NIGHTVISION SCOPES • SOLID-STATE COOLER • MULTIMEDIA WATCH

April 1994

Popular Electronics®

ALL ABOUT NIGHTVISION SCOPES

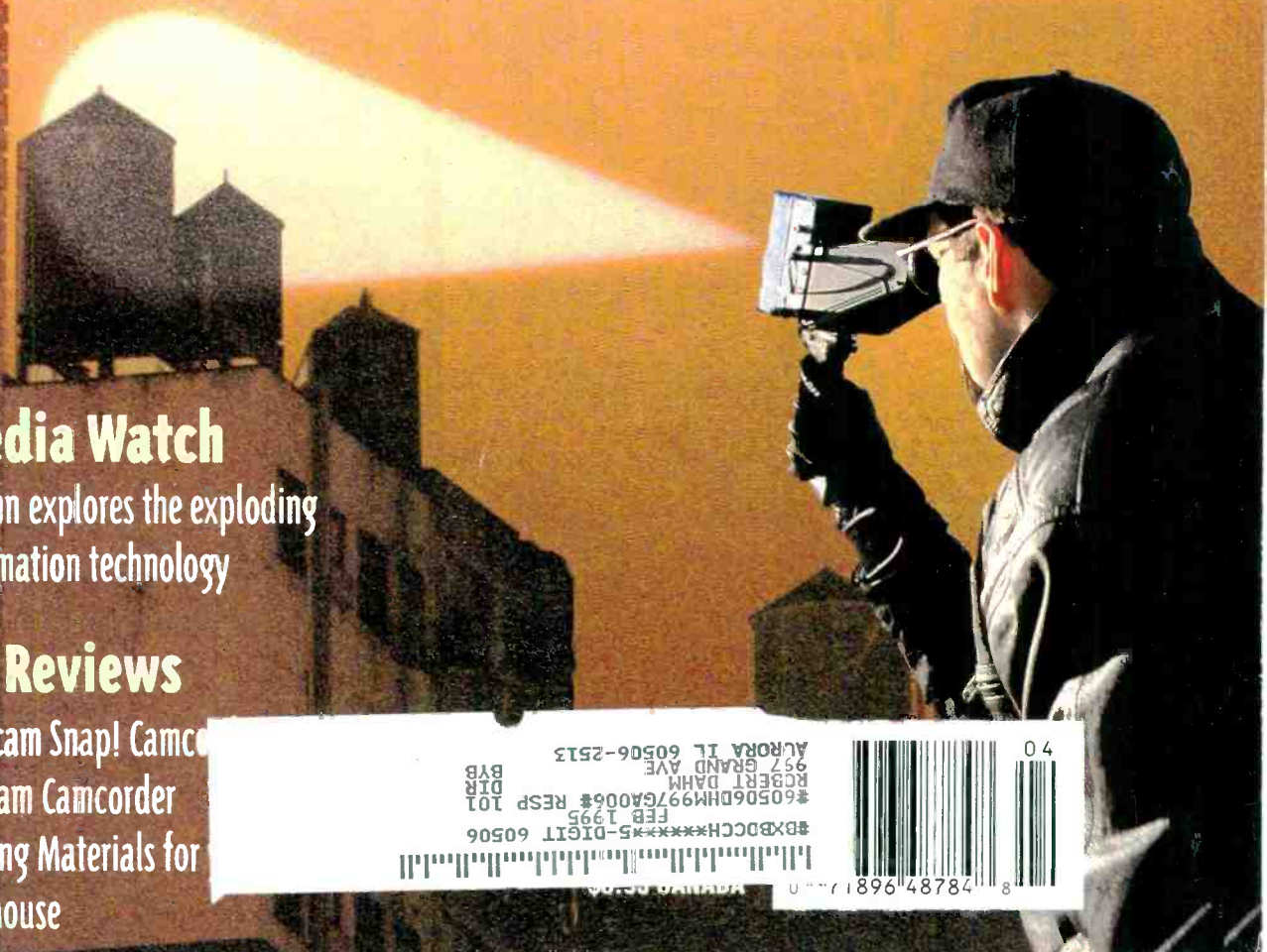
Learn how they work, and assemble your own unit

Build a Solid-State Cooler

Keep a six-pack of your favorite soft-drink cold whenever you hit the road

The ABC's Of Printers

This handy guide makes easy work of selecting the right computer printer



Multimedia Watch

Our new column explores the exploding world of information technology

Product Reviews

- Sony Handycam Snap! Camc
- Sharp Viewcam Camcorder
- Soundproofing Materials for
- Honeywell Mouse

What Do These Prestigious Companies Have In Common?

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

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AVX CORPORATION
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MLC, Tantalum and Thin Film Capacitors, Resistors, Networks, Trimmers, Oscillators, Resonators, Filters and Piezo Devices

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A COMPANY OF VISHAY
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DEARBORN WIRE AND CABLE L.P.

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Popular Electronics
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WATCHING MULTIMEDIA

If you are interested in computers, and you've been keeping up with the state-of-the-art, you know that the PC world has seemingly gone multimedia mad. CD-ROM drives are now standard on even new low-end systems. Hundreds of new CD-ROM titles have appeared since late 1993, and many old favorites have been re-issued in enhanced form on CD-ROM. What's more, hardware and software products are being sold in places that were unheard of just a short while ago. For example, the giant Blockbuster Entertainment chain has announced plans to rent and sell PC and MAC CD-ROM software and hardware by the end of this year.

All of that, however, is just the tip of the iceberg. We are entering an era in which how we learn, how we work, and how we are entertained may be changed forever. As computer, video, audio, telephone, and other technologies converge, and as we all plug into the "information superhighway," multimedia will likely play an ever-more important role in our lives. Unless, of course, we screw it up.

Make no mistake about it, multimedia is still an immature technology. For now, it is largely computer based—and adding multimedia equipment to an existing PC or compatible can be a beastly task that is full of pitfalls for the uninitiated. Further, the software is uneven, to say the least. There are some fabulous titles, especially in the entertainment and educational areas, that take full use of the power of multimedia. Others, however, are mediocre, or worse.

That's where **Popular Electronics** comes in. This month marks the debut of a new feature, *Multimedia Watch.* In it we'll take an ongoing look at the exploding world of multimedia and offer tips on what equipment and software to look for, what to avoid, and how to get the most out of the technology. It all begins on page 5.

Carl Laron
Editor

LETTERS

ADDRESS CORRECTION

An error crept into the address for the supplier for the "Motorcycle Alarm" article that appeared on page 38 of the February, 1994 issue of **Popular Electronics**. *The correct address is Kasper Electronics, 400 West Willox Lane, Fort Collins, CO 80524.—Editor*

CASINO CIRCUIT CORRECTION

I would like to make a correction to my article, "Electronic Casino Circuit" (**Popular Electronics**, March 1994). On the circuit diagram and PC-board foil patterns, the decimal point inputs (pins 2 and 6) of each LCD display should be tied to the display common (pin 1). That keeps the decimal points from occasionally flickering on and off due to drifts in the voltages at the input pins.
Jay Kirschenbaum

BACK TO THE FOLD

I became interested in electronics at an early age and have been an avid enthusiast ever since. My first subscription to **Popular Electronics** was when I was still in elementary school. Some of my first issues, from the early 1960's, are still in my attic. I think the subscriptions cost about $6, which was a lot of money for an 8-year-old.

Popular Electronics raised me from a curious kid into a technical adult. While still in college, I had an interest in semiconductor lasers and their application in detection circuits. After some communications with a **Popular Electronics** contributing editor (Forrest Mims), I completed an outdoor alarm-system project. That project eventually led me to establish by own electronic-security business and central-station alarm company, which I sold a number of years ago.

Over the years, **Popular Electronics** substantially changed several times. Gradually, I stopped reading it, even though I have been involved in some way with electronics most of my adult life.

The other day, a subscription mailer reached my desk at the office. I hadn't seen a copy of the magazine in years. So I picked up a copy of **Popular Electronics** at a local store and was pleasantly surprised. It's the same great magazine that I used to read each month. The experimenter's columns, the projects, amateur radio, and product reviews are still there.

I am phoning in my subscription order this morning.
R.E.S.
Baton Rouge, LA

A DELIGHT

I found the article "What Are Electrons Made Of?" (**Popular Electronics**, December 1993) to be absolutely delightful! My undergraduate studies were in Electronics Engineering, and I took some extra math and physics courses out of interest.

Such timely and well-written articles remind one of the awesome, almost miraculous, reality of our physical universe. They make the contemplation, construction, and use of electronics devices even more fascinating.
A.B.B, MD
Westerville, OH

HAVES & NEEDS

I have a 1958 Wollensak stereo tape magnetic recorder model number T-1515 (cross reference T-1515-4), and I am looking for a 1⅞ and 3¾ I.P.S. conversion kit (part number 17956-0). It's mainly the motor pulley that goes on the motor shaft. I don't know if anyone stocks them anymore, since Wollensak discontinued the tape-recorder line several years ago.
MIKE DALEY JR.
36 North Shore Avenue
Danvers, MA 01923

I need the schematic for a Hallicrafters HF-32 transmitter, circa-1958 vintage. I'll be glad to pay expenses involved. Thanks!
ALTON SMILEY, K8NOV
9970 Page Road
Marlette, MI 48453

I'm seeking the schematic circuit diagram for an Eico Model 322 signal generator. I will pay for copying and postage costs.
LARRY WEILER
2600 Kirchoff Road
Rolling Meadows, IL 60008 ■

MULTIMEDIA WATCH

By Marc Spiwak

Let's Get Into Something New!

Welcome to a new column on multimedia. Before we get too far along, however, it is important that we define what we mean by multimedia. For our purposes, multimedia can involve any subject, as long as there's more than one form of information involved. Text by itself is not considered multimedia, but as soon as you add some pictures to it, it is. Now most of us have seen text and pictures used together before—a comic book is a good example. So why has the term "multimedia" become so popular in the last couple of years, when the concept is really not new?

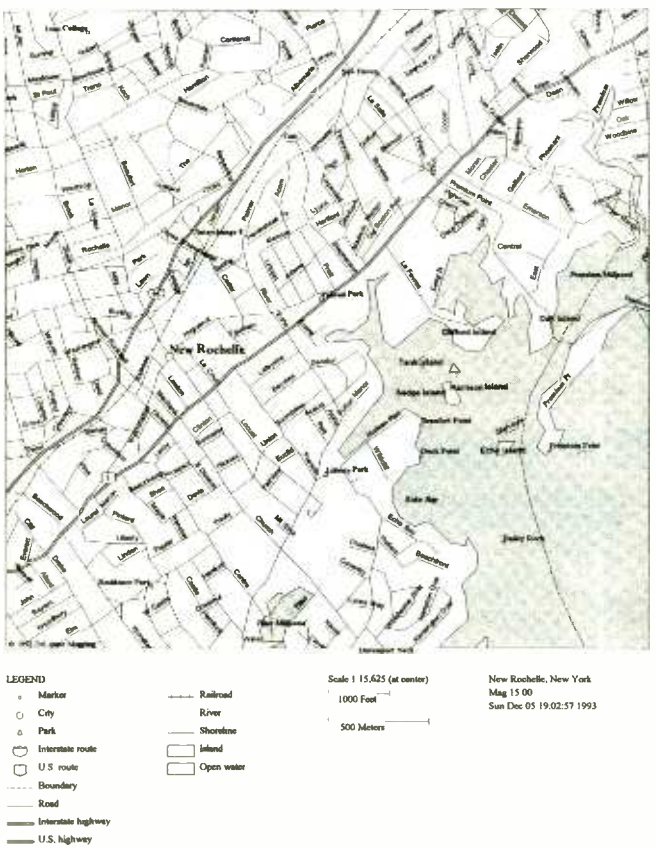

Fig. 1. With this map of New Rochelle made using MapExpert, and the written directions, we got to the wedding on time.

The excitement has been caused by the new types of multimedia that technology has made possible. Consider our comic book, but instead of pictures and words, consider video, animation, and sound. There's still no big deal, but what if you give the "reader" the ability to control the ways in which the story unfolds—see the action from any character's perspective, or even become a character in the story and interact with the others? Further, what if our decisions either on behalf of a character or as a character could significantly alter the outcome of the story? As you can see, you would have something new and exciting.

For the meantime, most of our multimedia activity will be centered around the personal computer, because it's the most versatile multimedia tool we've got. But some time in the near future, computers, TV's, telephones, fax machines, modems, printers, and the information highway will all be combined into one big multimedia system.

Just think, you'll come home from work—unless your job is one of the many that can be done from home—sit down in a super-comfortable virtual-reality chair, check your E-mail, do some shopping, order dinner, play an interactive game with someone on the other side of the globe, finish voice-typing that business report, and watch an HDTV movie before going to bed. While you still might want to conduct business and pleasure in separate locations, you won't be forced to anymore. You also might like to move around from time to time during the day, but that's another story entirely. The point is, if you want to do everything from one place you'll be able to—well almost anything.

HOW WE GOT HERE

This column is the offspring from our February story on multimedia and CD-ROM's. At the time I wrote that article, I contacted various CD-ROM publishing companies and asked to see samples of what's out there. For the moment, CD-ROM's are the ideal medium for multimedia, as they can hold nearly 700 megabytes of data and can be produced for only a couple of bucks apiece in volume. They're actually cheaper, easier, more reliable, and faster to use than floppy disks, so you're sure to see a lot of them coming your way soon. Virtually every new high-end PC has a CD-ROM drive installed, and 5¼-inch disks are disappearing. It's obvious that the CD-ROM is a new standard. And while it's still expensive to record your own CD-ROM discs—although hardly impossible—I'm sure we'll see $500 recording systems in the next few years.

Anyway, I looked at a lot

of interesting stuff in preparing that article. While much of the eye-popping stuff is game and entertainment oriented, there's quite a bit of more mundane, yet very useful, productive software that takes advantage of the strengths of CD-ROM to do things that would otherwise be impossible, or at least more difficult. For example, take *Map Expert* from DeLorme Mapping. I went to a wedding yesterday in New Rochelle, New York. I live about an hour from there, and don't know the streets at all, but with Map Expert, I was able to print out a map of the area that showed street names. That, plus the directions we had, and we had no trouble getting there at all. Had the wedding been in any state in the country, I would have been able to do the same. The disc has maps containing nearly every street in the country.

After that article was finished, new CD-ROM discs kept rolling in and consumer interest came to a boil. During the same time period, double-speed drives have became the norm, triple-speed drives have been introduced, and quad-speed drives are on the way. It was therefore decided that we have to keep a watch on multimedia, hence the *Multimedia Watch*.

We'll be getting into a lot more than just new CD-ROM's. Among some of the future topics we'll be discussing are desktop video and audio on a PC, triple- and quad-speed drives, telecommunications, a monthly CD-ROM magazine called *NautilusCD*, the Information Highway, and more. Consider this column a forum for multimedia. I'll do my best in answering your multimedia comments and questions; you can write to me at **Popular Electronics**, 500-B Bi-County Boulevard, Farmingdale, New York 11735.

WHAT YOU NEED

You need a pretty good set-up to get the most out of multimedia. My PC is a 486 DX2-50, with 16 MEG of RAM, a 200-MB hard drive, a 15-inch Super VGA monitor, two floppy drives, a 1 MB VRAM ATI Ultra Pro video adapter, a tape-backup system, a double-speed CD-ROM drive, and a 16-bit stereo sound card. At the moment, I've also got a Media Vision Pro MovieStudio installed that lets me create AVI files. I'll talk about that next month. An HP Laserjet IIIp with 5 meg of memory completes the system.

While some of you might be flabbergasted by the collection of hardware in my PC, let's not kid ourselves—you can't play with state-of-the-art stuff on a less-than-state-of-the-art machine. While you can certainly get by with a fast 386, you'd be crazy to buy anything less than a 486 if you're shopping for one now. Besides, I wouldn't recommend that you buy anything less than I would for myself. So here's what I recommend you buy if you're shopping for a PC:

- A 486 DX, not an SX
- 8 meg of RAM
- A 15-inch monitor
- A double-speed, multi-session CD-ROM drive
- A 16-bit stereo sound card
- And the biggest hard drive you can afford! (200 meg bare minimum)

If you are shopping for a PC, it makes sense to get one with everything installed for you, including a CD-ROM drive and sound card. You'll find that it saves you a lot of time and

money. Add up the prices of the individual components included in a multimedia PC and you'll find that you can't possibly match the price of a system by piecing one together.

One last accessory I'd like to mention is a must for all die-hard game players: The *Advanced Gravis Analog Joystick and Eliminator Game Card*. I'm not even that big into games, and I've broken a couple of those cheesy joysticks, which don't seem to work well with fast machines anyway. The problem is that fast machines are too fast for the old game ports that worked well with XT's. When the standard game port is used on a 486, regular joysticks seem to take on a fly-by-rubber-band feel, and are way too sensitive for best results.

The Eliminator Game Card lets you connect up to two joysticks and works with all IBM compatibles operating with speeds from 4.77 to 50 MHz. A really neat speed-adjuster dial is connected via a cable to the back of the game card. That lets you fine-tune the joystick control to the speed of the machine. All I can say is that it works like a charm, and my game playing improved dramatically with this one inexpensive addition. The Analog Joystick is special too. It is extremely sturdy and well-made, and very stable on a surface. All button functions can be programmed, and the handle-tension is fully adjustable from very stiff to completely loose where it stays wherever you leave it—useful for certain CAD functions. The joystick/game-card combo from Advanced Gravis sells for under a hundred dollars and is well worth the cost. It screams class as soon as you open the box.

I WANT MY MPC

If you already have a PC worthy of an MPC upgrade (no less than a 386), buy an entire multimedia upgrade package. That should include a CD-ROM drive, a sound card, various discs, and perhaps powered speakers. If speakers aren't included, you'll also need speakers and an amplifier or amplified speakers. An upgrade package includes everything you need to get started, and software installation is usually a painless procedure. You'll want an upgrade package that complies with the MPC-2 specifications.

The original MPC specifications called for a CD-ROM drive with an average seek time of less than 1 second and a data-transfer rate of 150 kilobytes per second, all while using less than 40 percent of the CPU's resources. MPC-2 calls for a double-speed drive with at least a 300 kilobyte-per-second transfer rate, and multisession and XA compliance.

As for a sound card, it's best if the one included in an upgrade is a 16-bit stereo card. An 8-bit mono card sounds dull and flat. Today you can buy an MPC-2 multimedia upgrade package with a stereo sound card and speakers for under $500, and that's what I recommend you buy.

A NOTE TO MAC OWNERS

I hope that all of this PC talk hasn't completely turned you off. I am well aware that in the Mac is in many ways superior to the PC when it comes to multimedia. It is just that my experience is in the PC world.

That's not to say that the Mac and Mac software will be ignored here. I am working on getting a Mac, and if all goes well we will be giving equal space to your machine before too long. In the meantime, much of what we will review and talk about here is still relevant to you since in many cases Mac versions are available.

NEWS

Every month I intend to report on things I've seen and read, so here goes for this month. A recent article in The New York Times stated that the United States is at least ten years ahead of Japan in computers and networking. Finally there's something we're good at.

Where To Get It

Advanced Gravis
101-3750 North Fraser Way
Burnaby, British Columbia
Canada V5J 5E9
604-431-5020

Aris Entertainment, Inc.
310 Washington Blvd., Suite 100
Marina Del Rey, CA 90292
310-821-0234

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

Grolier Electronic Publishing, Inc.
Sherman Turnpike
Danbury, CT 06816
203-797-3500

InfoBusiness
887 South Orem Blvd.,
Suite B Orem, UT
84058-5009
801-225-0817

Media Vision
47300 Bayside Parkway
Fremont, CA 94538
510-770-8600

NautilusCD
7001 Discovery Blvd.
Dublin, OH 43017
800-637-3472

Quanta Press, Inc.
1313 Fifth Street SE, Suite 208C
Minneapolis, MN 55414
612-379-3956

World Library, Inc.
12914 Haster Street
Garden Grove, CA 92640
714-748-7197

Computers and networking will surely play a major role in the future global economy, and it's nice to see that we're in the lead.

Moxy, the world's first live cartoon was debut to a potential worldwide audience of 74 million homes in 55 countries. Who's Moxy? He's a strange looking animated dog with the voice of Bobcat Goldthwait. What's new is that the animation is done on the fly by a computer, as a live actor in a sort of virtual-reality suit controls the animation. Moxy can move around, change his appearance and facial expressions, and answer questions in direct response to viewers. Moxy can be seen on the Cartoon Network.

NEW STUFF

As I mentioned before, after I completed the article on multimedia, the discs kept coming. So here's what I've seen since then. I've been playing a hot new CD-ROM game from Media Vision called *Critical Path*. This $79.95 game uses the Quicktime format to let you play an interactive action game with real live-action video. A woman pilot named Kat, who has 9 lives, has to crash land her helicopter. The intro to the game is actual video and audio of the helicopter going down. You then have to help Kat make her way through a dangerous, booby trapped factory through the use of a video link and radio transmitter.

Quanta Press has sent us lots of discs. One of them, *FracTools III* lets you generate, play with, and print a variety of fractal images. Anyone who has never seen fractal images displayed on a PC should check out this $79.95 disc. Quanta also puts out a

(Continued on page 92)

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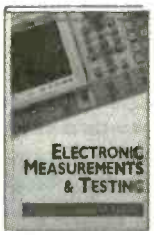
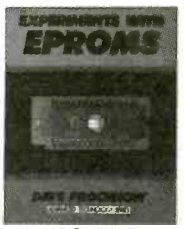
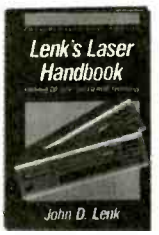


003961H $40.00



2962P $18.95
Softcover



037505H $39.50

070439H-XX $60.00
Counts as 2

10010P $22.95
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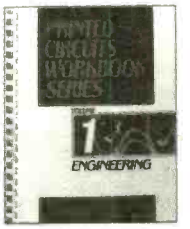
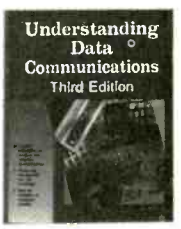


012739H $26.95

3837H $27.95

031716H $50.00



586312H $24.95

9255H-XXX $105.50
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011200H $45.00

044847H-XX $40.00
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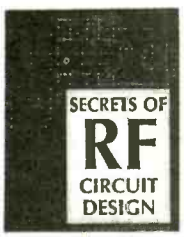
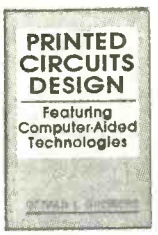
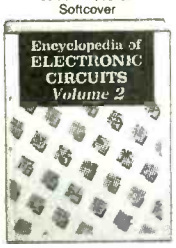


3710P $19.95
Softcover



10016H $43.00

060333H $50.00



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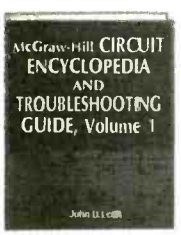
3991H $39.95

0415250H-XX $57.75
Counts as 2

037504H $39.50

4228H $32.95

012742H $26.95



037603H-XX $59.50
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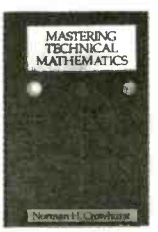

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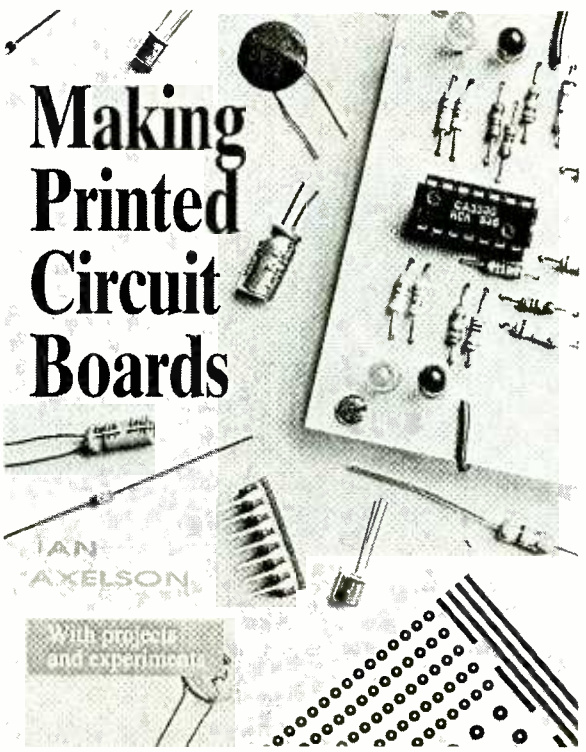
ELECTRONICS LIBRARY

Making Printed Circuit Boards

by Jan Axelson



Even if you've never built a printed-circuit board, you'll be able to master the fast, easy, and inexpensive construction techniques presented in this book. Aimed at students and weekend experimenters as well as technicians, the book takes you step-by-step from schematic diagram to finished project. It explains how to draw circuit diagrams, transfer your artwork to PC blanks, etch copper patterns, choose components, drill holes for leads and mounts, and solder components to the board. The book also covers troubleshooting, repairing, and modifying boards. It discusses making double-sided boards, choosing and using photoresists, working with surface-mount components, and safely handling and disposing of etching chemicals.

The book includes projects and experiments to help you get started, providing all the information needed to go from schematic to ready-to-use PC boards for a five-volt power supply, an all-purpose pulser/flasher, and a two-channel logic probe.

Making Printed Circuit Boards costs $19.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.

CIRCLE 98 ON FREE INFORMATION CARD

TEST AND MEASUREMENT CATALOG NO. 24

from Leader Instruments Corporation

This 120-page, full-color catalog features complete product descriptions and technical specifications for 81 instruments, including ten new products. The full-line catalog includes general-purpose test instruments, such as analog and digital storage oscilloscopes; to audio, function, video, and RF generators; audio analyzers; video-monitoring equipment; programmable RGB generators; meters and bridges; frequency counters; and bench power supplies.

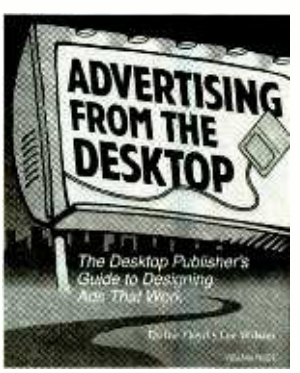
The Test and Measurement Catalog No. 24 is free upon request from Leader Instruments Corporation, 380 Oser Avenue, Hauppauge, NY 11788; Tel: 516-231-6900 (in NY) or 800-645-5104.

CIRCLE 90 ON FREE INFORMATION CARD

ADVERTISING FROM THE DESKTOP: The Desktop Publisher's Guide to Designing Ads that Work

by Elaine Floyd and Lee Wilson

Aimed at any desktop publisher who is faced with the challenge of promoting a business, association, school, or non-profit organization, this book is filled with marketing and design advice. It assumes that the reader has identified the target audience and has some experience in writing advertising copy (although a useful appendix provides sources for training in that area). Instead, the focus is on making design decisions.

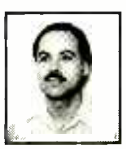


After exploring how a solid marketing plan can increase the power and performance of ads, the book goes on to offer advice on how to create layouts that command attention and attract buyers, and make headlines and logos hit the mark. It ex-

Just like these Fully Trained Electronics Professionals

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

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



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Daniel N. Parkman
Missile Electro-Mechanical Technician
U.S. Air Force

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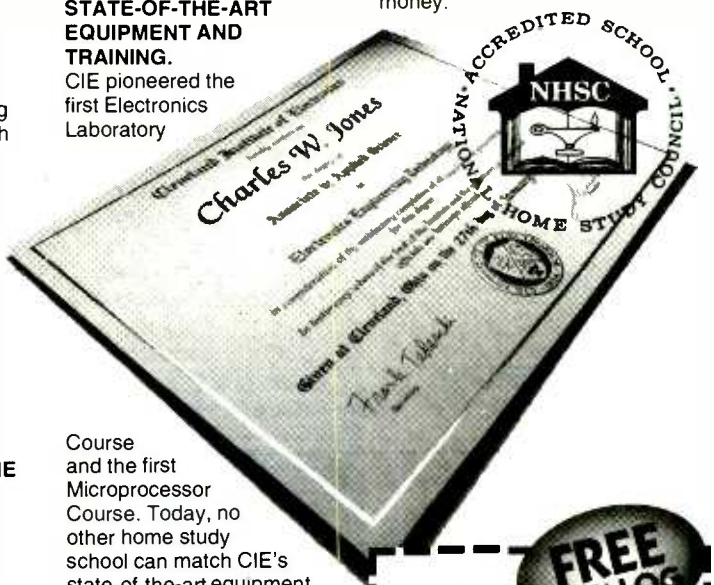
While some of our students have a working knowledge of electronics others are just starting out. That's why CIE has developed twelve career courses and an A.A.S. Degree program to choose from. So, even if you're not sure which electronics career is best for you, CIE can get you started with core lessons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



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plains when to use—and when to avoid—special effects, and how the judicious use of color can influence prospective customers. The book explains how to put the designer's knowledge to work creating effective and attractive advertisements, flyers, exhibits, and sales materials.

Several practical appendices are provided. The first covers software, listing sources for page-layout, word-processing, special-effects, clip-art, image-database and specialty programs; services such as bulletin board systems, and on-line forums; multimedia companies and software; and clip media. Also listed are books and periodicals; associations, consultants, and training programs; advertising software features; and a glossary of desktop advertising terms.

Advertising from the Desktop 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 91 ON FREE INFORMATION CARD

FCC TEST MANUALS

by Martin Schwartz

All the latest changes in FCC Amateur Radio test-preparation requirements are incorporated into the new, revised editions of Ameco's License manuals. Separate manuals are available for the Novice Class (Cat. #27-01), the Technician Class (Cat. #28-01), and the new No-Code Technician Class (Cat. #78-01). Each book covers all the current FCC examination questions for its class, with corresponding multiple-choice answers. A clear, precise explanation is provided for each correct answer, which helps the reader fully understand the theory and concept behind the question. All questions and answers are conveniently arranged so that the reader does not have to flip back and forth between pages.

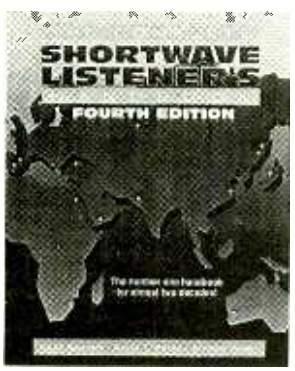
The Novice Class and Technician Class manuals each cost $5.95, and the No-Code Technician Class manual costs $9.95. They are published by Ameco Corporation, 224 East Second Street, Mineola, NY 11501; Tel: 516-741-5030; Fax: 516-741-5031, and are available at local ham-radio equipment dealers.

CIRCLE 92 ON FREE INFORMATION CARD

THE COMPLETE SHORTWAVE LISTENING HANDBOOK: Fourth Edition

by Hank Bennett, David T. Hardy, and Andrew Yoder

Whether you're a beginner who needs advice on choosing a shortwave receiver or a more advanced listener looking for guidance on antenna design, this book provides all you need to know to listen in on broadcasts from around the world. The fourth edition of this popular shortwave-radio handbook has been revised and expanded



to include the latest information on shortwave equipment, stations, procedures, and operating practices. It features updated frequency listings, broadcast schedules, and club data, as well as the NASWA Radio Country List. The book explains how to set up and use receivers and antennas to tune into foreign and domestic broadcasts. It shows how to prepare and send QSL reports, prepare reception reports, and keep a logbook. The book covers monitoring the VHF and UHF bands, and using FM and TV DX equipment. Several handy appendices include listings of FAA stations offering continuous weather broadcasts on the longwave band, world times, commonly used SWL abbreviations, Q signals, international Morse code, amateur callsign allocations, and FCC field offices.

The Complete Shortwave Listener's Handbook, Fourth Edition costs $19.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 800-233-1128.

CIRCLE 98 ON FREE INFORMATION CARD

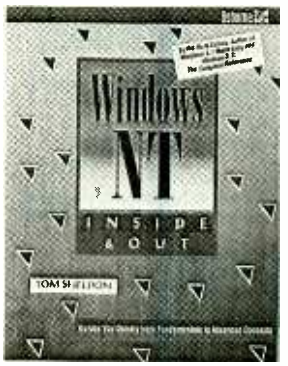
WINDOWS NT INSIDE & OUT

by Tom Sheldon

Microsoft's Windows NT operating system is totally different from Windows 3.1 in the way it uses hardware and runs applications. It doesn't require DOS, although it will run DOS applications as well as applications written for other operating systems such as UNIX. Compatible with current applications, Windows NT can provide a computing environment for the future.

Written for anyone who is considering using Windows NT, this book provides step-by-step coverage of the fundamentals that allows readers to get started quickly and build on the those skills to move to intermediate and more advanced topics. The book explains how to use Windows NT to run all Windows applications more effectively, and how to run multiple applications at the same time. Well-chosen illustrations and practical examples accompany the text.

The book is divided into four sections. The first provides an introduction to the NT environment—how it works, hardware requirements, basic features, and its security and virus-protection systems. Part II is devoted to the basic concepts for using the Windows NT interface. It includes a basic overview and then explains how to start applications, use common interface options, use the NTFS file system, access and use printers, share information with other network users, and access a DOS-like command



prompt for executing DOS and other operating-system commands. The second section also includes a look at utilities and accessories. Part III focuses on customizing, configuring, and managing Windows NT, and includes topics for system and network administrators. The fourth section covers two network applications—Microsoft Mail and Microsoft Schedules.

Windows NT Inside & Out costs $27.95 and is published by Osborne McGraw-Hill, 2600 Tenth Street, Berkeley, CA 94710; Tel: 510-549-6600; Fax; 510-549-6603.

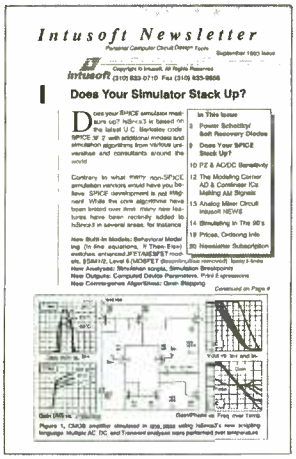
CIRCLE 93 ON FREE INFORMATION CARD

INTUSOFT NEWSLETTER

from Intusoft

The Intusoft Newsletter is a free publication dedicated to discussing topics related to the SPICE circuit-simulation program. For instance, the September 1993 issue, pictured here, contained several articles designed to help engineers simulate circuits more efficiently. The first article discussed the power Schottky and soft-recovery-rectifier diodes and how to model them in SPICE. The "Intusoft Modeling Corner" is a regular column in the newsletter. In the sample issue that we saw, the column covered new SPICE models released by Comlinear and Analog devices and explored a sample application of an analog mixer using the Comlinear CL532 and a newly developed AM-signal generator.

A floppy disk containing all of the schematics and SPICE netlists in the newsletter and some not covered in the newsletter, along with the new


Intusoft Newsletter

Does Your Simulator Stack Up?

Comlinear and Analog Devices models, is available for a nominal fee. The newsletter disk contains 40 new models from Analog Devices for a variety of IC's and a Comlinear library of more than 20 models.

A complimentary copy of the Intusoft Newsletter is available. A yearly subscription for the newsletter and floppy disk costs $44 (domestic) and $55 (foreign) and is available from Intusoft, P. O. Box 710, San Pedro, CA 90733-0710; Tel: 310-833-0710; Fax: 310-833-9658.

CIRCLE 89 ON FREE INFORMATION CARD

1994 POLICE CALL FREQUENCY DIRECTORY

edited by Gene Hughes

The 1994 edition of the Police Call Frequency Directory is the largest in the reference's 31-year history, reflecting the thousands of frequency additions and changes in the FCC's Public Safety Radio Services (current through October 1993). The radio codes and signals, consolidated frequency list, and listener's guide sections have also been updated and expanded.

The book is published in nine regional volumes that cover the continental United States. Each volume is divided into nine sections. Part I contains information from copies of licenses issued by the FCC, arranged alphabetically by state and name of licensee. The data includes frequencies, call signs, transmitter locations, and types of stations. In Part II, the data from Part I is cross-referenced by frequency. The book also contains separate sections for frequencies used by the federal government, railroads, and aircraft. A consolidated frequency list tabulates the usage of 4000 FCC and federal frequency allocations, while the Radio Codes and Signals section of the directory provides 14,000 entries listed by user.

The 1994 Police Call Frequency directory costs $9.95 and is published by Hollins Radio Data division of Mobile Radio Enterprises, Inc., P. O. Box 35002, Los Angeles, CA 90035.

CIRCLE 88 ON FREE INFORMATION CARD

ECG AUDIO AND VIDEO REPLACEMENT PARTS & SERVICE AIDS

from Philips ECG

The expanded line of ECG audio/video parts and service aids covered in this catalog now features replacements for more than 3500 industry model/part numbers for 31 VCR and camcorder brands. Additions to the line include a compression-spring kit, a felt washer kit, assorted parts kits, head pullers for VHS-C and 8mm camcorders as well as for standard VHS units, a retaining-ring puller, and a spring hook. An expanded mechanical parts replacement line is also featured. Included in the line are VCR modulators, pinch rollers, opto-sensing devices, idler wheels/assemblies and tires, springs, washer kits, individual belts, belt kits, and VHS and Beta replacement heads. Featured service aids include precision VCR tools, VCR and audio test cassettes, alignment jigs, lubricants, and cleaning materials. The catalog provides product descriptions, pictorial selection guides, specifications, cross-reference sections, and related replacement information.

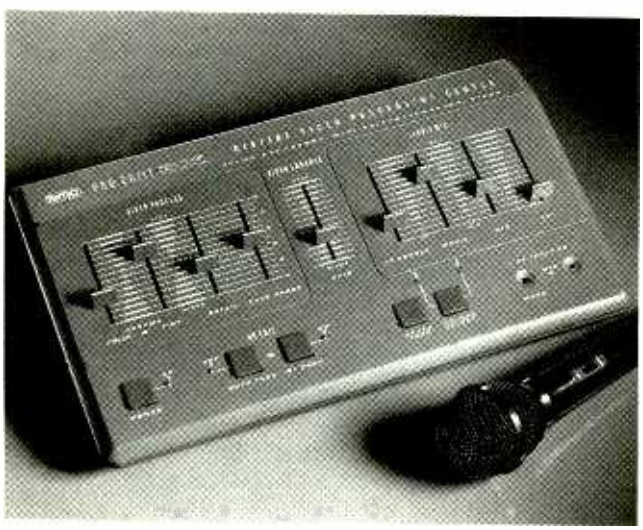
The ECG Audio and Video Replacement Parts & Service Aids catalog is free upon request from Philips ECG, 1025 Westminster Drive, Williamsport, PA 17701; Tel: 800-526-9354. ■

CIRCLE 87 ON FREE INFORMATION CARD

NEW PRODUCTS

Digital Video-Processing Center

Home video editors can create near-professional quality videotapes using *Sima's Pro Ed/it 3X*, a combination editor and color processor that features digital technology and variable-speed timing of fades from one to six seconds. During editing, the device creates automatic touch-button video and audio fades at the desired speed at the desired point in the tape. A patented bypass feature allows home editors to visually zero in on specific scenes to be inserted or deleted from the final edited tape.



The Pro Ed/it 3X's full-featured digital-video color processor enhances picture and color quality of the edited tape. Simple slide controls are used to adjust color intensity, tint, and detail. A video-enhance control boosts the video signal to restore washed-out colors. Digital color-processing capabilities allow the amateur video buff to create the best possible picture when editing.

Other features include two switchable input sources for easy editing from two tapes, and cross-fading, which allows one input source to be faded out and another to be faded in with the touch of a single button. Dual outputs allow the user to make two simultaneous copies of the edited tape. An audio mixer enables editors to add music and/or narration using the included high-fidelity microphone.

The Pro Ed/it 3X has a suggested retail price of $250. For further information, contact Sima Products Corporation, 8707 North Skokie Boulevard, Skokie, IL 60077; Tel: 708-679-7462; Fax: 312-286-7227.

CIRCLE 100 ON FREE INFORMATION CARD

INDOOR POWER STEREO ANTENNA

Terk Technologies calls its *AM-FM Q* the industry's most advanced power stereo antenna and a new reference standard in indoor radio-antenna performance. The AM-FM Q can receive up to 25% more stations than the company's Pi antenna even in the most difficult reception areas. The AM-FM Q offers both wideband- and narrowband-reception modes. In wideband mode, the antenna enhances the reception of all radio broadcasts, while its pick-up pattern makes it easy to attain maximum signal clarity.

For noisy or hard-to-receive broadcasts, the AM-FM Q offers "Pin-Dot Pre-Tuning" that enables the antenna to precisely lock in on broadcast frequencies, minimizing the noise and interference caused by unwanted signals. The Pin-Dot Pre-Tuning circuit varies the resonant frequency of the antenna system for maximum efficiency ("Q") in the desired frequency range. That extra tuning stage, coupled with an ultra-low-noise amplifier, results in a high level of clarity and signal purity.

The AM-FM Q consists of three complementary elements: a curved, matte-gray FM antenna plate; a "corrugated," high-gloss, black-lacquer AM antenna wing; and a convex aluminum base. For optimum reception of AM and FM broadcasts, the antenna uses Terk's Non-Coinduction™ feature, which maximizes gain from each antenna element by eliminating interaction between them.

The AM-FM Q indoor powered radio antenna has a suggested retail price of $99.95. For more information, contact Terk Technologies, 65 East Bethpage Road, Plainview, NY 11803; Tel: 516-756-6000; Fax: 516-756-6007.

CIRCLE 101 ON FREE INFORMATION CARD

COMUNICATIONS DECODER

With the ability to simultaneously read 50 sub-audible (CTCSS) tones, 106 digital (DSC) codes, and 16 Touch Tone (DTMF) characters, *Optoelectronics' Model DC440* communications decoder has applications in two-way communications tests, repeater monitoring, updating older service monitors, enhancing recreational monitoring, and security and surveillance monitoring. In its all-mode-decode mode, the unit monitors the demodulated audio output from a communications receiver, service monitor, scanner, or interceptor. CTCSS tones, DCS codes, and any DTMF characters are automatically detected and displayed on a two-line alphanumeric LCD readout. The Model DC440 offers five other operating modes, including CTCSS/DTMF, DCS/DTMF, Period Measurement, DTMF Only, and DTMF Recall.

A serial data jack allows the DC440 to be connected to a PC's serial port using the optional *Model CX12* RS-232 interface. A complete set of control codes permits remote operation from a PC. *ToneLog*™ data-logging software can be used to survey a busy communications channel. For monitoring multiple channels, the DC440 is compatible with popular Scan Star software.

The DC440 communications decoder, CX12 RS-232 interface, and ToneLog™ software cost $259, $89, and $49, respectively. For more information, contact Optoelectronics Inc., 5821 NE 14th Avenue, Fort Lauderdale, FL 33334; Tel: 800-327-5912; Fax: 305-771-2052.

CIRCLE 102 ON FREE INFORMATION CARD

ENVIRONMENTALLY SAFE DEOXIDIZER

Pretreating with *Caig Laboratories' DeoxIT D100S* contact cleaner, deoxidizer, and preservative will reduce intermittent connection problems, and increase transmission quality and product reliability. The environmentally safe aerosol provides short bursts of 100% pure, concentrated DeoxIT solvent via a precision metered valve. The solution contains no CFC's or

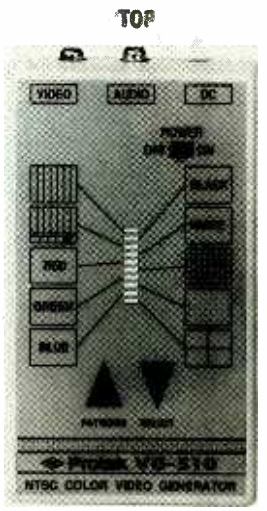
HCFC's. The spray's active ingredients lubricate, clean, deoxidize, preserve, and improve conductivity on metal connectors and contacts—without the need for carrier solvents. DeoxIT can be used on switches, relays, batteries, connectors, plugs and sockets, edge connectors, terminal strips, interconnecting cables, and other metal surfaces.

DeoxIT D100S has a suggested price of $11.95 per can. For additional information, contact Caig Laboratories, Inc., 16744 West Bernardo Drive, San Diego, CA 92127-1904; Tel: 619-451-1799; Fax: 619-451-2799.

CIRCLE 103 ON FREE INFORMATION CARD

HANDHELD NTSC VIDEO-TEST GENERATOR

The pocket-sized *Model VG-510* NTSC video and audio generator from *Protek* will provide more than 40 hours of operation on four AA batteries. It offers ten test patterns: SMPTE; black burst; full-field color bars; red, green, blue, and white fields; center pulse cross; cross hatch; and dots. Intended for testing, adjusting, and repairing video



equipment, the VG-510 is also a handy tool for video editing. Black burst can be used to lay down black on tapes and to record SMPTE color bars with tone at the beginning of the tape. Audio output is 1 kHz with an adaptor included for 120-volt studio use. The unit measures 5½ × 3¼ × 1½ inches and weighs less than a half pound without batteries.

The VG-510 handheld NTSC video-test generator costs $299 without SMPTE bars, $399 with SMPTE bars, and $540 with S-VHS output. Options include RF

output, rechargeable batteries, and a PAL-standard version.

CIRCLE 104 ON FREE INFORMATION CARD

UNIVERSAL IC PROGRAMMER

A cost-effective universal IC programmer from *Xeltek*, the *Superpro/EM* provides full programming capability for EPROM's and microcontrollers. It supports more than 1300 devices, including microcontrollers and up-to-8MB EPROM's, EEPROM's, and Flash EPROM's from most manufacturers. The Superpro/EM also programs some basic PAL's and GAL's, including 16V8 and 20V8, and performs functional tests of IC's, CMOS, and memory.

The menu-driven software provides a comprehensive device library for programmable IC's. Macro and batch functions automate programming procedures with single key-stroke control. A number of new devices have been added to the present library, and free software upgrades are available every two months to Xeltek customers through the company's 24-hour bulletin board.

The Superpro/EM costs $399. For additional information, contact Xeltek, 757 N. Pastoria Avenue, Sunnyvale, CA 94086; Tel: 408-524-1929; Fax: 408-245-7084.

CIRCLE 105 ON FREE INFORMATION CARD

MULTIMEDIA PC

The 1994 *Tandy Sensation! Multimedia Personal Computer* (MPC) includes a fast 486-based processor, advanced audio and video technology, send and receive fax capability, Photo CD compatibility, and an array of bundled software in a fully

integrated system.

This year's version adds state-of-the-art features to its award-winning Sensation! predecessor. It has a faster clock speed and a larger (212MB) hard drive. Local Bus video reduces the time needed to draw and process sophisticated graphics. The dual-speed, multi-session CD-ROM drive reads directories and transfers data faster than conventional CD-ROM drives, and reads photographic images that have been stored on a Photo CD. The 1994 Sensation is Energy Star compliant; with dramatically reduced electricity consumption, it is rated energy-efficient according to EPA standards and saves money. The modem can be used to send and receive faxes, and is enhanced by WinMate's InTouch software.

Bundled software includes MS-DOS 6 with Tools, which doubles disk space by substituting symbols for recurring text and includes an automatic backup program and virus protection; Macromedia Action! for creating multimedia presentations; Lotus Organizer personal information manager; Check-Free electronic bill-paying system; Intuit Quicken for Windows Special Edition financial tracker; a CompuServe start-up kit; and Worldshop Online Shopping Service. Tandy's easy-to-use WinMate Software organizes applications under eight function categories. Users can access a category directly or call for a digitized voice description of its content. It also allows users to send or play back messages in text or voice format, access messages or calendar schedules via telephone, or send and receive fax messages. WinMate also features the Microsoft Bookshelf for Windows CD-ROM reference library, a complete AT&T 800-number directory, sound effects, music clips, digitized photographs, and hundreds of clip-art images.

The Sensation! MPC is available at a suggested retail price of $1799, or $1999 with a Super-VGA color monitor, at local Radio Shack stores nationwide. For more information, contact Tandy Corporation, 700 One Tandy Center, Fort Worth, TX 76102.

CIRCLE 106 ON FREE INFORMATION CARD

MAGNETIC-FIELD DETECTOR

Responding to the increased public awareness of potential health risks from long-term exposure to low-level electromagnetic fields, *Environmental Electronics* has introduced the *MFD-1* magnetic-field detector. The sensitive *MFD-1* detects both the strength and direction of many of the low-level electromagnetic fields that have been linked to serious illness. Field strengths from 0.25 to 57 milligauss can be

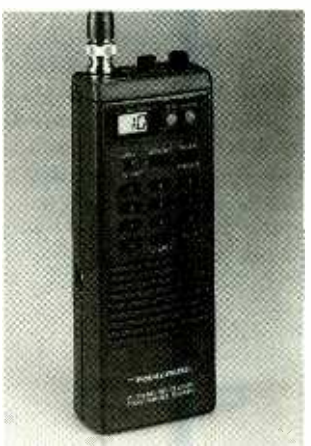
measured. The device's bandwidth goes from 20 to 10,000 Hz, enabling it to measure almost all extremely low frequency (ELF) and some very low frequency (VLF) fields. The ten-segment LED bargraph has two ranges and a power on/off indicator.

The MFD-1 magnetic-field detector, complete with one-year warranty, illustrated instructions, and a 9-volt battery, has a suggested retail price of $39.95. For further information, contact Environmental Electronics, Inc., P. O. Box 980, Goshen, IN 46527; Tel: 616-641-7645; Fax: 616-641-5738.

CIRCLE 107 ON FREE INFORMATION CARD

HANDHELD SCANNER

A custom-designed microprocessor in the *Realistic PRO-41 Direct Entry Programmable Scanner* provides users with direct access to more than 20,000 frequencies including police and fire departments, amateur radio, commercial radio, and transportation services. Programmed channels are scanned automatically at a rate of ten per second; a lock-out function skips over unprogrammed channels. An automatic



three-second scan delay prevents any missed replies. The PRO-41 can be operated on five "AA" batteries or rechargeable batteries, a standard AC outlet with an optional AC adapter, or a vehicle battery with an optional DC adapter. A low battery is indicated by an audible alarm, and the built-in memory backup retains stored channels for up to 30 minutes without the battery. The scanner measures just 7 × 2.6 × 1.4 inches and weighs 11.2 ounces. It has an easy-to-read, backlighted liquid-crystal display; a ⅛-inch jack for attaching headphones or an extension speaker; a belt clip; a detachable flexible antenna, a BNC antenna jack; and a jack for attaching the optional AC and DC power adapters.

The realistic PRO-41 scanner (Cat. No. 20-301) sells for $119.95. It can be seen and purchased at Radio Shack stores nationwide. For more information, contact Radio Shack, 700 One Tandy Center, Fort Worth, TX 76102. ■

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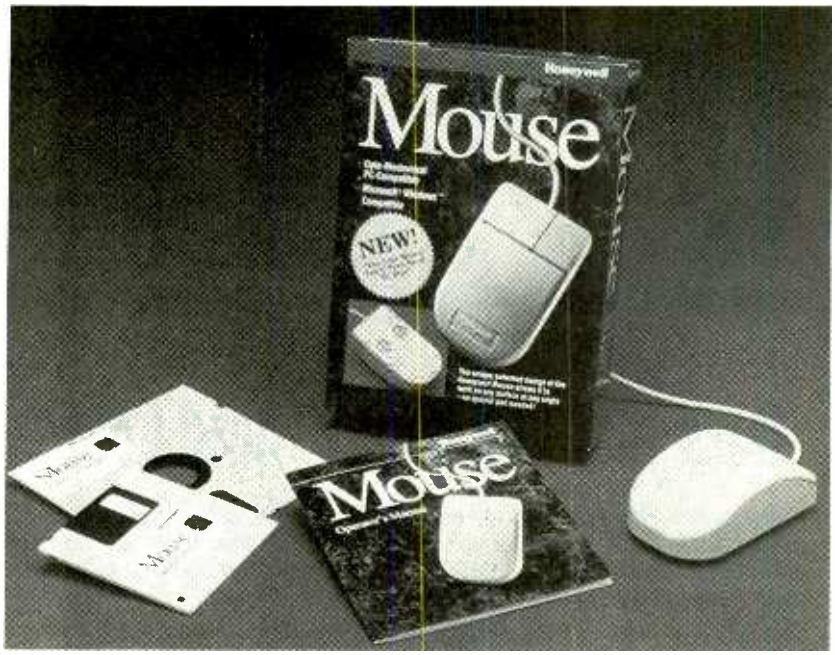
HONEYWELL MOUSE



CIRCLE 119 ON FREE INFORMATION CARD

Some mice are born a little different than others.

