

Popular Electronics



HEADPHONE AMPLIFIER

For Your Guitar

An easy-to-build amp that features a stereo-imaging effect, adjustable distortion, overdrive, and more

Build A Novel Nightlight

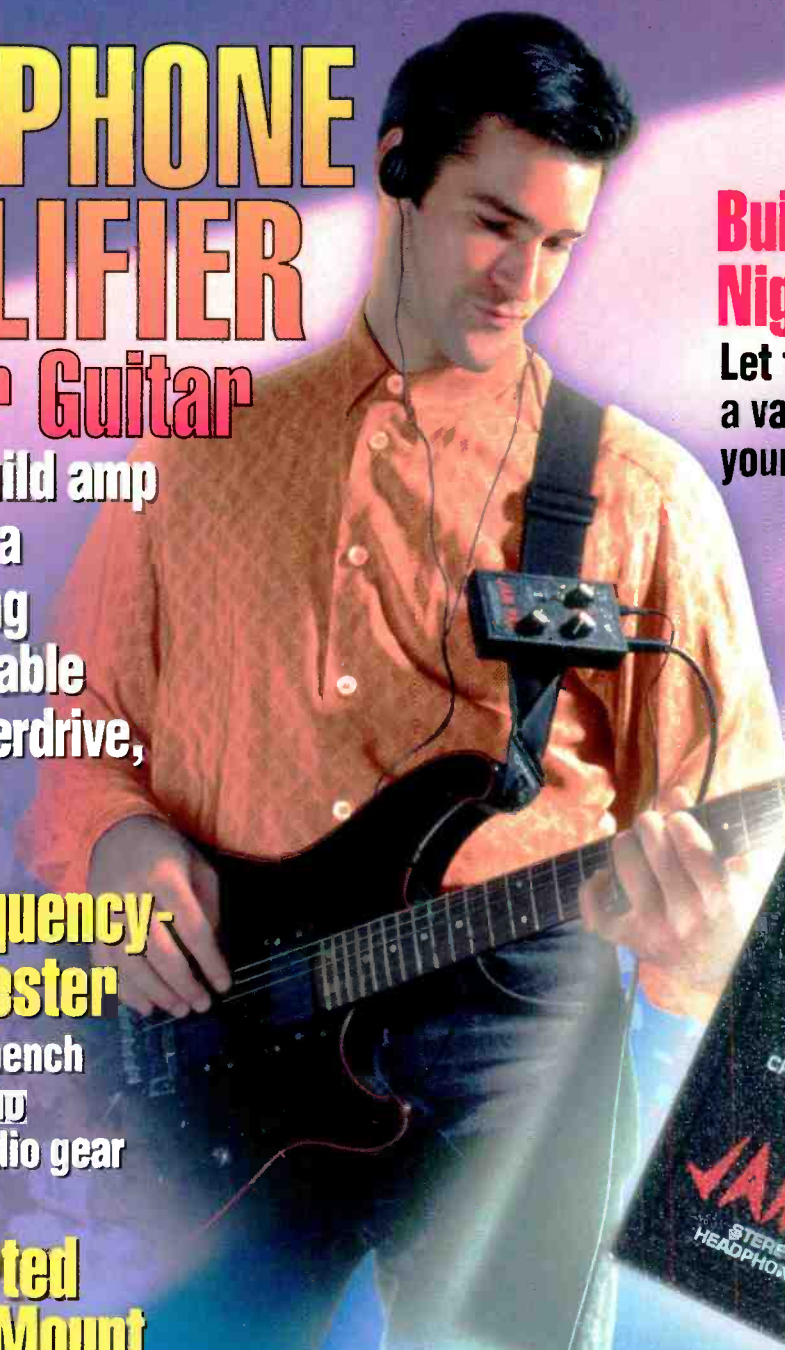
Let the gentle glow of a vacuum tube light up your night

Build A Frequency-Response Tester

A welcome workbench aid for anyone who troubleshoots audio gear

Getting Started In Surface-Mount

Two to help you get started in the world of SMT construction



\$3.50 U.S.
\$3.95 CAN.



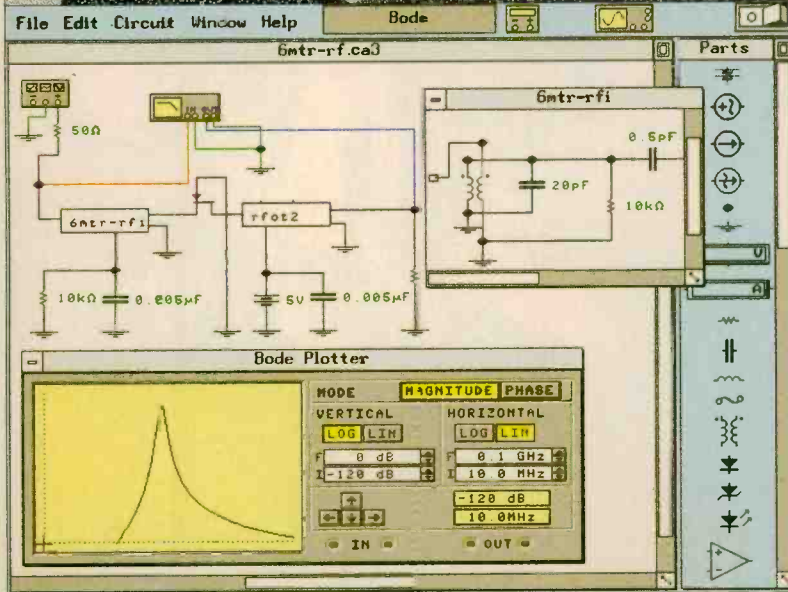
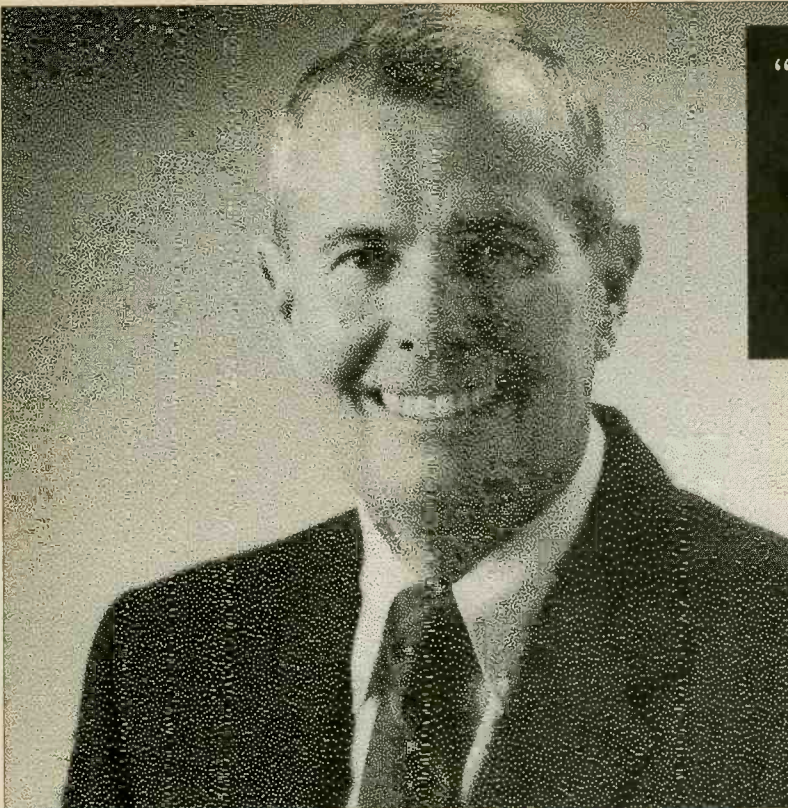
A GERNSBACH PUBLICATION

#BXBDCC*****3-DIGIT 605
#60506DHM97GA006# RESP 112
ROBERT DAHM
997 GRAND AVE
AURORA IL 60506-2513
BFL
306

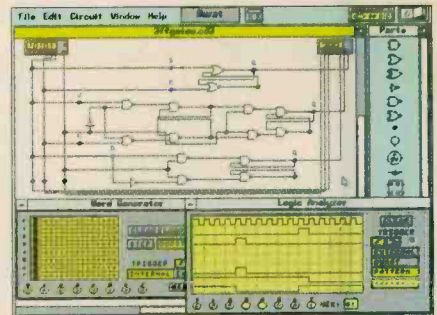
“Electronics Workbench – As an affordable tool for performing design trade-offs, you can’t beat it.”

M.A. Chapman
Oceanside, California

Electronics Workbench gives you the freedom to quickly translate your design concepts and specs into a workable circuit. Fine tune effortlessly. Play “what if” scenarios. And monitor the circuit response. The simulated components and test instruments work just like the real thing.



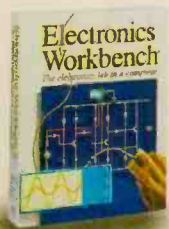
Analog Module: Tuning an RF front end.



Digital Module: Analyzing a logic circuit.

With a full complement of professional test instruments and an unlimited supply of components, it's the ideal proving ground for your design concepts. Electronics Workbench puts you in control. Guaranteed!*

The standard for simplicity and power for over six years, Electronics Workbench is the most popular tool of its kind. It has gained worldwide acclaim as the ideal complement to any test bench. **Fact: Over 90% of our customers recommend it to their friends and colleagues.**



Electronics Workbench®

The electronics lab in a computer™

Call: 800 263-5552

Just \$299*
For DOS, Windows or Mac Version.



INTERACTIVE IMAGE TECHNOLOGIES LTD.
908 Niagara Falls Blvd. #068, North Tonawanda, NY 14120-2060
Telephone: (416) 361-0333 FAX: (416) 368-5799

*30-day money-back guarantee.

Prices in U.S. dollars, shipping \$15. Offer valid in U.S. and Canada only.
All trademarks are the property of their respective owners.



CIRCLE 157 ON FREE INFORMATION CARD

Popular Electronics®

MARCH 1995

Vol. 12, No.3



COVER STORY

33 Build a Headphone Amplifier for your Guitar

Prepare for your "rock-and-roll" career, without annoying your family or waking up your neighbors, with this versatile headphone amp that even features special effects—*Rodrick Seely*



Page 9

CONSTRUCTION

37 Build a Novel Nightlight

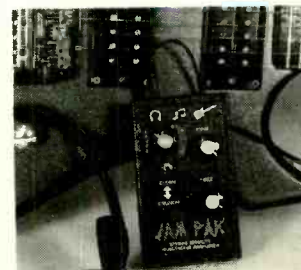
Let the gentle glow of a vacuum tube light up the night—*Larry Lisle*

39 Getting Started in Surface-Mount Technology

Learn how to work with surface-mount components when you build these two classic yet simple projects—*Ronald A. Reis*

51 Build a Frequency-Response Tester

A welcome workbench addition for anyone who troubleshoots audio gear—*Randy Constan*



Page 33

FEATURES

46 SIM-EQ: The Simultaneous Equation Program

Let your computer do the work—*James E. Tarchinski*

49 Exploring the Imagination

Your computer comes alive with fun when you explore this on-line service—*Donna Roach*

57 Making Squarewaves at Home

Generating squarewaves is easy when you follow the recipes in this cookbook—*Joseph J. Carr*



Page 37

POPULAR ELECTRONICS (ISSN 1042-170-X) Published monthly by Gernsback Publications, Inc. 500-B Bi-County Boulevard, Farmingdale, NY 11735. Second-Class postage paid at Farmingdale, NY and at additional mailing offices. One-year, twelve issues, subscription rate U.S. and possessions \$21.95, Canada \$28.84 (includes G.S.T. Canadian Goods and Services Tax Registration No. R125166280), all other countries \$29.45. Subscription orders payable in U.S. funds only, International Postal Money Order or check drawn on a U.S. bank. U.S. single copy price \$3.50. Copyright 1994 by Gernsback Publications, Inc. All rights reserved. Hands-on Electronics and Gizmo trademarks are registered in U.S. and Canada by Gernsback Publications, Inc. Popular Electronics trademark is registered in U.S. and Canada by Electronics Technology Today, Inc. and is licensed to Gernsback Publications, Inc. Printed in U.S.A.

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

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

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

MARCH 1995

PRODUCT REVIEWS

9 Gizmo

Magnavox CD-i player, Compaq Presario computer, Sharp portable music system, Desper Products Spatializer audio processor, and much more

24 Hands-On-Report

Elenco Electronics Digital/Analog Trainer

COLUMNS

6 Multimedia Watch

A multimedia monitor—*Marc Spiwak*

28 Think Tank

Model-railroad circuits—*John Yacono*

64 Antique Radio

It's mailbag time again—*Marc Ellis*

68 Computer Bits

Objects and hierarchies—*Jeff Holtzman*

70 Circuit Circus

Controller circuits—*Charles D. Rakes*

76 DX Listening

Shortwave from Austria—*Don Jensen*

78 Ham Radio

Some antenna topics—*Joseph J. Carr*

82 Scanner Scene

PC-powerful scanning—*Marc Saxon*

DEPARTMENTS

3 Editorial

4 Letters

73 Electronics Market Place

84 Electronics Library

88 New Products

97 Popular Electronics Market Center

128 Advertiser's Index

129 Free Information Card

Popular Electronics

Larry Steckler, EHF, CET,
editor-in-chief and publisher

EDITORIAL DEPARTMENT

Carl Laron, editor
Dan Karagiannis, associate editor
Teri Scaduto, assistant editor
Evelyn Rose, editorial assistant
Marc Spiwak, editorial associate
Joseph J. Carr, K4IPV,
contributing editor
Marc Ellis, contributing editor
Jeffrey K. Holtzman,
contributing editor
Don Jensen, contributing editor
Charles D. Rakes,
contributing editor
Marc Saxon, contributing editor
John Yacono, contributing editor

PRODUCTION DEPARTMENT

Ruby M. Yee, production director
Karen S. Brown,
production manager
Kathy Campbell,
production assistant

ART DEPARTMENT

Andre Duzant, art director
Russell C. Truelson, illustrator

Jacqueline P. Cheeseboro,
circulation director

Michele Torriolo,
POPULAR ELECTRONICS bookstore

BUSINESS AND EDITORIAL
OFFICES

Gernsback Publications, Inc.
500-B Bi-County Blvd
Farmingdale, NY 11735
1-516-293-3000
FAX: 1-516-293-3115
President: **Larry Steckler**

SUBSCRIPTION
CUSTOMER SERVICE/
ORDER ENTRY
1-800-827-0383
7:30 AM - 8:30 PM EST

Advertising Sales Offices
listed on page 128

Composition by Mates Graphics

Cover by Loewy Design
Photo Illustration by Chris Gauld



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

EDITORIAL

HELLO DSS

If you were with us last month, you already know how I feel about my cable company. Because of that, I had long wanted to put in a satellite installation. Unfortunately, aesthetics (there was no getting around the need for an 8- to 10-foot dish) and other factors (namely numerous trees) made that virtually impossible. That's why Thompson's DSS (digital satellite system) was like a dream come true.

For those of you still unfamiliar with it, DSS uses two (soon to be three) closely spaced, high-power satellites to beam roughly 175 channels of audio and video programming directly to consumers' homes. The high power means that you can use a small (18-inch) dish, while the close spacing means that you do not need an actuator to move the dish from one satellite to the next.

I've had my system for a little under a month now, and so far I am very pleased with it. While not perfect, the video and audio quality far surpass what I was getting from cable, and should improve as a more advanced digital-compression scheme is phased in early this year. As for programming, although I am paying a little less per month than I used to for premium cable, I have picked up almost 125 additional channels, including 50 pay-per-view channels and 25 audio-only music channels; and the number of channels is expected to expand still further during the year. Of course, there is also the initial outlay of \$699 to \$899, plus installation costs. Due to high demand, there is little if any discounting going on at this time.

In deciding whether or not DSS is for you, there are a few downsides to consider. First, you need a clear line-of-sight to the satellites. Second, if you want local programming, you will need to either get it off-the-air or subscribe to your cable company's "broadcast basic." The five major networks are also available via satellite if you live in an area where over-the-air reception is not satisfactory. Finally, unlike large dishes, there are no in-the-clear (unscrambled and free) signals.

DSS is an evolving technology, but the early results, and acceptance, are promising. We will be keeping an eye on it, as well as other satellite-TV services, and are planning some in-depth coverage for later in the year. Look for it.



Carl Laron
Editor

EARN YOUR B.S. DEGREE IN COMPUTERS OR ELECTRONICS



By Studying at Home

Grantham College of Engineering, now in our 45th year, is highly experienced in "distance education"—teaching by correspondence—through printed materials, computer materials, fax, modem, and phone.

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

Our Engineering Technology B.S. Degree Program is available in either of two options:

- (1) The B.S.E.T. with Major Emphasis in Electronics, OR
- (2) The B.S.E.T. with Major Emphasis in Computers.

Our Computer Science B.S. Degree Program leads to the B.S.C.S.—the Bachelor of Science in Computer Science.

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

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

Accredited by
the Accrediting Commission of the
Distance Education and
Training Council

GRANTHAM
College of Engineering
Grantham College Road
Slidell, LA 70460

LETTERS

PINNING US DOWN

A sharp-eyed reader spotted two errors in my article, "Switching with PIN Diodes" (*Popular Electronics*, December 1994). In Fig. 5, diode D3 is drawn in backwards. The "arrow" should point up. In Fig. 7, diodes D3, D6, D9, and D12 are also shown backwards. I hope those errors did not cause anyone too much confusion.—
Joseph J. Carr.

LOW-VOLTAGE POWER CONTROLLER

We have been advised of a few corrections for the article "Build a Low-Voltage Power Controller," which appeared in the December, 1994 issue of *Popular Electronics*. First and foremost, there has been a revision in the foil pattern for the main board; the revised foil pattern is shown here in Fig. 1. Second, the phone/Fax number for the supplier, TW Engineering, has changed; the new number is 714-527-2547. There were also a few typographical errors: In Fig. 1, pins 6 and 7 of U2-b are reversed; in Fig. 4, connection points P1 and P2 are reversed; and in the parts list, D2 should be specified as a 1N751 Zener diode. We apologize for any problems those errors may have caused.—
Editor

I am writing about Fazal A. Rehman's article, "Build a Low-Voltage Power Controller" (*Popular Electronics*, December 1994). I am wondering about the use of multiple IRFZ40's for currents of more than 4 amps. I

believe that the use of a heat sink for Q1 would be easier and more cost-efficient. According to the data in the November–December 1994 Digi-Key catalog, the IRFZ40 has an ID continuous rating of 35 amps, and a PD maximum rating of 125 watts. Even with derating to one-half, heat sinking of Q1 would allow a current much larger than 4 amps. Also, for lower currents, the IRFZ20, at less than half the cost of the IRFZ40 and the IRFZ42, should be an excellent choice. The IRFZ20 is rated at 15 amps and 40 watts. Because of the higher on resistance of the IRFZ20 (0.1 ohm versus 0.028 ohm for the IRFZ40), a small heat sink should probably be used if the current is as high as 3 or 4 amps.

The article presents an excellent idea. I have never seen a similar DC power controller, and I can think of several uses for one. I think most of the construction articles (and others) in *Popular Electronics* are good, although I frequently make minor changes in the projects, which (I think) are improvements. B.S., CET Hillsboro, MO

BELATED THANKS

I'm offering a very belated thank-you for publishing my "Haves & Needs" letter in the

December 1993 issue of *Popular Electronics*. I was trying to get parts and a service manual for my Gulbransen electronic organ. Health problems, both my wife's and mine, including a couple of small strokes, kept me from my computer and from working on the organ.

I received letters from New York, Minnesota, and Missouri, and even as far away as Puerto Rico. A gentleman from Connecticut even phoned and offered to test the tubes, replace them, and provide a service manual!

Again, thank you. You can be sure that any time I have a problem with an electronic device, I will turn to *Popular Electronics* for a solution. J.W.H. Leewood, KS

LEARNING VS. TEACHING

This letter is in response to the letter by A.S. from Taneytown, MD, which appeared in the December 1994 issue of *Popular Electronics*. I cannot claim to fully understand the U.S. educational system, nor will I pretend to. I wish to state, however, that claiming that trigonometry and complex algebra are not important in today's society is pure nonsense. There are virtually no engineering fields—electronics among them—in which you are not required to use those branches of mathematics.

No one is forcing the writer to forget his skills; it is solely his responsibility that they remain strong. Most teachers I know do their absolute best when it comes to teaching, and I have yet to see one who will not answer a question that is off the beaten path of what is currently being taught. I believe that the writer has a bad attitude when it comes to learning or just is not interested in the subjects being taught. Perhaps both. My advice for him is to find a field that grabs his interest—it does not

sound as if it is electronics. The learning will then be replaced by a natural desire to know all he can about the field, and it won't seem like learning at all. F.B. Canada

MONITORING SOLAR FLARES

Thank you for the article "Ground Zero: The Other End of the Radio Spectrum" by Karl T. Thurber (*Popular Electronics*, October 1994). That is an area that deserves more visibility.

Unfortunately, the information contained in the section on solar-flare monitoring is a bit outdated—much has happened since Cherman's book was published. For readers who might be interested in this fascinating area, I would like to direct their attention to Peter O. Taylor's book, *Observing the Sun* (Cambridge University Press, 1991). The author is the chairman of the Solar Section of the American Association of Variable Star Observers (AAVSO), and his book covers electronic solar-flare observation as well as visual techniques. Peter Taylor leads an active network of amateurs who, with simple radio equipment, monitor and report solar-flare activity. Those observations currently make up more than 70% of all stations reporting data to the National Oceanic and Atmospheric Administration (NOAA). Thus, it is an excellent way for electronics hobbyists to make very useful contributions to science.

The AAVSO observers receive regular reports that summarize all contributions, as well as a technical newsletter that describes new receiver circuits, antennas, computer-based and electromechanical data recording methods, surplus-equipment conversion, etc. Mr. Taylor has also published related information in *Communications Quarterly*. S.H. Amherst, NH

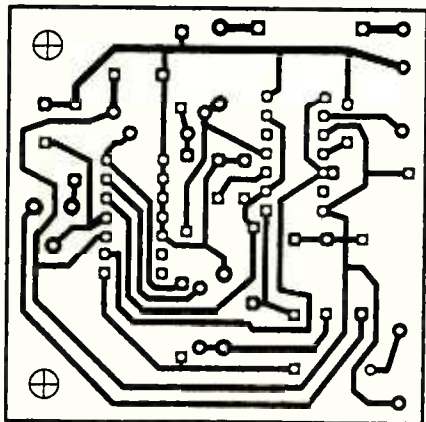


FIG. 1

The Four-Year Electronics Degree Program That Really Hits Home!

Bring The Technology Home With A Bachelor Of Electronics Engineering Degree. No Hassles. No High Cost!



Now's the time to prepare for a profitable career.

We've lowered the cost of higher education.

It's true! You can earn a four-year Bachelor of Electronics Engineering Technology degree today ... and prepare yourself for a high-paying electronics career ... without quitting your job or ever leaving your home. Because World College, an affiliate of the Cleveland Institute of Electronics, offers you the total flexibility of independent study programs proven effective for people like you who truly want to succeed! World College independent study lessons help you build valuable skills

**Mail/Fax Today
or Call
1-800-696-7532**

step-by-step, and expert instructors are personally available to you with a toll-free call. What a way to earn an education!

A world of opportunity.

Where is your career headed? With a four-year bachelor's degree from World College, you call the shots, choosing from incredible, high-paying opportunities in electronics, telecommunications, computer, electrical power, and many other growing fields.

World College gives you the skills, the knowledge, the power to take advantage of your best opportunity in electronics. And you can do it all at your own pace!

Without leaving home.

World College continually works to provide its students with the most advanced education tools. From the latest equipment and reference books to breakthrough computer-simulated experiments, students are exposed to the latest technological advancements.

All the equipment, parts, and software you need are included in your affordable tuition, including more than 300 hands-on lab experiments you can complete in your home.

Choose your own pace.

Earn your bachelor's degree on your time — and at your pace — because you pay tuition to World College only as you complete the upper-level semesters close to graduation. The faster you make it through, the less you pay. So you have an incentive to make your future happen quickly — yet the freedom to choose your own pace!

Send today for your FREE course catalog — and give yourself that future you've always wanted — with an electronics degree education from World College.



Take charge of your future in electronics.

Four Powerful Reasons To Connect With World College Today:

1. Earn your four-year degree!
2. Self-paced training!
3. Independent study in your home!
4. Expert instruction!

Give Me The Power!

Send me a FREE World College course catalog today!



(Please Print Neatly)

Name _____

Address _____

City _____

State, Zip _____

Phone (____) _____

Age _____

**For faster service, call
1-800-696-7532,
or call
1-804-464-4600.**

**Or fax this coupon to
1-804-464-3687.**



Lake Shores Plaza
5193 Drive, Suite 113
Virginia Beach, VA 23455-2500



Affiliated with
Cleveland Institute of Electronics
WAH18

MULTIMEDIA WATCH

By Marc Spiwak

A Multimedia Monitor

For a long time, basic computer peripherals performed the same old functions. A keyboard was just a keyboard, a modem was just a modem, a monitor was just a monitor, and a joystick was just a joystick. But at some point, various kinds of pointing devices started to appear on keyboards and fax capability was added to modems.

Today we also have monitors with speakers built-in, just like they are in a TV set. Specifically, I am now

neat zoom feature built-in. That eliminates the need to reposition and resize the picture for different applications.

The speakers are not self-amplified, so you need some kind of amplification, either from a sound card with a built-in amp or a separate add-on one. While the speakers are not the kind that an audio enthusiast (or loud-music listener) will want, they are more than adequate for the average guy or gal who just wants to enjoy a little multimedia, as well as for most business-audio applications.

The best thing about the Audio 15's speakers is that they don't take up any extra space on the desktop, which I know is always a very crowded place. I would not be surprised if eventually all monitors have built-in speakers, and audio enthusiasts will simply buy better ones just as they always have in the past.

The Audio 15 has a suggested retail price of \$499. Street prices, of course, will surely be much lower than that.

A NEW CONTROLLER

I mentioned before that at one time, joysticks were simply just joysticks. But I've played with some unusual joystick-like controllers recently, including the new *Phoenix* flight- and weapons-control system from Advanced Gravis. To start with, *Phoenix* includes Gravis' usual high-quality joystick control with adjustable ten-

sion. But *Phoenix* is much more than just a joystick.

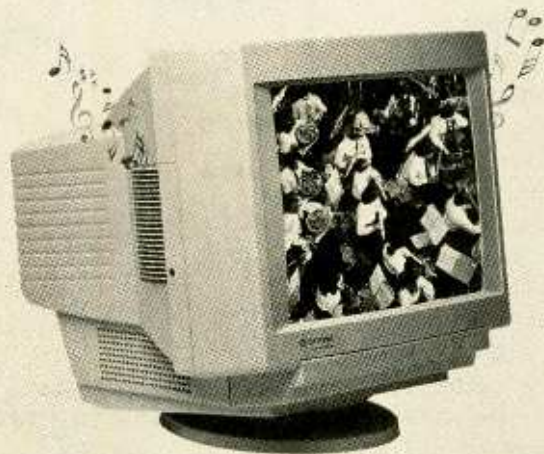
That bizarre-looking controller combines a joystick, a throttle and rudder controller, and 24 programmable buttons all in one unit. The buttons can be set to execute any joystick or keyboard command. The buttons can also serve primary and secondary functions, for a total of 46 customizable functions. The unit ships with pre-configured control settings for many popular games, and custom settings can be saved to disk.

Phoenix can control so many functions because it connects to both the joystick port and the keyboard connector. A *Phoenix* connector plugs into the keyboard connector on your PC, and your keyboard plugs into the end of the *Phoenix* connector.

Phoenix has a list price of \$149.95. For people who want the utmost in flight realism and control convenience, there's nothing like a *Phoenix*.

NEW STUFF

This month I have a few discs that are particularly useful to the staff here at **Popular Electronics**. The first one, *Books in Print Plus* from Reed Reference Publishing, is basically a database of all books that are in print. Naturally, the power of a computer and a CD-ROM make it easy to find what you are looking for. *Books in Print* does not come cheap, though. A year's subscription to the

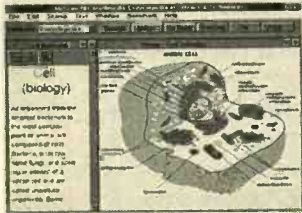


The Audio 15 from Tatum adds a pair of speakers to an excellent 15-inch computer monitor. It makes for a near-perfect multimedia workstation.

testing out a new 15-inch monitor from Tatum, the *Audio 15*. Besides having a nearly flat screen and a crisp, clean picture, the *Audio 15* has built-in stereo speakers. The digitally controlled monitor also has a

Measure It All!

The DMM/LCR Meter/ Frequency Counter. All in One.



The *Encyclopedia of Science and Technology* is a comprehensive reference work that includes 7,300 articles and more.

disc sells for \$1,095 for the regular version and \$1,595 a year for the version that includes 238,000 book reviews. Pricy as it is, it is mighty useful.

The second disc that's useful in the everyday production of a magazine like this one is the *McGraw-Hill Multimedia Encyclopedia of Science & Technology* for Windows. That disc includes 7,300 articles, 105,100 terms, and 122,600 definitions from 81 major subject areas. It is loaded with pictures, audio, and video. This disc is also an expensive one, priced at \$1,300, but it is an exceptionally useful disc to have on hand for anyone who can afford it, as it contains information on almost any conceivable technical or scientific topic—including electronics.

The third disc is a year's worth of Ziff-Davis' *PC Magazine* on CD-ROM—the complete text of 22 issues. While I prefer to read the printed version of the magazine, the CD-ROM version is the best way to look up information on a particular subject or product that has been covered within the last year. I find it difficult to keep up with all the reading material included in two 500+ page editions of the magazine each month, and so the CD-ROM is a good way to find anything important I might have missed.

Moving on, I also I have a small collection of discs that

Troubleshoot down to the component level — any component! Verify poorly marked parts, test for tolerances and damage. Wavetek's new DM27XT is not only a full-function DMM, but also includes complete inductance, capacitance, and frequency measurement capabilities.

- **Wide LCR range:**
10 Ω to 2000 M Ω
10 pF to 2000 μ F
100 μ H to 20 H
- **Autoranging frequency meter** 10 Hz to 20 MHz
- **Ac and dc current to 20 A**
- **Logic test, diode test, max reading hold, continuity beeper, input warning beeper, fused input protection, battery saver**

Consolidate your test bench with one meter that does it all — Wavetek's high-performing, full-function XT Series DMM. It's all in one compact, rugged, field-ready package with a big 0.7-inch, 3 1/2-digit display. Insulated probes and alligator clip leads are included, and there is a huge selection of accessories, including current, rf and HV probes, temperature converters, holsters, and cases. Ask for Wavetek DMMs. They're the meters to pick when you have things to fix.



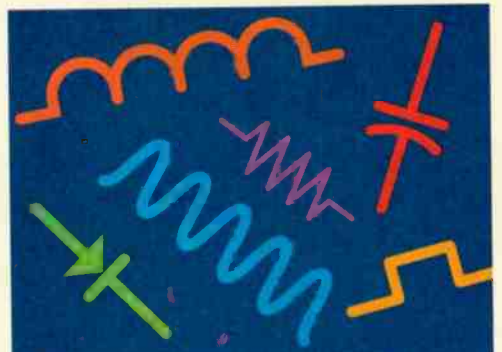
\$119⁹⁵

Other XT Series DMMs from \$89.95

U.S.A.: (619)279-2200
Europe: (44/243) 531323
Asia Pacific: (852)865-1903

©1993 Wavetek Corporation

CIRCLE 168 ON FREE INFORMATION CARD

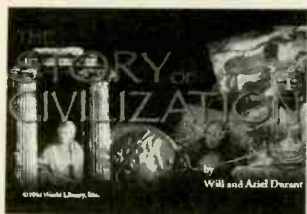




The Phoenix flight and weapons control system from Advanced Gravis is a game-player's dream come true.

all deal with history in one way or another. The first one, *America's Civil War—A Nation Divided*, from Software Marketing Corporation, is a complete collection of Civil War trivia presented via stories, photos, videos, narrations, maps, and more. All of the major players are covered. Any war buff or person needing to research the war between the states should check out the disc. It retails for \$59.95.

The next disc deals with history on a much larger scale than just one war. *The Story of Civilization*, from World Library, Inc., is Will and Ariel Durant's compilation of more than 3,000



The Story of Civilization covers more than 3,000 years of history on a single CD-ROM.

years of history on a single multimedia CD-ROM. The full text of all 11 volumes of the Durant's work, including over 800 illustrations, audio, and video, details history

and culture from prehistoric times to around 1840. The disc is a wonderful study aid for history students and historians, alike. It has a retail price of \$99.95.

Leonardo The Inventor, from Future Vision Multimedia, is about one man who made his own history—that man being Leonardo daVinci. Many of daVinci's inventions, or visions, while unused in his time, have come to pass in ours. His many accomplishments can be explored through animations and more on this disc that's a lot of fun to play with.

Another disc is—or was—history in the making. *A Hard Day's Night* from The Voyager Company is the complete and uncut Beatles movie in QuickTime for Windows format with lots of extras thrown into one CD-ROM. While it's better to see the movie on the big screen, the disc includes stuff that might be hard to find elsewhere, such as the original script including deleted scenes, the theatrical trailer, and more. Beatles fans will probably want this CD-ROM in their collection, simply because it's the Beatles.

A while back, I looked at

WHERE TO GET IT

Advanced Gravis
#101-3750 North Fraser Way
Burnaby, B.C.
Canada V5J 5E9
Tel. 604-431-5020

CE3 Incorporated
3134 Pacific Coast Highway
Suite 216
Torrance, CA 90505
Tel. 800-AutoDisc

Discovery Enterprises
7700 Wisconsin Avenue
Bethesda, MD 20814
Tel. 301-986-1999

Future Vision Multimedia
300 Airport Executive Park
Nanuet, NY 10954
Tel. 914-426-0400

LucasArts Entertainment
Company
P.O. Box 10307
San Rafael, CA 94912
Tel. 415-721-3300

McGraw-Hill
Professional Book Group
11 West 19th Street
New York, NY 10011
Tel. 800-722-4726

MPI Multimedia
16101 South 108th Avenue
Orland Park, IL 60462
Tel. 708-460-0555

Reed Reference Publishing
121 Chanlon Road
New Providence, NJ 07974
Tel. 908-464-6800

Software Marketing
Corporation
9830 South 51st Street
Building A-131
Phoenix, AZ 85044
Tel. 602-893-3377

Tatung Inc.
2850 El Presidio Street
Long Beach, CA 90810
Tel. 213-979-7055

The Voyager Company
578 Broadway, Suite 406
New York, NY 10012
212-431-5199

World Library, Inc.
2809 Main Street
Irvine, CA 92714
Tel. 714-756-9500

Ziff-Davis
One Park Avenue
New York, NY 10016
Tel. 212-503-5100

a disc published by The Discovery Channel, *In The Company Of Whales*; it's an entertaining multimedia look at those unusual ma-

rine mammals. It seems that The Discovery Channel plans on producing lots of new CD-ROM's on various topics. One of them, *Normandy—The Great Crusade*, is certainly history-related. That disc chronicles D-Day—June 6, 1944. That's the day that Allied forces invaded the beaches of Normandy in order to liberate Europe and crush the Third Reich. Two other new discs have less to do with history and more to do with the neat stuff you see on The Discovery Channel. *An Interactive Journey With... Sharks* is an entertaining look at those creatures that have roamed the seas for 400-million years. *Beyond Planet Earth* takes you on an interactive journey through the heavens.

I like cars—I've been interested in them for as long as I can remember. If cars are also your passion, this month I have two discs that you won't want to miss.

The 1994 *Auto Almanac* from CE3 Incorporated contains over 2,000 pages of automotive information. There's almost a quarter-million vehicle specifications and prices, photos, video, and more. The 1995 version should be out by the time you read this. The disc has a suggested retail price of \$14.95.

The second disc on cars is called *Cars! Cars! Cars!* and is published by MPI Multimedia. The disc is loaded with videos, photos, facts, and trivia on all kinds of cars ranging from dream cars to racing cars to wacky cars, and will be enjoyed by any car buff.

Last this month is a new screen saver from LucasArts called *Star Wars Screen Entertainment*. The software comes on floppy discs, but is great nonetheless. At \$35.95, it's a must-have for fans of the film.

GIZMO®

A CHRONICLE OF CONSUMER ELECTRONICS

Video CD-i

MAGNAVOX CDI450 COMPACT DISC-INTERACTIVE MULTIPLAYER WITH ADD-ON DIGITAL VIDEO CARTRIDGE. Manufactured by Philips Consumer Electronics Company, One Philips Drive, Knoxville, TN 37914-1810; Tel. 615-521-4316; Suggested retail price: \$299; Digital Video Cartridge: \$249.

We've always said that when we have kids, there will be no video games allowed in the house. Sitting zombie-like in front of a TV, controller in hand, cannot be a positive, life-enhancing way for kids to spend their time. Shouldn't they have some better things—sports, reading, playing, chores—to do? Will they ever do anything else if video games are around?

After all, we—and our editors—are well aware of the fact that we've yet to meet a deadline when we've had a game machine in for review. And we're "responsible adults." What effect would videogames have on our kids' homework assignments?

Well, if the system is *Philips' Magnavox CDI450* or *CDI550*, it's possible that those school assignments would be improved. Compact Disc-Interactive, or CD-i, is more than just a game system. It's an interactive "multiplayer" that can be used to research term papers (with an interactive encyclopedia); improve one's tennis or golf game (with interactive sports instructions); play audio CD's; view Photo CD's; watch full-length movies in full-color, full-motion video; and, of course, play games.

Compact Disc-Interactive has been evolving rapidly since its market introduction about three years ago (see *Gizmo*, February 1992). In fact, the latest generation of CD-i products bears little outward resemblance to its earliest ancestors.

The first CD-i players were full-sized components, designed to look like everything else in your entertainment center. And they bore a hefty suggested-retail price tag—\$1000. The CDI450 is less than



a quarter of the size and a third of the price of the original. The 11.75 × 7.5 × 2.6-inch player carries a suggested retail price of \$299.

It offers all the functions of the original player, with a very special optional bonus—a Digital Video Cartridge that allows the CD-i unit to play full-length feature films and advanced action games. The add-on cartridge (*Model 22ER9956*) retails for \$249.95, and can easily be plugged into a slot on the top of the CDI450 by the user. The step-up model CDI550 comes with the Digital Video Cartridge already installed, at a suggested retail price of \$499.

The Digital Video Cartridge is based on the MPEG-1 international standard, developed by the Moving Picture Experts Group. It delivers computing performance of 400-millions instructions-per-second (MIPS) with multiple RISC (reduced instruction-set computer) processors. The result is a 5-inch disc that contains more than 72 minutes of 30-frame-per-second, full-motion digital video, along with CD-quality audio.

Independent of NTSC and PAL broad-

cast standards, Video CD has been designed for compatibility with multiple playback platforms, including dedicated Video CD players, Video CD-compatible computer systems, and CD-i players equipped with the Digital Video Cartridge. The new generation of CD-i players are the first—and, so far, only—devices on the market that can be used to play Video CD movies and music videos.

The new CD-i players are also blessed with an abundance of available software, which has grown substantially since the product was introduced three years ago. The CDI450 is bundled with "International Tennis Open," and the CDI550 with the arcade hit, "Space Ace." Both players also come with the CD-i version of "Compton's Interactive Encyclopedia."

The quality, as well as the quantity, of the software has improved; many newer titles have been specifically designed to take advantage of CD-i's full-motion video capabilities. Philips' software division, Philips Media, recently created four publishing subdivisions—Games, Family Entertainment, Home Entertainment, and Video CD—each of which has been busy

creating new CD-i titles. More than 150 titles are currently available, including new releases resulting from Philips' agreements with such major motion-picture studios as MGM/UA and Paramount. A review of some assorted CD-i software follows our look at the latest hardware.

The CDI450 and CDI550 are virtually identical; the only difference is that the Digital Video Cartridge, which is included with the latter, must be purchased separately for the CDI450. The top of each CD-i player contains two covered compartments. The smaller one, on the left side, holds the plug-in Digital Video Cartridge. To the right is the larger disc compartment. The only thing on the front of the unit is the input for the wired game controller. The power switch is found on the left side panel. The rear panel contains a jack for the outboard power supply and a set of three RCA phono jacks for connecting the CD-i multiplayer to a TV and, if desired, a stereo audio system.

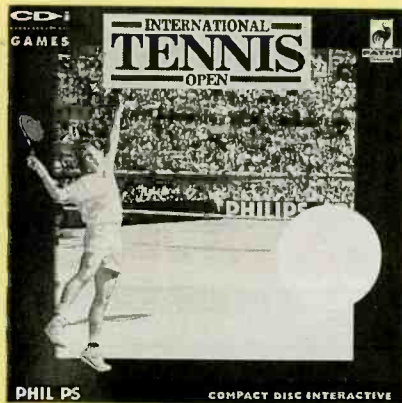
Installation of the Digital Video Cartridge is simple. With the player switched off, the disc compartment cover is opened to reveal latches used to remove the cover of the Digital Video Cartridge compartment. A special, pen-shaped tool is then used to remove a protective metal cover from the connectors within the compartment. The cartridge plugs into those connectors, and the compartment cover is replaced. Because the Digital Video Cartridge also contains memory that is required for some programs and games, removal is not recommended unless repair is required.

When the CDI450 is turned on, an opening screen appears on the television screen. It contains the Magnavox logo, a small box that notes the time and date, an indication if a disc is in place or if the disc compartment is open, and a bar labeled "Options." Clicking on the options bar opens the options screen, which is used for CD audio play, setting the time and date, and storage of audio and Photo CD programs.

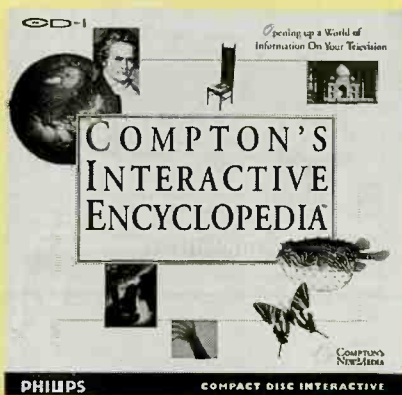
To play a CD-i disc, the disc compartment is opened by pressing on the front edge of the cover. The cover gradually opens to a 60° position, where it remains until the disc is in place and the cover is pressed closed. An LED flashes while the disc is starting up, and remains lighted while the disc is in play.

Each disc contains a brief set of instructions. Further help is often available on-screen, if needed, although most play is largely intuitive. (More so for some people

Gizmo is published by Gernsback Publications, Inc., 500-B Bi-County Blvd., Farmingdale, NY 11735. Senior Writers: Chris F. O'Brian and Teri Scaduto. Copyright 1995 by Gernsback Publications, Inc. Gizmo is a registered trademark. All rights reserved.



The two-player version of International Tennis Open is included with the CDI450.



Including "Compton's Interactive Encyclopedia" with the CD-i player will make parents view it as more than just a game system.

than others—a 14-year-old relative using CD-i for the first time never even glanced at the instructions, yet he easily beat our high scores on every game!)

We were particularly impressed with the quality of CD-i movies. The video was not laserdisc quality, but it was easily equivalent to VHS tapes, and the digital audio sounded every bit as good as a CD or laserdisc. The full-spectrum sound was most obvious on "Star Trek IV: The Undiscovered Country." When the Enterprise's engines were placed on warp speed, they could be felt, as well as heard, throughout the viewing room. (Don't throw out the old VCR yet—the CD-i movie selection is still pretty limited, although several new ones are in the works.)

The full-motion video capability also is used to enhance some CD-i games, many of which require a Digital Video Cartridge. For instance, the adventure game "Dragon's Lair" features motion-picture style animation, and the interactive drama "The 7th Guest" uses real actors in ghostly digital video sequences.

The game controller included with the CDI450 is a wired, one-person device.

(An optional splitter allows two-player play with the addition of a second controller.) A 12-foot cord allows freedom of movement while playing. The controls are found on the rounded section that tops a narrower grip. At the center of the round section, a circular, directional thumb-pad moves the cursor up, down, left, right, and, in some programs, diagonally across the screen. To either side of the thumbpad are action buttons.

The controller is fairly accurate and easy to use. We had one problem with it, however. We tended to accidentally hit the left-side action button while working the directional controller, with the unfortunate result of inadvertently exiting a game—usually at a crucial point.

Several optional CD-i controllers—a joystick, a mouse, a trackerball, and a roller controller—are available. We tried out the Model 22ER9017 joystick, which carries a suggested retail price of \$29.95. That controller has a more traditional look; designed for two-handed play, it has a joystick on one side and four action buttons on the other. Traditional with a twist, that is: The optional controller is adaptable for left- or right-handed play. The player can hold the controller with the joystick on the right side, or flip it over so that the joystick is on the left. When a slide switch is also "flipped," the controls are reversed as well, so that pressing the joystick forward still makes the cursor move up or forward. The four buttons on the other side of the controller are actually two sets of A and B buttons; they are in the proper places no matter which way the controller is held.

The model 22ER9017 gave a finer degree of control to game play. It also totally eliminated the problem of hitting the wrong button at an inopportune time.

The CDI450 comes with "International Tennis Open" and "Compton's Interactive Encyclopedia." The tennis game allows you to assume the persona of Victor Player, a promising young hopeful just starting out on the pro circuit. Player strives to win the three major international Tennis Open Championships, held in London, New York, and Paris. On the way, he trains and plays "friendly" exhibition matches against four top players—Julio Jimenez, Thomas Ullman, Erik Andersen, and Robert Garrett. This two-player game also allows competition with a friend. At the end of each match, Player receives his International World Partner player ranking.

We wish we'd had "Compton's Interactive Encyclopedia" back when we were in school, writing reports. Not only is it much more convenient than going to the library and hoping that none of the other 29 kids in the class, all with the same assignment, were using that volume of the printed encyclopedia—it's also more inter-

(Continued on page 19)

CD-i Games People Play

CD-i SOFTWARE ASSORTMENT. Published by Philips Interactive Media, 11111 Santa Monica Blvd., Suite 400, Los Angeles, CA 90025; Tel. 310-444-6600; Price range: \$20 to \$60.

The following are some admittedly subjective reviews of several CD-i titles from each category. They represent each category produced by Philips Media: Games, Family Entertainment, Home Entertainment, and Video CD. Where available, prices for specific games are included.

GAMES

We are no experts when it comes to video-gaming, and our tastes differ from the average gamer. For instance, we tend to steer clear of any games that feature graphic violence and are won by brute force. And we've yet to play one of those interactive drama/mystery games to a successful conclusion—we just don't have the patience. However, we do get hooked on those games that combine strategy and timing.



Keeping those criteria in mind, it's not surprising that our favorite game by far—and the reason for this month's missed deadline—was "MegaMaze" (\$34.98). To be fair, its packaging did contain a clear warning that the game was highly addictive. Aimed at players aged 10 to adult, MegaMaze is essentially an electronic version of one of those handheld mazes in which you must guide a small ball into a hole by tilting the board. The CD-i adds some twists, however, including purple balls, which also move as you tilt the "board" but which explode on impact and can destroy the blue ball that you are trying to get "into the vortex." Then there are sink holes, and laser guns, and trap doors, and, well, you get the picture. There are 75 levels of increasing difficulty, with a total of 165 mazes. To reach the rank of

Mazemaster, you must complete a maze level within a pre-set time limit, or guide all four purple balls home before the blue ball.

"The 7th Guest" (\$59.98) is one of those "interactive dramas of mystery and intrigue" that leave us totally baffled. The double-disc set takes place in the haunted mansion of toymaker Henry Stauf, who disappeared a couple of months before the start of the game. He has invited six guests to a party at his home, and none of them



are ever seen again. The player takes on the persona of the 7th Guest, "a mysterious entity known only as Ego ... [whose] role, identity and purpose is not shown or explained, but is rather experienced as a seamless, integral part of the total environment." The goal is to explore the mansion, obtaining clues by solving puzzles and viewing dramatizations of the missing guests. Perhaps if we'd had more time or patience, we'd have done a bit better; as it is, we gave up after solving only a few puzzles. A Digital Video Cartridge is required, and results in video quality that far surpasses that of any of the other platforms on which we've seen the game.

"Dragon's Lair" (\$49.98) pits Dirk the Daring against a host of villainous obstacles as he battles his way through the evil wizard Mordroc's castle to rescue the lovely Princess Daphne. This game, which also requires a video cartridge, is an excellent example of how full-motion video can



be used to enhance game playing. The animation is excellent—colors bright, motion seamless—as is the accompanying soundtrack. The game requires speed, timing, and cunning, as the wizard attacks in various unexpected ways. Dragon's Lair was created by Don Bluth, who is best known for the arcade hit Space Ace.

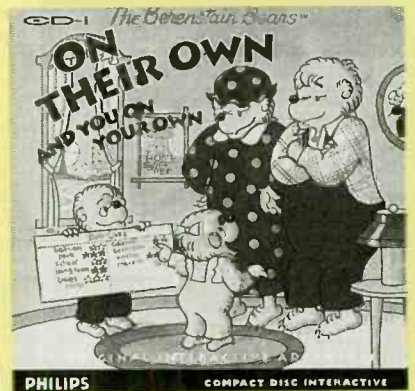
"Lilil Devil" stars Mutt, a little demon who has been "volunteered" to navigate through a winding obstacle course called The Labyrinth of Chaos to retrieve the Mystical Pizza of Plenty. Players must guide Mutt through five levels of increasingly difficult game play, all the while avoiding a wicked character called The Entity, who tries to whisk Mutt off to a torture chamber. Poor Mutt suffered mightily at our hands—being beaten by a club-wielding monster, and repeatedly drowning while trying to cross a river—



even when we switched to the upgraded game controller. "Lilil Devil" also uses the Digital Video Cartridge, and has the enhanced video and audio to show for it.

FAMILY ENTERTAINMENT

By "family entertainment," Philips Media means software for young children. In this category, there is no violence, and the emphasis is on learning.



"The Berenstain Bears on Their Own and You on Your Own" (\$39.98, for ages 4 and up) teaches "school skills" such as counting, colors, and the like, but its main emphasis is on responsibility. The pro-

World's first wireless home theater system makes professional-quality surround sound affordable...

Now you can add surround sound to your home entertainment lineup with the amazing new Chase Technologies decoder that works with your existing stereo and an assortment of wired and wireless speakers.

by John Lindner

Let's face it. As much fun as renting a video can be, it's just not the same as seeing a movie in a theater. I remember the first time I saw *Jurassic Park*—I nearly jumped out of my seat when the dinosaurs roared. One of the reasons movies seem so real is because surround sound makes it seem

The secret of surround sound

Surround sound has become the rage of the '90s because it adds depth and realism to stereo sound, giving you the home theater experience. In short, it makes you feel like you are actually at a concert or theater.

To get surround sound, some people have tried simply adding additional speakers to their home entertainment lineup. But it takes more than additional speakers to get surround sound; there needs to be a way of separating the original signal into distinct channels so that you're not just duplicating the same sounds and broadcasting them from different areas of the room.

The new Chase Technologies HTS-1 surround sound decoder does just that, and in a revolutionary way that rivals the best Dolby Pro-Logic and THX systems available. The HTS-1 provides five channels of sound from any two-channel stereo source.

The HTS-1 works with a variety of speakers. In the front, you can use your existing stereo speakers. For the rear, choose from inexpensive wired speakers, high-quality wireless speakers, or even an audiophile-quality wireless satellite subwoofer system. The HTS-1 also gives you the ability to add a powered center channel speaker (instead of using your TV's built-in speaker).



like you're actually there when events are happening. Now there's an incredible new device that lets you use your stereo receiver to get that same surround sound in your home.

The secret's in the signal. To get surround sound, you need to do more than simply add extra speakers. There needs to be a way of separating the signal from the musical score or movie soundtrack into distinct channels for each speaker. The new Chase Technologies HTS-1 surround sound decoder does just that, and in a revolutionary way that rivals the best Dolby Pro-Logic and THX systems available today.

Wins over critics. In the September 1994 issue of "High Performance Review," noted audio critic Daniel Kumin said "the HTS-1 can do quite a job of recreating a 3D theatrical experience...surround effects emanated with satisfying fullness...sound was clean at any level...with quite involving and natural sound ambience."



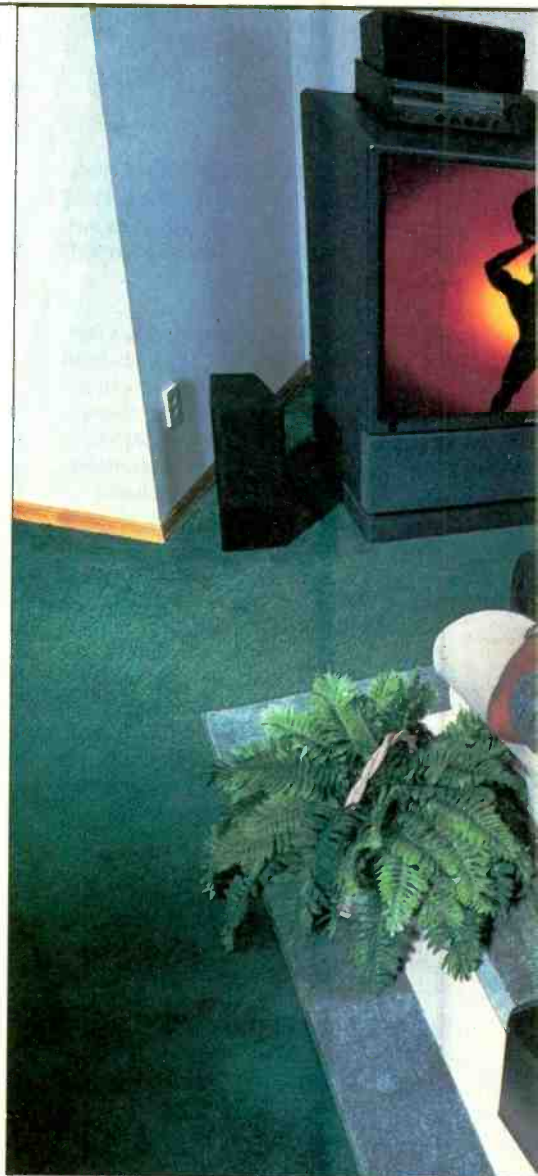
The new HTS-1 decoder won the Design and Engineering Award at the Consumer Electronics Show for being one of the best and most innovative new products.

Surround™ signals in every stereo, videotape or laserdisc. This passive method is superior to active decoders such as Dolby and THX because it requires no AC current to decode. As a result, you experience more clarity, more detail, and a greater sense of space. Plus, you won't experience the noise or distortion which can occur with active decoding methods. You don't need any extra amps! Just connect the HTS-1 to your stereo, add your speakers, and you'll experience the magic of home theater at a fraction of the cost of other systems.

Plus, John Sunier, a leading authority on surround sound and producer of *Audiophile Audition*, a nationally syndicated radio program for audio enthusiasts, says, "...the new Chase HTS-1, when used to decode the hidden ambience in all musical recordings, definitely outperforms all the Dolby and THX processors (which could cost you up to \$3,000)...I am impressed!"

Decoding breakthrough.

Last year, audio industry veteran Bob Rapoport invented a new five-channel "passive" circuit for decoding the Dolby



Five channel options. The HTS-1 decoder can be used with two, three, four or five channels of amplification, making it the most cost effective method for upgrading your stereo system to full home theater performance on the market. Best of all, the HTS-1 works with a variety of hard wired and wireless speakers.

In the front, most people use wired stereo speakers. Use your existing stereo's speakers or use one of a variety of wired speakers. Comtrad also offers the Chase Dialog center channel speaker. If your front speakers are more than eight feet apart, adding a center channel speaker will help keep voices and sound effects centered on the screen for stunning localization and clarity. The Dialog is self powered and video shielded to prevent interference with your television set.

The Chase HTS-1 decoder is the most cost-effective method for upgrading an existing stereo system to full home theater performance on the market.





The new Chase Technologies HTS-1 surround sound decoder gives you the option of using either traditional wired speakers like the Chase ELF-1s, or using wireless speakers or a wireless satellite subwoofer system for additional convenience and enhanced sound quality.

Wireless freedom. When it comes to rear speakers, you can again choose standard wired speakers like the Chase ELF-1s. But if you want to avoid the hassle of running speaker wire up and down walls, behind furniture, and under carpet, you can add the freedom and convenience of wireless speakers.

Recoton wireless speakers utilize a transmitter which broadcasts sound signals up to 150 feet through walls, floors and ceilings. The speakers can be placed anywhere; they plug into a standard electric outlet. This eliminates the need to have wires running from the stereo to the speakers, which can be a nuisance with surround sound since the rear speakers are often elevated or wall mounted.

Affordable option. Recoton's W440 speakers allow you to add wireless rear channel speakers without compromising the sound quality that wired speakers deliver. Each self-amplified speaker contains a two-inch tweeter and four-inch woofer. They deliver 10 watts per channel for strong, clear fill sound. Their compact design (9" high x 6" wide x 5.5" long), make them the perfect bookshelf-sized companion to your home entertainment set up.

Audiophile quality. For the true stereo enthusiast, we offer the Recoton self-amplified wireless satellite subwoofer system. The satellite speakers in the system each bolster 25 watts of clean, distortion-free sound. The subwoofer adds a whole new dimension to your home theater with its 50-watt amplifier that's capable of creating enough rumble to make you feel like you're in the middle of an earthquake.

The Recoton wireless subwoofer's 50-watt 10-inch speaker delivers thunderous bass that adds depth and realism to the surround sound experience.



Even the most discriminating surround sound enthusiast will be engulfed by the abundant power and delighted with the full-range, first-rate sound from these black oak vinyl veneer speakers.

Easy to install. Every speaker option offered by Comtrad can be easily installed with the HTS-1 in a matter of minutes. Just connect the speaker outputs of your receiver or amp to the HTS-1, then

connect speaker wire to the front and rear speakers. When using wireless speakers, connect the transmitter to the output. One transmitter will broadcast to each wireless speaker.

Risk-free home trial. The best way to evaluate surround sound is in your home—not a showroom. That's why we're offering the 30-day risk-free home trial. Try these products in your home and if you're not delighted with the the surround sound experience, return them for a full "No Questions Asked" refund.

HTS-1 surround sound decoder.....\$99 \$10 S&H
Please mention promotional code 711-PL1111.

For fastest service call toll-free 24 hours a day

800-704-1211



To order by mail, send check or money order for the total amount including S&H (VA residents add 4.5% sales tax.) Or charge it to your credit card, enclosing your account number and expiration date.

COMTRAD INDUSTRIES

2820 Waterford Lake Drive, Suite 106
Midlothian, Virginia 23113

Speaker Options

Wired Speaker Options

Front Speakers: The Chase HTS-1 surround sound decoder can utilize your existing stereo speakers, or any of a variety of wired speakers available through Comtrad or your local electronics dealer.



Center channel speaker. If the front speakers are more than eight feet apart, adding a center channel speaker will keep voice cues centered on the screen. We offer the Dialog. It is self-powered and video shielded to prevent interference with TVs. Dialog \$75 \$8 S&H



Rear channel speakers. We recommend the quality Chase ELF-1 in either white or black for inexpensive rear channel speakers. Mount them with the enclosed color-matched mounting brackets or flush mount them on the wall. ELF-1\$99/pair \$10 S&H

Wireless Speaker Options



Rear channel speakers. Recoton W440 wireless speakers are the perfect option for people who want quality stereo rear channel speakers without having to run speaker wire. Their two-inch tweeters and four-inch woofers deliver 10 watts per channel—clear, strong stereo fill sound. The speakers work up to 150 feet from the transmitter without loss of sound quality. TX1000 transmitter (works unlimited speakers)\$69 \$7 S&H
W440 wireless speaker (each)\$89 \$9 S&H

Get the Chase HTS-1 **half off** (\$49) when you buy the W440 speaker system!



Rear channel speakers. For true audiophile-quality rear channel speakers, we offer the Recoton wireless satellite subwoofer system. This first-of-its-kind system combines a 10-inch rear-firing subwoofer with a pair of 25-watt satellite speakers. The subwoofer provides that distinctive "low-end punch" that you feel in movie theaters, while the satellites are designed to coincide



with surround sound processor specifications balance perfectly with the front speakers. WHT470 transmitter\$69 \$7 S&H
WHT421 wireless 50-watt subwoofer\$299 \$24 S&H
WHT462 pair of wireless 25-watt satellite speakers \$329 \$24 S&H

Get the Chase HTS-1 **FREE** when you buy the satellite subwoofer system!

gram has two distinct parts: a cartoon, and a self-paced tour of Berenstain Bear country. In the cartoon, the two Berenstain cubs want to go to the Country Fair by themselves. Before their parents will grant permission, the cubs must prove that they can behave responsibly, by completing a list of chores and challenges—get ready for school on time, go to the market, share, etc. Further lessons in responsibility are found in the “on your own” segment. As the players travel through the bear’s house, the market, the school, the park, and the fair, they learn important safety tips and play learning games. Successful completion of the games earns them gold stars, as well as tickets to the fair, where they can play still more games. The story is charming, and there are plenty of activities to keep kids busy. This version does not require the Digital Video Cartridge.

The “Hanna-Barbera Cartoon Carnival” (\$39.98) brings back some fond memories for Baby Boomers who grew up with the Jetsons, Top Cat, Yogi Bear, the Flintstones, and the other characters featured on this disk. Each cartoon character has his own “booth” at the interactive carnival. The player (aged 6 and up) is challenged by a different game at each booth—guide Scooby Doo through a maze, help Fred Flintstone catch balloons

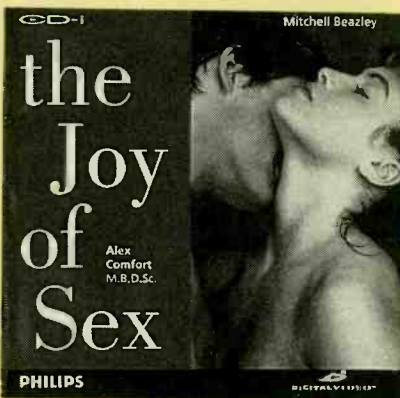


in a butterfly net, match colors at Huckleberry Hound’s Gift Emporium and sounds at Yogi’s Pic-a-Nic. (Top Cat’s trivia game reminded us just how long ago it was that we watched those Saturday morning cartoons!) Some of the games seem designed to hone the youngster’s gaming skills in preparation for the more sophisticated games he or she will be playing a few years down the road. For instance, the young gamer must help George Jetson navigate his space car past dangerous asteroids while trying to pick up stray satellites. Every time the player wins a game, he is awarded a letter on the “Cartoon Carnival” banner. When the banner is completely filled in, the player is rewarded with a short cartoon. Each game has several increasingly difficult levels, so players

won’t get bored quickly. The Digital Video Cartridge is recommended but not required; with it installed, the video quality was excellent.

