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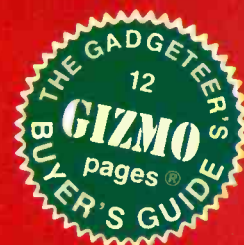
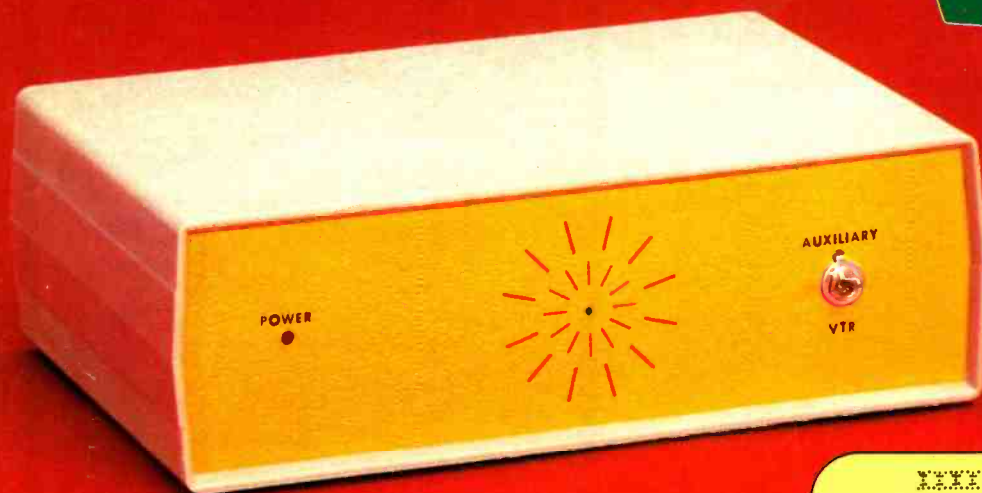


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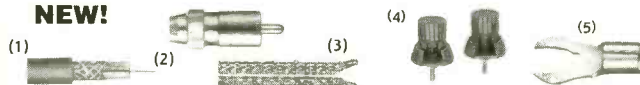
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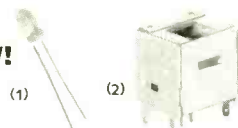
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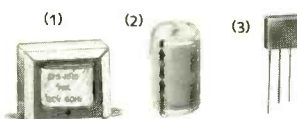
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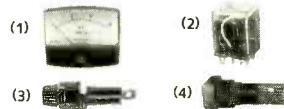
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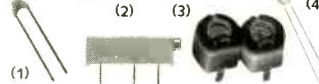
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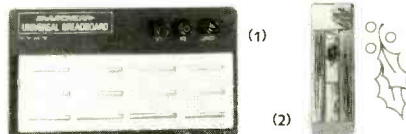


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Editorial

WELCOME BACK!

With this issue, we close out the first full year of the new **Popular Electronics**. It has been an exciting one, to be sure. We've tried a variety of new things and ideas. Some have worked out very well; others, not so well.

On the whole, though, things are looking up. And how do we know that? Because you've told us so!

You've told us through your encouraging letters; a small selection of those have appeared in "Letters" over the past year.

But, perhaps more important, you've told us with your pocketbooks. As of this writing, our circulation is up a dramatic 20% over December of 1988, and is increasing monthly as more and more of you are discovering that your old friend is back.

Thank you for coming back; we'll do our best to never give you a reason to leave.

And this month, we welcome back one of **Popular Electronics'** old friends, Len Feldman. Len is one of the best-known writers in the consumer-electronics field; his work regularly appears in *Video Review*, *Audio*, *Ovation*, and elsewhere. His new **Popular Electronics'** column, "Product Test Reports," will take an in-depth look at the hottest new consumer-electronics products. Along with his colleagues at the Advanced Product Evaluation Laboratories (APEL), Len will give meaning to the sometimes confusing jumble of manufacturer's specifications and help you tell the difference between hype and actual performance.

On behalf of all our readers, Len, we're glad to see you back!

Carl Laron
Managing Editor

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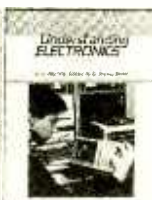
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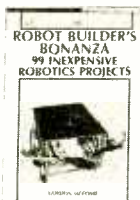
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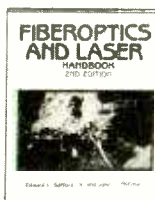
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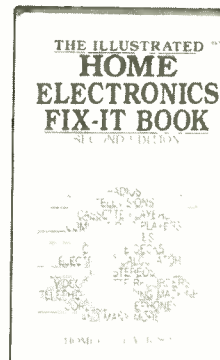
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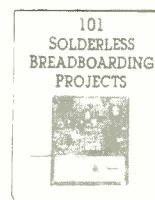
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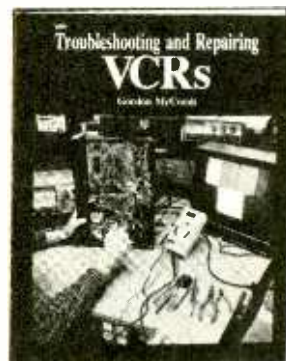


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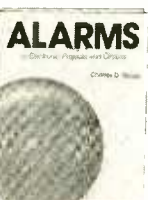
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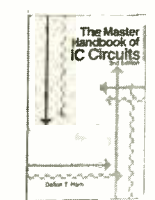
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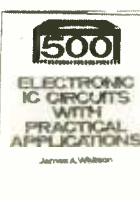
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Letters

NON-SENSE

That doesn't make sense to me! (Editorial, September 1989 **Popular Electronics**) When Zenith's president said, "Tax us to help pay for what we need," he meant *tax you and me* for what *he* needs. The "acknowledged" need for HDTV research-and-development subsidies is highly disputed. Obviously, U.S. taxpayers are soon to be voting with their dollars and opting for Japanese HDTV's. That the U.S. government is paying for Japan's military defense so that the Japanese government can save its money to subsidize HDTV is something that Mr. Pearlman of Zenith ought to take up with Uncle Sam. I'll be glad to join him to stop that dole. I don't want to pay twice for the same TV (once to subsidize the Japanese and once to subsidize Mr. Pearlman).

Let's get efficient for once! *Let's level not only the playing fields but the battlefield!*

By the way, I thought the technical article on HDTV by Robert Angus in that issue was great!

W.J.B.
Palm Bay, FL

FEATHERING WHOSE NEST?

Regarding your editorial in the September 1989 issue of **Popular Electronics**:

Tax us?! The U.S. is the consumer—not His Pompous Majesty, Mr. Pearlman, Chairman and President of Zenith Electronics Corporation. The consumer has traditionally paid for research-and-development costs in the marketplace, on *successful* products.

Now His Highness and others of his ilk would have the consumer pay in advance for dubious R&D that may or may not benefit him or her.

Zenith should use their own capital for R&D, and not the consumer/taxpayer's money. Instead of lauding Mr. Pearlman's devious plan, we should set about heating the tar and gathering the feathers!

E.R.K.
Steger, IL

VOICE-SWITCH ADDENDUM

I inadvertently left out some information regarding the kit for the Voice-Operated Switch (November, 1989). The kit available for \$35.00 postpaid from Pershing Technical Services (P.O. Box 1951, Fort Worth, TX 76101) also includes the 10-MHz crystal, the electret mike element, and all resistors, in addition to all capacitors, semiconductors (except the VCP-200, which is available from Radio Shack), and the transformer as mentioned.

Luther Stroud

TESLA-COIL TIPS

I enjoyed Vincent Vollono's article on the "Square Tesla Coil" (**Popular Electronics**, August 1989). The rotary gap gives more flexibility.

However, I did worry a bit about your stationary-gap detail. The *length* of the 1/2-inch wood dowel was not given. Should it absorb moisture, or should the user be standing on a moist concrete floor, it could be shocking if it is too short. I have used rigid-plastic tubing or a taped acrylic rod with enough heat sink to prevent melting.

Also, I've also found that carriage-bolt heads will rust after some use. Stainless-steel or aluminum machine screws should work better.

R.A. Ford
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KEEP THE CODE

In his editorial in the August 1989 issue of

Popular Electronics, Mr. Martin asked readers for their opinions on "code-free" ham radio, and I'd like to respond.

Since the beginning, the Morse code has been a unique, distinctive trademark of amateur radio. Removing it attracts the lazy and the unmotivated to our wonderful hobby. Let those people have the CB's. I am shocked to find people within the ranks of licensed amateurs working to destroy that which took so long to build.

I held a license some years ago, and have recently rekindled my interest in ham radio. However, if ham radio becomes an expanded citizen's band, why should I take the time to bother with it? I will only be able to tell my children about "... the days when we used to have ham radio."

D.R.S.
Los Lunas, NM

SPEAKER AMP

I recently came across the "Speaker Amp" by Fred Cardwell of Omaha, NE in the February 1989 "Think Tank" column. I would like to say that the circuit works extremely well for individual speaker control.

I have a modest stereo setup in my "shack" that consists of two radios and four speakers. I tried to place them at the four corners of the room to get the best stereo. However, when I'm sitting at my desk one of the speakers is too far away. Rather than adjusting the balance and losing the true stereo effect, I installed the amplifier circuit inside the furthestmost speaker and set the volume to suit.

The results are perfect—even better than I expected! My thanks to Byron Wels and the rest of the staff for a most helpful and informative magazine.

D.L.B.
Phoenix, AZ

ALL SHOOK UP

My granddaughter got all excited about the picture of "Shaky" on the cover of the September issue of **Popular Electronics**. It is a cute idea, so I decided to make it for her.

I found an error that should be brought to the attention of anyone else who's building the project. The schematic in the article is correct, but the parts-placement diagram (Fig. 3 in the article) incorrectly shows LED3—LED12 connected with their anodes common; follow the orientation shown in the schematic when installing those components.

R.B.
Huntington Station, NY

TAPPED COIL CRYSTAL RADIO

My article "Tapped Coil Crystal Radio" (**Popular Electronics**, October 1989) contains a mistake. I should have mentioned in the Parts List that the six metal terminal posts used for the ground, antenna, earphone, and diode connections are *not* included in the mail-order kit from Yeary Communications. However, with or without the terminal posts, the

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style to enhance a corporate image, and then goes on to specifics. It explains how to prepare a manuscript and clarifies typing guidelines. The illustration process is also examined, offering solutions to the problems of naming and locating pictures, marking them in the manuscript, and captioning them. Time-saving pointers on copy editing, proofreading, and indexing are included, and the book illustrates how to format pages by merging text and pictures into a finished document.

A separate section of the book serves as a reference, providing full-scale examples

of the tools and techniques previously described, as well as additional resources. An optional disk includes all of the sample documents.

Managing Desktop Publishing is available for \$9.95 from New Riders Publishing, P.O. Box 4846, Thousand Oaks, CA 91360. The optional "Managing Desktop Publishing" disk costs \$7.95.

CIRCLE 90 ON FREE INFORMATION CARD

BASICS OF ELECTRIC MOTORS: Including Polyphase Induction and Synchronous Motors

by Anthony J. Pansini

Written for anyone involved with electric motors—consumers as well as mechanics, electricians, operators, and maintenance personnel—this book clearly explains their technical aspects in jargon-free text. The book is divided into two parts. In the first, the author describes electric motors—the different types and their characteristics, operation, maintenance, and applications. The second section explains the properties of electricity and magnetism that are associated with electric-motor action.

Specific topics covered include electricity and electromagnetism, direct-current motors, alternating-current polyphase induction motors, AC synchronous motors, single-phase AC motors, construction, and maintenance. Also examined are the elements of electricity, properties of electric circuits, inductive and capacitive impedance, transformers and autotransformers, and electrical measurements. The text is amply illustrated, and includes utility standards and specifications.

Basics of Electric Motors: Including Polyphase Induction and Synchronous Motors is available for \$32.00 from Prentice Hall, Englewood Cliffs, NJ 07632.

CIRCLE 99 ON FREE INFORMATION CARD

USING OS/2

by Caroline Halliday, David Gobel, and Mark Minasi

OS/2, the second-generation operating system for personal computers, can be intimidating to novices and veterans alike, and for a similar reason: fear of the unknown. For those who are complete strangers to computers, this book's early chapters provide a basic introduction to help them get started. Experienced DOS users, reluctant to start from square one with a new operating system, will find helpful information to ease the transition to OS/2.

The book covers OS/2 Standard Edition



V1.1, which includes the Presentation Manager. It provides an overview of PC's and operating systems before explaining the fundamentals of using OS/2. The book describes how to master the essential OS/2 commands; manage files with hierarchical directories; create batch files; manipulate devices, disks, and displays; use the Presentation Manager; and work with the DOS-compatibility box. Once a level of proficiency has been reached, the information on advanced commands and customizing OS/2 that found in later chapters will be especially valuable.

Using OS/2 is available for \$23.95 from Que Corporation, 11711 N. College Ave., Carmel, IN 46032.

CIRCLE 94 ON FREE INFORMATION CARD

FM ATLAS AND STATION DIRECTORY Twelfth Edition

by Bruce F. Elving, Ph.D.

On-the-go FM listeners will find valuable information in this guide to the airwaves. More than 90 pages of maps and—new to this edition—map insert finders make it easy to pinpoint over 6,500 FM stations, both commercial and educational, in the U.S., Canada, and Mexico. The station directories, arranged by geography and frequency, list music formats and stereo and technical data. A special section covers FM boosters and translators. The book includes "non-ID's," as well as stations known to have a Subcarrier at 57, 67, or 92 kHz.

A new section called "FMusings" explores some controversial issues, including abuses by national translator networks, FMX, and the broadcasters' trend to acquire stations in small towns near large cities and promote those as belonging to the cities. The continued gains of FM over AM is discussed, along with ways to improve FM reception. There's an "FMiscellany" section, and another new feature, "FMemoranda" provides room for readers to plan out their listening on upcoming trips.

The FM Atlas and Station Directory

Electronics Library

THE HOMEBUILT DYNAMO

DYNAMO DESIGN AND CONSTRUCTION
WITH CERAMIC MAGNETS
AN ORIGINAL MODULAR DESIGN
BASED ON PRACTICAL EXPERIENCE
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A Picture Diary of Step-by-Step Construction
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and Build at the Home

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The Homebuilt Dynamo: Dynamo Design and Construction with Ceramic Magnets is available in hardcover in the U.S. for \$65.00, including airmail postage, from Todd-Forbes Publishing, P.O. Box 3919, Auckland, New Zealand.

CIRCLE 93 ON FREE INFORMATION CARD

MECHANICAL PARTS CATALOG AND CROSS-REFERENCE GUIDE

from Philips ECG

An expanded line of audio/video parts and accessories—featuring two new belts and nine idler wheels and assemblies for VCR's—is included in this brochure. Also described are the VCR mechanical parts line, including pinch rollers and idler tires; audio and VCR test cassettes, VCR tape-repair kits; tools; lubricating and cleaning materials; VCR replacement heads; and opto-sensing devices. The booklet also contains over 400 cross-reference listings; it is the most comprehensive source for such information in the industry.

The Mechanical Parts Catalog and Cross-Reference Guide is available from Philips ECG, Inc., 100 First Avenue, Waltham, MA 02254; Tel. 1-800-225-8326 (in MA, 617-890-6107).

CIRCLE 101 ON FREE INFORMATION CARD

PORTABLE ELECTRONICS DATA BOOK

by John Douglas-Young

This reference book is designed to quickly put thorough, up-to-the-minute information at the fingertips of those who are well versed in electronics—but can't rattle off every fact and figure from memory. Arranged alphabetically from *Alternating Current* to *Zener Diode*, the "encyclopedia-style" book contains major topics interspersed with minor references and com-

mon abbreviations. The entries are cross-referenced as needed for clarity and ease-of-understanding.

Many of the references include computer programs that may be used to do calculations with dependable results. Those programs are written in BASIC and have been run on IBM, Commodore, TRS80, and other popular computers.

The book's emphasis is on facts and figures, with explanatory text included only on less widely known subjects. There is no basic mathematical instruction; instead, the section entitled "Calculus" contains the standard formulas to use, as well as a computer program to do integration. Another section contains mathematical tables.

The Portable Electronics Data Book is available, cloth-bound, for \$33.00 from Prentice-Hall, Inc., Englewood Cliffs, NJ 07632.

CIRCLE 99 ON FREE INFORMATION CARD

TROUBLESHOOTING AND REPAIRING COMPACT DISC PLAYERS

by Homer L. Davidson

Like any other kind of electronic device, compact-disc players can break down. Having one repaired can be expensive—and knowing how to repair them can be quite profitable. This book, written by an experienced professional, helps you save money and time—or make money and save time—by explaining how to



troubleshoot and fix CD players. It is aimed at electronics students and hobbyists at all levels, as well as practicing technicians who'd like to take advantage of a whole new field in consumer-electronics maintenance.

The book provides a complete guide to CD players, beginning with basic principles and ending with schematic diagrams of home, auto, and portable CD players. In between are discussions on how to clean and care for CD's and descriptions of the signal circuits and servo system, the laser-pickup assembly, motor and control circuits, optical lenses, and remote-control systems. Troubleshooting methods include

practical tips on using test instruments, and valuable service hints are provided.

Troubleshooting and Repairing Compact Disc Players is available for \$17.95 from Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.

CIRCLE 98 ON FREE INFORMATION CARD

MOBILE COMMUNICATIONS SYSTEMS

by J.D. Parsons and
J.G. Gardiner

The world of mobile communications has undergone dramatic changes and increases in use over the past several years. The 1980's have seen the emergence and fast-growing acceptance of analog cellular systems. The demand for mobile telecommunications is growing, and with the future technology of digital systems well defined if not in place, it would appear that the 1990's will see a further boom in the field.

This book, which concentrates exclusively on mobile land radio used by civilians, is aimed at advanced undergraduate and postgraduate students, as well as researchers and practitioners in communications, information technology, and electronics. For readers with little prior knowledge of those fields of technology, an introduction to mobile communications includes background on the properties and characteristics of radio channels with regard to both signals and noise. The propagation of signals and the interference created by the terrain are discussed, with a separate chapter devoted to the subject of propagation in urban areas. The book covers both analog and digital systems, with the emphasis on the latter. Digital techniques associated with two-way speech-based communications systems are discussed, and future developments are considered.

Mobile Communications Systems is available in hardcover for \$44.95 from John Wiley & Sons, Inc., 1 Wiley Drive, Somerset, NJ 08875-1272.

CIRCLE 102 ON FREE INFORMATION CARD

PRACTICAL TRANSFORMER DESIGN HANDBOOK: Second Edition

by Eric Lowden

Essentially a "how-to" guide, this book deals more with the methods used in designing transformers to meet your individual needs than with specific construction projects. It shows how to build power, impedance, and current transformers, taking into consideration both the mechanical and the electrical aspects, so that the finished design will fit together properly. Al-

(Continued on page 12)

Learn to troubleshoot and service today's computer systems as you build a fully XT-compatible micro, complete with 512K RAM and powerful 20 meg hard drive

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Your NRI computer training includes all this: • NRI's unique Discovery Lab® for circuit design and diagnosis • NRI's hand-held digital multimeter featuring "talk-you-through" instructions on audio cassette • A digital logic probe that lets you visually examine computer circuits • The new Packard Bell VX88 computer with "intelligent" keyboard, 360K double-sided, double-density disk drive, 512K RAM, 16K ROM • 20 megabyte hard disk drive • Bundled software including MS-DOS, GW-BASIC, word processing, spreadsheet, and database programs • Packard Bell reference manuals with programming guidelines and schematics.



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Jobs for computer service technicians will almost double in the next 10 years according to Department of Labor statistics, making computer service one of the top 10 growth fields in the nation.

Now you can cash in on this exciting opportunity—either as a full-time industry technician or in a computer service business of your own—once you've mastered electronics and computers the NRI way.

NRI's practical combination of "reason-why" theory and hands-on building skills starts you with the fundamentals of electronics, then guides you through more sophisticated circuitry all the way up to the latest advances in computer technology. You even learn to program in BASIC and machine language, the essential language for troubleshooting and repair.

Get Real-World Skills as You Train With a Powerful XT-Compatible Micro—Now With 20 Meg Hard Drive!

To give you hands-on training with the absolute in state-of-the-art computer technology, NRI includes the powerful new Packard Bell VX88 computer as the centerpiece of your training. As you assemble this fully IBM XT-compatible micro from the keyboard up, you actually see for yourself how every section of your computer works.

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peripheral—now included in your course to dramatically increase the data storage capacity of your computer while giving you lightning-quick data access. Plus you work with exclusive word processing, database, and spreadsheet software, yours to use for your own professional and personal applications.

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No classroom pressures, no night school, no need to quit your present job until you're ready to make your move. And all throughout your training, you've got the full support of your personal NRI instructor and the NRI technical staff, always ready to answer your questions and help you whenever you need it.

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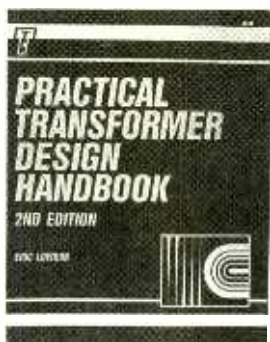
Accredited Member National Home Study Council

18-129

Electronics Library

(Continued from page 8)

though the book contains material at professional and academic levels, it is written for anyone with an interest in transformers—from hobbyists and experimenters to lab technicians and circuit designers. Designed to be easy to follow, the book presents information at various levels of complexity; the reader can choose how far to delve. For example, while only elementary algebra and arithmetic are used—no calculus—the author sometimes develops an idea along mathematical lines. You can opt to follow along, or to skip to the final answer. A mathematical tutorial is in-



cluded, and the working formulas are gathered together in one chapter. There is also a short refresher course in the general theory of electromagnetics.

The book explores how to test transformers, and how to build transformers from salvaged parts. Also covered are losses, the core, windings, off-the-shelf transformers, and new developments in transformer design.

Practical Transformer Design Handbook: Second Edition is available in hardcover for \$34.95 from Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.

CIRCLE 98 ON FREE INFORMATION CARD

TOOLS AND ACCESSORIES CATALOG

from Paladin Corporation

Paladin's complete line of West German-made tools and accessories is depicted in a 152-page, full-color catalog. The brochure contains product shots, application photos, and diagrams that explain the features and advantages of each product.

The catalog includes sections devoted to each of the following applications: electronic production, screwdrivers, electrical/

industrial, cable preparation, telecommunications, and connectors. A special section of the catalog is devoted to new products, including insulated safety tools and power transmission tools. To help the user find the correct tools needed for each application, the catalog includes extensive cross-references.

The Tools and Accessories Catalog is free upon request from Paladin Corporation, 3543 Old Conejo Road, Suite 102, Newbury Park, CA 91320; Tel. 805-499-0318.

CIRCLE 103 ON FREE INFORMATION CARD

USING VIDEO IN YOUR HOME

by Gordon McComb

Today's home-video systems can be as basic as a TV and a VCR, but once you start adding video cameras, cable or satellite systems, video processors, antennas, video selectors, audio processors, and other equipment, getting the whole setup to work correctly can be a nightmare. This book aims at reducing the confusion surrounding how to use, install, connect, and maintain video systems—whatever their level of complexity.

In plain English, accompanied by clear illustrations, the book explains what you need to know before purchasing video equipment—the basics of how individual



components work and how you can put together a system that works for you. Once you get all the parts home, it describes the connectors, cables, and system interconnections needed to make the components mesh properly, for systems with as many as five sources and three outputs. A troubleshooting guide and a special section on VCR care are also included.

Using Video in Your Home costs \$12.95 (plus \$1.50 shipping and handling) from Master Publishing Inc., 14 Canyon Creek Village, M/S-31, Richardson, TX 75080. ■

CIRCLE 104 ON FREE INFORMATION CARD



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CIRCLE 17 ON FREE INFORMATION CARD



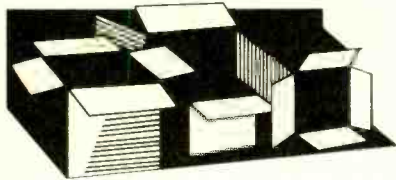
One tree can make
3,000,000 matches.



One match can burn
3,000,000 trees.



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New Products

To obtain additional information on new products covered in this section from the manufacturer, please circle the item's code number on the Free Information Card

PERSONAL COMPUTER

Available in either dual-floppy-disk or floppy-and hard-disk drive configurations, the *Apex 100* personal computer from *Epson America* offers flexible PC/XT compatibility and includes a bundled software package. It has an 8088-10 microprocessor, selectable 4.77- or 10-MHz clock speeds, a 20-bit address bus, and an 8-bit data bus. The computer offers 640K RAM on its main system board with 120-ns ac

cess time and zero wait state. The floppy-disk controller supports multiple formats: 5 1/4- and 3 1/2-inch disks. Each computer comes with an AT-style, detachable, 3-position keyboard with 10 function keys. The built-in multi-graphics video board supports CGA, monochrome, and Hercules modes. Standard interfaces include an external game port, as well as a Centronics-compatible parallel port and an RS-232C-compatible serial port, both with DB-25 connectors.

The *Apex 100* comes with PFS: First Choice integrated software, which includes a spell checker, a thesaurus, an electronic spreadsheet, data management, electronic communications, and business graphics. MS DOS 3.3 is also included.

In its standard configuration, the dual-



floppy-disk drive has two 5 1/4-inch half-height drives with 360-KB storage capacity each. The floppy- and hard-disk configuration has a 5 1/4-inch half-height floppy drive with 360 KB and a 3 1/2-inch half-height hard-disk drive with 20-MB storage capacity.

The *Apex 100* personal computer has a suggested retail price of \$1,199.99 in its dual-floppy configuration, and \$1,599.99 with floppy- and hard-disk drives. A 12-inch monochrome and a 13-inch color monitor are available optionally for \$149.00 and \$449.00, respectively. For more information, contact Epson America, Inc., 23530 Hawthorne Blvd., Torrance, CA 90505.

CIRCLE 75 ON FREE INFORMATION CARD

PORTABLE AUDIO

Variety is the word—*Sanyo* offers consumers a choice of portable audio products. The *MGR90* (pictured) is a mini-sized stereo radio/cassette player that combines "fashion-conscious styling" with portable technology. Digital tuning locks onto a station's frequency to assure clear, drift-free reception. The radio has 12 preset stations



EMINENCE



MOTOROLA

Polydax

PIONEER

1-800-338-0531

3-WAY 100W CROSSOVER

12 dB/octave rolloff. 800Hz, 5000Hz crossover points. 8 ohm. 100 watts RMS.



#260-210 \$12.50 (1-9) \$9.95 (10-up)

SPEAKER CONTROL PANEL

Panel with 50 watt L-pads for tweeter and midrange and built-in LED power meter. 5" x 2 1/2" 100 watt version available



#260-235 \$14.50 (1-5) \$12.90 (6-up)

12" POLY WOOFER

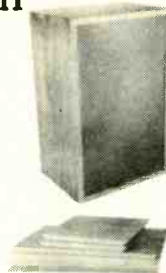
Super duty, 40 oz. magnet. 100 watts RMS, 145 watts max. 4 and 8 ohm compatible (6 ohm). 2" voice coil. fs = 25 Hz. QTS = .166, VAS = 10.8 cu ft. Response: 25-1500 Hz. Net weight: 9 lbs. Pioneer #A30GU40-51D



#290-125 \$36.80 (1-3) \$34.50 (4-up)

WALNUT SPEAKER CABINET KIT

Super quality, genuine walnut veneer cabinet. Kit includes: routed and mitred top, sides, and bottom in unfinished 3/4" walnut veneer. Cut your own custom holes in the front and rear to match your drivers. 15" x 24" x 11". Volume: 1.9 cubic feet.



#260-350 \$22.50 (1-3) \$19.95 (4-up)

PIONEER HORN TWEETER

Mylar dome. 2.93 oz. barium ferrite magnet. 8 ohm. Response: 1800-20000 Hz. 35W RMS, 50W max. fs = 2000 Hz. SPL = 106 dB. Pioneer #AHE60-51F



#270-050 \$6.50 (1-9) \$5.90 (10-up)

12" SUB WOOFER

Dual voice coil sub woofer. 30 oz. magnet, 2" voice coils. 100 watts RMS, 145 watts max. fs = 25 Hz. 6 ohm (4 and 8 ohm compatible). SPL = 89 dB 1W/1M. Response: 25-700 Hz. QTS = .31, VAS = 10.3 cu. ft. Pioneer #A30GU30-55D. Net weight: 6 lbs.



#290-145 \$39.80 (1-3) \$36.80 (4-up)

15" THRUSTER WOOFER

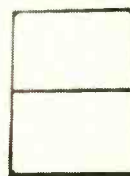
Thruster by Eminence. Made in USA. Poly foam surround, 56 oz. magnet. 2-1/2", 2 layer voice coil. 150 watts RMS, 210 watts max. 4 ohm. fs = 23.5 Hz. QTS = .33, VAS = 17.9 cu ft. SPL = 94.8 dB 1W/1M. Net weight: 15 lbs.



#290-180 \$43.50 (1-3) \$39.80 (4-up)

GRILL FRAME KIT

With this kit you can make speaker grill frames up to 30" x 40". Kit includes 4 corner pieces, 2 "T" brackets, and 7 frame bars. Grill mounting kit included.



#260-333 \$8.50 (1-9) \$7.80 (10-up)

18" EMINENCE WOOFER

MADE IN USA

100 oz. magnet, 3" voice coil. 250 watts RMS, 350 watts max. 8 ohm, 30 Hz resonant frequency. 22-2700 Hz response. Efficiency: 95 dB 1W/1M. Paper cone, treated accordion surround. Net weight: 29 lbs.



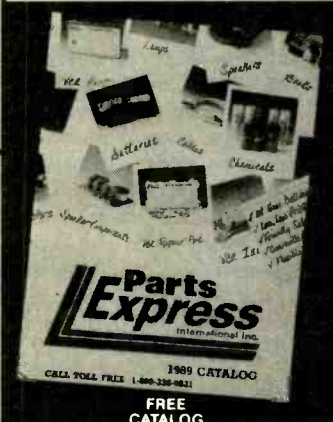
#290-200 \$98.90 (1-3) \$89.50 (4-up)

TITANIUM COMPOSITE TWEETER

Titanium is deposited on a polymer dome to combine the advantages of both hard and soft dome technologies. 8 ohm. Ferro fluid cooled voice coil. fs = 1200 Hz. SPL = 90 dB 1W/1M. 90 watts RMS. 70 watts max. 4" round. Polydax part #DTW100T125.



#270-047 \$27.50 (1-9) \$24.80 (10-up)



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CIRCLE 10 ON FREE INFORMATION CARD

New Products

(9 FM/3 AM) spread over three bands, so that different types of stations can be grouped for quick, convenient tuning. The MGR90 also features auto-reverse, a 3-band graphic equalizer, and automatic and manual tuning.

For the economy-minded listener, the MGR78 is an AM/FM stereo cassette player with 3-band equalizer, 4-button control, adjustable headphones, a detachable belt clip, and AC/DC operation. The MW708 portable double-cassette deck offers two tape-transport modes for high-speed dubbing and longer listening pleas-



ure. Tape features include one-touch recording, play-only in Deck A and record in Deck B, and auto stop. The MW708 also has an AM/FM-stereo radio, stereo-headphone jack, tone control, automatic level control, and AC/DC operation.

The suggested retail prices for the MGR90, the MGR78, and the MW708 are \$89.95, \$29.95, and \$49.95, respectively. For further information, contact Sanyo Fisher (USA) Corporation, 21350 Lassen Street, Chatsworth, CA 91311-2329.

CIRCLE 76 ON FREE INFORMATION CARD

SWEEP/FUNCTION GENERATOR

As an added bonus B&K-PRECISION'S model 3026 sweep/function generator has a built-in frequency counter. The versatile 0.5 - 5-MHz signal source also features internal or external AM modulation; variable, DC-offset, internal or external gated-burst operation; three calibrated steps, and variable attenuators.

The sweep generator offers fully variable sweep width and rate as well as a sweep ramp output for oscilloscope sync. The sine-wave, square-wave, and triangle-wave outputs are available with normal or inverted polarity selection and variable duty-cycle control. The 3026 can also gen-



erate ramp and pulse signals. With the unit's separate TTL output, the correct output level is obtained without time-consuming set-up adjustments.

The 3026's 5-digit LED display can be used to indicate output frequency or to measure external signals to 10 MHz. Four selectable gating times are available in the external-counter mode.

The model 3026 sweep/function generator has a suggested user price of \$596.00. For further information, contact B&K-PRECISION, Maxtec International Corporation, 6470 West Cortland Street, Chicago, IL 60635.

CIRCLE 77 ON FREE INFORMATION CARD

INFRARED WIRELESS HEADPHONES

Providing high-quality sound with freedom of movement and comfort, Bondwell's BW-2800 infrared wireless headphone system transmits full-frequency sound with minimal distortion. It adapts to any radio, television, or VCR with a standard headphone jack.

The system's sleek base transmitter features a 9-volt battery-recharge circuit, a DC adapter and jack, a phone jack, power-on/off control, a mono-cable plug, and a charge indicator. The wireless headphone



receiver has a 9-volt rechargeable battery, an on/off control, and a volume control.

The BW-2800 infrared wireless headphone system has a suggested retail price of \$79.00. For more information, contact Bondwell Industrial Co. Inc., 47485 Seabridge Drive, Fremont, CA 94538.

CIRCLE 78 ON FREE INFORMATION CARD

AUTOMOBILE ALARM

Providing security but requiring no installation, CarCop portable auto alarm from

Kansas Microtech can be mounted on a vehicle's window in seconds. Based on a patented motion- and vibration-sensing technology, it will sense any disturbance to the vehicle and sound a piercing 105-dB alarm. The completely portable unit runs on a 9-volt alkaline battery and can be moved from one vehicle to another as needed.

Window-mounted, the CarCop is a highly visible deterrent to would-be thieves. The compact, self-contained system is simple to use. It slips over the top



of an open window, with the alarm on the outside and the main unit inside the car. To "arm" the unit, set the door locks, switch the CarCop "on," and roll up the window. Unlocking the car disarms the unit, which can be stored in the glove compartment when not in use.

The CarCop portable auto alarm has a suggested list price of \$149.95. For additional information, contact Kansas Microtech, Inc., 7300 West 110th Street, Suite 990, Overland Park, KS 66210.

CIRCLE 79 ON FREE INFORMATION CARD



"Sorry guys, we were bought out by an electronics conglomerate"

MULTI-ROOM REMOTE CONTROL

Extending remote control to other rooms of the house, Sansui's RemoteRemote system (model IR-1000U) comes as a complete kit that you can install to suit your needs. All the functions that your audio or video system's regular remote operates can be controlled from another room via the RemoteRemote. Additional rooms can be wired using individual elements, which are sold separately.

The system—which consists of a receptor to be installed at the remote location, an infrared sender to be placed with the main equipment, 50 feet of wire, and a 9-volt-battery power supply—lets you operate your main audio or video system from anywhere in the house, using its regular



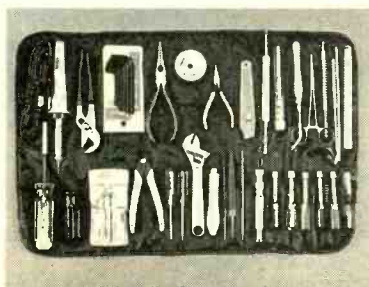
remote control. The sender is affixed to the top or bottom of the main unit, in line with the main unit's remote sensor. At the remote location, the receptor can be placed on a bookshelf or piece of furniture that is in plain view. Because the system uses hard wire to transmit the signal, it can also be installed out of sight in a closet or other concealed location.

The RemoteRemote system has a suggested retail price of \$60.00. (Professional installers can purchase separate system components at bulk prices.) For additional information, contact Sansui Electronics Corporation, 1250 Valley Brook Avenue, Lyndhurst, NJ 07071.

CIRCLE 80 ON FREE INFORMATION CARD

ROLL-POUCH TOOL KIT

Containing 39 basic tools needed for electronics work—including electromechanical instrumentation—Contact East's model RP3926 tool kit rolls up to just 3×13 inches and is secured with an elastic tie band. The kit includes an assortment of pliers, cutters, and fastening tools that are



commonly used to access and maintain electronic equipment. A voltage-tester screwdriver, which detects the presence of voltages from 80–330 volts AC, comes with the kit. A complete set of professional soldering tools is also included. The rugged pouch is made of reinforced, fabric-backed vinyl, has 26 pockets, and rolls open to 13×21 inches.

The model RP3926 roll-pouch tool kit costs \$115.00. For further information, write to Contact East, 335 Willow Street South, P.O. Box 786, North Andover, MA 01845.

CIRCLE 81 ON FREE INFORMATION CARD

"ANTENNA-LESS" CORDLESS PHONE

Featuring a sophisticated internal antenna system built into its handset, Cobra's Intenna line of cordless telephones eliminate awkward external telescoping antennas. The internal antenna system is based on an ultra-thin, metallic-plate antenna that is matched to the microprocessor-based cordless system and electronically fine-tuned to produce full-power output comparable to that of standard cordless phones with external handset antennas. The Intenna phones have Cobra's "Clear Call

Circuitry" for optimum sound, as well as digital security coding to prevent interference from other cordless phones and "Secur-Loc" to protect against unauthorized use of a phone line.

The Intenna line includes the basic model CP-480 (pictured), which features



base-to-handset paging, switchable tone/pulse dialing, and consumer-replaceable batteries. The model CP-482 adds a 9-number memory, electronic hold, and a base-to-handset intercom system. The premium Intenna model CP-485 offers two additional features—electronic channel

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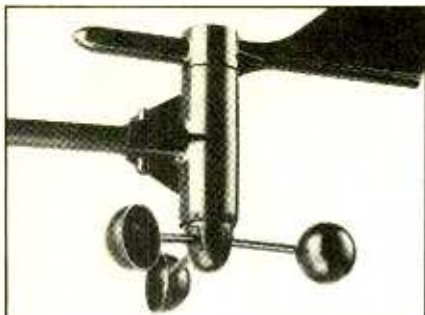
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advance that advances through three different channels to allow selection of the clearest one for every call, and a high-quality speaker phone that works with the unit's hands-free two-way intercom.

The Intenna models CP-480, CP-482, and CP-485 have suggested retail prices of \$129.95, \$179.95, and \$229.95, respectively. For further information, contact Cobra Electronics Group, Dynascan Corporation, 6500 West Cortland Street, Chicago, IL 60635.

CIRCLE 82 ON FREE INFORMATION CARD

SYNTHESIZED FREQUENCY SOURCE

Featuring 10-ppm or 0.001% accuracy and stability over its 1-Hz – 100-kHz frequency range, Teledata Systems' **WAVEBOX 100** typically performs at three orders of magnitude better than most other signal sources in its price range. The benchtop synthesized frequency source is well suited for production and educational applications including power, audio, telecommunications, and ultrasonic-frequency testing.

The output frequency is dialed up directly on thumbwheel switches for accu-



rate ease of use. Resolution is 1 Hz over the entire range, and the sinewave output is variable up to 20-volts peak-to-peak with a ± 10 -volt offset. Total harmonic and non-harmonic distortion is better than 40 dB. The instrument also provides an auxiliary TTL/CMOS level square-wave output.

The **WAVEBOX 100** synthesized frequency source costs \$325.00. For further information, contact Teledata Systems, 68 Reservoir Road, New Milford, CT 06776.

CIRCLE 83 ON FREE INFORMATION CARD

VIDEO LIGHT

ToCAD America's **CV-300 Sunpak** portable camcorder light offers automatic exposure control of the light's output. Light output is regulated for close distances, adjusting at ranges of 10 feet or closer, to provide improved detail and color up to 30 feet away while eliminating the harsh glare that causes subjects to squint. The video light has two output-control positions: Automatic provides 18–30 watts, and manual outputs 30 watts only.

The cordless Sunpak allows shooting



times as long as 36 minutes. An extra Ni-Cad battery module provides more running time if needed. The removable battery takes a 2-hour charge and has a built-in circuit breaker to prevent overcharging.

The Sunpak CV-300 video light has a suggested retail price of \$269.95. For more information, contact Sunpak/ToCAD America, Inc., 401 Hackensack Avenue, Hackensack, NJ 07601.

CIRCLE 84 ON FREE INFORMATION CARD

DIGITAL MULTIMETERS

Two hand-held digital multimeters from Carlo Gavazzi Instruments offer LSI design technology; rugged, industrial-rated cases; and 3200-count, full-scale, analog bar-graph displays. The **SOAR 3255** and **SOAR 3250 DMM's** also provide a range of advanced features for testing automated office and plant equipment. Both models incorporate such functions as automatic or manual range selection, temperature test, ADP mode, Data Hold, high-speed sampling for the 32-segment bar-graph display, and high-speed autoranging—up and down, 6 per second.

The **SOAR 3255** comes in a lightweight, high-impact, yellow case that is water-



proof, dust proof, and shock and heat resistant. The **SOAR 3250** is encased in a rugged, industrial-type dust-proof case. Each unit measures $3\frac{1}{2} \times 7\frac{3}{8} \times 1\frac{3}{4}$ inches and weighs 1½ pounds with batteries. The instruments each come with a set of test leads, two AAA batteries, a spare fuse, and an instruction manual.

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accuracy. Current measurements range from 300µA to 10A, AC/DC. DC-voltage measurements range from 3mV to 1,000V; AC voltage ranges from 3V to 750V. Both devices use the dual-slope integration measuring method.

Suggested retail prices for the SOAR 3250 and the SOAR 3255 are \$129.95 and \$144.95, respectively. For further information, contact Carlo Gavazzi Instruments Corporation, 434 Windsor Park Drive, Dayton, OH 45459.

CIRCLE 85 ON FREE INFORMATION CARD

TITLER/CHARACTER GENERATOR

Making its U.S. debut is the VideoScript 50, from the German photo- and video-accessory manufacturer, Hama. The video titler and character generator can create up to 72 lines of text and insert them into either live video recordings or existing videotape recordings. It works with 8mm, VHS, and VHS-C camcorders and VCR's.

The VideoScript 50's typewriter-style keyboard is used to create characters, numbers, and letters. It can make upper- and lower-case letters in two type fonts (Helvetica and Eurostyle) and four character sizes. It can use eight different colors, including black and white, for characters and background.

Additional accessory keys are used to program the screens and to create patterns, designs, and graphics. Nineteen graphics symbols can be mixed and matched into a wide array of designs. The additional keys are also used for special



effects such as vertical or horizontal scrolling. Solid color "wipes" can be created vertically or horizontally in 16 speeds and 8 colors. The "window" function sections off a portion of the screen, which can be wiped from 4 directions. The "key effect" displays a solid background color with "cut-out" characters or symbols through which screen action can be viewed. Words or graphics can be made to flash in 16 speeds. A digital timer can be generated anywhere on the screen.

The VideoScript 50 has a suggested retail price of \$1,049.95. For additional information, contact Photo Systems Inc., 7200 Huron River Drive, Dexter, MI 48130; or Dot Line Corp., 11916 Valerio Street, North Hollywood, CA 91605.

CIRCLE 86 ON FREE INFORMATION CARD

PORTABLE COPIER/DIGITIZER

At the heart of Ricoh's Portable Digital Information System (PDIS) is the MC50 portable copier and digitizer. The complete system allows users to scan a document, make copies of it, modify it, store it in internal memory or in a computer, and fax the information to any G3-compatible unit.

The MC50, a flatbed-scanner copier, is placed directly on top of the original—which can be checked for proper place-

ment through the unit's viewing glass—and scans without being rolled over the original. The result is a distortion-free, 37/8- × 61/2-inch copy that is fed out in seconds. The MC50 accepts either thermal paper rolls or plain-paper or transparent sheets. Measuring only 12 × 6 × 13/4 inches; powered by AC, an included NiCd battery pack, or an optional 12-volt DC car converter; and weighing only 3 pounds including battery, the MC50 is easily portable.

The other system components are the

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New Products

IM-A image-controller/scanner module and the IM-F50 facsimile-transceiver module. With the IM-A module connected to the MC50, the user can scan the image data into an IBM PC or compatible, using a standard RS-232 interface. The IM-A module also lets the user reduce or enlarge the original or specific portions of it, copy half-tones, produce mirror-reversed images, and transform black copy to white



and vice versa. The IM-F50 is a half-duplex portable transceiver/telephone adaptor that transmits data at 4800 BPS when a modular jack is used. Large-size documents transmitted to the IM-F50 are automatically reduced in width to 4 inches and then printed out on the MC50.

The MC50 copier has a suggested retail price of \$540.00. The IM-A image controller/scanner module and the IM-F50 fax module have suggested retail prices of \$510.00 and \$540.00, respectively. For more information, contact Ricoh Consumer Products Group, 155 Passaic Avenue, Fairfield, NJ 07006.

CIRCLE 73 ON FREE INFORMATION CARD

IC TESTER

The second-generation *Chiptester* digital integrated-circuit identifier and tester from *Precision Motion* gives non-technical people the ability to repair complex digital circuitry. The easy-to-use instrument will test most TTL and CMOS digital IC's, as well as 4164, 41256, and 2114 RAM chips. It automatically adjusts for TTL or CMOS



load conditions. Standard, open-collector, and tri-state outputs are tested. Most chips can be identified and tested in a fraction of a second, although the RAM-chip test takes 20–80 seconds.

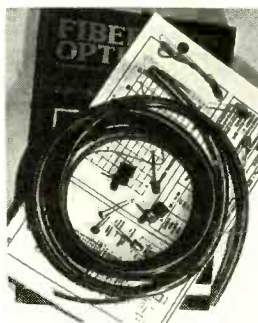
Operation is fully automatic; there is nothing to set. The part to be tested is plugged into the zero-insertion-force socket, and its identity is shown on a 4-digit display. If, for example, a 74LS395 was plugged into the socket, the readout would be "395" if the chip was good, or if it was bad. The handheld Chiptester includes a regulated power supply and comes with a concise manual.

The Chiptester has a suggested price of \$277.00. For additional information, contact Precision Motion, 3563 Sueldo Ct. Building J, San Luis Obispo, CA 9340. For placing orders only, call 800-373-9703.

CIRCLE 88 ON FREE INFORMATION CARD

FIBER-OPTIC KITS

Providing hands-on learning experiences through projects and experiments, a variety of *Fiber-Optic Kits* from *Sintec* present the latest theory and practice in fiber-optics communication links. The kits cover subjects such as light pipes, multitone modulation of digital transmissions, an AM fiber-optic receiver, a fiber-optic light-open cable, single or bi-directional communications, and digital data links. The kits include hardware—emitters, detectors, the necessary electronics parts, simplex and



duplex cable, and connectors—as well as easy-to-follow instructions and well-illustrated manuals.

The fiber-optic kits range in price from \$19.95 to \$54.95. (Teachers with quantity orders are eligible for discounts.) For additional information, contact Sintec Company, 28 8th Street, P.O. Box 410, Frenchtown, NJ 08825.

CIRCLE 89 ON FREE INFORMATION CARD

REMOTE MINI SPEAKER/AMP

Goodmans, an English high-fidelity audio-component manufacturer specializing in

miniature designs, has introduced its line on this side of the Atlantic. Their *Maxamp Remote* loudspeaker, which measures only 10 1/4 x 6 3/4 x 8 inches, includes a built-in 25-watt amplifier with its own infrared receiver. A full range of operations—volume, mute, left/right channel, and treble/bass balance—can be operated by its hand-held remote control.

When used with portable audio sources such as personal stereos, tape players, or



CD players, the Maxamp loudspeakers provide enhanced power-handling capabilities, high-fidelity sound, and the convenience of remote operation. The speakers can also be used with home entertainment equipment, including CD players and stereo TV's and VCR's; electronic keyboards and musical instruments; and paging systems. Optional accessories include a carrying case with pockets designed to carry Goodman's personal CD player and CD's, and "Performance Points"—mini spikes that act as speaker stands.

Maxamp loudspeakers have a suggested retail price of \$475.00 per pair. For additional information, contact Goodmans of England, 1225 17th Street, Suite 1430, Denver, CO 80202.