If you look underneath a typical mouse, you'll notice that there's a ball, usually a steel one with a rubber or vinyl coating, although a really cheap mouse might have just a plastic ball. The ball is situated inside the mouse such that it rotates according to the user's hand movements, and also rolls against the shafts of two optical encoders inside the mouse: one to detect x-axis movements, the other for y-axis movements. This x- and y-information then moves your arrow around the screen and lets you point to text, graphics, icons, buttons, menu options, and so on.

Although most computer users today would be lost without a mouse, mice do have their problems. For one, in order for the ball to properly track the user's movements and at the same time rest with enough pressure against the encoder shafts to rotate them, a mouse pad—or other similar surface—is required. We've all tried to use a mouse on a surface where it just doesn't work properly. Another problem is that mice balls collect lint and dirt, which gum up the encoders and causes a mouse to skip, jump, or go belly up altogether. You eventually get unpredictable cursor behavior, and your Windows arrow seems to have a mind of its own.

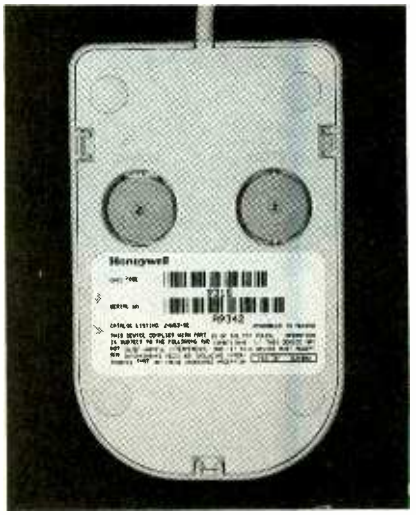
While dirt and lint can usually be cleaned from a mouse, putting it back into working order, we all know lots of computer users who wouldn't have a clue as to what to do if their mouse started to give them trouble. Besides, even with regular cleaning, it's the dirt that usually leads to premature mouse failure of the permanent kind. That's especially true if you use a mouse in a particularly dusty environment. If you own a company where time is money, and computer down-time means a loss of money, then it pays to buy the most reliable equipment you can get, including mice, especially if the good stuff doesn't cost much more than the cheap stuff.

A Ball-less Mouse. Knowing that a mouse ball means trouble, we were curious about the Honeywell Mouse, which supposedly has no ball at all, and yet will work on any surface—even if its upside down! While you might be more familiar with their thermostats, Honeywell's Keyboard Division (4171 N. Mesa Bldg. D, El Paso, TX 79902. 915-544-5511) produces quality peripherals such as the mouse we'll discuss.

The underside of the Honeywell mouse reveals two wheels that are positioned almost parallel with the underside, except that one wheel is cocked at a slight angle in the x direction and the other at a slight angle in the y direction. The wheels are secured to the underside of the mouse on spring-mounted shafts, making them springy, like the floating heads on an electric shaver. When you place the mouse right-side-up, the edges of the wheels press against whatever surface it's on, and they help generate the same x-y information that a ball does—except that there's no ball to track dirt into the mouse!

The mouse is available in four versions: 2- and 3-button serial versions and 2- and 3-button PS/2 versions. All have resolutions of 320 dots per inch. Honeywell includes software drivers with the mouse on both 3½- and 5¼-inch disks. The Honeywell mouse is 100% Microsoft compatible—we know that because we didn't even have to change our mouse driver. We simply unplugged our Microsoft mouse, plugged in the Honeywell mouse, and booted up; the mouse worked just fine. A 9- to-25-pin adapter was included with our serial mouse, although we didn't need it.

We used the Honeywell Mouse while writing this review. Its curved shape supports your hand, has a very



Here's an underside view of the Honeywell mouse. It's lack of a ball mechanism offers some significant advantages over standard devices.

sturdy feel, and is really quite comfortable to hold. It worked at least as well as other mice we've used, and better than most of them. The buttons have a light enough touch so that you don't need a muscular index finger to operate them, although they're not so sensitive that you'll inadvertently press one.

While our wrist felt more comfortable when using a mouse pad, the Honeywell Mouse worked well on any surface we tried. To see if the Honeywell Mouse is better than a ball mouse at keeping dirt out, we rubbed clothes-dryer lint all over a mouse pad, and ran the Honeywell and a regular mouse back and forth across it several times—with the computer off, of course. Afterward, we found several bits of lint and dirt inside the ball mouse, while the Honeywell mouse had none.

We're Sold. We can find no faults with the mouse; it works well for everybody. Its exceptional cleanliness makes it especially well suited for an industrial environment, or for messy users. Honeywell says this mouse will last a lifetime, and to prove that they back it with a limited lifetime warranty. With a retail price of $79, this mouse should seriously be considered the next time you need a mouse—or if your present ball mouse always needs cleaning. For more information on the Honeywell mouse, contact Honeywell directly, or circle No. 119 on the Free Information Card. ■

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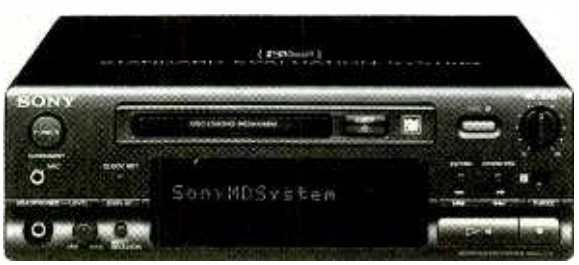
PRODUCT TEST REPORTS

By Len Feldman

Sony MDS-101 MiniDisc Recorder

The past year and a half has seen the introduction of two new home-recording formats, both intended to ultimately replace the long-lived compact cassette. The Digital Compact Cassette, championed by Philips, is a digital tape-recording system, while the MiniDisc (MD for short), invented by Sony, uses laser-optical technology much like that used for Compact Discs.

The Sony MiniDisc system uses a data-reduction system, known by its acronym "ATRAC," that makes it possible to place up to 74 minutes of digital audio on a disc that measures only 2½ inches in diameter. Unlike standard compact discs, the MiniDisc is a recordable medium. Using a highly sophisticated magneto-optical erasing and recording system, Sony claims that blank MiniDiscs can be recorded and erased and rerecorded at least one million times. Prerecorded discs, issued by major recording companies, are also available and are produced very much like conventional CD's.



CIRCLE 120 ON FREE INFORMATION CARD

The Sony MDS-101 home MiniDisc recorder.

Sony's first home unit is the MDS-101 MD recorder/player. That unit was preceded on the market by a portable recorder/player, a portable play-only unit, and a car MiniDisc/receiver. Sony sees the MDS-101 as a product that will give consumers the means to make high-quality digital recordings conveniently at home for subsequent playback "on-the-go."

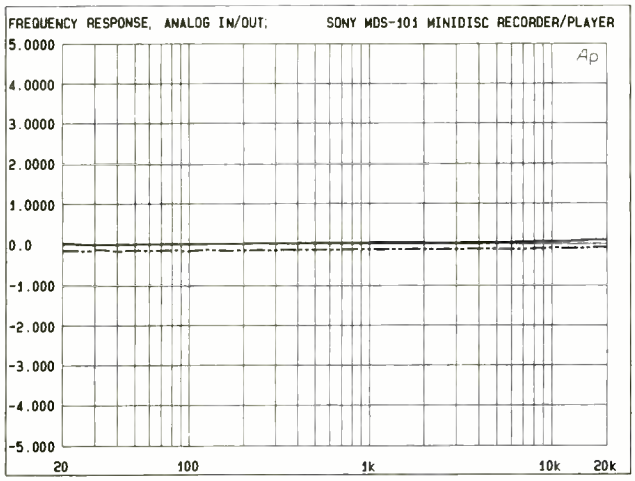
Recording is simplified on the MDS-101 by an automatic-scan feature that locates blank sections on the disc and begins recording, filling all the available spaces on the disc until recording is complete. The MDS-101 can record from analog signal sources as well as from the digital (optical) outputs of CD players or DAT recorders.

The editing features of the MDS-101 include "divide," which creates cueing points on the disc; "combine," which combines two or more existing tracks into one; "erase," which eliminates a single track or erases the whole disc; and "move," which changes the track running order. All of these, and many other features, can be accessed with the touch of a button on a supplied 25-key remote control.

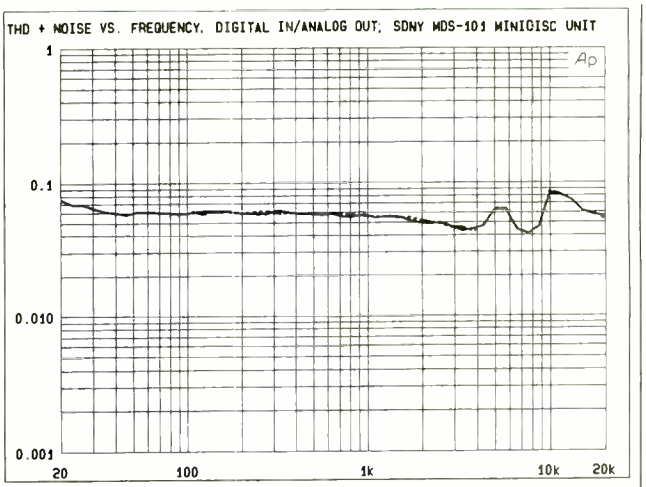
Some features, such as playing tracks in random order, playing tracks or track programs repeatedly, playing specific portions of a track repeatedly, and locating desired tracks in a fraction of a second, have been carried over from CD-player technology. One of the most interesting features found on the MDS-101 (and on earlier MD recorder/players) is the ability to create titles for your recordings. These titles, which may consist of up to 100 characters per selection, for a maximum of about 1700 characters per disc, will then appear in the display window of the MDS-101 as the selection is played. Prerecorded discs generally also contain titles showing the name of the selection, the name of the performing artist or artists, etc. The text that appears when playing a prerecorded disc is placed on the disc by the recording company and cannot be edited or changed.

CONTROL LAYOUT

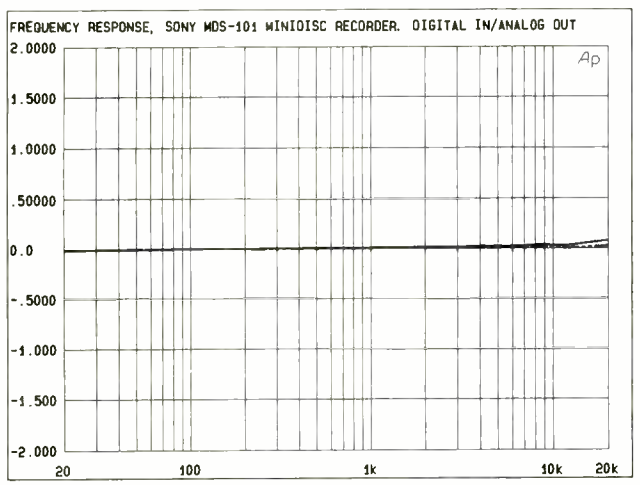
A power switch is located at the upper left of the front panel. When power is off, the word "standby" appears in the display. The disc slot is to the right of the power switch, with an "eject" button nearby. Further to the right is a "record" button and a "record-level" control for adjusting recording level when recording from analog sources. A pair of editing buttons labeled "no" and "yes" are located below the record button. The "no" button is sequentially pressed until the desired editing function appears in the display, at which time the user presses the "yes" button. A button



Frequency response using the analog inputs was nearly flat with just a 0.2-dB difference between the channels.



Total harmonic-distortion-plus-noise using the optical inputs was a low 0.058% at 1 kHz and 0.08% at 10 kHz.



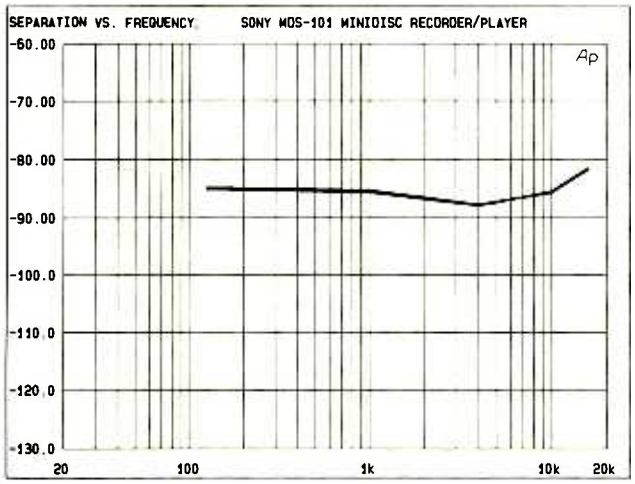
When the optical (digital) inputs were used, frequency response was again virtually flat, but the output levels for both channels was nearly identical.

labeled "p-mode" determines the playback mode (continuous, shuffle play, or programmed play). Nearby are track-advance and reverse buttons which, when held down continuously, also perform fast searches in either direction. Below these buttons, at the lower right corner of the panel, are a large "play/pause" button and a "stop" button.

The display area is centered on the panel and, in addition to scrolling the previously described titles, provides information about tracks, time, record/playback level, and much more. To the left of the display area are a "clock set" button (for setting date and time, which can also be displayed) and a miniature microphone-input jack. Below these are a mini headphone jack, and its associated headphone-level control and an input-selector button that chooses between analog or digital inputs.

While the supplied remote control duplicates most of the control functions found on the front panel, it also provides additional control functions, such as direct numeric access to tracks, date buttons, an auto-space button for automatic insertion of a 3-second blank space between tracks, a "scan" button used to scan the first few seconds of each track in succession, buttons for synchronizing an associated CD player with the recorder, CD-player operating buttons (for use with certain Sony CD players), and a "scroll" button for scrolling titles that are longer than 12 characters.

The rear panel of the MDS-101 MiniDisc recorder is equipped with standard analog pairs of input and output RCA-type jacks. Also provided are the now-standard TOS-LINK digital (optical) input and output



Stereo separation was above 80 dB even at the highest test frequency of 16 kHz.

TEST RESULTS—SONY MDS-101 MINIDISC RECORDER

Specification	Mfr's Claim	PE Measured
Frequency response		
20 Hz to 20 kHz	±1.0 dB	±0.2 dB
THD + noise, 1 kHz		
Analog	N/A	0.05%
Digital	N/A	0.08%
Signal-to-noise ratio	N/A	97 dB
Channel separation	N/A	85 dB
Output level		
Line	2.0 volts	2.08 volts
Headphone	28 mV	30 mV
Input level		
Line	500 mV	Confirmed
Mic	0.8 mV	Confirmed
Power requirements	120VAC, 60 Hz, 17W	Confirmed
Dimensions (W×H×D, inches)	8¼×3×1¼	Confirmed
Weight	6 lbs. 6 oz.	Confirmed
Price:	$1000.00	

terminals. There is also a small socket for connection of what Sony identifies as an "Audio Bus Cable." The only notation concerning that socket that we could find in the preliminary owner's manual indicated that the time display would appear on certain future "Mini Hi-Fi Component" systems instead of on the MD unit when both are connected by an audio-bus cable.

LAB MEASUREMENTS

Our first performance measurements for the MDS-101 involved frequency response for the complete record/play cycle. First, we recorded frequencies from 20 Hz to 20 kHz onto a blank MiniDisc via the analog inputs. Playback of this frequency sweep disclosed absolutely flat response over that range with perhaps only about 0.2 dB of difference between channels. Next, we repeated the same type of measurement via the optical digital inputs, using digital signals derived from our Audio Precision test system. Again, results were virtually flat over the range of frequencies tested, and this time, output levels from both channels were identical.

Next, we measured harmonic-distortion-plus-noise versus frequency, again first using the analog inputs, and then the optical (digital) input. At mid-frequencies (around 1 kHz) THD-plus-noise while playing back the recording made using the analog input measured approximately 0.05%, rising to around 0.09% at 10 kHz. We were somewhat surprised to find that the same measurements made for the recording produced via the optical digital input actually yielded a slightly higher THD-plus-noise reading of 0.058% at 1 kHz, though the 10-kHz reading was a bit lower—0.08%—than during the earlier test. Since both THD-plus-noise readings are so low as to be insignificant, the difference is only of academic interest and may well be attributable to quantization noise rather than to actual distortion.

In order to isolate the actual distortion components from any residual noise, we next used the digital facilities of our Audio Precision test system to conduct a spectrum analysis of the harmonic components of a 1-kHz signal recorded via the analog inputs. The only significant harmonics observed were those at 3 kHz and 5 kHz, each of which was some 80 dB below the maximum recorded level. Calculations then revealed that these components were equivalent to an actual distortion level of only 0.014%. The remainder of the earlier reading, therefore, is attributable to random residual noise rather than actual harmonic distortion.

Stereo separation was measured next. It remained well above 80 dB even at the highest test frequency of 16 kHz. Furthermore, separation was the same whether measured from left channel to right channel or from right channel to left channel. The A-weighted signal-to-noise ratio for the MDS-101, when going through a complete record/play cycle, either analog-to-analog or digital-to-analog, measured 97 dB below the maximum record level, which is about what we have come to expect from CD players and other digital equipment. Examining the residual noise using spectrum analysis over the range from 20 Hz to 20 kHz, we noted that even the power-supply line-related hum components at 60 Hz, 120 Hz, and 240 Hz were all more than 110 dB below the maximum recording level.

Record/playback linearity, when playing back a gradually decreasing signal that had been recorded via the digital inputs was extremely good. Less than 1 dB of deviation was observed, even at a −90-dB record/playback level. Additional measurements of our sample MDS-101 revealed that the line-level output for a 0-dB recorded signal (maximum recorded level) was 2.08 volts as against a nominal specification of 2.0 volts. The headphone output jack delivered 30 millivolts of output into 32-ohm loads. Input sensitivity for the analog line-level inputs was 500 mV, as claimed, while microphone input-sensitivity measured 0.8 millivolts as claimed by the manufacturer.

HANDS-ON TESTS

Despite the many controls and features found on the Sony MDS-101, we found that basic recording operations were really quite simple. You simply insert a blank disc, wait a couple of seconds for the system to "read" any existing Table of

(Continued on page 92)

THINK TANK

Equipment and Chips

By John J. Yacono

This month, as promised, I'll continue presenting some of the more major violations to the IC-designation standard. Last month's rogues' gallery consisted of chips that were functionally different yet carried the same designation. This month's units will have that same flaw. Once we're through with the IC's, I'll present some useful test equipment sent in by readers. For now, let's check the chips.

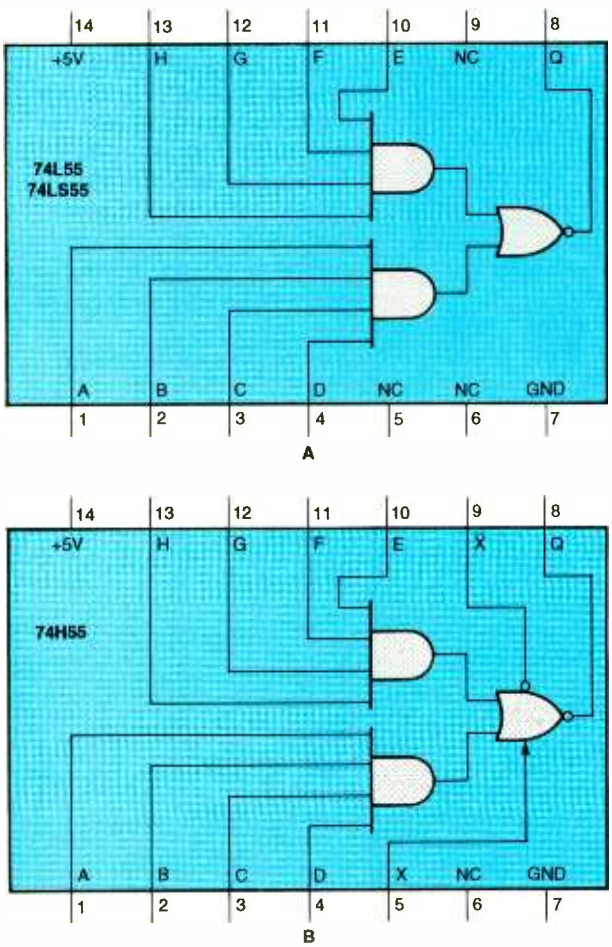


Fig. 1. The 7455 comes in two forms: a plain unit in the low-power and lower-power Schottky formats (A), and an expandable device in the high-power style (B).

MORE CULPRITS

Last month's IC's were all AND-NOR gates, but this month we have just one of those to present. It's the 7455, shown in two forms in Fig. 1. The key difference between the two models is that the low-power and low-power Schottky versions (Fig. 1A) are lacking the expansion inputs found on the high-power units (Fig. 1B). In an effort to save space this month, we won't bother with the simple truth table for this chip.

The 7471 presents more of a dilemma. Its low-power and high-power versions (shown in Figs. 2A and 2B, respectively) have radically different input and processing stages, although both devices are flip-flops. The 74L71 is an RS flip-flop whose two main inputs are each fed by one 3-input AND gate. It possess both preset and reset inputs to produce the moderately complex behavior shown in Table 1. (Note that for simplicity, the table does not show all the states for the AND-gate inputs, but rather just the AND-gate outputs, which are tied to the R and S inputs of the flip-flop.)

The high-power unit, on the other hand, has a more complex input network consisting of two 2-input OR gates that are each fed by two 3-input AND gates. One input from each AND gate is tied to the clock input, so they only produce valid pulses when the clock signal has reached a certain level. Aside from the input network, the flip-flop used is also different. A JK flip-flop is present in the 74H71, and it doesn't have a reset input. That leads to the simpler behavior shown in Table 2. (Note again, the truth table only contains the flip-flop inputs.)

That's all we have room for this time. Now we'll dive into the mail bag for some shop goodies.

TABLE 1—74L71 LOGIC STATES

Inputs					Outputs	
Preset	Reset	Clock	S	R	Q	$\bar{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H*	H*
H	H	⊓	L	L	NC	NC
H	H	⊓	H	L	H	L
H	H	⊓	L	H	L	H
H	H	⊓	H	H	**	**

* Unstable NC – No change ** Undefined

TABLE 2—74H71 LOGIC STATES

Inputs				Outputs	
Preset	Clock	J	K	Q	$\bar{Q}$
L	X	X	X	H	L
H	⊓	L	L	NC	NC
H	⊓	L	H	L	H
H	⊓	H	L	H	L
H	⊓	H	H	T	T

NC – No change T – Toggle

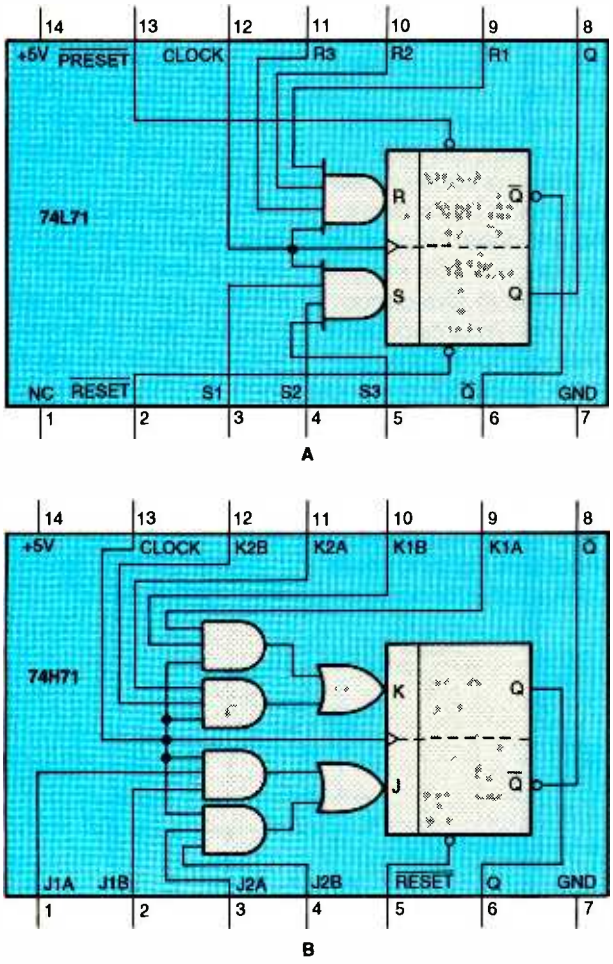


Fig. 2. The 74L71 in A, which contains an RS flip-flop, is radically different than the JK-flip-flop based high-power version of that chip.

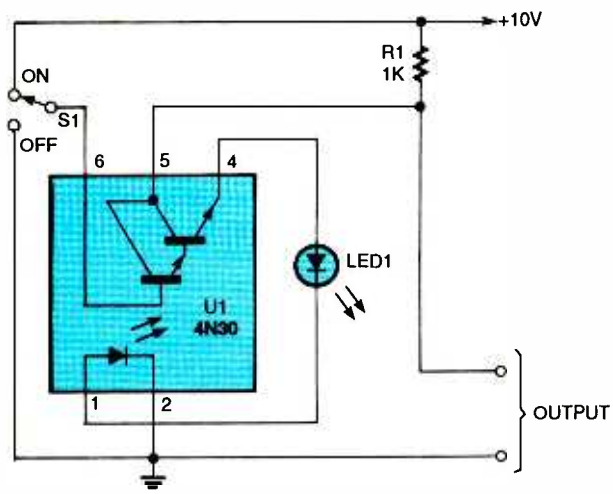


Fig. 3. A simple but versatile bounceless switch can be made from one opto-isolator and a couple of additional components. (Note: the external LED is optional.)

BOUNCELESS SWITCH

While breadboarding a circuit, I needed a bounceless on/off switch to produce single pulses, so I built the circuit shown in Fig. 3. Flipping S1 on applies a positive voltage to the base of one of the NPN transistors in the optoisolator. That causes current to flow through the transistor, the external LED (which acts as an indicator), and the internal LED, which latches the circuit on. Switching S1 to off puts a negative voltage on the base of the first transistor, turning it off.

Wired as shown, the circuit produces pulses that dip from 10 volts down to 4 (a 6-volt drop) when S1 is switched on. With R1 moved to fall between pin 2 and ground, pin 5 tied high, and the circuit's output taken from ground and pin 4, the circuit would produce pulses that rise from ground to about 9 volts with S1 on.

When using an optoisolator containing a Darlington transistor as shown, the CTR (current-transfer ratio) is 50% to 100% and the turn-off time is about 40 microseconds. By replacing the indicating LED with the internal LED of an optoisolator with a Triac output (like the one shown in *Think Tank*, Sept. 1991) one could even control heavy loads.

—Cy Besanson, Green Bay, WI

I've never seen an opto-isolator used as a bounceless switch. It's a shame there's a 4-volt drop across the output when the circuit goes low. I guess you could improve the output by shorting the external LED, but I like the presence of the indicator.

A TIP TIP

You will be disappointed with the home-made soldering iron tip as described in *Think Tank*, July 1993. Solder will attack the copper and destroy it in short order. That is why purchased tips have heavy copper at the tip end. The solution is easy,

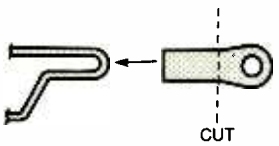


Fig. 4. The home-made soldering iron tip mentioned some months ago will last much longer if it is capped with a lug as shown here.

first construct the tip as described. Then, take an uninsulated crimp-on ring lug, cut the ring off as shown in Fig. 4, and crimp the remaining neck to the tip. The crimp-on tip will last *longer* than the purchased variety.

—Art Rideout, WA6IPD, Fallbrook, CA

Thank you for that addition. I admit I haven't tried the trick myself just yet, so it might have some kinks in it. It's neat to think that the home-made tip will last longer than a store-bought unit, though.

AUTO WIRING TESTER

I used a sensitive FET switch circuit (see Fig. 5) to make a versatile test probe. The bulb lights if the probe tip touches 6 volts or more provided its case is somewhat grounded, say via the body of its user.

To use it to test for positive voltage on car or trailer wiring, hold the tester with one hand, with the other hand on a metal ground.

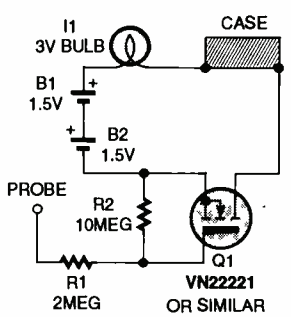
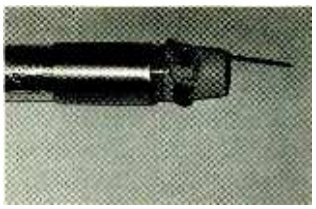


Fig. 5. This simple tester is very useful and doesn't require a return lead provided your body is at least slightly grounded.



As you can see, the probe components can all be installed on even a small flashlight. That, plus the lack of a return (or ground) lead, makes it great for use in tight spaces.

Then touch the probe tip to the bare wire or terminal in question.

You also can use it around the house. Start by placing one hand on a known good ground with the tester in the other hand. Touch the probe to the ground terminal of an AC receptacle. If the bulb lights, the receptacle is poorly grounded and should be checked and fixed.

The bulb also lights if the probe touches the antenna of a working transmitter, or an antenna receiving RF signals. So you can use the unit to check TV lead-ins.

An old 3-volt flashlight makes a good body. It should be metal with a plastic cap or, if it's all plastic its body may be wrapped with heavy foil. I slipped a sleeve over the foil to make good contact. The sleeve I used was made from the case of a C-size rechargeable battery with the ends cut off. Discard the flashlight's switch. A large sewing needle makes a good probe. Heat the needle and force it into the plastic cap that holds the flashlight bulb in place. Solder the FET and resistors to the probe and the metal collar that holds the bulb in the cap. Fasten them to the cap with epoxy. That assembly method makes the tester easy to unscrew to replace batteries, although that is not frequently necessary as they last as long as their shelf life.

—Jay Hawthorne, Clareshalm Alta., Canada

Unlike conventional test instruments (say, a DMM), this unit doesn't require you to look away from the point of interest to take a reading. I also like it because it frees you from a ground tether, which can be a pain in tight places like under a dashboard.

SAFETY CIRCUIT

I originally designed this circuit (see Fig. 6) to meet OSHA safety standards on a punch press. For it to work as required you must separate the two pushbutton switches (S1/S2) so that the operator must use both of his hands to actuate them, while being safely away from moving parts, sharp edges, high voltage, laser emission, etc. The switches can't be defeated mechanically, such as by taping one down, so the operator won't have a free hand to get in trouble with.

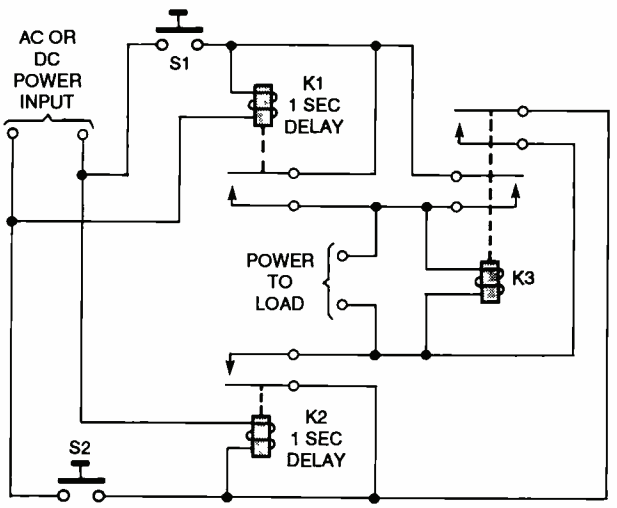


Fig. 6. This circuit is sure to keep both of your hands from the business end of a tool during operation. To use it one must depress and hold down both S1 and S2.

The heart of the circuit are K1 and K2, two 1-second delay-on-operate relays. As you can see from the diagram, if both switches are actuated within 1 second of each other, K3 will latch on along with the load. No power will go to the load under any other condition!

You should select all relay and switch contacts to handle the desired load current, and the relay coils must be rated at the load voltage. Of course, you can build this circuit to run on low voltage; just use another relay in place of the load and let the added relay handle the load voltage.

—Skip Campisi, So. Bound Brook, NJ

I would recommend only using this circuit with low-power DC, or to drive equipment that does not have a grounded case (perhaps with a plastic enclosure). For the sake of argument, let's say the power source is the AC line, S1 is along the hot leg, and the load has a metal cabinet that is internally grounded. If only S1 is depressed it will connect the hot side of the load to AC current, and the load will conduct it to the case—not too safe since you now have a free hand to touch

(Continued on page 91)

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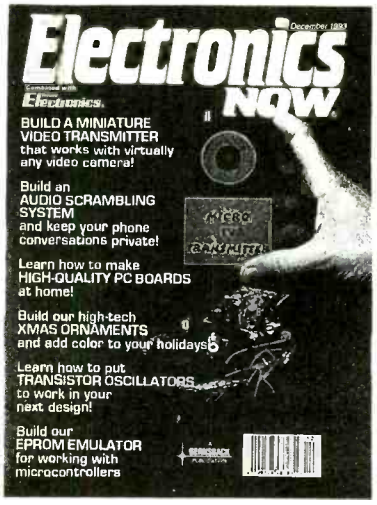

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7PD46

See how night-vision systems work and learn how you can build one of your own.

All About Nightvision Scopes

BY CHARLES D. RAKES

Electronically enhancing ones ability to see in the dark has fascinated many electronic enthusiasts and science buffs. There are several ways to optically penetrate the darkness. The most obvious method is to simply turn on a light, but that's not really seeing in darkness.

Another method, which is used in the Starlight Scope (one of the more popular and inexpensive night-vision enhancement devices), actually amplifies the available light to a practical viewing level. The problem with such a system is that if there is absolutely no light, it won't work. Among the other night-vision enhancement systems are infrared (IR) viewers, which are probably the oldest and most common form of night-vision enhancement devices.

In such systems, infrared light is used to illuminate the area of interest. Any of the IR light bouncing off of any object is picked up by an IR-sensitive receiver/amplifier circuit. After amplification, the IR signal is fed to an image-converter tube, where it is converted to pixels and displayed as a green image on a phosphorescent screen.

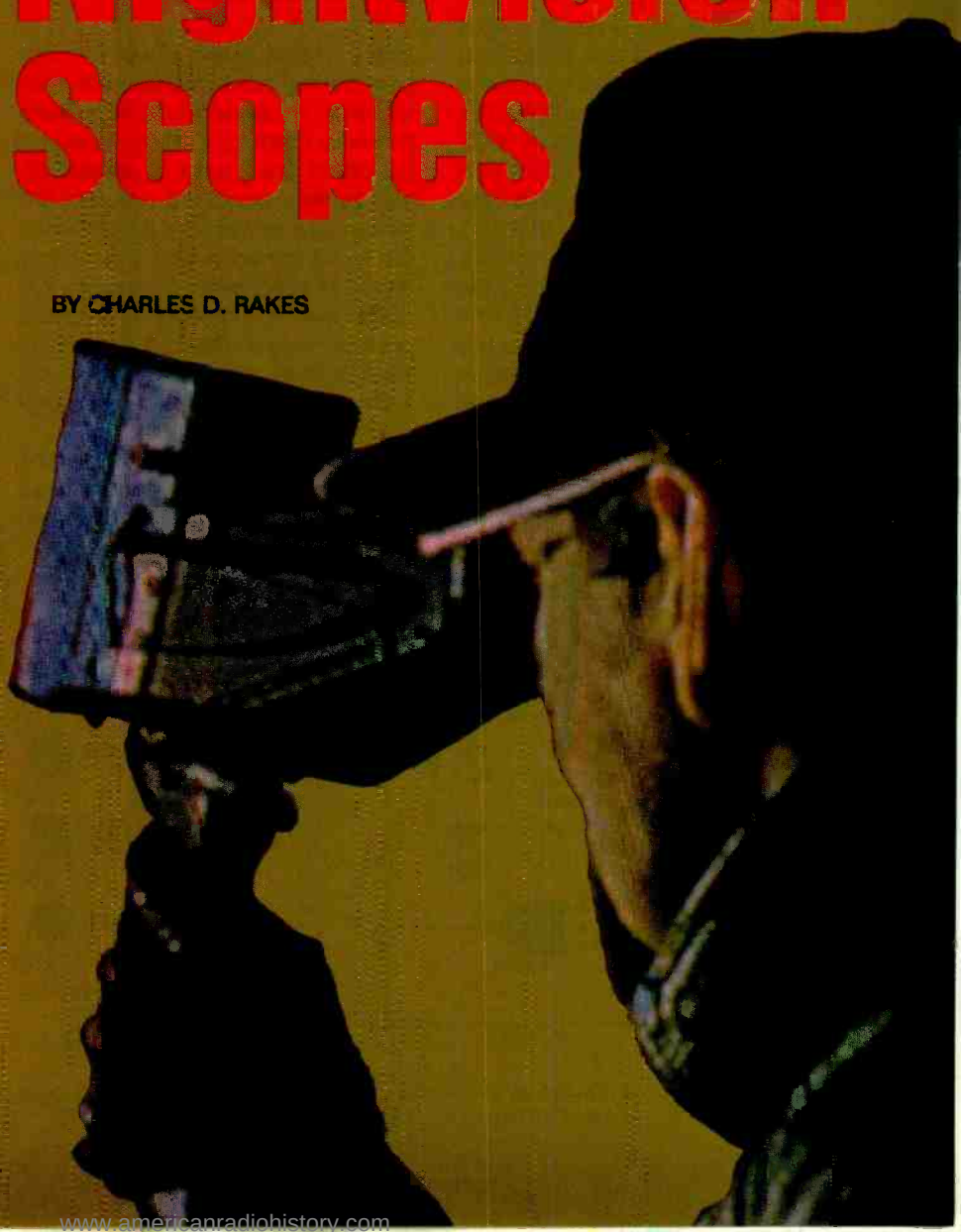
The night-vision system described in this article also uses an IR light source, but the images are displayed in black and white on an LCD screen.

Seeing the Light. The *NightVision View Scope* is comprised of four basic subassemblies: a CCD camera, a video monitor, a control/voltage-regulator circuit, and an IR light source, as shown in the functional block diagram in Fig 1.

At the heart of the system is a CCTV Corp. (315 Hudson St., New York, NY 10013; Tel. 800-221-2240) CCD-200 camera. The camera, which is IR sensitive (and can function at light levels as low as .03 lux), produces over 400 lines of resolution and has an automatic, variable-speed electronic shutter that compensates for all light levels reaching its pick-up. The camera, which measures about 3 × 2 × 1 inches, has a built-in sensitive condenser mike and preamplifier, and draws only about 170 mA at 10- to 14-volt DC.

Just as important to the system is the display section—which is comprised of a Citizen M329 Mark II LCD color video monitor. (The monitor is available from many local video stores; if you can't locate one or a similar unit, I was able to obtain mine from Colonel Video and Audio, 16451 Space Center Blvd., Houston, TX, 77058; Tel 713-486-8866.)

With those two self-contained units, all that's needed to complete the system are an IR-light source, and a power source. The NightVision View Scope works best with a strong IR source. The circuit shown in Fig 2 serves well in that application. The IR source, which has a variable IR output,



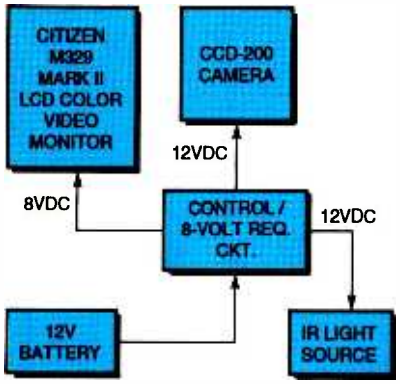


Fig. 1. The NightVision View Scope is comprised of four subassemblies: a camera, a video monitor, a control/voltage-regulator circuit, and an IR light source.

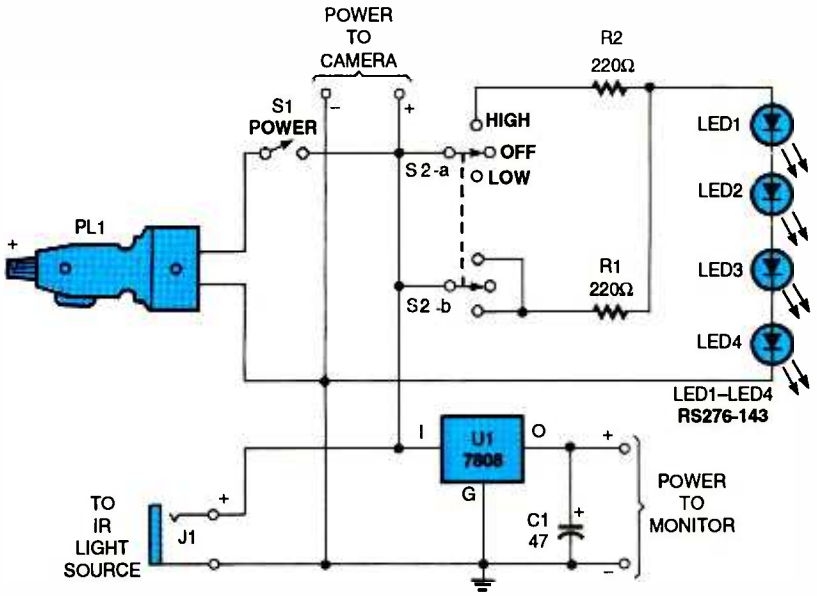


Fig. 3. Power for the NightVision View Scope is provided by a 12-volt, 7-amp/hour battery pack. The supplied power is regulated to 8 volts by U1, and is then used to power the video monitor.

plugs into the viewer. When the IR source is used with the viewer, objects become visible at distances of up to about 10 feet.

In that circuit, two gates of a 4001 CMOS quad 2-input NOR gate (U1-a and U1-b) are configured as a variable pulse-width astable oscillator. The output of the oscillator (at pin 4 of U1-b) is fed to the gate of an IRF511 hexFET, Q1. The drain of the hexFET is connected to two strings IR LED's (LED1–LED4 and LED5–LED8). The hexFET operates like a switch, turning the LED's on and off at about 100 Hz with R4 setting the LED's on time. The two 56-ohm resistors, one connected in series with each of the LED's strings, limit the maximum current through those units to a safe level.

Power for the NightVision View Scope is provided by an Omicron Deluxe portable video 12-volt 7-amp/hour battery pack (available on special order for about $60.00 from Radio Shack as catalog No.1265). However, just about any 2-amp, or greater, 12-volt battery pack will operate the viewer. Raw power from the battery is fed to the control (which is essentially a pair of switches) and regulator circuitry (see Fig. 3) through a cigarette adapter plug to the 12-volt camera, the IR light source, and a 7808 8-volt, 1-amp voltage regulator, which provides power to the LCD monitor.

The control circuit is used to set the IR output of LED1–LED4 at one of three levels: OFF, HIGH, or LOW. When S1 (a dual-gang switch) is set to the OFF position, the switch is open and no current flows to the IR LED's, so they remain dark. When S1 is flipped to the LOW position, current flows through S1-b and resistor R1 only, causing the LED's to light at low power. When S1 is switched to the HIGH position, current flows through both S1-a and S1-b and their respective resistors. The two currents add, channeling twice the current to the LED string, causing it to radiate about twice the IR energy.

The 7808 voltage regulator (U1) reduces the 12-volt source to 8-volts, which is then used to power the video monitor.

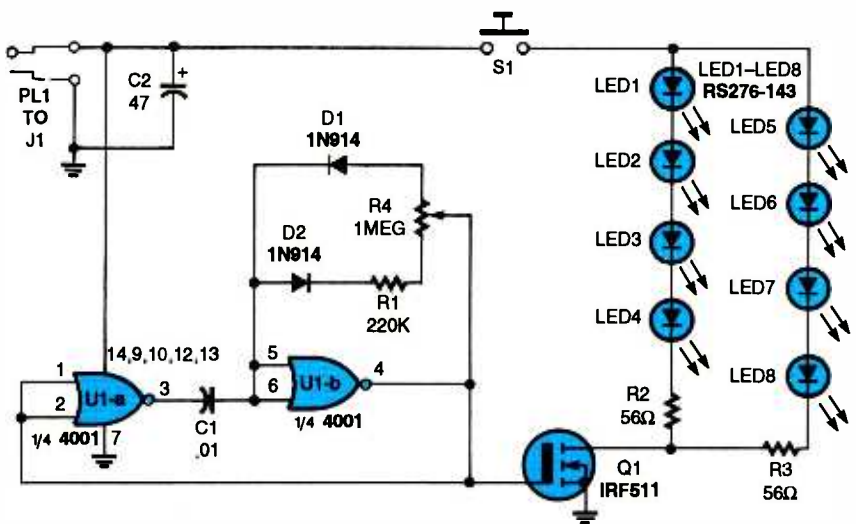


Fig. 2. The IR light source—which is comprised of half of a 4001 CMOS quad 2-input NOR gate, a hexFET, and 8 IR LED's—plugs into the viewer.

Putting it Together. The camera, control/voltage-regulator circuit, along with its four IR LED's are housed in two Radio Shack (part #270-222) deluxe plastic project cases. The two cases are bolted to the stand that comes with the monitor, as shown in Fig. 4. The monitor mounts to the monitor stand with the supplied hardware.

The control/voltage-regulator circuit is assembled on a 1 × 2½-inch piece of perfboard. Since there's nothing critical about the circuit, any layout scheme will do. Drill holes at the top and bottom of the board to allow mounting to the case, and then set the board aside while you prepare the cabinets.

The camera is located in the front

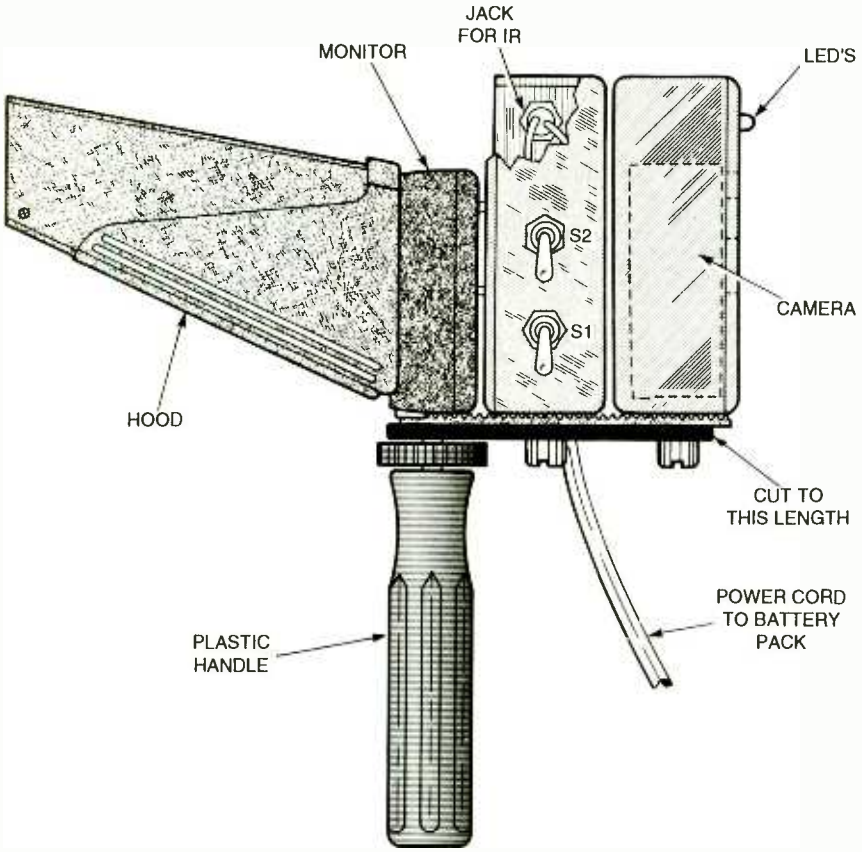


Fig. 4. Most of the NightVision View Scope (the camera, the control/voltage-regulator circuit, and IR illuminator) is housed in a pair of plastic enclosures that are bolted together and mounted to a plastic stand.

cabinet and is kept in place with a piece of foam rubber. Prepare the cabinet lid (top) as shown in Fig. 5. Four holes are drilled (or punched) across the top of the lid of the camera for the four IR LED's of the control/voltage-regulator circuit. A small drop of glue will help keep the LED's in place.

Next, punch or drill two holes—one ¼-inch hole about 1⅜-inches down from the top of the lid and one ½-inch hole about 2 1/16-inches down—to accommodate the camera.

Four holes also need to be drilled in

PARTS LIST FOR THE INFRARED ILLIMINATOR CIRCUIT

SEMICONDUCTORS

U1—4001 quad 2-input NOR gate, integrated circuit
Q1—IRF511 hexFET
D1, D2—1N914 general-purpose silicon diode
LED1–LED8—IR light-emitting diode (Radio Shack 276-143 or similar)

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—220,000-ohm
R2, R3—56-ohm ½-watt
R4—1-megohm potentiometer

CAPACITORS

C1—0.01-μF, ceramic-disc
C2—47-μF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

S1—Normally open pushbutton switch
PL1—RCA phono plug
Perfboard or printed-circuit materials, plastic enclosure (Radio Shack No. 270-221 or similar), wire, solder, hardware, etc.

Note: A circuit board and all of the parts that mount on it is available for $9.95 postage-paid from Krystal Kits, P.O. Box 445, Bentonville, AR 72712. Arizona residents please add appropriate sales tax.

PARTS LIST FOR THE CONTROL/VOLTAGE-REGULATOR CIRCUIT

SEMICONDUCTORS

U1—7808 8-volt, 1-amp, voltage-regulator, integrated circuit
LED1–LED4—IR light-emitting diode (Radio Shack 276-143 or equivalent)

ADDITIONAL PARTS AND MATERIALS

C1—47-μF, 16-WVDC, electrolytic capacitor
R1, R2—220-ohms ½-watt, 5% resistor
S1—SPST miniature toggle switch
S2—DP3T center-off switch
PL1—12-volt cigarette lighter plug
J1—RCA phono jack
CCD-200 or similar video camera (see text for supplier), Citizen M329 Mark II LCD or similar color video monitor (see text), Omicron Deluxe portable video 12-volt battery pack and charger with case (Radio Shack special order catalog No. 1265, about $60.00) or similar, perfboard materials, plastic enclosure (Radio Shack 270-222 or similar), plugs to match monitor or patch cords (see text), plastic handle, foam rubber, hardware, wire, solder, etc.

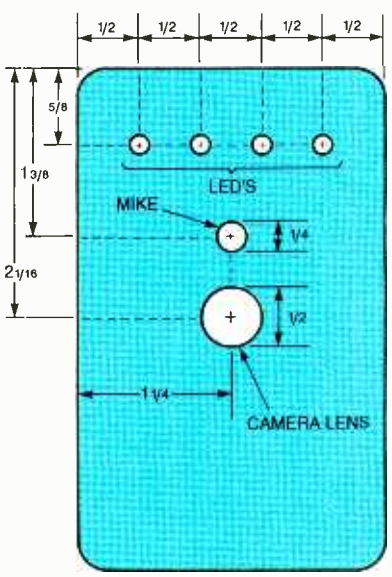


Fig. 5. Prepare the front (camera) case as shown in this drilling guide. Four additional holes will also be drilled in the rear (bottom) of this case.

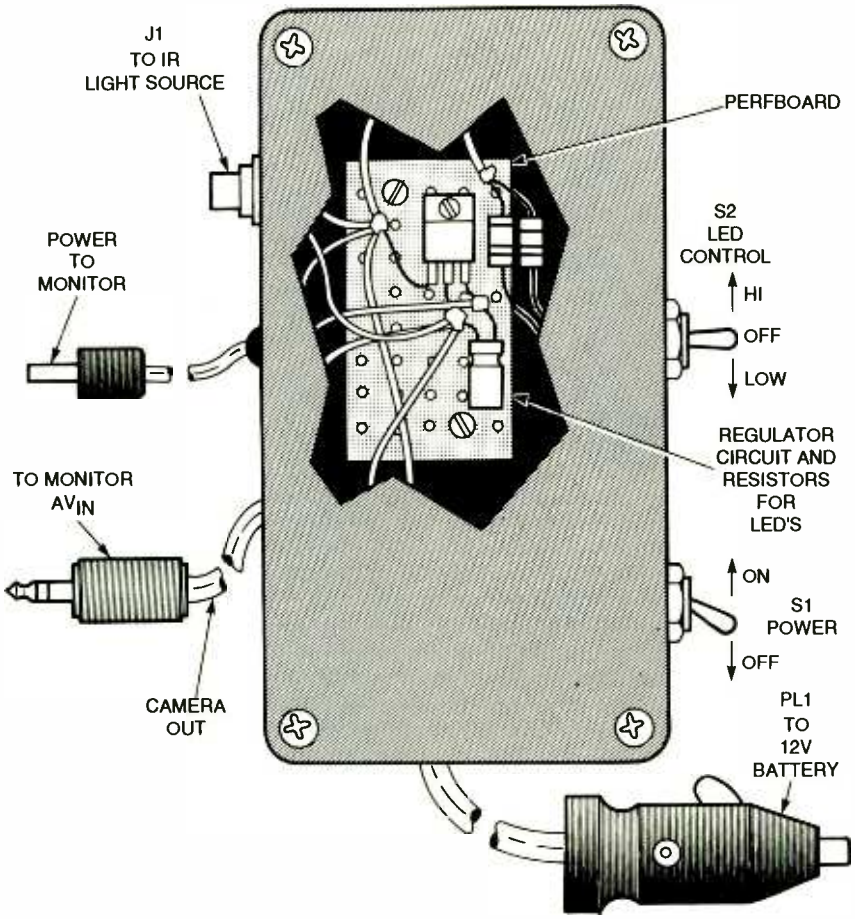


Fig. 6. Two holes are drilled through the perfboard and both cabinets and then outfitted with appropriate screws and nuts to hold the entire assembly in place.