HOME ENTERTAINMENT

Philips Media Home Entertainment produces a wide variety of adult interactive titles. By “adult,” they mean programs of interest to grownups. “Time-Life Astrology,” for instance, offers customized astrological information for every day of the year, draws astrological charts, provides personal horoscopes, and offers compatibility reports. “Titanic,” takes players on a tour of the ill-fated ship, narrated by Star Trek’s Patrick Stewart, that includes more than 2500 historical photos, actual ship diagrams, videos of the re-discovery of and more recent exploration of the wreck, and storylines of actual passengers and crew members.



The only Home Entertainment title that we received for review, however, earns its “adult” label in more ways than one. “The Joy of Sex” transforms Alex Comfort’s classic book into an interactive sex manual, complete with full-motion video (Digital Video Cartridge required), explicit line drawings, and partial nudity. While some segments are certainly titillating, the disc is not about gratuitous sex. Aimed at couples in committed, monogamous, loving relationships, it looks at sex from the points of view of four people—a twenty-something man and woman who each miss the passion of the honeymoon phase, and a man and woman in their fifties who would like to rediscover sex from a more mature perspective. “The Joy of Sex” tries to help those four representative people make the most of their sex lives through expert advice, game playing, quizzes, drawings, and video.

VIDEO CD

Video CD could very well be the wave of the future. Recently, seven major motion-picture studios—Disney, Warner Brothers, Columbia Pictures, MGM, Viacom, MCA/Universal, and Paramount—joined together in an “ad hoc advisory group” to



explore the possibilities of the format, which would put 135 minutes of video, preferably of laserdisc quality, on a single 5-inch disc. Philips and Sony are currently collaborating on a digital video system, as are Toshiba and Time Warner.

In the meantime, however, Philips Media’s Video CD Group was the first to release full-length movies and music videos on five-inch CD’s. The video CD-i discs can hold 72 minutes of VHS-quality video, along with CD-quality sound, so most movies come on two-disc sets. The platform also allows publishers to include such “value-added features” as behind-the-scenes information about the film and even on-screen sales of tie-in merchandise (parents, beware!).

The CD-i player allows customized control over the viewing experience. Via an on-screen panel, the Video CD viewer can select slow motion or freeze-frame with continuing sound, as well as fast forward, remote, and pause modes lacking the jitter associated with VCR’s. It’s also possible to skip forward or back to a specific scene in the movie, conveniently listed in the table of contents.



In “Star Trek VI: The Undiscovered Country,” as the Federation and the Klingons are preparing for a “glasnost-like” peace summit, Captain Kirk and the crew of the Enterprise (they’re baaack) are accused of attacking a Klingon vessel. The CD-i version of the film provides video

(Continued on page 19)

Family Computing

COMPAQ PRESARIO CDS 520. From Compaq Computer Corporation, P.O. Box 692000, Houston, TX 77269-2000; Tel. 713-370-0670. Price: \$1699.

Choosing a TV or home-theater system is confusing enough for most consumers—in fact, it can cause severe anxiety attacks. If you make the wrong choice in home-theater equipment, you can simply chalk it up to experience. But if you make the wrong choice when buying a computer for your family, you might permanently ban them from the heralded information superhighway!

Back in the early 1980's, everyone predicted a home-computer revolution. Even though millions of computers were sold, the revolution didn't happen back then. The incompatibilities between the computers that were sold, and the growing pains of the industry were only partially to blame; the main reason was that the computers weren't powerful enough for the mainstream mass market. What was powerful enough for many business uses just couldn't provide entertainment.

Today, of course, things are quite a bit different, as can be seen with the latest computers introduced by *Compaq*. We examined the base entry model of the company's new introductions, the *Presario CDS 520*.

Just what is an entry-level computer today? The CDS 520 is powered by a 486SX2 processor running at 66 MHz. The 486SX does not have a math coprocessor. However, according to Compaq, it performs 26% better than a 486DX2/50 in most Windows applications. The computer contains a single, high-density, microfloppy disk drive; a double-speed CD-ROM drive; a built-in sound card; and speakers. A Fax/modem and speaker phone are also standard.

The standard configuration for the CDS 520 is 4 megabytes of RAM (which is installed directly on the motherboard). Our machine was equipped with 8 megabytes; the machine can be expanded to 64.

The Presario CDS 520 has a unique all-in-one design; everything except for the keyboard and mouse are contained in a single package with a small footprint. Because of that, a Presario setup can be surprisingly neat. Neat enough, for example, to be kept in the family room.

To keep the size of the unit down, Compaq came up with an interesting configuration. First, the unit has no plug-in cards installed. All of the features that would normally reside on plug-in cards are instead integrated on the motherboard. That



eliminates the need for a disk controller, local-bus video card, fax/modem, sound card, I/O card, and CD-ROM controller. (The CD-ROM drive is run from the hard drive's IDE controller.)

The case can accept two ¾-length expansion cards. It wouldn't take much to run out of expansion slots. If you installed, for example, a video-capture card and PCMCIA adapter, you'd have no room when you went to install a network, radio, or TV card. Because the case offers only three drive bays—which are already occupied by the floppy- and hard-disk drives as well as the CD unit—an expansion to include, for example, a tape-backup drive would require an external case.

Although those somewhat limited expansion capabilities would be cause for concern to us, we doubt it's important to most new users, who probably have no intention of ever opening the computer case.

The Presario CDS 520 is equipped with a generous bundle of software, including MS-DOS 6.2 and Microsoft Windows 3.1. Application programs shipped with the computer include Microsoft Works for Windows, Quicken for Windows, Microsoft Encarta CD, Kidsoft CD, the Home Survival Toolkit, and The Even More Incredible Machine. In short, there's something for every member of the family.

Some utilities are supplied expressly for the Compaq machine, including the Welcome Center/Control Center/Learning Center, and Compaq Utilities. Startup kits, which provide one month's free service (but which also require that you subscribe by entering your credit card number), are provided for America Online, CompuServe, Prodigy, and the Imagination Network. Unfortunately, no

communications software is provided with the system other than the Terminal program that is part of Microsoft Windows.

It isn't easy to build a computer that can be purchased as a commodity at a local store, taken out of the box, and set up successfully even by someone who has never used a computer before. But building such a "family" computer is exactly what Compaq sought to do with the Presario, which is now available in more than 5600 stores across the country.

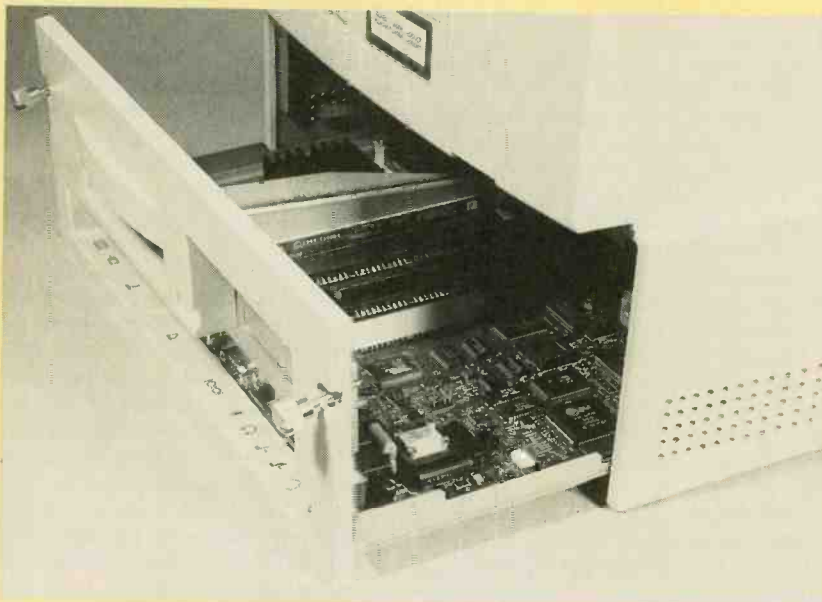
The system is packaged in a single, large carton with un-intimidating photographs of a father and son building a model airplane while referring to software describing historic aircraft. If everything goes according to plan, the largest problem that someone will have setting up the Presario is getting it out of the box. For hardware setup, the only other requirements are to plug in the cables for the keyboard, mouse, and telephone line. Even that is a breeze because of clearly labeled rear-panel jacks. Purchasers who are still intimidated might find some comfort in the VHS videotape that is included with the unit.

In the event that any problems occur, Compaq does offer a free (and toll-free) 24-hour technical hotline. Be prepared to wait for the service, however. In random calls, our wait times—when we didn't lose patience and hang up—ranged from 10 minutes to about 40 minutes.

Once the computer is out of its box and plugged in, and the keyboard, mouse, and phone line are attached, the power switch can be turned on. Setup software that is installed on the hard disk takes care of the rest. The user is asked for his or her language and country. When selected, the appropriate software is installed (de-



The Presario does its best to make even computer neophytes feel comfortable with the system. TabWorks (top left) is a replacement for the Windows Program Manager. The Phone Center (top right) is easy enough for anyone who has ever used a traditional phone. The sound-system controls (bottom left) also mimic real audio components. An "operator" (bottom right) tries to guide users along.



The Presario's motherboard contains many of the functions that would normally be incorporated on separate plug-in cards. For upgrades, the motherboard simply slides out in a drawer from the main chassis. Note the clearly labelled input and output jacks.

compressed) from the hard-disk drive. The software that is configured for other languages is deleted. The entire setup process takes about 35 minutes. The only other questions that the user needs to answer is for printer setup.

Although the software installation is straightforward and almost foolproof, it does present some potentially serious problems. Most of the software is contained only on the hard disk; no installation diskettes are supplied for most of the

applications, including Microsoft Windows. If power were turned off (or lost) during installation, it would likely cause a fatal error. If files became corrupt, a user would have no way to correct a problem unless he or she had done a full backup. (As with most computers, a practical backup system isn't included with the CDS 520 except to floppy diskette.) Even a full backup, however, doesn't give a user the same flexibility to correct a problem as having installation diskettes.

In our opinion, Compaq would have served its customers better by including all of the installation software on a CD-ROM instead of on the hard disk.

The software that the setup program installs is a collection of programs that a family will likely find useful along with some software that is probably of little use, and some demonstration packages that might whet a family's appetite to buy more.

The Documentation supplied with the CDS 520 should help most beginning computer users get familiar with the system.

The default configuration for the machine is to boot up running Windows. Instead of the Program Manager that is the default shell of Microsoft Windows, the Presario loads TabWorks, an alternate shell.

Although there is nothing inherently wrong with TabWorks, it doesn't seem to provide any better interface than the default Program Manager shell. If someone in the family is somewhat familiar with Windows through exposure to it at work or school, TabWorks could be a detriment to learning how to use the computer efficiently. Fortunately, Compaq makes it easy to switch between the TabWorks and Program Manager shells.

The CDS 520 offers energy-saver power-management options. During periods of inactivity, the monitor and hard disk can be turned off to conserve power. A strike of a key or movement of the mouse restores the computer to full operation virtually immediately. The monitor comes up to full brightness in only a matter of seconds; the hard disk takes a little longer to come up to speed.

The time-out settings for the monitor can be set in five-minute intervals from five minutes to a half hour, and the hard-disk time-out can be set in one-minute intervals between ten and twenty minutes. The energy-saver feature can be turned off if it is not needed. Because the system looks as if it's off when in its sleep mode, the user can choose to have the power LED blink.

An interesting and useful feature of the Presario is a built-in, full-duplex speakerphone, with an answering machine that can be set up with individual voice mailboxes for family members. Although the speakerphone performance was surprisingly good, we were happy that a handset could be plugged in for more privacy.

When we initially saw the Presario CDS 520, we thought that it would be fine for non-serious users, but unsuitable for performing serious tasks. We no longer think that, and, despite some limitations, would feel comfortable recommending the machine to most families. ■

Slip Slidin' Away

WQ-CH800 PORTABLE MUSIC SYSTEM WITH FIVE-DISC CHANGER.
From Sharp Electronics Corporation,
Audio Division, Sharp Plaza, Mahwah,
NJ 07439-2135; Tel. 1-800-BE-SHARP.
Price: \$249.95.

Most of us associate portable music with the Walkman—pocket-sized, lightweight, and private. But there are times when we'd like to take music with us, and still be able to share it with friends. That's where the boombox comes in.

Aimed primarily at teenage and twenty-something males (who tend to prefer their music loud, and are strong enough to lug around a good-size portable music system), the boombox can be carried from a dorm room to the park or beach. It allows the listener's choice of music to be heard by anyone in the immediate vicinity.

Today's portable stereo systems often incorporate a CD player, along with the requisite AM/FM radio and tape deck. Some even offer CD changers.

Sharp's *WQ-CH800* is a portable stereo system with a unique five-disc changer. The discs are loaded label-side-up into the top of the unit. The changer mechanism slides the stored discs to either side of the center position. To move a CD into play position, the changer glides to the left or right to pick up the selected disc. The labels of the discs remain face up and visible as they pass through the system. The time needed to change from disc 1 to disc 5 is an impressively quick 4.7 seconds.

The *WQ-CH800* is about the size of many of today's mini, bookshelf stereo systems. It measures $21\frac{1}{4} \times 10\frac{3}{16} \times 9\frac{1}{4}$ inches, and weighs in at a hefty 15 pounds. A handle folds up from the top to facilitate carrying. The CD changer also is set in the top of the unit. Three windows allow you to view the disc in the play position and those in the top slot on either side of it. CD controls include track-selection buttons (numbered 1-5), and **PLAY** and **STOP** buttons.

The front center section of the boombox contains a small display that indicates the disc and track number, and mode or programming information when applicable. To the left of the display is a four-band graphic equalizer; to the right are the remaining CD controls.

The tuner is centered on the front panel, with the rotary **VOLUME** and **TUNING** knobs placed to its left and right. Just beneath the radio dial is a four-position slide switch that doubles as a power switch and function selector. The dual-well tape deck is located below the tuning dial, with tape controls arrayed along the bottom of the front panel. Two-way speakers with four-



inch woofers flank the CD changer, radio, and tape deck.

The back panel is stark. It contains a headphone jack, the input for the included AC power cord, a flip-up telescoping antenna, and a large battery compartment that holds the eight D-size batteries required to power the *WQ-CH800*.

Loading the CD player is a breeze. By pressing the disc select buttons in order (one through five), you can position five discs in the changer. Each disc is placed on its tray, and when the next button is pressed, the tray lifts the disc and whisks it off to the side. You're then ready to load the next one. When all five are loaded, the CD compartment lid is closed manually.

To play a disc, you simply press its number to move the CD into the play position and press the **PLAY** button. Playback automatically begins with the first track on the first disc and proceeds in order through the tracks and discs, unless you opt for one of the available playback options.

Those options include disc-number selection, direct-selection play, random play, Automatic Programmable Music Selection (APMS), and repeat play. Any disc number can be selected during playback or when the changer is stopped, simply by pressing the desired disc number button. It's also possible to select a specific track on any disc in the disc holder, by pressing first the disc number and then using the up or down button to choose the track number.

Random play is programmed by simply pressing the **RANDOM** button either during playback or in stop mode. The random indicator will light up, and random play will begin with the next track.

Up to 32 tracks can be selected in any order to create a programmed sequence using APMS. Pressing the **MEMORY** button while in stop mode puts the *WQ-CH800*

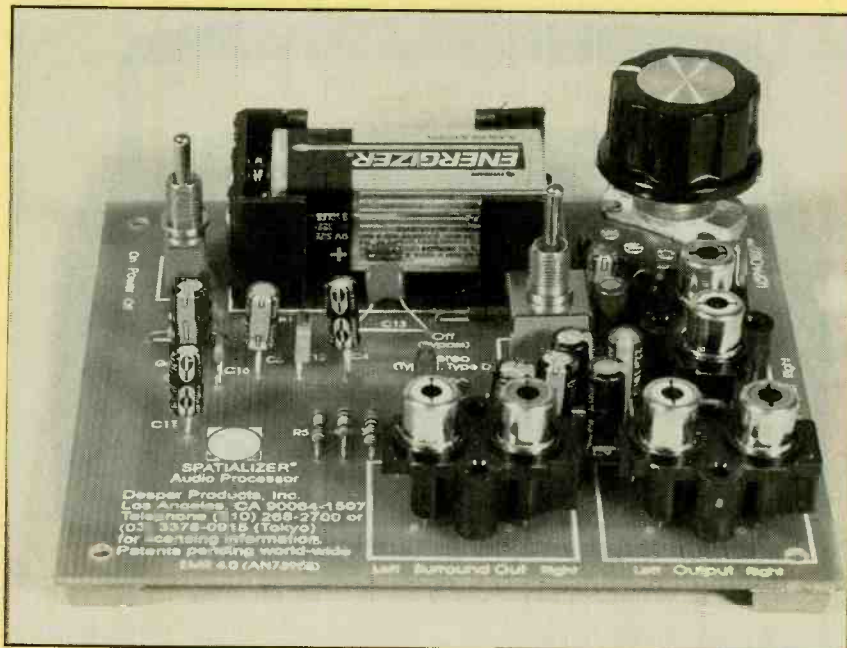
into the program mode, and the program indicator appears in the display. To select each song, first the disc number button is pressed, and then the up/down buttons are used to reach the desired track number. A second press of the **MEMORY** button stores the track in memory, and the programmed number will appear in the display.

Repeat play can be used to repeat all the tracks on every disc in the disc holder, or to repeat a sequence programmed using APMS. Pressing the **PLAY/REPEAT** button twice causes all the tracks on all the discs in the disc holder to be repeated. If the **PLAY/REPEAT** button is pressed twice when a sequence of tracks has been programmed (the program indicator will be lighted), that sequence will continually repeat.

Other CD functions include Auto Program Search System (APSS) and cue-and-review. APSS automatically locates the beginning of the next track. Cue and review allows you to fast forward audibly to reach a specific portion of a track.

The tuner is the weakest section of the *WQ-CH800*. Tuning is manual, not digital, so it is not as accurate and, of course, it is not possible to store station locations in memory for immediate access.

The dual-cassette deck allows you to record from the CD, radio, or tape 1 to tape 2. A synchronized recording system makes it easy to record from the CD player. When the **RECORD** button on the tape deck and the **PLAY** button on the CD player are pressed, recording begins automatically. The tape stops when the disc ends or is stopped or paused. Pressing the **STOP/EJECT** button of the tape deck ends the recording session. Although continuous playback (from tape 1 to tape 2) is possible, only tape 2 can be used for recording. That means that the *WQ-CH800* can't be used to record long radio programs on two tapes, for instance. ■



Spacing Out

SPATIALIZER EMR 4.0 AUDIO PROCESSOR. Manufactured by Desper Products Inc., 11400 West Olympic Blvd., Suite 1100, Los Angeles, CA 90064; Tel. 310-268-2700; Price: N/A.

Stereo, it seems, just can't cut it any more. Surround sound is no longer limited to movie releases and instead is being used more and more in the recording studio. The booming popularity of surround sound—it is now included in most main-line stereo receivers—is testament to the fact that three-dimensional ambience is here to stay.

Audio-equipment manufacturers have long sought a way to get the performance of a surround-sound system from a single pair of speakers. Various strategies have been developed through the years to extend the sound beyond and behind the loudspeakers and to add a third dimension of depth to audio. In other words, to improve the stereo process so that its reproduction duplicates what you might hear in a live performance.

Desper Products, Inc., has developed a new audio-processing technique called *Spatializer* that promises to add another dimension to audio so that sounds seem to come not only from beyond and behind the speakers, but from in front of them as well. In a departure from what we normally do here at *Gizmo*, we will not review a *Spatializer* equipped product as much as we will describe *Spatializer* technology, which you are bound to encounter frequently in consumer products in the coming years.

You may have, in fact, already encountered one form of the technology, the PRO *Spatializer*. The professional system was used, for example, to mix the audio for Disney's *The Lion King*, some of the performances on the MTV Music Awards, Bonnie Raitt's latest album, and many others. The Pro *Spatializer* allows recording engineers to place audio from any recording track in 3-dimensional space.

Spatialization is a one-way process—that is, *Spatialized* program material does not require a decoder for the effects to be heard. It was possible, for example, for us to experience the *Spatializer*'s effects with a demonstration CD that contained A/B comparisons between *Spatialized* and non-*Spatialized* recordings. The CD provided some insight into how *Spatializer* can work.

Even more convincing, however, were the effects produced by Desper's *Spatializer EMR 4.0 Demonstration Board*, which is designed to demonstrate the new EMR 4.0 integrated circuit. Matsushita Electronics Corp., a subsidiary of Matsushita Electric Industrial Company, the consumer electronics giant whose brands include Panasonic, Technics, and Quasar, is manufacturing the EMR 4.0 IC under license for Desper Products. The chip will make it easy for manufacturers to incorporate *Spatializer* technology into a wide range of products.

The demonstration board accepts a stereo signal input via board-mounted RCA-type phono jacks. It provides a stereo output, as well as an optional surround output. It is powered by a 9-volt battery, and contains a power switch, a bypass switch that permits A/B comparison, and a potentiometer that allows the effect to be varied.

The heart of the board is a 20-pin integrated circuit mounted on the bottom of the board.

The bypass switch on the EMR 4.0 demonstration board also switches the chip between its three separate *Spatializer* modes: Type E (*Spatial Expansion*), Type D (*Directional Positioning*), and Type S (*Spatial Synthesis*).

Spatial Expansion enhances and expands the sound from normal stereo recordings and requires only two speakers. Although centered images remain in the center, off-center instruments and sounds are expanded so that hard-panned images sound as if they originate from locations well outside the speakers, and even around the listener. That is the mode that, say, TV-set or boom-box manufacturers would use if they choose to incorporate *Spatializer* technology in their products.

The *Directional Position* mode is essentially the same as *Spatial Expansion*. In fact, the mode switch is left in the same position for either mode. The *Directional Position* mode, however, requires additional circuitry that is not included on the demonstration board, notably *pan pots* such as those found on a mixing console. The *pan pots* provide the ability to locate and move individual sounds up to 270 degrees around the listener in real time. As the sound is panned from one side to another, it moves outside the speaker boundaries and around the listener.

One use for the Type D mode would be in computer videogames, where the software equivalent of *pan pots* would position the sound in relation to game play. According to Desper, multiple sounds can be directionally positioned. However, each would require its own *pan pot* (or software equivalent), and the outputs of all the potentiometers would be summed together.

The final operating mode is Type S or *Spatial Synthesis*, which provides a pseudo-stereo image with mono inputs. Because much multimedia sound is mono, this mode should be effective in providing greater depth and realism.

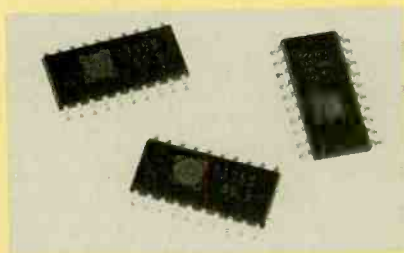
As mentioned earlier, the intent of *Spatializer* technology is to create an expanded sound stage from a single pair of stereo speakers. The effect is intended to be more than simple expansion, and instead closer to surround sound.

Previous attempts that we have heard from other companies had drawbacks ranging from an ill-defined sound stage to a small "sweet spot" to mono incompatibility to a sound that was simply unnatural. In contrast, however, *Spatializer* works amazingly well.

We auditioned *Spatializer* with a variety of program material and a variety of hardware. We sampled, for example, stereo television broadcasts on a run-of-the-mill, 26-inch, stereo TV receiver with small,



Spatializer technology is already in use in a variety of products. The PRO Spatializer was used in recent CD releases including a box set of the original Woodstock album, and new releases from Bonnie Raitt and Barbara Streisand to name a few. Hardware products that contain Spatializer include a Panasonic boom box and a unique multimedia sound board from Multiwave Innovations.



The Spatializer audio processor is available in a 20-pin surface-mount integrated circuit.

built-in speakers. Because of the limited distance separating the speakers, stereo performance was really in name only. With the EMR 4.0 installed, the speakers no longer seemed to be located in the TV cabinet. Instead, they shifted far to the left and right.

In one test, we placed dummy speakers at various locations along the front of the room and asked subjects to pick the speaker pair that they thought they were listening to. By varying the space control—and therefore the Spatialized soundstage—we could position the sound so that it seemed to emanate from the dummy speakers. Our test subjects, who were unaware of what we were doing, confirmed that Spatialization was doing its job.

We found that it was possible to adjust the ((space)) control until the sound became unnatural, but it was also possible to create a very pleasing performance. The Spatializer processor varies not only the width of the soundstage, but its depth, as well. The soundstage becomes a true three-dimensional space, and that, we pre-

sume, is how Desper came up with the Spatializer name.

According to the company, the effect is obtained by creating the equivalent of optical illusions for the human ear-brain mechanism. The position of a sound source is determined from several clues, such as the phase difference between the sound at each ear. Humans instinctively and instantly perceive the sounds and reflections of sound to determine the distance, location, and size of sound sources.

Spatializer technology will never replace Dolby Surround, but it is completely compatible with Dolby Surround and it should make itself useful in many applications where the expense of surround sound and the requirement of rear speakers make it unjustifiable. Spatializer technology would make sense in a TV set in a bedroom or dorm room where surround sound would normally not be considered. The computer multimedia market is already incorporating Spatializer in its products. Multiwave Innovations, for example, has incorporated the chip in its new Command 3-D Sound Engine audio processor. Boom boxes could benefit immensely from the technology, as could many television sets. Audio/video receivers could also benefit from Spatializer as an addition to the DSP features that are already incorporated. ■

VIDEO CD-i

(Continued from page 10)

esting and, yes, even fun to use. It offers videos, audio selections, pictures, photos, maps, and a built-in dictionary and atlas.

You can search for a topic by typing it in on the on-screen keyboard, by scrolling through an alphabetic list of all articles, or by using the Topic Tree Fact-Index. The Topic Tree breaks down all of the major articles on the disc into menus of topics and subtopics for easy reference. The Fact-Index includes close to 30,000 short articles on a wide range of subjects, as well as thousands of references to articles. Selecting the "jump" icon in the Fact-Index will call up the main article on that subject. The Time Machine lets users select past eras in history and learn about major events and life during that time.

Our review unit also came with an assorted sampling of CD-i titles—several games, a couple of movies, a few sports programs, and some kiddie titles. (Reviews follow.) Unfortunately, the interactive encyclopedia was the least frequently used title in our house—as we suspect it might be in most homes.

The encyclopedia is a tremendously useful information resource. And its inclusion with the CDi450 might make parents more willing to bend the "no video games in this house" rule. But, in reality, CD-i remains a high-tech video-game player and, with the added Digital Video Cartridge, movie playback system. ■

GAMES PEOPLE PLAY

(Continued from page 14)

and audio quality far superior to that of the VHS tape we'd rented several months earlier. The disc comes with "liner notes" about the making and makers of the film, and an "About the Cast" section that features biographies similar to that found in a theater playbill.

"Peter Gabriel: All About Us" (\$24.95) provides a behind-the-scenes look at the musician's award-winning music videos, including "making of" footage, video clips, and interviews with Gabriel's production team. Viewers learn, for instance, how the special-effects team created the illusion of snails crawling across Gabriel's eyes and how it was possible for his head to appear as if it emerged from a speeding train. In exclusive interviews, Gabriel reveals his motivation for lyrics, personal moments in his life, and his feelings about the state of the world and the human condition. The Video CD features the music videos "Digging in the Dirt," "Steam," "Blood of Eden," and "Kiss that Frog," from the CD "Us." It also features music videos for songs from the "Passion" CD, including "Come Talk to Me" and "Zoar," as well as a music video from the 1977 hit, "Solsbury Hill." An on-screen function panel gives viewers complete interactive control of the viewing experience. ■

GIZMO NEWS

Audio on Demand

A unique combination of existing technology promises to create a new way for information junkies to get their fix. The Information Highway Media Corporation of Cupertino, CA is planning to launch its Audio-On-Demand subscription service.

The service will allow users to select from a wide variety of audio programming, and store the programming on a pocket-sized device. Up to ten hours of personalized programming can be obtained in about five or six minutes. It can then be played back through a car stereo system or through a portable audio device.

The programming that will be offered will consist of audio versions of newspapers, magazines, and books, as well as radio programs, special-interest programming, and even TV audio.

The audio will be sent in digital form to

Stop That Car!

Almost anyone who's ever received a speeding ticket has fantasized that he or she could have outrun the cops if he or she had really wanted to. Such thoughts remain fantasies for most rational people. Even so, high-speed auto chases occur frequently, resulting in thousands of accidents each year.

In the future, new anti-vehicle electronic countermeasures—or AVECM, as their creators like to call them—will offer a way to catch fleeing suspects without a chase. According to Creative Electronics Consultants, small, portable electronic devices that are capable of disabling the engine operating system of a pursued vehicle will bring it to a standstill within seconds. Those devices are, according to the company, "a promising alternative to conventional barrier technology."

that can be set up to "interrogate" vehicles. Vehicles with the proper code will pass over the device safely.

There is no firm word when those devices will be available to law-enforcement agencies. The company, which is headquartered in Sleepy Hollow, Illinois, is seeking venture capital investment.

Consumer Electronics No-Show

The Consumer Electronics Show - Interactive (CES-I), which was scheduled to be held in May in Philadelphia, has been canceled. Gary Shapiro, vice president of the Electronic Industries Association Consumer Electronics Group, said, "After reviewing the pressure and stress put on potential exhibitors, buyers, and journalists to decide between two major industry shows being held at the same time, on two separate coasts, we chose to do what was best for the interactive industry and reschedule our show in 1995 to 1996."

CES-Interactive was the scheduled replacement for the Summer CES that was traditionally held in Chicago in late spring. CES-I has been rescheduled to be held in Orlando in May 1996.

The other industry show to which Shapiro was referring was the Electronic Entertainment Expo (E3) that will debut in Los Angeles from May 11 to 13—the same days that CES-I had been scheduled. The E3 show will focus exclusively on the development, marketing, and merchandising of software titles for all game platforms and CD systems.

Following the EIA decision, the organizers of E3 (the Interactive Digital Software Association or IDSA) released a statement saying, "We believe this is the right decision for everyone involved and are pleased to have the matter finally resolved. It underscores the coming of age of the \$8 billion interactive entertainment industry, which has long needed to make a statement of independence with its own dedicated show."

Strong Sales

As the consumer-electronics industry looks for "the next VCR"—that is, the next product that will send consumers in droves to their local electronics retailers and restore life to the industry—some old products are showing renewed strength. Even though the household penetration of TV sets is over 98%, sales are strong—stronger than ever, in fact. In September of last year, the last figures that were available as we went to press, the TV industry had its best month ever. For the first time, unit sales of TV sets passed 3-million. ■



Listen Up audio receivers. The primary means of distribution will be through cable-TV systems, which will receive the audio data via satellite. The service might also be made available to TVRO (big-dish) and DBS (little-dish) satellite-TV system owners.

Preliminary field testing is going on now, and initial production units should be available by the end of this year. Although prices haven't been determined yet, the Listen Up audio system should cost less than \$500. Monthly service charges will apply to basic audio programming. Premium programs will also be offered.

The device is a pancake-like disc with a diameter of 42 inches and a height of about 3 inches. It is made of high-strength polycarbonate and contains several high-voltage electrodes.

When it is set up in the road, it appears only as a small bump. However, the disc can be armed before the target vehicle passes over it by the pursuing police officers or by other officers at the scene. When the target vehicle passes over it, the disc discharges high-energy electric charges, which disable engine controls, sensors, computers, and other circuits.

The developers envision future versions

ELECTRONICS WISH LIST

Mini-Component Audio System

The six-plus-one CD changer in the *MS 7766* bookshelf stereo system from *Sansui USA Inc.* (1290 Wall Street West, Lyndhurst, NJ 07071) provides hours of uninterrupted music. The changer has an internal stacking design and features 24-track programmability. With the touch of a button, the user can choose one of 30 preset radio stations, thanks to the system's PLL digital tuner. The dual-well, auto-reverse cassette deck makes dubbing simple. A clock/sleep timer adds to the system's convenience. The 50-watts-per-channel system also offers sound-field control, Dynamic Bass Boost System, and a remote control. Price: \$649.95.



Sansui Mini-Component Audio System

Game Boy/Super NES Adapter

The *Super Game Boy* accessory from *Nintendo of America Inc.* (4820 150th Avenue N.E., Redmond, WA 98052-5111) allows video-game enthusiasts to play any of the more than 350 available Game Boy cartridges on the Super Nintendo Entertainment System (Super NES), displaying them in full color on the TV screen for the first time. The Super Game Boy is a Super NES cartridge that contains a Game Boy adaptor. When a Game Boy cartridge is inserted, it is transformed from a black-and-white game to a bright, multi-colored image on a big television screen, complete with stereophonic sound. Game action is displayed in varying shades of four colors that can be customized by the player. The player can also use one of several pre-stored, animated border designs or can create his or her own using a paint-type program. New titles specifically designed for the Super Game Boy will use the 256-color palette of the Super NES. Price: \$59.95.



Game Boy/Super NES Adapter

Plain-Paper Fax

The *FX5500* is *Samsung Electronics America's* (105 Challenger Road, Ridgefield Park, NJ 07660-0511) first entry into the plain-paper fax market. The fax uses LED printing technology, features a 256-KB receiving memory, and offers a telephone answering-machine interface. It has a nine-second transmission speed, a 20-sheet automatic document feeder, and a printing speed of five pages per minute. The *FX5500* can store 20 one-touch and 50 two-touch programmable numbers. Price: \$1699.99.

Multiroom, Powered "Tube" Loudspeaker

The *Bang & Olufsen* (1200 Business Center Drive, #100, Mount Prospect, IL 60056) *Local Control System 9000* is a unique, two-in-one active loudspeaker that was specifically designed for multiroom applications. It can bring both sound and control of a centrally located audio system to different rooms. Right and left amplified speakers, a status display with clock, an independent volume control, and an infrared remote-control transceiver are all housed in a slender oval cabinet of polished aluminum, intended for horizontal placement. The black speaker grilles are divided by a field that contains an illuminated status display and two sets of sensi-touch controls for hands-on operation. A Beolink remote control also can be used to gain access to all available sound sources. The tube-shaped *LCS 9000* measures $43\frac{3}{4} \times 3\frac{3}{4} \times 4\frac{3}{8}$ inches and comes with a bracket that allows it to be wall mounted. An optional stand is available for table-top or bookshelf placement. The *LCD 9000* uses *Bang & Olufsen's* Adaptive Bass Linearization (ABL) technology to provide large speaker sound. It features two loudspeakers, each with its own amplifier. One, for the treble, drives a $\frac{3}{4}$ -inch tweeter; the other, for the bass, drives a $3\frac{1}{2}$ -inch woofer. The close connection between the amplifier and loudspeaker is said to give improved signal control and provide extra power for a purer, more authentic sound. Price: \$1395.



Bang & Olufsen LCS 9000 Powered Loudspeaker

ELECTRONICS WISH LIST



Radio Shack Mini Cellular Phone



Sanyo Fuzzy Logic 8mm Camcorder



MicroPak Mini Travel Clock Radio

Mini Handheld Cellular Phone

Weighing just seven ounces and measuring a compact $5.25 \times 2.1 \times 0.9$ inches, the *Radio Shack* (700 One Tandy Center, Fort Worth, TX 76102) *CT-352* handheld cellular phone makes it easy to keep in touch while commuting, at a job site, on a business trip, or on a family outing. It will store up to 98 different names or numbers for quick dialing. To dial by name, you enter the first one or two characters of the name and the phone automatically locates the number. Incoming calls can be answered by pressing any key on the keypad. The phone can also be set to automatically answer without pressing any key. A menu system lets you quickly view and change the current setting of any phone function, including ring type, volume, light control, and auto-answer. Other features include a supertwist, backlit LCD; continuous battery-power-level and signal-strength indicators; touch-tone compatibility for special services such as banking by phone and voice mail; and scratch-pad memory for temporarily storing a name and number during a call. Price: N/A.

Adjustable Monitor Arm

Designed to free up valuable desk space, the *EasyVue Model 6130* adjustable monitor arm from *MicroComputer Associates* (Division of Rubbermaid Office Products Inc., 9920 La Cienega Blvd., Inglewood, CA 90308-7032) lifts the monitor above the worksurface. To provide the most comfortable viewing angle, a notch-slide mechanism is used to adjust the height in one-inch increments, four, five, or six inches above the desktop. The monitor platform rotates, tilts, and swivels for enhanced viewing, and the base also rotates. The platform holds monitors weighing up to 40 pounds with foot separations up to 12 inches. The arm attaches to the desk with a metal clamp. Price: \$49.95.

Fuzzy Logic Camcorder

The *VM-RZ2R* 8mm camcorder from *Sanyo* (21350 Lassen Street, Chatsworth, CA 91311-2329) offers fuzzy-logic control and preset shutter speeds for easier operation and better videomaking results. The high-speed (up to $1/10,000$ second) electronic shutter offers six presets identified in the viewfinder as sports, auto high-speed, low-light, flicker, close-up, and normal. Those settings eliminate guesswork and simplify shutter-speed selection. Sanyo's fuzzy-logic technology automatically adjusts the focusing, iris, and white balance by imitating the human thinking processes. For instance, the automatic white balance corrects color for different lighting conditions by analyzing picture information from 64 separate image areas. Manual focusing is also possible. The *VM-RZ2R* also features an 8:1 power zoom lens, a flying erase head, a wireless remote control, 1-lux low-light capability, and a built-in omnidirectional microphone. Price: \$699.99.

Tiny Travel Clock/Radio

According to *Executive Travelware* (P. O. Box 59387, Chicago, IL 60659-0387; Tel. 1-800-397-7477), its *MicroPak* is the world's smallest full-feature, AM/FM travel clock radio. Because of its ultra-compact size, it can be packed into the tightest space. The clock radio measures $4\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{16}$ inches when closed. With the touch of a button, the *MicroPak's* black clam-shell case pops open to reveal a large LCD time display, angled for easy reading. The power switch is located under the lid to prevent the power from being accidentally turned on while the radio is packed in a suitcase. The *MicroPak* provides a choice of music or beeper wake-up alarms. It features a telescoping whip antenna, a snooze button, and an earphone jack. Price: \$49.95.

Your own TV station for less than \$100?

Recoton's engineering breakthrough transmits cable, TV, VCR and satellite programs throughout your home...without wires!

By Charles Anton

Today television choices are virtually unlimited. With cable, satellite TV, videos and network programming to choose from, it's a full-time job just trying to keep up with everything. And it promises to get worse from here. Newly developed fiber optic technology will bring more than 500 TV channels to your home.

Home broadcasting breakthrough. The only problem with all this technology is the expense. Now, a newly developed wireless video broadcasting system gives you the power to utilize this technology, without the hassle and expense of wiring your entire home.

Recoton's research and development team brings you the next generation in wireless broadcasting. The wireless video broadcaster enables you to transmit (re-broadcast) cable, TV, VCR or satellite programs to any other TV in your home, without wires!

Wave of the future. Never again will you have to drag your VCR from room to room, or have to buy more than one. With the wireless video system you can broadcast videos to any other TV in your home.

You won't have to worry about running cable wire all over the place either. Besides, who could afford to install cable in every room anyway? With the wireless video system, you won't have to. You can even watch one program on your main TV and watch a different program or video on the other. It's like having a personal broadcasting system in your own home—and it's legal in every state.

Hi-tech home broadcast. Recently, the Federal Communications Commission allocated a band of radio frequencies specifically for wireless, in-home product applications.

Recoton's research and development group took advantage of the 1989 FCC ruling by creating and introducing wireless home transmission equipment that could transmit pictures and sound in the prescribed frequency over distances of 150 feet or more.

One transmitter, unlimited receivers. One transmitter operates an unlimited number of receivers. That means one transmitter in the den can send signals to the TVs in the bedrooms, kitchen and wherever else. Put your favorite programs in the places you want them most.

Even more choices.


Since the system utilizes the latest 900 MHz frequency signals, no time-consuming or complicated wiring is required. The receiver can be moved from one TV to another as your needs change. Or the transmitter can broadcast to multiple receivers, so that you can watch the same program on many TVs simultaneously. The transmitter simply connects to the source TV; the receivers connect to the others.

Easy-to-use. With state-of-the-art resonator quality, both the transmitter and the receiver provide users with a small, easy-to-install product that does not require the adjustments that competitor's models do.


This latest version incorporating space-age styling with the latest miniaturized design circuitry, enables

the transmitter and receiver to be substantially smaller than previous models.

Exclusive direct offer. With this breakthrough in home video broadcasting technology, you can have the convenience of your



Size: 1059 feet
Weight: 260 tons
Cost: \$3.5 million



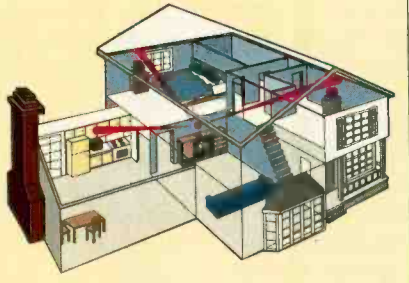
Size: 4.5 inches
Weight: 3 pounds each
Cost: \$99

Home Video Broadcasting System

TV broadcasting comes to the home.

Wireless Video Breakthrough... watch what you want, where you want

- **Cable.** Broadcast cable channels to the other TVs in your home that aren't wired for cable... even premium channels.
- **Videos.** Transmit VCR signals to rooms that have no VCRs. Watch videos in any room of the house, even if someone's watching TV in the room with the VCR.
- **Satellite programs.** Watch satellite programs throughout your home without stringing cable everywhere.
- **Network programming.** If you have a house full of TVs but only one is hooked up to an antennae, you can broadcast the clear signal from that TV to all the others.
- **Live video.** Watch your home videos as you film them. Or turn your camcorder into a security camera.



own personal wireless broadcasting system for a fraction of the cost of owning your own TV station. For a limited time, we are offering the Recoton wireless video broadcasting system direct-to-the-public for only \$99. Remember, one transmitter will operate an unlimited number of receivers, you can order additional receivers for other TVs for only \$59. So order now and put a personal broadcasting system in your home.

Risk-free offer. We are so confident that you will love the wireless video broadcaster that we back it up with our "No Questions Asked" 30 day money-back guarantee. If you are not completely satisfied for any reason, just return it within 30 days for a full refund. It also comes with a one year manufacturer's limited warranty.



Video Broadcasting System.....\$99 \$9 S&H
Includes one transmitter and one receiver.

Additional Receiver.....\$59 \$7 S&H

To receive this special pricing, you must mention promotional code 172-PL1112

For fastest service call toll-free 24 hours a day

800-992-2966



To order by mail send check or money order for the total amount including S&H (VA residents add 4.5% sales tax). Or charge it to your credit card by enclosing your account number and exp. date.

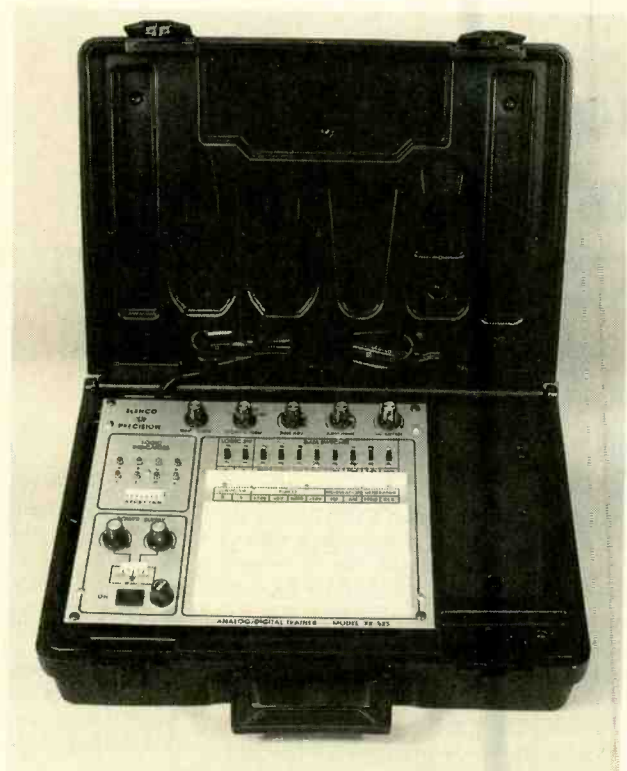
COMTRAD INDUSTRIES

2820 Waterford Lake Drive Suite 106
Midlothian, Virginia 23113

March 1995, Popular Electronics



ELENCO ELECTRONICS XK-525 DIGITAL/ANALOG TRAINER



CIRCLE 119 ON FREE INFORMATION CARD

Breadboard analog and digital circuits the easy way with this versatile digital/analog trainer.

Breadboarding circuits is always difficult work. It requires lots of patience and extreme concentration because it's very easy to misplace a lead or leave a connection out entirely. It makes sense, then, that any device that makes breadboarding circuits neater, simpler, or less time-consuming is a good investment—as long as it's not an expensive one. In that light, one of the best breadboarding investments that I have found is the Model XK-525 *Digital/Analog Trainer* from Elenco Electronics, Inc. The trainer is sold as a kit for \$149.95.

Features. The XK-525 makes short work of breadboarding circuits by putting lots of what you need to do it right at your fingertips. Different power supplies, a function generator, and a digital-logic section are all combined on one control panel. There's also plenty of room for installing your own components: two large breadboards, each with 830 tie points. In addition, six separate power-bus lines that span the width of the breadboards can be

used as common tie points for different voltages. Everything is housed in a rugged plastic case.

A power supply is essential in any circuit, and the XK-525 provides five different DC voltage sources that can satisfy almost any conceivable circuit requirement. To begin with, there are two variable supplies, one positive and one negative. The positive variable supply is adjustable from +1.25- to +20-volts DC, and the negative variable supply is adjustable from -1.25- to -20-volts DC. The variable supplies can output a full ampere at up to ± 15 volts and half an ampere at ± 20 volts. Positive and negative, 12-volt, fixed power supplies are also included, both of which can output up to 1 ampere. There's also a fixed +5-volt, 1-amp supply. All of the supplies are regulated and short-circuit protected. A 30-volt AC, center-tapped supply is also present. The trainer draws its own power from any convenient 117-volt AC outlet.

A function generator is a valuable accessory when designing or testing out a new circuit. It's a quick way to

input signals of different frequencies into a circuit. The XK-525 has a built-in variable function generator that can generate sine, square, and triangle waveforms from 1 hertz to 100 kilohertz in 5 steps. The output is variable from 0- to 15-volts peak-to-peak. The DC offset can be adjusted ± 10 volts from the zero crossing. An AM input allows an external signal to amplitude modulate the function-generator output, while an FM input allows an external signal to frequency modulate the function-generator output.

The digital section of the XK-525 includes 8 data switches that set outputs to high and low logic values (+5 and 0 volts). The 8 outputs each have 5 tie points, which can be used to set conditions on a data bus, as well as for other applications.

Two logic switches are included, both with normal and complimentary outputs. The logic switches are bounce-free. If you are unfamiliar with that concept, the contacts of a regular switch can "bounce," causing sensitive, high-speed digital logic in-

(Continued on page 94)

Just like these Fully Trained Electronics Professionals



"Thanks to CIE I have tripled my previous salary, and I am now in a challenging and rewarding new field where only the sky is the limit."

Daniel Wade Reynolds
Industrial Electrician
Ore-Ida Foods



"CIE was recommended to me by my boss. It was appealing since I could study at my own pace at home and during business travel."

Dan Parks
Marketing Manager/Consumer Products
Analog Devices, Inc.



"I loved the flexibility CIE offered. It was the only way I could continue both school and my demanding job."

Britt A. Hanks
Director of Engineering
Petroleum Helicopters, Inc.



"I liked the way the school was set up with laboratory assignments to enforce conceptual learning. The thing which impressed me the most about CIE's curriculum is the way they show application for all the theory that is presented."

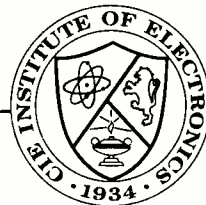
Daniel N. Parkman
Missile Electro-Mechanical Technician
U.S. Air Force



"Completing the course gave me the ability to efficiently troubleshoot modern microprocessor based audio and video systems and enjoy a sense of job security."

Tony Reynolds
Service Manager/Technician
Threshold Audio & Video

Graduate with an Associate Degree from CIE!



CIE is the best educational value you can receive if you want to learn about electronics, and earn a good income with that knowledge. CIE's reputation as the world leader in home study electronics is based solely on the success of our graduates. And we've earned our reputation with an unconditional commitment to provide our students with the very best electronics training.

Just ask any of the 150,000-plus graduates of the Cleveland Institute of Electronics who are working in high-paying positions with aerospace, computer, medical, automotive and communications firms throughout the world. They'll tell you success didn't come easy...but it did come...thanks to their CIE training. And today, a career in electronics offers more rewards than ever before.

CIE'S COMMITTED TO BEING THE BEST...IN ONE AREA...ELECTRONICS.

CIE isn't another be-everything-to-everyone school. CIE teaches only one subject and we believe we're the best at what we do. Also, CIE is accredited by the National Home Study Council. And with more than 1,000 graduates each year, we're the largest home study school specializing exclusively in electronics. CIE has been training career-minded students for nearly sixty years and we're the best at our subject...
ELECTRONICS... IT'S THE ONLY SUBJECT WE TEACH!

CIE PROVIDES A LEARNING METHOD SO GOOD IT'S PATENTED.

CIE's AUTO-PROGRAMMED® lessons are a proven learning method for building valuable electronics

career skills. Each lesson is designed to take you step-by-step and principle-by-principle. And while all of CIE's lessons are designed for independent study, CIE's instructors are personally available to assist you with just a toll free call. The result is practical training... the kind of experience you can put to work in today's marketplace.

LEARN BY DOING...WITH STATE-OF-THE-ART EQUIPMENT AND TRAINING.

CIE pioneered the first Electronics Laboratory



Course and the first Microprocessor Course. Today, no other home study school can match CIE's state-of-the-art equipment and training. And all your laboratory equipment, books and lessons are included in your tuition. It's all yours to use while you study and for on-the-job after you graduate.

PERSONALIZED TRAINING....TO MATCH YOUR BACKGROUND.

While some of our students have a working knowledge of electronics others are just starting out. That's why CIE has developed twelve career courses and an A.A.S. Degree program to choose from. So, even if you're not sure which electronics career is best for you, CIE can get you started with core lessons applicable to all areas in

electronics. And every CIE Course earns credit towards the completion of your Associate in Applied Science Degree. So you can work toward your degree in stages or as fast as you wish. In fact, CIE is the only school that actually rewards you for fast study, which can save you money.



YES!

I want to get started. Send me my CIE course catalog including details about the Associate Degree Program. (For your convenience, CIE will have a representative contact you - there is no obligation.)

Please Print Clearly

Name _____

Address _____

City _____

State _____ Zip _____ Age _____

Phone No. _____

Check box for G.I. Bill Benefits.

Veteran **AH63**

Active Duty

Cleveland Institute of Electronics, Inc.
1776 East 17th Street
Cleveland, OH 44114

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

Send for CIE's FREE Course Catalog and See How We Can Help Your Career Too!

THINK TANK

By John J. Yacono,
Technical Editor,
Windows Magazine

Model-Railroad Circuits

Last month, we talked about the various wattages that resistors come in and how to tell the wattage of a resistor by its appearance. We'll continue our discussion of resistors this month, and also get to a few model-railroad-related circuits sent in by some contributors.

As you'll recall, the wattage of a resistor determines how much heat it can dissipate per second. Another even more important characteristic of a resistor is its resistance to current flow, which is measured in ohms. Resistors rated above 5 watts have their resistance values stamped on them in plain English. Lower-wattage resistors have three or four (in the case of 1% resistors) colored bands on

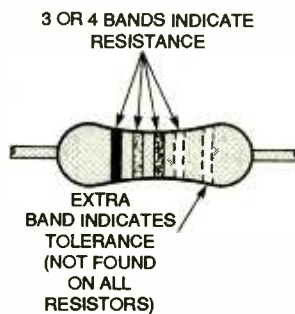


Fig. 1. Colored bands are used on a resistor to indicate its value in ohms and its tolerance.

their bodies (see Fig. 1) that indicate the resistance value. Most of the time, there is an extra band that indicates the part's tolerance (which we'll explain next time). Resistance-indicating bands can be one of ten colors; each color represents a digit, as shown in Table 1.

To see how the system works, let's take an example.

Say you pick up a resistor and it has three bands on it: yellow, violet, and orange. (Any bands of a color not found in Table 1 deal with tolerance, so we'll ignore them for now.) Using Table 1, we find that the bands indicate the digits 4, 7, and 3.

TABLE 1—
RESISTOR-BAND COLORS

Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

The first two digits indicate significant numbers (47), but the last digit (3) tells us how many zeroes follow the first digits. In that case three zeroes should follow the 4 and the 7. That gives us a value of 47,000 ohms.

Let's take another example, this time with four resistance-indicating bands of these colors found in Table 1: brown, red, green, red. The first three bands indicate significant figures, and from the table we can see that brown/red/green means 125. The last band, which tells us how many zeroes follow the numbers, is red. That tells us that 2 zeroes follow the number 125, so the resistor's value is 12,500 ohms.

What if the last band is black? That means that no zeroes follow the first digits. For example, if the resistor bands are white (9), brown (1), black (0), the resistor's value is simply 91 ohms, no zeroes follow. But right now

some readers' letters do follow:

MODEL-RAILROAD SOUNDER

The circuit that I have enclosed (see Fig. 2) can be used in model railroading to sound an electronic diesel horn when the train approaches a railroad crossing. I mounted the circuit in a 50-foot HO-scale box car, and placed the 8-ohm speaker, S1, behind the doors, which I now have to keep open. A longer cattle car would be a better enclosure because it is larger and has holes for sound to escape.

Reed switch S1, which I cannibalized from a Radio Shack reed relay, was mounted on the bottom of the car. When the "sound car" approaches the crossing, S1 is momentarily closed by a magnet that must be installed under the track, thus starting the timing cycle and sounding the horn.

Before you can use U2, the ISD 1000A record and playback IC (available at Radio Shack and elsewhere), you must first program it by breadboarding the circuit found in the applications data included with the IC. To record sound on U2, you'll need a sample of the sound that you want the IC to play. I called a local railroad yard to make an appointment to record the sound that I required. Another option is to stand near a railroad crossing holding a microphone, waiting for a train.

During construction of the playback circuit, save space by using single-turn trimmers for the variable re-

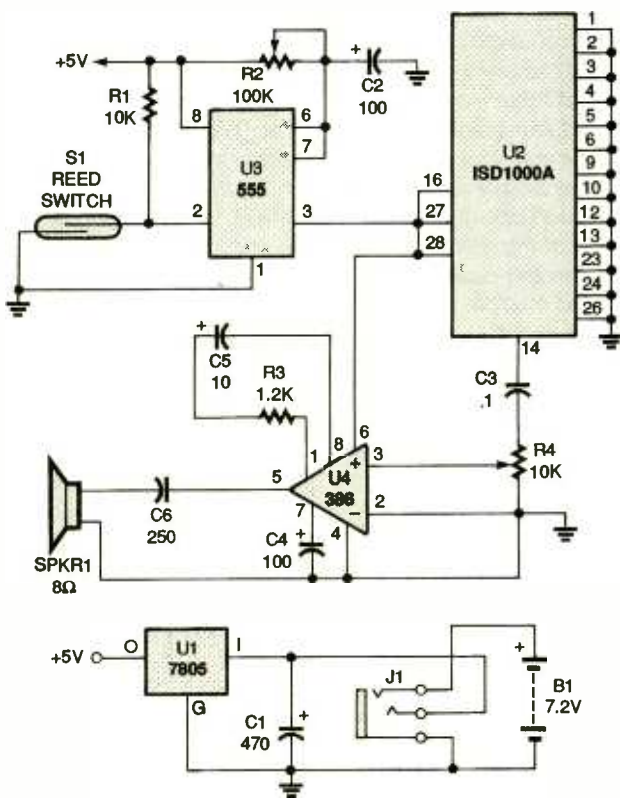


Fig. 2. This circuit can fit inside a model-train car and output any sound you record in the ISD1000A. Imagine a cattle car that moos!

sistors. To install U2, mount it on a low-profile socket. If you have an O or larger-scale railroad, you could use larger and louder speakers, an LM380 IC amplifier for more power, and another battery in parallel for extended use because of the extra space.

The phone jack, J1, which is mounted on the bottom of the car, serves two purposes. It serves as a means of charging B1, the 9-volt NiCd battery, and also provides a way to turn the circuit off. To charge the battery without disassembling the car, just wire a 9-volt battery snap to a male phone plug. Then just insert the phone plug into the car and the battery snap into your battery charger. The battery will last about 4 hours, depending on how many railroad crossings you have on your layout. When not in use, insert the phone

plug to turn off the circuit.

There are unlimited applications for the above circuit in model railroading. In addition to providing a horn for a train, it can be used to reproduce the sound of a ringing bell at a railroad crossing, or a police or ambulance siren. However it is used, the circuit is sure to make a

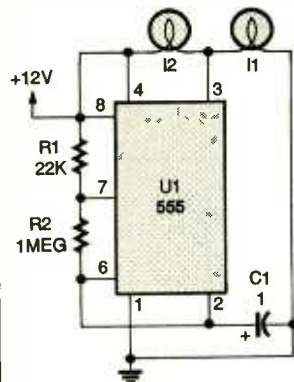


Fig. 3. This simple circuit can operate the incandescent bulbs in a railroad-crossing flasher.

model railroad heard as well as seen.

By the way, although I have been an avid reader of **Popular Electronics** for many years, I have no idea what book everyone is talking about in *Think Tank*. I would like to know what type of book you are sending to people who have their articles published in the column.

—Brian Couchene,
Escanaba, MI

Normally, when someone's letter appears here they are sent a *Think Tank II* book, which is a collection of circuits that have appeared in the past. If a reader already has one, or we are temporarily out of stock, they receive another book from our library, for example a *Circuit Circus* book.

By the way, I like your circuit a lot. The recharging

plug is a nice, practical touch.

CROSSING-GATE FLASHER

This circuit (see Fig. 3) is the solution for Bob Williams' concern in the October 1994 *Think Tank*. It works great as a crossing-gate flasher. The circuit contains only six parts, including the two incandescent lamps, and is cheap and easy to build. However, you do need a filtered power supply to run the circuit.

The two lamps, I1 and I2, flash back and forth at a rate of about 1 hertz. That flash rate is determined by the values of R2 and C1. You can alter the value of R2 for faster rates, and C1 for slower rates. Hope that helps you out.

—Paul Vandermyde,
Morrison IL
I like it when readers help

The professional weather station for people curious about the weather.

Haven't you always wanted a weather station? The Weather Monitor II makes a state-of-the-art weather monitoring system affordable enough for home use!

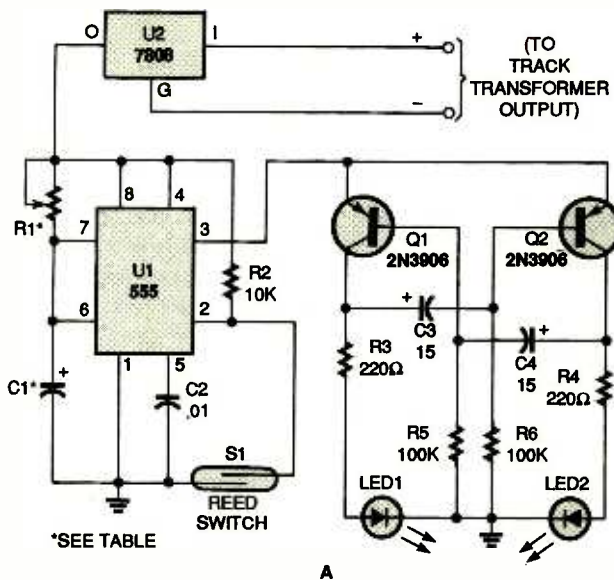
FEATURES INCLUDE:

- Inside & Outside Temps
- Wind Speed & Direction
- Barometer
- Time & Date
- Inside Humidity
- Wind Chill & Alarms
- Highs & Lows
- Rainfall Option
- Instant Metric Conversions
- Outside Hum. & Dew Point Option
- Optional PC Interface

Order today:
1-800-678-3669

M-F 7 a.m. to 5:30 p.m. Pacific Time • PE651E
FAX 1-510-670-0589 • M/C and VISA
One-year warranty • 30-day money-back guarantee

DAVIS INSTRUMENTS
3465 Diablo Ave., Hayward, CA 94545



*SEE TABLE

A

R1	TIME	
	C1 = 10 μ F	C1 = 100 μ F
100K	2 SEC.	16 SEC.
220K	3 SEC.	33 SEC.
470K	6 SEC.	70 SEC.
1MEG	15 SEC.	175 SEC.

B

Fig. 4. Featuring a reed switch operated by train proximity, this circuit (A) has everything you need to activate an LED-based crossing signal. To change the time period of U1, use these substitutions (B).

each other out. While you'll need a means to switch this circuit on and off, the reed-switch technique used in Fig. 2 should give you some ideas. By the way, because the 555 must source current part of the time, I recommend using a 555TLC, the CMOS version of the 555. The output from the lamps will be more even then.

FLASHER REVISITED

I am responding to your column in the October 94 issue about hobby circuits. I used a similar circuit (see Fig. 4A) in a crossing signal. It is a pretty-common timer circuit, based on a 555 timer IC (U1).

The monostable timer, U1, is triggered by a reed switch via a small magnet under the engine. When that happens, the output at pin 3 of U1 remains high for a time period determined

by C1 and R1. To alter that time period, replace C1 and R1 with components of the values in the provided table (see Fig. 4B). The output of pin 3 is connected directly to the flash circuit, which is a free-running multivibrator (in this case a flip-flop that triggers itself).

Resistors R3 and R4 limit current to the LED's (which flash alternately). If desired, changing the values of C3 and C4 will change the

flash rate. Power comes from an extra set of outputs from the back of a train transformer via the 8-volt voltage regulator.

—Brian Rapp, Buffalo, NY

The power-supply feature is much appreciated. This is one of the few projects where the designer provided multiple parts values for a circuit. I would be very surprised if any of our readers wouldn't have some combination of junk-box parts to make the circuit.

