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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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You know that the Russians secretly installed countless microphones in the concrete work of the American Embassy building in Moscow. They converted what was to be an embassy and private residence into the most sophisticated recording studio the world had ever known. The building had to be torn down in order to remove all the bugs.

Stolen Information

The open taps from where the information pours out may be from FAX's, computer communications, telephone calls, and everyday business meetings and lunchtime encounters. Businessmen need counselling on how to eliminate this information drain. Basic telephone use coupled with the user's understanding that someone may be listening or recording vital data and information greatly reduces the opportunity for others to purloin meaningful information.

The professional discussions seen on the TV screen in your home reveals how to detect and disable wiretaps, midget radio-frequency transmitters, and other bugs, plus when to use disinformation to confuse the unwanted listener, and the technique of voice scrambling telephone communications. In fact, do you know how to look for a bug, where to look for a bug, and what to do when you find it?

Bugs of a very small size are easy to build and they can be placed quickly in a matter of seconds, in any object or room. Today you may have used a telephone handset that was bugged. It probably contained three bugs. One was a phony bug to fool you into believing you found a bug and secured the telephone. The second bug placates the investigator when he finds the real thing! And the third bug is found only by the professional, who continued to search just in case there were more bugs.

The professional is not without his tools. Special equipment has been designed so that the professional can sweep a room so that he can detect voice-activated (VOX) and remote-activated bugs. Some of this equipment can be operated by novices, others require a trained countersurveillance professional.

The professionals viewed on your television screen reveal information on the latest technological advances like laser-beam snoopers that are installed hundreds of feet away from the room they snoop on. The professionals disclose that computers yield information too easily.

This advertisement was not written by a countersurveillance professional, but by a beginner whose only experience came from viewing the video tape in the privacy of his home. After you review the video carefully and understand its contents, you have taken the first important step in either acquiring professional help with your surveillance problems, or you may very well consider a career as a countersurveillance professional.

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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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EDITORIAL

BUMPS ALONG THE ROAD

Some recent events have given rise to suspicions that all the hype surrounding the so-called "information superhighway" is just that—hype. Several major entertainment providers, most notably Disney, have expressed reluctance in getting involved, at least on the ground floor. Time Warner delayed the introduction of their ambitious Orlando interactive cable service citing both hardware and software problems.

Even many of the much ballyhooed marriages between cable and telephone companies may never be consummated now that the biggest merger of them all, between TCI and Bell Atlantic, has been called off. The companies blamed the FCC's relatively meager attempts to regulate cable rates, claiming that it made it difficult to anticipate future revenues. Most experts believe, however, that the deal was killed by falling stock prices, and that those prices were falling because investors were having doubts that the information superhighway was ever going to be anything more than smoke and mirrors.

We disagree. However, it is becoming clear that there are tremendous technological and social problems that must be overcome before the "Infobahn" (the latest buzzword) becomes a reality. In the meantime, if you can live without "500 channels of video on demand" (and who couldn't?), and you own a personal computer, you can enjoy many of the benefits of the proposed information superhighway right now. In *Going On-Line with your PC* we explore the world of on-line information. On-line you can shop from home; read newspapers and magazines; search information databases; make plane, car, and hotel reservations; send and receive mail; check stock and mutual-fund prices; chat with friends around the country and the world; play games with computer and human opponents; and the list goes on and on. The story also covers the hardware and software that you need, on-line procedures and etiquette, costs, and more; it begins on page 37.

Carl Laron
Editor

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LETTERS

RECALLING THE GOOD OLD DAYS

I just read the article "Hamming in the Fabulous Fifties," by Karl Thurber (**Popular Electronics**, March 1994). I got my Novice License in 1955 but, contrary to what Thurber says, a fellow worker with a General Class License gave me the code test and witnessed that I took the written test in his presence. It was not necessary to go to an FCC office. A year later, I did the same for my Technician Class license.

Mr. Thurber brought up many interesting points concerning the era and triggered many fond memories, but he completely ignored the wealth of military surplus equipment that was available at the time. That was the most important factor, as I see it, in allowing those of us with small incomes to get started in this fascinating hobby. Magazines were full of ads for the BC-XXX aircraft receivers, ARC-5 transmitters, etc. My first ham station consisted of a home-brew transmitter and two BC receivers. The extra receiver tuned the second harmonic of the transmitter and functioned as a monitor of my own signal. It doesn't sound like much, but I can't tell you how exciting it was.

My last license expired about 1965, and even then it had been long unused. I have two sons, both licensed amateurs, although neither is very active at the present time. They have both suggested that I get my license back, but I just don't think there is much there anymore. It appears to me that the good old ARRL sold out to commercial interests and started the recruiting of CB'ers in order to open up new markets for equipment manufacturers. I go to hamfests from time to time, and they aren't the same either—just a lot of guys with strange-looking call signs on their caps, all carrying miniature transceivers and muttering what sounds like CB lingo. I doubt that many of them have ever built anything at all, or would be able to repair their store-bought equipment. I guess it is now possible to "join the ranks" without learning Morse code—unthinkable!

All in all, I guess that ham radio is a "dead horse" that must live only in memory, like many things from bygone eras.

K.R.C (ex-K8BZX)
Mogadore, OH

MORE HAMMING IN THE FIFTIES

In his enjoyable article, "Hamming in the Fabulous Fifties," Karl T. Thurber, Jr. states that Novice Class ham license exams were given at FCC offices because "there were no volunteer examiners then."

Not so! Novice and Technician Class exams became available from volunteers beginning in 1954. Exams for the Conditional Class (now part of the General Class) license and its predecessor, the Class C license, were administered by volunteer examiners since the latter's creation by the Federal Radio Commission in 1933.

Moreover, written exams for the predecessors of Class C, the Temporary Amateur License and Amateur Second Grade, were "self-administered" by the applicant beginning with the dawn of amateur licensing in 1912. The truth is that the federal government has never relied exclusively upon itself to administer all amateur-radio examinations!

N.D.F., N3DF
Boulder, CO

WORLD-BAND RADIO CORRECTION

I particularly enjoy the receiver projects that you publish from time to time and would like to see more of them. I found Lyle Williams' article "Build a World-Band Regenerative Radio" (**Popular Electronics**, March 1994) to be especially interesting. The regenerative and super-regenerative receivers are classic receiver designs for the beginner, and Lyle's design is quite interesting from several perspectives. I plan to build at least one with my amateur-radio students.

Other readers might not have noticed that the formula that appears on page 36 is incorrect. The correct formula for computing the necessary inductance for the three free-resonant circuits is:

$L = [1/f(6.96 \times 10^{-5})]^2$

Great article otherwise!

R.O.
Chatanooga, TN

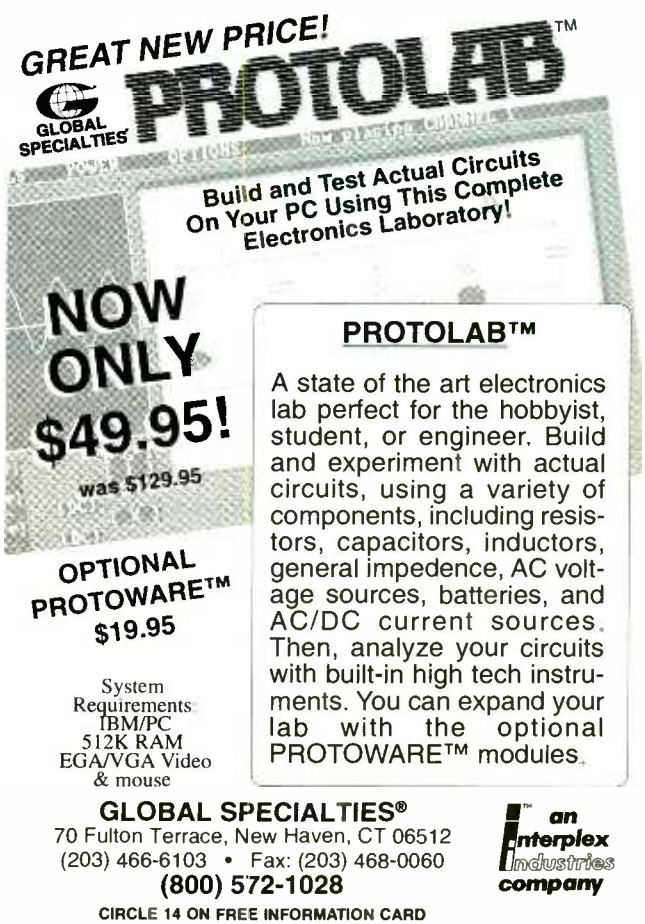
HAVES & NEEDS

I am writing to see if any of your readers can locate the circuit boards or the circuit-board patterns used for the "System E" and "LS/100A" model lighting kits. Those two systems are from Paul M. Hewitt's book *Star Fleet Assembly Manual 4*. Neither Mr. Hewitt nor his company are still at the listed addresses, so I can't order them. The publishing company's address is not listed in the book, which is about ten years old. The circuit board was designed by Russell B. Dawe. Any information as to the whereabouts of Mr. Hewitt or Mr. Dawe would be appreciated. I am also on the lookout for Mr. Hewitt's *Star Fleet Assembly Manuals 2 and 3*. Thank you.

R.D. HORTON
201 Butler Blvd.
Wilmore, KY 40390

I am looking for the schematic for a Mantola AM-Shortwave receiver, model 572. I will gladly pay for any copying and postage costs. Thank you.

MICHAEL ROBERTS
583 North Prospect Street
Marion, OH 43302-2367 ■



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MULTIMEDIA WATCH

By Marc Spiwak

Research on CD-ROM

Moveable type changed publishing forever; it put literature in the hands of the common man. Slowly but surely, CD-ROM is again changing the face of publishing. Not by replacing printed matter, but by enhancing it.

I think that a replacement for paper books is a long way off; I personally wouldn't want to cozy up with my computer to read a good book, and I'm sure you wouldn't either. Reading printed material is much easier on the eyes than staring at a computer monitor for hours, and it's certainly more convenient for reading a book in bed. I figure that books will be replaced by silicon when we're able to buy a $50 appliance that's about the size and weight of a book, has a display with laser-printer clarity, the ability to store several books in memory, and that will run for months on a single charge. Until then I'll do my writing and editing on a PC and my reading from books and magazines. But I wouldn't think of doing research on anything but my PC.

NautilusCD from Metatec is a "multimedia, multimedia magazine" with articles, movies, music, shareware, demos, drivers, and much more.

Microfiche replaced microfilm, and CD-ROM will surely replace microfiche if my guess is correct. You see, a single CD-ROM can hold nearly 700 megabytes of data—that's enough for thousands of books, entire encyclopedia volumes, several years' worth of a particular magazine, or even one year's worth of hundreds of different magazines. The powerful search capabilities that are possible with CD-ROM make finding what you're looking for a breeze, and multimedia lets you see things in ways that otherwise would be impossible.

To date, many different publications are available on CD-ROM, and I'm sure that some day all magazines will be available in that format. To prove how popular these discs already are, *PC Magazine* announced the sale of a disc containing the entire contents of the past 12 months of the magazine for about $15. The disc makes it easy to research anything mentioned during the past year, which is quite a task with the paper-bound product. It was said that if sales were good, the CD-ROM version would become a full-time product. Sales were indeed good—the disc was sold out in short order.

PUBLISHING ON CD-ROM

I've been examining a number of different publications on CD-ROM, some with a familiar title, and others without. One of them is a disc called *Computer Select* from Ziff-Davis Publishing. This incredible disc contains a year's worth of over 150 computer publications. More than 75,000 articles are contained on the disc, as well as specifications for over 75,000 hardware and software products. A powerful search engine in both DOS and Windows versions makes sifting through all the information very easy.

Computer Select lets you search by word, product, author, publication, topic, date, and so on, or by any combination of requirements. I wanted to know more about a game I'm going to be looking at called *Iron Helix*, so I searched Computer Select for information on it. Included on the disc were several articles that mentioned Iron Helix. The only drawback to Computer Select is its price; a one-year subscription is about $1200 for a single user.

At a much more affordable price ($69.95), *USA Today, The '90s, Volume I*, from Context Systems, is a multimedia time capsule of current events. The CD-ROM contains more than 112,000 stories that appeared in the newspaper between January 1, 1990 and August 31, 1992. The disc includes complete text

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from the newspaper, hundreds of color photos, and audio clips. Because it runs under Windows, USA Today is very easy to use.

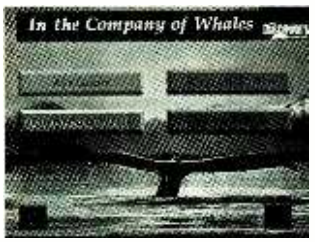
Besides basic topics like top events, news, money, sports, and life, there's in-depth coverage of major historic events such as the Persian Gulf War and the collapse of communism.

Another news-related disc is *Newsweek Interactive*. The subscription price for four quarterly issues is $99.95. The disc is available in both the DOS format and in the CD-ROM XA format for Sony's MMCD player. Newsweek Interactive combines text, audio, video, narration, and color photos. In addition to special feature articles on each disc, an archive of the previous three months of Newsweek is included.

While Newsweek Interactive runs fast and includes full-screen color photos, it does require VESA-compatible SVGA video and 570K of free conventional memory. Once I ran a boot disc that freed up enough memory on my machine, and ran a VESA driver, Newsweek worked well.

Two similar products are available from Compact Publishing: *The 1993 Time Almanac* and *CNN Newsroom Global View*. The Time Almanac includes more than 20,000 articles—everything from 1989 to January 4, 1993, and selected articles dating back to 1923. Also included are photos, charts, maps, and over an hour of current and historical video footage. The Time Almanac runs in Windows and costs $99.95.

CNN Newsroom Global View deals with world affairs but does not include complete text from any particular source. Instead it cross references over an hour of television footage



In The Company of Whales is sure to enchant the young and young-at-heart.

to various interviews, articles, commentary, and charts. A world atlas, world clock, and calendar are included. Global View sells for $49.95 and runs in DOS.

Encyclopedias have been popular multimedia titles from the beginning. That's because multimedia features combined with "something for everyone" makes for an excellent family-entertainment bargain. I just got *The New Grolier Multimedia Encyclopedia,* and it sure is fun to explore. Everything is here: photos, charts, maps, video, animation—you name it. I really wish I had something like this when I was in school; perhaps I actually would have studied a little if I did!

One of the best things about The New Grolier Multimedia Encyclopedia is its new low price of $149.95—down from $395. Supposedly this price is for a limited time only, but if the disc sells well at the low price, it probably won't go back up again—at least I hope not. At $149.95, this disc is a terrific investment, and it's useful for the entire family. It's much cheaper than a set of encyclopedia books, and takes up a lot less space.

CD-ROM ONLY

Some day many publications will probably be on CD-ROM only, but one such product that's here today is *NautilusCD* from Metatec. NautilusCD is published monthly, and only on CD-ROM. It's basically a "multimedia, multimedia magazine." The basic subscription price for 12 issues of NautilusCD is $119.40, and discounts are often available.

Imagine if a magazine came with a 600-megabyte hard drive chock full of goodies every month. That's basically what NautilusCD is. Every month, in addition to various articles, the subscriber receives sample fonts, archive photos, WAV files, CD audio tracks, software demos, games, and more. Had I looked at my copy of Nautilus just two days earlier, I could have saved myself a long-distance telephone call to Canada to download the latest drivers for my video card; current drivers for all types of hardware are included every month. From now on, I'll surely check out my new copy of NautilusCD as soon as I get it—I don't want to miss anything useful.

NEW STUFF

Aris Entertainment just sent me their most recent MediaClips disc, *Animal Kingdom*. This disc contains 100 wildlife photos, 25 videos, and 100 new-age audio clips, all of which may be reproduced royalty-free. This is the first title to combine MPEG, MPC, and Macintosh-compatible material. MPEG promises full-screen, full-motion video for people who have installed an add-on MPEG board. (I'll be looking at one in the next few months.) Animal Kingdom is $29.95.

Even The Discovery Channel is getting into multimedia with their *In The*

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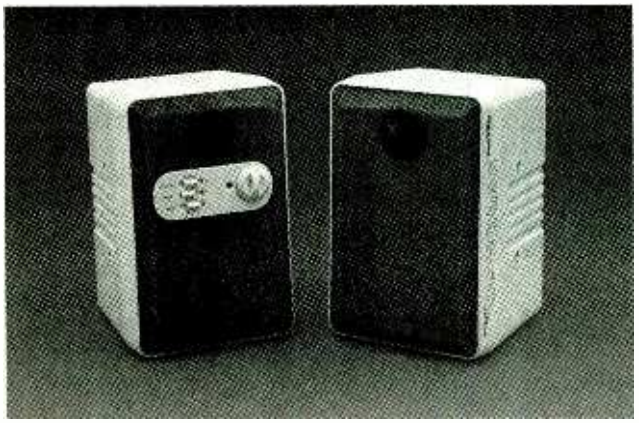
Company Of Whales CD-ROM. This complete collection of whale information contains video, text, speech, and sound. It runs in Windows so it's very easy to use. Kids are sure to love this disc, and with a price of $49.95, parents will love it too.

If you want to teach yourself a foreign language, then Hyperglot is the company you should be calling. They market a complete line of language software on CD-ROM. These multidisc sets let you read, write, and hear a foreign language. With the CD-ROM format, you can quickly jump from section to section, and learn a new language at your own pace. My wife wanted to pick up a little Italian, so she's been playing with *Berlitz Think & Talk Italian*. The CD-ROM certainly has more patience with her than many instructors would!

The Time Warner Interactive Group distributes lots of multimedia titles. One of them, *It's All Relative*, contains over 50 video shorts of comedians from Comedy Central's *Short Attention Span Theater*. The disc is available in MPC and Mac versions and lets you easily jump from category to category, and from comedian to comedian. It sells for $49.95. *Sound It Out Land* is a $49.95 musical adventure for kids that helps them learn how to read. Four animated characters guide children through the land of sounds. Six original songs on the disc will also play on any audio CD player.



These Sound Mate Ultra speakers from QuickShot give your multimedia setup plenty of punch without excessively denting your wallet.

Hell Cab, also distributed by Warner, is a wild time-travel adventure in a New York Hell Cab with a 666 license plate and a driver named Raul. The game starts off when you're greeted by Raul at the airport. He suggests that you take a ride with him to kill some time, but it could be you who gets killed in this bizarre, but at times slow journey through time. Some of the video in Hell Cab is amazingly lifelike, especially when Raul turns around when you tap him on his back in the cab. Hell Cab seems to require the most recent Windows video drivers in order to run properly, but that's not all that uncommon. This is the only $99.99 disc I know of that lets you go to the top of the Empire State Building and have a look around. Hell Cab is available in Mac and Windows versions.

The *Journeyman Project* from Quadra Interactive, also for Mac or Windows, runs at a smooth quick pace, and is one of my favorite games so far. The year is 2318. Somebody or some thing has been messing around with time travel and has altered the course of history. Your job as a member of the Temporal Protectorate is to locate the source of the alteration and restore things to normal, without changing history yourself. The graphics and sound effects in this game are superb.

A SOUND INVESTMENT.

One thing that enhances any multimedia session is a good pair of speakers connected to your sound card. QuickShot, a company that makes a wide variety of game controllers and PC accessories, just sent me their latest PC speakers, the *Sound Mate Ultra*. These magnetically shielded, amplified, 2-way bass-reflex speakers provide 40 watts of power, with controls for balance, bass, and treble located on the righthand one. Unless you want to rock the house with your PC, you'll find the Sound Mate Ultra to be more than powerful enough. At $99.99 a pair, anyone in need of multimedia speakers should check these out.

For people on a tighter budget, QuickShot also makes the *Sound Mate 3* and the *Sound Mate 4*, priced at $27.99 and $29.99, respectively. While those little guys don't pack the punch of the Sound Mate Ultra, they are perfect for a basic multimedia setup. ■

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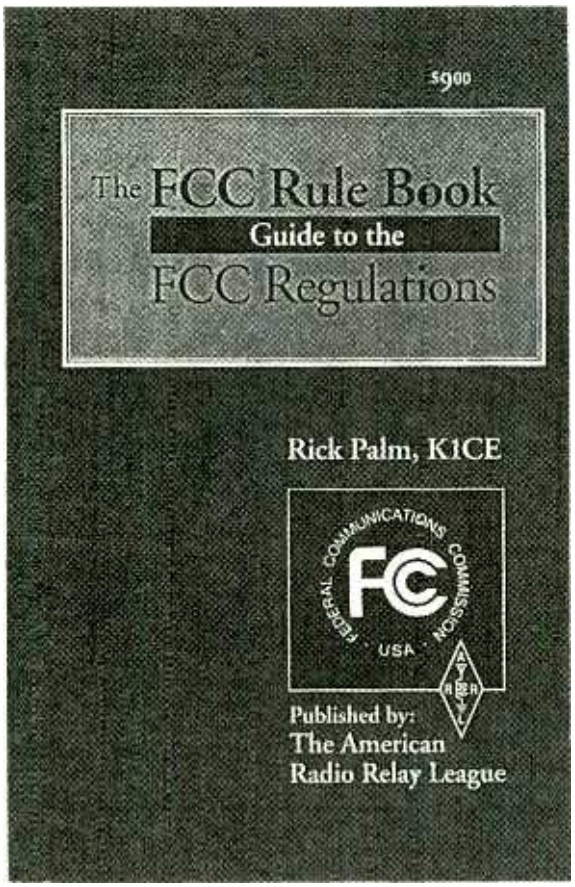
ELECTRONICS LIBRARY

The FCC Rule Book

by Rick Palm, K1CE



Amateur radio has grown and developed under a dynamic regulatory environment that has fostered technological growth and encouraged diversity. Federal Communications Commission rules define amateur radio, spell out its purposes, and clarify the legal guidelines and conduct of behavior that operators must follow. Because the FCC rules are such an intrinsic part of the hobby, this book has been a popular title among hams for the past decade. Now in its ninth edition, the book provides an up-to-date set of the amateur rules found in Part 97 as well as a clear understanding of how amateur-radio enthusiasts can apply those rules to their daily operating. The book explains how the rules are made, and how hams can be a part of the rule-making process. It includes reference information on operating abroad, international regulations, a listing of countries that allow third-party traffic handling with U.S. amateurs, band plans, testing procedures, call-sign assignments, and more.

The FCC Rule Book costs $9 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111; Tel: 203-666-1541; Fax: 203-665-7531.

CIRCLE 90 ON FREE INFORMATION CARD

1994 PRECISION WEATHER INSTRUMENTS CATALOG

from Davis Instruments

You can do more than talk about the weather—you can monitor it with the equipment offered in this 14-page, full-color catalog. Davis' new line of weather-monitoring instruments offers redesigned displays and keyboards, upgraded features—including humidity, dew point, and barometric trend—and state-of-the-art microprocessors for enhanced accuracy. All models measure highs and lows with time and date, and offer metric conversion at the touch of a key. Programmable alarms and scan routines allow the units to be customized. Accessories include rain monitors, temperature/humidity sensors, and the Weatherlink, which allows any model to record, summarize, and graph stored weather information on an IBM-compatible PC or a Macintosh.

The 1994 Precision Weather Instruments Catalog is free upon request from Davis Instruments, 3465 Diablo Avenue, Hayward, CA 94545; Tel: 510-732-9229; Fax: 510-732-9188.

CIRCLE 91 ON FREE INFORMATION CARD

AN INTRODUCTION TO SATELLITE COMMUNICATIONS

by F. A. Wilson

Satellites are instrumental in today's communications, providing us with a wealth of television programming and a host of other communications services. Hundreds of them are already in orbit, and more are following in quick succession. This book strives to give readers an appreciation of what those satellites are and how they work. Written at a moderately technical level, the book is aimed not at the expert in the field, but at the general electronics engineer or enthusiast who would like to learn the basics of satellite technology. Students and beginners with some interest in electronics should also be able to grasp the complex concepts, which are presented in as simple a manner as possible. Little more than elementary mathematics is required for the main text. For

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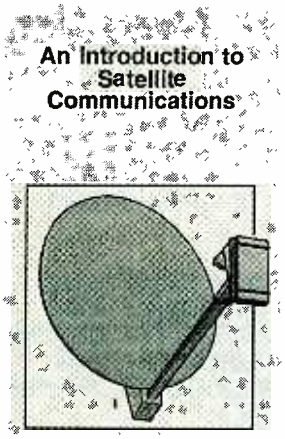


those who prefer to go into more depth, additional technical detail is included in the appendices. For the do-it-yourselfer, the book provides practical advice on choosing and installing the most problematic part of home satellite systems—the dish antenna.

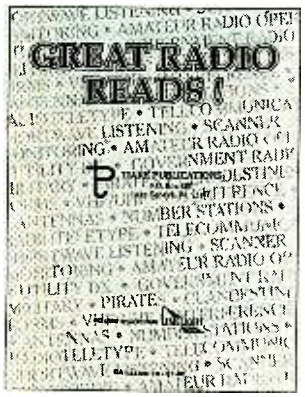
An Introduction to Satellite Communications (order number BP326) is available for $7.95 plus $2.50 shipping and handling from Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.

CIRCLE 97 ON FREE INFORMATION CARD

GREAT RADIO READS!

from Tiare Publications

Tiare's 1994 catalog is filled with books that will help you get the most from your radio hobby, no matter what form it takes. The catalog features books covering everything from amateur-radio QSL'ing to scanning your local law-enforcement agencies to tuning in radio signals from outer space. Other books can show you how to work more



stations, log more stations, get a better response from your QSL'ing efforts, and run your ham station more efficiently. A new division of Tiare, LimeLight Books, offers general non-fiction titles for the radio enthusiast.

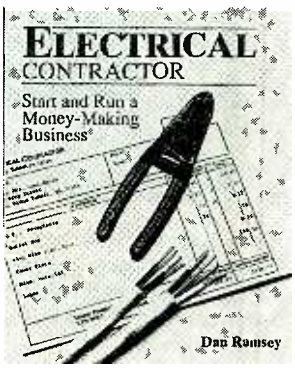
Great Radio Reads! (Catalog #8) is available for $1 from Tiare Publications, P. O. Box 493, Lake Geneva, WI 53147; Tel: 800-420-0579 (8AM to 6PM Central Time).

CIRCLE 92 ON FREE INFORMATION CARD

ELECTRICAL CONTRACTOR: Start and Run a Money-Making Business

by Dan Ramsey

This book provides apprentice and journeyman electricians with the knowledge they need to make it on their own without a business degree. It offers sound advice on how to start or expand a self-owned electrical-contracting company. The book



begins by describing the latest opportunities for residential, commercial, and industrial electricians, including the newest technologies that make electrical contracting more productive and profitable than in the past. The book goes on to address all the issues that would-be contractors are likely to face. Those include choosing a location and obtaining a license; obtaining financing; reducing overhead; estimating jobs and setting prices; hiring and managing employees; leasing versus buying equipment; finding and keeping customers; minimizing risk; marketing and advertising; and communicating

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with clients, employees, partners, and government officials. The book includes practical worksheets that make it easy to estimate jobs and costs, keep track of income and expenses, and bid on jobs.

Electrical Contractor: Start and Run a Money-Making Business costs $17.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel: 1-800-233-1128.

CIRCLE 98 ON FREE INFORMATION CARD

MS-DOS 6 EXPLAINED

by N. Kantaris & P.R.M. Oliver

To use a PC effectively, you must have a thorough working knowledge of its operating system. This book helps readers gain such an understanding of MS-DOS 6. For those who are upgrading, the differences between versions 5 and 6 are explained wherever possible. Written for busy, non-expert PC users, each self-contained

chapter builds upon what was taught in previous chapters.

The book explains the enhancements over previous versions, how the operating system is structured, how to use directories and subdirectories to effectively structure the hard drive, how to use the DOS Shell graphical interface, how to manage disk files, and how to use the MS-DOS editor to fully configure the system. In addition, it covers how to increase memory using MemMaker, how to increase speed, how to write batch files to automate system operation, and how to write and implement multiple configurations. The book describes the use of Microsoft Utilities such as DoubleSpace, MsBackup, and AntiVirus. A summary of all DOS commands, illustrated with examples, is provided in the last chapter.

MS-DOS 6 Explained (order number BP341) is available for $7.95 plus $2.50 shipping and handling from Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.

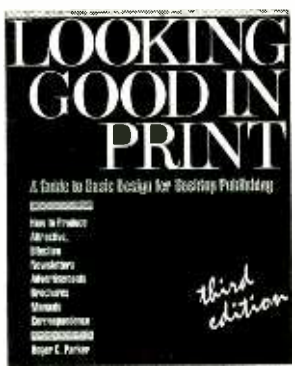
CIRCLE 97 ON FREE INFORMATION CARD

LOOKING GOOD IN PRINT: A Guide to Basic Design for Desktop Publishing

by Roger C. Parker

There's more to successful desktop publishing than learning to use the software. Good design is a basic element of any effective printed material, be it a newsletter, an ad, a manual, or a letter. Aimed at any computer-literate but "graphically challenged" desktop publisher—regardless of the type of hardware and software being used—this book teaches the elements of good design. As it guides the reader through the maze of boxes, grids, screens, fonts, clip art, and other graphic elements, it offers guidelines, advice, and a wealth of ideas for creating professional materials.

The third edition contains new information on adding impact and accent with color in a new chapter with 24 pages of four-color illustrations. It also explains how to choose, place, crop, and retouch photos; work with service bureaus; and vast resources of ready-made art that are available to desktop



publishers for a minimal cost.

Looking Good in Print, Third Edition costs $24.95 and is published by Ventana Press, P. O. Box 2468, Chapel Hill, NC 27515; Tel: 919-942-0220; Fax: 919-942-1140.

CIRCLE 93 ON FREE INFORMATION CARD

ELECTRONIC PARTS AND COMPONENTS CATALOG

from MCM Electronics

More than 1000 new items, including expanded lines of computer and cellular products and a selection of appliance-repair parts, are highlighted in this comprehensive catalog of parts and components. In total, the catalog features more than 20,000 items in dozens of product categories.

The Electronic Parts and Components Catalog (#32) is free upon request from MCM Electronics, 650 Congress Park Drive, Centerville, OH 45459-4072; Tel: 800-543-4330.

CIRCLE 80 ON FREE INFORMATION CARD

1994 PRODUCT GUIDE OF ENGINEERING SOFTWARE AND HARDWARE TOOLS

from BSOFT Software

This 32-page booklet describes PC Bus board and engineering software products for PC's and compatibles. It contains detailed information on digital-I/O, data-acquisition, and signal generation products as well as engineering-schematic and PC-board CAD-related software.

The 1994 Product Guide of Engineering Software and Hardware Tools (Catalog #7) is free upon request from BSOFT Software, Inc., 444 Colton Road, Columbus, OH 43207; Tel: 614-491-0832; Fax: 614-497-9971.

CIRCLE 81 ON FREE INFORMATION CARD

BASIC ELECTRONIC COMMUNICATIONS FOR THE FCC GENERAL RADIOTELEPHONE OPERATOR'S LICENSE EXAM

by Victor F. C. Veley

This comprehensive study guide and reference work provides all the information necessary to pass the FCC General Radiotelephone Operator's License (GROL) exam. More than just a sampling of exam questions, the book provides detailed answers and explanations that help aspiring technicians fully understand the principles of electronic communications. Starting with the basics of alternating and direct current, the book progresses logically through the operation and use of diodes and power supplies, transistors and other semiconductor devices, AM and FM transmitters and receivers, transmission lines and antennas, microwaves and radar, numbering systems, and digital

concepts. The Ship Radar Endorsement (Element 8) is also thoroughly covered.

Basic Electronic Communications for the FCC General Radiotelephone Operator's License Exam costs $24.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel: 1-800-233-1128. ■

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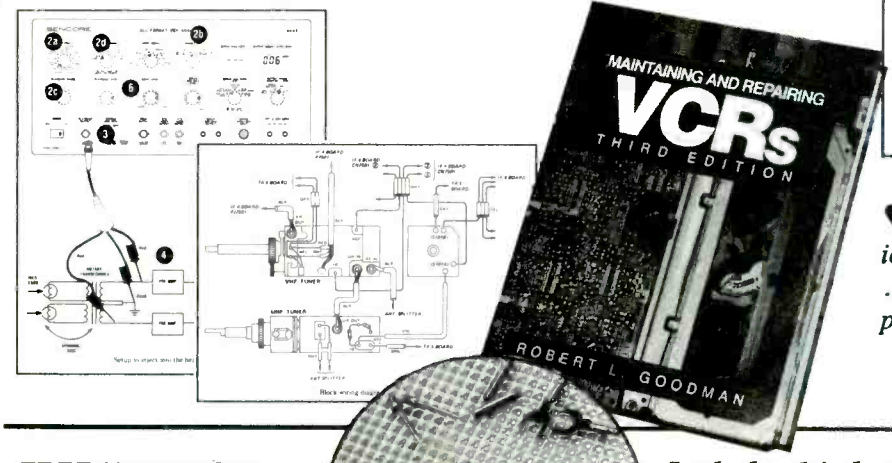

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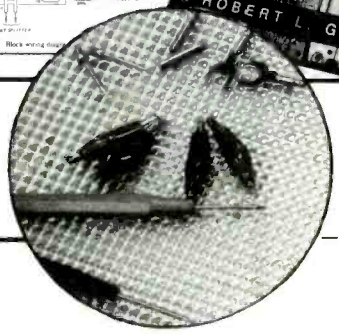

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The SA-VA3 home-entertainment sound system has a suggested retail price of $950. For additional information, contact Sony, 1 Sony Drive, Park Ridge, NJ 07656.

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Because police laser-monitoring devices can clock both approaching and receding vehicles, *BEL-Tronics' Super Wideband with Laser Plus* series of integrated radar/laser detectors feature rear laser detection. No added attachments are required for rear detection. Besides Dual Tracking Laser (DTL) system, the new detectors also feature a wide field of view for off-axis laser detection and advanced super-wideband

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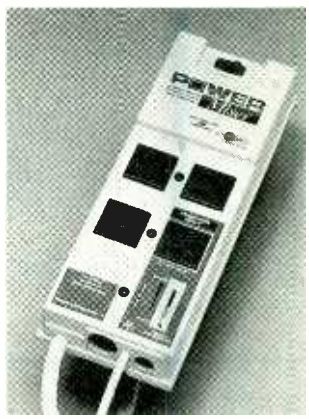
Prices for the Super Wideband with Laser Plus series of radar/laser detectors range from $279.95 to $499.95. For more information, contact BEL-Tronics Limited, 8100 Sagi Parkway, Covington, GA 30209; Tel: 404-787-6500 or 800-828-8804; Fax: 404-784-9898.

CIRCLE 101 ON FREE INFORMATION CARD

SCREEN MONITOR/ SURGE SUPPRESSOR

As a member of the EPA's Energy Star program, *Tripp Lite's Power Miser*, a combination screen monitor and surge suppressor, is recognized as a power-conserving computer accessory. The Power Miser saves electricity by automatically turning off power-hungry computer monitors when no keyboard activity is detected. The user can select shut-off times ranging from five to 60 minutes, using a convenient slide adjustment. Keyboard activity instantly restores the monitor. By powering down the computer monitor, the Power Miser can provide savings up to $190 per year per monitor.

The device is also a four-outlet surge suppressor with superior spike and line-noise filtering for connected equipment. It provides 720 joules of



surge suppression and excellent RFI and EMI noise rejection. Installation is simple, with all cables included.

The Power Miser screen monitor/surge suppressor has a suggested retail price of $99.95. For further information, contact Tripp Lite, 500 North Orleans, Chicago, IL 60610-4188; Tel: 312-329-1777; Fax: 312-644-6505.

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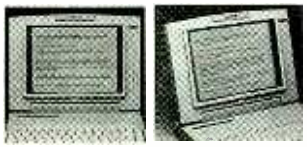
play blurred and illegible when viewed from the side. Viewed straight-on, the image is perfectly clear—and glare is reduced by 99% thanks to multiple thin-film coatings. When viewed from either side, however, light is scattered to distort



the image. The filter is designed for all backlit and TFT LCD displays, and allows for excellent light transmission without changing the optical image of text and graphics. Made of optically pure safety glass mounted in an injection molded, durable, ABS-plastic frame, the filter weighs only seven ounces.

The Secure-View notebook filter, including a carry/storage case, has a suggested retail price of $119. For further information, contact Kantek Inc., 15 Main Street, East Rockaway, NY 11518; Tel: 516-593-3212; Fax: 516-593-3295.

CIRCLE 103 ON FREE INFORMATION CARD

HEAVY-DUTY THERMOMETERS

Two *Heavy Duty Type K Thermometers* from *Extech* accept either single or dual inputs for wide measuring ranges of −050°C to 1000°C (−58°F to 2000°F). Each is highly accurate (to ±0.3%) and offers a front-panel offset adjustment to optimize accuracy. The thermometers are encased in a rugged package for field use.

The single-input *Model 421305* offers 0.1° or 1° resolution; the dual-input *Model 421306* offers 1° resolution and also provides differential readings. Both models are Centigrade/Fahrenheit switchable. Maximum reading, data hold, and auto polarity are displayed on each unit's large 3½-digit LCD readout. Each thermometer comes with a 9-volt battery, a rubber holster with stand, a wrist strap, and a bead-wire temperature probe.

The single-input and dual-input thermometers cost $79 and $99, respectively. For additional information, contact Extech Instruments Corporation, 335 Bear Hill Road, Waltham, MA 02154; Tel: 617-890-7440; Fax: 617-890-7864.

CIRCLE 104 ON FREE INFORMATION CARD

HOME-STUDY ELECTRONICS ENGINEERING TECHNOLOGY DEGREE

A leading electronics home-study school, the *Cleveland Institute of Electronics (CIE)*, has organized *World College*, which offers a Bachelor's Degree in Electronics Engineering Technology (BEET). The independent-study program concentrates on electronics technology and also includes courses on computer engineering, mathematics, basic science, communications, social science, and humanities. World College, which is located in Virginia Beach, has been authorized to enroll students in the BEET program by the Virginia Council of Higher Education, and is currently awaiting the Council's approval to grant the BEET degree. World College is also accredited by the Accrediting Commission of the National Home Study Council.

For additional information, contact World College, 1776 East 17th Street, Cleveland, OH 44114; Tel: 800-243-6446.

CIRCLE 105 ON FREE INFORMATION CARD

32-SWITCH REED-RELAY CARD

A versatile PC-based switching solution from *AccuSys*, the *32-Switch Reed Relay Card*, allows PC's to control real-world applications by smoothly switching any signal. Offering simple-to-use and completely configurable low power management of analog or digital signals, the card can be used in such diverse applications as flight simulators, home automation, irrigation systems, modem switching, and even model-train operation. An expanded options connector allows more switch configurations than other switch cards, including conditional and multi-conditional switching combinations. New circuitry allows status checks of any relay with a simple software inquiry. An optional Windows application,

"Win-Switch," offers simple control and relay scheduling with an easy graphic interface. A broad selection of addressing options allow the user to populate any ISA-slot compatible system with as many cards as there are slots available. That allows a single PC to control hundreds of signals. If an application requires a lot of specially wired cards, mini-daughterboards are available optionally for easy replication of special relay interconnections. An optional B-side connector, which provides discrete access to both sides of all relays, is also available.

The 32-Switch Card, including software primitives in Assembler, BASIC, C, Fortran, Cobol, FoxPro, and dBase, costs $395. The B-Side connector costs $29, and "Win-Switch" costs $89.95. For more information, contact AccuSys, Inc., Information Group, 3695 Kings Row, Reno, NV 89503; Tel: 702-746-1111.

CIRCLE 106 ON FREE INFORMATION CARD

QUICK-BOND KIT

To provide rugged, instant bonding of metals, rubbers, and plastics, *Planned Products' 4300 Circuit Works Quick-Bond Gel Kit* includes an accelerator that can be applied directly over the adhesive. The kit is intend-

ed for design, prototype, and repair applications, and is well suited for filling gaps, wide tolerances, and bonding dissimilar materials. The one-part, cyanoacrylate gel will not spread to unwanted areas after application. It can be used alone, or with the accelerator for instant bonding. Bonding is instantaneous as the accelerator contacts the adhesive, assuring reliable results regardless of temperature or humidity. Cured Quick-Bond Gel is a colorless solid that resists shock, impact, and temperature cycling. Applications include bonding jumper wires to circuit boards, fixturing surface-mount components, component mounting, strain relief, shallow potting, and general instant bonding.

The 4300 Circuit Works Quick-Bond Gel Kit, including the gel adhesive, the accelerator, and a brush and a pipette for applying the accelerator, costs $6.95. For further information, contact Planned Products, 303 Potrero Street, Suite 53, Santa Cruz, CA 95060; Tel: 408-459-8088; Fax: 408-459-0426.

CIRCLE 107 ON FREE INFORMATION CARD

CORDLESS PHONE/ ANSWERING SYSTEM

Sanyo's CAS-170 cordless telephone/digital TAD provides noise-free, tape-free convenience. With all-digital recording, an integrated chip stores up to 18 minutes worth of incoming messages, and two 60-second outgoing messages. The record-memo function allows the user to record a message for a family member or friend without calling in. A two-digit LED call counter lets the user know exactly how many messages have been received. The answering machine also features a time/day stamp, two-way recording from the base or the handset, extension-

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phone disconnect, rapid message erasing, announce-only mode, and 100 user-selected security codes. The phone features Compander IV noise reduction, which compresses the audio signal at the base and amplifies it at the headset,

which leaves noise outside audible levels. The CAS-170 also offers 10-million digital security codes.

The CAS-170 cordless telephone with digital answering system has a suggested retail price of $229.99. For more information, contact Sanyo, 21350 Lassen Street, Chatsworth, CA 91311-2329; Tel: 818-998-7322; Fax: 818-701-4149.

CIRCLE 108 ON FREE INFORMATION CARD

AC-ONLY CHARGERS/ DISCHARGERS

With more and more 8mm and VHS camcorder owners recognizing the importance of eliminating battery memory, chargers and reconditioners are becoming must-have accessories. *Sima's PowerMax Models SPM-8* and *SPM-9* are specialized charger/dischargers in that they are AC-only. The SPM-8 is for use exclusively with 6-volt batteries, the most commonly used type. The SPM-9 can be used with virtually all 6-, 7.2-, and 9.6-volt batteries. In addition, the

SPM-9 features an auto-select mechanism that automatically senses battery voltage and begins charging/discharging. Users don't have to remember to switch the unit to the proper setting. Both products fully discharge and then charge camcorder batteries in one automatic and continuous cycle.

The PowerMax Models SPM-8 and SPM-9 chargers and reconditioners have suggested retail prices of $37.45 and $47.45, respectively. For more information, contact Sima Products Corporation, 8707 North Skokie Blvd., Skokie, IL 60077.

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CLAMP-ON DIGITAL MULTIMETER

The use of advanced Hall-effect technology allows *Wavetek's CDM600* digital multimeter to measure currents without requiring the user to interrupt circuits.

The clamp-on instrument can measure AC and DC current up to either 200 amps (high resolution of 100 mA) or 600 amps without disturbing the circuitry. The CDM600 has two ranges—200 and 600 amps—for measuring AC and DC current with 1% accuracy. The multimeter measures AC voltage to 750 volts, DC voltage to 100 volts, and resistance to 2000 ohms. An auto-zero control eliminates the effect of stray magnetic fields while measuring DC current. Other features include a continuity beeper and a data-hold switch to freeze the measurement value on the display.

The CDM600 digital multimeter costs $249. For further information, contact Wavetek Corporation, 9145 Balboa Avenue, San Diego, CA 92123; Tel: 619-279-2200. ■

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A Hands-on Electronics® REPORT

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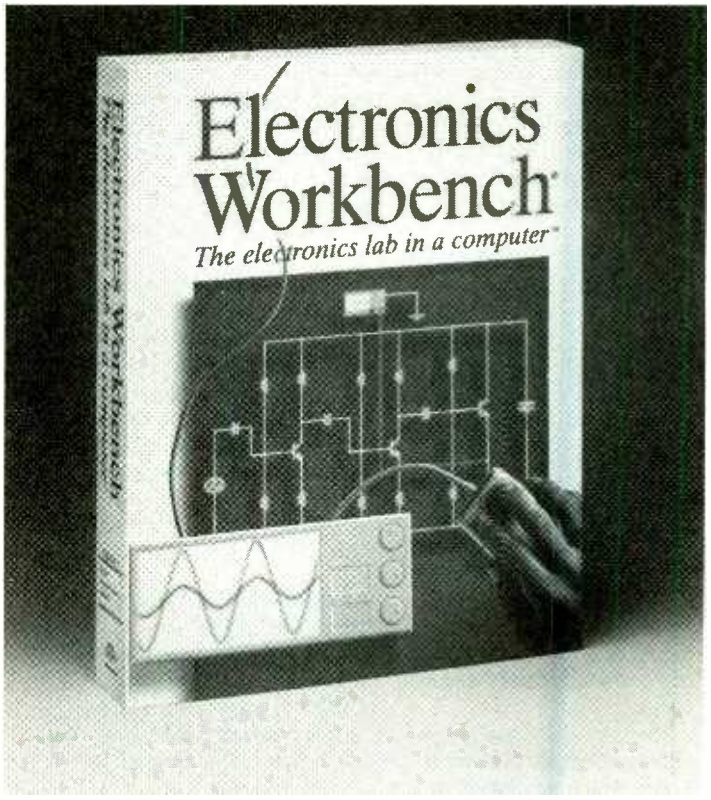

CIRCLE 119 ON FREE INFORMATION CARD

An educational time-and-money saving lab in a computer for beginners and seasoned hackers alike.

Face it, economically things are tough. Certainly tough enough to keep many would-be electronics hobbyists from buying their first suite of test equipment. Purchasing lots of must-have parts also adds to the burden. So where's the next generation of electronics whizzes going to come from? The answer to that question might be "the virtual lab!"

I know what many of you are thinking, "where's the romance of burnt transistor and soldering-iron scars on the kitchen table." For nostalgia's sake, something in me sympathizes with that point of view. But now *I* own the kitchen table, not to mention the test equipment. I don't want my kid to have a go at either just yet, so a lab simulator is the next best thing. Furthermore, if the software is instructive in-and-of itself, so much the better—you can't learn much from a piece of mute test equipment.

The Electronics Workbench software-based lab we'll discuss in this article is just the thing. It's easy to use, full-featured, and educational. Its on-line help and excellent manual make it a good learning experience for a beginner.

Also, the manual's explanation of its circuit-simulation techniques and how to alter simulation parameters allows the experienced user to tweak to his heart's content. So much so, that I'm sure that even I'll be using it to test spur-of-the-moment designs and test-equipment-sensitive circuits alike. It will also come in handy when I'm pressed for time, as building and reworking a virtual circuit takes much, much, less time than prototyping the real thing—even on solderless breadboard. Reworking a design is proportionally easier, as well.

The software is divided into two independent parts: the analog module and the digital module. That is because it cannot run hybrid analog/digital simulations. For that reason, each module only contains parts and test equipment pertinent to its function. For example, a logic analyzer is only present in the digital simulator. Still, the two simulators have many things in common, so let's discuss the commonalties first.

Basic Features. The software requires an IBM-compatible 286 or greater running DOS 3.0 or higher, with at least 2MB of available hard-disk space, 640KB RAM, a Microsoft-compatible mouse, and EGA or VGA graphics. It can support a math-coprocessor, but one is not required.

Complete with a schematic-design area (called a "breadboard"), a parts-selection area (called a "parts bin"), and simulated test instruments, the modules permit you to draft a circuit, stimulate it with input, simulate its operation, and view its functioning. You can also obtain printouts of a schematic, the parts it contains, and test-instrument displays. All the common laser and dot-matrix printers are supported.

The screen for both modules is divided up into a few important areas. Let's start with the very top border. There to the left are depictions of the available test instruments. That area is

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called the "instrument shelf." In the middle, the circuit type (analog or digital) and filename appear. To the right are some program-control icons. One on-screen button activates the simulation; another calls for a pull-down menu. The other two are for scrolling around the schematic and the parts bin (both of which can be larger than the screen allows).

The parts bin is along the right border of the screen. It contains schematic depictions of the parts, not simple labels. There's also a connection dot, and power and ground symbols. If you want, you can create your own parts (say, to adjust the operating parameters of the active analog components) using the program's macro feature.