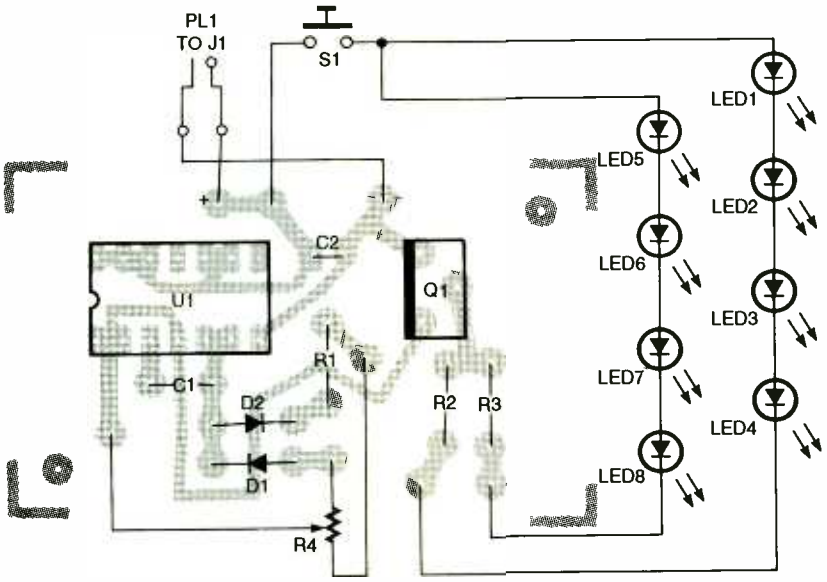


Fig. 8. This diagram shows the parts-placement and orientation of the IR illuminator board. The 8 LED's are mounted in two rows across one end of a plastic project enclosure.

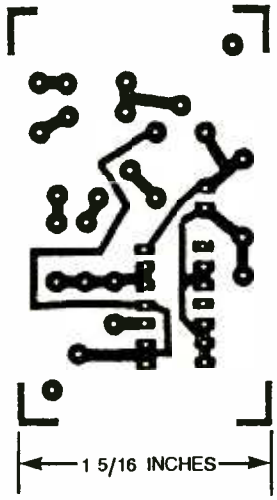


Fig. 7. The IR-illuminator circuit was assembled on a printed-circuit board. A template for that printed-circuit layout is shown here full size.

the back of the cabinet. One is for the camera output and power leads; it should measure ⅜ inch and be positioned for easy routing of the cables. The second hole is for the leads between the LED string and the control/voltage-regulator circuit board; the hole should measure ¼ inch and be positioned ½-inch down from the top of the case. We'll get to the other two holes in a moment.

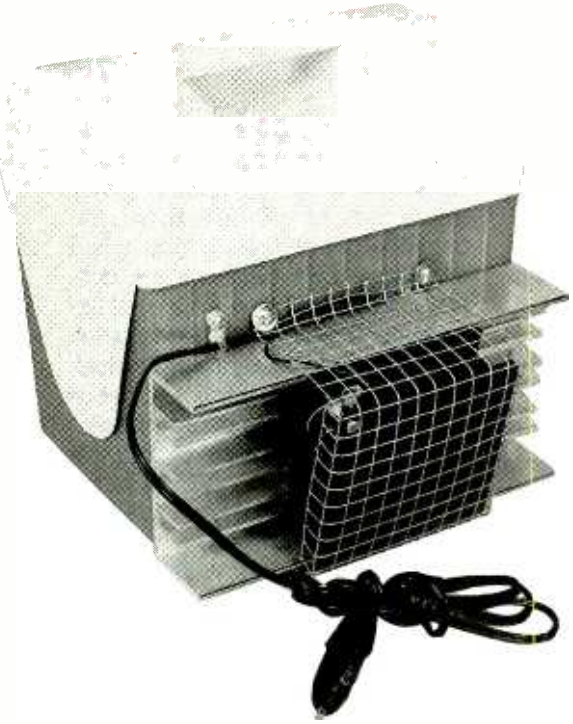
Next, we need to prepare the second, rear case (see Fig. 6). Begin by drilling the required holes for S1 and S2, J1, and the monitor and power leads. Then, using the front case as a guide, drill holes in the rear of the cabinet to match the LED- and camera-lead holes that you drilled earlier.

Now, you need to mount the perfboard circuit. Begin by finding a convenient location in the rear case; make sure it is clear of the holes you just drilled. Then align the two cases and drill mounting holes through both. Bolt the perfboard and case assembly together.

Next, you need to complete the off-board connections. Mount S1, S2, and J1 on the case and wire them to the appropriate points on the board. Cut the camera's power leads to about 6 inches and wire the camera directly to the circuit. The audio and video leads are then cut to about 8 inches and wired to a standard mini-stereo plug to match the monitor's input. If you'd prefer not cutting any of the camera or monitor cords, simply use

(Continued on page 95)

Build a Solid-State Cooler



This solid-state cooler will let you chill out on long road trips.

BY MARC SPIWAK

You know how those long road trips are—you're in a car, jam-packed with luggage, for many boring hours. The last thing you have room for is a big cooler full of ice and other goodies, and once you pack food and beverages into a small cooler, there's not much room left for ice. Besides, ice makes things soggy when it melts, and then you have to stop for more. Who wants to have to stop for both gas *and* ice?

Usually you end up bringing a sandwich and a couple of cold sodas with you because you don't plan on stopping until you need gas. To keep from getting too bored, you hold off on snacking until you're a couple hours into the trip. By that time your sodas are at room temperature, which is not very thirst quenching, and the lettuce on your sandwich is wilted and warm, which is not very appetizing.

Readers of this magazine are always looking for a better device to do something. A better way to keep things cold on a long road trip is the *Solid-State Cooler* described in this article. To accomplish its task, the Solid-State Cooler depends on a solid-state cooling module. The cooling module makes use of the "Peltier effect," which is best understood by examining a thermocouple.

A thermocouple is created when two dissimilar metals are joined together. Peltier devices have three sections as shown in Fig. 1. When one junction is heated or the other is cooled, a voltage will be generated across the assembly. That's known as the Peltier effect. One common two-material thermocouple device is the type used with a DVM to measure temperature. More powerful thermocouples can generate electricity.

If we instead pass a current through the circuit shown in Fig. 1, one junction temperature will rise and the other will fall. The circuit, in effect, moves heat from one side to the other. The simple setup in Fig. 1 wouldn't transfer very much heat, but specially doped metals set up in arrays like that shown in Fig. 2 can transfer lots of heat—more or less so depending on the type of materials used and their doping, the number of junctions, and so on.

Our Module. We got our cooling module from Melcor (1040 Spruce Street, Trenton, NJ 08648; Tel. 609-393-4178). They carry a full line of cooling modules in different sizes, number of junctions, and operating voltages. Also associated with each module is a maximum current and a maximum ΔT, or temperature differential between the hot and cold side, among various other specifications.

Although there can be lots of math and physics involved in choosing the proper module for a particular application, we basically chose one that could both operate at our target voltage—an automobile's 12-volt electrical system—and do a lot of cooling. A third consideration was price, and the one we chose costs under $30 in single-unit quantities.

The module we used is a Melcor CP 1.4-127-045L Thermoelectric Heat Pump Module, which measures exactly 4 centimeters square, and is 3.3 millimeters thick. It's maximum operating voltage is 15.4 volts DC and it can handle up to 8.5 amps. The unit also has a maximum ΔT of 67 degrees Celsius. We will operate it from 13.8-volts DC (the actual voltage of an automobile's electrical system), where it will draw about 6 amps.

Even though the specifications of the Peltier module are impressive, we have to admit up front that we are not using the module as efficiently as possible, due to both practicality and circumstances beyond the control of the typical hobbyist. (We'll talk more about that later.) So our cooler won't be as cold as it theoretically could be with a 6-amp current consumption, but it will still get things pretty cold. Besides, power consumption is not a priority, as we won't be using batteries; power from a car's cigarette-lighter socket is very available, as long as the car is running.

Design Considerations. To build the Solid-State Cooler, we used a six-pack sized cooler with a flip-top lid made by Rubbermaid, which we bought new for under $10. However, any small plastic cooler will do. Basically a square hole was cut into one side of the cooler, and the module was placed into the cutout sandwiched between a heat sink on the outside and a "cold sink" on the inside. Actually there's no such thing as a cold sink, as there's no such thing as "cold;" there's only the absence of heat. Our cold sink simply absorbs heat from inside the cooler which is then removed from the cold sink by the Peltier device

and transferred to the outside air by the heat sink. As heat is removed from inside the cooler it gets colder.

That explanation of the cooling scheme is somewhat simplified, as the final configuration, shown in Fig. 3, came about after a trial-and-error period of less-effective designs. As you can see from Fig. 3, the final design includes a sheet-metal sleeve resting on foam insulation. The sleeve tends to remove heat from anything resting on it much more effectively than air alone would. The cold sink really just cools the surrounding air, which then cools the cooler's contents.

Because the cooler walls are much thicker than the Peltier module, square aluminum spacers were used to make things fit. As you can see from Fig. 3, three spacers were required: two between the Peltier's cold side and the sheet metal sleeve and one between the sleeve and the cold sink. (That's one of the things beyond the control of the average hobbyist.) Two thin spacers back-to-back are definitely worse than one thick one, but the design flaw exists because we used 3/16-inch thick aluminum to make the spacers, of which two were needed to clear the wall of the cooler. Even at that thickness, the aluminum is difficult to cut with hand tools, so the compromise had to be made. Admittedly, we didn't have any thicker aluminum on hand either. When building your own cooler, try to use as few spacers as possible.

Notice that we put the module directly against the outside heat sink. That's because, after much experimentation with the design of the cooler, it became apparent that it's more important to effectively remove heat from the module's hot side than it is to remove heat from the cooler. The third spacer, the one placed between the sleeve and the cold sink, allows for tighter mating of surfaces and a more effective heat transfer to the module.

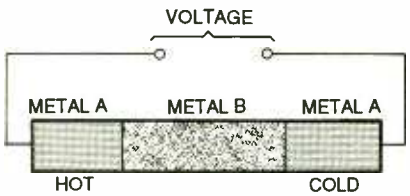


Fig. 1. A thermocouple is created when dissimilar metals are joined together. When one junction is heated or the other is cooled, a voltage is generated across the assembly.

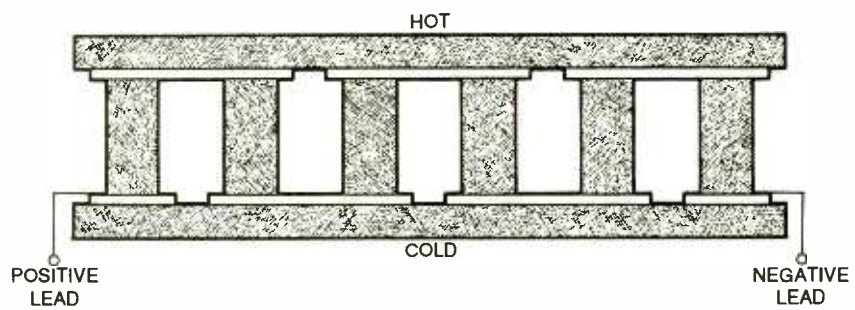


Fig. 2. Specially doped metals set up in arrays like this can transfer lots of heat—more or less so depending on the type of materials used, their doping, the number of junctions, and so on.

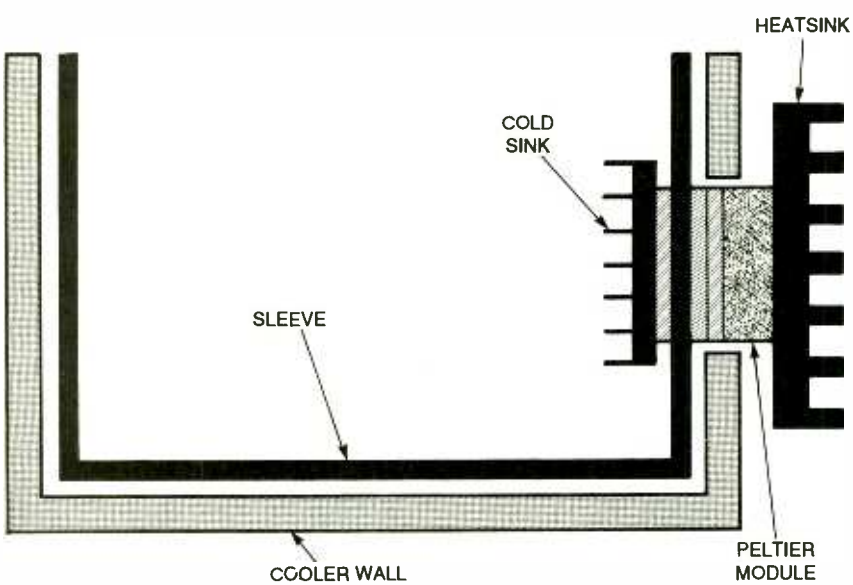


Fig. 3. In the Solid-State Cooler, the sleeve removes heat from anything resting on it and the cold sink cools the surrounding air.

PARTS AND MATERIALS LIST FOR THE SOLID-STATE COOLER

Peltier device
Cooler
Two heat sinks
Sheet aluminum
Aluminum spacers
12-volt DC Muffin fan
Cigarette-lighter plug
Chicken wire
AC line cord (see text)
Foam rubber
Optional capacitor (see text)
Solder, hardware, etc.

As mentioned before, the most important thing with Peltier modules is that heat be removed from the hot side as quickly as possible, and the module we used sure can generate—or more precisely move—a lot of heat. An "oversize" heat sink is therefore required. Actually the heat sink only looks oversize, but in this application, the bigger the better.

Since the cooler measures about 10 inches wide, we figured that would also be a good size for the heat sink. We also needed one perfectly flat side with no holes in the area where the module would make contact. After the surplus market and usual catalog sources turned up nothing suitable, we decided to make our own heat sink out of a 10-inch long, 5-inch wide piece of aluminum channel. Because the channel had only two fins on the outside, we added three 10-inch sections of smaller channeling as shown in Fig. 4. Using three channels left clearance for four bolts—one at each corner of the module—that would later be used to hold everything together.

After positioning and marking the smaller channels, holes were drilled through both channels at the same time, while being careful not to damage any heat-exchanging sur-

faces. The holes in the smaller channels were then enlarged so that self tapping screws could spin freely in those pieces yet still get a bite in the larger channel. The smaller channeling was then given a thin coat of thermal grease and attached to the larger channel with some short, self-tapping screws.

A local metal-supply house was kind enough to both stock and cut the metal we needed at $2 a pound. We also picked up a scrap piece of the larger channel to make the spacers we would need. In all, it was about $10 worth of aluminum. However, you certainly don't have to duplicate the heat sink we made—just use anything that's big enough with the proper specifications.

Our home-made heat sink presents another hobbyist limitation: ultra-smooth heat sink and spacer surfaces are preferable, which a home-made heat sink or spacer doesn't have. However, hobbyists always have to be willing to make certain compromises, and here it's at the expense of cooling efficiency. So keep in mind that the higher the quality of the heat sink, the better the cooler will work.

A smaller flat-sided heat sink was used as the cold sink. The cold sink is less-critical than the heat sink, so it should be easier to find. You could probably get by with a flat plate of aluminum for the cold sink.

Once a heat sink removes heat from something it has to give up that heat to the outside air or else it becomes useless. A good way to cool a heat sink is forced-air cooling with a fan. After experimenting with a wimpy 12-volt fan, we decided to go with the largest 12-volt DC Muffin fan that we could find. American Design Components (400 County Ave., Secaucus, NJ 07094; Tel. 800-776-3700) had just what we needed: a 12-volt DC fan that moves air at about 102 cubic feet per minute (cfm), and costs less than $10.

Although all this cooling effort might seem like overkill, it's not. It's actually just a hobbyist attempt at getting the cooling module to work as efficiently as possible. To prove the point of how important it is to remove heat from a Peltier device, we tried several different cooling configurations before we settled on the final design. We first tried using two modules thermally in parallel (*i.e.*, side by side) for what we thought would be double the heat transfer at double the current. It turned out that the heat sink got too hot and so the module's cold side wasn't cold enough to cool the cooler. Then we tried using two modules in series—one stacked on top of the other—for a theoretical double ΔT, but again the heat sink got too hot. So it turned out that a single module would do job as long as we made sure that we removed heat from its hot side quickly enough.

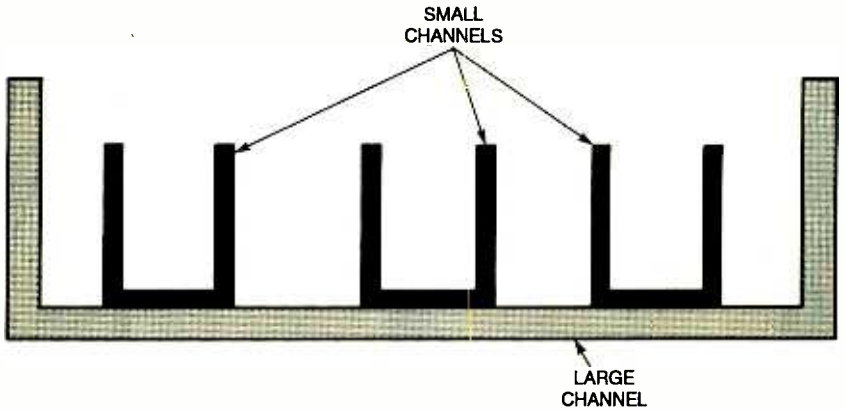


Fig. 4. The heat sink was made from a 10-inch long, 5-inch wide piece of aluminum channel. Three 10-inch sections of smaller channeling were added as shown. The smaller channeling was given a thin coat of thermal grease and attached to the larger channel with self-tapping screws.

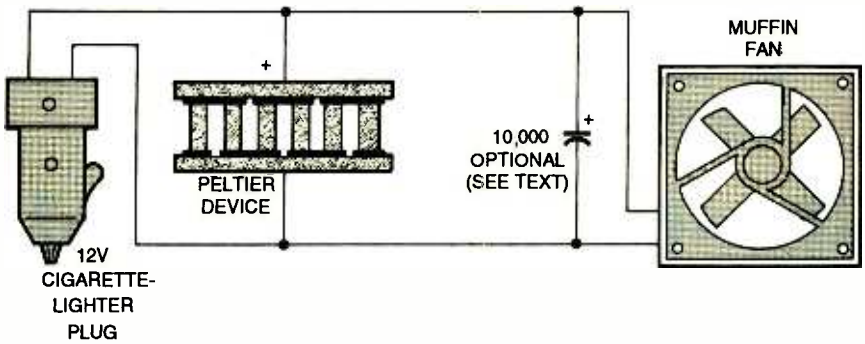


Fig. 5. The capacitor in this schematic of the Solid-State Cooler is necessary only if both the cooler will be used in a car and the car's power supply is noisy (see text).

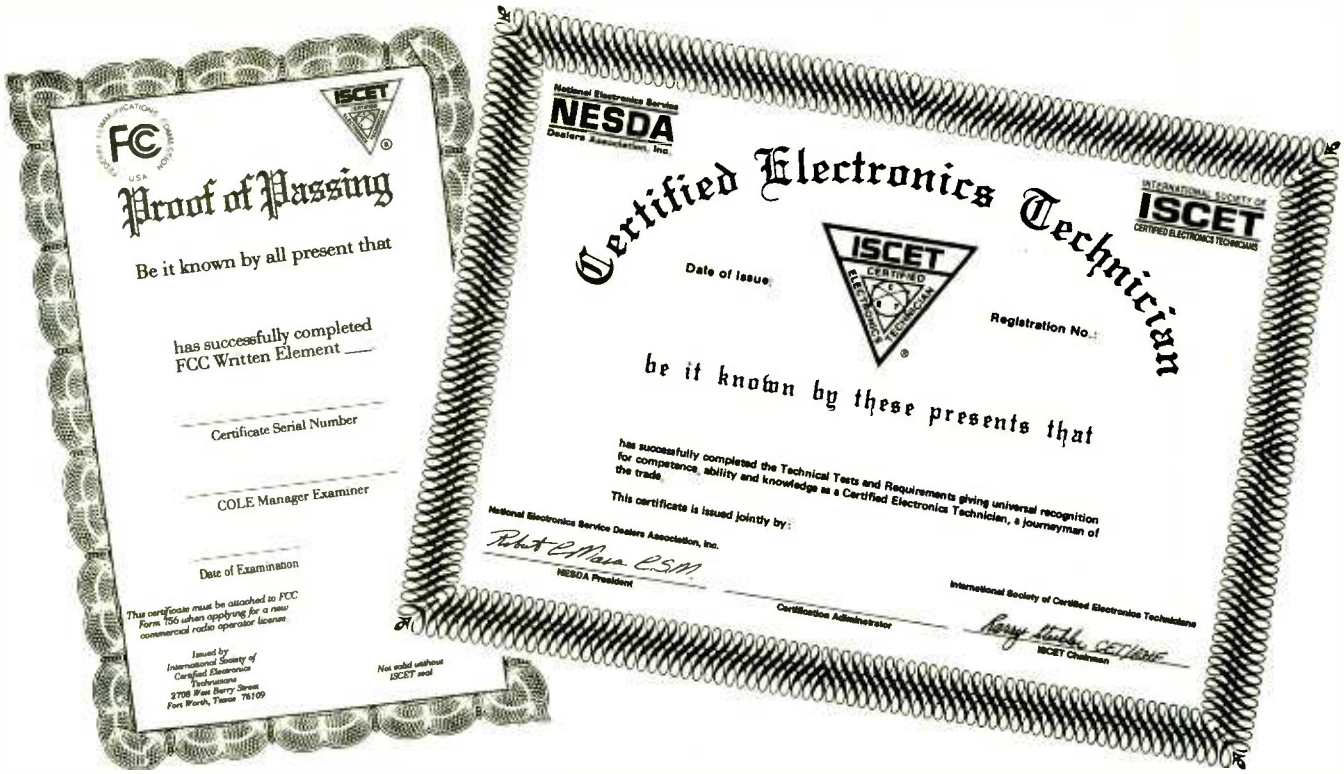
Electrical Considerations. The second most critical thing when using Peltier devices is that clean DC be used to power them. That means no ripple in your supply's output. If you intend to use the cooler indoors, perhaps as a "second fridge," you'll need a somewhat expensive power supply, one that's capable of outputting a clean 12 volts at about 7 amps.

Because our cooler was intended to work in a car, the power supply was never really a concern. However, ripple can be a concern. Although the supply is clean when the engine's not running, it can get pretty noisy or spiky when the engine is running. If it turns out that you have a "noisy" cigarette lighter—if the cooler seems to be less effective in the car than when powered from a laboratory-grade DC supply, just slap a few large electrolytic capacitors—several thousand microfarads—across the Peltier terminals. Figure 5 shows the schematic of our cooler.

Be sure to use wire of adequate gauge to power the cooler, at least AC-line cord weight. That way, voltage won't be dropped—or power simply wasted—in the wire itself and not be used to cool anything. As a rule of thumb, any wire that get's warm to the touch when powering the cooler should be replaced immediately with a heavier gauge.

Building the Cooler. From this point on we'll assume that you have all your parts ready, and that you're sure they will fit together properly. Drill a hole in each outside corner of the outside

(Continued on page 95)



Electronics Technician's Day

International Electronics Technician's Day is the perfect time to join the ranks of the certified service professionals.

The world that surrounds us is filled with the wonders of electronics. As examples are the highly technical and complex devices that keep us in touch with each other, that bring entertainment into our homes, that run our factories, that help us heal, and that promise an even brighter tomorrow. The cornerstone of this pampered world is the dedicated professional electronics technician. Without those marvelous craftsmen, all of these electronic devices would soon become worthless junk.

In recognition of the technicians of the world, the International Society of Certified Electronics Technicians (ISCET) has proclaimed April 5, 1994 as International Electronics Technicians Day.

This year, that date takes on a very special meaning. For the first time, ISCET examiners have been able to give exams for Federal Communications Commission (FCC) commercial licenses. That is in addition to conducting tests for ISCET's Certified Electronics Technician (CET) and Certified Appliance Technician (CAT) programs.

"Certifying commercial radio operators for the FCC is a giant step for the future of ISCET," according to ISCET Chairman Larry Steckler CET/EHF. "ISCET has been internationally recognized for the high standards of performance maintained by its members throughout the 28 years of this professional certification program. By actively participating in FCC testing and making it a part of ISCET's overall responsibility to our industry, ISCET once again assumes the role of leader in our industry."

National Testing Day. In addition to its designation as International Electronics Technicians Day, April 5, 1994 will serve another purpose: It has also been set aside as International Testing Day for the certification of electronics and appliance technicians. Many of the extensive corps of volunteer ISCET test administrators will use "T-Day" to encourage non-certified technicians to demonstrate their technical expertise by taking one or more of the many different exams offered by ISCET.

As this article is being written, more than 150 ISCET Certification Test Administrators have volunteered to honor Electronics Technicians Day. They will offer CET, CAT and FCC testing from April 2 through April 9. A complete list of all of these test sites (which includes the Farmingdale, NY editorial offices of this publication) can be found elsewhere in this article.

FCC Exams. The two FCC exams that are currently available through ISCET are Element 1, basic radio law and operating practice; and Element 3, electronic fundamentals and techniques required to adjust, repair, and maintain radio transmitters and receivers. By passing both of those tests,

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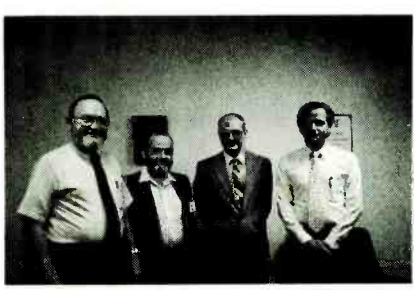
the examinee qualifies to receive an FCC General Radiotelephone License.

Other FCC license exams will soon be available. As question pools for those other elements are released to the Commercial Operator License Managers, ISCET test administrators will also offer the appropriate exams. They will include telegraphy exams for receiving Morse code; Element 5, radiotelegraph-operating practices; Element 6, advanced radiotelegraph, technical, and legal; Elements 7 and 9, Global Maritime Distress and Safety Systems (GMDSS) operating practices and radio maintenance; and Element 8, the ship-radar endorsement.

All of the exams are being developed under the auspices of the FCC Private Radio Bureau Aviation and Marine Branch. George Dillon, Chief of the Branch, tells us that the question pools for all of the exams should be available before the end of May, 1994.

The FCC released its first question pool to the examiners September 6, 1993. The first technician to be FCC certified by ISCET was Antonio C. Gomez of Santa Isabel, PR, on September 16, 1993. Gomez received the rare certificate serial number of I-93-000001!



ISCET Chairman (and **Popular Electronics** *Publisher and Editor-in-Chief) Larry Steckler CET/EHF (second from left) poses with FCC officials at the FCC Licensing Bureau in Gettysburg, PA.*

In the Beginning. ISCET was founded in 1970 by a committee of Certified Electronics Technicians. Their main purpose was to foster respect and admiration for their profession. By maintaining the rigorous standards of its certification program, ISCET can identify and recognize highly skilled and knowledgeable technicians. Membership is open only to those technicians who have passed the Journeyman CET exam, the CAT exam, or the Associate CET exam. In addition to regular newsletters, magazines, conventions, and technical-training seminars, members receive frequent updates on new technology, an annual information directory, and a variety of other technical benefits

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(Continued on page 96)

The ABC's of Printers

KARL T. THURBER, JR.

Have a new printer in mind? Here's the no-nonsense lowdown on today's exciting and affordable printer technologies.

When the first low-cost personal-computer (PC) printers appeared, users thought they were finally delivered from the dark ages—even if the nine-pin print wasn't all that sharp. However, that was just the beginning.

Printers have changed dramatically, advancing even faster than the PC's they're connected to. No longer are PC printouts characterized by eye-straining output. Today, without very-close examination, you'd probably be hard pressed to tell whether a page emerged from a dot matrix, laser, LED/LCS (light-emitting diode/liquid-crystal shutter), or inkjet printer. Furthermore, for what an impact printer cost just a few years ago, you now can buy a much more capable laser printer.

The Old Days. Before PC's and PC printers, there was the typewriter, the simple office workhorse that's mostly relegated to just printing on envelopes today, if even that. It produced high-quality documents and became the standard for "letter-quality" (LQ) printing. Later, dedicated word-processors (with incorporated, noisy "daisywheel" printers) appeared.

A daisywheel has a set of closely packed flexible spokes extending from a central hub, something like the arrangement of petals on a daisy. At the end of each spoke is a character dye just like the character type on a typewriter element. Like the typewriter, the daisywheel spoke impacts the ribbon and leaves its image on paper. Hence, it's called an "impact" printer. Daisywheels are faster than typewriters, but they're still too slow. A daisywheel can print only about 15 to 50 characters per second (CPS). Also, they're inconvenient: if you want to change the type style, you have to manually change the daisywheel. They're also quite noisy too.

The Dot-Matrix Printer. In the early 1980's, another type of impact printer called the "dot matrix," emerged. Like the typewriter and daisywheel, they hammer ink from the ribbon onto the paper. However, instead of a hammer for every letter, the dot-matrix printer has a row of wires in its printhead that prints a matrix or pattern of dots to form individual characters. The printhead travels from one side of the paper to the other as it places each dot in position.

The first dot-matrix printers used a matrix nine dots high and nine dots wide (9 × 9), for 81 dots per character. However, the dots caused visible gaps in the letters. Print quality could be enhanced by making more dots in the same space (or "cell"). For that, the printer would make two passes: first, printing the character and then adding more dots to it on a second pass. The two-pass mode was called "near-letter quality" (NLQ).

Today, most nine-pin printers offer two print densities: The "fast-draft" mode, produces characters with a 9 × 12 dot matrix (108 dots per character), while the slower, NLQ mode, makes two passes for 216 dots per character.

In connection with dot-matrix printers, you also see the expression "dots per inch" (DPI) used. The DPI ratings don't deal with character matrixes, instead they refer to the number of dots packed into an inch. The more dots, the higher the printer's resolution and the higher the density of text and graphics that appears on paper. Most nine-pin printers are capable of up to 240 dots horizontally and 216 dots vertically, per inch.

Today, most dot-matrix printers have 24-pin printheads for LQ printing. They may use a 24 × 12 matrix in draft mode and a 24 × 36 matrix in LQ mode. Since they produce more dots in a pass, the 24-pin models don't have to make two passes to produce quality outputs. Many 24-pin models print 360 dots horizontally and 360 dots vertically, for 360 DPI. The draft mode of a 24-pin printer is faster than its LQ mode and its output often looks good enough for many applications.

Dot-Matrix Advantages. Dot-matrix printers are the most versatile and flexible of printers. Also, they're usually cheap: $200 or so buys a good model. Another advantage is speed,

The Panasonic KX-P2124 is a 24-pin LQ impact printer with eight built-in fonts, optional color-printing capability, 360 × 360 DPI graphics resolution, 320 CPS draft speed (about 4 PPM), and two levels of quiet printing. It's under $300 on the street.

which ranges from 150 to over 1,000 CPS. They also can print on almost any paper, including multi-part and carbon forms. They can use perforated or continuous-feed paper, and the wide-carriage models can handle wide spreadsheets. Other advantages include flexible paper handling, multiple fonts, and low maintenance.

A dot-matrix printer usually has a low cost-per-page for consumables (like ribbons). The cost for operating a dot-matrix printer runs about a half cent per page, as opposed to a laser printer's three to five cents per page. Quite a difference! Dot-matrix printers also have industry-wide compatibility. Most emulate, "clone," or are otherwise compatible with Epson's standard printer language for 9- and 24-pin dot-matrix printing. So most dot-matrix printers will work with just about any popular software package on the market.

Dot-matrix printers can be excellent values as manufacturers pack more and more features into them and their prices plummet. That makes them good candidates for the home office and small business. However, they do have some drawbacks.

All impact printers are noisy, more so than typewriters. That's why many users choose a non-impact printer like a laser or inkjet (which we'll discuss shortly). Also, you might have to put up with tractor-feed problems, paper jams, and messy ribbons. Dot-matrix printers are also relatively slow. In fact, their speed is measured in characters per second (CPS), while laser speeds are measured in pages per minute (PPM). Why? Lasers first create an image of the entire page and then print it, while dot-matrix printers work sequentially, character by character, line by line. Furthermore, dot-matrix printers are even slower in NLQ or LQ modes. The slowest laser printers print at four PPM; which is still faster than a 24-pin dot-matrix printer in LQ mode. A good rule of thumb for making comparisons is that a 4 PPM laser generates text at about the same rate as a 320 CPS impact printer.

Enter the Laser. When it comes to cranking out sharp looking copy quickly, and professionally, nothing beats a laser. It offers refined images, consistent blacks, and quiet operation at a reasonable price.

In operation, laser printers are similar to copying machines. Like a copier, true laser print engines use a pulsing beam from a solid-state laser diode to trace pixels on a photosensitive drum. The laser itself is stationary, but a moving mirror reflects the beam to the revolving drum. Wherever the beam shines, the drum becomes charged.

Dry ink, called "toner," sticks to the charged points. As the drum turns, it comes into contact with the paper, and the toner rubs off onto the paper. The toner is then melted into the paper by a hot roller called the "fuser." Because the toner "runs together" when it's fused, it nicely smoothes the characters' edges, so that instead of seeing individual dots, you see good, solid black regions with smooth edges.

Today, lasers offer a broad range of capabilities in all price ranges. We'll examine several of these differences, starting with speed. At the low end, the output rate is about 4–6 PPM. From there, rates can rise to surpass 20 PPM. However, speeds claimed by manufacturers reflect the maximum imaging rate of the printer under ideal circumstances, as when printing text. True print speeds for complex graphic pages are greatly limited by the printer's electronics.

Raw speed alone isn't everything. In many offices, the issue is how long a printer will go without attention, so paper-tray capacity is more important. Some low-end printers handle as few as 50 sheets, so you have to reload the tray after every few print jobs. Larger tray capacities mean fewer interruptions.

Lasers also differentiate themselves by output quality and resolution. Once all lasers promised 300-DPI resolution, but now there are alternatives. HP's "Resolution Enhancement Technology" and Epson's "Resolution Improvement Technology," for example, improve the quality of text and graphics and make 300 DPI resolution appear sharper by varying dot size for smoother curves and diagonal images. Others improve quality by using true gray-scale capabilities to increase the apparent resolution of continuous-tone images. Still others offer modification kits that break the 300-DPI limit. More recently, the newest generation of lasers deliver true 600-DPI and, in some cases, higher resolution.

However, lasers are more complex and expensive to produce than impact or inkjet printers. They're also limited by media flexibility in terms of limits on paper size and weight, and most lasers are designed for cut sheets and so can't handle continuous forms. Impact and inkjet printers do well both with continuous-form and hand-fed individual sheets. Impacts win over both inkjets and lasers when you must use a variety of paper stocks or print on forms.

Laser Look-alikes. Not all "laser printers" really use a reflected laser beam to expose a drum. Some printers use light-emitting diodes (LED's) or liquid-crystal shutters (LCS's). The difference between these and true lasers lies in the light source that writes the image to the drum. The remaining printer mechanics are esentially identical.

In a true laser engine, a spinning mirror directs a single laser beam across the drum to paint each row of pixels. By contrast, LED and LCS printheads are fixed arrays of many LED's. They use light from the LED's to charge the drum. The LED's turn on and off as the drum rolls past them. Lasers, on the other hand, use a motor to spin a mirror and so have more moving parts. Whether these differences make LED and LCS printers more or less reliable than laser printers is debatable, though LED/LCS printer manufacturers do tend to offer long printhead warranties. All three engine types have good reputations and can produce very high-quality output.

Inkjets. Laser and LED/LCS printers aren't the only non-impact printers. If you want a high-resolution printer, but can't afford a laser, consider an inkjet printer, especially for portable use. Results are competitive with lasers, they typically list between $300 and $600, and they have zero warm-up time. To most eyes, the difference between inkjet and laser output is almost nil.

An inkjet (sometimes called "bubble-jet") printer contains a moving printhead with several ink-spraying nozzles that squirt dots onto paper. The dots form the characters on the page.

Since inkjets use liquid ink, the early models suffered from ink smears and clogging. The water-based ink tended to either dry up and clog the nozzles, or it ran as soon as it hit the paper. Inkjet technology has become more popular thanks to advances both in the ink and in the hardware. The introduction of low-cost cartridges (about $15 to replace), which include a new printhead, have served to popularize inkjets.

Early-on, light fastness was also a problem. A printed page would fade so that you could hardly read it. The fading was a by-product of heating of the ink, which caused it to break down. In recent years, the ink has been stabilized.

However, many inkjet printers require specially treated paper for best results. Sprayed onto ordinary paper, the ink is absorbed and the image can become fuzzy and washed out.

Still though, inkjet printers can deliver especially good results on treated paper and on transparency film, offering sharper images and brighter colors than impact printers. Moreover, the size of the dots made by inkjet spray is easier to control than the hammered dots of impact printers. That characteristic allows inkjets to realize higher resolution.

Like dot-matrix printers, inkjets offer two modes: a fast-draft mode and a slower higher-quality mode. The printers are rated in terms of CPS, like dot-matrix printers, but users usually prefer to compare inkjets to lasers since their output quality is comparable.

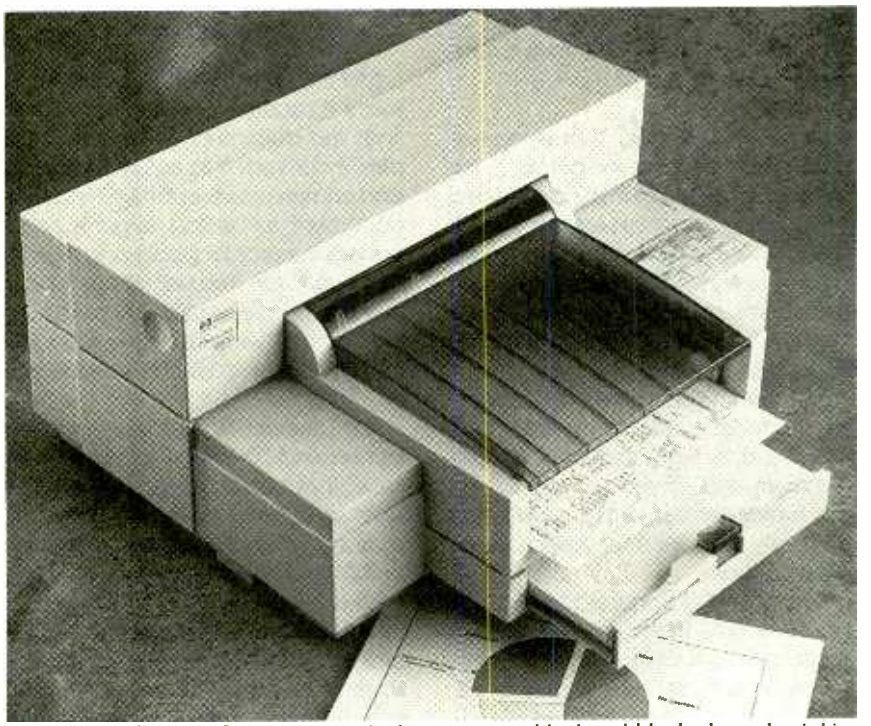
Inkjet print speed falls somewhere between that of dot-matrix and laser printers. Typical inkjets are rated at about 120 CPS, or about two to three PPM.

Most inkjet (and dot matrix) printers can handle almost anything you toss at them. Both let you cover more paper area than lasers, leaving no border. While most lasers have small unusable borders, most inkjet and impact printers allow you to print edge-to-edge. Also, both inkjet and impact printers with wide carriages can handle wide media.

One nice feature of inkjet printers is portability, and several companies offer portable inkjets. These streamlined road warriors are designed to be used with notebook PC's, or even combined with them. As far as portability goes, laser printers probably will never be able to compete because of all the mechanical parts they require. It would be difficult to reduce those parts to the size required in a portable printer.

Low-Cost Color Printers. The most popular printing specialty is color. It's a luxury with a premium price tag. However, as color-printer technology has matured, the price of color has come down dramatically.

Impact printers offer the lowest-cost color printing. Many inexpensive dot-matrix printers can be upgraded with special printheads and color ribbons at low cost. Their resolution is equivalent to that of monochrome printers in the same class, but color suffers as their ability to blend colors is mini-



The HP DeskJet 550C is an economical, easy-to-use black and black-plus-color inkjet. The $879 printer offers 3 PPM print speed, a convenient dual-cartridge system including a tricolor ink cartridge, and six resident fonts.

mal—the number of colors ribbons can offer is limited. Also, the inks, which are partly absorbed into paper, lose intensity. They're also subject to banding (where each printhead pass leaves a visible band across the paper), color variation from uneven paper absorbency, humidity, slow speed, and fuzzy imaging.

If you want a good resolution color printer, consider a color inkjet: prices are now well under $1,000. Inkjets, which work best with specially coated papers or transparency media, provide good resolution and color blending. Color inkjets can use wax-based inks that stand out vividly because they're not absorbed by paper; the solid-ink jets spray molten wax-based ink at paper on which the ink sticks and solidifies. A related technology—thermal-transfer or heat-fusion—is also increasing in popularity. Perhaps more akin to dot-matrix printing, wax-based ink is melted off a page-wide ribbon known as a transfer sheet.

Both methods of color printing can produce sharp, well-saturated, uniform 300-DPI or better images. The inkjets can print seven colors directly; the thermal-transfer types can print up to 256 colors simultaneously for a photo-like appearance. However, the cost of consumables for color printers is much higher than for black-and-white printers. The cost-per-page of the typical color inkjet printer is a relatively high nine cents.

Special Features. Some newer lasers, even those in moderate price ranges, offer surprisingly advanced productivity-boosting features. The HP LaserJet 4L printer is a good example of a low-end ($849 list) printer that embodies several such innovative features, so we'll use it as an example in describing them.

Till now, laser printers didn't have a "draft mode" as such; everything was produced in high-resolution. The alternative was to produce drafts on dot-matrix printers, or put up with the relatively high cost of laser copies used as drafts.

Recently, HP introduced the Econo-Mode feature in its LaserJet 4L. As a result, you can reduce your cost per page by 50% for proofs and drafts, and also lengthen the toner-cartridge life. Practically any typeface is readable when printed in Econo-Mode since the leading edge of each character is printed at full resolution, although draft copies do have a grayish cast.

HP's Memory Enhancement technology (MEt), a compression technique, is also worth noting, especially if your printer has limited memory. In the past, when a laser ran out of memory while printing, it only produced part of an image. With MEt, large or complex images are compressed and printed out.

The HP LaserJet 4L is HP's lowest priced laser printer, listing at $849. The 4 PPM, 300 DPI printer includes a one-button control panel, setup software, a draft mode, and memory-enhancement technology that doubles printer RAM.

MEt first examines the document to see if it requires compression. If MEt finds the document to be too complex, it converts it to actual laser dots and compresses them. If MEt finds the document to be too large, it compresses the graphics data and fonts to find room for the rest of the document. MEt also allows you to download about twice as many soft fonts into a given amount of printer memory.

The LaserJet 4L also has a 100-KB-per-second "Bi-Tronics" parallel interface. That bi-directional port lets the laser send status messages to the PC showing when the printer needs servicing or additional paper. The interface also allows you to control printer functions using the supplied HP Explorer software, which gives on-screen access to the normally hard-to-set printer control-panel options. Special printer drivers that incorporate the on-screen printer-control features are available from HP for Windows and major Windows applications.

PCL's and PDL's. Software programs must speak the same language as the connected printer to be effective. So several printer languages have become standard. The language(s) you need depend on the software applications and the printer(s) used.

While most applications directly support a wide range of laser printers, two languages (in various dialects) virtually guarantee compatibility with the widest range of applications: Printer Control Language (or PCL), developed by Hewlett Packard, and the Adobe PostScript Page Description Language (or PDL).

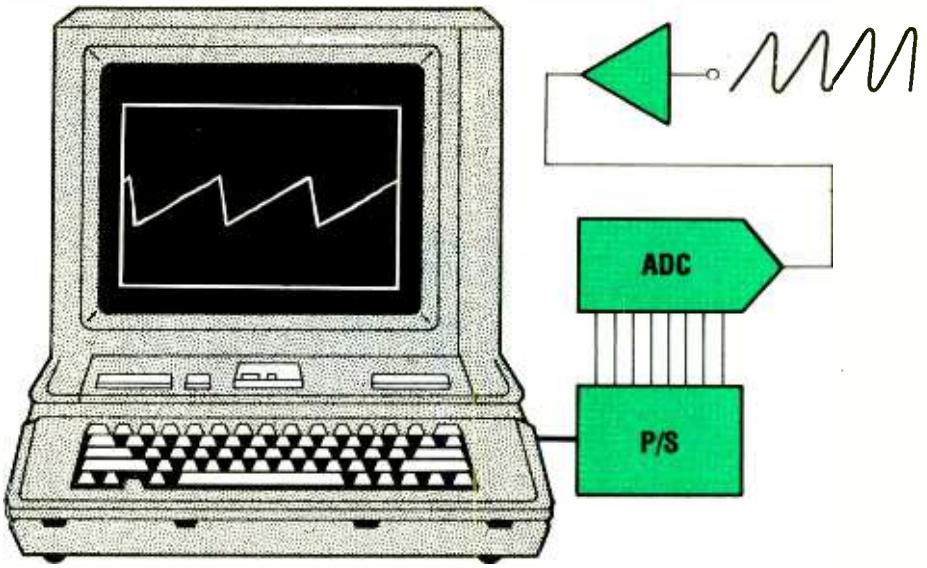
Nearly all laser and LED/LCS printers are compatible with either PCL or PostScript, sometimes both. Many PCL printers can be modified to print PostScript files by adding a special font cartridge or by installing a circuit board in the printer, as well.

PCL contains commands that inform your printer to change margins, fonts, and other page-formatting options, and otherwise control the printer's microprocessor. Three PCL versions are important today: PCL 3, the language of HP's original LaserJet that supports only cartridge fonts in text modes; PCL 4, which allows multiple fonts on the same page and downloaded bitmapped fonts; and enhanced PCL 5, introduced with the LaserJet III early in 1990 to support scaleable fonts, vector graphics, reverse printing, and a new version of HP's Graphics Language.

PCL 5 dramatically narrowed the gap between PostScript and PCL. PCL 5 gives users scaleable fonts using a proprietary font technology, called Intellifont, built right into the printer itself just like PostScript printers. With it, many users won't have to buy additional font cartridges or soft fonts. What's more, the newest versions of PCL are backward compatible with older versions. Old documents produced with PCL 4 can be printed on a PCL 5 printer.

PostScript PDL. PostScript is a page-description language known for its power and control over the

(Continued on page 94)



A Low-Cost Analog-to-Digital Converter for your PC

Here's an inexpensive project that lets you use your PC as a data-acquisition tool and much more.

BY PATANIT SANPITAK

It certainly would be interesting to use one's computer as a data-logging device. Unfortunately, the signals from most transducers are analog while a computer's on-board interfaces are digital. Of course, that discrepancy can be overcome by digitizing the analog signals from a transducer. That's why analog-to-digital converter circuits play an important role today in the world of automated-measurement and data acquisition.

There are a lot of companies that make special adapter cards or external modules you can add to your PC for such purposes. The prices of the units vary according to their capability and quality. Some budget-priced models can cost around $80, while some professional packages (typically for use in the laboratory for precision measurements) can run up to several thousands.

In contrast to those devices, the project presented in this article is designed to be economical (it should cost under $30) and all of its parts are easy to find (most of the IC's are probably in your supply box). The unit is considerably flexible and can be easily modified to suit your own needs. In fact, we'll present transducer circuits to measure temperature, light-intensity, and blood flow (the last of which we'll explore in depth), and some software to demonstrate the ADC's usefulness.

Why Use the Serial Port? First of all, most computers come with at least one serial port, usually intended for connecting the computer to a serial peripheral (*i.e.*, a light pen, mouse, modem, digitizing board, or a serial printer/plotter, etc.). Its presence gets us half-way there by allowing us access to the PC's bus from outside the computer. That makes the project inexpensive and simpler as it eliminates the need for you to make your own adapter card and open-up your PC. In fact, the connection to the PC is simply a 2-conductor shielded cable.

Now, you have to keep in mind that using a serial interface consigns you to a slower data-transfer rate than say, a parallel port. For example, the circuit we are going to describe is designed to communicate at 9600 baud with 1 frame of data consisting of 8 data-bits, 1 start-bit, and 1 stop-bit (or 10-bits per word of data). So the maximum data-transfer rate will be 960 words-per-second (or 9600/10). That, (according to the Nyquist sampling theory) would not be sufficient for sampling a signal with a frequency higher than 480 Hz (which is 960/2). However, that data rate is more than enough to sample most common, slowly varying, physical properties (*i.e.*, temperature, pressure, strain, light intensity, etc.) and, in fact, our circuit will operate a bit slower than that.

How it Works. Figure 1 shows the main circuit, which consists of only 7 IC's; all of them popular and inexpensive. Let's start with the ADC0804, a CMOS 8-bit successive-approximation analog-to-digital converter. The chip can easily be configured to operate as a "stand-alone" or "free-running" unit. It has an on-chip clock-signal generator whose frequency is determined by R1 and C1. The chip's conversion accuracy is guaranteed when operating at a clock frequency of up to 640 kHz, which will give a conversion time of 100 µs to provide a 10-kHz sampling rate. As already mentioned, we will not use it at that high a frequency in our circuit because our maximum data-transfer rate will not be over 960 samples/sec.

For the free-running mode, the read (pin 2) and chip-select (pin 1) inputs must be tied to ground, while the interrupt output (pin 5) is connected to the write-data input (pin 3) to automatically restart conversion

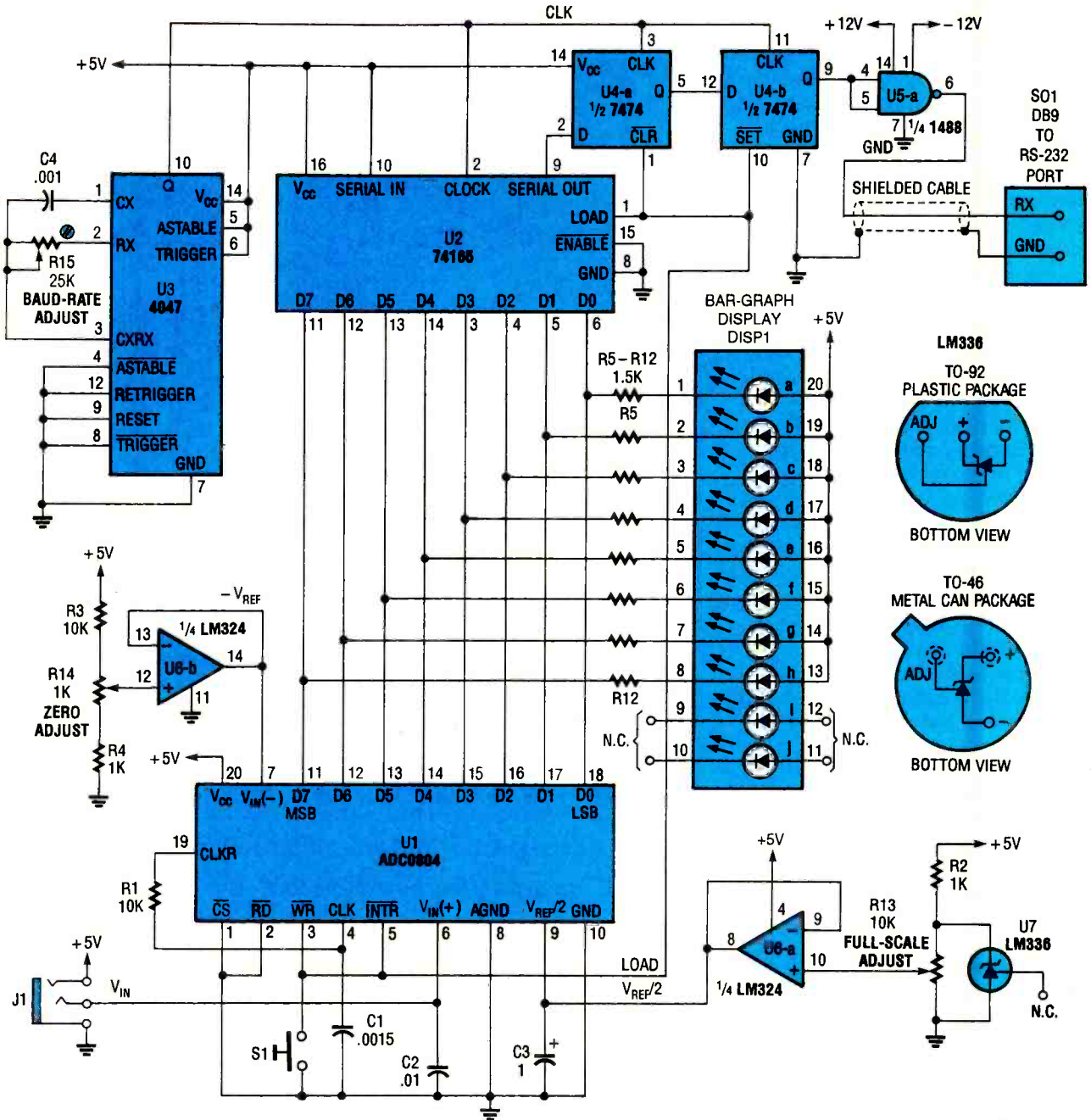


Fig. 1. The main circuit of the ADC can be broken down into two sections, a 10-bit serial shift register to format and transmit data, and an analog to digital converter that produces data.

with each available word of data. A momentary-contact pushbutton-switch (S1) is present so the user can force the write data pin low to initiate the first reading after power-up. A required reference voltage ($V_{REF}/2$) is provided by an LM336, (a 2.5-volt reference diode) via one section of an LM324, used as a buffer, and a 10k potentiometer that acts as a full-scale adjustment control. The pin labeled $-V_{in}$ is used to receive a zero-adjust voltage produced by a resistor divider (composed of R3, R4, and R14) and buffered by the other section of the LM324.