TRACK-CONTROL SIGNAL

This circuit (see Fig. 5) is a variation of the track-control signal circuit printed in *Think Tank* in the October 1994 issue. It is used to indicate trains in hidden tracks, such as tunnels and holding tracks, and does not require modifying the trains themselves.

The circuit is based on a 555 timer IC, U1, and operates on 5-volts DC to make it usable with digital logic. The operating power of the circuit can be converted to 12 volts by increasing the values of R2 and R3.

Train detection is accomplished by photocell PC1, which should be mounted between the rails, flush with or slightly below the ties. A small light must be mounted directly above PC1 when used in any dark area. Resistor R4 is adjusted so that when a train covers PC1 the circuit triggers. Re-

sistor R1 reduces the current to U1 if R4 is set for minimum resistance.

Variable resistor R4 can also be adjusted so that each individual car in a train will change the colors of LED1, a bi-color unit, back and forth indicating train movement. That can be handy if 2 circuits are used, one at each end of the track block. It will indicate that the train has begun to move.

Mount LED1 on the control panel. The circuit is designed to indicate a green when no train is present. When a train covers photocell PC1, U1 switches LED1 to red, indicating the train is in position.

A 3-lead, bicolor LED could have been used to conserve power, but that would have meant one more wire running to the control panel.

—Robert Hartle, Tionesta, PA

To change the values of R2 and R3 to deal with 12 volts, double the values shown in the schematic, then jump to the next-highest standard value. For crowded control panels I recommend using ribbon cable to improve neatness. Start by hooking up the indicator furthest from the cable inlet with two adjacent conductors, then peel back the rest of the cable to the position of the next indicator, and trim. Connect that indicator and proceed in the above manner until a whole row of indicators is wired; then, run the cable out the panel. Also, take advantage of using common wiring (+V or ground) whenever possible.

Well, it's time to close. Till next time, please send in your creations and suggestions to me here at *Think Tank*, Popular Electronics, 500-B Bi-County Blvd., Farmingdale, NY 11735.

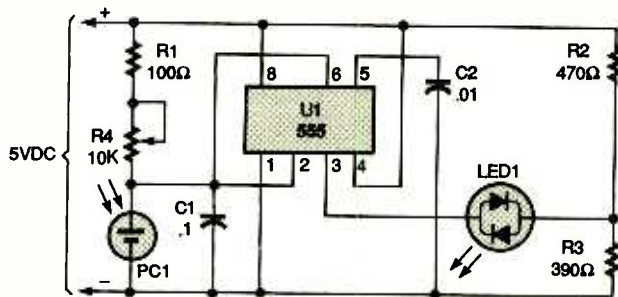
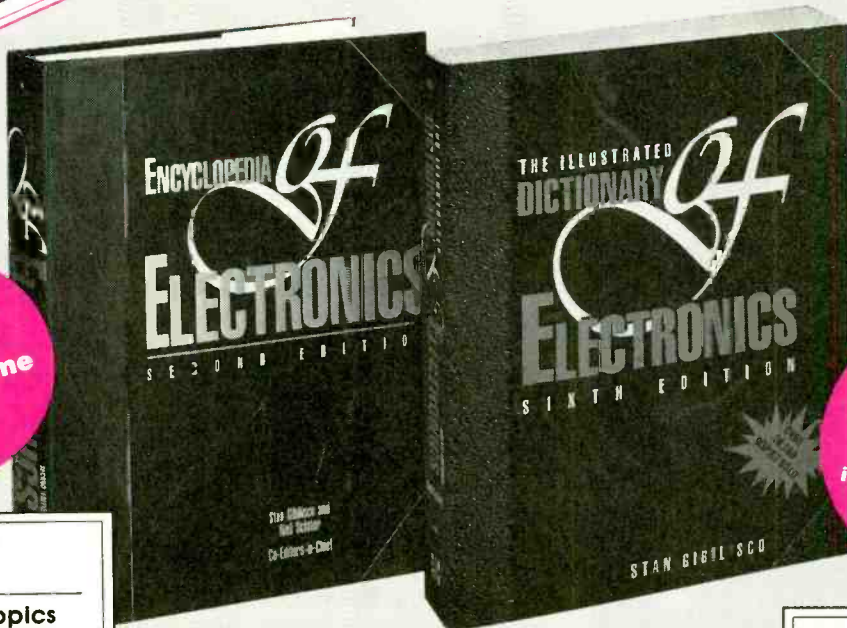


Fig. 5. Want a full-blown railroad-control panel? Try using multiple copies of this circuit to keep track of train positions.

**ALL NEW EDITIONS! MORE ENTRIES!
COMPLETELY UPDATED! THE BIGGEST AND MOST
COMPREHENSIVE REFERENCE BOOKS AVAILABLE.**

**Now, you can enhance your
library ... for a very special price...**



**Save \$20
on this
Two-Volume
Set**

**Try this
two-volume set—
FREE—for 30 days
and lock-in
this special
introductory price!**

**Encyclopedia of
Electronics**

- Over 3,000 topics
- 1,000 pages
- 1,400 illustrations
- New information on digital electronics, computers and integrated circuits

"... a fine one-volume source of detailed information for the whole breadth of electronics ... easy to follow ... without any sacrifice of thoroughness or technical accuracy."

Now you can own the Ultimate Electronics Reference Set—packed with the latest in technological information and lavishly illustrated for quick and easy use.

These two huge volumes provide students, hobbyists, technicians and engineers with a single, authoritative source of information on all aspects of electricity, electronics and communications technology.

Save money when you order now at this very special introductory price. Get both volumes for just \$89.45—a \$20 savings. Just fill out and mail the attached coupon or call 1-800-822-8158.

**The Illustrated Dictionary
of Electronics**

- Over 27,000 entries
- Generously illustrated
- Includes over 400 terms

"... highly recommended for virtually any collection which deals with electronics ... very useful for day-to-day reference."

The Ultimate Electronics Reference Set

Send order to:

McGraw-Hill, Inc.

P.O. Box 508, Columbus, OH 43216-0508

- More definitions, abbreviations and descriptions
- More diagrams, charts, photos and illustrations
- Completely updated with the latest information
- Hundreds of new entries

YES! Please send me the Ultimate Electronics Reference Set (#5867C3-6) for my FREE 30-day examination. Within the 30-day examination period, I will pay the special Introductory Offer Price of just \$89.45 for both volumes (plus \$6.50 s/h and appropriate sales tax) or return the book without further obligation.

Name _____

Signature _____
(offer invalid without signature)

Phone () _____

Address _____

City _____ State _____ Zip _____

Professional books may be tax deductible. See your tax advisor. Offer expires June 30, 1995.

☎ Call 1-800-822-8158, 24 Hours a Day, 7 days a week in U.S. and Canada

March 1995, Popular Electronics

GET THE LATEST ADVANCES IN ELECTRONICS

SUBSCRIBE TO—

Electronics NOW[®]



ENJOY THE WORLD OF ELECTRONICS EACH MONTH!

Subscribe to the best informed electronics magazine—the one that brings you the latest high-tech construction projects, feature articles on new technology, practical troubleshooting techniques, circuit design fundamentals, and much more.

Electronics Now looks to the future and shows you what new video, audio and computer products are on the horizon. You'll find helpful, monthly departments such as Video News, Equipment Reports, Hardware Hacker, Audio Update, Drawing Board, Computer Connections, New Products, and more. All designed to give you instruction, tips, and fun.

Electronics Now gives you exciting articles like:

- Buyer's Guide to Digital Oscilloscopes
- Build A Scanner Converter
- Single-Chip Voice Recorder
- Build A MIDI Interface for your PC
- Troubleshoot Microprocessor Circuits
- Build A High-Power Amplifier for your Car
- Add Music On Hold to your Phone
- All About Binaural Recording
- VGA-to-NTSC Converter



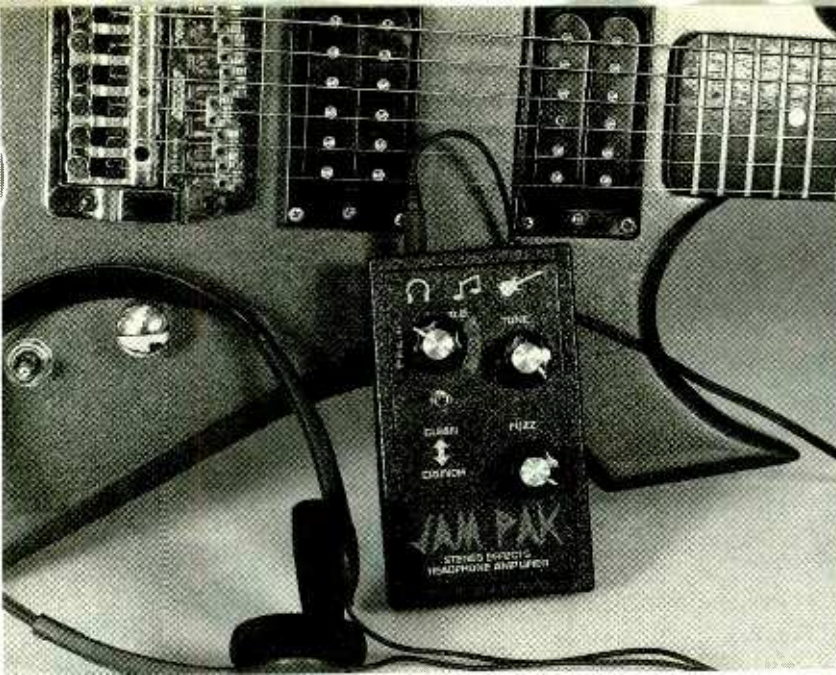
FOR FAST SERVICE CALL OUR TOLL-FREE NUMBER!

1-800-999-7139

DON'T DELAY — SUBSCRIBE TODAY!

If you prefer, just fill out the order card in this magazine and mail it in today.

7PC54



With this headphone guitar amplifier you can practice your guitar playing and prepare for a rock n' roll career, all without waking up the neighbors.

BUILD A HEADPHONE AMPLIFIER FOR YOUR GUITAR

Any electric-guitar player knows about the high cost of musical equipment. To purchase a small practice amp, one or two effects pedals, associated patch cords, and batteries and other power-supplies can cost at least a few hundred dollars. Not only is that equipment bulky and expensive, but to make things worse for the budding musician, there's always someone who doesn't appreciate a killer overdrive sound rattling the windows!

It's not easy becoming a rock 'n' roll superstar. However, with the *Jam Pak* headphone guitar amplifier described in this article, you will find it easier to practice. Simply plug in your "ax," put on the headphones, and crank it up as loud as you like. You can jam anytime, anywhere, without disturbing your family or neighbors. Similar headphone amplifiers available through music stores typically cost around a hundred dollars, but you can build the *Jam Pak* for under \$50!

The *Jam Pak* is a personal-headphone guitar amplifier featuring a unique stereo-imaging effect, and adjustable distortion, overdrive, and tone controls. It also has an auxiliary input that allows you to plug in any walkman-style tape- or CD-player and play along with your favorite

songs. That input can also be used with a keyboard or drum machine. The *Jam Pak* works with any stereo headphones and will operate for hours from a single 9-volt battery.

Circuit Description. Figure 1 is a schematic diagram of the *Jam Pak*. The main components in the circuit are two LM324 quad op-amp IC's (U1 and U2) and two LM386 power-amp IC's (U3 and U4). The inputs to U1 and U2 are biased to a little less than half the power-supply voltage by resistors R10 and R11. Capacitors C1 and C2 filter the power-supply and bias voltages.

There is no power switch in the circuit. Input-jack J1 turns on the *Jam Pak* when the input plug is inserted. When an audio signal from an instrument is input through J1, the signal is fed through coupling-capacitor C3 to the tone-control circuit composed of U1-c, R2, R4, and C4. Frequencies above 1 kHz are amplified or attenuated depending on the position of potentiometer R4, which is the tone control. Resistor R2 and capacitor C4 filter unwanted high frequencies.

Audio level and overdrive are controlled by potentiometer R9; with that level-control adjusted to full volume, the circuit's final amplifiers are over-

driven to produce a soft distortion effect. To prevent any unwanted DC "swishing" noise, a coupling capacitor, C8, is used.

Switch S1 toggles between the clean and distorted signals. When S1 is on the CRUNCH setting, diodes D1 and D2, and U1-d produce a distortion effect by clipping the amplified signal at 0.7 volts. Frequencies below 160 Hz are attenuated by R5 and C6. The amount of gain or "fuzz" is controlled by R7 and potentiometer R6, and resistor R8 adjusts the distortion level to match the tone-control level.

One of the reasons that the *Jam Pak* sounds great through a pair of headphones is its unique stereo-imaging effect. That is produced by a phase-shift circuit, composed of U2-a through U2-d, R20-R23, and C9-C12. Each stage shifts 90 degrees at the same frequency. The frequency of the shift at U2-a is:

$$f = 1/(2\pi RC)$$

where f is the frequency in hertz, π is equal to 3.14159, R is the value of R20, and C is the value of C9. For the frequency of the shift at U2-b-U2-d, use the values of R21-R23 and C10-C12, respectively (as Fig. 1 shows, those values are all equal). The four stages provide 360 degrees of phase-shift at 330

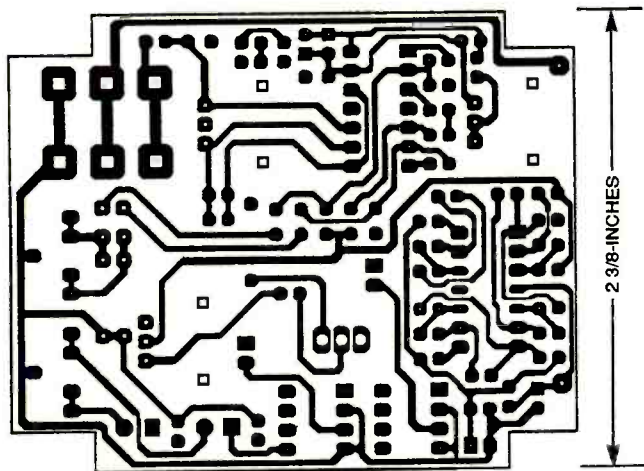


Fig. 2. Use this template to etch the component side of the printed-circuit board. The pattern is shown here in its full size of $2\frac{3}{8} \times 3$ inches.

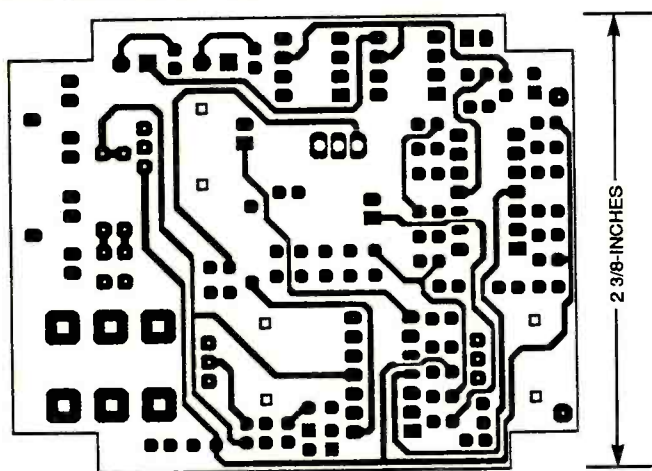


Fig. 3. This is the template for the solder side of the PC board. Like Fig. 2, it is also shown full size.

drilled enclosure with battery compartment, belt clip, and two-color silk-screening is available from the kit supplier.

Use the parts-placement diagram in Fig. 4 as a guide when building the Jam Pak, but keep the following in mind: To keep the circuit board small, most of the resistors are installed close together and standing up. To prevent a short, make sure that those part leads are not touching. Double-check your placement of integrated-circuits U1-U4 and the six electrolytic capacitors (C1, C2, and C15-C18) to make sure their polarities are correct. Also check to see if diodes D1 and D2 are installed with their banded ends facing in the directions indicated by the parts-placement diagram.

Install the IC's, jacks, capacitors, and fixed resistors on the component side of the PC board. The switch and the potentiometers should be mounted on the solder side of the circuit board (using PC-mount potentiometers eliminates the need for messy wiring, but panel-mounted units could be substituted if absolutely necessary). Make sure to solder on both sides of the circuit board whenever necessary. After you have installed all the circuit-board components, solder the 9-volt-battery snap in place, making sure that the polarity of the snap's leads is correct.

PARTS LIST FOR THE JAM PAK HEADPHONE GUITAR AMPLIFIER

SEMICONDUCTORS

U1, U2—LM324A quad operational amplifier, integrated circuit
 U3, U4—LM386N-1 low-power amplifier, integrated circuit
 D1, D2—1N4148, small-signal diode

RESISTORS

(All fixed resistors are $\frac{1}{4}$ -watt, 5% units)

R1—1-megohm
 R2, R8, R26, R27—47,000-ohm
 R3—1000-ohm
 R4—100,000-ohm, linear-taper potentiometer
 R5—4700-ohm
 R6—500,000-ohm, linear-taper potentiometer
 R7—470,000-ohm
 R9—10,000-ohm, linear-taper potentiometer
 R10—100,000-ohm
 R11—82,000-ohm
 R12-R23—22,000-ohm
 R24, R25—33-ohm

R28-R35—10,000-ohm

CAPACITORS

C1, C2—100- μ F, 10-WVDC, electrolytic
 C3, C6, C8, C13, C14—0.1- μ F, ceramic-disc
 C4, C7—0.001- μ F, ceramic-disc
 C5, C19, C20—0.01- μ F, ceramic-disc
 C9-C12—0.022- μ F, ceramic-disc
 C15, C17—1- μ F, 35-WVDC, electrolytic
 C16, C18—220- μ F, 10-WVDC, miniature electrolytic

ADDITIONAL PARTS AND MATERIALS

J1— $\frac{1}{4}$ -inch stereo phone jack, circuit-board mount
 J2, J3—3.5 mm stereo phone jack, circuit-board mount
 S1—SPDT, micro-miniature toggle switch
 B1—9-volt alkaline battery

Printed-circuit materials, enclosure, knobs, stereo headphones, 9-volt-battery snap with leads, wire, solder, hardware, etc.

Note: The following items are available from Lynn-Eren Electronics (17093 S. W. Lynnly Way, Sherwood, OR 97140; Tel. 503-625-2205): a complete kit of parts including an etched, drilled and plated-through PC-board with solder mask, and a pre-drilled enclosure with belt clip and two-color silk-screening, \$49; a fully assembled and tested unit, \$59; the PC-board only, \$15; stereo headphones only, \$10; a 72-inch auxiliary-input cable (3.5 mm stereo plug to 3.5 mm stereo plug), \$5. Please add 5% shipping and handling. Check or money order, VISA and MasterCard are accepted.

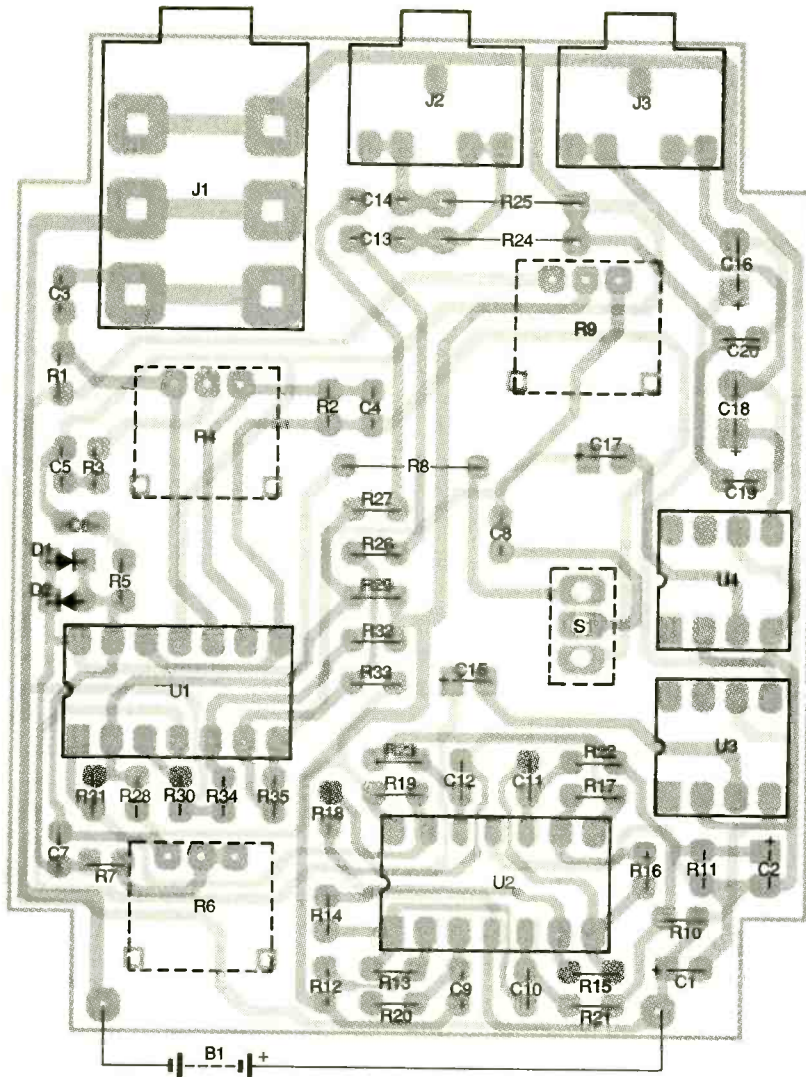


Fig. 4. Be sure to double-check the placement and polarity of your components with this diagram to avoid damaging any of them. Note that switch S1 and potentiometers R4, R6, and R9 mount on the solder side of the board.

Checkout and Use. When the placement of all components has been thoroughly checked, you are ready to try out the Jam Pak. Plug a guitar, bass, or other unamplified musical instrument into input-jack J1, and plug stereo headphones into headphone-jack J3. Note, however, that the sound heard through the headphones might be surprisingly loud, so it is a good idea *not* to put them on just yet.

Connect a fresh, 9-volt alkaline battery to the unit. With switch S1 in the "clean" position and level-control R9 set at low to moderate volume, the amplifier should sound undistorted. Adjusting potentiometer R9 to a high volume setting should overdrive the amplifier and produce a soft distortion effect. Level controls on the guitar or other instrument might need to be turned up to achieve the overdrive effect.

With switch S1 in the "crunch" position, the amplifier should produce a hard distortion or fuzz sound, which can be adjusted using the "fuzz" control, R6. The tone control, R4, should adjust the treble of both the "clean" and "crunch" sounds.

Playing scales is a good way to hear how the Jam Pak amplifier's stereo effect works. As the frequency changes, the position or panning of the stereo channels also changes. The stereo effect will sound the fullest when playing chords or fast riffs with a wide frequency range.

To use the auxiliary input, connect any stereo walkman-type cassette- or CD-player, drum machine, or other amplified audio equipment to jack J2. That input has a low impedance, which is appropriate only for devices intended to drive headphones or speakers. Other high-impedance sources might be damaged if connected to J2.

The unit will operate for several hours on a good alkaline battery. Because the power switch is part of J1, it is a good idea to disconnect the plug from the input when the amplifier is not in use.

Once you get the Jam Pak working, you'll be able to practice any time of day or night you please, without irritating those around you. And who knows, with a bit of practice and some luck, rock n' roll stardom could be just around the corner! ■



This compact amplifier lets guitar players brush up on their skills without annoying others.

Glowing gas-discharge tubes were among the first electronic wonders. In the past, they were used as voltage regulators in tube circuits. However, even though gas-discharge tubes are still one of the easiest ways to regulate voltages higher than 75 volts, they are rarely applied to that task anymore.

What's a good use for a glowing tube? Well, because it is a source of faint light, a voltage-regulating gas-discharge tube makes a great nightlight. With just one of the tubes (which you can pick up on the antique-tube market for a buck or two), a couple of mirrors, and a few other components, you can build the *Novel Nightlight*, a truly unique project for the electronics-oriented household.

Voltage-Regulator Tubes. Voltage-regulator (VR) tubes are diodes; they have a plate and a cold cathode (i.e. one without a filament). During the manufacture of a VR tube, air is removed from the tube and the glass envelope is filled with small quantities of helium, neon, argon, or other gases at very low pressure. When enough voltage is placed between the plate and the cathode, the tube glows.

Let's take a look at how the tubes

work. A typical circuit using a VR tube is shown in Fig. 1. As long as the current through the tube is kept within the manufacturer's ratings (typically 5 to 40 mA), the voltage at E_2 will change very little, despite variations in supply voltage E_1 or in the load current.

The above circuit only has one resistor, R1. To find the value of that resistor in ohms, use:

$$R1 = (E_1 - E_2) / I_{max}$$

where I_{max} is the maximum tube current.

BY LARRY LISLE, K9KZT

Build this unusual nightlight in an evening or two, using an old, gas-filled voltage-regulator tube.

Build a Novel Nightlight

As you can see, the operation of a VR tube is simple. However, for this project we won't be using it to regulate voltages. We just want to make the tube glow!

The Circuit. Figure 2 shows the circuit of the Novel Nightlight. It's basically a transformerless, half-wave power supply that puts out enough voltage to keep V1, the OA3/VR75 VR tube, glowing. Because the circuit has no transformer, it's absolutely necessary for safety that all conductors be enclosed in insulated material!

In the event of component failure, fuse F1 will blow and interrupt the current flow. Resistor R1 limits the current through diode, D⁺, which rectifies the AC; capacitor C⁺ smoothes out the pulsations. The function of resistor R2 isn't immediately obvious but it is important. If R2 wasn't in the circuit, unplugging the nightlight would cause the voltage on C1 to discharge through R3 and V1. However, when the voltage dropped below 75 volts, V1 would go out and the 75 volts in the tube would just sit there waiting to zap someone. Even with a "bleeder" resistor like R2, it's always a good idea to short power-supply capacitors with an insulated screwdriver after unplugging.



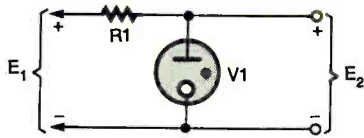


Fig. 1. This is the basic circuit for using a gas-discharge tube as a voltage regulator. In the nightlight project, however, we just want to make the tube glow!

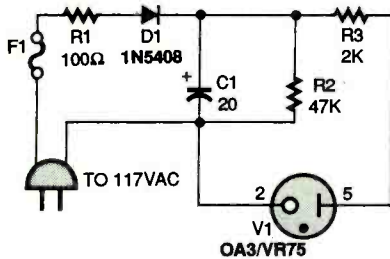


Fig. 2. The circuit for the Novel Nightlight is basically a transformerless, half-wave power supply that provides enough DC to light up V1, the voltage-regulator tube.

PARTS LIST FOR THE NOVEL NIGHTLIGHT

- D1—1N5408 silicon rectifier diode
- R1—100-ohm, 1-watt resistor
- R2—47,000-ohm, 2-watt resistor
- R3—2000-ohm, 5-watt resistor
- C1—20- μ F, 250-WVDC, electrolytic capacitor
- V1—OA3/VR75 voltage-regulator tube
- F1— $\frac{1}{4}$ -amp, fast-acting fuse
- $7\frac{3}{4}$ -inch square baseboard, 7-inch square pieces of glass (2), 7-inch square pieces of mirror (2), $7\frac{1}{4}$ -inch square piece of glass, rubber mounting feet (4), molding strips (8), power cord and plug, octal relay socket for tube (Potter & Brumfield 27E122 or equiv.), Fahnestock clips, fuse holder, epoxy glue, wire, solder, etc.

ging the circuit and before touching anything.

Construction. The method of wiring used to build the nightlight isn't critical. For the prototype, Fahnestock clips and some of the unused tube-socket terminals were used to make connections. If you do the same, be aware that pins 7 and 3 of the OA3/VR75 are connected internally.

The circuit should be mounted on a wood baseboard. In the prototype, that measures $7\frac{3}{4} \times 7\frac{3}{4}$ inches. Drill a hole in one corner of the board for the power cord to go through, but make

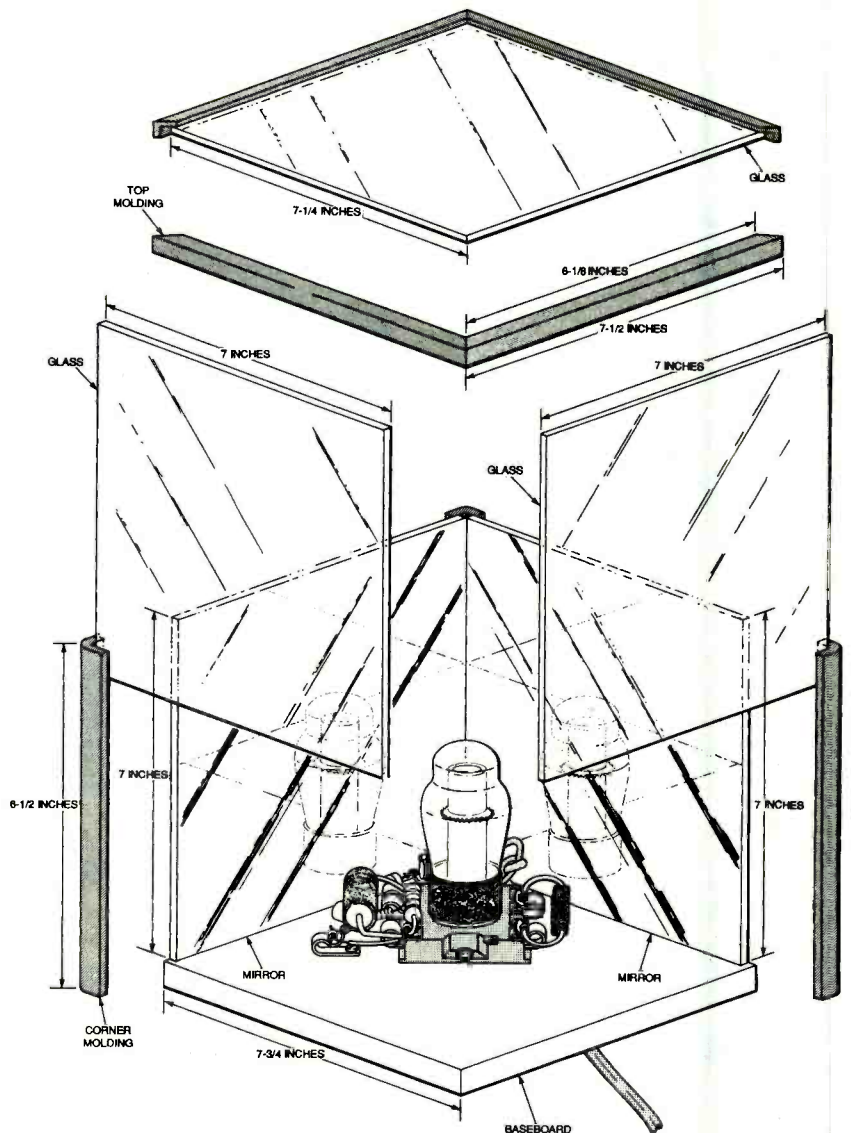


Fig. 3. Here is an exploded view of the nightlight-case assembly. The molding strips hold the pieces of glass and the mirrors together once they are glued. Note the 45° angles on the top molding which allow for a tight fit.

sure to tie a knot in the cord before inserting it, as that prevents strain on the wiring. To keep the unit from wobbling, attach four rubber feet on the bottom of the baseboard.

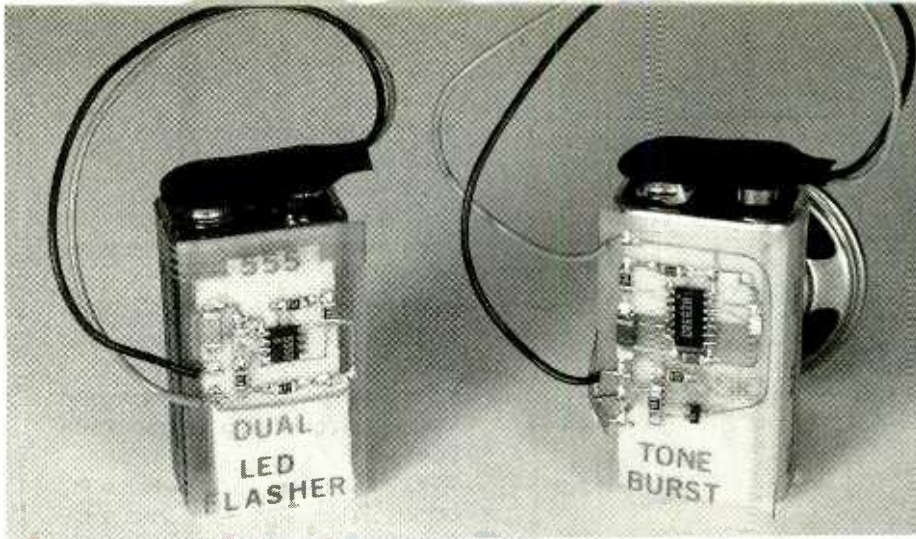
There are a few ways to adjust the brightness of the Novel Nightlight. First of all, you can change the value of R3. However, keep in mind that the current shouldn't exceed 40 mA (with the values shown in Fig. 2, it's about 31 mA). Also, other voltage-regulator tubes can be used instead, even though the OA3/VR75 was the brightest of the several that I tried. For a little variety, you could also add flashing neon bulbs with a capacitor and resistor for each, or an old mercury-vapor rectifier such as an 866.

Because of the high voltages present in the nightlight and the fact that the tube will get hot, once you have the circuit working, you should place it in some kind of enclosure or cover. An inverted food-preserving jar, an old aquarium, or a Plexiglas enclosure can be used. In the author's prototype, the enclosure was built as a 7-inch-on-a-side glass and mirror box (see Fig. 3). Two of the sides were made of mirror squares, so that when the unit is assembled and viewed at an angle, it looks as if there are four glowing tubes.

To duplicate the enclosure shown in Fig. 3, you will need two glass squares and two mirror squares, measuring 7

(Continued on page 96)

Getting Started in Surface Mount Technology



Two projects that will get you started in building with surface-mount components.

BY RONALD A. REIS

For most electronics hobbyists, the idea of hand-assembling surface-mount components (SMC's) into a working project seems ludicrous. After all, as most of us know, surface-mount technology (SMT) was developed with automatic assembly in mind. Finding, grasping, arranging, and somehow soldering those tiny, leadless SMT components by hand is ridiculous. Right? Wrong—delightfully wrong! Not only is it possible, but it can be accomplished easily, quickly, and, for the most part, with tools and materials you now have on your workbench.

As mentioned in the article "A Hobbyist's Guide to Surface-Mount Technology" (*Popular Electronics*, January 1995), SMT is a packaging revolution that attaches tiny, essentially "leadless" components to pads on the surface of a printed-circuit board (hence the name, "surface-mount technology"). That contrasts with traditional "insertion-mount technology" (IMT), which uses components with leads that are inserted through the PC board.

As you are about to discover, project-building with SMT is fascinating, fun, and, increasingly, inevitable. Even though today, for the most part, you still have a choice between traditional IMC's (insertion-mount components) and SMC's, tomorrow you might not; already, 50% of all the components in commercial electronic as-

semblies are SMC's. So, if you don't want to let a whole component-packaging revolution pass you by, learn to build the electronic projects of the near future, now.

SMT Project Building. To get you started in building tomorrow's electronic projects today, here are two fun, attention-getting, and, most important, easy-to-build SMT projects: the *555 Dual-LED Flasher* and the *Tone Burst*. Furthermore, to give you practice in fabricating SMT PC boards and soldering SMC's in place, a printed-circuit template for an SMT Practice Board is also included.

Both of the SMT projects presented here were chosen to give the begin-

ner the widest possible SMT project-building experience, using readily available, low-cost surface-mount components. Each project is built on a 1- x 1¾-inch PC board that is intended to be taped to the side of a 9-volt battery, its power source. The 9-volt-battery snap found in both projects, and the 8-ohm speaker in the *Tone Burst* are the only non-SMT components used.

Circuit Descriptions. The first project, the *555 Dual-LED Flasher*, alternately flashes a pair of tiny, surface-mount LED's at a rate of approximately 1 Hz. Figure 1 contains the schematic for that project.

The 555 timer, U1, is configured as an astable multivibrator (oscillator), the frequency of which is determined by the values of resistors R1 and R2 and capacitor C1. As C1 charges from ⅓ to ⅔ the supply voltage through R1 and R2, U1's output, pin 3, is high. As a result, LED2 is on (its anode is positive, its cathode, negative) while LED1 is off (both its anode and cathode are positive). When C1 discharges from ⅔ to ⅓ the supply voltage through R2, pin 3 goes low. As a result, LED1 turns on (now its cathode is negative and its anode is positive) and LED2 turns off (both its anode and cathode are negative). The duty cycle for the circuit is nearly 50 percent; therefore, each LED is on for close to an equal duration.

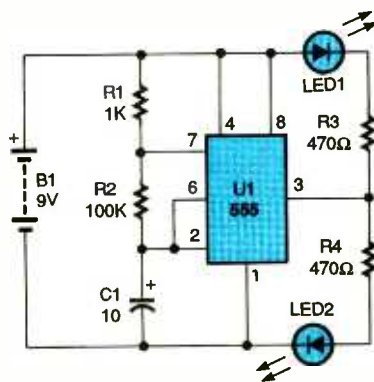


Fig. 1. Here is the schematic for the *555 Dual-LED Flasher*. The circuit alternately flashes LED1 and LED2, two surface-mount LED's, at a rate of approximately 1 Hz.

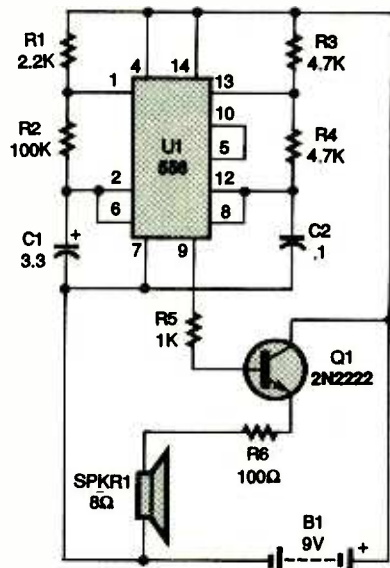


Fig. 2. The Tone Burst circuit puts out a 500-Hz tone, at a rate of 1 Hz, through an 8-ohm speaker, SPKR1. Besides the 9-volt battery and its connecting snap, SPKR1 is the only non-surface-mount component in the circuit.

The Tone Burst puts out a 500-Hz tone at a rate of 1 Hz. At the heart of the circuit is U1, a 556 IC, which is just two 555 IC's in one 14-pin package (see Fig. 2). Both "555's" are configured as astable multivibrators. The first, or low-frequency, oscillator, using resistors R1 and R2 and capacitor C1, turns on the second, or high-frequency, oscillator at a 1-Hz rate. The latter is alternately on and off for half a second. When it is on, it generates a 500-Hz signal, that value being determined by resistors R3 and R4 and capacitor C2. That signal is amplified by NPN transistor Q1, which drives the 8-ohm speaker.

SMT PC-Board Fabrication. The steps in fabricating an SMT printed-circuit board are identical to those used in etching a traditional, single-sided, IMT PC board. There are, however, two additional steps, or cautions, that should be observed when SMT boards are etched. We'll look at both in a moment, but first, here are the ten steps required to produce either an IMT or SMT PC board:

1. Clean the blank board with fine steel wool to get rid of contaminants and oily residue.
2. Spray a liquid photoresist onto the copper-clad board.
3. Dry the photoresist with a hair dryer.
4. Expose the sensitized board, with

- the artwork negative on top, to ultraviolet light.
5. Let the image develop.
6. Rinse and drip-dry the board.
7. Immerse the board in acid (ferric chloride is often used).
8. When etching is complete, thoroughly wash the board and then dry it with a paper towel.
9. Remove the remaining photoresist layer by lightly rubbing the board with steel wool.
10. Drill all necessary holes in the PC board. In an SMT PC board, only mounting holes might be required.

The PC-board template for the 555 Dual-LED Flasher is shown in Fig. 3 and the one for the Tone Burst is shown in Fig. 4. Note the small component pads and the extremely thin traces—in some cases, a mere 0.015-inches wide. When fabricating those and other SMT boards, two cautions are worth observing:

First, because you are dealing with

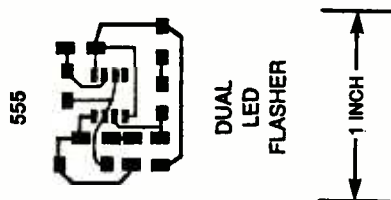


Fig. 3. This template for the 555 Dual-LED Flasher's PC board is shown in its actual size of only 1 × 1¼ inches! Note the small pads and extremely thin traces.

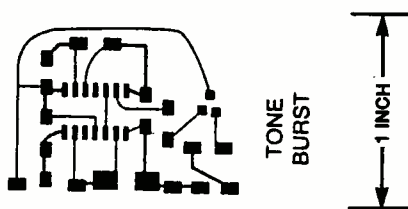


Fig. 4. The printed-circuit template for the Tone Burst is also shown here full size.

traces not much thicker than a line drawn with a pencil, it is a good idea to check the etching process frequently. Pull the board out of the acid bath often and examine it closely for acid undercuts. The narrow traces of an SMT board are delicate—leaving your board in the acid any longer than necessary to etch away unwanted copper might damage the traces.

Second, once the board is complete, check the PC-board pattern

with a magnifying glass. However, that might not be enough to locate any possible trace breaks, so you should check each trace (and pad) with a continuity checker (ohmmeter). That way you can be sure that the board is ready for the installation of surface-mount components.

Figure 5 is the template for an SMT practice board. By fabricating that board, you can gain experience in etching SMT PC boards with small pads and thin traces. Also, you can use the practice board to rehearse the SMC assembly techniques discussed later. For those reasons, etching the practice board before tackling either of the two SMT project boards is recommended.

Tools and Materials. In building either of the two projects presented here, you will need the right tools and materials. A full explanation of the items required was presented in "A Hobbyists Guide to Surface-Mount Technology" in the January 1995 issue of **Popular Electronics**. If you have a copy of that article, you might want to look it over.

Briefly, here are some tools you'll need: a soldering iron, a tweezers, a vise, and a magnifying glass. The soldering iron needs to be from 25 to 40 watts and should have a tinned tip with a conical shape, ¼ of an inch or less in diameter. The tweezers should have forceps-style tips. A small vise is ideal for securing the PC board while components are being attached. Because SMC's are so tiny, no matter

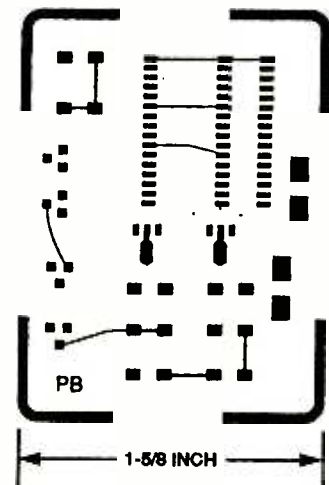


Fig. 5. Fabricating this SMT practice board will give you practice in etching an SMT PC Board, and in mounting SMC's. It is shown here full size.

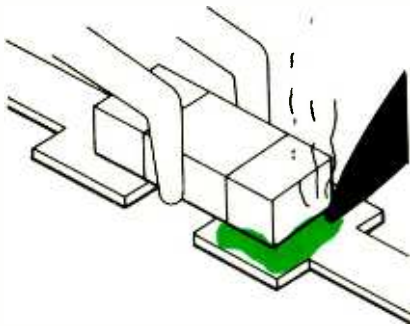


Fig. 6. To tag solder a two-terminal SMC in place, create a pool of solder on a pad, place the component above it, and reheat the solder so the SMC can "sink" close to the board surface.

how good your eyesight is, you'll want a magnifying glass close by. A desk-top illuminated magnifier, the kind that sells for around \$80, is ideal. At the very least, get yourself an inexpensive hand-held lens.

The materials you'll require are solder, liquid flux, a drop dispenser, a defluxer, and solder wick. The solder should have a 63/37 tin-lead mixture, and should be no greater than 0.020 inches in diameter. If you can find it, a 0.015-inch-diameter solder is even better. When purchasing a bottle of liquid flux, be sure it is of the noncorrosive type. To directly apply the flux where it is needed, you will want a drop dispenser. Also purchase a light-duty defluxer, in a spray can, which will be used to clean your assembled PC board of all contaminants. Finally, when choosing solder wick, select a width of 0.030 inches.

Attaching SMC's to PCB's. In building an SMT project, we suggest that you use the tag solder method discussed in the aforementioned article. Here is a review of the procedures for tag soldering various SMC's to a surface mount PC board:

To tag solder a two-terminal SMC to the surface of your PC board, first, using your drop dispenser, apply a dab of liquid flux to one PC-board pad. Then, using your soldering iron and solder, create a small pool of solder on that pad. Allow the solder to solidify.

Next, with the SMC held in your tweezers, rest the component on its PC-board pads and hold it in place. Then, using a soldering iron held in your other hand, reflow the solder so that the component "sinks" close to

the board surface (see Fig. 6). Remove the iron, allow the solder to cool again, and release the tweezers. With the component "held" in place, you're ready to solder the other terminal in a traditional manner.

To solder gull-wing leads on three- and four-lead components, proceed as above. Tag solder one lead and then solder the remaining leads in the conventional way (see Fig. 7).

When soldering DIP, gull-wing surface-mount IC's (SOIC's), first create a pool of solder on a corner pad in preparation for tag soldering. Then pick up the IC with a tweezers and

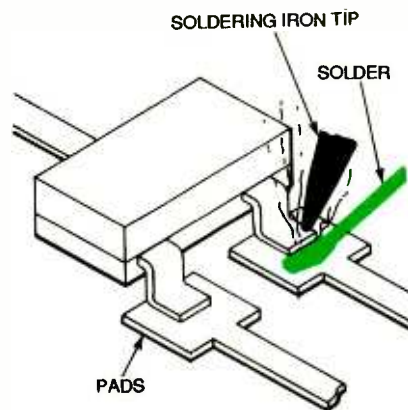


Fig. 7. To solder gull-wing leads to a PC board, use a 63/37 tin-lead solder that is 0.015 inches in diameter, and a conical soldering-iron tip that is 1/16 of an inch or less in diameter.

place it onto the copper pads, making sure to center the IC right-to-left as well as top-to-bottom. While holding the chip in place, apply the soldering iron tip to the pre-tinned pad. Keep the iron in place just long enough to flow the solder. If necessary, pivot the IC about the soldered pin to again align all pins with their respective pads.

To ensure the IC doesn't pivot, solder a second pin "kitty-corner" to the first. When doing so, don't forget to apply a small amount of liquid flux. When the chip is secure, "bathe" one line of pins with liquid flux and solder each pin, moving quickly to avoid overheating the IC. Then repeat the above step with the opposite row of pins. Finally, inspect your work under the magnifying glass, looking in particular for solder bridges.

At this point, you could continue directly to the assembly of your chosen project. However, if the procedures

just outlined seem a bit intimidating, you might want to practice a little SMC-placement first. That's where the SMT practice board, mentioned earlier, comes in. If you have etched the board, as suggested, you can now proceed to "stuff it" with surplus SMC's. As you will notice, pads to accommodate various sized two- and three-terminal SMC's, as well as thin- and wide-bodied DIP SOIC's, are provided.

Before actual component-placement and assembly begins, clean your PC-board traces and pads with steel wool. Next, mount the PC board securely in a vise. If you don't have a vise, you can try holding the PC board down by taping its corners to a flat surface with masking tape.

If you are using a desk-top magnifier, swing it into place and turn on the light. Place the rest of your tools, materials, and components nearby, within easy reach, and get comfortable. Pretend you're a surgeon about to perform a delicate operation. Then, just pick out a component location on the PC board, take a deep breath, exhale, and give it a go. You'll be a pro at SMT hand assembly in no time. Now, let's build our projects!

Construction. The parts-placement diagram for the 555 Dual-LED Flasher is shown in Fig. 8, and the parts-placement for the Tone Burst is given in Fig. 9. Whichever project you build, begin by attaching the integrated circuit. Note that in both projects the IC is placed so that pin 1 is on the top-left pad. Next, install any polarized capacitors (the positive terminal is indicated by either a colored bar or a

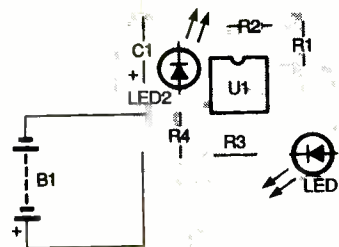


Fig. 8. Use this diagram as a guide when building the 555 Dual-LED Flasher. Because their markings are so small, polarized SMC's can be hard to work with, so be careful when aligning them.

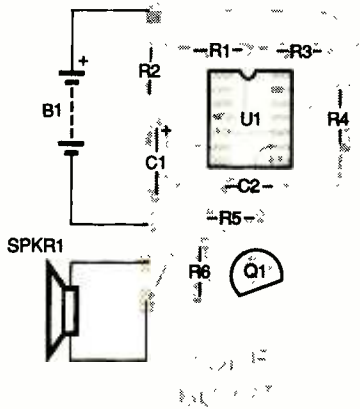


Fig. 9. This Tone Burst parts-placement diagram should make building the project a lot easier. Double check your battery- and speaker-wire connections to make sure they are correct.

PARTS LIST FOR THE 555 DUAL-LED FLASHER

- U1—555 timer, surface-mount integrated circuit
- LED1, LED2—Green LED, surface mount
- R1—1000-ohm resistor, surface mount
- R2—100,000-ohm resistor, surface mount
- R3, R4—470-ohm resistor, surface mount
- C1—10- μ F, 10-volt, electrolytic capacitor, surface mount
- B1—9-volt alkaline battery
- Printed-circuit materials, 9-volt-battery snap with leads, wire, solder, hardware, etc.

PARTS LIST FOR THE TONE BURST

- U1—556 dual timer, surface-mount integrated circuit
- Q1—2N2222 transistor or equivalent, surface mount
- R1—2200-ohm resistor, surface mount
- R2—100,000-ohm resistor, surface mount
- R3, R4—4700-ohm resistor, surface mount
- R5—1000-ohm resistor, surface mount
- R6—100-ohm resistor, surface mount
- C1—3.3- μ F, 10-volt, electrolytic capacitor, surface mount
- C2—0.1- μ F chip capacitor, surface mount
- B1—9-volt alkaline battery
- SPKR1—8-ohm speaker
- Printed-circuit materials, 9-volt-battery snap with leads, wire, solder, hardware, etc.

small marking). Proceed to install any non-polarized capacitors.

You can then place all the resistors. Because those components have no polarity, they can be installed in either direction. Do, however, solder them in place so that their resistance value is visible (for an explanation of how the values are read, once again refer to the previously mentioned article).

The 555 Dual-LED Flasher uses two LED's that are, of course, polarized. The cathode end is usually marked with a dot of green or red paint. If you're building the project, attach the LED's at this time.

The Tone Burst Project includes a three-terminal transistor. Because that tiny component can be placed on

"abuse," this is the time to find out. If your assembly techniques were good, the SMC's will hold.

Finally, attach a 9-volt battery. Your project should blink or beep, depending on which one you built. If the project fails to function correctly, make sure that you are using a fresh 9-volt battery. Then, check component placement and solder-joint integrity, and examine the project under your magnifier.

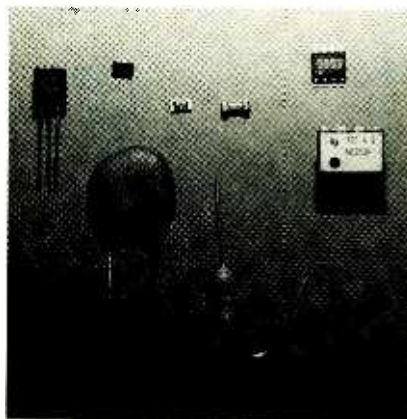
When your project is working, attach it to the battery with double-sided tape. For the Tone Burst, if you used a small enough speaker, you can affix the unit by taping it to the opposite side of the battery.

How to Get SMC's. You can purchase surface-mount components in single-lot (or "near-single-lot") quantities from a growing number of electronics distributors and retail outlets. First, check with your local electronics store. Second, look at the list of distributors presented in the aforementioned SMT article.

One of those sources, the Electronics Goldmine (P.O. Box 5408, Scottsdale, AZ 85261; Tel. 602-451-7454), has exactly what you need for either of the above two projects. In some cases you will have to purchase components in lots of anywhere from 5 to 20. That's practical, however, because you'll probably want to use the extras for solder practice or for building more projects.

Conclusion. Having built one or both of the SMT projects presented in this article, you have entered an entirely new realm of project building. In doing so, you have taken a leap not unlike that experienced by earlier electronics hobbyists when going from vacuum-tube-, to transistor-, to IC-based projects. You, too, are an electronics pioneer. But don't stop now.

SMT project kits are beginning to appear from a variety of sources. Purchase some of those kits and build them. Also, in the months to come, as you page through new issues of **Popular Electronics**, zero-in on the simpler IMT-based projects and try creating your own SMT versions of them. In no time at all, you will become an experienced pro at SMT project building.



Surface-mount components are much smaller and lighter than their insertion-mount-component cousins.

the PC board in only one correct direction, you can't get its placement wrong. If you are building the Tone Burst, install the transistor now.

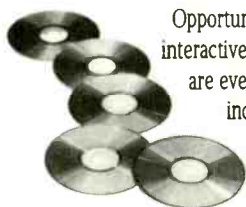
Tag solder the battery-snap wires directly to the appropriate PC board-pads. Be sure to observe correct polarity. Finally, if you are building the Tone Burst, attach speaker wires, approximately 2-inches long, to the correct pads on the PC board (see Fig. 9). Solder the other ends to SPKR1. For the sake of proportion, and to make an interesting assembly (more on that later), select a miniature unit for that speaker.

Checkout and Use. Before testing your project, spray it with the light-duty defluser. Then take a nail brush and scrub vigorously to remove contaminants. Don't be afraid that you'll scrape off an SMC or two. If the components can't stand the rubbing

Earn Top Dollar as a Multimedia Programmer!

America's #1 choice for at-home training. Only NRI gives you hands-on experience with a fast, powerful 486DX2/66MHz multimedia computer system you train with and keep!

Today, computer programming is not only the fastest-growing computer career field, it's also one of the most respected, highest-paid professions in America. And no wonder: Recent advances in multimedia applications have put programmers at the forefront of yet another new revolution — one that's changing forever the way the world lives, learns, and works with computers.



Opportunities to create interactive multimedia programs are everywhere: in retail, to increase sales with immediate, point-of-purchase kiosks; in education,

to increase students' level of understanding and retention in all subject areas; and in business and industry, for more persuasive sales presentations and for cost-efficient and effective skills training.

Now, with NRI's one-of-a-kind training in Multimedia Programming, you can take advantage of this growing specialty field and chart your future in an exciting, money-making career.

NRI's Multimedia Programming course includes everything you need for a fast start in a new career

NRI's unique modular training gets you started fast with step-by-step lessons and hands-on projects that bring theory to life and reinforce every important concept. Your training is *complete* computer programming training, starting with the basics and moving on to the more advanced languages used in today's multimedia authoring programs.

Best of all, you train with and keep a powerful, state-of-the-art 486DX2/66 MHz computer, Windows 95 — the newest version of this popular graphical user interface — and Multimedia Toolkit authoring software. What's



more, you turn this powerful computer into an MPC-2 system when you add the CD-ROM drive, sound card, and stereo speakers included in your course!

You're backed by a team of pros

NRI's team of professional instructors is behind you all the way — on hand and ready to assist if you need help at any point in your training. And now, you can complete your training even faster with NRI's new TeleGrading system that lets you take your tests and get your grades 24 hours a day by phone!



Train with and keep a 486DX2/66 Multimedia PC!

Here's what makes your computer such a powerful tool for multimedia programming:

- High speed Intel 80486DX2 CPU with 66 MHz clock
- 420 megabyte hard disk drive
- Built-in math coprocessor
- ZIF socket
- Pentium Overdrive-ready motherboard
- 8 meg RAM installed
- High density 3.5" floppy disk drive
- Fax/modem
- Double-speed CD-ROM drive, sound card, and speakers
- 14" Super VGA color monitor with .28mm pitch and tilt-swivel base

**Send Today For Your Free Catalog
Or call 1-800-321-4634 extension #1063**

Send for your free full-color catalog that describes every aspect of NRI's breakthrough training in multimedia programming as well as at-home training in other high-tech career fields.

If the coupon is missing, write to NRI Schools, McGraw-Hill Continuing Education Center, 4401 Connecticut Ave., NW, Washington, DC 20008.

SEND THIS COUPON TODAY!

NRI Schools McGraw-Hill Continuing Education Center
4401 Connecticut Ave., NW, Washington, DC 20008

YES! I'm interested in learning more about this exciting new course! Please rush my FREE catalog today!

Check one only:

- | | | |
|--|---|---|
| <input type="checkbox"/> Multimedia Programming | <input type="checkbox"/> Programming in C++ | <input type="checkbox"/> Bookkeeping |
| <input type="checkbox"/> Computer Programming | <input type="checkbox"/> With Windows | <input type="checkbox"/> Fiction/Nonfiction Writing |
| <input type="checkbox"/> Microcomputer Servicing | <input type="checkbox"/> PC Applications Specialist | <input type="checkbox"/> Desktop Publishing |

Name _____ (Please Print) _____ Age _____

Address _____

City _____

State _____ Zip _____

Accredited Member, National Home Study Council 1901-0395

SIM-EQ: The Simultaneous-Equation Program

Let the silicon brain sitting in your den do some of the number-crunching on your electronics calculations.

BY JAMES E. TARCHINSKI

Everyone who works with electronics has their own reasons for choosing it as a career or a hobby. Some like the challenge of designing circuits, others take pleasure in building them, and a few enjoy the "pleasant" frustrations of debugging a circuit once it's built. There is even a group of people who enjoy electronics, at least in part, because of the mathematics involved. Yes, you read that last sentence correctly: It does read "because of" and not "in spite of" the math involved.

Even the most devout mathematician, however, eventually grows tired of repeatedly performing a single sequence of calculations. An example of repetitive calculations is the solving of a series of simultaneous equations that is often necessary to analyze complex electronic circuits. The first few times you solve a group of simultaneous equations it's fun; after that it becomes drudgery and you start looking for some relief.

SIM-EQ.BAS can provide that relief. It is a BASIC program that can solve a series of up to 25 simultaneous equations with real, constant coefficients. Although the program was written for IBM-compatible PC's, it can easily be modified to run on any machine that supports BASIC.

But before you can use *SIM-EQ* to solve a series of equations, you need a series of equations to work with. Therefore, let's take a look at how to solve and obtain simultaneous equations, using a sample circuit for illustration.

There are two basic analysis approaches that can be used to solve complex electronics circuits: one based on Kirchoff's Current Law (KCL)

and the other based on his voltage law. (For more information on both types of analysis, refer to the article "Beyond Ohm's Law," by Paul Coxwell, in the May 1994 issue of **Popular Electronics**.) We will briefly look at the approach based on KCL, which is generally known as "Nodal Analysis."

Nodal Analysis. Kirchoff's Current Law states that the sum of all the currents flowing into a node of a circuit must equal the sum of all the currents flowing out of that node. To perform nodal analysis, all you need to do is write one KCL equation for each node of the circuit, not counting the ground node. That means that in a circuit containing a total of N nodes you will end up with a total of N independent equations. For example, in a three-node circuit ($N = 3$), you would have three equations.

The next step in nodal analysis is to replace every current variable in the equations you just generated with a term based on the node voltages of the circuit. For a resistive element, use Ohm's law to represent the current flow through the element in terms of its resistance and the voltages at the

two nodes to which it is connected. For current sources, that particular step does not apply because the current supplied is not a variable but a fixed number. Therefore, it is already in a form that is easy for a computer to deal with.

After completing those two basic steps you will end up with a total of N equations, within which there should only be references to the N node voltages of the circuit. Unfortunately, you can not solve those equations one at a time. All the equations need to be solved *simultaneously*, and hence mathematicians call those types of equations *simultaneous equations*.

Over the past few hundred years, several methods for solving series of simultaneous equations have been developed, but the best method was created about 40 years ago. That, of course, is to let a computer do it, which is precisely what the *SIM-EQ* program was written to do.

Program Operation. To demonstrate the use of *SIM-EQ.BAS*, let's use it to solve a series of three equations with three unknown values. To obtain those equations, we must first perform

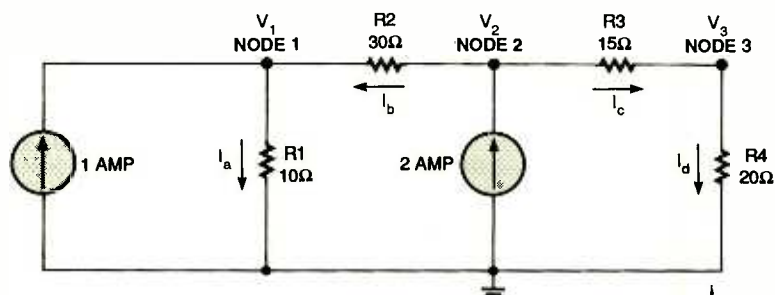


Fig. 1. Performing nodal analysis on this three-node circuit generates equations 10, 11, and 12. The *SIM-EQ* program can then be used to solve those equations to obtain node voltages V_1 , V_2 , and V_3 .