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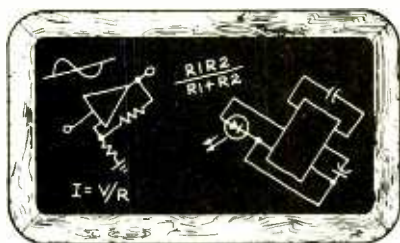
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Think Tank

THE CHANGES KEEP COMING

One of my favorite duties each month is writing this column and talking to you guys. But this month, I've got some pretty-heavy stuff to go over. Those of you who come from my own generation of electronics, will surely understand that things change fast in the electronics industry. We've had to learn to keep up or drop by the wayside.

I can remember a scant 10 years or so ago, I was at lunch with a man who's a respected member of the electronics community, and who is a genuine *mavin* when it comes to computers. He used to get calls from some of the top companies with problems, and he could solve those problems with a 10-minute conversation on the phone.

At that lunch, he looked depressed, and I asked him why. His answer floored me! "Things are changing too fast, Byron," he said. "It's getting away from me, and I just can't keep up with it anymore." Now let me tell you, if *that* man couldn't keep up, how can any of us?

There *is* an answer. But don't you younger experimenters start to get complacent! I can assure you that even if you are on the cutting edge of technology today, the time is going to come when you too will be astonished at how time has flown, and the latest in technology is going to start getting away from you! Just as those of us who were raised on vacuum tubes marvel at the myriad IC's, you will wonder and try to keep up with whatever the future brings.

Fortunately for us all, there is a way to keep up with technology. You're holding the answer in your hands right now. Magazines such as **Popular Electronics** can keep you up-to-date. Read each and every issue, study the magazine, and drink in each and every word. (Don't just scan it and put it aside.) Do that and you can rest assured that you'll be right there when the next technological explosion takes place.

Now let's check the mail bag and see what the immediate future holds.

By Byron G. Wels

Train Throttle Control. What makes this control unique is its momentum feature, which adds a degree of realism. I use a model train at my bar to deliver drinks without spilling them. The train draws about 0.5 ampere at 8 volts, but the circuit will operate well for trains drawing up to 1 ampere at 15 volts. None of the components are critical.

Here's how it works (see Fig. 1). In the start mode, current source Q1 charges capacitor C1. The charge current and start-up time are adjusted by resistor R2. In the stop mode, current-sink Q2 discharges capacitor C1. The discharge current and stop time are set by resistor R4. In the coast mode, op-amp U1 draws very little current from C1, so the speed will remain nearly constant for some time, and then gradually decrease. Transistors Q3 and Q4 form a Darlington emitter follower to amplify the output of U1. Diode D7 reduces the output by about 0.8 volt. Another diode

could be added in series to decrease output to 0 in the stop mode.

With a 12-volt power pack, the output varies between 0.2 and 9.3 volts. Why not use a resistor to charge and discharge C1? Use of a current source/sink produces a linear voltage ramp on C1. If a resistor is used, the voltage ramp is exponential, which is poor for control of train speed.

—Craig Sharp, Pardeeville, WI

Thank you Craig, for the excellent (and different) idea, as well as the thorough explanation. Craig also sent in the following idea, and we're rewarding him not just with a copy of the *Fips Book*, but a copy of the *Think Tank* book as well. Hope you enjoy both.

BCB Booster. This preamplifying device (see Fig. 2) turns your AM radio into a real signal puller. Build the amplifier first, then connect it to a receiver. Put the pick-up loop on the toroid coil form, and the receiver can now be used to zero in on the number of coil turns necessary to tune the broadcast band with the tuning capacitor and the coil form used. You can salvage the tuning capacitor and antenna loop from any junked AM radio.

You can build the output transformer on a piece of ferrite rod from an old transistor-radio antenna. However, should you elect to go that route, you'll have to use more turns than those specified for the suggested toroid core.

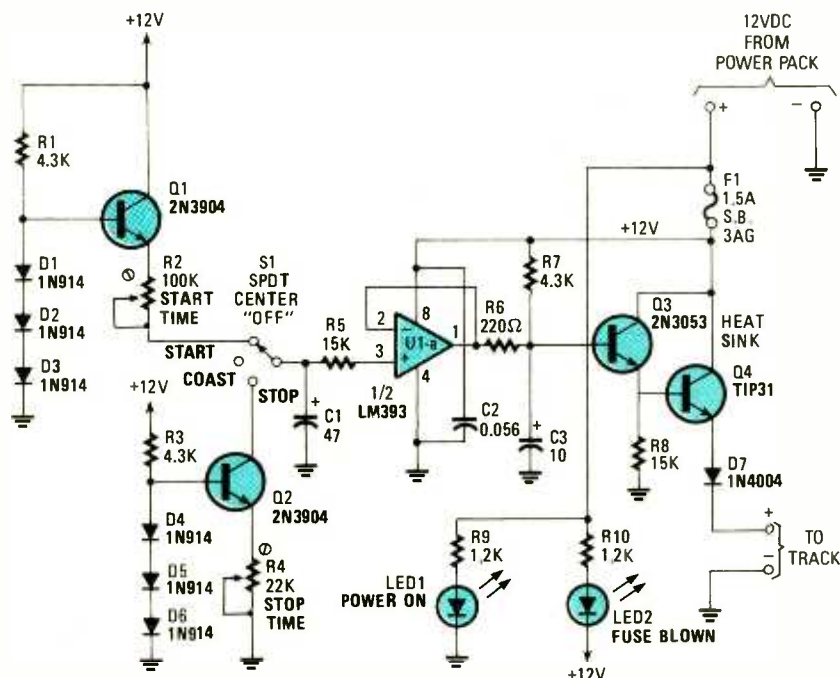


Fig. 1. The Train Throttle Control—which provides three operational modes; start, coast, and off—is built around a single op-amp IC and a handful of transistors.

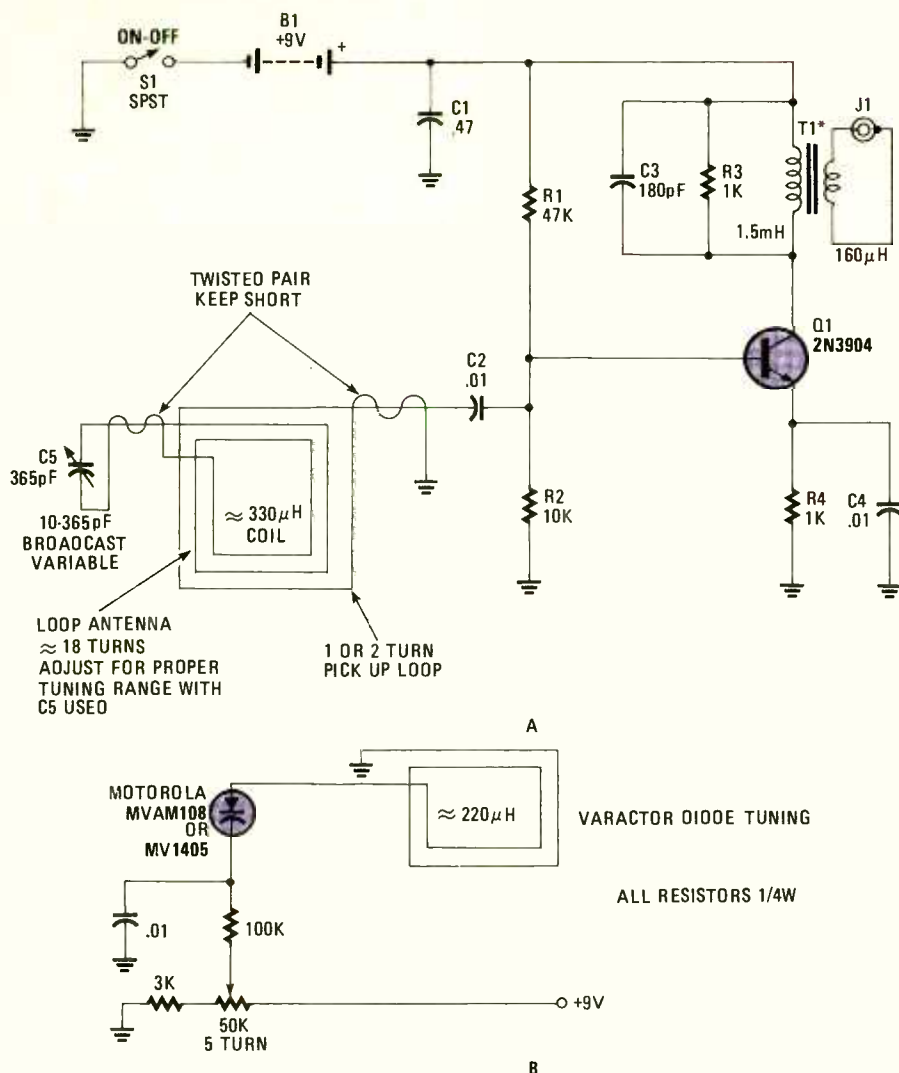


Fig. 2. The BCB Booster, a preamplifier circuit, turns almost any basic AM radio into a real signal puller.

The output transformer can be replaced with an emitter-follower stage, but then you pay a penalty of increased battery drain. Two variations of the circuit have been tried. The pick-up loop and amplifier were removed and the loop antenna used as a passive booster with a small, hand-held radio with good results. An additional one-turn loop was placed on the antenna coil to couple a long-wire antenna. I have built a couple of those for friends and all reported excellent results. The most-noticeable improvement appears to be on expensive stereo receivers, which seem to consider AM radio almost as an afterthought.

Here are some additional thoughts on that idea: An additional 1-turn loop may be used to couple a long-wire antenna to the circuit allowing it to be used as a preamp. Placement of the antenna next to the receiver may cause instability. Use about three feet of

coaxial cable to separate the antenna from the receiver.

While it isn't at all critical, select a value for capacitor C3 to roll off gain above the broadcast band. The unit will work without C3, but then the receiver may develop image rejection problems. If you like, tuning capacitor C5 and the amplifier can be built into the middle of the coil form, and the rotating base deleted. Current drain is about 1 mA at 9 volts. You can expect 300 hours of operation from an ordinary carbon/zinc battery.

You can add or delete turns from the coil until C5 tunes the broadcast band. If the tuning range is too narrow, remove the capacitor.

Finally, note that a bigger loop area will pick up more signal. The one-foot square design is a compromise for table-top use. My own loop now is on a 12- by 18-inch cardboard box!

—Craig Sharp, Pardeeville, WI

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THINK TANK

As you've already learned Craig, the books are on the way. You readers will see by examining Craig's work that there are lots of available options, and you can pick and choose the ones you like. That's why we're called experimenters!

Ignition Cut-Off. This circuit has been extremely useful. It's cheap, easy to build, and uses only a few, easy-to-find components. The circuit—an ignition cut-off circuit—is shown in Fig. 3. After closing the ignition switch on your car, relay K1 won't latch because the SCR is not conducting. The relay contacts remain open. That means that 12 volts won't reach the coil and the car won't start.

To start the car, all you have to do is make the SCR start to conduct by applying a positive voltage to its gate. Pilot lamp I1 (when on) is an indicator that the relay has latched and its contacts are closed. Your car's coil is now getting 12 volts and is ready to go.

I like to connect the SCR gate to the car's horn. The horn on my car is pretty loud. However, other accessories can

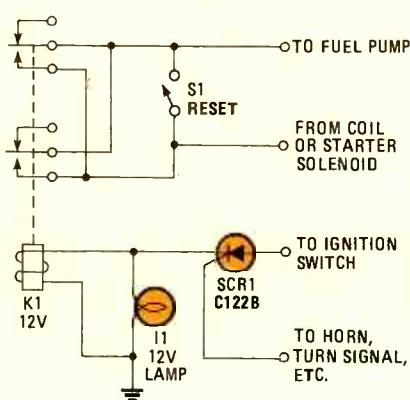


Fig. 3. Ignition Cut-Off switch arms itself after the engine is cut-off via the ignition switch.

also be used. And I installed a reset switch in the engine compartment just in case. The advantage of using an SCR is that you do not have to hide a switch under the dashboard. The circuit arms itself after opening the ignition switch. Nice, Huh?

—**Rolando Farfan, Montreal, Quebec, Canada**

Rolando, you're in for a very-pleasant surprise! You sent in two schematics (only one of which appears here), you get two free books, both the ones you wanted. Hope you're happy!

Capacitance Bridge Tester. After experimenting for years, I decided that I needed a capacitance-bridge tester, and went shopping for one. Byron, you wouldn't believe the prices! All I could think was that they're nothing but a big rip-off. And that's why I opted to build my own. (See Fig. 4)

It's an audio oscillator combined with a modified Wheatstone bridge. Of course, it isn't as accurate as a commercial, high-tech type, but it is inexpensive and will measure practically everything between 0.001 μ F and 10 μ F.

When you build it, you can use practically any PNP transistor, such as the 2N3906. You can also use any resistor reading within $\pm 15\%$ tolerance. After you've done a nice job building it into an experimenter's box, bring out a cou-

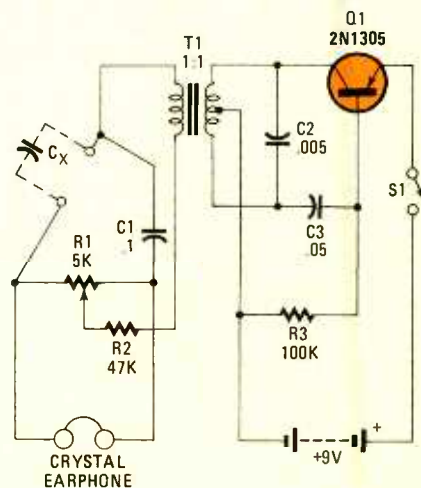


Fig. 4. The Capacitance Bridge Tester, consisting of an audio oscillator combined with a modified Wheatstone bridge, will measure practically everything between 0.001 μ F and 10 μ F.

ple of terminals for the capacitor-under-test and start testing capacitors of known values to calibrate it. Adjust the calibrations with the 50k potentiometer.

—**Andrew Waud, Lakeside, Ontario**

Alright Andy, the Fips Book is on the way, and we appreciate your circuit. It seems there are a lot of us out there that are particularly interested in test equipment we can throw together ourselves.

Electronic Dice. This circuit (see Fig. 5) will give you a general introduction to using digital counters. In the circuit, a 7447 BCD-to-seven segment decoder/driver (U3) is used to drive a common-anode display. The decoder/driver is, in turn, fed from a 74161 synchronous 4-bit counter with parallel inputs.

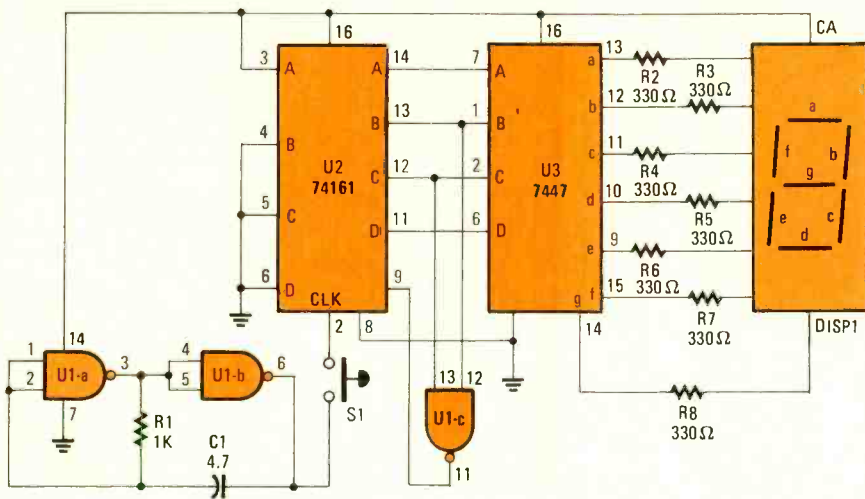


Fig. 5. The Electronic-Dice circuit is nothing more than an oscillator (built around a 7400 quad 2-input NAND gate) feeding a synchronous 4-bit counter, whose output is fed to a 7447 BCD-to-seven segment decoder/driver, which is used to drive a common-anode seven-segment display.

When pin 9 of U2 is brought low, the counter receives the binary number applied to the parallel input and goes on counting. That low is obtained in this circuit by feeding outputs B (pin 13) and C (pin 12) to U1-c, ¼ of a 7400 2-input NAND gate; U1-c outputs a low only when

both the B and C outputs of the counter (U2) are high.

Two of the remaining three gates of U1 form an astable multivibrator (free-running oscillator), which provide clocking for the circuit. Pressing S1 feeds a random string of pulses to the clock

input of U2, which then counts the number of pulses in the input string and outputs that number in 4-bit binary form. The output of U2 is fed to the binary inputs of U3, which decodes the binary input and drives the appropriate segments of the display.

—Julio Cesar Orue Duenas, Arequipa, Peru

Thanks for the circuit, Julio, and I hope you enjoy your Fips book.

IR Detector. This device was developed to facilitate testing of handheld, infrared, remote-control transmitters. It offers a go/no-go test and allows technicians to repair them in a shorter time. When the infrared transmitter is pointed at Q1, and S1 is pressed (see Fig. 6), buzzer BZ1 provides an audible indication of the presence of infrared signals. It's that simple. The total parts cost is a mere \$2.00 and all of them are available at Radio Shack.

Now Byron, does this rate a Fips book?

—Ken Tarver, Lake Charles, LA
Ken, it sure does. And it's exactly the kind of thing we want to see. Quick and
(Continued on page 27)

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Shape Memory Alloys have crystal structures that can assume radically different forms at distinct temperatures. When passing an electric current, BioMetal's internal resistance causes it to heat, and activate this "phase change". The wire shortens in length, and puts with a usable amount of force. When cooled, BioMetal returns to its original shape. If not overheated or overextended, BioMetal will perform for millions of repeated cycles.

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(Continued from page 25)

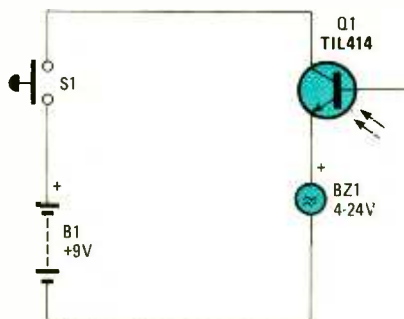


Fig. 6. The IR Detector was developed to test handheld, infrared-remote transmitters on a go/no-go basis.

idle) a battery would be very short-lived.

Activating the momentary pushbutton switch starts the 555's cycle and momentarily provides current to the relay coil to close the relay contacts. After the cycle has expired, current to the relay coil is turned off, opening the relay and shutting off power to the coffeemaker.

There's one word of caution that's due here: Make sure you use an adequate rating on the relay contacts. I used a 10 ampere rating as my coffeemaker draws 875 watts! I hope this gets me a copy of the Fips Book.

—Claude L. Johnson, Ann Arbor, MI
Claude, I can't see any reason why

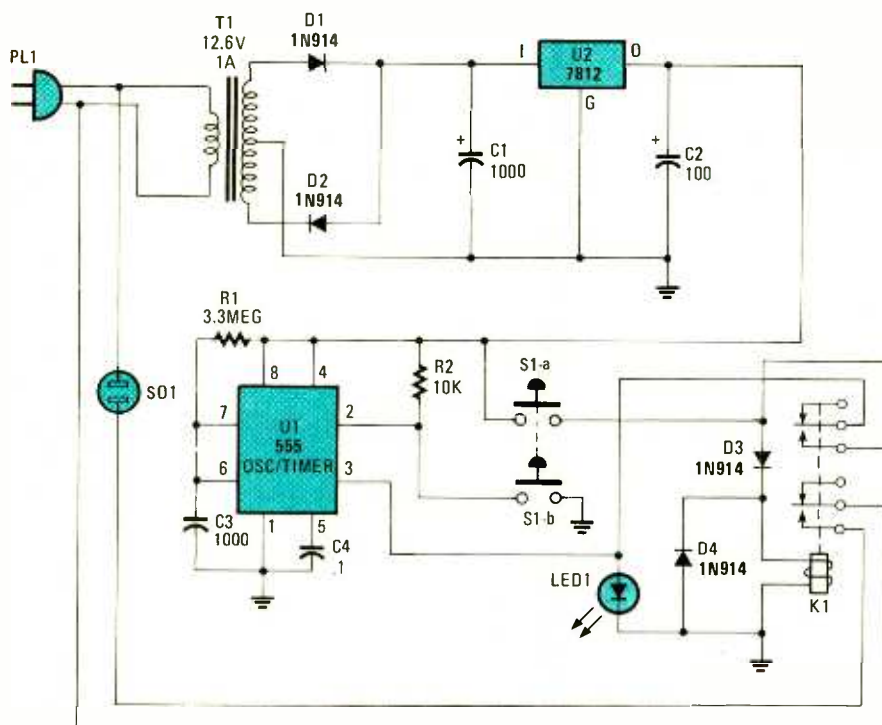


Fig. 7. The Coffee De-Burner is a simple timed, cutoff switch, consisting of a 555 oscillator/timer and a double-pole, double-throw relay.

easy-to-do projects that don't require an advanced engineering degree to understand.

Coffee De-Burner. I sometimes found myself leaving the drip coffeemaker on all day long. Frankly, there's something about burned coffee that's terribly unappealing, and I decided to do something about it. See Fig. 7. I wanted a circuit that provided adequate brewing/drinking time; for my coffee-drinking habits, that means about 60 minutes, or so.

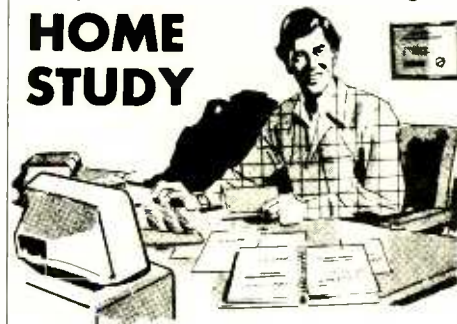
The circuit is fairly simple. I opted for an AC supply; since the circuit draws almost 90 mA while brewing (3 mA at

not!) You've taken a simple timer circuit and applied it in an interesting fashion. Now I'm going to take a walk out to our stock room and see if I can't dig up a copy of the book for you!

Well, that seems to be just about all we have room for this month, fellows. But you can be sure that we'll have much more the next time we get together in these pages.

In the meantime, please keep those circuits coming in, and don't forget the circuit descriptions that go along with the them. Keep everything simple. Send your circuits to **Think Tank**, Popular Electronics, 500-B Bi-County Blvd., Farmingdale, NY 11735.

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When television broadcasting began, it was impossible to foresee the large variety of video sources that would someday be available to the consumer; for instance, cable TV converters, video cassette recorders (VCR's), video games, satellite receivers, and a host of products as yet unheard of in the video marketplace. Thus, TV manufacturers did not see fit to endow their receivers (except for the more recent units) with multiple-input capabilities, and so today we suffer from that unfortunate handicap.

To compensate for that oversight, multiple-input capability has been handled (through after-market devices) in a rather cumbersome way: all video devices modulate their output signal to an unused TV channel, and an external RF switch is used to select which video source is to be viewed.

Why Baseband Switching? To illustrate the awkwardness of the modulate/switch/demodulate scheme, imagine a hi-fi system in which all audio sources (turntable, cassette recorder, CD player, etc.) are FM modulated before being sent to a receiver, where the desired program material is selected.

Aside from the obvious cost increase (extra circuitry can add a couple hundred bucks to equipment prices), no serious audiophile would ever consider degrading the high-quality output of a CD player by modulating the signal and then demodulating it again to produce a considerably degraded adaptation (with

The Video/Audio Switcher



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switcher to your home-
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lost to modulation/
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bandwidth and dynamic-range limitations, noise, and distortion products) of the CD output.

The same holds true for video. Why modulate a video signal and thereafter be subjected to a demodulated and degraded signal? Fortunately, most new video products have been endowed with baseband video and audio input/output capabilities. Only the cheaper television receivers provide only RF inputs. In fact, baseband video and audio inputs, once only found on very expensive monitors, are appearing on medium-priced sets.

Although signal-source switching must still be handled through external equipment, the availability of baseband signals allows us to switch video signals in the same way that a hi-fi system switches audio.

Signal Comparisons. Since a picture is worth a thousand words, let's compare the waveforms taken from a good modulator/demodulator arrangement to those taken from the *Baseband Video Switcher* described in this article. Figure 1 shows a video test signal known as a *multiburst* signal. That signal has several frequency bursts at 0.5, 1.0, 2.0, 3.0, 3.58, and 4.0 MHz. Note that the amplitude of the signal is diminished ever so slightly from the low-frequency burst (0.5 MHz) to the high-frequency burst (4.0 MHz).

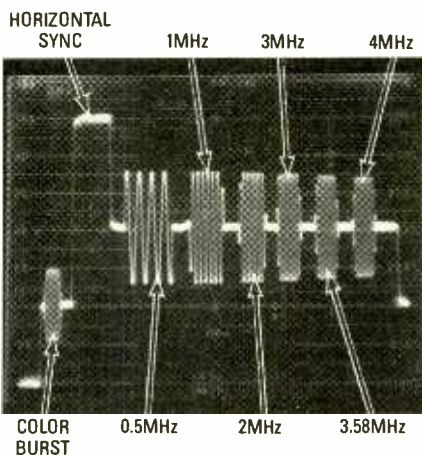


Fig. 1. This video test signal, known as a *multiburst*, has several frequency bursts at 0.5, 1.0, 2.0, 3.0, 3.58 and 4.0 MHz. Note that amplitude of the signal is diminished ever so slightly from the low-frequency burst (0.5 MHz) to the high-frequency burst (4.0 MHz).

Now look at Fig. 2, which shows the same signal after RF modulation and demodulation; the differences in amplitude between bursts are more ap-

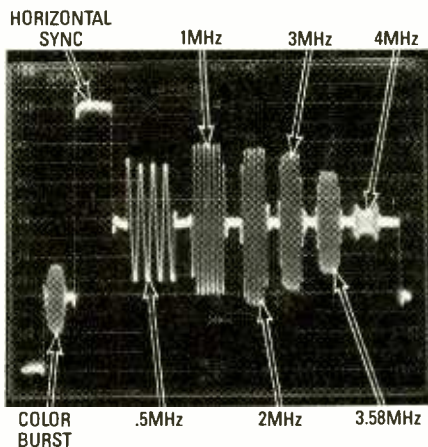


Fig. 2. Here is another view of the *multiburst* test pattern after being fed through a modulator/demodulator network: Note that the differences in amplitude between bursts are more apparent, and that the 4.0 MHz burst has almost vanished.

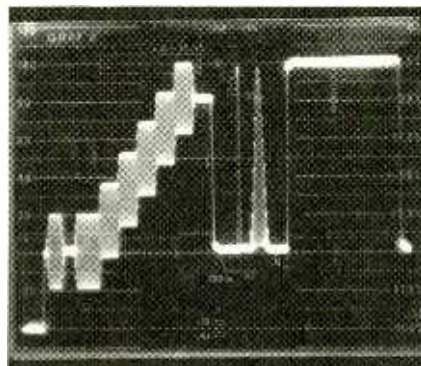


Fig. 3. The composite video pattern includes a chroma-modulated staircase, a fast-risetime pulse, and a 2T burst signal. Note the fast risetime and negligible overshoot in the waveform through the baseband-switching device.

parent. Note that the 4.0 MHz burst has almost vanished. Many will point out that actual TV signals contain no significant information above 3.58-MHz, therefore it's useless to care about 4.0 MHz. That is only partly true: To explain, let's return to the audio analogy.

Although even rock-and-roll music seldom has any worthwhile signal content above 15 kHz, studies have shown that a much wider bandwidth is required to accurately reproduce the signal. Audio manufacturers strive to make their products usable to at least 20 kHz.

Figure 3 shows another test pattern, known as a *composite video* signal. That pattern includes a chroma-modulated staircase, a fast-risetime pulse, and a 2T burst signal. Note the fast risetime and negligible overshoot in the waveform through the baseband switching device.

Now refer to Fig. 4, which shows the

same signal after passing through a modulator/demodulator combination. Note the distortion in the signals. In particular, the 2T burst signal shows a curved deformation at the bottom, indicating chroma/luminance delay. We could show you other test patterns, but by now you should have become a believer. It's better to perform the most critical test, viewing the TV image, to see what you have been missing.

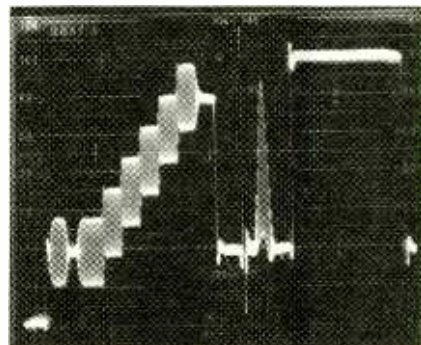


Fig. 4. Here's the composite video signal after being fed through a modulator/demodulator combination. Note the distortion in the signals. In particular, the 2T burst signal shows a curved deformation at the bottom, indicating chroma/luma delay.

General Circuit Description. Figure 5 is the schematic diagram for a two-channel version of the *Baseband Video Switcher*. (Note: Additional channels can be added as desired.) At first glance, the circuit may appear complicated, but don't let that worry you—the circuit is mostly wiring and switching devices.

The circuit provides 75-ohm, buffered-video input/output ports; stereo-compatible buffered audio inputs and outputs; and tape monitor and second-source-viewing capabilities (the ability to view one source while recording another). Video-signal switching is accomplished via DIP reed relays (K1 through K3). Audio switching is handled by a pair of 4053 analog multiplexer/demultiplexers (U7 and U8). Relays are used for the video signal because of the very low impedance involved in video; the residual "on" resistance of the analog IC switches would create undesirable attenuation.

Each audio/video source is divided into three individual signals; video, left audio, and right audio. Before any switching is done, each signal is fed to a buffer circuit in the channel to which it is connected; two channels (denoted Channel A and Channel B)—consisting of U1 through U3 and U4 through U6, respectively—are shown.

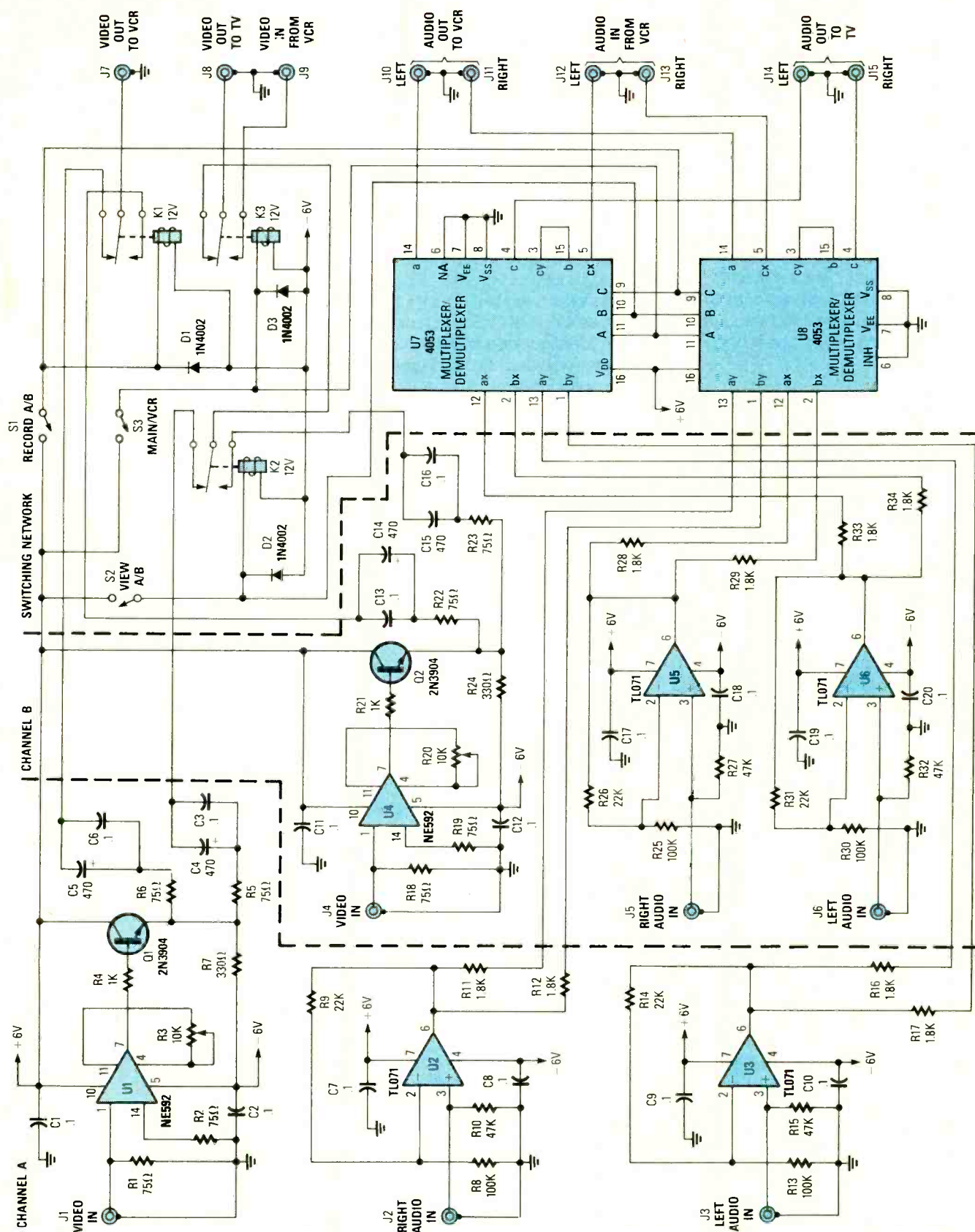


Fig. 5. Here is a schematic diagram of the two-channel version of the Baseband Video Switcher. (Note: Additional channels can be added as desired.) The circuit provides 75-ohm buffered, video-input/output ports, stereo-compatible buffered audio I/O's, and tape-monitoring capabilities. It also allows you to record a different source from the one being viewed

Each buffer circuit has two outputs. The two outputs of the audio buffers are fed to a pair analog multiplexer/demultiplexers (U7 and U8), which are controlled by switches S1–S3. The video outputs are switched via K1–K3, and are also controlled by S1–S3.

Whenever switch S1 is open, K1, U7, and U8 route the Channel A signal to the VCR input; when closed, the Channel B signal is routed to the input of the VCR. Before being fed to the TV monitor input, we have another level of switching, handled by K3, U7, and U8, and controlled by the TV/VCR switch, S3. That switch allows you to view the main video signals (the signal fed through the buffer circuitry) or you can monitor the VCR output.

Buffer Circuits. Now let's concentrate our attention on the Channel-A portion of the circuit as we take a closer look at the buffering circuits. The right audio signal is fed to the non-inverting input of U2—a TLO71 low-noise bi-FET op-amp—which provides a slight signal gain to compensate for expected signal losses across R11 and R12, which protect U2 against short-circuit conditions. (The left audio input to Channel A is handled in an identical fashion by U3 and its associated components.)

Aside from protecting U2, R11 and R12 passively divide the output of U2 along two paths, while preventing interference between the two outputs. The outputs of the audio buffers (left and right) are fed to U7 and U8.

Video-signal buffering is handled by U1 (an NE592 video amplifier). The video-buffer circuit has an input impedance of 75 ohms (as determined by R1). The gain of U1 is set by R3 (a 10,000-ohm unit, connected between pins 11 and 4), which should be adjusted to yield a 1-volt peak-to-peak output (a gain of slightly higher than two).

The output of U1 is fed through R4 to the base of Q1 (a 2N3904 general-purpose transistor, configured as an emitter-follower), which provides sufficient current to drive a pair of 75-ohm loads.

Because of the large output-voltage offset, direct-coupling is not possible. So capacitors C4 and C5 are included in the circuit to block the DC content of the video signal. Since electrolytic capacitors have a fairly high, equivalent series resistance, C4 and C5 are bypassed by a pair of 0.1- μ F ceramic capacitors (C3 and C6 in Fig. 5) to maintain good frequency response of the circuit.

Audio/Video Switching. Separate switching networks are provided for the audio and video signals. Audio switching (as mentioned earlier in this article) is handled by a pair of 4053 triple 2-input analog multiplexer/demultiplexers (U7 and U8). The 4053 can be viewed as little more than three electronically controlled, single-pole, double-throw semiconductor switches. Each switch has one terminal connected to Channel A and the other connected to Channel B.

The right audio input of Channel A is fed to U8 at pins 1 and 13, while the left audio input is fed to U7 at pins 1 and 13. (Remember that Channels A and B perform identical operations, so any description of Channel A's operation is also applicable to Channel B.)

The control terminals (pins 9, 10, and 11) of U7 and U8 are connected to switches S1, S2, and S3 (which also control the video outputs). When S1 and S2 are open, no +6-volt trigger signal is applied to the pin 9 and 10 control inputs of U7 and U8, so the left and right Channel A signals are then routed to the final stage of switching. When S1 and S2 are closed, however, the Channel B input is routed to the final stage of switching.

Video signal switching is handled in much the same manner, except that instead of multiplexer/demultiplexers, the switching is done by three single-pole, double-throw DIP reed relays. As with the audio section, the signal source is selected via S1, S2, and S3, and follows the same sequence as the audio section. That is, when S1 and S2 are open, the Channel A video source is fed to the final stage of switching; with those switches closed, the Channel B source is routed to the final stage of

switching. Note that regardless of which source channel (A or B) is selected, its signal will always be present at J7.

The output of K2 is routed to K3, which determines which video source is displayed on the TV screen. Switch S3 determines which source—main (buffered signal source) or VCR output—is routed to the TV receiver. With S3 open, the selected buffered source is output to the TV; with it closed, the VCR output is routed to the TV.

Power Supply. Figure 6 is the schematic diagram of the power-supply portion of the AV switch circuit. Power for the circuit is provided by a bipolar (+/-) 6-volt supply, consisting of a transformer (T1), a bridge rectifier (made up of D4 to D7), a pair of voltage regulators, and four capacitors (C21 through C24). A series resistor/LED combination (R35 and LED1)—which is connected across the positive and negative supply rails—is included in the circuit as a power-on indicator.

There is nothing critical about the power supply for the circuit; in fact, any power supply capable of supplying +/-6 volts of reasonably ripple-free DC will suffice. Power-supply component substitutions are also permissible. For instance, the four diodes that make up the bridge rectifier can be replaced by a 1-amp, 50-volt (50-PIV), or better, full-wave bridge rectifier. And T1 can be replaced by any center-tapped unit capable of supplying 18-volts peak-to-peak (perhaps, a 24-volt unit) with a current rating of at least 100 mA.

No AC switch is provided since power consumption is so small; but one may be included if desired. To add an on/off switch, simply insert a switch in series with one of the transformer's AC inputs.

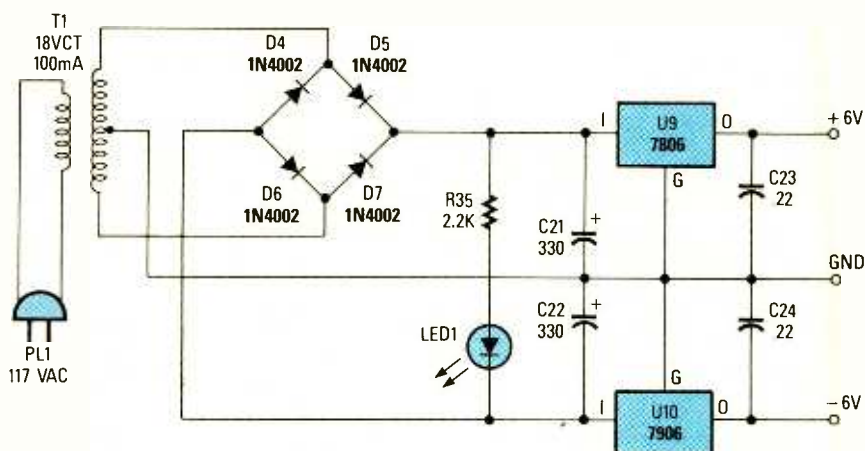


Fig. 6. The audio/video switch is powered from a bipolar 6-volt supply like the one shown here. Since the switcher's current draw is so low, no on/off switch is included, but one can be added in series with the AC line if desired.

Construction. There is nothing critical about the construction of the Baseband Video Switcher. Either point-to-point wiring or the printed-circuit method may be used. But whichever method you opt for, remember that high-frequency signals can pose some coupling problems. Therefore, it is recommended that signal-input runs be kept

PARTS LIST FOR THE BASEBAND VIDEO SWITCHER

SEMICONDUCTORS

U1, U4—NE592 video amplifier, integrated circuit
 U2, U3, U5, U6—TL071 low-noise, bi-FET op-amp, integrated circuit
 U7, U8—CD4053 triple 2-channel analog multiplexer/demultiplexer, integrated circuit
 U9—7806 6-volt, 1-amp, positive-voltage regulator, integrated circuit
 U10—7906 6-volt, 1-amp, negative-voltage regulator, integrated circuit
 Q1, Q2—2N3904 general-purpose NPN transistor
 D1—D7—1N4002 rectifier diode
 LED1—Miniature light-emitting diode

RESISTORS

(All resistors are 1/4-watt, 5% units, unless otherwise noted.)
 R1, R2, R5, R6, R18, R19, R22, R23—75-ohm
 R3, R20—10,000-ohm trimmer potentiometer
 R4, R21—1000-ohm
 R7, R24—330-ohm
 R8, R13, R25, R30—100,000-ohm
 R9, R14, R26, R31—22,000-ohm
 R10, R15, R27, R32—47,000-ohm
 R11, R12, R16, R17, R28, R29, R33, R34—1800-ohm
 R35—2200-ohm, 1/2-watt, 5%

CAPACITORS

C1—C3, C6—C13, C16—C20—0.1-μF, ceramic-disc
 C4, C5, C14, C15—470-μF, 16-WVDC electrolytic
 C21, C22—330-μF, 16-WVDC, electrolytic
 C23, C24—0.22-μF, 50-WVDC, ceramic disc

SWITCHES

S1, S2, S3—SPST miniature toggle switch
 K1, K2, K3—12-volt DIP reed relay (form C)

ADDITIONAL PARTS AND MATERIALS

J1—J15—RCA phono jack
 T1—18-volt, CT, 100-mA, power transformer
 Printed circuit or perfboard materials, enclosure, IC sockets, coax cable, wire, solder, hardware, etc.

separate (*i.e.*, **do not** run them close together). In addition, signal wires should be kept as short as possible, and be made using coax cable.

The author's prototype was built entirely on perfboard, but for convenience a printed-circuit board for the buffer section is shown in Fig. 7. Note: For a two-channel unit like that shown in the Fig. 5 schematic diagram, it will be necessary to etch two such boards. The purpose of doing things that way is to allow for flexible switching arrangements.

For example, you may wish to use more sources than the two shown in the schematic diagram. It is very easy to do; you need only use the appropriate number of relays and analog switches, and buffer each source with the buffer board shown in Fig. 7.

No printed-circuit board is provided for the switching network (U7, U8, and K1—K3), so that section of the Baseband Video Switcher will have to be hard-wired to the buffer board(s). As an alternative to hard-wiring the switching network, you might consider developing your own printed-circuit pattern for that section, and combine the switching-

network pattern with the buffer-board pattern in the etching process. In that way, all that you'll need to do is jumper the two patterns together at the appropriate points. Or, if you are a fairly competent PC-pattern draftsman, you might consider developing a complete circuit-board pattern with all components on a single board.

The parts-placement diagram for the Baseband Video Switcher's buffer board is shown in Fig. 8. Once you've obtained the components listed in the Parts List and etched your board(s), begin assembly by first installing IC sockets at the appropriate points on the printed-circuit board(s). The IC sockets will function as reference points when attempting to locate the proper positions for the other components.

Calibration. The Baseband Video Switcher circuit is very stable; any noise or spurious oscillation will be mainly due to poor grounding or routing techniques. Note that each buffer board has a pair of outputs for each signal path, those outputs are identical and may be interchanged.

The only adjustment required is to

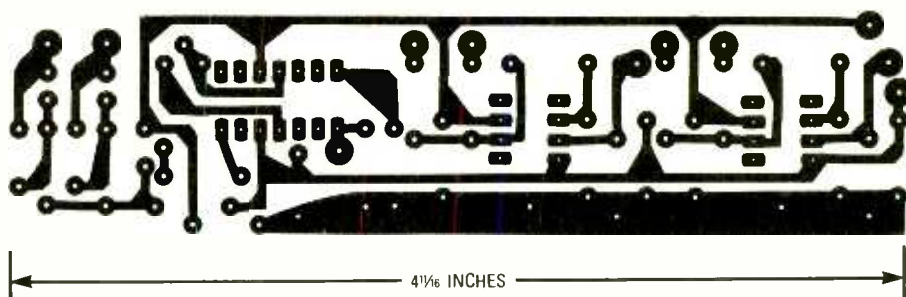


Fig. 7. A printed-circuit board for the buffer portion of the Baseband Video Switcher is shown here. For a two-channel unit, like that shown in the schematic diagram, it will be necessary to etch two such boards. The purpose of doing things that way is to allow for flexible switching arrangements.

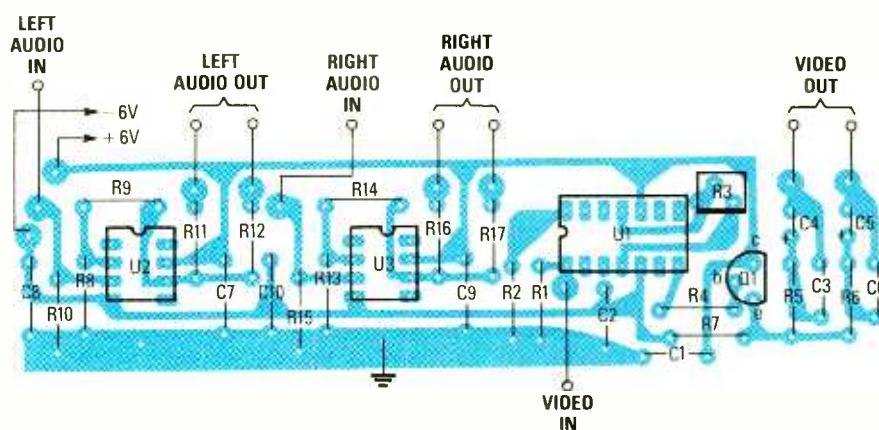


Fig. 8. Don't let this parts-placement diagram fool you. Only half of the buffer-board components listed in the Parts List are indicated here. A second board (identical to this one) contains the remaining buffer components. The switching network and power supply were hard wired to the circuit.