With that arrangement, any analog voltage presented to the $V_{IN}(+)$ pin will be converted into an 8-bit digital output available at pins 11 through 18. The value of that voltage, which can range from 0 to 5 VDC, can therefore be represented by 256 discrete binary values from 00000000 to 11111111 (or 0 to 255 in decimal). The difference between successive digital values (the quantum-step size for the circuit) will be equivalent to a change of 19.53 mV (5 volts divided into 256 steps) in input voltage. In this case, any signal variation less than the quantum-step size will not be seen by the ADC.

The 8-bit digitized data is fed to a 74165, an 8-bit parallel-to-serial shift register. Since we have to add a 0

PARTS LIST FOR THE 8-BIT ADC

SEMICONDUCTORS

U1—ADC0804, 8-bit successive-approximation analog-to-digital converter, integrated circuit
U2—74LS165, 8-bit parallel-to-serial shift register, integrated circuit
U3—CD4047, monostable/astable multivibrator, integrated circuit
U4—74LS74, dual D-type flip-flop, integrated circuit
U5—MC1488, quad RS-232 line-driver, integrated circuit
U6—LM324N, quad low-power op-amp, integrated circuit
U7—LM336Z, 2.5-volt reference diode
DISP1—10-segment LED bar-graph display

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1, R3—10,000-ohm
R2, R4—1000-ohm
R5–R12—1500-ohm
R13—10,000-ohm, potentiometer
R14—1000-ohm, potentiometer
R15—25,000-ohm, 15-turn trimmer potentiometer

CAPACITORS

C1—0.0015-µF, ceramic-disc
C2—0.01-µF, ceramic-disc
C3—1-µF, 16-WVDC, electrolytic
C4—0.001-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

J1—⅛-inch, 3-conductor phone jack
SO1—Female, DB-9 connector
S1—Normally open, momentary-contact, pushbutton switch
Perfboard, IC sockets, hook-up wire, 3-feet of 2-conductor and 1-conductor shielded cable, solder, etc.

start-bit and a 1 stop-bit to each data word, the serial output from 74165 will pass through 2 D-type flip-flops (both in a 7474 IC). The last flip-flop in line (U4-b), appends its bit (set to be a 1 as we'll describe) to the end of each data word, and the other flip-flop attaches a "0" behind that as the start bit of the word yet to come. Together, the 74165 and the 7474 thus form a 10-stage shift register that formats the data for transmission. The serial input of 74165 is hardwired to be in a logic-1 state. So, if enough clock pulses go by without a new "Load" signal, continuous 1's are shifted into and out of the register.

Which brings us to the baud-rate clock. A CMOS 4047 functioning in its astable-multivibrator mode provides that function for the 10-stage shift register. Capacitor C4 and the setting of R15 determine the frequency of the clock. Potentiometer R15 can be adjusted to produce almost any reasonable baud rate. As mentioned, in this project the clock frequency will be adjusted to 9600 Hz. The 4047 astable-multivibrator doesn't use a crystal, so its stability is not very good. However, it can be used in our circuit because in a 10-bit-per-frame serial communication, if the transmission-clock frequency shifts less than ±10% and the receiver clock is pretty stable, the receiver should still be able to receive the correct data from the transmitter. So, if we can set the baud clock to be 9600 Hz ±100 Hz, (a maximum error of only 1.04%), that should be more than good enough.

An MC1488 RS-232 line driver receives the serial data stream from the 10-stage shift register and converts it's TTL signals to RS-232 signals. That is the only signal line connected to the PC's serial port. The only other connection to the PC is for the signal ground. Both the signal and ground connections

PARTS LIST FOR THE ADC POWER SUPPLY

SEMICONDUCTORS

U1—LM7805T, 5-volt regulator, integrated circuit
U2—LM337T, adjustable negative-voltage regulator (optional, see text), integrated circuit
D1–D4—1N4002, 1-amp, 100-PIV, rectifier diode
D5–D6—1N4742, 12-volt, 1-watt, Zener diode

RESISTORS

(All fixed resistors are ½-watt 5% units.)
R1—130-ohm (optional, see text)
R2, R3—390-ohm
R4—1000-ohm, potentiometer (optional, see text)

CAPACITORS

C1, C2—1000-µF, 30-WVDC, electrolytic
C3—0.01-µF, Mylar
C4–C6—100-µF, 25-WVDC, electrolytic (C4 is optional, see text)

ADDITIONAL PARTS AND MATERIALS

T1—24-VAC, 450-mA, center-tapped, power transformer
S1—3-amp, 125-VAC, SPST, power switch
Perfboard, hook-up wire, solder, etc.

are made via SO1, shown as a female DB-9 connector. If your serial port requires a DB-25 connector, use pin 3 on that connector for the serial-data line and pin 7 for the ground.

Let's now see how the free-running 10-bit shift register works with the ADC IC. At the end of every conversion, the interrupt output of the ADC0804 produces a negative-going pulse. That pulse is sent to the set input of U4-b, the clear input of U4-a, and the load input of the 74165. When that happens, the digitized data, a 0, and a 1 are loaded into the 74165, U4-a, and U4-b, respectively.

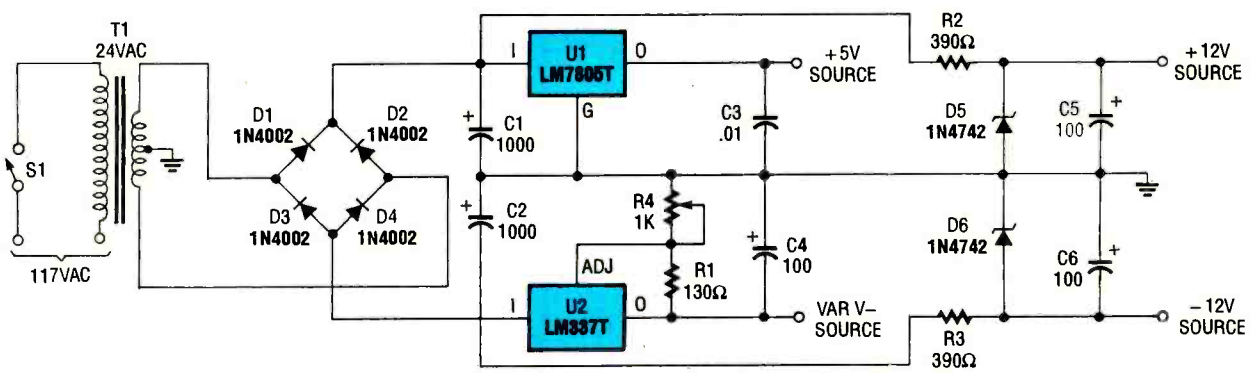


Fig. 2. This power-supply is more than adequate for the ADC. In fact, you can leave out certain components if you don't need an adjustable negative-voltage supply.

n the next baud-rate clock pulse, -b will transmit its pre-set 1 (the stop bit). Since the ADC (which initiates the production of this 1 bit) and the baud-rate clock (which shifts it out to the computer) are not synchronized, the stop bit is of an indeterminate duration. That's okay, because stop-bits are essentially ignored by the computer regardless of duration. However, the stop bit is necessary because if a stop bit is not used, the start bit would be the bit of indeterminate duration, which would result in a break-down of communication. By the way, that's why 1's are serially loaded into the shift register when the parallel inputs are idle: so they will appear as one long stop bit. The real stop bit will be appended to this chain, and so must be of the same logic state to blend in.

The next baud-rate clock pulse will shift-out a full "0" (which originated in U4-a) as a start bit. Then the next 8 clock pulses will shift the 8-bit data from the 74165 out in ascending order of significance. A string of 1's (the giant "stop bit") will follow the eight-bit data until the next load command is inserted.

Note the 10-bit shift register cannot receive load signals at a frequency higher than 960 Hz (which is 9600/10) because it needs a minimum of 10 clock pulses to complete shifting-out 1 frame of data. That is why the ADC in this circuit is operating at a low frequency (approximately 700 Hz).

The 8-LED bargraph display (actually just 8-segments of a 10-segment unit) is optional. It displays the 8-bit digitized data from the ADC in inverted form and might help you check the circuit's operation. It can particularly help you adjust the zero point and full-scale range of the unit whenever you change transducers.

Note that J1 is a ⅛-inch female 3-conductor phone-jack that carries ground, and 5 volts from the supply. The supply voltage is present to power whatever transducer module you wish to use to produce V_{IN}.

Power Supply. Any power supply capable of producing a clean 5 VDC at 200 mA and ±12 VDC at 50 mA should be sufficient for the circuit. Figure 2 shows the supply circuit that I used for the prototype. In addition to the required voltages, the supply also provides a variable negative voltage (labeled VAR V−) as an auxiliary supply for future implementations of the project. If that is overkill for your purposes, eliminate U2, R1, R4, and C4.

If you plan to use this project "in the field," perhaps with a laptop PC, you can power the circuit from two 9-volt batteries. They should be wired to form a ±9-VDC supply, replacing the ±12-VDC supply (as that won't adversely affect the RS-232 communication), and the +9-volt battery should be regulated down to 5 volts to act as the 5-volt supply. For minimal power consumption, it is also a good idea not to use the LED display section in a portable unit.

Construction. Since the circuit is very simple (consisting of only 6 DIP IC's) and the operating frequency is not at all high, any method of construction is suitable. For my prototype I used a universal PCB and point-to-point wiring. Use sockets for all the DIP-based IC's if you plan to follow suit. Potentiometers R13 and R14 can be PC- or panel-mount units, but R15 should be a 15-turn trimmer. Be sure to position them for easy access.

Common Statements. You may write a program in any language that suits you and your PC (*i.e.*, Fortran, Basic, C, etc.) for the ADC. The software I used (which we'll discuss shortly as an example) was written in Basic with the Microsoft Quick Basic Compiler Version 4.5 because of its simplicity, popularity, and economical price. Before we get to the programs I wrote, let's look at some fundamental programming statements for handling serial ports from Quick Basic.

For an IBM or compatible PC there is an area of memory outside the normal memory-address space that is dedicated for use by hardware ports. In fact, there are 64K (or 65,536) port addresses available and most are typically not used. Some examples of common port addresses are shown in Table 1, although the 2 serial-communication ports listed there are the only ones we are interested in. We will use only the base address (first byte) of one of those ports as they are used for data-byte transfer, while the others are for control and checking status when operating in a handshaking mode (*e.g.*, with a modem, or terminal). They are 3F8 in hexadecimal (1016 in decimal), and 2F8 hexadecimal (or 760 in decimal) for serial ports COM1 and COM2, respectively.

Quick Basic provides a very simple statement to read bytes from any hardware port. Its syntax is:

INP(*port*)

where (*port*) is the address of the port in question—an integer ranging from 0 through 65535 (0-FFFF in hexadecimal).

Before we can use that data-transfer statement, we need to initialize the port by specifying the communication parameters that will be used. That is handled with a different statement, and its syntax is:

OPEN "COM*port*:*params1 params2*" [FOR *mode*]AS[#]*file*[LEN = *length*]

The items in brackets are usually optional, while the items in italics are parameters. The *port* parameter is either 1 or 2 defining whether COM1 or

TABLE 1—SPECIAL ADDRESSES

Port Address in Hexadecimal	Device Description
3BC–3BF	1st parallel port
378–37F	2nd parallel port
300–31F	Prototype card
3F8–3FF	1st serial port
2F8–2FF	2nd serial port

TABLE 2—PARAMS1 DESCRIPTION

Parameter	Description	Value
Speed	Baud rate (bits-per-second)	75, 110, 150, 300, 600, 1200, 1800, 2400, 9600
Parity	Type of parity checking	N = none, E = even, O = odd, S = space, M = mark
Data Bits	Number of data bits in each group that represent actual data	5, 6, 7, or 8 (8 is the default with no parity check)
Stop Bits	Number of bits used to mark the end of each word	1, 1.5, 2

COM2 will be used, respectively. The item *params1* is actually a list of four parameters that specify the speed, parity, data bits, and stop bits of the communication. Details for that set of parameters are given in Table 2. You must use a comma as a place holder for any parameter you do not use. Next, *params2* is a list of the parameters related to the hand-shaking mode of the communications link, but it is not our concern in this case. Just enter that set of parameters just as they appear in the example programs I'll provide. (The curious can find the details in the *Microsoft QuickBasic Reference book.*) The *mode* parameter is one of the keywords: RANDOM, INPUT, or OUTPUT. Of course, INPUT is the appropriate choice for us, although RANDOM will also work. The item *file* is the number of the file from which you'll access the communications port; it is not really applicable to our project, but a number must be supplied anyway. Last, *length* is an integer that specifies the record size used with the port. You can use *length* if the value of *mode* is RANDOM.

Operation-Check Program. In Listing 1 is a program you can use to check and calibrate your finished unit. The program starts (after some remark statements) with an OPEN statement, which sets the communication parameters to 9600 baud, no parity check, 8 data bits, and 1 stop-bit. The purpose of the program is to read the data from the project and display the value of the data in decimal on the screen. The statement DAT = INP(1016) will read the data from the COM1 port and assign it to a variable named DAT, which will be immediately displayed on the screen. That statement is inside a conditional DO loop, which will repeat until the escape key is pressed.

Of course, if the project is to be connected to the COM2 port, the port address used in the input statement must be 760, not 1016. Now let's see how this program can be used during the testing procedure.

Operational Check and Calibration. If you have included the LED readout in your unit, it can help you set up half of the circuit: namely the voltage references for the ADC. After turning on the power, push the reset switch and your circuit is ready to test.

LISTING 1

```
REM            ***   OPERATION-CHECK PROGRAM   ***

REM IF YOUR PROJECT IS CONNECTED TO COM2 CHANGE COM1 TO COM2
REM AND CHANGE INP(1016) TO INP(760)
REM COMMUNICATION SET FOR 9600 BAUD 8-BIT, 1 STOP-BIT, AND NO PARRITY

OPEN "COM1:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR INPUT AS #1

CLS
PRINT "*************************************************"
PRINT "*      8-BIT ADC VIA SERIAL COMMUNICATION PORT      *"
PRINT "*        OPERATION CHECK AND CALIBRATION            *"
PRINT "*************************************************"
PRINT "   :- ZERO ADJUST"
PRINT "      CONNECT Vin TO GROUND AND ADJUST VR2          "
PRINT "      UNTIL DIGITIZED DATA READ :   0               "
PRINT "   :- FULL SCALE ADJUST"
PRINT "      CONNECT Vin TO + 5 V. AND ADJUST VR1          "
PRINT "      UNTIL DIGITIZED DATA READ : 255               "
PRINT


PRINT "           PRESS (ESC) TO EXIT"
LOCATE 14, 10: PRINT "***************************************"
LOCATE 15, 10: PRINT "* DIGITIZED DATA IN DECIMAL :-"; "   "; "    *"
LOCATE 16, 10: PRINT "***************************************"

  DO
     DAT = INP(1016)
     LOCATE 15, 41: PRINT DAT

  LOOP UNTIL INKEY$ = CHR$(27)
CLOSE #1
END
```

Connect V_{IN} to ground, the digitized data from the ADC should be 00000000, so all 8-LED's should turn on (remember, the display shows inverted logic: a lit LED indicates a 0 and a dark LED indicates a 1). If not, correct the situation by adjusting R14. Then connect V_{IN} to 5VDC. The output from the ADC should be 11111111, so all the LED's should be off. Use the full-scale adjustment (R13) to adjust the unit to the point where all the LED's just turn off. DISP1-a should be the last to shut off.

It is also important to adjust the baud-rate clock frequency, which we want to be 9600 Hz. To do that you will need a frequency counter or a DMM capable of frequency measurement. Start by turning the ADC's power on and let it warm-up for at least 10 minutes. Then adjust R15 to get a 9600-Hz reading on your counter or DMM.

If up to this point your ADC is working fine, you'll still need to check whether your computer can communicate with it. The simple display program I presented earlier can now be used to check the operation of the whole project. Enter and run the program, and use a 100k variable resistor connected as shown in Fig. 3 to simulate a transducer. Slowly vary the potentiometer's setting to see if you can get every numeric value from 0 to 255 in decimal.

Keep in mind that the project is a

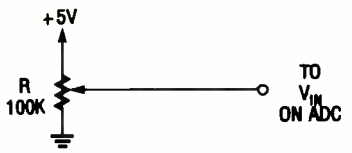


Fig. 3. You should make sure your ADC can produce all the data values from 0 to 255 by using a simple potentiometer connected as shown to simulate a transducer.

serial peripheral, so the PC will confuse it with any other serial device that's set-up to use the same serial port. For example, if a mouse was originally set-up to use COM1 and you still load its driver while the ADC is using COM1, any program looking for the mouse will run into trouble.

Transducer Modules. Many kinds of transducers can be designed for use with the ADC to measure almost anything you wish. The important point is to design the transducer module so its output-voltage range will be as close as possible to the full range of the ADC (*i.e.*, 0–5 VDC). If that is impossible, then readjust the full-scale and zero potentiometers to match your transducer output.

To get you started, two example transducer modules are shown in Fig. 4. The module in Fig. 4A indicates relative light intensity, while the one in Fig. 4B can be used to measure tempera-

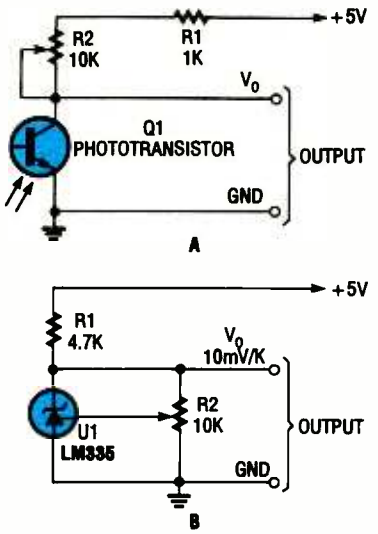


Fig. 4. Transducers to measure relative light intensity and temperature are shown here in A and B respectively. The potentiometers labeled R2 can be used to adjust the range of each to suit your own needs.

ture. You must calibrate both modules by placing them in extreme conditions and adjusting their potentiometers for the widest output-voltage range. For example, to adjust the module in Fig. 4B, place its sensor (U1) first in an area at the highest temperature it will typically experience and measure its output voltage. Then place in an area at the lowest practical temperature and measure its output voltage again. If necessary, adjust R2 to increase the output-voltage span. Repeat your measurements, adjusting R2 as necessary until the voltage range is just at a maximum when moved between the temperature extremes. Then adjust the full-scale and zero potentiometers on the ADC to match the transducer's output-voltage extremes as mentioned earlier.

Once you have decided on a particular transducer module, you will have to write software to convert its voltage output into meaningful measurements. The conversion routine you write, of course, will depend on the module you build, the sensor you use, its linearity, and operating range. Those characteristics can be found in standard data books, or at the very least through experimentation. Now let's turn to a full-blown ADC application (complete with a transducer module and software) for non-invasively (externally) measuring blood flow.

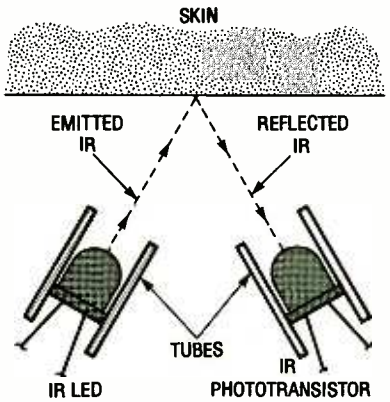


Fig. 5. This simple arrangement can be used to detect the blood density in an area of the skin by bouncing some infrared light off its surface.

PARTS LIST FOR THE HEART-BEAT TRANSDUCER

SEMICONDUCTORS

Q1—SY32PT, infrared phototransistor (Radio Shack No. 276-145, see text)
Q2—2N2222A, general-purpose NPN silicon transistor
LED1—SYIR53L, high-output infrared LED (Radio Shack No. 276-143, see text)

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—150-ohm
R2—1000-ohm
R3—10,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS

J1—⅛-inch, male, 3-conductor, phone jack
Perfboard, hook-up wire, solder, etc.

Heart-Beat Transducer Module. A simple heart-beat transducer can be made from an infrared LED and an infrared phototransistor positioned as shown in Fig. 5. It works because skin acts a reflective surface for infrared. The IR reflectivity of one's skin depends on the density of blood in it. Blood density rises and falls with the pumping action of the heart. So the intensity of infrared reflected by the skin (and thus transmitted to the phototransistor) rises and falls with each heartbeat.

The circuit that takes advantage of that fact is shown in Fig. 6. In it, the IR

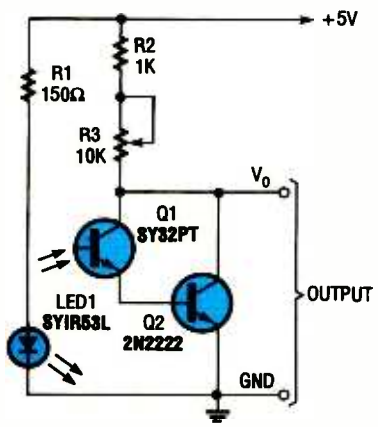


Fig. 6. This is the schematic diagram for the heart-beat transducer module. You adjust its output via R3 just the way you'd adjust the other transducers presented.

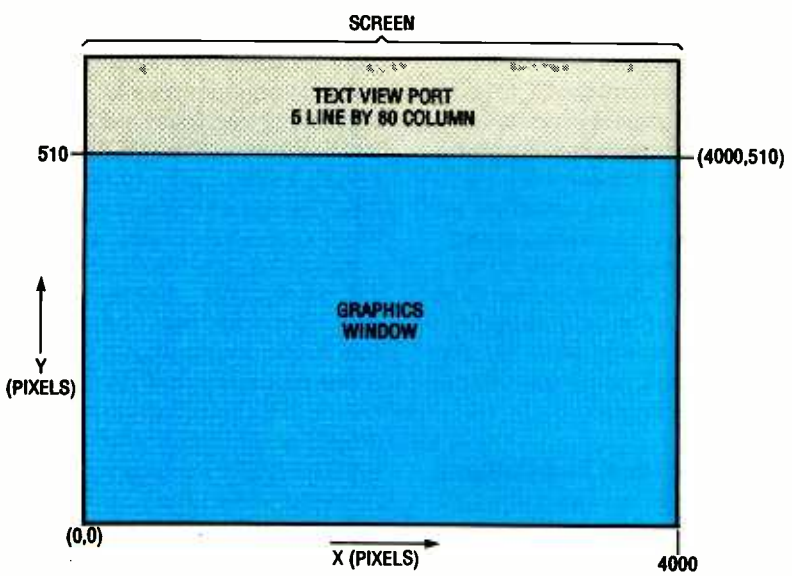


Fig. 7. The statements that set up the screen define two main regions, one used for text and another for graphics. Keeping those regions distinct allows the graphic window to be cleared after each plot without affecting the text viewport.

LISTING 2

```
REM            ***   HEART-BEAT MONITOR PROGRAM   ***

REM PROGRAM WRITTEN FOR PC SYSTEM WITH VGA SCREEN
REM FOR COM2, CHANGE COM1 TO COM2 AND INP(1016) TO INP(760)

DECLARE SUB DELAY (TIDL)
OPEN "COM1:9600,N,8,1,CD0,CS0,DS0,OP0,RS" FOR INPUT AS #3

REM SCREEEN TEXT AND GRAPHIC SET-UP
  SCREEN 12
  SCW = 4000
  COL = 15
  WINDOW (0, 0)-(SCW, 510)
  WIDTH 80, 30
  VIEW PRINT 1 TO 5
  VIEW (1, 80)-(638, 450), , 14

PDAT = 0
TIME$ = "00:00:00"

LOCATE 1, 1: PRINT "PRESS (ESC) TO EXIT"
LOCATE 2, 1: PRINT "PRESS (R) TO RESET TIMER"
LOCATE 3, 1: PRINT "ELAPSED TIME :- "; TIME$

ON TIMER(1) GOSUB SHOWTIME
TIMER ON
   DO
     PX = 0
        FOR X = 0 TO SCW
          REM READ DATA FROM PORT HERE
            DAT = INP(1016)
          REM MANIPULATE DATA HERE
            DAT = (DAT * -2) + 510
            LINE (PX, PDAT)-(X, DAT), COL
            PX = X
            PDAT = DAT
            CALL DELAY(50)
        NEXT X
     CLS 1
     IF INKEY$ = CHR$(82) OR INKEY$ = CHR$(114) THEN TIME$ = "00:00:00"
   LOOP UNTIL INKEY$ = CHR$(27)
TIMER OFF
CLOSE #3

END

SHOWTIME:
   LOCATE 3, 17: PRINT TIME$
   RETURN



SUB DELAY (TIDL)
    FOR A = 1 TO TIDL
    NEXT A
END SUB
```

phototransistor and a plain NPN transistor form a Darlington pair to increase the module's sensitivity. The circuit can be constructed on a small piece of universal PC board. Be sure to use pieces of opaque plastic tubing as light guides for the IR LED and phototransistor, as shown back in Fig. 5. The guides should allow light reflected off the skin to enter the phototransistor, but not light from the side, or directly from the IR LED.

Any part of the skin where you can feel your heart-beat by applying moderate pressure (say, a finger tip) can be used with the transducer. Adjust the signal from your transducer so that it is not saturated and readjust the ADC range to get the maximum sensitivity. Also, adjust the proximity and angle of the LED and phototransistor for best results and fix their position with epoxy.

Heart-Beat Monitor Program. An example program (see Listing 2) has been provided for use with the heart-beat transducer module. It will plot your relative blood flow on the screen.

The program contains two subroutines (both shown toward the bottom of the listing); let's dispense with them first. The SHOWTIME subroutine displays the time (received from the TIME$ function) on line 3 starting in column 17 on the screen. It is indirectly called once each second from the main program by the interrupt-checking statement: ON TIMER(1) GOSUB SHOWTIME. The value of the time is not used for calculations, it is used simply to display the elapsed time on the screen.

The SUB DELAY subroutine is just a dummy FOR-NEXT loop to stall or delay program execution at a certain point. The length of the delay (*i.e.*, the number of times through the loop) is determined by the value of the variable TIDL.

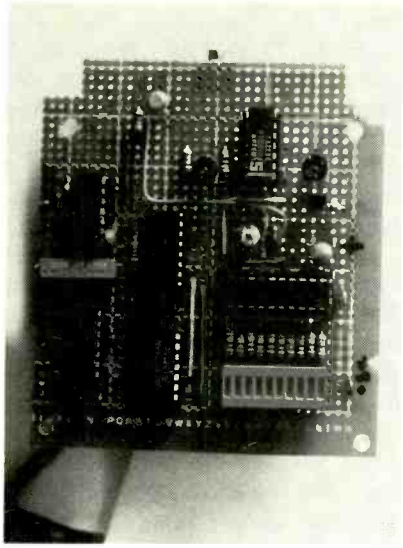
Now let's turn our attention to the main program, ignoring the remark statements as we proceed. First, the subroutines just mentioned are explicitly declared. Next, the OPEN statement is used to prepare the communications port.

The next series of statements prepares the screen for graphics as follows: First, SCREEN 12 sets the screen mode to 640 × 480 VGA resolution and 16 colors. Next the value of two variables (SCW and COL), which will be used later, is set. Then the WINDOW statement specifies the coordinates of the lower-left and upper right corners of the graphics window (the region of the screen where the graphics will appear), respectively. See Fig. 7 for a clarification of the coordinate system used.

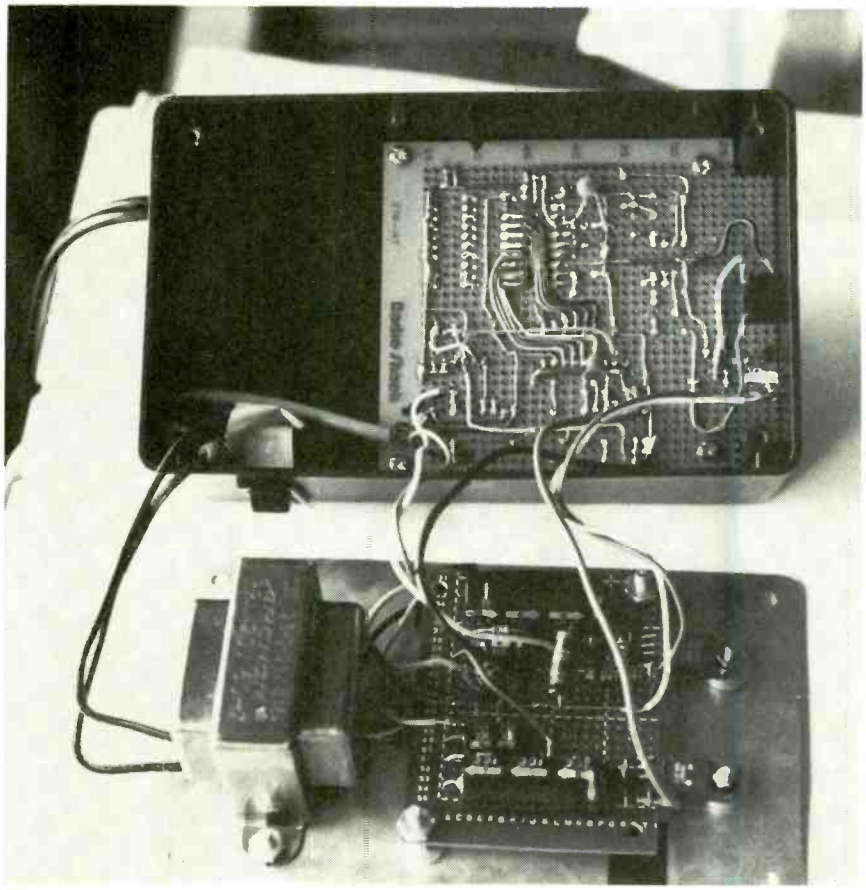
The next two statements prepare the screen for text. First, the WIDTH 80, 30 statement specifies that 80 columns and 30 rows of text can be displayed on the overall screen. Next, the VIEW PRINT 1 TO 5 statement defines lines 1 to 5—from the top of the screen—as a text view port (again, look at Fig. 7). So any output from a PRINT statement will be displayed there.

The last screen set-up statement, VIEW (1,80)-(638,450), , 14, tells the computer the overall size of the usable view port (text and graphics). The first two pairs of parameters indicate the physical screen coordinates of opposite corners of the view port being defined, thus setting up a 637 × 370-pixel area. The next parameter, which would define the background color, is left blank indicating the screen background is to have no color. The last parameter (with value 14) specifies that a bright-yellow border be drawn around the view port.

The next two statements initialize the variables TIME$ (to reset the timer) and PDAT (which we'll discuss shortly). Then some operating instructions are written to the screen in the text area. The timer-interrupt routine mentioned



Here we show the component layout of the prototype's main circuit board. Note the potentiometers have been placed for easy adjustment from the front of the unit (the same side as the display).



This is the circuitry for the whole prototype. It fits into a 6¼ × 3¾ × 2 project box with an aluminum cover. The box contains the transformer, power-supply circuit board and the main-circuit board nicely with little room to spare.

earlier is next activated and the timer is enabled.

All that sets the stage for the hard-working part of the program: a DO loop. The DO loop executes until the escape key is pressed (as indicated by the LOOP UNTIL statement near the end of the main program). Terminating the loop's execution in that fashion, causes the main program to execute the statements that follow the loop, which turn off the timer, close the communications link to the serial port, and end the program.

The loop's job is to plot the heartbeat data along the y-axis against the time increment along the x-axis. It uses two variables for the x-axis coordinates (PX and X) and two for the y-axis coordinates (PDAT and DAT). Variables PX and PDAT hold the previous values (if there are any) of the x and y coordinates. PDAT was initialized to zero prior to the loop, while PX is initialized to zero as the first step of each execution of the DO loop. Another way of saying that is that PX is set to zero after each complete plot.

The program then enters a FOR-NEXT loop that will create one complete plot. That loop will increment the value of X from 0 to SCW (or 4000). With each increment in X, heart-beat data is sampled and stored in the variable DAT, by the DAT = INP(1016) statement.

The raw data in DAT is, of course, an integer from 0 to 255. With the statement DAT = (DAT* – 2) + 510, the data value will be doubled, inverted, and shifted up by 510 units (in this case pixels), to prepare it for plotting. The reason we have to invert DAT is because we want the plot of the heartbeat signal to correspond with the physical change of blood-density detected at the skin.

A line between adjacent data points is made by the statement LINE = (PX,PDAT)-(X,DAT),COL. It plots a line between the previous x-y coordinate and the present x-y coordinate with the color white (specified by the COL = 15 statement toward the beginning of the program). After plotting the line segment, the present x-y coordinates (X and PDAT) will replace the previous x-y coordinates (PX and PDAT) to be used as the beginning x-y coordinate for the next plot. The FOR-NEXT loop will produce 4000 such line segments, butted end to end to draw one complete plot when through with all its iterations.

Then there is a small time delay caused by the CALL DELAY (50) statement. The value for the delay can be changed to achieve the desired software sampling frequency. I cannot give the exact amount of actual time related to the delay value, as that depends on the speed of your computer.

After the delay, the FOR-NEXT loop repeats, plots the next value from the ADC, and so on. When X is equal to the full screen width (SCW = 4000), the FOR-NEXT loop completes. The CLS 1 statement will clear the plot in the graphic window (leaving the text window untouched). After the first execution of the DO loop, if the "R" of "r" keys are ever pressed, the IF INKEY$ = CHR$(82) OR INKEY$ = CHR$(114) THEN TIME$ = "00:00:00" statement will reset the timer. The DO loop then re-executes to draw the next complete plot.

This program is just to give you an idea of how to acquire, manipulate, and display data from your transducer module. A lot more can be done with a more complicated pro-

(Continued on page 97)

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Everyman's ViewCam

VIEWCAM MODEL VL-E30U 8mm CAMCORDER WITH LCD VIEWFINDER. Manufactured by Sharp Electronics Corporation, Sharp Plaza, Mahwah, NJ 07430-2135. Price: $1199.

CIRCLE 50 ON FREE INFORMATION CARD

When *Sharp* introduced its ViewCam Model VL-HL100U last year, the camcorder represented a breakthrough in technology. With its four-inch LCD screen serving as a viewfinder, the ViewCam could be held away from the face, or above the head, freeing the videographer to participate in the action while recording it. For all the details on the Hi8 ViewCam, check out our review in the September 1993 **Gizmo**. To summarize our findings, the VL-HL100U would he a great camcorder to own—*if* we had $2199 to shell out for a camcorder, that is.

Recognizing that, for many potential ViewCam buyers, that price was too steep, Sharp came out with the *ViewCam Model VL-E30U*, at half the price. Let's take a look at the trade-offs they made to achieve a $999 street price. (We actually saw it advertised locally at a hard-to-believe sale price of $649!)

The most obvious physical difference between the two ViewCam's is screen size. The VL-E30U's LCD measures three inches diagonal, compared to the VL-HL100U's four-inch LCD. The less-expensive ViewCam is standard 8mm, not Hi8, and it's missing several features—including stereo sound, an image-stabilization system, digital special effects, fader, titler, and manual iris and shutter-speed controls—that are included on the original ViewCam.

The result might be stripped down, but it's certainly not stripped bare. Feature-wise, the VL-E30U is comparable to other camcorders in its price class. It offers four auto-exposure modes, auto white balance, auto-focus, an 8× power zoom lens, on-screen menus, automatic date/time function, an infrared remote control, a flying-erase head, automatic head cleaner, and edit search. Also, the VL-E30U is the only camcorder in its class to offer the unique ViewCam design.

Basically, the ViewCam's main body is a tiny VCR. Attached to it is a swivelling grip that contains the camera. There is no viewfinder; action is viewed on the color LCD as it is being recorded. Because the camera portion of the unit pivots up to 270-degrees, the ViewCam can be held at whatever position the user finds comfortable. Home-made and pre-recorded 8mm tapes can he played back on the ViewCam, complete with audio, with no need for complicated (for many people) connections to a TV.

Besides the VCR mechanism, the ViewCam's main body contains the cassette compartment, microphone, lithium battery compartment, VCR controls (REWIND, PLAY, FAST FORWARD, STOP, and PAUSE), jacks for an external microphone and headphones, a three-way power switch (CAMERA/VCR/OFF), and the LCD. At the top of the unit is a covered compartment that contains AV-adjust, volume control, menu, counter, and tape-eject buttons.

The camera module also contains a zoom lens with built-in lens cover, and the lens-cover open/close switch. The REC START/STOP and POWER ZOOM/POWER FOCUS buttons are located behind the lens. A handstrap is attached to the side of the grip, as is the unit's mono speaker.

The entire Viewcam weighs under two pounds (without the battery), and measures just 7⅞ inches wide by 4⅞ inches high by 3 inches deep. We found it to be exceptionally easy and comfortable to hold. The controls were generally well placed, although we're not sure why Sharp decided to move the RECORD START/STOP button from the front of the camera module (where it was found on the original ViewCam) to the back. We preferred the original placement, where it was operated with the index finger, to the new thumb-controlled placement.

We also missed the VL-100U's image-stabilization system. As with any small camcorder, it's difficult to hold the ViewCam steady. The lack of any stabilization system in the VL-E30U is particularly obvious in close-up shots.

In all other respects, there's not much difference between the two camcorders in actual use. Like the original ViewCam, VL-E30U can be held at waist level to reduce arm strain, or above your head to avoid filming the backs of other spectators' heads at a sporting event, or at whatever

The ViewCam allows the videographer to capture close-up action without losing track of the big picture.

position you find most comfortable—and most unobtrusive to you and your subject.

Even camera-shy subjects are more at ease with the ViewCam than with traditional camcorders. Hams are in their glory with the instant gratification provided by playback on the LCD screen. In our tests, we found young children to be particularly eager ViewCam subjects. In fact, we had to be sure to keep the VL-E30U stored safely out of reach of curious kids when it wasn't in use—a problem we've never had with traditional (*i.e.*, boring) camcorders.

For self-recording, the camera can be rotated 180 degrees so that it's facing the same direction as the LCD. You might expect the image to be inverted, but as the camera pivots around, the image flips itself right-side-up. That feature is another big hit with the kids.

By leaving off some of the features standard on the original ViewCam—in particular, the fader, titler, and digital special effects—Sharp made the VL-E30U not only less expensive, but also easier to use. There are fewer aesthetic decisions to be made, and there's no need to fiddle with iris and shutter-speed controls. By placing the ViewCam in auto mode, its "Neuro Auto Exposure" system measures the light and adjusts exposure automatically. Four other modes, corresponding to different recording situations, can also be selected. The Sport mode is for fast action, Snow/Sand mode is for use in exceptionally bright backgrounds; twilight can be used to record sunsets, and party is recommended when the scene is illuminated by candles or a spotlight. Selections are made via an on-screen menu.

Like its predecessor, the VL-E30U doesn't require hook-up to a TV for viewing tapes—which is the major drawback of other 8mm camcorders. The VCR portion of the ViewCam allows users to view their tapes on the built-in LCD screen. It's even possible to play tapes in a widescreen 16:9 mode.

Although the VL-E30U lacks the titler and fader functions of the more expensive ViewCam, its instant playback allows editing-as-you-go. Taped sequences can be monitored on the LCD, without stopping to connect the unit to a TV—and without the loss of picture quality associated with dubbing to another tape. If you don't like what you've just taped, you can record right over it. If you want to keep the scene, a push of the INDEX SEARCH button will quickly return the tape to the end of the last recorded scene. The EDIT SEARCH lets you do the same, but without switching from VCR to camera mode.

There are times, however, when it makes sense to connect the ViewCam to a TV or VCR. For large-screen playback, editing, and recording from an outside source, an audio/video pack is included for connection to a TV or VCR. The manual provides clear hook-up directions for that, and they are accompanied by plenty of illustrations.

When editing a tape that was recorded earlier, the ViewCam serves as the source VCR. Its tape counter makes it easy to keep track of the beginning and end of tape sequences that you intend to keep. The menu-edit setting can be used to minimize the picture-quality reduction when dubbing tapes.

The A/V pack also allows users to tape television programs for playback on the ViewCam. On-screen menus are used to control the VCR functions. (There is no timer-record function.) An optional tuner pack allows the VL-E30U to serve as a portable television for real-time TV viewing. Both of those features are particularly handy during slow times on vacation or on long car trips with children, who can be kept entertained watching their favorite shows or movies. A headphone jack provides some privacy and better sound than the unit's built in speaker.

It might not be fair to compare the VL-E30U with its higher-priced predecessor, but such comparisons are unavoidable. If money were no object, we'd certainly opt for the Hi8 VL-100U, with its larger screen, advanced features, and image-stabilization system.

Then again, we are experienced camcorder users who enjoy using all the bells-and-whistles provided on high-end units. People who keep all their camcorder settings on automatic whenever possible wouldn't even miss those features. Besides, like it or not, money *is* an object! When shopping for consumer electronics, most of us decide first how much we can afford to spend, and then comparison shop.

When it's stacked up against the competition in its price range, the ViewCam VL-E30U definitely comes out on top. If we were shopping for an under-$1000 camcorder, the ViewCam would be our first choice. ■

Senior Writers: Chris F. O'Brian, Teri Scaduto.

It's a Snap!

HANDYCAM SNAP! MODEL CCD-SC5 8mm CAMCORDER. Manufactured by Sony Electronics Inc., 1 Sony Drive, Park Ridge, NJ 07656. Price: $1200.

On Halloween, we went to a neighborhood party dressed as a black-widow spider and a hangover sufferer, and we carried along a camcorder that was disguised as a old-fashioned box camera. That camcorder was *Sony's Handycam Snap! (CCD-SC5)*, a tiny 8mm camcorder with a box-like shape and a 3-inch LCD screen. The LCD doubles as a viewfinder during taping, and as a monitor that shows instant replays of the tapes that you record.

The Snap! doesn't look anything like any other 8mm camcorder that we have seen—not even the Sharp ViewCam also reviewed in this issue, which is also equipped with a 3-inch LCD. Sony's Snap! camcorder measures 5½ × 4⅛ × 3¼ inches. Weighing in at 1.4 pounds (minus the battery and tape), it's easy to hold in one hand. The camcorder is designed to be held vertically during taping. You can opt to leave the LCD in its standard position, lying flat against the camcorder, and hold the Snap! up near eye level while taping. Or you can flip the display up and out and hold the camcorder lower, peering down to watch the LCD viewfinder—just like you used to peer down into those old box cameras, if you're old enough to remember them. To save battery power, you can turn the LCD off and use the still-camera-like viewfinder.

When compared to standard camcorders, there are very few visible controls on the Snap!, and there aren't many hidden ones either. The most frequently used ones are located at the top of the grip, within easy reach as the camera is held in the right hand. At the top of the grip is a three-position dial that switches the Snap! from video-player, to video-camera, to power off. Just in front of that dial is the red RECORD/STANDBY button. Just in front of and below that button, on the front of the unit, is a lever that controls the camcorders' dual-lens system. Rather than a standard zoom lens, the Snap! provides just two settings: wide-angle and telephoto.

Just below the LCD are buttons that set the date/time stamp and that turn the LCD on and off. A small volume-control dial is found just above and to the left of the LCD. Below it, set along side the LCD itself, is a tiny screw that can be used to adjust the color of the picture. (Sony suggests that a screwdriver be used to do so, but notes that color adjustments shouldn't be necessary in everyday use. We found no need to fiddle with the color.) On the bottom of the Snap! To the left of the screen is a covered

CIRCLE 51 ON FREE INFORMATION CARD

compartment that is home to the videocassette player function controls (PLAY, REW, FF, and STOP), the LCD-brightness controls, the COUNTER RESET button, and the DISPLAY button that turns the on-screen indicators on and off.

That's about it as far as controls go. As for other distinguishing features, there's a speaker just above the LCD and a mono, omnidirectional microphone on the front. Two slide switches on the camcorder's right side are used to open the battery compartment and the tape well. A rubber cover along the right front side of the camcorder lifts to reveal jacks for a microphone and MIC/DC output, and video and audio outputs. There is no video input, which means that you can't record 8mm tapes off the TV for later viewing—on a long car trip, for instance. Of course, you can use the Snap! to view pre-recorded 8mm tapes, if you can find them in video stores in your area.

As its name and the scarcity of controls might suggest, the Snap! is quite easy to use. Virtually everything is automatic. In fact, there is only one variable to control: You can choose between wide-angle and telephoto lenses. You probably won't want to switch back and forth during taping, however, because doing so creates a clearly audible "snap" sound on the tape during playback. (Perhaps that's another reason Sony chose to name it the Snap!.) Sony recommends that you set the lens switch before you begin to tape, and leave it in that position. That's sensible advice—it's the way a zoom lens should be used 99% of the time.

There's a price to pay for the almost fool-proof videomaking and the instant gratification of on-the-spot replays provided by the Snap! It allows very little artistic license. For that reason, the Snap! is not a camcorder for serious videographers.

Most people—especially those who have shied away from camcorders until now—are not striving for artistic perfection, and would rather not be bothered with adjusting the exposure or creating fades during taping. Nor do they expect to create professional-quality productions. What they want is a camcorder that's easy to use, one that makes all the decisions for them, one that provides the equivalent of "video snapshots." Well, that's an accurate description of the Snap!.

We found the Snap! to be comfortable to hold and use. With the LCD serving as a viewfinder, you don't have to hold the camcorder up against your face. That makes it easier to feel as if you're a part of the action, instead of being stuck behind the scenes. It also makes the camcorder seem less threatening to camera-shy subjects.

The 76,000-pixel, active-matrix screen provides high resolution and good color under most ambient lighting conditions, thanks to a special anti-glare coating. A snap-on sun screen further cuts down on glare when taping outdoors, and it serves to protect the LCD from dust and fingerprints. Unfortunately, the Snap!'s compact design makes it difficult to pick up the camcorder without accidentally touching the unit's LCD screen.

The Handycam Snap! also provides a viewfinder that is similar to those found on fixed-focus cameras. There are times when it makes sense to use it. Turning off the LCD during taping significantly increases battery life—from 40 to 75 minutes. Battery life during playback is about 45 minutes. The Snap! uses a lithium-ion battery that is smaller than its NiCd counterparts and that can be recharged without removing it from the camcorder. An on-screen indicator keeps you informed of battery status. When the battery gets very low, another indicator flashes in the center of the LCD.

We put the Snap! through its paces on Halloween. That afternoon, we stood inside our door and taped trick-or-treaters as they approached the house. In that difficult backlit situation, the Snap! did what we expected—we ended up with trick-or-treaters silhouetted against the afternoon sun. That evening, we brought the camcorder to a costume party, where everyone wanted to give it a try. None of the usually camcorder-shy users had any trouble with the Snap!, and even the kids found it easy to hold and use.

Features like a buzzer that sounds to let you know when recording has begun and ended make the Snap! a snap to use. So that everyone can get in the picture, an included stand allows the Snap! to be set on a table for remote taping. The remote control operates both recording and playback functions.

A birthday was celebrated at the same party. The Snap!, with its 5-lux minimum illumination, managed to capture all the kids' faces (albeit along with a bit of video noise), illuminated only by the candles on the cake, as they sang a chorus of "Happy Birthday."

The camcorder was quite a hit even before we demonstrated its playback capability, a feature that charmed adults and kids alike—even the camcorder "pro's" were impressed. It was obvious that the tape had been made by several different people, with varying levels of camcorder experience. The result might not have been a video masterpiece, but all of it was readily viewable—and viewable immediately, without being hooked up to a television set. None of it suffered from the beginner's classic mistake of zooming in and out, and in and out ....

Basically a point-and-shoot camcorder, the Snap! won't win any prizes in the bells-and-whistles department (it didn't even win a prize at the Halloween party for its box-camera disguise). But, if there had been a prize at the party for popularity, the *Sony Handicam Snap* would have been a sure bet to win. ■

"Sorry Ed, my computer just crashed."

The Sounds of Silence

ACCUMAT SOUND BARRIER AND DAMPING MATERIAL. From: Schosche Industries, Inc., 5160 Gabbert Rd., P.O. Box 8099, Moorpark, CA 93020-8099; 800-621-3695, 805-523-0687. Price: N/A.

According to a recent study by the University of Maryland, adult Americans spend on average only 20 minutes a week of their leisure time listening to music. Does that mean all those CD's and tapes are sitting unused in their owners' entertainment systems? Or that the millions of dollars spent on radio advertising are going to waste?

The answer is no. Leisure time accounts for only 40.1 hours a week, according to the same study. It doesn't include working hours, or the time spent traveling to and from work. Nor does it count the hours spent in the car running errands.

Nothing can make a grueling commute more bearable, or errands less boring, than good music. Cars can be a great place to listen to music, particularly when you are alone. You can choose the music, crank up the volume, and even sing along without bothering anyone (as long as you keep the windows rolled up!).

Cars, however, have some serious problems as audio listening rooms, the most important of which is noise. The engine, tires, and wind conspire to reduce the usable dynamic range of any audio system. Some car-stereo systems have a compression switch for CD's to boost low-level signals so they can be heard above the road and engine noise. That's one possible way to combat the problem. We looked at the situation from a different angle: why not reduce the offending noise?

That's just what we tried to do by installing the *Accumat* vibration-damping and noise-barrier material from *Schosche Industries*. The test car was a 1988 Mazda 626. We took measurements of the interior sound levels at various speeds (idle, 30 mph, and 60 mph) at each stage of the installation.

Our first set of measurements were made before we installed anything. It consisted of 15 measurements, five at each speed. Measurements were made at the inside ear level of the driver and three passengers, and at floor level on the front-passenger side, near the transmission.

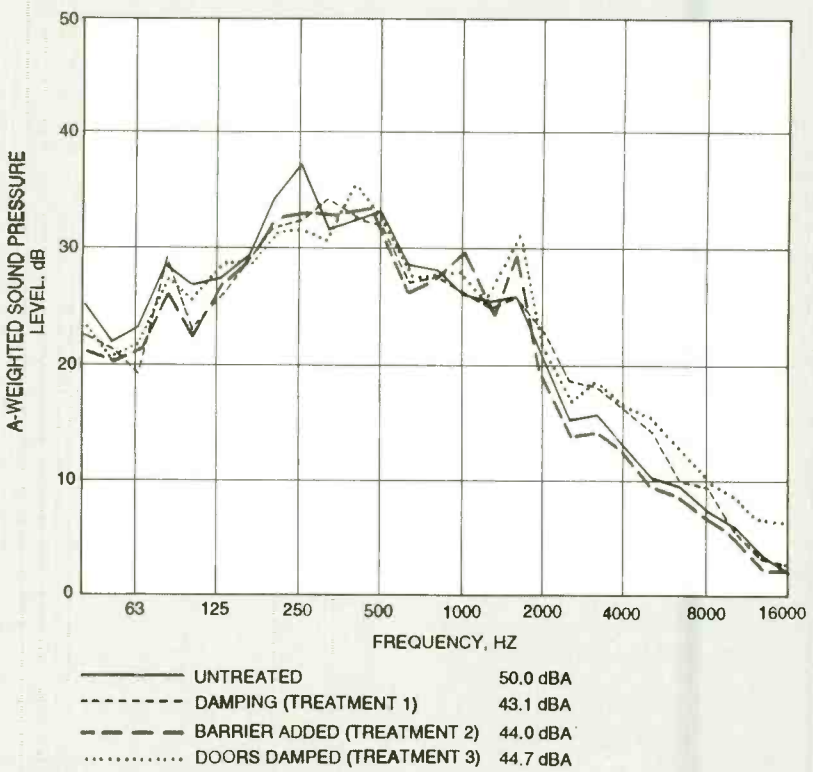
Once we had our base-case measurements done, we were able to begin. Our first treatment was to install a layer of Accumat *AMT045* vibration-damping material on the floor of the car. AMT045 is a thin, flexible, viscoelastic material that is designed to reduce interior noise by reducing the vibration of the various panels that make up a car's body. Much of the noise heard in a car isn't transmitted *through* the body, but is transmitted *by* the vibrating body panels. Damping reduces the amplitude of the vibrations, and thus reduces the sound that is radiated.