LISTING 1

```

100 CLEAR : DIM A(25, 26): KEY OFF
110 SCREEN 0, 0, 0, 0: COLOR 10, 0, 0: WIDTH 80: CLS
120 PRINT "SIM-EQ: The Simultaneous Equation Program"
130 PRINT "Copyright (c)1988-94 by James Tarchinski"
140 PRINT
150 PRINT "Enter the number of variables/equations"
160 INPUT "in the system you wish to solve (1-25): ", IN$
170 PRINT : N = VAL(IN$)
180 IF N > 25 OR N < 1 THEN PRINT "PLEASE ENTER A VALID NUMBER!": GOTO 140
190 N1 = N + 1
200 PRINT
210 '
220 '***** ENTER THE COEFFICIENTS *****
230 FOR I = 1 TO N
240 PRINT : PRINT "---- Column #"; I; " ----"
250 PRINT
260 FOR J = 1 TO N
270 PRINT "A("; J; ", "; I; ") = ";
280 INPUT " ", IN$: A(J, I) = VAL(IN$)
290 NEXT J
300 NEXT I
310 PRINT
320 '
330 '***** ENTER CONSTANTS AND CORRECT ERRORS *****
340 FOR I = 1 TO N
350 PRINT "Constant of Row #"; I; " = ";
360 INPUT " ", IN$: A(I, N1) = VAL(IN$)
370 NEXT I
380 '
390 PRINT
400 INPUT "Are all the values you entered now correct (Y/N)? ", IN$
410 IF IN$ = "Y" OR IN$ = "y" THEN 530
420 IF IN$ <> "N" AND IN$ <> "n" THEN PRINT "Please enter Y or N!": GOTO
390
430 '
440 INPUT "Row to modify: ", I
450 IF I = 0 THEN GOTO 530
460 IF I > N OR I < 1 THEN PRINT "Value out of range!": GOTO 440
470 INPUT "Column to modify: ", J
480 IF J > N1 OR J < 1 THEN PRINT "Value out of range.": GOTO 470
490 PRINT "Change A("; I; ", "; J; ") from "; A(I, J); " to: ";
500 INPUT " ", IN$: A(I, J) = VAL(IN$)
510 GOTO 390
520 '
530 '***** GAUSSIAN ELIMINATION *****
540 CLS : PRINT "Calculating, please wait..."
550 FOR I = 1 TO N
560 HF = I
570 B = ABS(A(I, I))
580 FOR K = I + 1 TO N
590 T = ABS(A(K, I)): IF T > B THEN B = T: HF = K
600 NEXT K
610 IF I = HF THEN GOTO 650
620 FOR K = 1 TO N1
630 SWAP A(I, K), A(HF, K)
640 NEXT K
650 IF B < 9.9999E-20 THEN GOTO 870
660 T = A(I, I)
670 FOR K = I TO N1
680 A(I, K) = A(I, K) / T
690 NEXT K
700 '
710 FOR K = 1 TO N
720 IF K = I THEN 770
730 T = -A(K, I): A(K, I) = 0
740 FOR L = I + 1 TO N1
750 A(K, L) = A(K, L) + T * A(I, L)
760 NEXT L
770 NEXT K
780 NEXT I
790 '
800 '***** PRINT THE RESULTS *****
810 CLS : PRINT "The answers are:": PRINT
820 FOR I = 1 TO N
830 PRINT "X("; I; ") = "; : PRINT A(I, N1)
840 NEXT I
850 GOTO 880
860 '
870 PRINT "ERROR! - Equations can't be solved!"
880 PRINT : PRINT "Press any key to exit...";
890 IN$ = INKEY$: IF IN$ <> "" THEN GOTO 890
900 IN$ = INKEY$: IF IN$ = "" THEN GOTO 900
910 'End of Program Listing

```

a nodal analysis on the circuit in Fig. 1. As mentioned earlier, the first step in

nodal analysis is to write one KCL equation for each node of the circuit.

Doing that to the circuit in Fig. 1 yields:

$$\text{Eq. 1: } I_a = I_b + 1.0$$

$$\text{Eq. 2: } I_b + I_c = 2.0$$

$$\text{Eq. 3: } I_d = I_c$$

where I_a through I_d are the different currents in amperes. Equations 1, 2, and 3 are derived from nodes 1, 2, and 3, respectively.

Now that you have three KCL equations, use Ohm's law to replace each current term with terms based on the circuit's node voltages and resistor values. Remembering that the current through a resistor is equal to the voltage across it divided by its resistance, you get:

$$\text{Eq. 4: } \frac{V_1}{10} = \frac{(V_2 - V_1)}{30} + 1.0$$

$$\text{Eq. 5: } \frac{V_2 - V_1}{30} + \frac{(V_2 - V_3)}{30} = 2.0$$

$$\text{Eq. 6: } \frac{V_3}{20} = \frac{(V_2 - V_3)}{15}$$

where V_1 through V_3 are the different voltages in volts.

The next step is to eliminate the fractional elements in the above equations, which makes the equations easier to look at and deal with. To do that, multiply each equation by a constant value. For "real-world circuits" it is not always practical to perform that step, so instead, fractional components are often replaced with their decimal equivalents (for example, $\frac{1}{10}$ would become 0.1, $\frac{1}{30}$ would become 0.033333, etc.).

To eliminate the fractions in the three equations, multiply equations 4 and 5 by a factor of 30, and equation 6 by 60. In that same step, combine all like terms to give:

$$\text{Eq. 7: } 4V_1 = V_2 + 30$$

$$\text{Eq. 8: } 3V_2 - V_1 - 2V_3 = 60$$

$$\text{Eq. 9: } 7V_3 = 4V_2$$

To make it easier to enter the above equations into the simultaneous equation program, you need to write them in a standard format. That is accomplished by doing three things: First, rearrange the equations so that the unknown variables are lined up in columns on the left side of the equal signs, and the constants are in a column on the right side of the equal sign. Second, when a variable does

not have a coefficient explicitly listed in an equation, enter a zero value as a place holder. Third, write the row numbers in front of the equations and the column numbers above the unknowns. Note that you will always have one more column than you do rows, because of the constant terms on the right sides of the equations. Here is an example of the standard format, using the above equations:

	{1}	{2}	{3}	{4}	
Eq. 10:	(1)	+4v ₁	-1v ₂	+0v ₃	= 30
Eq. 11:	(2)	-1v ₁	+3v ₂	-2v ₃	= 60
Eq. 12:	(3)	+0v ₁	-4v ₂	+7v ₃	= 0

As far as SIM-EQ.BAS is concerned, all of the numbers in the above equations are known as A(r,c) coefficients, where r is the row number that the coefficient is in, and c is the column number of the coefficient. For example: A(2,3) is the coefficient in row 2, column 3, which is -2; A(1,1) has a value of +4; A(2,1) is -1; and A(3,4) is 0.

For clarity, numbers to the right of the equal signs have two different names. Besides being called A(r,c) coefficients, the terms are also called "constants of the row" for obvious reasons.

TABLE 1—SAMPLE OUTPUT

SIM-EQ: The Simultaneous Equation Program
Copyright (c)1988-94 by James Tarchinski

Enter the number of variables/equations
in the system you wish to solve (1-25): 3

---- Column # 1 ----

A(1 , 1) = 4
A(2 , 1) = -1
A(3 , 1) = 0

---- Column # 2 ----

A(1 , 2) = -1
A(2 , 2) = 3
A(3 , 2) = -4

---- Column # 3 ----

A(1 , 3) = 0
A(2 , 3) = -2
A(3 , 3) = 7

Constant of Row # 1 = 30
Constant of Row # 2 = 60
Constant of Row # 3 = 0

Are all the values you entered now correct
(Y/N)? Y

Calculating, please wait...

The answers are:

X(1) = 18
X(2) = 42
X(3) = 24

Press any key to exit...

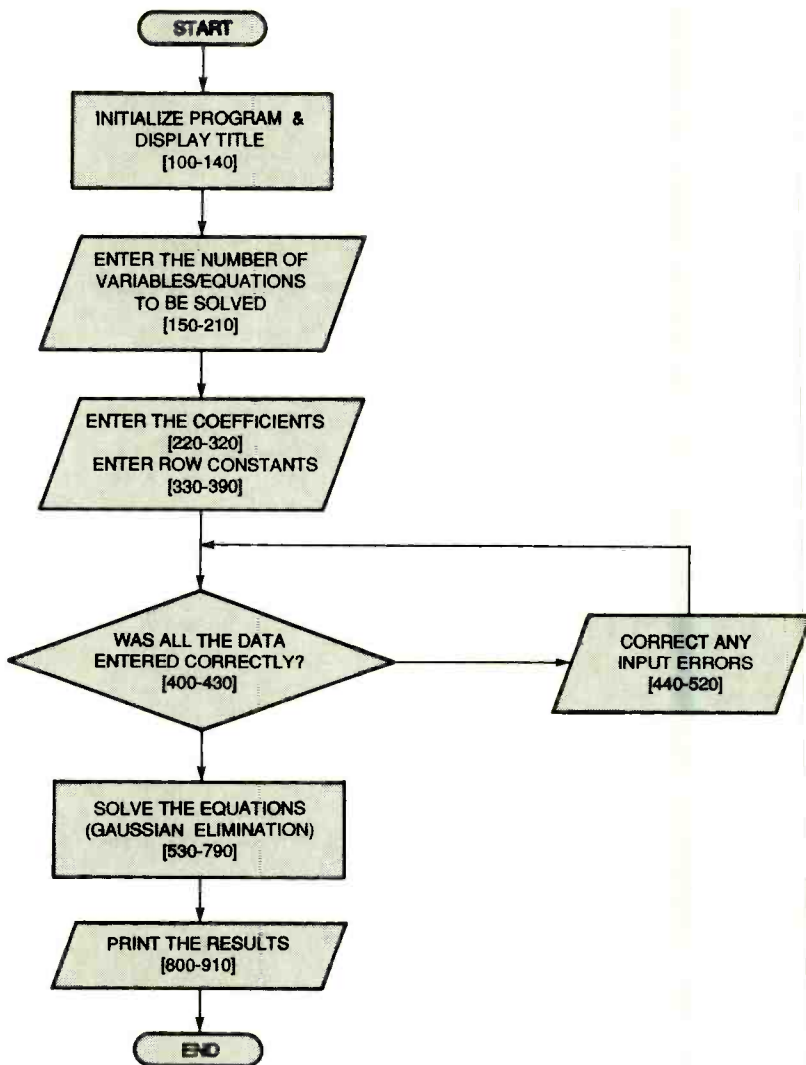


Fig. 2. This flow chart shows the sequence of logic in the SIM-EQ program. Note that the numbers given in square brackets refer to the corresponding line numbers in Listing 1.

Now that you have three equations in a standard format, and are familiar with the terminology the program uses, you are just about ready to use SIM-EQ.BAS to solve for node voltages V₁, V₂, and V₃. Loading the program into your computer is the only other step that needs to be completed.

If you've never entered a BASIC program into a computer before, you might need to consult your computer's instruction manual or your DOS manual for a complete description of the process. As given in Listing 1, the program will run on Microsoft-DOS based computers that utilize the BASICA, GWBASIC, or QBASIC implementations of the BASIC programming language. Users of other implementations, or users of other machines, might have to make some

minor modifications to the program, but the bulk of it should run as presented.

Once you've entered the program into your computer and have saved it to disk (as a precautionary measure), you are ready for the moment of truth—the solution of equations 10, 11, and 12. Run the program, and enter data as shown in Table 1. Be certain to look back at equations 10 through 12 while entering the data, so that you can see where the data originally came from. Note that in the table, all user input is underlined, while all computer-generated text is shown in normal type.

The program will solve the three simultaneous equations after only a few milliseconds of calculation, out-

(Continued on page 96)

Exploring the

IMAGINATION!



BY DONNA ROACH

Your computer comes alive with fun when you explore this very different on-line service.

How would you like to pilot your own plane in a heated dog-fight; gamble the night away in Las Vegas; play a friendly game of cards or 18 challenging holes of golf; or explore mazes while fighting monsters in a medieval land, without ever leaving the comfort of your own home? You can, over *The ImagiNation Network* (INN), an "entertainment network" that brings the world (via computer modem) to your doorstep. Log in and you will find thousands of friendly members from all over the country ready to enjoy this piece of cyberspace with you!

Before we go any further, let me introduce myself: I am INNTilli, and I am c sysop for the ImagiNation Network. Sysops, (short for systems operators), are the "social directors" of INN, devoted to helping all members enjoy ImagiNation.

Touring the Countryside. So that you can become more familiar with INN, let's take a little tour. You start by creating your own on-screen persona, complete with a face you design by choosing from a variety of features such as nose, hairstyle, eye color, etc. Once that's done, you can

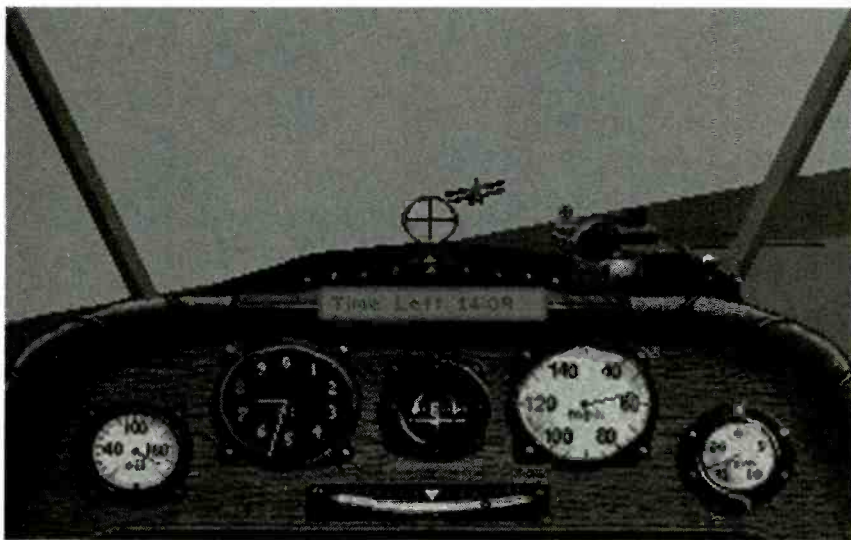
add information about yourself, including where you live, your hobbies and interests, etc., and you are ready to go!

Next, it's time to take a trip to ImagiNation! As you dial into the service, the scene on the monitor changes into a colorful picture of the "Sierra Mountains" as you watch a "signal" bounce off a satellite and connect. The scene changes again and you are looking down on the buildings of a small town. Created by Sierra On Line, Inc., the company that brought you games such as *King's Quest*, *Aces over Europe*, and the *Leisure-Suit Larry* series, ImagiNation Network consists of four separate and distinct "lands," each with its own character.

Let's start with the "Clubhouse," which you can enter with just a mouse click. There you will find many popular games, and plenty of friendly members to play them with. Chess, Checkers, Bridge, and Backgammon are available here, as well as Hearts, Spades, Euchre, Cribbage, Reversi, and Go. Those are all played live, in real time against real people. Select a room to play in, and you'll find yourself in a waiting area where you'll see names of other members who are on-



Anyone for a game of Bridge? In *The ImagiNation Network* you can play against opponents who range from beginners to champions.



Try your hand at *Red Baron*, a WWI flying game. Rather than a computer, your opponent is another network member.

line. You may talk to them, look at their picture (or "toon" as it's often referred to), and invite them to play a game with a simple click of your mouse. The game graphics are very realistic and colorful, and your opponents' toons appear on the screen in front of you as you play. Instant conversations are accomplished simply by typing messages during games.

But that's just the beginning! Enter the room in the Clubhouse named "INNUiversity," and you can take lessons in subjects ranging from C+ programming to learning how to play any of the games mentioned above. In the Chess Club you can find players ranging from beginners to world-class champions; and in the Bridge Club

(which ranks among the top ten in the nation for membership), ACBL-rated experts are often found tuning up for their next competition. Tournaments for all games are held frequently. You can also participate in live conferences on a myriad of subjects, and there are also over 175 (at last count) bulletin boards covering a wide range of topics to explore.

Click on the "Shopping Mall" to order Sierra games and other products like modems and hint books; or explore the Shopper's Advantage Network. Just above that is the Post Office, where unlimited E-mail may be sent or received between members. E-mail substations are available in the Clubhouse as well.

"SierraLand," (all decked out in pink), is where you can play *Red Baron* (a WWI flying game) and take part in "dogfights" against other pilots (real people and in real time, of course). There you can also find 18 holes of 3-D Golf, an incredibly realistic mini-golf game that's full of surprises, and NTN Trivia, where you can see your own scores and how you rank with other players around the country. SierraLand also contains games such as Paintball, Rocket Quiz, Graffiti, Boogers, and Stratego.

"CasinoLand" is where you'll find Poker, Slots, Blackjack, and Roulette, using "LarryBucks" for money. (Just make a little trip to "Nurse Clot" at the "Bloodbank" if you go broke!) Or relax in "Lefty's Bar" with a special friend, send her roses or kisses, and play *Veracity* or *Liar's Poker*. The atmosphere there is VERY adult as "community standards" are relaxed in this land. For that reason, the area is restricted to members 18 and over, and can be password-protected to prevent young family members from entering. If you are easily offended or shocked, but still wish to partake in the activities offered there, I recommend that you enter the room called "Polite Place." But if you enjoy a bawdy joke or two on occasion, the other rooms in CasinoLand can be loads of fun!

Looming up as a volcano in the distance is "MedievalLand," which contains two fantasy/adventure/role-playing games: *The Shadow of Yserbius* and *The Fates of Twinion*. Both are fascinating and tough to solve. There are over 30 mazes to explore in each, while fighting an assortment of creatures, ranging from Gargoyles to Manticores and Dragons. You must choose your best weapons, find proper keys for doors, go on various quests, etc., in order to complete them. But you don't have to struggle all alone, pitted against your computer. You can join a party of other members to explore the depths of the volcano. Experienced players are available to answer questions or help you find your way when you get lost.

Or you can ask me! That is where I do my work for ImagiNation. It's my job to greet new players and instruct them in the basics of playing. I tell them how to "walk and talk," how to arm themselves with weapons and
(Continued on page 92)

BUILD A FREQUENCY RESPONSE TESTER

BY RANDY CONSTAN



With it, you'll never again have to guess about the frequency response of an audio device.

Many off-the-shelf audio processors, such as equalizers, enhancers, and pre-amplifiers, alter audio signals even when in their so-called "pass-through" modes. The resulting frequency-spectrum losses often cause unwanted distortion, which can be very difficult to isolate if there are several components in an audio system. Therefore, a device that measures the frequency response of audio components should be a welcome addition to the toolbox of any audio-electronics enthusiast.

With the *Frequency-Response Tester* described in this article, you can directly view the frequency response of almost any audio gadget right on your oscilloscope screen, with a minimum of fuss. If any lumps and bumps appear in the signal of a device under test (DUT), the mystery of your sound troubles will be solved. Furthermore, the Tester will allow you to take corrective action, and quickly view the results.

The Tester works by generating two signals. The first is a linear-sawtooth sweep waveform that drives the horizontal input of your scope. Internally, that signal is transformed into a logarithmic waveform that spans three decades of voltage differential. That signal is applied to a function-generator IC to produce the second output, a sine-wave signal. The sine wave has a frequency that follows the log-

arithmic waveform, and has an amplitude that remains constant.

By connecting the DUT between the sine-wave sweep output and your scope's vertical input, the DUT's response to the entire frequency spectrum can be easily viewed. The logarithmic nature of the frequency sweep assures that the entire audio range appears as an ordered display, in which each $\frac{1}{3}$ of your scope's horizontal range depicts one decade of frequency span. In other words, the ranges are: 20 to 200 Hz, 200 to 2,000 Hz, and finally 2,000 to 20,000 Hz, from left to right. Because the unit also generates your scope's horizontal sweep, the scaling remains stable and repeatable no matter how you vary the sweep rate.

Frequency-sweep generators are not a new or unique idea, but unfortunately their cost can be somewhat prohibitive for the average hobbyist. However, you can build the Frequency-Response Tester for under \$50, depending on your junk-box supplies. Even though this project will save you some money, keep the following in mind: The circuit requires an initial setup and occasional calibration; also, accuracy beyond two digits is impractical unless your scope uses sophisticated on-screen digital readouts for frequency and voltage levels.

A plain, vanilla scope will work fine with the Tester, as long as its time base

and vertical amplifiers provide reasonable accuracy. A frequency counter is also recommended, at least for the initial setup.

Circuit Description. The schematic for the Frequency-Response Tester is shown in Fig. 1. The two quad op-amp sections, U3-c and U3-d, are configured as a linear-ramp generator. With switch S2 in the SWEEP position as shown, the output of U3-d is low. Zener diodes D2 and D3 limit that output to about -7 volts, which is the 6.2-volt reverse drop across D3, plus the forward drop of D2. The internal short-circuit protection of the op-amp limits the Zener current to several milliamperes.

Because the output of U3-d is negative, integrator U3-c generates a linear ramp in a positive direction, at a rate determined by the resistance of R4 and R29, and the capacitance of C5. A portion of that output is fed back to the noninverting input of U3-d via the voltage-divider network consisting of R2 and R3. Because U3-d is basically operating as a comparator with its inverting input grounded, its output will switch positive as soon as its noninverting input crosses zero volts. That will occur when the positive-going ramp reaches about $+5.8$ volts.

Once U3-d switches to a high-output state, the operation is repeated with the opposite polarity except that

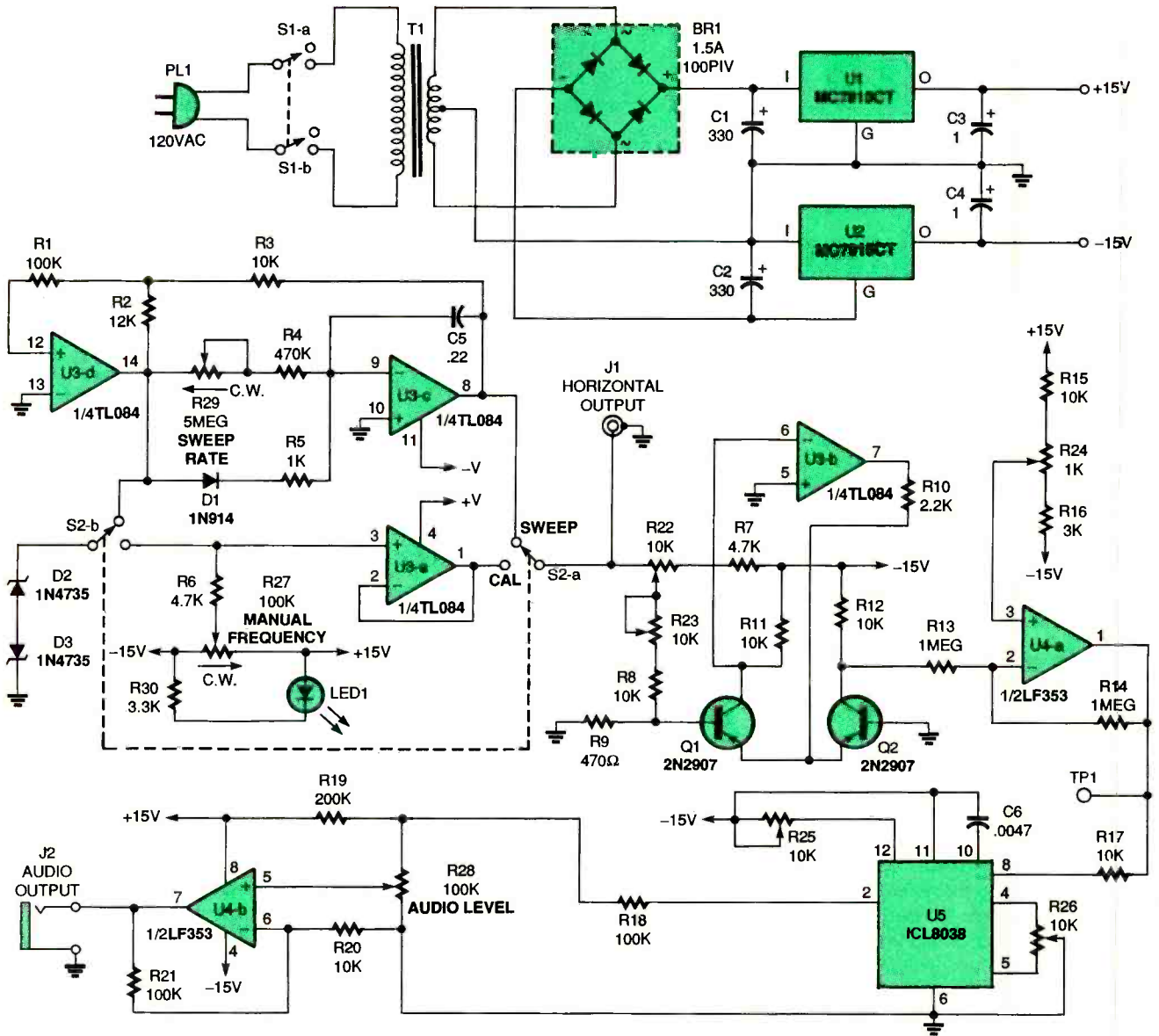


Fig. 1. As this schematic for the Frequency-Response Tester shows, there are five trimmer potentiometers, R22–R26, that are used for calibration. But don't worry, the process is not as hard as it might seem.

diode D1, now forward biased, allows an additional current path to U3-c via R5. Because the resistance of R5 is much less than the combined values of R4 and R29, the negative-going ramp time is almost negligible compared to the positive ramp, and the overall effect is to produce a sawtooth waveform with an amplitude of over 10-volts peak-to-peak. That is more than sufficient for just about any scope's horizontal input.

Next, the linear ramp undergoes a series of level and offset adjustments via resistors R7, R8, R9, R22, and R23, and is then applied to the base of Q1. The emitter-coupled transistors, Q1 and Q2, in combination with U3-b, produce an anti-log transfer function.

That means that when properly adjusted, the output at the collector of Q2 will be logarithmic with respect to the input, yielding a one-decade voltage differential for every few volts of input. To be more specific, if you divide the peak-to-peak voltage of the initial linear sweep by 3, the anti-log-generator output increases by a multiple of 10 each time the input voltage crosses another 1/3 milestone. That will all become much clearer when you see the logarithmic curve on your scope during the calibration phase discussed later in this article.

Next, U4-a inverts the polarity of the signal, so that it starts high and ends low. That is necessary because the output frequency of the 8038 function

generator, U5, is inversely proportional to its input voltage. In addition, U3-d's offset voltage is nominally set at about -7.5 volts by the combination of resistors R15 and R16, and can be trimmed precisely by the 15-turn trimmer potentiometer, R24. That shifts the logarithmic-sweep waveform to suit U5, which in our circuit receives its supply voltage from the ground and -15-volt source. Recall that our logarithmic sweep must span three decades of voltage differential, which means that if its final voltage were 5 volts, its initial voltage would be 1/1000 of that, or .005 volts. Tiny voltages like that have to be carefully controlled, which is why R24 is used for that critical adjustment.

Finally, we come to the heart of the circuit, U5. That relatively inexpensive ICL8038 function generator produces constant-amplitude sine waves, as well as triangle- and square-wave outputs, from 20 Hz through 20 KHz. Also, its output frequency is nearly a perfect inverse proportional to its input voltage, so driving its input with our custom logarithmic-sweep circuit will produce the balanced, three-decade frequency sweep we desire.

The sine-wave output from U5 is fed to the voltage divider made up of R18 and R19, which restores the DC offset to zero. That eliminates the need for any coupling capacitors in the output stage, which makes it possible for output level to remain independent of frequency. The voltage-divider output is then applied to potentiometer R28 for output-level control, and is subsequently routed to U4-b for a boost in both amplitude- and current-drive capability. Output can range from 0- to over 10-volts peak to peak, which is enough for testing almost any audio device.

The DPDT switch, S2, has another position called "CAL." In that position, potentiometer R27 controls the frequency of the sine-wave output for setup and calibration purposes. However, because the output of R27 is buffered by U3-a and routed through the anti-log circuit, the Tester can also serve as a simple stand-alone signal generator. Potentiometer R27 is also indispensable for "homing in" on a troublesome frequency during actual response testing.

Construction. The method chosen to build the Frequency-Response Tester is not critical; however, the easiest method is to use the single-sided PC-board layout provided in Fig. 2. If you're looking for a good PC-board project to try, the Tester PCB is an excellent choice because it is both single-sided and reasonably low in component density. When cut to the size shown, the board fits comfortably within the widely available metal enclosure noted in the Parts List.

If you choose to use a PC board, a parts-placement diagram is provided in Fig. 3. If you choose not to use a PC board, a perf-board approach with point-to-point wiring will work fine. Just remember that an oversized zero-volt ground bus, or the use of a

single-point grounding scheme is always recommended in circuits involving op-amps. In any case, a metal enclosure is recommended to reduce noise and provide stable support for output connectors. One important layout consideration is to place R24 near the edge of the board, so that an access hole drilled in the enclosure will allow occasional calibration.

Most of the components in the Tester are of easy-to-obtain values, with a few exceptions; for that reason some reasonable parts substitutions can be made. For example, power-transformer T1 does not have to be a single 36-volt, 300mA center-tapped type as shown. Two smaller single-output transformers may be wired with their outputs in series to yield the same result, as long as each output is at least 18 volts at 200 mA.

On the more critical side, Q1 and Q2 must be a reasonably matched pair in order for the anti-log circuit to work properly. The 2N2907's specified are cheap, widely available, and have a lot of uses, so buy a few extra so you can look for a reasonable match. Using a DVM in diode-test mode, check the nominal voltage drop across the transistor's emitter-base junction. Two transistors that match up within or close to 3-digit accuracy are more than sufficient for the project. If your DVM does not have a diode-test function, make a temporary test jig with a 9-volt battery, a 10K resistor, and the base-emitter junction of the transistor. When the junction is forward biased (positive at the emitter for PNP devices), you can compare the voltage drops across the junctions of several transistors with an ordinary DVM set on its 0- to 1-volt range.

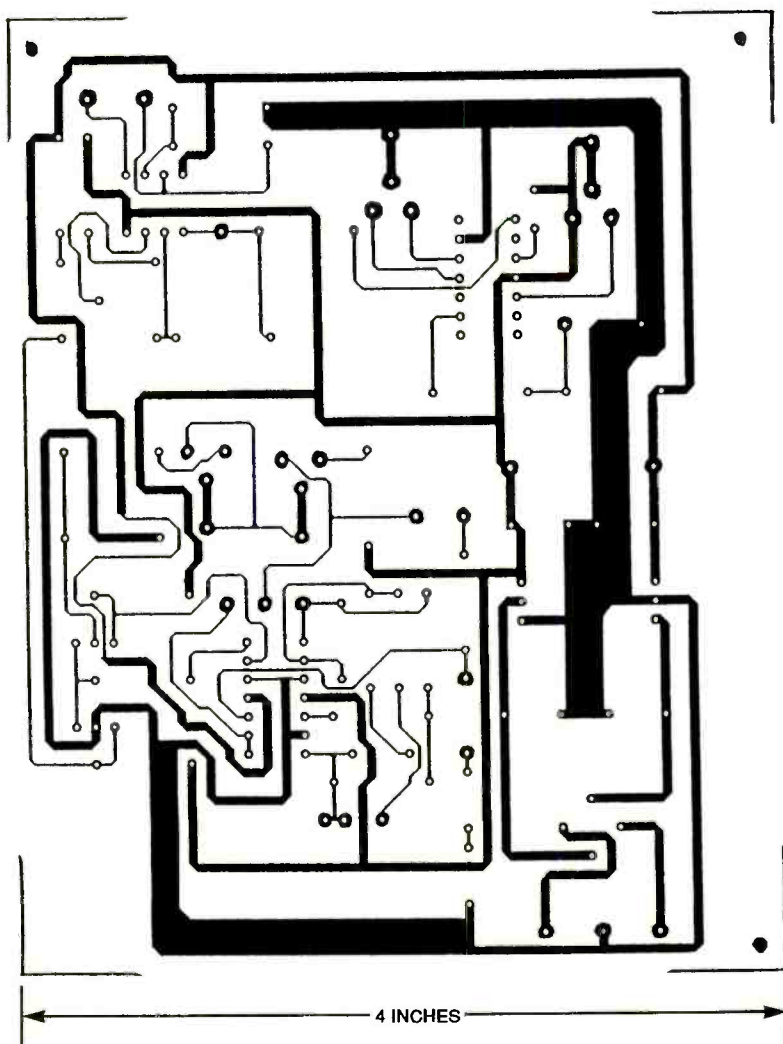


Fig. 2. The PC-board template for the Tester is shown here in its full size of 4 × 5 inches.

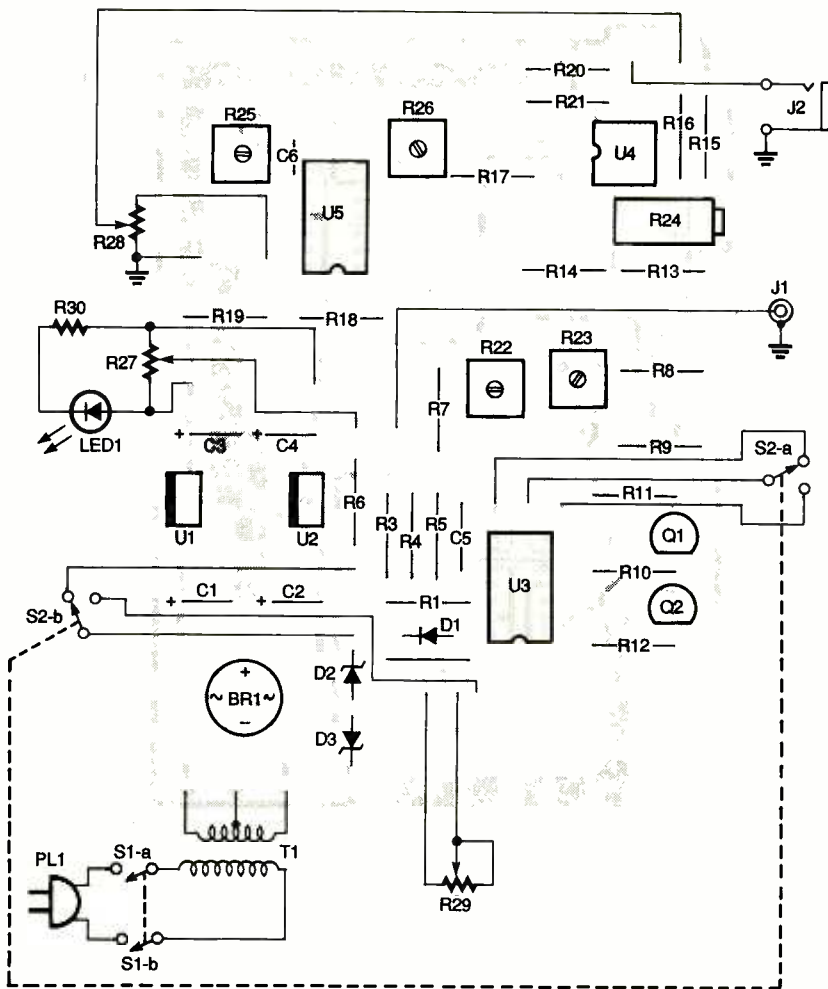


Fig. 3. Use this parts-placement diagram as a guide when making the various on- and off-board connections. Note that there is an off-board ground between a few of the components; connect those points and ground them to the metal chassis.

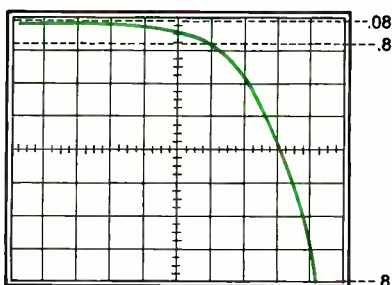


Fig. 4. Once calibrated, your Tester should display a three-decade logarithmic waveform that resembles this illustration.

Another critical item is R24, which must be a 15- or 20-turn trimmer potentiometer. It should also be obvious that even though normal component tolerances are not a problem, arbitrary substitution of seemingly "close" resistor values is unwise in the Tester circuit.

Here are a few things to watch for when using the parts-placement di-

agram in Fig. 3: Be careful when inserting Q1 and Q2, because the physical pinout of the transistors you obtain might not match the case style shown in Fig. 3. There, the emitter pad is closest to the edge of the board, and the base is the center pad. Also note that all pads that connect to off-board components such as potentiometers, switches, and outputs are slightly oversized for easy connection and identification. Some pads might not seem to be logically placed, which is a necessary sacrifice in maintaining a single-sided layout. Extra pads are provided for the center position of all trim pots except R24, to accommodate a wider physical variety of those parts. Socketing of all but the voltage-regulator IC's is recommended.

Potentiometers R27, R28, and R29 mount on the faceplate of the project case. Use insulated wires to connect them to the PC-board, as shown in Fig.

3. For best results, you might want to use coaxial cable for the connection to R28; if you do so, ground the cable and the off-board ground points shown in Fig. 3 to the metal chassis to provide shielding. Jacks J1 and J2, switches S1 and S2, resistor R20, LED1, and power-transformer T1 all mount off-board as well. Within the constraints of the enclosure, mount T1 as far from the board as possible.

Solder a small piece of stiff wire to the board at test point TP1. Make the wire just long enough to access later with your scope probe. Finally, when attaching the power cord to S1, use some kind of strain relief or grommet where the cord enters the case.

Check and re-check your connections before testing the project. The board itself can be mounted with some insulated stand-offs, but you might want to save that final mounting step until after initial checkout. In

PARTS LIST FOR THE FRE

SEMICONDUCTORS

- U1—MC7815CT 15-volt, positive-voltage regulator, integrated circuit
- U2—MC7915CT 15-volt, negative-voltage regulator, integrated circuit
- U3—TL084 quad op-amp, integrated circuit
- U4—LF353 dual op-amp, integrated circuit
- U5—ICL8038 function generator, integrated circuit
- Q1, Q2—2N2907, PNP transistor
- BR1—1.5-amp, 100-PIV, full-wave bridge rectifier
- D1—1N914 general-purpose silicon diode
- D2, D3—1N4735, 6.2-volt, Zener diode
- LED1—Red light-emitting diode

RESISTORS

- (All fixed resistors are 1/4-watt, 5% units, unless otherwise indicated.)
- R1, R18, R21—100,000-ohm
 - R2—12,000-ohm
 - R3, R8, R11, R12, R15, R17, R20—10,000-ohm
 - R4—470,000-ohm
 - R5—1000-ohm
 - R6, R7—4700-ohm
 - R9—470-ohm
 - R10—2200-ohm
 - R13, R14—1-megohm
 - R16—3000-ohm
 - R19—200,000-ohm
 - R22, R23, R25, R26—10,000-ohm, trimmer potentiometer, PC mount
 - R24—1000-ohm, 15-turn, trimmer potentiometer, PC mount

any case, plan to mount the board in such a way that a hole can be drilled to access R24 without opening the case. That is the only trim adjustment that you will occasionally need to touch up after initial calibration.

Calibration and Set-up. With all the trimmer potentiometers on the Tester's circuit board you might think that calibration is going to be a real nuisance, but that's not the case. The process is greatly simplified because you can use an oscilloscope to make almost all the adjustments visually. A separate frequency counter is also useful, but is not absolutely necessary. Another suggested tool to have on hand is a pair of walkman-type headphones. Hearing the frequency of the audio output is a good way of roughly gauging whether or not you're covering the entire audio range.

Start by centering all the trim pots,

FREQUENCY-RESPONSE TESTER

- R27—100,000-ohm, linear potentiometer
- R28—100,000-ohm, logarithmic potentiometer
- R29—5-megohm, linear potentiometer (see text)
- R30—3300-ohm, 1/2-watt

CAPACITORS

- C1, C2—330- μ F, 50-WVDC, radial-lead electrolytic
- C3, C4—1- μ F, 25-WVDC, radial-lead electrolytic
- C5—0.22- μ F, polyester
- C6—0.0047- μ F, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

- S1, S2—DPDT toggle switch
- T1—AC power transformer, 115-VAC primary to 36-VAC secondary, 300-mA center-tapped (Stancor P-8612 or equivalent, see text)
- J1—BNC jack
- J2—Phone jack
- PL1—2-conductor power cord and plug
- Printed-circuit materials, metal chassis (Radio Shack 270-253 or equivalent), insulated wire, solder, hardware, etc.

Note: A drilled and etched PC board is available postpaid from the author for \$20. Contact him on GENie at the E-mail address: R.CONSTAN for ordering information.

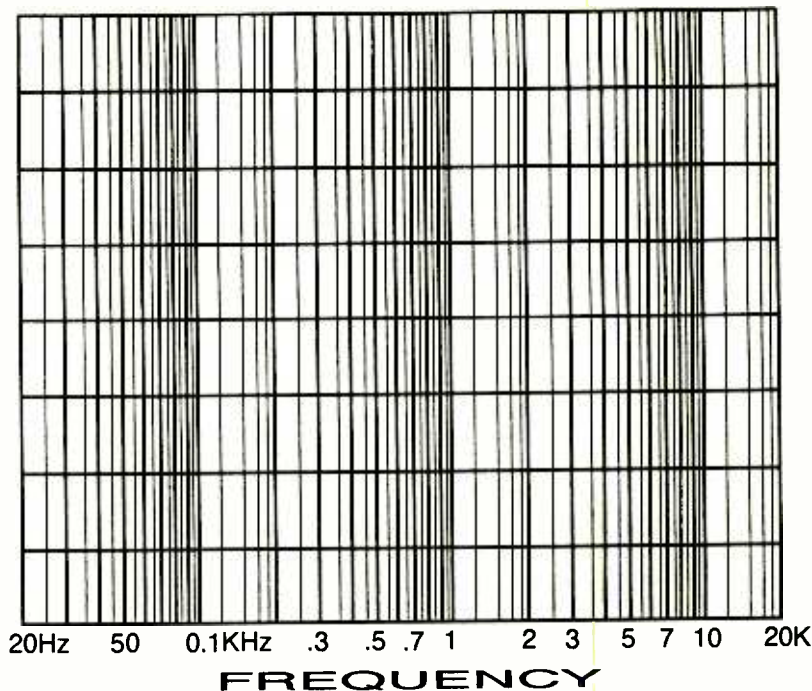


Fig. 5. By copying this scale to transparent film, you can create a custom reference graticule for your scope and greatly improve the visual accuracy of the display.

including R24. Before connecting any external equipment, power up the unit by itself to check that correct power-supply voltages are present in all the right places. Once you're confident that the circuit powers up correctly, you can proceed. Note that it is normal for the TL084 (U3) to run a little warm, and for both positive and negative regulators to become rather hot to the touch. If overheating becomes a concern, small heatsinks can be mounted on the regulators.

For your initial setup, connect the horizontal output to the horizontal input on your scope, and the audio output to your headphones. If the headphones are stereo, it is possible to hear through both right and left with an appropriate adapter. In the absence of headphones, a stereo-system auxiliary input will do, but be careful to keep the volume level down to avoid speaker damage.

Connect a probe to your scope's vertical input. Power up the scope, set the horizontal time base for external, and set both the vertical and horizontal amplifiers for DC measurement. With S2 in the SWEEP position and both R28 and R29 set to minimum resistance, power up the Frequency-Response Tester. The scope should display a horizontal sweep, the speed of which you can adjust using R29. For calibration purposes, use the horizon-

tal-gain and horizontal-position controls to produce a nine-division sweep deflection that is lined up with the left-most, vertical graticule line. Because nine divisions can easily be divided by three, setting up the three-decade logarithmic response we discussed earlier will be easy.

The next step is a bit tricky because it involves several coinciding adjustments. Connect the vertical input of your scope to the short wire you attached to TP1 earlier. If you turn up the AUDIO LEVEL control, R28, slightly, you should hear some kind of audio sweep that appears to follow the rate of the horizontal sweep (don't panic if that is not the case; the trim pots might just be too far out of adjustment). Flip S2 to the CAL position; the horizontal display will revert to a dot. Because the horizontal position of the dot is related to the audio-output frequency, refer to the screen display while using MANUAL FREQUENCY CONTROL R27 for calibration. Set R27 so that the dot once again lines up with the left-most, vertical graticule line on your scope. Then, adjust R24 to bring the audio-output frequency as low as possible. You will have to calibrate that more exactly later, but, for now, the lowest "bass note" you can hear without the audio dropping out is close enough.

Once the tone is established and set to the lowest frequency you can

detect, re-adjust R27 so that the dot moves exactly nine divisions to the right on your scope screen. The frequency should audibly rise. Adjust R22 at this time to a point just past the highest frequency you can hear. Repeat the process of "low" and "high" adjustment of R24 and R22 at least one more time, and then flip S2 back into the SWEEP position.

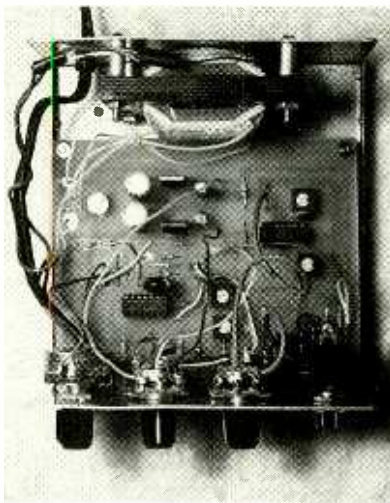
With the SWEEP RATE control, R29, set to maximum speed, you should be able to adjust your scope's vertical sensitivity and position until you can see a curve starting high on the left, and sloping downward on the right. Continue to adjust the position and vertical sensitivity, abandoning the "calibrated" setting on your scope as needed, so that the vertical deflection exactly fills the screen, from the highest vertical division available, to the lowest. That resulting curve is a logarithmic progression.

The next step is to contour the curve so that every three horizontal divisions correspond to a $\frac{1}{10}$ difference in vertical deflection. That is accomplished mainly with R23, which serves as a "decades/volt" adjustment for the anti-log network. Unfortunately, adjusting R23 is likely to affect the total vertical amplitude, so you might have to "see-saw" between R22 and R23 until the desired curve is obtained. Trim pot R24, which mainly affects the "top" portion of the vertical deflection, will probably not make much of a difference. In the end, your curve should resemble the one shown in Fig. 4 as much as possible.

The curve in Fig. 4 assumes that your scope graticule has eight major vertical divisions. Using the top line as a reference, note that the total deflection is eight divisions down at the right edge of the trace. Because the width of the trace has been set at nine divisions, you can easily divide the display into three sections. If you start at the right and move left, you'll see that the deflection from the top line is $\frac{1}{10}$ less each time we cross $\frac{1}{3}$ of the total width. So, the total deflection is 8, .8, and .08 vertical divisions at 9, 6, and 3 horizontal divisions respectively. Obviously, $-.08$ divisions is not really visible, and in fact, the start point of the curve should really be $-.008$ divisions, which is certainly not visible. Because the anti-log network defines the curve, we can assume that once one

decade is correctly "tuned," the others will all fall into place. By continuing to adjust the decades-per-volt trim pot, R23, along with the high log-level trim pot, R22, you should be able to approximate that curve.

The two remaining trim pots, R25 and R26, adjust the purity of the sine-wave output, and should be set as necessary before final calibration. Potentiometer R25 adjusts the duty cycle so that the top portions of the sine



As this internal view shows, the transformer in the Frequency-Response Tester should be mounted as far from the board as the project case allows.

wave equal the bottom half, while R26 is used to trim out distortion. Those controls do not treat all frequencies equally, so waveform purity must be optimized at a specific frequency. The author recommends a mid frequency of about 1000 Hz. Using your scope in its normal internal-sweep mode, set the tester to CAL, and observe the audio-output waveform while making the above adjustments. In the end, both controls should be somewhere near their initial center position, or the frequency span might suffer.

The final step in calibration is simply to repeat the setups of R24, R23, and R22, this time with a frequency counter added to the audio output. Instead of using your ears for the low- and high-frequency adjustments, use the frequency counter to obtain values of 20 Hz and 20,000 Hz. For that final calibration, make sure the unit has been on for a few minutes to allow it to stabilize.

If no frequency counter is available, you can use the scope as a frequency

counter by switching it back to internal sweep, connecting the audio output to the vertical input, and making calculations based on time/division. That is a bit of a hassle because it means doing a lot of switching, and you must remember to restore the horizontal gain to the original nine-division setup in between each measurement. If you have a dual-trace scope, you can set up one channel to represent the nine-division span of the Tester's horizontal output, and the other to monitor the audio output. You will still have to go back to the original setup at least once more to touch up the log curve with R23. Remember, you've already set up the unit to span from the lowest to the highest frequency you can hear, which is all that really matters. The good news is that once the Tester is set up, only the low adjustment, R24, will need an occasional touch up.

If you wish, use a photocopier that has a scaling capability to make a copy of the log scale in Fig. 5. By making the copy on a transparent sheet, such as the ones used for overhead projectors, you can make a custom reference graticule for your scope and greatly aid the visual accuracy of the display.

Using the Tester. For accuracy at the low-frequency range, always allow the Frequency-Response Tester to remain powered-up for a few minutes prior to running response tests. As we've seen, the Tester's entire first decade from 20 to 200 Hz depends on the stability of a very small control voltage, which usually takes a little time to settle. To test the response of an audio device, simply connect the Tester's audio output to the DUT's input, and the DUT's output to the vertical input of your scope.

(A note of caution is in order here: Some power amplifiers have outputs that cannot be ground referenced. In such cases, a dual-channel scope used in differential mode via both inputs is the only safe way to monitor the amplifier. Also note that power amplifiers usually require output loading for proper operation.)

When your test set-up is complete, switch S2 to CAL mode, and select a middle frequency using the MANUAL FREQUENCY control, R27. Then, adjust the

(Continued on page 93)

MAKING SQUARE WAVES AT HOME

Generating square waves is easy when you follow the simple "recipes" in this cookbook.

BY JOSEPH J. CARR

Square waves are among the most useful waveforms around. They are used to make qualitative tests of amplifier and passive-network circuits, and for radio troubleshooting. Square waves are even used as clocks in digital circuits.

Fortunately, square waves that are stable in both amplitude and frequency are relatively easy to generate using the following circuits. Let's take a look.

Types of Square Waves. Figure 1 shows five different types of square waves. For all five, the signal is inherently binary—it quickly jumps between two values ("high" and "low"). Because the square wave never permanently remains at just one level, it is said to be astable. For that reason, most square-wave generators are called "astable multivibrators."

A positive, monopolar square wave is shown in Fig. 1A. For that type of square wave, the two ideal voltage levels are zero volts and some positive voltage ($V+$). In transistor-transistor logic (TTL), the low level is anything below 0.8 volts and the high level is anything from 2.4 to 5 volts. Non-TTL-based square waves of that type might use different voltage levels. For example, while CMOS chips can generate TTL-compatible voltage levels, they are often used in circuits with much larger high-level voltages.

Figure 1A also shows the time relationships of a positive, monopolar square wave. A total cycle consists of

one high and one low, each of equal length. The total period required for the square wave cycle is:

$$T = t_1 + t_2$$

while the frequency (f) is:

$$f = 1/T$$

A negative, monopolar square wave is shown in Fig. 1B. The negative square wave is similar to the positive one shown in Fig. 1A, but in the negative square wave, a high is defined as 0 volts, while a low is some negative potential ($-V$).

Another square wave is the symmetrical, bipolar square wave of Fig. 1C. In that type of square wave, the high and low voltages are equal potentials above and below the voltage axis. A variation on that is the offset, bipolar square wave of Fig. 1D. That wave has a DC offset voltage that prevents it from being symmetrical around the voltage axis. The square wave shown has a positive DC component added to it, but that offset voltage could be negative instead.

Figure 1E shows another asymmetrical square wave. In that case, however, the lack of symmetry is not across the voltage axis but in the relationship between t_1 and t_2 — t_1 does not equal t_2 . The percentage of the time the wave is high, or:

$$100\% \times t_1/(t_1 + t_2)$$

is called the "duty cycle" of the square wave.

One of the things that make square

waves so useful for testing purposes is that they contain a large number of harmonics, or integer multiples of the fundamental frequency. Because the symmetrical, bipolar square wave has both baseline and time symmetry, it produces only even-order harmonics—harmonics with frequencies that are even multiples of the fundamental—as shown in Fig. 2. Theoretically, those harmonics extend to infinity, but in reality, a good, sharp, clean square wave has even-order harmonics out to about $1000f$.

Square waves can be generated by digital TTL and CMOS IC's, 555-timer-based circuits, and operational amplifier ("op-amp") circuits. Let's look at each in turn.

TTL Generators. TTL integrated circuits have a 74 or a 54 as the first two digits of their part numbers. They are powered by a 5-volt DC supply. Because a high level in TTL IC's is anything from 2.4 to 5 volts, a TTL signal is said to change state when it crosses a 2.4-volt threshold.

Normal TTL chips operate at speeds of up to 18 MHz, with some cooking along at 25 MHz. Special types go up to 80 MHz or more.

The inverter is a basic element in TTL-based square-wave generators.

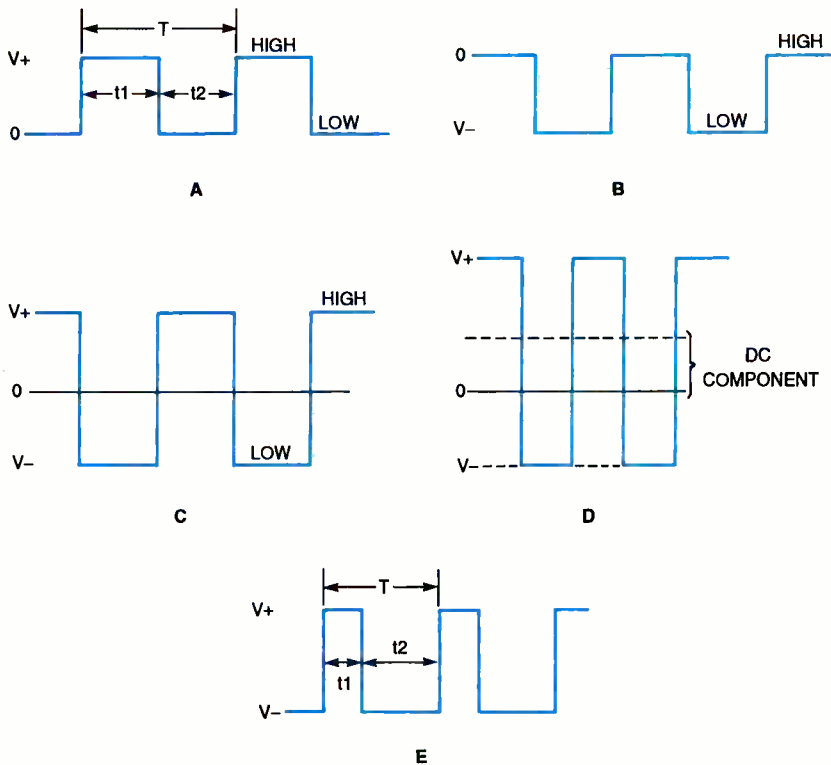


Fig. 1. Here are the five main types of square waves: positive monopolar (A), negative monopolar (B), symmetrical bipolar (C), asymmetrical bipolar (D), and time asymmetrical (E).

Those components can be either discrete inverters (such as the 7405), or NAND gates (like the 7400) or NOR gates (for example, the 7402) with their inputs tied together to form an inverter. Figure 3 shows a typical TTL ring oscillator that will produce square waves in the 500-kHz to 10-MHz range. In that form, it is made from three sections of a 7405 hex inverter chip.

The circuit's frequency is set by the values of C1 and R2. The value of C1 should be in the range of 390 pF to 0.005 μ F, while R2 can vary from 1 to 3.9k ohms. It is common to use a circuit like the one in Fig. 3 to generate a frequency that is higher than the one needed, and to then divide the frequency with a series of TTL counter circuits cascaded together.

CMOS Generator Circuits. The CMOS family of digital integrated circuits operates at lower frequencies than the TTL family, but in return, CMOS IC's consume less power. While a typical TTL device might dissipate milliwatts of power, an equivalent CMOS device dissipates microwatts. Like TTL IC's, CMOS devices can also be powered from a 5-volt supply, and depending on the situation, might be TTL

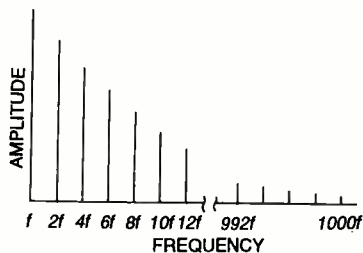


Fig. 2. The frequency spectrum of symmetrical square waves consists of the fundamental frequency and a large number of even harmonics.

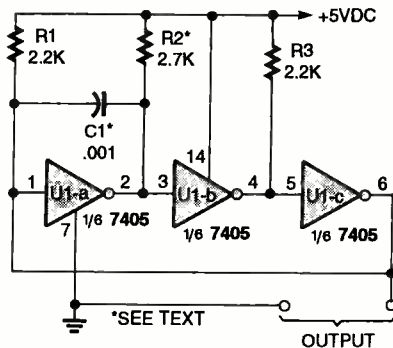


Fig. 3. A TTL ring-oscillator circuit uses an odd number of inverters in an astable configuration.

compatible. However, many CMOS devices can be powered at higher voltages.

For a typical CMOS chip, a signal is said to change state when it crosses the voltage half-way between the supply voltages. For example, when a +mi12-volt supply is used, the threshold is 0 volts, and when a single 12-volt supply is used, the threshold is 6 volts. The first digits in a CMOS-chip number are generally 4 or 45.

A Schmitt trigger is a special circuit that obeys slightly different rules than do other forms of digital gates. For example, when the 4584 hex inverting Schmitt-trigger IC is operated from a 5-volt power supply, the output state will change on positive-going input signals at 2.9 volts, and on negative-going input signals at 2.3 volts. The difference between the 2.9- and 2.3-volt signals is called the "hysteresis band."

Figure 4 shows a 4584 inverter (1/6 of the total 4584) used in a very simple square-wave oscillator circuit. Because the 4584 is an inverter, a low at input pin 1 produces a high at output pin 2, and consequently, a high input produces a low output. When power is initially applied, capacitor C1 is discharged so the input sees zero volts (it is low); the output is therefore high, allowing C1 to charge from the output voltage at a rate limited by the time constant R1C1. When the voltage at the input reaches the Schmitt trigger's positive-going trip point, the 4584's input sees a high. That results in a low output, which causes C1 to discharge through R1 until the voltage drops below the negative-going threshold. The capacitor will continue to charge and discharge between those two levels at a frequency of approximately $0.72R1C1$.

Figure 5 shows a CMOS square-wave oscillator based on inverters (or NAND or NOR gates wired to act like inverters), which is similar to the ring oscillator shown previously. Unlike some CMOS inverter-based circuits, the one in Fig. 5 will produce a square wave

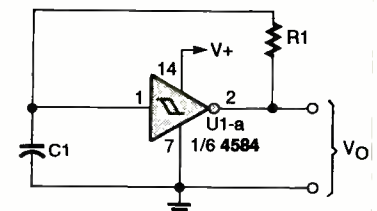
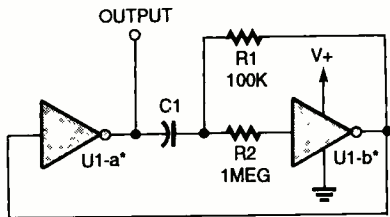


Fig. 4. A CMOS, inverting, Schmitt-trigger square-wave oscillator requires very few components to function.



*SEE TEXT

Fig. 5. This CMOS, inverting square-wave oscillator can be varied over a wide range. Note that R2 should be ten times the value of R1, as shown.

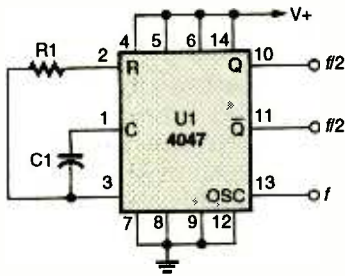


Fig. 6. This square-wave oscillator, based on the 4047 CMOS device, has complementary half-frequency outputs.

that has a 50% duty cycle. There are two resistors used in that circuit; R1 is used to set the operating frequency and R2 is approximately 10R1. Typical values for R1 and R2 are 100,000 ohms and 1 megohm, respectively. The value of C1 is less than 1000 pF. The operating frequency can be from 0.1 Hz to 1 MHz, depending on the values of R1 and C1, and is determined from:

$$f_o = 1/(2.2R1C1)$$

where f_o is in hertz, R1 is in ohms, and C1 is in farads.

Another CMOS square-wave generator is shown in Fig. 6. That circuit is based on the 4047 multivibrator circuit, which can be used for either monostable ("one-shot") or astable applications. In the configuration shown in Fig. 6, the 4047 is an astable multivibrator. There are three outputs from the 4047. The first is the oscillator (OSC) output, which is connected directly to the internal oscillator circuit. The other two outputs, Q and \bar{Q} , are complementary to each other and operate at one-half the frequency of the internal oscillator.

The output frequency is set by timing components R1 and C1, as in the last equation, but the Q and \bar{Q} outputs obey:

$$f_o = 1/(4.4R1C1)$$

The value of R1 should be between

10,000 ohms and 1 megohm, while the value of C1 should be 100 pF or more (the maximum capacitance is not limited theoretically, but a practical limit exists when the leakage resistance of C1 is of the same order of magnitude as R1).

555-Timer Oscillators. The 555 timer, with the possible exception of either the 741 operational amplifier or some microprocessors, is probably the most popular IC. That is because the 555 is versatile, low-cost, and behaves itself (which means that designing 555 projects is relatively easy).

The 555 is used to make monopolar square waves that can be either TTL compatible (V+ must be 5 volts DC), or CMOS compatible. Any power-supply voltage from 4.5- to 18-volts DC can be used, as the voltage sets the value of the high state.

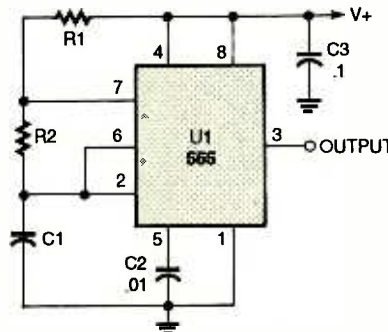


Fig. 7. Of course, the old 555 timer can be used as an astable multivibrator to generate square waves. However, for the circuit shown, they will not be symmetrical.

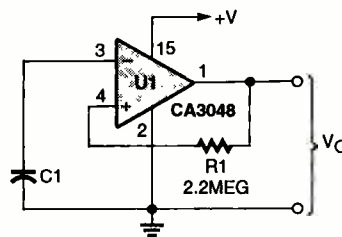


Fig. 8. An operational transconductance amplifier, square-wave generator circuit looks much simpler than it sounds.

The 555 can be connected in either monostable or astable configurations, but for continuous square waves, the astable version is used (see Fig. 7). The square-wave signal appears at pin 3 of the 555, while timing signals are processed at pins 2, 6, and 7. The output frequency of the 555 astable multivibrator is found from:

$$f_o = 1.44/((R1 + 2R2)C1)$$

The duty cycle of the 555's square-wave output is determined by the relationship between R1 and R2, and is given by:

$$\text{Duty Cycle} = (R1 + R2)/R2$$

Linear IC Generators. Several types of linear integrated circuits can be used to make square waves. The simplest of those is the operational transconductance amplifier (OTA). The only components in the simple circuit shown in Fig. 8 are a CA3048 OTA, a feedback resistor (R1), and a timing capacitor (C1). The output frequency is approximately given by:

$$f_o \approx 1/(2\pi R1C1)$$

Timing resistor R1 should be from 1 megohm to 3.9 megohms. When R1 is of a greater value, the circuit sometimes stops oscillating, depending upon the specific CA3048 used.