BASEBAND VIDEO SWITCHER

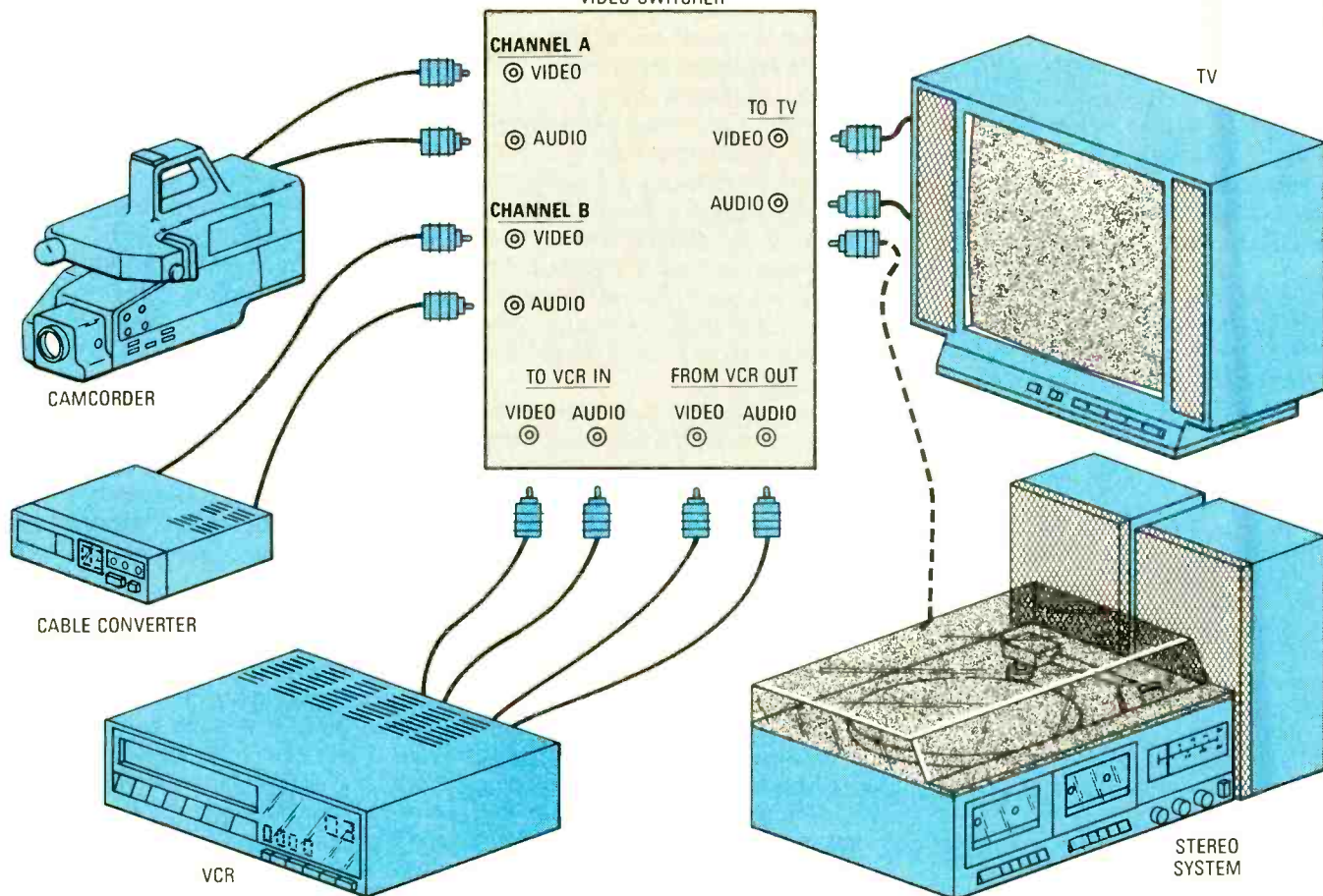
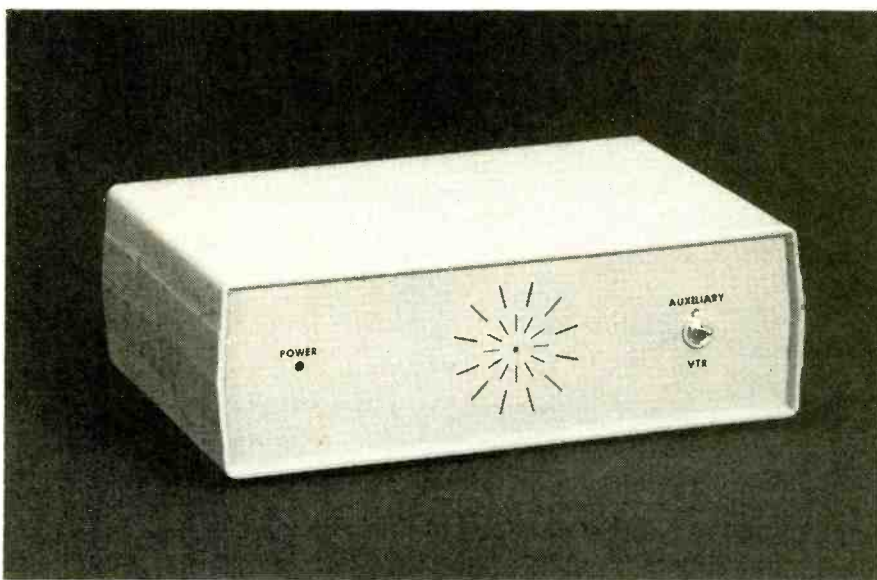


Fig. 9. For the sake of sanity and clarity, only one audio channel is shown in this connection diagram, which assumes that your TV has baseband inputs. Note that the audio-output signal need not go to the TV: It may be fed to the auxiliary inputs of a hi-fi stereo system to obtain a tone-rich, full-spectrum audio output.



Here's the author's completed prototype. The type of cabinet used is not critical, but dressing it up will make it a more welcome addition to your living room.

calibrate for unity gain in the video amplifiers (U1 and U3 in the schematic diagram). The best way of accomplishing that is to feed a video test signal that has a saturated white field and adjust

R3 (and its equivalent) in each buffer board for a 1-volt peak-to-peak output with a 75-ohm termination. If you don't have access to a video-pattern generator, you may use a "live" video signal

and a dual-channel scope; set both channels for 0.5-volt per division and adjust R3 (or its equivalent) so that the output trace is identical in amplitude to the input trace.

For the audio channels, just check that about 10% extra gain is available at the output with a 10,000-ohm load.

After the calibration procedure is completed, install the project in a suitable enclosure, and you are ready to view the difference.

Hooking Up. A suitable hookup is shown in Fig. 9. For the sake of sanity and clarity, only one audio channel is shown. Note that up to this point we are assuming that your TV has baseband inputs. (It may sound obvious, but better safe than sorry). Otherwise this project is not for you.

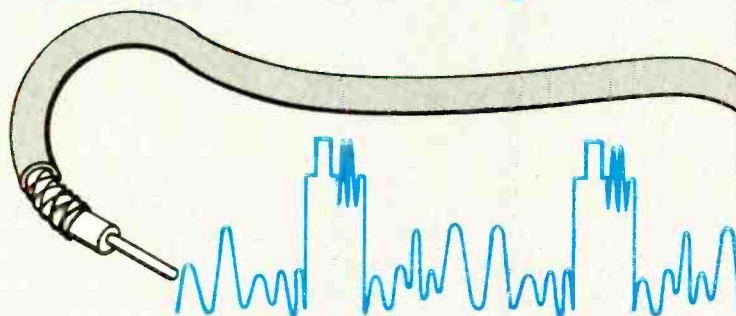
Note that your audio need not go to the TV. It may be fed to the auxiliary inputs of your hi-fi system to obtain a tone-rich, full-spectrum audio output.

Speaking of audio, a problem may arise if one of your sources is monophonic, and another stereo. In that case, it would be wise to split the signal via a "Y" adapter and feed the monophonic source to both channels. ■

BEHIND THE

SCREENS

BY JACK CUNKELMAN



We present a guided tour of the composite video signal, how NTSC video came about, and more.

What is this thing called "video?" We all know its end result—a picture on a TV screen or monitor—but how is the image represented before it becomes the picture we see; how does the picture get there; how does a screen work? Together we will explore the answers to those questions by taking a look at a standard TV screen, the "composite video signal" that controls it, and how and why our present video standard came about.

The two most widely used kinds of video signals are computer-generated (or digital) video signals and TV (or analog) video signals. Computer-generated video signals produce a more or less "static" picture, and TV video signals, reproduce real-life familiar objects and scenes with real-time motion. The two mediums are similar, but there are important differences in the video signals themselves. We will first check out the TV video signal in depth and then touch on some of the ways the computer-generated signal differs from it.

The NTSC Standard. First, let's discuss the NTSC (National Television Systems Committee) RS170 system. The basic design of the system was set forth by the NTSC in the 1940's as the standard for entertainment viewing in the United States. It was modified in the 1950's for color compatibility, and is now called the RS170A color system.

The standard is used in only one or two other countries, so it is not a worldwide standard by any means. However, the basic principle is the same for all of the TV video systems around the world.

No matter what the standard, the picture information is encoded in the same way. Only the amount of information and the frequencies of operation vary between systems.

Currently there are a few new standards being proposed for something called "High Definition Television" (denoted HDTV), that unfortunately requires broader bandwidth to work effectively. That's because the bandwidth of any video system determines the amount of picture detail it can render. Bandwidth also determines how many images can be sent each second. The wider the bandwidth the greater the detail and number of images you can send. Since the original NTSC signal was designed to be transmitted by radio-frequency modulation, there had to be bandwidth limits set on the signal because of the limited amount of RF spectrum space available.

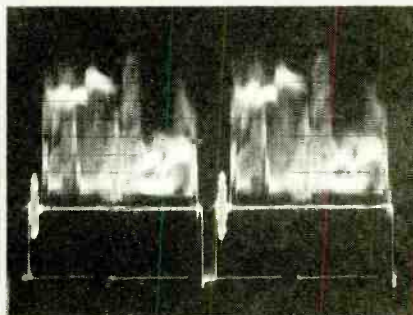
The bandwidth limitations of NTSC signals are now causing a problem in the development of a compatible HDTV system. The solutions to the limita-

tions are varied and often inelegant, which has lead to heated debate over which HDTV system to use. As a result, we are currently living with a system that was state-of-the-art back in the 40's and, because no one wants to put millions of existing TV sets out to pasture, has yet to be changed. For more on the HDTV debate, see "The HDTV Revolution" in the September 1989 issue of **Popular Electronics**.

The Picture. An image on the television screen is produced by a "scanning" process. In a TV camera or camcorder, a scene is broken down into a series of nearly horizontal lines. Each line is scanned and the data from each line is sent to a recording device one line at a time. There are 525 such "scan lines" in a complete picture in the NTSC system. Referring to Fig. 1, let's see how those lines are laid down on a TV screen by a similar scanning process.

In a standard TV, a beam of electrons from an "electron" gun located behind the screen, is aimed at phosphor dots on the screen's surface. When the beam strikes a dot, the dot glows; the stronger the beam, the brighter the dot. The beam is swept across the screen from left to right starting at point A. The strength of the beam as it excites each dot is determined by the voltage of the video signal. The higher the video-signal voltage, the lower the beam intensity, and the dimmer the phosphor dot.

When the beam reaches the right-hand side of the screen (i.e. traced the first scan line) it jumps to the beginning of the next line at the left-hand side of the screen, and the process repeats using the video signal for that scan line.



This is what a composite video signal looks like when you extract it from a video detector. The signal is inverted so the dark portions have low voltages.

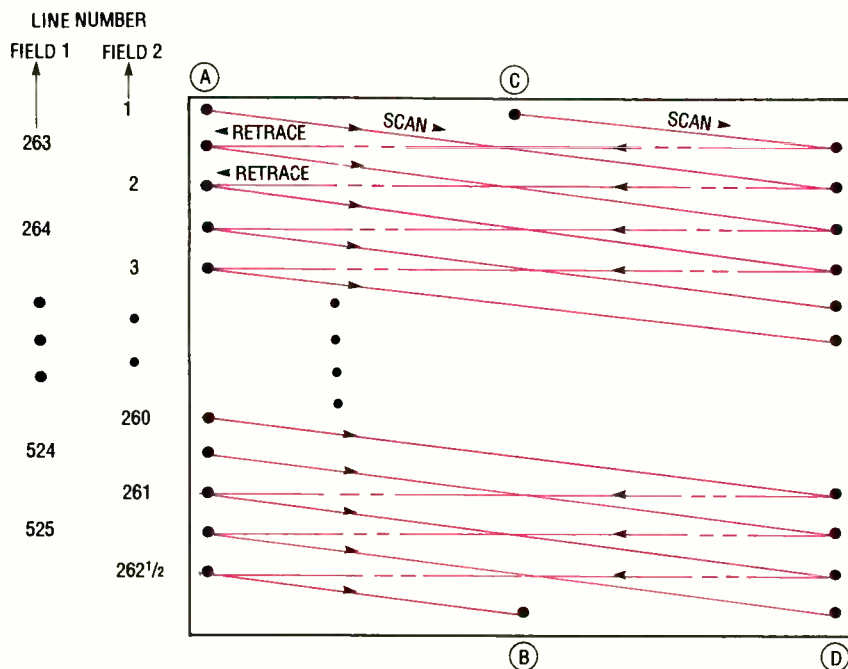


Fig. 1. A picture is scanned onto a video screen one line at a time. The entire screen is scanned twice for each picture with a total of 525 lines.

and so on. The movement back to the left side is called "horizontal retrace" and the electron beam is shut off during the retrace period.

The process continues until the bottom of the screen is reached (point B), at which time the beam does a "vertical retrace," moving back up to the top of the screen to point C; not to point A. Of course, the beam is shut off during the vertical-retrace interval. We have now traced out what is called a "field," which consists of 262½ scan lines. It takes two fields to complete a picture or "frame" and the second field begins at point C in the middle of top of the screen. The beam moves across and down the screen just as it did when tracing out the first field, but now it moves *between* the lines traced for the first field. When it reaches the bottom (point D), it completes the second field and the two fields together make up a frame that consists of 525 scan lines. The whole process of "weaving" the two fields together is called "interlace" scanning. The reason for complicating a scanning scheme with interlacing is to prevent flickering images while using minimal bandwidth.

Interlacing screens is similar to a photographic technique used by the motion-picture industry. Originally films were recorded at 24 frames per second (fps). At that rate, motion in a scene could be accurately recorded, but there was severe flicker in the image when projected on a screen. To elimi-

nate flicker, each frame was shown twice on the screen, and that "fooled" the eye into thinking the rate was 48 fps. That is somewhat analogous to laying down two fields per frame in television.

As we stated earlier, the bandwidth of a video system constrains the number of frames you can present each second. Since the video bandwidth of a standard television channel was set at about 4.5 MHz, the frame rate was set at 30 fps to stay within that bandwidth limit (the power-line frequency also played a part in selecting that particular rate, as we will discuss shortly). At 30 fps, motion could be accurately reproduced, but flicker would still have been a problem. Borrowing the motion picture technique, each picture or frame is broken down into the two fields we mentioned previously, and then painted on the screen. The apparent presentation rate is doubled, and flicker is reduced.

It takes 1/60th of a second for 262.5 lines—one frame—to be scanned. Notice that the frame frequency is equal to the operating frequency of common power lines—60 Hz. That is to reduce interference and crosstalk in the TV receiver. As we will learn later, the scanning rate is slightly different to accommodate color-television requirements.

From what we know, we can now calculate the horizontal scan rate: Since there are 30 frames per second and each frame has 525 lines, there are

15,750 lines scanned per second, so each line is scanned in 1/15,750th of a second, or approximately 63 microseconds.

Since the beam must be cut-off or blanked-out during horizontal and vertical retraces, some of the video signal will contain "blanking pulses"—maximums in the video signal that turn the beam completely off. The combination of video information and blanking pulses is called the "composite video signal."

Sync. As we have seen, the movement of the electron beam must be precisely timed with respect to the video information. Additionally, it must also be synchronized with the TV or video camera used to capture the image. If synchronization does not occur, the reproduced picture will resemble a scrambled picture from a cable service or satellite. In fact, scrambled signals are produced by altering a picture's synchronizing signals.

Synchronization signals are generated by a synchronization (sync) generator. There is a sync generator of one form or other in every piece of equipment that generates and manipulates video signals. A horizontal-sync pulse from a typical color-sync generator is shown in Fig. 2. Such a sync signal is present at the end of every scan-line sweep.

The voltage of the pulse is high enough to blank out the beam when it retraces from right to left on the screen, but the key parts of the horizontal-sync signal have other jobs also. The leading edge (sometimes called the front porch) is used by video circuitry to determine the starting position of a scan line. The color burst signal—set precisely at 3.579545 MHz—provides a frequency and phase reference for chrominance information (more on that later). The information for two scan lines would be located to the left and right of that pulse.

If you adjust the time base on your scope to 10µs and view the composite video signal from a video detector in a TV or VCR, you can examine that portion of the waveform along with the video information. The sync will appear as an upside-down version of Fig. 2 because the signal is inverted by the detector. That means the blackest parts of the picture would occur at the lowest voltages and the brightest portions will appear well above the sync-signals' blanking plateaus.

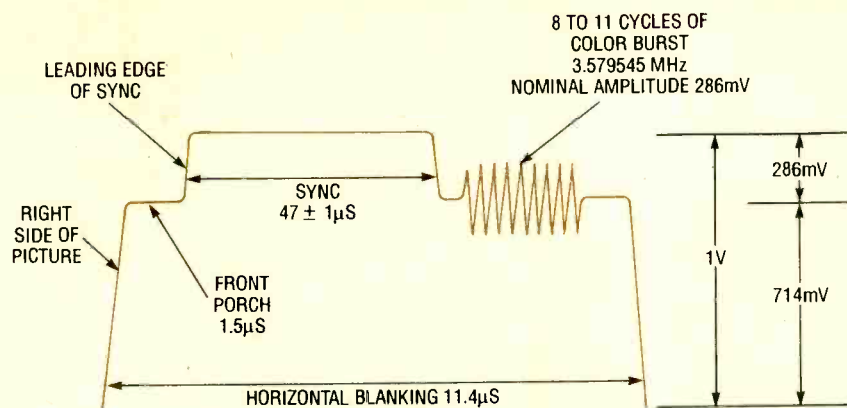


Fig. 2. Horizontal sync pulses do more than tell a TV when lines begin and end. They provide color information, and shut the electron beam off as well.

The trace would contain two lines of video surrounded by sync pulses. The video information for all the scan lines would appear on top of each other, resulting in a bright blur on the scope between the sync pulses.

The standard voltage level for a composite-video signal is 1 volt peak-to-peak across 75 ohms. The voltage levels of video signals inside video equipment may vary, but the video signals that they output for use by other equipment will always obey that standard.

Figure 3 is a diagram of the vertical-blanking interval. The first portion of the vertical-blanking interval is used to move the beam back up to the top of the screen. That movement takes 9 horizontal scan-line periods. In order to keep the horizontal circuitry locked (even though we are not using the horizontal information during the retrace period) equalizing pulses are put into the vertical signal.

The vertical scan actually starts "above" the top of the screen with spe-

cial signals called "vertical interval test signals" (denoted VITS) that are inserted at network- or satellite-distribution points to continuously check signal quality. We say the scan begins "above" the screen because the vertical scan is adjusted, so those signals are not visible. The entire vertical blanking interval is 20 horizontal lines in duration and is followed by the picture information.

Genlock and Special Effects. If we were to simply use a potentiometer to reduce the video signal to zero volts in an attempt to "fade" a picture to black, it should not work for obvious reasons: As the picture portion of the signal would go to zero, so would the sync signals and the TV or monitor would become unsynchronized. By the same token, if we used a potentiometer to dissolve between two unsynchronized video signals, at some point into the dissolve the resulting signal would become a mix of the two independent

signals and the TV set would not know which sync signals to lock onto.

In order to manipulate two video signals, whether to add them or dissolve between them, the signals must be synchronized. All of the sync generators in a TV station, for instance, are locked together or "genlocked" and adjusted or "timed" so the leading edge of the sync portions of the individual video signals occur simultaneously. The result of dissolving between two signals that are genlocked but not timed, is a horizontal shift on the screen when dissolving between the two pictures.

To insure a rock-solid sync signal, most video special-effects equipment strip the sync from the input signals, manipulate just the picture portion of the signal, and then add the sync portion of the signal back on. However, the composite signals into the equipment must still be genlocked and timed.

Color. When color television came along, the NTSC was faced with the problem of establishing a system that would carry the color information for color sets, but would also be compatible with the long established black-and-white system to allow the old sets to function normally.

The system chosen reproduces colors in terms of how much red, blue, and green color there is in a scene. Since the eye views a color in terms of its brightness, hue, and saturation, all that information had to be transmitted about the red, blue, and green content of a scene. That information is contained in the "chrominance signal" that is used to modulate a subcarrier within the video bandwidth. The brightness information—the information we had been transmitting from the old black-and-white days—is known as the "luminance" signal.

Since both the luminance and chrominance signals had to be transmitted within the already established bandwidth, several clever schemes were conceived of to accomplish it. In order to stay within the 4.5-MHz bandwidth, a process called frequency interleaving was used. Do not confuse this form of interleaving with scan-line interleaving.

Frequency interleaving is possible because the original black and white or luminance information is concentrated in clumps in the frequency spectrum. It was found that those clumps or groupings of energy occurred at multiples of the frame- and line-scanning

(Continued on page 106)

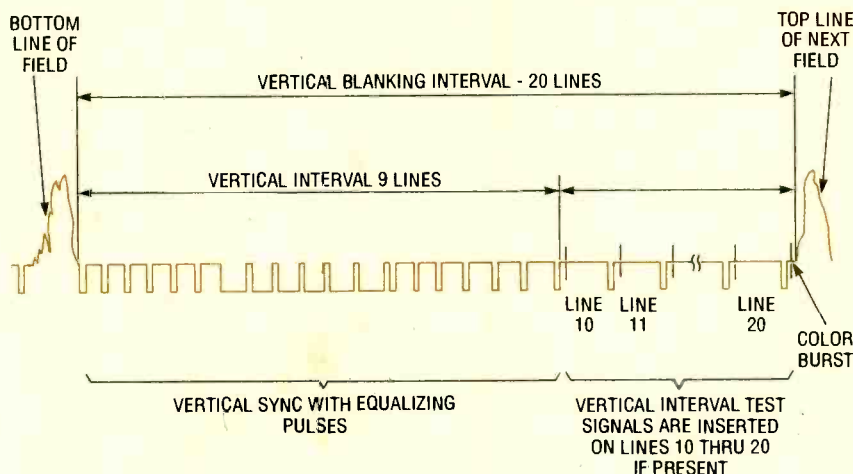


Fig. 3. The vertical sync pulse has to keep the horizontal sync circuits in sync even though no horizontal retrace is performed. It also provides a little color information and can contain test signals used by satellites and transmitters to check their operation.

Three for Christmas

BY LARRY LISLE, K9KZT

Christmas is a time for giving and this year you can give the gift of a life-long interest in electronics by building the three electronic toys described in this article.

The projects are simple and cheap to assemble. You can put any of them together in an evening—or, better yet—give the parts in kit form and help your youngsters put them together themselves.

The Electronic Puzzle Box. The electronic puzzle box is simply three six-position rotary switches wired in series with an LED assembly, a pair of batteries, and a push-button switch (see Fig. 1). Different "combinations" can be set by means of alligator clips on short jumper wires.

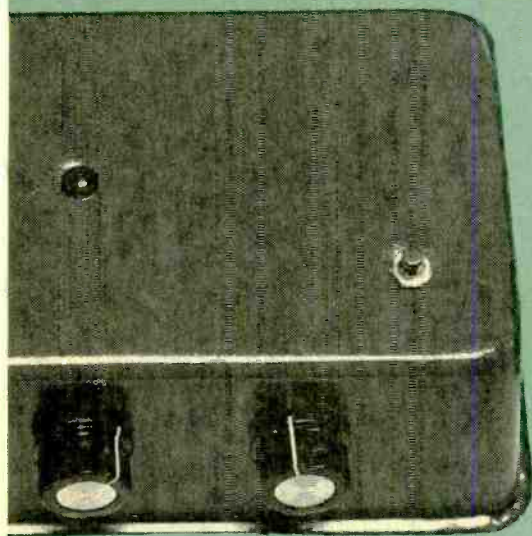
To play, one person sets the combination by attaching the clips to the tabs on the rotary switches. The other

tries various positions of the switches and pushes the momentary contact button to see if they're correct.

A variety of games are possible. For instance, two players can alternately set the combination and try to solve it, the winner being the one with the fastest time after so many turns.

The puzzle box encourages logical thinking as the players will soon learn that random twisting of the knobs isn't as effective as following a pattern.

After a while the game can be made more challenging by adding a buzzer wired to the unused contacts of one of the switches. Hitting that particular setting could then add a minute to the



Are you looking for a sure-fire way to make your holidays the brightest ever? This season, why not give a gift that grows and keeps on giving... knowledge!

player's score the first time they hit it, two minutes the second time, and so on. Obviously, a player shouldn't hit the penalty buzzer more than once if they're keeping track of what they're doing!

Still another variation would be a second set of rotary switches wired to the first set so the player who sets the combinations can vary the settings while the solver is turning the switches. This can lead to some interesting psychological gamesmanship!

My puzzle box was built in a small baking pan and only basic hand tools were needed. The switch positions can be labeled with decals, but I think kids learn to follow a systematic approach faster if they're not.

There are many other ways to build the puzzle box. A flashlight bulb or buzzer could be used instead of the LED for instance. Check your junk box and use what you have.

The Treasure Finder. The treasure finder is a very basic metal detector. The circuit, shown in Fig. 2, is a Hartley oscillator with its coil wound around the perimeter of a 9 x 6 x 1-inch board. To use the treasure finder, a nearby portable AM radio is tuned to a broadcast station. The variable capacitor on the treasure finder is rotated until a heterodyne squeal is heard in the radio as the signal from the oscillator beats with the carrier frequency of the broadcast station.

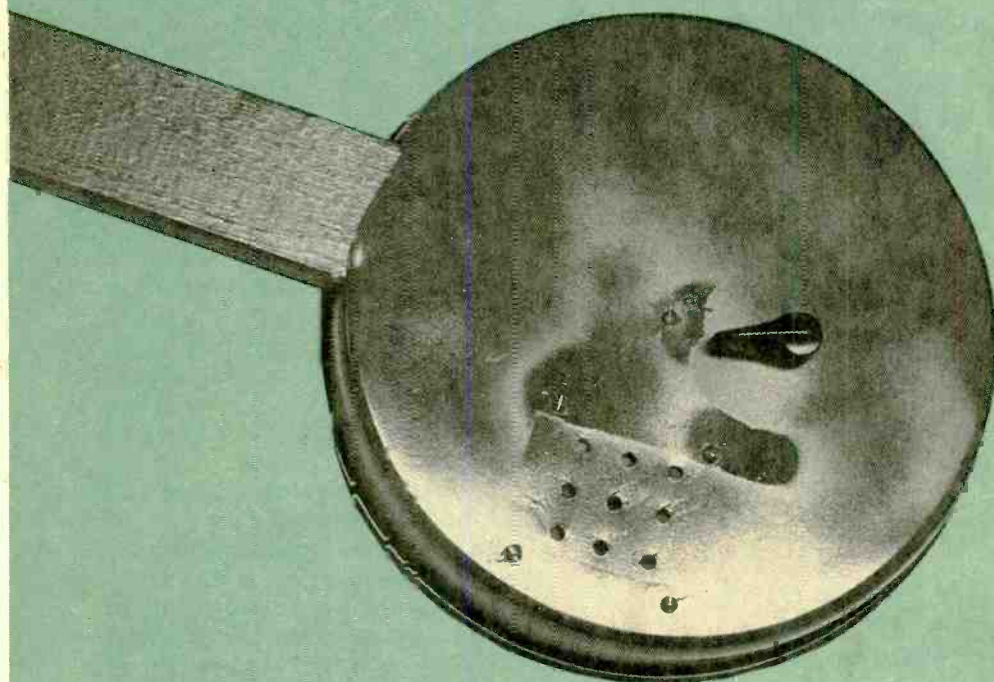
Moving the treasure finder near a piece of metal will cause the inductance of the coil to change slightly, which will change the frequency of the oscillator and cause the beat note in the radio to become higher or lower.

The treasure finder isn't as sensitive as it could be because the search coil is small and the metal components in the field of the coil cut down on the response to other metal objects. That was deliberate. After all, we don't want your children digging up the back yard because they had a reading from an old Studebaker hubcap buried six feet deep! But it is sensitive enough to allow the user to trace metal heating or cooling ducts under the floor, metal pipes and conduit in the walls, and so on.

The treasure finder will also help a child discover a number of electronics principles such as resonance, heterodyning, and the directional properties of loop antennas.

Building the Treasure Finder. To build the treasure finder, start by notching the smallest edges of the board with a knife or rasp to hold the search-coil windings. Then mount a fahnstock clip (a spring-action wire clip) about two inches in from one of the narrow ends of the board using a screw, but don't tighten it down. Measure off 41 feet of #22 enameled wire and form it into a loop 20½ feet long. Sand or scrape 2 inches of the enamel from the wire's middle. Place the stripped middle around the screw but under the fahnstock clip and twist the leads until the twist in the wire reaches the edge of the board. Now wind the two leads in opposite directions around the board. When the winding is complete hold the wire in place with tape and mount the rest of the parts. Placement is not critical as long as the component leads will not be inadvertently connected. Finally, hook the free ends of the coil to the appropriate fahnstock clips after sanding the ends of the wire. There's no on/off switch necessary since you can easily get to the battery and unplug it.

A note about the transistor: Germanium transistors are not as common as they once were. If you don't have a suitable unit in your junk box, you may have difficulty locating one. The ECG (Sylvania) and SK (RCA) devices listed in the Parts List will be the easiest to find; however, while the ECG and SK lines are popular and industry-standard, they are rarely stocked by hobby-oriented retailers. If you have difficulty finding the



transistor, look up your local Sylvania or RCA parts distributor in the telephone book. If you can't find one, try your local TV-repair shop; they almost certainly use parts from those companies in their repair work and can direct you to a source or perhaps even order the transistor for you.

To avoid interference with other receivers, check to see how far the signal from the treasure finder can be detected before turning it over to your youngsters. If it can be received beyond the property line, R2 can be increased or a lower voltage battery substituted to reduce the output.

When the kids tire of using the metal detector a number of changes can be made in the circuitry. Substituting a carbon microphone for R2 will turn it into a wireless mike, while replacing R2 with a pair of high-impedance earphones will make it a regenerative receiver. Let the youngsters do the experimenting and the learning.

The Electric Boinger. Your kids can take their first steps toward a great musical career with the Electric Boinger. Well, maybe one little step.

The Electric Boinger is a very simple variable-frequency audio oscillator driving a small speaker. The project is assembled in a 10-inch round cake pan with a 2-foot long, 1 × 3-inch

PARTS LIST FOR THE ELECTRONIC PUZZLE BOX

B1, B2—Size-C flashlight batteries
LED1—Super-bright snap-in LED
(Radio Shack 276-088 or equivalent)
S1—Momentary-contact SPST switch
S2, S3, S4—6-position rotary switch

ADDITIONAL PARTS AND MATERIALS

Baking pan 10 × 6 × 3-inches, knobs, battery holder, alligator clips, wire, solder, screws, etc.

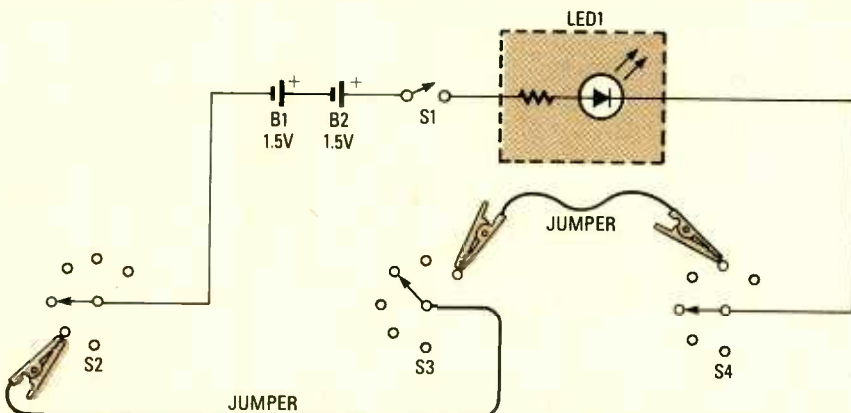


Fig. 1. The simplest things in life are often the most amusing, and the Electronic Puzzle Box is no exception.

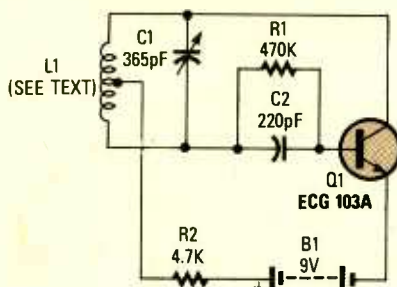


Fig. 2. If you experiment with the Treasure Finder's circuit a bit, you'll find that it is a very versatile little oscillator.

PARTS LIST FOR THE TREASURER FINDER

B1—9-volt transistor-radio battery
C1—365-pF, variable capacitor
C2—220-pF, ceramic-disc capacitor
L1—see text
Q1—ECG103A, GE-59, SK3835/103A, or equivalent NPN germanium transistor
R1—470,000-ohm resistor
R2—4700-ohm resistor

ADDITIONAL PARTS AND MATERIALS

Board 9 × 6 × 1-inch, 2-foot long 1-inch diameter dowel, knob, fahnstock clips, bracket for variable capacitor, battery clip, battery holder, 41 feet of #22 enameled wire, hook-up wire, solder, screws, etc.

board serving as the neck. The frequency or pitch is controlled by a pointer knob on R2, and it is activated by an on/off lever-type switch on the top of the neck.

To play the Electric Boinger, press the switch while moving the pointer knob. Many interesting musical effects are possible—it's hitting the right notes that's hard, but children have a good imagination.

The electric boinger can be made in a variety of shapes. You can trace an electric guitar on piece of plywood for a modern look, or trace a violin if your

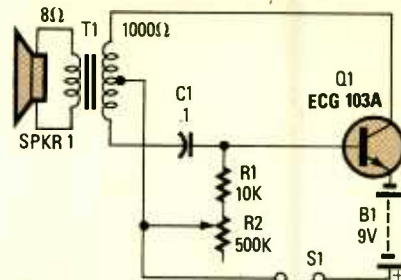


Fig. 3. Put your child on the path to a musical career with the Electric Boinger, it's sure to amuse them.

PARTS LIST FOR THE ELECTRIC BOINGER

B1—9-volt transistor radio battery
C1—0.1-μF disc capacitor
Q1—ECG103A, GE-59, SK3835/103A, or equivalent NPN germanium transistor
R1—10,000-ohm resistor
R1—500,000-ohm potentiometer
S1—Subminiature SPST lever switch (Radio Shack 275-016 will do.)
SPKR—8-ohm speaker
T1—1000-ohm to 8-ohm center-tapped transformer

ADDITIONAL PARTS AND MATERIALS

10-inch round cake pan, 1 × 3 × 23-inch board, knob, fahnstock clips, tape, battery clip, screws, wire, solder, etc.

child is the classical type. You can build a whole symphony in a few evenings!

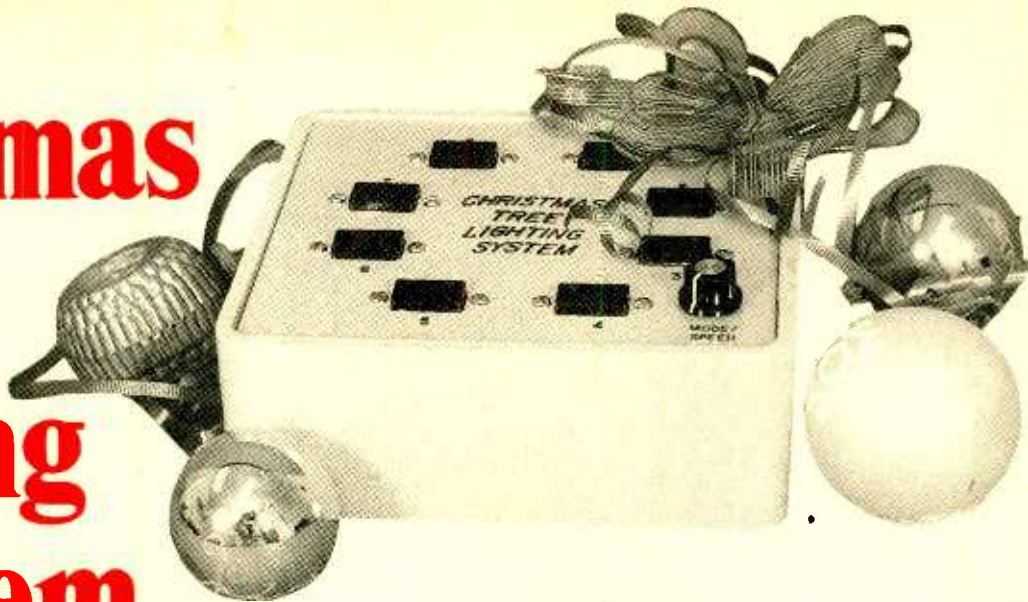
Many variations are possible. The first that comes to mind is substituting a pair of 8-ohm earphones for the speaker. If you use a different transformer than that shown in Fig. 3, a different value of C1 may be necessary. Also, should you have trouble getting the transistor, try your local TV-repair shop as we mentioned earlier.

The only semi-difficult part of building the boinger was cutting a rectangular hole in the side of the cake pan for the neck. Fortunately the aluminum is thin and very soft. I started the hole with a 1/4-inch drill bit, roughed it out with a coping saw, and finished it with a file.

All the parts are held to the board with fahnstock clips and their placement isn't important. A battery holder could be used for B1 but a piece of tape works nicely.

There are many other projects that can be built using the parts in these three toys. When the other Christmas toys have been broken or discarded, these may still live on in a variety of gadgets the kids have dreamed up themselves. And that's the real value of these toys. Merry Christmas!

Christmas Tree Lighting System



BY DR. CHARLES SCHULER

Build our microprocessor-based controller and deck the halls with an unusual light display this holiday season

Have you ever watched the flashing lights on a rather sophisticated control panel, or perhaps noticed others watching them? Hollywood has long been aware that the blinking lights used in sci-fi films have a way of captivating the audience. Many people are fascinated by blinking lights, especially when the lights form interesting and unusual patterns, but rapidly tire of ordinary blinking lights.

For that reason, many people elect not to install a blinker in their Christmas tree light strings. Simple on-off blinking can be boring and even annoying in some cases. However, imagine a Christmas tree with the lights producing illusions of changing geometric patterns, rotations, reversals and fades. The effects are very absorbing and combine well with music.

There are several approaches to controlling lights so that interesting patterns are formed. Obviously, few designers (given today's technology) would choose to use mechanical timers and relays. A solid-state design is a better choice. For example, a clock circuit, a binary counter, a ROM or EPROM, and some control devices would fill the bill. Such an approach would certainly work, but would increase the parts count, and advanced features would be more difficult to implement.

Computers are the ultimate controllers. However, using a personal computer for such an application would definitely be overkill, and additional circuitry would still be required. So rather than build a computer-dependent circuit, it was decided that a circuit—like the *Christmas Tree Lighting System* presented in this article—built around a single-chip microcomputer was the way to go. The circuit is about as simple as a light controller with interesting features can be.

About the Circuit. Figure 1 shows a schematic diagram of the Christmas Tree Lighting System. At the heart of the circuit is Motorola's MC68705P3 8-bit EPROM microcomputer, a 28-pin DIP device containing a CPU, clock, EPROM, bootstrap ROM, RAM, 20 TTL/CMOS compatible I/O lines, and a timer. Powered from a single-ended +5-volt supply, the circuit dissipates about a half watt of power.

The MC68705P3's software instruction set is similar to that of the familiar 6800 family. The control program must be stored in the chip's internal EPROM. (Pre-programmed MC68705P3's are available from the supplier given in the Parts List.) Note that in Fig. 1, the MC68705P3's PBO through PB7 I/O lines are used to drive 8 identical sensitive-gate, SCR load controllers. To conserve space,

only one SCR circuit is shown.

The SCR's selected were chosen for their gate sensitivity, thereby allowing them to be triggered directly from the microcomputer's port B I/O lines. Note: Only port B supplies sufficient current to directly drive the gates of the SCR's, so the others are not used. When any of port B's I/O lines go high, the corresponding SCR is gated on, turning on the corresponding load. When any port B I/O line (in Fig. 1) goes low, the corresponding SCR's do not gate and the appropriate loads remain off.

A full-wave, bridge rectifier is used to convert the AC line voltage to pulsating DC, allowing the full AC cycle to be applied across the load, thereby driving the load to full brilliance. Without the full-wave bridge circuit, only half of the AC cycle (and thus half the power) would be applied to the load. That's because the SCR (which can be viewed as a gated rectifier), like any diode, passes current in only one direction. And when the SCR's anode is negative with respect to its cathode, there is no current flow. In other words, the SCR acts as a common diode.

However, because of the nature of the bridge rectifier, the anode of the SCR is always positive with respect to its cathode, so it will conduct during both halves of the AC cycle. The bridge rectifier can be eliminated by using Triacs

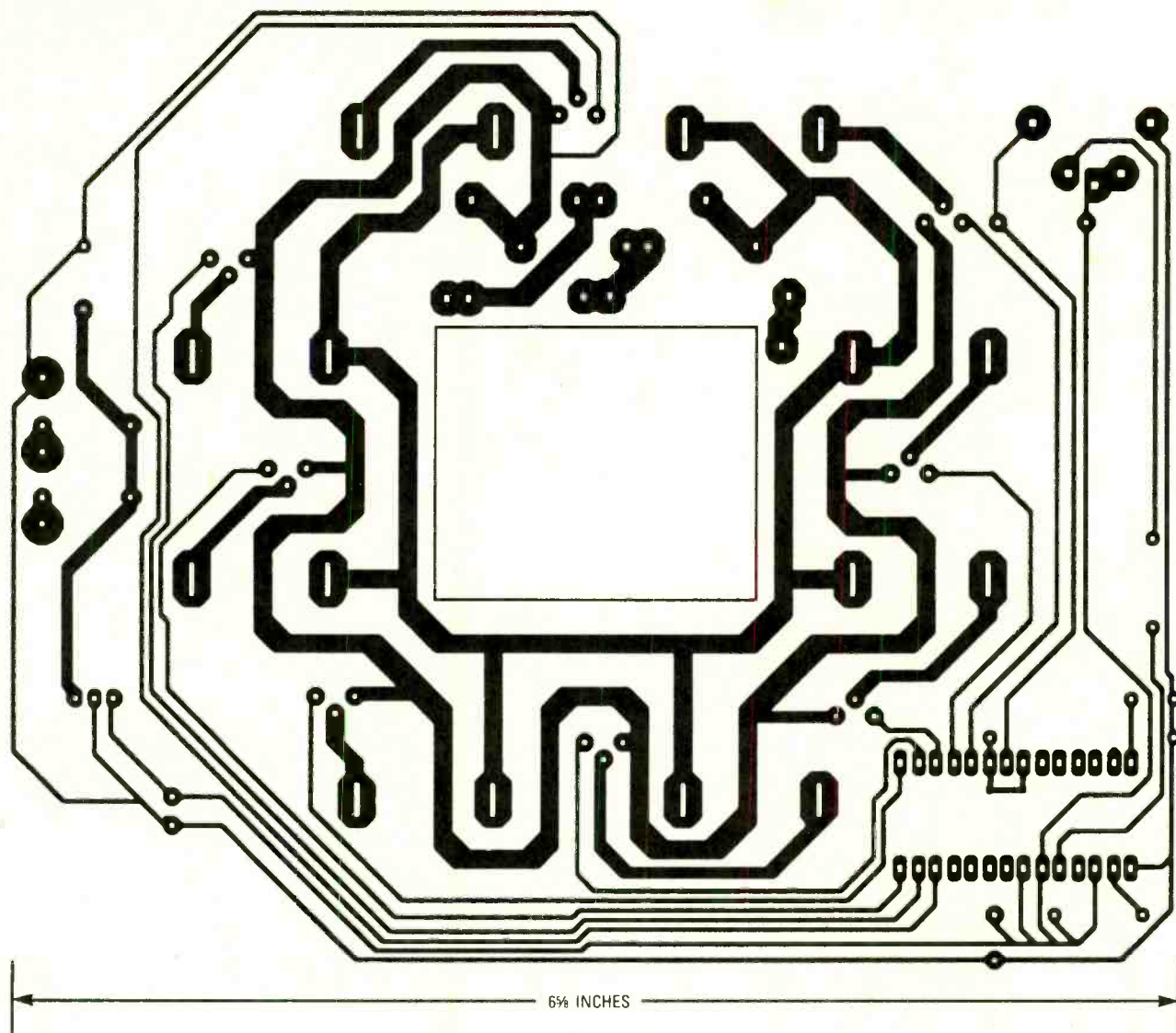


Fig. 2. The template for the Christmas Tree Lighting System's printed-circuit board. The rectangular cutout at the center of the board is reserved for the power transformer, T1.

mended that the circuit be assembled on a printed-circuit board. Figure 2 shows the template for the author's printed-circuit rendition of the circuit.

Once you've etched and drilled your board, begin installing the board-mounted components, guided by the parts-placement diagram shown in Fig. 3. It is recommended that an IC socket be used for U1. Note that while SO1–SO8, R4, and S1 may appear as though mounted to the board in Fig. 3, they are actually mounted to the front panel of the project's enclosure.

However, it is possible to mount the sockets directly to the printed-circuit board, with the sockets protruding through the front panel of the enclosure. Of course, that would require that the cutouts you make in front panel for the sockets line-up with the socket-

mounting positions on the on the board. That can easily be accomplished by laying a piece of tracing paper over the foil pattern in Fig. 2, and tracing the socket outline on the board, and then using the tracing as a template. Assembling the project in that manner would also mean that the printed-circuit board will have to be mounted to the front panel of the enclosure.

As is the case when assembling any line-fed (or operated) device, exercise caution—any line-operated device (in our circuit, the AC outlets, SCR's, the fuse, and the bridge rectifier) represents an extreme shock hazard when assembled in a haphazard fashion. The rectangular cutout at the center of the foil pattern is reserved for power transformer T1.

Once the printed-circuit assembly is completed, prepare the enclosure that will house the printed-circuit board by making eight cutouts for AC sockets (SO1–SO8) and drilling a hole to accommodate the shaft of the R4/S1 combination (S1 is piggy-backed to R4).

Checkout. Testing the completed project is easy. However, do not troubleshoot the unit with line-operated equipment such as an oscilloscope unless you use an isolation transformer or some other established safety procedure. Begin with the microprocessor out of its socket. Connect the controller to the AC line (or the isolation transformer) and check for +5 volts at socket pins, 3 6, and 7.

Pins 1, 20, 22, and 27 should be at ground potential. Pin 21 should be at

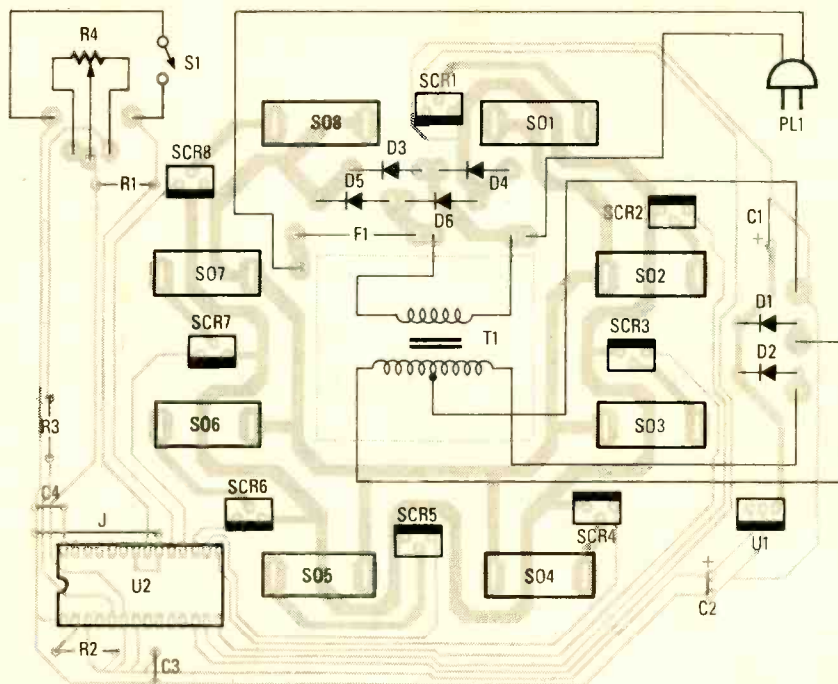


Fig. 3. Install the on-board components of the project guided by this parts-placement diagram. It is recommended that U1 be installed in a socket.



While the photograph does not do it justice, the lighting system creates displays that make the author's tree the hit of the neighborhood.