Installing the material is not an easy job for most people. Professional installation by an experienced car-stereo shop is recommended. That's the route we chose. According to our installers, when compared with competing damping material, Accumat AMT045 is considerably easier to install. It is more flexible, even in cold weather, and has a superb self adhesive.

For the first treatment, we removed the car seats, carpet, and the limited factory-installed damping material. We then used a mild solvent to clean the floor to ensure good adhesion. We installed the AMT045 simply by peeling off the backing and sticking it to the floor with its self adhesive. To reduce the chance of creating "bubbles," or air pockets, we started from one end of the material and worked toward the opposite end. A wooden roller helped to ensure good contact with the floor.

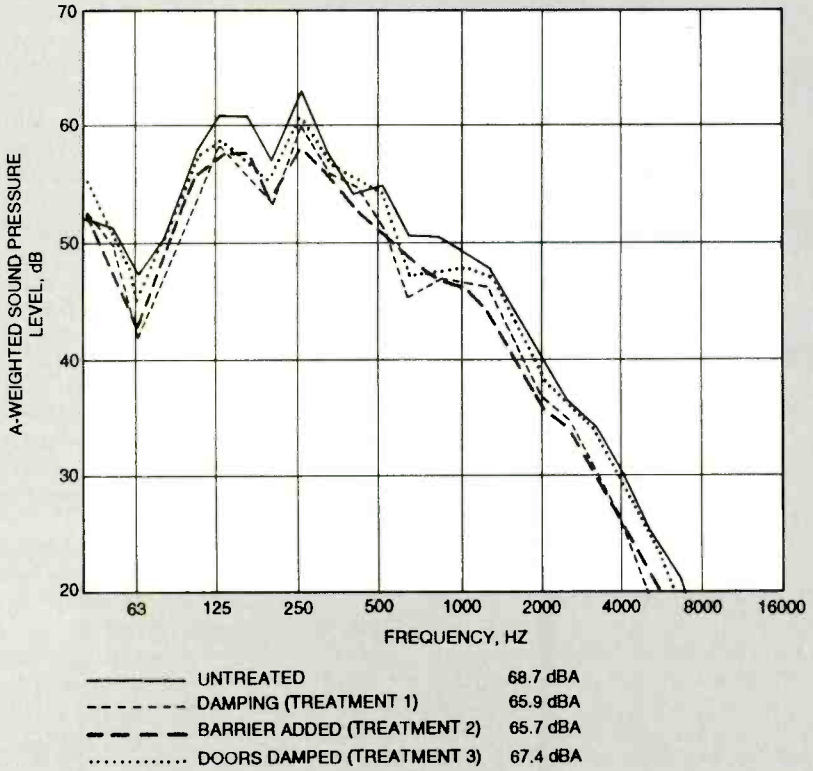
We covered the entire floor, although such thorough coverage isn't essential for vibration damping. (Consider how placing a finger on a crystal goblet will damp its vibrations.)

After the material was in place, we reinstalled the carpet and the seats, and drove to our testing labs for the next set of

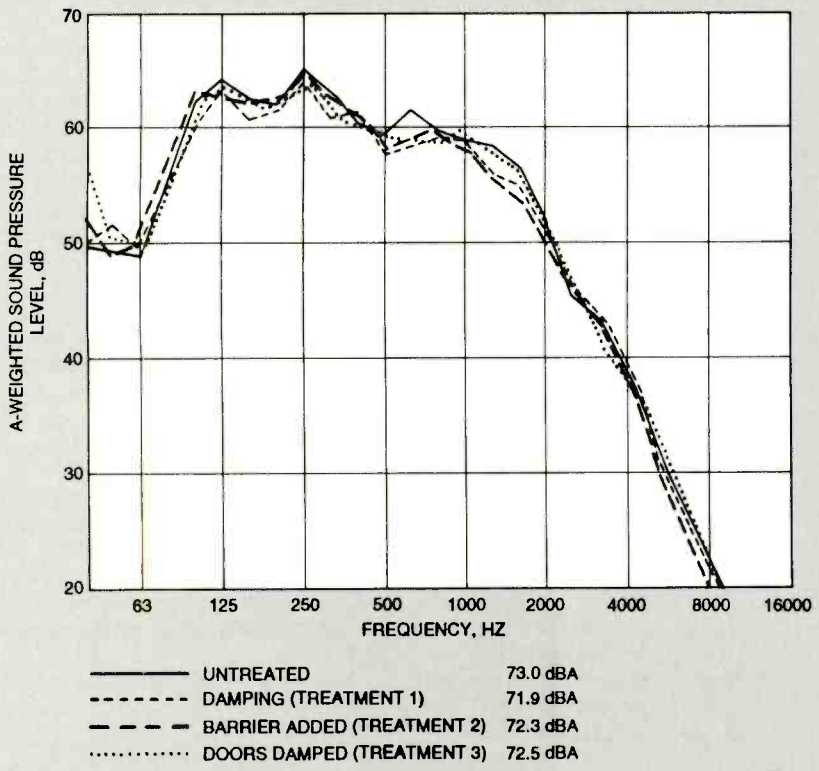


Sound levels at idle with various noise-reduction treatments installed. These measurements were made at the driver's ear position.

measurements. To our ears, the results were dramatic. The car had a pleasant, dead sound, even while driving through construction zones. It sounded much less like a metal box on wheels. The measurements showed significant noise attenuation (5–8 dBA) at idle. Increasing speeds showed decreasing attenuation: 1–3 dBA at 30 mph, and virtually no attenuation at 60 mph.



Sound levels at 30 mph with various noise-reduction treatments installed. These measurements were made at the driver's ear position.



Sound levels at 60 mph with various noise-reduction treatments installed. These measurements were made at the front passenger's ear position.

For our next noise-control experiment, we installed a layer of Accumat *AMT250* barrier material on the floor of the car. AMT250 is a two-layer material, with a tough, flexible layer over acoustical foam. We installed the material from as high as we could reach on the firewall to the trunk.

When compared to the damping material, the barrier is more difficult to install. It is thicker (¼ inch) and therefore can make the re-installation of the carpet and seats troublesome. Also, it's important that the barrier cover the surface as completely as possible. A gap in sound-barrier material acts like an open window in an otherwise soundproofed wall.

As we drove our car after the installation, we were impressed by the quieter, more solid feel of the ride. The difference did not seem as dramatic as what we noticed when the damping material was installed, but we felt that the improvement was worth the effort nonetheless. We assumed that the measurements would back up our impressions, but we were wrong.

The measurements showed only the slightest improvement. Puzzled, we moved on to the next phase of treatment: adding vibration-damping material to the doors.

Because the AMT045 material had given us our most significant improvement when installed on the floor, we had high hopes for it. The first time we slammed our door shut, we felt the difference. It felt more like a Lexus than a Mazda. On the road, our ears heard a quieter ride. Our test microphone, however, heard no improvement at all.

The measurements puzzled us. After all, we have driven our car for years, and we know what it sounded like. Why could the changes that we heard not show up on the measurement equipment?

At high speeds, the dominant noises are tire noise and wind noise. We didn't make any attempt to counteract wind noise, which would require, perhaps, sealing the car better, redesigning the car body, or perhaps installing absorptive material under the headliner. Because our measurements were taken on a concrete highway, the tire noise was very high.

In our day-to-day driving, we don't drive as much on concrete roads as we do on asphalt, which produces significantly less tire noise than does concrete. Perhaps because our subjective evaluation was made over a wider variety of conditions, the improvements weren't masked by tire noise. One thing that struck us as we drove the car was that wind noise *increased*. Because we hadn't done anything that would affect wind noise, the only explanation is that other offending noises were reduced.

The controlled measurements do show, however, that we went about things the

(Continued on page 62)

Write On!

MP100 WRITING PAD. Manufactured by Inforite Corp., 1670 S. Amphlett Blvd, Suite 100, San Mateo, CA 94402; 800-366-4635, 415-571-8766. Price: $299.

Pen-based technology has gotten a lot of press lately, including here in **Gizmo**, where we reviewed pen-based personal digital assistants (PDA's) last month. This month, we look at how pen-based technology can be added to just about any PC-compatible computer with the *Inforite MP100 Writing Pad*.

Most people don't have pen-input capability on their list of requirements for a PC, but we had it on ours. We needed a way to get our signature into our computer-generated correspondence. Then the documents—complete with our signature—could be faxed to the recipient directly through our computer's fax/modem. Without the ability to add our signature electronically, we would have to print out a letter, sign it, and then send it from a traditional fax machine.

If you have signed for a package from the United Parcel Service recently, you've used the same technology that Inforite has installed on its MP100. In fact, Inforite also manufacturers the AS1050 "clipboard" that UPS agents use. However, the MP100 can do more than just capture signatures. It can also act as a pointing device in either the Microsoft Windows or MS-DOS operating systems.

The Writing Pad measures about 6 × 8 × 1 inches; the active pad area is about 4 × 2¼ inches. Its resolution is 1024 × 1024 "pixels." Three buttons are located along the top of the unit. A plastic-tipped stylus is normally used for pad input. There is nothing special about the stylus. Anything that is hard, but that won't scratch the pad can be used. For many applications—such as using the MP100 as a pointing device—a fingernail suffices.

Installing the MP100 is a two-step (hardware and software) affair. The hardware installation is rather straightforward: The 9-pin serial connector is plugged into a serial port (COM1 or COM2) on your computer, and the wall-mount AC adapter is plugged into a jack on the back of the serial connector.

The software installation is a little more complicated. However, because we examined a pre-production version of the software, we didn't have the benefit of a menu-driven installation program, which was still under development. The main task of the installation program is to install the proper drivers that are required by the Writing Pad.

There are a couple of things to consider when installing the software. The first is that if you want to use the MP100 in Windows, you must deactivate (or not install) the drivers for DOS. Second, if you want to use the Writing Pad in DOS, the converse is true.

Another potential source of confusion arises when the Writing Pad is installed along with a mouse. A driver that allows concurrent operation with a mouse and the MP100 is included, so that a standard mouse can be used for pointing, while the MP100 is used strictly for signature capture.

We mostly used the writing pad in Windows. Although the main reason we installed it was to capture signatures, we soon found it to make a great replacement for a mouse.

The MP100 has two modes of operation: relative (pointing) and absolute (writing). When the MP100 is in its relative mode, it behaves very much like a mouse. For example, if you were to pick up a mouse, move it to the left, and then put it down somewhere else, you wouldn't expect the on-screen cursor to move. The movement depends only on the relative motion of the mouse ball. Similarly, with the MP100 in the relative mode, if you pick up the stylus and put it down somewhere else on the pad, the on-screen cursor doesn't move; it reacts only to relative movement on the pad.

In the absolute mode, the Writing Pad acts like a pen on paper. If you lift the stylus from where you had been writing, say the right side of the pad, and place it on the left side, the on-screen writing will jump from the right to the left. That isn't too useful in Windows where you want to point to something, but it is essential for capturing handwriting, where the stylus is typically picked up and placed elsewhere—to cross a "t" or start a new word, for example.

The relative or absolute mode is chosen with the center of the three buttons on top of the pad. The left and right buttons act as left and right mouse buttons.

A signature-capture utility called MPDEMO is supplied with the MP100. It can be used to capture signatures and place them on the Windows clipboard for export to other Windows applications. It can resize the signature for placement in a document, which is important if the target application doesn't permit imported objects to be scaled.

The MP100 isn't a mass-market product. It is a good, although not an ideal, "mouse" for Windows. It would be a better mouse if the buttons were located below, instead of on top of, the pad, but that would interfere with writing. We'd like to see software that would allow the pad to be turned upside down for better use as a mouse.

However, even if the MP100 Writing Pad isn't a perfect mouse, it's an ideal way to capture handwritten data. In fact, the technology is sure to become more commonplace in the coming months. For example, a new version of the pad, the MP200, is targeted at retailers for point-of-sale signature capture. It could do away with paper credit card receipts that thieves often use for fraudulent purposes. Alternatively, the Writing Pad could be used to store an electronic version of a signature in addition to a paper copy—the pad can be used with a ball-point pen on top of paper as a stylus.

Another potential application of electronic signature capture is in electronic tax filing. The IRS isn't quite ready to accept electronic signatures, but it is possible that they will be by the time your 1993 taxes are due. ■

Food for Thought

NUTRIBASE PERSONAL NUTRITION MANAGER SOFTWARE. From: CyberSoft, Inc., 3851 E. Thunderhill Place, Phoenix, AZ 85044-6679; 602-759-4849. Price: $69.95.

"You are what you eat" has never been as true as it is today, when common headlines might read "Broccoli Reduces Risk of Cancer" or "Thin Men Live Longer." If we want to live longer, healthier lives, we have to make sensible nutrition choices.

Unfortunately, there are several real-life factors that prevent many of us from eating wisely. At the top of the list is the lack of time (or desire) to cook. Today's busy families tend to eat on the run. That means dining at fast-food restaurants or bringing home take-out meals. These days, a "home-cooked" meal can be a frozen entree that's been heated in a microwave oven.

Two seemingly contradictory deterrents to a sound diet are a lack of and an overload of information. Those nutritional-information panels on food packages provide a lot of data, but don't tell us how to interpret the figures. Also, it seems that every day a new study is published that tells us what we should eat in mass quantities or avoid like the plague. Those reports often contradict last month's findings.

There are some basic nutritional facts upon which all the experts agree. As outlined in the national dietary guidelines, we should ingest a variety of foods from the different food groups (these days, different levels of the food pyramid). We should also maintain a healthy body weight ("yo-yo" diets do more harm than good) and cut way back on sugar, salt, and alcohol. Our diet should be low in fat, especially saturated fats and cholesterol, and should include plenty of fruits, vegetables, and grain products. Moderate daily exercise is also recommended.

That sounds simple enough. Yet Americans can't seem to get the hang of it. We continue to eat twice as much protein as we require. Our average percentage of calories from fat is 40%, quite a bit above the recommended 30% (and double that of the average person in Japan).

Perhaps some more detailed, yet practical, information is required. Does a cheeseburger with lettuce and tomato on a bun and a side of French fries with ketchup qualify as a "variety of foods"? How do you determine what "healthy body weight" you should be maintaining? If you don't add salt or sugar to your food, are you really avoiding those substances? If you eat out all the time, how do you know what they're putting in your food?

All of those questions, and many more, are answered by *NutriBase Personal Nutrition Manager* software from *CyberSoft, Inc.* The program is intended to allow users to take control of their nutritional intake, and meet their health and weight-loss (or -gain) goals. The program contains a huge database of food information, a personal-nutrition goal planner and tracker, a record-keeper, and a wealth of information about diet, nutrition, exercise, and health.

NutriBase contains complete nutritional information on more than 34,000 food entries, including 25,850 brand-name items, 8201 generic foods, and 2213 menu items from 43 different restaurant chains. For each item, the program displays serving size, calories, total fat, saturated fat, percentage of calories from fat, protein, carbohydrates, fiber, sodium, cholesterol, and alcohol. It's also possible to add your own foods in a category called "Personal Food Items," either entering them from scratch or by using existing food listings to recreate your personal recipes.

The program's user-information section allows you to input personal information (age, sex, height, weight, exercise and activity levels, goal weight, and desired weekly weight loss or gain). NutriBase then calculates the daily intake of calories and grams of protein, fat, carbohydrates, and sodium required to meet your goals.

NutriBase's record functions allow you to track your weight over a period of time, record every morsel of food that passes your lips, and then compare it to what you should be eating. The program can generate charts and graphs to map your progress.

The information section of the program provides a mix of practical and inspirational advice. It includes a glossary of food and cooking terms, helpful hints on dieting and nutrition, and dieter's quotations. It also explains how NutriBase calculates your goals, and how to determine exercise intensities.

The program is quite easy to use, and the manual is clear and helpful. The main

menu lists the four main categories; clicking on one calls up sub-menus.

We started in the food database, and found ourselves browsing through it for quite some time—it's huge. Food subcategories include baby food, breakfast, dairy, snacks, restaurant, prepared meals, meats, vegetables, grains, and several more. Within each group there is an incredibly detailed list of foods. The "Meat" category, for instance, included more than 540 beef listings, not counting the 20 or so "vegetarian beef" items. Other meat entries included such "delicacies" as alligator, antelope, squirrel, and bear meat. Restaurant listings include entrees, side dishes, drinks, desserts, salad-bar offerings, and even condiments from such chains as McDonald's, Dunkin' Donuts, Pizza Hut, Little Caesars, Arby's, Taco Bell, and others.

The program does more than simply display the foods and their nutritional values. You can create high-to-low or low-to-high rankings of food by one or more nutritional factors. For instance, you might create a list of restaurant (or frozen) pizza ranked by calories, or by percentage of calories from fat, or sodium content, or all three. Clicking on any item in that list calls up its complete nutritional data.

A query function (actually a Boolean AND search) allows you to display a list of food or foods that meet certain nutritional criteria. For instance, we tried to find a lunch meat with less than 15% calories from fat and low sodium—less than 100 milligrams. We further refined the search to include four brands that we've bought in the past. The list was short: just one product met our criteria. One slice of Healthy Choice honey-baked ham has 15% calories from fat and 90 grams of sodium.

We then tried the same search without taking into account the sodium content, and came up with eight choices. We still kept an eye on the sodium level, and were shocked to find a couple with 600 milligrams! Upon closer examination, however, we realized that those entries were for *six* slices of Healthy Choice lunch meat—and that illustrates one problem with the program. The portions vary widely within each category, making some comparisons difficult and the results unfair.

We encountered another serious drawback to the program that was exacerbated by the portion problem. The program is aimed at folks who eat out at chain restaurants and dine in on prepared—canned, frozen, prepackaged—meals and snacks. Granted, that covers a large part of the population. There are exceptions, like us, who either cook meals from scratch using almost no prepared goods, or dine at local non-franchise restaurants.

To accommodate folks like us, NutriBase provides a personal food item category, but when we tried to add last night's pot-roast dinner, we were stymied. We had hoped to enter the eight ingredients as they appear on our recipe card. Unfortunately, we couldn't find listings for 2½ pounds beef for pot roast, 2 onions, 1 clove of garlic, 1/4 cup of teriyaki sauce, 4 carrots, etc. We tried dividing each ingredient by ten (the recipe makes ten servings), which is fairly complex in itself, but then we couldn't find a listing for 3/10 stalk of celery.

When we tried to record today's breakfast, we found no listings for either bagels or croissants, except for those served at fast-food joints. Nor could we find the 60% margarine/40% butter spread we use. (We had already discarded the outer wrapper for the spread, so we had no way of determining its nutritional content.)

Assuming that you do find the foods that you eat in the comprehensive listings supplied, you can record your food intake simply by clicking on Record while that food is displayed on the screen. It's even possible to set an alarm to go off if you try to record a food that's too high in calories, fat percentage, or sodium, according to your personal goals.

Those goals are determined by NutriBase after you've input some basic personal statistics. To help you determine your ideal weight, the program provides five different charts, ranging from the classic Metropolitan Life Insurance Company chart to one from Weight Watchers. If the goal based on the data you've input is unrealistic—for example, if your lifestyle is sedentary, you don't do any exercise, and you want to lose two pounds a week, you could take in only 800 calories per day—NutriBase warns you that such a diet would be unhealthy, and advises you to set different goals. Even if your goals are practical, the system advises that you to consult a doctor before beginning a weight-reduction plan. As you continue to input your food consumption and your weight fluctuations, the program will generate charts and graphs to illustrate how close to your goals you are.

The information section serves both to educate and inspire the user. It contains a lot of statistics about food, exercise, and health, albeit poorly organized and somewhat repetitive. Dieting tips are commonsense advice, but nothing that an experienced dieter hasn't heard before.

NutriBase won't lessen the pain of dieting, but it doesn't promise to. It recognizes that changing the eating habits of a lifetime is a difficult, one-day-at-a-time, process. It does try to make it easier to come up with a personalized, sensible, nutritionally sound diet based on your own lifestyle and eating patterns. Particularly for those who indulge in fast food and prepared meals, NutriBase can provide the education and information needed to make healthy food choices. ■

SOUNDPROOFING MATERIAL

(Continued from page 59)

Proper installation of Accumat vibration-damping and sound-barrier material requires the removal of the seats, carpeting, and any factory-installed damping material.

wrong way. Also, they show that it is difficult to solve the engineering challenges of noise control without a rigorous engineering approach.

For example, at the beginning of the project, we never properly identified the sources of noise that we were trying to counteract. How much of the sound level in the passenger compartment was due to engine noise being transmitted through the firewall? Perhaps we should have been more careful in installing the barrier material there, even though it's not an easy place to get to.

How much of the sound level was due to engine noise being transmitted through the front windshield? Maybe we should have added damping material and barrier material to the hood as well. Why didn't the vibration damping in the doors improve things (other than the providing a new, comfortable thud)? Perhaps because most of the noise transmitted through the doors comes in through the glass, not the door itself.

We might go back and try to improve our numbers a bit—maybe by adding damping and barrier material to the wheel wells and engine compartment. But maybe we won't. Our ears tell us that our car sounds quieter. Perhaps more important, it sounds *different*, and that difference sounds good to us. Until all car manufacturers pay attention to sound proofing, Accumat barrier- and vibration-damping materials are the next best thing. ■

Desktop PDA

PALMCONNECT CONNECTIVITY SOFTWARE. From: Palm Computing, Inc., 4410 El Camino Real, Suite 108, Los Altos, CA 94022. Price: $129.

When we reviewed the Tandy Z-PDA Zoomer personal digital assistant (PDA) last month, the most difficult task was entering the data that we needed to store. Pen input is great for short entries made while on-the-go. However, until handwriting recognition is perfected, the keyboard is far more efficient.

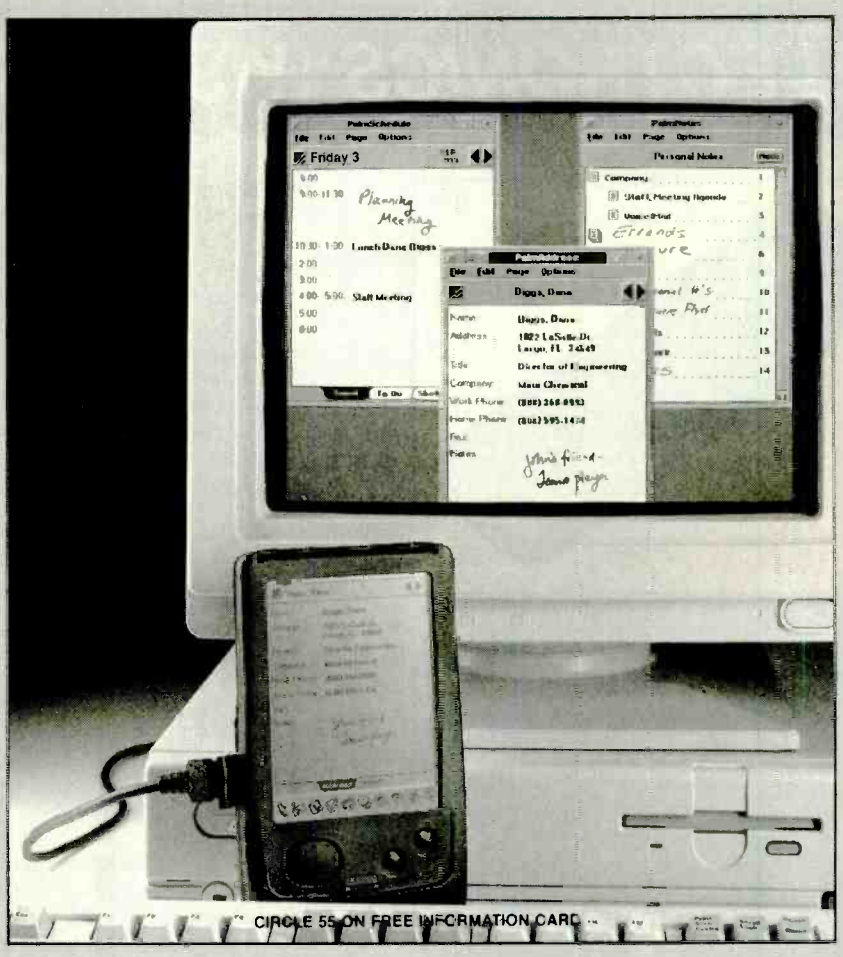
We had some other concerns, too. Even with the Zoomer's long battery life, more-than adequate low-battery warning, and backup lithium battery, what would we do if the batteries died and erased all of our data? Or, if our Zoomer was lost or stolen?

PalmConnect provides a way to back up PDA data to a hard or floppy disk, and then restore it to the PDA. Data that is entered in PC versions of PalmAddress, Palm Notes, and PalmSchedule can be transferred to Tandy's Z-PDA or Casio's Z-7000 PDA. The PC version of PalmAddress can accept data from database programs or personal information managers such as a Sharp Wizard or Casio Boss. The only requirement is that the organizer or database program be able to output comma-delimited files.

PalmConnect comes with a PDA-to-serial cable (JAE-10 to DB-9) and a DB-9 to DB-25 serial adapter. Sets of 3½ inch and 5¼-inch high density diskettes are also included.

Zoomer users should have little trouble learning the user interface, because the Zoomer interface is available on the PC. The address book on the PC looks just like the Zoomer's address book. Text can be entered via the keyboard, and "handwritten" notes or maps can be entered with the mouse. (In our case, we tried to use the Inforite MP100 Writing Pad reviewed elsewhere in this issue. Unfortunately, PalmConnect did not support its relative mode, so "drawing" with the pad was as difficult as drawing with a mouse.)

Installing PalmConnect is simply a matter of running the INSTALL.EXE program, which copies files from the floppy disk to a user-selected drive on the hard disk. Our only difficulty arose when we tried to install PalmConnect on a laptop computer that had only one serial port. We had to remove our serial mouse to open up the port for communication. Unfortunately, PalmConnect absolutely requires a mouse. Other requirements are that the computer be an IBM AT or better, with 640 kilobytes of RAM, 4 megabytes of hard-disk space available, and VGA or double-scan CGA video.



Before files can be transferred between the PDA and PC, the machines have to be linked together with the cable that is supplied with PalmConnect. The Zoomer's serial port has a JAE-10 connector, the kind that is found on many notebook computers. The other end of the six-foot cable has a 9-pin serial "D" connector. A 9-pin to 25-pin adapter is also included.

When everything was plugged together, we turned on both machines. On the PC, we ran the PALMCONN.BAT file, which brought up the Geos file manager. From there, we clicked on the Connect menu, and chose "File Linking." A box saying "Attempting to connect" then appeared.

The software for linking to the PC is built into the Zoomer. We simply pressed the launch icon, and chose "Utilities" from the launch menu, "Preferences" from the Utilities menu, and "Connect" from the Preferences menu.

When the two machines establish communications, new drive icons appear on both the PC's and the Zoomer's screen. On the PC, the new drive—called Remote-b or PDA-b, or any name you choose to give it—represents the Zoomer. On the Zoomer, the new drive represents the PC. We were able to back up our PDA data by selecting the appropriate files and copying them to the new "drive."

The PalmConnect packaging is slightly misleading. The illustration shows a handwritten entry being made on the PDA's calendar. A PC in the background shows the same calendar and entry. Such real-time transfer isn't possible, however. The computer can run PC-versions of some of the Zoomer's software, but the link is only for file transfer. The computer can't run the Zoomer's software, and the Zoomer can't run the PC's software.

Running the PalmAddress, PalmNotes and PalmSchedule applications on the PC is almost identical to running Address Book, Note Book, and Date Book on the Zoomer. However, the PC software allowed us to create a complete address book using our keyboard for entry—a far more pleasant task than doing it on the Zoomer.

Unfortunately, the fourth main application in the Zoomer, Pocket Quicken, requires a separate program for transferring its data to Quicken for Windows. A coupon supplied with PalmConnect can be used to order the transfer disk for $19.95. The coupon also allows you to purchase both the transfer disk and Quicken for Windows for $45.

PalmConnect should be essential for anyone who owns a Zoomer's PDA. We're tempted to say that the Zoomer isn't really complete without it. ■

ELECTRONICS WISH LIST

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

Fox 4 Record Universal Remote

"No-Brain" Remote

Couch potatoes who have as little desire to exercise the "muscle" between their ears as the muscles in their bodies should flip for the "No-Brainer Entertainer." Also known as the *Fox 4 Record* from *Fox Electronics & Technology, Inc.* (265 Eisenhower Lane South, Lombard, IL 60148), the device is a universal remote control that can program virtually any remote-controlled VCR for automatic multi-program recording. The unit's built-in clock and calendar display the time and date in its LCD window. To activate automatic VCR recording, the user is prompted to enter the program's date, time, and channel. The Fox 4 Record is then set on a coffee table, or anywhere with a clear line of sight to the VCR. At the appropriate, time the "No-Brainer Entertainer" turns on the VCR, changes the channel, starts and then stops recording, and turns off the VCR. Timer settings for up to four different TV programs can be stored in the remote's memory. The Fox 4 Record serves as a replacement remote for up to four different video devices. Price: $50.

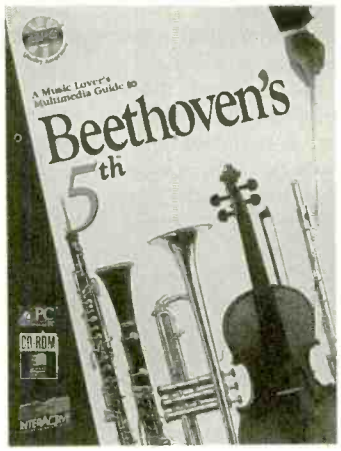
CIRCLE 56 ON FREE INFORMATION CARD

Recoton Wireless Headphones

Wireless Peace-Makers

In households that include a hard-of-hearing family member (and many that don't), it's common to have a running battle over the volume of the TV or stereo. If it's loud enough for that person to hear, it's so loud that no one else can hear himself think. *Recoton* (46-23 Crane Street, Long Island City, NY 11101) offers two solutions to the problem, with their *W200SX* and *W500* wireless stereo headphone systems. Both models use 900-MHz RF technology to transmit audio 150 feet or more to stereo headphones. The W200SX combines a small transmitter (which features an integrated circular antenna), a shirt-pocket-sized receiver, and a headset. Users can substitute virtually any other low-impedance headphone for the one supplied. The patented W500 system pairs the same transmitter with a lightweight, comfortable headphone that contains all necessary RF-receiving circuitry. Because RF signals travel through walls and floors without suffering degradation, the wireless systems can be used for outdoor or other-room listening, as well as for assistive listening devices. The wireless headphones can also provide peace in families that include video-game addicts. Price: W200SX, $129.99; W500 (pictured here), $159.99.

CIRCLE 57 ON FREE INFORMATION CARD



Beethovan's Fifth on CD-ROM

Classical CD-ROM

Classical music takes on a few new dimensions in *Beethoven's 5th: A Multimedia Symphony* from *Interactive Publishing Corporation* (300 Airport Executive Park, Spring Valley, NY 10977). The CD-ROM disk blends stereophonic and visual presentations to allow the user to "fully comprehend the vision and message behind one of the most brilliant minds in musical history." The user can view each movement, along with information on the inner workings of the symphony. Clicking on any section of the orchestra initiates commentary on that section. The disk also brings to life the influential people and elements in Beethoven's life, which is traced in a detailed biographical time line. Three games—"Play the Tune," "Match the Tune," and "Tune on Trivia"—test the user's musical expertise. Price: $59.95.

CIRCLE 58 ON FREE INFORMATION CARD

Decorative Wireless Doorbells

Available in a variety of attractive textured patterns surrounded by hardwood trim, the *Reflex SL-6171 Series* decorative wireless doorbells from *Heath Zenith* are stylish as well as functional. Radio signals are used to transmit between the pushbutton transmitter, which can be mounted outdoors with the included screws or double-sided tape, and the chime, which can be wall- or ceiling-mounted indoors. The wireless signal is coded so that it will not interfere with other wireless products, and has an effective range of up to 50 feet. The volume level of the ding-dong chime is adjustable. Price: $39.97.

CIRCLE 59 ON FREE INFORMATION CARD

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

ELECTRONICS WISH LIST

CD Accessory Kit

The *Sound To Go* kit from *Memtek Products* (P. O. Box 901021, Fort Worth, TX 76101) contains everything needed to keep a portable CD player clean and safe. The package includes a soft CD-player carrying case and Memtek's *Compact Disc Radial Cleaner* and *CDL-100* laser-lens cleaner. The CD Radial Cleaner thoroughly and safely cleans the compact-disc surface in a straight line, from center to edge and back. It includes a tray that holds the CD during cleaning, a pump-spray bottle of a cleaning solution that won't leave any residue, and a cleaning pad made of a micro-thin fiber with a non-abrasive cloth to remove fine particles of dirt and dust. The CDL-100 laser lens cleaner, which resembles an ordinary CD but features a two-brush cleaning system, is inserted into the CD player and plays music and voice instructions during the cleaning process. Price: $29.99.

CIRCLE 60 ON FREE INFORMATION CARD

Memtek Sound to Go CD-Cleaning Kit

Wizard Add-On Card

Users of Sharp's Wizard 9000 Series organizers can add yet another function with *Rupp Technology Corporation's* (3228 East Indian School Road, Phoenix, AZ 85018) *Time & Expense Card 9000*. The IC card helps Wizard users effectively track and manage their billable time expenditures and specific expense-related business records, and to print-out copies. Users can instantly enter time records and compute billings by client, project, type of service, and/or activity. The card also contains an Expense Manager function for tracking all types of expenses and any related data (dates, payment method, check numbers, etc.). It includes fields for mileage and other travel expenses and records for tax preparation. An Itinerary Manager logs travel, lodging, and rental-car information. The Time & Expense Card 9000 also offers a currency-conversion function. Each function contains open fields that can be customized for the user's applications. Price: N/A.

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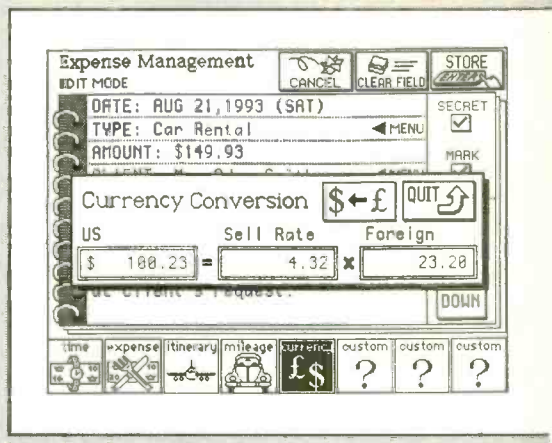

Time & Expense Card for Wizard Organizers

Camcorder Battery Eliminator

If you use your 6-volt camcorder on the road—or on the sea—*Sima Products Corporation's* (8707 North Skokie Blvd., Skokie, IL 60077) *Universal Battery Eliminator* will allow you to use your auto or boat battery as the power supply for camcorder recording. The Battery Eliminator plate is attached to the camcorder in place of the camcorder battery, and its six-foot cord is plugged into a cigarette-lighter socket. When not in use, the compact, portable device can be stowed in a glove box or under a seat. It is compatible with virtually all 5-volt JVC, Panasonic, Sony, and Hitachi camcorders. Price: $34.95.

CIRCLE 62 ON FREE INFORMATION CARD

Sima Universal Battery Eliminator

Faxphone with Digital TAD

Aimed at small businesses and home offices, the *Faxphone 17A* from *Canon U.S.A., Inc.* (One Canon Plaza, Lake Success, NY 11042) is a compact, efficient facsimile machine with a built-in digital answering machine. The answering machine can store up to 59 messages in memory. Because it's digital, it offers instant playback and allows users to repeat, delete, or skip individual messages as needed. A remote-retrieval function provides the convenience of listening to messages when away from home or out of the office. Fax features include automatic identification of incoming fax and phone calls, eliminating the need for a separate line; auto redialing at programmable intervals; delayed transmission; automatic document feeder; and 16-level gray scale. Price: $795.

CIRCLE 63 ON FREE INFORMATION CARD

ELECTRONICS WISH LIST

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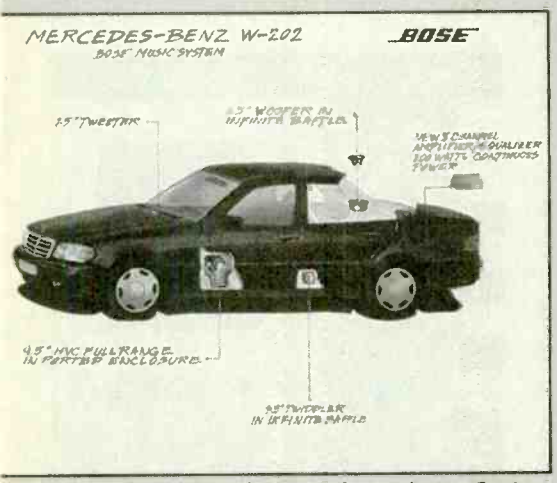
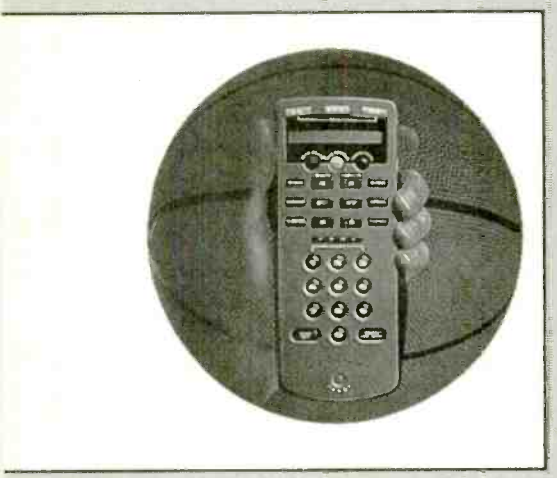


Mercedes with Bose Acoustimass System

Acoustimass-to-Go

Three 1994 models of Mercedes-Benz SL coupe/roadsters will feature the first automotive applications of *Bose Corporation's* (The Mountain, Framingham, MA 01701-9168) *Acoustimass* loudspeaker technology. Acoustically tailored Bose audio systems are already standard on all S-class sedans and coupes, and Acoustimass speaker systems will be standard in the SL320, SL500, and SL600 cars in the United States and Japan (optional in Europe). Acoustimass speaker technology launches sound via two air masses to produce a deep, pure bass sound with no audible distortion. Using computer measurements to evaluate the car's interior dimensions, driver and passenger listening locations, and acoustic properties of the seat leather, carpeting, and dashboard materials, Bose acoustically customized the system for the Mercedes-Benz automobiles. Speaker components are placed for optimum performance, and the system is automatically equalized. The system features a four-channel amplifier/equalizer with 200 watts of power (continuous) built into the Acoustimass module. Positioned behind the driver's seat, the module contains a 5.25-inch woofer. Two 2.5-inch *Twiddler* drivers are mounted in infinite baffles above the package area, and a tweeter and full-range driver are located in both the driver and passenger doors, for a total of seven loudspeakers in the car. Price: N/A.

CIRCLE 64 ON FREE INFORMATION CARD



Basketball Stat Pro Electronic Scorebook

Handheld Basketball Scorebook

Basketball coaches, fans, and players can instantly view team or player statistics at any time during or after a game, with the *Basketball Stat Pro* electronic scorebook from *Vertical Sports, Ltd.* (2799 Middlefield Road, Palo Alto, CA 94306). About the size of a TV remote control, the device uses proprietary software and a 4-bit microcontroller to record a running total of data for an individual player or an entire roster of up to 15 players. Coaches can track each player's performance by entering the player's jersey number and then pressing the appropriate key for any scoring or play-making action. The device provides instant stats on two- and three-point shots made and missed, foul shots made and missed, total points scored, offensive and defensive rebounds, assists, steals, turnovers, blocks, and fouls. The Basketball Stat Pro can instantly calculate and display shooting percentages from the two- and three-point ranges and foul line, as well as a summary of the above statistics for a single player or the whole team. A serial port allows data to be printed or downloaded to a PC for aggregate season statistics. Price: $129.

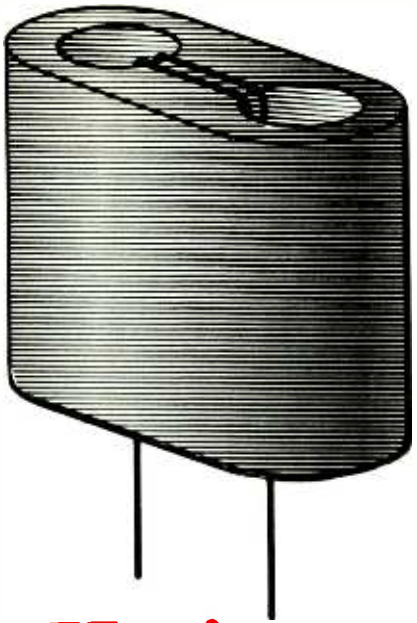
CIRCLE 65 ON FREE INFORMATION CARD

Panasonic Big-Screen TV

Big-Screen TV

The 60-inch *Model 60SX4K UltraVision* projection TV features *Hitachi Home Electronics (America)'s* (3890 Steve Reynolds Road, Norcross, GA 30093) exclusive UltraBlack high-contrast dark-tint screen, said to increase contrast by more than 30 percent. An "HDTV color-correction" lens system and digital convergence are used to attain 1000 lines of horizontal resolution. The set comes with the illuminated Genius™ remote, which works with 48 brands of VCR's and 11 cable decoders, and can control CD and laserdisc players as well. In low-light situations, 16 commonly used buttons can be illuminated. A second, streamlined remote is also included. The UltraVision features a four-channel amplifier and digital signal processing for Dolby Pro Logic capability. The TV can generate impressive sound from standard stereo sources by electronically synthesizing extra channels. Other features include quick-freeze picture-in-picture, child lock, a message center with up to three messages, on/off timers, and favorite-channel groupings. Price: $4399.

CIRCLE 66 ON FREE INFORMATION CARD



Using "Binocular" Coil Forms

Here's an alternative to toroidal cores for inductors, transformers, and baluns in RF circuits.

BY JOSEPH J. CARR

Radio-frequency (RF) inductors and transformers can be made using a number of different core materials. The main difference between the materials is their permeability (denoted μ) . Since coil inductance is directly proportional to the permeability of the core, the material chosen determines the amount of inductance-per-turn the coil will have. So, high permeability can result in very large inductances with only a few turns. Since the cores used for the inductors you use in your projects is then so obviously important, you should be aware of the kinds of cores available and how to chose between them. In the course of this article, we'll provide that information as well as look at a special coil form called a "binocular core" and ways to simulate binocular cores with more readily available core forms.

Toriodal Cores. For powdered-iron and ferrite materials, the inductance per a set number of turns is called the material's "A_L" rating. For powdered-iron cores, an A_L rating is stated in terms of microhenrys- (μH) per-100-turns, while ferrite is rated in millihenrys- (mH) per-1,000-turns.

Of course, the shape or "form" of a core is important, too. The toroid is perhaps the most common form of fixed core for making RF coils. Figure 1 shows the familiar toroid inductor in monofilar (Fig. 1A) and bifilar (Fig. 1B) winding styles. The monofilar style is used to make ordinary inductors for use in active-RF circuits and in RF-filter circuits. The turns of wire are spaced out over 270° of the circumference of the toroid core. The 30° gap at one spot serves to reduce the stray capacitance of the winding to a minimum. There would be a tremendous amount of stray capacitance if the coil were wound over the entire circumference of the core.

The bifilar style is used in wideband RF transformers, BALUN transformers, and related devices. In this style of winding, two wires are wound parallel to each other at all points along the circumference of the core. A trifilar winding uses three wires, and even up to five parallel (or "pentafilar") windings have known to be useful.

A related bifilar winding style is shown at Fig. 1C. This type of winding calls for the two (or more) wires of the winding to be twisted together before being wound on the core. The wires can be twisted together using a hand drill or, if you are very careful and wear safety glasses or goggles while doing it, a slow-speed electric drill. Fasten the two (or more) wires into the drill chuck, and then anchor the opposite ends (I usually use a bench vise for that).

Now let me take a moment to prove the value of choosing the *right* toroidal core: Recently, I have been working with circuits for the AM-broadcast band (540–1700 kHz), so I needed some pretty large inductance values. For example, when a standard 365-pF capacitor is used to tune the AM band, an inductance of about 225 μH is needed. At lower frequencies (LF and VLF), even higher inductances are needed. To achieve such inductances with Type-15 powdered-iron 0.44-inch toroid core (*i.e.*, the T-44-15 RED/WHT core) would require 117 turns. That's a lot of winding. In fact, it may not even be possible to fit that many turns on a 0.44 inch core. When switching to ferrite, which tends to have higher A_L values than powdered iron, it is possible to get away with fewer turns. For example, the 225 μH coil wound on a FT-50-43 (with an A_L of 523) would require only 21 turns.

Binocular Cores. The toroidal core has a certain charm because it is easy to use, predictable, and inherently self-shielding (by virtue of its geometry). However, the binocular core also offers very high permeability in a small volume (see Fig. 2). It, too, can provide very high inductance values without being excessively large. A binocular core of Type-43 ferrite of about the same weight and size as the T-50-43 (which has an A_L of 523) has an AL value of 2,890; only 8.8 turns are required to achieve 225 μH on this core!

There are actually two different types of binocular core in Fig. 2. A Type-1 binocular core is shown in Fig. 2A. It is larger than the Type-2 (Fig. 2B), and has larger holes. It can, therefore, be used to form transformers and very large values of inductance. The Type-2 core can be thought of as a two-hole ferrite bead.

Table I shows several popular-size binocular cores and their associated A_L values. The two center digits of each part number indicates the type of ferrite material used to make the core (*e.g.*, BN-xx-202), while the last digits refer to the size and style of the core.

Three different ferrite materials are commonly used in binocular cores: namely types 43, 61, and 73. The Type-43 material is a nickel-zinc ferrite, which has a permeability of 850. It

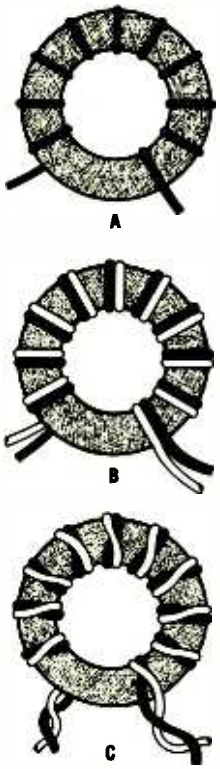


Fig. 1. These toroid cores: are A) single wound; B) bifilar wound (three wires would be trifilar wound); and C) twisted bifilar wound.

is used for wideband transformers up to 50 MHz, and has high attenuation from 30 to 400 MHz. It can also be used in tuned RF circuits from 10 to 1000 kHz. The Type-61 material is also nickel-zinc; it has a permeability of 125. It offers moderate-to-good thermal stability, and a high "Q" from 200 kHz to 15 MHz. That core can be used for wideband transformers up to 200 MHz. The Type-73 material has a permeability of 2,500 and offers high attenuation from 500 kHz to 50 MHz.

Figure 3 shows some Type-1 binocular cores wound in various ways. The normal manner of winding the turns is shown in Fig. 3A; the wire is passed from hole-to-hole around the central wall between the holes. The published A_L values for each core are based on this style of winding.

An edge-wound coil is shown in Fig. 3B. In that coil, the turns are wound around the outside of the binocular core. To check the difference, I wound a pair of BN-43-202 cores with ten turns of No. 26 wire; one in the center (Fig. 3A) and one around the edge (Fig. 3B). The center-wound version produced 326 µH of inductance, while the edge-wound unit produced 276 µH.

TABLE 1—CORE CHARACTERISTICS

Part No.	A_L Value	Size (o.d./i.d./H/T)	Style
BN-43-202	2890	0.525/0.150/0.550/0.295	1
BN-43-2302	680	0.136/0.035/0.093/0.080	1
BN-43-2402	1277	0.280/0.070/0.240/0.160	1
BN-43-3312	5400	0/765/0.187/1.00/0.375	1
BN-43-7051	6000	1.130/0.250/1.130/0.560	1
BN-61-202	425	0.525/0.150/0.550/0.295	1
BN-61-2302	100	0.136/0.035/0.093/0.080	1
BN-61-2402	280	0.280/0.070/0.240/0.160	1
BN-61-1702	420	0.250/0.050/0.470/—	2
BN-61-1802	310	0.250/0.050/0.250/—	2
BN-73-202	8500	0.525/0.150/0.550/0.295	1
BN-73-2402	3750	0.275/0.070/0.240/0.160	1

Counting the turns on a binocular core is a little different than you might expect. A single "U" shaped loop that enters and exits the core on the same side (Fig. 3C) counts as one turn. When the wire is looped back through a second time (Fig. 3D) there are two turns.

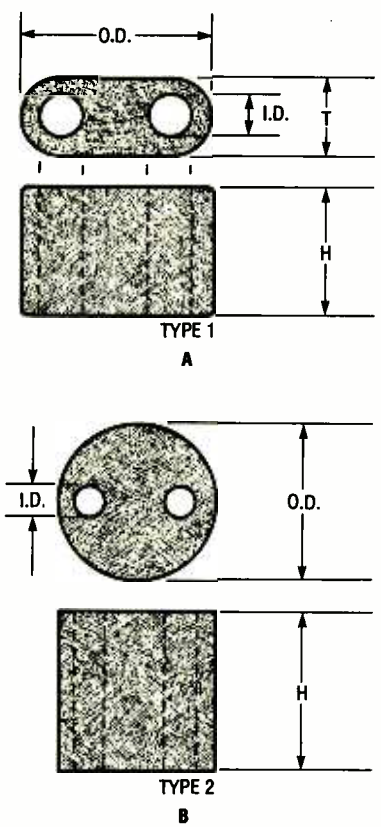


Fig. 2. With regard to binocular cores, there are two kinds: regular or Type-1 (A), and bead or Type-2 (B).

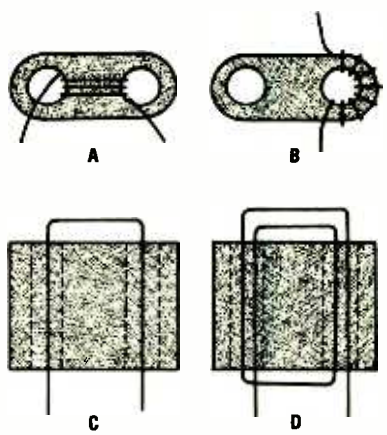


Fig. 3. Binocular cores can: be center wound (or normal) (A), edge wound (B), have a single-turn winding (C), or have a multiple-turn winding (D).

Winding the Binocular Core. Some people think that it is easier to use binocular cores than toroids. After spending a rainy weekend winding LF and AM-broadcast-band coils, I am inclined to partially agree. However, only partially, because while they require few turns, it takes some experimenting to figure out the best way to wind them. I came up with two related methods: The first method is shown in Fig. 4. For that technique, the core is temporarily affixed to a stiff piece of cardboard stock, such as a 5 × 7 card, or a piece cut from the stiffener used in men's shirts at the laundry. The cardboard is taped to the work surface, and the core is taped to the card board. One end of the wire that will be used for the winding is taped to the cardboard with enough leader (2–3 inches) to permit working the end of the coil once it is finished. Pass the wire

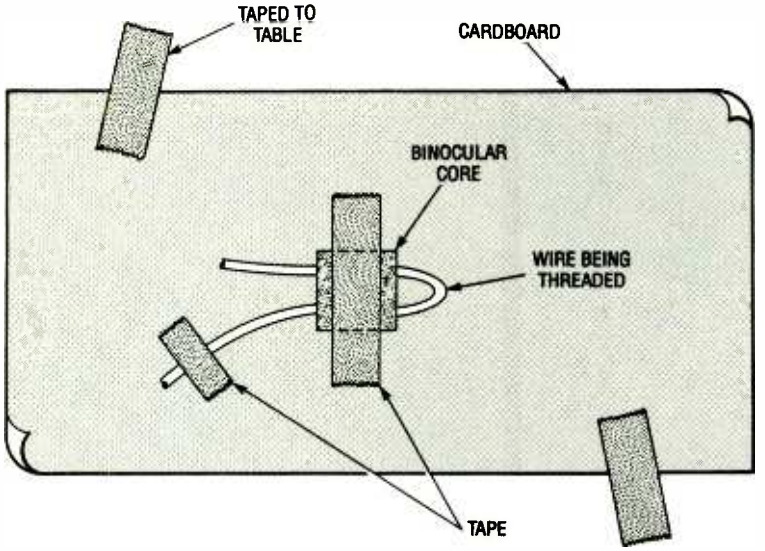


Fig. 4. For this method of winding binocular transformers a piece of cardboard is needed to secure the core.