Operational-Amplifier Generators. The operational amplifier is one of the most useful linear ICs made. When introduced in the late 1940's (in vacuum-tube form), the op-amp was intended for performing mathematical operations in analog computers. Very rapidly, however, designers realized that the op-amp could be used for a wide variety of applications other than computing. The transistor soon introduced more people to the op-amp, but it wasn't until the advent of the integrated circuit that the complexity of the op-amp became an internal affair. The result was a simple amplifier in which the transfer function was set by manipulating the feedback.

Figure 9A shows a common op-amp square-wave generator circuit. It uses two feedback paths: one sets the DC level at the noninverting input (+), while the other is the RC timing network (R1C1). In general, if the feedback constant (β) is:

$$\beta = R3/(R2 + R3)$$

the output frequency is set by:

$$f_o = 2R1C1 \ln((1 + \beta)/(1 - \beta))$$

But, as with many circuits, a simple assumption can simplify the equation quite a bit. If we assume $R2 = R3$, then the equation reduces to:

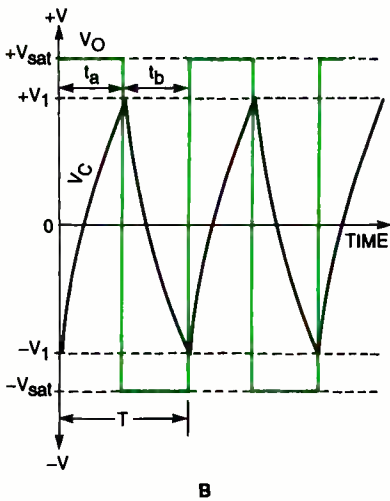
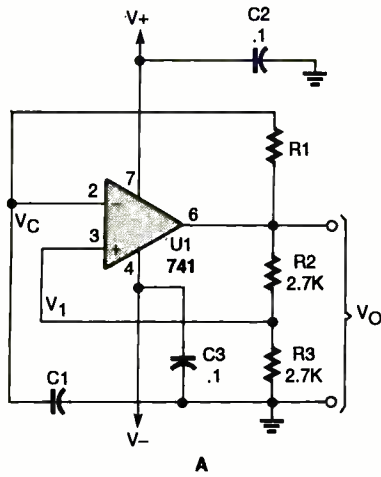


Fig. 9. This operational-amplifier square-wave generator (A) produces a 50-percent duty-cycle signal. That is because both the charge and discharge current for C1 flow through R1. The resulting charging and output waves are shown in B.

$$f_o = 1/(2.2R1C1)$$

Figure 9B shows the annotated timing waveform for the above circuit, with the capacitor charge/discharge curves superimposed on the output waveform. Because the op-amp is powered from a bipolar supply, output voltage V_o jumps between $+V_{sat}$ and $-V_{sat}$. The noninverting input is biased to voltage V_1 , which is a fraction of output voltage V_o according to:

$$V_1 = V_o \beta = V_o R3 / (R2 + R3)$$

Since $R2 = R3$:

$$V_1 = V_o / 2$$

The rules for the operational amplifiers used in the above nonlinear circuits are simple: If the inverting input is less positive than the noninverting input, then the output is high; if the inverting input is more positive than the noninverting input, then the output is low; if the two inputs see the same potential, then the output is zero.

Assume on initial turn-on that the capacitor is discharged, so capacitor voltage V_c is zero. According to the rules for operational amplifiers, that forces a high output. Capacitor C1 can now charge under the influence of $+V_{sat}$ and the R1C1 time constant. After time t_a expires, the capacitor voltage V_c reaches $+V_1$, so the output snaps low to $-V_{sat}$. At that time, the low segment of the output waveform begins, and C1 begins to discharge under the influence of $-V_{sat}$. It then recharges under the opposite

polarity. The process then repeats itself. The high time is t_a and the low time is t_b , while the total period is:

$$T = t_a + t_b$$

and the output frequency is $1/T$.

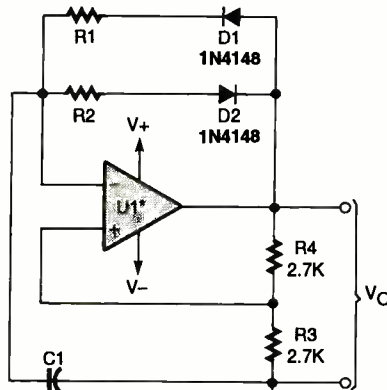
The circuit shown in Fig. 9A produces a time- and voltage-symmetrical square wave. We can alter that time symmetry by making either of the following two modifications to the circuit.

The first modification is shown in Fig. 10. That circuit uses two resistors in the timing network, and a pair of PN-junction diode switches to select which resistor is used at any given instant. Diodes D1 and D2 are backwards with respect to each other, so they conduct on alternate polarities of output voltage V_o . When the output is high, D1 is forward biased and D2 is reverse biased. As a result, R1 is used with C1 to time the circuit. When the output state changes to low, D1 is reverse biased and D2 is forward biased. In that case, R2 times the circuit. Because R1 and R2 are not equal to each other, their timing is different, so the output waveform's highs and lows are not equal.

A limitation on the circuit in Fig. 10 is that the duty cycle of the output square wave is fixed. The second modification to the circuit in Fig. 9A is the variable-duty-cycle square-wave generator shown in Fig. 11. That modification uses a DC-offset circuit (composed of R4 and R5) to inject a second current (I_2). Because of that bias, the half cycle when I_1 and I_2 have the same polarity is shorter. When R5 is set to the mid-point, the value of V_2 is zero, and the output waveform has the usual 50% duty cycle of the unmodified circuit.

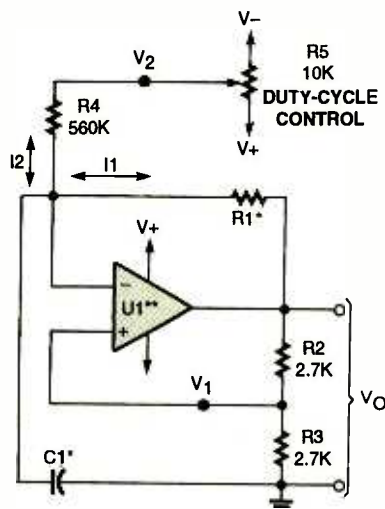
The circuit shown in Fig. 11 can be modified to perform pulse-width modulation. For that, one end of R5 is grounded and the other end is connected to a source of triangle, sawtooth, or sinewaves that modulates the duty cycle of the square-wave signal. The modulating signal should vary over a substantial portion of the $V+$ to $V-$ voltage range (but not more than those values) in order to produce maximum duty-cycle variation.

Square-wave generator circuits are easy to design, easy to build, and are extremely useful for a wide variety of applications in electronics. ■



*CHOOSE YOUR OWN OP-AMP

Fig. 10. Here is an op-amp-based square-wave generator that uses diode switching to produce a fixed duty cycle other than 50 percent.



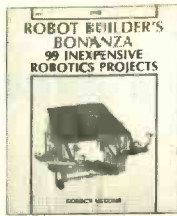
*SEE TEXT

**CHOOSE YOUR OWN OP-AMP

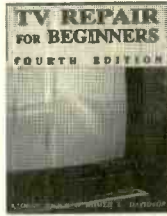
Fig. 11. Use R5 to adjust this variable-duty-cycle square-wave generator. That potentiometer controls I_2 to vary the timing.



3705P \$19.95



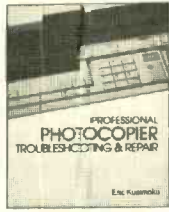
2800P \$17.95



3627P \$19.95



4170H \$28.95 Hardcover



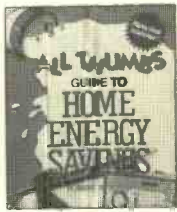
4331H-XX \$29.95 Counts as 2/Hardcover



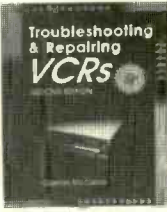
3270P \$26.95



4270H \$29.95 Hardcover



4244P \$9.95



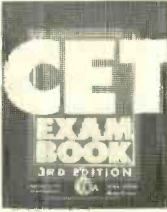
3777H \$32.95 Hardcover



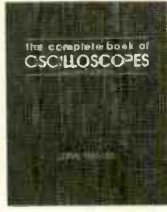
4362P \$16.95



3802H-XXX \$84.95 Counts as 2/Hardcover



4199H \$29.95 Hardcover



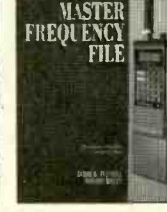
3825P \$17.95



3711P \$19.95



4334P \$17.95



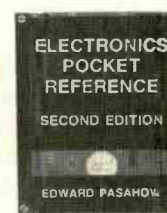
4229P \$29.95



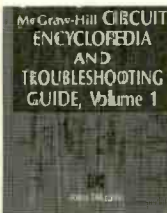
4227P \$15.95



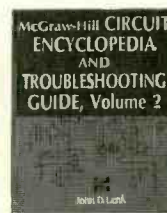
4263H \$28.95 Hardcover



0487375 \$24.95



D37803-XX \$59.50 Counts as 2/Hardcover



0376107-XX \$59.50 Counts as 2/Hardcover



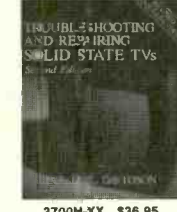
4136P \$16.95



3621H-XX \$39.95 Counts as 2/Hardcover



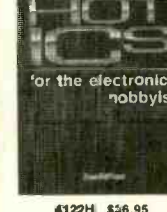
3765P \$19.95



3700H-XX \$36.95 Counts as 2/Hardcover



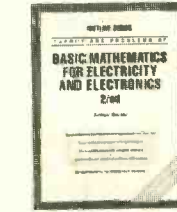
2790P \$17.95



4122H \$26.95 Hardcover



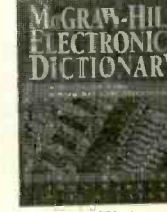
0156778-XX \$44.95 Counts as 2/Hardcover



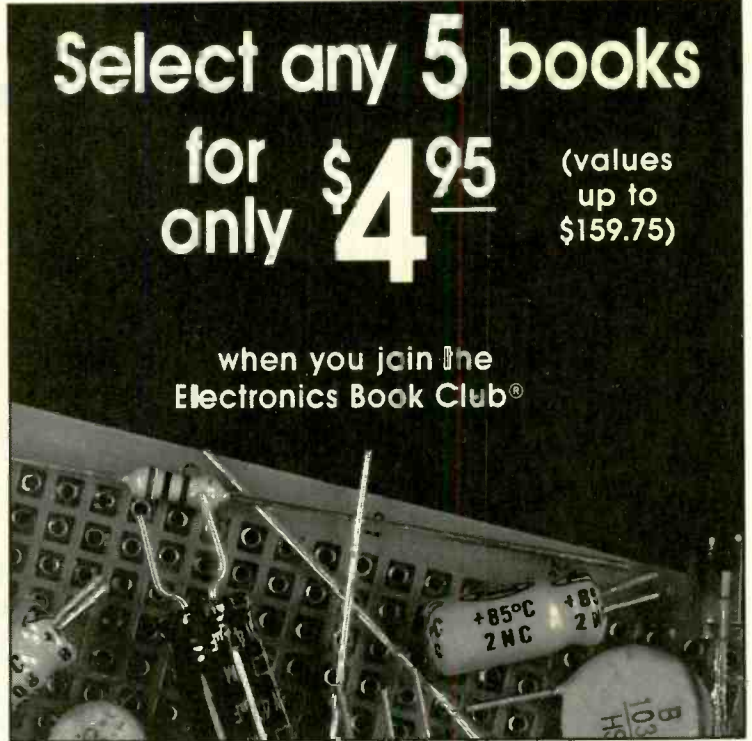
0044392 \$12.95



1367P \$29.95



0484345-XX \$49.50 Counts as 2/Hardcover



Select any 5 books for only \$4⁹⁵

(values up to \$159.75)

when you join the Electronics Book Club®

As a member of the Electronics Book Club . . .

. . . you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off of regular publishers' prices. If you want the Main Selection too nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want due to late delivery of the News, you can return it at our expense. Plus you'll be eligible for **FREE BOOKS** through the Bonus Book Program. Your only obligation is to purchase 3 more books during the next 12 months, after which you may cancel your membership at any time. A shipping/handling charge and sales tax will be added to all orders. All books are softcover unless otherwise noted. (Publishers' prices shown) If you select a book that counts as 2 choices, write the book number in one box and XX in the next. If you select a book that counts as 3 choices, write the book number in one box and XXX in the next 2 boxes. ©1995 Electronics Book Club PE395

If card is missing, write to: Electronics Book Club, A Division of McGraw-Hill, Inc., P.O. Box 549, Blacklick, OH 43004-9918

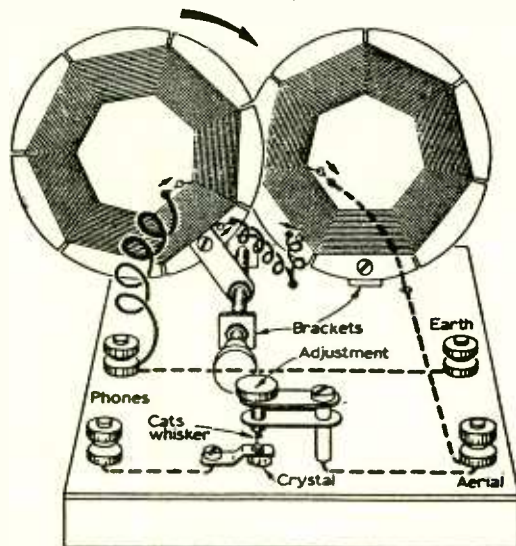
March 1995, Popular Electronics

ANTIQUE RADIO

By Marc Ellis

Mailbag Time Again!

It's time once again to give our readers the floor. Receiving mail from you is certainly one of the most enjoyable parts of this job! It's instructive, it's fun, and it keeps me in touch with your interests—which is a great help in planning the column.



Here's a pictorial of the reproduction 1922 British crystal set built by reader D.B. Millar from plans in *Practical Wireless* magazine. The set was tuned by swinging the front pancake coil over the back one.

My way of responding to your letters is to acknowledge them on these pages. If I tried to respond personally, particularly to the many requests for schematics, technical advice, and other information, I wouldn't have time to write *Antique Radio*.

So instead I share the letters, referring the questions and requests to the readership at large and passing along the many interesting tips and other pieces of information. For maximum impact, and in order not to interrupt the flow of ongoing projects or stories, your letters are

saved up and put together, in a special column or two, three or four times a year.

Since it does take another couple of months after I write a column for the magazine to hit the streets, it can be six months or more before you see your request or comment in print! So please be patient.

CRYSTAL SET COMMENTS

The series of articles on the NBS crystal set drew a lot of attention, and I'm still receiving comments from readers on that subject. Let's start with one from *Rudolf Mangold* (Penn Valley, CA), who remembers building crystal sets with his dad in the early 1920's. Even though the NBS set was designed to be scratch-built, Rudy doesn't understand why a capacitor wasn't used across the phones. The phones act as an RF choke, attenuating the flow of current through the crystal unless bypassed. "If we would show a crystal set without a capacitor at

our radio club, we would be laughed at." Rudy and his dad made their own phone capacitors by sandwiching alternate layers of metal foil and tissue paper.

D.B. Millar (Annapolis, MD) built a kind of British equivalent of the NBS set from vintage plans published in the UK magazine *Practical Wireless* (September, 1972). It was offered as a means for listening to the BBC 50th anniversary program (November, 1972) commemorating the first broadcast in 1922. That set didn't have a phone capacitor either, but (using a

formula from Ghirardi's *Radio Physics Course*) Millar built one from aluminum foil and masking tape—rolling up the "sandwich" into a neat cylinder.

Many folks who don't have the patience to fool with a cat's whisker (myself included) like to substitute a modern semiconductor diode for the galena while experimenting with crystal-set circuits. *George H. Haby* (Altadena, CA), who is 88 years old, goes us one better by using *four* diodes hooked up as a standard full-wave rectifier. The input terminals are connected where the crystal normally goes; the output terminals to the headphones.

Vincent Bashore (San Ysidro, CA) received his first crystal set as a birthday present in 1928, then got into building them. He once gave up school lunches for a week to accumulate parts money for a set using a coil wound on a maple rolling pin and tuned by a brass slider.

A photo received from *Robert S. Davey* (Frankfort, IN) shows a set he built from plans in *Popular Mechanics* (January, 1977). The published set used a 3½-inch-diameter, cylindrical salt container as a form, but Bob seems to have used some other kind of tube. For flexibility in experimentation, he substituted clip-lead coil connections for the permanent ones suggested in the article.

A. Ross (1926 Hafor Circle, Iowa City, IA 52246) is looking for two of the references I mentioned during the NBS set series: *How to Build Your Radio Receiver*,



Robert S. Davey's version of the "salt box" crystal set described in Popular Mechanics for January 1977. Clip leads make it easy to experiment with coil taps.

edited by Banning and Cockaday (Popular Radio, Inc. 1924), and *Radio for Everybody* by Austin C. Lescarboua (Scientific American Publishing Co., 1922). I've seen the former offered as a reprint but, unfortunately, don't recall the source.

M. DeLuca (E. Setauket, NY) requested the address of James Knight, who built the speaker-volume crystal set shown in the September, 1994 mailbag column. It's 222 Greenfield Ave., Tullahoma, TN 37388.

Finally, several folks are looking for copies of certain installments of the NBS set series. M.R. Angermiller (1239 Yale St., Houston, TX 77008-6959) needs January and May 1994. Gerry Hoye (Department of Civil Engineering, 220 Civil/Electrical Engineering Building, University of Alberta, Edmonton, Canada T6G 2G7) needs May and June. Cliff Stearns (803 W. Malone Dr., Connersville, IN) would like all the issues (January 1994 and April through August 1994). All those individuals offer to pay copying costs.

Here's a suggestion to anyone looking for back issues. If you need only a copy or two, they most likely

are available (the cost is reasonable) from the **Popular Electronics** Bookstore. Write them directly (not through this column) and inquire. If you need several issues, try your local library. Many subscribe to **Popular Electronics**, and most have copy machines.

HELP WANTED

Mrs. Tonya Dejong (1453 Garvin St., Prince George, BC, Canada V2L 3Z1) is looking for service info on a Vicking (could this be Viking?) N.A. 95. Larry Stanley (RT 1 Box 166, Delta, AL 36258) is looking for someone to repair his Zenith 9H081. John H. Rodriguez (123 Colonels Lane, Weymouth, MA 02189) needs help repairing the drive-motor circuitry (will not run on high speed) of his Akai Model M-7SP reel-to-reel tape player.

Could a Crosley expert give Randall Thacker (4216 East Hano St., Phoenix, AZ 85044) a hand? He's working on a Model E-15WE and is having trouble getting the knobs to stay on their shafts. It seems that the triangular plastic inserts are worn. Randy would like to find some used or reproduction replacements.

Randy also recently ac-

Electronic Security

2 for 1 SALE!



Mini Long Range FM Voice Transmitter (3 m) Ultra Sensitive - with fine tune, range control, more! Detects even whispers! FMX1 Kit and Plans.....~~\$49.50~~

Tiny Telephone FM Transmitter (3 m) - automatically operates when phone is used. Crystal clear clarity with fine tune and range control. TELX-1 Kit and Plans.....~~\$49.50~~

Both Easy-to-Build Kits Above only \$49.50!

Extended Play Telephone



Recording System - \$129.50

- Automatic - Crystal Clear - Easy to Use - Connects to Any Phone - Automatically controls and records both sides of the conversation on our extended play recorder. Caution - check local laws as some states require an alerting beeper.

TAP20X Ready-to-Use System only \$129.50

FREE CATALOG with order - or send \$1.00 P&H
INFORMATION UNLIMITED
 MC, VISA, Check, Cash or C.O.D.
 Send or Fax Orders to: Dept pe16
 PO Box 719, Amherst, NH 03031
 Orders: 800-221-1705 FAX 603-672-5406 Tel 603-673-4730

Earn \$1000

A Week While You Learn High Paying VCR Repair.

Earn While You Learn . . .
 Secrets Revealed . . .




Train at Home

If you are able to work with small hand tools and possess average mechanical ability, you could earn top dollar part time or full

time. Our learn by doing method teaches you how to work on VCR's without boring unnecessary electronic basics.

For Free Information Package Send Coupon to:
 Foley-Belsaw Institute, 6301 Equitable Road,
 Kansas City, MO 64120

Check VCR or another High Paying Career Field  Since 1926	(Check One Box Only)
	<input type="checkbox"/> VCR Repair, Dept. 62273
	<input type="checkbox"/> Computer Repair, Dept. 64171
	<input type="checkbox"/> TV/Satellite Dish, Dept. 31064
	<input type="checkbox"/> Advance VCR Repair, Dept. 65033
	<input type="checkbox"/> Camcorder Repair, Dept. 66043
<input type="checkbox"/> Fax Repair, Dept. 67043	
<input type="checkbox"/> Printer Repair, Dept. 68042	
Name _____	
Address _____	
City _____	
State _____ Zip _____	

CIRCLE 154 ON FREE INFORMATION CARD

quired an Echophone EC1, and wanted to review my July through October 1987 restoration series on that set. Randy couldn't find 1987 copies of **Popular Electronics** in his library. (Here's a hint, Randy: Back then, this publication was known as *Hands-on Electronics*!)

Anyone care to share their methods for (1) removing rust from chassis and transformers and (2) repairing large holes in speaker cones? Please contact *Glenn Woodward* (4003 Pine Hill Blvd., Racine, WI 53403). A schematic and service info for a Hallicrafters S-38C are being sought by *Howard Cummings*, 4700 Morris NE, Albuquerque, NM 87111. Howard could also use some restoration advice on that set. Please get in touch with *George B. Henley*, WA7GSN if you have information and/or schematics on the following test equipment: a Knight TEN-2 CB Checker, and an EMC (Electrical Measurements Corp. of New York, NY) Model 801 Resistance-Capacitance Comparator Bridge.

Christian Nielson (233



This grand-looking Pilot G-104 console was recently purchased by *Christian Nielson*, who seeks information on its rarity and value.

Eagle Ave., West Hempstead, NY 11552) sent us a shot of his recently purchased Pilot G-184. He'd like any information he can get on the set, especially an estimate of its rarity and market value.

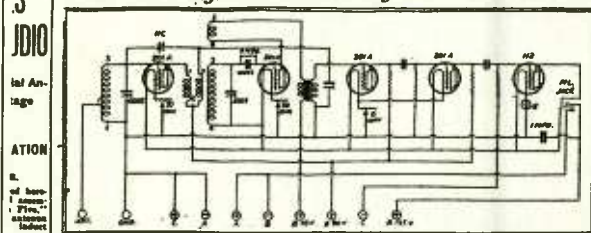
Craig Fiedler (22253 Pheasant Court, Hutchinson, MN 55350) needs an instruction book and calibration information for a Sprague Tel-Ohmike Model TO-6 Capacitor Analyzer. He found a 1968 date stamped inside the instrument and wanted confirmation that the analyzer could be so recent. All I can say is that it makes sense to me! The earlier Model TO-4 that I restored on these pages a few months ago was a late 1950's instrument.

THIS 'N THAT

Speaking of the TO-4 restoration, *Harry Atenik* (Hawthorne, CA) writes that he found it helpful in restoring his somewhat earlier TO-3. After replacing all the caps, including the filters, he fired it up and was quite pleased with its performance. Harry says that the TO-3 is more accurate than his Heathkit Digital L-C bridge or his EICO model 950 B.

Keith L. Fender (Mount Vernon, WA), who signs himself "Your Antique Reader," remembers starting his career in electronics with a "Quaker Oats" crystal set in the early 1920's. He sent a schematic and parts list of an AC-operated TRF—with Meissner tuning capacitor and coils—that he originally built (I would guess) in the late 30's. He's used it regularly over the years, making modifications and improvements from time to time. For example, the original grid-cap tubes were changed to single-ended types, and the set now sports a low-distortion de-

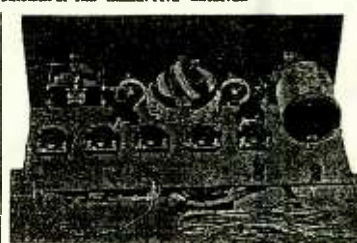
Schematic Diagram and Assembly of the "Ireland Five"



to not "too high and in slight; therefore, avoid voltage gain of the transformer coupled stage to produce the voltage gain of a pentode in a single stage. When general purpose tubes (12, 6BD4 or equivalent) are used in each.

Audio System
The filter, choke, and transformer to complete the detector tube to the first audio amplifier tube since the transformer distortion on one stage is so small that it cannot be readily detected, and the gain in signal voltage is very desirable. The audio system from this point to the output is a resistance coupled.

Each 6X4 tube may be used to very great advantage in the two, not one, stage and with a power tube in the output, a good speaker may be specified with maximum volume and the quality is generally all that can be desired. A C battery for the output tube is imperative for the results and for



Sent in by reader *John Lombardi*, the radio section from a 1927 Sunday paper conveys some of the excitement of the 1920's radio craze.

tor from the *ARRL Handbook* and a "Poor Man's Williamson Output Stage" from a 1950's *Radio News*.

When renovating his home, *John Lombardi* (sorry, I don't have John's location) came across some newspapers stuffed in the wall as insulation. Included were a couple of pages from the radio section of the *Philadelphia Public Ledger* (February 27, 1927), and John was kind enough to send copies. Looking at those old-time large pages stuffed with ads, program listings, and radio-related news, you can really get a feeling for the "Radio Craze" of the 20's. Come to think of it, if you'd like to get an idea of what those radio pages look like, check the computer section of the business pages in your current Sunday paper!

Thanks to *Robert Fleischer* (Lake Tahoe, CA) for the long note. I enjoyed reading about your career as a circuit designer and your "retirement" as a repairer/restorer of hi-fi sets, industrial gear, musical-instrument electronics, and antique radios. Thanks also

to *Terry Schwartz* (Shoreview, MN) for the latest set of photos of his collection. We'll run them soon, Terry! Another thank-you to *Robert Davey* who sent me some interesting photocopies from recently-acquired *Radio-Craft* and *Short-Wave Craft* magazines of the 30's and 40's. I particularly enjoyed the advertising material on Hallicrafters, Doerle, and Echophone sets.

Louis Duval (Quebec, Canada) gets a thank-you for sending info to reader, *Barry Stephens* (Austin, TX), who inquired about the Type XXL Loctal tube (and for including a copy for my files). And, finally, *Tom Byers*, WBYTG would like to express his appreciation to the several folks who responded to his inquiries for service info on the Hallicrafters S-40-A. He now has it working and is restoring several other communications receivers.

Do you have any questions or comments for inclusion in the next mailbag? Write me c/o *Antique Radio, Popular Electronics*, 500-B Bi-County Blvd., Farmingdale, NY 11735.

Hobbyist's Paperback Budget Books

Popular Electronic Circuits Book 1



□ **BP80/98—Popular Electronic Circuits—Books 1 and 2...\$11.90.** Contains a wide range of circuits which are accompanied by text giving a brief introduction, circuit description and special notes on construction and setting-up that may be necessary.

Coil Design and Construction Manual



□ **#160—Coil Design and Construction Manual...\$5.95.** A complete book for the home builder on how to make RF, IF, audio and power chokes and transformers. Practically every possible type is discussed and calculations are explained in detail.



□ **BP271—How to Expand, Modernize and Repair PC's and Compatibles...\$7.75.** All the practical information you are likely to need to upgrade your PC and compatible. Also contains useful information and illustrations to help you with repairs.

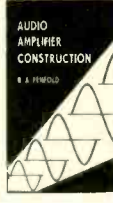


□ **BP182—MIDI Projects...\$6.95.** Provides practical details of how to interface many popular home computers of different manufactures with MIDI systems. Also covers interfacing MIDI equipment to analog and percussion synthesizers; amply illustrated.

50 Projects Using IC CA3130



□ **#223—50 Projects Using IC CA3130...\$5.00.** One of the more practical and useful operational amplifiers (opamp), the CA3130 integrated circuit chip is the heart of several easy-to-assemble projects covered in the book. The projects are divided into five categories: audio projects, RF projects, test equipment, household projects and a catch-all miscellaneous group. Ideal for all skill levels.



□ **BP122—Audio Amplifier Construction...\$5.75.** Practical designs are featured and include circuit diagram and description. Veroboard or printed-circuit board layout and construction notes. The text is divided into two parts. The first deals with many types of preamplifiers. The second covers power amplifiers from a simple low-power battery type to a 100-watt DC-coupled amplifier using four MOSFETs in the output stage.



□ **BP107—30 Solderless Breadboard Projects—Book 1...\$5.95.** Each project is designed to be built on a "Verobloc" breadboard and is presented with a brief circuit description, circuit diagram, component layout diagram and components list. Notes on construction and applications are provided. Wherever possible, the components are common to several projects to keep project costs down.



□ **BP266—Electronic Modules and Systems for Beginners...\$7.25.** Shows the reader how to build a number of simple analog and digital circuit modules, all suitable for battery operation, and all based on only 1 or 2 transistors or ICs.



□ **BP329—Electronic Music Learning Projects...\$6.25.** A beginner's book that will assist you in assembling such projects as the Elexylophone, Gildaphone, Melody Ranger, Cordmaker, Appealing Handbells, Electronic Sol-Fa, Tune-up Box and more.



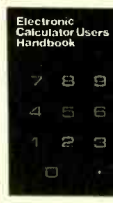
□ **BP319—Making MS-DOS Work for You...\$6.50.** What you need to know first, comes first, however the text is written in a circular style so that the reader can start anywhere in the text. This book is relevant to all versions of both MS-DOS and PC-DOS.



□ **BP303—Understanding PC Software...\$6.95.** Covers main types of PC software, giving details of typical uses, the basics of how they are used and their limitations. Each chapter covers popular software and programs of a similar type.



□ **BP105 Aerial (Antenna) Projects...\$5.50.** In this book the author has considered practical antenna designs, including active, loop and ferrite antennas which perform well and are relatively simple and inexpensive to build. The complex theory and mathematics of antenna design have been avoided. Also included are construction details of a number of antenna accessories including a pre-selector, attenuator and filters.

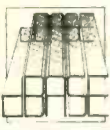


□ **BP33—Electronic Calculator Users Handbook...\$5.75.** The book eliminates the mysteries of the calculator and offers unique ideas for the simplest to most complex calculators. Covers the basic functions plus trigonometric, hyperbolic, logarithms, square roots and powers. Included are formulas and data for VAT, discounts, and mark up, currency conversion, interest, binary and octal numbers, and much more!



□ **BP125—25 Simple Amateur Band Antennas...\$5.50.** Plans to build antennas that are simple and inexpensive to construct and perform well. From the simple dipole to beam, triangle and even mini-rhombic types made from four TV masts and about 400 feet of wire. After the antenna discussion you will find a complete set of dimension tables that will help you "tune" an antenna on a particular frequency.

A Concise Introduction to dBASE



□ **BP263—A Concise Introduction to dBASE...\$6.95.** The most popular data-base program, dBASE, is difficult to master without help. This book helps you spend your time using dBase, not setting it up. A user's guide that covers all the basics up to dBase IV.



□ **PCP104—Electronics—Build and Earn...\$9.95.** Construction details are given to build a circuit demonstrator that is used throughout the book to introduce common electronic components and how these components are built up to useful circuits.



□ **BP302—A Concise Users Guide to Lotus 1-2-3 Release 3.1...\$6.25.** Written to help existing spreadsheet users upgrade to 1-2-3 Release 3.1, which has the ability to work 3-dimensionally with both multiple worksheets and files.



□ **BP146—The Pre-BASIC Book...\$6.95.** Another book on BASIC but with a difference. It concentrates on introducing technique by looking in depth at the most frequently used and more easily understood computer instructions.

Just What the Project Builder Is Looking For!

- | | | | |
|--|--------|---|--------|
| □ #160—Coil Design and Construction Manual | \$5.95 | □ 1596T—24 Silicon-Controlled Rectifier Projects..... | \$9.95 |
| □ #219—Solid State Novelty Projects | \$4.95 | □ BP58—50 Circuits Using 7400 Series ICs | \$5.50 |
| □ #222—Solids State Shortwave Receivers for Beginners..... | \$5.50 | □ BP69—Electronic Games..... | \$5.50 |
| □ #223—50 Projects Using IC CA3130..... | \$5.00 | □ BP71—Electronic House Projects | \$5.00 |
| □ #225—Practical Introduction to Digital ICs..... | \$5.25 | □ BP84—Digital IC Projects..... | \$5.50 |
| □ #226—How to Build Advanced SW Receivers | \$5.75 | □ BP93—Electronic Timer Projects..... | \$5.50 |

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. BOX 240, Massapequa, NY 11762-0240

Name _____
Address _____
City _____ State _____ Zip _____
PE2 Allow 6-8 weeks for delivery

SHIPPING CHARGES IN USA AND CANADA

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

SORRY No orders accepted outside of USA & Canada

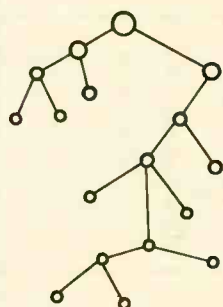
Number of books ordered

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

All payments must be in U.S. funds!

By Jeff Holtzman

Objects



HIERARCHICAL TREE

C:\	KINGDOM
C:\FINANCE	PHYLUM
C:\FINANCE\1992	CLASS
C:\FINANCE\1992\JAN	ORDER
...	FAMILY
	GENUS
	SPECIES

DOS ANALOGY

BIOLOGICAL ANALOGY

Fig. 1. Hierarchical trees are a common way to represent relationships among families, types of animals, units of an organization—and computer software.

was one such concept that just kept getting pounded and pounded. Today, \$100 and a little shopping will get you a pair of Ethernet cards and a copy of Windows for Workgroups. Other concepts (e.g., artificial intelligence) made small inroads, but remain on the back burner, waiting for a good application.

Another over-hyped yet persistent (so to speak) idea is that of objects. Several years ago, you couldn't open a magazine or trade journal without being bombarded with object-this and object-oriented that. But then the Internet happened (that is, the general public became aware of it), and object lost its cachet. *Byte* magazine (in their May,

1994 issue) even proclaimed that objects were dead.

It may no longer be fashionable, but make no mistake: Object technology is important. Object technology is in fact alive and well, and flourishing in Silicon Valley, as well as software shops worldwide. All the influential software and computer companies are deeply committed to object-oriented technology. That includes IBM, Apple, Microsoft, HP Digital, Borland, and numerous others.

There are object-oriented operating systems (OpenStep, Cairo), object-oriented programming languages (Smalltalk, C+), a few object-oriented applications programs, and even object-oriented hardware devices (e.g., miniature sensors that operate on a network and provide feedback about the operational state of an automobile or manufacturing process).

If you're brand new to computers and programming, you may wonder what all the fuss is about. But if you've had any exposure to Basic, C, Pascal, FORTRAN, or most other programming languages, you have to adjust your thinking. And old timers, deeply immersed in traditional procedural languages such as COBOL, can have a really hard time.

Despite all of that, the concepts are not difficult. This month I want to give you a basic sense of what object technology is all about; next time, we'll look at things a bit more rigorously.

HIERARCHIES

Let's start with hierarchies; see Fig. 1. If you understand how to organize files under DOS, you understand the concept of a hierarchy. In DOS, the root directory might contain multiple subdirectories, each of which could contain multiple subdirectories, and so on. Under DOS, any given directory can have multiple subdirectories. On the other hand, a given subdirectory can belong to only one directory.

We use the hierarchical structure to organize our work. For example, off the root directory, we might have subdirectories for storing text files, finances, games, utility programs, and so on. Some of these might be further subdivided according to year (1990, 1991, . . .), and so on. And outside the computer world, we're surrounded by many different hierarchical structures, even though we don't normally think of them as such.

For example, families are hierarchically structured. If you're like most people, you can easily trace your family back through three or four generations; if you're lucky, perhaps more. Corporations are often structured hierarchically. So is the military. When we speak of the animal kingdom, we're really talking about a hierarchy. There are many species of dogs, and cats. Dogs and cats are both mammals. Mammals includes all dogs and all cats; it also includes human beings, apes, bears, and so on. The list of examples goes on and on.

Object technology (and

computer technology in general, for that matter) depends heavily on the concept of the hierarchy. Developing object-oriented software means building hierarchies. It means grouping like things together—dogs with dogs, cats with cats—grouping groups, grouping groups of groups, etc. Talent in object-oriented software design and development involves the ability to recognize and create consistent patterns among groups.

In the animal kingdom, a dog is real, but higher levels in the classification scheme are abstract. One of the key things about object-oriented technology is that it follows the same idea. It starts with a real object (a document, an inventory list, a video clip, a scanned photograph) and builds around it a hierarchy that

enables efficient computer processing.

That is in marked contrast to older, procedural ways of thinking about software. In those older ways, you neither started out nor ended up with something that directly corresponded to anything in the real world. A classic textbook is called *Algorithms + Data Structures = Programs*. The thinking symbolized by that title shows a computer-centric view of the world. By contrast, the modern way of thinking is to model the real world; that is, to represent it directly.

One thing that makes objects so exciting is the ability to use the hierarchical structure to create variations on a theme. By analogy, the class "dogs" includes Dalmatians, Sheep Dogs, German Shepherds, Scottish Terriers, Poodles, Chihuahuas, Dachshunds,

Irish Setters, Bulldogs, and many more.

If you were going to design a new dog, you wouldn't have to go all the way back to hydrogen, oxygen, and carbon. You could start off with the group of characteristics represented by "dog" (e.g., walks on four legs, omnivorous, gives live birth, is domesticated), and customize just those features necessary for your particular dog.

That is how object-oriented software works. Take an object, customize a few features to meet your needs, and that's it. Well, not quite. Things can and do get complicated. But the point is that object-oriented technology starts and ends with the real world. That fact alone gives the software a higher chance for success than would otherwise be the case.



One tree can make
3,000,000 matches.



One match can burn
3,000,000 trees.



A Public Service of This Magazine
& The Advertising Council



Whether you wish to save money, boldly go where no guitarist has gone before or simply have fun building electronic gadgets designed for your musical pleasure, then read

Electronic Projects for GUITAR

\$12⁹⁵

Some of the add-on guitar gadgets you can build are:

Preamplifier • Headphone Amplifier • Soft Distortion Effects Unit • Compressor • Auto-waa • Waa-waa Pedal • Phaser • Dual Tracking Effects • Distortion Unit • Expander • Dynamic Treble Booster • Direct Injection Box • Dynamic Tremelo • Thin Distortion Unit • and Guitar Tuner.

Anyone with some previous electronic project building experience should have no problem assembling the projects.

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

Yes, send my copy of ELECTRONIC PROJECTS FOR GUITAR by RA Penfold to the address at right. I am enclosing \$12.95 plus \$2.95 for shipping charges in USA and Canada. All payments must be made in US funds. Sorry, no orders accepted outside of USA and Canada. New York State residents add local sales tax. Allow 6-8 weeks for delivery.

Check enclosed.

Please charge my Visa MasterCard

Signature _____

Account No. _____ Expir. Date _____

Name _____

Address _____

City _____ State _____ ZIP _____

FULL- OR PART-TIME JOB/BUSINESS:

Learn VCR repair!



Career-level home study. Master easy-to-learn, high-profit repairs without buying costly, high-tech instruments. Free literature: send or call 24 hours a day.

800-223-4542

Name _____ Age _____

Address _____ Phone () _____

City _____ State _____ Zip _____

The School of VCR Repair

PCDI, 6065 Roswell Road

Dept. VRC341, Atlanta, Georgia 30328

Be a computer repair expert!

Career-level home study course. Learn all about PC repairs, troubleshooting, installation, upgrading, servicing.

Open your own business; become a more valuable employee. For free literature: send or call 24 hours a day.

800-223-4542

Name _____ Age _____

Address _____ Phone () _____

City _____ State _____ Zip _____

The School of PC Repair

PCDI, 6065 Roswell Road

Dept. JJC341, Atlanta, Georgia 30328



CIRCUIT CIRCUS

By Charles D. Rakes

Controller Circuits

It's show time, and are you ready for some circuitry fun? Good! Make yourself comfortable and get ready to share a few electronic control circuits.

Over the last two decades, U.S. manufacturers have steadily moved away from slow, and often unreliable, relay-control circuitry to the faster and more reliable microprocessor-based programmable controllers. The majority of those programmable controllers were designed to be placed in service by electricians who, in many cases, had little or no electronic training but were experi-

troller circuit, see Fig. 1, uses two hexFET's and half of the inverters in a single IC to perform a simple two-function operation. The heart of the controller circuit is a set and reset latch circuit made up of two inverters.

When the input (pin 3) of the U1-a is grounded via S1, the output (pin 2) goes high, driving the input of inverter U1-b high as well. That forces U1-b's output low, latching the input of U1-a low. In that latched condition, the output of U1-c is high, turning on Q1 and operating the motor. At the same time, the low output of U1-b keeps Q2 turned off.

The circuit remains in that state as long as switch S2 remains open. When the motor has completed its function, the stop switch, S2, can be manually closed. That forces the input of inverter U1-b low, and its output high which causes the output of U1-c to go low, turning off the motor. At the same time, the high at the output of U1-b turns on Q2, allowing a second load to operate. Although that load is shown as a solenoid in the schematic, it could be a relay, another motor, etc.

The circuit will remain

latched until S2 is opened and S1 is closed. Note that S2 must be opened before the cycle is restarted via S1; as long as S2 is closed S1 will have no effect on the circuit.

FOUR-OUTPUT TIMER

Our next controller, see Fig. 2, offers up to four timed outputs that can be used to operate motors, air valves, solenoids, relays, etc. Two dual, retriggerable monostable IC's and a few support components are all that's required for the circuit. The timer sections are cascaded so that as one timer times out, it triggers the next timer, and so on until the last timer times out.

The intended application for the controller required a two-sensor input that would only start when both inputs occur simultaneously. Note, however, that the start-signal logic could be modified to accommodate a combination of any number of input sensors, or even a single switch closure. The controller also includes an inhibit circuit that keeps the sequence from re-starting before a cycle is completed.

Here's how it works. At rest,

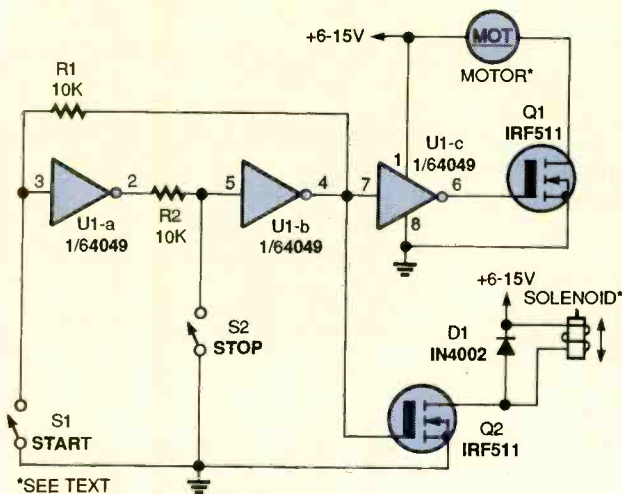


Fig. 1. This two-function controller operates a motor when started, then energizes a solenoid, relay, etc. when stopped.

enced in relay-ladder logic.

Since it's so easy to program and use those controllers, many are used to perform simple functions that often could be done as well or better with a simple shop-built circuit.

TWO-FUNCTION CONTROLLER

Our first electronic con-

PARTS LIST FOR THE TWO-FUNCTION CONTROLLER (Fig. 1)

SEMICONDUCTORS

U1—4049 hex inverting buffer, integrated circuit
Q1, Q2—IRF511 hexFET transistor
D1—IN4002 silicon diode

ADDITIONAL PARTS AND MATERIALS

R1, R2—10,000-ohm, 5%, 1/4-watt resistor
S1, S2—SPST switch
Motor (see text), solenoid (see text), wire, solder, etc.

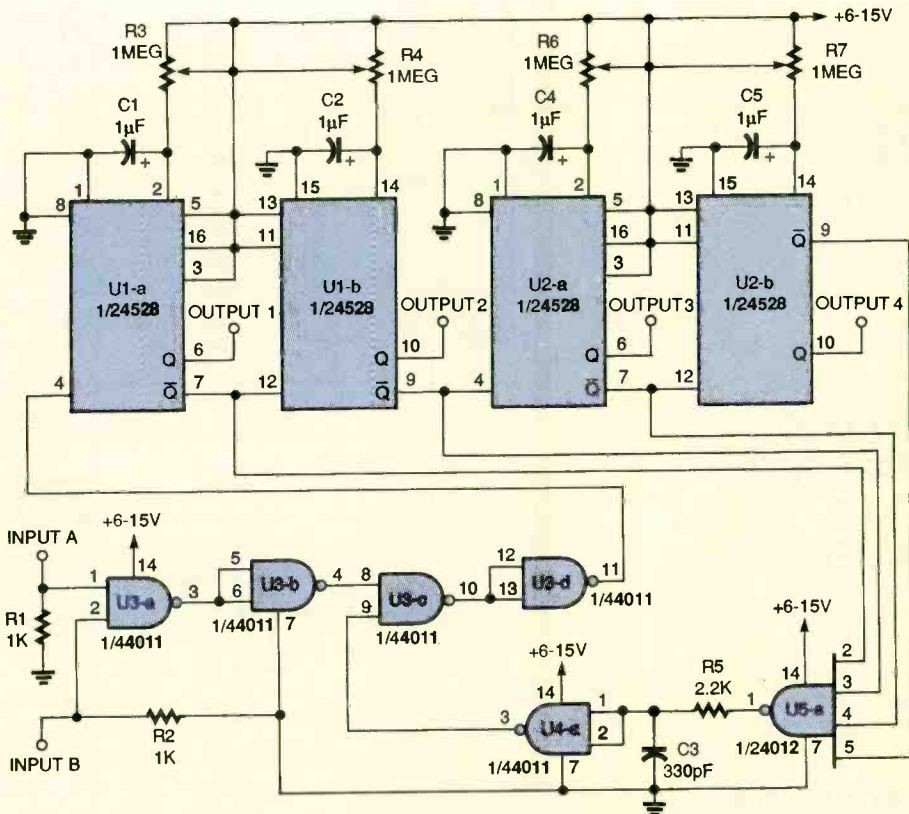


Fig. 2. This four-output controller features an inhibit circuit built around U5-a.

As soon as U1-a triggers and goes into its timing cycle, the \bar{Q} output (pin 7) goes low and the Q output (pin 6) goes high; the Q output is available at output 1. Those outputs remain in that state for the duration of the timing period determined by R3 and C1. At the end of the timing period the outputs change state, with the rising edge of the \bar{Q} output triggering the next timer, U1-b, and so on.

An inhibit function is provided by U5-a. When each timer's Q output goes low, that low is fed to one of U5-a's inputs. Whenever any of the inputs is low, the gate's output goes high, causing the pin-9 input of U3-b to go low. When U3-b is in that state, the sensor inputs are unable to trigger U1-a. To allow for pulse transition time between timers, R5 and C3 add a slight time

PARTS LIST FOR THE FOUR-OUTPUT CONTROLLER (Fig. 2)

SEMICONDUCTORS

U1, U2—4528 dual retriggerable monostable timer, integrated circuit

U3, U4—4011 quad 2-input NAND gate, integrated circuit

U5—4012 dual 4-input NAND gate, integrated circuit

RESISTORS

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

R1, R2—1,000-ohm

R3, R4, R6, R7—1-megohm, potentiometer

R5—2,200-ohm resistor

ADDITIONAL PARTS AND MATERIALS

C1, C2, C4, C5—1- μ F, 35 WVDC, electrolytic

C3—330-pF, ceramic-disc

Wire, solder, etc.

and before the cycle starts, the four inputs of U5-a, one half of a 4012 dual-input NAND gate, are all high. That produces a low output, which is passed to the inputs of U4-a, 1/4 of a 4011 quad two-input NAND gate. As a result, the output of U4-a is high; that high signal is fed to one input (pin 9) of U3-c. Two sensors connect to the circuits via inputs A

and B. When both sensors go high, the output of U3-a goes low. Gate U3-b inverts that signal, and passes the resulting high to the other input (pin 8) of U3-c. When both inputs of U3-c are high, the output of that device goes low. That input is then inverted by U3-d and the resulting high is used to trigger the first sequential timer, U1-a.

BECOME AN ELECTRICIAN!

PROFESSIONAL-LEVEL HOME STUDY

Train now to make good money working on electrical systems in homes and businesses.

Learn all about how to wire, install, and maintain lighting, circuits, control panels, cables, appliances, phone systems, utilities, and much more.

Fascinating, fun, and easy-to-follow. Learn at your own pace, in the comfort of your home. For free literature, send or call 24 hours a day.

CALL 800-223-4542

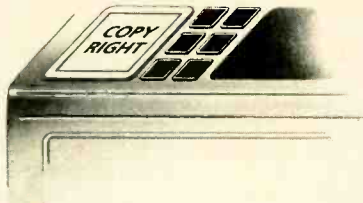


Name _____
Address _____
City _____
State _____ Zip _____
Age _____ Phone () _____

THE ELECTRICIAN SCHOOL

Dept. TEC341, 6065 Roswell Road
PCDI, Atlanta, Georgia 30328

CIRCLE 159 ON FREE INFORMATION CARD



THE MOST
**AN IMPORTANT PART
 OF YOUR PHOTOCOPIER
 ISN'T PART OF
 YOUR PHOTOCOPIER**

Having a machine may not permit you to photocopy books, journals, newsletters and magazines. The Copyright Clearance Center CAN. Contact us to find out how you too can COPY RIGHT!SM

COPYRIGHT CLEARANCE CENTER

222 Rosewood Drive, Danvers, MA 01923 □ Tel. (508) 744-3350 □ Fax (508) 741-2318

© 1993 Copyright Clearance Center

In the April 1995 Issue of

Popular Electronics

⇒ **Home Theater** is hotter than ever. The editors present basic to deluxe home-theater systems you can buy today and they provide in-depth reviews to guide your purchase.

Plus:

- ⇒ **Build the Sprinkler Guardian:** Give your garden or lawn the right amount of water.
- ⇒ **Buried Bytes—The History of the PC:** Trace the history of personal computers and computing devices.
- ⇒ **Auto Electronic Stethoscope:** An easy way to hunt for sources of whines, rattles, squeaks, and other troublesome automotive noises.

On Sale February 16, 1995

Pick up *Popular Electronics* at your favorite Newsstand, Bookstore, Supermarket or Convenience Store

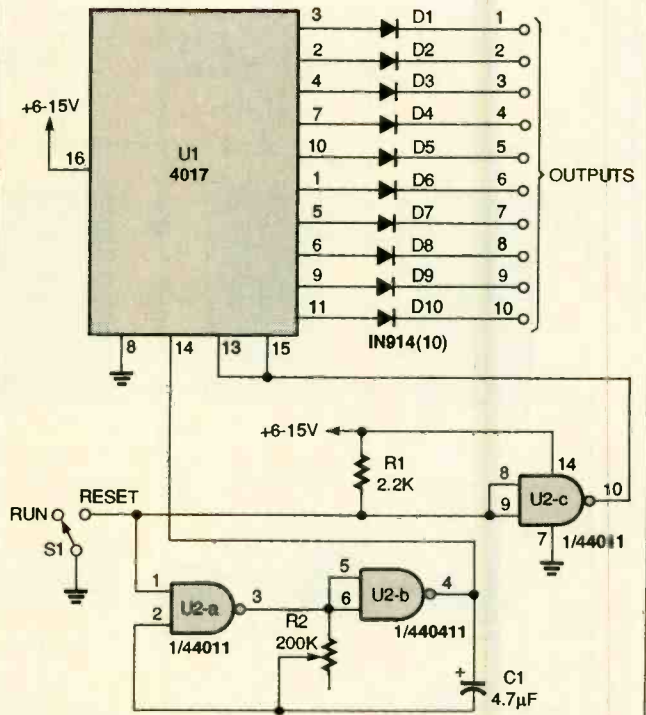


Fig. 3. Adjacent outputs of this 10-step counter can be combined to produce longer on times.

PARTS LIST FOR THE 10-STEP COUNTER (Fig. 3)

SEMICONDUCTORS

- U1—4017 counter/divider, integrated circuit
- U2—4011 quad 2-input NAND gate, integrated circuit
- D1-D10—IN914 silicon diode

ADDITIONAL PARTS AND MATERIALS

- R1—2,200-ohm, ¼-watt, 5% resistor
- R2—200,000-ohm potentiometer
- C1—4.7-µF, 16 WVDC, electrolytic capacitor
- S1—SPDT switch
- Wire, solder, etc.

delay to the inhibit gate's output.

If a longer on-time is desired at any stage, just increase the setting of the appropriate timing potentiometer. Higher valued capacitors and potentiometers (or even fixed resistors) can also be substituted if they are needed for a particular application.

TEN-STEP TIMER

Our last circuit, see Fig. 3, operates in a sequential ten-step mode with each of the timing periods being equal. Adjacent outputs can be tied together to

produce longer timing periods or, using diodes, the outputs can be configured to produce repeating sequences.

A 4017 divide-by-10 counter IC is the heart of this simple ten-output controller circuit. Two gates of a 4011 quad 2-input NAND gate IC are connected in an astable oscillator circuit to clock the divide-by-10 counter, U1. The step time is set by R5. With the run/reset switch in the run position, U1 takes ten equal steps and then stops. Momentarily switching S1 to reset starts the cycle over.

ELECTRONICS MARKET PLACE

FOR SALE

SECRET cable descramblers! Build your own descrambler for less than \$12.00 in seven easy steps! Radio Shack parts list and free descrambling methods that cost nothing to try, included. Send \$10.00 to: **INFORMATION FACTORY**, Dept. 5, PO Box 669, Seabrook, TX 77586. For COD's (713) 922-3512 any time.

CB Radio modifications! Frequencies, 10M, sliders, FM, amplifiers, books, kits, repairs, high-performance accessories. The best since 1976! Catalog \$3.00. **CBCI**, Box 31500PE, Phoenix, AZ 85046.

T.V. notch filters, free brochure, **MICROTHINC**, Box 63/6025, Margate, FL 33063. (305) 752-9202.

CABLE test chips. Jerrold, Tocom, S.A., Zenith. Puts cable boxes into full service mode! \$29.95 to \$59.95. 1 (800) 452-7090, (310) 902-0841.

THE Case Against Patents. Thoroughly tested and proven alternatives that work in the real world. \$28.50. **SYNERGETICS PRESS**, Box 809-C, Thatcher, AZ 85552. (602) 428-4073. Visa/MC.

PRINTED circuit boards — etched, drilled, tin plated. Single sided \$1.25/sq. inch. **CHELCO ELECTRONICS**, 61 Water Street, Mayville, NY 14757. 1 (800) 388-8521. Fax (716) 753-3220.

CLASSIFIED AD ORDER FORM

To run your own classified ad, put one word on each of the lines below and send this form along with your check to:

Popular Electronics Classified Ads, 500-B Bi-County Boulevard, Farmingdale, N.Y. 11735

PLEASE INDICATE in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of \$11.00.

() Plans/Kits () Business Opportunities () For Sale
() Education/Instruction () Wanted () Satellite Television

Special Category: \$11.00

PLEASE PRINT EACH WORD SEPARATELY, IN BLOCK LETTERS.

(No refunds or credits for typesetting errors can be made unless you clearly print or type your copy.) Rates indicated are for standard style classified ads only. See below for additional charges for special ads. **Minimum: 15 words.**

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15 (\$23.25)
16 (\$24.80)	17 (\$26.35)	18 (\$27.90)	19 (\$29.45)	20 (\$31.00)
21 (\$32.55)	22 (\$34.10)	23 (\$35.65)	24 (\$37.20)	25 (\$38.75)
26 (\$40.30)	27 (\$41.85)	28 (\$43.40)	29 (\$44.95)	30 (\$46.50)
31 (\$48.05)	32 (\$49.60)	33 (\$51.15)	34 (\$52.70)	35 (\$54.25)

We accept MasterCard and Visa for payment of orders. If you wish to use your credit card to pay for your ad fill in the following additional information (Sorry, no telephone orders can be accepted.):

Card Number

Expiration Date

PRINT NAME

SIGNATURE

IF YOU USE A BOX NUMBER YOU MUST INCLUDE YOUR PERMANENT ADDRESS AND PHONE NUMBER FOR OUR FILES. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

CLASSIFIED COMMERCIAL RATE: (for firms or individuals offering commercial products or services) \$1.55 per word prepaid (no charge for ZIP code)...**MINIMUM 15 WORDS.** 5% discount for same ad in 6 issues within one year; 10% discount for 12 issues within one year if prepaid. **NON-COMMERCIAL RATE:** (for individuals who want to buy or sell a personal item) \$1.25 per word, prepaid...no minimum. **ONLY FIRST WORD AND NAME** set in bold caps at no extra charge. Additional bold face (not available as all caps) 30¢ per word additional. Entire ad in boldface, \$1.85 per word. **TINT SCREEN BEHIND ENTIRE AD:** \$1.90 per word. **TINT SCREEN BEHIND ENTIRE AD PLUS ALL BOLD FACE AD:** \$2.25 per word. **EXPANDED TYPE AD:** \$2.05 per word prepaid. Entire ad in boldface, \$2.45 per word. **TINT SCREEN BEHIND ENTIRE EXPANDED TYPE AD:** \$2.55 per word. **TINT SCREEN BEHIND ENTIRE EXPANDED TYPE AD PLUS ALL BOLD FACE AD:** \$2.95 per word. **DISPLAY ADS:** 1" x 2 1/4"—\$225.00; 2" x 2 1/4"—\$450.00; 3" x 2 1/4"—\$675.00. **General Information:** Frequency rates and prepayment discounts are available. **ALL COPY SUBJECT TO PUBLISHERS APPROVAL. ADVERTISEMENTS USING P.O. BOX ADDRESS WILL NOT BE ACCEPTED UNTIL ADVERTISER SUPPLIES PUBLISHER WITH PERMANENT ADDRESS AND PHONE NUMBER.** Copy to be in our hands on the 13th of the fourth month preceding the date of issue (i.e., Sept. issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure. Circle Number 49 on the Free Information Card.

ANTIQUE RADIO CLASSIFIED Free Sample!

Antique Radio's
Largest Circulation Monthly.
Articles, Ads & Classifieds.



6-Month Trial: \$17.95. 1-Yr: \$34.95 (\$51.95-1st Class).
A.R.C., P.O. Box 802-L14, Carlisle, MA 01741
Phone: (508) 371-0512 VISA/MC Fax: (508) 371-7129

CABLE TV CONVERTER & DESCRAMBLER

COMBINATION SPECIALS!

All you need for one LOW price



1-800-228-7404



CONVERTERS / DESCRAMBLERS

30 DAY MONEY BACK GUARANTEE
ORDERS SHIPPED WITHIN 24 HOURS HAVE MAKE & MODEL # READY FOR THE BEST PRICE & SERVICE
HOME TECH COMMUNICATIONS
CALL TODAY 1-800-310-1157
NO TENN. SALES

HOT deal! CD-ROM with over 1.2 gigabytes of retail software demos and full running versions over 170 full programs. 800 # will provide support. For IBM/MS-DOS/Windows. Send \$40.00 money order to: **ACN**, POB 232673 Anchorage, AK 99523-2673. (907) 349-7116.

REAL stuff! Surveillance, people tracking, entry, night vision — lowest prices. Catalog \$15.00. 1 (800) 805-5544. **INTELLIGENCE INC.**, Dept. KJ, 2228 El Camino Real, San Mateo, CA 94403.

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

BOOKS — CATALOGS — MAGAZINES

PINBALL MACHINES BOOKS, Parts, Supplies. Catalog \$1.00. MARCO, 2401-(PE) Sunset, West Columbia, SC 29169-4717.

GIFT CATALOG SEND \$2.00 to: 4241 W. Dickman Road, Apt. 3C-(PE), Battle Creek, MI 49015.

COMPUTERS & ELECTRONICS

FOR THE LOWEST Priced Computers, Printers And Hardware Call 800-540-2855.

EDUCATION

HIGH SCHOOL DIPLOMA Fast New Program, Credit For Experience. 1-800-470-4723.

FINANCIAL

SIGNATURE — LOANS \$1000 — \$50,000 No-Collateral (\$3.00) Refundable: TAYOE ODESANYA, 427 Church Street, Williamstown, NJ 08094.

MONEYMAKING OPPORTUNITIES

SURPLUS PROPERTY BRINGS you big bucks! Guaranteed guide shows you how. Send \$10.00 to PLATINUM PRESS, 519(C) Castro St., San Francisco, CA 94114.

GUIDE TO HOME Employment! Push \$1.00 and SASE for information: JNJ, Suite 147-(PE), 8A Village Loop Road, Pomona, CA 91766.

MILLIONAIRE REVEALS MONEY making secrets! Send SASE: PROCUREMENT, Box 425-NM, Miami, FL 33263.

1000% PROFIT WITH your computer! For complete details call: (419)-872-2792.

OF INTEREST TO ALL

MEXICO TRADE DIRECTORY \$15.00 Postpaid. Box 661, Dallas, GA 30132.

RELIEVE STRESS — NATURE To Classical Audio Cassettes, CD's. Catalog \$9.95. Video vault, 3081 Hillcrest Avenue, Nekeosa, WI 54457.

PLAY PIANO LIKE LIBERACE \$1.00: LINDA GENTEEL, 6122 MONMOUTH, VENTNOR, NJ 08406.

RECYCLE PERSONAL COPIERS Cartridges. Instructions \$14.95. Charles Bruns, Box 543, Applegate, CA 95703.

SLOT PLAYERS HOTLINE. Methods That Work! FREE RECORDED MESSAGE 416-499-8698.

POETRY CONTEST WIN \$1,000, be published! Send one poem to: POETRY, Box 20296-(PE), Baltimore, MD 21284.

CABLE descramblers, build your own, SSAVI, gated sync, sinewave. \$14.95. CABLETRONICS, Box 30502P, Bethesda, MD 20824.

TEST chips. Put your cable box in full test mode. Call (303) 731-9400.

PARTS for \$1.00. Resistors .25W 12, .5W 8. Capacitors .001uF 5, .01uF 5, .1uF 4, 1uF 3, 10uF 2, 100uF 1. Semiconductors 1N4004 4, 2N2222 1, 2N3904 2, 2N3906 2, TIP31A 1, TIP32A 1, LM741 1, LM555 1, LEDs red 3, green 2. Catalog \$1.00, foreign add \$1.00. ZIPFAST, Box 12238, Lexington, KY 40581-2238.