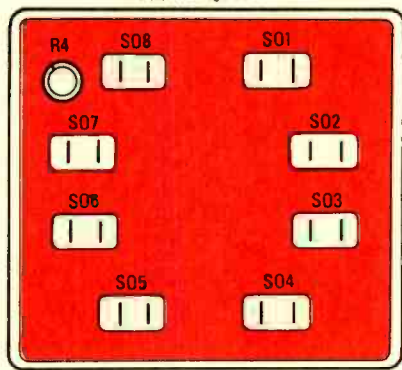
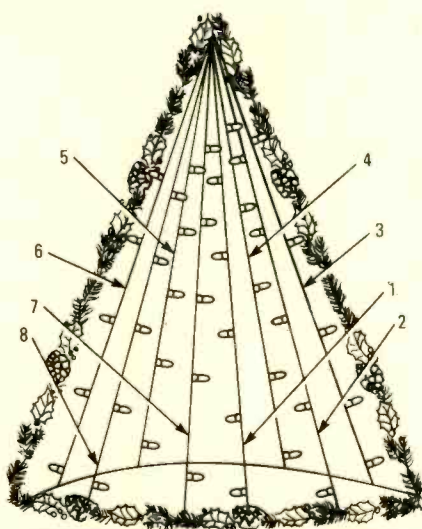
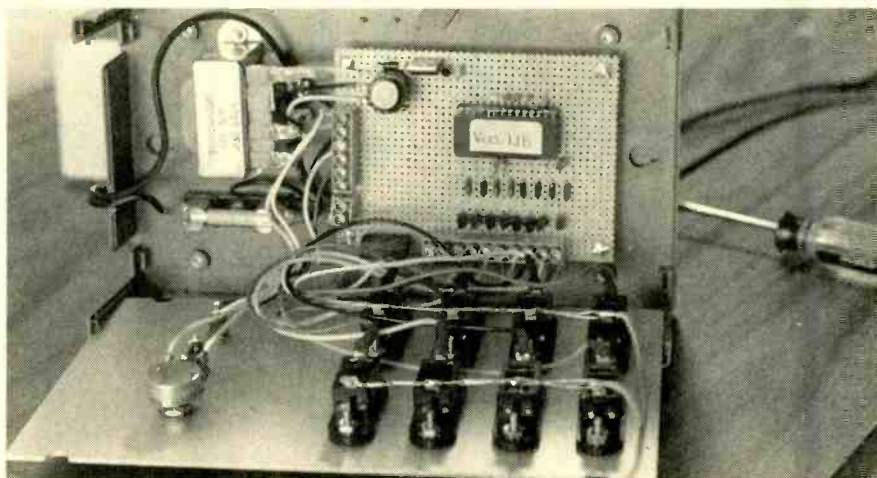


Fig. 4. Where you place the light strings connected to the controller (on a tree or door, in a window, etc.) is strictly a matter of choice. One pleasing arrangement is eight vertically-strung and equally-spaced strings on a Christmas tree.



Since the circuit layout is not critical, the original prototype was built on perfboard.

either +5 volts or ground depending on the setting of S1. If your controller passes those tests, remove the line cord from the outlet. Wait a minute for the capacitors to discharge and then place the microcomputer (U1) into its socket. Plug a string of decorative lights or a test light into each of the eight receptacles. Use only incandescent lamps and be careful that you do not exceed a load of 60 watts on any one AC socket. Re-energize the circuit and check the operation of the two user controls.

The popular miniature 35-lamp light sets are rated at about 20 watts, so you can safely run as many as 3 such sets per outlet. If in doubt, please check the wattage ratings on the light packag-

ing. The arrangement and location of the light strings (on a tree or door, in a window, etc.) is purely a matter of choice. However, it is important to spend some time arranging the lights to achieve the most eye-catching effect.

One arrangement that seems rather pleasing is eight vertically-strung, equally-spaced strings on a Christmas tree (see Fig. 4). Another arrangement might be a fan pattern strung across a garage door. Use your imagination and try various configurations; you'll be able to achieve some really unusual effects. Then, as your holiday visitors file past the visual delight that you've created, you'll be happy (and proud) to say that you built it yourself.

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A CHRONICLE OF CONSUMER ELECTRONICS

Watch It!

SONY GV-8 VIDEO WALKMAN. Manufactured by: Sony Corporation, 9 West 57th St., New York, NY 10019. Price: \$1300.

We have seen the future, and it is small. Sony's little 2½-pound *Video Walkman* combines a battery-operated TV receiver with a 3½-inch LCD screen with an 8mm VCR—everything in one small package you can easily tuck under your arm. And, it all works pretty well, too.

To begin with, the display is excellent. LCD's, both color and black-and-white, have been infamous for their lack of contrast and the washed-out images they typically deliver. Not this one. It has lots of snap, and its blacks are truly very close to being black. Coupled with the ability to provide really saturated colors, the Video Watchman's screen allows you to see a range of hues superior to that we've seen on all but one or two other LCD screens. Of course, there is a limit to how small the size of each pixel—picture dot—can be on such a screen, and that manifests itself as graininess in the picture, but there is sufficient resolution to make out news-broadcast captions and then some. This is a state-of-the-art display.

The screen is backlit, and there is no provision for turning the backlight off. That seems to be the trend in LCD's these days. Ambient light is too variable and unpredictable to permit comfortable viewing, and different types of light sources will affect the color balance of the picture. Therefore, even though it means more battery drain, the backlit screen is probably a good idea. The display can be turned off to conserve power while taping or just listening to the TV sound. Because it depends on a small fluorescent bulb for back-lighting, the Video Watchman's screen washes out in direct sunlight. If you can get it in the shade, though, it can present an acceptable picture. Although subdued light is not a necessity, the unit works best indoors.

A BRIGHTNESS control does not do as much to affect the actual brightness of the picture as it does to adjust its contrast to the viewing angle. LCD's have a very narrow vertical-viewing angle—the contrast



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changes very quickly as you move your head up and down relative to the screen, and the image just disappears if you move too far—but this control, together with the hinged panel in which the LCD is mounted, allows you to watch the GV-8 head-on, while it is lying on its back (probably the way most people would use it), or from any angle in between.

The audio quality of the Video Watchman is not, alas, up to the standards of its video. Of necessity, the speaker is small, and we realistically did not expect anything like high fidelity from it. However, what we did get was very tinny and very distorted. Surely Sony could have found a way to put a speaker just a little bit larger in *somewhere*. There is also, of course, an

earphone jack. Its output is monophonic. Too bad. It would have been nice if it had been stereo, and that nicety would probably not have been too much more work to include.

The tuner section of the unit is of the scanning electronic type. That is, you press the "+" or "-" button to make it look for the next TV channel up or down the band. We've never cared too much for that type of tuner, since it often gets distracted by interstation noise and stops midway between one channel and the next, where it stays until you force it to move by pressing on one or the other of the tuning buttons. An on-screen vertical bar points to channel numbers printed just above the

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And It Comes Out Here

**PROTON SD-1000 SURROUND
SOUND DECODER. Manufactured by:
Proton, 5630 Cerritos Avenue,
Cypress, CA 90630. Price: \$999.**

The "total movie experience" isn't complete without a wide-screen 70-mm print, a big tub of popcorn, and Dolby Surround sound. And, although at-home wide-screen TV isn't expected for another couple of years, you can have better sound—and popcorn too, although that's another story—at home with ease. Representative of the forward edge of the current crop of surround-sound decoders for home use is *Proton's SD-1000*. Proton has established a reputation for itself as a producer of moderate-to-high-end audio and video equipment that's affordable, well thought out, and provides the features and performance one would want in a not-too-expensive package. The SD-1000 maintains that reputation. It costs more than many other surround-sound units, but it is a quality piece of equipment.

A brief word about how surround-sound encoding and decoding works. All the movie's (or tape's) audio information is contained in just the right- and left-channel tracks. However, the rear-channel information is recorded out-of-phase with the rest, and can thus be recognized and extracted. In conventional stereo systems that out-of-phase "ambience" information may sometimes be heard as sounds emanating from beyond the bounds of the sound stage established by the locations of the speakers. In the Dolby Surround process the information contained by the out-of-phase signals is heard from behind the viewer or combined with front-channel information to produce a phantom sound source "above" him.

We'll admit right from the start that we couldn't put the Proton unit through *all* its paces—we ran out of amplifiers and speakers before it ran out of outputs. The SD-1000 derives a total of six (or seven, depending on how you count) channels of

surround sound from a stereo input carrying sufficient information. The six channels are: LEFT FRONT, CENTER FRONT, RIGHT FRONT, LEFT BACK, CENTER BACK, and RIGHT BACK. The seventh output channel is intended to drive a subwoofer; since very low frequencies are essentially omnidirectional its placement is not especially critical. Proton does not assume that you will like what it might provide in the way of an amplifier, so it supplies none and leaves the choice up to you. One pair of channels can be driven by the stereo amp you already own and you have to take it from there. We ran our SD-1000 with a pair of left- and right-front speakers, another pair for left- and right-back, and the obligatory subwoofer. Proton claims the unit is smart enough to sense what is connected to it and adjust its processing accordingly, so we left the center channels to fend for themselves.

We were afraid that making all the hookups was going to require ripping out all the existing cabling to our receiver and reconnecting it elsewhere, but we'd forgotten in our excitement that all the multi-channel output is ultimately derived from just two stereo channels. In the end all we needed (aside from a second stereo amp, a second pair of speakers, and the cable to connect them) were six ordinary audio cables with RCA plugs. One pair took the signal from our receiver's preamp section to the SD-1000, another pair brought it back to the receiver for amplification (you can also use your receiver's tape monitor loop for this purpose; the SD-1000 has its own loop to replace the one you may lose). The last pair of audio cables was used to convey the rear-channel information from the decoder to line-level inputs on the second amplifier. That done, we used our receiver, with all its preexisting connections, to select the input to the decoder.

The most time-consuming part of setting up the SD-1000 is getting the sound levels in all the channels balanced. Not only do you have to determine the proper output levels for your amplifiers, but each of the SD-1000 inputs has its own level control as well. It takes a bit of juggling, but Proton provides a lot of helpful infor-

(Continued on page 4)

Just a TAD

COBRA AN-8521 CORDLESS PHONE ANSWERING SYSTEM. Manufactured by: Cobra Electronics Group, Dynascan Corp., 6500 West Cortland Street, Chicago, IL 60635. Price: \$199.95.

It's getting hard to sell a telephone that doesn't have something going for it in addition to its ability to transmit and receive voices. Among the gimmicks we saw at the last Consumer Electronics Show were a phone built into a wooden space-shuttle replica, one shaped to look like a golf bag, and another that at the press of a button shot sound effects over the line to the party at the other end. That might be good news for gizmo fans, but we're not sure what it says about the industry (or our society) in general.

Fortunately, many of the value-added phones do have some worthwhile features. One of the hottest sellers is the phone that combines several functions—each of them useful in and of itself—into a single package. That not only saves precious desktop or counter space, but may also result in a monetary saving as well, since some components or functions can be shared by several of the phone's systems.

One such device is *Cobra's AN-8521* answering machine *cum* cordless phone. (Answering machines, for your information, are now known as *TAD's*, or Telephone-Answering Devices. They still do the same thing, though.) The Cobra unit comes in a package measuring about 8 × 8 × 3 inches, which makes it more compact than many single-function answering machines. We'll consider each of its functions individually.

As an answering machine—sorry ... as a TAD—the AN-8521 does an acceptable job. Much of its compactness, though, derives from the fact that it uses a single-microcassette system rather than a dual-cassette one with full-size cassettes, for message handling. That leads to some compromise in quality, both of the audio and in operating convenience.

The little microcassette is moved by a very simple transport that appears not to include any sort of capstan mechanism to stabilize the tape speed. Without that regulation, the tape is prone to wow and flutter, and the unit we had sometimes suffered so much from wow that it sometimes sounded as though we were getting ready to gargle.

In a dual-cassette system, one cassette, usually an endless loop that runs for 20 seconds or so, is used to hold your outgoing message. When the message has been delivered, the tape continues to move until its beginning has been reached, at which time it stops and awaits the next incoming call requiring a response. The messages



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recorded by a dual-cassette TAD go onto a separate ordinary audio cassette, which usually allows about 45 minutes of messages to be stored.

Using a single-microcassette system instead results in some compromises. The first, which will not be objectionable under most circumstances, has to do with the fact that both the outgoing and incoming messages are recorded on the same small cassette. That, when you are trying to play back your messages, and then replay them to catch something you missed the first time, results in a lot of microprocessor-controlled tape-shuttling back and forth as the mechanism does...well, we're not sure exactly what it's skipping over, but it does take its time doing it. That can be frustrating if you're in a hurry.

A different problem arises from the recording time afforded by the microcassette medium. The cassette that came with our AN-8521 indicated that it had a playing time of 15 minutes per side. Even with the TAD's built in VOX circuit, which stops recording during silences, and its two-minutes-per-message time limit, it does not leave space for many calls. Of course, the unit does offer several different options for erasing old messages, thus clearing space for new ones, but this is still an inconvenience of some degree.

By the way, replacement microcassettes are available in almost any office-supply store or Radio Shack. Just make sure that you get the right type; there are two different—and incompatible—styles.

You can, of course, call in from a remote phone to collect your messages. If the message tape is full the TAD will let the phone ring ten times, and then give three beeps, to tell you so. After collecting your messages you can erase the tape by remote control, so that it is ready to take new ones. You can use the microcassette as a "memo" medium to leave messages either to yourself or others. You can even call in and leave a memo. And, if the TAD is off and you want to turn it on remotely, there's a way to do so.

And, a final note about the TAD's operation, at least as it pertains to our device. You can set it to answer after one or two rings, after about six rings, or put it into a "toll saver" mode that is most useful if you call the machine yourself looking for messages—it prevents the machine from answering if no new messages have been recorded. In its "short" mode, our unit picked up on the first ring, always before we could intervene. We quickly caught on to this, though, switched to the "long" mode, and gave up trying to play "Beat the TAD."

Despite all this nitpicking, the AN-8521 performed pretty well as a TAD and didn't really give us any trouble.

The other half of the AN-8521 package is a cordless phone. We were, on the whole, quite pleased with its performance, although (as usual), we do have a couple of comments to share with Cobra's engineers. The phone's audio, both as a transmitter and receiver, was very good. It did

not have that "dead" quality that's frequently associated with audio in cordless-phone operation and we were told by several parties that they would have been unaware that the phone was a cordless model had we not told them. Occasionally there was a very faint hum, presumably from the power supply, but it was noticeable only under very quiet conditions.

The phone, which is frequency modulated in the 47-49-MHz region, provides you with a choice of four operating-frequency pairs to prevent interference to or by other cordless-phone systems. The phone's instruction manual lists all 10 frequency pairs assigned for cordless-phone operation, but does not—probably very sensibly—show the correlation between the switch settings and frequency. (If you're really curious about your phone's frequencies, you can probably track them down using a scanner.)

The phone was comfortable to use, and the batteries in the handset gave it a comfortable heft that is frequently missing in cordless phones. Of course, the phone section of the AN-8521 features auto-redial, a nine-number memory, a real FLASH button that only briefly interrupts the circuit no matter how long you hold it down, and other amenities. One of the AN-8521's strongest selling points is that you can use its phone section to screen incoming calls and choose either to answer them from the handset or to let the TAD take care of them. What we thought was a nice add-on, a belt clip, is available from Cobra for a few dollars. That, combined with the phone's long capability for standby operation, makes it extremely convenient to use for extended periods away from its base.

The AN-8521 charges when the handset rests in its cradle, which is built into the base. It charges more rapidly when in its STANDBY mode (when just its receiver is active) than when in its TALK mode, when both the receiver and transmitter are on. A slide switch on the side of the phone allows you to go from one mode to the other, and an AUTO-STANDBY mode automatically switches the phone from TALK to STANDBY when it is placed in its cradle.

Now for the Cobra engineers: First, the phone's electronic ringer is nice and loud, a good idea if you're going to be using it out of doors, perhaps around a lawn mower or other noisemaker. However, Cobra, there's no way to turn it down when you take the phone back inside! On several occasions we received quite a start when the thing went off!

Our other beef with the AN-8521 concerns its rather useless CHARGE indicator. When you put the handset in its cradle, the indicator lights, when you pick it up, the LED goes out. That's all it does. When the handset's in its cradle, the LED is always lit at the same intensity—it doesn't show when the handset's battery is low, or fully charged, or when the charger switches

over from full- to trickle-charging. A more informative indicator would have been a nice feature to have.

All in all, though, we were quite pleased with Cobra's combination. And, from what we've heard about the back-order situation, lots of others are pleased too. ■

SURROUND SOUND

(Continued from page 2)

mation on the procedure in the instruction manual—we wish they had supplied as much about the way the decoder worked and the uses to which it could be put. There's also a large knob on the front of the unit that functions much like the phasing controls that used to be found on early stereo receivers—you turn the knob until as much of the rear-channel signal as possible disappears. That ensures the maximum degree of separation.

That knob, and an accompanying push-button that mutes the front-channel sound during adjustment, are the only controls on the face of the SD-1000. Everything else is on the remote-control unit, and there's no duplication! There's even just one ON-OFF switch, and it's on the remote. That can be disconcerting at first, but you quickly get used to—and even develop a liking for—that method of doing things. We suspect that other equipment designers will follow this pattern. The remote unit, by the way, has won at least one award for design. It fits naturally in the hand and its infrared head is angled to aim at the decoder while you're holding it at an angle comfortable to the wrist and arm.

Controls on the remote allow you to shift the balance of the sound forward, to the back, and to the left or right. There's also a pair of buttons for overall volume control, as well as the all-important MUTE button—a must when you're listening to six or seven channels of high-intensity sound and there comes a knock at the door. A MON button controls the decoder's tape monitor loop if it is used.

The SD-1000 supports three modes of operation, selectable in rotation by pressing the MODE button on the remote. The first, "MUSIC", provides the greatest differentiation among channels. The next, "CINEMA", produces a monophonic rear-channel signal, which is what is done in movie houses showing surround-sound material. The last mode, "BYPASS", eliminates the rear channel altogether—your system reverts to sounding the way it used to. Also selectable from the remote are four levels of separation enhancement. The "separation," in this case, refers to separation between adjacent channels such as front-left and front-center; there's no effect on the separation between left and right, or front and back. Proton claims that this helps make sound seem to come from where it's intended to when you are sitting close to the speakers and might

otherwise find the effect of one overwhelming the one adjacent to it. Proton specifies separations between adjacent channels of 3, 6, 18, and an astonishing 50 dB, depending on the level selected.

The SD-1000 also incorporates a function to control a phenomenon known as "dialogue scatter." That occurs when, for one reason or another, a soundtrack or recording contains a lot of sibilants or other "hissy" sounds. Without dialogue-scatter reduction (DSR), these sounds may be decoded so as to pop up more or less at random within the sound-field. The DSR control is said to put them back where they're supposed to be. Proton remarks that DSR can also be used to improve noisy material, and we found that it did quiet down an unusually hissy tape considerably. Finally, the decoder utilizes circuitry developed by a firm called Apex Inc., whose sound-processing equipment is used mostly by professionals in the broadcasting and recording industries. The Apex RatioMetric Detection System used in the SD-1000 is said to yield separation superior even to that provided by professional theater decoders.

After all that, how does it sound? It sounds pretty good! Of course, as is the case with life, what you get out of the decoder depends on what you put into it. We'd been saving a tape of a film called *Runaway Train*, which has a spectacular soundtrack even in ordinary unenhanced stereo, for just an occasion such as this. With the SD-1000, it was better than being in a theater!

On broadcast television, the decoder sometimes worked and sometimes didn't do a thing. It's hard enough to get real stereo from most stations, let alone ambient sound that can be processed for a surround effect!

We also tried the SD-1000 in its MUSIC mode on various pieces of recorded material. The decoder added a certain presence to a performance of Mozart's *Symphony No. 40*, although the effect was not what we'd label concert-hall realism. And, on some more popular material it did a curious thing. What had previously been left-right ambience material (and would have been heard from way off in the wings using something like a Carver Sonic Holography processor) took on a front-back orientation. It took some getting used to on our part since we were accustomed to hearing particular passages coming from particular spaces, but the overall effect was not unpleasant.

In fact, this review has taken us a little longer than most to finish; as we write, we're listening to some old records through the SD-1000. Every once in a while we have to stop and get up so we can restart a track and position ourselves to hear what the unit does to some passage or other. The effect, as we've said, is pretty good! ■

Caveat Emptor

TEAC AG-75 75-WATT AM/FM A/V RECEIVER. Manufactured by: Teac Corporation of America, 7733 Telegraph Road, Montebello, CA 90640. Price: \$399.95.

Teac has quite a reputation for tape-recording equipment, from little home cassette decks up to big 15-inch-per-second, ten-inch open-reel ones. Now, it seems, the company is testing the waters in other parts of the home-entertainment swimming pool. One Teac entry in the marketplace is its 75-watt-per-channel AM/FM A/V receiver, model AG-75. When we saw Teac's information sheet on this product we became quite interested in it—it was billed as an A/V (which we assumed to mean "Audio/Video") receiver, something we'd been wanting to try. We also came across mention of the AG-75 referring to its "matrix surround-sound" capabilities. Now we couldn't wait!

It turns out that we could have.

Don't misunderstand us—the receiver is quite adequate. Not especially exciting, not much out of the ordinary, but passable. It's simply that those special features we'd assumed it had—and which were what we really wanted to try out—are not what they were made out to be, or at least not what we assumed them to be from what we had read. The AG-75 is no more a video receiver than was the *Heathkit AR-15* we built back in 1968 (and from which we got excellent service until it died of old age a couple of years ago)! The unit *does* have a line-level input marked CD/VCR, but that's as close as it ever comes to video unless you include receiving the audio portion of a PBS simulcast on FM.

As far as the "matrix surround-sound" part goes, the receiver allows you to switch between two pairs of speakers, A and B, or (under special circumstances described below) to use both pairs simultaneously. About that, the Teac manual says: "When both the A and B buttons are pressed simultaneously, the built-in surround-sound circuit is engaged. For a better surround-sound effect with a greater feeling of presence, place the speakers connected to the SPEAKERS A terminals to the front of the listening position, and place the speakers connected to the SPEAKERS B terminals to the rear."

That indicated to us only that the two sets of speakers would be connected in parallel, meaning that the same information would be coming from the rear pair of speakers as from the front ones. While that might be called "being surrounded by sound," it was certainly not "surround sound," not to mention "Surround Sound." We brought the matter to Teac's attention and discovered that when both

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speaker buttons were depressed, the rear pair of speakers received not the left- and right-channel signals as we had inferred from the manual, but a signal consisting of the left and right *difference* information (L - R). It is generally assumed that ambience information is contained in this out-of-phase signal and, in fact, the earliest known ambience system used the same method Teac uses in the AG-75. That system, while somewhat primitive by today's standards—and certainly not what we expected when we came across the term "surround sound" (we've had trouble with definitions of the term before, but never to this extent)—can add a certain degree of "presence" to material that contains enough ambient sound information. Both of the receiver's rear speakers reproduce the same signal, which probably means that you can get away with only three speakers for Teac surround sound.

Well, if it doesn't do "real" surround sound, and it doesn't do video, what *does* the AG-75 do? And how well does it do it?

The AG-75 is stated to deliver at least 75-watts-per-channel RMS into an 8-ohm load over a frequency range from 20-20,000 Hz. In our listening it certainly had plenty of power, and the sound it output was clean. The synthesized frequency tuner section allows for 16 station presets, which should be more than enough for most listeners. It can be tuned manually or put into an AUTO TUNE mode that sweeps up the band and pauses briefly at the stronger stations while you decide whether or not to enter each into memory as a preset. A MEMORY-SCAN function sends the tuner zipping through the presets sequentially at the rate of one every five seconds until you find one you want to stay with. And the preamp section of the unit allows you to tape from one source while listening to another, not an unusual feature to find these days, but still a nice one to have.

There are a couple of built-in features that we appreciated. One is a variable LOUDNESS control. In most receivers, the loudness function (which boosts low and high frequencies to compensate for the ear's dropoff in sensitivity at low listening levels) can be switched in or out, but the degree of boost is fixed. When you reduce

the volume level, you can switch in the loudness circuit to compensate for your ear's shortcomings. With this receiver, if you want to listen at a reduced level, you leave the VOLUME control where it is and adjust the one marked LOUDNESS. That reduces the volume while at the same time boosting the signal at the low- and high ends of the audio spectrum. A nice touch. There's also a CD DIRECT button that passes signals input to the CD/VCR jacks straight through the amplifier, with no bass, treble, loudness, balance, or other processing to possibly deteriorate them. Only the VOLUME and RECORD SELECT controls are active in this mode.

The AG-75's remote control does not offer *complete* control of the receiver, but perhaps that's just as well, since some things (such as setting the station presets) have to be done only rarely, and you can at those times be troubled to get up and walk over to the unit to do what has to be done.

There seems to be a difference of opinion in the electronics industry about which of two ways is the better to control volume—digitally, through a step attenuator, or mechanically, through motorized control of a potentiometer. We favor the latter, and so does Teac. This system provides much closer control over volume levels than can the digital one. There are no "missing steps," which usually happen to be the ones you want (that is especially noticeable at low settings).

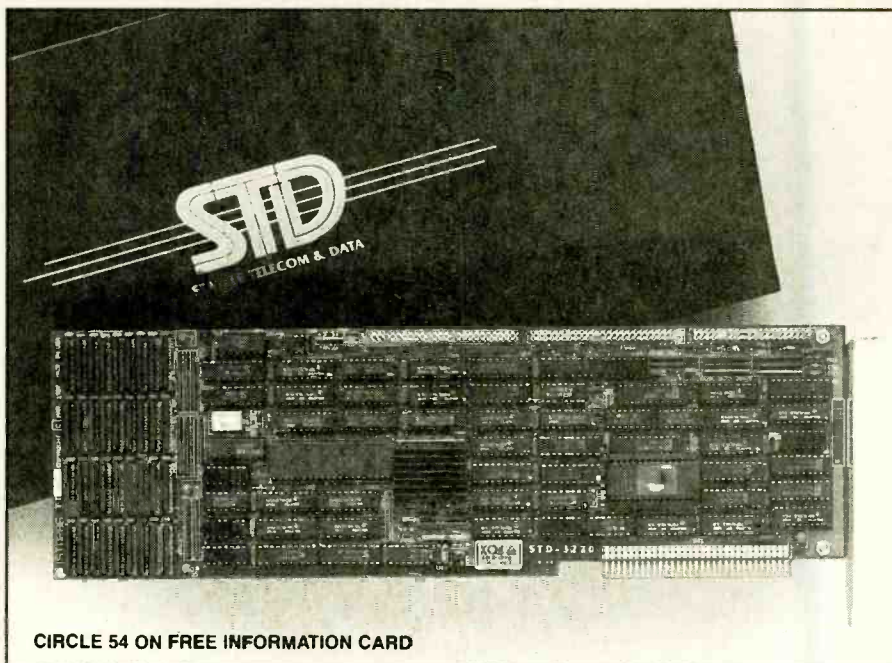
What the remote control lacks, though, and should have, is a MUTE button. When the phone rings in the middle of Tchaikovsky's "1812 Overture," it would be nice to be able to turn off the sound temporarily while you answer. That saves a lot of running back and forth between the receiver and the phone. You can, of course, reduce the volume (to zero if you like), but that takes a couple of seconds. We've been using a makeshift MUTE function: we simply use the remote to switch to an unused input—perhaps TAPE 2 when we're listening to the radio—until we're done with the call and ready to switch back to FM or whatever input we were listening to. The remote also required careful aiming; we frequently had to wave it around in the air until it found its target.

Whether that is a shortcoming of the remote transmitter or receiver, we do not know for certain, but we suspect the receiver.

We found the connectors for the speakers and antennas quite convenient to use, although we feel that we would have had difficulty in fitting really heavy-gauge speaker wire into their holes. We also got a nasty surprise when we went to connect our 75-ohm FM antenna cable—there's no coax connector at the back of the receiver; you have to use 300-ohm twin lead! If you think you can beat the system and decide to use a 75-ohm-to-300-ohm matching transformer as an impedance- and mechanical-matching device, you'll have to cut the spade lugs off the ends of its little piece of twin lead and strip the ends of that piece bare so they can fit into the holes of the connectors. Teac supplies indoor antennas for both AM and FM.

Another design flaw, much more serious than the omission of a MUTE button on the remote control or an antenna input for 75-ohm coax, has to do with the output impedance of the AG-75's amplifier. The AG-75 is designed to drive speakers having impedances of eight ohms or greater. It will presumably be damaged if used with speakers having lower impedances. The "surround sound" passage we quoted above from the manual continues with: "NOTE: When speaker systems with an impedance of less than 8 ohms are connected, do not press the SPEAKERS A and B buttons simultaneously." Unfortunately (for listeners anxiously awaiting Teac's version of surround sound), while many speakers systems do have impedances of eight ohms, many models are rated at only four ohms. When speakers are connected in parallel (in the AG-75 the two sets of speakers are connected in series-parallel when the A and B speaker buttons are both depressed) their combined impedance drops; two 8-ohm speakers in parallel have a combined impedance of only four ohms, and two 4-ohm speakers connected in parallel have a combined impedance of just two ohms. With Teac's system the actual impedance that results is a little higher, but it is still lower than that of the individual speakers. We discovered in talking with a Teac engineer that you *can* drive 4-ohm speakers with the AG-75, but only if you're careful not to push the amplifier too hard. In other words, you'd better not.

If this receiver had been promoted more accurately, our opinion of it would have been somewhat higher than it is. With disappointment, though, came an increased sensitivity to other shortcomings of the AG-75. Reviewing this receiver was, however, a valuable experience. What happened brought home rather forcefully the meaning of the expression *Caveat emptor*—"Let the buyer beware!" Never, ever, believe anything until you see it with your own eyes! ■



Faster ... Faster!

PC-286 II 80286 ACCELERATOR BOARD. Manufactured by: **Seattle Telecom & Data, 2735 152nd Avenue NE, Redmond, WA 98052. Price: \$695.**

Were you around for the Golden Age of personal computing? When you knew as much as the salesman about computers (which really wasn't much at all)? When you built your computer from a kit of parts you carted home from the computer mart downtown or that came on the UPS truck? When what little documentation there was appeared to have been written by the subject of a sleep-deprivation experiment? When the only way to get the computer working was to get help from someone who'd already gotten *his* working ...? Well, **GIZMO** readers, those days are not gone forever. The spirit of the Golden Age is still very much alive in the hearts and products of many small companies, if you know where to look for them.

One such product is an 80286 accelerator card, the **PC-286 II**, intended for plug-in installation in IBM PC's and XT's and clones of those systems. The manufacturer, *Seattle Telecom & Data*, produces both entire 80286 and 80386 replacement motherboards, and plug-in upgrade cards. We chose the 286 II because we felt it represented an upgrade path likely to be chosen by many owners of older IBM PC's or clones.

Before we start going into detail about the board's performance, we'll answer the question that's probably at the top of your mind: "Does it work?" Well, yes. It does speed things up somewhat, which is presumably why you are interested in it. The

card delivered a Norton *SI* (Speed Index, which does not take into account hard-disk performance, only computational speed) of 9.8, compared with a 3.1 for our unembellished 8-MHz XT clone using a marginally faster NEC V20 in place of the standard 8088, and a 1.8 for the same computer running at its "normal" speed of 4.77 MHz. In practical terms, we certainly appreciated the speed-up the card gave to our spell-checking program and to memory-intensive programs such as Microsoft's Word (which does its own character generation, and has to recalculate like mad every time the screen requires updating).

At what expense this speedup comes, though, is another matter, and one that we'll go into in some depth below.

In keeping with a hallowed Golden-Age tradition, the documentation accompanying the **PC-286 II** is rudimentary and confusing. Most of it concerns the installation of the board, which is supposed to be a simple "drop in" operation. In our talks with them, STD emphasized that installation of the card was not intended to be a job for neophytes, that some degree of computer experience was advisable. Having been active participants in the original Golden Age we felt that we had that experience, and that we'd have no difficulty in getting the board into our venerable XT clone and getting it operating. Hah!

Getting the card into the computer was not that big a deal in itself. It's necessary to remove the existing microprocessor (not a job for someone who's never before tried to get a large IC out of its socket), insert the **PC-286 II** card in one of the motherboard's expansion sockets, and connect a ribbon cable from the accelerator card to the microprocessor socket. That portion of the job took us about half an hour, most of

that spent in juggling cards that were already installed in our computer to make room for the new one, and to route and reroute cables from those cards. That was the easy part.

With high hopes we turned on the system, awaiting a lightning-fast boot-up and got ... nothing. No video, just a single short beep from the speaker and some dithering around from the hard-disk drive. Well, back to the instructions. We now, upon close reading of the instructions, discovered what seemed to be a conflict.

The PC-286 II can be ordered with up to 2.1 megabytes of on-board RAM (although 640K seems to be the size usually supplied), at least part of which is intended to replace the RAM on the computer's motherboard. Under certain conditions, some of that original RAM can also be used, as can that on special-purpose memory-expansion cards. Much of the manual devotes itself to switch settings and memory-size restrictions under various conditions. The switch settings it refers to are those on the IBM motherboard; the DIP switches on many clones work differently (and are not covered by the STD instructions). Furthermore, at one point the instructions mention the fact that only 256K of original RAM can be left in place on the motherboard, while nowhere else do they tell you to remove the amount in excess of that. Maybe that was why our board didn't work. So we called STD.

When we mentioned the fact that the instructions were specific only about installation in IBM equipment, and that there was nothing about even the most widespread clone designs (many clone brands can all be traced back to the same origin), we were told more or less that it was unnecessary to provide that information since people installing the STD board in clones always called them anyway and were provided with the information they needed at that time. Well, *of course* they always called! You would too if the instructions you got with your board were not only self contradictory, but also said nothing at all about your computer! Is that any way to do business? Welcome back to the Golden Age.

In the course of our talk with STD we found out more about the board than we, perhaps, had wanted to know. For example, there are five positions at which small jumper plugs can be used to change operating characteristics of the board (characteristics such as slow- or fast boot-up speed, which may affect the operation of some software, and that affects how the board treats the 80287 math-coprocessor that can be added to it). What appears to be an addendum to the instructions illustrates the jumper positions and describes, in its Golden-Age fashion, their functions. True to form, many of the descriptions read either "Factory Setting" or "N/A" ("Not Applicable"). Big help!

With regard to our problem we were told that one or two of the jumpers might be responsible for the board's non-operation. There's one labeled "ENHC," which apparently refers to a normal or enhanced keyboard. What the jumper *really* does, though, has nothing to do with keyboards, but with whether the card uses its own ROM BIOS or the one on the computer's motherboard. How were we supposed to know this? "Well, they have to call anyway, so we tell them then ..." Thanks!

We're still not sure how we did it, but we eventually did get the board running. (We suspect it was just something not properly seated in its socket.) Of course, now we got a "Floppy Disk Controller Bad" error message when the system booted up, but at least it ran and the error message appeared to be a misunderstanding of some sort, since the controller continued to work. We began to enjoy the benefits of a faster processing speed ... until ...

We recently completed a book (which, we hope, will eventually be favorably reviewed here in **Popular Electronics**), and the time had come to print it out. We spent the better part of a morning and a portion of the afternoon trying to get our upgraded system to talk to its old friend, the printer. Nothing worked. It turned out that we could address the serial port in question directly through a communications program, but our word processor and even MS-DOS itself were blind to it. Finally, with deadline time nigh, we pulled the STD card and reinstalled our original microprocessor. Back came the printer!

When that task was finally accomplished and the manuscript was safely in the hands of Federal Express, we called STD again. Well, maybe it was the BIOS jumper (nope, we were already using our BIOS); maybe it was the boot-up speed ...; maybe it was ...

STD claims that this version of its board will work in any IBM PC/XT clone. We wouldn't want to be the ones to have to verify that!

Now for the 64-dollar (or 695-dollar) question: Is it worth it? Putting aside all the confusion and frustration that reigned until the board was working, and working properly, in our system is it worth nearly seven hundred dollars to add an afterburner to your old computer? We're not so sure anymore.

First, the degree of speedup you get is dependent on other parts of your existing system. Any bottleneck in the system is going to slow down the whole thing. For example, the 80286 uses a 16-bit data and instruction path. That's one reason the STD card has its own memory. Anything that forces it to revert to an 8-bit path is going to slow things down. The most apparent stumbling block in that area is your old hard-disk drive. Speed aside (the once popular 20-megabyte ST-225 drive has an average access time of 65 ms, compared to

the 28 ms or so obtainable with many drives of more recent manufacture), the disk controllers available for XT-type computers use an eight-bit data path. True AT-type systems with 16-bit buses can transfer data from computer to disk or the other way around much, much more quickly than their older brethren. If what you're doing is disk-intensive—if there is a lot of reading from and writing to disk in your applications—an accelerator card of this sort is going to be of much less value than you initially expect.

Furthermore, the speed increase you get will also depend on the sort of application you're running and the types of operations it performs—that is, how it uses the microprocessor. You'll find that some programs benefit more than others from a 16-bit board's extra processing capabilities.

There are many complete 16-bit AT-clone systems, and even just replacement AT-type motherboards for XT-type computers, to be found these days at prices comparable to that of the STD PC-286 II. For your money you get a 16-bit bus throughout the system. Because you can frequently reuse many of the components (display card, monitor, modem, I/O card, maybe even RAM chips) from your old/current system in a new one, it is possible, perhaps, to get a speed increase simply by adding a replacement motherboard and a faster hard-disk drive. Having tried the add-in card method and given the matter some thought, the former appears to be the better way to go.

Come to think of it, I never did like the Golden Age anyway! ■

VIDEO WALKMAN

(Continued from page 1)

screen as you tune. The color of the bar—green or red—tells you whether you are tuning VHF or UHF. The tuner's sensitivity was so-so, adequate but not outstanding.

Of course, there have been little color LCD TV receivers floating around for several years, although generally not of this quality. What makes the Video Walkman unique, though, is its built-in VCR. You can take this thing with you and watch movies! It's still a little difficult to locate sources of movies in the 8mm format, but they're around if you look for them. You can also use the Video Walkman to record from other video sources or to tape off the air from its own tuner. If portability isn't enough, you can have portability *plus* time shifting. The GV-8 has a built-in 24-hour/one-event timer.

The 8mm video cassettes bear a strong resemblance to the more familiar Philips-type audio cassettes, and are very nearly the same size. The Video Walkman allows you the choice of two tape speeds, the slower one affording four hours of recording time. While it will play tapes recorded

in analog stereo (it has no facilities for digital PCM recording or playback) they will, as was pointed out above, come out in mono.

The quality of the video from the tape unit is quite good. It's not as good as Super VHS or the new Hi-8 8mm system, but it's amazing what can come out of a unit this size. We used the Video Walkman's AUDIO and VIDEO RCA-type jacks to feed the off-tape signal to a 27-inch Pioneer monitor with very good results—the picture from the prerecorded 8mm tape was better than that from many VHS rentals we've sat through. There are also RCA-type jacks for audio and video input to the VCR section of the unit, as well as a multi-pin camera connector. Indeed, if you add a camera to the Video Watchman you have everything you need for live taping, even a color monitor. We recently heard of a skier who stuck a Video Walkman in his pocket, affixed a videocamera to his headgear, and came back with some absolutely incredible footage.

The question now arises, "How do I power all this stuff... and how long can the batteries last?" Sony gives you a number of choices. Our unit was supplied with a 6-volt, 1000-milliampere, rechargeable nickel-cadmium battery pack that could provide about an hour's worth of playback time. (That is a hefty battery pack—most are rated at only 500 milliamperes!) An optional rechargeable pack doubles that, and that higher-capacity power pack would be our choice since much of the material you would want to tape requires more than an hour. A holder for alkaline "AA"-size cells is also available, but that method of powering the unit should be reserved as a desperation measure—we suspect that the Video Walkman would suck those batteries dry almost as fast as you could load them in. You can also purchase an accessory cable that will allow you to operate the device from your car's cigarette-lighter receptacle.

Finally, the recharger for the nickel-cadmium battery pack doubles as an AC adapter. Sony cautions you against trying to recharge the batteries and run the Video Walkman at the same time. This caution is unnecessary, though, since the connector that outputs DC is located so that a charging battery (which must be removed from the unit and placed in the charger—something of an inconvenience) blocks access to it. You can use the charger as a power source only if there's no battery pack in it being charged.

The demand for the Video Walkman is said to be extremely high. Who's buying them all? A good question. We suspect that people who do a lot of taping, especially of live subjects, get camcorders while those who are more into viewing—on-the-go couch potatoes—are buying this. Whoever they are, they're getting quite a product! ■



CIRCLE 55 ON FREE INFORMATION CARD

Remotely Possible

BONDWELL UNIVERSAL REMOTE CONTROL. Manufactured by: Bondwell Industrial Company, 47485 Seabridge Drive, Fremont, CA 94538. Price: \$89.99.

At the moment we have four remote-control devices in the living room, and one or two are scattered elsewhere about the premises. The number shrinks and grows according to what *Gizmo* material is being evaluated at the moment. It isn't always easy to reach out and grab the appropriate control when we need it—sometimes we have to fumble around under a pile of other stuff to find the one we want, and at times we have found ourselves staring blankly at the collection of remotes for a moment before recognizing the one we want. Bondwell's BW-5000 Universal Remote Control affords a solution to this predicament.

The BW-5000 is one of those "trainable" remotes that work on the "monkey see, monkey do" principle. That is, when you get it, it has lots of labeled buttons on it but doesn't know how to control anything. You teach it how to be a remote control for your equipment by putting it into its LEARN mode and pointing it at one of your existing multitude of remotes from a distance of one or two inches. You mo-

mentarily press the button labeled with the function you want the remote to execute (to fast-forward your VCR, for example) and the LEARN LED comes on. You then hold down the FAST FORWARD (or whatever) button on the old remote until the new one's LEARN indicator goes out, a matter of a second or two. The new remote now presumably knows how to command your VCR to go into fast-forward. Repeat that process for all the functions on all your remote controls and you can—you hope—put them neatly away somewhere and rely on the universal unit to handle everything.

And you know what? It works. There are a few tradeoffs in convenience you may have to make, but they may very well be worth it considering what you no longer have to put up with.

The BW-5000 has 64—count 'em, 64—buttons and one switch (to go from LEARN mode to USE). In addition, 32 of the buttons lie behind a sliding panel (with cut-outs for the buttons), which when it is slid up causes the buttons to perform one function and when it is moved down causes them to perform another. That makes for a total of 96 functions! Unless you're into some really high-tech gear, that number should be enough for you.

The buttons are arranged in groups according to the devices they are labeled to control. DAT (digital audio tape)/tape; LD (laserdisc)/CD; and TV/cable TV are the three pairs of functions that are alternated by moving the sliding panel; the remaining

groups are labeled VCR and surround amp. At the bottom are eight buttons devoted to turning your collection of equipment on and off.

How do you tell which button does what? Bondwell has combined several methods to differentiate one button from all the others. Everything is labeled, of course, although sometimes the labels are a bit hard to read, especially in the subdued light you may use when viewing TV. As we've mentioned, buttons are grouped by device and a few (such as the RECORD buttons for VCR and other tape equipment) are colored. In most cases, color coding also distinguishes the labels for the buttons controlling one device from those for another. Finally (and especially useful in the dark) the position and shape of each button helps you to identify it. There are round buttons, long rectangular ones, short rectangular ones, square ones, triangular ones, and even a couple shaped like the little houses used in playing *Monopoly*—one right side up and the other upside down. All the power-control buttons at the bottom of the control are colored orange.

Despite that bewildering array, we quickly became proficient in locating the buttons we used most frequently, and did not usually encounter too much difficulty in finding others we required less often.

The question arises, "What do I do if one of my pieces of equipment has a function not on the remote?" *No problema*, as they say. Until you teach it so, the unit doesn't know that the VCR FAST FORWARD button is supposed to make your recorder advance the tape—in fact, the USE LED, which lights to indicate that a command is being sent, doesn't light if a button hasn't been programmed. You can assign any function to any button, even turning on your coffee maker if it has an infrared remote control. The only restrictions seem to be on equipment that responds to commands using variations in frequency of the infrared beam, or those referring to RAM built into the original-equipment remote—they won't respond to the unit.

There are a couple of buttons whose labeled functions baffled us—one, for instance, being the big square BALANCE button. This button, surrounded by the four arrow-shaped ones used to control sound level in a surround-sound amplifier's four channels, had us puzzled for a while. How could you control balance—which implies two sides, two directions, or two *somethings*—until we realized that maybe there's equipment out there whose balance shifts one way when the button is pressed once, and the other when it's pressed again. It doesn't matter anyway, since you can program any button for any

function. Buttons can be reprogrammed for new functions as easily as they can be taught in the first place.

The POWER buttons on the remote have an interesting twist. Besides there being a button for each device to be controlled, there's also a MASTER power button. That causes all the individual power signals to be sent in sequence at 1/10-second intervals. Of course, the "turn-on" signal is usually also a "turn-off" signal, so depending on the state of a piece of equipment when the signal is sent, some interesting things can happen if you're not careful with the MASTER button.

The BW-5000 is a little large to be handheld conveniently—aside from the weight contributed by four "AA" batteries, the fact that its topside is covered with buttons makes two-handed operation a necessity if you insist on holding it. Fortunately, Bondwell realized that and engineered the case of the device so it can rest comfortably on a coffee table or other platform with its front end raised slightly to give the infrared signal a flying start. Combined with a very strong (strong enough to work even when reflected off the wall, sometimes) and well-dispersed beam of infrared light, the unit worked well from its tabletop position by our side. We're quite pleased with Bondwell's contribution to the welfare of couch potatoes. ■

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

ELECTRONICS WISH LIST

Portable VCR

If you can't get enough video at home, Goldstar (1050 Wall Street West, Lyndhurst, NJ 07071) has a portable VCR that you can take with you when you're away. The player, model VCP-4205M, measures 11.4 × 3.5 × 12.9 inches and weighs 11.5 pounds. It features automatic speed selection, auto repeat play, power-assisted front loading, and visual search/still/cue review. The unit comes with an AC-power cord and a 12-volts-DC car cord. Price: \$329.95.

CIRCLE 56 ON FREE INFORMATION CARD



Goldstar Portable VCR

Friendly Remote

Do you talk back to your TV or VCR? Well, now it can talk back to you—or almost, anyway, with Sharp Electronics' (Sharp Plaza, Mahwah, NJ 07430) Voice Coach remote control that comes with its Optonica line of VCR's. The Voice Coach goes on-screen displays one better, with a synthesized voice that has a 50-phrase, 500-word, vocabulary. A typical Voice Coach message might sound like, "Select either AM or PM by using the AM/PM button, and set the hour and minutes by using the numbered keypad, then press the PROGRAM/SET button." Once that had been done, the remote would then verbally confirm the time that had been set. The Voice Coach can be used to control Optonica and practically all Sharp VCR's and TV's. In addition to the usual functions, when used with Optonica equipment the remote can perform alarm-clock setting, remote-control videocassette eject, tracking adjustment, and simulcast recording (video from one source and audio from another). Price: Included with Optonica VCR's.

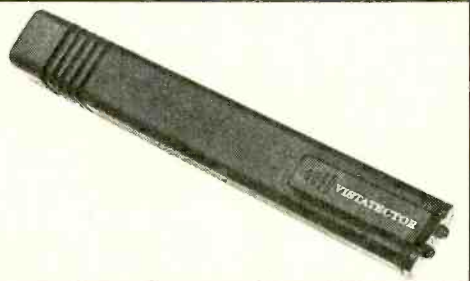
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Optonica Talking Remote Control

ELECTRONICS WISH LIST

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



Vistatech Counterfeit Detector

Real Counterfeit Detector

If worrying about the state of the economy keeps you awake at night, *Vistatech Security Products* (935 Broadway, New York, NY 10010) *Vistatech* counterfeit-currency detector may help you to sleep. This pen-sized device can be used to verify the authenticity of bank notes, traveler's checks, and credit cards. It can be used on U.S. dollars, deutschmarks (issued after 1971), British pounds, Swiss francs, Japanese yen, and other currency. The Vistatech works by sensing the presence of magnetic ink, which is used in printing the "black" side of U.S. currency. Most forgers use more conventional inks. The detector can also be used on a credit card's magnetic strip or on the row of numbers located at the bottom left of traveler's or conventional bank checks to determine their validity. Acceptance is signified by the illumination of a green LED and the sounding of a buzzer. The Vistatech comes complete with an easily replaceable 12-volt battery. Price: \$99.