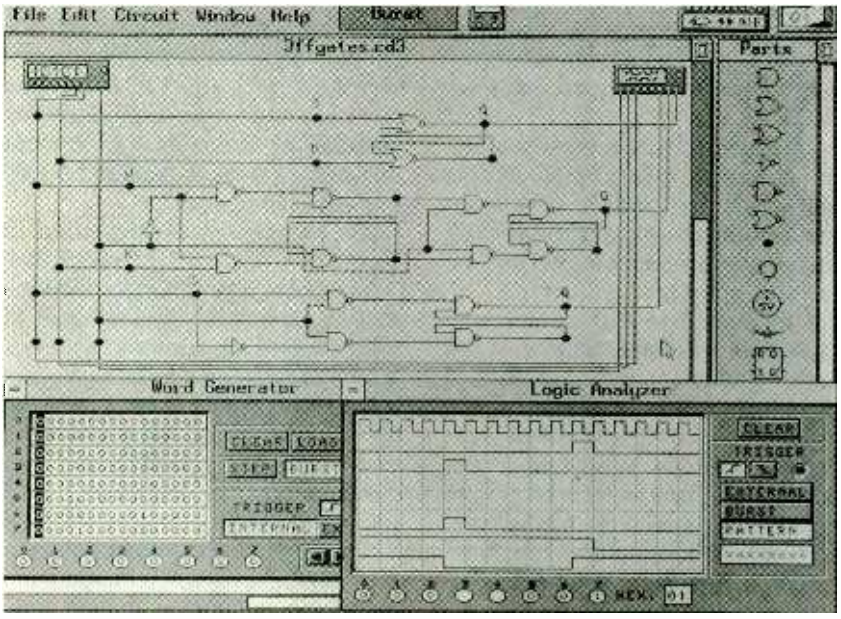
The rest of the screen is the work area in which you draft a schematic and connect test equipment to it. Both the items in the parts bin and the test-equipment icons are dragged to the breadboard area for use. You can use as many copies of parts as you like, but only one copy of each test instrument is allowed. To get to an instrument's control/display panel, you simply double-click on its icon.

Wires between parts leads, power points, connection dots, and test-equipment terminals are routed automatically. You just move the cursor close to the business end of an item (a lead, connection dot, terminal, or whatever) until a "handle" (a dark square) appears. Then you click and drag a wire to its destination where another handle appears, and then release the mouse button.

To edit parts already on the schematic, you must first select them by enclosing them in a special rectangle. The rectangle is formed by clicking the right mouse button where you want one of its corners, then dragging the mouse to position its diagonal corner. Once selected, the objects can be manipulated by commands from the menu. The menu allows you to get help on, create, cut, copy, move, label, set values for, or rotate items; zoom in, zoom out, or clear the screen; set defaults; load or save schematics; or print.

By the way, on-line help for any component can also be had by selecting it and pressing the F1 key. If you create your own parts, you can provide help text for them, too.

Analog Module. The Analog Module automatically sets up Spice simulations for its circuits. However, the program allows you complete control of all of the simulation's parameters. Furthermore, the program can do both transient and steady-state analysis to determine how the circuit functions at turn on and thereafter, respectively.



Here's the digital simulator showing off its two most-powerful test instruments—the word generator and logic analyzer—at the bottom of the screen. Note how the icons for the units are wired to the schematic.

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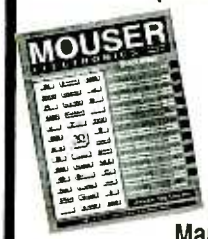

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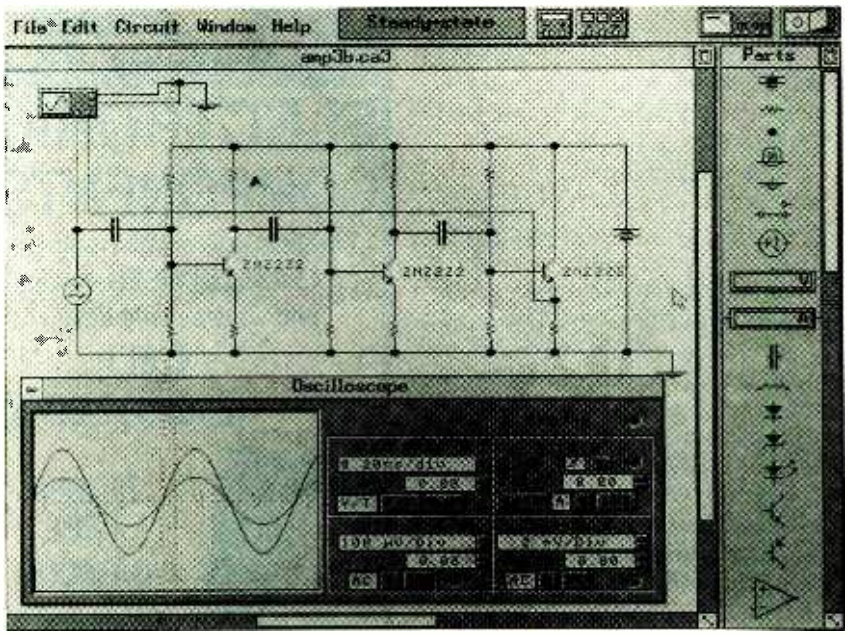

The analog simulator can operate in both transient mode (for -power-up simulation) or steady-state mode. Here it's shown in steady-state mode so its oscilloscope displays a periodic waveform generated by the virtual circuit.

Its bundled parts bin contains resistors, capacitors, inductors transformers, diodes, Zener diodes, bipolar transistors, LED's, bulbs, fuses; AC and DC voltage and current sources; and voltmeters and ammeters. Those last two can help you monitor multiple points in a circuit in lieu of sufficient test equipment.

Speaking of test equipment, there's a 1 HZ-to-999 MHz function generator for square, triangle, and sinusoidal waves. You can adjust its amplitude, frequency, duty cycle, and DC offset.

There's also a multimeter that measures current, voltage, resistance, and dB's. Unlike real meters, this software unit is ideal (placing no load in a circuit), but its characteristics can be altered for realism.

The 1 HZ-to-999 MHz dual-trace oscilloscope present supports internal and external triggering on either the positive or negative edge. It is also capable of X-Y mode for plotting characteristic curves and Lissajous patterns.

The included Bode plotter allows you to study the frequency response of a circuit. You just specify the frequencies of interest and the unit plots them versus their phase shift or gain. The plot can be either logarithmic or linear.

Digital Module. There is one feature of the digital simulator that's both good and bad: it "uses" ideal components. Thus the slew rates (or rise and fall speeds) and fan outs are infinite, and the propagation delays are zero. The good news is that that is fine for verifying truth tables and testing combinational-logic circuits. It also enhances the speed of the simulator. The bad news is that the simulator will not reveal race conditions in sequential-logic circuits (circuits with feedback loops like simple RS flip-flops). But that is a universal short-coming of digital simulators that cost less then $1000.

The digital parts bin contains AND, OR, XOR, NOT, NOR, and NAND gates RS, JK, and D flip-flops, half adders, seven-segment displays, and voltmeters. Of course you can add more parts to this pretty good list.

With regard to test equipment, there is a multimeter included in the digital instrument shelf. However, it can only act as a voltmeter.

There's also a 16-word, 8-bit data generator. All you do is type in the appropriate value of each bit, or load a previously saved pattern in from the hard disk. The generator has three modes: single step, which produces one word each time you hit the step button; burst, which sequences through all 16 words; and cycle, to sequence the words over and over.

The module also has an 8-channel logic analyzer with graphical and hexadecimal displays. It can be triggered by pattern recognition, or by a rising or falling external signal.

The most powerful "instrument" is the truth table. It performs conversions between gate, truth-table, and Boolean representations. Just think, you could enter a truth-table, and the program will wire up the appropriate circuit as well as give you the logic expression for your notes! This is where software leaps beyond what is possible in the real world.

There's More. As if these extensive tools and parts aren't enough, there are supplemental products you can buy to add even greater usefulness to the Electronics Workbench. One of the most powerful of those is called "Model Set 1." In it you'll find simulations of the most commonly used components listed by part number. Each model is not generic; it is a simulation of each part according to manufacturer's specifications. How many parts? There are 22 plain diodes, 38 Zener diodes, 30 op-amps, 72 NPN transistors, 70 PNP transistors, 41 N-channel JFET's, 12 P-channel JFET's, 12 N-channel MOSFET's, 13 P-channel MOSFET's. That's a lot of virtual silicon for $29.95

Another product suitable for beginners and the experienced is the round-up of 150 pre-made circuits. They come on diskette along with a 7-chapter book describing the operation of every circuit for $39.95. (Plans are also in the works to produce another book/diskette set of even more circuits, so it looks as though the support may never end.)

Whether you're an old hand at electronics that likes powerful CAE "toys," or just getting started and hesitant to commit *beacoup* bucks to supplies and equipment, the Electronics Workbench comes highly recommended. It's simple enough to use for the beginner, and powerful enough for reconfiguration and augmentation by the advanced user. If you fall into either category and wish to find out more about the $299 package, contact Interactive Image Technologies, Ltd. (700 King St. West, Suite 815, Toronto, Ontario, Canada M5V 2Y6) directly, or circle No. 119 on the Free Information Card. ■

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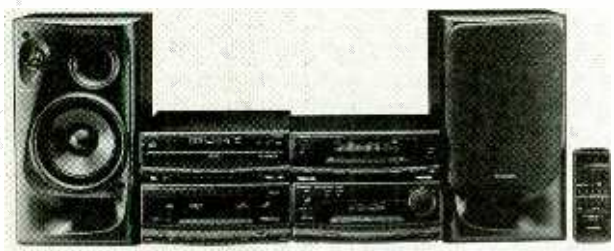
PRODUCT TEST REPORTS

By Len Feldman

Technics SC-CH555 Mini Component Stereo System

Not everyone wants the bother of "mixing and matching" audio components in order to assemble a good sounding stereo system. That is one of the chief reasons behind the popularity of all-in-one "mini" component systems. Besides taking the drudgery out of the selection process, mini systems also take up less room than full-size systems; they can usually fit on a shelf. Finally, and perhaps best of all, by retaining control of both the electronics and the loudspeakers, the manufacturer of a mini system can make certain that overall response of the entire system is as flat and uniform as possible.



CIRCLE 120 ON FREE INFORMATION CARD

The Technics model SC-CH555 mini-component system.

We recently evaluated and tested several such systems and were most impressed by the Technics SC-CH555. That system consists of four components: an integrated tuner/amplifier, a three-disc CD changer, a dual-transport cassette deck, and a sound-field processor that can be used to simulate various acoustic environments. The sound-field processor can use preset equalization curves, or equalization curves that you establish yourself and store in memory. The CD changer allows you to change discs even while one disc is playing. More important, the CD player uses Technics famous MASH system of D/A conversion, which ensures extremely linear recovery of digitally recorded signals.

The system's quartz-synthesized tuner provides 20 random presets. A program timer lets you fall asleep listening to one musical source and volume level and wake up to a different source at a different volume. A multi-function remote control comes with the system and allows you to select and operate any of the program sources from the comfort of your listening position. The system even boasts a microphone input and a "Karaoke" (sing-along) feature that lowers the level of a recorded vocalist (through frequency analysis) and allows you to substitute your own vocal talents. The results of this effort can be recorded using the system's cassette tape deck. The system makes it easy to transfer the music from CD's to tape as well, with the system even capable of analyzing how many tracks will fit on each side of a tape and editing the recording accordingly.

The system is supplied with a pair of three-way loudspeaker systems that have been designed to work ideally with the electronic components. In fact, Technics has built in a moderate amount of bass boost in the amplifier section of the system in order to extend bass response that might otherwise begin to roll off at very low frequencies.

One feature that will appeal to many prospective purchasers is the fact that the four electronic components of the system are truly separate. They are powered by a flat-wire cable equipped with connectors that plug into all four components, but the cable is long enough so that the components can either be stacked vertically or in two stacks of two. Sufficient speaker wire is provided so that the speakers can be positioned far apart if room allows.

CONTROL LAYOUT

Controls for the system are distributed among the four components as appropriate to their function. The main-power/standby switch and master volume control are located on the tuner/amplifier unit. All controls work as you might expect and are clearly labeled. Each component is also equipped with an easily read display section that clearly indicates the status of that particular component.

The wireless remote control supplied with the Technics SC-CH555 is clearly divided into sections.

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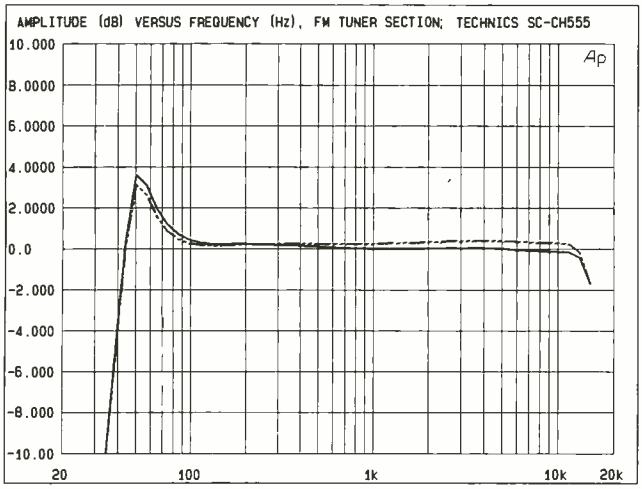
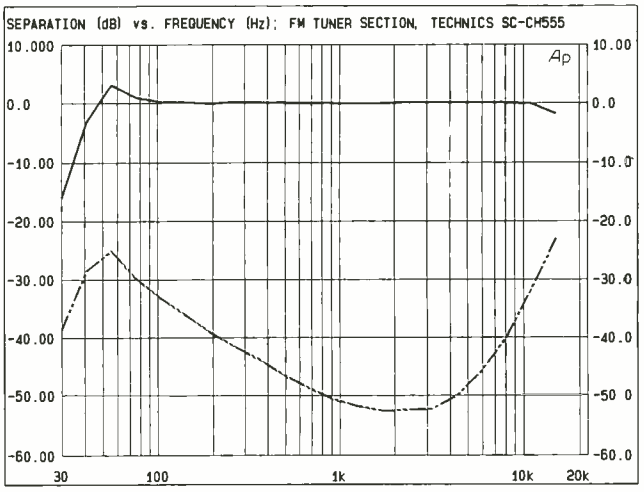
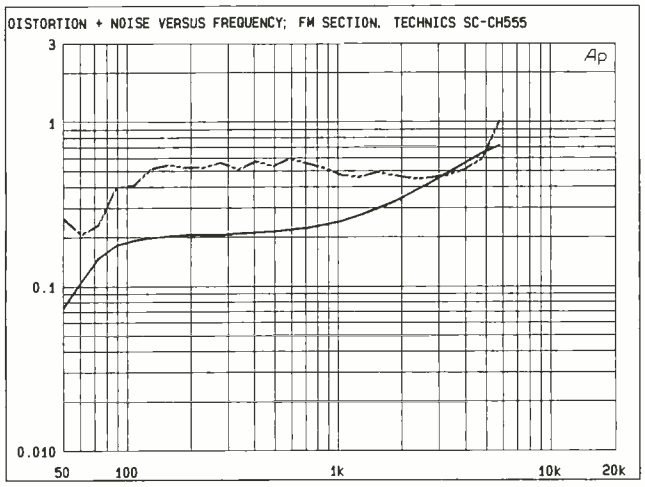


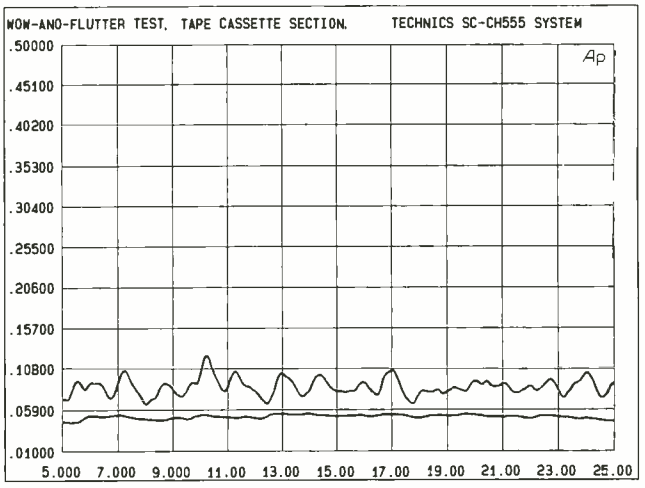
The rise in response at 50 Hz is deliberate and intended to enhance the bass response of the unit's small speaker enclosuers.



The FM-receiver section boasted outstanding stereo separation. At 1 kHz, separation measured more than 50 dB.



The total-harmonic-distortion-plus-noise (at 1 kHz) measured 0.25% for mono (solid curve) and 0.48% for stereo (dashed curve).



While Technics claimed a wow-and-flutter figure of 0.1% (WRMS), this sample measured closer to 0.05% WRMS (lower trace). Even using the IEC peak-weighted method (upper trace), peak wow-and-flutter rarely reached 0.1%.

There are tuner controls, sound-processor buttons, compact-disc changer buttons and cassette-deck controls. In addition, controls for adjusting volume, selecting program source, setting the sleep timer, and muting are common controls that operate for all program sources.

Hookup of the four components and the speakers took only a few minutes, and was much easier than would be the case for separate components made by several manufacturers. For one thing, the flat, multiconductor cable not only delivers power to each of the components, but also routes the audio signals from the source components to the tuner/amplifier. Speaker connections were made via color-coded spring-grip terminals. An AM loopstick is easily attached to the rear of the tuner/amplifier. As for FM, a simple indoor wire antenna is supplied, but serious FM listeners will want to use a better antenna (either an outdoor unit or a powered indoor one).

TUNER-SECTION MEASUREMENTS

We first measured the performance of the FM-tuner section of this system. The frequency response was virtually flat from 100 Hz to 15 kHz, but below 100 Hz there was a rise in response of approximately 4 dB (with its peak at 50 Hz). We soon discovered that this was not a function of the tuner, but rather a built-in characteristic of the amplifier section, designed to enhance the bass response of the relatively small speaker enclosures. That moderate amount of bass boost was effective without tending to overload the amplifier (or the loudspeakers) at normal listening levels.

The quieting characteristics of the FM-tuner section were not as good as we have come to expect from separate full-size tuner components or even from better integrated full-size receiver components. Still, during subsequent listening tests, using a decent, powered indoor antenna, we were able to pick up all of our favorite FM stereo stations with acceptably low background-noise levels. The best signal-to-noise ratio for strong (65 dBf) incoming signals measured 70 dB for mono and 60 dB for stereo signals.

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TEST RESULTS—TECHNICS SC-CH555 MINI STEREO SYSTEM

Specification	Mfr. Claim	PE Measured
Tuner Section		
S/N Ratio (mono/stereo)	75dB/N.A.	72dB/60dB
Stereo Separation	35 dB	51 dB
Distortion (mono/stereo)	N.A./N.A.	0.23/0.48%
AM sensitivity	500μV/m	450μV/m
Amplifier Section		
Power output/channel	35 watts	36 watts
Rated THD	0.9%	0.8%
S/N ratio	88 dB	Confirmed
Frequency response	40 Hz-30 kHz	See text
CD-Changer Section		
Frequency Response	N.A.	See text
THD at 1 kHz (L/R)	N.A./N.A.	0.03/0.05%
Linearity at –90 dB	N.A.	–0.9 dB
S/N ratio	N.A.	90 dB
Dynamic range	N.A.	93 dB
Sound-Processor (Equalizer) Section		
Input sensitivity		
Aux	250 mV	Confirmed
Mic	0.6 mV	Confirmed
Cassette Tape-Deck Section		
Wow-and-flutter	0.1%WRMS	0.05%WRMS
Frequency response (Type II)	40 Hz-15 kHz±4dB	40 Hz-14 kHz±3dB
S/N ratio (no NR/Dolby B/ Dolby C)	55/66/74	Confirmed
General Specifications		
Dimensions (inches)		
Sound processor	10⅜ × 3 17/32 × 10 1/32	Confirmed
Tuner/amplifier	10⅜ × 4 1/16 × 13 3/16	Confirmed
CD changer	10⅜ × 3 17/32 × 12 13/32	Confirmed
Cassette deck	10⅜ × 4 1/16 × 10 13/32	Confirmed
Weight (lbs.)		
Sound processor	3.75	Confirmed
Tuner/amplifier	10.1	Confirmed
CD changer	6.4	Confirmed
Cassette deck	6.2	Confirmed
Suggested retail price:	$849.95	

The total harmonic distortion plus noise measured for a 1-kHz, 100% modulating signal was only 0.25% in mono and 0.48% in stereo. Distortion remained at approximately those levels for low and mid-frequency modulating signals, but rose to 0.7% for mono and 1.0% for stereo for a 6-kHz modulating signal.

Perhaps one of the most outstanding features of the FM-tuner section was its stereo-separation. At 1 kHz, separation measured more than 50 dB. Very few full-size tuners (no matter how costly) or receivers can boast that kind of separation figure. Even at 10 kHz, where separation normally decreases significantly, this tuner section maintains a stereo separation of 35 dB.

Turning to the AM-tuner section, we measured its frequency response. The –6-dB roll-off points occurred at 85 Hz and at 3.5 kHz. While these results are not particularly impressive, they are well within the average range that we measure for separate "high fidelity" tuners and receivers—this despite the efforts of many radio stations to induce radio manufacturers to treat AM radio as more than an afterthought when designing new products.

CD-CHANGER MEASUREMENTS

Next, we measured the performance of the CD changer. Once again, the frequency response of the CD-changer section was governed by that slight but permanent bass boost below 100 Hz. Channel balance was accurate to within a fraction of a dB and roll-off at 20 kHz amounted to no more than 1.5 dB for the left channel and 0.5 dB for the right channel.

All of our measurements were made via the loudspeaker-output terminals, since that corresponds to the way consumers would use the system. Nevertheless, at all but maximum power output levels, CD-changer-section distortion plus noise was so low as to be insignificant. At 1 kHz, the left-channel-distortion-plus-noise measured 0.03% for the left channel and 0.06% for the right channel. More important, the levels of distortion remained fairly constant over much of the audio spectrum, unlike some CD players that have a significant rise in distortion at treble frequencies.

Low-level linearity was excellent, with deviation from perfect linearity never exceeding 1 dB even at –90-dB playback levels. The signal-to-noise ratio for the CD changer was just short of 90 dB, while the dynamic range measured approximately 93 dB.

We tested the error-correction capability of this CD player by playing a special test disc that contains opaque areas of various lengths. The player was able to "play through" missing data of as long as 2.0

(Continued on page 26)

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THINK TANK

By John J. Yacono

Muscle Wire and Auto Stuff

With the warmer weather upon us, many of us are likely to hit the open road more often. So this month's letters will deal with projects for the "great American automobile," or the equally venerable motorcycle.

For our introductory topic, I've decided to give our IC overview a rest. We've been at that topic a while now, and I thought a break would be nice before launching into the CMOS logic family. That said, this month we'll look at a somewhat new component that might find its way into your projects: "Muscle Wire," which can be made to contract when heated by an electric current.

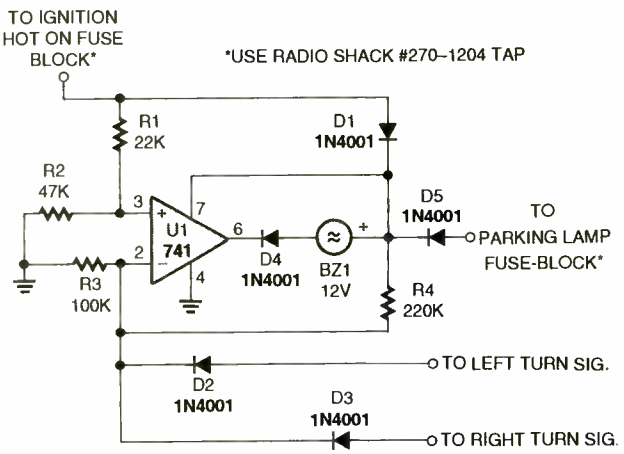

Fig. 1. This useful device provides multiple indications. It tells you when your blinkers are on and if you've left your parking lights on once you've turned the ignition off.

ALLOYS WITH MUSCLE

Muscle wire can be made out of any of a series of Shape-Memory Alloys (SMA's), also called "memory metals." An alloy is formed by first heating precise ratios of two or more elements (usually metals) from the periodic table beyond a particular temperature called the transition temperature. The elements are continually mixed until they reach the "annealing" temperature and allowed to cool. That causes the elements to form crystals. The geometry of the crystals depends on the elements used, their ratio, and the temperature at which the crystals form. Of course, the geometry of the crystals plays a key role in determining the density and thus volume of the alloy, as you'll see.

Once cooled down to room temperature, an SMA can be easily deformed in all sorts of ways. During deformation, the crystals assume a different, looser geometry that can only exist at room temperature. Unlike an alloy used for a spring, they retain their mangled shape. However, that is only a property of the crystals at room temperature. When raised to the transition temperature again, they are not so forgiving and quickly regain their old posture or "phase." That is known as the Shaped-Memory Effect (or SME).

Since SMA materials can be "taught" any shape during annealing, they can be used in a variety of ways. For example, an alloy can be first trained to form a small blood-clot filter, then scrunched-up, quickly chilled, and inserted into an artery. Once warmed by the blood, the filter would simply unfold itself. That only requires a half-hour medical procedure and local anesthetic! They can also be used as spring-like actuators in temperature sensitive valves, or heat-difference pumps that require no overt power input.

Because SMA's are typically made of conductors with some inherent resistance, they can be heated by passing a current through them (the Joule effect). So, after they are deformed, they can be electrically activated to assume their memorized shape. That makes them useful as valve solenoids or tactile-feedback actuators.

Many other currently proposed uses, such as for prosthetic limbs and organs, or in robotic appendages need much more development. That's because the heat generated within an SMA to cause it to "remember" must be carried away before the alloy can be flexed again. Air cooling is far too slow for most applications, and water-jacket and heat-sink cooling are cumbersome in design and use.

Still and all, they can be used by hobbyists to produce interesting effects. The most common memory alloy found in the hobbyist market is nitinol (pronounced *night-in-all*), which is a 50/50 combination of nickel and titanium. Wires of nitinol, heat-difference pumps, kits, and other SMA-related products can be purchased from a company called Mondo Tronics (524 San Anselmo Ave. #107-20, San Anselmo, CA 94960). They are the company that has popularized the name "Muscle Wire,"

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and produce an interesting book called "Muscle Wires Project Book." It's filled will all kinds of facts and fun projects dealing with nitinol wire.

Next month I'll continue our discussion on memory alloys. We'll explore their electrical properties, and I'll describe how to design circuits for them. Now let's open the mail bag.

HEADLIGHTS/TURN-SIGNAL REMINDER

I drive a bare-bones work van with a noisy cab. That makes it difficult to be aware that at times the flashers may be on for miles! Also, after forgetting to turn off headlights and requiring a jump start, I decided it was time to come up with a simple and inexpensive solution to both those ongoing problems. The result is shown in Fig. 1.

If the ignition is on and the parking lights are on or off, the non-inverting input of U1 is at 8 volts and the inverting input is either 0 or 4 volts. That causes pin 6 to go high, keeping the buzzer off. If the ignition is off and the parking lights are on, the non-inverting input is at 0 volts and the inverting input is at 4 volts. That brings pin 6 low, activating the buzzer. With the ignition and turn signal on, and the parking lights on or off, the non-inverting input is at 8 volts and the inverting input pulses at 12 volts, causing the buzzer to sound in step with the blinker.

The turn-signal wires in my case were easily found by removing the shroud on the lower part of the steering column. To find the correct wire for your installation, equip the buzzer with test clips and a safety pin. Using the safety pin as a probe, pierce the insulation of likely wires to find the turn-signal wires. Make sure to turn each flasher on as you proceed.

Auto-parts stores sell a plastic splice that is ideal for making the wire connections. All other items were located at Radio Shack. After purchasing everything, I had change left from a $10 bill.

—Roger W. Hamel, Cedarville, MI

Very, very versatile. You certainly got a lot for your investment. Those of you that will use the wire-piercing technique should seal the tiny pin holes with electrical tape. Remember, cars are exposed to harsh environments and that can lead to wire corrosion even from a pin hole.

CHARGE IT

Here in Ohio you can never tell what the weather will bring. For instance, last winter was extremely dry, so I never used my tractor to push any snow. Also, on occasion a person can go for a motorcycle ride in February. Instead of removing the batteries from those vehicles for the winter I made this circuit (see Fig. 2) to keep them charged all year round.

The circuit is built around an LM317T adjustable voltage regulator. Its output voltage (V_{OUT}) is determined by the formula:

$V_{OUT} = 1.25(1 + R2/R1)$

I chose a 10K resistor for R1 and a 100K resistor for R2 to allow for a little wasted current flow (around 125 μ amps). That arrangement will develop 13.75 volts between the output terminal and ground. I connect that to the battery through R3 and a diode to prevent burn out if the terminals are shorted or reversed, and to prevent battery discharge in the event the regulator is disconnected from the main power supply. The capacitor is optional but will make life easier on the chip under an extreme charging cycle. With proper heat sinking, the IC is capable of carrying 1.5 amps to the battery. The circuit can be left hooked to the battery all of the time and it won't over-charge it.

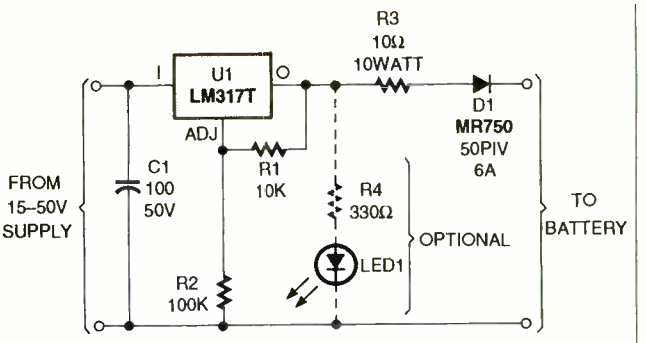
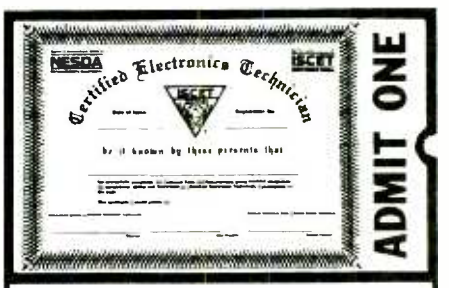


Fig. 2. Keep those batteries nice and juicy all year long with this trickle battery charger. Be sure to use heavy-gauge wire for all connections since you might eventually want to charge a battery that's very low.

I wired a plug to an easily accessible place on each machine for convenient connection and disconnection. For those of you that enjoy lights, run a LED in series with a 330-ohm resistor from pin 3 to ground as a power-on indicator as shown. For the input you can use any DC power supply yielding between 15–50 volts. I use old wall-type power supplies from worn-



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I hope this circuit makes life a little easier for somebody.

—Joseph D. Gaskill, Austintown, OH

You seem to have thought of everything. Everybody be sure to use heavy-gauge wire for this one.

STARTER CUT-OFF

In the October 1992 issue I read the submission for the starter cut-off which utilized a relay. I am submitting a circuit that uses a NPN transistor as a switch instead. In my auto-starter cut-off circuit (see Fig. 3), two conditions are required to start the car: the keyswitch must be turned to the starting position, and Q1 must be turned on. When Q1 is switched to the on state, current flows through the gate allowing current to pass through the SCR, provided that the keyswitch is also turned to the starting position. Note that this is a passive circuit since, once the keyswitch is returned to the run position, the SCR's current flow is interrupted and unlatched, thus resetting the SCR.

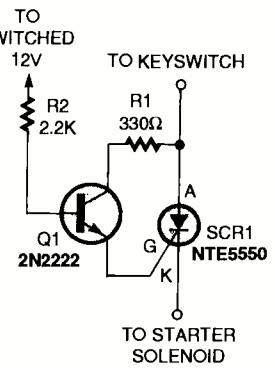

Fig. 3. This starter cut-off switch should be inserted in the line between the ignition switch and the starter solenoid. It can receive its switching signal from a switch you install, or any switched source one would not normally activate during starting.

Transistor Q1 can be turned on by connecting R2 through a separate switch to a 12-volt power source, or by using an existing switched source. Examples of existing sources might be a brake light, turn signal, parking light, or anything that most people would not normally activate while starting a vehicle.

With regard to using a turn-signal indicator, it doesn't matter that the power applied to Q1 is not constant. Only a pulse is required to latch the SCR on, provided that the keyswitch is in the starting position. The SCR I used is a 25-amp, 50-volt unit.

—Don Bradley, Owensboro, KY

That SCR is more than suitable since it only supplies current to the starter solenoid and not the starter itself. By the way I prefer your circuit to the original design. There are no contacts to wear out or pit from repeated starting. You idea for using existing accessory switches is also a winner, provided the accessory chosen will not draw too much power making cold-weather starts difficult.

That's all the room we have for this month. Till next time, send your best efforts to me here at *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. If your work appears here, a book form our library will become yours. ■

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PRODUCT TEST REPORT

(Continued from page 23)

millimeters without introducing any audible artifacts. That's more than three times the minimum requirement stated in the audio-CD standard. Furthermore, the CD changer was highly resistant to external shock and vibration, literally requiring fairly heavy fist-pounding before any mistracking occurred.

CASSETTE TAPE DECK MEASUREMENTS

Using Type-II recording tape, we found that the record/play frequency response of the tape section extended from 40 Hz to 14 kHz, ±3 dB. While Technics' published specifications claim a wow-and-flutter figure of 0.1% (WRMS), our sample actually measured closer to 0.05%. In fact, even using the IEC peak-weighted method of wow-and-flutter measurement, peak wow-and flutter rarely reached the 0.1% level.

The signal-to-noise ratio for an analog-cassette deck depends in part on the deck's electronics as well as on the type of tape being used. We again used a high-grade Type II tape and obtained signal-to-noise readings of 56 dB without Dolby, 66 dB with Dolby B, and an outstanding 74 dB using Dolby C noise reduction.

AMPLIFIER-SECTION MEASUREMENTS

With both channels driven, the amplifier delivered 35-watts-per-channel into 6-ohm loads, over the frequency range from 40 Hz to 20 kHz, at just under the rated distortion level of 0.9%. The signal-to-noise ratio, measured via the external auxiliary input and referenced to the rated output, measured 88 dB. The frequency response of the amplifier section (discounting the small bass boost referred to earlier) extended from 40 Hz to 30 kHz.

HANDS-ON TESTS

Once we installed a couple of CD's and a blank tape into the deck-2 well, we were able to operate the entire system using the remote control. We listened to radio broadcasts, switched easily to CD listening, and initiated tape recording all from the comfort of our listening position. Despite the fact that there are only two loudspeakers, using the "Space" equalization settings and other available EQ modes, sounds seemed often to extend beyond the physical limits of the loudspeakers.

Overall, we were pleased with the tonal quality of the system and with the stereo imaging and the apparent depth of the sonic field of the Technics SC-CH555. We doubt that you could assemble a system of separate components (including speakers) for the modest cost of this entire system and have it perform as well, let alone offer all the convenience features.

For more information on the Technics SC-CH555, contact the manufacturer (Matsushita Electric Corp. of America, One Panasonic Way, Secaucus, NJ 07094), or circle no. 120 on the Free Information Card. ■

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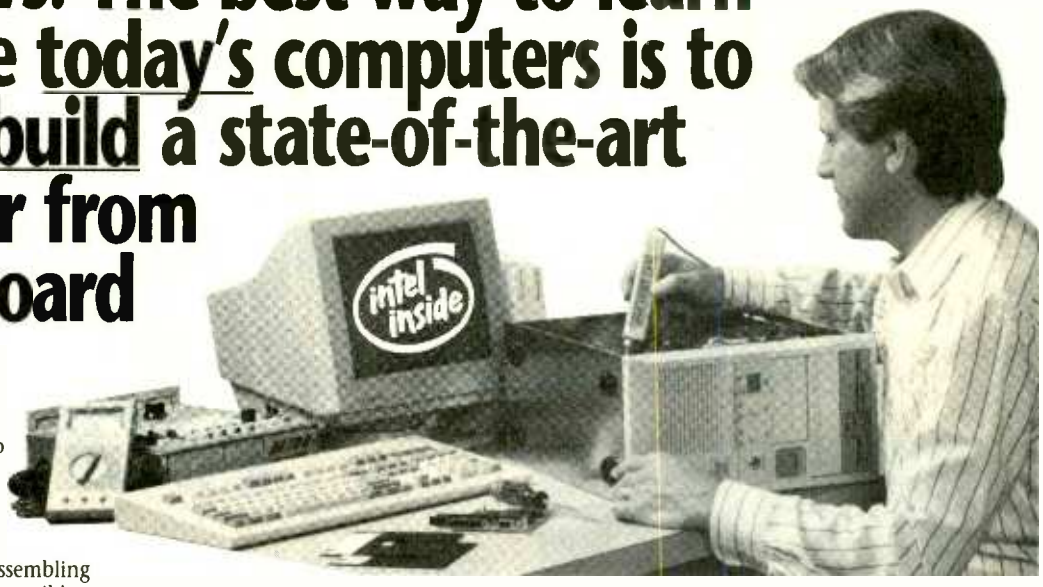

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Build The Call Blocker

Use this circuit and the telephone company's "Caller ID" service to spare yourself from unwanted calls.

BY TERRY J. WEEDER

Have you ever been annoyed by a phone that constantly rings off the hook while you were trying to devote your attention elsewhere. To make matters worse, it seems that most of those calls are from people you did not wish to speak with. You can, and at times probably have, broken down and turned off the bell on your phone just to get a little peace and quiet. The only problem with that solution is that you are then completely cut off from the outside world and even important calls from friends or family can't get through.

There are a number of companies that are now offering a device that will display the number of the calling party for you to view prior to picking up the telephone (called "Caller ID"). That is nice, but even if you can determine that you don't want to answer the call, your peace has already been invaded by the ringing of the telephone and the act of getting up to see whose number is displayed on the screen.

There is a better solution. The *Caller Block* described in this article is a device that connects between your telephone and the telephone wall jack and prevents the phone from ringing unless the telephone number of the person calling matches one of the numbers you have entered into its memory. For maximum versatility, an answering machine can be placed on the same line to handle those calls that do not qualify to ring the phone; those can be dealt with later on at your own convenience. The unit can be used in conjunction with a Caller-ID display unit

A list of up to 62 different telephone numbers can be easily entered into the non-volatile memory using a tone-dialed phone without changing the initial hook-up of the Caller Block unit. The memory is broken up into two separate directories with an external switch used to select which one will be active. One of the directories can be used to hold a large list of numbers from people whom you wish to allow to ring your phone on a daily basis, while the other directory can be used for a more selective list of the most important callers for those times when you want more privacy. Because the Caller Block's memory is stored in an EEPROM, all telephone numbers programmed into memory will stay there even if the power is interrupted.

About Caller ID. With the recent implementation of the service known as CND (Calling Number Delivery) on most major phone networks, it is now possible to receive data about the calling party prior to picking up the phone. That data is what is used by the many caller ID units now hitting the market, and it is what makes this circuit possible. CND is a subscriber feature that transmits data (date, time, number) about the calling party during the silent period between the first and second ring. You must subscribe to the service or no data will be received, but once you have subscribed, you will receive the data on all calls regardless of whether the caller subscribes or not. Call your local phone company to get more information about getting CND on your line.

The date and time information is sent on all calls, but the actual calling number will only be available from parties who are calling from within your area. At the present time "your area" consists of local calls that originate from where CND is available, but will soon be set up to include long-distance calls made from wherever CND is available. As more and more telephone companies upgrade their equipment, the list of callers outside "your area" will continue to decrease.

The actual data sent over the telephone line is a burst of modem tones using 1200 Hz as a logical 1 (mark) and 2200 Hz as a logical 0 (space). The data stream begins with a "Channel-Seizure" signal that consists of a block of 300 alternating mark/space bits used by the receiver as an indication that data will soon follow. That is followed immediately by 180 mark bits; that allows time for the receiver to set up for the first word. Each data word is 8-bits long (least significant bit transmitted first), and is preceded by a start bit (space) and followed by a stop bit (mark). In addition, up to 10 mark bits may be added between words.

The portion of the message that contains the calling number is preceded by a "type code" of 04(hex). The first word to follow is a "length" word that indicates the number of the words in the message. Following the length word, the date, time (in 24-hour format), and the telephone number is sent in ASCII format. Finally, a "checksum" word is sent. For example, 01-15-94 2:30pm 513-555-1212 would be sent as follows:

<type><length>
01159414305135551212
<checksum>

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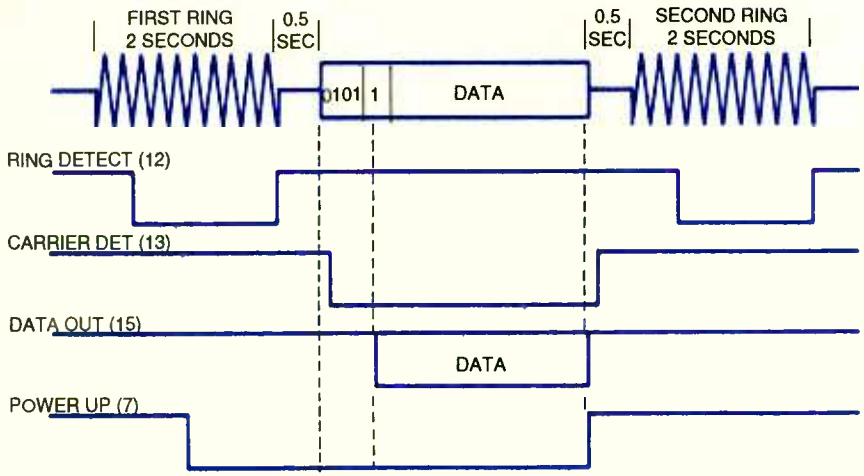

Fig. 1. The timing relationships between the data sent over the phone line (top trace), and the output pins of U2 (Motorola's new calling line identification receiver chip) are shown here.

Circuit Theory. The circuit is made possible by U2, Motorola's new Calling-Line Identification Receiver chip (part no. MC145447), which receives the modem-like tones from the telephone line and decodes them. Figure 1 shows the timing relationship between the data on the phone line (top), and the various output pins of that IC.

When a ring pulse is detected on the phone line, the RING DETECT pin (pin 12) goes low. About ½ second after the end of the ring, the channel-seizure signal (shown as 0101) causes the CARRIER-DETECT pin (pin 13) to go low. The "1" shown after the "0101" represents the series of marks that are sent to allow the microprocessor to set up to receive data. The DATA-OUT pin (pin 15) goes low when receiving the very first start bit, which is the space following the series of marks, and continues to output the decoded data, serially, at TTL levels. The POWER-UP pin (pin 7) was designed for use in battery-operated circuits to conserve power and is not used here.

The schematic diagram for the Caller Block is shown in Fig. 2. The modem-like tones are coupled through C3, C4, R1, and R2 to pins 1 and 2 of U2. The metal-oxide varistor (MOV1) protects the circuit from high-voltage spikes, such as those produced by lightning strikes. The ring pulses are coupled to the RING-DETECT pins (pins 3 and 4) of U2 via C1, C2, BR1, and R3–R5. The relay (K1) is used to connect/disconnect the telephone from the phone line. The optoisolator (U5) monitors the current flow through the telephone and pulls the voltage on R10 low when the phone is lifted off hook. Transistor Q2 is used as a switch to turn LED1 on and off, which indicates when the circuit is in the programming mode.

Power is taken from a 9-VDC wall adapter and is regulated by U6, a low-current 5-volt regulator, and filtered by capacitors C13–C15. To allow the telephone's keypad to be used, current is supplied to the telephone through R9 when the circuit is in the programming mode.

The heart of the circuit is U1, a PIC16C55 EPROM-based 8-bit CMOS microcontroller manufactured by Microchip. That microcontroller has one 4-bit and two 8-bit I/O ports, with each I/O pin being configured separately as either an input or output through software commands. The chip has 512 × 12 bits of EPROM memory to hold the operating program and 32 × 8 bits of data RAM used for working registers. A block diagram of U1's operating program is shown in Fig. 3. For those who wish to program their own PIC, the .ASM and .OBJ code files are available in the PE Library on this magazine's BBS (516-293-2283, 8N1, up to 9600 bps), or a pre-programmed PIC16C55 microcontroller can be purchased from the source mentioned in the Parts List. A non-programmed chip along with a PIC programmer can be obtained from Digi-Key (701 Brooks Ave. South, P.O. Box 677, Thief River Falls, MN 56701-0677) and other sources.

The output pins of U2, as referred to in Fig. 1, are connected to U1 through the upper half of port B. U1 monitors the RING and CARRIER-DETECT pins and when a call is detected, U1 reads the calling party's number from U2, which is output serially through pin 15, and stores it in an internal register. The telephone number is then compared to the group of numbers stored in U4, a 93LC56 2K serial EEPROM also manufactured by Microchip. The 93LC56 uses a 4-line (CHIP SELECT, CLOCK, DATA IN, and DATA OUT) interface, which is connected to port A of U1. After a high is detected on the CHIP-SELECT pin, data is then transferred to and from the 93LC56 on the positive transition of the CLOCK pin. Each read or write function is preceded by a start bit, an op-code (identifying the function to be performed, *i.e.* read, write, etc.) an 8-bit address, and the 8 bits of data that are being written to, or read from, that address. Immediately preceding and following all write operations, the microcontroller (U1) sends instructions to the 93LC56 that enables/disables the write function, thereby protecting the data afterwards.

When entering the programming mode, the telephone is disconnected from the phone line by the relay (K1) and is connected to the analog input (pin 7) of U3, a DTMF receiver manufactured by Motorola. Integrated-circuit U3 is used to decode the tones emitted by the telephone and place its 4-bit word equivalent on the lower half of U1's port B. As each number is entered by the telephone, U1 reads the 4-bit word on port B and writes it to the EEPROM (U4) using port A. If the jumper (JU1) is installed, the microcontroller is configured to omit all area codes (both in programming and receiving), thereby simplifying the programming operation and allowing more numbers to be entered into memory.

Construction. The whole circuit, except for the switches and LED, fits nicely on a double-sided printed circuit board. The artwork is provided in Fig. 4 for those who wish to etch their own board, or you may purchase a pre-etched and drilled PCB from the source mentioned in the Parts List. Once you have obtained your board, identify the component side of the PC board (which is marked), then refer to the parts-placement diagram shown in Fig. 5 to begin construction.

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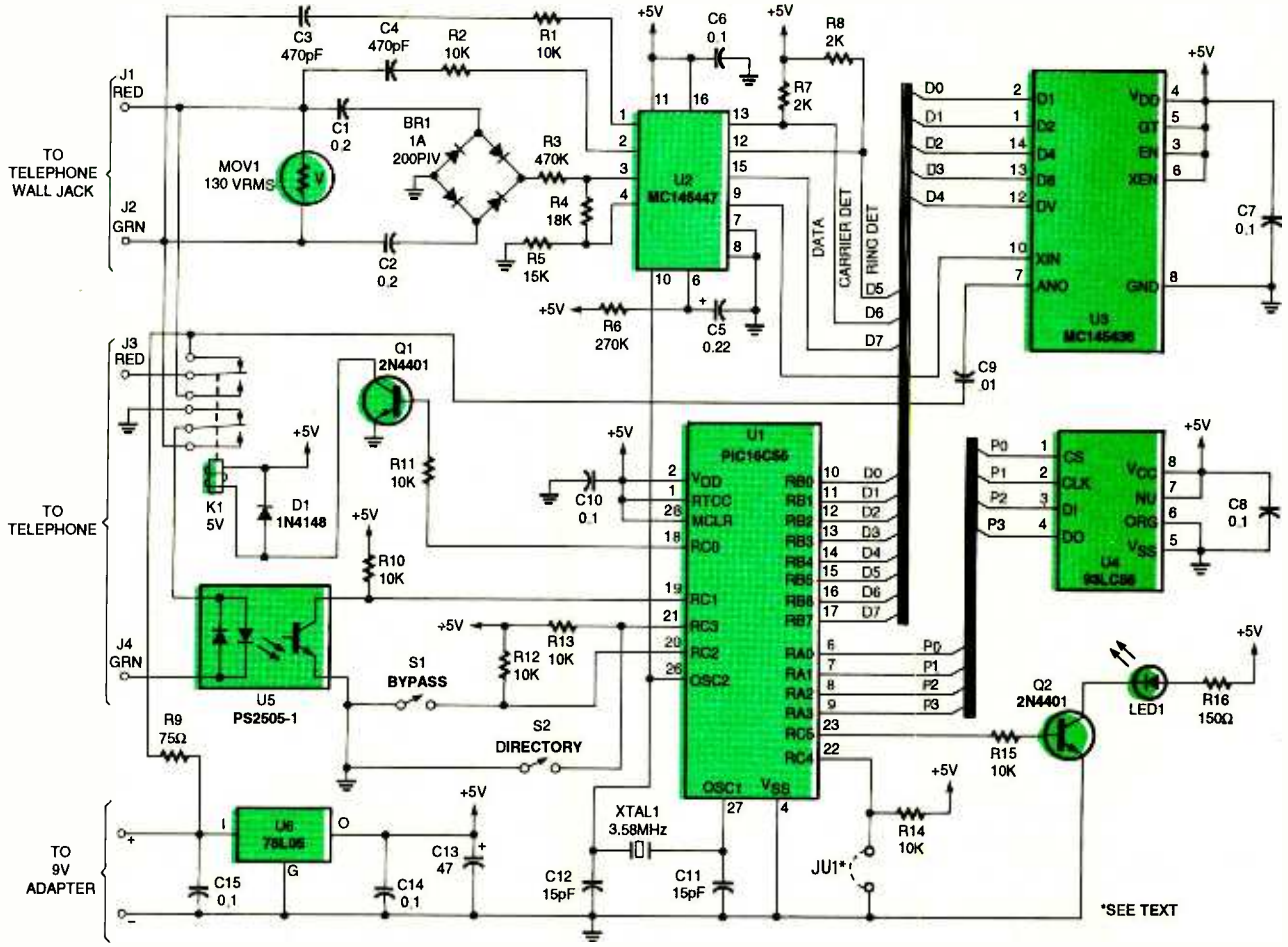

Fig. 2. Microcontroller (U1) reads the calling party's telephone number from U2, compares it to the list of user-entered numbers stored in U4 and closes the relay (K1) if a match is found.