DESCRAMBLE cable with circuit added to Radio Shack RF modulator and using VCR as tuner. Instructions \$10.00. TELCOM, POB 832-P3, Brusly, LA 70719.

300 Experimenters Circuits — Complete in 6 practical books using diodes, relays, FET's, LED's, IC 555's, and IC CA3130's for building blocks. Only \$33.00 plus \$5.50 for shipping. USA and Canada only. US funds. ETT, INC., PO Box 240, Massapequa Park, NY 11762-0240.

CABLE descramblers and test turn-on kits available for most makes and models. No catalog, no 800 number equals your lowest prices. Call others, then compare our prices! We pay cash for unwanted cable boxes. No Florida sales. (305) 425-0751.

PLANS & KITS

60 Solderless Breadboard Projects in two easy-to-read pocket books. Complete with circuit descriptions, schematics, parts layouts, component listings, etc. Both books (BP107 & BP113) only \$11.90 plus \$3.50 for shipping. USA and Canada only. US funds. ETT, INC., PO Box 240, Massapequa Park, NY 11762-0240.

SURVEILLANCE/countersurveillance, bugging phone tapping detector, telephone/fax encryption, vehicle tracking, covert video, transmitter kit, and more... A.B. ELECTRONICS, (718) 253-3637.

CRYSTAL set Handbook — Visit antiquity by building the radios your grandfather built. Assemble a "Quaker Oats" rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$3.50 for shipping and handling. ELECTRONIC TECHNOLOGY TODAY, INC., PO Box 240, Massapequa Park, NY 11762-0240. US funds only! USA and Canada — no foreign orders.

COUNTER-Surveillance technicians earn \$250.00/hr! Free catalog and complete dealer information shows you how! 1 (800) 732-5000.

BUILD a 486 personal computer. Easy reading guide \$19.95. QUANTA ENTERPRISES, PO Box 273, Dept. 50, Northfield, NJ 08225.

FIBER optics experimenters parts, supplies and tools: Fiber, cable, connectors, splices, detectors, lasers, kits, plans, newsletter. Send \$2.00 for catalog. LIGHTLINE ENGINEERING, PO Box 24, Mullica Hill, NJ 08062.

THE ultimate in Electronics! Kits, plans, surveillance, test, radios, more! Part locating! Best prices. Send \$1.50 (refundable) NEUTRONICS, 4 Croydon Court, Englishtown, NJ 07726.

CABLE descrambler — Build your own! — Complete set of plans include parts list, circuit board pattern, instructions, and more. Send SASE and \$19.95 check or money order to: PLANS, PO Box 446, Exeter, RI 02822.

SATELLITE TV

VIDEOCYpher II descrambling manual. Schematics, video and audio. \$18.95. Software \$25.00. Videocypher II 032, \$15.00. Videocypher II Plus, \$20.00. VCII Plus Software, \$30.00. CABLETRONICS, Box 30502P, Bethesda, MD 20824.

EDUCATION/INSTRUCTION

MAGNETIC Measurements Handbook. \$20.00. Free descriptive literature. MAGNETIC RESEARCH INC., PO Box 375, Butler, NJ 07405.

ELECTRONIC engineering. 8 volumes complete. \$109.95. No prior knowledge required. Free brochure. BANNER TECHNICAL BOOKS, 1203 Grant Avenue, Rockford, IL 61103.

COLLEGE degrees by mail from prestigious colleges. Details \$1.00: BAYSTATE SPECIALISTS, Box 191 W, Hopkinton, MA 01748.

FCC General Radiotelephone Operator's license. Answers, solutions to latest 889 for elements 1,3 examinations. Prepared by professional engineer. To receive this publication, send \$20.00 to UNIVERSAL COMMUNICATIONS, PO Box 11646, Palm Desert, CA 92255-1646.

BUSINESS OPPORTUNITIES

EASY work! Excellent pay! Assemble products at home. Call toll free 1 (800) 467-5566 ext. 5730.

START your own technical venture! Don Lancaster's newly updated **Incredible Secret Money Machine II** tells how. We now have autographed copies of the Guru's underground classic for \$18.50. SYNERGETICS PRESS, Box 809-C, Thatcher, AZ 85552. (602) 428-4073. Visa/MC.

GET paid \$268.20 per roll taking easy snapshots! No experience. Film supplied. PHOTOTEK, Box 2457, Dept. 2, Pinecove, CA 92549. Recorded information: (909) 659-9757 ext. 8.

INVENTIONS

FREE Invention package: DAVISON & ASSO- CIATES offers customized development, patenting, and licensing for new products and ideas. Proven results: 1 (800) 677-6382.

BOOKS

ROBOT books! Free catalog by mail! Write: COGNITIONS, Dept. 1200, 71 Widow Sweets Rd., Exeter, RI 02822.

REACH FOR THE POWER. TEACH.

No other profession has this power. The power to wake up young minds. The power to wake up the world. Teachers have that power. Reach for it. Teach. For information call:

1-800-45-TEACH.



Recruiting New Teachers, Inc.

BUY BONDS

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

OF THE
Popular Electronics

For the month of **SEPTEMBER** 1995

ISSUED MONTHLY

1. Title of publication: Popular Electronics

2. Issue date for circulation data below: SEPTEMBER 1995

3. Issue frequency: MONTHLY

4. Issue month for annual statement: SEPTEMBER

5. Annual subscription price: \$21.95

6. Total number of copies (net press run): 151,894

7. Total number of copies (gross press run): 150,500

8. Total number of copies (net press run) less: 151,894

9. Total number of copies (gross press run) less: 150,500

10. Total number of copies (net press run) less: 151,894

11. Total number of copies (gross press run) less: 150,500

12. Total number of copies (net press run) less: 151,894

13. Total number of copies (gross press run) less: 150,500

14. Total number of copies (net press run) less: 151,894

15. Total number of copies (gross press run) less: 150,500

16. Total number of copies (net press run) less: 151,894

17. Total number of copies (gross press run) less: 150,500

18. Total number of copies (net press run) less: 151,894

19. Total number of copies (gross press run) less: 150,500

20. Total number of copies (net press run) less: 151,894

21. Total number of copies (gross press run) less: 150,500

22. Total number of copies (net press run) less: 151,894

23. Total number of copies (gross press run) less: 150,500

24. Total number of copies (net press run) less: 151,894

25. Total number of copies (gross press run) less: 150,500

26. Total number of copies (net press run) less: 151,894

27. Total number of copies (gross press run) less: 150,500

28. Total number of copies (net press run) less: 151,894

29. Total number of copies (gross press run) less: 150,500

30. Total number of copies (net press run) less: 151,894

31. Total number of copies (gross press run) less: 150,500

32. Total number of copies (net press run) less: 151,894

33. Total number of copies (gross press run) less: 150,500

34. Total number of copies (net press run) less: 151,894

35. Total number of copies (gross press run) less: 150,500

36. Total number of copies (net press run) less: 151,894

37. Total number of copies (gross press run) less: 150,500

38. Total number of copies (net press run) less: 151,894

39. Total number of copies (gross press run) less: 150,500

40. Total number of copies (net press run) less: 151,894

41. Total number of copies (gross press run) less: 150,500

42. Total number of copies (net press run) less: 151,894

43. Total number of copies (gross press run) less: 150,500

44. Total number of copies (net press run) less: 151,894

45. Total number of copies (gross press run) less: 150,500

46. Total number of copies (net press run) less: 151,894

47. Total number of copies (gross press run) less: 150,500

48. Total number of copies (net press run) less: 151,894

49. Total number of copies (gross press run) less: 150,500

50. Total number of copies (net press run) less: 151,894

51. Total number of copies (gross press run) less: 150,500

52. Total number of copies (net press run) less: 151,894

53. Total number of copies (gross press run) less: 150,500

54. Total number of copies (net press run) less: 151,894

55. Total number of copies (gross press run) less: 150,500

56. Total number of copies (net press run) less: 151,894

57. Total number of copies (gross press run) less: 150,500

58. Total number of copies (net press run) less: 151,894

59. Total number of copies (gross press run) less: 150,500

60. Total number of copies (net press run) less: 151,894

61. Total number of copies (gross press run) less: 150,500

62. Total number of copies (net press run) less: 151,894

63. Total number of copies (gross press run) less: 150,500

64. Total number of copies (net press run) less: 151,894

65. Total number of copies (gross press run) less: 150,500

66. Total number of copies (net press run) less: 151,894

67. Total number of copies (gross press run) less: 150,500

68. Total number of copies (net press run) less: 151,894

69. Total number of copies (gross press run) less: 150,500

70. Total number of copies (net press run) less: 151,894

71. Total number of copies (gross press run) less: 150,500

72. Total number of copies (net press run) less: 151,894

73. Total number of copies (gross press run) less: 150,500

74. Total number of copies (net press run) less: 151,894

75. Total number of copies (gross press run) less: 150,500

76. Total number of copies (net press run) less: 151,894

77. Total number of copies (gross press run) less: 150,500

78. Total number of copies (net press run) less: 151,894

79. Total number of copies (gross press run) less: 150,500

80. Total number of copies (net press run) less: 151,894

81. Total number of copies (gross press run) less: 150,500

82. Total number of copies (net press run) less: 151,894

83. Total number of copies (gross press run) less: 150,500

84. Total number of copies (net press run) less: 151,894

85. Total number of copies (gross press run) less: 150,500

86. Total number of copies (net press run) less: 151,894

87. Total number of copies (gross press run) less: 150,500

88. Total number of copies (net press run) less: 151,894

89. Total number of copies (gross press run) less: 150,500

90. Total number of copies (net press run) less: 151,894

91. Total number of copies (gross press run) less: 150,500

92. Total number of copies (net press run) less: 151,894

93. Total number of copies (gross press run) less: 150,500

94. Total number of copies (net press run) less: 151,894

95. Total number of copies (gross press run) less: 150,500

96. Total number of copies (net press run) less: 151,894

97. Total number of copies (gross press run) less: 150,500

98. Total number of copies (net press run) less: 151,894

99. Total number of copies (gross press run) less: 150,500

100. Total number of copies (net press run) less: 151,894

101. Total number of copies (gross press run) less: 150,500

102. Total number of copies (net press run) less: 151,894

103. Total number of copies (gross press run) less: 150,500

104. Total number of copies (net press run) less: 151,894

105. Total number of copies (gross press run) less: 150,500

106. Total number of copies (net press run) less: 151,894

107. Total number of copies (gross press run) less: 150,500

108. Total number of copies (net press run) less: 151,894

109. Total number of copies (gross press run) less: 150,500

110. Total number of copies (net press run) less: 151,894

111. Total number of copies (gross press run) less: 150,500

112. Total number of copies (net press run) less: 151,894

113. Total number of copies (gross press run) less: 150,500

114. Total number of copies (net press run) less: 151,894

115. Total number of copies (gross press run) less: 150,500

116. Total number of copies (net press run) less: 151,894

117. Total number of copies (gross press run) less: 150,500

118. Total number of copies (net press run) less: 151,894

119. Total number of copies (gross press run) less: 150,500

120. Total number of copies (net press run) less: 151,894

121. Total number of copies (gross press run) less: 150,500

122. Total number of copies (net press run) less: 151,894

123. Total number of copies (gross press run) less: 150,500

124. Total number of copies (net press run) less: 151,894

125. Total number of copies (gross press run) less: 150,500

126. Total number of copies (net press run) less: 151,894

127. Total number of copies (gross press run) less: 150,500

128. Total number of copies (net press run) less: 151,894

129. Total number of copies (gross press run) less: 150,500

130. Total number of copies (net press run) less: 151,894

131. Total number of copies (gross press run) less: 150,500

132. Total number of copies (net press run) less: 151,894

133. Total number of copies (gross press run) less: 150,500

134. Total number of copies (net press run) less: 151,894

135. Total number of copies (gross press run) less: 150,500

136. Total number of copies (net press run) less: 151,894

137. Total number of copies (gross press run) less: 150,500

138. Total number of copies (net press run) less: 151,894

139. Total number of copies (gross press run) less: 150,500

140. Total number of copies (net press run) less: 151,894

141. Total number of copies (gross press run) less: 150,500

142. Total number of copies (net press run) less: 151,894

143. Total number of copies (gross press run) less: 150,500

144. Total number of copies (net press run) less: 151,894

145. Total number of copies (gross press run) less: 150,500

146. Total number of copies (net press run) less: 151,894

147. Total number of copies (gross press run) less: 150,500

148. Total number of copies (net press run) less: 151,894

149. Total number of copies (gross press run) less: 150,500

150. Total number of copies (net press run) less: 151,894

151. Total number of copies (gross press run) less: 150,500

152. Total number of copies (net press run) less: 151,894

153. Total number of copies (gross press run) less: 150,500

154. Total number of copies (net press run) less: 151,894

155. Total number of copies (gross press run) less: 150,500

156. Total number of copies (net press run) less: 151,894

157. Total number of copies (gross press run) less: 150,500

158. Total number of copies (net press run) less: 151,894

159. Total number of copies (gross press run) less: 150,500

160. Total number of copies (net press run) less: 151,894

161. Total number of copies (gross press run) less: 150,500

162. Total number of copies (net press run) less: 151,894

163. Total number of copies (gross press run) less: 150,500

164. Total number of copies (net press run) less: 151,894

165. Total number of copies (gross press run) less: 150,500

166. Total number of copies (net press run) less: 151,894

167. Total number of copies (gross press run) less: 150,500

168. Total number of copies (net press run) less: 151,894

169. Total number of copies (gross press run) less: 150,500

170. Total number of copies (net press run) less: 151,894

171. Total number of copies (gross press run) less: 150,500

172. Total number of copies (net press run) less: 151,894

173. Total number of copies (gross press run) less: 150,500

174. Total number of copies (net press run) less: 151,894

175. Total number of copies (gross press run) less: 150,500

176. Total number of copies (net press run) less: 151,894

177. Total number of copies (gross press run) less: 150,500

178. Total number of copies (net press run) less: 151,894

179. Total number of copies (gross press run) less: 150,500

180. Total number of copies (net press run) less: 151,894

181. Total number of copies (gross press run) less: 150,500

182. Total number of copies (net press run) less: 151,894

183. Total number of copies (gross press run) less: 150,500

184. Total number of copies (net press run) less: 151,894

185. Total number of copies (gross press run) less: 150,500

186. Total number of copies (net press run) less: 151,894

187. Total number of copies (gross press run) less: 150,500

188. Total number of copies (net press run) less: 151,894

189. Total number of copies (gross press run) less: 150,500

190. Total number of copies (net press run) less: 151,894

191. Total number of copies (gross press run) less: 150,500

192. Total number of copies (net press run) less: 151,894

193. Total number of copies (gross press run) less: 150,500

194. Total number of copies (net press run) less: 151,894

195. Total number of copies (gross press run) less: 150,500

196. Total number of copies (net press run) less: 151,894

197. Total number of copies (gross press run) less: 150,500

198. Total number of copies (net press run) less: 151,894

199. Total number of copies (gross press run) less: 150,500

200. Total number of copies (net press run) less: 151,894

201. Total number of copies (gross press run) less: 150,500

202. Total number of copies (net press run) less: 151,894

203. Total number of copies (gross press run) less: 150,500

204. Total number of copies (net press run) less: 151,894

205. Total number of copies (gross press run) less: 150,500

206. Total number of copies (net press run) less: 151,894

207. Total number of copies (gross press run) less: 150,500

208. Total number of copies (net press run) less: 151,894

209. Total number of copies (gross press run) less: 150,500

210. Total number of copies (net press run) less: 151,894

211. Total number of copies (gross press run) less: 150,500

212. Total number of copies (net press run) less: 151,894

213. Total number of copies (gross press run) less: 150,500

214. Total number of copies (net press run) less: 151,894

215. Total number of copies (gross press run) less: 150,500

216. Total number of copies (net press run) less: 151,894

217. Total number of copies (gross press run) less: 150,500

218. Total number of copies (net press run) less: 151,894

219. Total number of copies (gross press run) less: 150,500

220. Total number of copies (net press run) less: 151,894

221. Total number of copies (gross press run) less: 150,500

222. Total number of copies (net press run) less: 151,894

223. Total number of copies (gross press run) less: 150,500

224. Total number of copies (net press run) less: 151,894

225. Total number of copies (gross press run) less: 150,500

226. Total number of copies (net press run) less: 151,894

227. Total number of copies (gross press run) less: 150,500

228. Total number of copies (net press run) less: 151,894

229. Total number of copies (gross press run) less: 150,500

230. Total number of copies (net press run) less: 151,894

231. Total number of copies (gross press run) less: 150,500

232. Total number of copies (net press run) less: 151,894

233. Total number of copies (gross press run) less: 150,500

234. Total number of copies (net press run) less: 151,894

235. Total number of copies (gross press run) less: 150,500

236. Total number of copies (net press run) less: 151,894

237. Total number of copies (gross press run) less: 150,500

238. Total number of copies (net press run) less: 151,894

239. Total number of copies (gross press run) less: 150,500

240. Total number of copies (net press run) less: 151,894

241. Total number of copies (gross press run) less: 150,500

242. Total number of copies (net press run) less: 151,894

243. Total number of copies (gross press run) less: 150,500

244. Total number of copies (net press run) less: 151,894

245. Total number of copies (gross press run) less: 150,500

246. Total number of copies (net press run) less: 151,894

247. Total number of copies (gross press run) less: 150,500

248. Total number of copies (net press run) less: 151,894

249. Total number of copies (gross press run) less: 150,500

250. Total number of copies (net press run) less: 151,894

251. Total number of copies (gross press run) less: 150,500

252. Total number of copies (net press run) less: 151,894

253. Total number of copies (gross press run) less: 150,500

254. Total number of copies (net press run) less: 151,894

255. Total number of copies (gross press run) less: 150,500

256. Total number of copies (net press run) less: 151,894

257. Total number of copies (gross press run) less: 150,500

258. Total number of copies (net press run) less: 151,894

259. Total number of copies (gross press run) less: 150,500

260. Total number of copies (net press run) less: 151,894

261. Total number of copies (gross press run) less: 150,500

262. Total number of copies (net press run) less: 151,894

263. Total number of copies (gross press run) less: 150,500

264. Total number of copies (net press run) less: 151,894

265. Total number of copies (gross press run) less: 150,500

266. Total number of copies (net press run) less: 151,894

267

Enter A World Of Excitement with a Subscription to

Popular Electronics[®]

Get the latest electronic technology and information monthly!

Now you can subscribe to the magazine that plugs you into the exciting world of electronics. With every issue of Popular Electronics you'll find a wide variety of electronics projects you can build and enjoy.

Popular Electronics brings you informative new product and literature listings, feature articles on test equipment and tools—all designed to keep you tuned in to the latest developments in electronics. So if you love to build fascinating electronics, just fill out the subscription form below to subscribe to Popular Electronics... It's a power-house of fun for the electronics enthusiast.

EXCITING MONTHLY FEATURES LIKE:

- CONSTRUCTION**—Building projects from crystal sets to electronic roulette
- FEATURES**—Educational training on digital electronics, Ohm's Law, Antennas, Communications, Antique Radio, Simplified Theory
- HANDS-ON-REPORTS**—User test comments on new and unusual consumer products
- SPECIAL COLUMNS**—Think Tank, Circuit Circus, Computer Bits, DX Listening, Antique Radio, Scanner Scene, Amateur Radio

PLUS: ALL OUR GREAT DEPARTMENTS!

You'll get 12 exciting and informative issues of Popular Electronics for only \$18.95. That's a savings of \$23.05 off the regular single copy price. Subscribe to Popular Electronics today! Just fill out the subscription order form below.



FOR FASTER SERVICE CALL TODAY

1-800-827-0383

(7:30AM-8:30PM) EASTERN STANDARD TIME

Popular Electronics[®] SUBSCRIPTION ORDER FORM

APEC5

P.O. Box 338, Mt. Morris IL. 61054

YES! I want to subscribe to Popular Electronics for 1 Full year (12 Issues) for only \$18.95. That's a savings of \$23.05 off the newsstand price. (Basic Subscription Rate—1 yr/\$21.95)

Payment Enclosed Bill me later
Please charge my: Visa Mastercard

Acct. #

Signature _____

Exp. Date _____

PLEASE PRINT BELOW:

NAME _____

ADDRESS _____

CITY _____

STATE _____

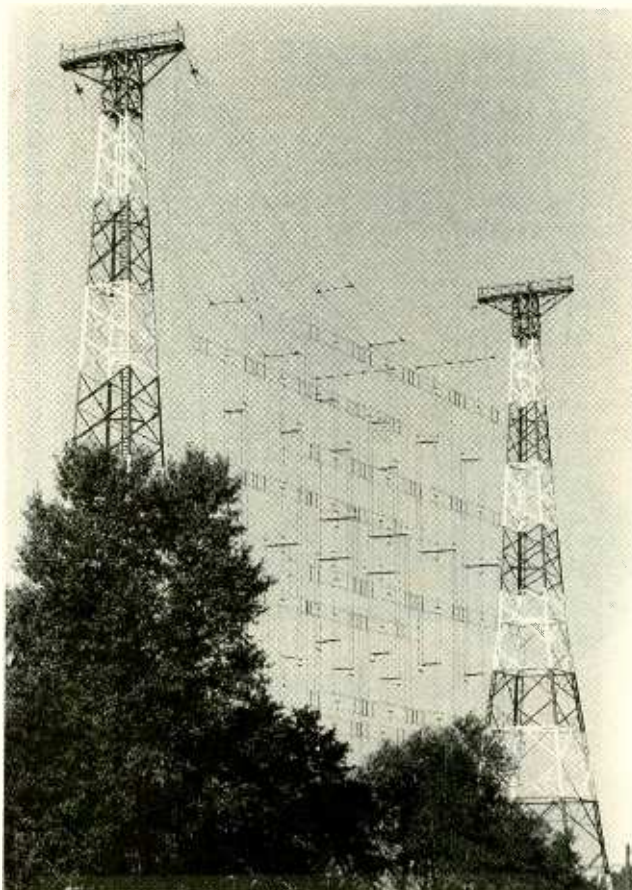
ZIP _____

Allow 6 to 8 weeks for delivery of first issue. U.S. Funds only.
In Canada add \$6.68 Postage (Includes G.S.T.) All Other Foreign add \$7.50 Postage.

DX LISTENING

By Don Jensen

Shortwave from Austria



This is part of Radio Austria International's elaborate shortwave-antenna system at Moosbrunn.

Shortwave is, of course, the classic, and oldest, means of international broadcasting. In the late 1920's, a number of nations began experimental transmissions on the SW frequencies. In central Europe, Austria was one of those shortwave pioneers.

As early as 1929, experimental programming was being aired by that country. In those days, high-powered transmitters were not available, nor, in those times of relatively little interference from other stations, were they needed to reach listeners overseas.

World War II ended all of

that, and it wasn't until the mid-1950's that Austria began planning and preparing for a major shortwave-broadcasting center. Then, in 1959, a foreign shortwave service began operating at Moosbrunn, some 25 kilometers southeast of the Austrian capital, Vienna.

Today, there are a pair of high-powered 500/300-kilowatt transmitters, plus two 100-kilowatt units, operating from Moosbrunn. With various directional broadcasts, sometimes operating in parallel in more than one language, *Radio Oesterich International* (*Radio Austria International*) transmits more than 80 hours of programming a day.

Since March 1989, some programs directed to North America are sent via satellite to *Radio Canada International's* transmitter facility at Sackville, New Brunswick, for relay. In return, the Austrian transmitters are used to relay some of RCI's shortwave broadcasts. In addition, English programming of Radio Austria International can be received in the United States on the C-Span audio network.

Since it began broadcasting to overseas audiences, the Austrian broadcaster has gained in importance. Production and studio facilities are located in the ORF Center in Vienna, where six well-equipped studios are used for producing programs. Radio Austria International has about 100 staff members and freelance employees providing language service, administration, and engi-

neering. The shortwave service airs programs in German, English, French, Spanish, Arabic, and the international Esperanto language.

The station's daily "Report from Austria" program includes world, European, and Austrian news, and reports on political developments, economics, the arts, current affairs, and sports. Austrian music adds an unmistakable flavor to the station's SW programming.

The program segments aimed at North America are aired at 0130 UTC on 9,655 kHz; at 0530 and 0630 UTC, relayed from Canada, on 6,015 kHz; and at 1130 UTC on 13,730 kHz. In addition, English transmissions beamed to South America can be received in the U.S. at 0130 UTC on 9,870 and 13,730 kHz.

For SWL's who want to write Radio Austria International, the address is Wurzburggasse 30, Vienna A-1136, Austria.

IN THE MAILBOX

James Wright, Houston, TX, writes with several questions.

"Will there ever be a shortwave-radio station in the state of Oklahoma? Seems like there would be in Tulsa, or Oral Roberts.

"What about Radio Australia? I never hear them anymore. And how about Hawaii? Why isn't there any SW station there?"

I can't say for sure, Jim, if there will ever be a shortwave broadcaster in Oklahoma. I've heard of no plans by the Oral Roberts organization to establish a station. Right now religious groups have no difficulty

buying air time on existing U.S. shortwave stations.

It shouldn't be too difficult to hear *Radio Australia*. You indicated that you listen mostly during the evening hours. Try these Radio Australia channels: 17,795 and 17,860 kHz, at 0030 to 0600 UTC; 9,860 and 11,910 kHz, at 0630 to 0730 UTC.

Finally, Jim, there is now a Hawaiian shortwave station, *KWHR, World Harvest Radio*, at Naalehu. Its schedule is: 0000 UTC on 17,555 kHz; 0200 UTC on 17,510 kHz; 0600 UTC on 9,930 kHz; 1600 UTC on 7,425 kHz; 1800 UTC on 13,625 kHz; 2000 UTC on 13,720 kHz; and 2200 UTC on 17,510 kHz.

A letter from Oscar Naimi of Mukilteo, WA, asks about shortwave receiving antennas. "I'm not using a serious antenna at the present time, just my bed frame (It may sound funny, but it's ok). I'd like to hear about suggestions on how to improve my antenna?"

Your bed may function as an "ok" antenna, Oscar, but you'll wake up your SW reception with a decent skywire. Fortunately there are a number of good reference books on SW antennas. Here are a few titles available:

Receiving Antenna Handbook, by Joseph J. Carr (\$19.95 + \$2.50 S&H, Grove Enterprises, P.O. Box 98, Brasstown, NC 28902); *The Antenna Handbook*, by Clem Small (\$12.95 + \$2.50 S&H, Grove Enterprises); *The Easy Wire Antenna Handbook*, by Dave Ingram (\$9.95 + \$1 S&H, Universal Radio, 6830 Americana

*CREDITS: Brian Alexander, PA; Marie Lamb, NY; Harold Levison, PA; John MacDonald, WA; William McGuire, MD; David Morasco, WV; Ed Newbury, NE; Betsy Robinson, TN; North American SW Association, 45 Wildflower Road, Levittown, PA 19057.

Parkway, Reynoldsburg, OH 43068); *Easy Shortwave Antennas*, by Frank Hughes (\$9.95 + \$2 S&H, Tiare Publications, P.O. Box 493, Lake Geneva, WI 53147); and *Limited Space Shortwave Antenna Solutions*, by Frank Hughes (\$10.95 + \$2 S&H, Tiare Publications).

You should find the answer to your antenna problem in one or more of those books, Oscar. Catalogs describing those and other shortwave-related titles are available from the firms mentioned above.

DOWN THE DIAL

Your shortwave loggings, with times, frequencies, and program descriptions, are wanted. Drop me a line at DX Listening, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735.

Here are some SW catches recently reported by listeners.


CONGO—4,765 kHz. *Radio Congo* has been noted in French around 0515 UTC with identification, African music, and rhythmic drums, followed by a newscast. The station operates in parallel on 5,985 kHz.

HUNGARY—9,835 kHz. *Radio Budapest* is heard with Hungarian ethnic music at around 0220 UTC. After an interval signal of trumpets and station identification, English programming begins at 0300 UTC.

INDIA—13,750 kHz. *All India Radio* is reported here with Indian music at 0020 UTC. That is followed by English news.

PARAGUAY—9,735 kHz. *Radio Nacional de Paraguay* broadcasts from one of the more difficult to log South American countries. Try for it at around 2230 UTC. It has been noted in Spanish with *futbol* news and Paraguayan music. ■

ATTENTION! ELECTRONICS TECHNICIANS



EARN YOUR B.S.E.E. DEGREE

THROUGH HOME STUDY

Our New and Highly Effective Advanced-Placement Program for experienced Electronic Technicians grants credit for previous Schooling and Professional Experience, and can greatly reduce the time required to complete Program and reach graduation. No residence schooling required for qualified Electronic Technicians. Through this Special Program you can pull all of the loose ends of your electronics background together and earn your B.S.E.E. Degree. Upgrade your status and pay to the Engineering Level. Advance Rapidly! Many finish in 12 months or less. Students and graduates in all 50 States and throughout the World. Established Over 40 Years! Write for free Descriptive Literature.

COOK'S INSTITUTE

OF ELECTRONICS ENGINEERING

CI 4251 CYPRESS DRIVE
JACKSON, MISSISSIPPI 39212

CIRCLE 14 CN FREE INFORMATION CARD

Make U.S. Savings Bonds part of your retirement savings program.



They're the safe, easy and affordable way to save for retirement. Buy U.S. Savings Bonds for as little as \$25. Ask your banker or your employer about including U.S. Savings Bonds in your retirement savings program.

For more information, write U.S. Savings Bonds, Washington, DC 20226. For a recorded message of current rate information, call 1-800-4US BOND • 1-800-487-2663

Take
Stock
in America



A public service of this magazine

HAM RADIO

By Joseph J. Carr, K4IPV

Some Antenna Topics

Antennas are near and dear to the hearts of ham operators and more advanced shortwave listeners. This month we will take a look at a couple of antenna topics, including an antenna project.

THE G5RV ANTENNA

The G5RV antenna was designed several years ago by Louis Varney (G5RV), a ham operator in the United Kingdom. The G5RV antenna is not terribly popular in the U.S., but if you read the ham magazines from Europe, you'll find that it's much more common "over there."

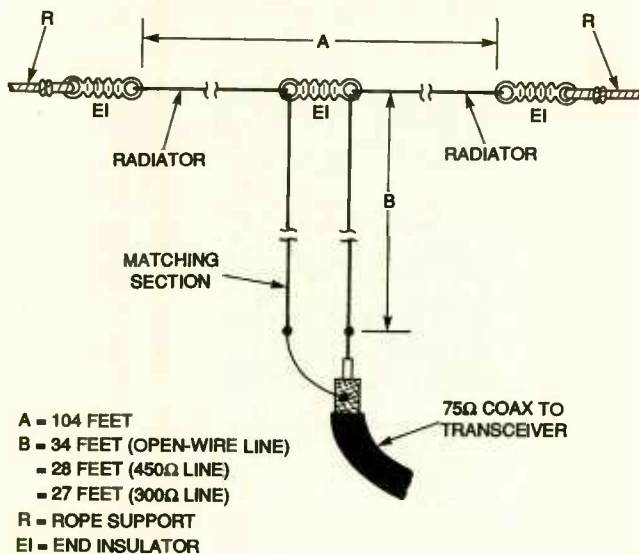


Fig. 1. The G5RV antenna is an interesting multiband ham antenna, but an antenna-tuning unit is a must for good results.

I've known several hams who've used the G5RV, and I've used one myself. The results are mixed, and I suspect the difference is in how well the design is implemented. It is significant, for example, that one chap who claimed the G5RV did not work well failed to use an antenna tuner between

the output of his transceiver and the feedline to the G5RV; as we will see, that's a critical mistake.

Although the dimensions of the G5RV have been subject to some controversy, for the high-frequency (hf) ham bands (80–10 meters) the G5RV dimensions have been pretty well-established by experiment and trade-off. As shown in Fig. 1, the two horizontal radiator elements are 52 feet long, or a total of 104 feet overall. The length of the matching section depends on which type of transmission line is used: If you prefer 450- to 600-ohm parallel open-line feeders, the length is 34 feet; if you prefer 450-ohm twin-lead, the length is 28 feet; and if you prefer 300-ohm twin-lead, the length is 27 feet.

The G5RV antenna is fed by 75-ohm coaxial cable, although the feedpoint impedance can vary quite a bit from 75 ohms. That's the reason why an antenna-tuning unit is needed!

The G5RV is built much like a dipole, using the same kind of wire and insulators. The rope supports (R), at either end, are connected to standard end insulators (EI), which are available at most radio-supply stores. The center insulator can be another end insulator (which will work well), or it can be a special center insulator. Make sure that the center insulator is not actually a BALUN transformer. While the BALUN is used extensively for dipole antennas, it is not appropriate with the G5RV.

The G5RV works differently on different hf

bands: On 3.5–4.0 MHz, the antenna works as a slightly folded, foreshortened dipole. On 7–7.3 MHz, it acts as two half-wave radiators fed in-phase. On 10 MHz, the antenna acts as a collinear antenna with two in-phase half-wave radiators (but its load is more reactive than on 7 MHz). On 14 MHz, the G5RV acts like a $\frac{3}{2}$ -wavelength dipole (i.e. like using a 40-meter dipole on 15 meters). At 18 MHz, the antenna is two full-wave radiators fed in-phase. On 21 MHz, the antenna acts like a $\frac{5}{2}$ -wavelength long-wire antenna. Finally, on 28–29.7 MHz, the G5RV acts like a $\frac{5}{2}$ -wavelength long-wire antenna, but with a much lower feedpoint impedance than on 21 MHz. Because of those differences in operation, the G5RV antenna will have a different feedpoint impedance at different frequencies. Again, that's why an ATU is a must!

RECEIVE OR TRANSMIT ANTENNAS?

One of the attributes of radio antennas is the property of reciprocity. That means antennas work the same on receive as they do on transmit. In other words, the azimuth pattern of a half-wavelength dipole is the same on both transmit and receive.

Reciprocity is a fact of life on antennas. Attempts to prove cases of non-reciprocal antennas have, thus far, always been based on a false premise or two. For example, one fellow attempted to prove that antennas are not reciprocal on the hf bands

because there are ionospheric conditions that are not bidirectional.

It is a well-known phenomenon that sometimes, especially in the late afternoon or evening on 40-meters, European stations are heard in the U.S., particularly on the east coast; but we cannot be heard by them. That is due to anomalies in the ionosphere that causes propagation in one direction to be different from propagation in the opposite direction. That difference is not a failure of antenna reciprocity, but an indication that the ionosphere sometimes isn't the same in both directions.

Another argument against antenna reciprocity is the operation of the Beverage antenna. The Beverage is a receive antenna that works best on the lower frequencies. The Beverage works best over a poor ground, except at the end far from the feedpoint. The best Beverage antenna is said to be one that is largely over desert or beach (which is a poor ground), with the termination resistor at the far end grounded in a brackish or salt-water swamp! The claim for non-reciprocity results from the fact that the Beverage is a very inefficient antenna, so it is not a good choice for transmitting. However, the patterns and impedances, and all other elements on which we characterize an antenna, are the same for both receive and transmit for the Beverage.

That brings up another issue: Is it true that the best receive antenna is also the best transmit antenna? Reciprocity would seem to say so, but that's a false notion. Why? The attributes of a good receive antenna are not the same as those of a good transmit antenna.

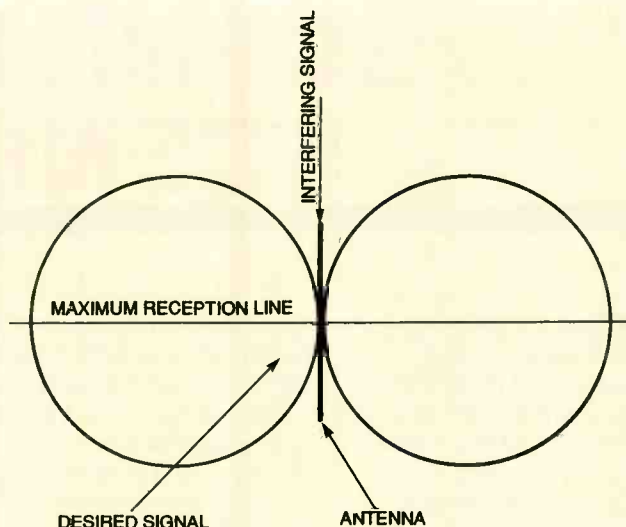


Fig. 2. For best results, a half-wave dipole should be oriented so that its deep side nulls point in the direction of an unwanted signal.

An ideal transmit antenna should be designed to maximize the gain in the direction in which one wishes to transmit. That way, we can take advantage of the inherent gain of the antenna for "free" power or signal strength. For example, if the antenna has a gain of 8 dB over a dipole (as is claimed for many 3-element beams), then a 1,000-watt transmitter will have the same signal strength at a distant point as a 6,300-watt signal fed to a standard half-wave-length dipole.

Another advantage of using an antenna with gain for transmitting is that it protects stations off-axis. In other words, while gaining a few dB of signal strength in the direction of interest, you also keep others from being clobbered by your signal in directions that are of no interest. That's good spectrum management, and good manners.

The receiver antenna, on the other hand, might have different goals than the transmitting antenna. Sure, we can use the gain of the antenna to boost received signals. But that is not usually a problem with modern

shortwave and ham-band receivers. With only 0.1 to 0.5 μV needed to produce a 10-dB signal-to-noise ratio, most receivers don't have to worry too much about getting enough signal. Of far greater importance is the signal-to-noise ratio (SNR) of the receiver system.

The SNR should typically be 10 dB for comfortable listening, although skilled operators can detect signal with a considerably worse SNR. In the case of the receiver system, the SNR includes not just internal white noise "hiss," electrical noise, and lightning static (snaps, crackles, and pops), but also undesired stations on the same or adjacent channels. When you are trying to copy a station through lots of co-channel or adjacent channel QRM (man-made interference, typically other stations), those QRM'ing stations are pure noise.

In the case of a receiver system, a good antenna might be one that has sharp nulls or notches, such as a half-wave dipole (see Fig. 2). Consider two signals, one the desired signal and one the interfering signal.

For best results, the antenna should be oriented so that the deep side nulls point in the direction of the undesired signal. While we don't pick-up the desired signal as strongly as we might if the maximum signal line was aligned with the signal, the ratio of the desired to undesired signal is maximized.

While it is true that most ham antennas are useful on both receive and transmit, that is not always the case. I've seen situations on the crowded 75/80- and 40-meter bands where a dipole was used as the transmitting antenna and a rotatable small-loop antenna was used as the receive antenna. The loop has an azimuth pattern similar to that of Fig. 2, but the axis is opposite (the nulls are broadside to the antenna, not off the ends as in the dipole).

Another example is the case of using a vertical antenna on transmit and a loop or dipole on receive. I've known one ham who had a 40-meter vertical plus two 40-meter dipoles at right angles to each other. He could select any of the three antennas for either transmit or receive, as needed. If transmitting east-west, for example, he might use the east-west dipole for the transmitter, and the north-south one for the receiver. Similarly, if transmitting on the vertical, for receive he selected whichever dipole reduced the interference the most.

Fortunately, some receivers allow separate receive and transmit antennas. If yours does, it will have a second rear-panel SO-239 connector marked for a receive antenna. Otherwise, you will need to build some type of system to switch between two antennas.

SCANNER SCENE

By Marc Saxon

PC-Powerful Scanning

Here's an exciting way to expand the capabilities of the already excellent *Realistic PRO-2005* and *PRO-2006* scanners. It's a product called the *OptoScan 456* system, which includes hardware and software for full computer control of all scanning functions. In addition, unlike all other radios, the *OptoScan 456* includes CTCSS ("PL tone"), DCS code, and DTMF (telephone touchpad) character reading, integrated with the software scan and log functions.



Put the power of a PC behind your *PRO-2005* or *PRO-2006* with the *OptoScan 456* interface system from Optoelectronics.

The hardware can sense when a computer interface is established. It then places the scanner's micro-processor into stand-by mode. Control over all radio functions passes on to the computer. A cable is provided for direct RS-232C interface with a computer's serial port.

Custom *OptoScan 456* introductory software for the PC is provided. All you have

to do is provide the scanner. The software is the OEM version of Scan*Star, which supports tone, code, and touchpad character decoding as well as received signal level. The power of the *OptoScan 456* is realized by the scanning software used. The professional versions of the ScanCat and Scan*Star software both support *OptoScan 456* with upgraded features, such as a spectrum display. Windows-based and Mac software are under development by independent organizations.

The *OptoScan 456* interface assembly can be installed in your scanner without cutting, drilling, or soldering. It's done with detachable cables, which are provided. The installation manual uses photos and step-by-step instructions. The entire installation should take the average scanner owner about two hours using simple hand tools.

With the *OptoScan 456* on the job, the scanner operates at high speed (50 channels per second) and has nearly unlimited memory. Even when you're not there, your scanner can continue to search out those frequencies that you want to check out, and can record them into a virtually unlimited number of memory channels. It relentlessly pursues and searches for elusive or infrequently used channels. The software makes scanning easier than the radio's front-panel controls. Software menus al-

low complex store, search, and scan features to be easily accessed.

The complete *OptoScan 456* installation kit includes the assembled and tested controller board, mounting hardware, cables, software, and installation manual. It costs \$299. For more information, write to Optoelectronics Inc. at 5821 N.E. 14th Avenue, Ft. Lauderdale, FL 33334, or call 1-800-327-5912 or 305-771-2050.

LOOK, UP IN THE SKY!

Readers often ask if it's possible to tune in directly to the space shuttle, and several times we have provided amateur radio, two-meter band frequencies that have been used. That isn't the only way, however!

For quite some time now, scanner owners have been advised that the space shuttle also has a (alternately reported AM or FM) "primary" frequency of 296.8 MHz, and a "secondary" frequency of 259.7 MHz. Those channels are, of course, in addition to the shuttle's main communications system, which operates at 2 GHz in a digital mode.

Actual use of the 200-MHz band by the space shuttle has been doubted, or at least questioned, by some monitors. Shall we say that reports of reception have not been abundant? We say, keep on listening!

I personally can attest to recent activity there. When astronauts Mark Lee and Carl Meade took their Ex-

travehicular Activity (EVA) space walk from the Discovery last September, I was able to directly monitor their communications on 259.7 MHz, in AM mode, as the craft was passing over my area.

That reception was accomplished using a PRO-2006 with a GRE Superamplifier hooked up to a MAX-225 UHF military aeronautics-band ground-plane antenna. Signals came through quite well, and were undoubtedly via an on-board repeater on the shuttle. The space suits transmit on 279.0 MHz, which must be the input for that repeater. Even so, the transmitter on 259.7 MHz probably wasn't running much power.

Keep 296.8 and 259.7 MHz, AM mode, plugged in during space shuttle missions. They are active frequencies, and good ones.

ALSO GOING UP

An interesting new satellite system will be using frequencies within the range of scanners. Leo One will have 48 low orbit (513 miles high) satellites circling the globe, with 12 satellites in each of four circular orbits. The satellites will be designed to support a variety of subscriber applications, including status monitoring, vehicle tracking, paging, E-mail, security monitoring and control, emergency alerting, etc. Leo One will provide store-and-forward data services.

Service is set to commence within two years. The satellites will have communications links with one another in the Ka-band (22 and 24 GHz), thus offering worldwide coverage.

Uplinks are all from 148.00 to 150.05 MHz. Transceiver downlinks are from 137.00 to 138.00 MHz, with

Gateway downlinks from 400.15 through 401.00 MHz.

IN THE MIX

Eugene W. McLees, of Madison, Connecticut, reports that his local police operate on 453.475 MHz, but complains that they scramble some of their transmissions. That is a grumble heard from readers in other areas, all of whom want to know if there is a scanner accessory available that will descramble and copy the transmissions.

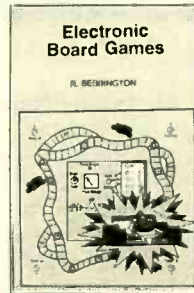
There was one, until about eight years ago, when the government forced the little gizmos off the market. Most police departments use a rather simple but effective form of analog scrambling. Analog scramblers are easy to crack. It's the same system used in today's 46-MHz cordless phones. Some clever "techie" might figure out how to adapt an analog-scrambled phone as a scanner accessory.

Analog scanning is vastly different from the digital scanning used in 900-MHz cordless phones and in the more sophisticated scramblers used by some federal-agency communications systems. Digital scrambling sounds like a hiss on a scanner. Thus far, it has never been possible for scanner owners to descramble digital scramblers.

An anonymous reader in Ohio passed along the Cuyhoga Falls trunked system in use for the past year. Police/Fire primary is 855.1625 MHz, with the secondary being 854.1625 MHz. Control or city services can be found on 853.1625 MHz, control or fire department on 852.1625, and city services or fire department on 851.3625 MHz.

That's all for now. See you again next month.

3 NEW BOOKS for the Project Builder

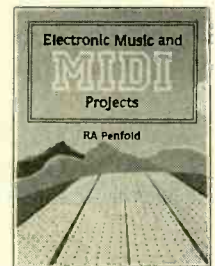


BP350—ELECTRONIC BOARD GAMES\$6.00

Twenty novel electronic board games that you can build from the plans in this book. Whether you are interested in motor racing, searching for buried treasure on a desert island or for gold in Fort Knox, spinning the wheel of fortune, or doing a musical quiz—there is something for you to build and enjoy!

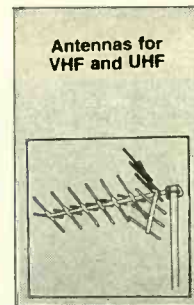
PCP119—ELECTRONIC MUSIC AND MIDI PROJECTS\$14.95

Save cash by building the MIDI gadgets you need. Want a MIDI THRU box, program change pedal, Metronome, analog echo unit, MIDI patchbay or switcher? Over 16 practical and very useful music and MIDI projects—all in this book! The projects are explained in detail with full instructions on assembly.



BP301—ANTENNAS FOR VHF AND UHF\$6.00

From installing a TV or FM antenna to setting up a multi-antenna array for shortwave listening or amateur radio, this book explains the basics of VHF and UHF antenna operation and installation. The text describes in easy-to-understand terms the essential information about how antennas work, the advantages of different antenna types, and how to get the best performance from an antenna.



Mail to: **Electronic Technology Today, Inc.**
P.O. Box 240 • Massapequa Park, NY 11762-0240

Shipping Charges in USA & Canada

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

Sorry, no orders accepted outside of USA and Canada. All payments must be in U.S. funds only.

Number of books ordered.

Total price of books	\$ _____
Shipping (see chart)	\$ _____
Subtotal	\$ _____
Sales Tax (NYS only)	\$ _____
Total enclosed	\$ _____

Name _____
Address _____
City _____ State _____ ZIP _____

Please allow 6-8 weeks for delivery.

ELECTRONICS LIBRARY

Giga Bites: The Hacker Cookbook 17th Edition

by Jenz Johnson

Hackers cannot live by computers alone—some physical sustenance is required as well. According to the author of this cookbook, food is often the only interruption tolerated by the dedicated (read: fanatical) hacker. Whether devoured over the keyboard or during a short break, the hallmarks of hacker cuisine (also known as "cyberchow" or "technogrub") are large portions, quick prep time, and unpredictable results. Although nutritional content is not a priority, none of the recipes in this book contain more than 6000 calories per serving—a real achievement when dealing with such culinary treats as "Twinkie Casserole," "Left-

includes pointers for guarding your keyboard from dip spills, preventing soggy chips, and cleaning your screen.

Giga Bites: The Hacker Cookbook costs \$9.95 and is published by Ten Speed Press, P.O. Box 7123, Berkeley, CA 94707; Tel. 800-841-2665 for orders or 510-559-1600; Fax: 510-524-4588.

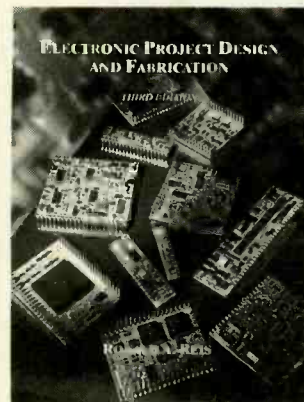
CIRCLE 80 ON FREE INFORMATION CARD

ELECTRONIC PROJECT DESIGN AND FABRICATION; Third Edition

by Ronald A. Reis

This book provides the real-life experience in project design, building, and documentation that every hobbyist and prospective electronics technician needs. It opens with a step-by-step guide through the prototype project design and fabrication process for the "sample project"—a variable power supply—and the "exercise project"—a three-channel color organ. Fifteen elective projects, including an audible logic probe, a digital temperature controller, a push-button combination lock, and a burglar alarm, are also presented in the book's first section, which concludes with an introduction to computer-aided design.

In Part II, project design and fabrication using surface-mount technology is covered in three chapters. An overview of the subject is followed by hands-on study of SMT component acquisition, circuit breadboarding, surface-mount PC-board design, and SMT project assembly using traditional hand tools. The third chapter explores the tools and techniques needed to re-work commercial products involving surface-mount circuits.



Part III is devoted to actual construction projects. It covers concepts, documentation, system diagrams, circuit design sketching, and packaging plans for 15 insertion mount technology (IMT) projects.

Electronic Project Design and Fabrication, Third Edition, costs \$45.00 and is published by Prentice Hall, Inc., Englewood Cliffs, NJ 07632.

CIRCLE 99 ON FREE INFORMATION CARD

THE VIRTUAL REALITY PROGRAMMER'S KIT

by Joe Gradecki

This book-and-software package provides everything that the computer user with no programming experience needs to produce virtual reality (VR) programs—including virtual cities populated with animated people, robots, or bizarre monsters—on his or her own PC. Readers who have a little knowledge of the C programming language will also learn to create multi-user worlds that work over modems; design labyrinths and VR games with sophisticated animation and 3D sound; and integrate projects from a companion book, *The Virtual Reality Construction Kit*, into original virtual worlds.



over Chinese Food Dip," and "Hacker Fondue with Pork Rinds." The microwave is the appliance of choice, and favorite ingredients include Cheez Whiz, Wonder Bread (usually squashed into bread balls), Spam, and anything that comes in a can. Along with recipes, the book



The package also offers tips for experienced C programmers, providing code to add advanced features to their creations. The four complete virtual-reality applications included on the disk can be explored as is or customized for unique VR experiences.

The Virtual Reality Programmer's Kit costs \$29.95 and is published by John Wiley & Sons, Inc., Professional Reference and Trade Group, 605 Third Avenue, New York, NY 10158-0012.

CIRCLE 88 ON FREE INFORMATION CARD

1995 ARRL HANDBOOK FOR RADIO AMATEURS

from *The American Radio Relay League*

The 72nd edition of this authoritative handbook is not merely a revision but an entirely rewritten book that supersedes all previous editions. It has been reorganized for easier reading and represents several years of research and revision. New sections cover digital signal processing and other evolving technologies that are shaping



amateur radio today and into the future.

The book is aimed at amateur radio operators, broadcast engineers, electronic hobbyists and professionals, science teachers and students, and anyone interested in communications technology. It features chapters on radio and communications theory, background information on assembling, setting up, and testing an amateur radio station; and a wealth of new projects for the home builder, from power supplies to transceivers and amplifiers.

The 1995 ARRL Handbook for Radio Amateurs costs \$30 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111; Tel. 203-666-1541; Fax: 203-665-7531.

CIRCLE 82 ON FREE INFORMATION CARD

THE VISUAL GUIDE TO dBASE FOR WINDOWS

by Carl Townsend

With tips for developers and designers at all levels, this book-and-disk package offers a comprehensive examination of effective, efficient database design for dBASE users. It provides a generously illustrated overview of dBASE for Windows, including version 5's fresh new interface and OOP language extensions.

The book defines dBASE basics, such as exploring the Navigator, Catalog window, Command window, tables, forms, and queries. It explains how to design dBASE databases, from analyzing your goals and needs, to using sound design concepts and techniques, to working with objects. The book provides hands-on practice in creating and modifying tables, organizing and moving data, indexing information, and correcting problems.

The book also explains how to design, create, and execute queries; create fast forms with the Form Expert; customize with the Form Designer and Crystal Reports; and use SpeedMenus and the Menu Designer to add menus, buttons, and SpeedBars. Finally, it shows readers how to develop

dBASE programs using dBASE for Windows' unique two-way tools. An in-depth index includes advanced administration and management information.

The companion disk features a tutorial software system that illustrates key techniques and features in programming. All of



the tables, queries, forms, reports, and programs needed for working with the examples in the book are on the disk, linked through a convenient menu system.

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

CIRCLE 83 ON FREE INFORMATION CARD

1995 TECHNICAL SUPPLIES CATALOG

from *Hub Material Company (HMC)*

HMC's full-line 1995 catalog is filled with the electronic tools, test gear, and technical supplies required for the assembly, testing, and repair of electronic products. The detailed buying guide features a broad selection of brand-name items at competitive prices, complete with large photographs, clear copy, and comparison tables of product features. The catalog includes test instruments, tool kits, soldering/desoldering systems, precision hand tools, work stations, industrial chemicals and adhesives, data communications and telecommunications equipment, PC-board handling equipment, and static-control products.



The 1995 Technical Supplies Catalog is free upon request from HMC, 33 Springdale Avenue, Canton, MA 02021; Tel. 617-821-1870; Fax: 617-821-4133.

CIRCLE 84 ON FREE INFORMATION CARD

SIMPLIFIED DESIGN OF LINEAR POWER SUPPLIES

by John D. Lenk

This one-stop guide to linear power-supply design is well suited for beginners, students, and experimenters, as well as design professionals. It feature step-by-step instructions and diagrams, and requires no previous design experience.

The book concentrates on the use of commercial IC regulators by discussing the selection of external components that modify the IC-package characteristics. A full chapter is devoted to heat sinks and other temperature-related design problems. Another chapter covers testing the linear supplies in both experimental and final form, and illustrates the connections of the completed supplies.

Operation of all circuits is fully detailed to provide a foundation for those who are totally unfamiliar with linear supplies and a refresher for professionals. All popular forms of linear supplies, including zener, three-terminal, feedback, current foldback, op-amp, series, shunt, and IC package, are covered in detail. In addition, the design examples can be put to immediate use as is, or can be modified to meet a specific design goal.

Simplified Design of Linear Power Supplies costs \$29.95

and is published by Butterworth Heinemann, 313 Washington Street, Newton, MA 02158-1626; Tel. 617-928-2500; Fax: 617-928-2620.

CIRCLE 85 ON FREE INFORMATION CARD

NET GAMES: Your Guide to the Games People Play on the Electronic Highway

by Kelly Maloni, Derek Baker, and Nathaniel Wice

By some estimates, more than half of online time is spent playing interactive games. At any hour of the day, millions of people worldwide are online playing games with each other in Cyberspace, where online camaraderie and competition rival the intensity of contact sports. The new breed of games takes advantage of the Internet and other computer networks to bring human rivalry and team spirit directly to your screen.

This book is a guide to more than 1500 of those new comput-



er games. It includes multi-player virtual scrimmages such as Air Warrior, Cyberstrike, Doom, and Bolo, which combine the local color of a hometown bowling league with the massive firepower of a Hollywood action movie. Traditional games, including chess, Go, bridge, and backgammon are also covered, as are play-by-mail classics like rotisserie baseball and Diplomacy. The book also covers MUD's, MOO's, and MUSH'es—participatory narrative adventures—in which players build and explore virtual worlds from the USS Enterprise to worlds based on Anne Rice's vampire chronicles.

Besides the games people play online, the book also covers the thousands of free computer games and demos that can be downloaded from online archives. It describes the clubs that share cheats, hints, and walk-throughs for mastering home and arcade hits ranging from Mortal Kombat to NBA Jam (and even the daily crossword puzzle).

Net Games: Your Guide to the Games People Play on the Electronic Highway costs \$19 and is published by Random House Electronic Publishing/Michael Wolf & Company, Inc.; Tel. 1-800-NET-1133.

CIRCLE 86 ON FREE INFORMATION CARD

MASTER CATALOG 1994-1995

from Jensen Tools

Jensen's latest catalog has been upgraded with larger pages, pictures, and type, to make it easier to use. The catalog offers a single source of tools and test instruments for the installation and maintenance of electronic equipment and systems. It features a full line of specialty tool kits and cases, as well as the latest portable field-test equipment from major manufacturers. Also included are hard-to-find tools,



static-control products, circuit-board accessories, lighting and optical aids, workbenches, soldering supplies, cables, connectors, LAN installation and maintenance products, shipping containers, and more. Jensen brand tools have a lifetime guarantee, and shipping is free in the continental U.S.

The Master Catalog 1994-1995 is free upon request from Jensen Tools Inc., 7815 South 46th Street, Phoenix, AZ 85044; Tel. 800-426-1195.

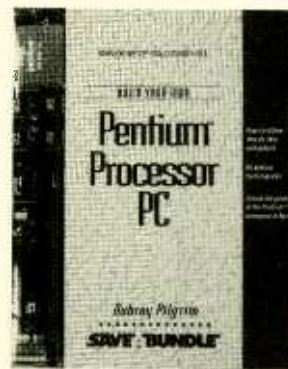
CIRCLE 87 ON FREE INFORMATION CARD

BUILD YOUR OWN PENTIUM™ PROCESSOR PC

by Aubrey Pilgrim

If you dream of owning a powerful new Pentium-processor PC, but can't afford to buy one at today's prices, this book is for you. Although a Pentium-based computer is much more powerful and expensive than most other commercial PC's, it isn't more difficult to assemble. This book explains how to construct an IBM-compatible Pentium computer out of mail-order parts and peripherals for a fraction of dealer prices.

After an overview of the Pentium processor and its capabilities, the book describes



in step-by-step, illustrated detail how to put together all the necessary components, including motherboards, floppy and hard drives, CD-ROM drives, printers, input devices, memory chips, monitors, graphics cards, fax/modems, and backup systems. It explains how and where to find the best components and peripherals at the lowest possible prices, and explains which software packages will best suit a variety of needs (including multimedia applications). The money-saving guide also contains a review of operating systems and a handy list of troubleshooting techniques, making it a valuable reference for those who are planning to

buy a Pentium-based PC instead of building one.

Build Your Own Pentium Processor PC costs \$19.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850;

Tel. 1-800-233-1128.

CIRCLE 98 ON FREE INFORMATION CARD

MINIATURE SATELLITE DISHES:

The New Digital Television

by Dr. Frank Baylin

Digital broadcasts from high-power satellites to 18-inch dishes are now being transmitted, and this book covers all aspects of the new direct broadcast satellite (DBS) industry, including the technology, the players, and the programming, as well as signal security and installation methods.

The book opens with an overview of DBS and also covers the underlying technology of satellites and receiver systems. Topics such as digital video compression, bit error rate, receiver design, and compatibility of large- and small-dish systems are studied. Next, the DBS players—DirecTV, EchoStar, PrimeStar, and USSB—are discussed, along with their satellites and systems. The book examines how DBS differs from large-dish satellite TV and cable TV, the origins of DBS, and DBS frequency allocations.

Subsequent chapters outline the encryption systems used for signal security and examine the program packages and prices offered by various players. The step-by-step procedures for installing both small- and large-dish satellite systems are presented in detail. The final chapter demonstrates the methods used to hook up and interface home-entertainment systems, including off-air antennas, stereos, and VCR's, with home satellite TV receivers.

Miniature Satellite Dishes: The New Digital TV is available for \$20 plus \$4 shipping and handling from Baylin Publications, 1905 Mariposa, Boulder, CO 80302; Tel. 303-449-4551; Fax: 303-939-8720.

CIRCLE 89 ON FREE INFORMATION CARD

Electronics Paperback Books



□ **BP88—How to Use OpAmps...\$5.95.** A designer's guide that covers operational amplifiers. Serving as both a source book of circuits and a reference book for design calculations. The text is non-mathematical and easy to understand by most readers.



□ **BP113—30 Solderless Breadboard Projects-Book 2...\$5.95.** Numerous hobbyist projects of useful gadgets and circuits using "Verobloc" breadboards. All the breadboard projects in this book are based on CMOS logic integrated circuits.



□ **BP177—Introduction to Computer Communications...\$5.95.** Details on types of modems and their suitability for specific application, plus details of connecting various computers to modems, and modems to the telephone system.



□ **BP276—Shortwave Superhet Receiver Construction...\$6.95.** Provides construction details, including coil winding, of a number of advanced-design receivers which should have performance levels at least equal to commercial sets of similar complexity.



□ **BP61—Beginners Guide to Digital Techniques...\$5.00.** Covers the basics of digital techniques—decimal, binary, octal and hexadecimal numbering systems are covered plus insights on weighted and non-weighted binary-coded-decimal codes and alpha-numeric codes. The basic building blocks of circuit logic, the common AND, OR, NAND, NOR and EXCLUSIVE-OR gates and bi-stables, are thoroughly covered.



□ **BP285—A Beginners Guide to Modern Electronic Components...\$6.50.** It is easy for newcomers to electronics to become confused. There are a great many different types of components available often with numerous variations of each type. This book presents the reader with a vast amount of invaluable parts information to enable the right component to be selected every time for repairs and projects.



□ **PCP103—Practical MIDI Handbook...\$9.95.** The Musical Instrument Digital Interface (MIDI) is surrounded by a great deal of misunderstanding. This book is aimed at musicians and technicians who want to explore the vast capabilities of MIDI. It covers MIDI-based equipment you can use: keyboards, drum machines, sequencers, effects units, mixers, drum pads guitars. There's also a section on computer music.



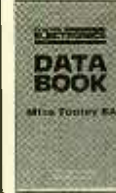
□ **BP90—Audio Projects...\$5.50.** Details the construction of preamplifiers and mixers, power amplifiers, tone controls and matching projects. All projects are fairly simple to build and include a number of board layouts and wiring diagrams.



□ **BP121—How to Design and Make Your Own PCBs...\$5.75.** Simple methods for copying printed-circuit board designs from magazines and books on to copper. Covers all aspects of simple PCB construction as comprehensively as possible.



□ **BP44—IC 555 Projects...\$5.95.** Every so often a device appears that is so useful that one wonders how life went on before without it. The 555 timer integrated-circuit chip is one such device. Included are basic and general circuits used by most hobbyists.



□ **PCP109—Everyday Electronics Data Book...\$10.00.** An invaluable source of electronics information—the text contains sections that deal with the underlying theory of electronic circuits and a wide range of practical electronic uses for everyone.



□ **BP60—Practical Construction of Pre-Amps, Tone Controls, Filters and Attenuators...\$5.50.** The book offers practical designs and details thereby enabling the project-builder enthusiast to construct, with the minimum of difficulty and expense, various audio pre-amplifier and tone control circuits, etc., which may be used with home-constructed audio equipment or even complex commercial gear.