CIRCLE 58 ON FREE INFORMATION CARD



Videonics DirectED PLUS

Home-Video Editor

Home video productions can be given a professional look with the *DirectED PLUS* from *Videonics, Inc.* (1370 Dell Avenue, Campbell, CA 95008). This universal edit controller combines the functions of video editor, titler, special-effects generator, and video "librarian" in a single package controlled by a wireless remote. The editor can be used with virtually any VCR that's equipped with wireless remote control and any camcorder (or a second VCR) with playback capability. A video monitor or TV receiver with RF modulator is also required. The DirectED PLUS includes 20 graphics, 12 title styles, and 17 special effects such as fades and wipes. Titles and graphics can be generated in 64 colors and can appear by themselves or superimposed on a video scene. The system is menu driven (menus appear on your video screen) and comes with a new "clarified" owner's manual. Further assistance is available by pressing the remote control's HELP key, which causes a screen of information relevant to the operation being performed to appear. Price: \$549.95.

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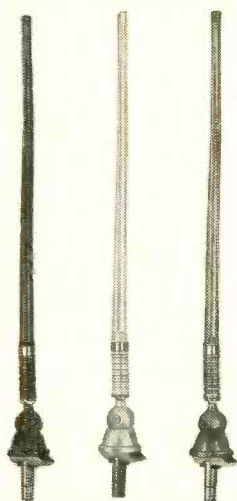


Canon 8mm Camcorder

8mm Camcorder

What makes *Canon's* (One Canon Plaza, Lake Success, NY 11042) *Canovision 8 E80* 8mm camcorder different from others is in its grip. Canon's "FlexiGrip" is a combination grip and electronic viewfinder that rotates 180 degrees to make low- and high-angle shooting easy and comfortable. The 2.7-pound camcorder uses a 270,000-pixel 1/2-inch CCD image sensor and is equipped with a 2-position high-speed shutter, a character generator for superimposing titles and dates, and an interval timer for time-lapse recording. Other features include active-infrared automatic focus, backlight compensation, fully automatic white balance, audio and video fade, and a self timer. The E80 comes with a Canon 9-54mm f/1.4 power-zoom lens with macro capability. The E80's 0.7-inch electronic viewfinder is housed in the rotating grip on the camcorder's right side. Integrating the grip and viewfinder makes it possible to shoot comfortably at any angle. To tape a crawling infant, for example, all that's necessary is to rotate the FlexiGrip upward and look down into the viewfinder; you don't have to get down on the floor to frame the shot. The camcorder also comes with a wireless-remote control that, in addition to controlling all record and playback functions, provides for remote operation of zooming and fades. Price: \$1649.

CIRCLE 60 ON FREE INFORMATION CARD



Harada Rubber Antennas

Colorful Antennas

If black is too somber for you, you can now have one of *Harada's* (1650 W. Artesia Blvd., Gardena, CA 90248-3297) line of RA-07 "Rubber Classics" vehicular antennas, available in red, white, or gray as well as basic black. These flexible and rugged antennas can be top- or side-mounted, and are adjustable through 180 degrees through their ball bases. The one-section detachable mast measures 14 1/4 inches in length and comes with a 72-inch cable. Price: \$19.95.

CIRCLE 61 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

Portable CD Player

If you're tired of having to replace the batteries in your portable CD player all the time, *Panasonic* (Panasonic Company, One Panasonic Way, Secaucus, NJ 07094) may have what you need. Its *SL-NP11* portable CD player is designed specifically to house a pair of rechargeable nickel-cadmium batteries in its case. The player can operate from two "AA"-size nickel-cadmium cells for up to two hours. Recharging takes three hours using the AC adapter that comes with the unit. An "auto power off" feature saves power by shutting the player off if it is left in the STOP or PAUSE mode for longer than five minutes. Four-times oversampling helps provide realistic sound quality and stereo imaging. A one-button remote control that is connected in-line with the headphone cord allows the user to control such functions as play, forward skip, stop, and volume level. A RESUME mode causes the SL-NP11 to resume playback from the start of the track that was playing when the power was turned off. Price: \$349.95.

CIRCLE 62 ON FREE INFORMATION CARD

Limited Edition CD Player

From the co-inventor of the musical compact disc, *Philips* (One Philips Drive, P.O. Box 14810, Knoxville, TN 37914-1810), comes what may be the ultimate in CD sound reproduction, the model *LHH1000* CD player. This audiophile product consists of a CD transport in one case, and a companion dedicated digital-to-analog converter in another. The D-to-A converter and digital filter use special "Select Grade" TDA-1541 AS-1 chips with four times oversampling, and realize more than 15.75 bits from the 16 bits available in the CD format. The separate CD transport section features a professional-quality Philips CDM-1 mechanism made of die-cast aluminum alloy with a single-beam laser pickup. The transport and D/A converter units can be connected either by system comes with a remote control that can learn 150 functions from other audio and video remotes. Price: \$4000.

CIRCLE 63 ON FREE INFORMATION CARD

Designer Tower Speaker

The *T930* tower speaker from *Boston Acoustics* (247 Lynnfield St., Peabody, MA 01960) is less than 10½ inches wide. The unit, which stands 36 inches high, is finished on all sides, including the back. The T-930's low midrange-woofer crossover frequency (350Hz) allows the midrange driver to cover even the lowest vocal range. The performance of the woofer is improved through the use of a "shorting" cylinder inside the driver's magnetic structure. That cylinder isolates the magnet from the effects of the moving voice coil, stabilizing the field strength of the voice coil gap. The 3-way tower system uses a 10-inch copolymer long-throw woofer, a 6½-inch copolymer midrange driver, and a CFT5 1-inch ferrofluid-cooled dome tweeter. Frequency response is given as 42-20,000 Hz ± 3 dB. Recommended amplifier power is 15 to 125 watts per channel. Price: \$800 (walnut), \$650 (black-ash vinyl).

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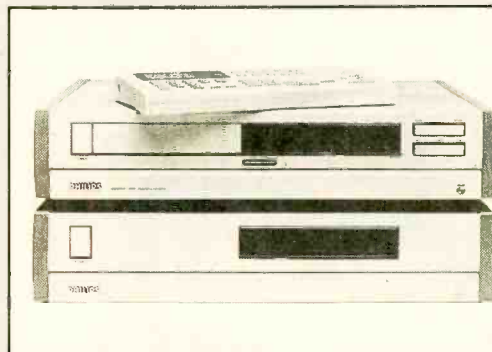
Autosound Crossover/Equalizer with Remote

An unusual combination electronic crossover and equalization system for car-audio applications, the *Ambiographic* model *ALC-20/ALC-20C*, has been introduced by *Altec Lansing Consumer Products* (Milford, PA 18337). The ALC-20 is a combination electronic crossover and equalizer, and the ALC-20C is an optional under-dash remote-control module. The ALC-20 provides four 3-way outputs (front left, front right, rear left, rear right), and two left-right subwoofer outputs, each of which can be optimized using crossover and equalizer controls. Separate volume controls can be used to adjust the levels for each output. The input circuitry accommodates fader outputs and the phase of each output can be reversed to ensure that all speakers in the system work in unison. The optional ALC-20C under-dash remote-control module controls the levels for high, mid, low, and sub bass, and indicates those levels on an LED display. A separate voltage-controlled amplifier is supplied with the remote and, when mounted near the ALC-20, eliminates hum and stray noise pickup. Price: \$600 (ALC-20), \$375 (ALC-20C).

CIRCLE 65 ON FREE INFORMATION CARD



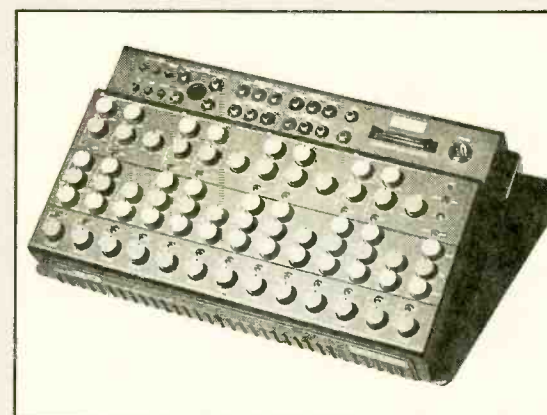
Panasonic Portable CD Player



Philips Audiophile CD Player



Boston Acoustics Tower Speaker



Altec Lansing Autosound Crossover/Equalizer

ELECTRONICS WISH LIST

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



NEC Cellular Phone

Hands-Free Cellular Phone

"An executive phone with elegance" is how *NEC America* (Mobile Radio Division, 383 Omni Drive, Richardson, TX 75080) describes its *M4700* mobile cellular phone. This model is equipped with a feature called "hands-free answering," which connects telephone calls automatically after two rings, thus allowing the driver to begin conversations without taking either his eyes from the road or his hands from the wheel. Other features of the phone include "pause dial," which allows several sets of numbers to be used together, long-distance call restriction, AM/FM mute, and a missed-call counter. To complement this, NEC America offers as an option an automatic message recorder that performs the same functions as a home or office answering machine and that can also indicate the phone number of the caller if that feature can be handled by the exchange carrier. Finally, to go along with the increased popularity of roaming (using a cellular phone outside one's registered service area), the *M4700* permits the addition of an option that allows the registration of up to four different phone numbers. Price: \$799.

CIRCLE 66 ON FREE INFORMATION CARD



Franklin Computer Electronic Bible

Electronic Bible

Smaller and lighter than most printed bibles, *Franklin Computer's* (122 Burrs Road, Mt. Holly, NJ 08060) *Electronic Holy Bible* provides the entire Old and New Testaments in a 13-ounce handheld, battery-operated package. With the press of a few keys, any passage can be located and viewed with ease. For example, typing in the words "valley," "shadow" and "death" will give you the response that those words occur in the 23rd Psalm. The press of one more key will take you directly to that section, which can be read on the unit's high-contrast supertwist LCD screen. Also included is a phonetic spelling system specifically designed for biblical vocabulary. Even if you are not familiar with the spelling of a word or name, you can enter it the way it sounds and the *Electronic Holy Bible* will locate it immediately. The built-in pronunciation guide features both traditional style (La'-mech) and easy-to-read newspaper-style (LAY-mek) explanations. Finally, a built-in thesaurus helps the user find passages that may be only imperfectly remembered. It knows, for instance, that "lamp" may be substituted for "candle," and that "heavier" is a form of "heavy." The *Franklin Electronic Holy Bible* comes in both King James and Revised-Standard Versions. Price: \$299.

CIRCLE 67 ON FREE INFORMATION CARD



Golgo 13 Comics

Game Aid

Addicts of the Nintendo video game "Golgo 13: Top Secret Episode" can get more of what they're after in *Golgo 13 Comics*, a joint venture of three Japan-based companies. Based on the popular Japanese-language "Golgo 13" graphic novels, which have sold more than 70 million copies over the 16-year history of the series, *Golgo 13 Comics* are "jam-packed with the most incredible, state-of-the-art, for-your-eyes-only, confidential, and (oh yes) top-secret collection of zealously guarded tips and tricks for the serious Golgo 13, 'Top Secret Episode' video game player." This will provide a new medium through which Golgo 13, alias "Duke Togo, secret agent for hire," can relay messages to his ever-growing army of field operatives (also known as "video-game players"). Price: \$1 per issue.

CIRCLE 68 ON FREE INFORMATION CARD

Eight-Track Cassette Recorder

The *Tascam 238 Syncaset* is an 8-track cassette recorder from *Tascam* (7733 Telegraph Road, Montebello, CA 90640) that claims to offer professional-level performance in an affordable package using an affordable medium. The *Tascam 238* records multitrack audio on ordinary Philips-type cassettes running at 3 3/4 inches per second for a frequency response of 30 Hz-16 kHz \pm 3 dB. With dbx II noise reduction, S/N ratio is 90 dB and channel separation is 70 dB. The recorder uses a specially engineered head to keep interchannel crosstalk to a level otherwise attainable only on one-inch open-reel machines. Tape tension, and therefore head contact, is controlled by a hysteresis tension servo-controlled system, bypassing the less-accurate pressure-pad control ordinarily used in such cassettes. That keeps wow-and-flutter levels low. The *Tascam 238* also features MIDI compatibility, two auto-locate functions, a return-to-zero function, auto-punch-in-and-out, and is said to be SMPTE-friendly. Price: \$1799.

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Tascam 8-track Cassette Recorder



HEINRICH HERTZ:

Radio's Unassuming Pioneer

BY JAMES P. RYBAK

The only thing Heinrich Hertz didn't realize about electromagnetic waves was how useful they would be for communicating!

Heinrich Hertz's keen mind and inquisitive nature would have produced significant contributions in whatever area of science or the arts he might have chosen to pursue. The fact that he was particularly interested in the study of electricity was highly significant to the development of radio as we know it today.

Not Much Was Known. Many before Hertz, including Ampere, Faraday, Henry, and Edison, had made important observations and predictions concerning the nature of electricity. Often, however, they did not fully realize the significance of their observations and did not fully understand the physical principles behind their predictions. Precise knowledge concerning electricity was meager in the mid 1800's.

Then, in 1865, James Clerk-Maxwell published a revolutionary mathe-

matical theory to the effect that electric and magnetic fields traveled as waves through space at a finite speed—the speed of light. Clerk-Maxwell asserted that light together with electric fields and magnetic fields were merely different manifestations of the same phenomenon. The interference, reflection, and refraction of light should be exhibited by electric and magnetic fields according to Clerk-Maxwell's theory. The capability did not exist at that time, however, to generate or detect those waves at frequencies that would allow meaningful and accurate laboratory measurements to be made. Clerk-Maxwell's predictions could not be investigated experimentally in a satisfactory manner.

It remained for someone to test Clerk-Maxwell's theory experimentally and to develop a clearer understanding of that theory. Heinrich Hertz was to

be that person. He wasn't satisfied with predictions. Hertz wanted to make observations and measurements.

The Background of the Pioneer.

Heinrich Rudolph Hertz was born in Hamburg, Germany on February 22, 1857. Young Heinrich showed a unique desire and ability to learn at a very early age. When barely more than an infant, he became exceptionally interested in books and loved to be read to and to read. Hertz always excelled at his boyhood studies. He attended a typical, middle-class, private school until the age of fifteen. The school was strict and required that the students work extremely hard. Heinrich liked his studies, but his father felt that the school placed too many demands on the boy. The elder Hertz arranged for Heinrich to leave the school and to be tutored privately for one hour each day. Heinrich

would spend the rest of each day studying by himself and doing basic chemistry and physics experiments with equipment he built in his workshop. It was here that Hertz developed his love for experimental work.

This continued for two years until in 1874, at the age of seventeen, he entered the *Gelehrtenschule* (somewhat comparable to what we would call a high school) in Hamburg to complete his classical studies. After receiving his diploma in 1875, he pondered whether he should pursue a career in engineering or if he should study the pure sciences. He realized the differences between the two careers and was attracted to a certain extent by both. He knew that he had always enjoyed constructing mechanical devices in his workshop but was not completely certain that he was well suited for the life of a scientist. As a result, he decided to work for a year in Frankfurt for an engineering firm.

Heinrich then attended the *Polytechnic* (a technical school) in Dresden for six months to study mathematics and science before voluntarily joining the army for a year of active duty where he served with an engineering unit in Berlin. Finally, in late 1877, he again found himself faced with making a career choice between engineering and science. This time, however, he was beginning to realize that only by choosing a career in science would he have the opportunity and freedom to make discoveries. That was becoming more and more important to him.

Hertz now went to the *Polytechnic* in Munich where he enrolled as a student in civil engineering. It was not long, however, before he switched to mathematics and experimental physics at the University of Munich. He had found his niche. Heinrich now studied with the greatest enthusiasm he had ever known. The next year he transferred to the University of Berlin where he could study under the top scientists of the day—von Helmholtz and Kirchhoff.

Not long after Hertz arrived at the University of Berlin, the faculty offered a prize for the best answer to a question concerning the possible existence of inertial effects associated with the flow of electricity. If the flow of electricity exhibits inertia, they argued, then this inertia must manifest itself by "extra" currents when the main current starts or stops. The faculty required the contestants to develop a theory, make ex-

perimental measurements and, from those measurements, arrive at a conclusion.

Professor von Helmholtz, already recognizing the exceptional ability of his student, urged Hertz to enter the competition. Heinrich attacked the problem with enthusiasm and ingenuity. As a result of his work, Hertz won the prize, which was a gold medal. The results arrived at by Hertz were basically negative and of only limited scientific significance. The technology which existed at that time did not enable the generation of electrical oscillations of sufficient frequency to prove or disprove the theory Hertz had developed. What was of value, however, was the enthusiasm the project generated in Heinrich's mind. He now knew with certainty that he had made the correct career choice.

The faculty at the University of Berlin were not slow to notice the talent of this bright young man. What amazed people was the speed with which Hertz could develop clear, concise thoughts concerning the theory associated with his research. In addition, they were amazed at his exceptional insightfulness in planning experiments to prove or disprove his theories. Often he fabricated the laboratory equipment needed to carry out these experiments from wood, wax, string and whatever else was on hand. In 1880 the University conferred upon Hertz the title of *Doktor*.

Even more noteworthy is the fact the title was awarded *magna cum laude*, a distinction conferred only very rarely. Later in the year, in recognition of his outstanding experimental capabilities, Hertz was selected by von Helmholtz to be the "demonstrator" (chief experimentalist) in physics at the University of Berlin.

In 1883 Hertz left Berlin to take a position as a lecturer in theoretical physics at the University of Kiel where he devoted his energies to various theoretical and experimental problems in meteorology and thermoelectricity. However, by early 1884 the entries in his scientific diary indicate that he was spending more and more time thinking about electromagnetic "rays" (as they were then called) and by May of that year his diary entries show that the study of electromagnetics was his sole and compelling interest.

He soon moved on again, this time to the *Polytechnic* at Karlsruhe where he was appointed professor of experimental physics in the spring of 1885. The following year, at the age of 29 and after a three month courtship, Hertz married Elizabeth Doll, the daughter of a well known surveying and mapping instructor at Karlsruhe University. Hertz was now firmly entrenched in academic life and had a wife who understood and supported his commitment to that life.

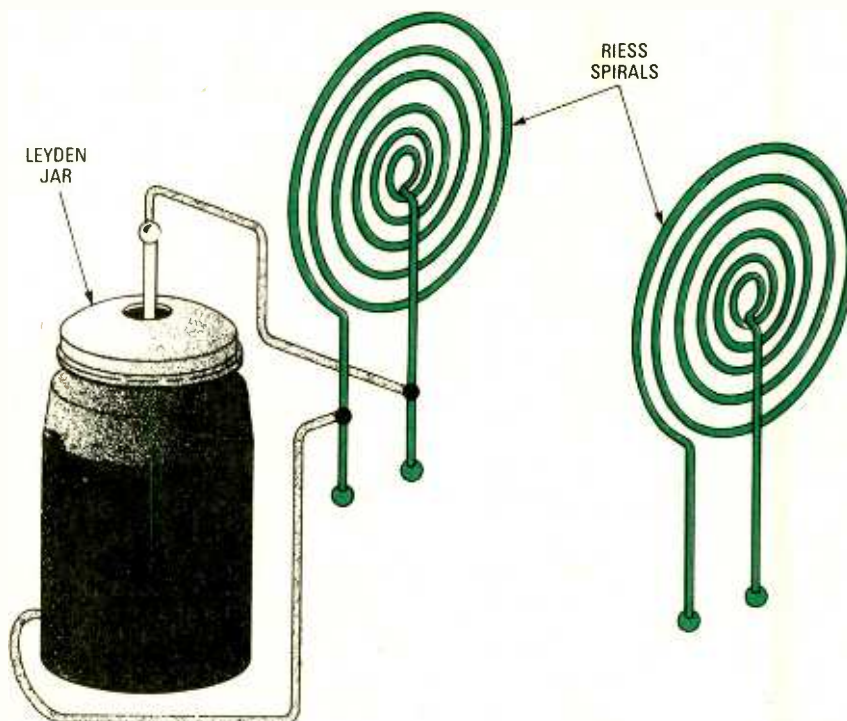


Fig. 1. When experimenting with Riess (or Knochenhauer) coils, the "radiator" coil was connected to a charged Leyden jar. The waves it emitted were detected by a second coil of similar dimensions.

Electric Waves Do Exist! A highly significant event in the history of physics and in the subsequent development of radio occurred one day in 1886. Hertz was performing some experiments during a lecture and discovered that the discharge of a Leyden jar (capacitor) through one of a pair of Riess (also known as Knochenhauer) spirals produced an induced current in the other, nearby spiral (see Fig. 1). The spirals were relatively short, flat coils of wire with all the turns in the same plane. The discharge of the Leyden jar through the primary coil produced an arcing across its slightly separated terminals. The induced current in the secondary coil produced arcing across its own slightly separated terminals. The two coils were not in physical contact with each other. Hertz had, in one experiment, discovered both a convenient way of generating electric waves and a simple way of detecting them.

Hertz was able to demonstrate that the waves were indeed oscillatory by using a second detector to locate peaks and nulls in the electric waves produced. It had long been proven that the discharge of a Leyden jar produced oscillatory currents. Hertz, however, had now verified Clerk-Maxwell's prediction that the accelerating electric charges in such a discharge produced oscillatory electric waves. Further experimentation resulted in the discovery that a "harmony" or "syntony" (resonance) effect could be produced between the exciter of the electrical waves and the detector by adjusting the dimensions of the detector.

In later experiments, however, Hertz often constructed an electric wave exciter (he called it a "radiator") by connecting conducting spheres (or sometimes cylinders), 10 to 30 cm in diameter, to a pair of wire rods that terminated in small spherical knobs as depicted in Fig. 2. The small knobs served as spark-gap points and the spacing between them could be varied. The large conducting spheres of the exciter were charged by an induction coil. The greater the charge put on the exciter, the larger the spark-gap across which arcing could occur, and the greater the resulting electric-wave intensity.

The large conducting spheres acted as the plates of a capacitor, the wire rods acted as inductors, and together they acted as an oscillator. The oscillating current, in turn, produced oscillating electric and magnetic fields that prop-

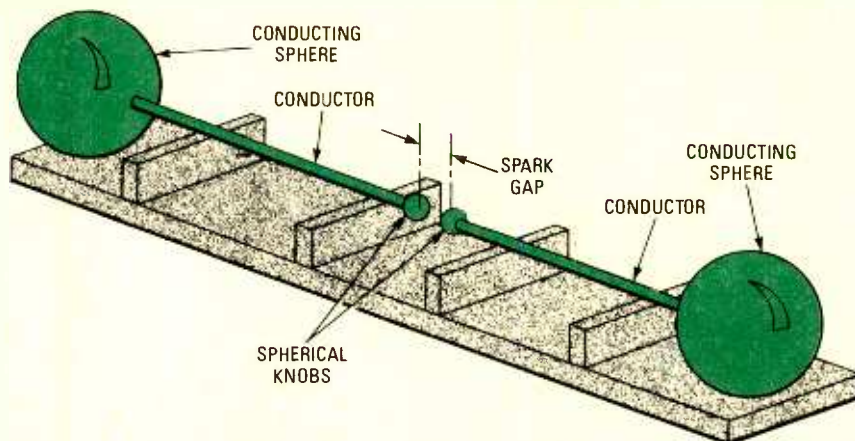


Fig. 2. This is a typical Hertzian "radiator." Two copper rods are connected to large conducting spheres. The supports and base are made of non-conducting material.

agated through space as waves. The frequency of the radiated waves depended on the effective values of the inductance and capacitance of his exciter that were, in turn, dependent upon the physical dimensions of the rods and spheres. The radiated waves Hertz experimented with usually were in the VHF and UHF range, as they are called today.

For his detector or receiver (or "resonator" as he called it), Hertz often used a circle or rectangle of wire about 2 meters in length with a spark-gap. A typical detector is shown in Fig. 3. The length of the spark-gap in the detector or the exciter, usually could be varied with a micrometer screw adjustment. Later experiments by Sir J. J. Thompson showed that a potential difference of at least 300 volts is needed to produce a visible spark across the spark-gap in the detector. It was no small achievement for Hertz to make the experimental observations he did with such crude and insensitive equipment.

In 1888, Hertz published a paper in which he described his experimental results indicating that electric radiation travels in straight lines and exhibits the same wave behavior exhibited by light. Earlier experimenters had unknowingly produced wavelengths that were long in comparison with the dimensions of their laboratories, and thus had been unable to observe the wave nature of electromagnetic radiation.

Hertz was able to detect peaks and nulls at various points in space when electric waves were reflected from a 2-½-meter square zinc plate, clearly confirming the wave nature of the radiation and allowing him to measure the wavelength. The measurements also proved that the velocity of propagation of electric waves is finite.

Additional experiments allowed Hertz to prove that the speed of electric waves in air is the same as the speed of light, exactly as Clerk-Maxwell had predicted. Hertz also observed and measured refraction, polarization, and additional reflection phenomena associated with the electric waves all of which also were consistent with Clerk-Maxwell's predictions.

Those phenomena had long been associated with light and observed quite routinely with relative ease. That is due to the very short wavelengths involved (less than 1 micron or millionth of a meter) and the correspondingly small physical sizes of the lenses, mirrors, and prisms required. For the experiments performed by Hertz involving electric waves, the wavelength of the radiation was about 0.5 meter, corresponding to a frequency of 600 million oscillations per second (the frequency was 600 MHz but the adoption of the "hertz" as a unit of measure did not occur until about 70 years after his death).

The Experiments Were Not Simple.

As a result of wanting to work with wavelengths approximately one million times longer than optical wavelengths, Hertz had to use parabolic mirrors over two meters in height to study reflection effects. The study of the polarization phenomena required a grid of 1-mm diameter copper wires spaced parallel to each other at 3-cm intervals. The grid was attached to an octagonal frame with a height of 2 meters. Refraction experiments required the use of a prism made of pitch with a mass of 800 kg!

At times, the comparatively long wavelengths of the electric waves caused unexpected problems when making measurements, even for the brilliant Hertz. He had found experimen-

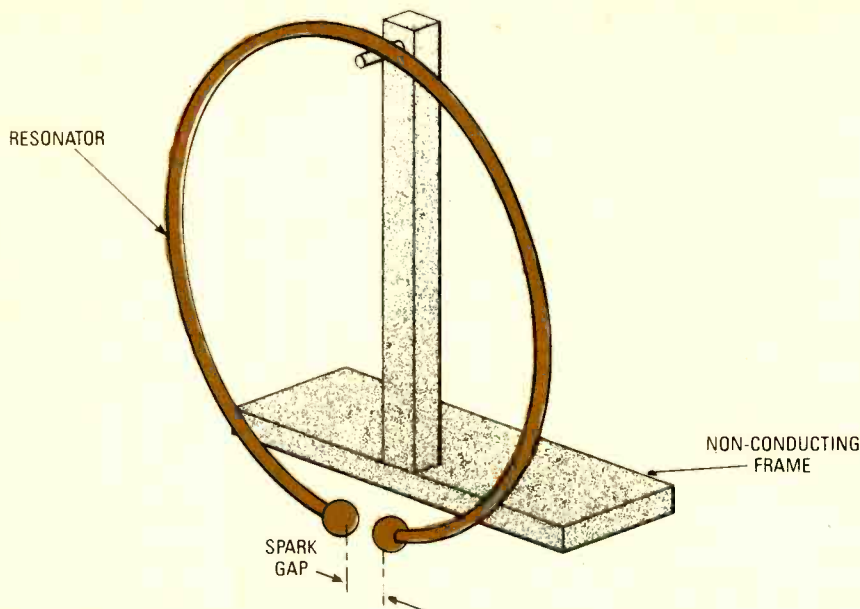


Fig. 3. This is what Hertz's detector or "resonator" looked like. The wire loop is supported on a wooden frame.

tally that the velocity of electric waves in air was the same as that of light, an observation which was in perfect agreement with Maxwell's theory. His measurements, however, showed that the velocity of electric waves on wires to be only $\frac{1}{3}$ of the speed of light. That was clearly not in agreement with theory. Hertz was not sure of the cause of the discrepancy. He knew that it could be due to faulty calculations on his part or to an improperly conducted experiment.

Additional experiments showed that the problem was due to the walls of Hertz' laboratory being too close to the experimental apparatus, producing reflections of the electric waves. The walls needed to be many wavelengths away from his apparatus in order not to produce the troublesome reflections. When others repeated Hertz' experiment without nearby walls, the velocity of propagation of electric waves on wires was found to be identical to the velocity of light. Of course there is a difference between the speed of light in air and metal, but it was too slight to be detected at that time.

Surface Conduction Experiments.

One of Hertz' more interesting experimental topics concerned separate theories developed by Oliver Heaviside and by J. H. Poynting. They stated that the conduction of a very high frequency current flows only on the surface of a conductor and does not penetrate into the conductor itself to any appreciable extent. Their theories also stated that

the induction of a current in a secondary conductor is affected only by the dielectric space outside it and only on the surface of that conductor.

Hertz found that when high-frequency waves were produced by his exciter, a conducting sheet of zinc placed so as to completely enclose the detector loop effectively shielded the detector from the waves. Even though prior to the placing of the conducting enclosure large sparks had been generated in the detector, the enclosure eliminated the sparking completely. The same effect was noted when the exciter was completely surrounded by a conducting enclosure. Hertz had shown that conductors are opaque to electric waves just as brick walls are opaque to light waves!

To determine the effect of the thickness of the shielding on its ability to stop the electric waves, Hertz replaced the zinc sheets with tin foil and then with metallic-gilt paper. As long as the edges of the tin foil or gilt paper made electrical contact with each other, the thickness of the conductor had no effect on the ability of the conducting enclosure to prevent penetration of the electric waves.

Hertz also showed that the effects of a high-frequency current flowing along a wire are confined to the surface of that wire. He did that by removing a 4-meter length from a long wire and replacing it with two strips of thin, sheet zinc, 4 meters long and 10 cm wide. The two zinc strips were flat and parallel, one slightly above the other, and had

Books of Interest

Syntony and Spark—The Origins of Radio, By Hugh G. J. Aitken, Princeton University Press, 1985.

Pioneers of Electrical Communication, By Rollo Appleyard, Macmillan & Co., 1930; reprinted by Books For Libraries Press, 1968.

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Invention and Innovation in the Radio Industry, By W. Rupert MacLaurin, Macmillan & Co., 1930; reprinted by Arno Press and the New York Times, 1971.

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their ends connected to the wire. A high-frequency current was made to flow along the wire and zinc strip assembly. An insulated wire in the space between the zinc strips was not able to produce any discharge when connected to an external spark-gap, thus demonstrating that no electrical effects can be observed in the interior of the conductor.

In 1889 Hertz became a professor of physics at the University of Bonn. He performed experiments involving electrical discharges in low-pressure gases. Hertz put thin metal plates inside his gas discharge tubes and found that "cathode rays" (what we now call electrons) could pass from one plate to the other. He nearly discovered the "X-rays" for which Roentgen was given credit in 1895.

While in Bonn, Hertz also undertook the job of developing a simple electromagnetic theory based on the principles of Clerk-Maxwell together with his own experimental observations. He spent three years in that effort, the re-

(Continued on page 103)

The



EXTENSION Silencer

BY TERRANCE KELLY

This project keeps your modem communications and important private conversations from being interrupted by locking out extension phones when the line is in use

Are you tired of others listening in on your conversations on an extension phone? Do you live with a computer hacker who always seems to want to dial out with his modem in the middle of your conversations? Fear no more, three inexpensive parts—which comprise the *Extension Silencer*—will solve all of your problems.

The *Extension Silencer* described in this article is a simple circuit that, when placed in series with each of your extension telephones, allows privacy at each location without interference from the others. All phones will ring normally and the first one to answer locks out the others. Someone picking up an extension will hear nothing if the phone is already in use. If you need to switch

extensions all you have to do is pick up one extension and hang up the other.

In order to fully understand the operation of the *Extension Silencer*, a little discussion on telephone operation is in order.

Telephone Operation. Each subscriber telephone is connected in what's called a *local loop* (see Fig. 1) to a central office, which contains switching equipment, signaling equipment, and a power source that supplies direct current (DC) for the operation of the telephone system within its coverage area.

Switches in the central office respond to a string of dial pulses to connect the calling station with the station being called. The switching array within the

central office feeds an AC ring signal down the line to the station being called. When a link is established (the telephone receiver is taken off-hook), the two stations communicate via transformer-coupled loops using DC power supplied by the central office.

When the telephone receiver is on-hook, the receiver holds down the hook-switch buttons in the base of the unit, creating an open circuit to DC between the receiver and the central office. The signaling circuit, which is AC operated, is always connected to the central office; a capacitor in the signaling circuit blocks the flow of DC, while passing the AC ring signal.

As long as the hook-switch buttons on the telephone are depressed, no com-

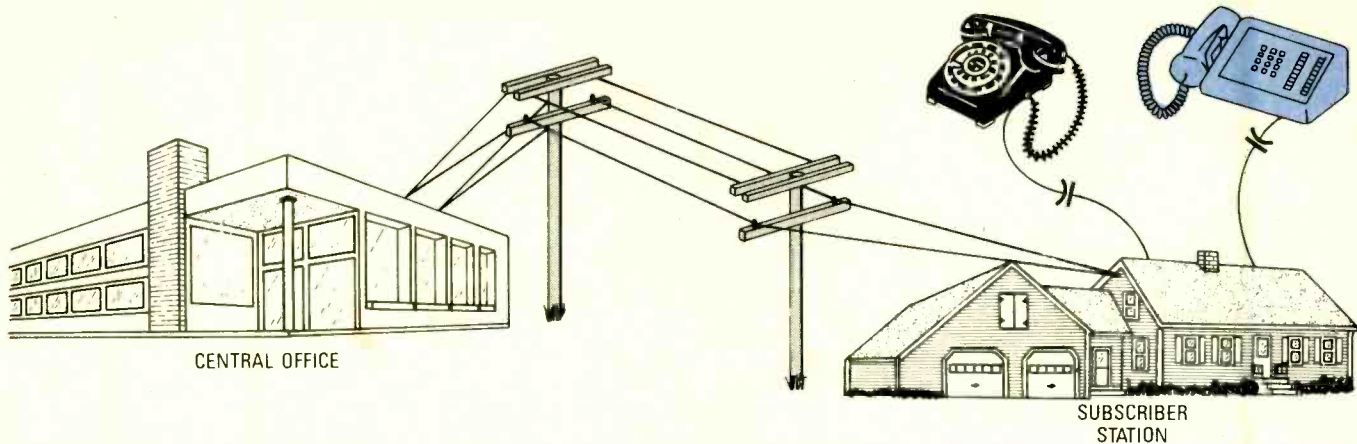


Fig. 1. Each subscriber telephone is connected in a local loop to a central office, which contains switching equipment, signaling equipment, and a power source that supplies direct current (DC) for the operation of the telephone system within its coverage area.

munications can take place. However, when the receiver is taken off-hook, the hook-switch closes contacts, passing DC to the telephone, activating the communications circuits, and causing the normal DC line voltage to drop due to the loading effect of the telephone.

Circuit Operation. Figure 2 shows the schematic diagram for the Extension Silencer. The circuit is little more than an electronic cut-off switch built around a Triac (the switching element). Two phone stations, A and B, are shown to make the circuit's operation easy to understand. (Component designations for only one circuit are given in the Parts List.) Note that an Extension Silencer circuit is connected in series with each station.

Normally when a phone is on hook,

the voltage across the phone line is 48-volts DC; when the receiver is taken off hook (is picked up), the DC voltage across the line drops to between 2- and 12-volts DC (typically about eight volts). That's due to the off-hook impedance of the telephone and the loop resistance between the subscriber station and the telephone company's central office.

As long as both the station A and station B receivers are on-hook, the voltage at the gates of TR1 and TR2 is sufficient to trigger TR1 and TR2 into conduction. That means that both Extension Silencer circuits connected to the line are conducting. But when one of the receivers—say station A—is lifted from its cradle, closing the hook-switch contacts, that telephone draws considerably more power, causing the line

PARTS LIST FOR THE EXTENSION SILENCER

TR1—1-amp, 50-PIV Triac
R1—1000-ohm, ¼-watt, 5% resistor
D1—1N4744, 15-volt, 1-watt Zener diode (Radio Shack 276-564, or similar)
Dual component perfboard (Radio Shack 276-148), quick-connect modular jack (Radio Shack 279-355), clear view speaker wire (Radio Shack 287-008), solder, hardware, etc.

voltage at TR2 to drop to around 0.6-volt DC.

The operational characteristics of the Triac are key to the operation of the Extension Silencer circuit. Remember that once a Triac is triggered (via a gate trigger voltage), it continues to conduct as long as the current through it remains above its holding-current (I_H) requirement, even if the trigger source is removed. And will cease to conduct, only when the current through the device is brought below its holding-current level. (In the case of an AC signal, a Triac would be triggered into conduction twice during a single cycle: once during the positive half-cycle, and again during the negative half-cycle. Therefore the 20-Hz ring signal is passed to the phone uninhibited.)

The 0.6-volt level at the main terminals of TR2 is too small to generate sufficient current through TR2 to satisfy its holding-current requirement, so it turns off, disallowing any communications through station B.

If the station B extension is taken off-hook and station A is hung up, a similar, but reversed action occurs, with station B absorbing the majority of the line-fed power, reducing the current through TR1 to a level insufficient to sustain conduction through that unit. And that in turn locks out station A.

A 15-volt Zener diode was used be-
(Continued on page 102)

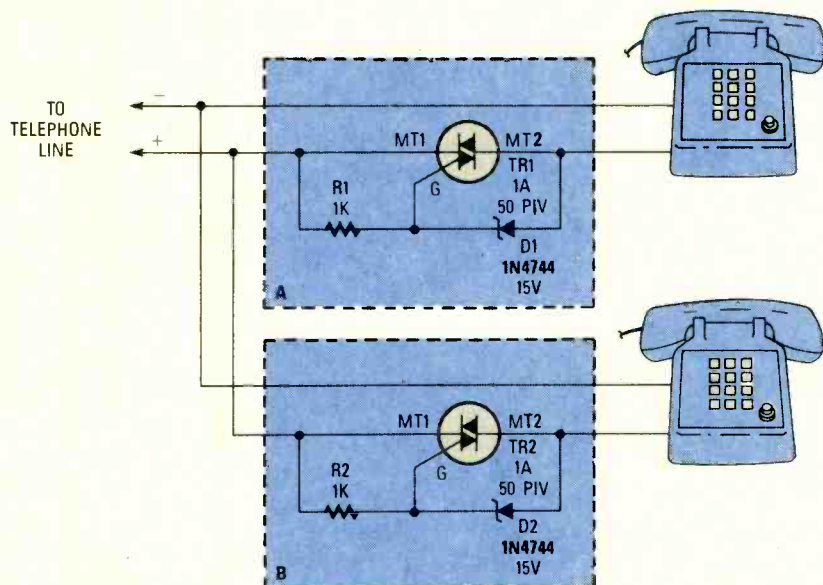


Fig. 2. The Extension Silencer is little more than an electronic cut-off switch, built around a Triac. The Triac's operating characteristics are key to the operation of the Extension Silencer circuit.

Writing Technical Articles for Fun and Profit

BY WALTER W. SCHOPP



Writing is easy. All you need to do is put your thoughts on paper in a logical order so that some one else can quickly grasp your ideas. How can anything so simple in concept be so intimidating? The answer to that question varies with the individual. With many, it is easier to procrastinate than to sit down and write. Often they don't get around to writing because they feel it would be too difficult to do well and they simply haven't the desire to overcome their fear. But written words are just a permanent record of what you say, and if you can talk, with some practice you can write.

There are sound reasons for writing professionally. Of course there's the money, but writing has fringe benefits that you might not have considered. For example, writing can help you at your job. Showing a copy of your published article to your boss may show him you have higher aspirations.

Also, you get your name in print listed in some huge reference volumes at your public library. Such books are dedicated to categorizing the thousands of

Here is an easy-to-understand crash course in writing that gives you all the basics for your first article.

technical articles written each year. A hundred years from now, what you wrote about will probably be of little value and you will not be around to care, but your name will be listed in the archives forever.

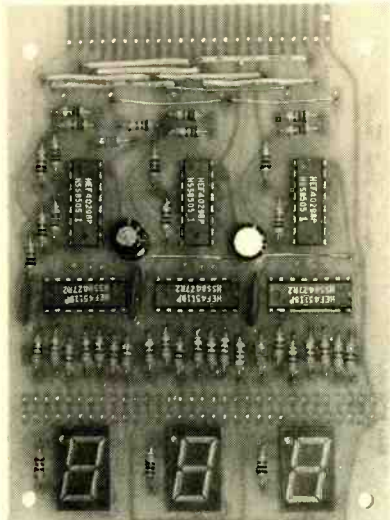
That may be spiritually uplifting, but as we mentioned the most obvious reason to write is for the money. Writing is a job that pays "more" as you become more proficient at it. That is because as you gain experience, less time is spent writing with no reduction in pay. Since time is money, it is just like getting a raise.

To write a technical article, you don't need a college degree. You don't even need a high-school diploma. If you can talk logically, you can write. To

write an article, only two things are really necessary. One is a subject to write about, and the other is a complete knowledge of the subject, everything else is presentation. Of course to be a successful writer, you must choose your subject matter carefully and your presentation should be befitting a publication, not just some odds and ends thrown together.

To such an end, we'll present you with a basic training course in writing and give you some tips on subject choice and article presentation. Armed with the knowledge you'll obtain, you should be able to write a technical article on any subject at which you're proficient.

The Subject. The subject can be anything: a gadget you made to do a special job, a topic you're interested in, or even an interesting circuit or component worthy of in-depth explanation. Keep in mind that the subject might be mundane to you, but can be valuable to a lot of readers. Often, a subject can be so familiar to you that you overlook its usefulness. That's because you understand the subject well enough to take it



Your photos should be clear enough to reveal all the detail in the object of the photo. Blurred or out of focus photos are unusable.

for granted. Keep that in mind when choosing a story topic.

No matter what subject you chose, it will probably lend itself to being written in one of a few basic forms. Let's review some basic story types to gain a feel of what the possibilities are and to get an understanding of what is required to do a polished job on each. Keep in mind that the more specialized your approach to a particular type of article, the greater the chances of getting paid for your effort.

The most fundamental article type is the general report-type of feature. Such an article describes a new technology or news-worthy item and can attract good attention among readers (and hence publishers). The prime requirement is authenticity. A poorly researched article can lose its author some respect among the public, if not the sale. Be sure of your facts, and do a complete job. If you aren't in a position to research and thoroughly document the facts, you shouldn't write about the topic in the first place.

How-to-do-it features are among the most interesting types of articles that you can write. Show a reader ten new ways to use his oscilloscope or sweep generator, or an easy way to make printed-circuit boards, etc., and your technique will be a hit with the readers. You must simply endeavor to completely describe all methods and techniques that are not common knowledge.

Troubleshooting and service manuscripts, on the other hand, are not easy to handle well. The author needs

to be experienced. Nothing falls apart as easily as a troubleshooting article written by someone who knows little about the subject. Often, good professional writers will do that type of story in collaboration with an expert troubleshooter, and they always check and recheck every stage of the writing with the expert.

Construction articles should show readers how to build electronic gadgets and projects. The device presented must be of practical use in the field of electronics, in hobby pursuits, around the house, or in the car. The cost of parts is also an important consideration. The cost of assembling a project should be justified by what it does. Also, if a similar device is commercially available, then the total assembly cost should be lower in price than that of the purchased unit.

Construction stories can be written for people with various levels of understanding from neophyte up to expert. It's a good idea to determine the level you want your story to appeal to before you start. That'll help you "aim" the article for the right audience.

Things to Avoid. The best-written articles are useless if they can't be published. An article on high-voltage sources might be perfect; but if it requires five TV-receiver schematic diagrams, it will not be printed because the drawings alone would take up too much space in the magazine. Furthermore, you may not be able to generate enough substantive text to go along with the artwork. Can you imagine how poor a story with more artwork than text would look?

Such "unprintable" things lead to rejection of otherwise excellent articles. Stories with no illustrations, or those without enough text to hold the illustrations together, show poor preparation. (We'll talk more about illustrations later.)

Lastly, if you want to write a construction article, avoid designing the project with hard-to-get items or those that are one-of-a-kind. There should be at least two sources for every part.

Assuming that a subject has been wisely chosen and researched enough, the next step is to create some sort of format or outline. A format is simply the procedure you will follow to present the facts. The article should always follow a format just like a novel has to follow a story plot to make any sense. Make certain that all the information presented is written in the correct sec-

tion of the article; jumping around from one topic to another can make for confusing reading, and it won't take long for any reader to discard the story even if the subject matter is good.

A simple format can consist of an introduction, some details, and a conclusion. That very simple format can be broken down into sub-topics as needed. Let's review the three parts in detail.

The Introduction. This part of the article can be as long as is needed to present facts relating to the non-technical aspects of your article. Use this part of your article to tell the reader how the topic or item will change his/her life style. Write to create a demand for your information in your readers mind. Getting the reader involved makes an article more enjoyable, and you do wish to entertain as well as inform.

For that reason, spend some extra time on the first paragraph. Make it exciting and try to entice your readers. Make a bold statement or shocking statement, or even use a cliché if it can be applied to your article in any way. Remember this: you only have the first paragraph to attract your reader's attention. Very few readers will deliberately read every article in a magazine. Each article is competing with all the others for the time and attention of the readers. If the reader's attention isn't captured after the first paragraph, he may not read any further even though the rest of the article may be excellent.

Write out all your thoughts that fit into the section just as you would say them if you were explaining them to a friend. Once a thought is on paper, it will never be lost. It can be modified and edited later, but it will never be left out. When writing the words that you would speak, you'll find that the sentences tend to be quite long. Don't worry about it until you have gotten through your whole introduction. After you complete the introduction, it's time to edit it.

Now comes the fun part, because until you actually edit your work, you will never realize how many unnecessary spoken words you use. Suppose you were telling someone about how to do a simple task. You might say, "pick up the soldering iron and solder the two wires together at terminal B." Taking out the unnecessary words to present the same thought in writing, you could edit the sentence down to, "solder the two wires at terminal B." You have reduced

the sentence by 50% and still retained the original thought without sacrificing clarity. After editing the introduction it will reduce to about half its size, but the part that is left will be packed with information. Magazine space is costly and it will not be filled well with long-winded presentations lacking in content. Remember that words are like machine-gun bullets—it doesn't matter how many are sprayed around, the only ones that count are the ones that hit the target.

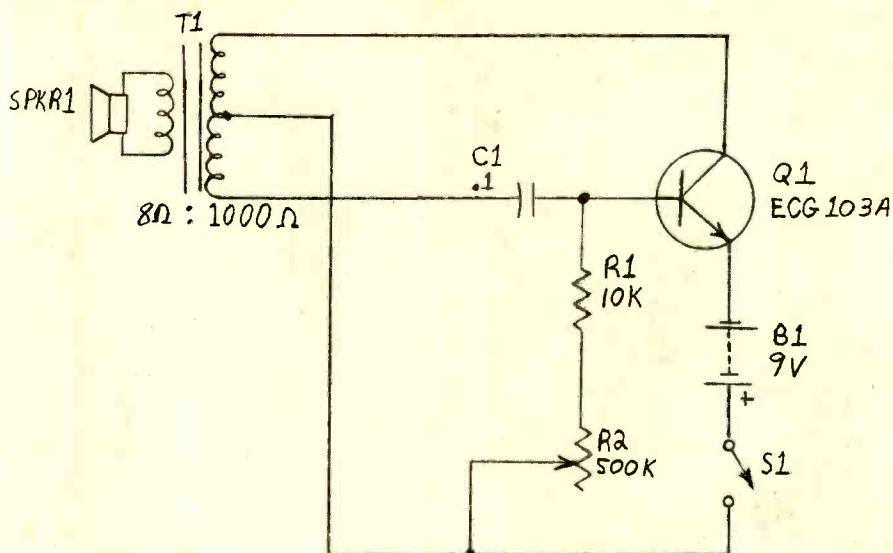
The Details. In this section, you would present the meat-and-potatoes part of the article. This section is used to explain the main aspects of your article. This is where step by step instructions on how it works, or why it works are presented.