Start by installing and soldering the IC sockets for U1 through U4. Solder U5 and U6 directly to the board, using the component orientations shown in Fig. 5. Mount the rest of the components to the board, paying particular attention to C5, C13, D1, BR1, Q1, and Q2 to prevent installing them backwards. When soldering the crystal (XTAL1), leave a small space between the bottom of the crystal and the PC board. There is a chance that the metal case of the crystal could short the two solder pads together if it is pushed flush against the board when soldering.

At the time of this writing, CND (Calling Number Delivery) was not available on calls originating outside the local area code (at least not in the author's community). As mentioned, with JU1 in place, the microcontroller is configured to ignore the area codes on all incoming calls; only the last seven digits of each number in your list of telephone numbers will have to be entered into memory. In the future, when the CND link has been extended nationwide, you can simply remove the jumper and re-enter your list of telephone numbers using their area codes.

After all components are soldered to the board, inspect both sides for solder bridges or cold solder joints, which appear as dull blobs of solder, and correct if necessary. Carefully plug U1 through U4 into their sockets, making sure that they are oriented correctly. Make sure that all IC's are seated correctly with no pins bent or misaligned.

Cut four pieces of insulated hookup wire, about 6-inches long, and twist them into pairs, then solder one end of each pair to the board terminals labeled S1 and S2. Cut two pieces of different-colored wire to the same length, and twist and solder them to the LED terminals on the board (take care to note which color is connected to the cathode terminal and which is connected to the anode).

The two telephone cords that plug into the telephone and into the wall jack can be made from a single phone cord with a modular plug on each end (such cords are available from Radio Shack and elsewhere) by cutting it in half. Label one cord TO WALL JACK and solder its red and green wires to terminals J1 and J2. Label the other cord TO TELEPHONE and solder its red and green wires to the terminals labeled J3 and J4. Note that the yellow and black wires on both cords are not used. Use an AC wall adapter with an output of 9VDC, such as the Radio Shack 273-1455; cut the coaxial plug off the end of the output cord and solder the "+" and "−" wires to the appropriate terminals on the board.

The size of the PC board and the location of the mounting holes are such that it will mount directly into a plastic enclosure available from Digi-

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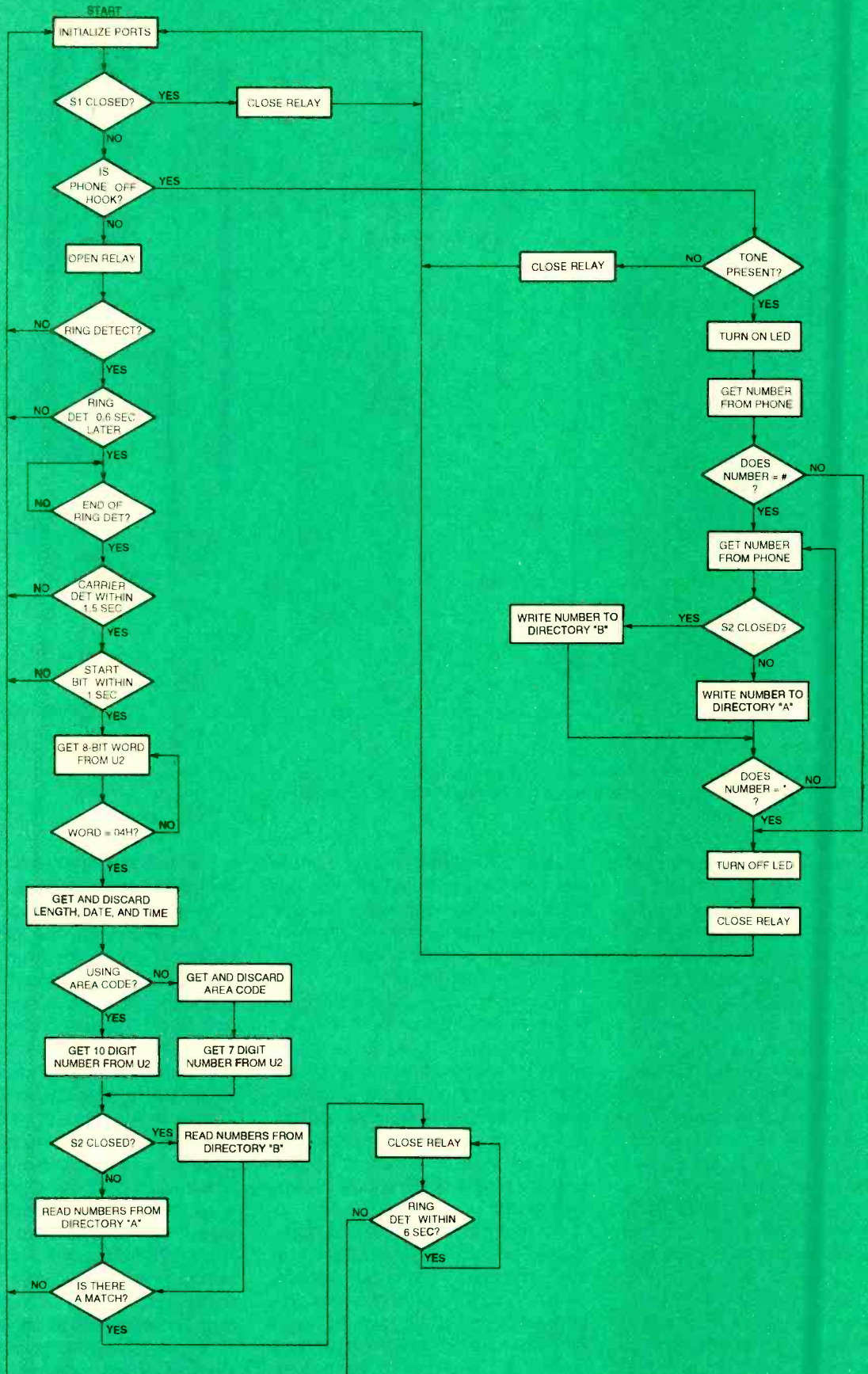

Fig. 3. This flowchart shows how U1's operating program works. A pre-programmed microcontroller is available from the source mentioned in the Parts List.

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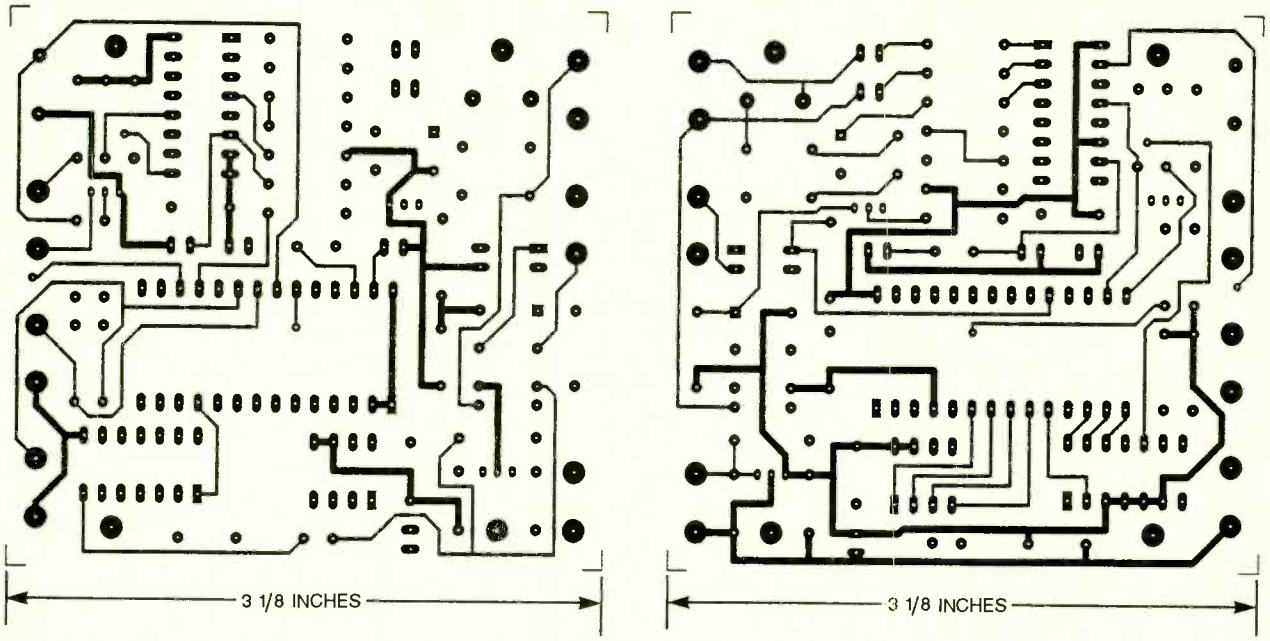

Fig. 4. The Caller Block is assembled on a double-sided PC board. Both sides of the board are shown here full size.

PARTS LIST FOR THE CALL BLOCKER

RESISTORS
(All resistors are 1/4-watt, 5% units)
R1, R2, R10–R15—10,000-ohm
R3—470,000-ohm
R4—18,000-ohm
R5—15,000-ohm
R6—270,000-ohm
R7, R8—2000-ohm
R9—75-ohm
R16—150-ohm

CAPACITORS
C1, C2—0.2-μF, Mylar
C3, C4—470-pF, ceramic disc
C5—0.22-μF, 16-WVDC, tantalum
C6–C8, C10, C14, C15—0.1-μF, Mylar
C9—.01-μF, Mylar
C11, C12—15-pF, ceramic disc
C13—47-μF, 16-WVDC, electrolytic

SEMICONDUCTORS
U1—PIC16C55-XT/P, microcontroller, integrated circuit (Microchip)
U2—MC145447, calling-line identification receiver, integrated circuit (Motorola)
U3—MC145436, DTMF receiver, integrated circuit (Motorola)
U4—93LC56, serial EEPROM, integrated circuit (Microchip)
U5—PS2505-1 optoisolator or equivalent, integrated circuit
U6—78L05 low power 5-volt regulator, integrated circuit
Q1, Q2—2N4401 general-purpose NPN silicon transistor
D1—1N4148 general-purpose silicon diode
LED1—Red light-emitting diode
BR1—1.0-amp, 200-PIV, fullwave-bridge rectifier

ADDITIONAL PARTS AND MATERIALS
K1—5-VDC, DPDT relay
MOV1—130 VRMS, metal-oxide varistor
XTAL1—3.58-MHz, TV colorburst crystal
S1, S2—SPST toggle switch
Enclosure, PC board, IC sockets, wall adapter (9-volt DC, see text), telephone cord with modular plugs, hook-up wire, solder, hardware, etc.

Note: The following items are available from Weeder Technologies, P.O. Box 421, Batavia, OH 45103: A double-sided etched and drilled PC board (WTCBL-B), $11.50; a kit of all board-mounted components including a pre-programmed PIC16C55 (WTCBL-C), $34.50; a pre-programmed PIC16C55 only (PIC-CBL), $18.00. All orders must include an additional $3.50 for shipping and handling. U.S. and Canadian orders only, please. Ohio residents must add 6% sales tax. Please call your local telephone company to verify that "Caller ID" is available in your area before ordering.

Key (part no. SR131G-ND), but it is not critical that you use that box. Any enclosure large enough to accommodate the board and front-panel mounted switches will do.

Drill a hole in the top of the enclosure for the LED, and two holes for the switches. Label the enclosure accordingly, using dry-transfer lettering (available from art or office-supply stores), and mount the switches and LED to the enclosure and connect them to the appropriate points on the board using the wire pairs you previously installed. Mount the PC board in the enclosure and cut three slots in the seam of the plastic case for the power cord and the phone cords. Finish by running these wires out through the slots and assembling the two halves of the plastic case.

Operation. You must call your phone company and subscribe to the Caller ID service for your Caller Block unit to function. It may take several days to be hooked up, depending on your local telephone company, so it is a good idea to do that in advance.

Plug the phone cord labeled TO WALL JACK into the telephone jack on the wall and plug the cord labeled TO TELEPHONE into your telephone. Plug the AC adapter into the wall and the Caller Block should be ready to go.

Using a piece of paper, make two lists of telephone numbers, one for

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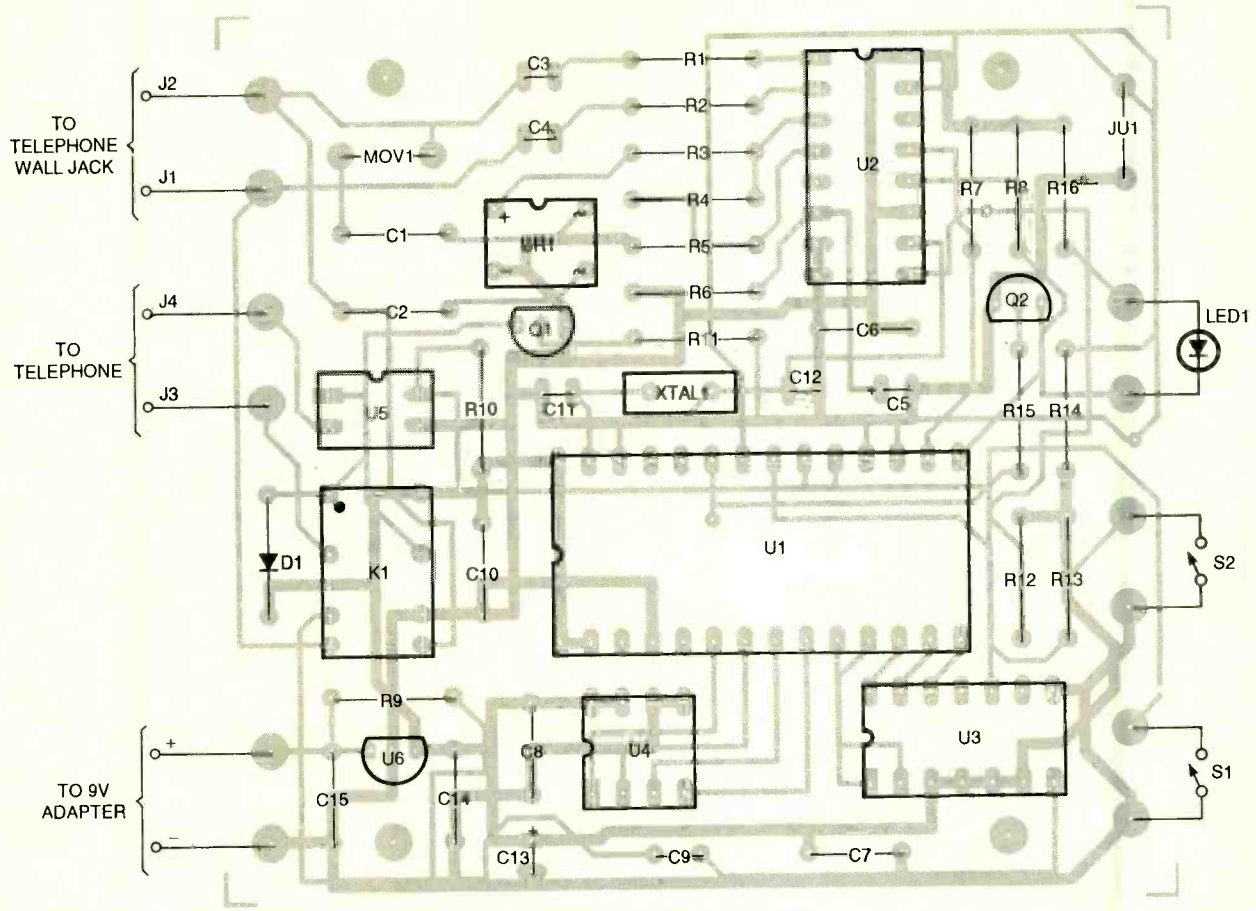

Fig. 5. Use this parts-placement diagram when assembling the PC board. The jumper (JU1) should be installed if you do not want to include area codes with each telephone number stored in memory.

each directory. As explained earlier, one directory can contain a large list of all your friends and family whom you wish to allow to ring your phone on a daily basis. The other list can be more selective, listing only those most important callers for times when you want more privacy. Each directory can hold up to 255 characters including the "#" sign, which is used to separate the telephone numbers. That works out to 31 different 7-digit telephone numbers or 23 different 10-digit numbers (those with area codes).

When programming the Caller Block, you may enter just a prefix such as "752", and all numbers beginning with "752" (752-0001 through 752-9999) will ring your phone. That comes in handy if you wish the people in your neighborhood to be included in your list but you do not want to enter all their numbers separately. Also, if the unit is configured to use the area code, entering a three digit prefix will include all callers from that particular area code.

Note: If you configured your Caller Block to use area codes (omitting JU1), all numbers entered into memory must include the area code whether local or long distance. The number "1" is not required at the beginning of long distance numbers and should not be used when entering your numbers.

To enter your list of telephone numbers into memory, first verify that the bypass switch (S1) is inactive (open), then switch S2 to the desired directory and pick up the phone while holding down the "#" button on its keypad. The LED should light indicating that you are in the programming mode. Release the "#" button and begin entering your telephone numbers with your phone's keypad. At the end of each telephone number press the "#" button, and after all numbers have been entered press the "*" button to end programming. An example would be as follows (note that hyphens have been added for clarity but obviously would not be entered):

555-1212#555-0110#231-0675#
753-9607#752#444-2276#
786#225-35#831-097#*

Note, that a prefix can be any length less then a full number. If you make a mistake, press the "*" button to end programming then hang up the phone and begin again. If the "#" button is accidentally pressed twice in a row while programming, it is interpreted as being a prefix consisting of no numbers, thereby allowing any telephone number to be accepted and ring the phone. After you have finished entering numbers into the current directory and ending by pressing the "*" button, simply hang up the phone, switch S2 to the second directory, and repeat the process with your second list of numbers.

If you run out of memory while entering your telephone numbers, the programming mode is automatically terminated. Count the characters in your list, including the "#" sign be-

(Continued on page 92)

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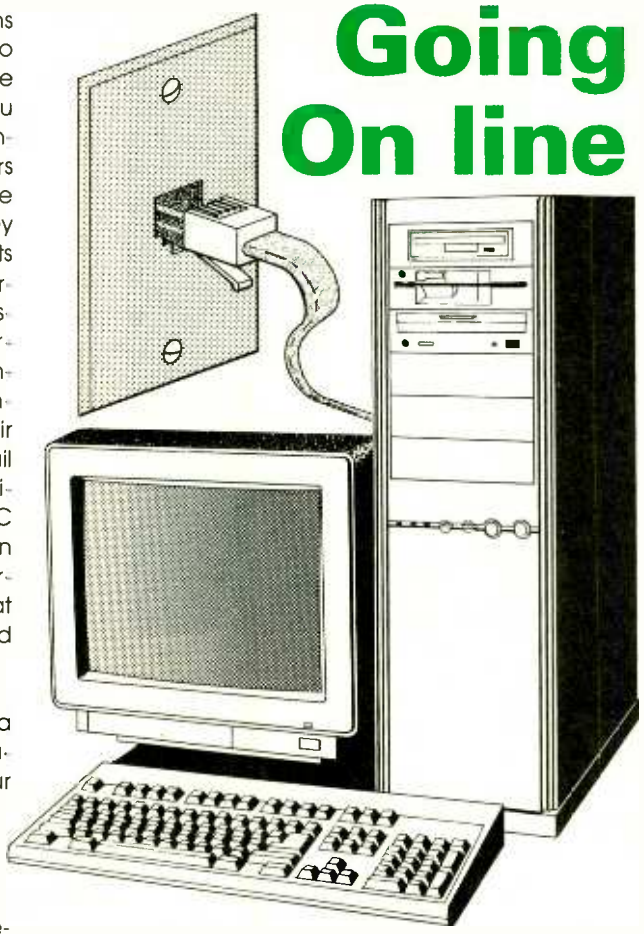
Going On line with your PC



Here's the lowdown on successfully entering a new "online cyberworld" with your PC.

BY KARL T. THURBER, JR.

Online communications lets you use your PC to keep in touch with the rest of the world, giving you access to almost unlimited information. But many PC users are intimidated by on-line communications. While they may be aware of the benefits of connecting with on-line services and bulletin board systems (BBS's), they're overwhelmed by the many complex procedures and confusing terms that stand in their way. This article blazes the trail to successful on-line experiences to help even the PC neophyte. Before we begin our explorations of cyberspace, however, let's look at some of the gear you'll need for your on-line travels.

Modem Basics. The idea behind on-line communications is simple. You link your computer to another over a telephone line, then send and receive data. However, there are a few things you need to "go on-line." Besides the computer itself, you need a communications program, and a modulator/demodulator, commonly known as a "modem." The modem is the linking device that allows the transfer of data between your computer and other computers, such as those operated by on-line services and BBS's.

Of course, you must also have a telephone line that you can connect to your computer's modem. You can use your regular home or office phone line, but when you're on-line, you won't be able to make or receive regular calls. If you're going to spend a great deal of time on-line, you may want to have another phone line installed just for your PC communications, but by no means is that a must.

Computers work by processing digital information. Telephone lines, where on-line communication takes place, transfer information in an analog form. When a computer sends information, its modem converts the computer's digital signals into analog signals and sends them along the phone line. A receiving modem changes the analog signals back into digital form for the receiving computer. The word "modem" comes from the MOdulation of digital signals into analog form and the DEModulation of analog signals back into digital form.

Speed. Modems come in a variety of configurations. Most have features such as automatic dialing (autodial) and autoanswer; automatic redial of busy numbers; and a built-in, standardized command-language set for more sophisticated and automated operation.

Modems come in different "speeds," which determines how long it takes to transfer information. The speed, or transfer rate, of a modem is measured in bits per second (BPS), also called "baud." A bit is the smallest unit of information in a computer; eight bits form one character of text, or a "byte." The more bits a modem can transfer per second, the faster it is.

Common data rates include 300, 1200, 2400, 4800, 9600, and 14,400, baud. Thanks to modems with on-the-fly data compression, speeds as high as 57,600 baud are now becoming vogue.

Of course, faster modems cost more than slower ones. However, when communicating on-line, the faster the modem, the less time it takes to move information, and the less a call costs if long-distance or connect-time charges are involved. However, some on-line services charge more for higher speed service. You have to balance the higher charges for high-speed service against the phone-bill savings. It usually works out that 2400 BPS is cheapest for routine communications, but 9600 BPS or faster is best if you transfer files. For file transfers a 2400-BPS modem is barely adequate, while a 300-BPS or 1200-BPS modem is only good for occasional BBS use at best.

The world is moving to higher and higher BPS rates. Modems cost from about $25 (for a now-obsolete 300-BPS unit) to several thousand dollars (for multi-line network units). A 2400-BPS model can be bought for about $50; 14,400-BPS modems start at around $125, but are rapidly falling in price.

You should buy the fastest modem you can afford. While modem standards are quite technical, suffice it to say that you should at least opt for a 14,400 BPS modem that complies with basic V.22 bis and V.32 bis data communications protocols plus V.42 error-correction and V.42 bis data compression standards.

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FAX/Modems. You should purchase a data/FAX modem if you are planning to communicate with any of the world's estimated 30-million FAX machines. Ordinary data modems cannot connect to FAX machines, but a FAX/modem can readily do so.

The FAX/modem should have at least 9,600 bits-per-second (BPS) FAX send/receive capability. Modern 14,400 BPS FAX/modems are increasingly affordable and usually make good long-term investments.

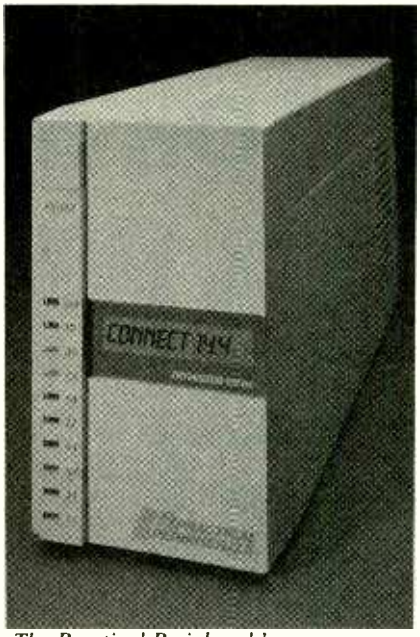
Transmitting FAX's created on a PC is a time-saver, but if you will be receiving lots of FAX's, as opposed to sending them, consider opting for a standalone FAX machine. Why? If you use your PC as a FAX machine, it must be turned on and configured for FAX reception—even when you are working on other projects—and you just might not want to keep your PC running 24 hours a day.

Internal or External. There are two basic types of modems: internal and external. An internal modem is on a plug-in card you install in your PC. An external modem is a self-contained device that plugs into one of the computer's serial ports via a cable.

Each type has advantages and disadvantages. Internal modems cost less than external modems since they don't need a separate power supply. However, an internal modem is harder to install than an external modem since you have to open up your computer and manually plug it into an available slot. You will also have to set jumpers, or perform a software setup, to specify the COM port and IRQ it will use.

External modems are easier to install and are readily transferable to other machines, but you'll need a cable, a power cord, and a free serial port on your computer. External modems also include lights that let you monitor modem status and diagnose on-line problems. Since external modems are located outside the computer, they do not take up one of the valuable adapter-card "slots."

Hooking up a modem is easy. If you have an external modem, you just connect it to an unused communications (COM) port at the rear of your PC with a modem cable. If you use an internal modem, you snap it into an unused card slot inside your machine.



The Practical Peripherals' PM14400FXSA is a state-of-the-art external modem for 14,400 BPS data and send/receive FAX transmission. The 12-character LCD display and the ten LED status lights make it easy to determine what the modem is doing at any given instant.

"Ma, I shrank the modem" might apply to this tiny, 4.2-ounce Practical Peripherals' PM14400FX PKT pocket modem, with 14,400 BPS data and send/receive FAX capability. You can pop the bantam package into your briefcase for use in the office, at home, or on the road.

For internal modems, the most difficult task is picking the right COM port and IRQ (interrupt request line) to use. That is necessary because conflicts between devices can arise if two peripherals or internal cards try to use the same COM port or IRQ. If, for example, you have a mouse attached to COM1 on your computer, you'll have to pick a different COM port for your modem. The modem manual should explain how to configure the card for the desired COM and IRQ settings.

Software. As mentioned, you need communications software to go on-line. The software provides the instructions your computer needs to become an on-line "terminal" and intelligently control and communicate through the modem. The software also lets you read, store, and manage incoming data. Older software forced you to memorize and create arcane commands to do even simple tasks. Modern communications software uses pull-down menus, some other simplified command structure, or a graphical user interface (GUI). The program translates your request into the appropriate modem commands for you.

To access an on-line communications service you must usually buy a startup kit. Such kits often include proprietary, service-specific communications software packages, although with some services, like CompuServe, you also can also use general-purpose communications software.

Parameters and Protocols. Before you can call another computer, you must first tell your communications software what protocols and parameters to use. They constitute the ground rules between computers, and control such factors as transmission speed and the size of each information "packet." Your parameters must match those of the computer to which you're connecting.

The most important initial communications parameters are transmission rate, parity, data-word size, and the number of stop bits. We won't go into all that here, but for communicating with BBS's, the most common settings are 8 bits, no parity, and 1 stop bit, sometimes seen written as "8-N-1." The most common terminal emulation setting for BBS's is ANSI BBS, and one of the most common file transfer protocols is ZMODEM.

If your modem does not respond to commands sent from your communications program, or if you connect to a remote system and see an odd assortment of characters and symbols, the most likely culprit is a parameter mismatch. Don't panic—just change the parameters, experimenting as necessary.

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Now that we've gotten the ground work out of the way, it's time to go on-line.

What Are BBS's? BBS's are places you visit electronically using your PC and a modem as a vehicle. They make good starting points for your on-line adventure, especially since (after providing some basic information about yourself) you can usually use them the first time you call. Commercial services, on the other hand, usually require you to become a dues-paying subscriber to sample the services offered.

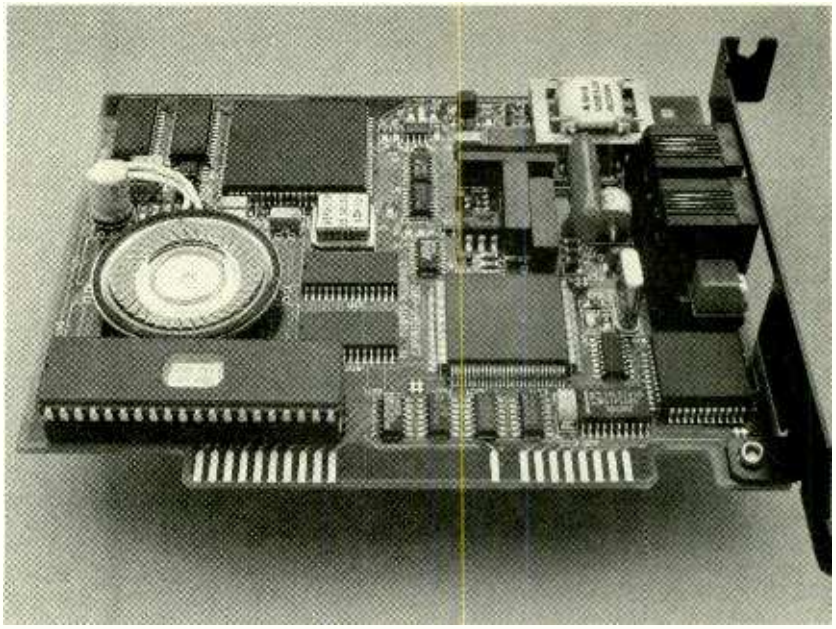
Most of the 40,000-plus public BBS's in the country (nobody knows just how many there really are, especially if you factor in countless private BBS's) are locally oriented or dedicated to a single theme or hobby. However, many provide connections to broad-based networks. Most BBS's are free, while certain large, multiuser boards charge a nominal fee to $10 an hour or more. Presently there are over 10 million BBS users, but that number may grow to 40 million or more by the end of the decade.

BBS's also differ from on-line communications services in that they usually serve a particular user niche, and they tend to be more interactive and informal. Since users don't usually have to worry about connect-time charges, they feel free to stay on-line longer and explore the system fully.

Most BBS's are "linear BBS's": their functions are organized hierarchically. In them, the BBS main menu is the starting point for most BBS functions. Another type of BBS is the "room BBS," which has a "lobby" as an entry point, and hallways and other areas (or "rooms") leading from the lobby. You can go from room to room, sending and receiving messages, and performing most BBS functions from whatever room you're in.

What BBS's Offer. Bulletin boards are electronic gathering spots that can offer hundreds of different functions. But the primary or "core" functions of a BBS are handing messages, E-mail, conferences, file libraries, games, and "doors."

People communicating with each other lies at the heart of any BBS, especially when the BBS organizes its message areas into separate user "forums" where people can exchange ideas on specific topics of interest. Most BBS's also offer free E-mail services, where messages can be directed to specific recipients rather than just being posted for all to read. While large collections of programs and files for downloading are useful, without user-to-user communications, a BBS is just a large file library.



An internal modem is on a plug-in card that you install inside your PC as you would any other card. Internal modems cost less than external modems since they don't need a separate power supply, and thus are favored by many PC users. Shown here is Practical Peripherals' PM14400FX internal half-card modem with 14,400 BPS data and send/receive FAX capability.

If you have read a few messages, you may wonder how people keep track of the many different subjects they want to discuss. A forum or "conference" is like a room where conversation is devoted to a specific subject. Conferences provide valuable information on a variety of subjects that may be useful in a hobby, a job, or just for debate and exposure to new ideas.

One of the most useful features of BBS's is their file libraries. These are collections of programs, data, images, utilities, and other files you can download (transfer) to your own computer for your personal use.

Thousands of free, open-access BBS's allow you to download software posted on their boards; most programs are free. While much BBS software is a "mixed bag" of sometimes useful, sometimes not, public-domain material, most boards also post good shareware software for downloading.

Many BBS's have special "doors" that you can enter. They allow you to run a program through the BBS. One door might take you into a chess game where you can play against other people; another might take you into a fantasy or science-fiction game. Yet another door might even let you run an application like a word-processor, spreadsheet, or off-line mail reader.

Calling a BBS. When you first call a BBS, you must register as a new user or visitor. That usually requires nothing more than providing your complete name, a password, your phone number, and location. Doing so gives you access by creating a user account under your name. Usually you can use a BBS the first time you sign onto it, although file access may be restricted until the BBS SYSOP (system operator) verifies your registration.

Once you have logged onto a BBS, you have to figure out how to find your way around. There are many different types of BBS software. However, most have common features, even if the commands you use are slightly different from system to system. If navigating a BBS seems confusing, you're not alone. BBS's are managed by their SYSOPS. They keep their BBS's in good shape, help you get answers to your

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On-line Services

On-line communication lets your personal computer keep in touch with the rest of the world. If the idea of having almost limitless information at your fingertips intrigues you, take a look at this sample of what commercial on-line services are available.

America On-line (Suite 200, 8619 Westwood Center Drive, Vienna, VA 22182; Tel. 800-827-6364), with more than 450,000 members, is a popular and rapidly expanding on-line-communications service that has begun to challenge CompuServe in many areas, especially with its superb messaging features and its attractive graphical user interface (GUI). It has also challenged Prodigy by slashing rates and increasing the free hours included with your $9.95 monthly fee. There's limited access to Internet, including E-mail. Best of all, new services are added almost daily.

CompuServe (P.O. Box 20212, Columbus, OH 43220-0212; Tel. 800-848-8199 or 800-848-8990), an over 1.5-million member utility, has a wide variety of services and databases, which makes it a first choice among many businessmen, researchers, PC power users, and professionals. The service traces its roots to 1968 when, known as Compu-Serv, it was a computer processing center for an insurance company. Today it provides access to electronic mail, travel services, financial information, shareware and public-domain software libraries, shopping, and much more. CompuServe has over 350 on-line forums, including many offered by PC hardware and software vendors.

Several membership plans are available, and free startup memberships are bundled in many software packages. One popular option is $8.95 per month for unlimited access to 50 basic services.

Delphi offers a low-cost connection to Internet, plus the usual functions of a major on-line communications utility. The 100,000-member Delphi claims it is the only major utility that offers full-featured access to Internet, including Telnet for host-to-host connections, FTP (file transfers), Usenet news and discussion groups, and Internet Relay Chat (IRC).

There are over 150 information and communications services to be found on Delphi. Its "Custom Forums" let you host forums and effectively run your own network. Two billing options are offered. Contact Delphi/General Videotex Corp. (1030 Massachusetts Ave., Cambridge, MA 02138; Tel. 800-695-4005, On-line: 800-695-4002) for more information.

GEnie (401 N. Washington St., Rockville, MD 20849-6403; Tel. 800-638-9636. On-line: 800-638-8369) is known for the variety and sophistication of its multi-player games, and it also boasts E-mail, a software library of more than 150,000 files, and dozens of special-interest forums and bulletin boards, known as GEnie RoundTables. It has 400,000 users. Basic membership is $8.95 per month, with a low hourly rate of $3 during non-prime time (5 non-prime hours are included free each month). There is support for a variety of hardware platforms in addition to the IBM PC.

Prodigy (P.O. Box 4064, Woburn, MA 01888-9961; Tel. 800-822-6922) claims more than 2 million users, more than any other on-line service. It offers many consumer-oriented options and graphical screens that are notably easy for computer beginners to navigate. The service has E-mail only access to Internet, but it allows access to ZiffNet (more on that later). Their basic "core" membership costs $14.95 per month; some Prodigy services cost extra.

The WELL (27 Gate Five Rd., Sausalito, CA 94965; Tel. 415-332-4335, On-line: 415-332-6106)—meaning the "Whole Earth 'Lectronic Link"—is an independent utility that's basically a computer-conferencing system. It features more than 200 BBS-style conferences for lively discussion. Other prominent features are E-mail, real-time conversations, and on-line files. There are no on-line games but considerable Internet access is offered. You can reach the WELL directly (long-distance, like a BBS), or through the CompuServe Packet Network (CPN) for a small surcharge.

ZiffNet is a specialized service for PC buyers and users. It brings together thousands of IBM PC and Macintosh freeware, shareware, and public-domain software programs, plus the excellent *PC Magazine* utilities, forums, product reviews and recommendations, databases of computer publications, and more.

You can access the service through CompuServe or go on-line directly with ZiffNet if you're not a CompuServe member. Additional information on ZiffNet is available through the CompuServe telephone numbers given earlier or presented each month in *PC Magazine*. Membership in ZiffNet ($2.50 per month) is separate from CompuServe, but can appear on your CompuServe bill.

Saving what may be the very best (and also the most complex) for last, Internet is a loosely-spun, worldwide web linking more than 14,000 computer networks in over 50 countries, from giant mainframes to desktop PC's. It's a cooperative effort between government agencies, educational institutions, and various commercial and nonprofit organizations. With more than 10-million users, it's the fastest-growing on-line resource. In fact, some parts of Internet are growing 5-to-10 percent or more a month: by the end of the decade there could be well over 100 million users.

Designed originally for research and technical use, it's not very user-friendly. But that's changing as more casual users seek convenient access. You may be able to hook up through work or school, on-line communications utility services, some BBS's, and Internet access providers that hook you up for a fee.

There's no directory of everything on Internet, but some of the countless things you can access include E-mail; government documents, library catalogs, and databases; White House press releases; weather maps and forecasts; professional sports schedules; ZIP codes; and much, much more. Many of the on-line communications utility services have Internet forums where you can "get smart" on Internet before actually trying it.

For more information and a list of Internet access providers, check with InterNIC Information Services (P.O. Box 85608, San Diego, CA 92186-9784; Tel. 800-444-4345). ■

questions, and manage the flow of messages and files.

When you log onto a BBS, you should learn its rules. On most BBS's the most important rules may be shown to you when you call for the first time, or they may be passed on if the SYSOP calls you to verify your account.

On most systems, you can read the bulletins to learn the rules; BBS SYSOP's use the bulletins to place information for new callers and regular users alike. Take the time to read the bulletins on a BBS to learn its policies and other special information, preferably the first time you sign on. Some SYSOP'S post lists of frequently asked questions (FAQ's) from those that new users typically inquire about; you should always read them before asking the SYSOP questions. Familiarity with the system helps keep you in good standing with its SYSOP, who controls your access to the system.

Vendor Sponsored BBS's. Many hardware and software vendors have established 24-hour, dedicated multi-user BBS's to support their products and exchange information. Their boards typically offer much the same information as the support forums on CompuServe and other on-line util-

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ities, although the vendor BBS's have more of a "company store" atmosphere.

Most support BBS's are configured similarly to hobbyist boards. Like the on-line communications services, vendor-sponsored BBS's afford users the opportunity to read the questions and answers of other product users, and they also offer libraries of technical notes and problem solutions. You may be required to be a registered user of the company's products to use a company sponsored BBS, but they are almost always free.

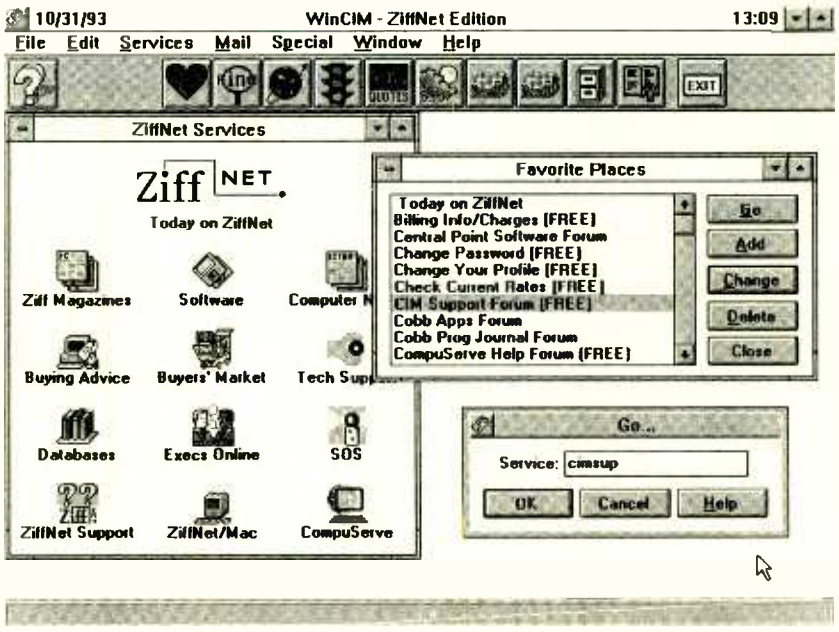
Online Services. Most of the major on-line services offer a variety of features, such as news, weather, and sports; sophisticated E-mail capabilities; on-line shopping; travel arrangements; bulletin boards, forums, and roundtables on many interests; multi-player games; on-line chatting; investment advice; educational services; information and reference databases; extensive files for downloading, and much more. Popular services include Prodigy, CompuServe, America On-line, and GEnie, among others (see the boxed text entitled "On-Line Services").

Probably the most popular features of on-line services are the forums that allow users to talk with each other via electronic messages. You can take a look at what messages are there, or you can jump into the discussions with your own messages. Forums also allow members to communicate directly with many if not most computer manufacturers and software publishers for the latest information, advice, and fixes for their products.

Many turn to on-line services for daily news. The services offer current stories on the latest issues, organized into topical sections. You can look at the news in the order you want, avoiding stories that don't interest you.

Education is a major goal of most services. Some offer an on-line encyclopedia and other research features to aid schoolwork. On-line information sources, unlike printed sources, don't go out of date because they are constantly revised.

Games are popular on the on-line services. Many users find on-line games more enjoyable than traditional computer games because, when you play on-line, you compete against real people, instead of playing against a computer.



Once intimidating and difficult to use with general-purpose communications software, the proprietary WinCIM software makes using CompuServe under Windows a snap. CompuServe itself has over 350 forums and massive libraries of shareware and freeware software.

When it's time to do business, your on-line service again comes into play. Many people are buying and selling stocks, shopping, and obtaining airline tickets on-line, among many other business- and household-related tasks.

Getting Online. Once you have the equipment and software set up, all you need is a telephone access number. The access number, which the on-line service provides you, ties you into a local or long distance "packet-switching network" that lets you call the on-line service.

If you must make a long-distance call, you'll be paying long-distance phone rates on top of any subscription charges, although most major on-line services give you access through a local data line. Usually the local-number access is free, but sometimes there are "communications surcharges" for using it.

There are various subscription rates and rate plans for on-line services. On many services you are billed for the amount of time you spend on-line, rounded to the nearest minute or second. Other services charge a flat monthly rate, with certain "high-cost usage" areas being billed separately.

New on-line users receive an account-identification number and a password, which will allow them to continue to access the service.

Now that you're hooked up to a service of your choosing, an incredible world of information awaits you. After that initial on-line enlightenment you probably won't be able to get enough of on-line information, and you'll likely feel like the entire world is only as far away as the click of your PC's mouse.

E-Mail. E-mail, as the nickname implies, is electronic mail. It's the timely transmission of communications and correspondence such as letters, memos, graphics, and spreadsheets from computer to computer over an interconnecting network. It's like the mail that goes through the U.S. Postal Service, but it offers several advantages over regular mail.

E-mail is fast and inexpensive. Not only can you send simple messages, but you can attach files to them, get receipt acknowledgment, and send copies of your messages to other addressees, all at the push of a button or a mouse click. It's estimated that there are over 40-million E-mail users globally.

To use E-mail, you must be electronically accessible to others—you

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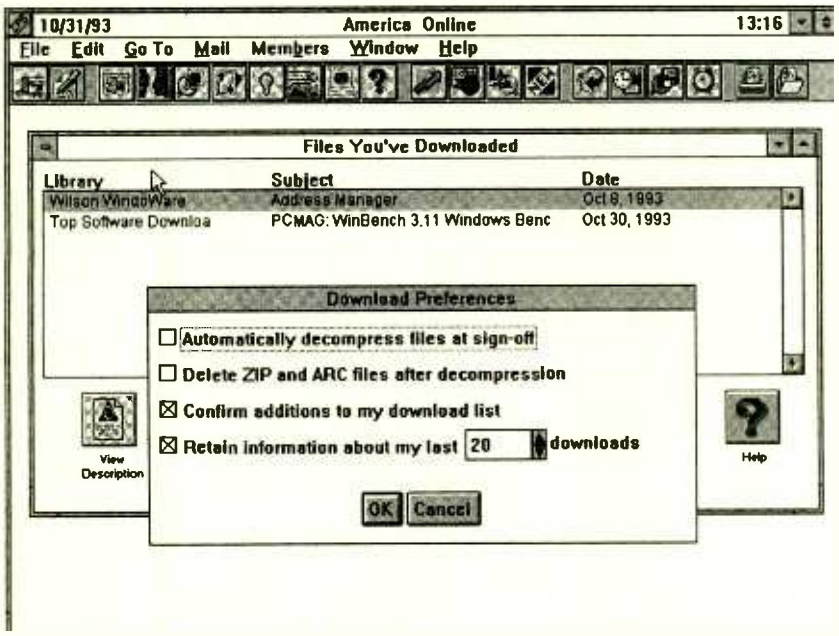

America On-line, with more than 450,000 members, is a popular and rapidly expanding on-line communications utility service that challenges CompuServe in many areas, especially with its superb messaging features, attractive graphical user interface (GUI), and ease of downloading.

must have an E-mail address. That is a set of commands used to route a message through gateways until it reaches its recipient. Each electronic service offering E-mail has its own format for E-mail addresses. E-mail can be sent from users on one service to users on another.

Using E-Mail. There are several ways you can go on-line with E-mail. Each has its advantages and disadvantages. For one, you can send your E-mail through a BBS. This is the simplest method; all you need do is to establish an account on your favorite BBS. Once you are an authorized user, you can E-mail other members of the local system as well as users on any other BBS's that are linked through a "free access" communications network to your "home" BBS. For many computer users, that is satisfactory for occasional personal communications, but the business-oriented E-mail potential of most BBS's is limited.

For another, you can join an on-line communications utility service. If you're a member of an on-line service like Prodigy, CompuServe, America On-line, or GEnie, you already have E-mail services. Almost all of the major on-line services offer E-mail, and most offer an Internet gateway to allow you to send E-mail to subscribers of the other services.

Third, you can subscribe to a commercial E-mail provider. The major E-mail providers are connected through Internet gateways to provide global public messaging. Thus they compete directly with on-line services for E-mail customers. Most of those providers use a simple in-box and out-box concept for managing mail.

Each E-mail provider has a sign-up fee, plus monthly or yearly usage fees. Some offer a rich set of messaging services and tools such as store-and-forward mail, FAX storage, E-mail to FAX conversion, paper delivery, letterheads and signatures, return receipts, and text-to-speech conversion. Most offer proprietary E-mail management software, like the $35 MCI Mail Express for PC's, that lets you manage your business correspondence and ensure worldwide delivery from your keyboard.

Communications software for E-mail providers is available from them, or you can use custom packages that provide an enhanced mail interface. One such Windows-based interface is The Wire, a robust mail-based "communications bridge" that lets you route messages by MCI Mail, telex, FAX, U.S. mail, and more using a standard model; its from Swfte International, Ltd. (P.O. Box 219, Rockland, DE 19732; Tel. 800-237-9383).

The E-Mail Connection software handles MCI, CompuServe, and other on-line services as well as local area networks. It's a powerful application that integrates disparate E-mail systems using a single universal interface. The Windows-based program offers template-based automation of sorting and scheduling your mail, intelligent routing, and simplified addressing. The $99.95 package is from Connect Software (6742 185th Ave., N.E., Suite 150, Redmond, WA 98052; Tel. 800-234-9497).

Last, you can directly communicate through Internet. Navigating Internet directly is challenging for most individual users. Few current software programs give you a slick interface to Internet, the kind of interface you'd expect from the major on-line communications services. However, if the volume of E-mail you send and receive is large, then using Internet directly may make both economic and practical sense for you.

The Future of E-mail. There are many bugs and wrinkles to be worked out; E-mail is in the state where FAX's were about five years ago. You may have guessed that sending and receiving messages and data via a wireless, cellular modem anywhere, anytime to any of the world's estimated 40-million plus "mobile workers" is one of the ultimate goals of most E-mail systems.

