data. (93V013) **$25.00**



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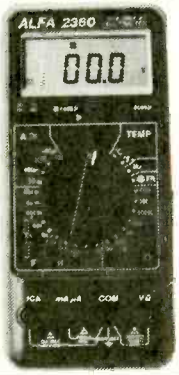

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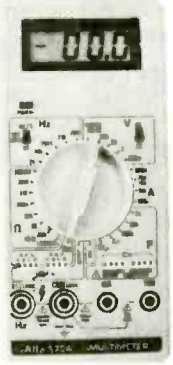

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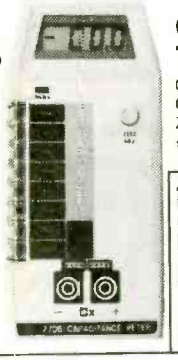

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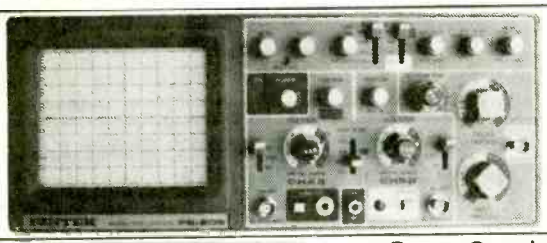

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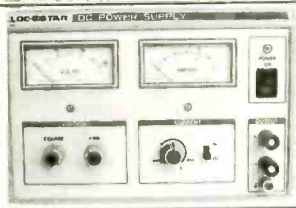

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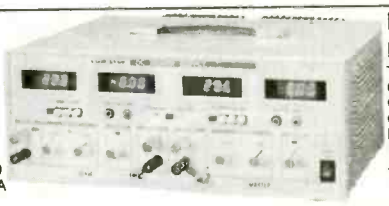

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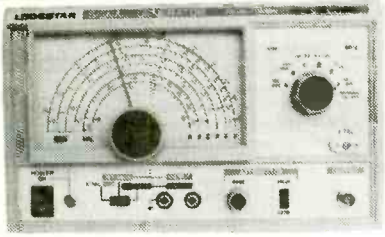

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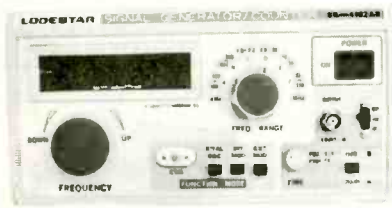

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Sensitivity <50mV

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Output impedance: 600 ohm

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- 16 levels of voice masking.
- Button for normal operation.
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STOP THOSE ANNOYING PHONE CALLS! Sound older and tougher when you want to. Not a kit, fully assembled. Single line phone operation only.

TRANSITION 2000 ..... $89.95

- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Use with any modular phone.
- Connects between handset and phone.
- 16 levels of voice masking.

TRANSITION 2001 VOICE CHANGING Accessory

STOP THOSE ANNOYING PHONE CALLS! Sound older and tougher when you want to. Use with single or multi-line phones. Not a kit, full assembled.

TRANSITION 2001 ..... $59.95

- Transmits both sides of phone conversation.
- Adjustable from 88-108MHz.
- Works with any FM broadcast receiver.
- Up to 1 mile range.
- Turns off when phone is not in use to extend battery life.

XTT100 LONG RANGE PHONE TRANSMITTER

Similar to our very popular XSP500, the XTT100 is battery powered for maximum range. It plugs into any phone jack and transmits all calls on that line.

XTT100(C) Kit $32.95

- Super sensitive, hear every sound in a house!
- Powerful 2 stage audio amp.
- Use with any FM broadcast receiver.
- Up to 1 mile range.
- Powered by 9V battery.

XFM100 MINIATURE FM TRANSMITTER

The XFM100 has a super sensitive microphone and is capable of picking up sounds at the level of a whisper and transmitting them to any FM broadcast receiver.

XFM100(C) Kit $32.95

- Transmits a continuous beeping tone.
- Adjustable from 88-108 MHz.
- Up to 1 mile range.
- Works with any FM broadcast receiver.
- Operates at battery voltages of 3 to 18 volts.

XTR100 TRACKING TRANSMITTER

Measuring .7 by 2.4 inches, the XTR100 is ideal for use in locating lost model rockets, bicycles, automobiles, games of hide-and-seek, and contests.

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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.

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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.

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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.

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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.

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