If it is a construction article, you might sub-divide this section into three parts and put the theories and explanations in the first part. The construction details can be presented in the middle part, and operating instructions can be presented on the tail end of the section.

Write your ideas as you would speak them, just as before, making sure everything that has to be known is presented. A reader is surely interested in your article if he has read up to this point, but if important information is obviously missing, it will make him an instant critic.

In this section it is very easy to assume your reader knows what you are talking about. Don't ever take it for granted that your readers understand what you are saying! Remember they're reading your article to learn something; if they already knew it, they wouldn't be reading it. Write simply and explain thoroughly. An extra explanatory sentence can be tolerated, but nothing of importance can be left out. You have led many of your readers into a strange new place, and you have to be able to lead them back without getting them lost. After you edit and proofread, you will more than likely find a few places where inserting a word, or re-writing a sentence will clear up any fog that is present.

Conclusion and Final Editing. This section is reserved for closing statements. If it's a report-type article concerning a new product, a few statements concerning the future of the item would be in order. If it's a construction article, assume the reader has already built it and you can tell him the various ways it can be used. After editing this section, you can put the three sections



If your drawn artwork is done neatly and accurately, it communicates that you really care about quality. It will also keep the staff from having to do major renovation on your schematics.

PARTS LIST FOR THE SUPER PROJECT

SEMICONDUCTORS

D1, D2—1N4001 1-ampere, 50-PIV, silicon rectifier diode

U1—LM386 audio-amplifier, integrated circuit

U2—MC68705P3S microcomputer, integrated circuit

U3—7404 hex inverter, integrated circuit

CAPACITORS

C1—4.7μF, 25-WVDC electrolytic

C2—1μF, 10-WVDC polystyrene

C3—.047 ceramic-disc or mica

C4—470μF, 25-WVDC electrolytic

C5—3.3μF, 16-WVDC, tantalum

C6—C9—.22μF, 100-WVDC, Mylar

RESISTORS

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

R1, R2—10,000-ohm, audio-taper potentiometer

R3—10-ohm

R4—R7—680-ohm

R8—R12—1000-ohm, 1/2-watt

ADDITIONAL PARTS AND MATERIALS

F1—5-ampere, 250-volt, 3AG fuse

J1—Miniature stereo jack

PL1, PL2—Male, shielded phono plugs

S1—SPST, miniature switch

T1—18-volt, center-tapped, 250-mA transformer

Printed-circuit board or perfboard materials, enclosure, IC sockets, line cord, fuse holder, breadboard, hookup wire, shielded cable, nuts & bolts, plastic spacers, knobs, etc.

In construction stories, the Parts List is an extremely important element. If a parts list is informative and conforms somewhat to the publication it's intended for, it indicates you really mean business.

together and you should have the start of a well-organized article. Read it through a few times and you will probably find places where a word change or two will dress it up with each reading.

Sometimes an extra sentence is needed to make a smooth transition between one section and the next. Just remember, never mix statements from different sections as that will destroy the logical order of presentation you are striving for. One way to final-edit the article is to put it away for a few days. If it still sounds good when you read it again, you could have a winner.

When finally typing, or printing-out your article, use standard 8-1/2- x 11-inch typewriter paper. Type on one side only and double-space between lines. It's a good idea to include a telephone number where you can be reached during the day in case anyone has a question that requires your immediate attention.

Now you have the basics for writing your first article. After writing a few articles, you will find that you are writing like a writer instead of a speaker. In time you will learn how to edit while you're writing. That will never take the place of final editing, but it will save you a lot of time.

Artwork. Good-quality photographs are required. They must be in focus, have good depth-of-field (so that no blur is seen). All details should be easy to see, not hidden in dark areas or "whited-out" in overexposed or too-bright areas. Photographs should be

(Continued on page 100)

THE DIGITAL ELECTRONICS COURSE

FINDING THE RIGHT COMBINATION

Learn how simple gates are
combined to produce complex
digital circuits

BY ROBERT A. YOUNG

Thus far in our series we've introduced the most basic forms of logic gates used in digital circuitry. All complex digital circuitry consists of some combination of the simple gates that we've discussed. By combining and repeating various gates—which is referred to as *Combinational Logic*—more complex circuits such as flip-flops, counters, oscillators, shift registers, arithmetic logic circuits, etc. can be produced.

Combinational logic is the process of combining basic logic gates in some orderly manner to yield a desired output. The output is strictly a function of present inputs and is not concerned with previous inputs. That differs from sequential logic, where the output is a function of both past events and present inputs.

The output signal of a combinational-logic circuit can be processed to turn on a lamp, actuate a relay or an SCR, sound an alarm, or any of a variety of other functions. In a large digital system, the output signal could, instead, be fed to another part of the system where it is used to perform some other operation. Obviously, combinational

Our gratitude is extended to the EIA/CEG for the creation of this course, especially to the consultants who brought it to fruition: Dr. William Mast, Appalachian State University; Mr. Joseph Sloop, Surry Community College; Dr. Elmer Poe, Eastern Kentucky University.

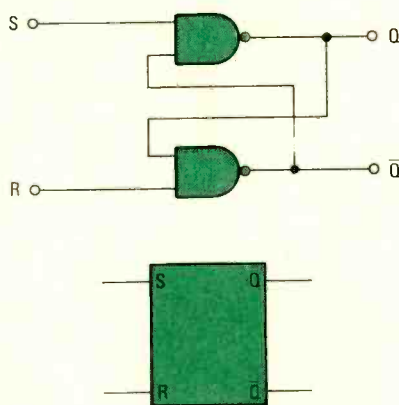


Fig. 1. Here is a simple R-S flip-flop (along with its schematic symbol) implemented using a couple of 2-input NAND gates.

logic is an important technique used in building digital-logic systems.

Flip-flops, for instance—the basis for many more complex circuits, like counters, dividers, registers, etc.—can easily be formed from NAND gates. Figure 1 shows a simple R-S flip-flop (along with its schematic symbol) implemented using a couple of 2-input NAND gates. By combining two additional NAND gates with the basic R-S flip-flop (as shown in Fig. 2), a toggle (or T) flip-flop is formed.

Figures 3 and 4 show two other flip-flop configurations common to digital circuitry; the D flip-flop and the J-K flip-flop, respectively. Note that in the case of the J-K flip-flop, 3-input NAND gates are used instead of the 2-input units

used to form the previous flip-flop circuits. Also note that the basic R-S configuration is present in each of the flip-flop circuits.

Boolean Terms, Logic Truth Tables, and Circuits. Each row of a truth table lists one possible combination of the input variables. Row-by-row, the logic levels at the outputs of all the gates can be determined by the use of the Boolean algebra. For example, if the term at the output of a gate is:

$$\bar{A}B + A\bar{B}C + \bar{B}C$$

and you want to know what the correct voltage level should be if:

$$A = 1, B = 1, \text{ and } C = 0$$

you would have:

$$\begin{aligned} \bar{A}B + A\bar{B}C + \bar{B}C &= \\ 1 \times 1 + 1 \times 1 \times 1 + 1 \times 1 &= \\ 1 + 1 + 1 &= 1 \end{aligned}$$

Therefore, you know that the output of the circuit should be high (or 1), assuming everything in the circuit preceding the output is operating correctly. Once the operation of a circuit is defined by its Boolean expression, a logic circuit can be constructed directly from that expression. For example, if you wanted to build a circuit that was defined by:

$$Y = A + B + C$$

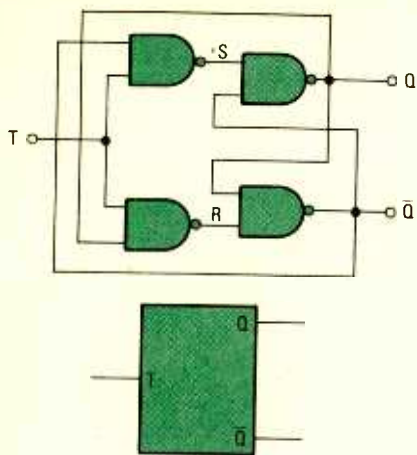


Fig. 2. By combining two additional NAND gates with an R-S flip-flop, a toggle flip-flop is formed.

You would immediately know that all you will need is a 3-input OR gate. Although that's a rather simplistic example, the important point is that it is possible to determine the type and number of gates needed to build a logic circuit from an output expression. Draw the logic diagram that is defined by the expression:

$$Y = \bar{A}B + CD + A\bar{D}$$

Inspection of that Boolean expression tells you that three minor terms, $\bar{A}B$, CD , and $A\bar{D}$ are OR'ed together. Therefore, the final stage of the circuit must be an OR gate with three AND'ed inputs. The first step, then, is to draw a 3-input OR gate and label each individual input with one of the three AND'ed minor terms (see Fig. 5A).

Now consider that each of the three inputs to the OR gate consist of two AND'ed variables. So the next step is to draw three AND gates and connect their outputs to the inputs of the OR gate and

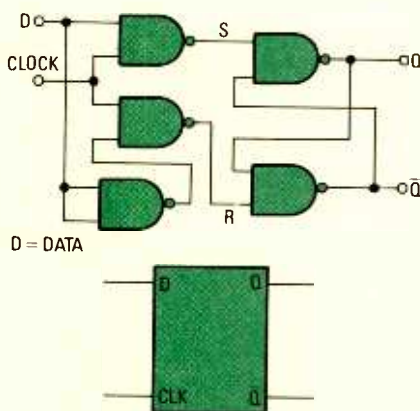


Fig. 3. With a slight modification to the NAND-implemented T flip-flop, and the addition of another NAND gate, a clocked D-type flip-flop is formed.

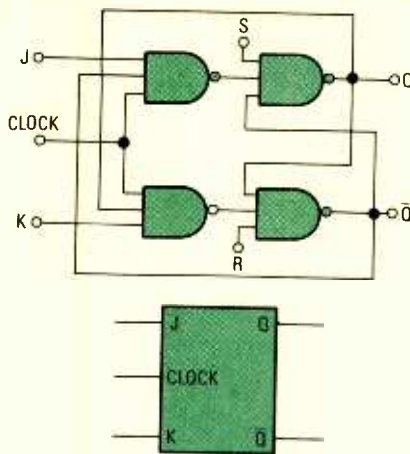


Fig. 4. Shown here is a J-K flip-flop formed from four 3-input NAND gates. Note that in this and the d-type flip-flop circuit, the basic R-S configuration has been retained.

label each output with its AND'ed terms, as shown in Fig. 5B.

The final step is to provide the proper inputs to the AND gates. Because the first AND gate output has the A signal inverted (\bar{A}), an inverter must be used in series with the A input. Similarly, the output of the third AND gate contains an inverted D, so an inverter must precede the D input. Draw the necessary inputs to the three AND gates, with the required inverters, and label their inputs, as shown in Fig. 5C. Writing the Boolean terms that appear at the inputs/outputs of the various gates in a schematic can aid in simplifying troubleshooting the circuit.

Let's look at another example in which the Boolean expression is:

$$Y = \bar{A}B + \bar{A}B\bar{C}$$

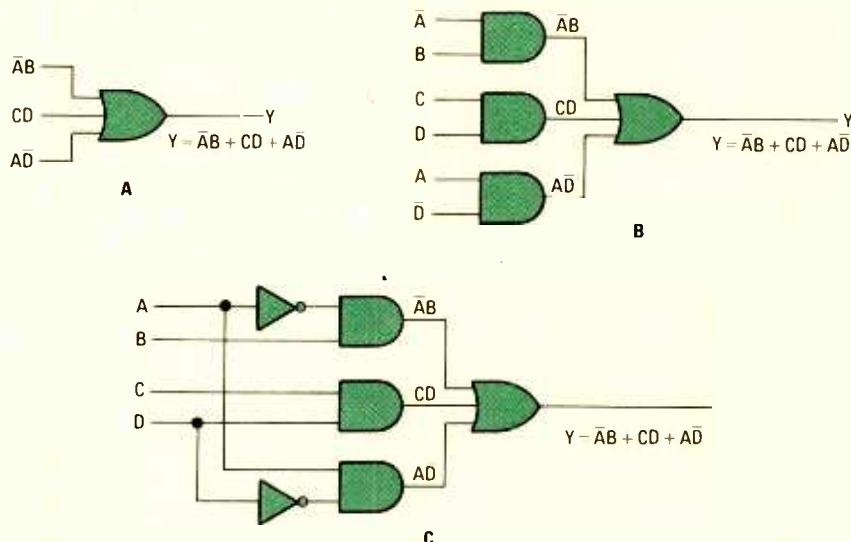


Fig. 5. Logic circuits can be constructed from Boolean expressions; for instance, the expression $Y = \bar{A}B + \bar{A}B\bar{C}$ indicates the the circuit consists of an OR'ed final stage (A) fed by three NAND gates (B), and that two of the NAND gates have one input inverted (C).

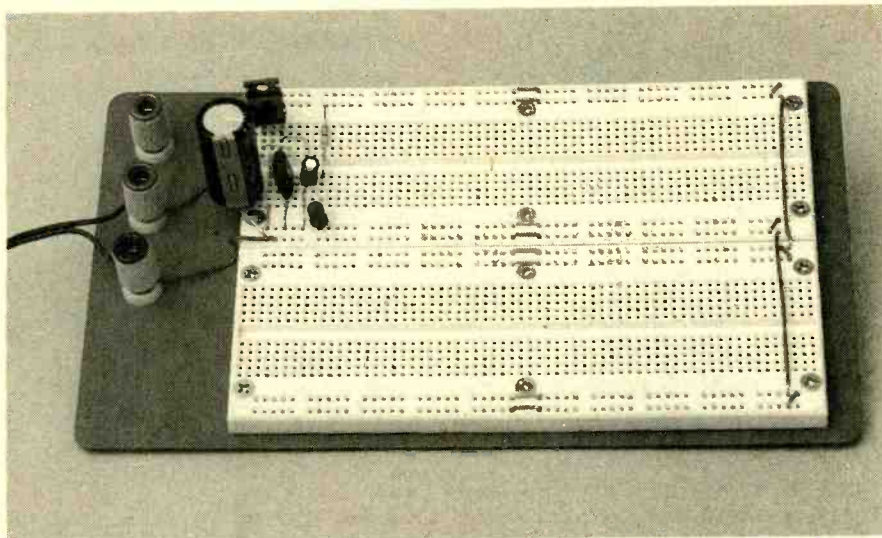
PARTS LIST FOR THE GATE EXERCISE

- U1—7400 quad NAND gate, integrated circuit
- U2—7402 quad NOR gate, integrated circuit
- U3—7404 hex inverter, integrated circuit
- U4—7408 quad AND gate, integrated circuit
- U5—7432 quad OR gate, integrated circuit
- U6—7486 quad exclusive OR gate, integrated circuit
- Logic probe, breadboard, ohmmeter, and No. 22 wire

The two Boolean terms tell us that the output will be 1 if A is 1, B is 0, and C is 1 or if A is 0, B is 1, and C is 0. Therefore to obtain the Boolean output expression for our problem we OR two AND'ed terms.

Now we come to the implementation of the logic. Looking at the output expression, we obviously need a 2-input OR as the final stage of our circuit. The output of the OR gate should be labeled Y and the two inputs should be labeled $\bar{A}B$ and $\bar{A}B\bar{C}$, as shown in Fig. 6A.

Because the two input terms to the OR gate are AND'ed terms, we draw two AND gates feeding the inputs of the OR gate as shown in Fig. 6B. The next step is to provide the proper inputs. For the first AND gate, we see that the B input is inverted. The other AND gate has both the A and C inputs inverted. Therefore, we must draw all of the inputs to the AND gates, inserting inverters wherever appropriate as shown in Fig. 6C.



To perform the experiment, assemble the circuits of Fig. 7 on a prototyping breadboard like this one. The power supply built in an earlier lesson should still be in place.

We now have the circuit in terms of AND's and OR's, but, as explained earlier, it is more desirable to work with NAND and/or NOR gates. Knowing that a NAND gate is equivalent to a negated input OR gate, we can replace the OR gate in Fig. 6C with a negated input NOR gate. Now, if we change the AND gates to NAND gates, we'll have implemented the circuit with NAND gates, as shown in Fig. 6D.

Combinational Logic Exercise.

Combining logic gates to form more complex circuits can best be understood by actually working with combinational logic circuits. So, pull out your breadboard. If you've broken down the

breadboard circuit after the last exercise, it will be necessary to re-assemble it. Also, be sure that the power supply we built in the first part of this course is still in place and operational. For this exercise, you'll need the parts listed in the Parts List.

Breadboard the circuit shown in Fig. 7A, and connect a logic probe or voltmeter to the output of the circuit. Assign pin numbers to the gates. Next determine the number of possible input combinations for the circuit ($2^n = 2^4 = 16$), and set up a truth table for the circuit. Apply +5 volts from the power supply to the two inputs of the circuit in the combinations indicated in

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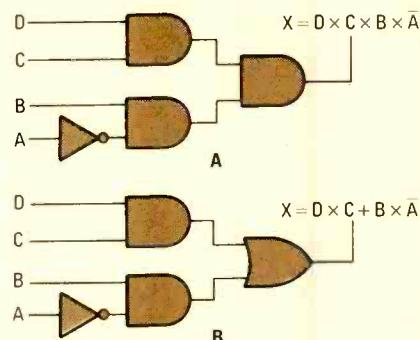


Fig. 7. Breadboard these two logic circuits, connect a logic probe to the output of the circuit, and observe the affect of various input combinations.

the Truth Table and record the output. It should be low for all input combinations except binary 14 (1110), which should force the output high.

Next simulate an open circuit by allowing input A to float (no voltage is applied to the input) and note the response of the circuit. (Recall that any open input to a TTL IC is seen by the unit as a logic high.)

Next wire up the circuit shown in Fig. 7B, and set up a truth table for the circuit. Apply +5 volts from the +V bus and use your logic probe to monitor the output of the circuit. Try all combinations indicated in the truth table, and record your observations. The output should be at logic low for all input combinations except for binary 2 (0010), 6 (0110), 10 (1010), 12 (1100), 13 (1101), 14 (1110), and 15 (1111).

That's all we have room for this month. For now, you can dismantle the experimental circuit (but *not* the power supply) and put the breadboard away until next time.

Next Month. Earlier in this article, we saw how we could use inverters to convert an OR gate into a NAND gate. In next month's lesson we'll examine that concept in more depth. That is, we'll see how some basic gates can be combined with inverters to form other basic gates.

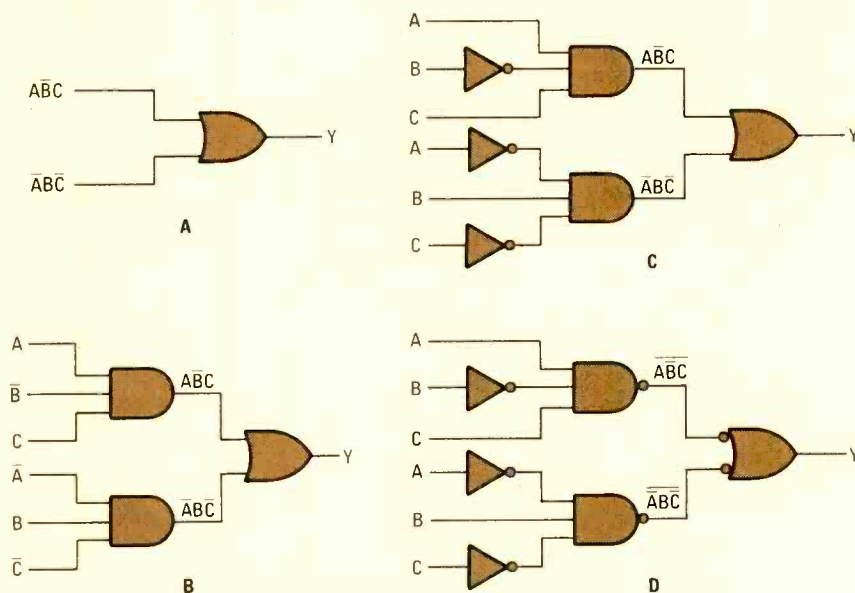


Fig. 6. Looking at the output expression ($Y = \bar{A}BC + A\bar{B}C$), it's obvious that it can be implemented using a 2-input OR gate (A), fed from a couple of AND gates (B), with some of their inputs inverted (C). The same circuit can also be implemented using NAND instead of AND gates (D).

Give a Friend a Year of Electronics Fun this Christmas. . .

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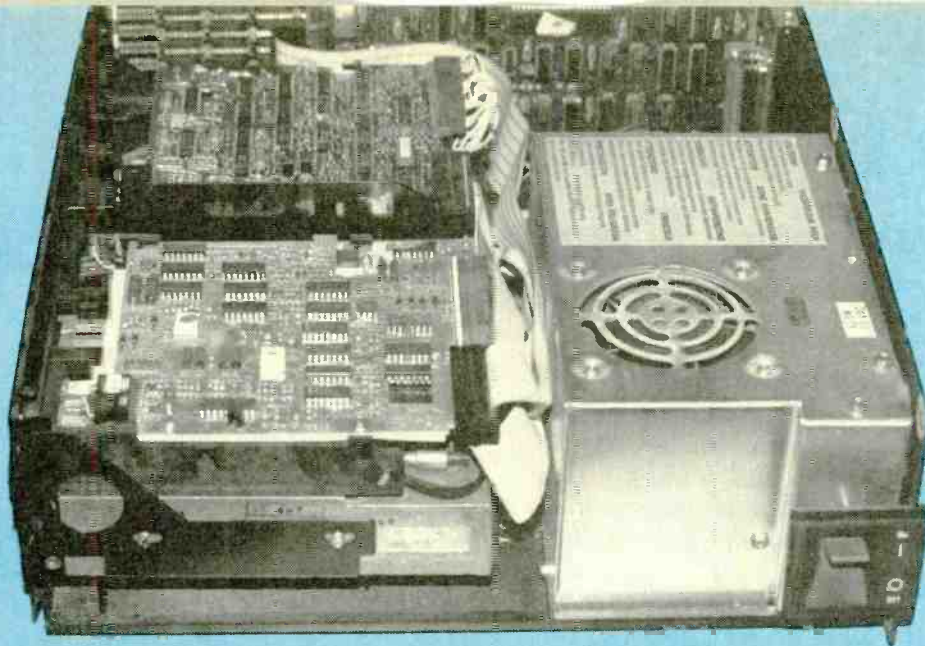
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Upgrading Your PC

BY JOSEPH J. CARR

*Who says you have to junk
your faithful old clunker.
Instead, learn how to
squeeze more performance
from your current machine.*

exclusively use *Half-Height (HH)* floppy-disk drives. And many current machines use HH quad density (1.44m) 5.25-inch drives, 720K 3.5-inch HH disk drives, or 1.44-megabyte 3.5-inch HH disk drives.

Avoid ESD Damage. A word of caution is in order before I describe my upgrade: Personal-computer motherboards, plug-in cards, and the electronics sections of disk drives use components that are sensitive to electrostatic potentials that can build up on your body. Static charges that you might not even feel can blow out or shorten the life expectancy of those electronic components. When working on your PC, always follow good anti-ESD (ElectroStatic Discharge) procedures.

For example, don't wear wool or garments made from synthetic fabrics that generate a lot of static electricity. Discharge yourself by touching a grounded point before starting to work. Ideally, wear a grounded ESD wriststrap (available at many electronics parts distributors), and use soldering tools that have grounded tips.

Lastly, don't remove boards or components from their packaging until you are ready to use them. Those translucent tubes and plastic bags are treated to prevent damage from any static electricity that may be present.

Basic Upgrade. The most basic upgrade that I, and most older-PC owners, needed was to add more DRAM and a serial port. There are a number of add-on boards that fit into the accessory slots on the motherboard to accomplish that. External connectors, if any, for the plug-in boards protrude through the rear panel of the computer. For my basic upgrade I selected the AST Six-pack expansion card because it offers up to 384K of additional memory, an asynchronous RS-232C serial port, an additional parallel printer port, a game port, and an on-board clock/date function that eliminates the need for typing in the date and time every time I boot-up—all on one card!

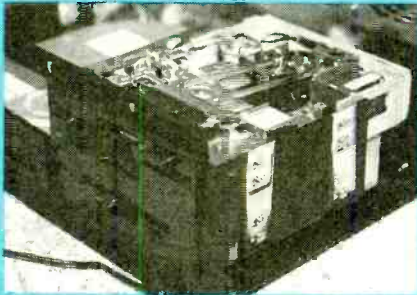
Shopping around for DRAM chips is definitely worthwhile. Don't take the prices in mailorder ads too seriously, however; Ads are prepared several months in advance, but the DRAM mar-

The personal computer revolutionized my working life. I routinely use several personal computers in my work as an electronics professional and as a technical writer. My main computer is an IBM-PC, and it was one of the first B-series (i.e. 256K motherboard instead of 64K) computers to arrive at the local dealer. That machine has served me well for several years, but now it's obsolete. Some software won't run on it at all, and other software is inconvenient to use because the machine lacks a hard-disk drive.

Starting about two years ago I slowly updated the old PC, to take advantage of current technology. In this article I'll show you how to upgrade your old PC (in steps or in one big swoop).

My IBM-PC has 256K of Dynamic Random Access Memory (DRAM) made up of four banks of 4164-150 DRAM chips, with nine chips per bank. Almost all modern software appearing on the market today requires at least 512K of RAM, therefore, my first upgrade was to add memory. MS-DOS and PC-DOS recognize up to 640K of memory, so I had to add 384K in order to bring the machine up to date.

The old PC had a parallel-printer port, a monochrome text-only TTL monitor, and a pair of 360K, 5.25-inch, Full-Height (FH) Double-Sided Double-Density (DSDD) floppy-disk drives. No RS-232C serial port was available, which makes using modems and some printers difficult. Today's systems almost



This old B-series IBM PC with two full-height 360K floppy-disk drives should give you some idea of the waste of space permitted way back when.

ket changes almost schizophrenically. I found the actual prices of DRAM's were lower than their advertised price. In one case, the DRAM price was 40-percent less than the advertised price. Although the price of memory is now on the upswing, it is worthwhile to call and ask the current price before buying.

When adding a product like the Six-pack you will have to configure the board and the motherboard to recognize the new memory size. Consult the owner's manuals for both the new board and the computer to find out how to set the DIP switches or on-board jumpers for the specific memory size that you select.

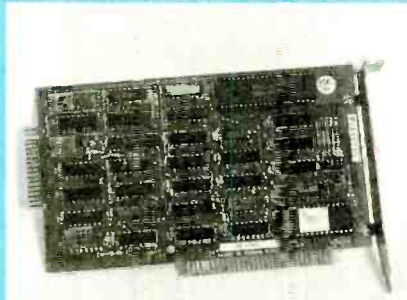
I also decided to add a simple graphics card to allow my IBM-PC to work with certain software. I selected the Hercules-format graphics card because it is minimally acceptable, and primarily because it would work with the standard green-screen TTL monitor that came with the machine many years ago. A new Hercules-format (or clone) card usually costs less than \$80, so it is a reasonable selection for an old computer. Those who want to add a modern monitor, and one that works a whole lot better, can use an EGA or VGA monitor with the appropriate card.

Adding/Changing Disk Drives.

When I bought my PC there was only one type of disk drive: the 5.25-inch FH, DSDD 360K model. But today there are several different types, sizes, and capacities such as the 5.25-inch HH 360K DSDD, the 5.25-inch HH 1.2-megabyte, the 3.5-inch HH 720K, and the 3.5-inch 1.44M HH. While I paid \$395 for an additional DSDD disk drive "way back when," current prices run from around \$60 to \$80 for 360K DSDD drives, to about \$120 to \$150 for one of the larger capacity 3.5-inch drives. If you hunt around a bit you will likely find them for even less.

One of the things that prompted me

to upgrade the old PC was the fact that one of my 5.25-inch 360K FH DSDD drives bit the dust. Instead of just replacing the drive with another of the same type, I opted to install a mix of drives. Because many software manufacturers may soon offer their wares only in the 3.5-inch, 720K format, it is wise to get one of those drives. The combination that I selected consisted of one 3.5-inch, 720K HH for drive B, and one of the original 5.25-inch, 360K drives for drive A. You can, however, use several drives



This floppy-drive controller card can only operate a floppy disk drive. It lacks the hardware to service input/output ports or a hard disk.

in differing mixes according to your own needs.

There is a mechanical problem that confronts owners of older PC's who wish to add a half-height drive: there are more holes in a slightly different arrangement in the newer models. Owners of older machines will have to either fashion an adapter plate of their own, or buy a commercially made mounting plate such as Jameco Electronics' Model TMHD mounting plate selling for about \$3. Also offered by Jameco are other disk-drive mounting hardware that may be needed by some people. In my case, replacing an FH drive with an HH drive left an empty space. I bought a bezel from Jameco for about \$1, which covered up the unsightly hole.

Adding a 3.5-inch disk drive to an older machine may not be the straightforward task that it seems. There might be problems with the internal BIOS (Basic Input/Output System) and the version of MS-DOS or PC-DOS that you have.

The BIOS is contained in a Read-Only Memory (ROM) chip on the motherboard inside the computer. It allows the computer to read disks (among other tasks) so that the disk operating system (DOS) and applications programs can be input to the computer. An old BIOS might not support newer drives, how-

ever, so you will have to buy a later version. Some authorized IBM dealers will sell the latest BIOS for your machine, although you might have to look hard to find one locally. Alternatively, you can use one of the many good clone BIOS available today. I selected the latest one (Version 2.52) from a company called Phoenix Computer Products.

One note when buying a new BIOS: These "firmware" programs come in two formats: one 28-pin DIP ROM chip or two chips. According to one dealer I consulted, some motherboards will not work properly with the two-chip version of the BIOS, so he recommends ordering only the single-chip version unless specific information is available on the particular motherboard being used. Note: the existence of two ROM sockets on the motherboard does not signify that the motherboard will only accept the two-ROM version of the BIOS.

Older versions of MS-DOS or PC-DOS will not support the latest floppy disk drives. I used DOS 1.1 and 2.0 for years, but they won't work with the newer 3.5-



Half-height hard-disk drives designed to fit into one of the slots intended for floppy disk drives, can give you super storage in a very tiny space. Technology has really changed!

inch drives. Use DOS 3.2 or higher for 720K drives, and 3.3 or higher for 1.44M drives. An anomaly reported on some versions of 3.30 is that the 3.5-inch drive must be drive A; version 3.30A allows any type of drive to be used as the A or B drives.

You may also need to obtain a newer floppy-disk controller card, and therein lies a pitfall for the unwary. There are several different forms of 3.5-inch drive, and the controller card must be capable of accepting the one that you buy. For that reason I recommend that you buy the disk drive and the controller card from the same source. I bought a Toshiba Model 352KU (720K) drive and the JE-1043 controller card from Jameco because their catalog specifically

listed those components as compatible with each other. The JE-1043 will control two drives, they can be any of the standard types discussed above, and they can be separately configured on the JE-1043 by moving jumpers around according to the instructions supplied.

When I finished with the first and most basic upgrade of my old IBM-PC, it was configured with 640K of memory, a parallel port, a serial port, one of the original 360K FH 5.25-inch floppy drives, a new 3.5-inch 720K drive, and a Hercules graphics card.

Higher Upgrades. The basic upgrade that I performed on my old IBM-PC was sufficient for my needs at the time, and it is still in use. But there are other things that could also be done to improve the machine. However, some of these are so extensive that one has to consider whether the task ought to be refurbishing an old machine, or building a new one. Both are viable alternatives for any electronics buff who knows how to use a screwdriver.

Hard-Disk Drives. All modern computers should use either an external or internal (preferable) hard-disk drive. Although the original IBM-PC/XT hard disk had only ten megabytes of storage (which seemed vast in 1985), currently several options are available to you for adding hard-disk capability. One recent catalog offers hard disks from 20-megabytes to 120-megabytes, and I've seen ads for models up to 350-megabytes.

Owners of older machines, especially the IBM-PC (or clones) that did not have a hard disk, may wish to use a "hard card." Those products are standard IBM-compatible plug-in cards that fit into one of the expansion slots. It contains a disk drive and a controller card on one plug-in assembly. I recently added a Shamrock Lepracard Model 330 30-megabyte hard card to my old IBM-PC, completing the upgrade.

Various manufacturers offer FH and HH hard-disk drives that can boost the usefulness of your computer considerably. Those drives can fit into one of the floppy-drive positions on your computer. A common configuration is to use a FH or HH hard disk in the right hand position formerly occupied by drive B, and the HH floppies in the left position formerly occupied by the FH drive A. Many people place a 5.25-inch, 360K (drive A) and a 3.5-inch 720K drive



This is a 150-watt replacement power supply for the PC/XT installed in a PC/XT cabinet. The number of screws to mount your power supply will depend on your cabinet.

(drive B) in the left side position, and a HH or FH hard disk in the right side.

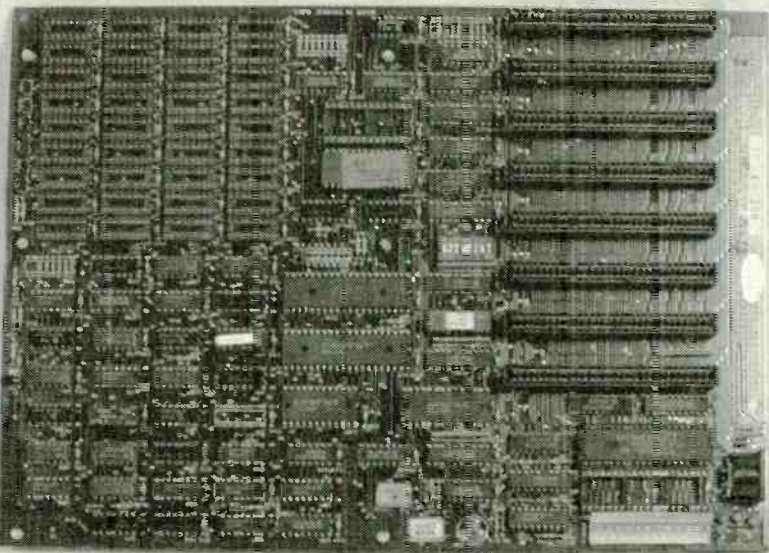
In my own situation, I recently built an XT-turbo class machine using a Seagate ST-238R 30-megabyte hard disk. That same drive (or one of the others) can be used in either a newly constructed machine or an upgraded or refurbished older machine. A hard-disk controller will be needed, and they can be bought from the same source as the drive. In fact, it is the best policy to buy both the drive and the controller from the same source so that you can make certain that they are compatible. Most mailorder companies will designate the controllers and drives that go together, and many of them offer a special price when the two are purchased together. Buying a "bargain" may produce unforeseen headaches!

In particular, you may run into prob-

lems if you've previously upgraded your PC with higher capacity 5.25- or 3.5-inch floppies, or if you plan to in the future. Your best bet then is one of the new breed of versatile controllers that can handle all of the popular floppy formats, as well as hard disks. One example of those is RMT Systems' RMT2001-F2H2 controller. That single-board controller can handle two 3.5- or 5.25-inch floppies, as well as most popular hard-disk drives, and free up an expansion slot in the bargain.

More Power To You. The original IBM-PC used a 67-watt DC power supply. If you add a lot of special-purpose expansion cards (with the full 640K of memory), or a hard-disk drive, then it may become necessary to beef up the DC power supply. Many sources exist for new power supplies in 135-watt, 150-watt, and even 250-watt capacities; I recommend at least 150 watts. The supplies fit directly into either the IBM-PC/XT type chassis, or the IBM-AT type chassis, and now cost less than \$100 (I've seen some 150-watt models advertised by mailorder sources for less than \$50). The DC supply fits into the computer case at the right rear corner, and is attached by two to five screws (depending upon its origin) to the rear panel. It can be replaced easily (in minutes) with only a screwdriver or 1/4-inch nut-driver.

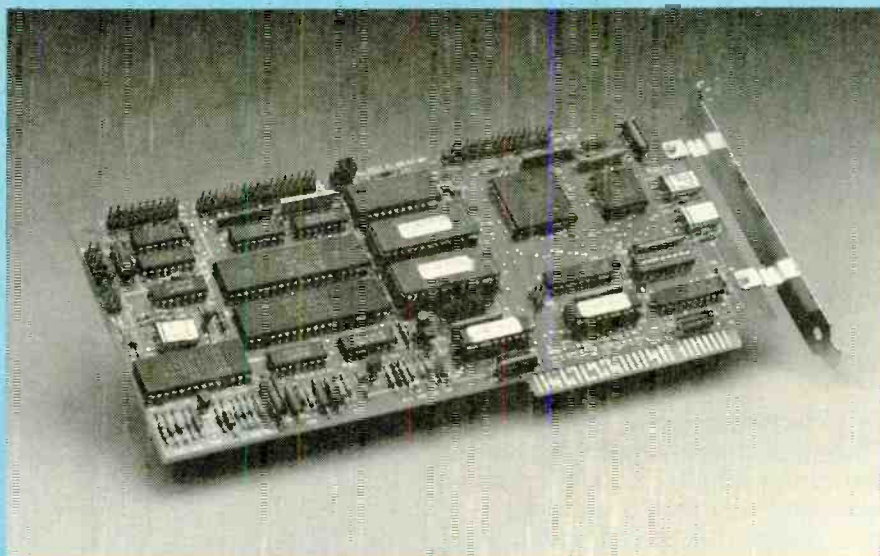
New Motherboards. The old IBM-PC operated at 4.77-MHz, so it is very slow



Here's an XT-turbo 8/10-MHz replacement motherboard. The on-board DRAM memory used on modern boards like this consists of 41256 chips or higher.

by modern standards. Along with improved speed, newer motherboards offer various features and later versions of the BIOS ROM. There are a lot of new "turbo" XT-compatible boards on the market, usually for less than \$100, that fit directly into the chassis of the IBM-PC or IBM-XT type of machine. The straight turbo boards usually feature either the same 8088 processor as the originals, or the supposedly faster 8088 replacement NEC V-20, but run at faster clock speeds. Common turbo boards operate at both the standard 4.77-MHz clock speed and a faster speed in "turbo mode" (either 8-MHz or 10-MHz).

You can also buy new motherboards that are AT-compatible, but fit into the PC/XT-size cabinet. Those boards are usually designated "baby-AT" or "mini-AT." Straight AT-compatible boards are a little larger, so must be installed in an AT-class cabinet. The AT boards are equipped with an 80286 processor. It is



If you want to conserve expansion slots on an 8-bit machine, a multi-purpose card is the way to go. This RMT2001-F2H2 controller card can support two floppy drives and two hard-disk drives simultaneously. To top it all off, it comes with an on-board BIOS so you can vary the configuration of the drives.

SOURCES OF PARTS

The list of sources below is not intended to be complete, but rather offers a point of departure for you in locating adequate sources of computer parts. Check the advertisements in this magazine for other sources.

American Design Components

815 Fairview Ave.
Fairview, NJ 07022
Tel. 800-776-3700, or
201-941-5000

CIRCLE 32 ON FREE INFORMATION CARD

AST Research, Inc.

2121 Alton Ave.
Irvine CA 92714-4992
Tel. 714-863-0181

CIRCLE 33 ON FREE INFORMATION CARD

Jameco Electronics

1355 Shoreway Road
Belmont, CA 94002
Tel. 415-595-2664

CIRCLE 34 ON FREE INFORMATION CARD

JDR Microdevices

2233 Branham Lane
San Jose, CA 95124
Tel. 408-866-6200

CIRCLE 35 ON FREE INFORMATION CARD

Jinco Computers, Inc.

5122 Walnut Grove Ave.
San Gabriel, CA 91776
Tel. 818-309-1108

CIRCLE 36 ON FREE INFORMATION CARD

RMT Systems, Inc.

18226 McDermott West, Suite E
Irvine, CA 92714

CIRCLE 37 ON FREE INFORMATION CARD

Shamrock

733-AA Lakeland Rd.
Westlake Village, CA 91361

CIRCLE 38 ON FREE INFORMATION CARD

also possible to buy different speed AT-class motherboards. Models from 8 MHz to 33 MHz are available.

Speed is sometimes a red-herring issue, and it's not always true that faster is better. But in general, there is good reason to buy a faster board if you have the money. But a word of warning is in order. Some manufacturers reportedly offer speedy boards that use a less speedy processor chip. Although the chip works at the higher speed, the internal semiconductor junction temperatures could rise above the maximum specified level. Reliability engineers tell us that a 10°C rise of junction temperature halves the mean time between failure (MTBF) rating of the device!

The prices on motherboards are dropping rapidly, and the picture of what's available is changing. You will have to check the mailorder ads and catalogs from mailorder companies to find the current offerings, but you are almost sure to be pleased with what you find.

Sources of Supply. Although there are dealers in some localities who handle a full line of components for either the builder or refurbisher of personal computers, most readers will probably want to buy mailorder. I experienced no difficulty in buying from mailorder sources, but you might want to use a little caution when dealing with unknown sources or sources that exist only as a post-office box. In general, the sources that advertise in national magazines are straight shooters (at least,

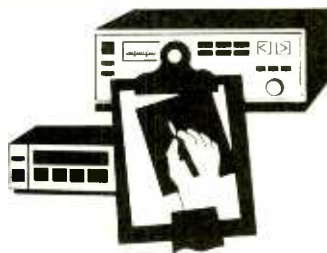
that's been my personal experience), and so can be a quality source of parts and components.

In general, unless you are familiar with the capabilities of the equipment you are acquiring, it is best to buy from a single source when purchasing items that must work together in an integrated manner. Examples include floppy-disk drives and floppy controller cards, hard-disk drives and hard-drive controllers, etc. It is also sometimes a problem mixing unknown motherboards with plug-in controller cards because of BIOS compatibility.

The only time I got "stung" on a part was at a hamfest/computerfest. One dealer offered motherboards at a good (but not great) price. I bought one, but when I fired it up at home I found certain read errors were happening. On calling Phoenix I found out that the BIOS chip it contained was an older version (2.27), and did, in fact, contain errors. They recommended that I buy Version 2.52 and provided a reasonably local telephone number for a "nearby" dealer. The new BIOS cost \$35 and solved the problem.

Some Common Sense. It is easy to rush out and buy all the parts that your bank account or credit-card limit can tolerate. If you're like me, then you're tantalized by the best and most recent of everything electronic. But when a dose of old-fashioned reality sets in, you may find that the latest and greatest is not needed. For example, your old PC

(continued on page 101)



Product Test Reports

Len Feldman

JVC RX-701VBK Stereo Surround-Sound Receiver

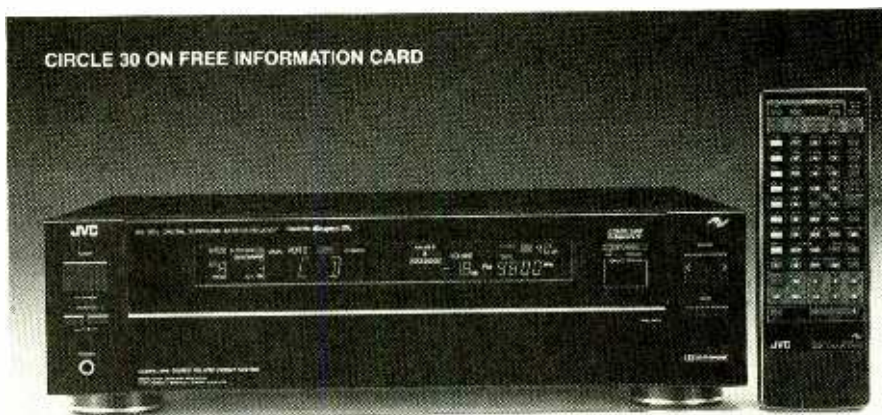
All too often, the words "Audio/Video Receiver" simply mean that the unit is equipped with a couple of extra audio inputs that have been marked VCR IN, VIDEODISC IN, or something similar. JVC's new RX-701VBK Stereo Surround-Sound Audio/Video Receiver is quite a different creature, however. That unit actually accepts, controls, and switches the video signals from such program sources as well. But, as you will soon see, that's not all that makes the receiver something special.

Features Galore. Among the more interesting features incorporated in this receiver is one called CSRP, or Compu Link Source-Related Presetting. It permits the user to preset six sound parameters or adjustments for up to five different program sources. Those sound parameters include volume, balance, graphic equalizer on/off, equalizer pattern, loudness, and surround-sound on/off.

Another Compu Link feature is the C ompu Link Communications system, which JVC has dubbed CCS. One of its functions lets the user give a 5-letter name to each of the five custom equalization patterns that can be memorized by the receiver's built-in memory. You can also assign a 5-letter name to each of the 40 AM/FM preset stations. That is especially convenient for those of us who know the station call letters but can never remember the correct frequency!

For video surround sound, the receiver incorporates a digital-delay Dolby Surround circuit and the extra two power amplifiers needed for surround-sound reproduction. Up to two video components can be connected to the receiver.

One of the most interesting and well-designed sections of the receiver is its S.E.A. circuitry. S.E.A. stands for Sound Effects Amplifier, the name that JVC insists upon calling what other people generally refer to as a graphic equalizer. In the case of this receiver, there are



JVC's RX-701VBK Stereo Surround-Sound Audio/Video receiver accepts, controls, and switches video as well as audio inputs.

seven separate bands of equalization, with frequencies centered at 63 Hz, 160 Hz, 400 Hz, 1 kHz, 2.5 kHz, 6.3 kHz and 16 kHz. By being able to adjust each of those bands by as much as ± 10 dB, the user can create precisely the type of response curve suited to his or her taste, to room acoustic requirements, or to the type of music being played.

That arrangement is far more flexible than ordinary bass and treble controls or even than three-part tone control systems (bass, mid-range, treble). In addition to being able to set up and memorize five of your own preferred response curves for instant recall, the RX-701VBK comes equipped with five factory-set response curves, identified by JVC as "heavy," "clear," "soft," "movie," and "vocal." We experimented with all of those settings, using appropriate program material, and found that they were nearly always close to the settings we would have chosen ourselves for the various types of musical material.

As for the more basic circuitry, the amplifier sections of the RX-701VBK use a proprietary power-output arrangement that combines the low distortion of Class AB and Class B circuitry. Featur-

ing high-power output transistors and a boosted power supply, the power-amp section of the receiver has the ability to deliver high dynamic (short-term) power well in excess of its continuous power rating of 80 watts-per-channel. The amplifier can also operate safely into the lower and complex impedances of some of today's more popular loudspeaker systems.

When operated as a four-channel "surround sound" system, the front

channel power is reduced to 70 watts-per-channel, and 12 watts-per-channel are delivered to the rear loudspeakers. There are those who maintain that in an optimum surround-sound system, as much power is needed in the rear as in the front channels. But most experts feel that rear speakers can be driven with more moderately powered amplifiers since they rarely carry primary signal information.