Going beyond E-mail, conducting all types of business electronically—electronic data interchange (EDI)—is the real wave of the future. The concept includes efficient and cost-effective computer-to-computer communications for the exchange of a variety of business transactions. E-mail, with its ease, economy, and effectiveness, fits in well alongside other EDI related partners such as FAX, telex, and radio paging.

Books. The *America On-line Membership Kit & Tour Guide* is a comprehensive, "official" 400-page guide to using AOL. The $34.95 package includes the proprietary AOL software.

The Guide escorts members through the service, including E-mail, interactive forums, software, computing support, on-line classes, news, stock quotes, and other attractions. The book is especially useful to the new user since AOL doesn't publish a

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paper-based user's guide, but instead relies on extensive on-screen help and a small, welcome guide.

The DOS edition is by Tom Lichty and Kathy Parks; Macintosh and Windows editions also are available. The Tour Guide series is available at most retail booksellers, or contact Ventana Press (P.O. Box 2468, Chapel Hill, NC 2755; Tel. 919-942-0220).

Dvorak's Guide to PC Telecommunications is a massive reference in its 2nd edition, by John C. Dvorak and Nick Anis. It presents users with understandable information on modems, how they work, and how to use them. The authors include detailed information on the major E-mail systems and on-line services, as well as many BBS's. They also cover the major commercial and shareware communications packages. Included is a 3.5-inch disk packed with communications and utility software. The 1128-page book/disk combo is $39.95. It's available in most bookstores, or from Osborne/McGraw-Hill (2600 Tenth St., Berkeley, CA 94710; Tel. 800-227-0900).

Get On-Line!: The Communications Software Companion, by Lamont Wood explains how modems work with software by demonstrating popular communications programs; users of these programs can easily work through the basic procedures. Special focus is on problems newcomers face. These include hooking up with remote computers; computing when traveling, especially using E-mail on-the-road; using text scrolled into a capture file with a wordprocessor; working with compressed files; and communications while multitasking under Windows. Wood's softcover is 336 pages and is published by John Wiley & Sons, Inc. (605 Third Ave., New York, NY 10158-0012; Tel. 800-225-5945). It's $24.95.

On Internet, there's a hard way and an easy way to do almost anything. *The PC Internet Tour Guide* makes things easier by helping the beginner navigate through a murky maze of obscure UNIX commands and frequent error messages. The book comes with everything you need to work the Internet with point-and-click convenience, including step-by-step instructions and a road map to the network. Also included is a diskette of software, including Minuet, a package featuring E-mail, news reading, and file transfers. The 350-page book is $24.95 from Ventana Press. Companion books for other platforms, *The Windows Internet Tour Guide* and *The MAC Internet Tour Guide* are also available.

The Whole Internet User's Guide and Catalog, written by Ed Krol, is a best-selling, comprehensive guide to Internet's vast resources. The book pays special attention to new tools for helping you find information, whether you are a student, a researcher, or just someone who likes the benefits of E-mail. Included in the 400-page book is a handy pull-out reference card. It's $24.95 from O'Reilly & Associates, Inc. (103 Morris St., Suite A, Sebastopol, CA 95472; Tel. 800-998-9938). A free catalog, in a magazine-like format, also is available.

Using Computer Bulletin Boards (2nd edition), by John Hedtke, introduces novices to BBS's and basic telecommunications, and it helps more advanced users to more effectively use BBS's. The book covers basic communications concepts, required equipment, telephone networks, on-line services, setting up a BBS, and more. Hedtke's book introduces you to a variety of popular BBS systems and on-line services, and it includes a disk with the Qmodem Test-Drive communications package. The 422-page book/disk combo is $29.95. It's from Henry Holt and Company Inc./MIS Press (115 West 18th St., New York, NY 10011; Tel. 800-488-5233).

Magazines. The *BBS Magazine* is mostly for BBS and on-line-service SYSOP'S, but serious BBS users will find much of interest here. Topics covered include setting up a BBS, BBS software, E-mail, Internet access, and more. The magazine also operates The Livewire BBS at (609) 235-5297. Subscriptions are $30 per year from BBS Magazine (701 Stokes Rd., Medford, NJ 08055; Tel. 800-822-0437).

Since 1987, *Boardwatch Magazine* has been a leading monthly communications publication covering BBS's and on-line services. Each issue has information on hundreds of BBS systems, shareware software, Internet, information databases, telephone-system technology, hardware and software reviews, profiles of industry players, and tips on how to get the most value from your modem-equipped PC. A one-year subscription is $36 from Boardwatch Magazine (8500 W. Bowles Ave., Suite 210, Littleton, CO 80123; Tel. 800-933-6038).

Computer Shopper is a physically massive monthly publication aimed at direct PC buyers. Primary coverage is of PC hardware, equipment, software, and technology. But attention is also paid to on-line topics, including BBS's, on-line services, and user groups. The magazine also publishes monthly BBS listings. Subscriptions are $29.97 a year from Ziff-Davis Publishing Co. (One Park Avenue, New York, NY 10016; Tel. 800-274-6384).

Referring to itself as "the modem user's resource," *Connect* spans a variety of on-line topics. They include communicating through BBS's and Internet, on-line shopping, book reviews, and more. There are individual columns for several of the major on-line services, including America On-line, CompuServe, Delphi, and GEnie, plus the Macintosh computer. Subscriptions cost $18 for 1 year (six issues). Details are available from Pegasus Press (3487 Braeburn Circle, Ann Arbor, MI 48108; Tel. 313-973-8825).

Having trouble setting up and using your modem? The On-line Access periodical is "the magazine that makes modems work." It's published eight times a year; domestic subscriptions are $19.80 a year. Typical areas covered include on-line finance and investing, telecommuting, Internet access, researching by modem, and even on-line religious resources. For more information, contact On-line Access, Chicago Fine Print, Inc. (920 N. Franklin, Suite 203, Chicago, IL 60610-9588; Tel. 312-573-1700).

Now you know what it takes to go on-line, what awaits you there, and where the rosy future of on-line communications is headed. If you're hesitant to use a BBS, E-mail, or an on-line service because you think your computer skills are insufficient, don't be concerned. It only takes a short time to become a knowledgeable on-line user. It's also great fun.

So hook up your modem, install the communications software, and get started. There's a new world waiting for you. The only way to find out how enjoyable that world can be is to go on-line. But your phone line may indeed be busy forevermore. ■

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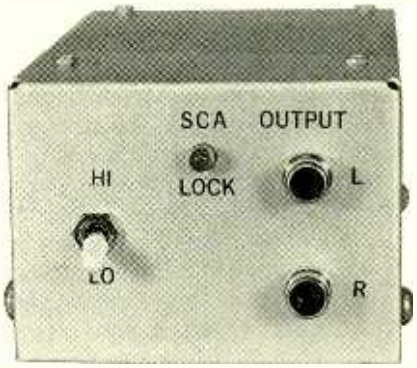
Build An SCA Adapter



Hear the hidden broadcasts on the FM band with this easy-to-build add-on unit.

BY DON McCORMICK

From time to time, articles on SCA communications have appeared in hobby-electronics periodicals. The articles range in emphasis from circuit experiments and construction projects to rather sensational sounding descriptions of secret or mysterious signals not accessible to the general public. Actually, there is nothing really that mysterious about SCA, which stands for Subsidiary Communications Authorization.

The technical basis for SCA is the FM-on-FM data-transmission technique developed by range-instrumentation engineers back in the 1950's. Shortly afterward, the FCC authorized its use by FM stations to expand their services. FM stations broadcasting SCA programs frequency-modulate their main carrier (88 to 108 MHz) with one or both of the commonly used subcarrier frequencies of 67 and 90 kHz. Those subcarrier frequencies are, in turn, modulated with program material. In order to prevent interference with the main program, both the amplitude and upper-frequency limit of the SCA programs are held to relatively low values.

Since SCA program material is not meant for reception by the general public, the FCC protects it by prohibiting manufacturers from selling SCA-capable receivers on the consumer market. For electronics experimenters, however, it is not hard to build a demodulator that can be connected to any FM tuner to receive these transmissions.

About the Circuit. A schematic diagram for the *SCA Adapter* is shown in Fig. 1. The circuit, for the most part, is comprised of seven active elements: five assorted transistors and two IC's. The 67- or 90-kHz subcarrier signal is picked off the FM tuner (more on that later) as the input to the circuit. After passing through a parallel-T network, the signal is applied to the input of a two-stage amplifier comprised of Q1 and Q2. That amplifier boosts the signal's strength by about 20 dB before it is applied to the input of U1 (an XR2211CP FSK demodulator/tone decoder) at pin 2. That chip contains a phase-locked loop or PLL (which in its most basic form is comprised of a phase comparator, low-pass filter, and a voltage-controlled oscillator or VCO), a quadrature phase detector (which provides carrier detection), an FSK voltage comparator, and a preamp. It is specifically designed for data communications, can operate over a wide supply-voltage range (4.5–20 volts), and can accommodate analog input signals of from 2 mV to 3 volts. Timing capacitor C7 (connected between pins 13 and 14) and the total resistance connected between pin 12 and ground determine the circuit's lock or center frequency. Switch S1 allows the user to select either 67-kHz (LO) or 90-kHz (HI) SCA reception.

The voltage at pin 6 is held at zero when the input signal is either off-frequency or missing. When locked, pull-up resistor R16 causes pin 6 to go high (rising to about 7 volts), causing Q5 to turn on and LED1 to light.

That high also causes squelch transistor Q4 (a 2N3820 P-channel JFET) to turn off. That allows the twice-demodulated signal, which is output at pin 11 of U1, to be fed through R18, C18, and R19 to the base of Q3 (the output amplifier).

Power for the SCA Adapter is derived from the circuit consisting of T1, BR1, U2, and their support components. T1 can either be a standard power transformer as specified in the Parts List or a wall-plug type with an appropriate AC output.

Assembly. The SCA Adapter was assembled on a small printed-circuit board measuring about 4 3/16 by 2 11/16 inches. A full-size template of the circuit-board layout is shown in Fig. 2. Once you have etched your own printed-circuit board and gathered all of the required parts, construction can begin.

Note that all components are readily available and none are critical to proper operation of the circuit with the possible exception of C7. Although a polystyrene capacitor is recommended for C7, a polyester unit can be substituted. Since the P-Channel JFET might be hard to find, three choices for it are listed in the Parts List.

Guided by the parts-placement diagram shown in Fig. 3, install the passive components first—beginning with an IC socket for U1, followed by the resistors and capacitors (making sure that the polarized capacitors are properly oriented). Normally, it would be advisable to install the jumper connections at this time, but because the jumpers will have to be snoked around many of the board-mounted components it is recommended that they be installed just before mounting U1 in its socket. When you reach the jumper phase of construction, leave one end of the squelch jumper (JU1) disconnected; that will deactivate the squelch function, thereby avoiding confusing behavior during the circuit's checkout routine.

In any event, once the passive components have been installed, install the active components, starting with the diodes followed by the transistors and U2. Do not install U1 in its socket yet; it will not be installed until the checkout phase of the construction. If desired, LED1 can be temporarily mounted directly to the board to facilitate the checkout.

Checkout. The circuit must be checked out and aligned before it is

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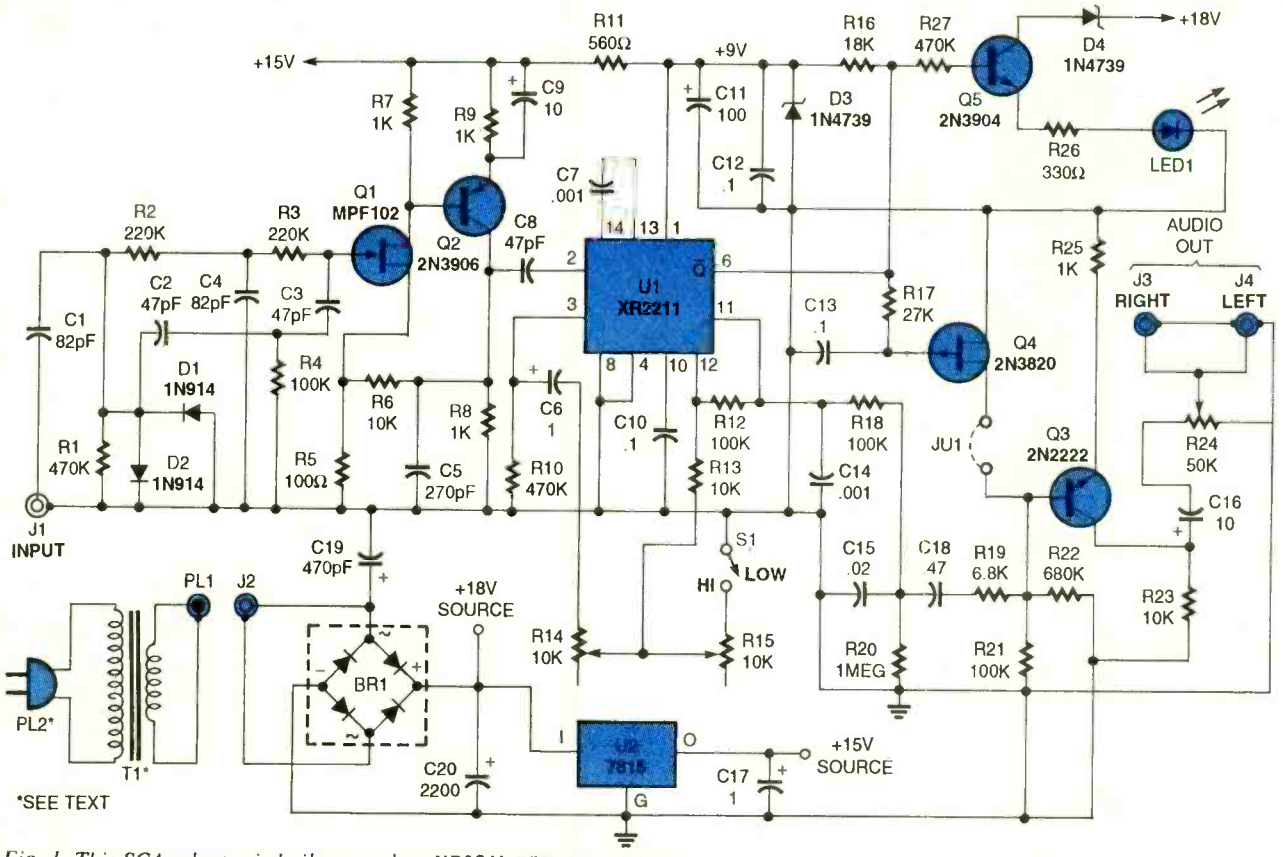

Fig. 1. This SCA adapter is built around an XR2211 FSK demodulator, some transistors, and a handful of support components.

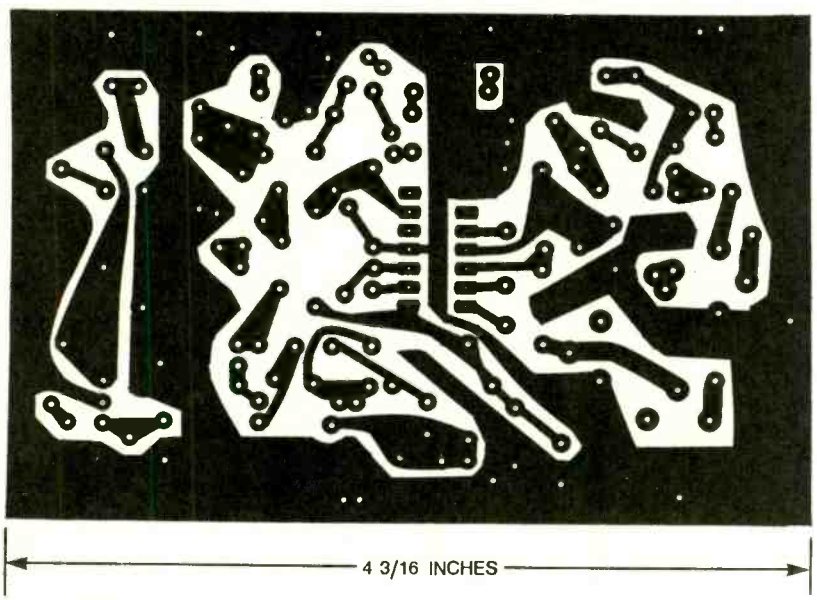

Fig. 2. Although not strictly needed, this foil pattern allows for neat and easy construction. It is shown here full size.

permanently connected to an FM receiver or mounted in an enclosure. Once the circuit has been assembled and you have double-checked your work, set each of the trim potentiometers at the midpoint of its rotation.

Power up the circuit and check the +18- and +15-volt DC voltages. Also, the voltage at pin 1 of the IC socket should measure between +8 and +9 volts DC. If the DC supply voltages are okay, remove power from the circuit, install the jumpers, and install U1 in its socket.

Set-Up and Use. The best way to align the board is with a signal generator that can cover the range from 50 to 100 kHz. With S1 set to the LO position, feed a low-level 67-kHz signal into the input and adjust R14 until LED1 lights. Continue adjusting R14 to find the point where the LED goes off and trim the adjustment to midway between the on and off points. Set S1 to the HI position, feed a 90-kHz signal to the input, and repeat the operation, this time adjusting R15.

In selecting a tuner or receiver you have two options. First, you can be brave and resourceful and use your favorite equipment. If that is too much excitement in your life, you can go looking for an old clunker tuner or pull-out car radio at garage sales, etc., keeping in mind that, while it can be either stereo or mono, it must work properly as an FM tuner. It should also have reasonably good RF and IF linearity to avoid cross-talk leakage between the main program and the SCA output. Modern PLL/digitally tuned re-

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PARTS LIST FOR THE SCA ADAPTER

SEMICONDUCTORS

U1—XR2211CP FSK demodulator, integrated circuit (Exar)
U2—7815 15-volt voltage regulator, integrated circuit
Q1—MPF102 N-channel JFET transistor
Q2—2N3906 PNP transistor
Q3—2N222 NPN transistor
Q4—J176, 2N3820, or NTE-326 P-channel JFET transistor
Q5—2N3904 NPN transistor
D1, D2—1N914 silicon diode
D3, D4—1N4739 9-volt Zener diode
LED1—red light-emitting diode
BR1—1.5-amp, 100-PIV bridge rectifier (Radio Shack 276-1152 or equivalent)

RESISTORS

(All fixed resistors are ¼-watt, 5% units unless otherwise indicated.)
R1, R10, R27—470,000-ohm
R2, R3—220,000-ohm
R4, R12, R18, R21—100,000-ohm
R5—100-ohm
R6, R13, R23—10,000-ohm
R7–R9, R25—1000-ohm
R11—560-ohm, ½-watt
R14—10,000-ohm, potentiometer
R15—25,000-ohm, potentiometer
R16—18,000-ohm
R17—27,000-ohm
R19—6,800-ohm
R20—1-megohm
R22—680,000-ohm
R24—50,000-ohm, potentiometer
R26—330-ohm

CAPACITORS

C1, C4—82-pF, ceramic-disc
C2, C3, C8—47-pF, ceramic-disc
C5—270-pF, ceramic-disc
C6—1-µF, tantalum
C7—.001-µF, polystyrene
C9, C16—10-µF, 16-WVDC, electrolytic
C10, C12, C13—0.1-µF, ceramic-disc
C11—100-µF, 16-WVDC, electrolytic
C14—.001-µF, Mylar
C15—.02-µF, Mylar
C17—1-µF, 16-WVDC, electrolytic
C18—0.47-µF, Mylar
C19—470-pF, ceramic-disc
C20—2200-µF, 25-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

T1—12–15-volt, 100–300-mA power transformer (Radio Shack 273-1385 or equivalent), see text
S1—SPST switch
J1, J3, J4—phono jack
J2—coaxial power jack
PL1—coaxial power plug
PL2—AC power plug
PC board; enclosure (Radio Shack 270-238 or equivalent), see text; solder, wire, hardware, etc.

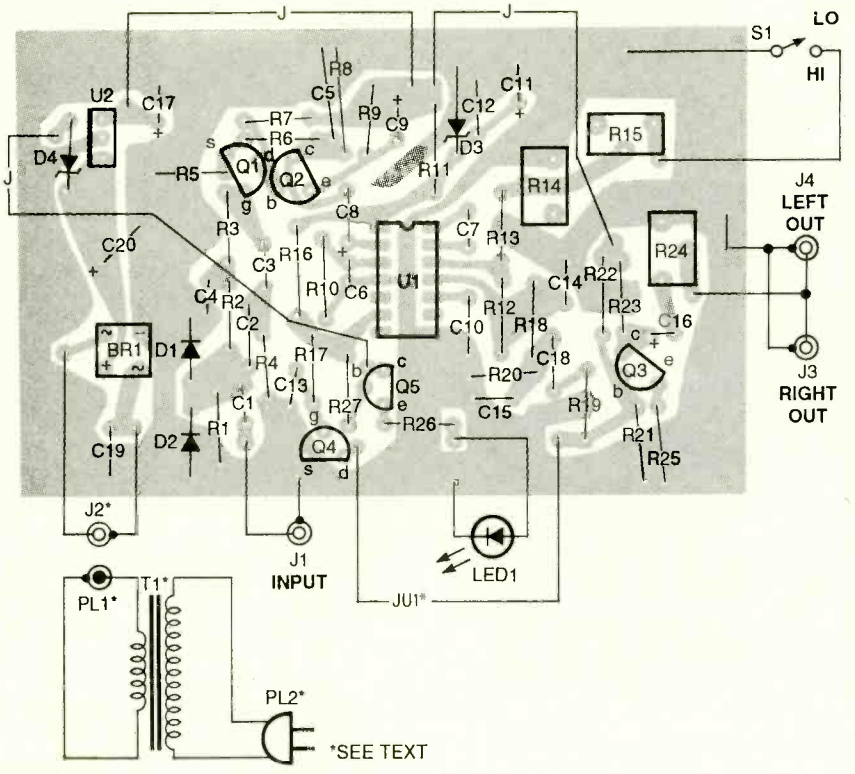

Fig. 3. Use this parts-placement diagram when installing parts on the PC board. Do not install jumper JU1 until the board has been completely checked out.

ceivers seem to be best in this regard.

If you have aligned your SCA board as previously described, you may use it as a probe to find the baseband signal take-off point in the receiver. The proper connection point is at the output of the FM demodulator before any de-emphasis circuitry. Locate a strong station, one that you know is broadcasting SCA signals. Connect the output of the SCA circuit to another amplifier and speaker and listen while you make trial connections to the receiver. Remember that the better the reception of the main FM program, the better the SCA reception. Once you've located the correct connection point, touch up the potentiometer settings by ear and enable the squelch circuit by connecting jumper JU1.

If you were unable to pre-align your SCA circuit, the same basic hook-up procedures should be followed, but there is a lot more trial-and-error involved. Set R14 to its midpoint for starters and try various combinations of hookup points and R14 settings until you find an SCA signal.

Now for the finished product. There are two ways to go. The easiest and most obvious is to house the SCA Adapter in a separate enclosure. If you choose to go that route, an appropriate enclosure is listed in the Parts List. You will also want to use a wall-plug type transformer rather than the one mentioned in the Parts List. Just make sure the one you select has an appropriate *AC* output.

The other approach is to house the adapter in the same enclosure as the radio with which it will be used. You will then need to select the unit so that there is sufficient space for the board and T1. The adapter controls can then be added to the front-panel of the receiver or mounted on a small piece of angle aluminum that is added to the top or side of the enclosure. ■

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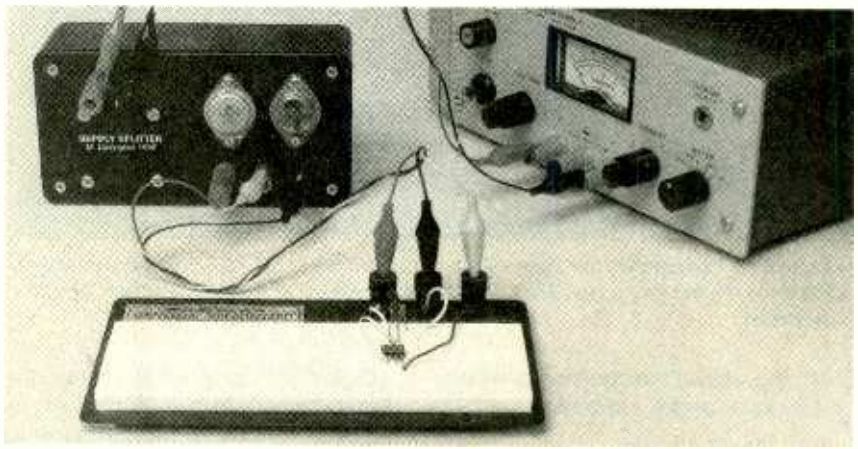
How to Split a Power Supply

What can you do if you need a dual supply, but only have a single-supply source? Build our splitter, of course!

BY MICHAEL A. COVINGTON



The splitter connects between the existing power supply and the circuit to be powered, in this case an op-amp circuit.

What do you do if you have a single output power supply and you need a dual one? That's a problem that often arises with op-amp circuits. Many op-amp configurations require a split supply, but most lab-type power supplies have only a single output. That means you can't use them to power op-amp circuits . . . or can you?

You can if you use the supply splitter circuit presented here. It neatly splits its input voltage—anywhere from 8 to 30 volts— in half to give you two equal voltages of opposite polarity.

How it Works. The key idea is that in a dual-supply powered circuit, "ground" is midway between the positive and negative supply voltages. Accordingly, all we have to do is derive a regulated voltage halfway between V+ and V−, and we're done.

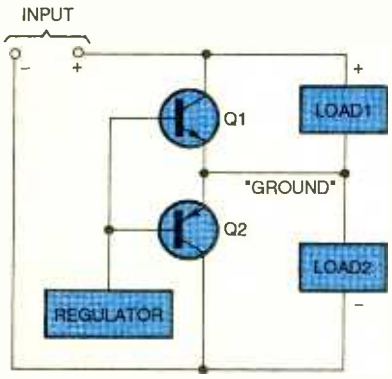


Fig. 1. Transistors Q1 and Q2 regulate the "ground" voltage to hold it midway between the + and − terminal voltages.

Unfortunately, ordinary voltage regulators can't do the job. The reason is that they can only source current, not sink it. However, the ground terminal in a dual supply may have to either source or sink current, depending on which half of the load is drawing more current at the time.

Figure 1 shows the idea behind our special two-way voltage regulator that does what's needed. If Load 1 and Load 2 are drawing exactly equal currents, then the voltage between them is already halfway between V+ and V−, so the regulator need not do anything. If the currents drawn by the two loads are different, then either Q1 or Q2 will conduct extra current to make up the difference. That way the ground voltage stays exactly halfway between the positive and negative rails.

Figure 2 shows the circuit. In it, R1 and R2 divide the input voltage in half. Op-amp U1 reproduces that voltage at the "ground" output terminal by making either Q1 or Q2 conduct as much as necessary. Capacitors C1 and C2

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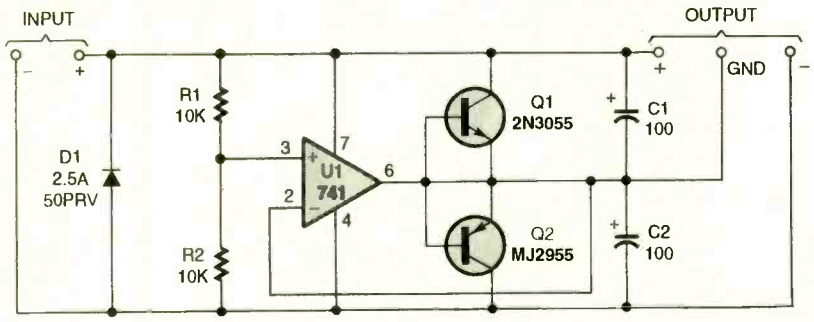
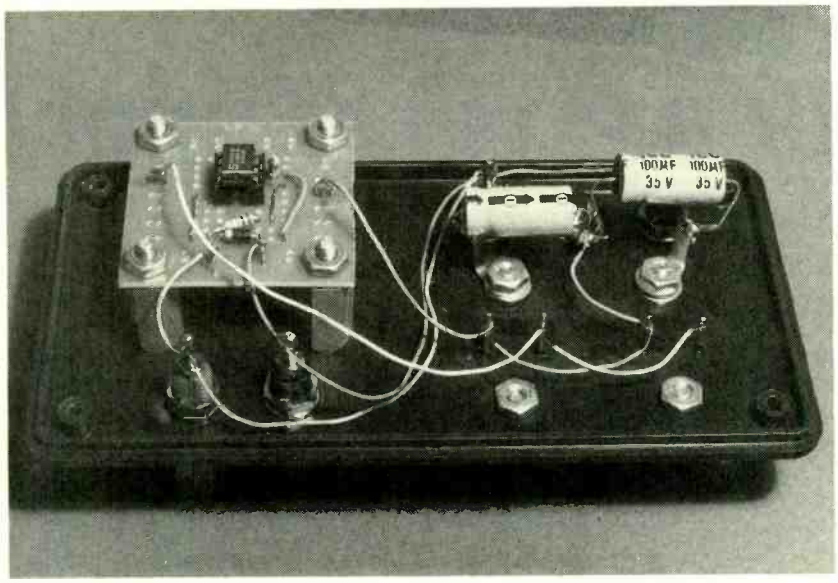


Fig. 2. In the actual circuit, a 741 op-amp (U1) is used as the regulator that controls the action of Q1 and Q2 to maintain a voltage between the input voltages.



The smaller components are mounted on perfboard while the capacitors are mounted directly to the binding posts. They, in turn, are mounted in holes in case just like the transistors.

hold the output voltage steady when the load changes suddenly.

PARTS LIST FOR THE POWER-SUPPLY SPLITTER

SEMICONDUCTORS

U1—LM741 operational amplifier, intergrated circuit
Q1—2N3055 silicon NPN power transistor
Q2—MJ2955 silicon PNP power transistor
D1—2.5-amp, 50-PIV rectifier diode

ADDITIONAL PARTS AND MATERIALS

R1, R2—10,000-ohm, ⅛-watt, 5% resistor
C1, C2—100-μF, 20-WVDC, electrolytic capacitor
Enclosure, binding posts, circuit board, solder, wire, optional heat sinks for Q1 and Q2, etc.

Diode D1 is present to protect the circuit's input from reversed polarity by blowing the fuse of the main power supply. If your power supply has no fuse or you might one day use the circuit with an un-fused supply, place D1 in series with the circuit (say, in the positive input line and pointing toward R1) instead. That will afford the same protection with only slightly reduced regulation and voltage output.

Purists may object that the turn-on voltages of Q1 and Q2 are 1.2 volts apart, producing an operational "dead zone" that the output of U1 must cross in order to catch up with an unbalanced load. It is possible to bias Q1 and Q2 to eliminate the dead zone, but that proved unnecessary in practice because U1 can cross the dead zone very rapidly. After all, C1 and C2 guarantee that changes in the load balance won't be instantaneous. In extensive testing, this circuit gave excellent regulation powering not only op-amp circuits, but also "messy" loads such as buzzers and flashing light bulbs.

Construction. Note that although this unit has separate input and output terminals for V+ and V−, the inputs and outputs are internally connected together. So, unless D1 was placed in series, you can build the splitter with three terminals instead of five if you wish.

Because there are so few components, a printed-circuit board is not necessary. Instead, the smaller components (D1, R1, R2, and U1) can be mounted on a small piece of perfboard. Capacitors C1 and C2, on the other hand, should be placed close to the output terminals. If you use binding posts, put them exactly ¾-inch apart so that dual banana plugs can mate with them.

With regard to using a replacement for U1, the best op-amp to use is actually the cheap 741 specified. Higher-performance op-amps such as the TL081 do not improve performance.

Using it. As mentioned, you can use the splitter with fixed- or adjustable-voltage power supplies ranging from 8 to 30 volts. Make sure your power supply is isolated. That is, neither V+ nor V− should be connected to the power-supply's cabinet ground or power-line ground.

How much current can the splitter handle? That's a tough question. Remember that as long as Load 1 and Load 2 are equal, the splitter doesn't do any work at all. For most op-amp circuits, that's typically the case.

As a rule of thumb, this splitter can handle at least 250 mA of difference between the two halves of the load while operating with a 30-volt input. To do that, either Q1 or Q2 has to dissipate almost 4 watts and will get quite warm. If, in practical use, you find the transistors getting so hot that you can't touch them comfortably, add a heat sink. With the specified transistors and an adequate heat sink, this splitter can handle several amps.

Remember that Q1 and Q2 are "hot" in another sense, too: the case of Q1 is connected to V+, and Q2's to V−. So don't let anything accidentally come into contact with them. ■

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A CHRONICLE OF CONSUMER ELECTRONICS

JUNE 1994

VOLUME 10, NUMBER 6

Get REAL

FZ-1 REAL 3DO INTERACTIVE MULTIPLAYER. Manufactured by Panasonic Company, One Panasonic Way, Secaucus, NJ 07094. Price: $699.95.

For the past couple of years, *The 3DO Company* has been actively, and very vocally, hyping "the next generation of multimedia . . . the 3DO Interactive Multiplayer," a 32-bit, CD-ROM-based device that would connect to the consumer's TV and allow the whole family to play games, learn, and be entertained, all interactively. For a behind-the-scenes look at the development of this new multimedia platform—unique both in its hardware and in its software-licensing arrangements—see the discussion entitled "Build a Better Mousetrap" that appears at the end of this article. But first we'll give you a close-up look at the first 3DO Multiplayer to hit the market—*Panasonic's FZ-1 REAL 3DO Interactive Multiplayer*—and some of the earliest 3DO titles to be released.

Panasonic's REAL Multiplayer meets all the hardware standards set by The 3DO Company: It is a 32-bit system that displays up to 16-million colors, offers animation at a rate of up to 16-million pixels per second, features a double-speed CD-ROM drive, and provides expansion ports for future enhancements or refinements. The device can play 3DO software, standard audio CD's, CD+Graphics (CD+G's) discs, and Photo CD's. It is not compatible, however, with software for other interactive multimedia systems, such as Philips' CD-i, Tandy's VIS, or MPC (multimedia PC) CD-ROM discs.

The fluted columns that round off each corner of the 10¼×10½×3½-inch FX-1 give it a vaguely classical look. The POWER button is found on the left column, while the LOAD/EJECT button is on the right column. The disc tray is centered on the front panel, with a status indicator located to each side. A red light on the left side indicates power on, and a green light on the right side indicates that the loaded disc is being accessed. The controller port is located at the bottom of the front panel.

Expansion slots can be found on the side and rear panels. On the right side is an A/V expansion slot that can accommodate a full-motion video (FMV) cartridge, expected to be available in the immediate future. When equipped with the FMV cartridge, the 3DO deck will play Video CD's. On the rear panel is an expansion slot for peripheral devices that use high-speed data transfer; it will be used for future networking applications. Also on the back panel are the AC power cord; RF, standard video, and S-Video outputs; and right- and left-audio outputs.

The manual provides clear, well-illustrated instructions for connecting the FX-1 to a TV (mono or stereo), TV and stereo, and TV and VCR. In most set-up scenarios, the provided cables will suffice; S-Video, however, requires a special optional cable. The REAL Multiplayer is not recommended for use with projection TV's, which are more susceptible to phosphor burn.

Except for powering up and loading discs, all Multiplayer functions are controlled via the wired 3DO control pad. Designed for two-handed use, the controller is curved, with raised, rounded handholds on each side. On the top left is a four-way directional pad; on the top right are A, B, and C buttons. Buttons labeled X and PLAY/PAUSE are in the center of the control pad. Along the back edge (the side that faces the TV) are right- and left-shift buttons. For multiple player use, it's possible to connect another, separately purchased, controller to the primary one via a port located between the shift buttons. A jack and volume control for headphones are found on the front edge.

The REAL Multiplayer came with two 3DO discs: *Crash 'n Burn*, a futuristic race-car simulator game that will be described below (along with several other software titles), and an introductory disc. Dubbed the "Sampler CD," it not only explains the various features of the Multiplayer and how to use them, but also offers a look at current and future 3DO titles.

The Sampler CD's main purpose—other than whetting your appetite for more 3DO software—is to help you get acquainted with the "feel" of the controller. To view current titles, for instance, you must move the on-screen pointer (using the directional pad) through an "art gallery," in which each "painting" represents a software category: entertainment, interactive movies, "edutainment," sim-

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ulators, and so on. Once the pointer is positioned in front of the painting of your choice, pressing the A button accesses that category. As each title is announced and displayed, another press of that button causes the preview—a short segment of the program—to run. Pressing the C button returns you to the list of titles (the beginning of the list, unfortunately, instead of where you left off; you have to let it run through the whole list again and again to see all the previews). Pressing C a second time returns you to the art-gallery floor so that you can view other software-category paintings.

The "Coming Soon" segment of the Sampler CD was the most intriguing. It contained snippets of several upcoming 3DO titles, each chosen to represent the platform's potential. There were excerpts from three soon-to-be released animated stories—Batman, Thumbelina, and 2 Stupid Dogs. Several game segments allowed us to play along: golf, an animated shell game, and an impressive racing game whose three-dimensional effects actually made us dizzy as we sped along.

As impressive as the audio and video quality may be, the one means provided to access and control the interactive multimedia programming is sorely lacking in finesse. It takes some time to get the feel of the 3DO controller; in fact, after dozens of hours of play, we still didn't feel as if we'd mastered it. Using the directional pad is awkward, resulting in jerky movements that tended to overshoot or fall short of our intended on-screen destination. That complaint holds across the board; we had the same problem in every 3DO application that we tried. In addition, functions of the A, B, and C buttons are not standard; in one title, A might be the "fire" button, while in another B is used to shoot. The more proficient we became at one game, the longer it took to retrain ourselves for another.

When playing audio CD's, the directional pad is used to scan tracks (left and right controls) and to fast forward or reverse between tracks (top and bottom controls). The PLAY/PAUSE button does just what you'd expect, and the X button serves as the stop button. The A button is used to change the display from the main screen, which displays the track number, elapsed time, sound levels, and play mode, to assorted graphics displays resembling circa-1968 Filmore West light shows. The B button is used to access graphics or language channels on CD + G's. And, in case you have trouble remembering all that, the C button calls up a help screen.

You'll need more than that bare-bones help screen for programming discs. Holding down either of the SHIFT buttons and then pressing the X button opens up a separate programming screen. Here, the controller's buttons take on yet another set of functions, allowing you to select repeat on or off, select the tracks you'd like to hear and the order in which they'll play, and select normal or random play. Programs are automatically saved in static RAM, and then retrieved whenever that CD is inserted in the Multiplayer.

With Photo CD's, the PLAY/PAUSE, STOP, and C buttons have the same functions as with audio CD's, but that's where the similarity ends. The directional pad is used to pan images, unless you also press a shift button, in which case it either creates mirror images or rotates the picture. The A button is used to advance to the next photo; used with the SHIFT button, it brings up the previous photo. The B button is used to select a zoom area; with the SHIFT button, to actually zoom in.

With a $700 suggested retail price for the Multiplayer, it would have been nice if Panasonic had included a specialized *remote* control for audio and Photo CD's. It is possible to purchase a 3DO mouse separately, and at least one company (CH Products, 970 Park Center Drive, Vista, CA 92083) has been licensed to market a 3DO joystick.

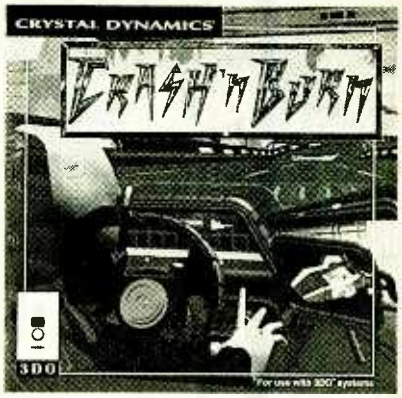
After significant doses of 3DO hype at three Consumer Electronics Shows, we were excited about getting our hands on a working model. The graphics were, indeed, impressive, as was the speed. For example, some of the non-action, introductory screens approached real video, and the fast-action game playing didn't suffer from blocky graphics.

But the technical abilities of the Multiplayer won't guarantee its success. Whether any software licensees come up with the 3DO equivalent to Nintendo's Mario or Sega's Sonic will determine its future. We don't think the roguish characters in Crash 'n Burn (described below) will do the trick.

Now, let's take a moment and look at some of the first titles released for the new 3DO platform:

CRASH 'N BURN; Crystal Dynamics, 2460 Embarcadero Way, Palo Alto, CA 94303; Price: Included with the REAL Multiplayer.

Reminiscent of the Mad Max cult movies, *Crash 'n Burn* is set in a post-apocalyptic world in which assorted unsavory characters and their flashy vehicles are pitted against one another in a race to the death. After selecting a car based on its speed, acceleration, defenses, and weaponry, and a driver personae, players

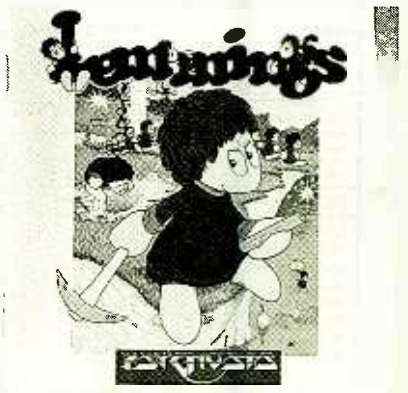


race along 30 different tracks. Road hazards include banked curves, corkscrews, tunnels, water patches, ice, sand, tar, and land mines—not to mention the other drivers, whose cars are equipped with a variety of deadly weapons. Vortex mines, nitro blasts, nuclear-fusion casters, and cannons are just part of the available arsenal. There is also a defensive "cloaking device" that allows cars to become transparent. Winners are judged by speed and firepower.

Crash 'n Burn showcases some of 3DO's graphics capabilities, including the transparency effect, movie-like video during character introductions, digitized voice and sound effects, and intricate moving backgrounds. Play is three-dimensional; players can see a missile floating in front of the car, dodge it, and then watch it from the side as they drive past it. Unfortunately, the game also underscores the inadequacy of the controller included with the Multiplayer.

LEMMINGS; Psygnosis, 675 Massachusetts Avenue, Cambridge, MA 02139; Price: $59.99.

Like their real-life counterparts, the animated critters in *Lemmings* exhibit extreme herding tendencies—they will follow one another to safety, or to their deaths, depending on the player's strategic thinking ability and reaction time. The player's goal is to successfully guide as many lemmings as possible to the safe



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haven that lies at the end of an obstacle course by equipping individual lemmings to climb over, float down, build across, or smash through the obstacles. With 120 increasingly difficult levels of play, Lemmings is intellectually challenging and appeals to players of various ages, genders, and cultures.

Lemmings has been around since 1991; we've played—and thoroughly enjoyed—it on a variety of game systems. We had hoped, however, for better resolution from the 3DO version. Yet we still had difficulty distinguishing between the icons at the bottom of the screen—and mistaking a builder for a floater can have tragic consequences for the lemming population!

PUTT-PUTT JOINS THE PARADE; Humongous Entertainment, 13110 NE 117th Place #180, Woodinville, WA 98072-9965. Price: $54.95.

A fine example of interactive storytelling, *Putt-Putt Joins the Parade* allows children (ages 3 to 8) to go on an open-ended adventure with Putt-Putt the car. Although there is a beginning and an end to the tale of the little car who must find a pet and balloon before he can enter the Cartown Pet Parade, what happens in between is entirely up to the player. Putt-Putt

can be guided down different roads, where he meets up with other Cartown residents and shopkeepers, gets a carwash bath, visits a toy store, mows some maze-like lawns to earn some money, and plays games. Players must remove such roadblocks as a large cow (by honking the horn), a pile of tacks (with a large magnet), and a music-less marching band (by turning on Putt-Putt's car radio). The main character is engaging, the story flows along at a nice clip, and every screen offers opportunities for kids to learn and explore.

SHELLEY DUVALL'S IT'S A BIRD'S LIFE; Sanctuary Woods, 1875 South Grant Street, San Mateo, CA 94402; 415-578-6340. Price: $54.95.

Shelley Duvall's It's a Bird's Life, aimed at children aged three years and older, combines a linear story—a flock of domesticated parrots, homeless after a fire destroys their family's California home, travels to the Amazon jungle and then back to L.A.—with interactive diversions. Players can click on objects on each page to make them move or speak, play games, solve puzzles, read the text themselves or have Shelley Duvall read it for them, and "color" the screen with on-screen paintbrushes. The "edutainment" program contains detailed information on the Amazon Rainforest, geography, clouds, and birds of the world, along with more than 400 word definitions and 11 original sing-along songs. Although It's a Bird's Life is both educational and politically correct, neither the plot nor the birds captured our hearts or imaginations. (Of course, we do not quite fit the intended user profile, and we don't like Barney either.)

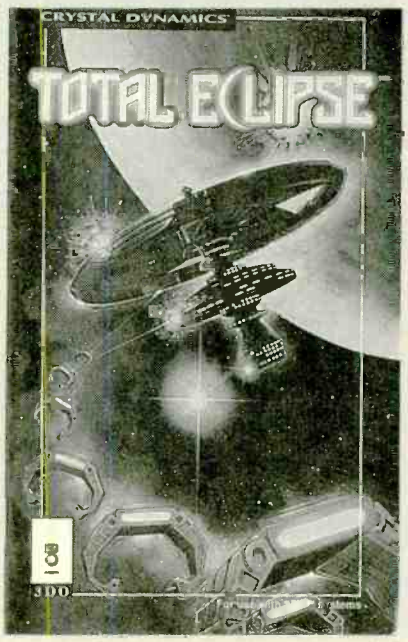
ESCAPE FROM MONSTER MANOR; Electronic Arts, 1450 Fashion Island Blvd., San Mateo, CA 94404; 415-571-7171; $59.99.

Designed from the ground up specifically for the 3DO system, *Escape From Monster Manor* features a full palette of colors

and translucency, a CD-quality soundtrack, and special graphics effects. The game is set in and around a mansion located in the "sinister world of the undead." The player's main goal is to find the scattered fragments of a golden talisman, so that the forces of evil will be forever banished from the land. Along the way, he must rid the property of ghosts, grim reapers, and other creepy beings by zapping them with a "ghost gun." The search for the talisman leads the player through the labyrinthian rooms of the mansion, which unfold, maze-like, as he moves from room to room picking up extra ammunition, health power-ups, and keys to the rooms that lie ahead. Luckily, it's easy to call up a map of the current level, or we'd still be wandering around the attic of Monster Manor!

TOTAL ECLIPSE; Crystal Dynamics Inc., 87 Encina Avenue, Palo Alto, CA 94301; 415-473-3400; Price: $59.95.

In *Total Eclipse*, the year is 2918, and our solar system is under attack by the Drak-sai, evil aliens intent on destroying our sun. The space-combat simulator game puts the player in the pilot's seat as he maneuvers through a realistic, finely sculptured, three-dimensional universe. The player's mission is explained by a lifelike, 3D virtual actor, synthesized from



sophisticated computer models: Destroy the Drak-sai before they destroy our universe. As a Stellar Guard pilot commanding the FireWing star fighter, the player flies over and around planetary surfaces, skimming mountains and exploring winding tunnels and deep canyons. All the while, he must dodge enemies and obstacles both air-borne and on the planet's sur-

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face. There are 20 different levels of play on five worlds with harsh terrains: lava, desert, swamp, metal, and ice. The game is fast-moving, realistic, and exciting, but maneuvering the FireWing using the 3DO controller gives the Drak-sai an unfair advantage. We'd like to try this game using a flight-stick controller.

STELLAR 7: DRAXON'S REVENGE; Dynamix, Inc., 1600 Mill Race Drive, Eugene, OR 97403; $59.95.

Based on the PC-based game, Stellar 7, *Draxon's Revenge* pits the player—Terran Defense Forces lead pilot—against the evil forces of Gir Draxon, supreme overlord of the aggressive Arcturan Empire. The player takes control of the Raven, a prototype heavy assault vehicle that has at its command a battery of weapons and defensive devices, including the super cannon and the RC bomb, along with the Cat's Eye

radar tracking system, the Inviso Cloak to render it invisible, and thrusters for a sudden surge of speed or vertical lift. It's also possible to use the Draxon's own Warp Links (similar to *Star Trek: The Next Generation's* "worm holes") to transport the Raven through space and time to attack the staging areas of the Draxon invasion fleet. The game offers seven challenging levels of fast-moving action and excellent three-dimensional graphics.

Building a Better Mousetrap?

Asked where the name "3DO" originated, Trip Hawkins, president of The 3DO Company, quipped, "Audio . . . video . . .[the next logical step in the progression is] 3DO." He hopes to make 3DO as omnipresent in American households as its "D-O" predecessors.

From its inception, The 3DO Company has proven to be a unique player in the multimedia field. It does not manufacture either software or multiplayers. It focuses, instead, on designing the 3DO multiplayer, setting standards for all 3DO software and hardware, and licensing manufacturers. Two areas in which the company excels are arranging strategic alliances with those companies that will manufacture future products—equity partners include Matsushita, AT&T, Time Warner, MCA, and Electronic Arts—and marketing the unusual 3DO concept.