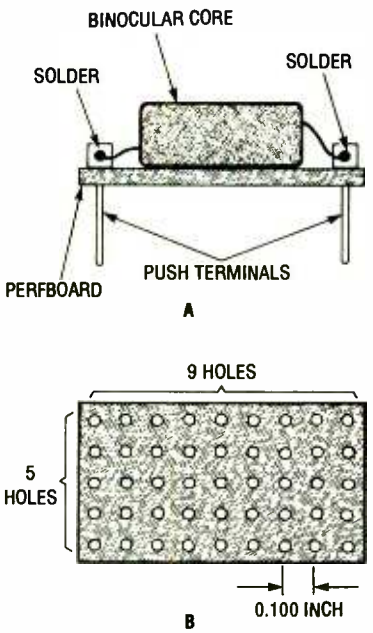


Fig. 5. This method of winding and mounting binocular transformers results in a header for easy installment of the coil.

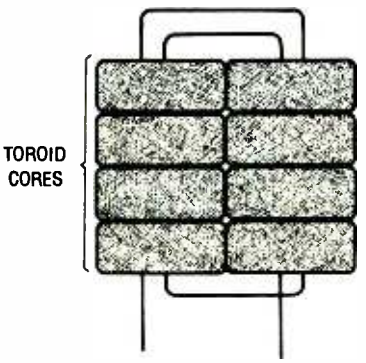


Fig. 6. A custom homebrew binocular core can be made from toroids by arranging them as shown.

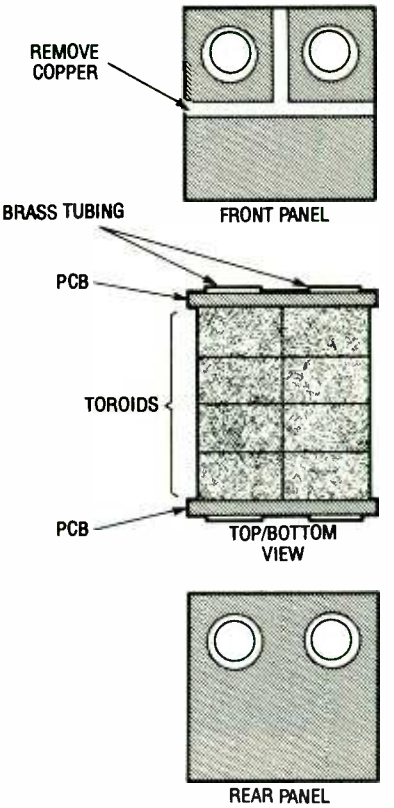


Fig. 7. For high-power applications, it is possible to make a homebrew transformer with a single-turn winding made of brass tubing and printed-circuit material, as shown here.

back and forth through the holes to make the desired coil and then anchor the free end to the cardboard with tape. If the device has more than one winding, make each one in this manner, keeping the ends taped down as you go. Once all of the windings are in place, seal the assembly with Q-Dope or some other sealant (RTV silicone, rubber cement, etc.) Q-Dope (which is made by GC Electronics) is intended for inductors, and can be purchased from GC product dealers, or by mail from Ocean State Electronics (P.O. Box 1458, 6 Industrial Drive, Westerly, RI, 02891; Tel. 401-596-3080, orders only: 800-866-6626, FAX: 401-596-3590).

The second method involves making a header for the binocular core. Figure 5A shows the basic configuration for my homebrew header (a DIP header can also be used). The header can be permanent, and used to install the inductor in a circuit just like any other coil with a header. The pins shown are perfboard push terminals (available anywhere that perfboard and printed-circuit making supplies are sold). They normally connect wiring or component leads to a perfboard.

As for the perfboard, I use the type that has solder terminals so that the push terminals can be held to the board with solder. Otherwise, they have a distinct tendency to back out of the board with handling. If built on the appropriate perfboard, the 0.100-inch on-center lead spacing will make it compatible with most prefabricated circuit boards. I found that a small segment of perfboard (five rows by nine columns) with 0.100-inch on-center holes (see Fig. 5B) was sufficient for the 0.525 × 0.550-inch BN-xx-202 form. Of course, larger or smaller pieces of perfboard can be cut to accommodate other binocular-core sizes.

When the header is finished, the binocular core is fastened to the top surface of the header with tape, and then the pins of the header are pushed into a large piece of perfboard. This step is done to stabilize the assembly on the work surface. It might be a good idea to affix the second piece perfboard to your workbench with tape to keep the assembly from moving about as you wind the coils.

Once the header and core are prepared, then it is time to make the windings. Scrape the insulation off one end of the wire for about ¼ inch. An X-acto knife, scalpel, or similar tool

(Continued on page 98)

Build an

Electronic Paint Shaker

A story guaranteed to shake things up.

BY MICHAEL A. COVINGTON, N4TMI

Shaking up old cans of spray paint is a common and time-consuming workshop task. This article will tell you how to automate the job using machinery you probably already have. The key elements are a microcomputer and a dot-matrix printer. The can of spray paint is held in a fixture attached to the platen knob on the printer, and a special program rotates it continuously for 8 minutes, rendering the paint as good as new even if it's been on the shelf for years.

Construction. To build the electronic paint shaker, you'll need a replacement knob for your printer (easily obtained from a junked printer of the same or similar model), two pieces of sheet metal about 2 × 4 inches, and some bolts, nuts, and threaded spacers. Figure 1 shows how the parts go together. The amount of bend in the sheet metal pieces is not critical, but a slight bend is necessary in order to hold the paint can properly.

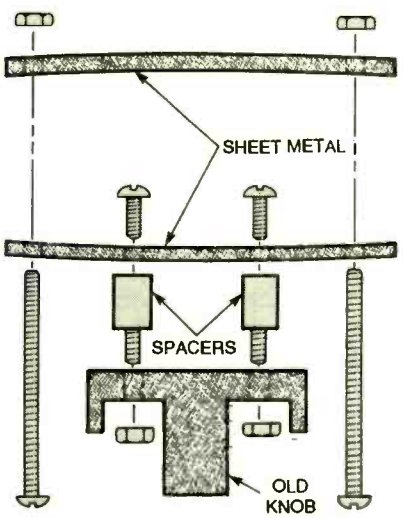


Fig. 1. The paint-shaker module can easily be made by mangling a perfectly good printer-platen knob.

Installation. To install the add-on paint shaker, first insert a can of paint into it and tighten the long bolts—but not too tight or the can may rupture and explode. Then pull off the printer's platen knob and attach the paint-shaker assembly in its place. Finally, remove any paper from the printer (unless you really don't care about the cost of operation) and insert a small piece of plastic in front of the paper-out sensor to fool the printer into thinking it's loaded with paper.

Software. It's quite possible to mix paint while running ordinary print jobs, but chances are you'll want to use dedicated software for more adequate performance. Listing 1 shows an assembly-language program for an IBM-compatible that sends 67 form feeds to the printer (exactly the right number for a good 8-minute shake on an Epson FX-85). Once entered and assembled, all you do is type the name of the program (which the author called "shake"), and the computer does the rest.

An important aspect of this program is its multitasking simulation; since the printer buffers the 67 form feeds, your PC can proceed with other work immediately! If you send

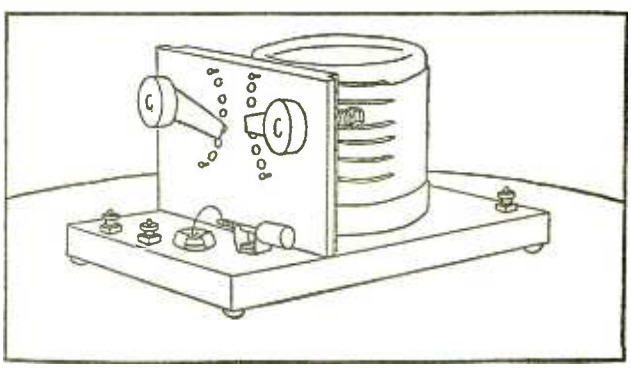
(Continued on page 97)

ANTIQUE RADIO

By Marc Ellis

The NBS Crystal Set

Back in the January 1994 column, I introduced a crystal-set project that had to be put on ice for awhile in order to provide timely coverage of the Antique Wireless Association national conference. Now we're ready to proceed again, and I'd like to start by reviewing what's been discussed to date.



This is a general view of the NBS crystal set. The cylindrical object in back of the panel is the 76-turn tuning coil.

This project was conceived in response to many reader requests for information on how to build an old-time crystal set. Since the classic receiver of this kind used a tuning coil wound on an empty Quaker Oats canister, and I'd heard that Quaker Oats had once published plans for such a radio, I began by calling up the Quaker Oats archivist. She couldn't find evidence that such plans had existed, but sent me a fascinating mid-1920's newspaper ad (see January column) for a promotional crystal set factory-built *entirely* (crystal detector, binding posts, coil and all) on a "Quick Oats" canister.

Quaker Oats still sells "Quick Oats" (and other products) in those neat round canisters. But that particular set would be hard to duplicate for a variety of reasons. For one thing, the tuning coil is wound *underneath* the Quaker Oats product label, so an authentic look would be quite difficult to achieve. For another, scratch-building the sliding-contact tuning mechanism (no tuning capacitor was used in the set) might be a bit challenging for the average home builder.

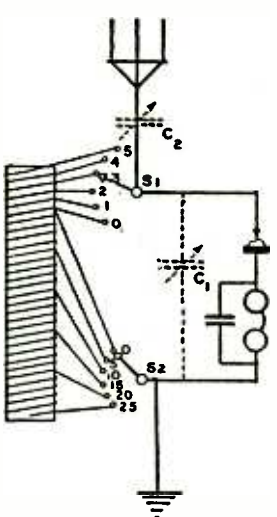
THE BUREAU OF STANDARDS SET

Accordingly, I decided to look around for a more practical project—preferably one that used a coil suitable for winding on a Quaker Oats canister. I finally found what I wanted in an old book titled "How to Build your Radio Receiver" (edited by Banning and Cockaday and published by Popular Radio, Inc. in 1924). The design is billed as " . . . a re-creation of the famous Bureau of Standards receiver, brought up to date with a suitable wavelength range . . . published by permission of the Director of the Bureau of Standards of the U.S. Department of Commerce."

I can't tell you anything further about the origins of the set. However, since a wavelength change was necessary to achieve broadcast reception, I'm surmising that the radio was originally designed for reception of long-wave (*i.e.* below the broadcast band) commercial and marine stations.

Like the Quaker Oats promotional radio, the NBS set is a very simple design using no tuning capacitor. Stations are selected by varying the inductance of the tuning coil—though in this case, the adjustment is made by switching coil taps (an easier arrangement for the average builder to tackle) rather than manipulating a sliding contact.

The original construction article provides complete details for fabricating every part of the set from scratch, including the crystal-detector stand and the tap switches used for station selection. But, folks, I have to tell you right now that I'm not into fashioning small parts from scraps of metal. I plan to use a commercially available detector stand and Radio Shack rotary switches for my version of the radio. However, I will provide details on the original tap switches. Those of you that have the patience to construct them will certainly achieve a quaint, old-fashioned look!



Here's the schematic of a tapped-coil crystal set that is very similar to the NBS version. Tuning capacitors (dotted lines) are not used.

GENERAL CONSTRUCTION STYLE

As the general view shows, the NBS radio employs a simple breadboard-and-panel layout. The cylindrical object behind the front panel is the tuning coil, which is normally concealed under a box-type cover (not shown) that fits over and around the front panel. Notice the home-made crystal holder and tap switches. Even the binding posts are home made, utilizing thumb-nuts from discarded dry cells.

A complete "how it works" discussion will be found in the January column. But I think it's important, at this time, to review the radio's tuning arrangement. So I'm repeating the schematic diagram on these pages.

This schematic is not from the NBS set article—which showed mechanical construction details only. It's for another radio of the same era and almost identical in design. Note that the coil inductance is adjusted by means of two separate tap switches (corresponding to the two switches you see on the general view of the receiver). The tuning capacitors (which are shown dotted) are not used in the NBS radio.

As the schematic suggests, one of the two switches (the lower one) cuts coil turns in and out of the circuit in groups of five. The upper switch cuts single turns in and out. While not as flexible as the sliding-contact method of tuning, this method provides fairly close frequency control. Coarse adjustments can be quickly made with the "fives" switch, followed up by fine adjustments with the "ones" switch.

And here we've put our finger on another difference between this schematic and the NBS set design. As you'll see when we get down to the details of constructing the coil, our coarse switching will be done in groups of six turns; our fine switching in groups of two.

COIL CONSTRUCTION ISSUES

As I mentioned earlier, I really had my heart set on using a Quaker Oats box as a form for the tuning coil on this set. As it turns out, I had to compromise, but only by a little bit. To understand my problem, we'll have to take a quick look at the theory of coil construction. The formula commonly used to estimate the inductance of a single-layer coil is:

$$L = (N \times A)2/9A/10B$$

Where L is the inductance of the coil in microhenries, N is the number of turns in the coil, A is the radius of the coil in inches, and B is the length of the coil in inches.

I won't go through the calculations in detail here, but from the dimensions (3½-inches diameter and 2½-inch length) and number of turns (76) specified in the 1924 construction article, I determined that the original coil had an inductance of close to 434 microhenries.

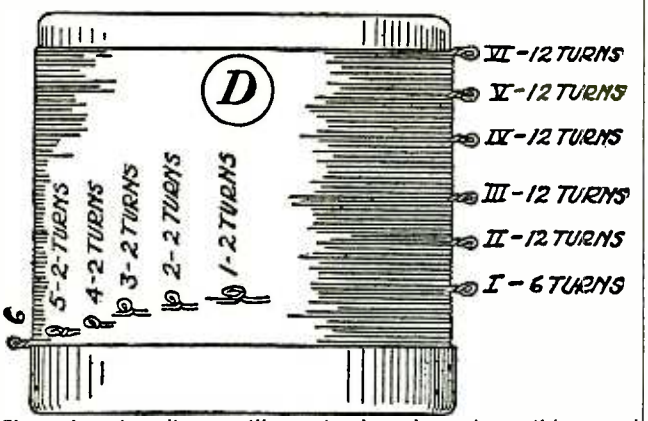
The original coil had been wound on a cylindrical cardboard one-pint container of a type I haven't seen around in years. The smallest diameter Quaker Oats container now on the market is that used for the "Quick Oats" product (the same product whose container was used to make that promotional crystal set). It has a diameter of four inches.

To see how the length of the coil would have to change to maintain the same inductance with the larger diameter, I transposed the coil formula as follows:

$$B = (N \times A)2\text{-}9LA/10L$$

Solving for the new length (B) that would be required if the radius (A) were to become two inches while the inductance (L) and number of turns (N) were maintained at the same value, I came up with a value of about 3½ inches. The original coil, containing 76 close-wound turns, had a length of 2½ inches.

What this meant was that, in order to use the Quick Oats container, I'd have to space out the coil windings so that the 76 turns would occupy an extra inch on the form. Maybe somebody with a steadier hand than mine could neatly maintain that spacing for 76 turns while stopping every once in a while to fabricate a coil tap. But I figured I'd have my hands full assembling that coil in close-wound fashion!



Shown here is a diagram illustrating how the tuning coil is wound on its cardboard form. We'll get into more detail on this next month.

At this point, I made a trip to the supermarket to find out what might come packed in a container having the proper diameter. Of course I checked out the Quaker Oats section first, and immediately discovered that some of that company's lesser-known products were marketed in 3½-inch-diameter canisters. They weren't as firm and sturdy as the oats containers, but would certainly do the job. I could choose between two kinds of Quaker cornmeal and a product known as "Quaker Quick Grits."

Okay, guys, I know that a "Quaker Quick Grits" container doesn't have the class of one that once held Quaker Quick Oats. But, hey! It's still a Quaker product, complete with the portrait of the round-faced guy who looks like Benjamin Franklin. I don't think that's such a bad compromise, do you?

CHOOSING THE WIRE

The final decision to be made about the coil involves the wire to be used. The original coil was wound with No. 24 dcc (otherwise known as double cotton-covered) wire. Dcc wire is well-nigh impossible to find today; most of the wire now sold for coil work is "magnet wire," which is insulated with a thin enamel coating.

As you might expect, given the same wire gauge, the magnet wire will have a slightly smaller outer diameter than the dcc wire. That's why I thought that the No. 22 magnet wire I had on hand might work. The

(Continued on page 93)

COMPUTER BITS

By Jeff Holtzman

Build Your Own Text Editor

Have you ever wanted to build your own text editor? Now's your chance. SemWare, the company famous for the Qedit shareware editor, has developed an absolutely fabulous text editing and customization engine. SemWare "modestly" calls it The SemWare Editor, (TSE for short). I looked at pre-release version 1.0; the final product should be out by the time you read this.

The SemWare Editor evolved from Qedit, one of the most popular shareware text editors in history. TSE allows you to build your own editor, including menus, keystrokes, and macros. The Pascal-like macro language allows extremely sophisticated text processing.

TSE consists of three components: a text-editing engine, configuration files, and a macro compiler. The text-editing engine does most of the hard work, including managing the keyboard, the mouse, memory, screen windows, text buffers, and searching and replacing text.

The configuration files serve a variety of purposes. They allow you to:

- assign commands and macros to specific keystrokes and keystroke combinations
- build hierarchical menu systems
- create your own help system
- create your own macros

The macro compiler allows you to compile ASCII source files into macros that TSE can execute. Compiled macros are typically stored as external files, but the compiler includes an option to "burn" macros into the main executable file, thereby allowing you to keep your favorite macros—as well as key assignments, menu system, and help files—all bound together in a single executable file. You can also dynamically load and unload macros during an editing session.

To get you started, TSE comes with pre-built configuration files that provide keystroke compatibility with WordStar, Brief, and WordPerfect. You can use one of those as the basis for creating a system that exactly meets your needs.

TSE has modest system requirements. The editor itself "weighs in" at about 100K, but that can vary, depending on the macros, key assignments, and help text you create. TSE requires about 150K of RAM to run. However, it can use XMS, EMS, and your hard disk to swap files in and out, so that it can edit a maximum of 64 megabytes of data. You can have as many as nine windows open simultaneously, including multiple synchronized windows into a single file. In addition, you can have as many open files as you have memory to store them.

TSE is relatively speedy, although it's not as fast as Qedit. (The reason is that Qedit is strictly a RAM-based editor that cannot edit files larger than available RAM.) On the other hand, TSE has numerous powerful features, including column-mode operations, sorting, regular expression search/replace, intelligent tabbing, support for C, C++, and Pascal program files, and the ability to execute DOS programs (*e.g.*, compilers and print utilities). File printing is the weakest point of TSE. The macro language is its jewel.

MY GAL SAL

SemWare calls its macro language SAL, for SemWare Application Language. SAL looks an awful lot like Pascal. SAL is not just a keystroke recording type of language, but a full-blown programming environment with variables, integer and string data types, control structures, variable scoping, and many functions for manipulating text, the screen, the keyboard, and the mouse.

SAL has a structure called a menu bar that allows you to specify the text of the main menu bar that appears across the top of the screen. The menuing mechanism is quite simple to use, but very powerful. Each item in a menu bar corresponds to a menu, and each menu can correspond to a submenu or an action (*i.e.*, a built-in command or macro).

For example, the menu bar might have a series of items including File, Block, Text, Search, and so on. Selecting one of those brings up a menu. For example, a file menu might

VENDOR INFORMATION

The SemWare Editor
SemWare Corporation
4343 Shallowford Road
Suite C3A
Marietta, GA 30062-5022
404-641-9002

have items for opening a file, saving a file, printing a file, and so on. Specifying menu items is as simple as specifying a name for each item in the menu, along with the associated command or macro. Menu items can also display "live" data (*e.g.*, whether word wrap is on or off, or the current value of the left margin).

Assigning commands and macros to keys is similarly simple. Just type the key name between angle brackets, then enter a command or macro name. Combining the <SHIFT>, <ALT>, AND <CTRL> keys is as simple as adding the corresponding word in the angle brackets. You can also define two-key commands (*e.g.*, <CTRL + K,T>).

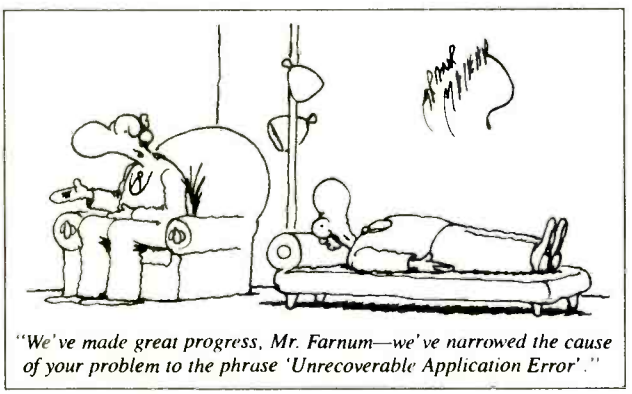
TSE has an extensive history mechanism so that the previously selected menu item comes up highlighted the next time you access that menu. History also applies to text entered into most dialog boxes. For example, each time you use the search command, the dialog box contains the preceding search term. In addition, you can scroll through previous search terms using the arrow keys. Histories are unfortunately lost between sessions.

A good deal of TSE is written using built-in commands, but several features (in the pre-release version) are actually implemented as macros and subsequently "burned in" to the editor.

CONCLUSIONS

Recently I spoke with Sammy Mitchell, the author of both Qedit and TSE, and he told me of some other upcoming goodies. Both file size and maximum line length have increased. In addition, the final version of TSE will come with extensive on-line hypertext documentation. A spelling checker will also be included. Final pricing had not been set, but it looks like upgrades from Qedit will be about $50, and new purchases, about $100.

I've been a Qedit fan for years (see my writeups here in the 7/89, 2/90, and 10/90 issues). SemWare recently upgraded Qedit to include a fair number of the features in TSE, along with a built-in spelling checker. But TSE is going to be my preferred text-processing program for the foreseeable future. It's been a long time since I've seen such a well-designed, well-executed, and well-documented piece of code. Kudos once again to SemWare. ■



"We've made great progress, Mr. Farnum—we've narrowed the cause of your problem to the phrase 'Unrecoverable Application Error'."

CIRCUIT CIRCUS

By Charles D. Rakes

Take the Speed Test

How often have you shelved a neat project because you couldn't locate a specific part or because the only company that sold that part had a $20 minimum order requirement? If you've been having similar experiences, then this circus visit is for you.

We're going to take a simple task and offer several different solutions. We'll use several different semiconductor device's with their own unique function to achieve the same desired results. Of course this scheme won't solve all of your part problems. But it should, by taking a good look at the circuit in question, give you a better understanding of that part's function.

PARTS LIST FOR THE ANALOG FIRST-RESPONSE MONITOR

SEMICONDUCTORS
SCR1, SCR2—2N5062 sensitive-gate, silicon-controlled rectifier
D1, D2—1N914 general-purpose silicon diode
LED1, LED2—Light-emitting diode (any color)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1, R2—1000-ohm
R3, R4—2200-ohm
R5, R6—10,000-ohm

ADDITIONAL PARTS AND MATERIALS
S1, S2—Normally open pushbutton switch
S3—Normally closed pushbutton switch
Perfboard materials, enclosure, 9-volt power source, wire, solder, hardware, etc.

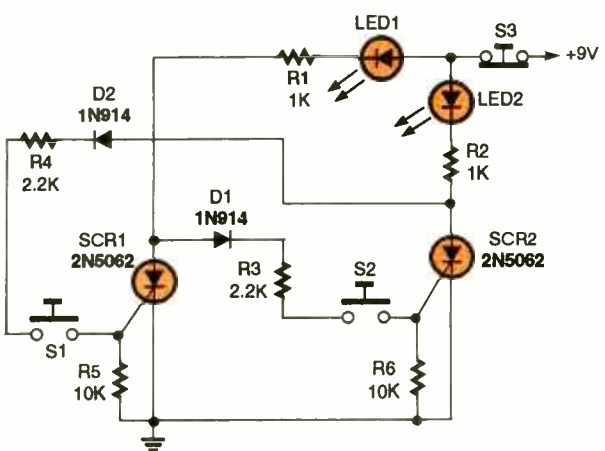


Fig. 1. The analog first-response monitor is built around a pair of cross-coupled SCR's, each of which receives its gate trigger current from the anode of the other SCR.

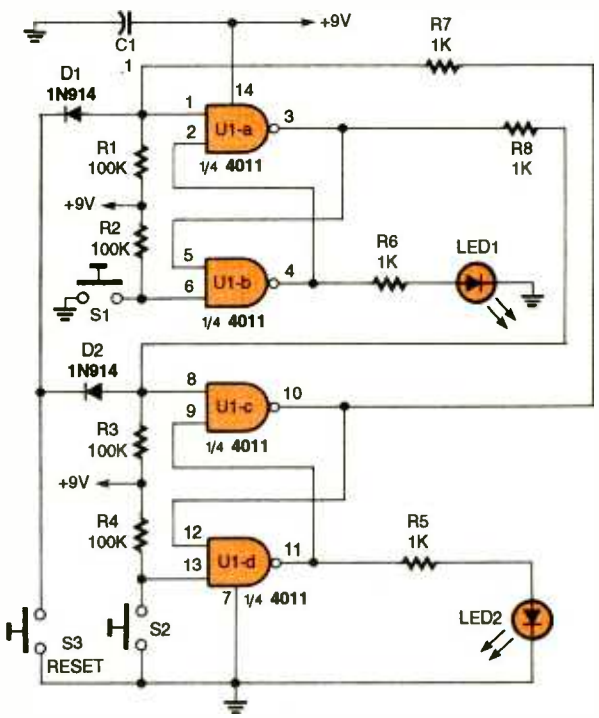


Fig. 2. This first-response monitor functions in the same manner as the previous one, but uses a digital IC—a 4011 quad 2-input NAND gate—instead of SCR's.

Not too long ago a friend of mine asked for a circuit that would indicate who was the first person to close a switch in a reflex-action test. It didn't matter who came in second or third.

A quick trip to the junkbox produced several 2N5062 sensitive-gate SCR's. That sparked an idea for their use in the "who's on first caper" project. When an SCR is turned on in a DC circuit, it remains on until it's reset. That latching characteristic looked promising as the memory device in our first circuit attempt.

ANALOG FIRST-RESPONSE MONITOR

The first attempt at designing a first-response monitor produced the cir-

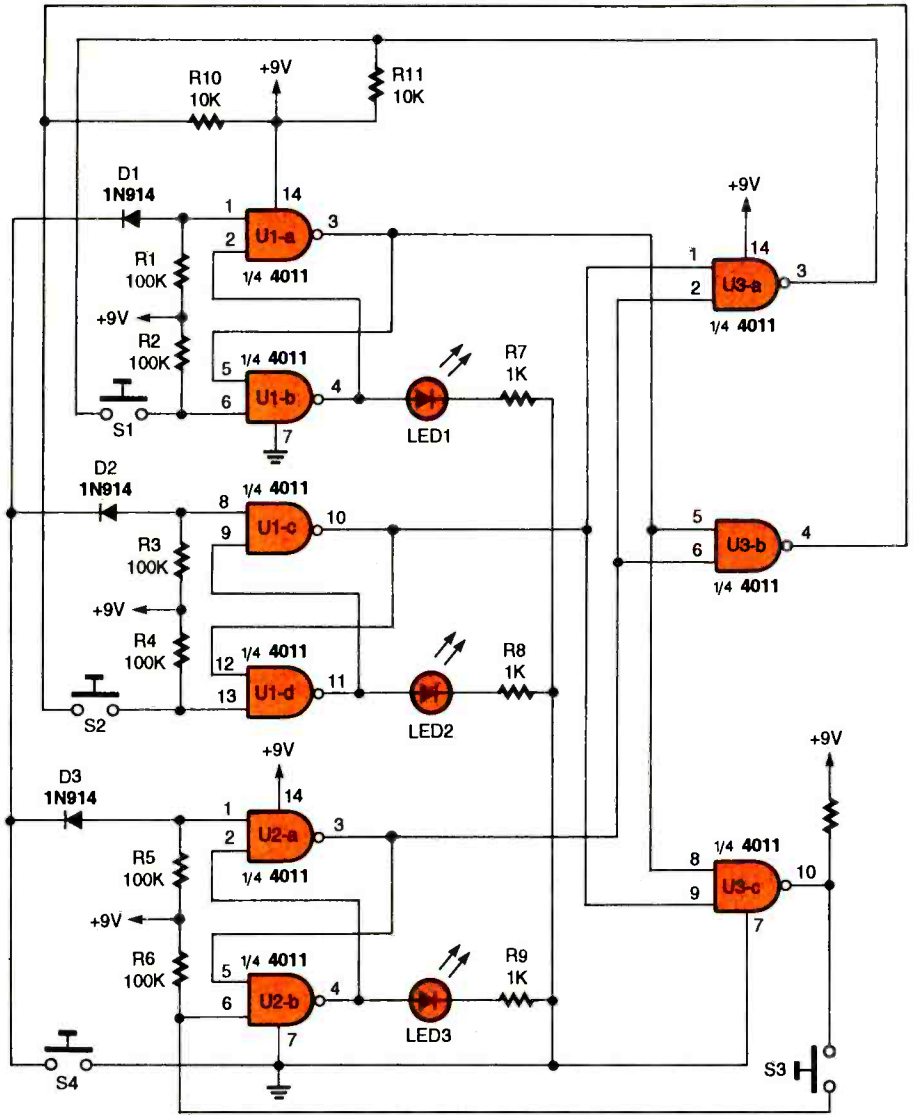


Fig. 3. The concept outlined in Fig. 2 is expanded here to allow three contestants to test their reaction time.

cuit shown in Fig. 1, wherein a pair of SCR's are cross coupled, with each SCR receiving its gate current from the anode of the other SCR. As long as neither SCR is turned on, the voltage at both anodes is at nine volts. But, if, for example, S1 closes before S2, the gate current for SCR1 flows through LED2, R2, D2, and R4 into the SCR's gate circuit, causing it to turn on and LED1 to light.

When SCR1 turns on, its anode voltage drops to near zero and remains there until the circuit is reset by pressing S3. As soon as SCR1 turns on, the source for SCR2's gate current is no longer available, so SCR2 can not be activated by pressing S2. So which ever switch closes first, it triggers its associated SCR, turning on its LED to indicate who responded first. The SCR approach turned out to be the simplest solution to the problem when only two competitors are involved in the contest.

DIGITAL FIRST-RESPONSE MONITOR

Our next circuit (see Fig. 2) serves the same purpose as the previous one, but uses a digital IC—a 4011 quad 2-input NAND gate—instead of SCR's. In that circuit, the NAND gates are paired into two set/reset flip-flops; the outputs of each flip-flop is tied to an LED.

When power is applied to the circuit and S3 is momentarily closed, the outputs of U1-a and U1-c go high, and the outputs at U1-b and U1-d go low. Under those conditions neither LED lights. But if S1 is closed before S2, the output of U1-b at pin 4 goes high causing LED1 to light, while the output of U1-a at pin 3 goes low. The low output of U1-a is coupled to pin 8 of U1-c through R8. Recall that when either input of a NAND gate is low, the output will always be high. In that circuit condition, operating S2 will light LED2 as long as the switch is activated, but it will not latch the flip-flop.

As soon as the switch is released (opened), LED2 goes out while LED1 remains lit, indicating that S1 was closed first. The opposite occurs when S2 is closed before S1. The same overriding low output is coupled from U1-c at pin 10 through R7 to U1-a pin 1.

EXPANDED DIGITAL FIRST-RESPONSE MONITOR

Our next first-response monitor, see Fig. 3, expands the concept outlined in Fig. 2, allowing up to three people to simultaneously test

PARTS LIST FOR THE DIGITAL FIRST-RESPONSE MONITOR

SEMICONDUCTORS
U1—4011 quad 2-input NAND gate, integrated circuit
D1, D2—1N914 general-purpose silicon diode
LED1, LED2—Light-emitting diode (any color)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1–R4—100,000-ohm
R5–R8—1000-ohm

ADDITIONAL PARTS AND MATERIALS
C1—0.1-µF, ceramic-disc capacitor
S1–S3—Normally open pushbutton switch
Perfboard materials, enclosure, 9-volt power source, wire, solder, hardware, etc.

PARTS LIST FOR THE EXPANDED DIGITAL FIRST-RESPONSE MONITOR

SEMICONDUCTORS
U1–U3—4011 quad 2-input NAND gate, integrated circuit
D1–D3—1N914 general-purpose silicon diode
LED1–LED3—Light-emitting diode (any color)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1–R6—100,000-ohm
R7–R9—1000-ohm
R10–R12—10,000-ohm

ADDITIONAL PARTS AND MATERIALS
S1–S4—Normally open pushbutton switch
Perfboard materials, enclosure, 9-volt power source, wire, solder, hardware, etc.

their reaction time. Like the last circuit, this one uses NAND gates, but requires nine of them (*i.e.*, three 4011 IC's). Six of the gates are used to form three set/reset flip-flop circuits (just like the ones in the last circuit).

Once the reset switch (S4) is momentarily closed, the outputs of U1-a and U1-c at pins 3 and 10, respectively, go high. The inputs of U3-a are connected to the outputs of U1-c and U2-a, which are both high. With both inputs of U3-a tied high, its output goes low. The inputs of U3-b and U3-c are also high and their outputs are low. The outputs of gates U3-a, U3-b, and U3-c are low, allowing any one of the input switches (S1, S2, or S3) to be the first to pass the low on to its flip-flop.

If S1 closes first, the U1-a/U1-b flip-flop changes states, lighting LED1 and applying a low to the inputs of U3-b and U3-c at pins 5 and 8 respectively. That causes outputs of U3-b and U3-c to go high. If switches S2 or S3 are closed nothing happens because the low necessary to toggle the two other flip-flops was removed when the outputs of U3-b and U3-c went high. The same holds true when either S2 or S3 closes first.

DIGITAL/ANALOG FIRST-RESPONSE MONITOR

Our final circuit (see Fig. 4) uses a mixture of gates and SCR's to form a less complicated, 3-competitor, first-response monitor. In this circuit, a 4081 quad 2-input AND gate, replaces the 4011 of the two previous circuit, and is used to control the logic between the SCR's.

Recall that when any input to an AND gate is low, its output will also be low; *i.e.*, both inputs must be high for an AND gate to have a high output. The SCR portion of the circuit in Fig. 4 is similar to the one in Fig. 1. After the circuit is reset (via S4), the three SCR's are cut off, and each AND-gate input is high, so the outputs of the AND gates are also high.

That high at the output of the three gates supplies the necessary gate current to turn on its respective SCR. If S1 closes first, the high output of U1-a is applied through R1 to the gate of SCR1, turning it on and causing LED1 to light. At the same time, the inputs to U1-b and U1-c (at pins 6 and 9, respectively), which are tied to the anode of SCR1, are pulled low. That causes their output to also be low, so neither SCR2 or SCR3 can be turned on.

The next time you're stuck with a project that looks impossible to complete, don't give up—simply try a different approach. Until we meet again, good luck with all of your circuits. ■

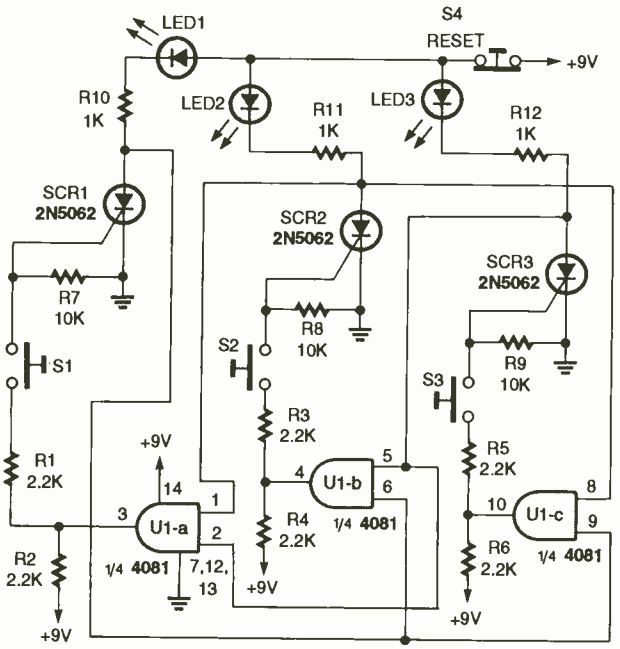


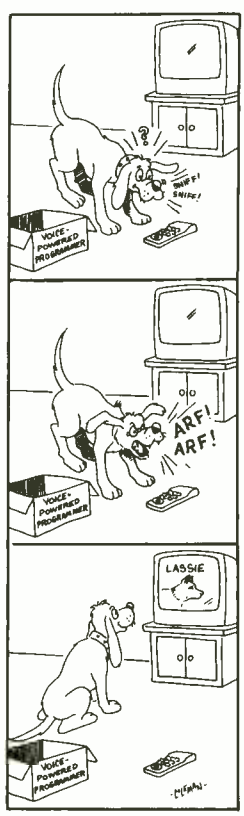
Fig. 4. This circuit, comprised of logic gates and SCR's, provides a less complicated, 3-competitor, first-response monitor.

PARTS LIST FOR THE DIGITAL/ANALOG FIRST-RESPONSE MONITOR

SEMICONDUCTORS
U1—4081 quad 2-input AND gate, integrated circuit
SCR1–SCR3—2N5062 sensitive-gate, silicon-controlled rectifier
LED1–LED3—Light-emitting diode (any color)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1–R6—2200-ohm
R7–R9—10,000-ohm
R10–R12—1000-ohm

ADDITIONAL PARTS AND MATERIALS
S1–S3—Normally open pushbutton switch
S4—Normally closed pushbutton switch
Perfboard materials, enclosure, 9-volt power source, wire, solder, hardware, etc.



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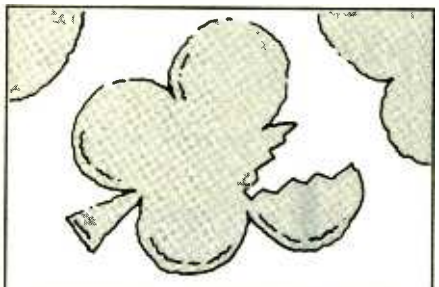

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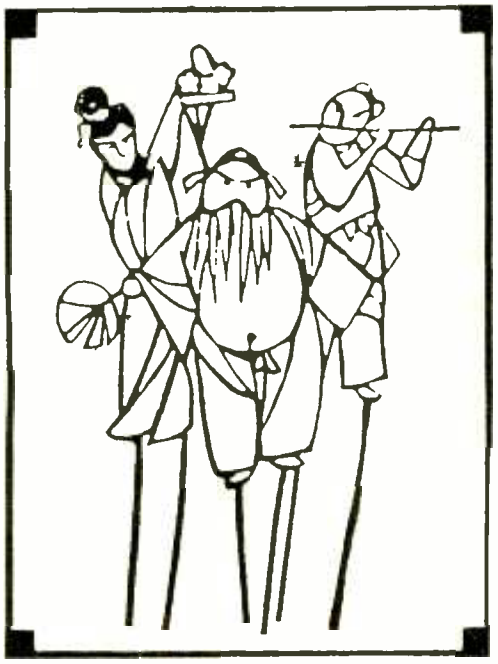
DX LISTENING

By Don Jensen

Maritime CW Disappearing

"Dash it! Dot's all for Morse," writes David Ross in his "Monitoring Services" column in a recent Ontario DX Association bulletin, *DX Ontario*. Morse code, maritime radio's original form of communication, is fast disappearing from the airwaves. For ship-to-shore communications, modern digital and satellite technology, marine telephone and teleprinter capability, and electronic-positioning equipment are pushing old-fashioned Morse radiotelegraphy



I ♥ VOICE OF FREE CHINA
我愛「自由中國之聲」

A bit of Oriental artwork from Taiwan's Voice of Free China.

The telegraphic code dates to the 1800's, when Samuel Morse invented wired communication. Marconi adopted it for his initial trans-Atlantic wireless experiments, and it has been with us ever since.

But times are changing! After nearly 90 years, last August the U.S. Coast Guard ended its around-the-clock CW monitoring of the 500-kHz, Morse-code distress frequency. Coast Guard radiomen had maintained a 24-hour-a-day watch on that longwave frequency since radio's infancy, answering thousands of SOS's and saving countless lives. In a nostalgic farewell, the Coast Guard station signed off, wishing shipboard operators best wishes and "fair winds and following seas."

Though gradually disappearing, maritime CW transmissions still can be found on shortwave, however. KLB, Marysville, WA, for instance, provides a Morse ship-to-shore SW link for vessels in the North Pacific and Bering Sea. But Craig Larsen, co-owner of KLB, is quoted in Ross' column as predicting that the day is not far off when there will be too few ships still using Morse code to warrant keeping the costal station operating. Then, like buggywhips and high-button shoes, maritime radiotelegraphy will disappear, a relic from the past.

If you have ham-radio experience, however, or remember Morse from your military or Boy Scout days, you can still log some of those coastal shortwave stations. Or, if your code skills are a bit rusty, you might try recording the repeated Morse "V" markers, or CQ's (usually followed by the letters "D-E," meaning, "from," and the station's call sign). Then you can play the tape back at half speed for easier deciphering.

Here are some coastal stations listed in Ross' column:

CFH—Halifax, Nova Scotia, 6,429 kHz

DAN—Norddeich, Germany, 17,143 kHz

FFL—St. Lys, France, 8,524 kHz

FUF—Fort de France, Martinique, 22,563 kHz

KFS—San Francisco, CA, 17,185 kHz

SVB—Athens, Greece, 16,965 kHz

VTG6—Bombay, India, 8,634 kHz

WCC—Chatham, MA, 6,375 kHz

WLO—Mobile, AL, 8,455 kHz

WNU—Slidell, LA, 8,687 kHz

Good luck! Get'em while you can.

ALL THE NEWS

Shortwave news is a "reality check," says *Passport To World Band Radio*, the respected shortwave-listening annual. "Radio news is news," says Passport (International Broadcasting Services, Box 300, Penn's Park, PA 18943). "Video news is entertainment."

If it bleeds, it leads the 11 o'clock news, according to the cynical complaint against television news broadcasts. Much is made of the human factor, and the emotional visual images. That's fine, as far as it goes, but for many, it doesn't go far enough. What are the real issues, the whys and wherefores behind the events? Where are the opposing views?

Shortwave-radio reporters aren't blessed with any special talents or standards,

Passport notes. It's just that the environment they work in leads to results that are different from what you get on TV. Some international broadcasters—London's BBC, for example—have deserved reputations for evenhanded news coverage.

Others may reflect a more partisan viewpoint, particularly when reporting events in which they have a national interest. But if one broadcaster slants certain news reports one way, there's sure to be another station on SW with a different viewpoint. That multiplicity of views gives SWL's a broad spectrum of information. For example, tuning in the 0100 UTC news from *Croatian Radio* (relayed by US shortwaver *WHRI* on 7,315 kHz) and the 0130 UTC news from *Radio Yugoslavia* (on 9,580 kHz) should give a more accurate picture of Balkan developments than listening just to one or the other.

Because so much news from so many perspectives goes out over shortwave, you can be your own editor, sifting and winnowing for the truth. Nowhere else, says Passport, can you hear so much news from so many different places.

Here's a sample listing of an evening's worth of English-language news broadcasts and some frequencies where you can find them.

0000 UTC (equivalent to 8 pm Eastern Daylight Time, 7 pm CDT, 6 pm MDT, or 5 pm PDT)—*BBC World Service*, 5,975, 6,175, 9,590, and 12,095 kHz; *World Service, Christian Science Monitor*, 5,580 and 13,670 kHz; *Radio Moscow World Service*, 12,050, 15,410, and 15,425 kHz.

0030 UTC—*Radio Nederland*, 6,020, 6,165, and 11,835 kHz; *Voice of the Islamic Republic of Iran* (Islamic news), 9,022 and 15,260 kHz.

0100 UTC—*Radio Canada International*, 6,120 and 9,755, kHz; *Radio Australia* (Asia and Pacific coverage), 15,240 and 17,795 kHz.

0130 UTC—*Voice of Greece*, 9,380, 9,420, or 11,645 kHz; *Radio Austria International* (Eastern European focus), 11,810, 13,610, and 15,105 kHz.

0200 UTC—*Voice of America*, 5,995, 7,405, 9,775, 11,580, and 15,120 kHz; *Voice of Free China* (Taiwan), 9,680 and 11,740 kHz; *Radio Havana Cuba*, 6,010, 9,655, and 13,660 kHz.

0250 UTC—*Vatican Radio* (Catholic issues) on 9,605 and 11,620 kHz.

0300 UTC—*Deutsche Welle* (Germany), 6,085, 6,145, 9,700, 11,810, 11,890, 13,610, 13,770, and 15,205 kHz.

0330 UTC—*United Arab Emirates Radio* (Dubai), 11,945, 13,675, 15,400, and 21,485 kHz.

0400 UTC—*Swiss Radio International*, 6,135, 9,885, 12,035, and 13,635 kHz; *Radio Prague* (Czech Republic), 7,345, 9,485, 11,990, and 13,715 kHz.

0430 UTC—*Radio Finland* (Nordic news), 11,755, 15,440 kHz.

IN THE MAIL

Your SW questions or observations are always welcome. Would you like to see your photo, at your shortwave listening post included in a future column? It starts with your letter. Write me, Don Jensen, c/o *DX Listening*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735.

This month we feature a note from Peter Salica of New York City, who says "The best thing about shortwave is the opportunity it offers to learn about the cultures of other people and places. I've found many great cultural programs on SW, but I'm always interested in learning more about the world. Any program suggestions, Don?"

How about "Folk Box," Peter? "Eclectic, exotic, informative, entertaining, original, enjoyable, a treasure chest of ethnic music," says Passport To World Band Radio, which rates hostess Kate Starkova's program as one of shortwave entertainment's ten best.

Try listening on Monday or Saturday evenings (UTC time would be Tuesdays or Sundays) at 2330 or 0130.

DOWN THE DIAL

Here are some stations to tune.

BULGARIA—11,720 kHz. *Radio Bulgaria* signs on here at 2000 UTC with English programs.

COSTA RICA—4,832 kHz. *Radio Reloj* (*reloj* means clock) is noted on this frequency with Spanish programming at around 0030 UTC with identification, time checks, and Latin ballads.

GERMANY—6,005 kHz. *RIAS*, Berlin, has been heard on this longtime frequency from around 2300 UTC with jazz and rock music, identification, and news in German.

MALTA—9,765 kHz. *Voice of the Mediterranean* has easy-listening music and English ID at around 0615 UTC. ■

*Credits: Brian Alexander, PA; Julianna Bickus, VA; Jim Clar, NY; William Davenport, TN; Marie Lamb, NY; Don Moore, IA; Maraina Pappas, SD; Ed Rausch, NJ; Robert Tucker, GA; North American SW Association, 45 Wildflower Road, Levittown, PA 19057; Ontario DX Association, P.O. Box 161, Station A, Willowdale, Ontario M2N 5S8, Canada).

By Joseph J. Carr, K4IPV

More Ham Miscellanea

This month we are going to discuss several topics of interest to hams. Normally, I like to limit a column to a single topic, with perhaps a few filler themes at the end. However, several times a year, I clean out the file of topics that don't generally warrant an entire column of their own. This is one of those times.

LICENSE RENEWAL

Late in 1993, I renewed my ham license (which I've held since 1959). You know the routine: fill out Form 610 and mail it to the FCC at Gettysburg, PA and wait, and wait, and wait, and wait. Well, they've gotten at least a little better. While some were telling me that ten weeks is the norm, I got mine in little over five weeks. The new license is a change from the old one.

My 1980's vintage renewal was the old impact-printed form that always faded, if it was at all legible when received. The new form is a laser-printed document that comes in two parts. One part is the familiar wallet size document, while the other is a 5 × 7 version that can be framed and hung on the wall. Be aware, by the way, that rule changes now make it permissible to just carry a photocopy in your wallet when operating other people's stations. That ought to preserve the document for the ten year term of the license.

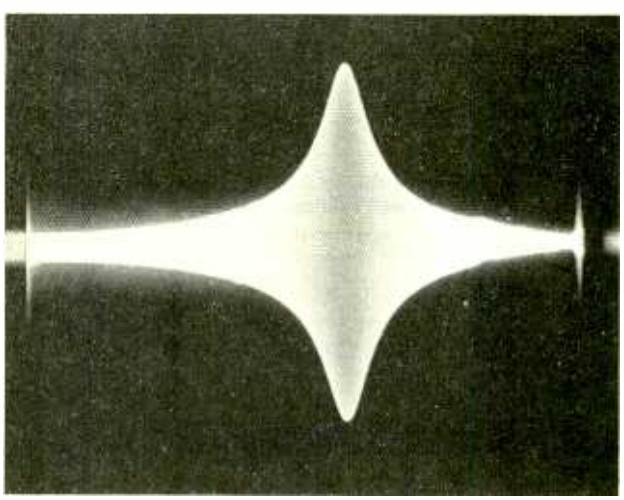


Fig. 1. Here is the output signal of the RSG-30 after passing through a 10.7-MHz IF-transformer-based tuned LC resonant circuit. Note the peaked response of the transformer.

RF SWEEP GENERATOR ANYONE?

A number of readers over the years have asked about RF sweep generators. Those signal generators use a sawtooth waveform to sweep through a range of RF frequencies. They are the best way to test bandpass or resonant circuits, but they are usually limited to professional laboratories and workshops because of the high cost. However, now you can buy the Boyd Electronics (1998 Southgate Way, Grants Pass, OR; Tel. 503-476-9583) Model RSG-30 sweep-generator kit, which covers 2 to 30 MHz in three modes. It is also available in ready-built form (contact Boyd Electronics directly for prices).

Figures 1 and 2 show the output signal from the RSG-30 under two conditions. In both cases, the signal was passed through a tuned LC-resonant circuit (I used a 10.7-MHz IF transformer for the test).

In Fig. 1, we see the raw RF with frequency along the horizontal axis, and amplitude along the vertical axis. Note that the peaked response of the transformer is clearly shown. Figure 2 shows the same signal detected by using a demodulator probe with the oscilloscope. Note that the shape is a little different because a different amplitude scale was needed to overcome losses in the probe.

The RSG-30 has three modes: CW, sweep, and video. The CW mode produces a single output frequency for each setting of the frequency control, as on any signal generator. The sweep mode sweeps over a range of frequencies as determined by the settings of the front-panel controls (that mode was used to make Fig. 1 and Fig. 2 photos). The video mode sweeps the entire range from 2 to 30 MHz, and can be used for testing video and other wideband circuits.

ANTENNA POLARIZATION

Last Fall I received several queries on antenna polarization. Some asked what the term meant, while others asked what effect it has. Let's take a crack at the topic.

A radio signal is a transverse electromagnetic wave that has both electric and magnetic fields that travel in the same direction, but at right angles to each other. By definition, antenna polarization is the direction of the electric field, and it is generally in the direction that is parallel to the antenna radiator (see Fig. 3). Therefore, a half-wavelength dipole that is horizontal to the Earth's sur-

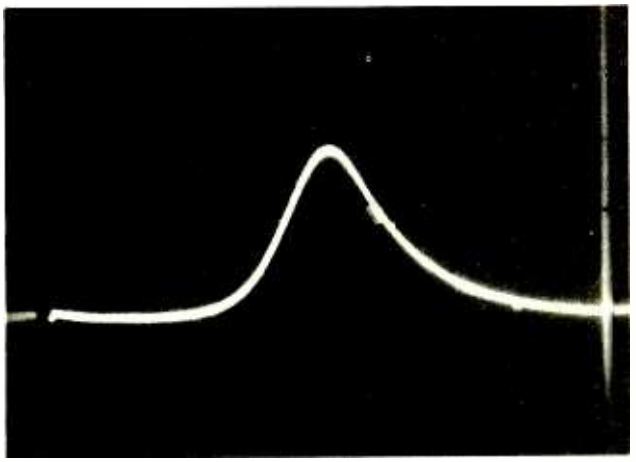


Fig. 2. Here is the same signal detected by using a demodulator probe with the oscilloscope. Note that the shape is a little different because a different amplitude scale was needed to overcome losses in the probe.