□ **BP297—Loudspeakers for Musicians...\$6.25.** Contains all the information that a working musician needs to know about loudspeakers; the different types, how they work, the most suitable for different instruments, for cabaret work, and for vocals. It gives tips on constructing cabinets, wiring up, available fittings, finishing and how to connect multi-speaker arrays, etc. Includes ten enclosure designs with plans.



□ **PCP110—Electronic Power Supply Handbook...\$10.95.** All types of power supplies used for electronics purposes are covered in detail, starting with cells and batteries and extending by way of rectified supplies and linear stabilizers to modem switch-mode systems, IC switch-mode regulators, DC-converters and inverters. The devices, their operating principles and typical circuits, are dealt with in detail.



□ **BP254—From Atoms to Amperes...\$6.50.** Explains in crystal-clear terms the fundamentals behind the whole of electricity and electronics. Really helps you to understand the basis of the complex subject perhaps for the first time ever.



□ **PCP101—Practical Digital Electronics Handbook...\$9.95.** An introduction to digital circuits, logic gates, bi-stables, timers, micro-processors, memory and I/O devices. A special feature of the book is the section on digital test gear projects.



□ **BP315—Introduction to the Electro-magnetic Wave...\$5.95.** A fundamental and easy-to-understand approach to a complicated theory topic. The beginner requires no more than elementary mathematics and basic knowledge of electronics.



□ **#228—Essential Theory for the Hobbyist...\$5.25.** Supplies to the hobbyist background knowledge tailored to the specific requirements of their activities. Relevant material is presented in a readable manner with a minimum of mathematics.

TEST EQUIPMENT SPECIALS

- **BP239—Getting the Most from Your Multimeter...\$5.95**
Covers analog and digital gear, component and gear testing.
- **BP267—How to Use Oscilloscopes & Other Test Equipment...\$6.95**
Get with the next step to proficient troubleshooting.
- **PCP111—Electronic Test Equipment Handbook...\$13.95**
The all-inclusive text covering test gear you'll use!

SUBSTITUTION GUIDES FOR HOBBYISTS

- **BP85—International Transistor Equivalents Guide...\$7.50**
The ultimate guide to replacing foreign and domestic transistors.
- **BP108—International Diode Equivalents Guide...\$5.95**
Rectifiers, Zeners, LEDs, OCIs, diacs, triacs...all hobby types.
- **BP140—Digital Equivalents and Pin Connectors...\$12.50**
A master reference for builders who design projects.

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. BOX 240, Massapequa, NY 11762-0240

Name _____
Address _____
City _____ State _____ Zip _____
PE1

SHIPPING CHARGES IN USA AND CANADA
\$0.01 to \$5.00\$1.50
\$5.01 to \$10.00\$2.50
\$10.01 to 20.00\$3.50
\$20.01 to 30.00\$4.50
\$30.01 to 40.00\$5.50
\$40.01 to 50.00\$6.50
\$50.01 and above\$8.00

SORRY No orders accepted outside of USA & Canada

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

Number of books ordered

All payments must be in U.S. funds!

NEW PRODUCTS

"Perpetual Memory" CW Keyboard

The MFJ-452 "Perpetual Memory" CW keyboard from MFJ Enterprises features eight 250-character nonvolatile message memories, a 150-character type-ahead buffer, a two-line LCD readout, an RFI-suppressed keyboard, and a powerful Morse code trainer. Even the hunt-and-peck typist can send perfect CW messages, because the buffer smoothes out one's typing and gives him or her more time to compose. There is no computer to boot up, and no program to

keys for easy use. The MFJ-452 also features an iambic keyer for fast break-in—by plugging in an iambic paddle you can use it as a full-featured keyer.

The Morse code trainer allows the user to practice or teach in Farnsworth or normal code. Letters, numbers, punctuation marks, and prosigns can be selected in any combination for practice.

The MFJ-452 Morse AT101-compatible keyboard, which plugs into a compact interface, costs \$129.95. For more information, contact MFJ Enterprises, Inc., P. O. Box 494, Mississippi State, MS 39762; Tel. 601-323-5869 or 800-647-1800 for orders; Fax: 601-323-6551.

CIRCLE 102 ON FREE INFORMATION CARD

RADIO-TRANSMITTER DETECTOR

Aimed at the security, surveillance, law-enforcement, and hobby monitoring markets, the Scout from Optoelectronics is a handheld device for detecting radio transmitters in the near field.

For walk-by applications, the Scout can automatically detect and record 200 unique frequencies and up to 250 repeat hits on any that were previously recorded. When used with the miniature DB32 antenna, the Scout will fit in a pocket, operating in a completely automatic mode, and will signal the user with a pager-style vibration when a frequency is recorded. After recording, the Scout data can be downloaded into a computer using the supplied software and an optional TTL to RS-232C interface converter.

In drive-by mode, the built-in beeper signals when the Scout records a new frequency with a double beep. A single beep indicates a hit on a previously recorded frequency. Automatic operation allows the driver to monitor frequencies without

load. The device allows the user to save his or her messages and settings for up to 20 years without power or batteries.

The display simultaneously shows what is being typed on one line and what is being sent out on the other. The user can review stored messages and keyboard settings, and can spot and correct any typing errors.

Thanks to RFI suppression, the CW keyboard won't lock up or send unwanted characters. Single-touch function keys make it easy to store and recall messages; set speed, weight, and tone; set up serial numbering; and turn on and off the transmitter tune. Commonly used prosigns are assigned



being distracted. Reaction tuning a receiver in drive-by operation provides instant, hands-free monitoring of the detected transmissions.

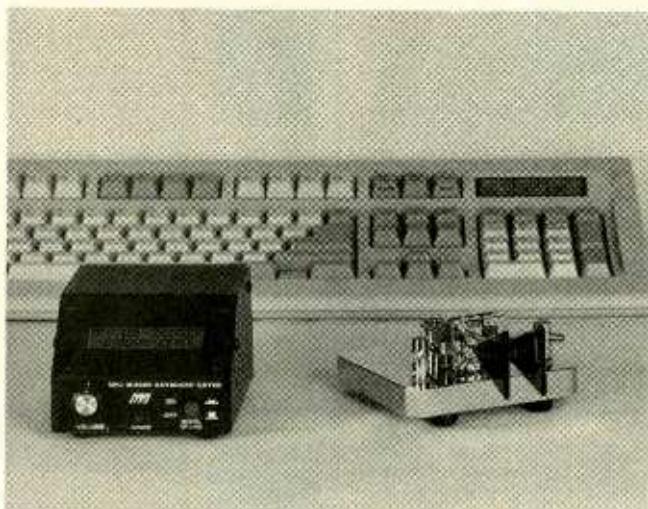
To distinguish actual radio frequencies from background noise, Optoelectronics' patent-pending Digital Filter/Capture technology is used. The beeper and LCD backlight are switch-selectable on power up. A NiCd battery pack provides at least six hours of portable operation. An AC adaptor/charger is included; a 12-volt DC adaptor is optional.

The Scout radio-frequency detector, complete with AC adaptor/charger, 3.5-inch disk with PC-compatible utilities, and user's manual, costs \$399. The DB32 miniature VHF/UHF antenna costs \$29, and the CX12-to-RS-232C interface costs \$89. For more information, contact Optoelectronics Inc., 5821 NE 14th Avenue, Ft. Lauderdale, FL 33334; Tel. 305-771-2050; Fax: 305-771-2052.

CIRCLE 103 ON FREE INFORMATION CARD

SERVICE KITS

Two digital multimeter service kits from Fluke each include a rugged handheld DMM, along with the accessories and training materials needed to perform electrical measurements.



The *Fluke 23* kit provides the industrial, electrical, and HVAC technician with a Fluke Model 23 analog/digital-display multimeter, an 80i-400 clamp-on AC-current probe, a TL20 test-lead set, and a C17Y case. The kit also includes electrical and HVAC/R application notes and training materials for DMM users.

The *Fluke 87* kit provides the user with a Model 87 analog/digital multimeter, an 80i-400 clamp-on AC-current probe, a TL20 test-lead set, a C28Y case, and a video titled "Understanding Harmonics." Additional training materials in the kit include the "High-Performance Guide to DMMs" application booklet and electrical, harmonic, and HVAC/R application notes.

The list prices for the Fluke 23 and the Fluke 87 service kits



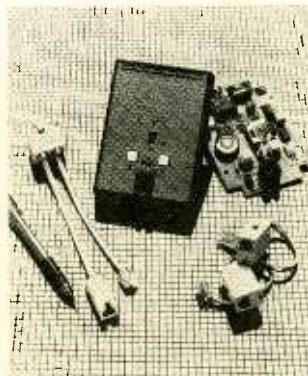
are \$309 and \$469, respectively. Those prices represent a 10% cost savings over purchasing the items separately. For further information, contact Fluke Corporation, P. O. Box 9090, Everett, WA 98206; Tel. 800-44-FLUKE; Fax: 206-356-5116.

CIRCLE 104 ON FREE INFORMATION CARD

TELEPHONE WIRETAP DETECTOR

With inexpensive, easy-to-use wiretapping equipment now readily available, both businesses and individuals are increasingly concerned about maintaining their privacy. As the threat of surveillance becomes obvious, businesses recognize the need to protect their information.

Security Call's SC1100 tele-



phone-wiretap-detector alarm system protects private phone lines from eavesdropping and tampering. The unit continuously monitors the phone line for suspicious changes in electrical characteristics, and alerts the owner with an audible tone when they occur. The small, microprocessor-controlled unit snaps easily into place and can be checked remotely.

The SC1100 wiretap-detector system costs \$139. For additional information, contact Security Call, 15425 Los Gatos Blvd., Los Gatos, CA 95032-2541; Tel. 408-356-6509 or 800-334-0074; Fax: 408-356-0758.

CIRCLE 105 ON FREE INFORMATION CARD

PROTOTYPE BOARDS AND COMPATIBLE BOXES

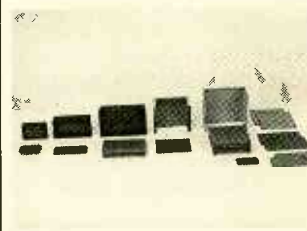
Jameco's line of 15 printed-circuit boards and 15 matching boxes features ABS speedy boxes, die-cast aluminum enclosures, sheet-metal aluminum boxes, and heavy-duty instrument cases. The compatibility between boards and boxes give electronics enthusiasts a quick start on their projects.

The pre-cut boards also allow the builder an immediate start on prototyping circuits. Each board has two or four mounting holes and is compatible with Jameco's PC-board mounting hardware. The 1/16-inch-thick boards are made of laminated glass epoxy, are copper-clad, and have a solder mask on one side.

The boxes are designed for convenience and durability. The ABS speedy box, for instance, can be used to enclose and protect the boards inside, as

well as to house the switch that activates the boards' circuitry. The number of boards that can be stacked is limited only by space, and the boards can be interconnected. The box has mounting slots on all four sides. The die-cast aluminum enclosures come with channeled walls for easy board mounting. Because the lid forms an effective screen against RFI, they are ideal for RF circuits. The sheet-metal aluminum boxes, consisting of two pieces that slide together, allow the builder to access the prototype boards from two sides as well as from the top.

The metal cabinets are de-



signed to suit a large variety of electronics projects. Slots are located on the sides of the cases for cooling purposes. The heavy-duty instrument case splits apart so that the builder can access the prototype boards from all sides. Four plastic feet secure the case in place on a desk or table. The case accommodates various board-mounting positions.

Prices for the prototyping boards range from \$3.95 to \$14.95. Prices for the boxes range from \$2.25 to \$9.49. For more information, contact Jameco Electronics, 1355 Shoreway Road, Belmont, CA 94002; Tel: 415-592-8097; Fax: 415-592-2503.

CIRCLE 106 ON FREE INFORMATION CARD

MACRO KEYBOARD

The *BAT (Biomechanical-Automated Technology) Personal Keyboard* from *InfoGrip, Inc.* compresses all the capabilities of a traditional keyboard into a seven-key unit that can be used with one hand. Its battery backup stores macros so they don't have to be reactivated every time the keyboard is turned off. The *BAT* keyboard can be used with several different PC-com-

patible computers—at the office, home, or on the road—without having to download your macros to floppy. The device weighs just 16 ounces and fits in a briefcase.

The user can quickly type any letter, command, or function with one hand by pressing key combinations of one to five fingers, similar to playing chords on a piano. *ChordEasy* software allows a library of macros and shorthand "WordChords" to be



created to save time and reduce errors. Frequently used phrases and commands of up to 250 characters can become macros that can be entered with just two chords. Those features make the *BAT* keyboard popular with the physically and visually impaired as well as with programmers, desktop publishers, and CAD and graphic designers who need to keep one hand free for using a mouse.

Letter and number chords can be learned in about an hour. To enter the letter "A," for example, the user simultaneously keys the thumb and first three fingers. Typical typing speeds reach 25 to 45 words-per-minute with one hand.

The *BAT* keyboard with battery backup, including custom carrying case, costs \$199. A 10-minute video demonstration costs \$2.95; the price of the demonstration video will be applied toward the purchase of a keyboard. For more information, contact *InfoGrip, Inc.* at 800-397-0921.

CIRCLE 107 ON FREE INFORMATION CARD

LIGHT-UP REMOTE CONTROL

Late-night TV viewers won't have to fumble in the dark for the right remote-control buttons with *Radio Shack's Light-Up remote*. The keypad lights up on command. The most frequently used controls (volume and channel up/down) are brighter than the others, making it easier to quickly find the correct button.



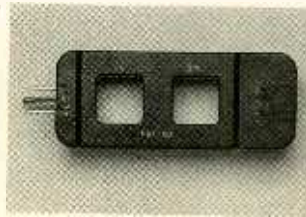
The Light-Up remote can be used to control a TV, VCR, cable box, and one other device. It is programmed to operate your specific equipment by entering the three-digit codes for your models. The owner's manual includes a list of codes for hundreds of models. The remote also works with Radio Shack's Plug 'n Power modules to control lights and appliances around the home.

The Light-Up remote sells for approximately \$29.99 at Radio Shack stores nationwide. For additional information, contact Radio Shack, 700 One Tandy Center, Fort Worth, TX 76102; Tel. 817-390-3300.

CIRCLE 108 ON FREE INFORMATION CARD

LINE SEPARATOR

You can safely monitor AC line current with the *Model 480172 line separator* from *Extech Instruments*. It allows easy access to a two- or three-wire power cord, so that a standard clamp meter then can be used to easily and safely record line



current. The device separates the hot/live conductor from the neutral (and ground) wire. Two- or three-prong plugs can be tested by placing the line separator between a standard wall outlet and a power cord. A $\times 10$ multiplier range allows precise measurements of low current levels.

The Model 480172 line separator costs \$15. For additional information, contact Extech Instruments Corporation, 335 Bear Hill Road, Waltham, MA 02154-1020; Tel. 617-890-7740; Fax: 617-890-7864.

CIRCLE 109 ON FREE INFORMATION CARD

HF ANTENNA TUNER

The *Tucker T-1000* antenna tuner operates from 1.8–30 MHz and matches any transceiver or receiver to almost any antenna with up to 300 watts of power-handling capability. It features a large, lighted cross-needle meter that simultaneously measures forward or reflected power and SWR. The metering system measures both peak and average power. A built-in 300-watt dummy load uses a special ceramic construction that actu-



ally becomes more resonant as it heats up.

The T-1000 has an eight-position front-panel switch that allows the user to alternate between two coax-fed antennas (either directly or through the tuner); a balanced line or wire antenna; a bypass position that allows switching directly to the antenna, thereby bypassing the

tuner; two positions that bypass the antenna tuner but keep the SWR/Power meter active; and two positions for the built-in dummy load (tuned or direct). Using the tuned dummy-load position allows the user to preset the tuner for the band in use without causing on-air interference. The tuning system itself uses two large, conservatively rated, continuous-rotation capacitors and a 12-position switched inductor. A heavy-duty 1:4 balun is built-in, along with binding posts for long-wire antennas and SO-239 connectors for coaxial-fed antennas.

The T-1000 antenna tuner has a list price of \$149.95. For further information, contact Tucker Electronics and Computers, 1717 Reserve St., Garland, TX 75042-7621; Tel. 1-800-527-4642.

CIRCLE 110 ON FREE INFORMATION CARD

INSULATION-TEST METER

The *Model DI-2000M* insulation-test meter from *HC Protek* measures insulation resistance as well as AC voltage and continuity. The rugged, easy-to-use meter has a built-in megohm meter with a range of 2–2000 megohms ($\pm 2\%$) at a terminal voltage of 500 volts. The meter measures AC voltage from 0 to 750 volts with $\pm 1\%$ accuracy. Resistance measurements range from 0 to 200 ohms at 0.1-ohm resolution and $\pm 1\%$



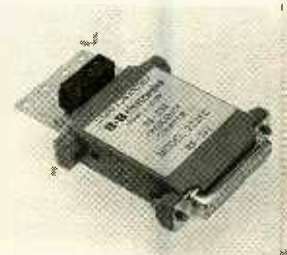
accuracy. Continuity checks are aided by a built-in buzzer. The tester measures $7.5 \times 4 \times 1.75$ inches and weighs approximately 1.3 pounds. It is powered by six "AA" batteries.

The Model DI-2000M insulation-test meter, complete with test leads, batteries, strap, and carrying case, costs \$120. For additional information, contact HC Protek, 154 Veterans Drive, Northvale, NJ 07647; Tel. 201-767-7242; Fax: 201-767-7343.

CIRCLE 111 ON FREE INFORMATION CARD

RS-232 FREQUENCY COUNTER

Powered from the RS-232 port handshake lines, the *Model 232FC* frequency counter from *B&B Electronics* allows you to make frequency measurements of TTL-level signals through your RS-232 port. If the handshake lines are not available, a 12VDC external supply can be used to power the converter. The 232FC makes frequency measurements from 5 Hz to 2 MHz and duty-cycle measure-



ments from 5 Hz to 50 kHz. Simple commands allow you to make measurements with your own program. The device is shipped with software that logs and plots frequency and duty-cycle information, and also displays histograms. Sample code in BASIC, Pascal, and C that demonstrates the 232FC commands is provided.

The 232FC frequency counter costs \$69.95. For further information, contact B&B Electronics Manufacturing Company, 707 Dayton Road, P.O. Box 1040, Ottawa, IL 61350; Tel. 815-434-0846; Fax: 815-434-7094; BBS: 815-434-2927.

CIRCLE 112 ON FREE INFORMATION CARD

Get the one you missed!

Popular Electronics

Popular Electronics back issues are available although quantities of some issues are nearly exhausted. Here's an opportunity to complete your collection, or obtain a selected back issue you cannot find elsewhere. This offer is valid only when using the coupon on this page or a photo copy.

Special Back Issue Offer!

Please circle the issue(s) ordered!

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
1987	1	2	3	4	5	6	7	8	9	10	11	12	
1988	1	1987-1988 back issues not available									22	23	24
1989	25	26	27	28	29	30	31	32	33	34	35	36	
1990	37	38	39	40	41	42	43	44	45	46	47	48	
1991	—	49	—	50	51	52	53	54	55	56	57	58	
1992	59	60	61	62	63	64	65	66	67	68	69	70	
1993	71	72	73										

Note: Issues prior to November 1988 are "Hands-on Electronics"—the predecessor of Popular Electronics.

How to determine cost!

Quantity	Price per copy		
	United States	Canada	Foreign
1-5	\$6.50 US	\$6.50 US	*
6-11	5.50	5.75	\$8.00 US
12-23	5.00	5.25	7.50
24 and more	4.50	4.75	7.00

Prices include handling and shipping. Prices subject to change. All orders payable in U.S.A. funds only, via international money order, check drawn on a U.S.A. bank, or acceptable credit card (Visa, MasterCard) in U.S.A. funds. Allow 6-8 weeks delivery. Foreign orders may take longer. *Minimum foreign order—6 issues.

Visa MasterCard USA Bank Check US or Int. Money Order

[Note: Credit Card minimum order is \$15.00.]

Credit Card Number _____ Exp. Date ____/____/____

Signature _____

Name _____

Address _____

City _____ State _____ ZIP _____

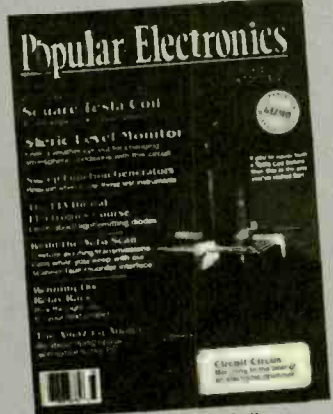
Send Orders To: CLAGGK, Inc., P.O. Box 4099, Farmingdale, NY 11735. Sorry, no telephone orders.



Plans for the world's zaniest plaything—
September 1989



Put together your own Macintosh computer—
September 1991



Build the Tesla Coil that went square!—
August 1989

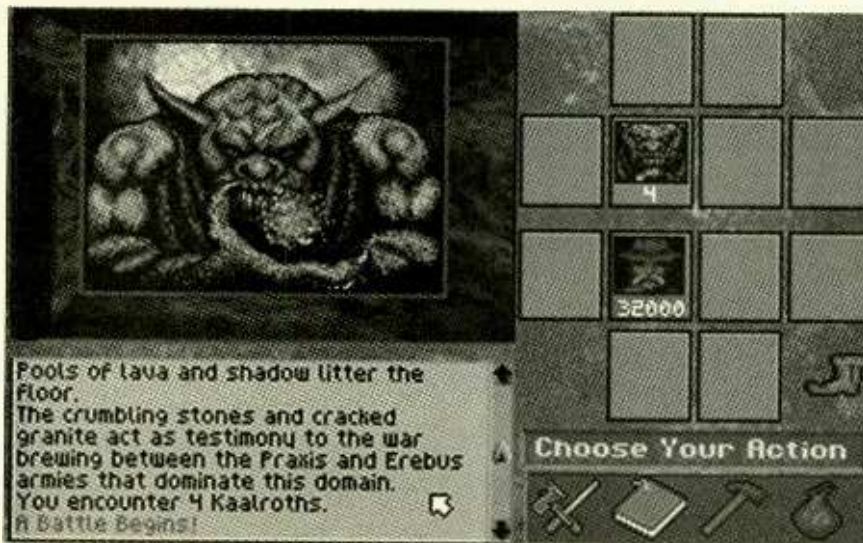


Take a chance on our Dice-Roulette project—
April 1989

THE IMAGINATION NETWORK

(Continued from page 50)

equipment, and how to fight battles. I also answer questions about other aspects of the network, monitor a portion of the bulletin boards to ensure that community standards are maintained, and deal with an occasional troublemaker. We have members from 8 to 80, and INN is first and foremost a family place.



If you are a fan of adventure/role-playing games, you'll love what you will find in MedievaLand, one of the lands in INN.

INN takes great pains to ensure that an enjoyable time can be had by all. If you should, by chance, receive a message from another member that you find offensive, you have the option to click a "complain button." That button records the exact message along with the offender's name and account number for INN personnel to review, and the staff will take action on it, if warranted. Occasionally, something improper gets posted after our daily monitoring, or a member becomes exceptionally unruly, in which case the offending post (or even the member) will be removed when called to our attention.

Some Background. The Imagination Network's cyberspace community is continually being expanded and upgraded. It was conceived by Ken and Roberta Williams, the founders of Sierra On-Line Inc. Folklore has it that Ken's grandmother was a person who loved to play cards, but because of her advanced years found it in-

creasingly difficult to get together with her friends for a game. He thought how wonderful it would be if she, and others like her, could always find friends for a game of cards, without needing to leave the comfort of her own home. Based on that concept, INN, (originally called The Sierra Network) was created.

In 1993, AT&T and General Atlantic Partners both invested in The Sierra Network and the name was then changed to The Imagination Net-

work. The interest of those larger companies was generated by their intent to use INN as a showcase and testing ground for a variety of on-line computer games, from Sierra and other companies. Many exciting things are planned for the future, but we'll keep those as surprises for now!

I may be biased, but I think that The Imagination Network is closer to "virtual reality" than any other computer network that I've explored. It's simple enough for the youngest child to enjoy, yet diverse enough to challenge even the most competitive adult. INN has grown rapidly from just a few hundred members in 1991, and is quickly approaching the 200,000-member mark as this article is being written.

If all that sounds like fun, you can call 1-800-Imagin-1 to obtain the software, which costs \$5.95 and includes a free trial. The basic membership package is \$9.95 monthly with 5 hours of on-line time included. Give the Imagination Network a try; I think you will enjoy it immensely. ■

TIPS FOR MAIL ORDER PURCHASE

It is impossible for us to verify the claims of advertisers, including but not limited to product availability, credibility, reliability and existence of warranties. The following information is provided as a service for your protection. It is not intended to constitute legal advice and readers are advised to obtain independent advice on how to best protect their own interests based upon their individual circumstances and jurisdictions.

1. Confirm price and merchandise information with the seller, including brand, model, color or finish, accessories and rebates included in the price.

2. Understand the seller's return and/or refund policy, including the allowable return period, who pays the postage for returned merchandise and whether there is any "restocking" or "return" charge.

3. Understand the product's warranty. Is there a manufacturer's warranty, and if so, is it for a U.S. or foreign manufacturer? Note that many manufacturers assert that, even if the product comes with a U.S. manufacturer's warranty, if you purchase from an unauthorized dealer, you are not covered by the manufacturer's warranty. If in doubt, contact the manufacturer directly. In addition to, or instead of the manufacturer's warranty, the seller may offer its own warranty. In either case, what is covered by warranty, how long is the warranty period, where will the product be serviced, is there a charge for service, what do you have to do to obtain service and will the product be repaired or replaced? You may want to receive a copy of the written warranty before placing your order.

4. Keep a copy of all transactions, including but not limited to cancelled check, receipt and correspondence. For phone orders, make a note of the order including merchandise ordered, price, order date, expected delivery date and salesperson's name.

5. If the merchandise is not shipped within the promised time, or if no time was promised, within 30 days of receipt of the order, you generally have the right to cancel the order and get a refund.

6. Merchandise substitution without your express prior consent is generally not allowed.

7. If you have a problem with your order or the merchandise, write a letter to the seller with all the pertinent information and keep a copy.

8. If you are unable to obtain satisfaction from the seller, contact the consumer protection agency in the seller's state and your local Post Office.

If, after following the guidelines, you experience a problem with a mail order advertiser that you are unable to resolve, please let us know. Write to Advertising Department, Gernsback Publications Inc., 500B Bi-County Blvd. Farmingdale, NY 11735.

Be sure to include copies of all correspondence.

FREQ.-RESPONSE TESTER

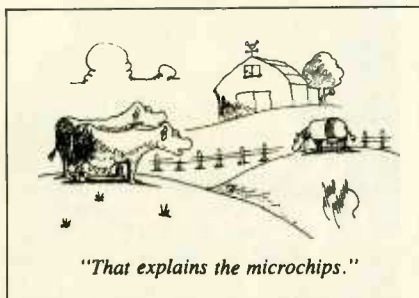
(Continued from page 56)

AUDIO LEVEL control using your scope as a waveform monitor with internal sweep, to make sure no clipping occurs. Switch S2 into SWEEP mode, and set your scope to external sweep as you did during calibration. If you made your own log scale using Fig. 5, set your horizontal gain to match its width. By adjusting the vertical gain, you should be able to see the DUT's response over the entire frequency spectrum.

Here are a few hints: Although the response display seems most easily viewed with SWEEP RATE control R29 set to maximum, the low-frequency portion of the display (the left side) will not be very accurate with that setting. The Tester's lowest output frequency is about 20 Hz. Because that frequency is constantly being modulated, if the frequency increases significantly before a single 20 Hz-cycle is completed, then your test at 20 Hz is invalid. For that reason, the slowest sweep rate should be selected when seriously examining low-end response. A storage scope is of course ideal for that.

Note that the vertical display of your scope simply reads peak-to-peak voltage, which is very different from the decibel scale normally used for audio. To put things in perspective, a 50 percent dip in vertical deflection corresponds to a -3-dB drop when monitoring power amplifiers, and a -6-dB drop when testing almost any other audio device.

Finally, you might wish to occasionally touch up the low-frequency calibration via the access hole you drilled for R24. As before, leave the Tester powered-up for a few minutes before proceeding, and then perform the calibration procedure as previously described. ■



"That explains the microchips."

Popular Electronics

REPRINT BOOKSTORE

- | | |
|---|---|
| <input type="checkbox"/> 225 Popular Electronics (1995 back issues) \$5.00
Write in issues desired _____ | <input type="checkbox"/> 211 Radio-Electronics (1991 back issues) \$5.00
Write in issues desired _____ |
| <input type="checkbox"/> 224 Popular Electronics (1994 back issues) \$5.00
Write in issues desired _____ | <input type="checkbox"/> 210 Radio-Electronics (1990 back issues) \$5.00
Write in issues desired _____ |
| <input type="checkbox"/> 223 Popular Electronics (1993 back issues) \$5.00
Write in issues desired _____ | |
| <input type="checkbox"/> 222 Popular Electronics (1992 back issues) \$5.00
Write in issues desired _____ | |
| <input type="checkbox"/> 221 Popular Electronics (1991 back issues, Jan., Mar. not available) \$5.00
Write in issues desired _____ | |
| <input type="checkbox"/> 220 Popular Electronics (1990 back issues) \$5.00
Write in issues desired _____ | |
| <input type="checkbox"/> EH94S Experimenters Handbook Summer Edition (1994) \$5.00 | |
| <input type="checkbox"/> EH94W Experimenters Handbook Winter Edition (1994) \$5.00 | |
| <input type="checkbox"/> EH94 Experimenters Handbook (1994) \$5.00 | |
| <input type="checkbox"/> EH93 Experimenters Handbook (1993) \$5.00 | |
| <input type="checkbox"/> EH92 Experimenters Handbook (1992) \$5.00 | |
| <input type="checkbox"/> EH90 Experimenters Handbook (1990) \$5.00 | |
| <input type="checkbox"/> HH94S Hobbyist Handbook Spring Edition (1994) \$5.00 | |
| <input type="checkbox"/> HH94F Hobbyist Handbook Fall Edition (1994) \$5.00 | |
| <input type="checkbox"/> HH93 Hobbyist Handbook (1993) \$5.00 | |
| <input type="checkbox"/> HH92 Hobbyist Handbook (1992) \$5.00 | |
| <input type="checkbox"/> HH91 Hobbyist Handbook (1991) \$5.00 | |
| <input type="checkbox"/> HH90 Hobbyist Handbook (1990) \$5.00 | |
| <input type="checkbox"/> GIZ Gizmo—The Consumers Guide to Electronics \$5.00 | |
| <input type="checkbox"/> Radiocraft 1993 Projects for Hobbyists \$5.00 | |
| <input type="checkbox"/> 215 Electronics Now (1995 back issues) \$5.00
Write in issues desired _____ | |
| <input type="checkbox"/> 214 Electronics Now (1994 back issues) \$5.00
Write in issues desired _____ | |
| <input type="checkbox"/> 213 Radio-Electronics/Electronics Now (1993 back issues) \$5.00
Write in issues desired _____ | |
| <input type="checkbox"/> 212 Radio-Electronics (1992 back issues) \$5.00 | |

REPRINTS REPRINTS

- | | |
|---|--|
| <input type="checkbox"/> 174 Electronics Comics (The Best of) \$2.00 | <input type="checkbox"/> 173 From Not-Working to Networking Troubleshooting Local-Area Networks \$5.00 |
| <input type="checkbox"/> 172 33 Bench-Tested Circuits \$2.00 | <input type="checkbox"/> 171 36 Time Tested Circuits \$2.00 |
| <input type="checkbox"/> 170 High-Voltage Projects for Fun and Science Book 1 \$4.00 | <input type="checkbox"/> 170A High-Voltage Projects for Fun and Science Book 2 \$4.00 |
| <input type="checkbox"/> 169 Think Tank (133 Circuits) \$3.50 | <input type="checkbox"/> 169A Think Tank Vol. 2 \$3.00 |
| <input type="checkbox"/> 168 Fact Cards (#34-66) \$3.00 | <input type="checkbox"/> 168C Fact Cards (#67-99) \$3.00 |
| <input type="checkbox"/> 168D Fact Cards (#100-132) \$3.00 | <input type="checkbox"/> 167 Designing With IC's \$4.00 |
| <input type="checkbox"/> 166 Collected Works of Mohammed Ulyses Fips(62 pages, April Fools Collection) \$5.00 | <input type="checkbox"/> 165 How to Repair CD Disc Players \$5.00 |
| <input type="checkbox"/> 164 Modern Electrics (April 1908) \$3.00 | <input type="checkbox"/> 163 Receiving Satellite TV \$5.00 |
| <input type="checkbox"/> 162 Build Your Own Satellite TV Receiver \$5.00 | <input type="checkbox"/> 161 Descrambling (Feb. 1984) \$4.00 |
| <input type="checkbox"/> 160 New Ideas - 42 Circuits \$3.50 | <input type="checkbox"/> 159 Low Frequency Receiving Techniques Building and using VLF Antennas \$5.00 |
| <input type="checkbox"/> 158 Electro Importing Co. Catalog (Circa 1918) \$5.95 | <input type="checkbox"/> 157 All About Kits \$2.00 |
| <input type="checkbox"/> 156 How To Make PC Boards \$2.00 | <input type="checkbox"/> 154 How To Repair VCR's \$3.50 |

To order any of the items indicated above, check off the ones you want. Complete the order form below, include your payment, check or money order (DO NOT SEND CASH), payable to and mail to Claggg Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735.

Please allow 4-6 weeks for delivery.

To place a credit card order by phone, Visa or Mastercard only.

CALL: 516-293-3751.

To use your Visa or Mastercard, complete the following:

Bill my Visa Mastercard

Card No. _____

Exp. Date _____

Signature _____

MAIL TO: Claggg Inc.

Reprint Bookstore, P.O. Box 4099, Farmingdale NY 11735

All payments must be in U.S. funds

SHIPPING CHARGES IN USA & CANADA

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

SORRY — We only ship to USA & Canada

Total price of merchandise \$ _____

Shipping Charge (see chart) \$ _____

Subtotal \$ _____

Sales Tax (New York State Residents only) \$ _____

Name _____ Total Enclosed \$ _____

Address _____

City _____ State _____ Zip _____

PE395

ELENCO TRAINER

(Continued from page 24)

puts to "see" multiple switch transitions instead of a single one. The logic-switch outputs are conditioned so that only one transition is generated at the output for each throw of the switch.

Also included are 8 LED readouts that can indicate the status, high or low, of up to eight points in a circuit—an 8-bit data bus is one example. The digital section also includes a built-in clock. The clock output is a 5-volt peak-to-peak square wave that can be set from 1 hertz to 100 kilohertz.

All of that is housed in a case that measures about 12 by 16 inches. The case includes a molded well that can be used to store loose parts, and a cord holder is built into the lid.

As you can see, the XK-525 is an invaluable aid in designing circuits. However, as it is a kit, it must be built before it can be used. Let's see what's involved in doing that.

Building the XK-525. As you might

imagine from the above discussion, there's quite a bit to this unit. As a result, building the kit requires quite a bit of work—too much to be completed in just one evening—even a long evening, at a frantic pace. Fortunately, the kit is built in sections that can be done at a leisurely pace, one section per evening, for example. That also makes it ideal for educational situations, as the kit is perfect for electronics students to build one section per class, per week, per course, or whatever.

The assembly instructions, which are clear and easy to follow, are laid out in an order that's designed to catch errors on the way and lead to a properly working unit when finished. Two separate PC boards must be assembled. Neither of the boards are a large project in themselves, and either could be built in one evening. However, one of the boards is built in two stages, and fully tested after each stage.

After that part of the construction is finished, the bulk of the work in assembling the XK-525 is in wiring the different components together. Everything mounts on the back side of a metal front panel, and wires connect things together. It's a lot of work, but well worth it in the end.

While putting together the XK-525 is a big job, it's the kind of activity that many of our readers enjoy. When complete, the result is a very useful instrument for the hobbyist who put it together. Building the XK-525 involves a little bit of everything, from PC-board assembly, to wiring, to mechanical assembly. It's actually a very good kit for someone who's starting to get more serious about his or her electronics hobby; it helps the user brush up on building skills and yields a versatile platform for future digital- and analog-circuit design. For more information on the XK-525 Digital/Analog Trainer, contact Elenco Electronics directly at the address given in the box below, or circle no. 119 on the Free Information Card. ■

FOR MORE INFORMATION

Elenco Electronics, Inc.
150 W. Carpenter Avenue
Wheeling, IL 60090
Tel. 708-541-3800

RAIN FOREST RESCUE: TO HELP SAVE HALF OF THE PLANTS AND ANIMALS ON EARTH


In the rain forest, the sounds of fires and bulldozers are replacing the sounds of nature.

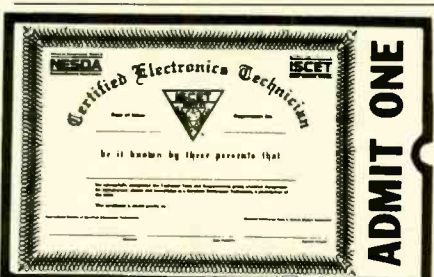
Recent studies show that the destruction of the rain forests wipes out 17,000 plant and animal species each year. That's about 48 extinctions per day, two per hour. These are plants and animals that will simply cease to exist, gone forever from the planet. And the toll mounts every day.

Join The National Arbor Day Foundation and support Rain Forest Rescue to help put a stop to the destruction. When you join, the Foundation will preserve threatened rain forest in your name.

An area of rain forest the size of 10 city blocks is burned every minute. Help stop the destruction. Before the sounds of nature are replaced by the sounds of silence.

To contribute to
Rain Forest Rescue, call
1-800-222-5312

 **The National
Arbor Day Foundation**



Your Ticket To

SUCCESS

Over 28,000 technicians have gained admittance worldwide as certified professionals. Let your ticket start opening doors for you.

ISCET offers Journeyman certification in Consumer Electronics, Industrial, Medical, Communications, Radar, Computer and Video. For more information, contact the International Society of Certified Electronics Technicians, 2708 West Berry Street, Fort Worth, TX 76109; (817) 921-9101.

Name _____
Address _____
City _____
State _____ Zip _____

Send material about ISCET and becoming certified.

Send one "Study Guide for the Associate Level CET Test." Enclosed is \$10 (inc. postage).



Denzel Washington

“He stood about five-foot, nine-inches tall, but he was a giant. Billy Thomas. He ran the Boys & Girls Club where I grew up. Now, I know today it’s different. Young people face problems I never even had to think about.

But that’s why now, more than ever, we need the Boys & Girls Club. It’s a positive place where thousands of people like Billy Thomas help young people succeed. Does it work? It did for me.”

1-800-854-CLUB



**BOYS & GIRLS CLUBS
OF AMERICA**

The Positive Place For Kids.



*From the Lab
to your
Living Room!*

Does your VCR have a "Head Cold?"

Probably not! However, through constant playing and using of degrading dry or wet cleaners, the output of your video tapes has slowly diminished to an unacceptable level and the VCR plays as if it has a head cold! The culprit is most likely clogged and dirty video and/or audio heads.

The **3M Black Watch™ Head Cleaner Videocassette** uses a patented magnetic tape-based cleaning formation to remove head clogging debris. No foreign substances such as cloth, plastics or messy liquids and no harsh abrasive materials are present. The cleaner’s usable life is 400 cleanings or more!

It’s easy to use. Place the **3M Black Watch™ Head Cleaner Videocassette** in the VCR and press the Play button. A pre-recorded message appears clearly on your screen and an audible tone is heard, telling you that the cleaning process is now completed. No guess work, you never over clean!

3M Black Watch™ Head Cleaner Videocassette **S**VHS **VHS**.....\$19.95

Once your VCR’s head cold is cured, and the unit plays like new, consider using the finest videocassette you can buy—the **3M Black Watch™ T120 Hi Pro VHS 4410 Videocassette**. The 4410 is the highest performing videocassette available today for use with all standard format VHS recording hardware!

Here’s what you hear and see....A sharp, clear picture—brightest colors—freedom from streaks, flashes and snow—outstanding high-fidelity audio reproduction—optimum camcorder performance—maintains recording integrity. **3M Black Watch™** video tape is 100% laser inspected to guarantee surface smoothness and drop-out free performance.

3M Black Watch™ T120 Hi Pro VHS 4410 Videocassette **VHS**.....\$8.00

CLAGGK INC. — 3M VHS Special Offer
P.O. Box 4099, Farmingdale, New York 11735

Yes, I like your offer and here is my order for 3M Black Watch™ products!

___ 3M Black Watch™ Head Cleaner Videocassette	(\$19.95 each)	___ \$
___ 3M Black Watch™ T120 Hi Pro VHS 4410 Videocassette	(\$8.00 each)	\$ ___
Shipping and handling per order		\$ 4.00
Total Amount in U.S. Funds only		\$ ___

New York State residents add local sales tax. Canadians add \$6.00 per order. No foreign orders. Do not send cash.

Bill my VISA MasterCard Expire Date ___/___/___

Card No. _____

Signature _____

Name (Please print) _____

Address _____

City _____ State _____ ZIP _____

SIMULTANEOUS EQUATIONS

(Continued from page 48)

putting numerical values for variables $X(1)$, $X(2)$, and $X(3)$. Those numbers are the solutions to the original equations. They represent the unknowns that were located in the first, second, and third columns (respectively) of the standard equation format. Because we were solving for the three node voltages of the circuit in Fig. 1, the computer's output shows us that:

$$\text{Unknown of column 1} = X(1) = V_1 = 18$$

$$\text{Unknown of column 2} = X(2) = V_2 = 42$$

$$\text{Unknown of column 3} = X(3) = V_3 = 24$$

Your version of SIM-EQ should output numbers very close to those listed above, but they might not be *exactly* the same. The reason for that is that every type of computer tends to round-off numbers in a slightly different way during its calculations. After several successive calculations, the amount of the round-off error increases, and hence one computer might output a value of exactly 42, while another might output 41.9996. That is completely normal and is not an indication that you entered the program incorrectly.

Program Description. The SIM-EQ.BAS program consists of five main sections of code that are delimited by asterisk-enclosed comment lines in the program listing. Each of those sections will be discussed below. Also, as an additional aid to understanding how the program works, Fig. 2 is a flowchart of its sequence of logic.

The first section of code in SIM-EQ, which includes lines 100 through 160, initializes the program and prints a brief introductory screen. It also prompts the user to input the number of unknowns in the series of equations to be solved. As indicated, the entered number must be within the range of 1 to 25.

After the number of equations (which is the same as the number of unknowns) is entered, the user is asked to input the values of the coefficients associated with the unknowns. That occurs in lines 220–320. It is important to note that the coefficients are en-

tered by *columns*, top to bottom, and then left to right. If you accidentally enter those numbers by rows you are guaranteed to get incorrect results!

The entering of the "constants of the rows" (i.e. the numbers to the right of the equal signs in the standard equation format) takes place in lines 330–390. After the user enters those numbers, the program then inquires if all the numbers, both coefficients and constants, were entered correctly. If you respond to that question with an "N" or an "n," the program will then prompt you to correct your mistakes. Otherwise, it will continue to the next section of the program.

The heart of SIM-EQ lies in lines 530–790. In that section, a process known as Gaussian Elimination is used to solve the simultaneous equations. Depending on the speed of your machine and the number of unknowns in the equations, that section can take up to several minutes to complete. You might need to be patient.

Once all the Gaussian Elimination calculations are completed, the program proceeds to execute lines 800–900, where the final results are displayed. On occasion, the program might need to print the error statement of line 870, which reads: "ERROR! - Equations can't be solved!" That indicates that either there was a mistake made in inputting the coefficients or constants, or that there are contradictions within the equations you are dealing with.

The following example of a series of "contradicting" equations illustrates the type of problem that would result in an ERROR statement. If you look closely at the following two equations, you will see that they do not agree with one another. One of these equations is obviously incorrect:

$$\begin{aligned} V_1 + V_2 &= 6 \\ 2V_1 + 2V_2 &= 20 \end{aligned}$$

If you ever see the ERROR message, try running the program again on the same data. Then, if you get the ERROR message again, take some time to determine if your original equations are correct. While it might be annoying to get an ERROR message after entering a multitude of numbers into the computer, it's better than solving five or six equations manually, only to discover that your original equations were incorrect! ■

NOVEL NIGHTLIGHT

(Continued from page 38)

× 7 inches each, for the sides of the nightlight. The top is a 7¼-inch square of glass. You will also need to cut four pieces of top molding and four pieces of corner molding, using the dimensions given in Fig. 3.

To assemble the nightlight cover, apply epoxy glue to the inside edges of each piece of molding that you are ready to attach. Carefully fit together the pieces of glass and the mirrors that make up the sides of the box (the mirrors should be adjacent), and hold them firmly in place to allow the glue ample time to dry. When the sides are assembled, glue the top square of glass to the pieces of top molding. After that has fully dried, glue the assembly to the top of the glass box.

The glass cover should be secured to the baseboard, especially if the Novel Nightlight will be used by young children. That can be accomplished in a number of ways. On the prototype, a piece of wire is connected between two small screws on opposite corner moldings. Sliding the wire under the baseboard prevents the cover from being lifted. If you prefer, you can attach small latches on opposite sides of the project, instead.

With the case assembled, you can safely plug in and use the Novel Nightlight. So, put an antique VR tube to good use, and brighten up your evenings while you're at it. ■



Popular Electronics[®] Market Center[™]

Weeder Technologies

FREE
construction plans for
any of these kits
Call 513-752-0279

Pro-Kit[™]

P.O. Box 421, Batavia, OH 45103

Educational Kits for the Serious Hobbyist

Caller Block

Connects between your telephone and its wall jack, and prevents the phone from ringing unless the calling party is one which you've entered into memory using your touch-tone phone. Your answering machine can handle all other calls. Change between two separate directories of callers with a simple flip of a switch.

Telephone Caller ID

Connects to telephone wall jack. Shows the telephone number of the calling party along with the time of day the call was received, on a 16x1 character LCD display. Stores the info from the last five calls in memory. Complete stand alone, no computer interface needed.

Telephone Call Restrictor

Connects to telephone wall jack. Disables all phones on the line if attempting to either: dial a number that has been stored in memory 'Block Mode' or, dial a number that has not been stored in memory 'Allow Mode'. Use touch-tone phone to enter telephone numbers into memory, and choose mode. Program from any phone on the line using your password.

50 MHz Frequency Counter

Reads frequency from 1Hz to 50MHz and displays it on a 16x1 character LCD display. Auto-range feature provides floating decimal point and automatically affixes the correct suffix (Hz, KHz, or MHz). Microcontroller based, very few additional components.

Telephone Scrambler

Scrambles your voice before sending it over the telephone line, and descrambles it on the other end. Connects between your telephone and wall jack. No modifications are required to your telephone. Full duplex operation.

Electronic Message Module

Use a set of four pushbutton switches to write and store your own personal message in a 8-pin non-volatile EEPROM, which can then be printed across a 16x1 LCD display. Message can be up to 240 characters long. EEPROM can be removed from socket and still retain message. Re-program over and over with new messages.

Vocal Filter

An audio device which can be used with a home component stereo system, to filter out the main vocal sound track from standard stereo recordings (CD, tape, record or FM), leaving the background music to sing along with. Produce your own karaoke tapes.

DTMF Decoder/Logger

Keep track of all numbers dialed from any telephone on your line. Connects to your telephone wall jack. Decodes all 16 touch-tones and displays them on a LCD display. Holds the last 240 digits in a nonvolatile memory. Use the 'shift back' and 'shift forward' buttons to scroll through and view all numbers in memory.

CABLE TV DESCRAMBLER KITS

"New & Improved Version"

Universal Descrambler

Includes all the parts and an etched & Drilled PC Board. Not included is AC adaptor or enclosure.....\$69.00

Tri-Mode Descrambler

Includes all the parts and an etched & drilled PC board & AC adaptor. Not included is the enclosure.....\$49.00

SB-3 Descrambler

Includes all the parts & an etched & drilled PC board & AC adaptor. Not included is the enclosure.....\$39.00

Call Toll Free 1-800-886-8699

Visa, MasterCard & COD.

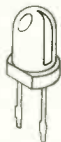
M & G Electronics, Inc. 2 Aborn Street, Providence, RI. 02903

It is not the intent of M & G Electronics, Inc. to assist any individual to defraud any pay TV operator or to violate any state or federal laws regarding the use of the descrambler kits. You must understand the kits being purchased for educational and or experimental use only.

ALL ELECTRONICS CORP.

QUALITY PARTS • DISCOUNT PRICES • FAST SERVICE • HUGE SELECTION

JUMBO SAVINGS JUMBO LEDs



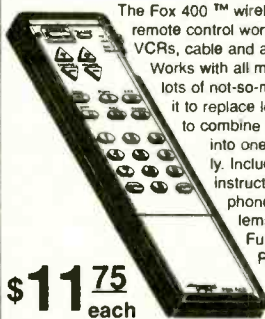
Liton # LTL 327C - 8MM
Ideal for eye-catching indicators and displays. A recent quantity purchase of these BIG, 8mm diameter, red diffused LEDs enables us to provide some very special pricing. The leads on these devices have been trimmed to 0.325", leaving plenty of room for soldering. Normally these parts would sell for more than twice our price.

5 for \$1.00

CAT # LED-23

100 for \$15.00 • 1000 for \$120.00

NEW LOW PRICE UNIVERSAL IR REMOTE CONTROL



The Fox 400™ wireless infrared remote control works with most TVs, VCRs, cable and audio devices. Works with all major brands and lots of not-so-major brands. Use it to replace lost IR remotes or to combine up to four remotes into one unit. User friendly. Includes complete instructions and an 800 phone number if problems should occur. Fully guaranteed. Requires 3 AAA batteries (not included).

\$11.75 each

CAT # IR-400

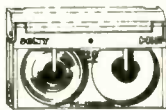
"HI-8" VIDEO CASSETTE (USED)

8 mm Video Camcorder Users!

SONY Hi-8

Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased, each cassette has its own plastic storage box. New, these high quality cassettes sell for considerably more. Satisfaction Guaranteed.

CAT # VCU-8



\$3.00 each

10 for \$28.00 • 100 for \$250.00

MINIATURE TOGGLE



D.P.D.T. (ON-ON)

ALCOSWITCH # MTM206NPC

Short bat handle, 0.25" long.

PC terminals

CAT # MTS-82PC

\$1.25 each

25 for \$25.00 • 100 for \$90.00

ALUMINUM KNOBS

6 FLUTE DESIGN W/ INDICATOR

LINE Alcoknob # KA700B1/4

0.75" diameter X 0.63"

6-32 set screw. CAT # KNB-73

\$1.00 each • 25 for \$ 18.75

3 FLUTE DESIGN W/SKIRT
AND INDICATOR LINE

Alcoknob # KS 500B1/4

0.5" dia. knob with 0.75" dia.

skirt. 0.63" high. 6-32 set screw.

CAT # KNB-75

\$1.00 each • 25 for \$ 18.75

7 Vdc MOTOR

Matsushita

MMX- 7AC O 8A

1.25" diameter x 1.25" high

motor. Prepped with 1.61"

diameter flywheel, pulley

and fiberglass mounting

board.

\$1.00



CAT# DCM-54

100 for \$80.00

2 1/2" 8 ohm SPEAKER



Special purchase of these 8 ohm, 1 watt speakers allows us to sell quantities at very special low prices. Mounting frame is 2.6" square. Overall depth, 0.75."

CAT# SK-251

\$1.25

10 for \$10.00
100 for \$75.00
1000 for \$ 600.00

9 VOLT 60 MA SOLAR PANEL



These 6" X 6" glass enclosed photovoltaic panels produce 9 Vdc at 60 ma. Ideal for charging batteries and powering small devices. Put two or more together for more current and voltage. Includes hook-up instructions.

CAT # SPL-960 \$5.25 each

LASER POINTER



The "Infiniter"™ # QPON-670-210

Projects a bright red spot up to 100 meters. An excellent business or educational aid. Settings for continuous or flashing beam. LED Indicator. Low battery indicator. Includes 2 AAA batteries. Hi-tech ergonomic gun-metal gray and black case.

CAT # LP-210

\$69.95 each

480 X 128 DOT LCD ASSEMBLY

Hitachi # LM215B

Originally built for Federal Express, these brand-new assemblies consist of a heavy-duty plastic display housing with a metal mounting bracket. Housing size:

13.18" X 4.93" X

1.2". Inside

the housing

and easily

removable

is a stan-

dard Hitachi

480 X 128

graphic and

alphanumeric

display with

built-in drivers.

Requires an external

controller (HD61830 or equiv.).

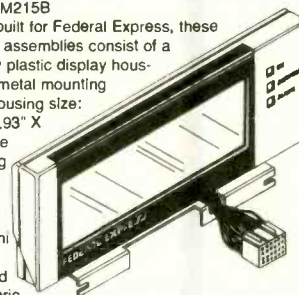
Display area is 9" X

2.71". Module size is 10.6"

X 4.33". Includes spec.

and hook-up sheet.

CAT # LCD-24



\$32.00 each

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write or Fax YOUR LIST.

CALL, WRITE
or FAX For A
Free 64 Page
CATALOG.
Outside the U.S.A.
send \$2.00 postage

ORDER TOLL FREE

1-800-826-5432

MAIL ORDERS TO:

ALL ELECTRONICS CORP.

P.O. BOX 567

VAN NUYS, CA 91408-0567

FAX (818) 781-2653

INFO (818) 904-0524

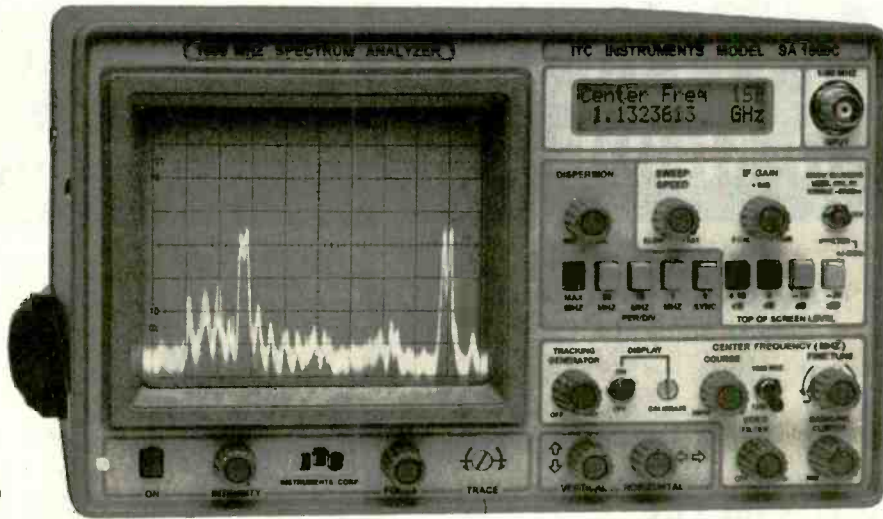


Minimum Order \$10.00 • All Orders Can Be Charged to Visa, Mastercard or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$4.00 for the 48 Continental United States • ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

CIRCLE 28 ON FREE INFORMATION CARD

www.americanradiohistory.com

500 MHz SPECTRUM ANALYZER \$895



6" x 12" x 16" (H x W x D)
(only 16 LB)

SA1800C SHOWN
\$2295.00

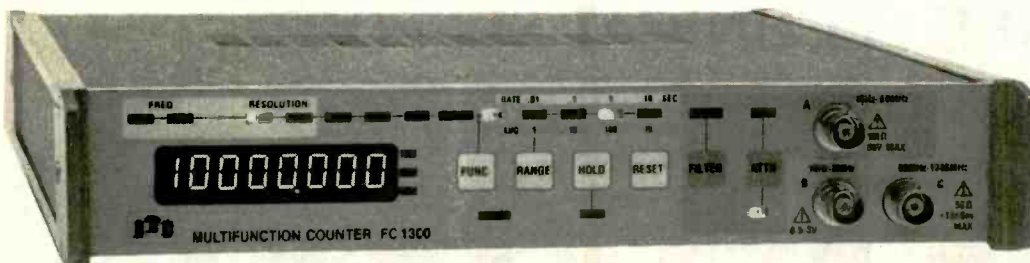
1-1300 MHz *In One Sweep* \$1895 MADE IN THE USA

ALL NEW SPECTRUM DISPLAY MONITOR PLUS FULL FUNCTION SPECTRUM ANALYZER

LET THE SA500A SPOT THOSE HIDDEN SIGNALS
The SA500A easily attaches to any receiver IF output jack. Providing a panoramic signal display of your 1-30 MHz and 30 to 2000 MHz scanner or communication receiver. The SA500A is a Professional Spectrum Surveillance Technology Monitor. A Full Function Spectrum Analyzer with +/- 5KHz Narrow Band Filter, Center Freq. Display, 50 MHz Marker Generator. Capable of Tuning Duplexes, Amps, Filters Receivers, Transmitters & Perform EMI, RFI, FCC, Testing. SA500A First affordable Professional Spectrum Monitor/Analyzer for all serious Ham Radio and Radio Monitoring Operators. just \$895.00

.2-1.3GHz SA1300B THE ULTIMATE LOW COST ANALYZER
Quality & Performance that's what ITC Spectrum Analyzers are known for. 80 dB on Screen, -110 dBm Sensitivity, Center Frequency Display, +/- 5KHz Narrow Band Filter (for 5KHz resolution bandwidth) 50 MHz Marker. DISPERSION ZOOM, Baseline Clipper, Sweep Speed, Adjustable Video Filter, 40dB of Input Attenuation. Standard on all ADVANTAGE Spectrum Analyzer specials. The SA1300B and SA1800C provide Laboratory Performance at a fraction of the normal cost. The SA1300B \$1895.00 -SA1800C .2-1.3GHz & .8-1.8GHz \$2295.00. Add a 1.3GHz Tracking Generator to any unit

1.3GHz FREQUENCY COUNTER .001 ppm



\$479.00

ISO9002 CERTIFIED
**FIVE YEAR
WARRANTEE**
REG. PRICE \$599.00
SAVE \$120.00

Laboratory Performance PROCESSOR STABILIZED OVEN OSCILLATOR .001 ppm

ITC FC1300: the first truly Accurate low cost Frequency Counter. Accuracy is the #1 Frequency Counter Requirement. The \$200 - \$800 counters being advertised the past few years are but toys when it comes to accuracy. These guess-so-matic units are off 5 to 10 PPM over temperature & time (That's +/- 6,000 -13,000 Hz at 1.3 GHz) The FC1300 is accurate to within +/-13 Hz at 1.3 GHz 0-40 degrees C. Sensitivity is < 5mV 1Hz to 13 GHz, 50 Ohm & 1 Meg Ohm inputs, LP filter, 1x -10x input Att. Frequency Measurement, Period Averaging, Time Interval, External Counter, Freq. Ratio, Hold & Reset Functions, 4 Gate times .01 to 10 Sec. Tired of guess-so-matic Counters: **Serious About Accuracy:** Ready to step up to **Laboratory Performance Accuracy:** Call Today & Order

ADVANTAGE INSTRUMENTS CORP. MASTER CARD - VISA - DISCOVER - AMX

3817 S. CARSON ST. # 818 CARSON CITY NV. 89701 Terms: COD - Check - Money Order
702-885-0234 FAX 702-885-7600 Call Toll Free 800-566-1818 - BBS 310-549-0321
PRICES & SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE OR OBLIGATION. F.O.B. CARSON CITY NV. NV. RESIDENTS ADD SALES TAX.

Call 800-566-1818
To Order or Info.
Free 1995 Catalog
ADVANTAGE
Carries a full line of
Scopes - Analyzers
Frequency Counters
Generators
LCR Bridges & DMM'S

CIRCLE 150 ON FREE INFORMATION CARD

CELLULAR SOFTWARE AND MODIFICATION GUIDES

Call Spy Supply for all of your Cellular needs!

We Carry:

CELLULAR SOFTWARE

(We have the software to do New Motorola Phones)

CELLULAR CABLES

(For the Motorola, Panasonic, and Nokia Phones)

CELLULAR MODIFICATION GUIDES

(Covers all cellular manufacturers)

CELLULAR PHONES

(We carry a complete line of cellular phones)



FREE TECHNICAL SUPPORT!

We now offer Cellular Phones cloned with your existing number! Buy a handheld, transportable or car mounted phone ready to go and have only one monthly bill!

Don't Get Ripped Off!

Before you buy our competitor's manual, call and ask if they offer **FREE TECHNICAL SUPPORT**

SPY SUPPLY

Find out why the CIA - FBI - DEA - SECRET SERVICE Have ordered from our catalog To receive yours, send \$5.00 to:

SPY SUPPLY

1212 Boylston St. #120
Chestnut Hill, MA 02167

SPY SUPPLY, 1212 Boylston St. #120, Chestnut Hill, MA 02167

(617) 327-7272

Sold for educational purposes only

B&S SALES

CALL (810) 566-7248 • FAX (810) 566-7258 24 hrs.

Hours: Monday through Friday 8am to 7:30pm EST - Saturday 10am to 3pm.

51756 Van Dyke St. #330, Shelby Township, MI 48316

Free Calculator with order!

CONVERTER

	5	10		5	10
PANASONIC TZ-PC 145362 ..	\$68	\$64	DRX-3 PJ.....	\$37	\$33
WAVEMASTER	\$65	\$60	DRZ-3 PJ.....	\$38	\$34
DRZ-3 A & B DUAL INPUT.....	\$39	\$35	8528 PJ	\$45	\$42

CONVERTER/DESCRAMBLERS

	5	10		5	10
8600	\$275	\$265	DPV-5	\$145	\$130
8590	\$260	\$250	DP-5	\$125	\$110
8580	\$195	\$185	DRZ-3-DIC	\$95	\$85
DPV-7	\$225	\$215	DRX-3-DIC	\$89	\$79

ADD-ON DESCRAMBLERS

10 LOT SPECIAL

PIONEER GREEN	\$65	J-TVT-GOLD.....	\$42
SA-M80	\$65	J-MINI TVT.....	\$42
J-TNT	\$65	H-MLD 1200-3	\$35
J-PURPLE	\$49		

NOTE: MENTION AD FOR THESE PRICES! NO MICHIGAN SALES

We are now offering a 6 month warranty. In order for warranty to be in effect, this form must be signed and returned. FOR VCR, SECOND, THIRD, ETC. HOOK-UPS.

YES, I agree all units are to be used or resold in compliance with Federal and State laws.