The Controls. When all controls are exposed and visible on the front panel of this receiver, the equipment may appear to be quite intimidating to the inexperienced user. For that reason, and for aesthetic considerations, JVC has hidden some of the less-often-used controls behind a swing-down door panel. With that panel closed, all that's visible on the front of the unit are a power switch, a pair of speaker-selector switches, and a stereo-headphone jack at the left, and volume up/down buttons and an audio-muting switch at the right. The entire upper central section of the panel is occupied by a multi-function display that shows operating status and a wide assortment of useful indicators including FM or AM frequen-

JVC RX-701VBK Published Specifications and Actual Performance

SPECIFICATION

MFR'S CLAIM

PE MEASURED

AMPLIFIER SECTION

Power Output/Ch. (Watts)		
2 Channel	80	83
4 Channel	70/12	Confirmed
Distortion	0.007%	0.026% (*)
IM Distortion	0.007%	0.062% (*)
Input Sensitivity		
High Level	200 mV	Confirmed
Phono	2.5 mV	Confirmed
Frequency Response		
High Level (5Hz-50kHz)	+0, -1 dB	Confirmed
Phono (RIAA 20Hz-20kHz)	±0.5 dB	+0.7/-0.1 dB
Signal-to-Noise Ratios		
High Level	85 dB (IHF)	85 dB (IHF)
Phono	78 dB (IHF)	79 dB (IHF)
Graphic EQ. Range	±10 dB	Confirmed

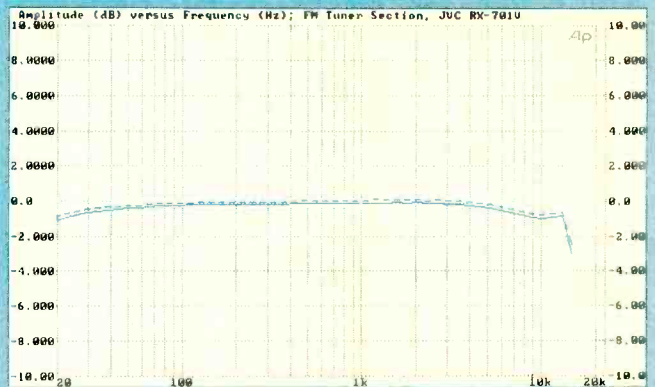
FM TUNER SECTION

Frequency Response (30Hz-15kHz)	+5 dB, -3 dB	+0 dB, -2 dB
50 dB Quietening Sensitivity		
Mono	16.3 dBf	14.0 dBf
Stereo	38.3 dBf	47.0 dBf
S/N Ratio, (Mono/Stereo)	81/73 dB	76/73 dB
THD (Mono/Stereo)	0.15/0.20%	0.08/0.06%
Capture Ratio	1.5 dB	Confirmed
Alt. Ch. Selectivity	60 dB	63 dB
Stereo Separation (1 kHz)	40 dB	38.5 dB

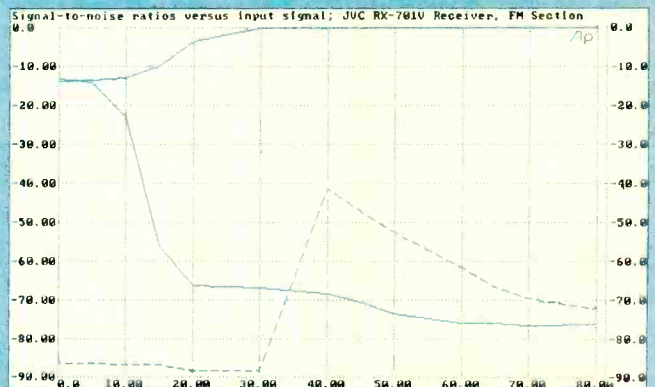
GENERAL SPECIFICATIONS

Power Requirements	120V, 60 Hz, 310 W.
Dimensions (W x H x D, inches)	17 1/8 x 5 x 15 1/8
Weight (Lbs./Kg)	24.0/10.9
Suggested Price	\$540.00.

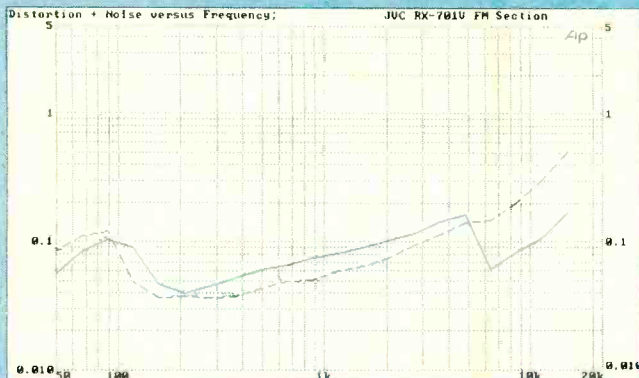
(*see text)



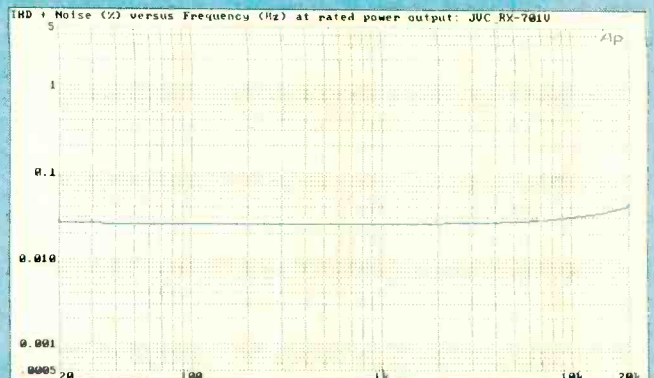
The frequency response was virtually flat over the entire FM audio range.



Signal levels required to produce a 50-dB signal-to-noise ratio: solid line is mono, dashed line is stereo, upper solid line is referenced audio level.



Distortion in both mono and stereo was quite a bit better (lower) than claimed, even at higher frequencies: solid line is mono, dashed line is stereo.



Our measurement of amplifier distortion versus frequency was somewhat different than JVC's, but the discrepancy was likely due to different measurement techniques.

cy, program-source selection, S.E.A settings, preset-number selection, and much, much more.

Lowering the hinged panel reveals controls needed for operation of the graphic equalizer, its memorized settings, program-source selection, preset selection, up/down frequency tuning, surround-sound selection, and the

Compu Link system. Loudness- and balance-control buttons are also found there.

The remote control supplied with the receiver not only operates just about all of the functions of the receiver itself, but if certain JVC Compu Link components are used with the receiver, those components can be activated and oper-

ated with the same remote. For example, the numeric keys on the remote are used to call up FM or AM preset numbers, but the same number keys can be used to select Compact-Disc track numbers, VCR-channel numbers, or TV-channel numbers on the appropriate JVC components.

(Continued on page 96)



MICROWRITER SYSTEMS AGENDA MODEL 32K



A pocket-size computer replaces the notebook and functions as a wordprocessor to boot!

Taking notes is a serious business for many people. Students do it at lectures, labs, and libraries. Businessmen are forever writing on scraps of paper. Order-takers, engineers, housewives, even editors are no exceptions. Of course problems arise when you rely on those scraps of papers: some are lost, others cannot be read because scribbling under pressure produces sloping handwriting and obscure abbreviations. A pocket tape recorder is a suitable substitute, but it is limited. Those are the very reasons the Agenda 32K was developed.

Why You Need One. The Microwriter Agenda Model 32K is an ingenious and sophisticated computer that performs many functions. It can store information about your business, as well as your social and family life—such as phone numbers, addresses, and lists of things such as restaurants, as well as details of expenses, bills to pay, train and plane timetables, and much more. Agenda can even be used as a daily diary of notes on your appointments, and will alert you when it's time for any of them.

The important thing is that you can carry all that information around with you and find it easily when you need it. It records most of that data in the form of "Action Lists"—a note pad that keeps a list of important things to do.

To top it all off, the Agenda is also a potent word-processor for producing letters, reports, or memos. The files created by using the word processor or any feature of the Agenda may be output by a printer using cables supplied

with the device. You can even tie the Agenda to your computer allowing data to be transferred for backup storage or use elsewhere. Not leaving any computerized stone unturned, it's also a calculator that can add, subtract, multiply, divide, and compute percentages.

Microwriting. Your first look at the Agenda Model 32k may intimidate you because the alphanumeric keys are pill-sized and arranged in alphabetic sequence on a keyboard whose overall size is approximately 3-inches wide by 1¼-inches high. Taking a closer look, there are also five larger keys that are arranged to accommodate the pads of the five fingers of the right hand (see Fig. 1). Using those keys—and it's easy to learn how—permits the user to input text and numbers at a speed approximately 1½ times your normal writing speed after several weeks of use.

To promote the use of the Microwrit-



The memory modules for the Agenda are deceptively small in size. The Agenda comes with special cradles (shown at the top) to protect unused modules.

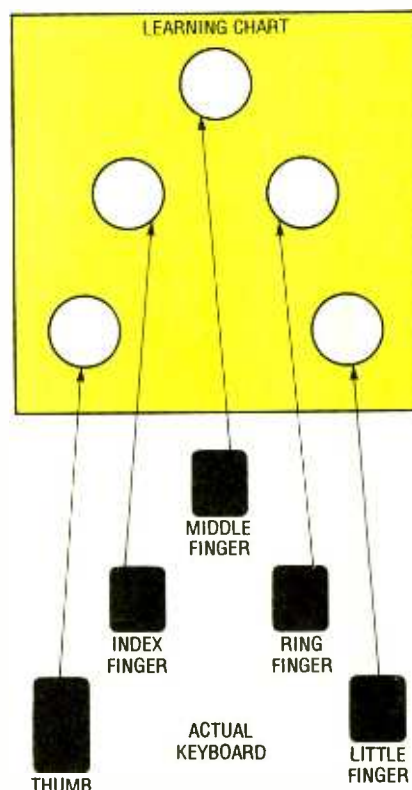


Fig. 1. Microwriting is based on the shape of letters. The keys for the finger pads are shown here and the basic learning chart is developed from that.

ing keys, a manual *Learn to Microwrite* is supplied with the Agenda. A portion of the manual is reproduced in Fig. 2 to illustrate the instruction technique used to learn the first four letters presented: "b," "d," "r," and "j". This reviewer peeked ahead to learn which pads to depress for the letters "e" and "l," and was knocking out words like "bid," "bed,"

"rid," "bib," "jeer," "jib," and "red" with the greatest of ease. In a week's time, the Microwriting of all the letters and numerals were mastered at a speed that was just a bit slower than normal writing with a ball point pen.

There are actually many function keys on the Agenda that enhance the total effectiveness of the device. You can get the hang of Microwriting as you learn to use the function keys that are important to you. Once you master the keyboard and the function codes you require, there is no need to ever look down at the keyboard or the LCD screen.

Learning Microwriting is an important step in the optimal use of the Agenda. A brief learning period and frequent use will permit the user to master Microwriting and achieve maximum benefit from the Agenda.

Memory Capacity. The Agenda 32K comes with 32K of memory, as you may have guessed. That is enough to store about 6,500 words. (Of course the 64K model can store up to 11,000 words.) The operator can check how much free memory is available by pressing the SHIFT and CALC keys simultaneously at the Start Menu. The LCD screen displays something like "Free.....28,550" which would mean that there's space for 28,550 more characters in memory. Interestingly, spaces usually do not use up memory.

If 32K of memory is not enough, "storage cards" can be slipped into the two slots at the back of the Agenda. Each card has its own random-access memory of 32K characters and its own long-life lithium battery that enables the storage card to retain information when it is removed from the Agenda. The battery needs no recharging and will last for more than five years.

The storage card can be used as a backup copy of the *whole contents* of your Agenda's on-board memory. The card can then be used to transfer part or all of the memory to another Agenda. Another card can be used as an archive on which specific information is stored for occasional use. Salesmen may want to keep their factory price list on one card and the distributor's price list on another. Two ports are available to plug in up to two storage cards, but only one port may be used to extend memory.

Connecting a Printer. Printer cables for either series or parallel printers are

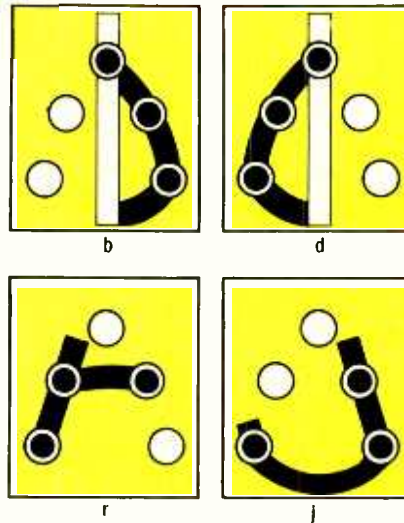


Fig. 2. The learning charts show how the letters "b," "d," "r," and "j" are visualized and what keys to press to send the letter to Agenda.



Shown here are the serial- and parallel-interface cables, the AC adapter, battery plug, modules with cradles, and the battery pack that are all accessories for the Agenda.

supplied with the Agenda. Our unit was connected to a typical parallel-interface printer and then both units were powered up. To print the contents of the screen, the SHIFT and HELP keys were depressed simultaneously and released. The printer jumped to life and the printout duplicated the data on the screen.

The manuals cautioned that trouble may be experienced with various printer models because printer standards are not universal. The text suggested discussing the problem with your dealer who would have information for properly interfacing most modern serial or parallel printers the Agenda.

PC Interface. The Agenda interfaces with an IBM PC or compatible through

the computer's serial port. The communications link was set up by issuing the DOS "MODE" command as follows:

```
MODE COM1:1200,N,8,2
```

The Agenda must use the same protocol, that is a baud rate of 1200, no parity, 8 data bits, and 2 stop bits. Then follow the simple instructions in the manual and data can be exchanged.

Some Interesting Facts. Agenda's memory is divided into 26 "drawers" or sub-directories—each represented by a letter of the alphabet. The user need not use all of them; in most cases three to five will do. But, salesmen may want to keep their product data and prices separate. You can use only the drawers you need without wasting memory as the unused drawers are simply not partitioned any memory. Any and all unused memory is at the disposal of any drawer you are dealing with.

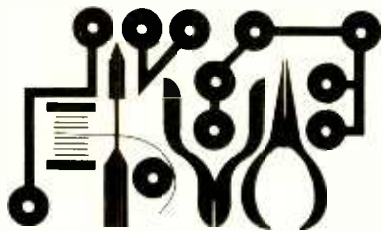
Being flawed, as we humans are, we sometimes erase files in error. The Agenda expects such human faults in its operators and has an "undelete" feature whereby deleted files can be restored. If you keyed in new data after the erasure, at least some portion of the deleted files may be recovered.

When brackets or quotation marks are input, the Agenda automatically produces a pair of them, with the cursor between them. This means that you key in whatever is to go between the brackets or quotes, the right hand one will keep moving just ahead of the cursor. There is no danger of you forgetting to close the bracket or quotation mark. When ready, press the right-arrow key and the cursor will step over the bracket or quotation mark.

The Agenda is shipped with a soft carrying case, two computer patch cords (serial and parallel), battery, and an AC adapter that doubles as a battery charger.

When in its case, the Agenda can be carried safely in the pocket, briefcase, bag, or suitcase without fear of damaging the keyboard from accidental knocks. If left unattended for five minutes, the Agenda will automatically power down to save battery power.

As of the time this article was written, the Agenda was available only in England; plans for its eventual introduction in this country are incomplete. For more information on the Agenda, contact Microwriter Systems, PLC (2 Wandle Way, Willow Lane, Mitcham, Surrey, England CR4 4NA), directly. ■



Circuit Circus

By Charles D. Rakes

DIGITAL, PROGRAMMABLE TIMERS, AND MORE!

This month the Circus is off and running with a circuit using a most unusual and flexible programmable IC timer. The MC14541B (or 4541) can be had for about a buck and will make the old faithful 555 oscillator/timer stand in the corner. That CMOS timer consists of a 16-stage binary counter, an internal R/C-oscillator circuit, an automatic power-up reset circuit, and a choice of output logic.

The 16-stage counter divides the oscillator frequency into four available outputs of 2^8 , 2^{10} , 2^{13} , and 2^{16} . The circuit counts 256 clock pulses for the shortest time interval (2^8), and 65,536 pulses for the longest time period (2^{16}). See the truth table in Fig. 1 for logic details.

By selecting the oscillator's frequency and the number of counter stages, the timing period can be set to just about any length you desire.

TABLE 1
COUNTER SELECTOR CHART

PIN 12	PIN 13	NUMBER OF COUNTER STAGES (N)	COUNT 2^N
0	0	13	8192
0	1	10	1024
1	0	8	256
1	1	16	65536

Fig. 1. The inputs at pins 12 and 13 of the MC14415 programmable counter determine the number of counter stages selected, and therefore the count.

Using the 14541. A get-acquainted timer circuit is shown in Fig. 2. When pin 5 of U1 is tied to a logic low (ground in our circuit) the counter circuit is automatically re-set when power is applied. The master reset at pin 6 requires a positive pulse to reset the internal counters and start the timing function.

Pin 9 sets the timer's output mode. Connecting pin 9 to ground keeps the timer's output voltage (pin 8) at ground potential until the timing cycle is com-

pleted and then switches positive. Connecting pin 9 to the V+ supply rail causes the opposite output conditions to occur: The output remains high until the timing cycle is completed and then goes low. Timing mode selection is made via S2.

The positions of S3 and S4 determine the timer's total count. With S3 in position 1 and S4 in position 0, the counter will total 256 before timing out. Match the positions of S3 and S4 to the truth table in Fig. 1 to set the desired count. The internal oscillator is set to the desired frequency with component values determined by the formula: $f = 1/(2.3 \times R4 \times C2)$. The value of resistor R3 should be about twice the value of R4.

Resistor R4's resistance is in megohms and C2's capacitance is in microfarads. For example, if R4 is 100k and C2 is 0.1 μ F, then:

$$f = 1/(2.3 \times 10^5 \times 10^{-7})$$

$$f = 1/.023$$

$$f = 43.4 \text{ Hz}$$

Our frequency counter measured 41 Hz, which is close enough. With pin 10 (the mode control) tied to ground, as shown in Fig. 2, the timer operates in a single-cycle mode, but when pin 10 is connected to V+, the mode changes to a recycling condition that causes the timing cycle to repeat over and over as long as power is applied to the circuit. Potentiometer R4 is used to make obtaining an exact time delay easy. After the desired resistor value is determined, R4 can be replaced with a fixed 1% unit, or left as is for changing at a later date. Pressing S1 resets the circuit.

MC14536 Programmable Timer.

Our second timer circuit is built around an MC14536B programmable timer, which contains a 24-stage, binary-ripple counter; 16 stages in that unit are selectable by a 4-bit binary code. The timer has a built-in RC oscillator (similar to the one in the previous IC), and a monostable-multivibrator output. Almost any timing period can be set by selecting the clock frequency and the proper counter stage for the desired time period.

In the Fig. 3 timer circuit, most of U1's options are selectable via individual switches. Pressing S1 supplies a positive pulse to the reset, or timer-start input, at pin 2 to initiate the timing cycle. Switch S2 selects the "8-bypass" option. Switches S3-S6 set the binary code for the counters.

Let's look into the IC in more depth; refer to Fig. 4 as we proceed. With pin 1

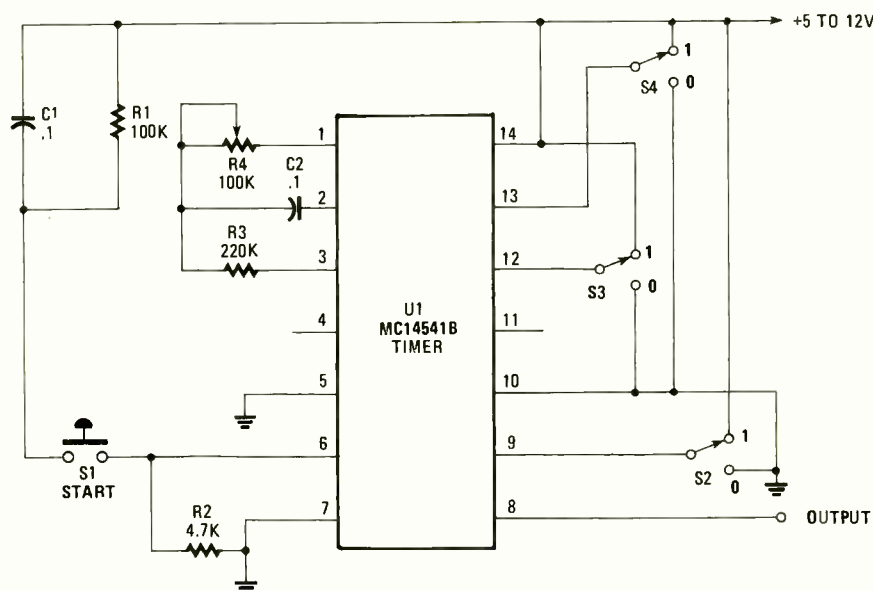


Fig. 2. The MC14541B (or 4541) programmable timer consists of a 16-stage binary counter, an internal R/C-oscillator circuit, an automatic power-up reset circuit, and a choice of output logic.

PARTS LIST FOR THE CIRCUIT IN FIG. 1

U1—MC14541B programmable timer, integrated circuit
R1—100,000-ohm, 1/4-watt, 5% resistor
R2—4700-ohm, 1/4-watt, 5% resistor
R3—220,000-ohm, 1/4-watt, 5% resistor
R4—100,000-ohm potentiometer (see text)
C1, C2—0.1- μ F ceramic-disc capacitor
S1—Normally-open pushbutton switch
S2, S3, S4—SPST switch (any type)
Printed-circuit or perfboard materials, enclosure, IC sockets, battery and battery holder, wire, solder, hardware, etc.

PARTS LIST FOR THE CIRCUIT IN FIGURE 3

U1—MC14536B programmable-timer, integrated circuit
R1, R2—100,000-ohm, 1/4-watt, 5% resistor
R3—220,000-ohm, 1/4-watt, 5% resistor
R4—4700-ohm, 1/4-watt, 5% resistor
C1, C2—0.1- μ F ceramic-disc capacitor
Printed-circuit or perfboard materials, enclosure, IC sockets, battery and battery holder, wire, solder, hardware, etc.

(set) tied high, the decode (out) pin (pin 13) is forced high and the internal oscillator is disabled. That places the circuit in the standby mode. Pin 1 must be tied low for the circuit to be placed into the timing mode. The reset input (pin 2) requires a positive pulse to activate the timer circuit by forcing the decode (out) terminal (pin 13) to go low, resetting all 24 flip-flop stages.

During the time that the pulse is positive, the chip's internal oscillator is inactive and the timing cycle remains in limbo until the negative-going edge of the input pulse starts the timing function. The in "1" terminal (pin 3) is the clock input. The internal counters advance on the negative-going edge of the clock input pulse. The clock input may be driven by the internal oscillator or from an external source.

If an external clock is used, both out "1" and out "2" (pins 4 and 5, respectively) may be left disconnected or used to drive other CMOS loads. When the 8-bypass terminal (pin 6) is tied high, the first 8 flip-flop stages are bypassed, making the device a 16-stage counter with each stage selectable from the 4-bit binary inputs.

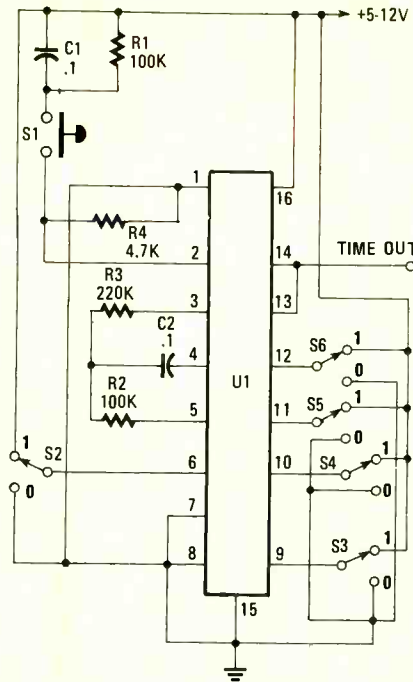


Fig. 3. This timer circuit is built around the MC14536 programmable timer, which contains a 24-stage, binary-ripple counter, a built-in RC oscillator, and a monostable-multivibrator output.

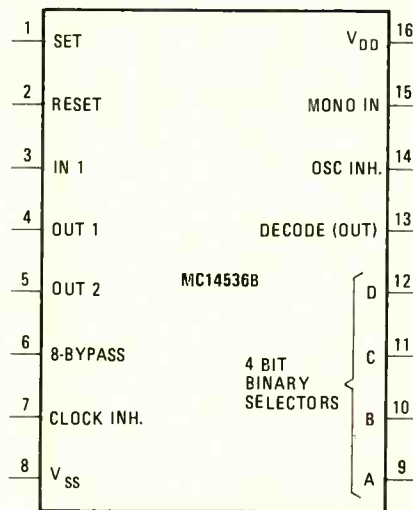


Fig. 4. Here's a pinout diagram of the MC14536. The chip can be programmed for the desired output frequency via its 4-bit binary-input selector (pins, 9, 10, 11, and 12).

With the 8-bypass pin tied to ground, all 24 flip-flop stages are used, with only the last 16 stages selected by the 4-bit binary inputs. Refer to the truth tables in Fig. 5 for selecting and setting the binary codes. The clock-inhibit terminal (pin 7) must be tied low for normal timing functions. If pin 7 (clock inhibit) is tied high, the first counter stage is disconnected from the clocking source. If

BINARY CODE INPUT					SELECTED STAGE FOR OUTPUT
8 BYPASS PIN 6	D PIN 12	C PIN 11	B PIN 10	A PIN 9	
0	0	0	0	0	9
0	0	0	0	1	10
0	0	0	1	0	11
0	0	0	1	1	12
0	0	1	0	0	13
0	0	1	0	1	14
0	0	1	1	0	15
0	0	1	1	1	16
0	1	0	0	0	17
0	1	0	0	1	18
0	1	0	1	0	19
0	1	0	1	1	20
0	1	1	0	0	21
0	1	1	0	1	22
0	1	1	1	0	23
0	1	1	1	1	24

A

BINARY CODE INPUT					SELECTED STAGE FOR OUTPUT
8 BYPASS PIN 6	D PIN 12	C PIN 11	B PIN 10	A PIN 9	
1	0	0	0	0	1
1	0	0	0	1	2
1	0	0	1	0	3
1	0	0	1	1	4
1	0	1	0	0	5
1	0	1	0	1	6
1	0	1	1	0	7
1	0	1	1	1	8
1	1	0	0	0	9
1	1	0	0	1	10
1	1	0	1	0	11
1	1	0	1	1	12
1	1	1	0	0	13
1	1	1	0	1	14
1	1	1	1	0	15
1	1	1	1	1	16

B

Fig. 5. These truth tables can be used to set the desired output frequency. Refer to the text for details.

the input is tied high during a timing interval, the current count will be kept on hold until the input goes negative.

When pin 14 is tied high, the internal RC oscillator stops, reducing power consumption during the standby period. Pin 14 must be tied low for normal timing functions. The binary inputs (A, B, C, and D at pins 9-12, respectively) select the number of the counter stages needed to set the desired time delay (see the truth tables in Fig. 5). The mono-in terminal (pin 15) controls the operation of the internal monostable multivibrator. To disable the multivibrator, pin 15 is tied low.

The multivibrator is activated by connecting a resistor between pin 15 and the +V bus. The multivibrator's timing period is determined by the resistor's value and the internal circuit capacitance. The timing period can be increased by adding a capacitor between pin 15 and ground. Resistor values should range between 5k and

(Continued on page 95)



Computer Bits

By Jeff Holtzman

PUBLIC DOMAIN AND SHAREWARE SOFTWARE

Many people think that "PC life" begins and ends with Lotus 1-2-3, dBASE, and WordPerfect. Actually, if you turn off "Big Three Highway" and take a ride down "Little Guys Lane," you're liable to find low-cost and free software gems that will quickly make themselves indispensable. You can find everything from full-blown word processors and spreadsheets to nine-byte programs for issuing a formfeed to your printer. The only problem is sifting through the thousands and thousands of programs available.

In what follows, I'll discuss both shareware and freeware. In many respects, shareware resembles software distributed through traditional commercial channels. Many shareware programs represent substantial programming efforts and provide registered users with telephone support, professional documentation, and frequent software updates.

Shareware licenses typically allow you to try the software for a limited period of time. If you decide you like the program and wish to continue using it, you are supposed to register it, which often entitles you to a copy of the current or next version, telephone support, and a printed copy of the documentation. In effect, shareware can be summarized as "try-before-you-buy." Freeware, on the other hand, is simply free. Freeware programs are typically small and easy to use; documentation is minimal, as is end-user support. Licensing terms of both shareware and freeware vary widely, so read your particular licenses carefully.

How To Obtain Software. There are three principal sources of shareware and freeware: electronic BBS's and on-line information services, computer fairs, and mail-order companies.

Most BBS's have lists of other BBS's in the area and nationally, so if you can find one, you should be able to locate many others. (For starters, try

```
C>d
```

```
HotDIR 2.01
```

```
Path: C:\*.*
```

BAT	<dir>	NORTON	<dir>	QW	<dir>	SETPATH	BAT	34	
CAL	<dir>	OU	<dir>	SKETCH	<dir>	COMMAND	COM	25276	
DOS	<dir>	PAB	<dir>	SYS	<dir>	FRECOVER	DAT	50688	
DU	<dir>	PCFDB	<dir>	TEST	<dir>	TT	DAT	711	
EZTAPE	<dir>	PCPLUS	<dir>	TURBOS	<dir>	AUTOMODE	DTX	830	
FW2	<dir>	PM	<dir>	TURBOTYP	<dir>	FRECOVER	IDX	29	
GU	<dir>	PRESS	<dir>	TX	<dir>	KTEXCEPT	IDX	2397	
HT	<dir>	PRO	<dir>	UGATEST	<dir>	CONFIG	SYS	292	
LABELS	<dir>	PRODIGY	<dir>	UP	<dir>	IO	SYS	22341	
LASER	<dir>	PROG	<dir>	UQ	<dir>	MSDOS	SYS	30128	
LL3	<dir>	P2P	<dir>	XY	<dir>	LAPLINK	TRE	507	
LOTUS	<dir>	QB	<dir>	FRECOVER	BAK	50688	KTINDEX	TXT	554
MYM	<dir>	QEDIT	<dir>	AUTOEXEC	BAT	422			

```
51 files totaling 184897 bytes consuming 202752 bytes of disk space.
```

```
2543616 bytes available on Drive C: No volume label
```

```
C>
```

HotDIR is one of thousands of shareware and freeware utility programs that are available for little or no charge.

Gernsback's RE-BBS at 516-293-2283, 300 or 1200 baud/8 bits/no parity/1 stop bit.) For computer fairs, watch your local newspaper, or check with the math or computer-science department of a local college or university.

One of my favorite mail-order companies is Public Brand Software. PBS publishes a catalog that currently runs more than 100 pages and is growing all the time. The PBS catalog lists hundreds of disks organized by categories (including programming aids, games, home finance, many sub-categories of utilities, etc.). There is a description of nearly every program, its hardware and licensing requirements, etc. Each disk costs five dollars, which is somewhat more expensive than disks from other companies, but getting on the PBS mailing list is worth the extra cost.

In addition, PBS is in the process of setting up a BBS with four telephone lines and a lot more than 1000 megabytes of on-line storage that contains the complete PBS library and more. A

yearly subscription costs \$50, which entitles you to one hour of on-line time per day. Telephone charges are, of course, extra.

Another mail-order company that I like is Public (Software) Library. PSL publishes a well-written and informative monthly magazine (PSL News) listing recent shareware/freeware releases. Subscriptions cost \$18/year; you can order disks from PSL even if you don't subscribe to the newsletter. PSL includes

a copy of the current issue with each order, and also sells a pair of disks containing reviews of all programs in the library. Included on the disk is a text-search program you can use to find programs you're interested in. PSL disks also cost five dollars apiece, but with every order you get a coupon for a free disk; you can redeem the coupon on the next order. The coupons are only valid for newsletter subscribers.

What's Out There. It would be impossible to provide a comprehensive listing of useful freeware/shareware programs. Some programs fit neatly into standard categories (word processors, spreadsheets, etc.), but many others represent solutions to relatively specialized problems. For that reason, I'll restrict myself to discussing programs I've used myself. The point is as much to tell you about specific programs and vendors as to encourage you to try to find solutions to your problems via other-than-standard commercial soft-

ware. I could not determine the original author of some of these programs; others I have been using for several years, and don't know exactly where I obtained them. However, many similar utilities exist.

● **PC-File:dB.** This is a database manager from Buttonware, probably the largest shareware company. I have used successive versions of PC-File for several years; for small- and medium-sized jobs, it's hard to beat.

● **QEDIT.** An ASCII text editor from SemWare. Qedit is very compact (50K), very fast, and very configurable. (Discussed here in depth in the July 1989 issue.)

● **LIST.** Use it to display and print text and program files. Provides both ASCII and hexadecimal formats, split screens, "junk" filtering, and more.

● **CED.** A DOS utility that lets you edit the DOS command line. CED stores each line in a buffer; you can scroll through the buffer using the up- and down-arrow keys, edit a desired command, and execute it by pressing the <ENTER> key. You can also create synonyms for single DOS commands and multi-command sequences, providing, in effect, very fast and efficient batch files.

● **HDIR.** A directory program that provides listings in various formats sorted by filename, extension, time/date, or size. On a color monitor, colors are used to indicate sort groupings. I use a batch file (D.BAT) to invoke the program quick-

ly in my favorite configuration.

● **SFIND.** A utility that helps you locate programs on your hard disk. Can optionally search ARC files.

● **ATTR.** A program from one of *PC Magazine's* programming columns that lets you alter file attributes (archive, read-only, directory, system) on one or more files.

● **SWEEP.** Another *PC Magazine* utility. Sweep lets you run a program on the current directory and all subdirectories. For example, you could delete all BAK files from your hard disk by executing the command SWEEP DEL *.BAK from your root directory.

● **COUNT.** Yet another *PC Magazine* utility. Count counts the number of words in an ASCII text file, and gives an index of readability. For instance, a rating of 12.0 corresponds to the reading ability of a high-school senior.

● **DIRS.** Specifies the amount of space occupied by a file or group of files in a single subdirectory.

● **RENDIR.** Renames a directory, which you can't do with standard DOS commands.

● **MOVE.** Move files from one directory to another, without COPYing and then DELETing them from the source directory. Very efficient.

● **PCCLICK.** Sounds a "click" (frequency and volume configurable) each time a key is pressed. Great for non-IBM "silent" keyboards.

File Compression. If you download software from on-line services, chances are it will be compressed in one of several formats; some mail-order disks also contain compressed files. For several years, System Enhancement Associates' ARC format was the standard, but a lawsuit with competitor Phil Katz has fragmented the market to the point that you may need three or more programs to be able to process anything you may run across.

As I write this, SEA's ARC program is currently in revision 5.32; it can usually decompress any file created by an SEA or an old Katz program. Katz's old compression and decompression programs may still be available in some places as PKARC and PKXARC, respectively. Katz's new format creates files with the extension .ZIP; you'll need PKUNZIP to decompress them. A third format is processed by a program called LHARC. Any reputable on-line service or mail-order house should be able to supply any files necessary for file compression/decompression.

VENDOR INFORMATION

Public Brand Software

P.O. Box 51315
Indianapolis, IN 46251
800-426-DISK, 317-856-7571

Public (Software) Library

P.O. Box 35705
Houston, TX 77235-5705
713-665-7017

Buttonware, Inc.

(PC-File:dB; Shareware, \$89.95)
P.O. Box 96058
Bellevue, WA 98009
800-JBUTTON, 206-454-0479

SemWare

(Qedit; Shareware, \$54.95)
730 Elk Cove Court
Kennesaw, GA 30144-4047
404-428-6416

Vernon D. Bueg

(List; Shareware, \$15)
139 White Oak Circle
Petaluma, CA 94952

Cover Software Group

(CED: Freeware and shareware versions available)
10057-2 Windstream Drive
Columbia, MD 21044
301-992-9371

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Antique Radio

TIME TO READ THE MAIL!

By Marc Ellis

Now that the *Pilot A.C. Super-Wasp* (see *Antique Radio*, July through November) is back together again and ready to try out, this seems like a good time to go through some of the accumulated reader mail. We're at a logical stopping point in the story and, frankly, I haven't quite finished planning and building the power supply that will be required to put the Super-Wasp through its paces.

It's a funny thing about the reader mail. The volume doesn't seem to be that great as it's coming in. But if I let the mail go for a few months without dealing with it, quite a formidable pile seems to build up!

We ran a pretty big mail roundup in the June issue, and most of the letters we're going to talk about now came in since that issue was prepared (roughly between March and July). Some, I'm ashamed to admit, are a little bit older than that. My apologies to the readers involved!

Before diving into the mailbag, it would probably be a good idea to talk for a minute about how I handle the correspondence that comes in from you readers. First of all, let me say that I value it highly and read it all carefully. Your comments (or lack of same) tell me how you are responding to the column and help me to choose subjects that will have the broadest appeal.

Many of you have been moved to send additional information about some of the topics I've covered. I always enjoy those letters and try to use them as quickly as possible so that we can all learn from them. I also enjoy hearing about the work you are doing and seeing the photos of your restorations. I think most people like looking at such shots as much as I do, and anyone who sends me a photo can be sure that it will eventually find its way into print.

Probably the largest category of letters come from readers who are looking for schematics, servicing informa-



Dave Potter's Philco model 40-216 is shown here during restoration.

tion, parts sources, or ideas on how to solve various restoration problems. Those are very interesting to me because they tell me what kinds of sets you are working on and what kinds of information you need. However, time just doesn't permit my answering such letters individually—even if you include a S.A.S.E.!

As space permits, I'll try to refer all requests for information to the readership at large. And I'll include the address of the requester so that anyone who'd like to reply can do so directly. That way the column can be a clearinghouse for those needing information and those who are willing to share it. Judging from the occasional reports I get, that process really works; the folks who can answer the questions seem quite willing to write to those who need their help.

A large percentage of the letters I receive eventually appear in the column, but you might have to be patient. There could be a wait of a few months before I can find room to handle a batch of mail. And there's an additional lag of about three months between the time I write the column and the time it appears in print. But now, without further ado, let's get to that pile of mail!

More Mystery Solvers. Let's start with a couple of late entrants to the Dick Spratley mystery "contest" (May 1989). Sgt. Kevin Murphy (APO San Francisco) and Douglas Robertson (Kings Mountain, N.C.) correctly guessed that the crystal set was providing free energy from a broadcast signal to power a calculator. Neither Kevin nor Doug picked up on the surprising fact that the crystal set was also being used to power the transistor radio shown in the photo, although Doug did mention the transistor set and made a couple of creative guesses about its function.

And, speaking of mysteries, a few more letters have come in about the Philco "Mystery Control" (first mentioned in the November, 1988 issue). Charles T. Muller (Bay Shore, NY) remembers seeing that wireless control system demonstrated in front of a department store when he was 19 years old. He was dying to own one of the sets but just couldn't come up with the cash. Since then, he has acquired both the radio and the control. The former works great, but he needs to get some bugs out of the latter.

Dave Potter (Ruston, LA) recently completed the restoration of a model 40-216 Mystery Control receiver. He acquired it in very poor shape—requiring extensive veneer restoration and a lot of work on the power supply. The radio is now in good working order and, judging by the photo Dave enclosed, it looks just great! Like Charles, Dave still has to work some bugs out of the control unit.

Dave would be glad to correspond with anyone who is interested in his work. Write him at 305 Cartwright St., Ruston, LA 71270.

Perhaps Dr. N. Curtiss Kimball (Box 1191, Sterling, CO 80751) could use Dave as a resource. He recently acquired a Philco Mystery Control set (Model 39-55), is new to the radio collecting hobby, and lives in a small town where he can't get much help. He needs a schematic, servicing information, and a remote control. Can anyone else help Dr. Kimball?

John P. Fitzgerald (Middleton, WI) correctly identified both the Philco speaker/microphone (first mentioned in the December, 1988 column) and the Philco Mystery Control. Mr. Jean B. Desautels (616 N. Silver Cir., Key Largo, FL 33057) used one of the little Philco speaker/mikes as a kitchen extension speaker in the early 1960's. After selling the house, he left the Philco unit in place for the new owners. Now he'd like



Randy Kaeding's magnificent Zenith model 9S263 shutter-dial console.

to find another one. Write him if you can help.

Yet Another Philco Mystery! Philco being the innovative manufacturer that it was, it's not surprising that another "mystery set" by that company has recently turned up. Reader Doug Robertson, who also correctly identified the Dick Spratley mystery setup, has a Philco model 41-226 bearing the following label:

"Built for Television Sound and Frequency Modulation The Wireless Way...When used with Philco Television Picture Receiver or FM converter. Needs no Wires, Plug-in or Connections of any kind."

Obviously, that radio received sound transmitted from the picture receiver or FM converter in much the same manner as the "mystery control" radio received signals from the wireless remote-control unit. I'd guess that the picture receiver or converter contained a small transmitter (similar to a phono oscillator) to send out the signal; the radio receiver could then pick up the transmission on one of its normal broadcast or shortwave frequencies.

Doug did find that the Philco could pick up (distorted) sound from an ordinary FM receiver if the Philco was tuned to 11.5 MHz. However, he must have been listening to the signal from the FM set's IF amplifier. The sounds would naturally be distorted because the Philco is an AM receiver and would not be capable of handling FM signals directly.

That looks like it has the makings of a good story, folks! So if any of you Philco experts would like to share schematics,

technical articles, or advertising material covering the radio, FM converter, or picture receiver, photocopies would be much appreciated. I'd also like to hear from people who have personal recollections of the system. I'll compile the information and write it up in a future column. Of course, all contributors will be appropriately credited!

Dick also needs a Philco logo decal for his restoration of the radio cabinet. For this I'd suggest he inquire at Antique Electronic Supply, 688 W. First St., Tempe, AZ 85281. Their catalogue shows a decal containing Philco and RCA logos, labels for various control functions, and miscellaneous numbers and letters. It's very reasonably priced at \$3.75.



Rear view of Randy's Zenith. Take a look at the speaker and you can see why Randy can shake the whole house with the bass turned up!

Shutter Dials Revisited. Randy Kaeding (Stevensville, MI) tells me that he enjoyed the series of articles on the restoration of the Zenith shutter-dial set (August–December 1988). And he included some shots of a magnificent shutter-dial console (model 9S263) that was given to him by his grandmother about 20 years ago. The chassis is similar to the one in my table model, but has the motor-driven tuning option (very helpful with that radio's highly geared-down vernier drive).

Randy's speaker is a large (perhaps 16-inch) metal-enclosed behemoth that bears little resemblance to the modest 10-inch job in my set. And he's especially fascinated by his radio's extended bass response. With the tone switch set to "bass" and the volume turned up, Randy can shake the whole house!

In the same letter in which he correctly identified the two Philco "mystery units," John Fitzgerald passed along a tip for replacing dial-drive belts in Zenith and other radios. The fabric belt-

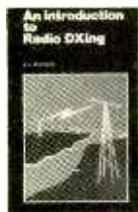
ing material sold in sewing-supply stores works well; purchase the correct width to fit your pulleys, cut to a slightly oversize length and join the overlapped ends with epoxy cement. John credits the *Journal of the California Historical Radio Society (CHRC)* for this tip. It should also be mentioned that Antique Electronic Supply (at the above address) stocks exact replacement dial belts for Zenith and other radios.

Finally, this looks like a good place to acknowledge the nameless contributor who sent me a copy of the Zenith service pamphlet for the shutter-dial and related radios. I guess your cover letter became accidentally separated from the copy before it was forwarded to me from the **Popular Electronics** offices. Sorry ... but thanks!

Help Wanted! Here's a list of radios for which fellow readers need schematics and/or service information. If you can help, please write the person directly. *Grunow* model 871, Chassis 8E (Robert Schaeffer, Star Cablevision Group, P.O. Box 1167, Fond du Lac, WI 54936-1167); *Firestone Air Chief*, Code No. 177-7-4A37A, Stock No. 4-A-37 (Emanuel Costor, 12301 Featherwood Dr., Apt. 43, Silver Spring, MD 20904); *Atwater Kent* models 43 and 606A, *Majestic* model 55, and *Pilot* model T-1351 (Ron Hughes, 618 S. Hightower, Altus, OK 73521); *Majestic* model 91 (Kenneth Sanderson, 1837 Springtree Dr., Perris, CA 92370); *Zenith* model 5808 (Mark Manosky, 15 Wilderness Dr., Mountaintop, PA); *FADA Neutrollette* Type 192A (Robert Ruhle, 10168 Wavell Rd., Fairfax, VA 22032); *Sparton* model E617 (Charles Meder, 219 Ventura, K.I. Sawyer AFB, MI 49843); *Hallcrafters* model S-120 (Jason Ingraham, Site 5, Box 30, RR#1, Windsor Junction, Nova Scotia, Canada, B0N 2V0); *Hazeltine* model 571TB (Christopher E. Searff, 5924 N. 131st St., Omaha, NE 68164); *Freshman Masterpiece* using four 01-A tubes (Jack Woodfin, 10422 Kern, Garden Grove, CA 92643).

Here are some readers who are trying to get information on sets lacking complete identification. Can anyone help from a few limited clues? Edward Hanson (116 Auburn St., Cranston, RI 02910) has a *Grebe* console using the following tubes: an 80, two 45's, three 24's and a 27. Byron Purcell (1102 Cedar Crest Drive, Demopolis, AL 36732) has a table-model radio-phono marked only "Supertone." It's an AC/DC set using the standard "all-American 5" tube com-

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Frances Gardiner would like to know what this Bosch Model 28 is worth, is interested in selling.

plement (12SA7, 12SK7, 12SQ7, 50L6 and 35Z5). D.V. Andes (Rt. 1 Box 460-B, Liberty, MO 64068) also has a table-model radio-phone. His is in an unusual curved, streamlined cabinet and marked only "Electromatic."

Samuel A. Walton, Jr. (10451 Fair Oaks Rd., Columbia, MD 21044) is looking for a replacement speaker that would work with his *Philco* chassis model 71, Code 75. Roald Bostrom (Portland, OR) wonders if anyone has a complete listing of *Zenith Transoceanic* models. And if someone does have that info, please send it to me; I'd like to print it in the column. Finally, Frances K. Gardiner (149 So. Edgelawn Dr., Aurora, IL 60506) enclosed a picture of her *Bosch* model 28 and would like to hear from anyone who can help her value it. It works, comes with some original brochures, and she's interested in selling.

Show 'n' Tell Time. Ray Muther (Concord, CA), who is new to the hobby, sent a photo of his beautiful restoration of a knockout radio: the *RCA Victor* model 97T2. Nice work, Ray! And picking up on my "When is a Duplicate not a Duplicate?" theme (June, 1989), Al Grant (Erieville, NY) sent along a shot of an interesting variant of Ken Sanderson's *Philco 37-610* pictured in that same column. Al's radio is marked "610-T" (no prefix) and looks identical to Ken's except for having a round dial instead of an oval one. Al also needs help in identifying an intriguing-looking unmarked 3-dialer, but we'll wait until he gets it back in the cabinet and can send a better shot.

California Historical Radio Society.

Bart Lee, who edits the *Journal of the California Historical Radio Society*, has sent me valuable information for the column on a couple of different occasions. For example, thanks to him, you'll be reading about the original *Pilot Wasp* radio in an upcoming *Antique Radio* column. In his last note, Bart asked me to pass along some information about his organization, which you don't have to be a Californian to join!

Broadly speaking, CHRS is devoted to the preservation of radio history and equipment. Members receive two journals and two audio tapes a year, and are also encouraged to contribute to both. The 8½- x 11-inch journals, which average 22 pages each, are crammed with radio history, data, and restoration techniques.

The audio tapes sometimes include interviews with radio collectors and figures of historical importance. They are also used to present examples of the sounds of early radio. For instance, one of the recent tapes included a recording of a message from a spark transmitter originally made in 1915 on Edison Dictaphone cylinders.

The Society also runs seven swap-meets in the Northern California area each year. Annual dues are fifteen dollars. To join, send a check to Adam Schoolsky, Membership Secretary, 38007 Stenhammer Dr., Fremont, CA 94536.