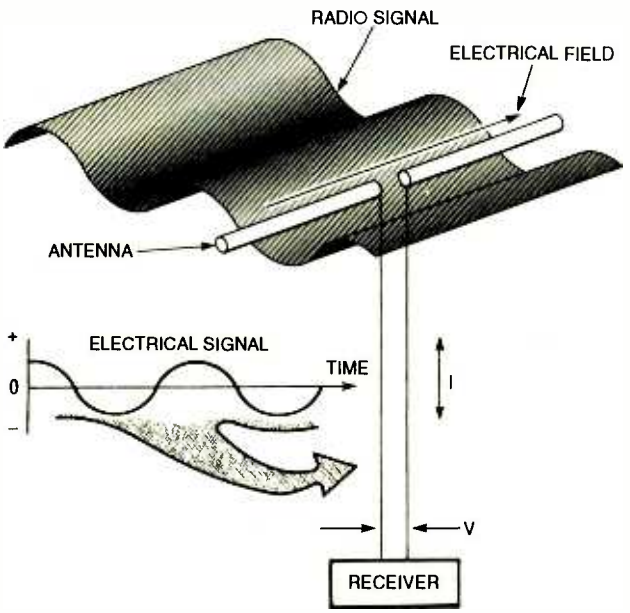


Fig. 3. Antenna polarization refers to the direction of the electric field—generally a direction that is parallel to the antenna radiator. The relationship between the antenna's radiator direction and the polarization of the radiated signal is shown here.

face produces a horizontally-polarized signal because of the direction of the electric field. A vertical antenna, for the same reason, produces a vertically-polarized signal.

Now, what difference does it make? There is a distinct polarity advantage (some sources say −3dB) to use an antenna on the receiving end that is of the same polarity as the incoming RF signal. On the HF bands, however, it makes little real difference most of the time. Polarity changes occur in the ionosphere and are also caused by reflection from the Earth's surface. So whatever the transmitting-antenna polarity, the polarity of the actual received signal will be determined in part by what happens to the signal on its way to you. As you tune across the HF-ham and SWL bands, you will encounter a wide variety of polarizations from signal-to-signal, so in the end it's a wash.

On VHF/UHF and microwave signals, however, the polarity differences can be more noticeable, especially when looking for weak signals (after all, −3dB looms much larger to a 2-meter DX'er or a moon bouncer than to a local rag chewer). On those bands, direct, non-reflected, communications are much more common, so the received signal is generally of the same polarity as the transmitted signal.

Two other polarizations are also seen. A circular polarized signal sweeps through the vertical and horizontal polarizations. Antennas such as the helical spiral radiate circularly polarized signals. It is common to find circular polarization on some microwave systems because a circularly polarized signal penetrates weather better (there is severe microwave attenuation due to moisture at some frequencies).

The other form of polarization seen in VHF-and-up systems on occasion is the cross-polarization. In those systems, both horizontally- and vertically-polarized antenna elements are used at the same time. Some experts tell us that there is little practical difference between the circular and cross polarized versions.

LOW-PASS FILTERS

Recently I received a letter from a chap who objects to using a low-pass filter in his transmission line on grounds that it: 1) interferes with his antenna tuning unit, and 2) causes signal loss. A low-pass filter is a device used to allow HF signals to pass from the transmitter to the antenna, but attenuates the frequencies above about 30 MHz.

There are several reasons for using a low-pass filter, even when an antenna-tuning unit is being used. Those frequencies above 30 MHz are the harmonics of your transmitter. They interfere with other services, such as television reception, and are illegal to emit. In other words, all transmitter operators have a legal responsibility to prevent harmonics from hurting other people's use of the air waves.

If the low-pass filter is interfering with the operation of the antenna-tuning unit (ATU), then you have placed it in the wrong spot. The low-pass filter goes between the transmitter output and the input of the ATU, and is not supposed to be between the output of the ATU and the antenna feedline. I suspect that's the reason for the problem experienced by the reader.

But we still have the question of why a low-pass filter is needed when an ATU is present. The answer is really simple: If the ATU is a resonant tuned-bandpass filter, then the low-pass filter is only extra insurance against harmonics. If the ATU does a good enough job, then it may be sufficient. But most coax-to-coax ATU's are not bandpass filters. In fact, unless there is a variable capacitor in parallel with the inductor in the ATU, the circuit may well be a form of high-pass filter . . . which makes things worse! So use the low-pass filter between the transmitter and the ATU, unless either the transmitter manufacturer or ATU manufacturer specifically advises against it.

That's all for now. If you have any ham-related questions, please contact me at PO Box 1099, Falls Church, VA 22041. ■

SCANNER SCENE

By Marc Saxon

The Phantom of the Airwaves

Who said a good scanner must be expensive? Unless you require a unit with all the bells and whistles, plus the 800-MHz band, you'd do well to look at the *Realistic PRO-2028*.

The PRO-2028 is a 50-channel desktop unit with 10 five-channel memory banks for temporary storage of new frequencies discovered while in the scan/search mode. The scanner covers the 29–54-, 137–174-, and 406–512-MHz frequencies, plus the 108–137-MHz VHF aeronautics band. In addition, there is one-button access to scan all of the 162-MHz NOAA weather channels. It scans at a rate of 14 channels per second.

The Realistic PRO-2028 offers a lot of scanning features at a very affordable price.

This unit has IF frequencies at 10.85 MHz and 450 MHz. The sensitivity, 20 dB S/N ±3 kHz, is 0.5 μV below 54 MHz, 0.7 μV from 137 to 174 MHz, and 1.0 μV in the UHF bands. In the VHF aeronautics band, with 20 dB S/N at 60% modulation, it is 2.0 μV.

Other standard PRO-2028 features include three-day memory retention during a power loss, channel lockouts, priority channel, selectable two-second delay, and monitor memories that allow up to five channels located during a frequency search to be saved.

As you can see, there's a lot to this piece of equipment, and at just $159.99. The Realistic PRO-2028 can be seen at any of Radio Shack's 7000 local stores.

THE PHANTOM

Air-traffic controllers at the Roanoke Regional Airport in Virginia were alarmed recently when they were monitoring 118.3 MHz. A phantom voice on the airport's control-tower frequency was giving pilots last-minute instructions to break off their landings or change altitudes. Sometimes he would tell them to shift to other frequencies. Those bogus instructions created considerable confusion and a dangerous safety hazard. The phantom even cried "Mayday" a couple of times, just to make things worse. There were also some episodes of obscene language as he argued with air-traffic controllers who were trying to get him off the air.

It was determined that the culprit was operating with a handheld transceiver from a vehicle. A two-month investigation by federal authorities lead to an arrest by the FBI of Eugene Bocook, a 28-year-old unemployed janitor. His defense lawyer requested that Bocook receive a psychiatric evaluation.

If found guilty, Bocook could end up behind bars for 22 years.

SKIPPING AROUND

Daniel Walker, of Clarendon, Newfoundland, Canada, was inspired by the mention here of trying to listen for distant stations operating in the 30–50-MHz band. At times, ionospheric conditions allow those signals to hopscotch hundreds, or even thousands, of miles.

Using his Realistic PRO-2027 and an outside-mounted antenna, David reports that he has heard several distant stations. One was an ambulance service on Long Island, in New York, monitored on a 33-MHz channel. That station was 1500 miles from David's location! Not surprisingly, he wrote to recommend this aspect of the hobby to others.

TWO COMMONLY ASKED QUESTIONS

One reader posed two questions that are asked quite often. Harold Ifill (Millwood, NY) wrote that his Realistic PRO-38 scanner will accept programming

only to three frequencies past the decimal point. Yet, in our November 1993 column we gave center frequencies (such as for the San Diego Stadium) that extended to four places beyond the decimal point. He wants to know what he must do in order to receive such frequencies.

Many scanners, especially handhelds, cannot be programmed out to four places past the decimal point below the UHF bands. That isn't anything to be concerned about. If you attempt to program in 164.2125 MHz, for instance, the scanner will round off the frequency and display either 165.21 or 165.215 MHz. No matter. Your scanner will still easily receive all transmissions within monitoring range on 165.2125 MHz, and without any loss in strength or quality. That is because your scanner will be tuned only 2.5-kHz away from the center of the signal, and that isn't sufficient to cause a problem when monitoring FM communications.

Harold's second question concerns finding out which specific cellular-telephone channels are assigned for use in certain communities, inasmuch as there are more than 800 different channel pairs available for use. This question assumes that cellular frequencies are doled out a few at a time to specific licensees, such as the police and fire services.

There are two competing cellular licensees permitted to exist in each service area. One is categorized by the FCC as the "wireline" carrier, and the other is called the "non-wireline" carrier. Usually, this means that the wireline carrier is also the local telephone company.

There are separate blocs of channels available for use by each category of carrier. Certain channels are reserved for non-voice control-data purposes. However, each licensee may utilize all of the channels authorized within the bloc available to its category. In smaller systems, all available channels might not have been put into service.

On a national level, non-wireline services can have voice communications between 869.04 and 879.36 MHz and 890.01 to 891.48 MHz. Wireline services have the following voice channels available: 880.65 to 889.98 MHz, and 891.51 to 893.97 MHz. In all cases, channels are separated by 30 MHz. The frequencies between 879.39 and 880.62 MHz are used only for the control tones required to operate the system.

READERS SPEAK

Don DeLisi, of Coram, New York, tells us that he monitors the Suffolk County Police 6th Precinct on 155.58 MHz. They leave him behind when they say they're going to channels 8, 10, or B.

Channels 8 and B are identical, a car-to-car simplex on 156.03 MHz. This is a short-range frequency since no repeater is used. Channel 10 is 155.655 MHz, which is the detective frequency.

From Trenton, New Jersey, Mike Randall tells us that the Great Adventure Amusement Park uses 464.425 MHz.

Let us know what *you* are up to, what you're hearing, and if you have any questions, comments or ideas that you want to share. Write to *Scanner Scene*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

THINK THANK

(Continued from page 28)

the load with. Of course, that can be overcome by using another relay in place of the load to properly apply power to the real load, as Skip suggests.

TUNER SUBSTITUTE

Commercial tuner substitutes are hard to come by and expensive, too. However, the home-made one in Fig. 7 is not time consuming, or expensive to build. The circuit consists of few parts and a discarded tuner you may have available.

It is powered by 12-volts via J1 and receives signals via the antenna input. When 12 volts DC is applied to the circuit, capacitor C1 filters out any ripple and the voltage is applied to both the positive tuner terminal and U1, a 5-volt regulator IC. The 5-volt output is applied to R1, a salvaged volume control used here to adjust the AGC voltage. The voltage from R1 is regulated by Zener diode D1 and filtered by C2. Resistor R2 acts as a voltage-dropping resistor for the AGC terminal. On the IF terminal, I attached some coax terminated with a probe. To make it look more commercial, I installed mine in a small plastic case with the AGC control mounted on the unit's front panel.

To use the setup, unplug your TV's IF terminal and apply your probe to the IF connector and the unit's ground lead to the ground of the TV. Then connect the TV antenna to the tuner's antenna leads. Adjust the AGC for a good picture. Make sure you use an isolation transformer for your TV test.

—Joseph Anie, Tema-Ghana, West Africa

I actually built something like that awhile ago. It's a great instrument to have around if you enjoy fiddling with video circuits because it reduces all signals to the IF frequency, which is much lower than transmission frequencies (and therefore easier to work with). I'm glad to pass the circuit on.

Well, that about does it. If you'd like to get in on the fun, please send your circuit ideas and suggestions to me here at Think Tank, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

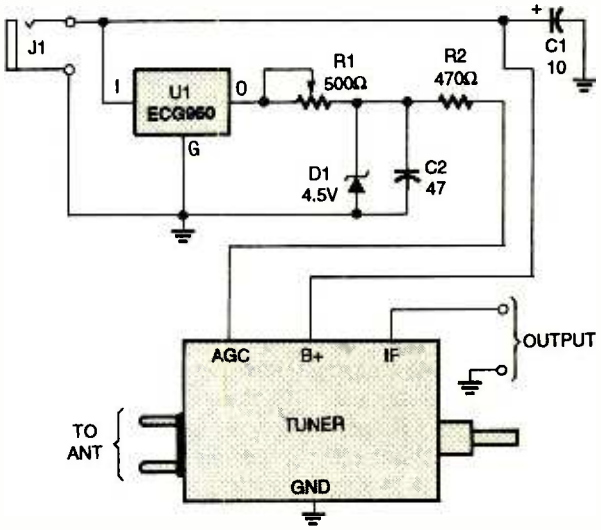


Fig. 7. Need a TV front end for your test bench? Try building this power supply and using a tuner section from an old TV.

MULTIMEDIA WATCH

(Continued from page 6)

guide to over 9000 special-interest videos. This $49.95 guide is a must for people who can't find what they want at Blockbuster.

I may never have to go to the library again thanks to four discs sent to me from World Library, Inc. One, *The Library Of The Future*, combines extensive search capabilities and the complete text from over 2000 novels, essays, poems, short stories, and plays on a single $299 disc. Think of a book, and the chances are that it's on this disc. After watching Bram Stoker's Dracula on HBO, I have to go no farther than my PC to read the book! *Great Poetry Classics* contains a similarly sized collection of poetry on one $49.95 disc—any poem I can think of is on it. *Great Mystery Classics* contains 171 unabridged stories of murder, mystery, and magic for $49.95. *The Shakespeare Study Guide* is a $24.95 disc that includes all of Shakespeare's plays and poems as well as Barron's Book Notes on the most popular plays. These four discs save me a lot of space—I don't think I could keep all these books at home otherwise.

Aris Entertainment has lots of discs containing various photographic images. Their new $39.95 *Tropical Rainforest* disc contains 100 photos of life in the rain forest, and 100 audio clips and 25 live-action videos. Aris also sent me their new *MPC Wizard 2.0* disc. This $14.95 test and tune-up disc contains over 100 megabytes of Windows 3.1 video and sound drivers and an extensive collection of multimedia clips. This inexpensive disc can tell you if your system meets MPC-2 specs, and is well worth the investment. Also from Aris is an unusual game called *Video Cube*. The game requires that you solve a Rubik's Cube-like picture puzzle to unlock a video show. Over 100 videos and sound effects combine to make an entertaining game. It comes in an even more unusual box. It is also like a Rubik's Cube in that you can keep unfolding it to display new outside images—almost as puzzling as the game.

InfoBusiness puts out a series of discs containing tons of government information that your tax dollars are used to create. Their *Government Giveaways for Entrepreneurs* disc helps you get money from the government for your business. Contact InfoBusiness to see if they have a disc containing the government information that you need.

Last but not least, the Guinness Book of Records is now available as the *Guinness Multimedia Disc of Records*, and it's published by Grolier Electronic Publishing, Inc. The disc contains every word from the book, and also contains video clips, photos, audio, and sound effects, not to mention data-retrieval and search capabilities. Clearly this is more than just a book.

NEXT MONTH

Next month we'll be taking a good look at desktop video. Until then, may your media be multiple. ■

PRODUCT TEST REPORT

(Continued from page 24)

Contents (TOC), press the "record" button (this places the system in the record/pause mode) and then press the "play" button. If your source is a digital signal, you need not worry about level-control settings. In fact, with a digital input, the record-level control is inoperative.

We should point out that like other consumer digital-recording components such as DAT recorders, the MiniDisc system uses the Serial Copy Management System (SCMS). That means that while you can make digital copies of CD's as many times as you like using the original CD as your source, you cannot make copies of the copies (*e.g.* from the digital output of this home MD recorder to a portable MD recorder).

Learning to add titles to some of the experimental recordings we made took a bit of effort, but the procedure is clearly outlined, in a step-by-step format, in the owner's manual. The same holds true for all those editing functions mentioned earlier, and for setting the correct time and date so that recordings you make yourself can be "date stamped" if you wish.

As for listening tests, we conducted two types. First we transcribed one of our favorite CD's to a blank MiniDisc. We then compared the sound of the original CD with that of the MiniDisc, after carefully adjusting the playback level of each. Sony does not claim that the MiniDisc's sound quality is equal to that of the CD. Still, it was almost impossible for us to detect any significant difference in sound quality between the two media.

Our second listening test involved playback of commercially available prerecorded MiniDiscs. At the moment, we own only two of them. One is a Sony sampler, featuring many Sony Music recording artists. The other is a full MiniDisc of vocalist Mariah Carey featuring seven of her hit songs. Since we own the CD version of this recording as well, it was again possible to compare the CD version with the MD version. Here, we did detect some minor differences in tonal color and balance, but we strongly suspect that the differences had to do with the fact that the recording engineers did a re-mix for the MD version. In any case, both versions were very pleasing to listen to and were totally free of any audible noise or distortion.

When you consider the fact that the ATRAC data-reduction system actually discards some four-fifths of the data that would normally be recorded on a CD, it is truly remarkable that MiniDiscs sound as good as they do. Sony has stated time and again that MiniDiscs are not intended as a replacement for CD's. Rather, they are intended as a portable format ideal for "Walkman"-type portable players, car-audio systems, and the like. As such, the quality of MD sound is far and away better than that of even the most carefully produced top-quality analog-tape cassettes.

The price of the home MDS-101 is rather high, at $1000, but all of us remember that early CD players (which, of course, had no recording capability) cost that much and more.

For more information on the Sony MD-101 and other MiniDisc products, contact Sony (Sony Drive, Park Ridge, NJ 07656) directly, or circle No. 120 on the Free Information Card. ■

ANTIQUE RADIO

(Continued from page 75)

slightly heavier gauge ought to compensate for the slightly thinner insulation—resulting in a coil having the proper (2½-inch) length when close-wound.

And, so far as I can tell, that seems to be true. My tests show that 8 turns of the No. 22 magnet wire occupy ¼ inch when close-wound. Doing some simple math, I find that the required 76 turns should measure out at almost 2.4 inches. Close enough, I'd say!

Since I have a bit of room to spare in the column this month (very unusual for me to be in such a position), let me suggest some sources for the parts you may want to purchase if you follow through with this project. Radio Shack stocks No. 22 magnet wire. But you'll have to buy a $5.00 assortment pack to get the size you want and the 40-foot length provided is not sufficient. You can splice at a coil tap when winding the coil, but you'd have to purchase at least two kits.

Both Antique Electronic Supply (6221 S. Maple Ave., Tempe Arizona) and Antique Audio (5555 N. Lamar, H-105, Austin, TX 78751) stock a 21-gauge magnet wire in rolls of adequate (100-foot) length. Both companies can also supply galena crystals, crystal stands, binding posts, headsets, and other items you may need to complete this project.

That's it for now! We'll continue working on the NBS set next month. Until then, write to me at *Antique Radio*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. Remember, we welcome your suggestions, and comments related to our hobby. ■

(Continued from page 46)

printed page. It's the industry-standard language for advanced graphics and publishing. The PDL is a set of codes within the printer that dictate character size, font style, line spacing, and other properties. The PDL is used to tell the printer how to position, manipulate, and print both characters and graphics.

PostScript and other PDL's contain only font outlines. Outline fonts describe characters with a series of mathematical equations. The equations describe the arrangement of selected points on each character's outline relative to each other and to a specific imaginary point. The various point sizes, stroke weights, and stroke angles needed by a given font are created as needed by a microprocessor in the printer that mathematically manipulates the outline as required.

A big plus for PostScript is that it's device and resolution independent: the same printer commands used to get output from an inexpensive laser printer will also produce the highest-resolution output from a phototypesetter. Thus, PostScript lets you make proofs on your PC and send the same file to a production house for publication-quality masters. By contrast, PCL is device-dependent, working specifically with lasers. Fortunately, practically all PostScript printers also offer HP emulation.

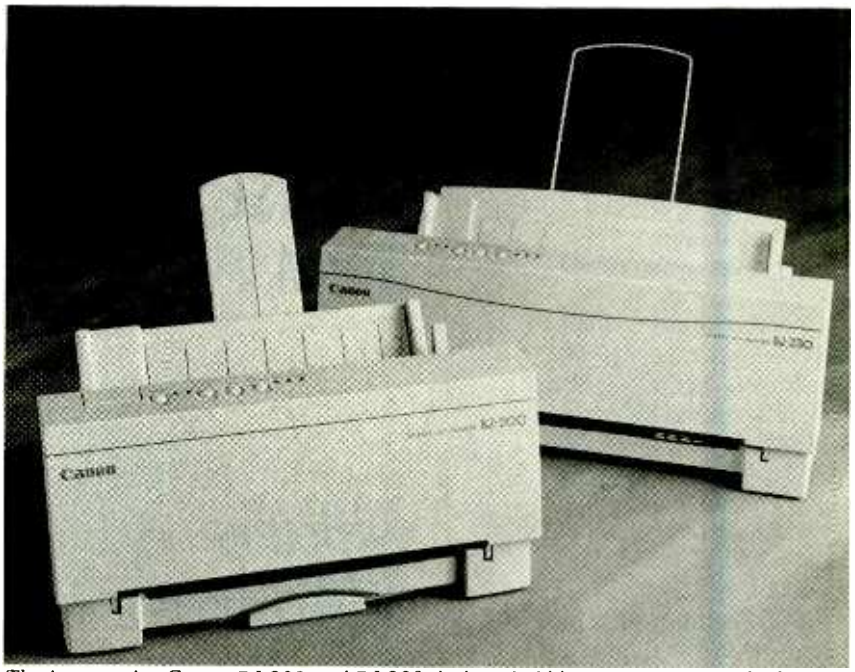
Today, there are two PostScript versions: the original PostScript, and PostScript Level 2. The new version includes standard and special color functions, composite-font extensions, and it supports Adobe's Multiple Master Fonts. It also promises higher speed through improvements in file and memory handling and data management. Level 2 PostScript is backward compatible.

Fonts for Everyone. Most printers come with fonts that are built into the printer's firmware. It's common to see 14, 28, or even 44 internal fonts as standard even with low-cost laser printers. The majority of those fonts are actually made up of just two different typefaces, such as Courier and LinePrinter. Why? Unlike scaleable fonts, each different weight and style of a bitmapped typeface—normal, bold, and italic, for example—counts as a separate font. When those variations appear in several point sizes, each size counts as a font. You also may get portrait and landscape versions of the typefaces. So a single typeface can count as dozens of fonts!

The classic way to add extra bitmapped fonts is with a cartridge. If cartridges seem clumsy, you can use downloadable HP-compatible "soft fonts" with practically any laser printer. These soft fonts are kept on your hard disk and are sent (downloaded) to the printer each time you use them. Still, regardless of how they're implemented, all bitmapped fonts have significant drawbacks. You can't resize them without severe distortion, and you can't transfer them to higher-resolution output devices.

Windows comes with several different built-in fonts. They are known as TrueType fonts. In most cases the fonts appear on-screen just as they will appear in your printed document. If your printer has internal fonts for which Windows doesn't have exact screen fonts, there's no big problem: Windows substitutes a font on-screen that's similar to the printer font. In that case, what you see may not be exactly what you get from the printer.

Best of all, TrueType fonts are scaleable and device independent. You can make the fonts very small or very large while retaining their distinctive shapes, and Windows lets the same fonts work anywhere. Thus, you can work with a variety of printers, including dot-matrix types—not just lasers. On dot-matrix printers, scaleable TrueType fonts are printed as bit-mapped graphics. Their quality is high, even on older nine-pin printers.



The inexpensive Canon BJ-200 and BJ-230 desktop bubble jet printers offer high quality, 360-DPI resolution at about 4 PPM. The BJ-200 (at $399 list) is for letter and legal-size documents, while the BJ-230 (at $549) can also use 11 × 17-inch stock. Both printers can print on practically all types of paper as well as transparencies, labels, and envelopes.

What Printer's Best for You? Each of the major printing technologies (impact, laser, and inkjet) has advantages and disadvantages. To proclaim that one printing technology is better than another is unrealistic.

Further, the differences between the print technologies are blurring. For example, the speeds available with the different technologies are merging. Resolution, too, no longer cleanly divides printers: even inexpensive dot-matrix printers can produce output suitable for correspondence and general-purpose use. Take time to consider all aspects of a given printer technology before you decide on the type of printer to buy, and be sure to become familiar with the features of the most recent models. ■

NIGHTVISION SCOPES

(Continued from page 36)

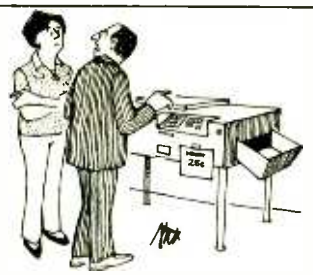
the appropriate matching connectors.

There is nothing critical about the IR illuminator circuit; therefore, it can be assembled using any method that you are comfortable with. However, a printed-circuit template is shown in Fig. 7 for those who prefer that type of construction. A parts-placement diagram for that printed-circuit layout is shown in Fig. 8. The 8 LED's are mounted in two rows across one end of a third Radio Shack deluxe plastic project case (part 270-221). The IR output control, R4, is mounted on the opposite end of the case, while S1 is mounted on the side of the case.

Actually, you could build the circuit in an old flashlight case, or in any other enclosure that you might happen to have on hand. A 4-foot length of 2-conductor speaker wire, terminated in an appropriate connector, can be used to supply power to the circuit.

Seeing in the Dark. Once the assembly is complete, the first thing that must be done is to check out the camera and monitor—that must be done in daylight. Begin by switching the monitor's power on. Then connect the NightVision View Scope to the 12-volt DC source and turn S1 on. The monitor's screen should light. Aim the camera at some close object and adjust the monitor's brightness control for the best quality picture.

Take the View Scope into a dark room (a closet will do) and flip S2 to HIGH. Objects within a foot or two should be easily visible on the monitor. Turn on your IR-light source; the viewing range should increase to over 10 feet. The actual viewing range is limited only by the available IR light. ■



"It makes a kind of laughing noise when I try to copy my tax return."

SOLID-STATE COOLER

(Continued from page 39)

heat sink. Position the heat sink on the side of the cooler and install a wood screw in each hole in the heat sink into the side of the cooler. Be sure to use screws that won't reach through to the inside of the cooler.

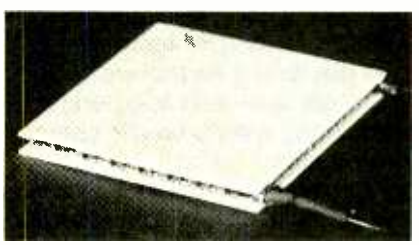
Remove the heat sink and cut a square hole, slightly larger than the module, in the center of where the heat sink goes. You might also have to gouge out grooves for the Peltier module's leads depending on the final clearance between the heat sink and the side of the cooler. Use a Dremel tool, jigsaw, or carpet knife to cut the cooler wall. The plastic is soft and easy to cut, but be careful not to cut yourself.

Test the module with a single D cell (red wire to +, black to −) while holding it between your fingers; one side will quickly get hot and the other cold. Mark the hot side with a red dot from a felt-tip pen or with a pencil. Also find four long screws and nuts that will reach through both heat sinks, the spacers, the module, the sleeve, and the cooler wall.

Mark the perimeter of the module on the center of both the heat sink and the cold sink. Position the cold sink centered on top of the heat sink and drill a hole about ¼-inch away from each corner of module's outline through both sinks. Also cut away any cooling fins that will interfere with the screws and de-burr any holes you drill. Reposition the heat sink on the outside of the cooler and use it as a drill guide to make matching holes through the cooler wall.

Make a sleeve for the inside of the cooler out of aluminum sheet metal. Size it so that it leaves about a ¼-inch gap between it and the cooler walls. Rest the sleeve inside the cooler on top of a ¼-inch spacer and drill through the holes in the cooler wall through the sleeve. At this point everything should be completely drilled and ready for final assembly. Test fit all of the parts together, but without the module or spacers, to make sure the holes line up and that the screws all fit in place.

Spread a thin layer of thermal grease over each heat sink and spacer surface that will press against another surface. With the sleeve in place on the foam blocks, pass the four screws through the cold sink and press a spacer onto it centered between the screws. Pass the screws through the sleeve and through the wall of the cooler. Next press the outside spacers on the outside of the sleeve in the hole in the side of the cooler. (Use as few spacers as possible so that when the module is in place, its outer surface is slightly higher than the outside wall of the cooler.) With the module's hot side facing outside the cooler, press it onto the spacers. Then slide the outside heat sink onto the screws and tighten up the whole assembly with nuts. Make sure the Peltier leads are accessible before tightening. Tighten the nuts only enough so that the whole assembly feels firm, and as one, without over tightening. Also install the four small wood screws that hold the heat sink firmly to the cooler.



The Melcor CP 1.4-127-045L Thermoelectric Heat Pump Module used in the Solid-State Cooler has a maximum ΔT of 67 degrees Celsius.

Mount the fan so that it blows at the heat sink. We used a piece of chicken wire bent to fit around the fan as both a fan shroud and to physically hold the fan in place. Four small wood screws and washers secure the chicken wire to the cooler. Twist the positive leads from the module and the fan together, and do the same for the negative leads. If you definitely want to add the filter capacitors, do so now. Attach a length of line cord to the leads, and mark the positive lead of the line cord. Then insulate all bare wiring and leads with heat-shrink tubing or electrical tape. Attach a cigarette lighter plug to the end of the line cord. The center conductor of the plug is positive.

You can now test out the cooler using either a lab-grade power supply or by plugging it into your cigarette lighter. If all went well, all you have to do now is chill out! ■

TECHNICIAN'S DAY

(Continued from page 42)

and Measurements, and Troubleshooting. That exam is frequently more challenging to the technician than the specialty exams since it requires a broad scope of electronic knowledge plus the ability to analyze troubleshooting problems. Of the technicians who take this exam, approximately one-third pass on their first attempt.

Individual Journeyman exams cover a number of electronic specialties:

- Audio—The exam consists of both digital and analog sections. Other technologies include amplifiers and sound quality, system set-up, speaker installation, servicing audio products, and troubleshooting audio systems.
- Communications—The exam begins with basic communications circuits and transmission systems, followed by AM and FM transmitters and their adjustment. Also covered are receiver adjustment, servicing, and troubleshooting systems used in communications.
- Computer—A knowledge of binary math, logic gates, and digital electronics is necessary to take this exam. Also covered are computer and LAN (Local Area Network) organization, input and output equipment, memory, elementary programming, and troubleshooting computer systems.
- Consumer—Beginning with digital electronics and linear or analog electronics, this exam then has specific questions about servicing televisions and VCR's. Questions are asked about troubleshooting those products and the use of test equipment.
- Industrial—This exam covers all aspects of industrial electronics, including transducers, sensors, switches, power factor, differential amplifiers, basic logic circuits, and functions. Questions are asked about analog and digital/microprocessor circuits and systems, and DC and AC power supplies. Finally, there is section on troubleshooting and circuit analysis of those systems.
- Medical—Technicians who take this exam need to know about electrical safety and accuracy of calibration for electronic biomedical instruments. The technician must be familiar with the basic concepts and vocabulary of instrumentation, telemetry, measurements, and differential-and operational-amplifier applications.
- Radar—General knowledge of both pulse-radar and continuous-wave-radar operation is necessary for taking this Journeyman option. The test covers transmitters and receivers, CRT display systems and their power supplies, antennas, and transmission lines and their characteristics.
- Video—The technician needs to know NTSC standards, video basics, test signals, and the operations of both the electronic and mechanical systems in video cassette recorders. Also covered are 8mm video, camcorders, cameras, and monitors, and the microprocessors used in video operations.

The CAT Exam. CAT testing is just one year old. "It opens a whole new area of trained and certified technicians," says Steckler. "Have you looked at any modern appliances lately?" he continues, "Be it a microwave oven, washing machine, stove, lawn-sprinkler timer, or whatever; it's bound to have electronics inside. The technicians who service this equipment have had to learn about those electronic circuits, in addition to the electrical and mechanical repairs and replacements they have always made."

The new Certified Appliance Technician exam is independent of the CET Associate or Journeyman certifications. However, the experience requirement is the same four years as for the Journeyman CET option—and the successful CAT receives a permanent wall certificate. The exam consists of 100 multiple-choice questions covering electrical circuits and components, refrigeration systems, laundry equipment, cooking equipment, and dishwashers and trash compactors. CAT's are eligible to join ISCET.

Exam Fees. The fee for the CET exam is $25. This includes both the Associate exam and any one Journeyman option. For technicians who take the Journeyman option separately from the Associate exam, each exam costs $25. Each additional Journeyman option is $25. The 100-question CAT exam is also $25. Should the technician fail any of these exams, the first retake is free, after a 60-day waiting period.

Fees for the FCC exams vary. The minimum fee for any examination session is $25. Element 1 is $25. Element 3 is $30. If the two examinations are taken at one session for a General Radiotelephone Operators License, the fee for the examination session is $35.

There are other combinations of elements and fees for the exams that are not yet available. A complete list of exam fees is available from the ISCET office, at the address listed below. There are no free retakes of the FCC exams.

Preparing to Take One of the Exams. The best way to prepare for any of these exams is to study, and ISCET has excellent and inexpensive study material for each exam. If you are just beginning, the Study Guide for the Associate CET Test is an excellent review for this first test. The 96-page booklet sells for $10. Practice tests are available for most of the Journeyman options. There are also excellent study books for each of the options.

FCC exams are selected from a published question pool. ISCET has copies of the Element 1 and Element 3 question pools for $10 plus $2 shipping, or there are self-test software packages available. Going into any examination session well prepared is often the difference between passing and failing.

If after reading this article, you're interested in taking the CET, CAT, or any of the FCC exams, contact any one of ISCET's volunteer test administrators listed elsewhere in this article for details. Again, the exams are scheduled to be given during the week of April 2 through April 9, 1994. For any additional information or an order form listing all materials, contact ISCET directly at 2708 West Berry St., Fort Worth, TX 76109; Tel. 817-921-9101, FAX 817-921-3741. ■

ELECTRONIC PAINT SHAKER

(Continued from page 70)

ple, though not quite as simple as under DOS. Versions for Macintosh, SunOS, Amiga, Cray, and TI-99/4A will

This Windows version of the control program will be on the market soon. Its resource requirements (a Pentium with 8 gigglebytes of memory, running two concurrent sessions of Windows NT, and a side order of fries) are a tad stiff though.

LISTING 1

```
; MS-DOS assembly code for electronic paint shaker.
; Link to make SHAKE.EXE.
;
STAC    SEGMENT STACK
        DB  64 DUP('STACK...')
STAC    ENDS
;
CODE    SEGMENT PUBLIC
        ASSUME CS:CODE,DS:CODE,SS:STAC
MAIN    PROC FAR
        PUSH DS
        SUB  AX,AX
        PUSH AX         ; set up for return to DOS
        MOV CX,66       ; for cx:=66 down to 0
FF:     MOV AH,05H
        MOV DL,0CH
        INT 21H         ; form feed
        LOOP FF         ; next cx
        RET             ; return to DOS
MAIN    ENDP
CODE    ENDS
        END  MAIN
```

further output to the printer, it will be printed as soon as the paint finishes shaking (which is not a good idea if paper isn't installed in the printer).

A Windows version of the program is being developed by the author. The user interface (see the photo) is simple, though not quite as simple as under DOS. Versions for Macintosh, SunOS, Amiga, Cray, and TI-99/4A will be developed if there is sufficient interest.

The assistance of Cathy Covington (age 8) is gratefully acknowledged. The author does not know if he is creative enough to have done this all by himself in time for April 1. ■

SERIAL ADC

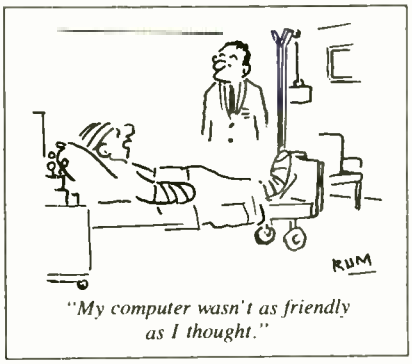
(Continued from page 54)

gram. For example, simple data handling (*e.g.*, to calculate and display the pulse rate, log data, plot on a printer, etc.) could be done in real time if the computer speed is fast enough. More complicated data analysis, (*e.g.*, digital filtering) could also be done in real time, but the required program would probably have to be written in assembly language to maximize its execution speed.

Circuit Alternatives. While the circuit is certainly very useful as is, much can be done to improve its performance. Here are some ideas for enhancing the circuit:

- The baud-rate generator can be replaced by a crystal-controlled type for greater stability.
- The 74165 and 7474 can be replaced by CMOS IC's (74C- series) for lower power consumption. That's especially worthwhile if the circuit will be powered by a battery supply.
- The baud-rate clock frequency can be increased to 19,200 baud by changing C4 to 470 pF. The sampling rate can then also be doubled (to approximately 1400 samples/sec) by changing C1 to 680 pF.

Conclusion. This project should have given you a practical idea of how to use your PC as an analog data-acquisition tool. It can be particularly useful for in-the-field data-logging if connected to a laptop computer. Occupying only the serial port, the printer port (which is a parallel-interface) remains free for use as a digital I/O port, perhaps for controlling motors to position a transducer for the ADC. But that's another story; perhaps one *you* will write about. ■



"My computer wasn't as friendly as I thought."

COIL FORMS

(Continued from page 69)

can be used to do this job. Turn the wire over several times to make sure that the enamel insulation is scraped away around the entire circumference. Some people prefer to burn the insulation off with a soldering iron, which also serves to tin the end of the wire as it burns the insulation away. I've found that method to be successful with smaller gauges of wire, but when quality No. 26 or larger wire is used, the scraping method seems to work better. If the scraping method is used, then follow the scraping by tinning the exposed end of the wire with solder. Each winding of the transformer can be made by threading the wire through the core as needed. As each winding is finished, the loose end should be cleaned, tinned, and soldered to its push terminal. After all the windings are complete, seal the entire assembly with Q-Dope or a suitable equivalent.

Homebrew Binocular Cores. Actual binocular cores are available in a limited variety of materials and sizes. However, you can build custom "binocular cores" from toroidal cores, which are readily available in many more mixtures of powdered iron and ferrite. Also, you can make larger binocular cores using toroids because of the wide range of toroid sizes.

Figure 6 shows the common way to make your own binocular core: stack a number of toroid cores in the manner shown. It is common practice to wrap each stack in tape, and then place the two stacks together and wrap the assembly together. Although four toroids are shown on each side, any number can be used.

A variation on that theme is shown in Fig. 7. That binocular core is designed to have a single-turn winding consisting of a pair of brass tubes passed through the center holes of the toroid stacks. The ends of the stacks are held together with a pair of printed-circuit boards. The rear panel has no copper removed, while the front panel is etched to isolate the two brass tubes. The pads around the brass tubes at the front end are used to make connections to the tubing (which serves as a single-turn winding). The other winding of the transformer is made of ordinary insulated wire, which is passed through the brass tubes the correct number of turns to achieve the desired turns ratio. This type of binocular core was once popular with ham operators who built their own solid-state RF power amplifiers. The high-power transformers needed to match the impedances of the base and collector terminals of the RF transistors were not commonly available, so many hams had to "roll their own."

The binocular core is not as well known as the toroid core, but for many applications it is the core of choice. That is especially true when low frequencies are used, or whenever large inductances are needed in a small package . . . that is if you don't want to work your arm off hand-winding a large number of turns. ■

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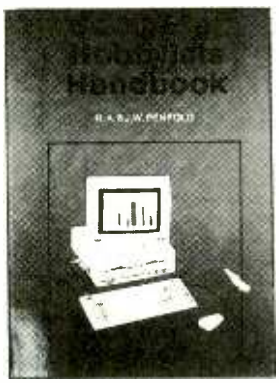

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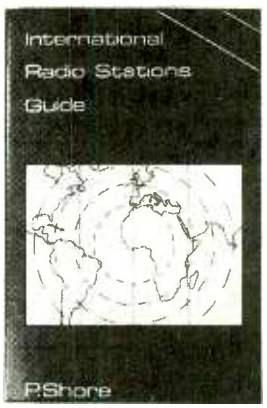

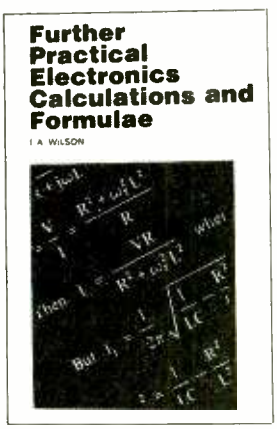

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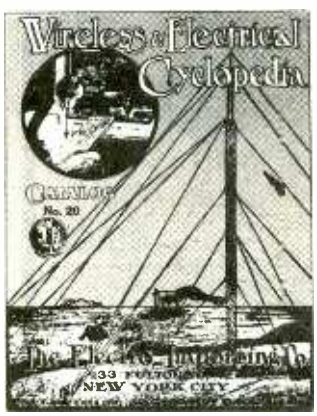

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Quickly & safely removes dust, lint & particles from sensitive electronic equipment, computers, lab equip., optical grade surfaces & other mechanisms & equipment.

FreezALL™
Quickly and safely cools circuits to -54°C. Locates intermittent components due to heat failure and hairline cracks on PCBs.

MechanicALL™
High Penetrating Anti-Corrosive Anti-Tarnishing Cleaner & Lubricant. Lubricates & Protects, Displaces Moisture, Stops Squeaks, Migrates & Coats Entire Surface.

ElectricALL™
Rejuvenating Solution For All Electrical Applications. Cleans, Preserves, Improves & Protects Connections, Removes Corrosion & Oxidation, Reduces Wear, Abrasion, Arcing & RFI.

DegreasALL™
For degreasing, cleaning & defluxing equipment and parts. Removes oil, grease, dirt and contaminants including rosin flux from PCBs, components and metal parts. Biodegradable.

CAEON™ 27
For sensitive equipment applications. For removal of oil, grease & dirt from surfaces. (Freon® TF).

CAEON™ 28
Degreaser and cleaning liquid removes organic contaminants including rosin flux from PCBs, components and metal parts. (Freon® TMC).

X-10S Instrument Oil
Contains silicone. Finest quality instrument oil for use on rubber, plastics and metals. Non-gumming, rust inhibiting, long lasting lubrication.

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BEST PRICE

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Most Versatile DMM

Inductance: 1µH-40H
Capacitance: 1pF-40µF
Frequency: 1Hz - 4MHz
Temperature: -40 - 302 °F
TTL Logic Test: 20MHz
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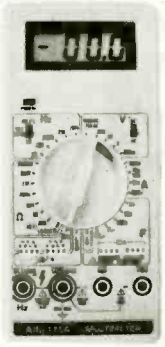
Volt, Amp, Ohm
3999 count display
Peak Hold
Auto power off
Ruggerdized case.
Rubber Holster $8.00



DMM 175A $67.95

DMM with 20 MHz Frequency Counter
Most Popular DMM

Freq. Counter 1Hz-20MHz
DCV 0.1mV-1000V
ACV 0.1 mV-750V
ACA/DCA 0.1µA-10A
Resistance 0.1Ω-2000MΩ
Capacitance 1pF-20µF
TTL Logic test 20 MHz
Transistor HFE test
Diode test ,LED test
3 1/2 digit display
10 MΩ impedance
Soft case$3.00, deluxe case $5.00

Fluke Multimeter

Fluke 12	$79.95
Holster C-10	$10
Fluke 70 II	$65
Fluke 73 II	$90
Fluke 75 II	$127
Holster C-70	$15
Fluke 77 II	$147
Fluke 79 II	$167
Fluke 29 II	$167
Fluke 83	$225
Fluke 85	$259
Fluke 87 True RMS	$285

Fluke 97 Scope Meter $1750

LCR Meter 814 $199.95

The Best Handheld LCR

Inductance: 0.1µH-200H
Capacitance: 0.1pF-20,000µF
Resistance: 1mΩ-20MΩ
1% basic accuracy
Dissipation factor indicates leakage in capacitor and Q factor in inductor
Zero adjustment to reduce parasitics from test fixture
Best for high frequency RF and surface mount components.
SMD and chip component test probe $25.00, Deluxe carrying case $5.00

LCR Meter 195 $119.95

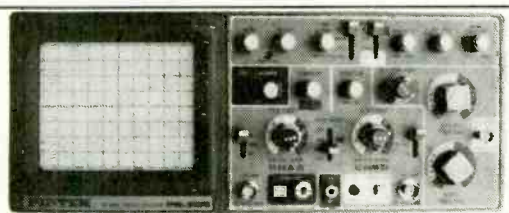
Very Popular LCR

Inductance: 1µH-200H
Capacitance:0.1pF-200 µF
Resistance:0.01Ω-20MΩ
Basic accuracy:R:1%, C:2%, L:3%
Test frequency 1 kHz
Soft carrying case $3.00
Deluxe case $5.00

Capacitance Meter 7705 $57.95

0.1 pF-20,000µF in 9 ranges
0.5% basic accuracy
Zero adjustment ± 20pF to compensate parasitics from test fixture

Also Available:
Heavy duty DMM, AC/DC clamp meter, Thermometer, Light meter pH meter,, High voltage probe Digital caliper, Anemometer Elctronic scale, Force guage Tachometer, Humidity & EMF adapter, Sound level meter Frequency counter, SWR/field strength/power meter, Dip meter



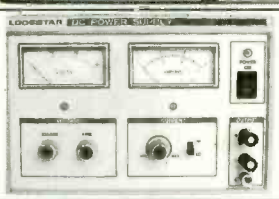
20 MHz Oscilloscope with Delay Sweep PS-205 $429.95

Dual Trace, Component test, 6" CRT, X-Y Operation, TV Sync, Z Modulation, CH2 Output, Graticule Illum, 2 probes each has x1,x10 switch. Best price with delay sweep.

PS-200 20 MHz DUAL TRACE	$339.95
PS-400 40 MHz DUAL TRACE	$494.95
PS-405 40 MHz DELAY SWEEP	$569.95
PS-605 60 MHz DELAY SWEEP	$769.95

20 MHz Digital Storage Oscilloscope DS-203 $729.95

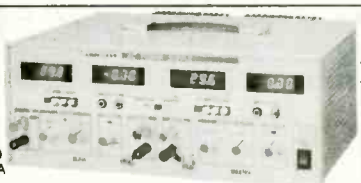
Switchable between digital and analog modes
2 K word per channel storage
Sampling rate: 10 M sample /sec
8 bit vertical resolution (25 Lerel/div)
Expanded Timebase 10ms/div - 0.5 s/div
Refresh, Roll, Save all , Save CH2, Pre-Trig
Plotter Control



DC Power Supply PS-303 $159.00

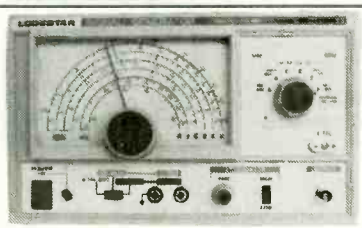
0-30 VDC , 0-3A output

0.02% + 2mV line regulation
0.02% + 3mV load regulation
1 mVrms noise and ripple
Short circuit and overload protected
PS-8200 with digital voltmeter $179.00
Also available: 30V/5A, 60V/3A, 60V/5A 16V/10A, 30V/10A



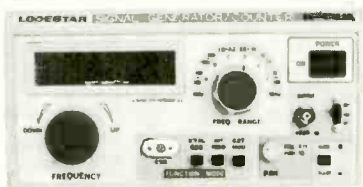
DC Power Supply Triple Output PS-8202 $499.95

Two 0-30 VDC , 0-3A outputs
One fixed 5VDC, 3A output
Capable of independent or tracking operation
Constant voltage and constant current mode
Four digital meters for volt and current display
Excellent regulation and low ripple
Short circuit and overload protected
Also available: 30V/5A triple output $549.95
60V/5A dual tracking $749.95



RF SIGNAL GENERATOR SG-4160B $119.00

100 kHz-150MHz sinewave in 6 ranges
RF Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz AM modulation
Audio output 1 kHz, 1 Vrms



RF SIGNAL GEN./COUNTER SG-4162 AD $229.95

Generates RF signal same as SG-4160B
Frequency counter 1Hz - 150 MHz for internal and external source
Sensitivity <50mV

AUDIO GENERATOR AG-2601A $119.00

10Hz - 1MHz in 5 ranges
Output: 0-8Vrms sinewave
0-10Vp-p squarewave
Synchronization: ±3% of oscillation frequency per Vrms
Output distortion:
0.05%-500Hz - 50kHz
0.5 % 50Hz - 500kHz
Output impedance: 600 ohm

AUDIO GEN./COUNTER AG-2603AD $229.95

Generates audio signal same as AG-2601A
Frequency counter 1Hz-150MHz for internal and external sources
Sensitivity <50mV

FUNCTION GENERATOR FG-2100A $169.95

0.2 Hz -2 MHz In 7 ranges
Sine, square, triangle, pulse and ramp
Output: 5mV-20Vp-p
1% distortion, DC offset ± 10V
VCF: 0-10V control frequency to 1000:1

FUNCTION GEN/COUNTER FG-2102AD $229.95

Generates signal same as FG-2100A
Frequency counter 4 digits
Feature TTL and CMOS output

SWEEP FUNCTION GEN./COUNTER $329.95

0.5Hz to 5 MHz in 7 ranges
Sweep: Linear 10:1/Log 10:1 20ms to 2s
AM Modulation
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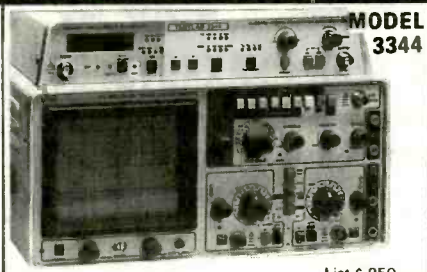
MODEL 3324

3 in 1 TESTLAB

- **25MHz DUAL TRACE OSCILLOSCOPE**
  1mV/div - 20V, div vert. sensitivity
  40nS to 0.2sec timebase/, 5 way trig.
  8 cm × 10 cm Rect CRT, Int graticule,
  X-Y operation/, Hold off/, Z modulation
- **TRIPLE OUTPUT DC POWER SUPPLY**
  +5V/1A, +12V/0.25A - 12V/0.25A,
- **DUAL CHANNEL COMPONENT TESTER**
  Active/, passive comp. test/, board test

List $ 525

$ 365



MODEL 3344

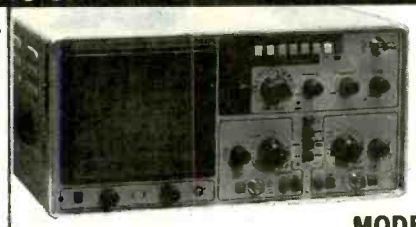
5 in 1 TESTLAB

All features of 3324 PLUS

- **100MHz/ 7 DIGIT FREQUENCY COUNTER**
  Digitally controlled/ 20mV sen to 60 MHz.
- **0.02Hz TO 2MHz FUNCTION GENERATOR**
  Sine/square triangle/DC, - Digital freq. indication
  10V pp output, variable DC offset.

List $ 950

$ 795



MODEL 3304

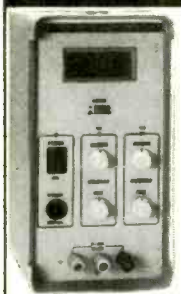
25 MHz DUAL TRACE OSCILLOSCOPE

- 1mV to 20V/cm - Vertical Sensitivity
- 40nS to 0.2 sec Time Base/5 Way Trigger
- 8 cm × 10 cm Rect CRT—Int Graticule
- X-Y Operation/Hold off/Z mod.

List $ 425

$ 315

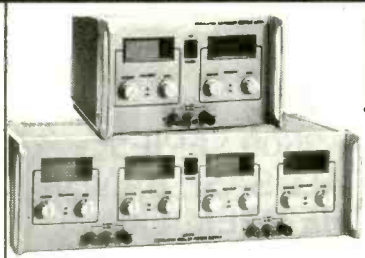
DC REGULATED POWER SUPPLIES — DESIGNED TO VDE/UL SAFETY SPECS.



160W DC POWER SUPPLIES

- 3 Digit DPM display output V & A
- CV/CC operation
- + 0.01% + 2mV Line & load regulation
- High efficiency
- VDE approved line components.

OUTPUT	MODEL	CURRENT PRICE	LIST
0.16V/10A	CP1610	$ 189	$ 295
0.32V/5A	CP3205	$ 199	$ 350



DIGITAL LABs

Dual output

- ± 0.01% line & load regulation CV/CC operation
- Accurate 3 digit DPM for voltage & current
- 19" Rack, 5.1/4"high.