That concept seems ingenious in its simplicity: Design a brand-new, ultra-fast multimedia standard from the ground up, and then encourage software developers and hardware manufacturers by offering generous licensing arrangements.

First, the company came up with a prototype based on multiprocessors that were specially designed to meet its unique requirements, rather than designing a machine around the capabilities (and limitations) of chips available at the time. 3DO's high-performance architecture is based on a pair of custom "graphics animation engines" that can display or move up to 64 million pixels per second, compared to an average of roughly one-million pixels per second for 16-bit game systems.

Graphics are organized by the animation engines into "animation cels"—high-resolution, full-color images that can be animated, scaled, rotated, and further distorted. Those cels might be loosely compared to the "sprites" used by developers of other game platforms, but they don't face the same limitations as sprites in regard to size, shape, color, and number available. In fact, animation cels have more in common with Hollywood production techniques in which animators use layers of independent art to achieve realistic visual depth. Specifically designed to animate cels, the 3DO Multiplayer does so faster and smoother than other platforms.

Working alongside the graphics-animation engines are a custom, 32-bit RISC (reduced instruction-set computer) processing unit that handles interactive processing, a double-speed CD-ROM drive, and a multitasking audio system. Said to deliver 50 times the performance of typical video game systems and personal computers, the Multiplayer also offers millions of simultaneous colors, full-screen, software-based video at 30 frames per second,

CH Products' Flightstick Pro is one of the first 3DO compatible joysticks to be introduced.

and CD-quality sound with digital signal processing. The device is compatible with music CD's, including CD+G's, and Kodak's Photo CD. Taking advantage of 3DO's open architecture and expansion ports, future enhancements can be added. Those include full-motion video using the MPEG-1 data-compression standard, MIDI capability, the ability to attach a camcorder or VCR for home video editing, and the multimedia networking with other 3DO users over standard telephone lines.

To facilitate the 3DO platform's broad-based introduction into the consumer marketplace, The 3DO Company is offering unusually generous licensing deals and extensive programming packages. After an initial sign-on fee, hardware manufacturers need not pay any royalties on units sold. The software-licensing fee and royalty program are significantly lower than those for other formats. In addition, under the 3DO licensing program software developers can publish as many titles as they want, with no restrictions on category types, content, or product-introduction scheduling. Licensees have access to the 3DO Content Library, a database of some 60 hours of music, 20,000 sound effects, 10,000 still pictures, hours of film footage, 350 megabytes of clip art, and 500 texture effects—all copyright cleared and license free. Parts of that sound library were contributed by Time Warner and MCA.

In fact, each partner of The 3DO Company brings some special resources to the 3DO enterprise. Pairing Hollywood investors such as Time Warner and MCA with Silicon Valley software designers like Electronic Arts opens a new outlet for those companies' existing libraries of properties, while allowing new interactive products to be sold alongside film, music, and book versions of the same. Time Warner—which owns Six Flags amusement parks, where video-game arcades are popular attractions—is better known as the nation's second largest cable operator.

(Continued on page 58)

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Shhhh!

NOISEBUSTER ACTIVE NOISE-REDUCTION HEADSET. From Noise Cancellation Technologies, Inc., 800 Summer Street, Stamford, CT 06901-1023; 203-961-0500. Price: $149.

We live in a noisy world. Our ears are bombarded from all directions. Cars, trucks, trains, the washer, dryer, dishwasher, and microwave all have their own unique contribution to our sound environment, and there's always a TV or stereo playing somewhere in the house. Noise—it sometimes seems as if there's no way to avoid it.

We all know that exposure to loud noise can damage our hearing. But that's only one of the problems associated with it. Constant exposure to noise can lead to stress, and recent studies have shown that noise can even elevate blood pressure.

Although we are not always able to control the sound to which we're exposed, we can take some steps. In our homes we can take such measures as insulating walls, closing windows, and perhaps even using a white-noise generator to mask unwanted external noise. In our cars, we can install improved soundproofing. (See our review of Scosche Accumat, April 1994.) Earplugs are yet another means to reduce exposure to potentially dangerous sound levels. They are essential when using power tools, lawnmowers, and other generators of excessive noise.

We recently found a new way to quieten the world around us: electronic noise cancellation as provided by the *NoiseBuster*.

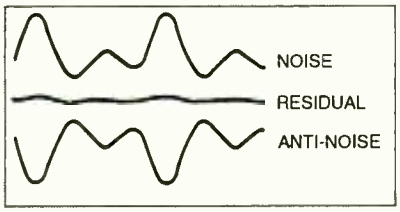
Noise Cancellation Technologies' NoiseBuster, which is powered by a 9-volt battery, looks something like a small personal stereo. A pair of comfortable, on-the-ear headphones is hardwired to a plastic box that measures about 3 × 3½ × 1¼ inches and contains most of the NoiseBuster circuitry. The normal appearance of the headphones is deceiving. They are special in that each earpiece contains a microphone as well as a speaker.

Those microphones listen for the offensive noise at your ear, and feed the information back to the main unit where its level and frequency are analyzed. The NoiseBuster then creates a noise signal of its own—an "anti-noise wave" that is a copy of the original noise, but 180 degrees out of phase with it. That anti-noise wave is fed to the headset, where it is output by the speakers. You can't hear it, though. When the anti-noise meets the offending noise, they cancel, reducing the apparent noise.

The NoiseBuster is designed to operate on noise from 30 Hz to 1500 Hz. The intent is to reduce or eliminate low-pitched rumbles and hums, without interfering with speech. The effectiveness of the device depends on how much of the noise falls within its operating range. Noise Cancellation Technologies claims that some noises—such as that found in an aircraft cabin—can be attenuated by as much as 95%. Other noises, such as a vacuum cleaner that generates higher-frequency sounds, might be reduced around 40%.

Our first experience with the Noise Buster was at the Winter Consumer Electronics Show in Las Vegas. It was the afternoon of the last day of the show, and much of the crowd had left. In short, the floor was on the quiet side—or so we thought. We put on the headphones, turned on the NoiseBuster, and were astounded at the reduction in the background hum of the convention center. We had no idea that it was still so noisy on the show floor!

When we received our evaluation sample, we first gave it a quick run on some of the noises we commonly encounter. We were disappointed to find that the power-supply fan on our computer was hardly quieted at all. Most of the noise it produces is evidently made up of higher-frequency components. The NoiseBuster merely changed the way it sounded by eliminating the low-frequency components of its hum.



The top waveform represents the sound pressure of the offending noise. The bottom is the anti-noise signal generated by the NoiseBuster. The residual noise is shown in the center.

We looked forward to giving the NoiseBuster a go on an airplane. Airplanes are incredibly loud, with noise levels in the passenger cabins somewhere around 80 decibels (dB). Typically, that noise—about the same as you might expect during the daytime in a busy city—makes it difficult to listen to a personal stereo, in-flight audio entertainment, or the soundtrack for an in-flight movie.

Normally, our first inclination would be to simply increase the volume of what we want to listen to. Think, however, what that means. If we assume that the airplane cabin noise level is 80 dB, then our stereo would have to be generating at least 83 dB because an increase of 3 dB is the smallest increment in sound level detectable by humans. Because the decibel scale is logarithmic, that increase of 3 dB actually represents a *doubling* of acoustic energy.

Shortly after takeoff, we put our headphones on and turned on the power. The noise was reduced dramatically—not the 95% reduction claimed possible, but substantially nonetheless. The reduction in low-frequency sound was enough to make us happy that we brought the headset along. There was still plenty of noise—any noise above 1500 Hz is not reduced.

The noise elimination could be most appreciated when we removed the headset

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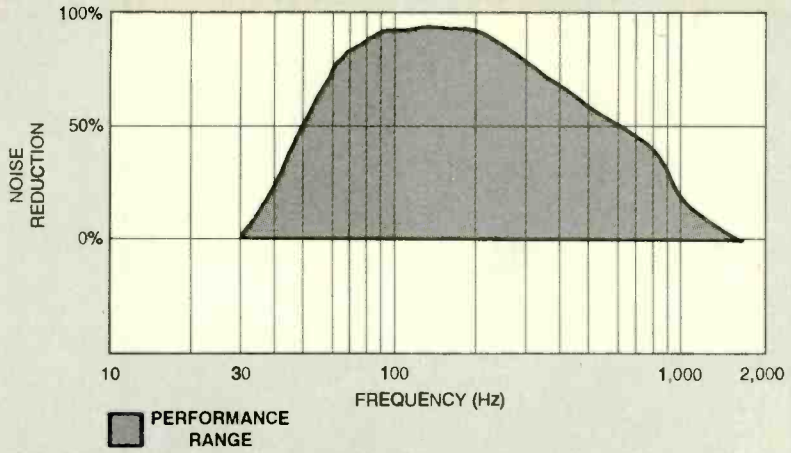


The NoiseBuster is designed to operate in a frequency range from 30 Hz to 1500 Hz so as not to interfere with speech.

to compare the noise levels. We got used to the reduced sound so much that we didn't want to take the headphones off. Although the noise was reduced, we could still hear and understand everything. The captain's announcements were easily understood, and the flight attendants were intelligible.

We then used the NoiseBuster in conjunction with our personal stereo and the in-flight entertainment. The NoiseBuster comes equipped with a cable that is terminated on either end with a miniature stereo phone plug. A volume control is in the middle of the cable. One end of the cable is plugged into the headphone jack of the stereo, and the other end plugs into the NoiseBuster. (On our flights, we were fortunate in that the airplane was equipped with standard headphone jacks. Some airplanes use a two-prong audio connector—an adapter, not supplied with the NoiseBuster, would be required for compatibility.)

The result was tremendous. Usually, we get fatigued quickly by the typical poor audio at a high volume in an airplane. Instead of getting fatigued, however, we listened for virtually the entire 4-hour flight. Audio in an airplane never sounded so good to us.

The NoiseBuster is the first active noise-cancellation device available to consumers at a reasonable price. (Previously, active noise cancellation was used by the military to block, for example, noise in helicopters. Other uses that you will potentially see in the future include an active automobile muffler.) It provides a new way to reduce the noise in your life. ■

TGIF

FRIDAY PERSONAL/OFFICE RECEPTIONIST. From Bogen Communications, Inc., 50 Spring Street, P. O. Box 575, Ramsey, NJ 07446; Tel: 201-934-8500. Price: $499, two-line version; $399, one-line version.

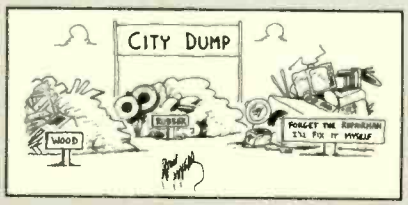
There are two things required to keep any company, regardless of size, operating at peak efficiency: a dependable staff and the tools they need to do their jobs. Topping the list of such tools is the equipment required to keep the lines of communications open between the staff and those they deal with outside the company.

Large or small, most businesses require, at the very least, a phone, a fax machine, and some way to answer and route incoming calls and to take clear messages when the calls cannot be answered immediately. There are two options open to large corporations—hiring a real, flesh-and-blood receptionist, or having an electronic voice-mail system installed. Despite our technological leanings, we still prefer to speak to a friendly, helpful person than a prerecorded message. However, comparing the costs of paying a salary and benefits year after year to the one-time price of a voice-mail system, many companies are opting for the electronic solution.

For many of the nearly 20 million small businesses and 24 million income-producing home-offices, however, neither voice mail nor a receptionist is an economically viable solution. Ironically, it's the small businesses and home offices for whom a professional, dependable communications presentation is most important. After all, large companies don't have to prove their professional integrity on each phone call—but small businesses do.

Home-office workers, in particular, face problems maintaining a professional image. Many people still can't accept that people who work at home are actually working. That non-professional image can be reinforced if, for instance, a home-office worker who decides to throw in a load of laundry while waiting for a document to print, forgets to answer the extension phone with the proper business greeting. Or if a toddler grabs the phone before his home-working parent can get to it. Those unfortunate scenarios, or similar ones, are familiar to most home-office workers.

Unable to afford sophisticated voice-mail systems or the salary of a receptionist, most small businesses and home offices still rely on standard telephones and answering machines. That's not the most effective communications arrangement—one out of seven home-based busi-



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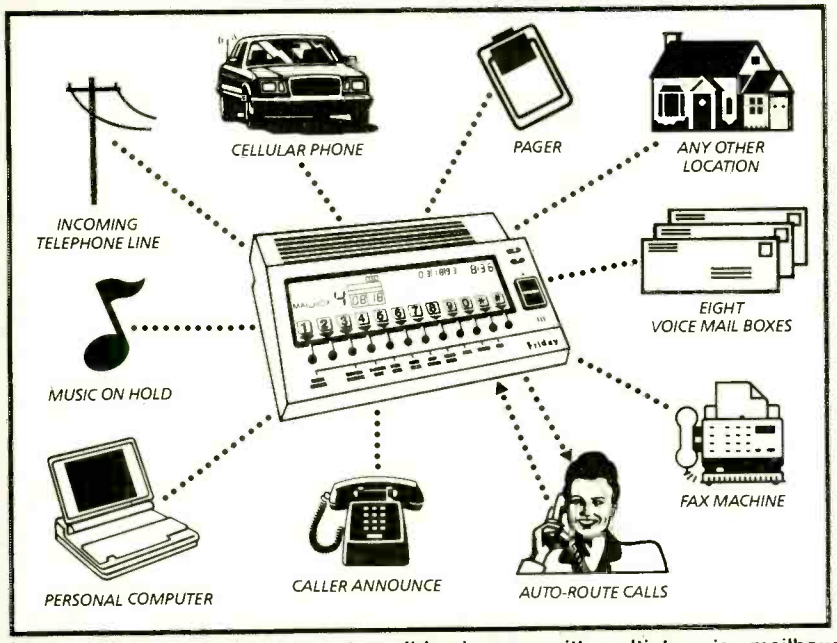

Friday provides home-based and small businesses with multiple voice mailboxes, and has the ability to selectively save and delete messages, to share phone lines with a fax or a modem, and to forward calls to any location—allowing you to be reached at a client's office, in your car, or on your pager.

nesses or services experiences a telephone-product failure each year. Missed calls result in wasted time, inefficiency, and possible loss of income.

Bogen Communications gives small businesses and home offices a competitive edge in communications with *Friday The Personal/Office Receptionist*. Billed as "the next generation telephone answering system," Friday is a scaled-down version of the voice-mail systems used by major corporations. Intended to enhance the business' existing phone and fax machine, the all-digital system provides multiple mailboxes with customized outgoing messages. It has the ability to forward calls to any location, automatically detect and route calls to a fax machine or PC, notify users of urgent messages, remind users of appointments, provide music-on-hold, and professionally manage and screen calls.

With a footprint of only 6×8 inches, Friday doesn't take up too much valuable desk space. In fact, it fit neatly on one 3-foot-long bookshelf, between our two-line phone and our fax machine, with room to spare for our Rolodex. Both the one-line model and the two-line version reviewed here come with a wall-mount kit for those who can't spare any shelf space at all.

We began the setup procedure by installing a 9-volt battery for memory backup, and making the proper connections between Friday, the telephone, and the fax or PC. The two-line version can accept either two one-line phones or one two-line phone, using the supplied line cords. Friday is then connected to the outside phone lines' modular jack. A fax or a PC with modem is also plugged directly to a jack on Friday's back panel. Finally, if you'd like your telecommunications system to offer music on hold, an audio source (personal stereo, tuner, portable CD player, or tape deck) can be plugged into the audio input. A volume control is located next to the audio input and can be adjusted using a small screwdriver. Friday is now ready to be plugged in.

After power-up, Friday performs a self-diagnostic test, as it counts down from 15 to 0 in the upper-right corner of the LCD. The manual is clearly written and well-illustrated; setup should cause no problems for even the technologically impaired. Unfortunately, the first unit we tested—one that had been reviewed by at least one other magazine and then shipped around repeatedly—flunked the diagnostic test. The replacement unit passed with flying colors, however, and was then ready to for initial setup and customized greetings.

Friday features a large (1¾×6-inch) LCD screen that displays the date and time, which mailbox is in use, and the number of messages—old and new—that are stored. Along the bottom of the display is a row of icons that includes the digits 1 through 0, an asterisk, and a pound sign. Immediately below the LCD are buttons that correspond to each icon; their everyday functions are clearly labeled on the front of the unit. During setup, however, those buttons perform other functions. The setup functions are accessed by flipping open the lid to a compartment that runs along the front of the unit.

Friday actually talks you through each stage of the setup process in synthesized voice, in a style that's familiar to anyone who's ever called a voice-mail system. For instance, when setting the number of rings desired, Friday prompts, "For Toll Save press 2, for three rings press 3, for four rings press 4. . . ." Similar instructions are provided for setting the time and date, and the volume of voice prompts and message playback, making those procedures as easy as possible.

With the basic settings programmed, the next step is recording the main greeting and the messages for each of the four mailboxes that can be used as individual answering machines, and for the three additional mailboxes that can be used for outgoing announcements. Again, the manual offers detailed advice, including this example of a main greeting:

"Hello, you have reached the ABC Company. To leave a message for Dave, press 1; for Amy, press 2; for Pete, press; 3; for Lisa, press 4. To hear our mailing address, press 5. To hear our office hours, press 6. To get directions, press 7. To send a fax, press 8. To repeat this message, press 0 at any time."

The personal messages would then sound something like: "Hi, this is Dave. Please leave a message after the tone and I'll get back to you."

Of course, all of the outgoing messages are entirely up to the user, who can personalize them to meet the company's needs. With the two-line system, two different main greetings can be recorded, or one greeting can be used on both lines. For the one-line unit, multiple greetings are possible only if Distinct Ring service is ordered from the phone company.

Home offices with only one or two workers can still put Friday to good use sorting out messages on the business and personal phone lines. If, for instance, Jane Johnson ran a catering business from her home, the main message on her business line might say: "You've reached Johnson Fine Foods. To leave a message for Jane, press 1. If you'd like to receive our brochure, press 2. If you'd like to hear our Spring menu and price list, press 5. If you need to know our address, press 6. If you'd like directions to our facilities, press 7. To send a fax, press 8." On line two, the personal line, the main message might say, "Hi. You've reached the Johnson residence. To leave a message for Jane, press 4. To leave a message for Tom, press 5." Or, in a home with kids, "To leave a message for Jane or Tom, press 4. To leave a message for Tom, Jr., press 5." It's also possible to reserve one box for private use by family members or employees only; simply leave that box number off the main menu and tell only those whom you wish to use it of its existence.

Friday can hold up to 18 minutes of

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messages in its RAM. However, an optional expansion module doubles the message storage time to 36 minutes. Because Friday is a digital answering machine, there are no tapes or moving parts to wear out. Digital playback features are extensive: you can instantly repeat, save, pause, or delete a message; skip forward or back one message; save a message to a different mailbox; play the time/date stamp; and even choose from three playback speeds—slow, normal, and fast.

The LCD indicates which mailboxes contain messages and how many new and old messages are stored in the currently active mailbox. Messages can be retrieved by selecting the appropriate mailbox and pressing the MESSAGE button. To call in for messages, a security code is always required; security codes can also be set to prevent local access to the messages in your mailbox or any other mailbox functions. With the proper security code, it is also possible to program the system remotely via telephone. (If security is not a priority and/or you have trouble remembering codes, you can opt to use the factory preset codes: "1111" for mailbox one, "2222" for mailbox 2, etc.)

Of course, a good receptionist does more than take messages. The job description often includes screening unwanted calls—or all calls, if the boss is in a meeting; relaying messages; providing clients with a number at which their contact can be reached; ascertaining a call's relative importance and acting upon it; passing along messages between employees, and even reminding employees that they have appointments scheduled.

Friday can do all that. When the announce-caller function is activated, Friday asks who is calling; the name can be heard over Friday's speaker. You can then decide whether to take the call or let the caller leave a voice-mail message. If you're in the middle of an important project, you can turn on the do-not-disturb function. Friday then answers the phone on the first ring and takes messages without broadcasting them over its speaker.

If you are going to be out of the office and don't want to miss your calls, you can have Friday forward the calls to another phone number or to a pager. (If your Friday is the one-line model, you must have 3-way calling from the phone company to use call forwarding. On the two-line unit, Friday uses the second line to call out.) When call forward is activated, the caller is told, "Press 0 to leave a message, or your call is being forwarded." Pager forward works in the same manner.

If you want only urgent calls to be forwarded, the remote-notify function is used. Each callers is asked if his message is urgent. If so, Friday will call you at the number that you have programmed. Of course, every office is plagued by at least one salesman who always considers his calls urgent! You can get around that with the call-block function, if you know his phone number. Intended to prevent toll fraud, the function allows you to block call-forward, remote-notify, and pager-notify attempts from up to three phone-number prefixes of up to four digits. If Joe from Acme Office Supply has been leaving urgent messages for you to call him at 555-5555, for instance, you can program Friday not to forward calls with the 5555 prefix.

Coworkers can leave messages for each other, or leave timed reminders for themselves or others. Up to three timed messages can be left in a mailbox; at the user-specified time and date, Friday beeps and puts the message in the mailbox. The 2-WAY/MEMO button is used to leave messages in other people's mailboxes. During a phone call, pressing that button records the conversation.

Friday can also recognize the phone company's Distinctive Ring, Indent-A-Ring or other services that permit multiple numbers on a single phone line. Each number has a different-sounding ring. Friday can distinguish between the different rings and be programmed to answer one number with a business message and the other with a personal message.

For fax reception, two routing methods are used. First, the caller could listen to the main message menu and be instructed to press 8 to send a fax. If someone just sent a fax without calling first, however, Friday can recognize the CNG tones of the fax machine and automatically route the call to the fax machine. (The two-line model allows faxes to be received on either number.) Friday cannot detect modem calls; the calling modem must first dial the phone number, then provide a pause until Friday answers, and then enter the 8.

From the user's perspective, Friday offers an easy-to-use, customized system whose variations are limited only by the imagination. Need a wake-up call when you're on a business trip? Use the timed memo function to call-forward a timed reminder. If your business is mostly repeat customers that know your staff by name, identify mail boxes by name. If you're actively courting new customers, record an outgoing message that prompts callers to "press 1 for sales, press 2 for accounting, etc."

From the incoming caller's standpoint, Friday is professional without being totally impersonal. At most, the caller is presented with eight menu choices. (We've called large corporations and had to listen to seemingly endless lists of employees before hearing the name we needed.) Call-forwarding functions help end games of

(Continued on page 58)

The Family Fax

HOME FACSIMILE MODEL FX40. Manufactured by Samsung Electronics America, 105 Challenger Road, Ridgefield Park, NJ 07660-0511; 201-229-4000; Price: $299.

The facsimile machine is a standard fixture in modern offices, right up there with the telephone system. It's rare to see a business card or letterhead that doesn't list both phone and fax numbers; some companies have standard and toll-free numbers for both their telephone and fax lines. From the corner deli to the Fortune 500, just about every business uses faxes to speed up paper communications.

The fax has not penetrated the home-office market to the same extent—at least not yet. As of last year, only 10% of homes with income-producing offices included fax machines. But that number is expected to increase dramatically in the next few years, as prices continue to drop, the units shrink in size, and more convenience features are offered.

Today's crop of thermal-paper fax machines routinely offer a built-in telephone, speed dialing, polling, and the ability to print out "reports" of stored phone numbers and recent transmissions. They don't even require a separate phone line, but can automatically route incoming calls to the fax or telephone, or to an attached telephone answering machine.

A few years ago, such a machine could not be found for under $500, and you could expect to pay much more. Today, however, you'd have a hard time finding a feature-laden home fax that cost as much as $500, and many cost considerably less. And at prices from $250 to $450, now you're talking consumer item.

It's not surprising, then, that facsimile manufacturers are targeting not only homes with offices, but also homes without them. Want your husband to pick up a few things at the grocery on the way home? Fax him a list. Forget to send your mother a birthday card? Fax her a home-drawn greeting at the last minute. Did Susie have a straight-A report card? Fax copies to all the grandparents. Can't remember how to make Mom's meatloaf? Ask her to fax you the recipe. For consumers as well as home-office workers, the key selling points are low price, compact size, and plenty of convenience features.

With a suggested retail price of $299, *Samsung's FX40* is a good example of the consumer fax machine. It offers all the basics listed above, plus a few bonus features, such as the ability, at the press of two buttons, to print out a "help" list of its functions. It does not offer some of the features found on top-of-the-line home fax

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machines, such as an automatic paper cutter, a paper feeder, and a half-tone mode for transmitting photographs. The lack of such features precludes using the FX40 in many home-office situations—a graphics designer would want the high-resolution of a half-tone mode, a lawyer would want to automatically feed in multi-page briefs or legal contracts, and the local deli owner wouldn't want her employees wasting their time cutting apart incoming pages of orders during the lunch-hour rush.

For those offices or homes that receive the occasional fax, or send out only printed material, the FX40 makes sense. Measuring just 13⅜ × 3¼ × 8¼ inches, it can fit in even in the tight quarters of many home offices—or can find a spot on the kitchen counter. And it's easy to install and to use.

Setup requires attaching the telephone handset to the left side of the main unit, and then connecting the unit to a telephone jack with the supplied modular cord. If desired, an extension telephone or an answering machine can be plugged into the extra jack on the back of the fax machine. If needed, the ring type (soft, normal, or off), pulse/tone switch, and volume control can be adjusted. The supplied 49-foot paper roll fits in a compartment under the top lid, which is opened with a press of the RELEASE button.

Before the FX40 is ready to send a fax, the correct time and date must be set, along with the terminal ID. All of that information will appear at the top of each fax that is transmitted. In fact, to prevent unwanted junk faxes, a federal law requires that every fax sent must include a terminal ID. That can consist of only a phone number, a name and number, or a company name, address and phone number. Date and time are set by pressing FUNCTION and 0, and then inputting the month, day, and year followed by the hour and minute in 24-hour format. Setting the terminal ID is slightly more complex. An asterisk must separate each digit or letter, and letters are selected with multiple taps on the numbered phone-dial buttons. A chart that appears in the manual makes the spelling process easier.

The FX40 can also be programmed with up to ten numbers for speed dialing. Pressing FUNCTION and then SPEED begins the process. The one-digit (from 0–9) number that will be assigned to the speed-dial number is entered first, immediately followed by a phone number that contains up to 34 digits. Pauses can be added anywhere within the number. A name can be added to identify each number, using the same spelling technique as to input the terminal ID. A plastic tray that slides out from the right side of the FX40 holds a name card on which the names associated with the speed-dial numbers can be listed for easy reference.

Documents ranging in size from 6 × 5 to 8.5 × 59 inches (width × length) can be transmitted. A document is inserted into the feeder on the front of the unit until a beep is heard and the paper is pulled in automatically. Two resolution modes are offered by the unit. Pressing the FINE button toggles between standard and fine modes. A green LED lights when fine mode is selected.

It isn't necessary to pick up the handset when dialing; instead, the MONITOR key can be pressed. The number can be entered manually or speed dialing can be used by pressing SPEED and the one-digit speed number. When the call goes through, a high-pitched warbling sound can be heard, and pushing the START/COPY button begins the transmission. To signal that the transmission is complete, the FX40 beeps five times. For multi-page documents, the next page must be inserted before the beeping ends.

The FX40 has the ability to print out several different types of lists. The most helpful, particularly for new users, is the help list, printed by pressing FUNCTION and then START/COPY. When programming the device, you can print out the time and date and terminal ID to verify that they were input correctly. Those printouts are generated by pressing FUNCTION, 0, and FUNCTION, 1, respectively. Using the same basic technique, you can also print out a list of your programmed speed-dial numbers; that's when you'll appreciate having taken the time to assign each speed number a name. You can also generate a communications report that lists the last 20 receptions and transmissions, including such information as whether the fax went through, the sending/receiving number, date and time, and number of pages.

The FX40 supports simple polling, which allows the unit to receive a document from an unattended remote fax machine—assuming, of course, that the remote fax also supports polling and that it is ready to send a document. To use the feature, simply call the remote fax, and when it answers, press the RECEIVE/POLL button. The FX40's polling feature won't work if the remote fax requires a password or poll code, and the machine can't be polled itself.

If you don't normally receive a lot of faxes, the expense of a second phone line is probably not justified. (In our neck of the woods, for example, the basic charge for the phone line, ignoring the installation fees, would eclipse the cost of the FX40 in a little over two years.) Because the FX40 can automatically recognize incoming autodialed faxes, a second line isn't required.

The reception modes work in a variety of different ways. In the full-automatic mode, the fax automatically receives the incoming document after a user-defined number of rings. If you rarely receive faxes, you'll want to set the FX40 to its full manual mode, where it doesn't answer any incoming calls. However, if you pick up the receiver and hear a fax tone, you can simply press the START key and hang up the receiver, and the fax will go through.

Another reception mode lets the FX40 share the line with an answering machine. In the answer mode, the answering machine is plugged into the EXT.TEL jack on the back of the machine. When a call is received, the answering machine answers and plays its outgoing message. But if the FX40 detects a fax tone, it automatically switches over and receives the incoming fax.

Incoming faxes can also be transferred from an extension phone to the fax machine. For example, if you answer an incoming call and hear a fax tone, you can press *9* (the default) to transfer the fax to the FX40. This feature doesn't work with just any extension phone—the extension must be plugged into the EXT.TEL jack on the FX40.

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As with any home fax machine, the FX40 doubles as a copier. The original is inserted through the feeder as though it was to be faxed, but the START/COPY button is pressed without dialing the phone. Of course, copies are made on thermal paper, which is not noted for its durability. Among other things, images fade when exposed to light, and the paper has the annoying tendency to curl.

The use of thermal paper alone would make the FX40 a poor choice for many serious fax users. Add to that the lack of a paper cutter or half-tone mode, and you have a machine that any frequent faxer (or faxee) would hate. For the low-volume user—to send off the occasional recipe or report card, for instance—the FX40 is an obvious value. ■

GET REAL

(Continued from page 52)

That puts them in a position to pave the way to transmit interactive multimedia over cable TV. Similarly, AT&T's leadership position in telecommunications enabled that company to develop and market a device that allows 3DO games to be played interactively over the phone wires, while still allowing the line to be used for conversation. Consumer-electronics giant Matsushita was the first to bring a 3DO Multiplayer to market, under its Panasonic label.

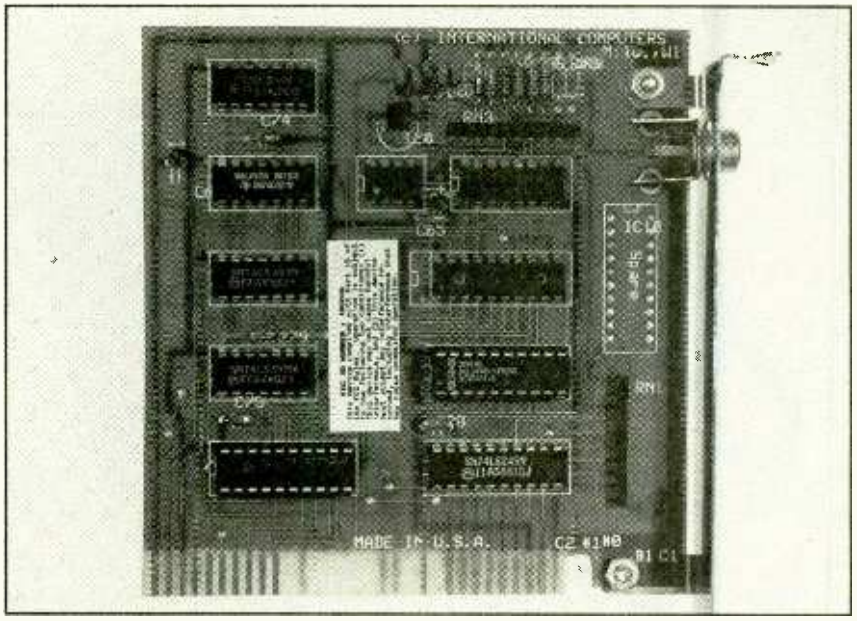
While AT&T and Matsushita have developed 3DO hardware and Electronic Arts has created several 3DO titles, those companies have done so as *licensees*, not as partners. Their products will carry the 3DO symbol, indicating that they meet the standards and are compatible with the format, not that they are manufactured by The 3DO Company. The 3DO company, so as not to compete at an unfair advantage over its licensees, does not and will not manufacture any hardware or software for the 3DO platform. ■

OFFICE RECEPTIONIST

(Continued from page 56)

phone tag, and special clients feel more important when they can let you know their messages are urgent—and you get right back to them.

We don't think Friday—or any electronic voice-mail system, for that matter—can replace a friendly, bright, cheerful, receptionist, but those are hard to come by for a one-time price of less than $500! For the small business that needs to present a modern, professional image and keep its communications under tight control, the Friday Personal/Office Receptionist is an elegant and effective solution. ■



This is Your Caption Speaking

CLOSED CAPTION DECODER. From International Computers, 12021 West Bluemound Road, Wauwatosa, WI 53226; 414-764-9000. Price: $89.

If you have bought a new TV recently, you are undoubtedly aware of closed captioning. The Television Decoder Circuitry Act of 1990 makes it mandatory for manufacturers to include closed-captioning decoder circuitry in every TV with a screen larger than 13 inches that has been manufactured for the U.S. market since July 1993.

Closed captioning, however, has been around for about a decade and a half, thanks primarily to the efforts of the National Captioning Institute (NCI). NCI is responsible for about 80% of all television captioning and about 95% of all videocassette captioning.

The captions are "closed" or normally invisible. They are "hidden" in line 21 of the vertical blanking interval or VBI. (The VBI is the time period between the fields of a TV picture during which the electron beam is turned off so that it can return to the top of the screen to "paint" the next field.) When accessed—either through an add-on or built-in decoder—they appear as white letters on a rectangular black background.

Most network prime-time programming is captioned, and many daytime network shows are as well. Although most programming is captioned during the post-production process, live programs—such as sporting events—are captioned in real time.

Although primarily intended for the hearing impaired, captions have other uses as well. They are valuable tools for children who are learning to read, or for anyone who is working to master the English language. Captions can also allow a viewer to enjoy programming without turning up the volume, to watch programs even when noisy kids are screaming in the background, or to watch without disturbing a spouse who prefers to read or listen to music.

A different way to view captions is provided by *International Computers*. That company provides a *Closed-Caption Decoder* as a plug-in board for IBM-standard computers. It not only permits captions to be displayed on the computer's screen, but also to be sent to a printer, or stored on disk in a text file.

When we first heard about the decoder, we were a little perplexed. Why, we wondered, would anyone want to use a computer to view captions? We could, perhaps envision toting our laptop computer to the living room if we needed to see the captions. But most laptops—including ours—can't accept plug-in cards, so we'd have to bring our desktop system to do the job. It didn't seem a practical way to access the captioning information.

That isn't really the purpose of the International Computer's closed-caption decoder. If you want to just read the captions, you're better off getting a decoder that displays them on the TV screen. Where the plug-in board is powerful is in saving the caption information in a computer text file.

Why would you want a file of captions? Well, political junkies can save transcripts

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of ows as the MacNeil Lehrer News Hour. Or perhaps they can watch Face the Nation while saving the transcript of Meet the Press. If you are looking for specific information, saving the transcript can be even better than recording the show on your VCR. That's because if you call up the text file on your favorite word processor, you can search for material that interests you. For example, did Senator Dole say anything about Clinton's healthcare plan? Just search for key words to find out. You'll find out much faster than trying to fast-forward through a tape.

Are you trying to learn how to write for TV? Is there a better way to learn techniques than by examining the teleplay text of hit shows?

The decoder board is easy to install—it simply plugs into any empty 8-bit slot. There are no interrupts to set, and no address block to be concerned with. It's not even necessary to set the monitor type. You just plug the board in, and it works.

The software that is supplied with the board includes a checkout program and an installation program. The main software, a program called CCD.EXE, has a file size of under 50 kilobytes. The advantage of the 8-bit board and the small size of the control software is that the closed-caption decoder could be installed in even an original IBM PC with a single 360-kilobyte floppy disk drive and still provide complete functionality. (Perhaps that could be a good use for that old XT of yours that's gathering dust.)

When the software is run, the main menu is displayed, and the main portion of the screen is split into four quadrants. Each quadrant contains a description of what is usually found there. At the top left is the C1 Caption quadrant. That caption channel is the most frequently used because it contains captions for the current program. The top right is the C2 Caption quadrant. Caption channel 2 is used only infrequently. It contains alternate program-related text captioning. It could be used, for example, for second-language captions, or for simplified text for children. It could also contain verbatim captions (which may move too fast for some viewers to read) instead of the edited captions of caption channel 1.

The bottom two quadrants, called C1 Text and C2 Text, are text channels that are used to present non-program-related text. Some popular uses for the text channels are to present program schedules, captioned-program schedules, or information of particular interest to the hearing impaired. In some areas, the text information might include news, weather reports, or community information.

The main menu presents six choices: Help, Get Captions, File Save, Print, Options Menu, and Exit. The Help option provides three screens of text that describe the operation of the decoder and software. The Get Captions option clears the screen and then displays captions and text, if available, in the four quadrants. The File Save option sets the software to save any acquired captions to a file.

Choosing the Print option toggles the printer output on and off. Because the caption data does not include many special characters, the output supports most printers. Special characters are translated by the software. Flash-on captions are printed in groups of eight lines, which represents how they would appear on the TV screen.

The Options Menu option brings up a second menu that allows further customization. The first choice allows you to choose which quadrant will be saved to a file. (It is possible to save only one quadrant at a time). The name of the save file is chosen with another menu entry. A third option lets you select whether the data will be appended to the capture file if it exists, or whether it will overwrite the currently existing file.

Just as captions can be saved from any quadrant, they can also be printed from any quadrant, and they can be sent to printer ports LPT1:, LPT2:, or LPT3:. The final option turns the error beep on or off.

Because almost all new TV sets contain closed-caption decoding circuitry, we hardly expected to find a unique caption-related product. This plug-in board, however, is just that. ■

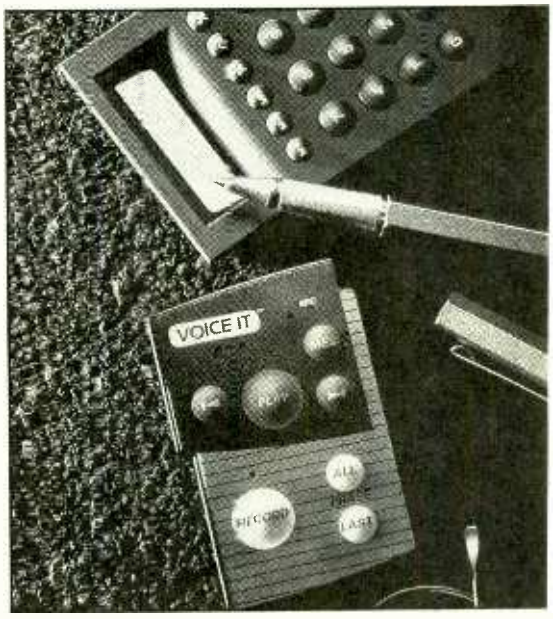
ELECTRONICS WISH LIST

Just Say It

Anyone who has ever searched in vain for pen and paper to write down a new idea or a reminder list will appreciate the *Voice It Personal Note Recorder* from *Voice It Technologies* (2643 Midpoint Drive, Fort Collins, CO 80525). The device is about the size of a credit card, but about ¼ inch thick. It records messages directly to a digital integrated circuit, allowing instant access to messages. Voice It can hold about a dozen brief messages. Price: $79.95.

Quiet Please!

The *Quiet Zone* noise-reduction system from *Koss Corp.* (4129 North Port Washington Ave., Milwaukee, WI 53212) acts as a kind of electronic earplug. Worn like the headphones for which the company is famous, the Quiet Zone reduces low-frequency noise (down to 30 Hz). It is said to be particularly effective on such sounds as droning lawn mowers, jet engines, or vacuum cleaners. Because it doesn't affect sounds above 1400 Hz, music and conversation are heard easily. In fact, they should be heard more easily than normal because the background buzz is eliminated by the headphones. The headphones work by sensing the surround noise and generating out-of-phase "mirror images" that cancel out the offending noise. The headphones also accept input from an outside source, so they can be used, for example, to listen to a portable cassette player while on an airplane with improved results. A 2-pin adapter is even included to use with in-flight entertainment systems. Price: N/A.



Voice It Personal Note Recorder

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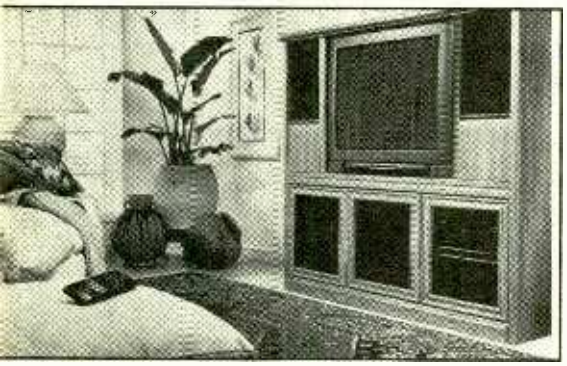
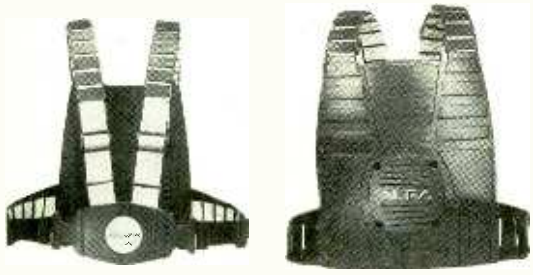
ELECTRONICS WISH LIST



Quasar Home-Theater System

SmartPage

Sharp ViewCam



Aura System's Interactor

Looking Good

In a move to combine home furnishing with home theater, *Quasar* (1707 N. Randall Rd., Elgin, IL 60123) has introduced the *HT1000* home-theater system. The system comes with an AM/FM A/V receiver with Dolby Pro-Logic technology, front, center, and rear speakers, a subwoofer, and either a 27- or 31-inch television with a high-contrast Black Tint Tube. The cabinet, which is available in cherry, oak or black, features smoked-glass equipment enclosures, and two pull-out storage drawers for video cassettes, and compact discs. Price $2799 (with 27-inch TV); $3399 (with 31-inch TV).

Relax!

Stressed out? *Cognitech Corp.* (University Place, 124 Mt. Auburn St., Suite 200, Harvard Square, Cambridge, MA 02138) has a solution. The *Brainwave 200 Mind/Body Exercise System* consists of a one-piece headset that integrates a light screen and earphones. Under microprocessor control, a combination of light and sound provide an environment that is said to aid maximum relaxation. A fingertip sensor records temperature rises due to increased blood circulation, which is a reliable way to measure relaxation. Price: $340.

Turning the Pages of History

One of the problems of traditional pagers is that they are too expensive for occasional use—the monthly fees are too high. *SmartPage Nationwide* (7165 S.W. Fir Loop, Tigard, OR 97223) has a new idea in which consumers pay just for the messages they use without monthly fees. Numeric and voice messages are bundled in *SmartPacks* and *VoicePacks*. The 30, 60, or 100-message packs can be used any time within two years. Pages are made through a toll-free number; callers are greeted with a user-customizable message. *SmartPage* comes with a pager and a package of 30 numeric and 10 voice messages. Price: $129.99.

Camcorder with a View

The latest addition to the ViewCam line from *Sharp Electronics Corp.* (Sharp Plaza, Mahwah, NJ 07430) is the top-of-the-line *VL-H400*. The Hi-8 camcorder features a four-inch color LCD screen, and new features including slow-motion playback, an 8× variable-speed zoom, and a wide-screen (16×9) recording mode. A "digital still snap" function enables users to capture a five-second still "snapshot" of an image, complete with audio. Digital image stabilization helps to compensate for slight hand movements. Price: $2199.

It's A Snap!

Able to turn a video image into a still photograph at the touch of a button, the *VideoSnap* from *Sansui, Inc.* (1290 Wall Street West, Lyndhurst, NJ 07071) lets users capture images from any video source. The device takes the video images from a camcorder, VCR, satellite dish, or TV broadcast and prints it as a Polaroid photograph. Price: $799.95.

Ouch!

In an attempt to make videogames even more exciting, *Aura Systems, Inc.* (2335 Alaska Avenue, El Segundo, CA 90245) has introduced the *Interactor*. Dubbed a "virtual-reality vest," the device adds the sensation of feeling to video games. The Interactor is worn over the upper torso. An electromagnetic actuator within the vest creates "body-pulsing vibrations" that are keyed to on-screen action. Controls allow the output to be fine-tuned from a feather touch to intense pounding. It can also be used to add a new dimension to other sound sources. Price: $90.

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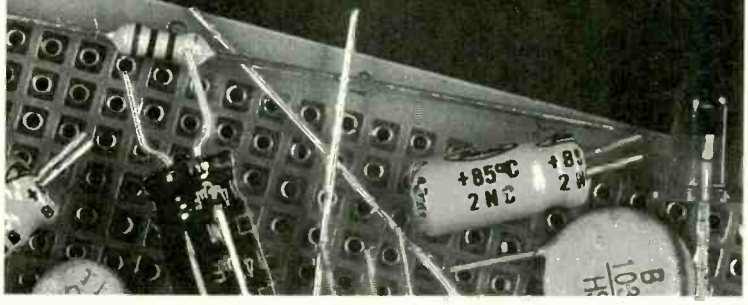

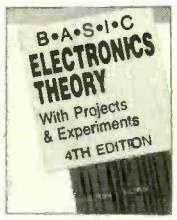

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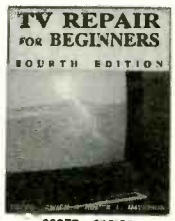

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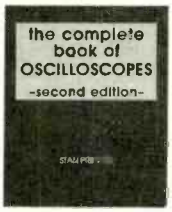

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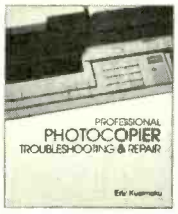

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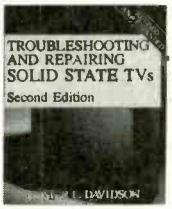

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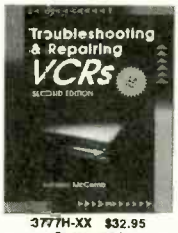

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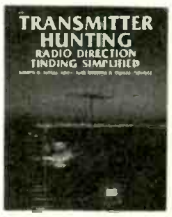

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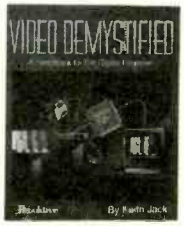

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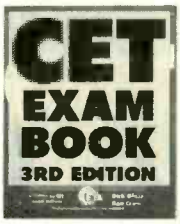

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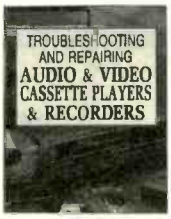

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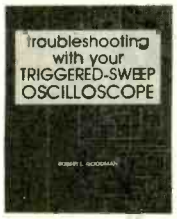

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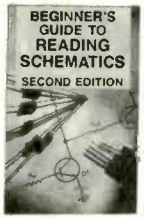

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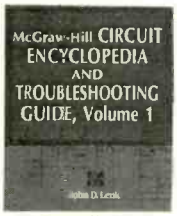

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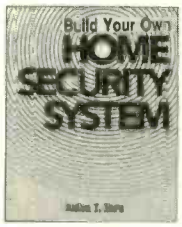

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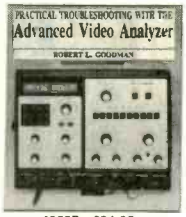

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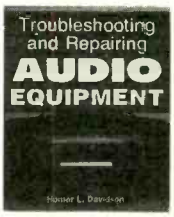

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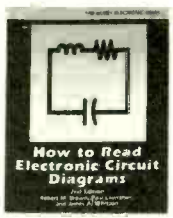

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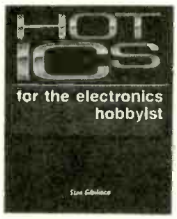

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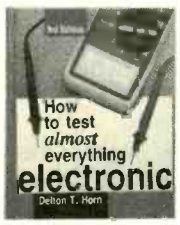

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LEGO for the 1990's

The Lego Dacta Control Lab

As we grow older and more mature, it's nice to see that things we remember from our childhood have matured along with us.

BY MARC SPIWAK

Most of us have grown up a lot quicker than we ever thought we would. It's unfortunate, too, that once we leave adolescence, we seem to loose touch with the toys we played with as kids.

As an example, we'd be willing to bet that almost every reader of this magazine has played with a *Lego* set at one time or another. Lego building blocks are instantly recognizable worldwide. Even adults like to play with Lego (when they're lucky enough to have the time).