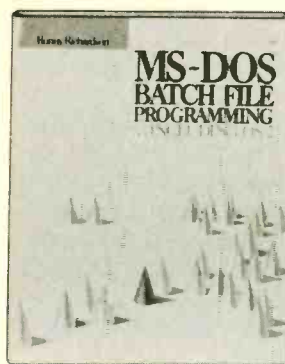
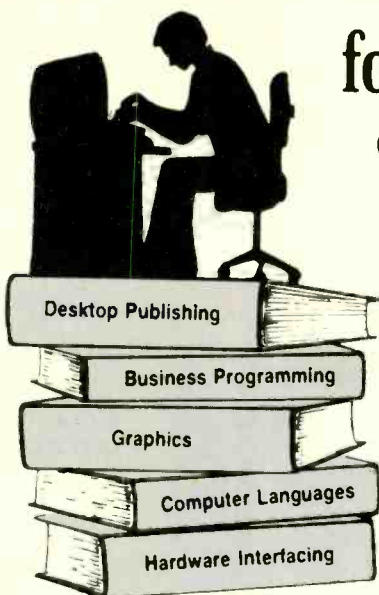
See You Next Month. In the meantime, my now-empty mailbag is waiting to be filled by more of your cards and letters! And remember, I'm still looking for your comments and recollections on the *Pilot Wasp* series of receivers. Address your correspondence to *Antique Radio*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■



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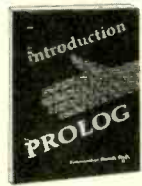
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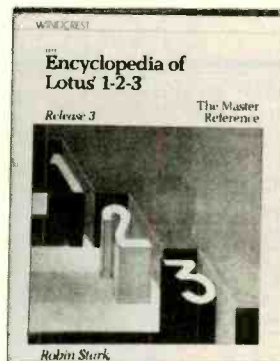
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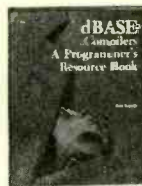
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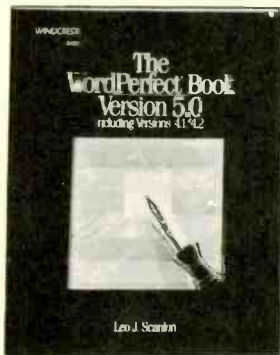
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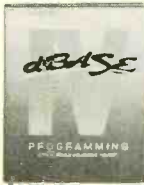
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Ham Radio

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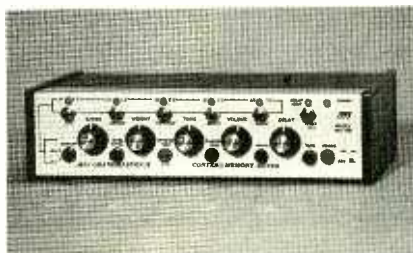
HIGH TECH CW

Although some amateur operators view CW as a necessary skill that must be mastered on the way to one's amateur-radio "ticket," and to be rapidly forgotten once they arrive at the license grade that suits them, others get a great deal of enjoyment out of operating CW.

In fact, CW's a blast! And guess what...CW operators can often use 40-meters after 6-PM EST (Eastern Standard Time) when SSB operators cannot! The DX opportunities on CW are as great as (or better than) those on the SSB phone bands. In addition, one can use the new 30-meter band if one can use CW effectively.

At one time, "high tech" CW meant that the operator could use a "bug," or semiautomatic telegraph key. My old *Vibroplex* bug was used for more than 25-years before being retired in favor of an electronic keyer. A bug is built with two sets of contacts between a vibrating arm. Push the paddle to the left, and a single contact closure allows you to either manually form a "dash" or continuously key the transmitter (as for tune-up).

Pushing the paddle to the right causes the arm to vibrate, which in turn causes the second pair of contacts to



The Model MFJ-486 Grand Master Memory Keyer features a CW "word-processor" function. Its over 8000 characters of soft-partitioned memory allow you to store frequently sent information.

be closed and opened repeatedly to form the "dots." The speed of the bug was adjusted by moving a thumb-screw-locked weight along the vibrating arm; and there were many bugs used by slow operators with a variety of additional weights (I used a clothes pin).

There were only two general types of "bug" available to most amateurs. There were various models of the *Vibroplex*, and a few World War II military surplus *Model J-36* bugs built by the Lionel Train people.

Prior to the solid-state revolution, electronic keyers were a lot harder to design and build. I recall seeing a CW

"memory keyer" designed sometime around 1960 that used the same type of ferrite-toroidal memory elements as computers of the era. It was both expensive and beyond the technical ability of most amateurs. (In a future *Ham Radio* column you will find a memory keyer construction project. I received the kit this week, and plan to put it together in the near future and provide it for your information.)

Several years ago I replaced the old bug with an MFJ Enterprises (PO Box 494, Mississippi State, MS 39762; Tel. 601-323-5869) *MFJ-401* electronic keyer and a *Vibroplex* key. The key is especially designed for use with electronic keyers, and is essentially a paddle-operated single-pole double-throw (SPDT) switch. There are three wires coming from the key to the keyer: common, dot, and dash. To form a dot, the dot-common connection is made; and to form a dash, the dash-common connection is made. A standard 1/4-inch stereo phone jack is used to connect the key to the keyer.

Power for the keyer is supplied either from an external DC power supply (the kind molded into an AC outlet plug along with the low voltage transformer), or an internal 9-volt DC battery.

The *MFJ-401* keyer is a basic, low-cost type that offers speed control and the ability to effect a contact closure on dash in order to simulate a bug and to tune-up transmitters. It has little additional capability. The newer *Model MFJ-486 Grand Master Memory Keyer*, however, is quite a new toy for CW operators.

Although it's billed as especially useful for DX'ers and contesters (both of whom often send out the same string of characters over and over), the *MFJ-486* is quite useful to all CW operators because it functions as far more than a mere keyer.

According to MFJ, "the *MFJ-486* gives you the power and versatility of a microprocessor memory keyer in an easy-to-use design that uses knobs and buttons instead of a keypad." The *MFJ-486* also gives you a CW "word-processor" function that allows you to edit a message without having to rekey the whole thing. The word-processor also allows you to move around within a message, insert text, delete text, and change the message until it's just right. You can store frequently sent information in various memories inside the *MFJ-486*: callsign, rig/antenna information, QTH/address, "UR RST 589 OM", etc.



The MFJ-401 Electronic Keyer (from MFJ Enterprises) and a Vibroplex key. The Vibroplex key—essentially a paddle-operated single-pole double-throw switch—is especially designed for use with electronic keyers. The MFJ-401 keyer offers speed control, and the ability to effect a contact closure on dash in order to simulate a bug and to tune-up transmitters.

There is also a "custom-speed" control that allows you to customize the operating speed to fit your individual abilities. Pressing the SPEED SET button sets the slowest start speed to either 4, 5, 6, or any other speed up to 20 WPM. You can also set the fastest speed at from 20 to 100 WPM.

One of the really neat features of the MFJ-486 Grandmaster Memory Keyer is that it contains a built-in software program for CW training. That feature makes the MFJ-486 a worthwhile investment for the aspiring amateur who does not yet have a license, as well as the licensed person who wants to upgrade.

There are three steps to the training regime: *Step 1* sends out random five-character groups; *Step 2* transmits random one- to eight-character groups for real-world code practice; *Step 3* gives you an "infinite" number (well, would you believe a whole bunch) of random QSO's in the same format as the FCC test requirements. According to MFJ, when you can copy those, you are ready to take the FCC test and upgrade.

An option for the CW training program allows you to use the "Farnsworth Method" of Morse-code training. Used for decades by the military to train ra-

dio operators, the Farnsworth Method differs from other methods in that the individual characters are sent at the target speed, and the inter-character spacing is varied to change speed.

For example, suppose you want to train for 15 WPM (75 characters-per-minute) in order to ensure passing the 13 WPM General-Class test, but can currently copy only 7 WPM (35 characters-per-minute). In the Farnsworth Method of training, the individual dots and dashes of each character are sent at 15 WPM, but the spacing between characters is lengthened to transmit at only 35 characters-per-minute, which is consistent with 7 WPM. That arrangement keeps the "tone pattern" consistent throughout the training, and some feel that that's terribly important.

Finally, the MFJ-486 provides over 8000 characters of soft-partitioned memory, arrayed in ten memory banks. It has a lithium battery back-up to retain the old messages, automatic incrementing, serial numbering, message repeat, and beaconing delay (1-3 minutes), A-lambic or B-lambic weighting, and other features.

Computers and Communications. In past columns I reviewed two Microlog CW products: *Morse Coach* and *SWL*. Those products are plug-in cartridges for the *Commodore 64* and *128* model personal computers (which seem to be the standard for amateur-radio applications). The *Morse Coach* is designed to provide Morse-code training, while the *SWL* is a nifty little device that will read Morse code, ASCII RTTY, Baudot RTTY, and other modes and display the text on the screen of the monitor.

Microlog also has their ART-series products that add the ability to transmit from the *Commodore* keyboard as well. Microlog products are now made and offered by G&G Electronics of Maryland (8524 Dakota Drive, Gaithersburg, MD, 20877; Tel. 301-258-7373). Contact them if you are interested in using your C-64 or C-128 for CW operations on the ham band.

Microlog's Morse Coach and SWL are plug-in cartridges for the Commodore 64 and 128 personal computers. The Morse Coach is designed to provide Morse code training, while the SWL is a nifty little device that reads Morse code, ASCII RTTY, Baudot RTTY, and other modes, and display the text on the screen of the monitor. There is also their ART-series of products, which add the ability to transmit from the Commodore keyboard as well.



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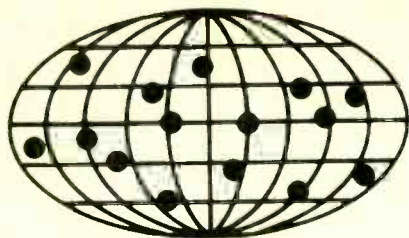
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CW Operating Tip. Working CW is very easy once you build even a moderate skill in Morse code. One trait of the really good operators, both DX'ers and traffic handlers, is that they listen a lot more than they transmit. Skillful listening will net you more contacts of higher quality per hour spent on the air than the endless repetition of "CQ, CQ, CQ," *ad nauseum*.



DX Listening

By Don Jensen

ONE-HUNDRED FIFTIETH BIRTHDAY BASH!

One of Europe's most interesting, and tiniest countries is Luxembourg. Earlier this year, Luxembourgers—Grand Duke Jean and his 372,000 subjects—celebrated their country's 150th birthday. The event got some world news coverage for that mini-monarchy tucked into a quiet corner between Belgium, Germany, and France. It wasn't much, to be sure, but it was more attention than Luxembourg usually gets.

Like comedian Rodney Dangerfield, Luxembourg historically hasn't received much respect. Its neighbors, over the centuries, nibbled off bits of its territory until less than 1,000 square miles remain. The anniversary celebrated an 1839 treaty under which the other European nations finally agreed to guarantee Luxembourg's borders by treaty.

For such a small and obscure country, Luxembourg has made a surprisingly indelible mark in radio broadcasting over the years. The reason: *Radio Luxembourg* was the European pioneer in commercial radio.

Decades ago, when the rest of Europe's broadcasting was especially stodgy and strictly non-commercial, Radio Luxembourg was broadcasting pop music and advertising "spots." On long wave, medium wave, and short-wave, it attracted a broad audience across Europe, far beyond its borders. Especially in Great Britain, Radio Luxembourg's English-language pops broadcasts were popular.

Forty years ago, Radio Luxembourg's medium-wave transmitter pumped out 150,000 watts (a hefty power level for that time), which allowed it to be heard continent-wide. That was later upped to 1.2-million watts (and the long-wave station on 234 kHz runs French programs with a cool 2-million watts!).

*Credits: Norman Bobb, MN; Brian Alexander, PA; Ron Howard, CA; Donald Berhent, OH; Harold Frodge, MI; John Tuchscherer, WI; Edward Cichorek, NJ; North American SW Association, 45 Wildflower Road, Levittown PA 19057.



Sheryl Paszkiewicz of Manitowoc, WI, began shortwave listening around 1975, but didn't start serious DXing until 1982. She uses a Japan Radio NRD-515 receiver with an Eavesdropper antenna. "My main interest," Sheryl says, "is African DX."

Historically, Radio Luxembourg operated on 6,090 kHz in the 49-meter band, a frequency it continues to use today. And its transmitter power, over the decades, has been increased from a mere 5 kilowatts (kW) to a world-class 500-kW station.

But outside influences have changed Luxembourg. Thanks to immigration, its population is holding steady. But because its native birthrate is declining while immigration is increasing, today, in a country whose people have traditionally spoken Luxembourgese, an obscure German dialect, 10 percent of the population speaks Portuguese!

Radio also has been affected. When most European countries finally allowed commercial broadcasting, Radio Luxembourg's monopoly began to diminish. The station no longer ranks among the top four or five major European broadcasters in listenership. Still, Radio Luxembourg continues undaunted and remains an interesting broadcasting target for SWL's.

Radio Luxembourg's English foreign service is aired from 0000 to 0300 UTC on the familiar old frequency, 6,090 kHz, where it can be heard by North American listeners, despite some interference from Germany's *Deutsche Welle* on 6,085 kHz. Perhaps the best time to tune in is around 0100 UTC, when Radio Luxembourg airs a newscast.

Reception reports may be sent to Ra-

dio Luxembourg, Villa Louvigny, Parc Municipal, Luxembourg-Ville, Luxembourg.

Getting Started. Universal Radio, one of the major national shortwave-equipment dealers, is offering a free series of seven informative how-to leaflets—four-page basic explanations covering various aspects of the radio hobby and related matters.

There are introductory leaflets with tips on getting started in SWL'ing or amateur radio. Another covers radio-teletype (RTTY) stations and equipment approaches. You can learn about the world of radio-facsimile (FAX) reception, including stations, equipment and sample FAX prints.

Other information sheets offer useful tips on safely installing antennas and towers, and instructions on installing the most common types of coaxial and other RF connectors.

Finally, Universal offers an instructional flyer on how to use UBIX, the Uni-

versal computer bulletin board. The leaflets are not in-depth instructions, of course, but they may serve to introduce you to some aspects of the electronics and radio hobby with which you're not familiar. The leaflets also offer reading lists of other source material if you wish to delve more deeply into the subjects. Any or all of the lists are yours for the asking. (\$.25 in stamps or coin per title to cover postage is appreciated.)

The available leaflet titles are:

- *Interested in SWL'ing?*;
- *Interested in Amateur Radio?*;
- *Receiving FAX on your SW Radio*;
- *Listening to RTTY*;
- *Guide to UBIX*;
- *Antenna Installation Advisory*; and
- *How to Install RF Connectors*.

The address to write is Universal Radio/PE, 1280 Aida Drive, Reynoldsburg, OH 43068.

Feedback. What are you hearing on shortwave? Do you have any questions about SWL'ing? Or do you just want to share your thoughts on this fascinating radio-listening hobby? This little corner of our monthly column is the place for your letters. Send them to *DX Listening*, **Popular Electronics**, 500-B, Bi-County Blvd., Farmingdale, NY 11735.

Last month, I asked for your ideas on the best looking QSL card. QSL's, as you know, are the verification postcards that stations send out to listeners who send them useful report letters about reception of their broadcasts.

Here are Bob Rannow's thoughts on the subject. Bob writes from Memphis, TN, to say, "Actually I like the whole series of photo QSL's that South Africa's *Radio RSA* sends out.

Some feature African wildlife, others scenic landscapes. If I had to pick out just one of the RSA cards I've received, my favorite would be one showing a pair of lions in close up! It's quite a card!"

Thanks, Bob. And how about the rest of you? Which is the best looking QSL in your collection?

On another subject, Art Pienckowski, a New York City reader, writes to say that he is a jazz fan.

"In the 1989 *Passport to World Band Radio* annual, I read that the *Voice of America's 'Jazz Hour'* was selected by that publication as one of the world's 10-best SW programs.

I'd like to hear Willis Conover's jazz program. But when and where should I tune? Can you clue me in?"

Sure, Art. Alex Batman, editor of the "Easy Listening Column," a fine review

of shortwave programming which appears in the *North American SW Associations'* bulletin, *FRENDX*, notes that Conover's program has been dropped from several of the VOA services. But you can find the "Jazz Hour" on 9,760 and 11,760 kHz at 1410 UTC, repeated at 2010 UTC, weekdays and Saturdays. It's a must program for music lovers.

Down the Dial. What's on the air? You too can join the ranks of readers who contribute to this segment of our column. Simply jot down the station, country of origin, time, and frequency of your loggings, and send them to "DX Listening" at the aforementioned address.

In the meantime, here are some of the shortwave loggings that others have been reporting lately. As always, all times are given in UTC (Universal Coordinated Time).

Algeria—9,509 kHz. *Radio Algiers* can be logged here, operating in parallel on 15,215 kHz, from around 1945-2000 UTC, with identifications in English and Spanish.

Bangladesh—15,195 kHz. *Radio Bangladesh* has been noted here with English commentary at around 1240 UTC.

Ecuador—3,2220 kHz. *HCJB* in Quito can be heard here with early morning programming in the Quechua language, a linguistic holdover from the ancient Inca days. Tune in at about 0930 UTC when you may hear an English identification too.

Great Britain—6,215 kHz. Well, actually, the location of *Radio Caroline International* is not Britain, but some miles off-shore aboard a ship. This station is an unlicensed broadcaster that sells radio time to a religious programmer known as *World Mission Radio*. You might be lucky and hear this one, in English, after 0600 UTC.

Tonga—5,030 kHz. The Tonga Broadcasting Commission's shortwave programming is new, and plenty of DX'ers are hunting its signal. Some western North-American listeners have managed to tune in programming from this Pacific Island kingdom at around 0600 or 0700 UTC.

Nigeria—7,255 kHz. The *Voice of Nigeria* in the capital of Lagos has been heard with the West African Service in English on this frequency during the 0500-0530 UTC period.

Vatican—21,570 kHz. This is a relatively new frequency for *Vatican Radio*. Tune in at around 1750 UTC for programming in English and French.

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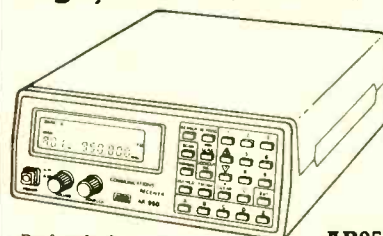
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CIRCLE 20 ON FREE INFORMATION CARD



Scanner Scene

By Marc Saxon

Scanner's Christmas choice

If jolly old Santa is going to carry a scanner down your chimney this holiday season, try asking him for a *Realistic PRO-2021*. This nifty scanner comes across as somewhat of a junior version of the *PRO-2005* (and its predecessor, the *PRO-2004*). Radio Shack appears to have conceived it as a mobile companion to the *PRO-2004/2005* series of base-station scanners.

The *PRO-2021* has a 200-channel memory and similar "all-band" coverage offered in the 2004/2005 scanner family.

Other features of this scanner include search/scan, plus easy transfer into memory of active frequencies discovered during search/scan. It's got a priority channel, selectable scan-delay, dual-speed scanning, and a large LCD readout. Although primarily designed as a mobile unit, it will also operate from 117 VAC.

The *Realistic PRO-2021* is priced at \$329.95. Okay, so it's not the most inexpensive scanner on the market...but it's a lot of hardware and has racked up a very respectable reputation for itself within the ranks of serious scanning enthusiasts. You might want to give it the once-over at any Radio Shack store, and then give serious thought to asking Santa to gently slide one into your stocking hung by the mantle.

Scanning on the Fly. Those who have taken certain commuter and long-haul airline flights might have noticed that many planes are equipped for air/ground telephone-call service. Air/ground telephones on those flights, as well as in many corporate aircraft, can be monitored on most scanners.

That is a full-duplex system operating in the UHF band. There are twelve channel pairs used for the conversations. The ground stations are on frequencies between 454.70 and 454.975 MHz (25-kHz channel spacing), with the paired aircraft frequencies exactly 5-MHz higher (459.70, 459.725, 459.75, etc.).



With 200-channel memory and "all-band" coverage, Realistic's PRO-2021 would be a welcome surprise under the Christmas tree for a scanner buff.

If you're located near a major metropolitan area, you may well be within range of a ground station operating on one or more channels in the 454-MHz band. In that case, you'll be able to copy both sides of the conversation, since the ground stations repeat the aircraft (459-MHz) transmissions. Put your scanner into search/scan mode between 454.70 and 454.975 MHz for a few hours any weekday during daylight hours and you'll learn if you're within receiving range.

Even if you're far beyond the range of a ground station, you should be able to copy transmissions from aircraft if you search/scan between 459.70 and 459.975 MHz. High-flying jets can be copied from more than 20 miles away, so you're likely to hear calls placed from aircraft to ground stations anywhere within a 400-mile range of your listening location. Of course, on 459 MHz, you'll hear only one side of a particular conversation.

Very often, those speaking from aloft will mention an approximate location and thereby provide an idea of your receiving range. You seldom hear or read about monitoring those transmissions, what with all of the current interest in monitoring cellular calls. Still, cellular phones aren't used in aircraft, and that doesn't stop people from wanting to

yak while in flight. Give a listen and see what you can receive.

Environmental Scanning. The last time I opened a window, I confirmed that the environment was going downhill at a rapid clip. Although the federal Environmental Protection Agency (EPA) receives much criticism for both the things it does and the things it fails to do, you might nevertheless find that its frequencies offer some insight into whatever it is that they're doing while in your area. EPA frequencies that have been reported as being in use include, 40.97, 41.39, 41.47, 163.435, 164.10, 164.125, 164.45, 165.41, 170.125, 172.30, 173.86, 173.91, and 408.00 MHz. In the VHF aero band, they sometimes use 122.925 MHz, and in the VHF-FM maritime band, you can try monitoring on 156.65, 156.70, and 157.125 MHz if you know that the agency is active near your home town.

A Little Birdie Told Me. Luke Yancey of Gulfport, MS, tells us that he has heard the term "birdies" used in relation to scanners and can't figure out by any known form of logical deduction what it means. He hopes that we can chirp out some information regarding what they are.

Modern programmable scanners are highly complex pieces of equipment that contain all sorts of circuits that are required to generate low-level signals. The way the sets are designed, it's necessary for such internally generated signals to exist. Sometimes a few of them occur on frequencies within the tuning range of the scanner, and those are known as "birdies." Should you attempt to program one of those frequencies into your scanner, you'll hear what sounds like an open carrier, and the scanning action will stop as the set locks up on the signal.

Some programmable scanners are more birdie-afflicted than others, and very often the operating manual that comes with a scanner will list all of the known birdies in that model. For instance, the *Realistic PRO-2004* book listed 53 birdies—which isn't much, all things considered. Luckily, they're not in very popular tuning ranges, although you might come upon several while you're in search/scan mode.

If you'd like to pass along any frequencies or suggestions, ask any questions, or submit a photo of your station, our address is: *Scanner Scene*, **Popular Electronics**, 500-B, Bi-County Boulevard, Farmingdale, NY 11735. ■

CIRCUIT CIRCUS

(Continued from page 83)

100k, and the capacitor should be no larger than 1000 pF.

The out "1" and out "2" terminals at pins 4 and 5 are used with the in "1" terminal to form an RC-oscillator circuit. The decode (out) terminal at pin 13 is the timer's output. For the circuit shown in Fig. 3, the frequency of U1's internal RC oscillator is determined by the same formula used in our first timer circuit. Set S2 and S3 to the 1 position, and switches S4, S5, and S6 to 0.

Figure 5B shows that we've selected the binary code for a divide-by-4 function. Note that S2 is set to bypass the first 8-counter stages. So after 4 clock pulses, the timer gives a positive output at pin 13. For a much longer time period, set S2 to the 0 position and S3, S4, S5, and S6 to 1. The oscillator will have to cycle through all 24 flip-flop stages for a count of 16,777,216 before the timer circuit will produce an output.

If the clock is running at 1 Hz, the timing cycle would take 16,777,216 seconds, or 279620.26 minutes, or 4660.33 hours, or 194 days to produce an output. To reduce the time delay by a factor of 10 just increase the oscillator's frequency to 10 Hz, or by a factor of 100 to 100 Hz, and so on.

The decode (out) terminal at pin 13 is tied back to the oscillator inhibit termi-

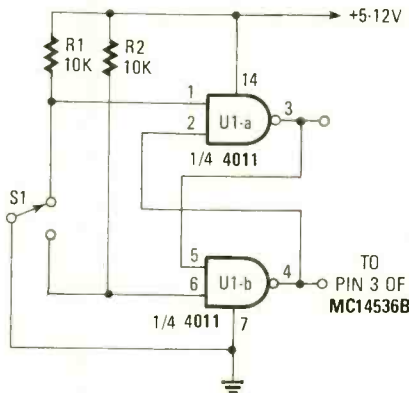


Fig. 6. This bounce-free switch circuit can be connected to the timer circuit. Pressing S1 clears and resets the timer circuit.

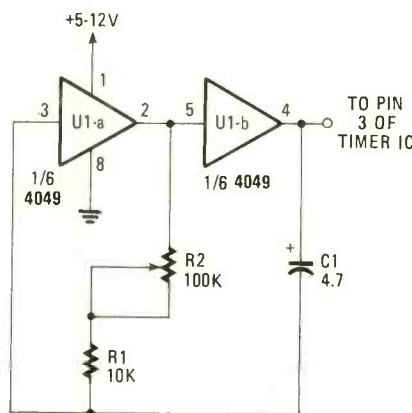


Fig. 7. A simple square-wave oscillator circuit (like this one) can be used to drive the timer if a lower clock frequency is required.

nal at pin 14, disabling the oscillator during standby to conserve power. Removing that jumper causes the timing cycle to repeat over and over as long as power is applied to the circuit. To use the timer in the multivibrator mode, disconnect pin 15 from ground and connect a timing resistor between that pin and the positive supply rail. Connect a timing capacitor between pin 15 and ground.

The bounce-free switch circuit shown in Fig. 6 can be connected to the timer circuit with pin 4 of the 4011 going to the in "1" pin of the timer. Push S1 to clear and reset the timer circuit. Each time S1, in Fig. 6, is activated the counter advances one count. When the total count is reached, the timer gives a positive output at pin 13. If a lower clock frequency is needed to drive the timer, try the simple square-wave oscillator circuit shown in Fig. 7. Resistor R2 controls the oscillator's frequency and the output (pin 4 of the 4049) connects to pin 3 of the timer.

PARTS LIST FOR THE CIRCUIT IN FIGURE 6

U1—4011 quad 2-input NAND-gate, integrated circuit
R1, R2—10,000-ohm, 1/4-watt, 5% resistor
S1—SPDT momentary spring-return toggle switch
Printed-circuit or perfboard materials, enclosure, IC sockets, battery and battery holder, wire, solder, hardware, etc.

PARTS LIST FOR THE CIRCUIT IN FIGURE 7

U1—4049 hex inverting buffer, integrated circuit
R1—10,000-ohm, 1/4-watt, 5% resistor
R2—100,000-ohm potentiometer
C1—4.7-μF, 25-WVDC, electrolytic capacitor
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JVC RX-701VBK

(Continued from page 79)

The Test Results. Comprehensive bench and listening tests of the receiver were conducted in our laboratory. A comparison chart showing major published specifications and our test results for this sample appear elsewhere in this report. Here, we will discuss just a few highlights of the measurements made in the lab.

We tested the performance of the FM-tuner section first. Frequency response was virtually flat over the entire FM-audio range. The 50-dB quieting point for mono (the amount of signal needed to produce a program signal quiet enough to be enjoyed) was actually less (better) than that claimed by JVC, measuring only 14.0 dBf as against 16.3 dBf shown in the published specifications. Stereo quieting, on the other hand, was a bit poorer than specified by the manufacturer, and required 47 dBf to produce the same 50-dB signal-to-noise ratio.

Distortion in both mono and stereo was quite a bit better than claimed, measuring around 0.1% at 1 kHz for both mono and stereo during an initial measurement, and even lower after the receiver was warmed up. Even at higher frequencies, total harmonic distortion (THD) remained well below the levels claimed by JVC.

FM-stereo separation, while falling marginally short of the 40 dB claimed at 1 kHz, was extremely uniform over the entire audio range, unlike the separation observed with some other FM-tuner circuits where separation is great at mid-frequencies but decreases markedly at the frequency extremes. In the case of the JVC receiver, separation remained at or near 38 dB from 100 Hz to 8 kHz and was still better than 35 dB at 10 kHz.

We normally spend very little time testing the AM-tuner sections of tuners or receivers; that's simply because most manufacturers spend equally little time designing those "low-fi" circuits. The AM section of the JVC RX-701VBK is no exception. Even allowing for the newly approved preemphasis curves that are now in use by many AM stations in the U.S., AM frequency-response was down by -6 dB at around 80 Hz and 3.0 kHz; that is hardly what you would call high fidelity!

Before checking out the power-amplifier sections of the receiver, we measured the performance of the phono-

input section, including its equalization, and found that the playback response was off by no more than 0.2 dB at the bass end, and by no more than 0.7 dB at the treble end of the audio spectrum.

While our measurements of amplifier-distortion versus frequency at rated power output (80 watts-per-channel, 8-ohm load) ranged above the 0.2% mark, the difference between our results and the 0.007% readings claimed by JVC may well be due to the fact that our measurements are for the combination of noise plus distortion, whereas JVC may have measured harmonic-distortion content only. In any case, whichever figure you accept, you can be sure that harmonic distortion will be inaudible at normal listening levels when using this receiver. Over the range from 8 to just over 80 watts-per-channel, THD plus noise was under 0.02%.

The Hands-On Tests. Having satisfied ourselves that the receiver performed well on the bench, our next step was to put it through its paces in the listening room. To put it simply, we liked what we heard. The amplifiers, especially in the two-channel mode, seemed to deliver more than their nominally rated 80 watts-per-channel when driving our relatively low-efficiency loudspeaker systems. Much of our listening was done using CD's, and even those having extremely wide dynamic range were reproduced well, with no evidence of overload or clipping at reasonable listening levels.

It took quite a while (and it will likely take you some time, too) to familiarize ourselves with all the controls and buttons, of which there are many more than are found on most other audio/video receivers. But that's the price you have to pay to get the incredible flexibility that's built into this do-it-all receiver. The various displays help unscramble all the features, but despite what we thought we knew about audio/video receivers, we found it essential to use the owner's manual when in doubt. Considering the many features of this receiver, we would conclude that this unit offers a great deal of value for its suggested price.

For more information on the JVC RX-701VBK receiver, contact the manufacturer directly (JVC Co. of America, 41 Slater Dr., Elmwood Park, NJ 07407) or Circle No. 30 on the Free Information Card.

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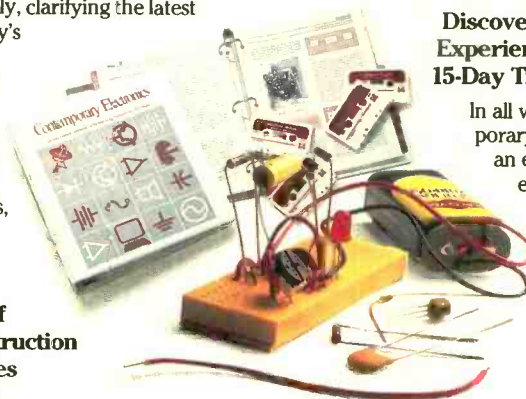
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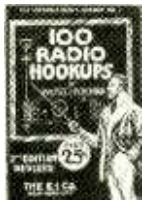
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TECHNICAL ARTICLES

(Continued from page 69)

black-and-white glossy prints, in good focus all over. If possible, avoid sending color prints.

Don't write on prints; you simply spoil them for reproduction. If you need to identify components, put a piece of tracing paper over the print and place your designations on that, pressing very lightly so you don't damage the photo.

If any of your photos is smaller than 8- x 10-inch, fasten them to standard-size sheets; a 2- x 3-inch piece of art can be easily lost.

Diagrams must be clearly drawn in pencil or ink, but need not be magazine-quality artwork as magazines have artists for that. Draw each diagram on a separate page and try to stick to the style of the publication that you have in mind. Use standard-size paper or sheets that can be folded to standard size. Drawings must be accurate. Check each one very carefully—it is almost impossible for editors to catch every error in a technical article.

Construction-Article Items.

Construction-type articles require a few extra things to make them complete. Schematics have to be drawn particularly clear with all parts numbered to coincide with explanations in the text. Place critical voltages on schematic diagrams; those help the builder check the finished project.

In the same vein, include calibration and adjustment instructions in all articles that require them. Include debugging information as well. How long did it take to get the device working? To build it? The reader might want to know.

You will need to include a parts list with brands and part numbers where necessary. To prepare a parts list, begin by first listing all the parts in the project in alphabetical order by their schematic designation (C1, or R5, for example). You may want to group semiconductors, resistors and/or capacitors together in the list. The exact style used depends on the magazine, so review a recent issue in order to learn their parts-list style.

More important than style is the accuracy and completeness of the list. Where values are not critical, say so and give approximate tolerances. For special parts, include *all* the specifications. For example, don't merely write "5,000-ohm relay" if contact spacing is critical.

Make sure that the list agrees with the schematic diagram(s) and be sure that all the parts in the diagram(s) are listed. Check your work! Make sure that if R1 is listed as a 100-ohm resistor, it is shown as such in the schematic diagram. Next, examine the parts in the actual project to be sure they are all listed correctly. The schematic diagram, the project, and parts list must all agree.

Provide model or catalog numbers for parts that are available only from certain distributors. If it is important, indicate why a particular part was chosen over others like it.

The parts list might include a PC board. If you have taken the time to build the project on a circuit board, share it with your readers by sending the foil pattern with a parts layout. If you only made one unit and you wire-wrapped the connections, think about cleaning it up as it might be required for photography by the magazine publishing your article.

Lastly, do not dismantle your equipment or make changes after sending in a manuscript. If the article is accepted, the editors may find it necessary to examine the device.

Last-Minute Stuff. Finish the job! Don't send half-done manuscripts. "Photos to come" or "material to be added here" are flags of incompleteness. No one can judge a manuscript without seeing all of it. It's your manuscript; take pride in doing the whole job, and doing it right.

When you submit something for publication, write a cover letter with it. That will help an editor quickly determine if the article fits the audience of the magazine.

Don't forget to keep a copy of everything you send just in case someone has a question about your article that can be resolved with a phone call. Besides, the post office has been known to lose things. Don't send Xeroxes of the manuscript or the illustrations. Send the originals and keep copies for your files.

If you are working on a computer, the magazine may wish to receive a floppy disk along with your manuscript. Find out by letter or by phone if that is so, and don't forget to ask if they require any particular file format or compatibility with a particular operating system.

Now you have the basics. Grab a pencil and paper, get to your typewriter, or sit down at your computer, the rest is up to you. ■

UPGRADING YOUR PC

(Continued from page 77)

with 640K of memory, a 20-megabyte hardcard, and a simple Hercules graphics card may be sufficient for a long time to come. In other cases, a turbo motherboard may be needed. The point is to scale the job to your foreseeable needs. A lot of wasted capability is simply lost money.

Also, when deciding on the refurbishment and updating that needs to be done, try to ascertain whether or not a new machine is what is actually needed. It is possible to change so much that only the cabinet is left from the old machine. In those cases it is probably worthwhile to simply build a new machine (a new cabinet is less than \$50). Besides buying a whole new machine might cost less they buying the parts for one piecemeal.

Nonetheless, just because your IBM or clone PC/XT machine is old and approaching obsolescence does not mean that you have to toss it out. You can easily refurbish or update your old machine. If you do want to build a new machine, however, the parts and assemblies are available and the job can be easily accomplished.



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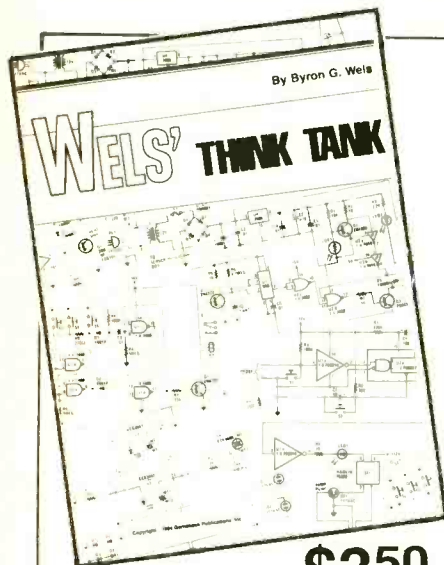
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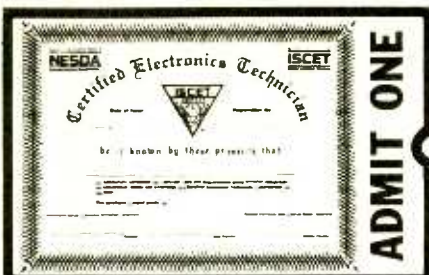
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THE EXTENSION SILENCER

(Continued from page 66)

cause that is all the local Radio Shack had in stock, but anything between 12 and 24 volts would have done just fine. The value specified for R1 (1000-ohms) was chosen to yield 35 mA of Zener current. That amount of Zener current may seem excessive, but keep in mind that it is on for a very short time. Before a call is answered there is no loop current because the phone-hook switch is open, so there is no Zener current.

Construction. There is nothing critical about the construction of the Extension Silencer. In fact the author's prototype of the circuit was assembled on a small section of perfboard—half of Radio Shack's 276-148 snap-apart perfboard—measuring about 1-3/4-inches square. The circuit-board assembly was then housed in a modular quick-connect phone-jack cover.

Before assembling any components on the board, the two sections must be separated and a hole drilled (through the center of the board) for a wood screw. The wood screw will be used for mounting the assembly to the wall. Next, solder the three parts onto the perfboard, interconnecting the components as they are installed.

Cut the black and yellow leads from the modular jack as they will not be used. Solder the red and green leads to the Extension Silencer perfboard since all telephones use the center two conductors of the six position jack. Take another short twisted pair of wires and solder them to the board for the phone line. Observe the proper polarity of those wires because the one that attaches to the red wire of the modular jack must connect to the minus terminal of the phone line.

Installation. Warning: Remember that all equipment installed on the telephone line must meet FCC part 68 requirements. The equipment must be certified by an authorized agent before it is used on the network. (This article is meant to be of instructional value and not as a certification for FCC approval.)

Since my house had phone jacks with screw terminals inside all I had to do was remove the face-plate and measure the voltage across the connection-block terminals. The connection block has four screw terminals

labeled L1-L4. In most cases, the terminals of the connection block are tied to the telephone line via a quad color-coded cable—red, green, yellow, and black. (Older installations use twisted twin lead tied into the telephone line.) Normally, the red and green wires are used as the communications pair, and are connected to the L1 and L2 terminals.

With my VOM, I determined the polarity of the phone line. If the positive lead of the meter is on L1 and the negative lead is on L2 and the meter reads a positive 48-volts DC, then L1 is positive with respect to L2. If it reads negative, then L2 is positive with respect to L1. In my own installation, the minus lead was attached in parallel with the L2 terminal (you may find it to be the L1 terminal) on the phone jack.

The plus terminal was then connected in parallel with the L1 lead. Remove the phone from the normal jack and insert its plug into the Extension Silencer jack, and you are ready to go. Pick up the phone with the silencer and listen for dial tone and hang up. Pick up the extension without the silencer and leave it off hook.

Pick up the phone with the silencer and it should be "dead." Hang up the phone without the silencer and there should be audio from the "dead" phone. You can add as many Extension Silencers as you have phones. For those readers who have a "smart modem," set it to return "no dial tone" if the line is in use. Also set it to keep retrying so that you can capture the line should it ever become free.



"What's the matter with you? Haven't you ever seen an oscilloscope before?"

HERTZ

(Continued from page 62)

sults of which were published posthumously in a volume entitled "Principles of Mechanics."

Untimely End. In July of 1892, Hertz developed an infected tooth. The infection spread and numerous operations were performed in an attempt to halt its course. Hertz was forced to slow the pace of his work and even went on several extended vacations in 1892 and 1893 in an attempt to regain his health.

His health improved to the point that in the autumn of 1893 he no longer seemed to be in serious danger. Soon, however, blood poisoning appeared and an infection developed in his bones. Hertz, nevertheless, continued his university lectures and planned additional experiments. In late December of 1893, his condition grew worse. This time there was to be no remission of the infection. Heinrich Hertz died on January 1, 1894 at the age of 36.

Those who knew Hertz personally remembered him as a pleasant, gracious, and unassuming person who lectured well but who never adopted the airs sometimes associated with one who considers himself to be a great professor. He lived modestly, away from and removed from the sophistication and prestige of the university. Even when speaking of his own numerous and great discoveries, his modesty kept him from mentioning himself.

It is impossible to overestimate the significance of Hertz' work to the development of radio which quickly followed. Hertz did not "discover" or "invent" radio, but his work was crucial to those who did. Hertz was merely interested in understanding nature. He never thought that electromagnetic waves could be utilized for communication purposes and dismissed as dreamers those who proposed otherwise. Nevertheless, today electromagnetic waves still are referred to as "Hertzian" waves and the unit of frequency has been named the "hertz" in his honor. ■

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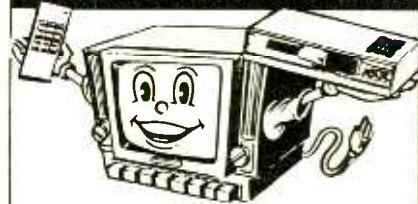
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BEHIND THE SCREENS

(Continued from page 37)

rates, so the best place to put the chrominance information is between those clumps. Figure 4 shows the color information inserted between the luminance information in the frequency spectrum.

The specific frequency of the subcarrier chosen for the transmission of the color information or chrominance information was calculated very carefully to fit between the luminance information. That frequency is 3.579545 MHz and is harmonically related to the line- and field-scanning rates.

In the first stages of development in the early 50's, distracting beat patterns were observed. In order to eliminate the problem, the horizontal scanning rate was changed to 15,734.3 Hz. That's a 1% difference from the 15,750 black and white scanning frequency so it was still within the lock-in range of all television receivers. Since we still wanted to have 525 lines per frame, the vertical-scan rate was changed to 59.94 Hz.

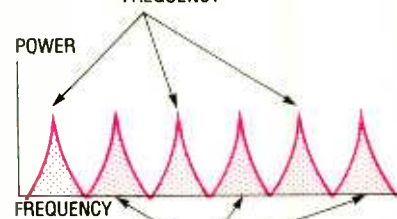
The color burst signal is used to demodulate or decode the color information and it consists of 8 to 11 cycles of the 3.579545-MHz reference signal. Its purpose is to lock the color circuits in a TV receiver or composite monitor with those in the color camera that recorded the image. Lack of the signal means no color is present. The color-burst signal must be synchronized when we manipulate the video signal just as the sync signals must.

Computer-Generated Video. The computer-generated image on a monitor is made up of picture elements called pixels. They are the smallest elements in a screen and each pixel is under the control of the computer (i.e., it can be turned off or on by the computer individually).

Since a monitor is directly connected to a computer via shielded cable, the bandwidth limitations of the NTSC video standard don't apply. How fast we scan the face of the picture tube is no longer a problem. Computer displays have horizontal scan rates that range between 15 kHz and 75 kHz, and vertical scan rates that can fall between 40 Hz and 120 Hz.

The problem of flicker must still be dealt with because the mechanisms of human sight are still the same. However, we do not have to resort to an interlace scheme to solve the problem because

DISTRIBUTION OF LUMINANCE ENERGY AT WHOLE MULTIPLES OF THE LINE FREQUENCY



DISTRIBUTION OF CHROMA INFORMATION, SUBCARRIER FOR CHROMA IS AN ODD MULTIPLE OF ONE HALF THE LINE FREQUENCY.

Fig. 4. There were gaps between places occupied by line information in the frequency spectrum that are now used for chrominance information.

we now have the bandwidth to put more lines in each frame of video.

Multiple Monitor Standards. The result of all that freedom is the generation of several "standards," the RGB system being among the most popular. RGB monitors can be used on many types of computer systems. The red, green, and blue portions of the color signal are connected to the monitor with three separate conductors. A fourth wire carries the sync signal to the monitor. Remember that we had to encode the red, green, and blue signals in a limited-bandwidth system to be able to transmit the color signal from the TV station to the receiver for TV video.

In the IBM world there are standards such as CGA, EGA, and VGA. All that is required of a specific system or standard is that the video driver card be matched to the monitor and that the computer and a program can talk to the specific video-driver card.

Experimenting and Troubleshooting. Armed with what you have learned, experimenting with video should prove fruitful. Just remember that even though composite video has a limited bandwidth, its bandwidth is pretty wide for test instruments and connectors. Connections should be made with coax of the correct impedance and terminated properly. The use of wideband oscilloscopes with triggered sweeps is almost a necessity for troubleshooting.

Aside from all of that, however, a simple, low tech, headset is one of my most useful tools. I use it to listen for sync buzz to tell if a video signal is present on coax. Have fun with what you've learned and keep in sync. ■

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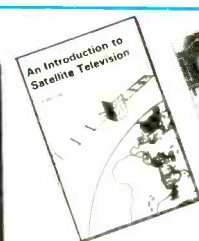
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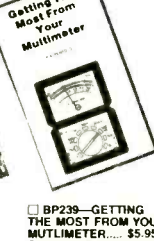
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List price \$799.95/CE price \$299.95/SPECIAL 16 Channel • 25 Watt Transceiver • Priority The Regency RH256B is a sixteen-channel VHF land mobile transceiver designed to cover any frequency between 150 to 162 MHz. Since this radio is synthesized, no expensive crystals are needed to store up to 16 frequencies without battery backup. All radios come with CTCSS tone and scanning capabilities. A monitor and night/day switch is also standard. This transceiver even has a priority function. The RH256 makes an ideal radio for any police or fire department volunteer because of its low cost and high performance. A 60 Watt VHF 150-162 MHz. version called the RH606B-T is available for \$429.95. A UHF 15 watt, 16 channel version of this radio called the RU156B-T is also available and covers 450-482 MHz. but the cost is \$454.95.

★ ★ ★ Uniden CB Radios ★ ★ ★

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Bearcat® 200XLT-T

List price \$509.95/CE price \$239.95/SPECIAL 12-Band, 200 Channel • 800 MHz. Handheld Search • Limit • Hold • Priority • Lockout Frequency range: 29-54, 118-174, 406-512, 806-956 MHz. Excludes 823.9875-849.0125 and 868.9875-894.0125 MHz. The Bearcat 200XLT sets a new standard for handheld scanners in performance and dependability. This full featured unit has 200 programmable channels with 10 scanning banks and 12 band coverage. If you want a very similar model without the 800 MHz band and 100 channels, order the BC 100XLT-T for only \$189.95. Includes antenna, carrying case with belt loop, ni-cad battery pack, AC adapter and earphone. Order your scanner now.

Bearcat® 800XLT-T

List price \$549.95/CE price \$239.95/SPECIAL 12-Band, 40 Channel • No-crystal scanner Priority control • Search/Scan • AC/DC Bands: 29-54, 118-174, 406-512, 806-912 MHz. Excludes 823.9875-849.0125 and 868.9875-894.0125 MHz. The Uniden 800XLT receives 40 channels in two banks. Scans 15 channels per second. Size 9 1/4" x 4 1/4" x 12 1/2". If you do not need the 800 MHz band, a similar model called the BC 210XLT-T is available for \$178.95.

Bearcat® 145XL-T

List price \$189.95/CE price \$94.95/SPECIAL 10-Band, 16 Channel • No-crystal scanner Priority control • Weather search • AC/DC Bands: 29-54, 136-174, 406-512 MHz. The Bearcat 145XL is a 16 channel, programmable scanner covering ten frequency bands. The unit features a built-in delay function that adds a three second delay on all channels to prevent missed transmissions. A mobile version called the BC580XLT-T featuring priority, weather search, channel lockout and more is available for \$94.95. CEI's package price includes mobile mounting bracket and mobile power cord.

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List price \$599.95/CE price \$299.95/SPECIAL 10 Meter Mobile Transceiver • New Features The new President HR2600 Mobile 10 Meter Transceiver is similar to the Uniden HR2510 but now has repeater offsets (100 KHz.) and CTCSS encode.



BC760XLT
800 MHz.
mobile scanner
SPECIAL!

CIRCLE 9 ON FREE INFORMATION CARD

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★ ★ ★ Extended Service Contract ★ ★ ★

If you purchase a scanner, CB, radar detector or cordless phone from any store in the U.S. or Canada within the last 30 days, you can get up to three years of extended service contract from Warrantech. This service extension plan begins after the manufacturer's warranty expires. Warrantech will perform all necessary labor and will not charge for return shipping. Extended service contracts are not refundable and apply only to the original purchaser. A two year extended contract on a mobile or base scanner is \$29.99 and three years is \$39.99. For handheld scanners, 2 years is \$59.99 and 3 years is \$79.99. For radar detectors, two years is \$29.99. For CB radios, 2 years is \$39.99. For cordless phones, 3 years is \$34.99. Order your extended service contract today.

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UC102-T Regency VHF 2 ch. 1 Watt transceiver \$114.95
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