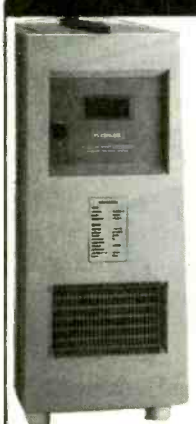
	OUTPUT	MODEL	CURRENT PRICE	LIST
128W	0-32V/2A 0-32V/2A	LD3202	$ 349	$ 465
320W	0-16V/10A 0-16V/10A	LD1610	$ 480	$ 615

COMPACT 60W DC POWER SUPPLY

- 3 Digit DPM display V&A
- ± 0.02% + 2mV line & load regulation
- Single or multioutput
- CV/CC operation

OUTPUT	MODEL	CURRENT PRICE	LIST
+ 15V/02A DUAL OR 0-30V/0-2A	CPD1502	$ 179	$ 245
0 + 25V/1A 0 - 25V/1A + 5/2A	CPD2501	$ 195	$ 285

POWER LINE CONDITIONERS AND AC SOURCES — W/W POTS



1KVA 'KLEENLINE'

LINE CONDITIONER

Complete 'Brownout' protection for workstations

- Isolation 130dB CMRR
- >10uA leakage at 4KV
- Output voltage regulation ± 5% for input line + 10% - 20%
- Noise & transient suppression with filters & transorbs.

List $ 375

$ 275

SHOCKSAFE

Variable Line Supply

- Double wound transformer less than 100 uA leakage
- Continuously adjustable output 0 to 130 V/4A or 0 to 260 V/2A
- 115V, 60 Hz input line.

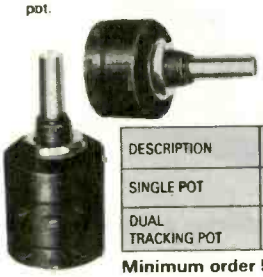
List $ 296

$ 215

W/W POTENTIOMETERS

2 Watt W/W 1" Dia

- Robust Industrial type
- 1% linearity
- Stability 100 ppm/°C
- 1% tracking for two section ppt.



DESCRIPTION	CURRENT PRICE	LIST
SINGLE POT	$ 2.60	$ 3.25
DUAL TRACKING POT	$ 5.80	$ 7.25

Minimum order 5 Pots

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500V (dc+ac peak)
10 MΩ in 1:10 position

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$ 23 for Two

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DPBB	8580	BA 5135	CR 6000-3M	5503 VIP	
DPV-5,7	8570				
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PINK PAN

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SAVE $

NEW REMOTE CONTROL AB SWITCH FOR DUAL SYSTEMS (WITHOUT LEAVING THE COMFORT OF YOUR CHAIR)

PANASONIC TZ — PC 1453G2

By far the best basic converter on the market today. 550 MHz (1 to 99) parental control, sleep timer, remote batteries, contrast and remote control range.

Superior to all other converters

NO MICHIGAN SALES

TVT GOLD ORIGINAL FOR MOST JERROLD SYSTEMS. LEADING SELLER OF ALL PANS

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We are now offering a 6-month warranty. In order for warranty to be in effect, this form must be signed and returned.
FOR VCR, SECOND, THIRD, ETC. HOOK-UPS.

☐ **Yes, I agree all units are to be used or resold in compliance with Federal and State laws.**

Signature _____ **Date** _____

Name _____ **Phone No. ( )** _____

Address _____

City _____ **State** _____ **Zip** _____

It is not the intent of B & S Sales to defraud any pay television operator and we will not assist any company or individual in doing the same.

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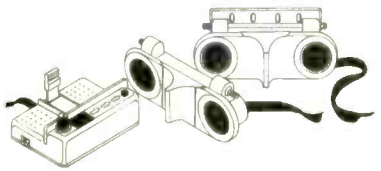
ULTRASONIC PROXIMITY DETECTOR



The ED-100 was designed for use as an auto/truck/RV back-up alarm. A digital display and audible beeper inside the vehicle inform the driver of the distance to impact beginning when the vehicle is within 14 feet of another object. Two 40 kHz ultrasonic emitter/detector modules, measuring 5.81" long X 1.9" wide, 2.05" thick, attach to the rear of the vehicle. The device operates on 12 or 24 Vdc.

These units are new, in original cartons and include instructions. The company that marketed this device is no longer in business, and no manufacturer's guarantee is in effect.

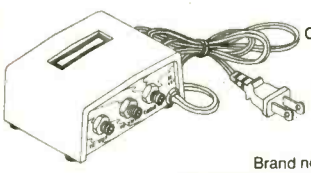
We offer these ultrasonic detectors for experimentation only, and in no way wish to promote their usefulness as a driving aid.

Originally sold for over $100.00.

CAT# ED-100

$24.95 per set

EXPERIMENTER'S DELIGHT VHF TO UHF BLOCK CONVERTER



Channel Master # 0746

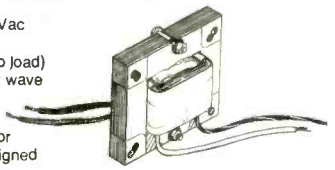
This is one of those deals that's too good to be true. Brand new, in the box, Channel Master block converters. They used to be quite popular back in the early days of cable television, before there were a lot of cable-ready TVs. Somewhere in the world we know there is still a demand for them--especially at this price. Designed to convert television VHF channels 2 through 13 and A through W to UHF channels 36 through 76. The box alone, is a great project box. The 10 ft. AC power cord, the interior components, F connectors and AC receptacles are well worth the price.

CAT# CM-0746

10 pieces for $18.50

$2.00 each

2KV TRANSFORMER



Primary: 120 Vac
Secondary:
1,890 Vac (no load)
2,250 with 1/2 wave rectifier
@ 4 madc &
.22 uf capacitor
Originally designed for laser power supply. Measures: 3.13" X 3.75" X 2.3"

$15.00 each

CAT# HVTX-3

SPECIAL! SPECIAL!

36 PIN SNAPPABLE HEADER

Arkles Corp. # 25MSS2A36GG030
Special purchase of 36 pin, single row 0.1" spacing headers. Snappable to smaller lengths. Sold only in bags of 100 pieces. Our regular price on a 40 pin header is $120.00 per 100 pieces.

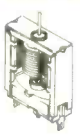
CAT# SHS-36

$40.00 for 100 piece bag

$350.00 for 1000 pieces

LOW VOLTAGE D.C. MOTORS

1.5 - 4.5 Volt



Mabuchi
Approx. 9000 RPM @ 3 Vdc.
Rectangular shape
0.71" X 0.75" X 0.38".
Shaft size 0.06" dia. X 0.27" long.
Solder loop terminals.

3 for $1.00 CAT# DCM-45

100 for $25.00 • 1600 for $320.00

1.5 - 3 Volt

Mabuchi
Approx. 9000 RPM @ 1.5 Vdc. Modified oval shape 1.15" long X 0.78" X 0.85". Shaft size: 0.08" dia. X 0.60" long. Pigtail leads.

CAT# DCM-46

3 for $1.00

100 for $30.00 • 1000 for $250.00

ELECTROLUMINESCENT "Glow Strip"

4.75" X 10.25" electroluminescent glow strip operates on 80-120 Vac.

Emits a soft pink/white glow when energized. Great for backlighting control panels and special effects. Thin and flexible, can be used on curved surfaces. 0.04" thick. 2 wire connection.

CAT# GS-510

$6.00 each

SLOTTED OPTICAL SWITCH

OPTEK# OPB970T55
Photo transistor output.
0.125" gap.

CAT# OSU-19

2 for $1.00

CAR LIGHTER SOCKET

SAFCO NO.20
Black cigar lighter socket with 24" of 18/2 black wire.

CAT# CLS-2

$1.25 each

10 for $10.00

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10 button, matrix encoded keypad. Peel-and-stick backing for easy mounting. Originally designed for use on a satellite TV tuner, the keys have satellite names and related text on them in addition to numerals 0 through 9. Overall dimensions are 9" X 1.625", but half of the strip can be cut off with a knife or scissors, leaving a self-sticking keypad or 4.5" X 1.625". Silver keys with charcoal numerals and background. 6.5" flexible ribbon cable, terminated with 7 pin socket connector - 0.1" spacing.

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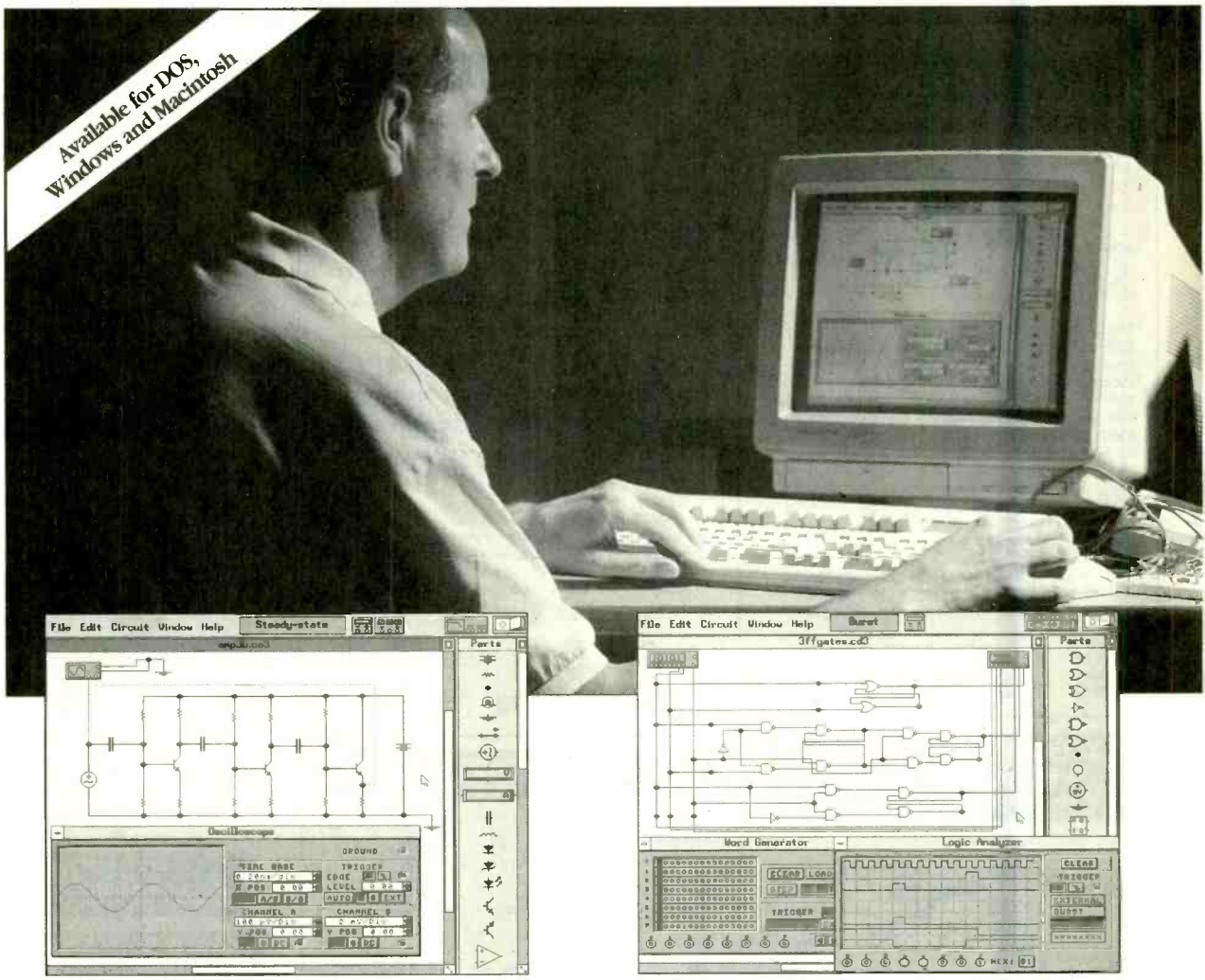

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- function generator (1 Hz to 1 GHz)
- dual-trace oscilloscope (1 Hz to 1 GHz)
- Bode plotter (1 mHz to 10 GHz)

Digital Module includes:

- fast simulation of ideal components
- AND, OR, XOR, NOT, NAND and NOR gates
- RS, JK and D flip-flops
- LED probes, half-adders, switches, seven-segment displays
- word generator (16 eight-bit words)
- logic analyzer (eight-channel)
- logic converter (converts among gates, truth table and Boolean representations)

Electronics Workbench®

The electronics lab in a computer™

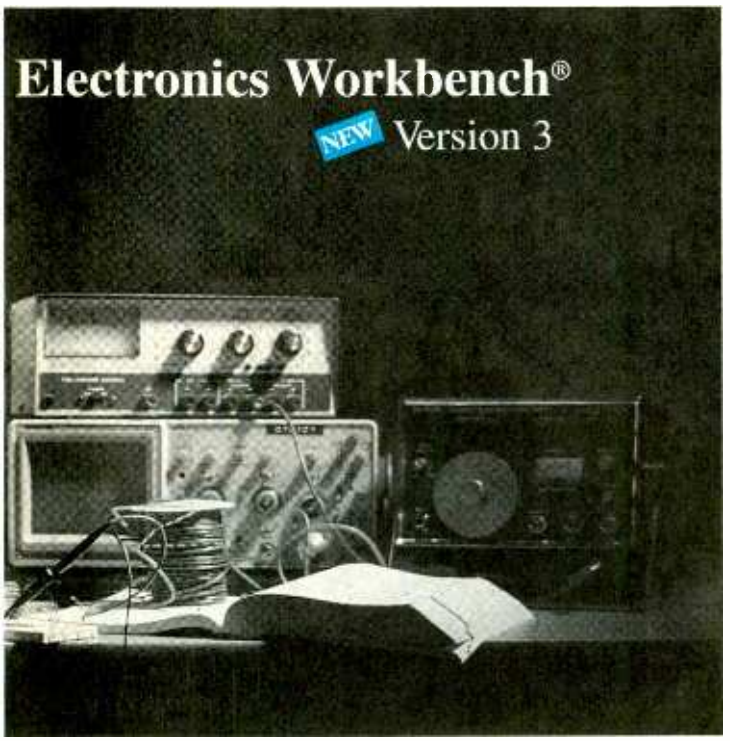
SYSTEM REQUIREMENTS

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.

Macintosh version: Macintosh Plus or higher, 2 MB RAM, System 6 or 7.

Circuits. Fast.



An Ideal Test Bench

Here's why Electronics Workbench belongs on *your* test bench: Wires route themselves. Connections are always perfect. And the simulated components and test instruments work just like the real thing. The instruments are indestructible and the parts bin holds an unlimited supply of each component. The result: thousands of electronics professionals and hobbyists save precious time and money. **Over 90% would recommend it to their friends and colleagues.** Electronics Workbench: the ideal, affordable tool to design and verify your circuits before you breadboard.

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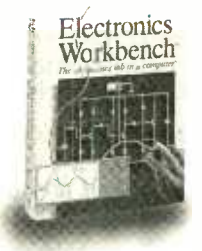
Version 3.0 simulates more and bigger circuits, and sets the standard for ease of use. Guaranteed!*



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NEW Features in Version 3

- new components include JFETs; MOSFETs; voltage- and current-controlled sources; and manual, time-delay, voltage-controlled and current-controlled switches
- real-world models for opamps, BJTs, JFETs, MOSFETs and diodes — over 100 models available
- MS-DOS version now supports up to 16 MB of RAM for simulation of bigger circuits
- new Microsoft® Windows™ and Macintosh® versions available
- Technical support now available on CompuServe®

"Design work is faster and cheaper with Electronics Workbench."
Mark L. Weaver, Production Engineer Technician, Colorado Memory Systems, Loveland, Colorado

"Building a circuit is simple and intuitive."
Jeff Holtzman, Computer Editor, Electronics Now

"I used Electronics Workbench extensively in the design of a six-meter receiver. I got surprisingly good comparison with actual breadboard and end-unit performance, even at 50 MHz. As an affordable tool for performing design tradeoffs, you can't beat it."
M. A. Chapman, Oceanside, California

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- Parental Lockout

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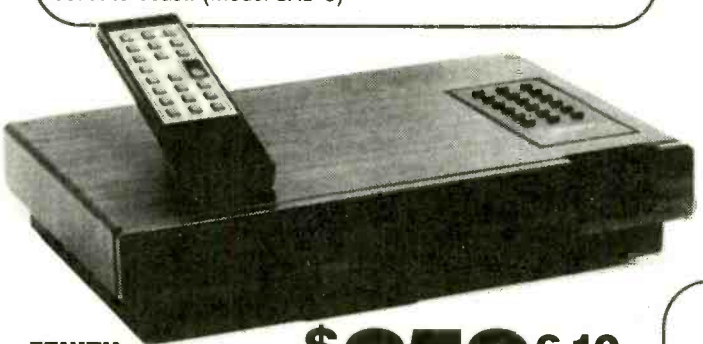

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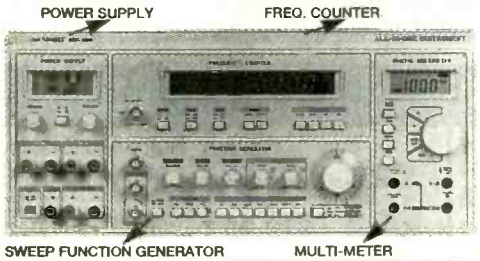

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Reg. $595.
$399.00

1 Function Generator
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- 0.02 Hz ~ 2MHz

2 Frequency Counter
- 8 Digit LED
- 1 Hz ~ 100MHz
- ± (1 Hz + 1 dgt. + Time Base Error)

3 Power Supply
- 3-1/2 Digit LCD
- Triple output: #1. 0~50V, 0.5A MAX #2, 15V, 1A #3. 5V, 2A

4 Digital Multimeter
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- ± (0.5% + 2 dgts)

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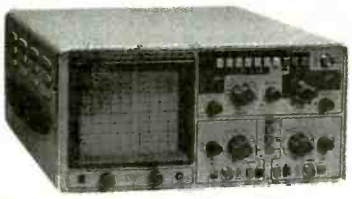
2 Yr. Parts/Labor Warranty



25 MHz Dual
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$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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Reg. $525. **$395.00**
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- 4 Digit LED Display
- 0.2 Hz ~ 2.0 MHz
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- Linear or Logarithmic Sweep
- Variable DC Offset Control
- 10 MHz Frequency Counter

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1.0 GHz Counter FC-200
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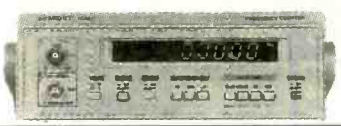
High Resolution Frequency Counter



- 1.0 Hz ~ 1.0 GHz
- 8 Digit LED Display
- Auto & Manual Range
- Measured Value Hold
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- Below 20mV Input Sensitivity
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- 10:1 Input Switchable Attenuator

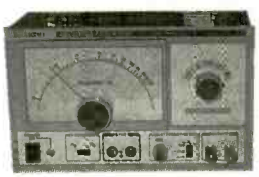
Reg. $199. **$119.00**

RF Signal Generator, SG-310 100KHz - 150MHz

- 100KHz ~ 150MHz, 6 Ranges.
- Accuracy : ± 5%
- RF Output: 100 m Vrms (Up to 35MHz Unloaded)
- Modulation
  Int. 1KHz (AM) 30%
  Ext. 50Hz ~ 20KHz
- Audio Output: 1KHz Min 2 Vrms

Reg. $199. **$119.00**

Audio Generator, AG-350 10Hz ~ 1MHz



- 10Hz ~ 1MHz, 5 Ranges.
- Accuracy : 5% ± 2
- Output Inpedance : 600Ω
- Sine Wave Output
  - Range : 10Hz ~ 1MHz
  - Output Voltage : 8 Vrms
- Square Wave Output
  - Range : 10HZ ~ 100KHz
  - Output Voltage : 15Vp-p

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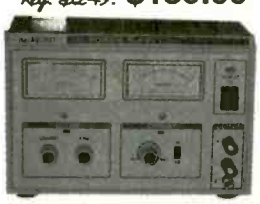
DC Power Supply, PS-500 0-30VDC, 0-3A



- 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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2.5 - 15VDC or 13.8VDC
Fully regulated, Short circuit protected
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3-14V @ 12A
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Separate Volt & Current Meters
Current Limiting, Low Ripple

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12V @ 1A
5V @ 3A
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Fully regulated & short circuit protected
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Triple Power Supply XP-620
Assembled $75
Kit $49.95

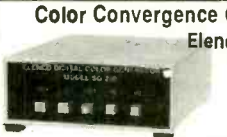
2 to 15V @ 1A,
-2 to -15V @ 1A
(or 4 to 30V @ 1A)
and 5V @ 3A
Made in USA by Elenco
All the desired features for doing experiments.
Features short circuit protection, all supplies.

GENERATORS & VIDEO PRODUCTS

Function Generator

Blox
#9600
by Elenco
$28.95
Provides sine, triangle, square wave from 1Hz to 1MHz
AM or FM capability
Kit $26.95

Color Convergence Generator



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RF & Video output

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RF Freq 100K-450MHz AM Modulation of 1KHz Variable RF output
SG-9500 w/ Digital Display & 150MHz built-in counter $239

Sweep/Function Generator
with Freq. Counter

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Ramp, .2 to 2MHz, Freq Counter .1-10MHz

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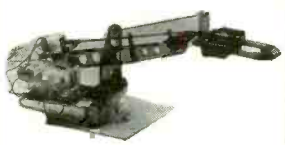
Robotic Arm Kit



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

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

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1.2GHz
$229

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

XK-500 Digital / Analog Trainer

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

$159.95 Assembled $129.95 Kit

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

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

Digital - Section
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- Clock amplitude 5VPP square wave

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

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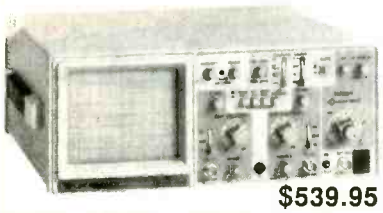

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20MHz $389 2 Channel — **Model 2125 Delayed Sweep**

40MHz DUAL-TRACE

Model 1541B

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

$695.95

60MHz DUAL-TRACE

Model 2160

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

$949.95

100MHz THREE-TRACE

Model 2190

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

$1,395.95

20MHz ANALOG WITH DIGITAL STORAGE

Model 2522A

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

$875

AFFORDABLE - ELENCO OSCILLOSCOPES

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S-1360 Delayed Sweep $775

- Automatic Beam Finder
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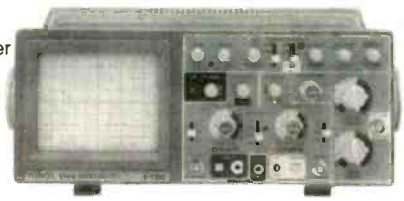
- 1mV Sensitivity
- Dual Time Base
- Illuminated Internal Gradicule
- TV Sync

60MHz Dual Trace



S-1365 Cursor Readout $849

- Voltage, Time, + Frequency differences displayed on CRT thru the use of cursors.
- 1mV Sensitivity
- TV Sync

S-1345 Delayed Sweep $575

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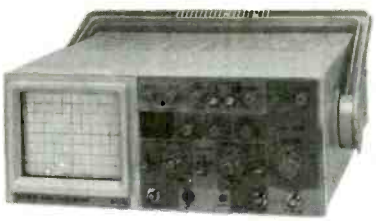
- Built-in Component Tester
- 1mV Sensitivity
- Dual Time Base
- Illuminated Internal Gradicule
- TV Sync

40MHz Dual Trace



S-1340 $495

- High luminance 6" CRT
- 1mV Sensitivity
- 12KV Acceleration Voltage
- 9ns Rise Time
- X-Y Operation
- TV Sync

S-1330 Delayed Sweep $449

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

25MHz Dual Trace

S-1325 $349

- High luminance 6" CRT
- 1mV Sensitivity
- 2KV Acceleration Voltage
- 18ns Rise Time
- X-Y Operation
- TV Sync

SPECIAL BUY HITACHI V-212

20MHz 2 Channel **$399**

Hitachi Popular Series

V-525 - 50MHz, Cursors	$995
V-523 - 50MHz, Delayed Sweep	$949
V-522 - 50MHz, DC Offset	$895
V-422 - 40MHz, DC Offset	$795
V-222 - 20MHz, DC Offset	$649

Hitachi Compact Series Scopes

V-660 - 60MHz, Dual Trace	$1,149
V-665A - 60MHz,DT, w/cursor	$1,325
V-1060 - 100MHz, Dual Trace	$1,395
V-1065A - 100MHz, DT, w/cursor	$1,649
V-1085 - 100MHz, QT, w/cursor	$1,995
V-1100A - 100MHz, Quad Trace	$2,495
V-1150 - 150MHz, Quad Trace	$2,895

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

$775

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- Plotter Output
- 8 Bit Vert. Resolution
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- Much More

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- Stores and recalls frequencies
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- Fast - 250 million counts per second for high resolution - 250 MHz direct count
- 10 Hz to 3 GHz
- Ultra sensitive bargraph w/ 16 segment display
- Multi-Function Counter with Frequency, Period, Ratio and Time Interval
- Optional ± .2 PPM TCXO- $100.

Model M1 $229.

Full Range Pocket Sized Counter

- Digital Filter
- Digital Auto Capture - Auto Hold
- Stores & Recalls Frequencies
- 4-5 hr. battery operation
- 10 Hz to 2.8 GHz
- 10 digit LCD with EL backlight

Model 8040 $679.

Multi-Function Bench/Portable Counter Measures Frequency Period, Ratio, Time Interval and Average.

- Digital Filtering to eliminate false counts
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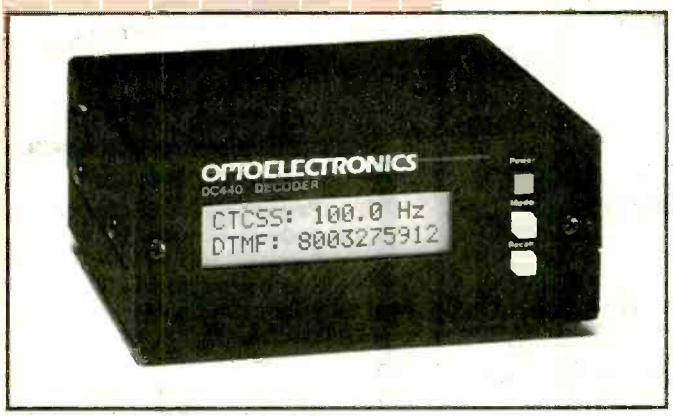

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- 100ft All in one ribbon cable
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An extremely valuable tool for designing and installing TVRO's, tailored for ease of use by professionals and dealers as well as by technically orientated TVRO owners. Demonstrates how changing parameters such as dish size or LNB noise temperature affect picture quality. The program performs both TVRO system analysis and antenna aiming. The analysis subcomponent, is especially useful for predicting performance when viewing signals from a particularly weak satellite. The aiming subcomponent calculates azimuth and elevation angles and range to all satellites within "view" of a TVRO. The names and latitudes of all world-wide C and Ku-band broadcast satellites, presently in service or to be launched by 1995, are listed. The user simply enters TVRO site latitude and longitude.

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10ft H.D.	"	"	449
12ft	"	"	649

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Bulz-I-Tuning Meter Now with audio alert

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Dish tuning meters are a must for the serious dealer or satellite system owner. Saves time, frustration and money. Use when installing a new system, moving your dish, re-alignment of a dish that has been moved by wind, frost heaves etc., gets you right on the satellite belt for the best possible pictures!

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*All you need to supply is ground pole to mount dish on. (3.5" O.D.)

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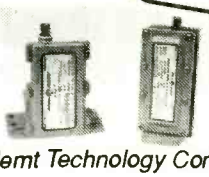

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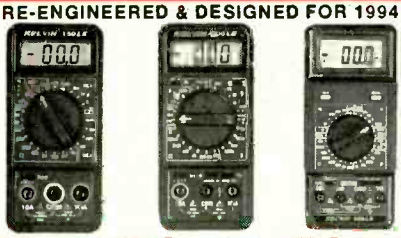

150 LE - Student | 200 LE - Technician | 400 LE - Engineer

Standard Features - ● AC & DC VOLTAGES ● DC CURRENT ● RESISTANCE ● TRANSISTOR ● CONTINUITY TEST - Buzzer ● DIODE TEST ● 3 1/2 Digit LCD ● 10M ohm INPUT IMPEDANCE

150 LE	200 LE	400 LE
BATTERY TEST TRANSISTOR	FREQ COUNTER up to 20MHz	INDUCTANCE Resolution 1uH
DC CURRENT 10 Amp	TRANSISTOR CAPACITANCE from 1pF to 20uF	FREQ COUNTER up to 20MHz
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		AC/DC CURRENT DUTY % 20 Amp
Stock # 990122	Stock # 990123	Stock # 990124
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Reviewed - May 1993

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TRUE RMS PLUS

Model 94
#990111
$199.95
*See Standard Features Listed below

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$199.95
A Must For Auto Mechanics

Standard Features plus - TEMP, TACHOMETER & DWELL ANGLE TESTER, DUTY CYCLE, 10M OHM IMPEDANCE, ANALOG BAR GRAPH, K-TYPE TEMP PROBE, ALLIGATOR CLIP TEST LEADS, INDUCTIVE PICKUP CLIP, 6' TEST LEADS & DELUXE CARRYING CASE

*** Standard Features - Models 94 & 95**

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- AC/DC CURRENT
- OHM METER
- DATA HOLD
- RELATIVE MODE
- FREQ COUNTER to 4 MHz (Model 95)
- AUDIBLE CONTINUITY TEST
- DIODE TEST
- MAX/MIN AVERAGE MEMORY RECORD
- 10A HIGH-ENERGY FUSE PROTECTION
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KELVIN 100 Basic

990087
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- DIODE TEST ● BATTERY TEST

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- ACCURACY: 0.5%
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- Zero Adjust
- Safety Test Leads
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KELVIN 300 LE
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$49.95
AUTO-RANGE

- ACV & DCV
- DC CURRENT
- RESISTANCE
- CONTINUITY TEST
- DIODE TEST 3 1/2 Digit LCD
- 10M ohm INPUT IMPEDANCE

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Dual Trace 2 Yr Warranty-Parts & Labor
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990105	RED	$.65 ea.	$.50 ea

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$5.50 ea / 3+ Qty

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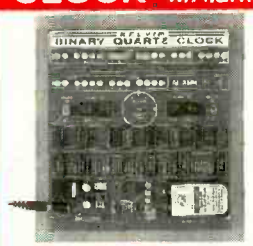

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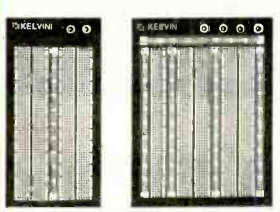

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680097	0	840	$ 5.95
680098	2	1380	$11.75
680100	4	2390	$22.95

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Pre-cut, Pre-Stripped

330289	140 Piece Set	$ 4.95
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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
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630383	PN2222	$.08 ea
600023	7805 Voltage Reg	$.36 ea

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(Similar to GE C106C1) 4.0 amp, 100PIV
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260027	GREEN	$.08 ea	$.07 ea
260026	YELLOW	$.08 ea	$.07 ea
260078	2 COLOR RED/GREEN	$.32 ea	$.29 ea

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for XenonStrobe Tube
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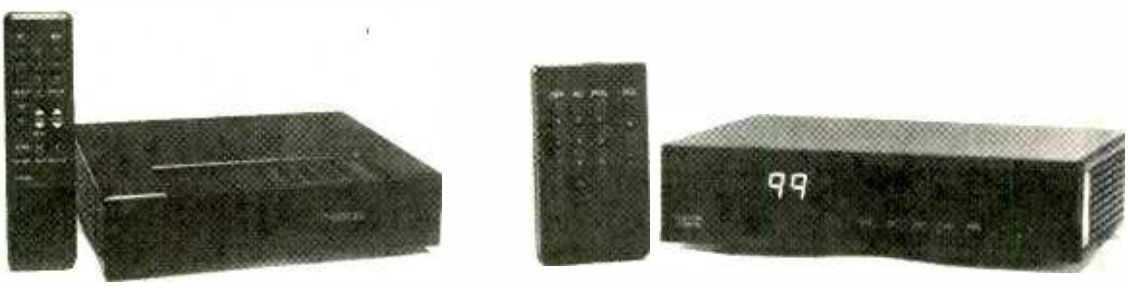

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Ni-Cads and A/C Charger INCLUDED with ALL Models

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1350	1-1300 MHZ, 10 HZ Res. 3 gate times, Hold switch	$119.	~~129.~~

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Increase range or distance from a transmitter with a Band Pass Filter. <1 dB pass band insertion loss.

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HP-400	400-1500 MHZ Usage	69.	
HP-800	800-2000 MHZ Usage	69.	
BP-3	Above 3 filters *(SAVE $30)*	$177.	~~207.~~

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A	*CC-90*	Case for all models	12.
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C	*TA-90-L*	Telescope elbow antenna	16.
D	*RD-150*	150 MHZ rubber duck	16.
E	*RD-2750*	27-50 MHZ rubber duck	28.
F	*RD-800*	800 MHZ rubber duck	29.
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H	*P-110*	200 MHZ, 1x, 10x probe	39.
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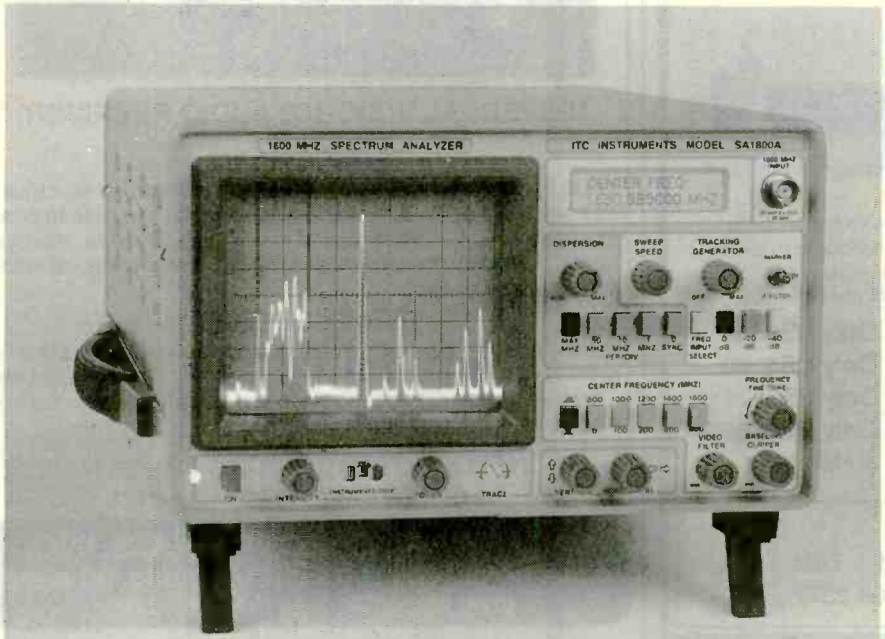

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- TWO-WAY & HAM RADIO
- ALL RF BASED SYSTEMS

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2mHz to 600mHz

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Opt. 1 50 mHz marker Generater
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The ***TriField***™ meter detects *far more* of these fields than any other electromagnetic pollution meter. It's the only one that independently reads AC electric fields, AC magnetic fields, *and* radio/microwaves. It also reads field strengths in *all directions simultaneously*. Every other meter that sells for under $500 reads only magnetic and only in one direction — they can entirely miss a magnetic field unless pointed correctly and are blind to radio/microwaves and electric fields, both of which cause biological effects.

The ***TriField***™ meter reads all three types of fields numerically and with a SAFE/BORDERLINE/HIGH SCALE, weighted proportional to effect on the body. Thresholds are based on epidemiological and laboratory studies. (While no *absolute* hazard thresholds have been established, reduction of *relative* exposure is prudent.)

The ***TriField***™ meter comes ready-to-use with battery, instructions, and one-year limited warranty. The cost is $144.50 postpaid.

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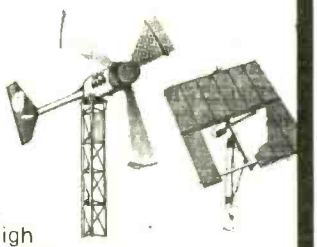

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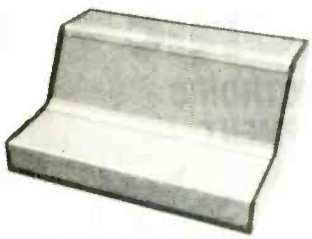

PANELS ARE .063" ALUMINUM

RACK CHASSIS

MODEL	DESCRIPTION W x D x H (inches)	PRICE $
1RU5	19 x 5 x 1.75	30.85
1RU7	19 x 7 x 1.75	33.10
1RU10	19 x 10 x 1.75	35.25
2RU5	19 x 5 x 3.5	33.10
2RU7	19 x 7 x 3.5	35.25
2RU10	19 x 10 x 3.5	37.80
3RU5	19 x 5 x 5.25	41.90
3RU7	19 x 7 x 5.25	44.10
3RU10	19 x 10 x 5.25	46.30

PANELS ARE .063" ALUMINUM

METAL CABINETS

MODEL	DESCRIPTION W x D x H (inches)	PRICE $
MC-1A	4 x 3 x 2	16.50
MC-2A	6 x 3 x 2	18.75
MC-3A	8 x 3 x 2	20.95
MC-4A	4 x 4 x 3	18.75
MC-5A	6 x 4 x 3	20.95
MC-6A	8 x 4 x 3	23.15
MC-7A	4 x 7 x 4	20.95
MC-8A	6 x 7 x 4	23.15
MC-9A	8 x 7 x 4	25.75

PANELS ARE .080"
ALUMINUM AND ARE FIELD REMOVABLE

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MODEL	DESCRIPTION W x D x H (inches)	PRICE $
3RU7 HD	19 x 7 x 5.25	115.00
3RU10 HD	19 x 10 x 5.25	121.00
3RU14 HD	19 x 14 x 5.25	134.00
4RU7 HD	19 x 7 x 7.0	121.00
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

DUAL SLOPE METAL CABINETS

MODEL	DESCRIPTION MAJOR DIM. SECONDARY DIM. W x D x H x H1 x S1 x S2 x D1 (in.)	PRICE $
DS-1	4 x 6 x 4 x 1.2 x 1.9 x 2.4 x 1.6	59.00
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 6 x 6 x 2 x 3.1 x 3.5 x 1.9	69.00
DS-8	6 x 6 x 6 x 2 x 3.1 x 3.5 x 1.9	73.00
DS-9	8 x 6 x 6 x 2 x 3.1 x 3.5 x 1.9	78.00
DS-10	10 x 6 x 6 x 2 x 3.1 x 3.5 x 1.9	82.75
DS-11	12 x 6 x 6 x 2 x 3.1 x 3.5 x 1.9	87.75
DS-12	18 x 6 x 6 x 2 x 3.1 x 3.5 x 1.9	100.75

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MODEL	HOLE SIZE & SHAPE	PRICE $
PUNCH 1	3/8" ROUND	9.95
PUNCH 2	7/16" ROUND	9.95
PUNCH 3	1/2" ROUND	9.95
PUNCH 4	9/16" ROUND	12.95
PUNCH 5	5/8" ROUND	12.95
PUNCH 6	11/16" ROUND	12.95
PUNCH 7	3/4" ROUND	12.95
PUNCH 8	13/16" ROUND	12.95
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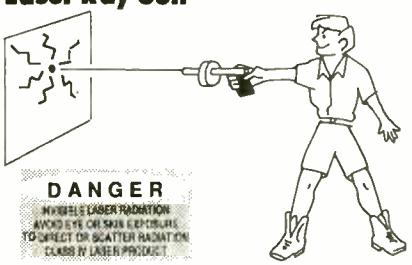

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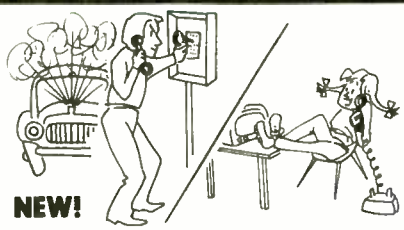

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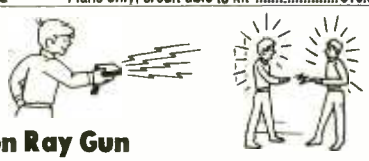

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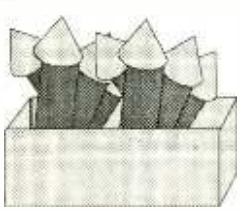

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Thousands of PBXs are hacked to the tune of about $8 Billion/yr! While our "VOICE MAIL HACKING" details how VMSs are hacked for "phun" and profit - including VMS methods for hacking PBXs themselves - "PBX HACKING" addresses ALL issues relating to PBX hacking, including countermeasures! Can your business or agency afford a $90,000 phone fraud loss (the average loss due to hacked PBXs)? As described in **Forbes Magazine. $39**

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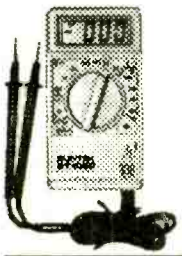

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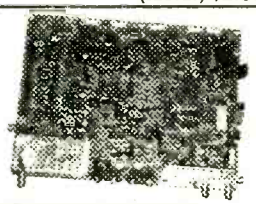

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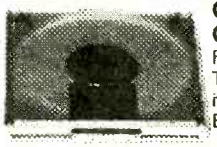

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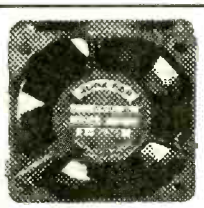

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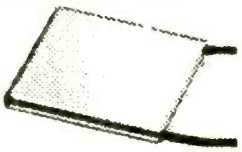

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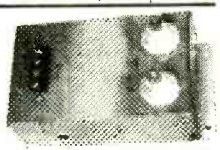

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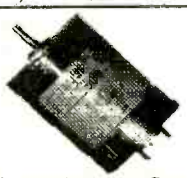

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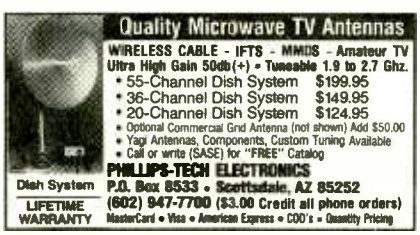

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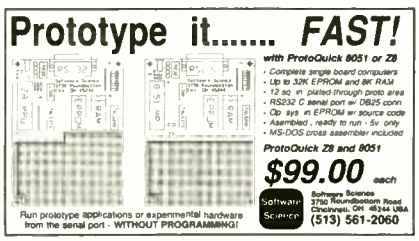

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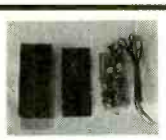
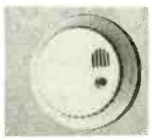


AD-500 VHF-FM TELEPHONE TRANSMITTER CRYSTAL CONTROLLED:
Operating Frequency: 139 - 149.450 MHz
RF power output: 11 MW
Dimensions: 1 3/4 x 1/4 x 3/4 (W x H x D)
Half assembled kit
Price: $115.00

AD-600 VHF-FM TRANSMITTER CRYSTAL CONTROLLED:
Operating Freqeuncy: 139 - 149.450 MHz
RF power output: 11 MW
Operates on 2 "N" Batteries
Operating time: over 100 Hrs.
Dimensions: 2 x 5/8 x 1 1/2 (W x H x D)
Half assembled kit
Price: $125.00

AD-268 VHF-FM TRANSMITTER CRYSTAL CONTROLLED:
Operating frequency: 139 - 149.450 MHz
RF power output: 268 MW
Dimensions: 2 x 3/8 x 5/8 (W x H x D)
Half assembled kit
Price: $145.00



CCD 100 + CCD 200 MICRO MINIATURE CCD CAMERAS - SMOKE DETECTOR DESIGN:
CCD-100: 300 lines resolution.
Price: $225.00
CCD-200: 400 lines resolution with sound.
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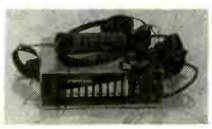

AS2000XLT RF BUG DETECTOR:
Operating frequency: 5 - 2000 MHz
Built in rechargeable battery.
Price: $525.00

CHINON CX-102 AUDIO MINIATURE BOARD MONOCHROME SOLID STATE CHIP CAMERA WITH AUDIO FEATURE/ BUILT IN MICROPHONE:
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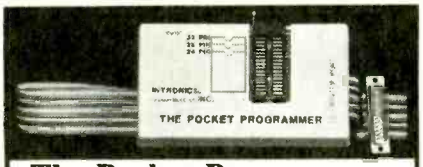

The Pocket Programmer

The portable Eprom programmer that uses the printer port of your PC instead of an internal card. The software has 24 easy to use functions and programs 27/25/28/68764 & Cmos from 16K (2K × 8)—2M (256K × 8) Eproms (32 pin socket, UpGradeable to 8Meg). Adapters available for MCU's, 40-Pin Eproms, 5-Gang and Eprom Emulator to 32K × 8.

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Add $3.00 for shipping.
Add $3.75 for COD.
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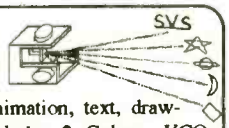
$129* Laser Light Show



This kit displays animation, text, drawings, & music! Includes 2 Galvos, VCO, Computer Interface, Manual & Software listing. Works from parallel printer port.

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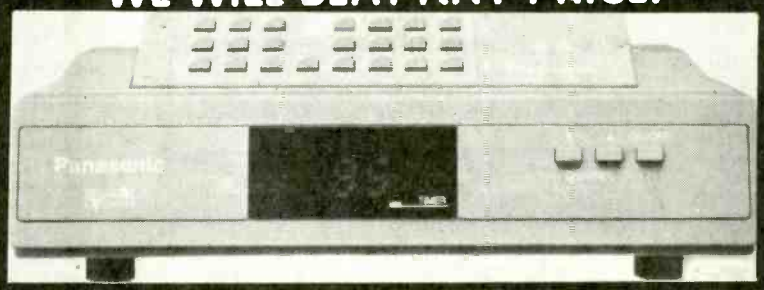

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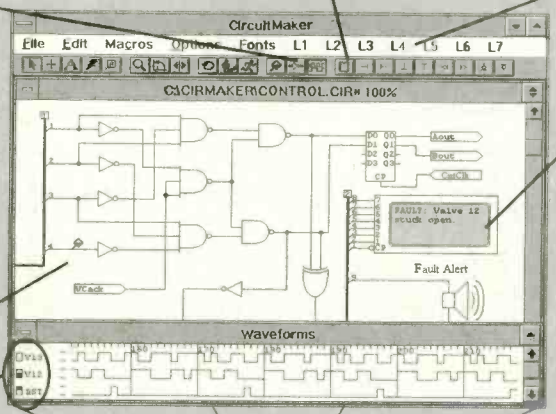

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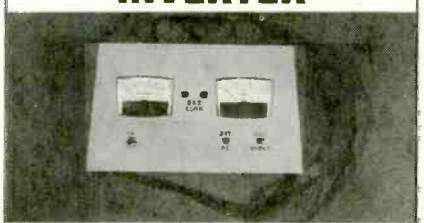

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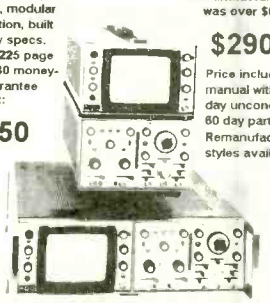
Price includes 225 page service manual with schematics. 30 day unconditional guarantee 60 day parts and labor. Remanufactured. Two cabinet styles available.



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"BULLET" BUSTER. Protect your cable box against the infamous cable "bullet." The "Bullet" Buster acts as an electronic shield. Installs in-line in seconds. Don't wait until it's too late! $19.95 +$3.00 S&H. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

CBTV DOCTOR Stop the Bullet and ID signal in cable lines. Send $20.00 to: R.R. Enterprise, PO Box 3532, Easton, PA 18043.

CABLE UNSCRAMBLED. Everything you wanted to know about cable, but were afraid to ask. $10.00. **Electroman,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

CABLE DOCTOR: Attention: All you cable box owners. Want to watch one channel & record another? I have what you need, send $74.00 to: R. R. Enterprises, PO Box 3532, Easton, PA 18043.

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READ BY 87,877 BUYERS OF ELECTRONIC EQUIPMENT ACCESSORIES AND PARTS

INSTRUCTION FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.00per word. Minimum charge is $15.00 per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT

All classified advertising in the **PE Market Center** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by November 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	**270** — Computer Equipment Wanted	**450** — Ham Gear Wanted	**630** — Repairs-Services
130 — Audio-Video-Lasers	**300** — Computer Hardware	**480** — Miscellaneous Electronics For Sale	**660** — Satellite Equipment
160 — Business Opportunities	**330** — Computer Software	**510** — Miscellaneous Electronics Wanted	**690** — Security
190 — Cable TV	**360** — Education	**540** — Music & Accessories	**710** — Telephone
210 — CB-Scanners	**390** — FAX	**570** — Plans-Kits-Schematics	**720** — Test Equipment
240 — Components	**420** — Ham Gear For Sale	**600** — Publications	

CLASSIFIED AD COPY ORDER FORM

Ad No. 1—Place this ad in Category # _____

1 - $15.00	**2** - $15.00	**3** - $15.00	**4** - $15.00
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Ad No 1—Total words _____ × $1.00 per word = $ _____

All Caps words _____ × .20 per word = $ _____

Bold words _____ × .20 per word = $ _____

Bold Cap words _____ × .40 per word = $ _____

TOTAL COST OF AD No. 1 $ _____

Total classified ad Payment $ _____ enclosed.

[ ] Check [ ] MasterCharge [ ] Visa ($15.00 minimum credit card order)

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Expiration Date _ _ / _ _

Signature _____

Name _____ Phone _____

Address _____ City State Zip _____

ADVERTISING INDEX

POPULAR ELECTRONICS magazine does not assume any responsibility for errors that may appear in the index below.

Countersurveillance

Never before has so much professional information on the art of detecting and eliminating electronic snooping devices—and how to defend against experienced information thieves—been placed in one VHS video. If you are a Fortune 500 CEO, an executive in any hi-tech industry, or a novice seeking entry into an honorable, rewarding field of work in countersurveillance, you must view this video presentation again and again.

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HAVE YOUR VISA or MC CARD AVAILABLE

Wake up! You may be the victim of stolen words—precious ideas that would have made you very wealthy! Yes, professionals, even rank amateurs, may be listening to your most private conversations.

Wake up! If you are not the victim, then you are surrounded by countless victims who need your help if you know how to discover telephone taps, locate bugs, or "sweep" a room clean.

There is a thriving professional service steeped in high-tech techniques that you can become a part of! But first, you must know and understand Countersurveilance Technology. Your very first insight into this highly rewarding field is made possible by a video VHS presentation that you cannot view on broadcast television, satellite, or cable. It presents an informative program prepared by professionals in the field who know their industry, its techniques, kinks and loopholes. Men who can tell you more in 45 minutes in a straightforward, exclusive talk than was ever attempted before.

Foiling Information Thieves

Discover the targets professional snoopers seek out! The prey are stock brokers, arbitrage firms, manufacturers, high-tech companies, any competitive industry, or even small businnesses in the same community. The valuable information they filch may be marketing strategies, customer lists, product formulas, manufacturing techniques, even advertising plans. Information thieves eavesdrop on court decisions, bidding information, financial data. The list is unlimited in the mind of man—especially if he is a thief!

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

Stolen Information

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

CLAGGK INC. **PE**
P.O. Box 4099 • Farmingdale, NY 11735

Please rush my copy of the Countersurveillance Techniques Video VHS Cassette for a total cost of $53.95 each (which includes $4.00 postage and handling)

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Total enclosed _____
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Signature _____
Name _____
Address _____
City _____ State ____ ZIP ____

All payments in U.S.A. funds. Canadians add $4.00 per VHS cassette. No foreign orders.

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

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

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

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

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

The Dollars You Save

To obtain the information contained in the video VHS cassette, you would attend a professional seminar costing $350-750 and possibly pay hundreds of dollars more if you had to travel to a distant city to attend. Now, for only $49.95 (plus $4.00 P&H) you can view ***Countersurveillance Techniques*** at home and take refresher views often. To obtain your copy, complete the coupon or call.

There are copies and then there are originals. Only Fluke meters – the original and most copied DMMs in the world – deliver the safety, quality and value they promise. They're built tough enough to achieve C.S.A. and U.L. listings, not to mention the considerable on-the-job punishment they endure. Each meter is loaded with features, of course. But those features are also designed to work together intelligently, so your job is easier. Faster. And safer.

If you're going to spend your hard-earned money on a multimeter, why buy an inferior copy when you can own an original? See Fluke's full line of handheld meters and accessories at your local distributor; or call 1-800-87 FLUKE for the name and number.

O R I G I N A L S

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