Most of the Lego sets we remember contained lots of fairly plain blocks that left much to the imagination, but they were still fun to play with. Some of the more deluxe Lego sets included specialized parts that added new dimensions of motion and a more finished appearance to projects. However, none of us would have ever imagined the capabilities of today's Lego.

Today's Lego. Lego has always been an excellent tool for helping children develop manual dexterity and mechanical concepts. Now, Lego is also an excellent way to learn how to use computers and software to control mechanical devices.

The Control Lab Starter Pack from Lego Dacta, the Education Division of the Lego Group (555 Taylor Road, Enfield, CT 06083-1600; Tel. 800-527-8339), contains everything you need to build a greenhouse project, a dynamometer, a pick-and-place robot arm, a color-code reader, motorized bridges, and much more. The only thing that's not included in the Control Lab is a PC or Macintosh computer to control the projects.

The heart of the Control Lab is the interface unit that connects to the serial port of a computer. Software loaded on the host computer communicates with that interface, to which

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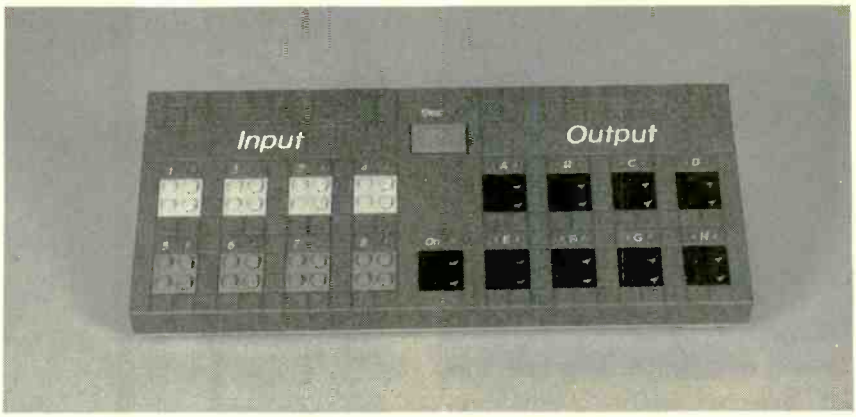
various electronic parts are connected. Half of the interface's front panel contains ports for connecting input devices such as sensors for temperature, touch, angle, and light. The eight input ports are labeled 1–8. The other half of the front panel has ports for output devices such as motors, lamps, and sound elements. The output ports are labeled A–H.

We worked with the No. 943 Control Lab Starter Pack intended for use with a PC. There's also a No. 942 Control Lab Starter Pack for use with a Macintosh. The PC requirements are DOS 3.1 or greater, 640K RAM (although 1 megabyte is recommended), a mouse, a hard disk, an EGA or better monitor, and one available serial port. The Mac requirements are System 6.0 or higher, 1 megabyte of RAM, Finder 6.0 or higher, a hard disk, and a free serial port.

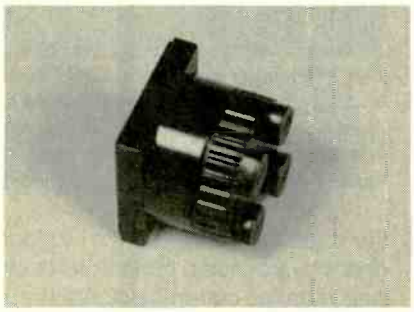
Both the No. 942 and No. 943 Control Labs carry an individual license and a price tag of $599. Two other packages include the same materials for Mac's and PC's, but with a site license, for $750. While the pricing might seem steep at first, keep in mind that the labs are intended for a classroom environment, to be paid for by a school rather than an individual. However, should an individual want to purchase a Control Lab for his own use, we're sure that the price tag will seem reasonable once the lab's capabilities are realized.

Lots of Parts. In addition to enough documentation for an entire classroom, the Control Lab contains 527 pieces including 3 motors, 4 lamps, 1 sound element, 1 touch sensor, 1 temperature sensor, 1 light sensor, 2 angle sensors, and plenty of power connectors of different lengths. Two bases are included, so depending on what projects are chosen, it is possible to have a classroom working on two different projects at once. However, only one serial interface is included with the Control Lab, so only one project can be controlled at a time.

As interesting as the projects built from the Control Lab are, what's perhaps more interesting is how clever some of the individual Lego components are, and how they're powered. Power is applied to motors and lamps via jumper wires with 2 × 2 Lego blocks at each end. Each block has specially shaped electrical contacts on each bump on top and in each hole on bottom. Those blocks allow DC power to be connected to a part in any position, and it is impossible to short anything out. You just press one of the connectors onto an accessory in almost any position, top or bottom, and power is supplied to it almost as if by magic. You'll have to play with them yourself to see what we mean.



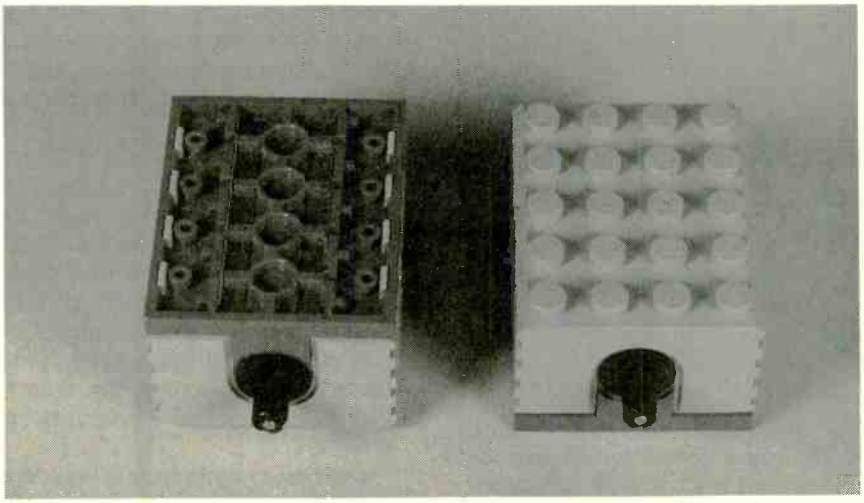
The heart of the Control Lab is the interface unit, which connects to the serial port of a computer. The left half of the interface's front panel contains ports for connecting input devices (sensors) and the right half is for output devices (motors, lamps, etc.).



This tiny sound element makes a beeping noise when current flows in one direction and a warbling sound when the current is reversed. It will also change sounds if you twist its top 180°.

Sights and Sounds. One of the most interesting parts in the set is a tiny sound element about the size of a 2 × 2 Lego block. It has a square base for its electrical connections, and a swiveling round top. The serial interface has one test connector on it that can be used to power a motor, lamp, or sound element with no help from the computer. With the interface unit powered up, and the sound element pressed onto the test connector, the element will beep repeatedly. If you remove the sound element, turn it 180°, and push it back on, it will make a warbling sound.

Similarly, if you leave the sound element in the same position, and simply twist its circular top 180 degrees, its sound output changes. With two dif-



The motors have a small drive shaft sticking out of one end onto which wheels, gears, belts, propellers, pulleys, or axles can be attached.

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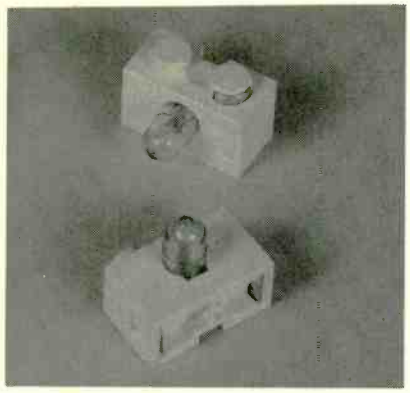
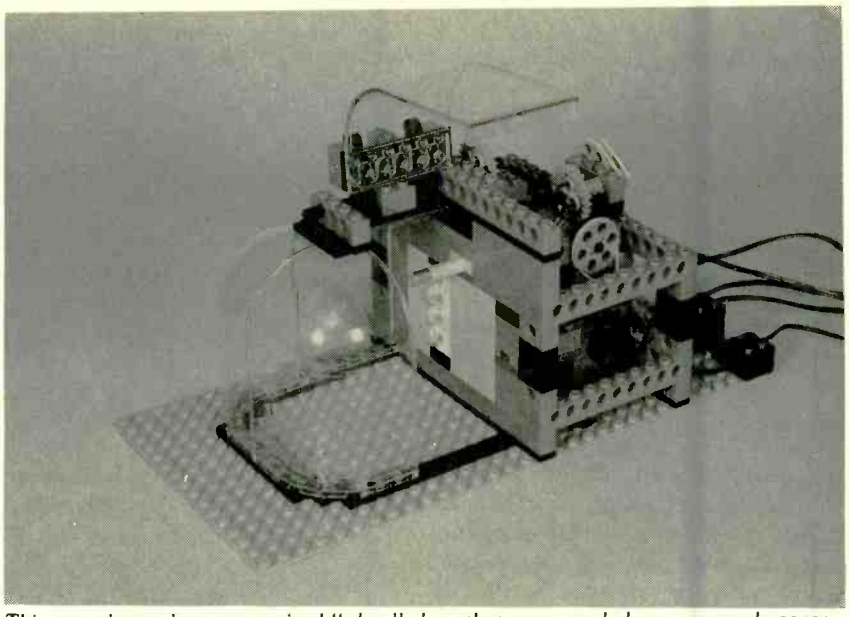


Incandescent lamps have colored lenses that can be placed over them to make different colored indicator lights. Also included are reflectors that make the light more focused.

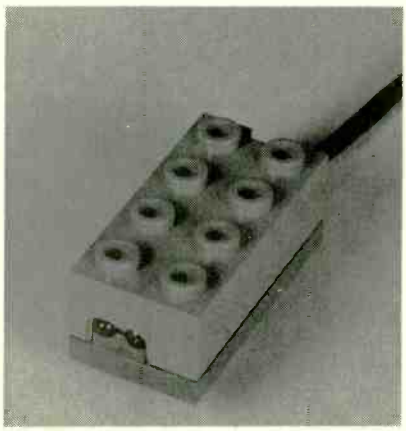


This greenhouse has a motorized "glass" door that opens and closes, an angle sensor to detect the position of the door, and an inside temperature sensor. The door can be opened and closed manually or automatically according to the inside temperature conditions. The sound element beeps when the door is opening and warbles when it's closing. We added lights and a light sensor.

ferent sound outputs, and the ability to switch between them either by reversing current direction (which the serial interface can do under software control) or by mechanical action, the possibilities for using the sound element are almost endless.

For light, four small incandescent lamps are fitted into small 1 × 2 blocks, and power can be applied to those blocks from the top or bottom. Various colored "lenses" can be placed over the lamps to make them into different-colored indicator lights. Also included are reflectors that fit over the lamps to focus their light.

Motion and Feedback. The three motors included in the set are all the size of a 4 × 5 block with a small drive shaft sticking out of one end. Various wheels, gears, belts, propellers, pulleys, and axles can be attached to any drive shaft. Power is supplied to the motors from the bottom surface, and the direction a motor rotates depends on the current's polarity. Therefore motion can be reversed under computer control. Because the motors have Lego bumps and holes, top and bottom, they can be used as structural components in mechanical assemblies, as can most of the parts in the kit.



The light sensor can provide a relative indication of the ambient lighting and a reading of the light reflected off a surface placed near the sensor.

Among the various sensors included in the Control Lab, one is for measuring temperature. That 2 × 3 Lego block has a temperature probe sticking out of one end and a permanent lead on the other. When the temperature sensor is connected to the serial interface, and the software is up and running, an actual temperature reading can be displayed on a computer monitor in either Fahrenheit or Celsius.

The touch sensor is really just a push-button switch housed in a 2 × 4 Lego block with a permanent lead attached. The edges of the button are tapered to enable cam-action switching. Also, an axle can be pushed into a hole at the end of the button to extend the switch's reach. Under software control, the state of the switch can be displayed on-screen.

An unusual light sensor is housed in a 2 × 4 Lego block. One end of the sensor has both a light emitter and light receiver built into it and the other end has a permanent lead attached. Not only can the sensor provide a relative indication of the ambient lighting on-screen, it will also give a reading of the light reflected off a surface placed near the sensor. That allows for projects such as color-code readers. Add an automated conveyor belt and a robot arm, and you could build an automated sorting system! But we're getting ahead of ourselves.

The angle sensors, also housed in 2 × 4 blocks, contain a rotating section through which you can slide an axle. You and the software can then keep track of the number of shaft rotations as well as the shaft position on any kind of device you build.

Software Setup. The software included with the Control Lab is written specifically for its intended platform (whether PC or Mac). Even so, the PC version that we used has a definite Mac look to it, indicating that the system was originally designed for a Mac and ported over to the PC. However, by no means is the software difficult to use on a PC, and we had no problems with it.

The main screen resembles the front panel of the serial interface. Icons are grouped on both sides of the display for input and output de-

(Continued on page 89)

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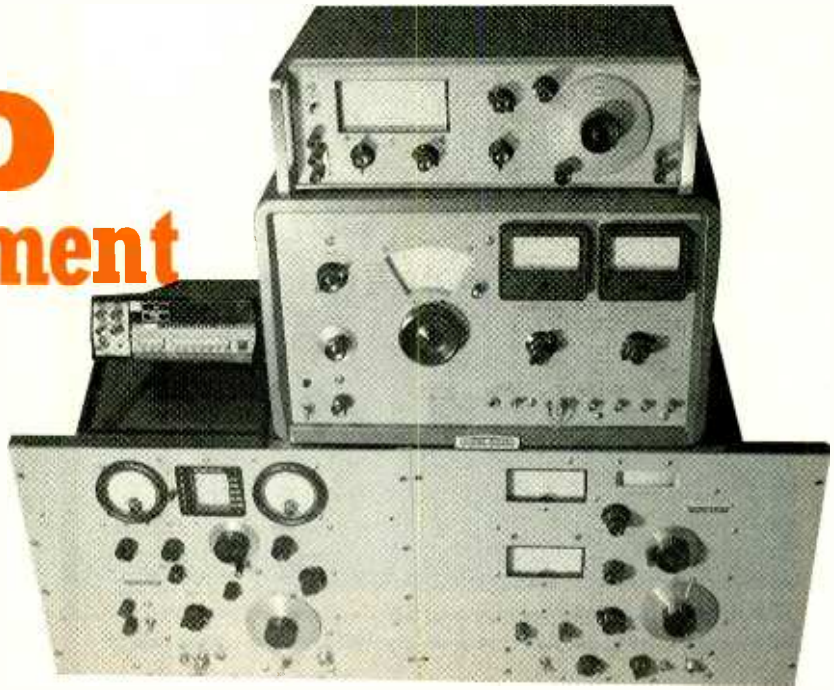
Buying USED Test Equipment



Do you want a top-notch test bench that won't break your budget? Try using our helpful tips to hunt for bargain-priced used units.

BY GERARD C.A. FONTE

Building and testing modern electronic devices requires sophisticated test equipment. Unfortunately, such equipment is too expensive for most hobbyists to afford. However, with prudent shopping and a little effort, pieces of equipment can be purchased used for as little as 10% of their original price.

Besides saving money, there's another reason for buying used goods: quality/performance. Used high-end gear can be purchased for the same price as low-end new pieces. So you get significantly better performance and specifications for the same money.

What's more, used equipment has a history. The fact that it is available after ten years or so is a testament to its durability.

What To Expect. It is very important to realize that used-equipment dealers generally only handle name-brand test equipment. You'll find lots of Tektronix, Hewlett/Packard, and other big names. You won't find Eico, Heath, or other hobbyist-level brands. The basic reason is that such dealers sell to industry. Industry wants commercial equipment and not hobbyist gear. Finally, the hobbyist equipment often ages poorly, so it does not provide re-sellers with much profit.

The first thing to know is that there is a whole range of used-equipment dealers. At the high-end are "leasers." They sell previously leased equipment. Such equipment is virtually new and often comes in original packaging with full warranties. They sell at 20% to 40% off list. That's not a bad deal, but going from $4000 to $3000 isn't enough of a difference for most of us.

Then there are the "re-calibrators." They sell used equipment guaranteed to meet original-equipment specifications. For a complex instrument, calibration may be a necessity; however, hobbyists generally don't need fully calibrated equipment. Additionally, calibration can often be performed by the hobbyist with inexpensive standards and common tools (more on that later). There is a substantial cost involved in buying calibrated equipment. Calibrated equipment can cost about twice that of uncalibrated equipment. Re-calibrators deal in equipment older than the leasers. The prices in the re-calibrator group tend to be about 40% to 60% off list depending on age. Warranties can be from several months to up to a year.

The next group are the "re-sellers." They buy equipment from bankrupt businesses, the government, and surplus-equipment sources. Normally, they examine the equipment to make sure that it is complete and works properly. They usually provide a 30-day warranty. Basically, the warranty says that the instrument works although it may not meet original-equipment specifications. They typically handle older equipment, too. Often the older equipment is perfect for hobbyists. Prices usually start at 60% off list and can go as low as 90% off list.

The last group are the "salvagers." They buy electronic equipment as scrap (by the pound). They cull out equipment that just looks like it's in good shape and sell it. Of course, their prices are very low. They almost exclusively sell older equipment. Often their approach is: "If it lights up and doesn't smoke or blow a fuse, it must be working." Be prepared to do some work on equipment purchased from salvagers. On the other hand, if you are willing and able to do the work, amazing prices can be found. For older pieces of equipment, prices start at 85% off list and go down from there. Typically, all sales are final, so bear that in mind.

By the way, remember that used equipment is sold on a first-come first-served basis. The dealer may only have one or two of the items that are listed. Once these units have been sold, the dealer may not be able to get any more.

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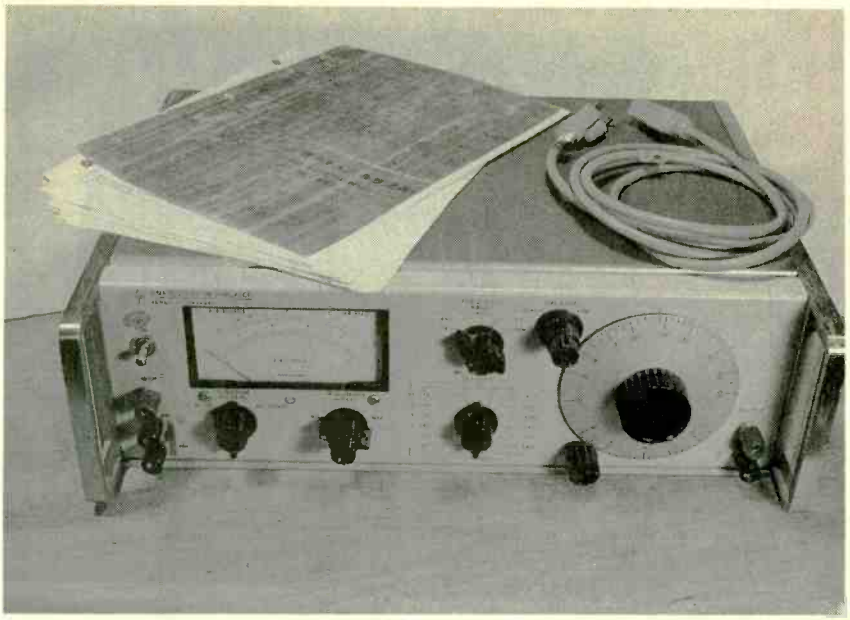

This HP 331A distortion analyzer cost $295—less than 10% of the original cost—from Tech systems. It can perform functions equivalent to a spectrum analyzer.

What Do You Need? The first thing to do is determine what you need. Are your needs analog or digital? Audio or RF? What do you expect to need in the future?

Second, you must decide what you can spend. If you're like me, what I want and what I can afford are never the same.

Then comes the hard part. You have to translate what you need into a manufacturer's model number—typically an obsolete one. Almost all of the used test equipment is defined by manufacturer's model number only. Only sometimes will you find a sentence or two describing each unit. That brings us to Rule 1: If you are not sure of exactly what it is, don't buy it!

There are several ways of finding out what model number you need. One of the best ways is to blanket all of the used-equipment dealers with general inquiries to get their price lists and descriptions. By studying and combining the descriptions you can usually get a feel for the basic specifications of an instrument.

The Tucker Electronics Company is a great resource for such information. They have a huge inventory and their catalog actually has whole paragraphs describing most instruments. Another source is old catalogs. A ten-year old Tektronix or Hewlett/Packard catalog will provide incredible assistance. Check libraries, colleges, and friends for them. Also, technical journals often provide product evaluations and comparisons. They might also be found in your local library.

Often a close-up picture of a unit's front panel can provide good insights about its capabilities. Look carefully. For example, if the oscilloscope photograph you are looking at doesn't have a second attenuator section, it probably isn't a two-channel oscilloscope.

Talk with people in the electronics business. Especially those who have 10 or more years of experience because they are more likely to have used the very equipment you are looking for. They can also provide you with insights and good/bad points about equipment.

Visit trade schools, colleges, hamfests, and electronics businesses if possible. Often, older equipment is still in use. If you can examine an instrument to determine your needs, then most of the battle is done.

Finally, it may be possible to get information from the equipment dealers themselves. There are a couple of problems with this approach. The first is that they often don't know what a piece of equipment does, so they won't be able to tell you what you need. Second, they are in business to sell equipment; naturally, they may not be completely objective.

What Not to Buy. There are certain types of used equipment (for example, computers and most digital equipment) that won't come close to matching the specifications and price of modern units. It doesn't make sense to buy a ten-year-old computer that needs obsolete software and operates at 10% the speed of a modern PC. So be sure to thoroughly examine the currently available products before buying used digital equipment. Many times what you need will be available new, with comparable

The Fluke 8800A was a great buy at $295 from Naptech. Its 5½-digit readout can resolve microvolts and milliohms. It came with a manual and a 6-month warranty.

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specifications at a comparable price, albeit not from Hewlett Packard or Tektronix.

Be especially careful when shopping for frequency counters, logic analyzers, printers, plotters, and the like. There are sources of new equipment that provide comparable performance and prices.

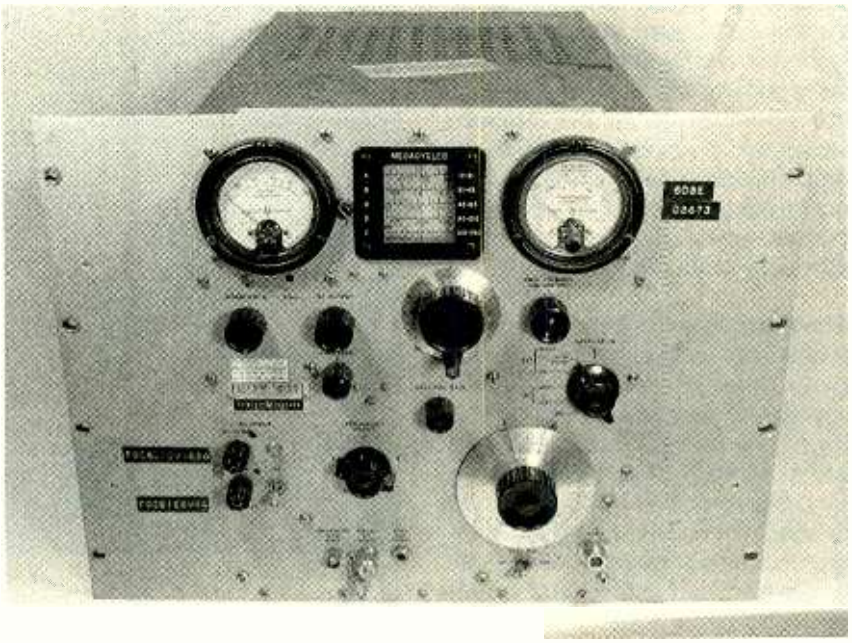
Also, be careful about purchasing mechanical devices, or equipment that contains them. They can wear out over time and might need a complete overhaul to be useful.

Calibration: Do You Need it? Sometimes, calibration may be worth the price for peace-of-mind only. A calibrated instrument is guaranteed to meet factory specifications. Effectively, the unit is working as new. This is important to many people. If it is, then buy a calibrated unit. However, remember that the unit will not stay calibrated forever. Getting it re-calibrated can be awkward and expensive.

Truthfully, most hobbyists (and even engineers) don't really need fully calibrated devices because they rarely need the precision. For example, do you really care if the frequency response of your digital meter only extends to 290 kHz instead of 300 kHz? What most users need is repeatability and reliability. That is: if you measure the same thing at different times the instrument should read the same.

In addition, calibration of the major aspects of most test instruments can be performed without too much cost or effort at home. For example, a simple precision voltage reference can be used to calibrate meters. A frequency generator can be used to test the response of an oscilloscope. A little effort and ingenuity can provide you with the assurance that your piece of test equipment is operating as well as you need it to. That is what really matters.

That doesn't mean that you shouldn't be concerned about calibration. Calibration goes hand-in-hand with repairing damaged equipment, and repair is an important issue. Since most hobbyists repair their own equipment, you must try to get as much documentation as possible. An operator/service manual should always be requested. It can provide information on how to use, calibrate, and repair the instrument. It should include schematics and technical descriptions. With that information, the unit can be repaired (even if you yourself can't repair it). Otherwise, repair would be difficult or maybe impossible.



This is typical of the appearance of the signal generators as received. They had clearly been stored for a long time (over 13-years judging from the calibration stickers).

Unfortunately, documentation is not always included with an instrument. The dealers buy equipment, not manuals, so it simply may not be available. If that is the case, be prepared to spend some more time and effort to obtain the documentation. Don't wait, because documentation becomes more difficult to get as time passes. That is especially true for the less-well-known brands. Sometimes the manufacturer can provide what you need (for a nominal charge).

An Example. Let's say that I need a 100-MHz oscilloscope. If I look for new equipment, I'll find them starting at around $1300. So for this exercise, let's look at what can be purchased for $1000 and also how cheap a 100-MHz oscilloscope can be.

You should be careful about buying oscilloscopes. There are some "mainframes" that are incomplete without plug-in modules. Look carefully for phrases like "plug-in's extra" or "mainframe only." Remember Rule 1: If you are not sure of exactly what it is, don't buy it.

Starting with Tucker (a re-calibrator), I see that they have a 465M (100-MHz, 2-channel) unit for $895 and a Tektronix 465 (with dual timebase) for $995. In their special non-calibrated flyer, they have a 200-MHz Hewlett Packard 1710B for $895.

There is quite a non-calibrated selection from re-sellers. For example, Tech Systems sells the same HP 465 for $695 and a HP 1740A (100-MHz 2-channel) unit for $795. They also have a Tektronix 454 (150-MHz, 2-channel) instrument for $595. Danbar Sales Company sells the HP 1740A for $500, the Tek 465 for $725, the Tek 465B for $825, and a whole lot more. Naptech sells the Tek 465 for $700, the HP 1740A for $600 and a Tek 475 (a 200-MHz device) for $995.

A salvager, Cadisco, has the Tek 454 (capable of 150-MHz operation) for $595 and the Tek 475 (a 200-MHz oscilloscope) for $895.

This exercise shows a number of things. First of all, there is a wide variation in price from dealer to dealer. Second, slight changes in model number can make a significant change in price and performance. Third, not every dealer has every instrument. That means that sometimes you must compare apples and oranges. In order to do this meaningfully, you *must* know the differences between the instruments. The dealers don't always know them.

Also note that the prices are not

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always fixed. That is especially true for the smaller dealers. If you can show them that a competitor is selling the same item for less, if you are going to buy more than one item, or are associated with a school, etc. they might drop their price. Remember, they are out to make money. If they can make a profit in dealing with you, then you can dicker from strength.

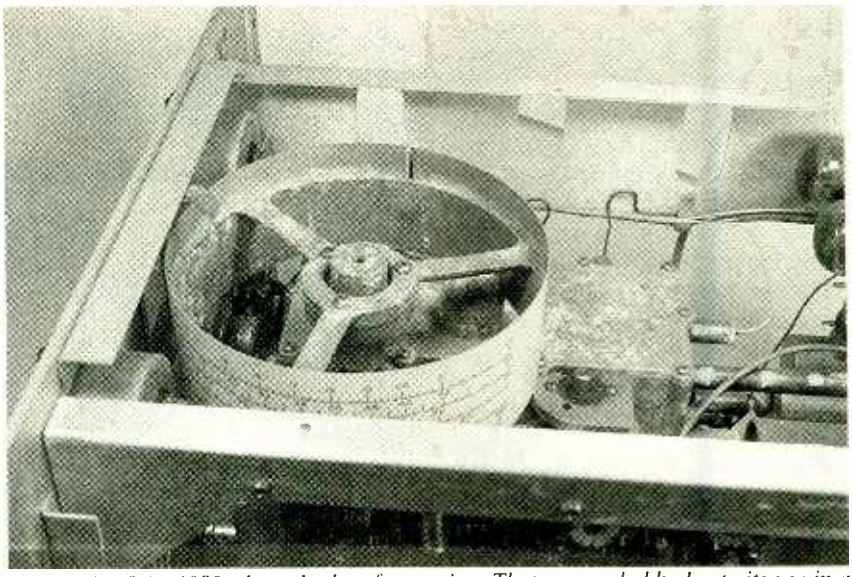
The Proof Is in the Eating. Recently it became necessary for me to upgrade my engineering lab with some specialized equipment. I was getting involved in precision audio and general-purpose RF design. I was looking for a high-precision VOM, audio and RF spectrum analyzers, RF signal generators, and a frequency counter with a ratio function. I wanted all of that for under $2000.

Unfortunately, the spectrum analyzers were still too expensive; they all cost well over a thousand each. I compromised by buying the inexpensive "Poor Man's Spectrum Analyzer" kit (from Science Workshop, P.O. Box 310, Bethpage, NY 11714; Tel. 516-731-7628) for the RF analyzer (for more about the kit, see Ham Radio in the October 1992 issue of **Popular Electronics**). For the audio-spectrum analyzer, I purchased some FFT software and am building a 16-bit analog to digital converter for my PC.

However, I still needed something to test precision audio circuits while I develop my spectrum analyzer. For that, I settled on a distortion analyzer that could also be used to calibrate my home-brew audio spectrum analyzer.

I searched and found an HP 331A from Tech Systems for $295. That was about $100 cheaper than any other dealer. The HP 331A is a very standard analyzer that's been around for a long time. It boasts a full-scale reading of 0.1%. That means that readings down to nearly 0.01% (−80 dB) are possible. It can also double as an RMS voltmeter. Just for reference, the HP 334A (with auto null, RF detector, and a slightly extended frequency range) currently sells new for $3810.

The unit I received was in reasonably good shape. It had clearly been mounted in a rack. The top was well-scratched, the feet and the cosmetic mounting-ear covers were gone. Of course, that has nothing to do with performance and is clearly minor. The banana-plug sockets for the test leads were well-worn, however. The leads that I had on hand (none were supplied) were very loose and would fall out easily. I bought a new set at Radio-Shack for $5.00 and they fit acceptably well. The unit came with a power cord and 16 pages of Xeroxed documentation. The documentation included operating instructions and theory of operation, but had no calibration procedures or technical schematics. It had a 30-day warranty and a 10-day return-for-any-reason right.



The inside of the 608D showed a lot of corrosion. That was probably due to its use in a salty environment by the Navy. There were some mechanical problems too, but they were minor.

Used-Equipment Suppliers

Cadisco Electronics (514-516 Ensor St., Baltimore, MD 21202; Tel. 410-685-1893): Salvager. All sales final. Small company, small flyer with a few pictures. Payment must accompany order.

Danbar Sales Company, (870 W. Cienega Ave. Suite 1, San Dimas, CA 91773; Tel. 909-592-2940): Re-seller, 90-day warranty. Re-conditioned and cleaned units. Family-operated company, nice catalog. Visa/MasterCard/COD.

Naptech Test Equipment (P.O. Box 30, 12312 Hwy. 175, Cobb, CA 95426; Tel. 707-928-1961): Re-seller, 6 month warranty, 10 day return. Rent, lease, extended warranty options. Small company, small flyer without pictures. COD.

Tech-Systems (P.O. Box 158, Avon, NJ 07717; Tel. 800-435-1516): Re-seller, 30 day warranty, 10 day return. Nice catalog with some pictures. Visa/MasterCard/COD.

Toronto Surplus and Scientific (596 Gordon Baker Rd., Willowdale, Ontario Canada M2H 3B4; Tel. 416-490-8865): No real information available. No catalog available now. Visa.

Tucker Electronics Company (P.O. Box 551419, Dallas, TX 75355; Tel 800-527-4642): Re-calibrator mostly. Great catalog, big company. Visa/MasterCard/COD

I found a precision volt/ohmmeter that fit the bill from Naptech. They had a Fluke 8800A for only $195. It is a 5½ digit multimeter! Its basic DC accuracy is about 0.005% which provides 1 micro-volt resolution. I've used that model before, and new it was very nice.

I got the meter 3 days after I ordered it. Other than a little dust, it was in perfect shape. It came complete with a power cord and the original operator/service manual. There was a 10-day return-for-any-reason right in addition to a 6-month warranty! It was a very good bargain.

I couldn't find any used frequency counter that matched the specifications of the new Optoelectronics 3000A (from Optoelectronics, 5821 NE 14th Ave., Ft. Lauderdale, FL 33334; Tel. 800-327-5912, 305-771-2050), which is what I eventually bought. It has a ten-digit display, and measures from DC to 3 GHz with 0.2 ppm stability, and has ratio capability all for $379. The used ones I saw all had a limited frequency range and lesser stability.

The RF signal generators are a whole story in themselves. I needed something cheap to generate a wide

(Continued on page 93)

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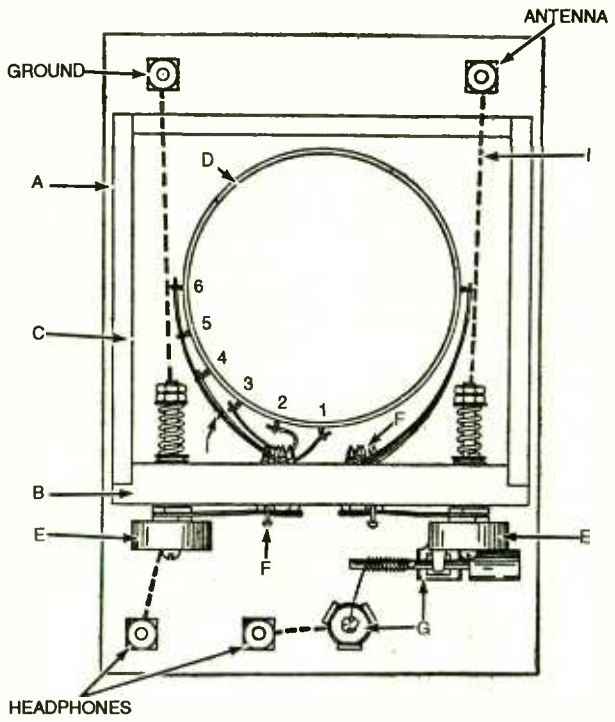
ANTIQUE RADIO

By Marc Ellis

Putting Together The NBS Set

For those who may have just joined us, we're in the process of building a simple crystal set from plans originally developed by the National Bureau of Standards in the early 1920's. Designed to be inexpensive and easy-to-build, yet efficient, the set helped make broadcast radio accessible even to folks with limited pocketbooks.



The plan view from the original construction article shows the placement of the front panel and major components.

Every part of this radio was designed to be fabricated with simple hand tools, even the switches and crystal holder. So if you have the time and the patience, you won't have to worry about finding vintage parts to make your set authentic. You can build them all! But if you're like me and lack both the time and the inclination to craft small parts out of sheet brass and wire, you can substitute modern and/or reproduction parts as necessary.

To review what's been discussed and accomplished so far, check your back copies of the column. This project was first introduced in the January 1994 issue, then continued in April and May.

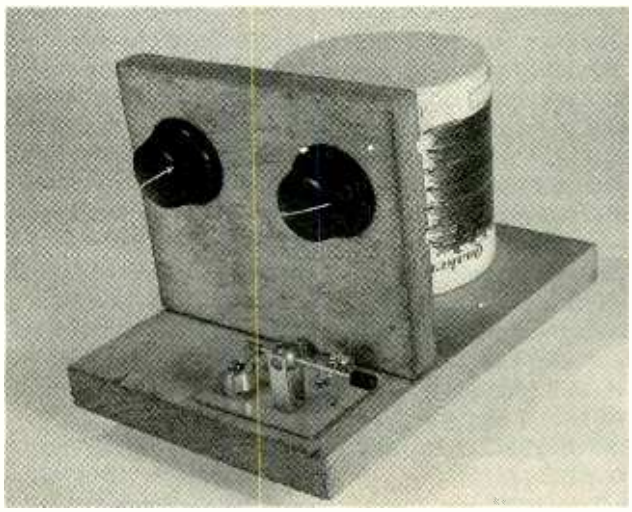
INFO FOR THE DIEHARDS

Last month, we completed the NBS set's tuning coil—which is the only part that will be handmade in my version of the radio. We also passed along, for the diehards, original drawings and construction information for the two required six-position tap switches. (My version uses a couple of six-position rotaries from Radio Shack.)

Now here's some data for those adventurers who'd like to build their own crystal-detector stand from the original NBS plans. Note that I've shown three drawings covering that apparatus: They include cutting patterns for the crystal clip and "cat's whisker" rod holder, as well as a view showing how those parts are bent, assembled, and arranged to form the complete detector stand.

According to the text of the NBS article, the crystal clip is to be cut and filed from No. 24 spring brass sheet. "All brass sheet must be bent with caution," the article warns, "the bends being made slowly and kept well-rounded." The rod holder is cut and filed from similar material "so that the grain of the metal runs with the narrow tongue."

No diameter is given for the "cat's whisker" rod (labeled as "g" in the diagram of the complete stand). But, judging by the 3/32-inch openings laid out in the rod holder, 1/16 inch would be about right. If your rod has a different diameter, you'll want to adjust the rod holder openings accordingly. The knob at the end of the



Here's my version of the NBS set almost ready for wiring. Wide-flange 1920's knobs cover countersunk holes (see text) and lend a vintage appearance to the modern switches.

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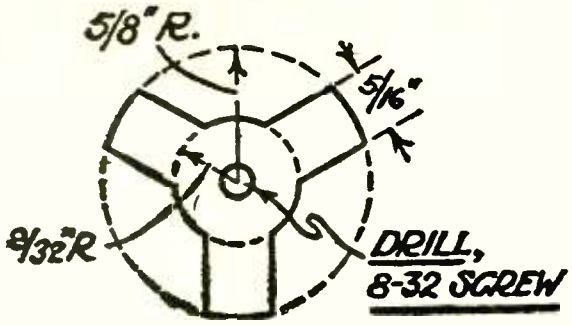


Here's the cutting, bending, and drilling guide for the scratch-built crystal clip.

rod is a cylinder cut from insulating material and drilled for a press fit.

The cat's whisker itself "... is an 8-inch length of fine springy wire wrapped 20 times evenly around the rod g,' and secured by a drop of solder h,' so positioned that when the rod is placed in the holder the lateral movement will be equal to the diameter of the crystal."

Amazingly enough, the NBS article leaves the constructor to his own devices when it comes to the galena crystal itself. Apparently, the use of a purchased, mounted crystal is condoned—although I have seen instructions, in other sources, for taking a piece of the raw galena mineral and setting it in a mounting cast from Monel metal.

I'm using a commercially available detector stand in my version of the radio. Two sources for the stand—as well as for other reproduction parts (including the mounted galena crystal) that you might want to use were recommended in a previous column. But for your convenience, I'll repeat them here. They are: Antique Electronic Supply (6221 S. Maple Ave., Tempe AZ 85283) and Antique Audio (5555 N. Lamar, H-105, Austin, TX 78751).

CARPENTRY CONCERNS

The NBS crystal set is built on a wood foundation consisting of a 5½ × 8-inch "breadboard" on which is mounted a 5½-inch-wide, 4½-inch-high control panel. (The original specifications called for the panel to be 3½-inches high, but I made mine a little taller because the tuning coil—which is mounted directly behind it—turned out to be taller than the original.)

The breadboard is cut from a piece of ¾-inch stock. Half-inch stock was specified for the panel—so I cut that from a piece of scrap door jamb, of about the right thickness, that I happened to have on hand.

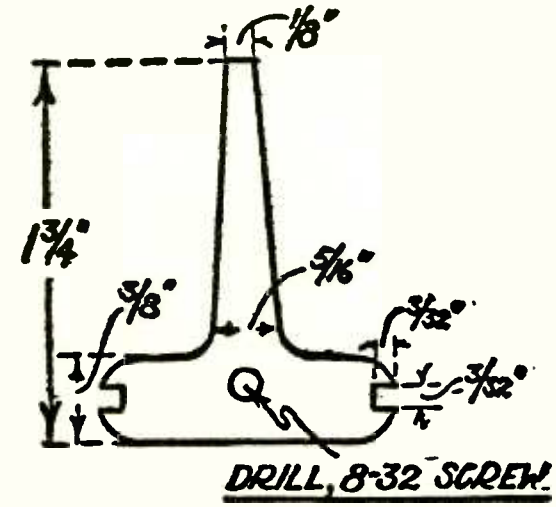
The panel is mounted across the short dimension of the breadboard about 2½ inches back—leaving a small "shelf" on which the crystal-detector stand and headset connections are mounted. I've included a plan view from the original article showing how the panel and other components are mounted on the breadboard.

The panel is secured to the breadboard by a couple of wood screws running up through the bottom. But before mounting it, provision should be made for installation of the two tap switches. A drawing of the front-panel layout was shown last month for the benefit of those who are fabricating their own controls.

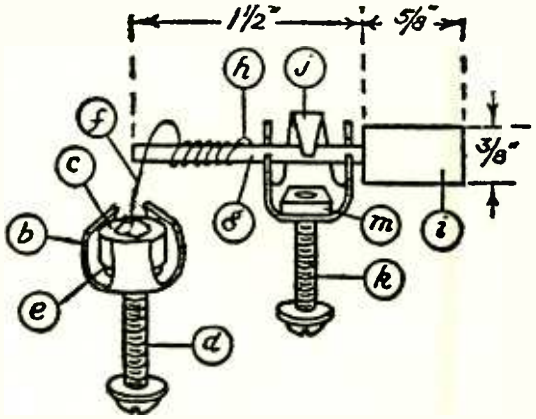
Your scratch-built switches should be installed on the panel at this time. But if you're using commercial rotary switches, as I am, all you have to do right now is drill holes for the shafts. I drilled mine 1½ inches down from the top and 1¼ inches in from each edge.

The commercial switches are designed to be mounted on metal panels no more than ⅛-inch or so thick, so their threaded mounting shafts won't extend out through the front of our ½-inch panel. To remedy this, countersink each shaft hole with a ⅝-inch hole drilled in from the front of the panel. Make it deep enough so that you can capture the mounting shaft with the nut, but be careful not to go all the way through the panel!

You'll notice from the plan view that the front panel is rabbeted out (if that's the right term) for a box-type cover intended to conceal the tuning coil. I guess that would give the set a much more finished appearance. However, I opted for the quainter (and easier to obtain) look of an exposed coil. After preparing the front panel for the mounting of the switches, I secured it to the baseboard. And just to give the wood a little color, as well as to provide a little bit of protection, I treated all surfaces with a coat of light walnut stain/sealer.



The cutting and drilling guide for the scratch-built "cat's whisker" rod holder is shown here.



Here's the completed scratch-built crystal stand all ready for mounting. See the text for details.

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PREPARATION FOR WIRING

After the stain has dried, you can begin to prepare the radio for wiring. First, if you're using commercial switches, go ahead and attach them to the panel.

Next, turn your attention to the 12 twisted-loop taps that you placed in the coil as you were winding it. Each one will have to be sanded or scoured with steel-wool to remove the enamel coating from the wire. Otherwise, you won't be able to make proper solder connections. Be patient and be sure to remove all (or at least most) of the coating from each tap.

You'll also recall that the bottom cover of the coil (which was originally the top cover of the Quaker Oats canister) was placed in position, but not yet glued on. Remove it now, center it in the space behind the control panel, and fasten it down (flange up, of course) with three or four thumb-tacks placed inside, around the periphery.

Next, you're ready to mount the coil permanently by gluing it into the cover. But before sliding the glue-coated coil bottom into place, make sure the coil is oriented so that the wiring to it won't be tangled. Keep in mind that a set of wires from the "stacked" set of six switch taps (see last month's column and plan view) will be run to one of the switches, while a set of wires from the "staggered" set will be run to the other.

If you have scratch-built your crystal-detector stand, the plan view of the radio will show you how the parts should be oriented on the breadboard. Drill the holes for the mounting screws and attach the parts now. But leave the screws loose; wires will be fastened under them later.

If you're using a commercial stand, as I am, place it on the right side of the board just in front of the control panel. Orient it so that the operating rod is at the front of the set and observe the location of the stand's binding posts or Fahnestock clips. Note, and mark, the appropriate locations for wires from these connections to pass through to the underside of the board. Then drill holes at these locations to pass your hookup wire. The detector stand can now be fastened to the board.

Now you have to decide what to use for binding posts. You'll need four: one each for the antenna and ground, and two for the headphones. The original design is simply a brass machine screw passed up through the board and fastened with a nut. About ¼ inch of the screw protrudes above the nut, and a knurled brass thumb-nut from a discarded dry cell is threaded onto that to capture the wire.

Discarded dry cells are hard to come by today, and they don't seem to have the neat little brass thumb-nuts anymore. The last ones I saw had molded plastic ones. In any case, those little nuts don't capture the tips on the end of headphone cords very well. So I opted to use Fahnestock clips. I had them on hand, they are authentic for the era, and they provide a much more secure electrical contact.

See you next month when we'll finish the wiring, hook up the NBS set to a good antenna and ground, and see what happens! Till then, send your comments and questions to me c/o *Antique Radio*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

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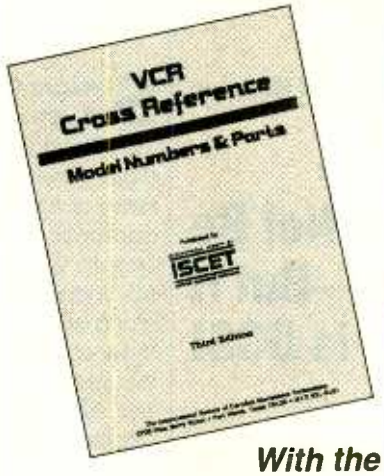

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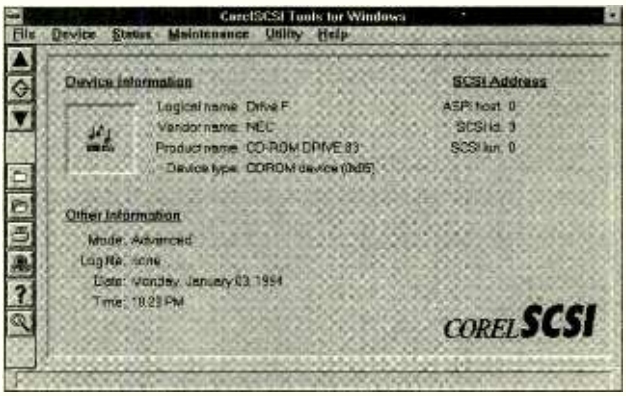
COMPUTER BITS

By Jeff Holtzman

It May Not Be Sexy—But It Sure Is SCSI

Software-wise, 1993 ended with a real bang in the PC industry. We saw major new releases of some of today's very best applications, including Microsoft's Word for Windows 6.0, ShapeWare's Visio 2.0, along with some fantastic "how-come-no-one-ever-thought-of-this-before" utilities, such as Bookmaker's ClickBook, as well as work-a-day yet indispensable device drivers, like Corel SCSI Version 2. Originally I planned to talk about some of the new software goodies this month, but in the process of trying to install everything, I ran out of disk space. The way I resolved that problem is a story in itself. So this month we'll do SCSI; watch for discussions of some of the other software products in the upcoming months. In the meantime, they're all highly recommended. Now let's get to the topic for this month.



Corel SCSI lets you load up a single SCSI adapter card with as many as seven peripherals, which may include hard disks, CD-ROM drives, printers, scanners, and more. For the best deal, buy it with a SCSI card.

First of all, if you don't know what SCSI is, it's an acronym for Small Computer System Interface. It's basically a bus, just like the expansion bus in your PC, along with a software protocol that allows devices to communicate over the bus in an orderly fashion. It's been around a long time; an early version of it even predates the PC. It is and has been for a long time the expansion interface for the Macintosh; it's also popular in engineering workstations. In recent years it has gained increasing popularity on the PC platform.

A couple of years ago, just before the IDE (Integrated Drive Electronics) interface took off, it became clear that the traditional hard-disk interface used by most PC's since IBM introduced the AT was dead. At that time there were two choices for high-performance disk interfaces: ESDI and SCSI. Even at that time, SCSI's advantages seemed indisputable to me, so I stuck my neck out and made a commitment to SCSI. Since then, ESDI has all but died, but in its place arose the IDE standard. The good thing about IDE is cost; the bad thing is its very limited expandability: a maximum of two devices can be connected across an IDE interface. In addition, getting IDE drives from several manufacturers to work together can be tricky. Further, until very recently, IDE drives were limited in size to 512 MB.

SCSI too has suffered cross-manufacturer compatibility problems, but it has never suffered from the size limitations of IDE, and it supports as many as seven devices (each of which may have hundreds of subdevices, although that capability is seldom used). SCSI is also available in "fast" and "wide" versions with rip-roaring performance.

Anyway, I chose SCSI, and have been thankful ever since that I did. During the three or four years that I've been using it, I have gradually added more and more devices, so that now I am running three hard disks and one CD-ROM drive off a single SCSI host adapter. Getting to this point, however, has been something of a roller-coaster ride.

PRE-WINDOWS

Originally I had one 150-MB Micropolis hard disk. This was the time just before Windows 3.0 was introduced; at that point, 150 MB seemed like it would last forever. Of course, things didn't work out that way. Within a few months I was running Stacker, which brought space up to about 250 MB (you never really get twice as much space from those types of disk compression programs). But even that began to fill up, so after another year or so I added a second hard drive, this time a 120-MB unit from Maxtor. Of course, by then, drive prices were less than half of what they were when I got the original Micropolis.

I had a weird problem getting that setup to work, one that had nothing to do with SCSI, but everything to do with magnetism. The Micropolis drive puts out a strong magnetic field that drove the Maxtor crazy. I

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tested things outside the case, where they worked fine, but inside, with the two drives stacked vertically, the Maxtor kept freaking out. After I figured out what the problem was, I rearranged the drives in the case, and everything is now fine.

Another year passed; space was continually tight, and I was continually, it seemed, grooming the two drives, trying to squeeze a few megabytes out wherever I could. Clearly, that was a waste of time; there was nothing to do but go beyond the magical two-drive limit. After doing some research, I settled on another Maxtor, this time a 345-MB unit, which I picked up for less than a dollar per megabyte. In contrast, the original Micropolis cost around $5/MB; the first Maxtor, about $2.50/MB. Now we're down to $1/MB at the retail level, in just about any capacity. In other words, you no longer have to buy gigabyte-size drives to attain the best cost-per-megabyte level.

INSTALLATION WOES

I ordered the drive from a mail-order source I found in Computer Shopper. It arrived without mounting rails and connectors. So then I had to locate a local computer store that wasn't going to take me to the cleaners over a couple pieces of sheet metal and some screws. Fortunately, I had some extra 50-pin header connectors left over from some old project. I squeezed a couple on the SCSI bus cable, one for the new hard drive, and one for the CD-ROM drive I had been running off a pseudo-SCSI interface on my sound card, a Media Vision Pro Audio Spectrum 16.

After carefully mounting and installing everything, and after ensuring that all the pin 1's aligned with the striped edge of the cable, I powered up the system. The BIOS chip on my SCSI adapter recognized the new devices, but I couldn't get at them through DOS. It turned out that my SCSI adapter needed a firmware upgrade.

A few days later the new chips arrived, and I shortly had access to all three hard disks. Note that this multi-drive access is a transparent, built-in feature; I don't have to load any special device drivers to get it to work. Any reputable SCSI host adapter BIOS has this multi-drive support built in. All other PC standards max out at two. In short, that is the reason to go SCSI: expandability.

Next came the CD-ROM drive. It does, unfortunately, require a device driver; two, in fact. That's the bad news. The good news is they work, pretty much transparently. So now I've got three hard drives and one CD-ROM working off one controller. That feat is well-nigh impossible with any other PC device interface.

Corel SCSI supports literally hundreds of SCSI-based devices, including not only hard drives and CD-ROM drives, but also printers, scanners, CD-ROM writers, and more. The package includes a raft of mostly forgettable utilities that occupy around 6 MB of hard-disk space; the essential drivers use less than 100K. Although available separately, the software is often bundled with SCSI host adapter cards at extremely attractive prices. ■

Vendor Information

Corel SCSI ($129)
Corel Corporation
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CIRCUIT CIRCUS

By Charles D. Rakes

Fluid Detectors

This visit we'll travel together on a circuit quest placing a single special-purpose IC in as many circuit applications as we can squeeze into our allotted space. There's an almost unlimited number of special-purpose IC's available to chose from and the one that piqued my interest for this edition of the circus is the ULN2429A fluid detector.

The ULN2429A was designed to be used as an automotive coolant-level detector. The IC can also be used to detect the presence or absence of a number of other liquids. It is available for less than $2 from D.C. Electronics (P.O. Box 3203, Scottsdale, AZ 85271-3203; Tel. 1-800-467-7736).

The IC features a high-current square-wave output that can be used to drive an LED, an incandescent lamp, or a speaker. The output may also be converted into a high-current DC voltage to control relays or solenoids. There's an internal voltage regulator that allows the IC to operate from a power source of 10 to 16 volts. The IC is also protected from reverse supply-voltage damage and is temperature compensated. The IC is also not bothered by high-frequency noise. All-in-all the ULN2429A IC is an excellent candidate for our purpose.

The IC's block diagram is shown in Fig. 1A and its schematic in Fig. 1B. There are four basic circuits operating within the IC. Transistor Q5 and the 7-volt Zener make up a series voltage-regulator circuit. Devices Q1, Q2, and Q6 operate together as a square-wave oscillator circuit. The oscillator's frequency is determined by the value of capacitor connected between terminals 5 and 7. Transistors Q3 and Q4 operate as a simple detector/amplifier circuit. Units Q7 and Q8 amplify the detected signal as either AC or DC to drive the load connected between Q8's collector and the positive supply.

If the circuit is to be operated in the AC-detection output mode no decoupling capacitor is needed between pins 10 and 11 or between pin 12 and

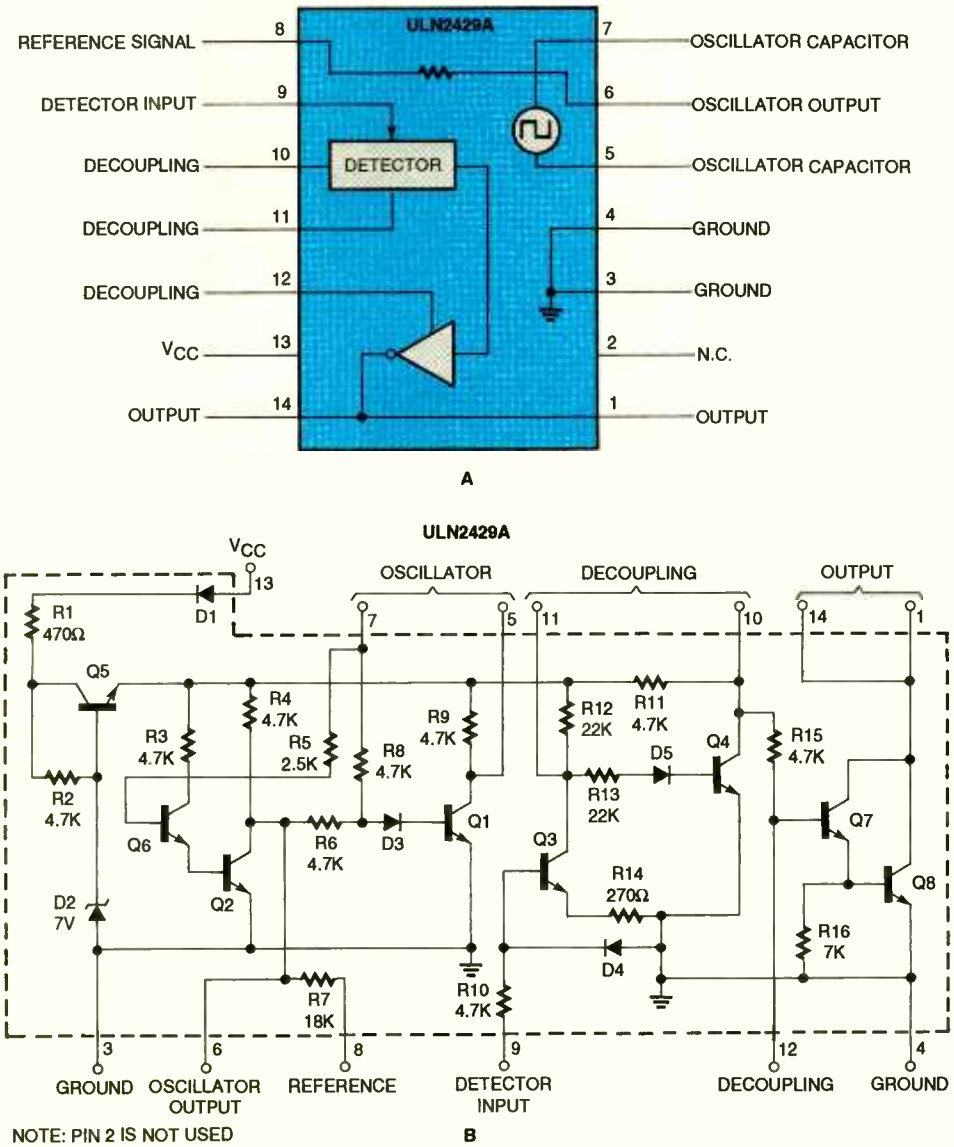

Fig. 1. As shown in A, the ULN2429A contains four basic circuits: a series voltage-regulator, a square-wave oscillator, a detector/amplifier, and a load driver. The components of those circuits are shown in B.

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ground. For the circuit to operate in the DC output mode a capacitor is needed at either or both decoupling locations. A relatively small capacitor value may be connected between pins 10 and 11 to remove any AC content from the output. A larger capacitor may be tied to pin 12 and ground to add a slight turn on/off delay to the DC output.

The circuit has two oscillator outputs. Pin 6 offers the maximum output of about 3 volts peak-to-peak and pin 8's output is buffered by an internal 18k resistor.

Our first two circuits will show the IC operating as intended in a level-detector circuit. Let's look at them right now.

LOW-LEVEL DETECTOR

The first level-detector circuit (see Fig. 2) turns on LED1 when the liquid level drops below the probe. Configured as shown, the internal oscillator is running at about 2.4 kHz. That is the IC's recommended operating frequency. With the probe immersed in the liquid, the oscillator's signal from pin 8, which must travel through the internal 18k resistor, is coupled to ground through the liquid. When the level drops below the probe, the oscillator's signal is no longer taken to ground and is coupled to the detector's input at pin 9 through a 0.1-μF capacitor, C3. The signal is detected, amplified, and converted to DC with the use of a decoupling capacitor, C2, between pins 10 and 11. The DC output turns on the LED indicating a low liquid-level condition.

HIGH-LEVEL DETECTOR

In the next circuit (see Fig. 3), the oscillator is again operating at 2.4 kHz. As long as the liquid level is above the probes, the LED remains on, indicating a normal condition. The liquid between the two probes couples the oscillator's output to the detector's input. When the liquid level drops below the probes, the signal is lost and the LED turns off.

A TOUCH SWITCH

Our first alternate application turns the liquid-level detector into a sensitive touch-activated switch. Shown in Fig. 4, the circuit kicks the IC into "turbo" operation by increasing the oscillator's frequency to about 250 kHz. The oscillator's output is coupled through two 39-pF capacitors to the detector's input. A touch terminal is tied to the junction of the two capacitors. With nothing

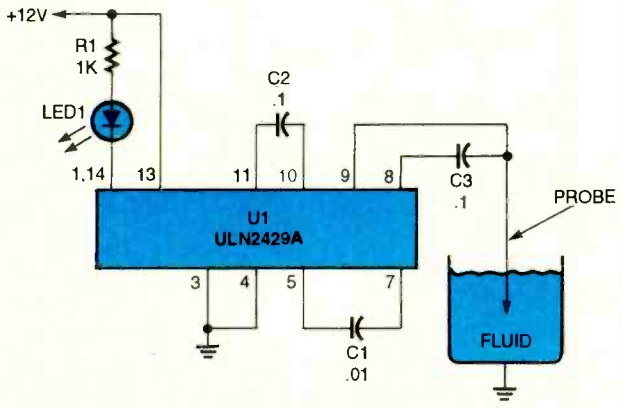

Fig. 2. Our low-level detector circuit turns on LED1 when the liquid level drops below the probe.

PARTS LIST FOR THE LOW-LEVEL DETECTOR

SEMICONDUCTORS
LED1—Light-emitting diode
U1—ULN2429A fluid detector, integrated circuit

CAPACITORS
C1—0.01-μF, ceramic-disc
C2, C3—0.1-μF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
R1—1000-ohm, ¼-watt resistor
Probe, perfboard, solder, wire, etc.

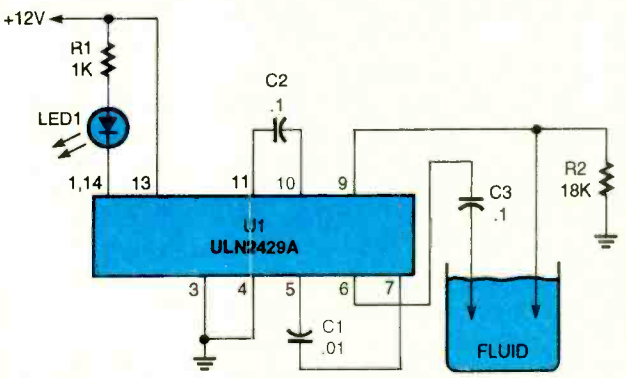

Fig. 3. The high-level detector keeps the LED on as long as the liquid level is above the probes. When the liquid level drops below the probes, the LED turns off.

PARTS LIST FOR THE HIGH-LEVEL DETECTOR

SEMICONDUCTORS
LED1—Light-emitting diode
U1—ULN2429A fluid-detector, integrated circuit

CAPACITORS
C1—0.01-μF, ceramic-disc
C2, C3—0.1-μF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
R1—1000-ohm, ¼-watt, 5% resistor
R2—18,000-ohm, ¼-watt, 5% resistor
Probes, perfboard, solder, wire, etc.

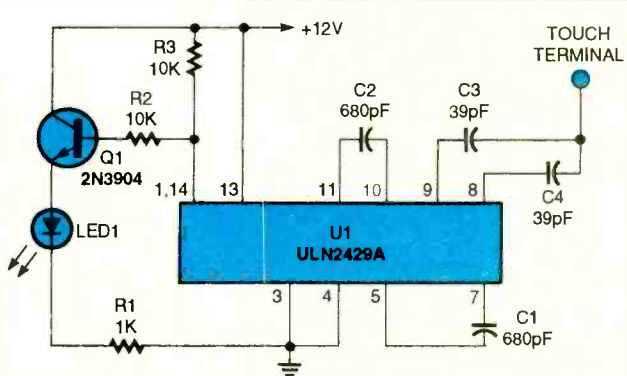

Fig. 4. In the touch-switch circuit, the oscillator's output is sent to the detector's input when nothing is touching the touch terminal. When the plate is touched the detector no longer receives enough signal to operate, so the output at pins 1 and 14 go high turning on Q1 and the LED.

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PARTS LIST FOR THE TOUCH SWITCH

SEMICONDUCTORS
LED1—Light-emitting diode
U1—ULN2429A fluid-detector, integrated circuit
Q1—2N3904 NPN transistor

CAPACITORS
C1, C2—680-pF, ceramic-disc
C3, C4—39-pF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
R1—1000-ohm, ¼-watt, 5% resistor
R2, R3—10,000-ohm, ¼-watt, 5% resistor
Touch terminal, perfboard, solder, wire, etc.

touching the touch terminal, the detector receives the oscillator's signal through the two capacitors and pins 1 and 14 are low. When contact is made with the touch plate, the 250-kHz signal is heavily loaded to the point where the detector no longer receives enough signal to operate, so the output at pins 1 and 14 go high, turning on Q1 and the LED.

To turn the LED off rather than on when the circuit is activated remove Q1, R2, R3, and connect the LED and the 1K resistor as shown in the output circuit of Fig. 3.

PROXIMITY SENSOR

Our next entry (see Fig. 5) uses the IC in a sensitive proximity-sensor circuit. Using a 9- × 12-inch piece of circuit board material for the pick-up sensor, the circuit can detect a person as far as 1 foot away. The circuit is very similar to our touch-switch circuit in Fig. 4, with a couple of component-value changes. The oscillator's frequency is pushed even higher by reducing the value of the tuning capacitor to 300 pF. The coupling capacitor, C4, is also increased in value to 300 pF to allow R2 to control the circuit's sensitivity.

With the pick-up clear of any close-by objects, R4 is adjusted to the point where the LED just turns on. When the pick-up is approached, the capacitance between ground and the pick-up is increased, reducing the signal going to the detector circuit and turning off the LED.

PEST REPELLER

In Fig. 6 the IC is turned into an ultrasonic "pest repeller." A 0.0018-µF capacitor sets the oscillator's frequency to about 20 kHz.

A small 8-ohm tweeter is driven by the circuit's output in the AC mode of operation. The 22-ohm resistor limits the IC's output current to a safe value.

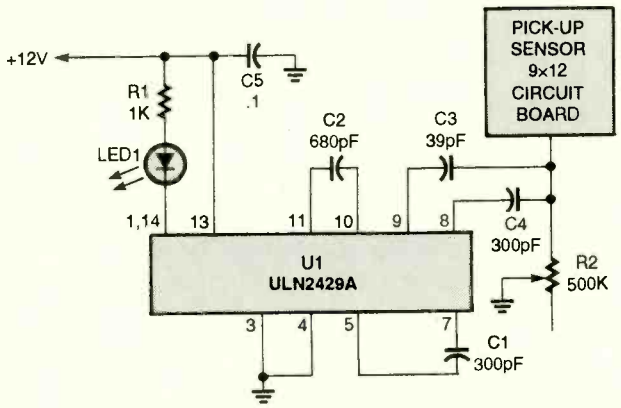

Fig. 5. The proximity sensor circuit can detect a person as far as 1-foot away. It is very similar to the touch switch circuit back in Fig. 4 with only a couple of component-value changes.

PARTS LIST FOR THE PROXIMITY SENSOR

SEMICONDUCTORS
LED1—Light-emitting diode
U1—ULN2429A fluid-detector, integrated circuit

CAPACITORS
C1, C4—300-pF, ceramic-disc
C2—680-pF, ceramic-disc
C3—39-pF, ceramic-disc
C5—0.1-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
R1—1000-ohm, ¼-watt, 5% resistor
R2—500,000-ohm potentiometer
Copper-clad circuit board, perfboard, solder, wire, etc.

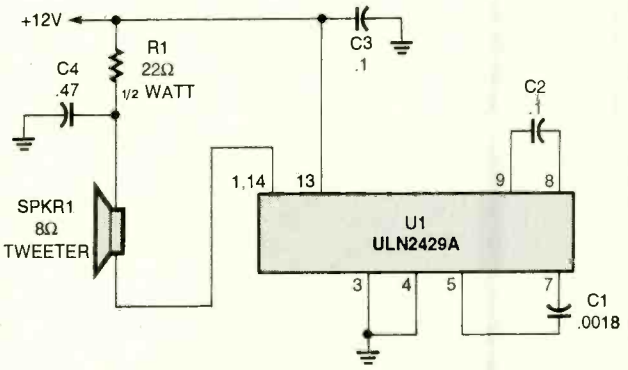

Fig. 6. To make a pest repeller, the IC is turned into an ultrasonic-wave generator. The circuit can be used to discourage rats, mice, and other pests from coming around.

PARTS LIST FOR THE PEST REPELLER

CAPACITORS
C1—0.0018-µF, 50-WVDC, Mylar or similar
C2, C3—0.1-µF, ceramic-disc
C4—0.47-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
R1—22-ohm, ½-watt, 5% resistor
SPKR1—8-ohm, tweeter speaker
U1—ULN2429A fluid-detector, integrated circuit
Perfboard, solder, wire, etc.

SQUAREWAVE GENERATOR

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(Continued on page 90)

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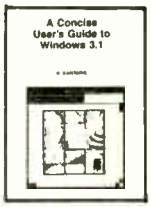

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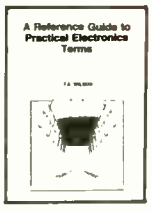

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DX LISTENING

By Don Jensen

South-American SW Broadcasters

Periodically, I like to focus this column on a particular area of the world. This month, let's look at some Latin American countries and their shortwave stations.

Like most "norteamericanos," SWL's tend to think of Latin America as being right next door. But like many perceptions of the world, that's only partly correct.

Ralph V. Kurtenbach has been one of the voices regularly heard on HCJB, The Voice of the Andes, in Quito, Ecuador.

Mexico, certainly, and Central America are our southern neighbors, and Cuba is just 90 miles off the tip of Florida. But Latin America also includes countries such as Argentina, Brazil, and Chile, and they may be farther away than you realize. For example, a jet flight from Chicago to Istanbul is shorter than one between the "windy city" and Buenos Aires. It's 5,000 miles from San Francisco to Tokyo, but nearly 6,000 miles to Santiago, Chile. New York is nearer Moscow than it is Rio de Janeiro, Brazil.

While much of Latin America speaks Spanish, the largest South American country, Brazil, speaks Portuguese. In three smallish countries on the northeastern "shoulder" of the southern continent (French Guiana, Guyana, and Surinam) French, English, and Dutch are the predominant languages. In the southern tier of Latin countries, notably Brazil, Uruguay, Argentina and Chile, many native-born citizens have German, Italian, even Japanese as their first language. Additionally, there are many people who speak the various indigenous Indian and Creole languages.

When it comes to music, there's no single type of music typical of Latin America. There's the galloping Colombian cumbia, hot salsa from the Dominican Republic, Mexican mariachi, Argentine tango, Peruvian huayno. These musical styles are no more alike than those of Johann Sebastian Bach and Billy Ray Cyrus! What this means is that when it comes to SW stations of Latin America, there's a tremendous variety of listening available.

One reason why many North Americans may not be familiar with these stations is that while there are hundreds of them on shortwave, most are relatively low powered, compared to the major international broadcasters of Europe. The signals, typically, aren't as big and booming. Also, the majority, though certainly not all, of them operate on the so-called "Tropical Bands," mostly the frequencies below about 5 MHz (5,000 kHz). Here reception is limited to the hours of darkness. There often are high static levels, especially in summer, and interference from other stations.

GETTING STARTED

If you've so far avoided these broadcasters, for these reasons, and because most broadcast in Spanish or Portuguese, I suggest you get started by tuning for the few that do have some English programming. Almost without doubt, one of your first South American SW loggings will be *HCJB*, The Voice of the Andes, in Quito, Ecuador.

That is a missionary broadcaster, to be sure, but its programming is an interesting mix of music and culture along with the religious. It has been on shortwave since the 1930's. It was my first shortwave logging more than 40 years ago, so I have a soft spot in the SWL'ing heart for HCJB.

Signals are strong and there are plenty of English broadcasts. You can find HCJB on several frequencies during much of the day and night. Highly recommended is the hour-long Studio 9 program, on the air weekdays from 0030 to 0130 UTC, on 9,745 and 15,155 kHz. Studio 9 includes world and Latin-American news, followed by a series of features and interviews. Particularly enjoyable is the Friday segment called *"Musica del Ecuador"*, in which Jorge Zambrano hosts a show featuring a blend of Ecuadorian and other Latin music.

Radio Nacional Brasilia also has some English pro-

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gramming. Check this one at 1200 UTC on 15,445 kHz.

There are a good many other Brazilian stations on shortwave, though their programs are in Portuguese. Several to look for include: *Radio Santa Maria*, 0000UTC on 11,705 kHz; *Radio Cultura*, 2300 UTC on 17,815 kHz; *Radio Clube Paranaense*, 2330 UTC on 6,040 and 9,725 kHz; *Radio Relogio Federal*, 0700 UTC on 4,905 kHz; *Radiodifusora Roraima*, 0300 UTC on 4,875 kHz; and *Radio Educacao Rural*, 0130 UTC on 4,753 kHz.

Another Latin station with English programming is *Radio Havana Cuba*. That station can be heard throughout the evening, from 000 until 0700 UTC, on 6,010 and 9,510 kHz.

Though it doesn't really qualify as a Latin-American station, as far as programming goes, *Radio for Peace International* does broadcast from Costa Rica in Central America and its programs are in English. It can be found throughout the evening on 7,385 kHz.

SPANISH VOICES

By this time, perhaps, you're ready to try for some stations that program in Spanish. Even if you don't know the language, you can find a lot of enjoyment in the musical programming.

From Colombia, one of the strongest and most consistent signals on shortwave is that of *CARACOL Colombia*, a key network outlet of the CARACOL chain, which we highlighted in a recent column.

You'll find this all-Spanish station quite easy to hear during the North-American evening hours on 5,075 kHz.

Radio Santa FE is noted evenings on 4,965 kHz, and you might find another Colombian outlet, *Ecos del Atrato* operating, irregularly perhaps, on 5,020 kHz during the 0200-0400 UTC time period.

Chile isn't the easiest country to log. There are only a few stations on the air now. But you might want to give a try for *Radio Santa Maria*, logged on 6,030 kHz especially in very early morning hours, say around 0930 UTC.

Even more difficult, and a real DX catch, is Paraguay's only currently operating shortwave station, *Radio Nacional* on 9,735 kHz. There have been reports, however, of one or two other stations becoming active in the future.

Peru is a curious case among the South-American countries. It has numerous stations operating on SW; they seem to come and go, many of them quite audible for a few weeks or months, only to vanish without a trace. Signals, typically, are not strong, since they are local stations, intended for Peruvian audiences. So things change quickly and any list of Peruvian stations is automatically a bit suspect. However here are some you might wish to try for:

Radio Naylap is said to be on the air 24-hours-a-day on a 4,300 kHz. *Radio Maranon*, 4,835 kHz, returned to the air after having been inactive for more than a year. It has been noted signing on at 100 UTC with the "Chariots of Fire" theme. *Radio Nacional del Peru* in Tacna also has been reactivated and has been noted on 6,095 kHz to 0500 UTC sign off.

Two of the more easily logged Venezuelan stations can be found within just 10 kHz of each other in the crowded 60-meter band. Look for *Radio Rumbos* on 4,970 kHz and *Ecos del Torbes* on 4,980 kHz. Programming is similar on those two stations—mostly Latin ballads and rhythms.

DOWN THE DIAL

Skimming through the frequencies, you may find quite a few Latin signals on your own. Let us know what you're hearing, the frequency, time heard, and a bit about the programming. I'll include your logging notes in future columns. Send your letters, questions, and comments to me, Don Jensen, DX Listening, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735.

Hear are some of the stations others are hearing:

BOLIVIA—4,965 kHz. *Radio Juan 23* has been noted in the early morning, around 0945 UTC, with flute music of the Andean region and clear identification. The number 23 sounds like "ben-tay trace" in Spanish.

GUATEMALA—5,955 kHz. *Radio Cultural* in Guatemala City is logged at about 1000 UTC with Mexican-sounding rachera music.

MEXICO—6,185 kHz. *Radio Educacion, XEPPM*, is often heard between about 0130 and 0530 UTC. Besides the Latin-American music and Spanish talk, you may also hear an occasional English identification and frequency announcement.

VENEZUELA—4,830 kHz. *Radio Tachira* has been heard here with live sports, probably a soccer game, in Spanish. ■

*Credits: Brian Alexander, PA; Mark Anderson, MI; Hans Johnson, MD; Ed Newbury, NE; Tony Orr, VA; North American SW Association, 45 Wildflower Road, Levittown, PA 19057

NEXT MONTH

In the July, 1994 Issue

Popular Electronics

It's July and the Annual Builders Special Issue contains a potpourri of projects for all levels of builders. Here are some of the project highlights:

- **Universal Noise Reduction System**
- **Digital Combination Lock**
- **Packet Radio Tuning Indicator**
- **Digital Clock**

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Wire Antennas

By Joseph J. Carr, K4IPV

To paraphrase an old saying: "Fall is fell, Spring is Sprung, grab a ladder and climb on a rung. . . ." It's antenna time again. Winter time is a time of damage to antennas, and it's generally too cold in much of the country to put one up without getting frostbite. In mid Summer, the temperature is too high to safely work on antennas without risk of heat stroke. But in the late Spring and early Summer, the weather tends to be a bit more temperate for antenna noodlers.

If you plan to put up an antenna, then now might be the time to do it. Standard antennas such as half-wavelength horizontal dipoles are easy to put up, but you might want to try a special or non-standard antenna. For the upper end of the high-frequency (HF) region, you might want to give the "Thorne array" (see Fig. 1) a try.

THE THORNE ARRAY

The Thorne array is an upside-down "bobtail curtain antenna," and is quite capable of a very low angle of radiation. I once used a Thorne array at a QTH in Texas, and was quite impressed with its performance for VK, ZL, and JA DX'ing. Such demonstrations do not usually impress me because antennas are difficult to analyze in isolation. But in the Texas instance, I was able to compare the Thorne array against a properly installed half-wavelength dipole, a trap vertical, and a tri-band three-element beam. It worked very well in comparison to those other antennas, yet it cost "bird seed" to build.

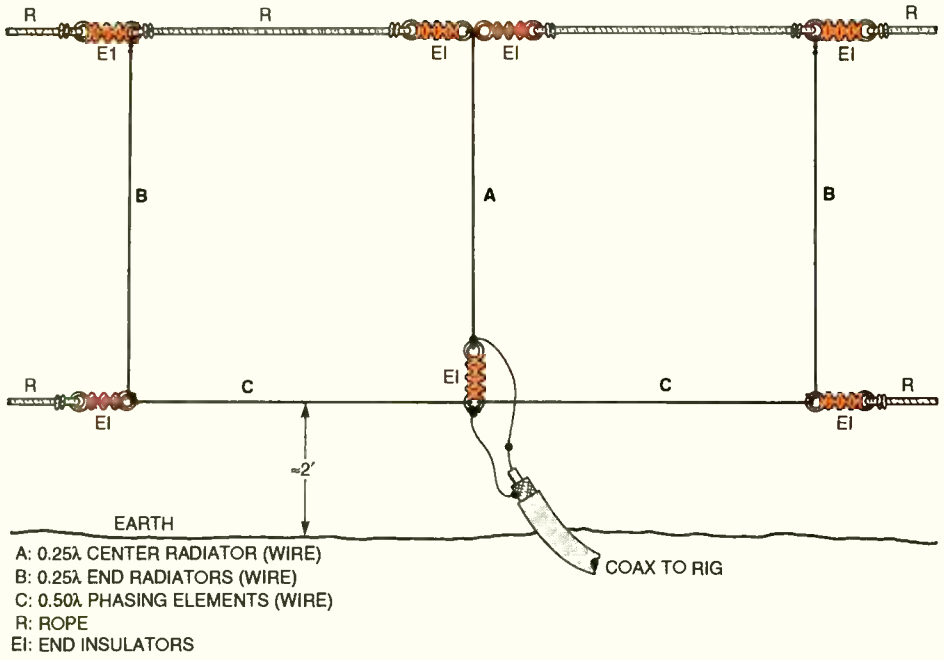

Fig. 1. For the upper end of the high-frequency (HF) region, you might want to give the "Thorne array" a try.

As shown in Fig. 1, the Thorne array consists of three vertical radiating elements, each a quarter-wavelength long. The center radiator (A) is isolated electrically from the others, and is connected to the center conductor of the coaxial cable. The other two radiators (B) are connected to the shield of the coaxial cable through half-wavelength phasing elements (C). All elements are made of #14 or larger wire. The phasing elements and the feedpoint are about two feet off the ground.

It is possible to build the antenna exactly as shown in Fig. 1. The four ropes (top and bottom) at the two ends are stretched between supports (trees, towers, wall of the garage, or whatever). If the assembly is a little too rickety, you can use a 2 × 4 stake at each vertical radiator. A quarter wavelength at 20 meters is 16 to 17 feet (depending on frequency), so you can easily use 16-foot 2 × 4 lumber mounted to a fence post or other support to hold the antenna.

SOMETHING DIFFERENT

Another neat antenna to try is the "Large Loop" or "Bi-Square" antenna (see Fig. 2), which is similar to a single-element "quad," but each side of the square is a half wavelength (λ/2) rather than a quarter wavelength. The feedpoint impedance is about 1000 ohms, so a quarter-wavelength matching section is required. The matching section is comprised of a quarter-wavelength piece of twin-

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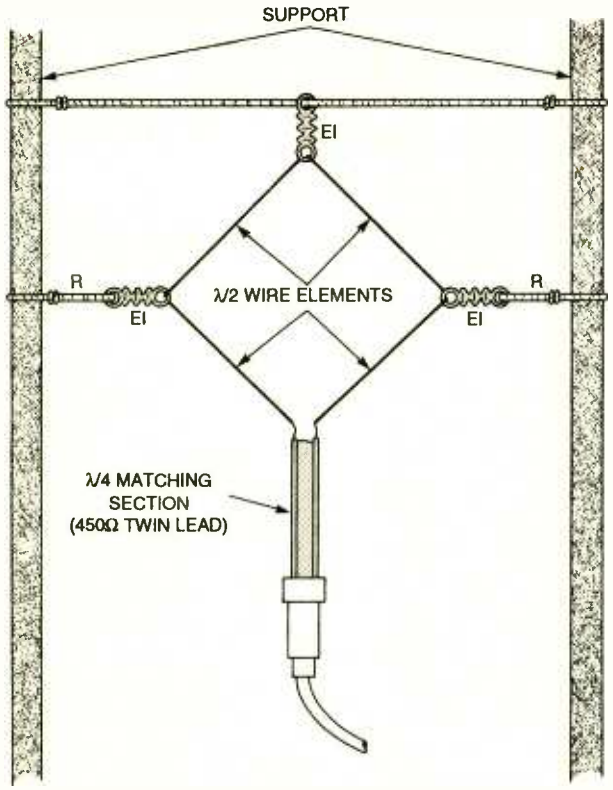

Fig. 2. The "Large Loop" or "Bi-Square" antenna is similar to a single-element "quad."

lead—either 300- or 450-ohm twin-lead can be used.

A 1:1 or 4:1 BALUN is used at the feedpoint. Normally, only a 1:1 BALUN is needed, but in some cases people like to operate the Bi-Square off the design frequency, in which case, the impedance of the feedpoint changes enough to make it worthwhile to try the 4:1 BALUN.

The Bi-Square antenna radiates in a figure-8 pattern, and provides as much as a 4-dB gain (isotropic) broadside to the plane of the antenna (*i.e.*, perpendicular to the page in Fig. 2). One neat aspect of that antenna is that it can be used at frequencies other than its design frequency. But when the frequency drops to half the design frequency, the gain drops to about that of a dipole. Using an antenna-tuning unit can smooth out what appears to be a relatively bad VSWR (about 2.25:1 at some frequencies).

Both the Thorne array and the Bi-Square antenna are easily made from wire and wire-antenna components like end insulators (EI in the figures), at least on frequencies above about 31 meters, although most users will probably be on 10 and 15 meters because of the antenna size required for the lower-frequency bands.

MY PREFERENCE

I am partial to low-cost, easy-to-assemble antennas made of wire or aluminum tubing. While I own a store-bought antenna, and use it regularly, I also have a few homebrew antennas. Supplies for wire antennas are available at most ham outlets, although some stores may only stock basic kits. For instance, Jim Thompson (W4THU) president of Radio Works—P.O. Box 6159, Portsmouth, VA 23703; Tel. 804-484-0140 (voice) and 804-483-1873 (fax)—recently sent me a pair of their catalogs: the general catalog is $3, and the reference catalog is $5.

Radio Works stocks a wide variety of their own antennas and BALUN's, the products of other manufacturers, plus other supplies and gizmos. They also stock antenna instruments and antenna-tuning units. I've gotten a few items from them over the years, and find they fill a needed niche.

ANTLERS SOFTWARE

For most ham-radio and SWL antennas, the principal design parameter is the length of the elements. Also of concern are the values of any inductors used in the various forms of compensation antennas. For loop antennas, which are really useful for low-frequency work (160 through 31 meters), the inductance of the antenna for any given physical dimension is important, as is the capacitance needed to resonate that inductance to a specific frequency. The Antlers software calculates all those factors for you.

While it is not a full antenna-design package, Antlers works well for most practical ham and SWL applications. Antlers runs on MS-DOS and Windows machines, and requires a color monitor. Contact me at P.O. Box 1099, Falls Church, VA 22041 for more information on the package. ■

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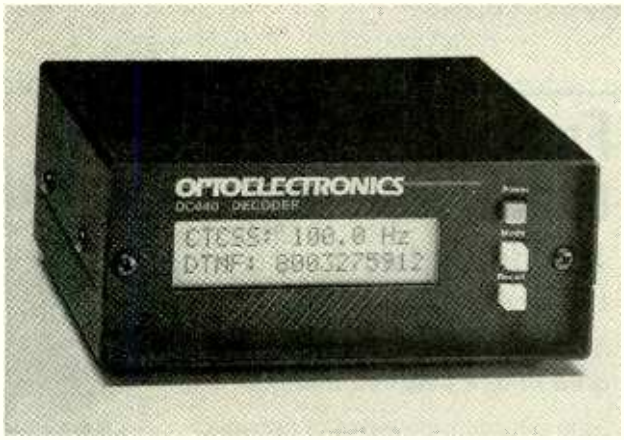
SCANNER SCENE

By Marc Saxon

A Look at Mobile Extenders

The *Optoelectronics Model DC 440* is a useful scanner accessory. It reads out 50 sub-audible PL tones (aka CTCSS tones), 106 digital (DCS) codes, and 16 Touch-Tone (DTMF) characters simultaneously! The DC440 monitors the audio of a scanner. In many applications, it can be connected directly to the external audio output. Note that some scanners have enough loss below 300 Hz in the audio section to prevent the DC440 from picking up PL tones without an internal connection to pick off audio before any low-frequency rolloff. The output of the discriminator is a good spot for that.



The Optoelectronics DC440 can read CTCSS tones, digital codes, and DTMF (Touch-Tone) characters simultaneously.

PL tones and DCS codes are automatically detected along with DTMF characters, and displayed on a two-line, alphanumeric, backlit LCD. On power-up, the DC440 will automatically display PL tones and DTMF characters. The DCS/DTMF combo can be accessed by a mode button.

PL digits remain on display until replaced by different ones, at which time an asterisk is displayed to indicate that active decode is taking place. A total of 10 DTMF digits can be displayed on the screen and will remain until new ones replace them. At that time, the older digits will shift to the left, one at a time, and will be stored in the DC440's memory. A scrollable display of 127 DTMF characters can be reviewed using the DC440's recall button.

Using the DTMF decode feature, it is possible, for instance, to read out the characters being entered into pushbutton cordless phones within receiving range of a scanner. CTCSS tone recognition sorts out different licensees sharing VHF and UHF repeater frequencies. Transmissions begin to take on more of an identity and are more readily recognized when using a DC440. Optoelectronics points out that, in addition to hobby usage, the DC440 is used for security and surveillance purposes, for repeater monitoring, and for communications testing purposes.

Accessories allow the DC440 to interface with a PC for remote operation. A custom data-logging software package for the PC can be used to survey a busy channel.

The DC440 runs on internal (optional) nickel-cadmium batteries that offer five hours of operation. An optional AC power supply is available.

The basic DC440 costs $259. For more information, contact Optoelectronics Inc., 5821 N.E. 14th Street, Ft. Lauderdale, FL 33334 or phone 305-771-2050.

MOBILE EXTENDERS

For months now, letters have been trickling in asking about "mobile extenders." Looks as if it's time for a discussion. It's worth devoting some space to an accessory that is generally overlooked by scanner owners.

Mobile extenders are small, special-purpose, low-powered mobile transmitters that are used by a number of law-enforcement agencies, particularly state police and highway patrols. The function of the unit is to serve as a relay so that headquarters can remain in contact with officers who are using their short-range handheld radios outside of their vehicles. The mobile extender, therefore, is a mobile repeater that re-transmits the signals from headquarters on a different frequency.

As long as a vehicle's mobile extender is turned on, it will repeat every transmission from headquarters. Most officers turn on their extenders when they go on duty, and leave them operating so that they don't forget to turn them on if they need to leave the vehicle. The average range of

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an extender is three miles.

Many (but not all) state law-enforcement agencies make use of mobile extenders because their vehicles are often so far from a dispatcher. Municipal agencies, however, don't usually need them. If you have a scanner, though, you would be able to receive those signals if your scanner were within range of such a station.

For example, on the Florida Turnpike, the extenders use 156.18 MHz, while on the Ohio Turnpike; they use 465.375, 465.425, 465.525, and 465.55 MHz. The California Highway Patrol's system uses 154.905 MHz; in Pennsylvania, they are on 159.21 MHz, and in Illinois, the frequency is 155.505 MHz. One interesting application is in Minnesota, where 458.25 MHz is used throughout the state except around Minneapolis/St. Paul. In the Twin Cities area, the frequency in use is 453.25 MHz.

One thing you'll know when you hear a mobile extender—there's a police car within three miles of your location!

WHAT'S IN THE MAIL?

Don Kiser, of Elmira, New York, has a Bearcat BC-200XLT. His problem is that the rechargeable battery pack decided not to hold a charge. Don wants to know if there's a way to rejuvenate it. Or, since the battery pack isn't going to hold a charge, he wonders if he can leave the scanner plugged into an AC adapter and operate it that way.

It's been our experience that a nickel-cadmium battery pack can be recharged over and over, but it will zonk out eventually. At that point, you should replace it with a new pack. The scanner should operate fine as a base station as long as it is used with an AC adapter that is supplying the proper voltage.

We also heard from Ron Bruckman, editor of the *Radio Monitors Newsletter of Maryland* (P. O. Box 394, Hampstead, MD 21074-0394). We are now aware of some significant changes in that state. Ron mentions that it has been several years since the Baltimore County Police Department left the 39-MHz band to move to 800 MHz. Not long ago, the Maryland State Police reshuffled and reorganized its 39-MHz operations to use those frequencies vacated by the Baltimore County police.

Some Maryland state police barracks remained on their original frequencies, some switched to other frequencies previously used by the state police, and now some barracks are also using 39-MHz frequencies salvaged from the abandoned county police assignments. State-police monitors who wonder what became of the stations they used to hear should search between 39.04 and 39.96 MHz to check up on the entire reorganized Maryland State Police system.

Ron puts out a fine newsletter. It costs $15 per year for 12 issues. A sample copy costs $2. The phone number is 410-239-7366.

In related news, the *Northeast Scanner News* (P. O. Box 67, Gibbstown, NJ 08027) advises of a change in their rates. A 12-issue subscription is now $29 per year by bulk rate, or $39 by first class mail.

KEEP IN TOUCH!

Please send along your questions, frequencies, and ideas to *Scanner Scene*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. Your input is important to us. ■

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LEGO-DACTA CONTROL LAB

(Continued from page 66)

vices. To set up the software, you drag device icons to their particular position on the serial-interface illustration using the mouse. The on-screen port then labels itself as "motora," "lampb," or whatever.

For motors and the sound element, two on-screen buttons above each port control the direction or the sound of its associated device. The on-screen buttons are positioned in the same places as indicator lights on the serial interface. You just click the mouse on a button to activate a device. While a button is being clicked, the corresponding light on the interface illuminates.

Similarly, icons for input devices are dragged onto input ports and the ports label themselves accordingly. When an angle sensor is first set up, it displays an angle of 0. Then, depending on the number of turns and the direction, a positive or negative number is displayed. Angle-sensor readings can also be reset to zero without rotating the shaft if desired. The output from a light sensor is also a number, although always positive.

The temperature sensor's readout is an actual temperature reading in Celsius by default. It's easy enough, though, to change the readout to Fahrenheit. The touch sensor's readout is simply the word "true" or "false," depending on whether its button is pushed in or not.

Software Use. Finished projects can be controlled manually from the main "project" screen, which can be saved as a file for later use. Also, control panels can be set up to allow easy control and monitoring of projects using mouse-operated buttons and slider switches. For example, the speed and direction of a fan could be controlled from a slider switch and button.

Control panels can be customized in many different ways. A graph tool lets you add a graph box that can display sensor results such as temperature over time. Text and pictures—a lamp, a motor, etc.—can also be added to control panels.

Programs can be written for automated control of projects. Programming is done in a sort of "Lego BASIC," which is very easy to understand and use. It also has built-in on-line feedback to help pinpoint and correct syntax errors. Take for example, the following simple program for a project entitled "thermostat." The project contains a temperature sensor that's heated up by a lamp and cooled by a fan:

```
TO THERMOSTAT
FOREVER [IF TEMP4 > 75 [TALKTO
"MOTORA SETPOWER 8 ON]
FOREVER [IF TEMP4 < 73 [TALKTO
"MOTORA OFF]
END
```

The programming language is so simple that you can probably figure out what each instruction does by yourself, but we'll explain it anyway. The first line simply activates the thermostat project. The second line tells motora (the fan motor) to turn on and stay on at power level 8 if the temperature is above 75 degrees. The third line tells the fan to turn off when the temperature drops below 73 degrees. Simple enough? If four simple program lines can do all that, imagine what a longer program can do!

Documentation. Four main instruction books are included with the Control Lab. The first one (which has 50 pages) is the *Setup Guide and Introductory Explorations*. The purpose of the book is to introduce the user—or more likely the teacher—to all the components in the lab. All of the specialized input and output devices are explained and experimented with individually. Then software commands are discussed and tested. Quite a bit about the lab is explained by that one manual.

The second manual, again about 50 pages, quickly goes over building a simple fan-control project. To prove that the emphasis of the Lab is on software control rather than building things, the fan itself is fully assembled by the end of page 7; pages 8–53 are devoted to controlling the fan, both manually and automatically.

A thick reference guide covers all aspects of the software and programming in great detail. There's enough information in that book to develop incredibly intricate programming for any conceivable type of device. The last book is essentially a classroom guide to several complete projects, or just an owner's manual if an individual is fortunate enough to acquire a Control Lab for himself.

Complete assembly plans are given for 7 projects: a greenhouse, a color-code reader, a dynamometer and motorized car, a joystick-operated wheelchair, a scanner, a sorter, and a robot arm. The projects are truly fascinating because of their functional complexity and physical simplicity—while they all do totally different jobs, they all use the same handful of input and output devices.

Dream On. The Control Lab is somewhat unbelievable in all that it can do—it can do almost anything. Lego has certainly grown up since we were kids, and we're betting that in ten years or so we'll see a Lego Dacta Space Shuttle kit on the market—okay, maybe 15 years.

For now, though, we built the greenhouse project. The plans called for a motorized "glass" door that opens and closes, an angle sensor to detect the position of the door, and an inside temperature sensor. The door can be opened and closed manually or automatically according to the inside temperature conditions. The sound element beeps when the door is opening and warbles when it's closing. We added lights and a light sensor to the inside of the greenhouse just for fun. If that kind of creativity sounds like fun to you, you're sure to enjoy building the many things possible with the Lego Dacta Control Lab. ■

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from 0 to about 10 volts peak-to-peak with R3.

CODE-PRACTICE OSCILLATOR

A nifty little code-practice oscillator circuit using the IC is shown in Fig. 8. The IC is connected in a variable low-frequency generator circuit driving a small 8-ohm speaker. With the key in the up position, Q1 is biased on through resistors R1 and R2. Transistor Q1's collector is tied to the base of Q7 inside the IC (see the IC's circuit diagram in Fig. 1B), keeping it and Q8 (also in the IC) turned off. The circuit's current drain is very low in the "key-up" position. When the key is closed, Q1 is turned off, allowing the AC signal to pass to the chip's internal driver transistors (Q7 and Q8) and on to the speaker.

ALARM CIRCUIT

A simple alarm circuit is shown in Fig. 9. As long as the three sensor switches (S1, S2, and S3) are closed,

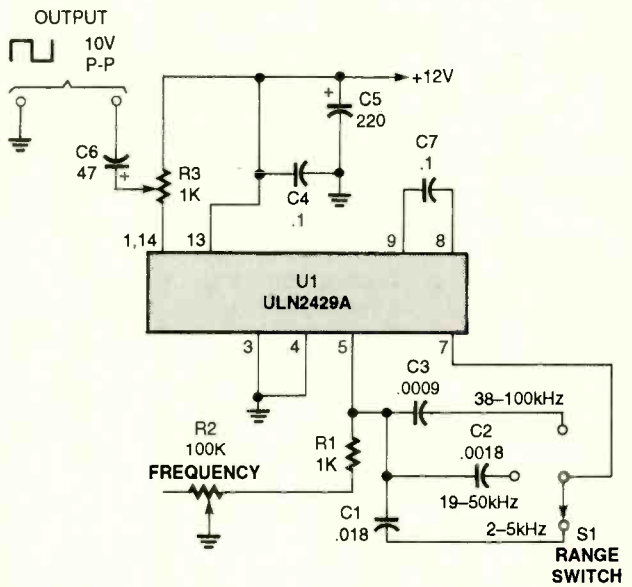

Fig. 7. The oscillator's frequency-setting capacitor values in this squarewave generator can be selected to give an overlapping and continuous range of operation from 1 Hz to over 250 kHz.

PARTS LIST FOR THE SQUAREWAVE GENERATOR

CAPACITORS
C1—0.018-µF, 50-WVDC, Mylar
C2—0.0018-µF, 50-WVDC, Mylar
C3—0.0009-µF, 50-WVDC, Mylar
C4, C7—0.1-µF, ceramic-disc
C5—220-µF, 16-WVDC, electrolytic
C6—47-µF, 16-WVDC, electrolytic

RESISTORS
R1—1000-ohm, ¼-watt, 5%
R2—100,000-ohm, potentiometer
R3—1000-ohm, potentiometer

ADDITIONAL PARTS AND MATERIALS
U1—ULN2429A fluid-detector, integrated circuit
S1—Single-pole, three-position switch
Perfboard, solder, wire, etc.

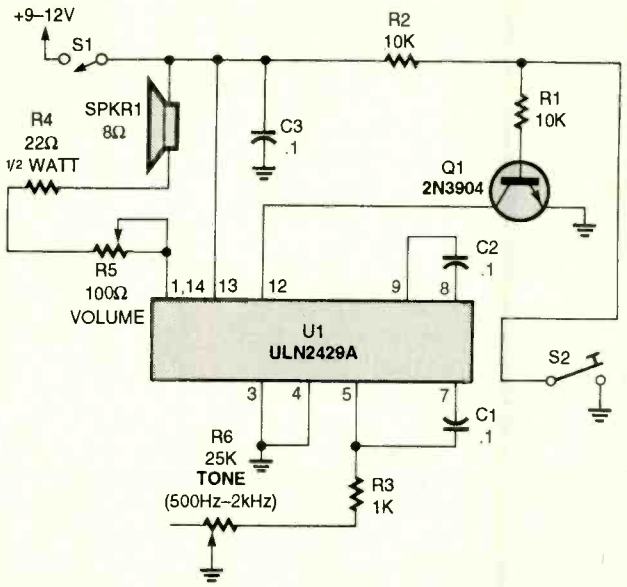

Fig. 8. In the code-practice oscillator the IC is connected as a variable low-frequency generator that drives a small 8-ohm speaker when activated by the telegraph key.

PARTS LIST FOR THE CODE-PRACTICE OSCILLATOR

SEMICONDUCTORS
Q1—2N3904 NPN transistor
U1—ULN2429A fluid-detector, integrated circuit

RESISTORS
(All fixed resistors are ¼-watt, 5% units unless otherwise indicated.)
R1, R2—10,000-ohm
R3—1000-ohm
R4—22-ohm, ½-watt
R5—100-ohm potentiometer
R6—25,000 potentiometer

ADDITIONAL PARTS AND MATERIALS
C1–C3—0.1-µF, capacitor
SPKR1—8-ohm, 4-inch speaker
S1—SPST switch
S2—Telegraph key
Perfboard, solder, wire, etc.

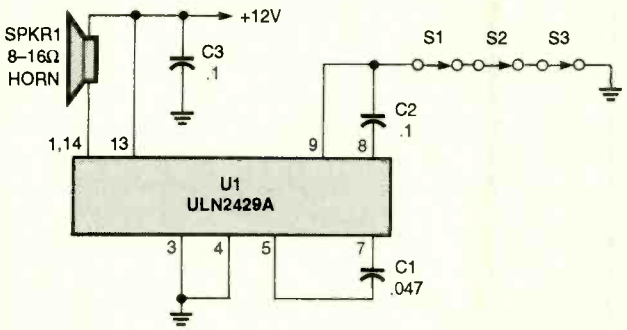

Fig. 9. This alarm circuit uses the IC as the sensor-detector and sounder circuit all in one. As long as the three sensor switches S1, S2, and S3 are closed no sound will come from the speaker. When any one of the sensor switches is opened, the oscillator signal will pass through C2 to the detectors and the speaker.

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PARTS LIST FOR THE ALARM CIRCUIT

CAPACITORS
C1—0.047-μF, ceramic-disc
C2, C3—0.1-μF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
U1—ULN2429A fluid-detector, integrated circuit
SPKR1—Horn speaker
S1–S3—Normally closed switch
Perfboard, solder, wire, etc.

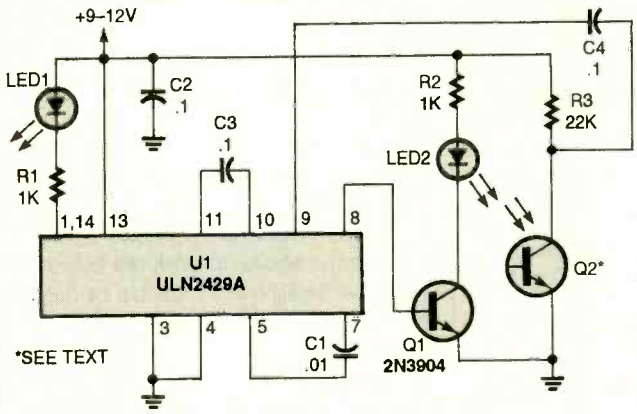

Fig. 10. In our light-beam circuit the LED's output is modulated, making the sensor less sensitive to ambient light.

PARTS LIST FOR THE LIGHT BEAM CIRCUIT

SEMICONDUCTORS
LED1, LED2—Light-emitting diode
Q1—2N3904 NPN transistor
Q2—Phototransistor (see text)
U1—ULN2429A fluid-detector, integrated circuit

CAPACITORS
C1—0.01-μF, ceramic-disc
C2–C4—0.1-μF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
R1, R2—1000-ohm, ¼-watt, 5% resistor
R3—22,000-ohm, ¼-watt, 5% resistor
Perfboard, solder, wire, etc.

no oscillator signal will reach the detector circuit at pin 9 and no sound will be heard. When any one of the sensor switches is opened, the oscillator signal will pass through C2 to the detector's input and out through the speaker.

LIGHT-BEAM CIRCUIT

Our last entry, Fig. 10, uses the IC in an LED-emitter/phototransistor-sensor circuit. The advantage of this arrangement is that the LED2's output is modulated, making the sensor less sensitive to ambient light. The oscillator is operating at about 2.4 kHz, with the output at pin 8 driving Q1. The LED in Q1's collector circuit (LED2) is switched on and off at the 2.4-kHz rate. The phototransistor is placed close to, and aimed at, the LED. Almost any phototransistor compatible with the LED used should work. As long as Q2 is receiving the 2.4-kHz light signal, LED1 remains on. When the light source is blocked, the signal path is broken and LED1 goes out. ■

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CALLER BLOCK

(Continued from page 36)

tween the numbers, and verify that it does not exceed 255 characters.

If you have a problem with certain callers whose numbers' you've entered into memory but can still not ring your telephone, call your phone company and ask if their exchange is included in your Caller ID network. Although the people calling you do not have to subscribe to Caller ID as you do, their exchange must be in the Caller ID network in order to ring your phone.

Closing the BYPASS switch (S1) allows you to bypass the circuit and allow all calls through as normal. When picking up the telephone to make a call, the circuit is also automatically bypassed. Note, that power must be applied to the Caller Block or the telephone will be disconnected from the phone line, even when the unit is switched to bypass or when trying to make a call. If you wish to use an answering machine, place it in the line ahead of the Caller Block. ■

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USED EQUIPMENT

(Continued from page 20)

range of RF for noise-susceptibility testing. There are several low-cost generators available new but they lacked the range I needed and also lacked a calibrated output-amplitude control. I wanted something that would generate wave amplitudes down to the micro-volt level. The HP 600 family of signal generators is perfect for this. They are old, tube/transistor types that can serve as boat anchors in an emergency, but they are reliable and cheap. I needed three: an HP 606B (with 50-kHz to 65-MHz operation); an HP 608E (ranging from 10 to 480 MHz); and an HP 612A (with 450- to 1230-MHz capability).

The 1989 Tucker catalog listed these for over $2000 each! Their new catalog only had the less-capable 606A for $250, without calibration. Tech Systems had them for $450 each (uncalibrated). Cadisco had them all at two for $250! I called the company and quickly worked out a deal for three units at $325.

About a week later I got the units. They were about as I expected from a salvager. Two were missing plug-in power cords (the third one's cord was permanently attached) and there was no documentation of any kind. All were salvaged from the Navy and were last calibrated sometime in the late 1970's.

The 606B was in relatively good shape. It lacked a power cord and the receptacle for it was non-standard. I bought a new cord and replaced the old receptacle with a standard one. While I had it apart, I examined it visually. That is always a good thing to do for very old and/or salvaged equipment. For example, always check the fuses. A blown fuse may indicate serious problems. No tubes were broken and everything looked to be in good order. I plugged it in and turned it on. Other than a noisy function switch (which worked flawlessly after a few pushes), everything worked okay. The modulation meter only needed an internal trimpot adjustment. All in all, it was a good buy for $108.

The 612A also was not in bad shape. Its insides were clean and there was no evidence of internal electrical problems. It did appear to have been stored for some time on its back. That put a kink in the attached power-cord. As a stickler for safety, I replaced it. In addition the attenuator mechanism was frozen, but it didn't take too much effort to free it up. I can't seriously test the unit until my RF-spectrum analyzer is working, but my TV tells me that a signal is being generated at the proper frequency.

The 608E was not the same story. It was apparently used in a salty environment—not all that unusual for a piece of equipment used by the Navy. The good news is that it has been sitting so long that the salt has completely reacted and there is little chance of any more corrosion. Also, there were no traces of arcing or any burning from salt-induced short circuits. A little elbow grease, a toothbrush and a vacuum cleaner removed the bulk of the corrosion. There were a couple of mechanical problems that were overcome with penetrating oil and patience.

However, one filter capacitor seems shorted, and I will not turn the unit on until I am confident that it will not smoke. So I needed the service manuals, which I've just received from HP for $10 each on microfiche—the only available medium for the three signal generators. My main city library has a fiche/copier. There are about 70 "pages" in each manual, although only half really need to be copied. At 25-cents per page that means about another $10 per manual, and an afternoon at the library will net me paper documentation.

Final Score. So how well did I do with my $2000? Did I get everything I wanted? Here's the summary. The Poor Man's Spectrum Analyzer including the case and extras was $450. The AF spectrum analyzer was replaced by Hyperception digital signal processing software with FFT's for $489 and a home-brew PC interface that required $100 in parts. The used RF Signal Generators cost $325. My new RF frequency counter was $379. I spent $295 on the used distortion analyzer and another $195 on the used precision volt/ohmmeter. The total came to $2233.

Yes, I spent more than I initially wanted; however there are good reasons why. While looking at FFT software packages, I realized that the Hyperception package (from Hyperception, 9550 Skillman LB125, Dallas, TX 75243) provided a code-generator for Texas Instruments' digital signal processors. That was something extra that would help me with several completely different projects. Plain FFT software can really be had for only about $100. In addition, I spent an extra $100 on the frequency counter for improved stability (0.2 ppm instead of 1.0 ppm). Had I settled for less in these two areas, the total would have been well below the $2000 mark. In any event, buying the same (or equivalent) equipment new would have cost much, much more.

Conclusion. Buying used test equipment can be very worthwhile. For a fraction of their original price, you can obtain quality units. Just because a piece of electronic equipment is used doesn't mean that it is no longer useful. A little care, patience, and effort can provide an impressive and valuable addition to the shack or shop without making an impressive dent in your wallet.

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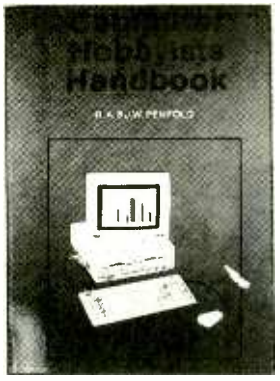

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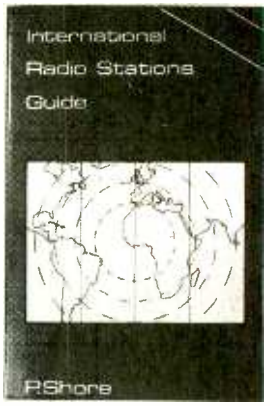

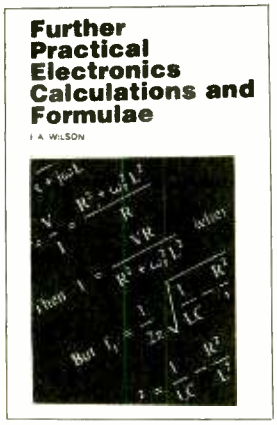

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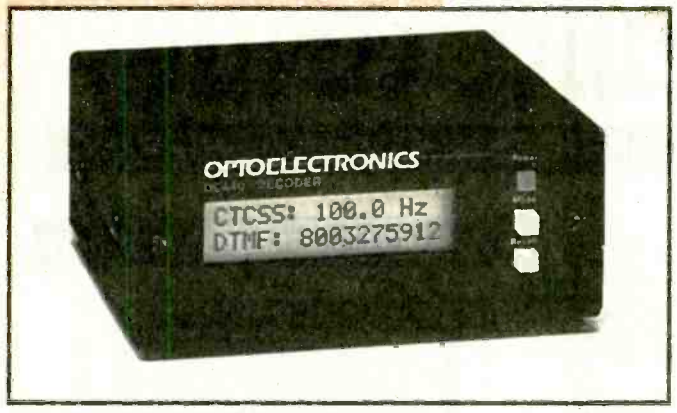

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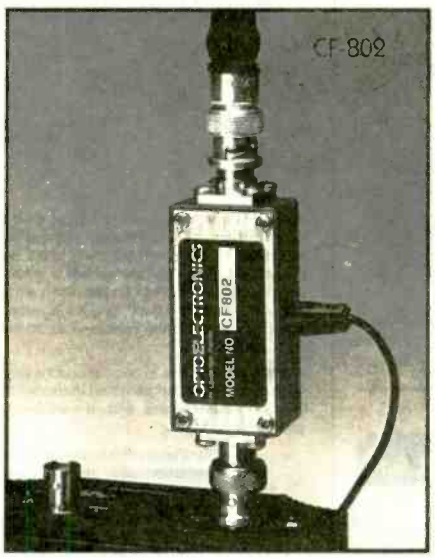

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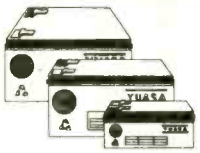

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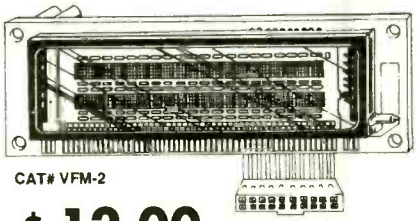

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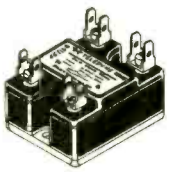

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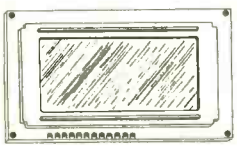

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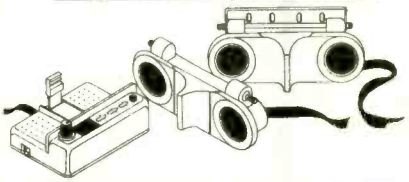

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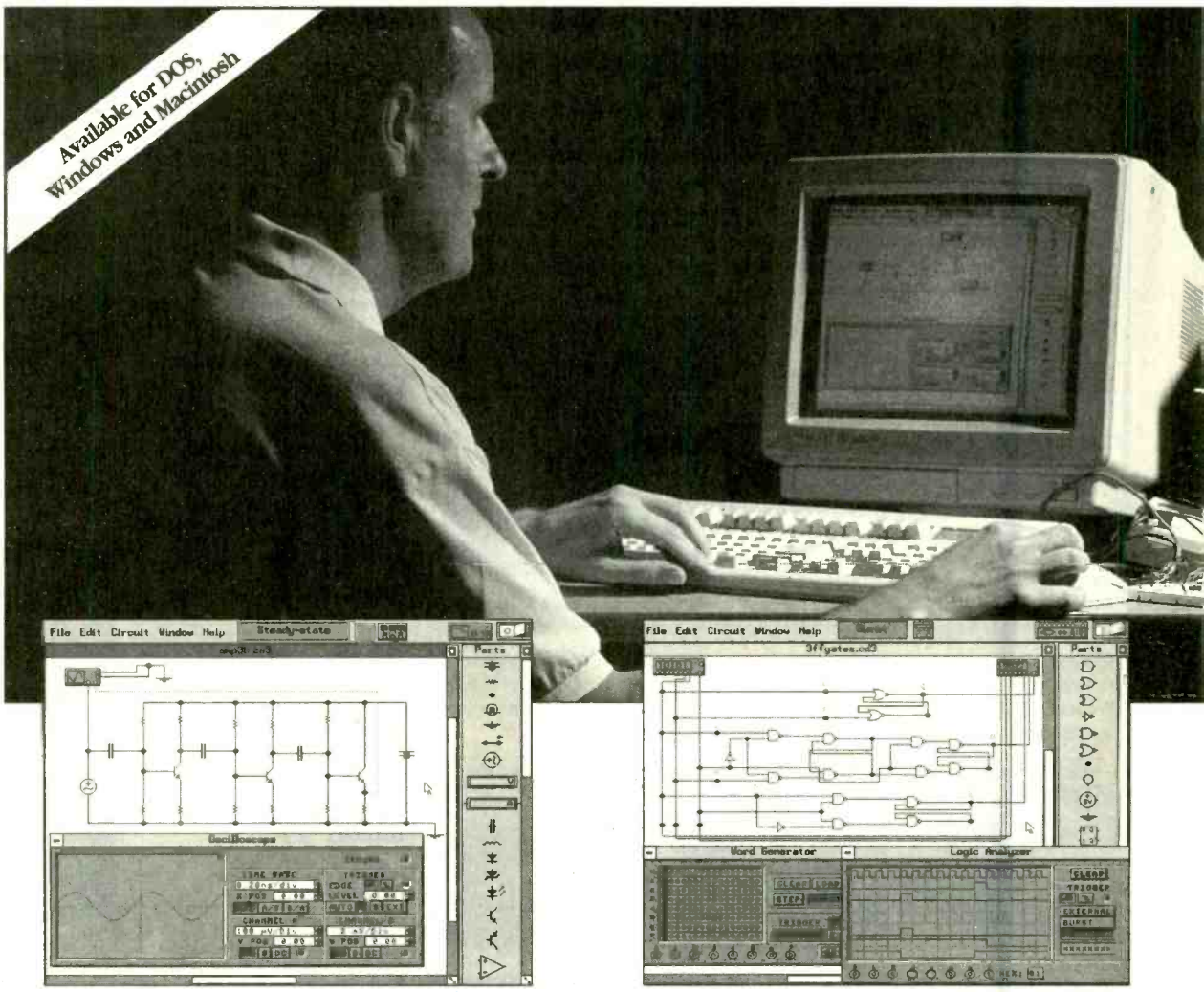

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Digital Module includes:

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- logic converter (converts among gates, truth table and Boolean representations)

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The electronics lab in a computer™

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MS-DOS version: Requires IBM AT, PS/2 or true compatible with 286 or greater, hard disk, 1 MB RAM, Microsoft-compatible mouse, EGA or VGA display adapter and DOS 3.0 or greater. Supports a math co-processor if available.

Windows version: MS-DOS 5.0 or higher. Microsoft Windows 3.1, 2 MB RAM with suitable pointing device.

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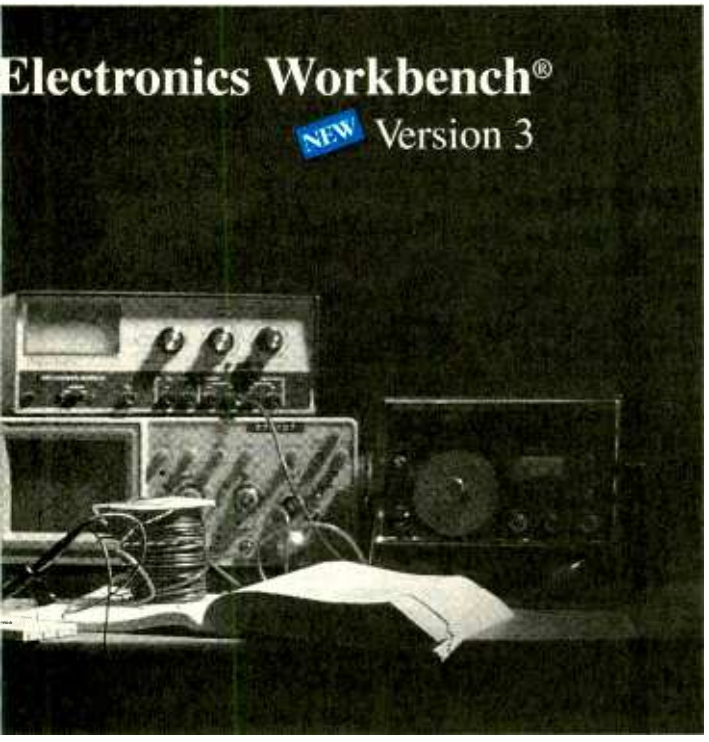

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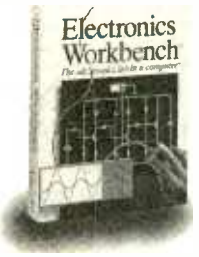

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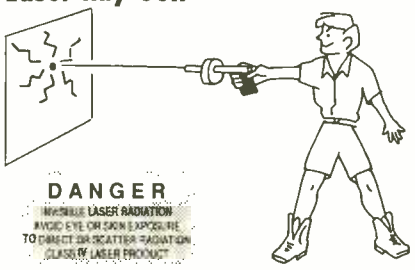

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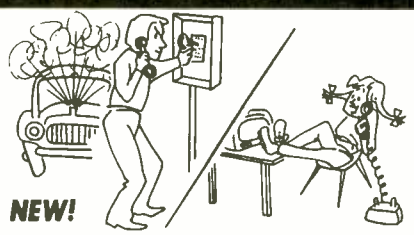

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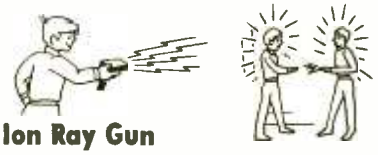

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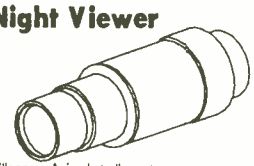

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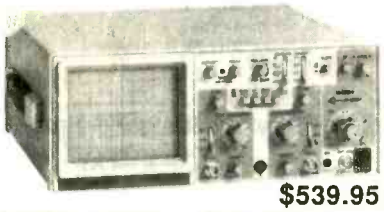

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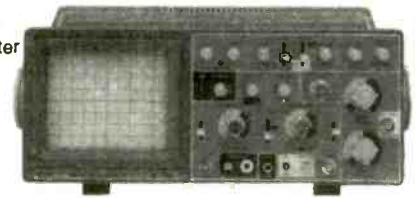

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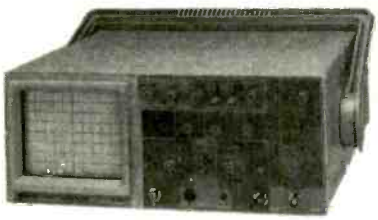

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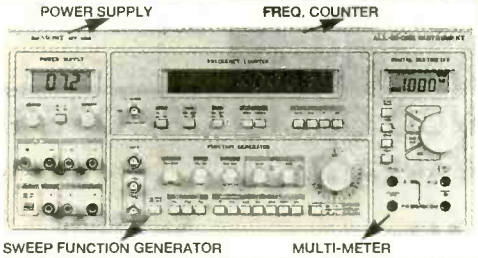

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2 Frequency Counter
- 8 Digit LED
- 1 Hz ~ 100MHz
- ± (1 Hz + 1 dgt. + Time Base Error)

3 Power Supply
- 3-1/2 Digit LCD
- Triple output: #1. 0~50V, 0.5A MAX #2, 15V, 1A #3. 5V, 2A

4 Digital Multimeter
- 3-1/2 Digit LCD
- DCV, ACV, Ω, DCA, ACA
- ± (0.5% + 2 dgts)

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2 Yr. Parts/Labor Warranty

25 MHz Dual
Reg. $525.
$299.00

25 MHz Dual
w/Component Test
Reg. $595.
$379.00

40 MHz
Dual/Delay
Reg. $695.
$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.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 12kV

GoldStar Oscilloscopes

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High Resolution Frequency Counter

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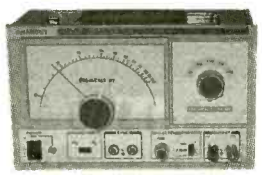
RF Signal Generator, SG-310 100KHz - 150MHz

- 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
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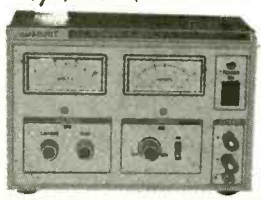
  - Output Voltage : 15Vp-p

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

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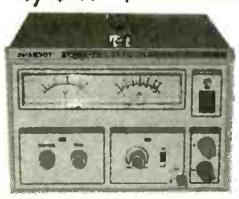

DC Power Supply, PS-540 0-16VDC, 0-10A

- 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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150 LE	200 LE	400 LE
BATTERY TEST	FREQ COUNTER up to 20MHz	INDUCTANCE Resolution 1uH
TRANSISTOR	TRANSISTOR	FREQ COUNTER up to 20MHz
DC CURRENT 10 Amp	CAPACITANCE from 1pF to 20uF	CAPACITANCE from 1pF to 200uF
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TRUE RMS PLUS

Model 94
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*See Standard Features Listed below

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- OHM METER ● DATA HOLD ● RELATIVE MODE
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- Safety Test Leads
- Test Socket for Plug-in Components

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KELVIN 300 LE
990125
$49.95
AUTO-RANGE

- ACV & DCV
- DC CURRENT
- RESISTANCE
- CONTINUITY TEST
- DIODE TEST 3 1/2 Digit LCD
- 10M ohm INPUT IMPEDANCE

INSTRUMENTS

20 MHz SCOPE
Dual Trace 2 Yr Warranty-Parts & Labor
Stock No. 740085 ..... $385

40 MHz SCOPE 2 Yr Warranty
Dual Trace with Delayed Sweep
Stock No. 740086 ..... $655

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990105	RED	$.65 ea.	$.50 ea

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Solar Motor Stock No. 850646
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$.55 ea / 50+ Qty

Solar Cells 3 3/4" L x 2 9/16" W
Stock No. 260099 1000mA .45V
$5.95 ea
$5.50 ea / 3+ Qty

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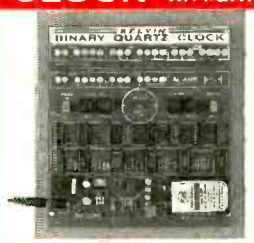
Laptop Digital Trainer comes with 100 page instruction manual, power supply, built-in 1 digit true Hexadecimel display, two independent clocks with user adjustable freq & duty cycles, 4 data bit switches and 4 LED displays. *Assembled*
Stock No. 840460 ..... $99.95

BINARY QUARTZ CLOCK w/Alarm



ORIGINAL DESIGN - 24 Hr. Binary Quartz Accurate Clock with 2 color LED's. Built-in **Alarm** and **Alarm Display** in binary code. **DESIGNED FOR LEARNING** *about digital circuitry & binary code.* Built with individual IC components. **Battery Memory Loss Prevention.** *Comes with rechargeable battery, DC wall transformer and* detailed instruction manual. **Advanced Level Kit**
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Intermediate Level Kit
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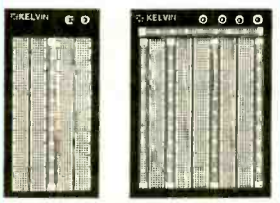

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680097	0	840	$ 5.95
680098	2	1380	$11.75
680100	4	2390	$22.95

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Pre-cut, Pre-Stripped
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600029	556 DUAL TIMER	$.40 ea
600039	LM566 PPL FUNCTION GENERATOR	$.60 ea
600018	741C OP-AMP INTERNALLY COMPENSATED	$.30 ea
600026	1458 OP-AMP DUAL 741C OP-AMP	$.35 ea
630041	2N2222	$.20 ea
630383	PN2222	$.08 ea
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260027	GREEN	$.08 ea	$.07 ea
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260078	2 COLOR RED/GREEN	$.32 ea	$.29 ea

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- **Mixed mode routing** Any combination of above connections is possible on any given node.
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- **Uses DOS versions 2 and above,** 3.1 and above preferred.
- **Print spooling**
- **Record locking via Dos SHARE**
- **Open network, API provided**
- **Runs ok with Windows 3.0**
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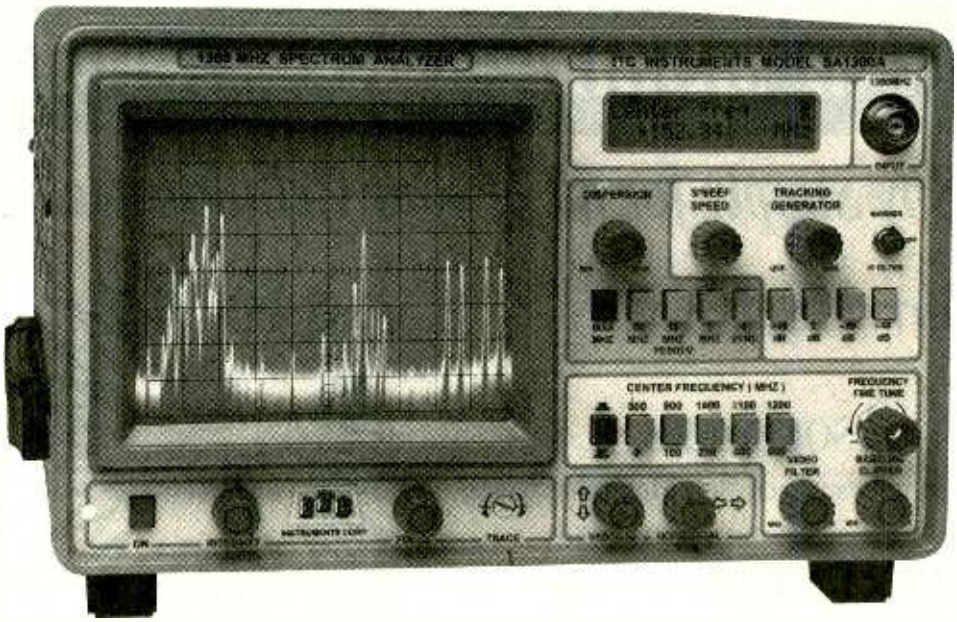

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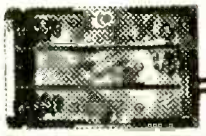

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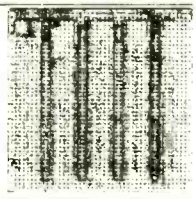

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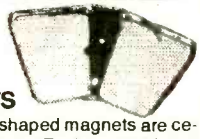

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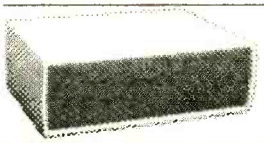

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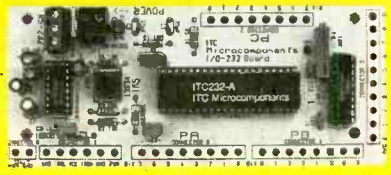

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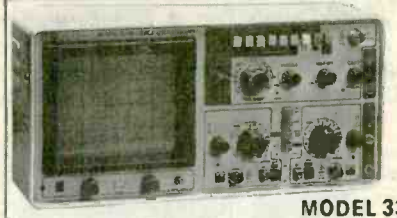

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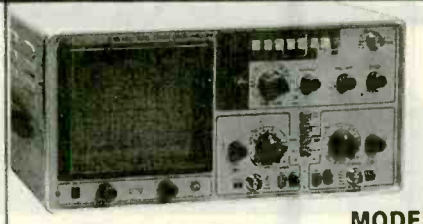

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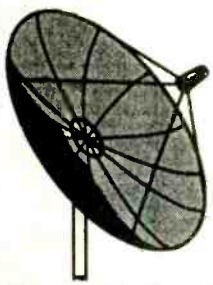

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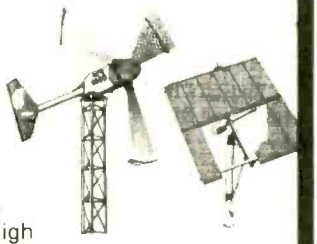

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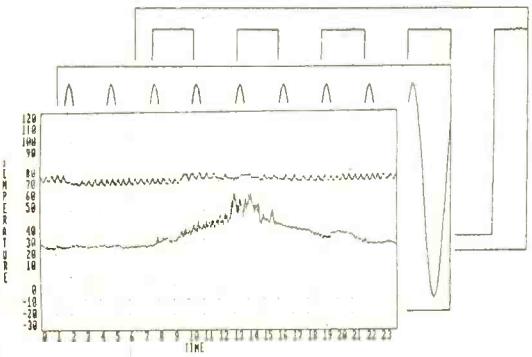

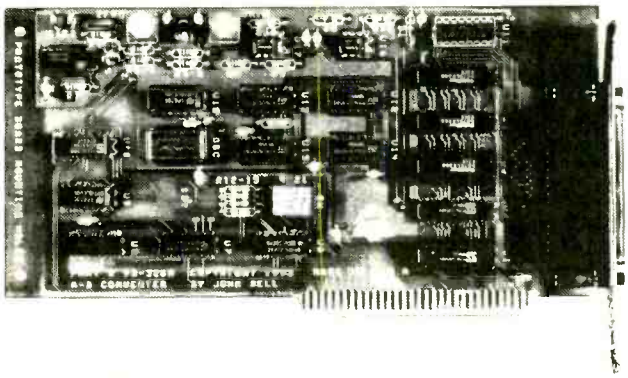

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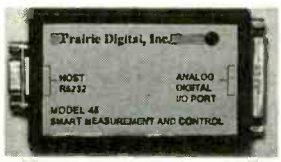

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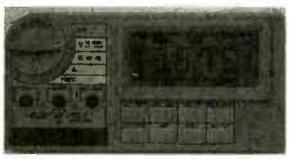

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MAXIMUM SECURITY — EASY OPERATION!

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Complete information describing the fantastic opportunities that are now open to trained Counter-Surveillance technicians and exactly how a number of individuals and firms are reaping a huge bonanza in the booming "Debugging" business! You'll learn how the ever increasing use of Electronic Listening Devices by investigative agencies, government agencies, unscrupulous business competitors, jealous suitors, etc., has created a tremendous demand for this type of service.

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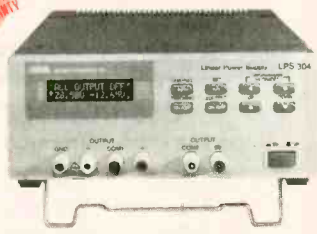

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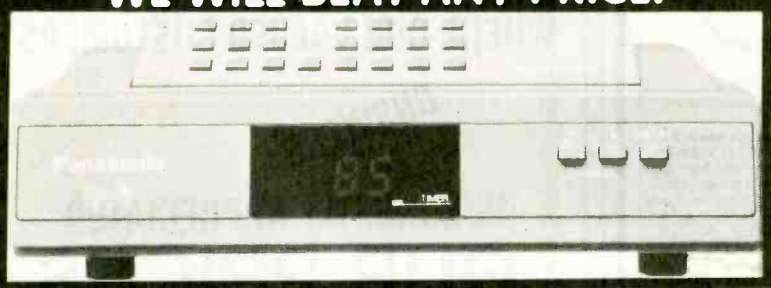

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LASERCOMS

Communicate high quality audio or data on an IR laser beam. Circuitry employs FM techniques with a 200KHz carrier. The kit includes two PCBs (transmitter and receiver), all the on-board components, an electret microphone, a speaker, a 5mW–780nM laser diode, a suitable collimating lens, and the instructions. That's everything you need to make a high quality IR laser communications link which has been tested to over 300 metres. An optional relay (12V) makes this unit double up as a perimeter protection system. Relay activates when the beam is broken.

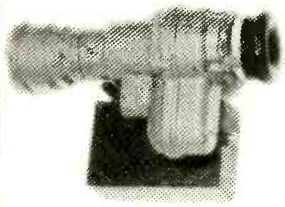
$39

A similar kit which does not include the laser diode and the collimating lens, but is supplied with an IR LED instead, is also available. This kit produces identical results over a much shorter range of 3-4 metres. All that is necessary to demonstrate communications on a light beam, a light beam relay, and "fibre optic" cable communications. Fibre optic cable is not supplied.

$23

12V relay suitable for use with either of the above: $2 extra.

PASSIVE NIGHT VIEWER



This kit is based on a BRAND NEW monocular night vision scope which is completely assembled and requires an EHT power supply. The EHT power supply is provided in kit form, and is easy to build. The scope employs a high gain passive first generation image intensifier tube which is made in Russia. It will produce useful images in sub-moonlight illumination, and can be IR assisted in total darkness.

$240

Available "Ready made" for an additional $50

IR BINOCULARS

HELMET NOT INCLUDED

High quality helmet mount, ex-military binocular viewer. Will stretch and clip over most military and some lightweight constructors helmets. Note that the helmet is not provided. Self powered by one 1.5V, "C" size battery. Adjustable eyepiece and focus: from 1 metre to infinity. Requires IR illumination. Limited stocks, at a CLEARANCE PRICE OF:

$220

MINIATURE FM TRANSMITTER

Not a kit, but a very small ready made self contained FM transmitter enclosed in a small black metal case. It is powered by a single small 1.5V silver oxide battery, and has an inbuilt electret microphone. Specifications: Tuning range: 88-108MHz; Antenna: Wire antenna — attached; Microphone: Electret condenser; Battery: One 1.5V silver oxide LR44 / G13; Battery life: 60 hours; Weight: 15g; Dimensions: 1.3" X 0.9" X 0.4".

$26

INFRA RED TUBE AND SUPPLY

These are the key components needed for making an INFRA RED NIGHT VIEWER. The tubes will convert infro red light into visible light on the phosphur screen. These are prefocussed tubes similar to type 6929. Do not require a focus voltage. All that is needed to make the tube operational is a low current EHT power supply, which we provide in kit form. Draws 20mA from a small 9V battery. INCREDIBLE PRICING:

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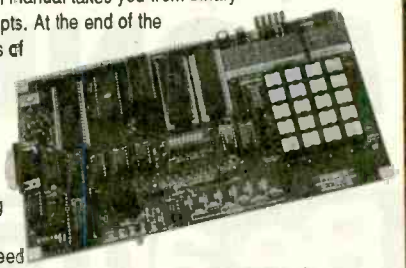

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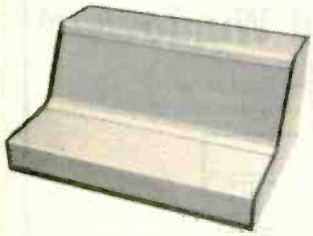

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MC-3A	8 x 3 x 2	20.95
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MC-5A	6 x 4 x 3	20.95
MC-6A	8 x 4 x 3	23.15
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4RU10 HD	19 x 10 x 7.0	129.00
4RU14 HD	19 x 14 x 7.0	134.00
5RU7 HD	19 x 7 x 8.75	126.00
5RU10 HD	19 x 10 x 8.75	133.00
5RU14 HD	19 x 14 x 8.75	143.00

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DS-2	6 x 6 x 4 x 1.2 x 1.9 x 2.4 x 1.6	63.25
DS-3	8 x 6 x 4 x 1.2 x 1.9 x 2.4 x 1.6	67.50
DS-4	10 x 6 x 4 x 1.2 x 1.9 x 2.4 x 1.6	71.50
DS-5	12 x 6 x 4 x 1.2 x 1.9 x 2.4 x 1.6	76.00
DS-6	18 x 6 x 4 x 1.2 x 1.9 x 2.4 x 1.6	61.00
DS-7	4 x 8 x 6 x 2 x 3.1 x 3.5 x 1.9	69.00
DS-8	6 x 8 x 6 x 2 x 3.1 x 3.5 x 1.9	73.00
DS-9	8 x 8 x 6 x 2 x 3.1 x 3.5 x 1.9	78.00
DS-10	10 x 8 x 6 x 2 x 3.1 x 3.5 x 1.9	82.75
DS-11	12 x 8 x 6 x 2 x 3.1 x 3.5 x 1.9	87.75
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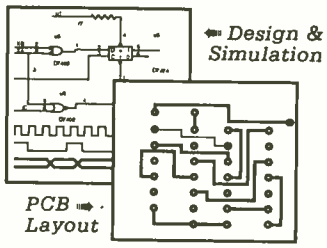

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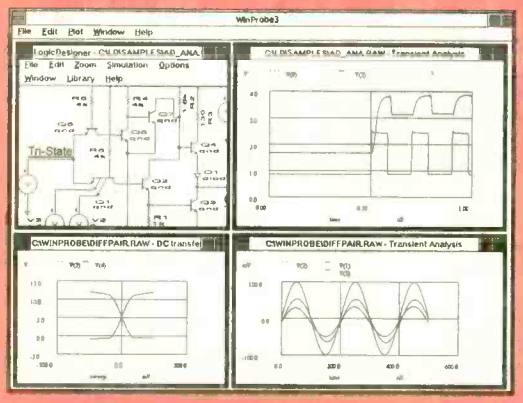

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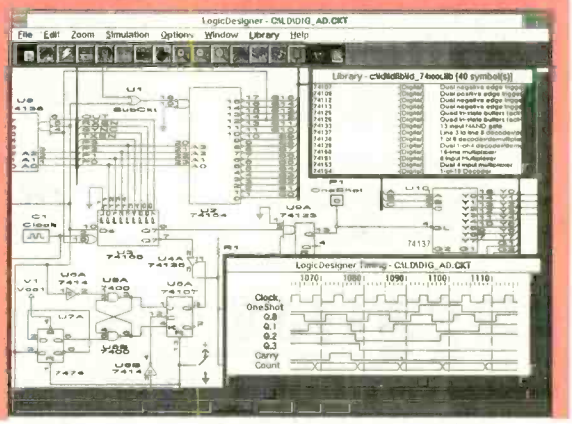

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- Adjustable from 88-108MHz.
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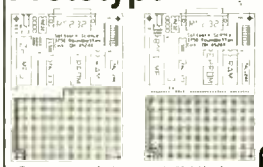

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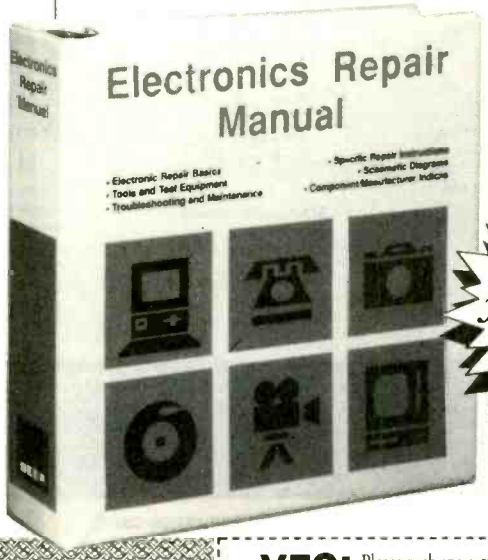

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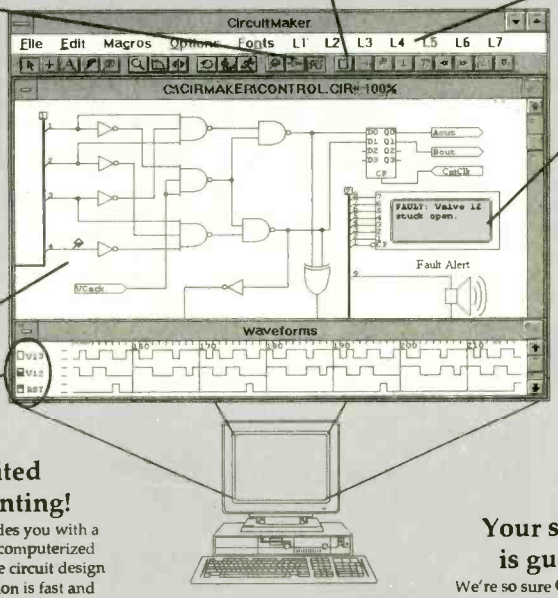

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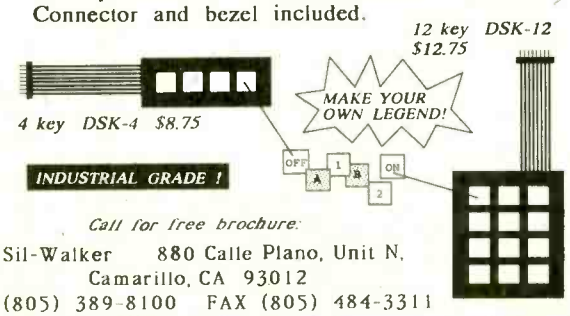

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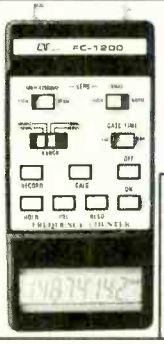

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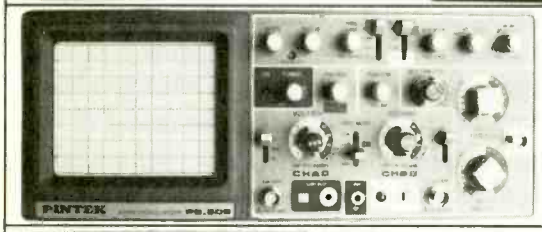

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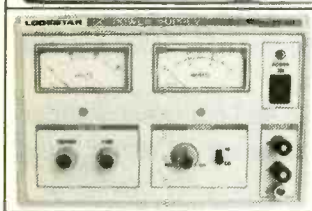

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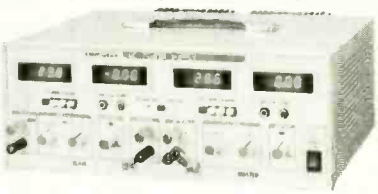

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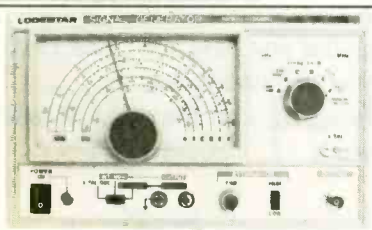

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We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.00per word. Minimum charge is $15.00 per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT

All classified advertising in the **PE Market Center** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by November 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.

AD RATES: $1.00 per word, Minimum $15.00.

Send your ads with payment to:
Popular Electronics Market Center, 500-B Bi-County Blvd. Farmingdale, NY 11735

CATEGORIES

100 — Antique Electronics
130 — Audio-Video-Lasers
160 — Business Opportunities
190 — Cable TV
210 — CB-Scanners
240 — Components
270 — Computer Equipment Wanted
300 — Computer Hardware
330 — Computer Software
360 — Education
390 — FAX
420 — Ham Gear For Sale
450 — Ham Gear Wanted
480 — Miscellaneous Electronics For Sale
510 — Miscellaneous Electronics Wanted
540 — Music & Accessories
570 — Plans-Kits-Schematics
600 — Publications
630 — Repairs-Services
660 — Satellite Equipment
690 — Security
710 — Telephone
720 — Test Equipment

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13 - $15.00	14 - $15.00	15 - $15.00	16 - $16.00
17 - $17.00	18 - $18.00	19 - $19.00	20 - $20.00
21 - $21.00	22 - $22.00	23 - $23.00	24 - $24.00
25 - $25.00	26 - $26.00	27 - $27.00	28 - $28.00

29 - $29.00	30 - $30.00	31 - $31.00	32 - $32.00
33 - $33.00	34 - $34.00	35 - $35.00	36 - $36.00
37 - $37.00	38 - $38.00	39 - $39.00	40 - $40.00

Ad No 1—Total words _____ × $1.00 per word = $ _____

All Caps words _____ × .20 per word = $ _____

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TOTAL COST OF AD No. 1 $ _____

Total classified ad Payment $ _____ enclosed.

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Card # _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Expiration Date _ _ / _ _

Signature _____

Name _____ Phone _____

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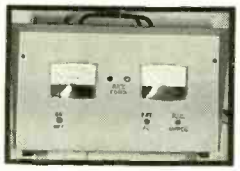

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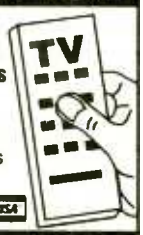

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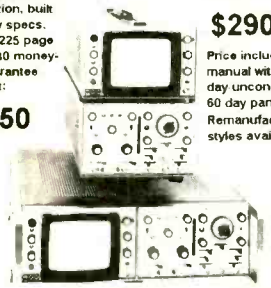

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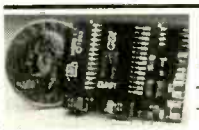

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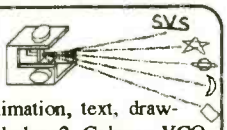

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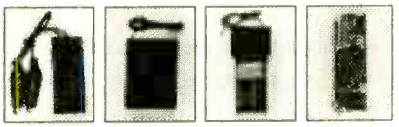

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