Signature _____ Date _____

NAME _____ ADDRESS _____

CITY _____ STATE _____ ZIP _____ PHONE _____

It is not the intent of B&S Sales to defraud any pay television operator and we will not assist any company or individual in doing the same.

ALFA ELECTRONICS

HIGH QUALITY TEST EQUIPMENT
BEST PRICE



DMM 89 \$199.95
Most Advanced DMM
All Purpose & Communication
80.7 to 81.4 dBm with 4Ω-1200Ω
20 reference impedances
True RMS
Frequency counter: 0.01Hz-10MHz
Capacitance: 1pF-50,000μF
Measure AC volt to 20kHz
5000 counts, 0.1% accuracy
Auto/manual range, fast bar graph
Min/Max/Ave/DH/Relative/Zoom
Auto power off
Input warning
Splash proof
Volt, amp, ohm, logic, diode, continuity
Ruggedized case
Rubber holster included



DMM 2360 \$119.95
DMM+LCR Meter
Very Versatile DMM
Inductance: 1μH-40H
Capacitance: 1pF-40μF
Frequency: 1Hz - 4MHz
Temperature: -40-302 °F
TTL Logic Test 20MHz
Diode, Continuity
Volt, Amp, Ohm
3999 count display
Peak Hold
Auto power off
Ruggedized case
Temperature probe included
Rubber Holster \$8.00



DMM 20 \$74.95
Inductance: 1μH-40H
Capacitance: 1pF-200μF
Frequency: 1Hz-20MHz
Volt, amp, ohm, diode,
20 Amp AC/DC current
Transistor HFE
Continuity, duty %
Peak hold/Max
Ruggedized case
Rubber holster \$8.00

Full line of DMMs,
economy, compact,
ruggedized, solar cell,
automotive, heavy
duty, industrial,
starts from \$15.95

Fluke Multimeter
Fluke 12 \$84.95
Holster C-10 \$10
Fluke 70 II \$67.5
Fluke 73 II \$94
Fluke 75 II \$129
Holster C-70 \$16
Fluke 77 II \$149
Fluke 79 II \$169
Fluke 29 II \$169

Fluke 83 \$225
Fluke 85 \$259
Fluke 87 \$287

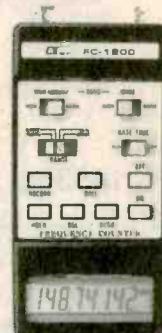
Fluke 97
Scope Meter \$1785



LCR Meter 131D \$229.95
Most Advanced LCR
Dual display L/Q or C/D
Inductance: 0.1μH-1000H
Capacitance: 0.1pF-10,000μF
Impedance: 1mΩ-10MΩ
0.7% basic accuracy
Auto/manual range
Dissipation factor & Q factor
Serial & parallel mode
Relative mode for comparison
and to remove parasitics
Statistics, tolerance,
Best for design, incoming
testing & production
SMD and chip component
test probe \$25.00



LCR Meter 814 \$189.95
Best Resolution LCR
Inductance: 0.1μH-200H
Capacitance: 0.1pF-20,000μF
Resistance: 1mΩ-20MΩ
1% basic accuracy
Dissipation factor indicates leakage
In capacitor and Q factor in inductor
Zero adjustment to reduce parasitics
Best for high frequency RF
SMD and chip component test probe
\$25.00
LIMITED QUANTITY SPECIAL
DIGITAL LCR METER \$74.95
0.1pF, 1μH, 10mΩ resolution



Frequency Counter FC-1200 \$129.95
Frequency: 0.1Hz-1.25GHz
Display: 8 digit LCD
Period: 0.1μs-0.1s
Records Max/Min/Average
Data hold, relative mode
Telescoping antenna \$8.00
Deluxe case \$5.00

Also Available:
AC/DC clamp meter, Light meter,
Thermometer, pH meter, High
voltage probe, Digital caliper,
Anemometer, Electronic scale,
Force gauge, Tachometer,
Stroboscope, Humidity & EMF
adapter, Sound level meter,
Frequency counter, SWR/field
strength/power meter, Dip meter

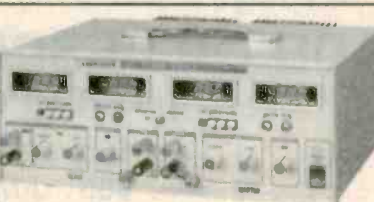


20 MHz Oscilloscope with Delay Sweep PS-205 \$429.95
Dual Trace, Component test, 8" CRT, X-Y Operation, TV Sync, Z-Modulation, CH2 Output, Graticule Illum, 2 probes each has x1, x10 switch. Best price with delay sweep.
PS-200 20 MHz DUAL TRACE \$339.95
PS-400 40 MHz DUAL TRACE \$494.95
PS-405 40 MHz DELAY SWEEP \$589.95
PS-605 60 MHz DELAY SWEEP \$769.95
Scope Probe: 60MHz x1, x10 \$15, 100MHz x1, x10 \$22 250MHz x1, x10 \$29, 250MHz x100 \$39

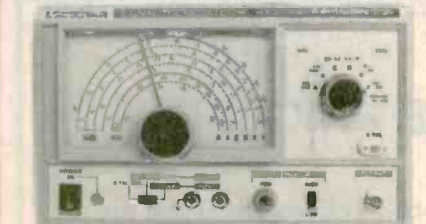
Digital Storage Scope
DS-203 20MHz, 10M Sample/sec \$729.95
DS-303 30MHz, 20M Sample/sec \$649.95
DS-303P with RS-232 Interface \$1,049.95
Switchable between digital and analog modes
2 K word per channel storage
8 bit vertical resolution (25 Level/div)
Expanded Timebase 10ms/div - 0.5 s/div
Refresh, Roll, Save all, Save CH2, Pre-Trig
Plotter control



DC Power Supply PS-303 \$159.00
0-30 VDC, 0-3A output
Constant voltage & constant current mode
0.02% + 2mV line regulation
0.02% + 3mV load regulation
1 mVrms noise and ripple
Short circuit and overload protected
PS-8200 with digital voltmeter \$179.00
Also available: 30V/5A, 60V/3A, 60V/5A 16V/10A, 30V/10A



DC Power Supply Triple Output PS-8202 \$499.95
Two 0-30 VDC, 0-3A outputs
One fixed 5VDC, 3A output
Capable of independent or tracking operation
Constant voltage and constant current mode
Four digital meters for volt and current display
Excellent regulation and low ripple
Short circuit and overload protected
Also available: 30V/5A triple output \$545.95
Dual tracking 30V/3A, 30V/5A, 60V/3A, 60V/5A



RF SIGNAL GENERATOR SG-4160B \$119.00
100 kHz-150MHz sinewave in 6 ranges
RF Output 10CmVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz
AM modulation
Audio output 1 kHz, 1 Vrms

AUDIO GENERATOR AG-2601A \$119.00
10Hz - 1MHz in 5 ranges
Output 0-8Vrms sinewave
0-10Vp-p squarewave
Synchronization: ±3% of oscillation frequency per Vrms
Output distortion:
0.05% 500Hz - 50kHz
0.5 % 50Hz - 500kHz
Output Impedance: 600 ohm

FUNCTION GENERATOR FG-2100A \$169.95
0.2 Hz - 2 MHz in 7 ranges
Sine, square, triangle, pulse and ramp
Output: 5mV-20Vp-p
1% distortion, DC offset ± 10V
VCF: 0-10V control frequency to 1000:1



RF SIGNAL GEN./COUNTER SG-4162 AD \$229.95
Generates RF signal same as SG-4160B
6 digit frequency counter 1Hz - 150 MHz for internal and external source Sensitivity <50mV

AUDIO GEN./COUNTER AG-2603AD \$229.95
Generates audio signal same as AG-2601A
8 digit frequency counter 1Hz-150MHz for internal and external sources Sensitivity <50mV

FUNCTION GEN./COUNTER FG-2102AD \$229.95
Generates signal same as FG-2100A
Frequency counter 4 digits
Feature TTL and CMOS output

SWEEP FUNCTION GEN./COUNTER \$329.95
0.5Hz to 5 MHz in 7 ranges
Sweep: Linear 10:1/Log 10:1 20ms to 2s
AM Modulation
Gated Burst, Voltage Control Generator
Generator Control Voltage & 6 digit counter
1Hz-10MHz for internal & external sources

ALFA ELECTRONICS
741 Alexander Rd., Princeton, NJ 08540

(800) 526-2532/(609) 520-2002 15 DAY MONEY BACK GUARANTEE. 1 YEAR WARRANTY
FAX: (609) 520-2007 CALL OR WRITE FOR FREE CATALOG AND BEST OFFER.
Visa, Master Card, American Express, COD, Purchase Order Welcome

CIRCLE 26 ON FREE INFORMATION CARD

RAINBOW KITS

Laser Pens 4 mW

Beam visible up to 500'.



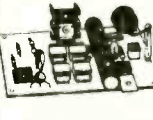
INCLUDES
2 AAA Batteries
Pen Size: 5 1/2" x 1/2"

SUPER
NEW LOW PRICE

\$59.95

STROBE LIGHT

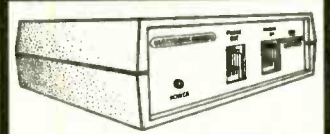
Do you need an attention getter, warning light, or flashing light for model airplanes? Then this kit is for you. Use it as an emergency light for your auto, radio tower, even use it on your bicycle. Has a variable flash rate. Size 3.5"x1.8" operates on 6 or 12v DC only.



ST-1

\$9.95

The Exciting New TELEPHONE MONITOR



Monitors your phone system, See how accurate your phone company really is!

- RECORDS OUTGOING CALLS :**
 - Date & time of each call.
 - Length of the call.
 - What number was dialed.
 - If you use a credit card it records the card number.
- RECORDS INCOMING CALLS :**
 - Date & time of call.
 - How many times phone rings.
 - If answered the length of call.
- RECORDS ANY DTMF TONE :**
 - Detects any tone on line sent by phone company or any other source.

Records to Screen or Floppy Disk

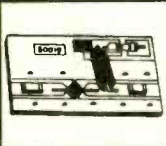
EASY TO INSTALL

- Connects to parallel port
- Phone line in.
- Phone line out to telephone.

All software included!

\$99.95
TM-1 ONLY KIT

BUILT **\$169.95**



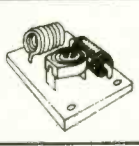
WIDE BAND PREAMP

The ideal preamp for scanners, hand held radios, frequency counters. Amplifies low level

(weak) signals. If the signal is extremely low 2 amps can be used in series. 1MHz to 2.5MHz @ 2.8dB nF 1dB compression = +0 dBm gain: 1MHz-20dB to 2.5Hz-6dB Requires 12VDC @ 16Ma

WBA-6

\$19.95

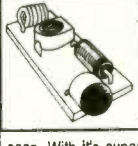


MICRO-MINIATURE PHONE TRANSMITTER

We haven't seen a smaller phone transmitter than the MMPT2 kit. Powered by the phone, it requires no battery. Transmits both sides of a phone conversation to an FM radio up to a 1/4 mile away. Tunable from 88 to 108MHz FM. Attach it to one phone or add it to the line to pick up all incoming calls. The MMPT2 is undetectable if properly installed. Unit has surface mounted parts, you install the leaded parts. Size .45"x.6"

MMPT2

\$29.95



MICRO-MINIATURE WIRELESS MIKE

So small you could hide this one on some real bugs! It's the smallest we've ever seen. With it's super sensitive mike it transmits a whisper or a room of conversation to an FM radio, tunable from 88 to 108MHz FM. With a proper antenna & 9v it transmits about 1 mile. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. Can operate on 6 to 12v DC. Size .35"x.9"

MMWMS

\$34.95



WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really

stomps out a signal. The WM-1 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. SIZE: .8"x1" 6 to 12VDC

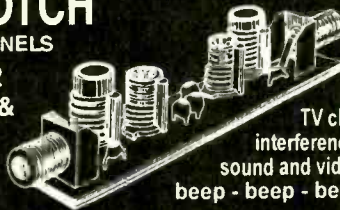
WM-2

\$14.95

TV NOTCH

FOR CHANNELS

2 thru 22
SNOOP &
BULLET



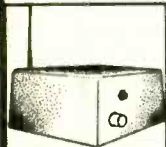
FILTERS

Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep - beep - beep.

NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

DF-222 Kit

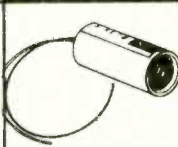
\$14.95



FM STEREO TRANSMITTER

Own your own FM radio station. Any Stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your cd's while mowing the lawn, Play music on one channel sing on the other. Clarity is excellent, approx. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls, & crystal for stereo separation. 9v battery operation

FMST-100 \$29.95 / FMSTC cabinet \$8.95



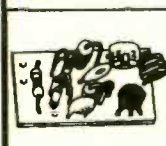
5.0mW Laser Diode

Great for making a gun sight, use as a transit, makes a super experimenters project. The beam is

visible with a wavelength of 670 nm. Size of beam is 6mm at 5 meters. Operates on 3 volts DC at 85mA. Size: 10.5mm x 18.5mm with an adjustable collimating lens.

LDM-5

NEW LOW PRICE
\$59.95



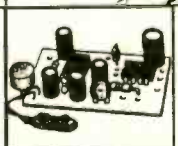
PHONE TRANSMITTER

Small but mighty, it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone

conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz to 130MHz FM. You can also use it as a speaker phone. SIZE .5"x1"

TEL-B1 **\$12.95**

BUILT **\$29.95**



SUPER SNOOPER BIG EAR

Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks

away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. SIZE: 1"x.75" 6 to 12VDC

AA-1 **\$10.95**

BUILT **\$29.95**



This Manual contains all schematics, parts lists, P.C.B., layouts for most of the Rainbow Kits. Use your own parts to construct any of our kits.

KIT BOOK
\$14.95

\$9.95 with the purchase of any kit.

Please add sufficient postage First lb \$5.00 Canada \$7.00 Additional LB. Add \$1.00 US FUNDS ONLY We will accept telephone orders for Visa or Mastercard



To Order Call
317-291-7262



ELECTRONIC RAINBOW INC

6254 LaPas Trail • Indianapolis, IN 46268
FAX 317-291-7269

CALL TOLL FREE
1-800-292-7711
1-800-445-3201 (Can)

C&S SALES

EXCELLENCE IN SERVICE

**WRITE FOR
FREE CATALOG**



**Line Tracker
MV-963
\$52.95**
(Infra-red Sensor)
The robot follows
a black line
on white paper
Preassembled PCB



**Dual-Display
LCR Meter
w/ Stat Functions
B+K Model 878
\$239.95**
Auto/manual range
Many features
with Q factor
High Accuracy

Electronic Tool Kit Model TK-1000
A professional organizer tool kit at affordable prices. No student should be without this unique tool kit that holds all the tools you need.

Including:
Diagonal Cutter
Long Nose Pliers
6" Wire Stripper
Solder 60/40
6" Screwdriver
6" Phillips Driver
Safety Goggles
IC Puller
3pc Nut Drivers
Iron Stand
Solder Wick
Desoldering Pump
5 pc Solder Ease Kit
6pc Precision Screwdrivers

\$39.95



**Robotic Arm
Y-01
\$49.95**
(Wired Control)
Movement grabs
& releases,
lifts & lowers,
pivots from side to side



**Stereo Cassette Player
Kit
Model
TR-18K
\$16.95**
Headphones
Included



**Digital
Multimeter
EDM-83B
\$175.00**
Almost every
feature available
Bargain of
the decade



**Elenco
LCR + DMM
LCM-1950
\$79**
12 Functions
Freq to 4MHz
Inductance
Capacitance



**Digital
Capacitance
Meter
CM-1555
\$49.95**
Measures capacitors
from .1pf to 20,000µf



**Digital
LCR Meter
LCR-680
\$79.95**
3-1/2 Digit
LCD Display
Inductance
1uH to 20MΩ



**Function Generator
GF-8026
\$239**
Int/Ext
Operation
Sine, Square, Triangle, Pulse
Ramp, .2 to 2MHz, Freq Ctr



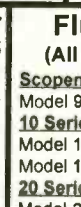
**3-3/4 Digit Multimeter
BK-390
\$139.00**
0.1% DCV acy
Analog bar graph
Auto/manual ranging
Capacitance meas
Temperature probe



**Digital
Multimeter Kit
w/ Training Course
M-2665K
\$49.95**
Full function 34 ranges
Ideal school project
M-2661 (Assembled) \$55.00



**Frequency Counter
F-1225
\$225.00**
8 Digit LED display
Wide meas range
High sensitivity
Data hold function
Input impedance 1MΩ or 50Ω
10:1 Input attenuation function



**Fluke Multimeters
(All Models Available Call)**
Scopemeters
Model 97 \$1,795
Model 10 \$62.95
Model 12 \$84.95
Model 29II \$175
70 Series
Model 70II \$69.95
Model 73II \$97.50
Model 77II \$149
Model 79II \$175
80 Series
Model 87 \$289



**Triple Power
Supply
XP-620
By Elenco
\$75.00**

3 fully regulated supplies; 1.5-15V @ 1A, -1.5 to -15V @ 1A or 3-30V @ 1A & 5V @ 3A Kit XP-620K \$49.95

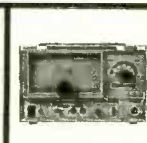


**Quad Power
Supply
XP-581
By Elenco
\$79.95**

Four supplies in one unit; 2-20V @ 2.5A, 5V @ 3A, -5V @ .5A and 12V @ 1A. All regulated and short protected



**High Current DC
Power Supply
BK-1686 \$169.95**
3 to 14 VDC Output
12A @ 13.8V
For servicing high
power car stereos,
camcorders, ham radios, etc.
Connect 2 or more in parallel

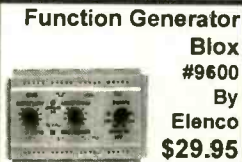


**Wide Band
Signal
Generators
SG-9000
\$124.95**
RF Frequency 100K-450MHz
AM modulation of 1KHz Variable
SG-9500 150MHz \$239.00

**Telephone Kit
PT-223K
\$14.95**



Available
Assembled
PT-223
\$15.95



**Function Generator
Blox
#9600
By
Elenco
\$29.95**
Kit \$28.95
Sine, Triangle, Square Wave

**Learn to Build & Program
Computers with this Kit**



**MM-8000
By Elenco
\$129.00**

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

**Digital/Analog Trainer
Complete Mini-Lab For Building,
Testing, Prototyping Analog and Digital**



By Elenco
in U.S.A.
**XK-525
\$159.95**
Kit
**XK-525K
\$129.95**

Designed for school projects, with 5 built-in power supplies. Includes a function generator with continuously variable, sine, triangular, square wave forms. All power supplies are regulated and protected against shorts.

**AM/FM Transistor
Radio Kit
with Training Course
Model AM/FM 108
\$29.95**

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

**Telephone Line
Analyzer**



Kit TT-400K \$19.95
Assembled TT-400 \$25.95

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

C&S SALES INC.

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



**15 DAY MONEY BACK
GUARANTEE
FULL FACTORY WARRANTY**
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 32 ON FREE INFORMATION CARD

www.americanradiohistory.com

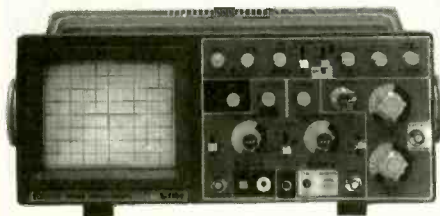
**FREE PROBES
WITH ALL
SCOPES**

**ELENCO ♦ HITACHI ♦ B+K
SCOPES
AT GUARANTEED LOWEST PRICES**

**WRITE FOR
FREE
CATALOG**

QUALITY - ELENCO OSCILLOSCOPES

2- YEAR WARRANTY



60MHz

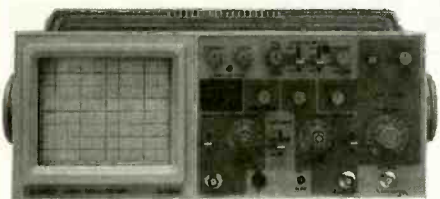
S-1360 \$775

Delayed Sweep

S-1365 \$849

Cursor Readout

- Voltage, Time
- Frequency differences displayed on CRT



40MHz

S-1340 \$495

2- Channel

S-1345 \$575

Delayed Sweep

- Beam Find
- Component Tester



25MHz

S-1325 \$349

2- Channel

S-1330 \$449

Delayed Sweep

- Beam Find
- Component Tester

Dependable Equipment at Affordable Prices

B+K 20MHz

2 Channel

Model 2120 \$389.00



Delayed Sweep

Model 2125 \$539.95

40MHz DUAL -TRACE

Model 1541B \$749.95

- 1mV/div sensitivity
- Video sync separators
- 2 axis input
- Single sweep
- V mode-displays 2 signals unrelated in frequency

60MHz DUAL-TRACE

Model 2160 \$949.95

- 1mV/div sensitivity
- Sweep to 5ns/div
- Dual time base
- Signal delay line
- Component tester
- V mode-displays 2 signals unrelated in frequency

100MHz THREE-TRACE

Model 2190 \$1,379.95

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

20MHz ANALOG with DIGITAL STORAGE

Model 2522A \$869.95

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

HITACHI POPULAR SERIES

V-212 - 20MHz, 2 Channel	\$425.00
V-222 - 20MHz, DC Offset	\$695.00
V-422 - 40MHz, Dual Trace	\$849.00
V-522 - 50MHz, Dual Trace	\$975.00
V-523 - 50MHz, Delayed Sweep	\$995.00
V-525 - 50MHz, w/ Cursor	\$1,069.00

HITACHI COMPACT SERIES SCOPES

V-660 - 60MHz, Dual Trace	\$1,375.00
V-665A - 60MHz, DT, w/cursor	\$1,449.00
V-1060 - 100MHz, Dual Trace	\$1,549.00
V-1065A - 100MHz, DT, w/cursor	\$1,695.00
V-1085 - 100MHz, QT, w/cursor	\$2,125.00
VC-6045A - 100MHz, Digital Stor	CALL
VC-6025A - 50MHz, Digital Stor	CALL

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



\$749

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

FLUKE SCOPEMETERS

A handheld instrument that combines a 50MHz, 25MS/s dual channel digital storage oscilloscope with feature-packed 3000 count digital multimeter.



Model 93 - \$1,225
Model 95 - \$1,549
Model 97 - \$1,795

- Auto-set, automatically sets voltage, time & trigger
- Multimeter display;
- 3-2/3 digits (>3000 counts)
- True RMS volts; AC or AC+DC up to 600V

C&S SALES INC.

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

CALL TOLL FREE

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



15 DAY MONEY BACK GUARANTEE
FULL FACTORY WARRANTY
ALL PRODUCTS ARE FACTORY NEW

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 32 ON FREE INFORMATION CARD

BLACK FEATHER ELECTRONICS

PERSONAL DEFENSE ALARM

Violent crimes are on the increase - don't take chances! Loud noise is your best defense! This is the loudest personal alarm we have ever tested! It is a security alarm designed to be your discreet companion and protector. The 130dB alarm is activated by pulling the pin out on the cord. Alarm will continue to sound up to 2 hours (with a fresh battery) until the pin is reinserted. The detachable clip on the back allows alarm to be attached to purse, belt, camera bag or pocket. Uses 9v battery (not included) WARNING - Alarm is so loud it may damage ears with continuous exposure. Makes a great gift for your loved ones. Measures 2 1/4" x 1 1/4" Black. Order now! CAT #PD-1



\$11.95 each

3 1/2 DIGIT PANEL METER

This meter has many useful applications such as Voltmeter, Thermometer, Db Meter, Watt Meter, Current Meter, Capacitance Meter, Lux Meter and LCR Meter.



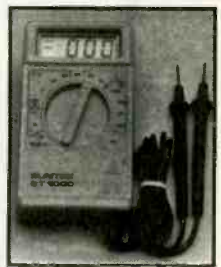
Features include: 200mV fullscale input sensitivity, single 9VDC operation and decimal point selectable. In addition, it has 13mm figure height, automatic polarity indication, guaranteed zero reading for 0 volt input and high input impedance (>100M ohms). Specifications: Max input 199.9mV DC-Max. Display: 1999 counts (3-1/2 digits). Measuring method: Dual slope integration A-D converter system, plus many other features. CAT# PM-1

\$17.00 each

DIGITAL POCKET MULTIMETER

- 3 1/2 Digit LCD Display
- AC & DC Volts
- DC Current

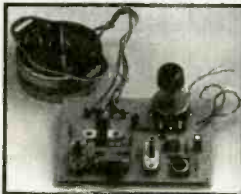
This little gem comes with many fancy features considering its compact size! Light weight and hand held, this unit also tests batteries and diodes. Great for the technician, student and hobbyist alike! SPECIFICATIONS: DC Volts: 2-500V, AC Volts: 200-500V, DC Current: 200mA, Resistance: 2K-OHMS-2MEG.OHMS, Diode Test: 3.2V Max 1=1mA (Diode), Battery Test: 1.5V AA (40mA) - 9V (24mA)



CAT# DM-01 **\$19.95 each**

STEPPER MOTOR CONTROLLER KIT

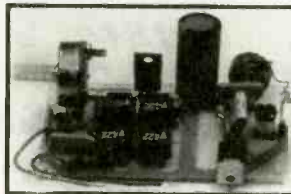
This kit allows you to adjust the speed and direction of a stepper motor. You can move the motor in one step increments or rotate it at a constant speed. There are a set of visual indicators that show the sequence of motion. Includes stepper motor, pc board, parts and instructions. (12vdc power source not included.) CAT# SMK-1



\$25.00 each

STROBE KIT

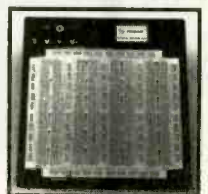
This kit allows you to vary the rate of strobe flashes 60 to 120 flashes per minute. Operating voltage is adjustable depending on how you wire the kit. It will work on 4.5, 6 and 12 VDC. Includes pc board, parts and instructions. CAT# SLK-1



\$7.50 each

BREADBOARDS

Breadboards allow you to design and prototype circuits quickly. It lets you position components on the board without soldering. Great for the experimenter, student and hobbyist! This breadboard is a large size board with enough room to design major projects. It measures: 7" x 9" and has 4 terminal strips, 7 distribution strips, and 4 binding posts mounted on an aluminum back plate. CAT# BB-2



\$35.00 each

CAMCORDER VIDEO TAPES

HI-8 120 MINUTE VIDEO CASSETTE TAPES (used)

They were recorded on once and played only a few times. Made by a major brand name manufacturer. Professional series metal tapes. Includes plastic jewel box.

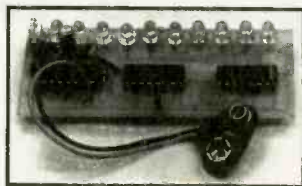


CAT# CCT-1 **\$3.00 each**
10 or more - 2.80 each

BACK-FORTH FLASHER KIT

WOW! An Eye-Catching Delight!

Great for special effects and other high-tech applications. Requires one 9V battery (not included). CAT# 10-02

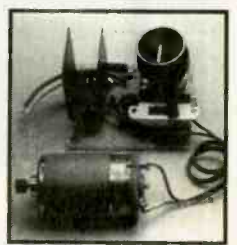


\$6.50 each

DC MOTOR SPEED CONTROLLER KIT

Easy To Build!

This kit allows you to control the speed and direction of a 6 to 12 volt motor. It is easy to build and includes pc board, motor, parts and instructions. CAT# MSC-1



\$15.00 each

REGULAR CAMCORDER TAPE

120 MINUTE VIDEO CASSETTE TAPE (used)

Major brand name manufacturer, recorded on once and played only a few times. Excellent condition! These will play on a regular camcorder, where the HI-8 tapes don't. If you have a regular camcorder machine then this is the tape for you. If you have an HI-8 machine, you may enjoy the higher quality provided by the HI-8 tapes. Includes plastic jewel box. CAT# CCT-2

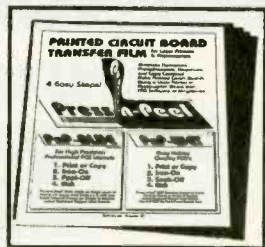


\$2.50 each
10 or more - 2.30 each

PRINTED CIRCUIT BOARD TRANSFER FILM

For LASER PRINTERS And PHOTOCOPIERS

Eliminate darkrooms, photochemicals, negatives, and copy cameras! Make printed circuit boards using a laser printer or photocopier, direct from CAD software or magazines. Only four easy steps: 1. Print or copy; 2. Iron-on; 3. Peel-off, 4. Etch!



CAT# TEK-1 **\$10.95 package of 5**

CALL TOLL FREE! 1-800-526-3717

1. California residents must include sales tax.
2. Pay by check, money order, Visa or MasterCard. NO C.O.D.s.
3. Quantities limited - prices subject to change without notice.
4. Add \$3.50 shipping & handling charge on all orders.



Black Feather ELECTRONICS

645 Temple 7B ▲ Long Beach ▲ California 90814
▲ (310) 434-5641 ▲ FAX (310) 434-9142 ▲



150 LE - Student 200 LE - Technician 300 LE - Auto-Range 400 LE - Engineer

KELVIN 100 Basic
990087 **\$19.95**

- AC & DC VOLTAGES
- DC CURRENT
- RESISTANCE
- 3 1/2 Digit LCD
- CONTINUITY TEST
- Buzzer
- LOW BATTERY INDICATOR
- DIODE TEST • BATTERY TEST



CAPACITANCE
KELVIN METER
250 LE \$59.95
990126

- 0.5% ACCURACY
- RANGES: 20mF, 2000uF, 200uF, 20uF, 2uF, 200nF, 20nF, 2000pF, 200pF
- Zero Adjust
- Safety Test Leads
- Test Socket for Plug-in Components



Standard Features • AC & DC VOLTAGES • DC CURRENT
• RESISTANCE • CONTINUITY TESTER - Buzzer • DIODE TEST
• 10M ohm INPUT IMPEDANCE • ACCURACY +/- 0.5% RDG

TRANSISTOR BATTERY TEST DC CURRENT
10 Amp

150 LE
Stock # 990122
\$29.95

FREQ COUNTER
up to 20MHz
CAPACITANCE
from 1pF to 20uF
TRANSISTOR AC/DC CURRENT
10 Amp

200 LE
Stock # 990123
\$49.95

AUTO RANGE
with 3200 counts
AC CURRENT DC CURRENT
10 Amp
ANALOG BAR

300 LE
Stock # 990125
\$49.95

INDUCTANCE
Resolution 1uH
FREQ COUNTER
up to 20MHz
CAPACITANCE
from 1pF to 200uF
AC/DC CURRENT TRANSISTOR DUTY %
40 Amp

400 LE
Stock # 990124
\$79.95

Designed to meet IEC-348 & UL-1244 safety specifications.

Protective Cases

For Models 100 Basic, 150LE, 200LE, 300LE
..... \$4.95 (#990088)
Case For Model 400LE \$9.95 (#990116)

2 Year Warranty
(Parts & Labor)

The Ultimate Meter
TRUE RMS - LCR - Hz - dBm

Popular Electronics (Reviewed - May 1993)

"Not only does the Kelvin 94 boast alot of features ... the features go the extra distance."

"If we had to run into a burning building to do some emergency trouble-shooting and could carry in only one piece of equipment, the Kelvin 94 would be it!"

12 INSTRUMENTS IN ONE -

DC VOLTMETER, AC VOLTMETER, OHMMETER, AC CURRENT, DC CURRENT, DIODE TESTER, AUDIBLE CONTINUITY TESTER, dBm, FREQ COUNTER, CAPACITANCE METER, INDUCTANCE METER, LOGIC PROBE

- 0.1% ACCURACY ON DC VOLTAGES
- TRUE RMS ON AC VOLTAGES & CURRENT
- FREQUENCY COUNTER TO 20 MHz
- LARGE EASY-TO-READ 3 3/4 DIGIT LCD DISPLAY
- AUTO SLEEP & AUTO POWER OFF BUILT-IN TO SAVE BATTERY LIFE with Bypass
- SHOCK RESISTANT HEAVY DUTY CASE WITH YELLOW RUBBER HOLSTER & TILT STAND
- WATER RESISTANT SEALED CASE
- 30 DAY MONEY BACK SATISFACTION GUARANTEE

\$199.95
MODEL 94
#990111

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

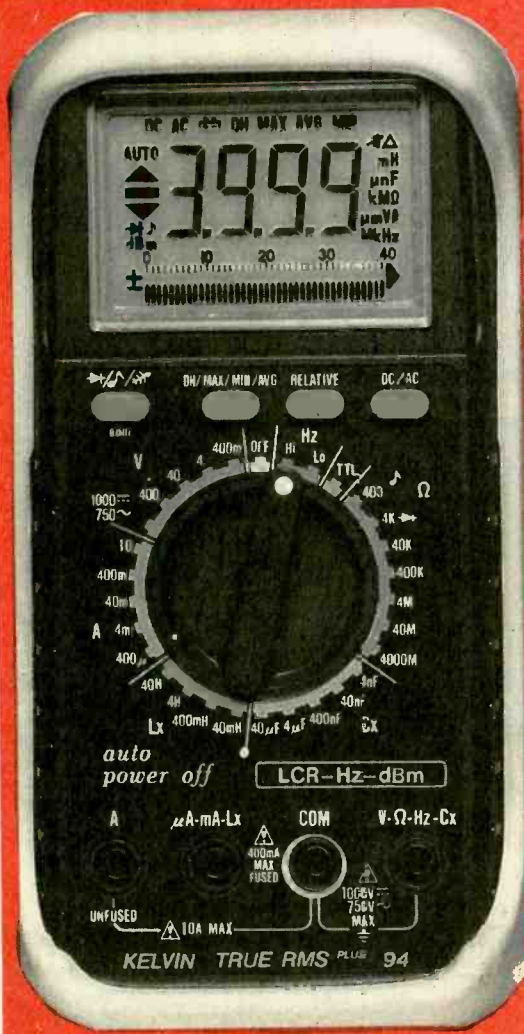
0.1% ACCURACY on DC Voltages Water Resistant

Freq Counter to 20 MHz

Protective Cases for Model 94

Regular Padded Zippered \$9.95 (#990116)
Deluxe Padded Zippered \$14.95 (#990115)

Meter is designed in accordance with safety requirements specified in IEC-348, UL-1244 VDE-0411.



CircuitMaker® vs. Electronics Workbench®

A NEW STANDARD HAS JUST BEEN SET!

State-Of-The-Art Analog Simulation

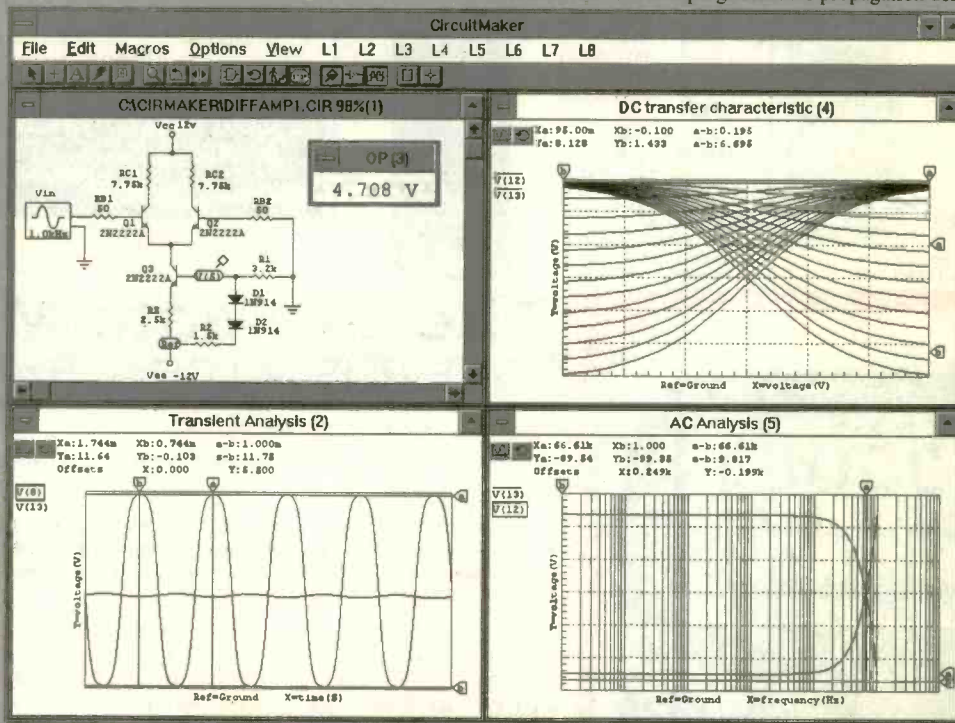
CircuitMaker's analog simulation results are shown in graph windows that provide powerful, interactive analysis options. You can plot multiple waveforms by clicking on the desired nodes and can select linear or logarithmic axes. Horizontal and vertical cursors facilitate quick and accurate measurements. You can also zoom in on any portion of the graph to obtain additional detail.

Electronics Workbench offers a single, small scope or Bode plot instrument window. The windows are not sizeable and only two waveforms can be plotted at a time. EWB has a single measurement cursor and provides no direct way to read results from the instruments.

Superior Digital Simulation

CircuitMaker has an exclusive Trace feature where the state of every node is indicated in color as the simulation runs. You can monitor as many waveforms as your screen will allow, set edge or level breakpoints for analysis, and interactively see the state of any node by touching the logic probe to it. The data sequencer provides 1024 words of pattern data. Additional digital instruments include ASCII and HEX input keys and an ASCII display. CircuitMaker includes tri-state devices and devices have programmable propagation delays.

Electronic Workbench has no interactive logic probe or Trace capability and no Hex or ASCII keys. Their "word generator" is limited to 16 words. EWB does not have tri-state devices and digital devices do not have programmable propagation delays.



Comprehensive Device Libraries

CircuitMaker includes libraries containing programmable, TTL, CMOS, generic analog and digital devices, and many powerful I/O devices. With CircuitMaker's macro function you can quickly and easily create your own functional devices and symbols. Now that's giving you the tools you need to get the job done right!

Electronics Workbench ships with only 17 digital devices. If you want additional devices you pay extra.

High-Performance Schematic Capabilities

CircuitMaker puts you in control of your schematic with SmartWires™, bussing, page connectors, and rubberbanding. You can label devices and pins, add fully stylized multiline text, and create a parts list or netlist. With the Macro feature you can add user defined symbols to your device library.

Electronics Workbench dictates wire placement to you. EWB limits your overall "workbench" layout to 1 x 2 pages. EWB has no bussing, page connectors, pagebreaks, print scaling, labeling, free text fields, netlisting, zoom, undo, and no Toolbar or Toolbox.

Competitive Upgrade Offer

You deserve the best. Upgrade from any competing product for only \$99. New users can purchase CircuitMaker for a limited time at a special introductory price of just \$269. Suggested Retail Price \$299.

Technical Support

MicroCode Engineering offers free phone support from knowledgeable engineers. And, you won't find yourself listening to music when you call for help.

Interactive Image Technologies offers 3 free calls and then you have to pay for all subsequent calls.

Comparison based on CircuitMaker 2.0 for Windows and Electronics Workbench 3.0 for Windows. All product and company names are trademarks of their respective owners.

CALL 800-419-4242
Risk free 30 day money back guarantee.

MicroCode Engineering
1943 N. 205 W. Orem, UT 84057
Fax (801) 226-6532
Phone (801) 226-4470

FREE FUNCTIONAL DEMO VERSION

available on most major BBS's or sent direct for \$10 &sh

Don't Despair...REPAIR!

Here's how to troubleshoot and repair your electronics successfully!

You Can Be Your Own Repair Expert!

For VCRs, camcorders, audio equipment, TV equipment, computer hardware, office equipment, home appliances, automobile electronics, and outdoor equipment.

- Pinpoint and analyze problems quickly.
- Successfully complete repairs with hands-on troubleshooting instructions.
- Become skilled understanding flowcharts and schematic diagrams.
- Confidently use test equipment such as oscilloscopes, frequency counters, and video analyzers.
- Keep your equipment in top condition with effective preventive maintenance techniques.

Continue to Broaden Your Repair Expertise!

You'll receive quarterly supplements, up to 160 pages, with new step-by-step repair and maintenance instructions, valuable schematics and new repair techniques. Learn how to repair a growing variety of appliances with hands-on repair projects that will keep you up-to-date with later models and technology. You'll be thrilled with your ability to repair a growing list of electronic equipment! Supplements may be returned or cancelled at any time.

SAVE \$10

Call our toll-free number, pay by credit card, and mention this ad. We'll deduct \$10!

We'll also waive shipping and handling.

Order today for your 30-day, no-risk review of The Electronics Repair Manual.

**For Faster Service Call TOLL-FREE
1-800-222-WEKA**

Or Fax To: 1-203-622-4187



One Source For All Your Repair Needs!

Better organized than a magazine, more current than a book.

- 900-page manual
- easy-to-follow, detailed instructions
- trouble analysis flowcharts
- safety precaution checklists
- comprehensive replacement parts list
- directory of manufacturers



**Order
your copy
today!**

MONEYBACK GUARANTEE

There's no risk in trying the **ELECTRONICS REPAIR MANUAL** to see if it's right for you. If you are not delighted, simply return the manual after the 30-day trial period and receive a prompt refund.



97 Indian Field Rd.
Greenwich, CT 06830

YES! Please rush me a copy of the new Electronics Repair Manual for only \$59.95 + \$5.50 shipping and handling. I understand that if I am not satisfied I may return the manual within 30 days for a complete refund. Supplements are sent quarterly for 25¢ per page (never more than \$30) and may be returned or cancelled at any time.

My payment is enclosed Bill me later
 Charge my Visa MasterCard

Acct. No. _____ Exp. Date _____

Signature _____

Phone () _____ Signature and phone number are required for all orders.

Name _____

Address _____

City _____ State _____ Zip _____

All payments must be in U.S. funds. Canada add \$10.
All other countries add \$15. CT residents add 6% sales tax.

Mail to: WEKA Publishing, 97 Indian Field Rd.,
Greenwich, CT 06830 **30381**



Get instant tech information FREE from your Fax or Computer!

You can obtain specs, freq. info, software and more from our automated services. For fax facts, call from your stand alone fax machine and follow the voice prompts. Use the BBS from your modem of fax/modem equipped computer. Dial 317-849-8683 for fax back service, or dial 317-579-2045 for our computer bulletin board service.

Continuous Coverage

Shortwave Radios

Sangean ATS-818CS.....	\$219.95
Sangean ATS-818.....	\$184.95
Sangean ATS-803A.....	\$169.95
Sangean ATS-808.....	\$179.95
Sangean ATS-606.....	\$149.95
Sangean ATS-606P.....	\$169.95
Sangean ATS-800.....	\$89.95
Grundig YB400.....	\$219.00
Grundig Satellit 700.....	\$399.00

Total Coverage Radios

TRIDENT

TR1200XLT
AM Broadcast to
Microwave 1000 Scan
Channels \$389.00

500KHz to 1300MHz coverage in a programmable hand held. Ten scan banks, ten search banks. Lockout on search and scan. AM plus narrow and broadcast FM. Priority, hold, delay and selectable search increments. Cell Lock. Permanent memory. 4 AA ni-cads and wall plus cig charger included along with belt clip, case, ant. & earphone. Size: 6 7/8 x 1 3/4 x 2 1/2. Wt 12 oz. Fax fact document # 205



Three new Bearcat units offer expanded coverage and more memory than before. The 890 offers 200 channels, base/mobile operation, VFO tuning, service search, weather alert, search and store, and more. The 2500 hand held has 400 channels, fast scan and more. The Bearcat 8500 has 500 channels in 20 banks, VFO, auto store, alpha numeric display, 10 priority channels, aux tape output jacks, and coverage to 1.3 Gigahertz.

TRIDENT

TR4500 \$449
2016 Channels
1 to 1300MHz
Computer Control

62 Scan Banks, 16 Search Banks, 35 Channels per second. Patented Computer control for logging and spectrum display. AM, NFM, WFM, & BFO for CW/SSB. Priority bank, delay/hold and selectable search. Cell Lock Permanent memory. DC or AC with adaptors. Mtng Brkt & Antenna included. Size: 2 1/4H x 5 5/8W x 6 1/2D. Wt. 11lb. Fax fact #305



TRIDENT

TR980 \$279.00
125 Channels
5MHz to
999MHz

Most Economical receiver in its class, offers AM, NFM Wide FM, modes. 5KHz increments. Delay & hold & Search. Cell Lock NiCads, chgr & whip ant. Size: 5 7/8H x 1 1/2W x 2 D. Wt 14oz.



Bearcat 2500XLTA hand held.....	\$349.95
Bearcat 8500XLTC mobile.....	\$389.95
Bearcat 890XLTB mobile.....	\$259.95

25-1300MHz, 500 ch. in 8500, 400 in 2500. 890 has 200 ch & 29-956MHz. All cell locked. Features include turbo scan, VFO, search and store, Priority, LCD display, and more. Fax Facts #474,475,476

Mobile Scanners

TRIDENT

TR2C
Police & CB
\$69.95

Scans police pre-programmed by state channel plus the CB channel of your choice. Also has Mobile Repeater and Weather. Extra cost option of CB and laser detectors built in. Compact size allows for dash or visor mounting. Mtng hardware and power connectors included. Size: 5 5/8 x 4 7/8 x 1 3/4. Wt: 1.5lbs. Fax fact #580



Bearcat 700AX 50Ch w/800.....	\$159.95
Bearcat 350A 50 Ch H/L/U.....	\$119.95
Bearcat 560XLJ 16 Ch H/L/U.....	\$ 89.95
Bearcat 760XM100Ch H/L/U/Air/800	\$219.95
Bearcat T2 state/state scan.....	\$144.95

Hand Held Scanners

Bearcat 200XLTN

\$209.95 200 Channels 800 MHz
Ten scan banks plus search. Covers 29-54, 118-174, 406-512 and 806-956MHz (with cell lock). Features scan, search, delay, 10 priorities, mem backup, lockout, WX search, keylock. Includes NiCad & Chgr. Size: 1 3/8 x 2 11/16 x 7 1/2.

Bearcat 120XL TJ 100Ch H/L/U.....	\$149.95
Bearcat 150XL TJ 100Ch H/L/U/8.....	\$199.95
Bearcat 220XL TJ 200 Ch H/L/U/8....	\$249.95

Coverage of above hand holds is: 29-54, 136-174, 406-512, and 800MHz band as indicated. Fax facts #475

Table Top Scanners

Bearcat 855XLTE 50 Ch w/800.....	\$159.95
Bearcat 142XLM 10Ch H/L/U.....	\$ 73.95
Bearcat 147XLJ 16 Ch H/L/U.....	\$ 89.95
Bearcat 172XM 20Ch H/L/U/Air.....	\$124.95
Bearcat 145 16Ch H/L/U.....	\$ 79.95

Accessories & Etc.

Mag Mount Mobile Ant MA100.....	\$ 19.95
Base Ant. 25-1000MHz AS300.....	\$ 59.95
Pre-Amp .1-1500MHz GW2.....	\$ 89.00
Wide Coverage Antenna.....	\$ 119.95
Base Discone Ant DA300.....	\$ 89.00
External Speaker MS190/opt. amp....	\$ 19.95
Old Scanner Repair, all brands.....	\$ CALL
Extended Warranties.....	\$ CALL
Frequency Info FaxFact/Modem.....	\$ FREE
On Glass Mobile Antenna.....	\$ 32.95

2 Way Radios

VHF hi band programmable mobiles as low as \$299.95. Call for quotes or Fax Fact #775

TRIDENT Winner of the 1994 INNOVATIONS Design & Engineering Honors, Electronic Industries Association. Trident TR2400 Total Coverage Receiver

Trident TR2400: 100KHz to 2060MHz. Ten scan banks of 100 channels each, ten search banks. Tuning increments as low as 1KHz. Beat Freq. Oscillator for SSB and CW modes. Search lockout and store. VFO tuning knob. Permanent memory. Bank lock and linking. Attenuator switch. Backlit LCD. 1 Yr Warranty. AM/NFM/WFM. Selectable increments. Delay, Hold, Priority. 5 7/8H x 1 1/2D x 2W. Wt 14 oz. \$499.00



Toll Free, 24 Hours! 800-445-7717 Fax Orders 800-448-1084 Fax Facts 317-849-8683!
Computer BBS Modem & Fax/Modem, 317-579-2045. Toll Free Tech Support, Dial 800-874-3468
International Fax: en Espanol, en Francais, und auf Deutsch, or just fax in plain English to: 317-849-8794



ACE Communications 6975 Hillsdale Court, Indianapolis, IN 46250
Service & Support hours: Mon.-Fri. 9AM to 6PM, Sat. 10-4 EST. Mastercard, Visa, Checks, Approved P.O.'s & COD (add \$5.50) & AMEX, Discover. Prices, specifications and availability subject to change. Flat rate ground shipping and handling charge only \$6.95 per unit. Express Air only \$9.95, for most units, to most locations. One week trial, no returns accepted two weeks after original receipt without substantial restocking charge. All units carry full factory warranty. Indiana residents add 5 per cent sales tax.



MICRO Kits

An educational and fun to build module line

Long range, high sensitivity FM microphone. 1.5-12 V bat.



Tiny. Use it to monitor sounds from a distance or to sing or play an electric guitar on your stereo.

FM MICROPHONE

K100 \$14.99

250 mW general purpose audio amp. Ideal as a bench monitor or together with K104 to hear sounds at a distance. 2-30 Ω output, Hi or Lo input Uses 5-12V



MINI AMP

K101 \$11.99

2.5 W discrete transistor audio amp. Low Z input. Great for understanding audio amps. Ideal for monitoring an electric guitar on headphones or a loudspeaker.



2.5 W AUDIO AMP

K102 \$14.99

8 W Audio amp, 2-16 Ω output. Ideal for singers, electric musical instruments, car radio power boosting, etc. Great sound quality. Overload protected.



8 W AUDIO AMP

K103 \$19.99

High gain audio preamplifier. Boosts any signal level for a power amplifier. Ideal combo with K101 for "snooping" sounds at a distance. Uses 5-12V.



AUDIO PREAMP

K104 \$10.99

Understand the secrets of regeneration with this simple and fun to build FM superregenerative, 2 transistor receiver. Uses 9 V battery.



REGENER. RADIO

K105 \$17.99

0.1 to 20 minute programmable/ resettable timer. Relay rated at 250 V 2.5 A. Requires 12 V DC. Use it to warm up your car, turn off your TV or lights, etc.



TIMER

K106 \$19.99

Transistor tester tests if device is NPN, PNP, FET-N, FET-P, OK or bad. Ideal for any shop, even professionals. Uses 9 V battery.



TRANSISTOR TESTER

K107 \$12.99

Regulated power supply (1.2-32 V, 1.8 A). Overload protected. Transformer is not included.



POWER SUPPLY

K108 \$19.99

Prevent skids from your bit when drilling printed circuit boards or mock-ups. Controls rate of acceleration and speed on 12 V mini drills.



SPEED CONTROL

K109 \$24.99

Antenna booster. Amplifies signals for any radio (1-100 MHz). Ideal for older receivers, SW listening or car radios.



ANTENNA BOOSTER

K110 \$11.99

Busy & hold button. When the green LED is on, the line is free. Press the button to put on hold. Plugs between the phone and the socket in the wall.



PHONE HOLD

K111 \$14.95

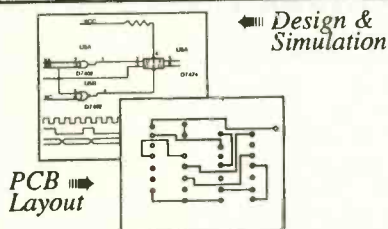
#680-177 Telegraph Rd.
Bellingham WA 98226
TOLL FREE: (800) 474 7644
Fax: (604) 985 6417

Add \$7 shipping & handling

We accept VISA, MO or cheques (sorry, no COD)

Check our BBS at (604) 985 1380 for other products

Low Cost CAD Software
for the IBM PC and Compatibles
Now In Windows™



- Easy to use schematic entry program (SuperCAD) for circuit diagrams, only \$149. Includes netlisting, bill of materials, extensive parts libraries, More parts, and automatic wiring available in enhanced CAD package (SuperCAD+) for only \$249.
- Powerful, event-driven digital simulator (SuperSIM) allows you to check logic circuitry quickly before actually wiring it up. Works directly within the SuperCAD editor from a pulldown menu and displays results in "logic analyzer" display window. Starting at \$149 this is the lowest cost simulator on the market. Support for PALs, a larger library, and a separate interactive logic viewer are available in full-featured SuperSIM+ for only \$399. Library parts include TTL, CMOS and ECL devices.
- Circuit board artwork editor and autorouter programs (SuperPCB), starting at \$149. Produce high quality artwork directly on dot matrix or laser printers. You can do boards up to 16 layers including surface mount. Includes Gerber and Excellon file output. Autorouter accepts netlists and placement data directly from the SuperCAD schematic editor.
- Low cost combination packages with schematics and PCB design: 2-layer for \$399, 16-layer for \$649.
- DOS version available.

Write or call for free demo disks:
MENTAL AUTOMATION
5415 - 136th Place S.E.
Bellevue, WA 98006
(206) 641-2141
BBS (206) 641-2846

TONY TALLI'S ORIGINAL TELEVIEW DISTRIBUTORS

WHERE OUR VALUED CUSTOMERS'

BUSINESS

IS HONESTLY APPRECIATED

OUR PRICES

1 800 847 3773

Call Us Today

90 DAY + GUARANTEE

SCIENTIFIC ATLANTA

JERROLD PIONEER

OAK HAMLIN



HRS. M - F 9-4 PST NO NV. SALES

CABLE CONVERTER SPECIALS

	1	5	10+
Sigma 550 NEW — 86 channel O & I compatible Last channel recall — lightning protection 1 year warranty	99.95	75.00	70.00
Timeless 550 P/C Same as above, different manufacturer with parental lockout. HRC switchable 1 year warranty	99.95	75.00	70.00
Northcoast Excell American manufactured!! 70 channel Fine tuning — Standard HRC tuning through remote, sleep timer. Green LED w/dimmer Parental lockout. Deluxe! A/B twinline available. . .	109.95	85.00	75.00



United Electronic Supply

P.O. Box 1206-PE
Elgin, IL 60121

708-697-0600

Orders Only Fax Number: 708/658-9515.

No Illinois Sales

NEW ITEM

Zenith Universal Remotes
Fully Programmable
New Program / Learn Type
Combines both functions
for
VCR / Cable / TV / Stereo
All in remote.

As low as **\$19.95**

Hours: Mon - Fri: 8:30 — 5:00 pm CST

24 Hour Answering Machine for orders



**PCB Artwork
Made Easy!**

PRINTED CIRCUIT DESIGN SOFTWARE
for

Layout - Autorouting - Schematic

- * Supports all Video Modes including SVGA
- * Copper Flooding for Ground Areas
- * Mirror Imaging for Laser Output
- * Circuit Simulation Programs available
- * **NEW - WINDOWS**™ versions
- * **NEW - DOS** versions
- * **FREE** - Heat Transfer Film with Order
- * Great for All Printed Circuit Projects

Download Demos from BBS (205)933-2954

PCBoards Layout Only ... \$99.00

Layout for Windows™ starts at ... \$149.00

Call or Write for Full Product Line, Prices & Demo Packages

PCBoards

**2110 14th Ave. South
Birmingham, AL 35205**

(800) 473-7227

Fax (205) 933-2954
Phone (205) 933-1122

Learn MICROCONTROLLERS and EMBEDDED SYSTEMS with the AES-10



The AES-10... a complete learning system, a complete embedded control system. Extensive manuals guide you through your 8051 development project. Assembly, BASIC, and C programming. All hardware details, complete schematics. Learn to program the LCD, keypad, digital and analog I/Os for your applications.

80C32 Computer/Microcontroller board with:

- 32K ROM . 32K RAM
- 2 by 16 Liquid Crystal Display
- 4 by 5 Keypad
- Digital, A/D . D/A, and PWM, I/O
- Built in Logic Probe
- Power supply. (can also be battery operated)
- Extended AES BASIC and AES Monitor in ROM
Built-in routines for LCD, Keypad, A/D, D/A and Digital I/O ports
See 80C32 registers while you Step
See all memory locations and data on LCD
See memory contents in dec. hex. and binary
- RS-232 cable to connect to PC for programming
- 8051/52 DOS Cross Assembler
- Program disks with well documented examples
- User's Manual, Language Manual, and Text



1407 North Batavia Street, Orange, California 92667, USA

\$365 . Money Back Guarantee

Free Brochure, M/C Visa

800 - 730-3232

714 - 744-0981

Fax 714 - 744 2693

AMERICAN RELIANCE

AMREL Offers Lowest Prices & Best Warranties on DC Power Supplies ANYWHERE!

3 YEAR WARRANTY



3 YEAR WARRANTY



AMREL Offers Superior Analog Power Supplies Starting as Low as \$149.00

- Low Output noise rating less than 0.3mV.
- Line/load regulation rated at low 0.01% + 1mV.
- Transient response time of 50µ Sec.
- Overload protection, and Output enable/disable.
- Coarse and fine voltage/current adjustment.
- Auto series/parallel operations for triple output supplies.

AMREL Offers Features And Prices on Digital Power Supplies That The Competition Can't Beat!

- Microprocessor controlled.
- User friendly keypad data entry.
- Low output noise rating less than 1mV.
- Line/Load regulation rated less than 2mV.
- Output enable/disable and Power off memory.
- Optional RS-232 interface capability.

Model	LPS-101	LPS-102	LPS-103	LPS-104	LPS-105	LPS-106	LPS-301	LPS-302	LPS-303	LPS-304	LPS-305
Rating	30V/1A	30V/2A	30V/3A	+30V/1A -30V/1A 3-6.5V/3A	+30V/3A -30V/3A 3-6.5V/3A	60V/1A	15V/2A(H) 30V/1A(L)	15V/4A(H) 30V/2A(L)	30V/3A	+30V/1A -30V/1A 5V/2A	+30V/2.5A -30V/2.5A 3.3-5V/3A
List Price	\$195	\$225	\$295	\$395	\$495	\$245	\$249	\$299	\$369	\$399	\$599
Sale Price	\$149	\$179	\$199	\$375	\$469	\$219	\$199	\$285	\$350	\$379	\$569

PR INT™
Products International Inc.



Call: **1-800-638-2020**



8931 Brookville Road • Silver Spring, Maryland 20910 • Fax: 800-545-0058 •

CIRCLE 46 ON FREE INFORMATION CARD



CABLE TV

UNIVERSAL PRODUCT
New Technology



UNIVERSAL 5000 \$199.95

Our fully assembled product is factory tested and **GUARANTEED** to work on your system.

MODEL 4000 KIT \$ 79.95

The 4000 KIT comes with all the electronic parts and our Cad designed PC board. We provide parts list, full schematic, wiring diagram and tutorial.

MODEL 4000A Enclosure \$ 44.95

The 4000A Enc. Package will provide the hobbyist, who has our 4000 Kit, a custom enclosure, AC adaptor and finish accessories to enclose their kit.

MODEL 4000 And 5000 Features

- The latest in Video Amplification Technology.
- New clocking circuits to stabilize color and picture performance.
- The most advanced picture locking circuitry.
- Inverted Video Option is available.
- NO CONVERTER BOX is necessary.

The Halcyon Group 1-800-664-6999

In Canada call 813-751-3262

PROTOTYPE PC BOARDS!

Made In USA!

only **\$595!**

*free CAD/CAM



18"x18"x4.6" WORK AREA

THIS IS THE MACHINE YOU'VE BEEN WAITING FOR!

Have you ever dreamed of letting your computer prototype PC boards directly from your CAD drawings? If so, the Neuractor CNC-4+ Desktop Manufacturing System may be just the machine you need! This fourth-generation CNC machining center can automatically drill, mill and route printed circuit boards, not to mention three-dimensional products in wood, plastic and light metals DIRECTLY FROM YOUR CAD DRAWINGS! You've seen the rapid-prototyping and "Santa Claus" machines that cost thousands of dollars, but did you know that as an electronic technician you can assemble one yourself from this inexpensive kit? Utilizing patent pending technology the Neuractor CNC-4+ kit provides you with everything you need to machine products in three dimensions with a resolution of .001". All mechanical components are pre-fabricated, pre-machined, plated and painted. Includes four 83 oz/in digital CY-MOTORS, interface card, 5 amp power supply, 10 pitch steel lead screws, 4 proprietary Slide Block actuator mechanisms, 4 aluminum linear actuator channels, polished steel guide-rods, Dremel bracket, hardware, etc. (You provide Dremel MotoTool(tm) or flex-shaft router and work surface.) It's a complete kit! All you do is put it together and calibrate it! IF THAT'S NOT ENOUGH, WE'RE THROWING IN A FREE FULL-FEATURED 3D CAD/CAM SOFTWARE PACKAGE WITH EACH UNIT! Large 18"x18"x4.6" cutter travel directly from CAD-generated or scanned ASCII, DXF & HPGL plot files! Get started by ordering your own Neuractor CNC-4+ today! ACT NOW! Kit \$595 + \$24.95 S/H. (For PC board routing the heavy-duty upgrade is suggested, add \$149) Allow 4-8 weeks for del. U.S. CYBERLAB, 14786 Slate Gap Rd., West Fork, AR 72774 (501) 839-8293. **Free Info! X-Y Power/Rotary Tables and larger CNCs now available!**

March 1995, Popular Electronics

Tap into a World of...

FREE ELECTRICITY

Our 150+ page *Self-Reliance Catalog*
IS JUST LOADED WITH DC to AC
ENERGY INDEPENDENCE ...

We offer:

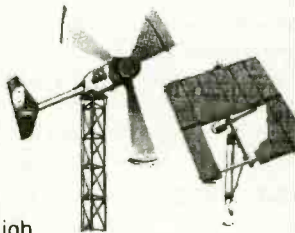
Solar, Wind & Hydroelectric energy systems. True Sine Wave DC to AC Inverters. Electric Boat & Car kits. Portable power packs. Solar Lighting & Cooling systems. Solar Pool Heaters. Solar Battery chargers. Solar Books & Toys. DC Appliances. Active & Passive Solar Air & Water Heating Systems. Composting Toilets. Hydroponic, Fish-Farming, Solarium & Greenhouse Systems. Water Testing, Treatment, & Pumping Systems. Emergency Food & H₂O Kits. High Efficiency AC/DC Refrigeration + More...

A LOT OF INFORMATION FOR ONLY \$5.75 ...

SEND CHECK or MO TO:

Self-Reliance Company Inc.

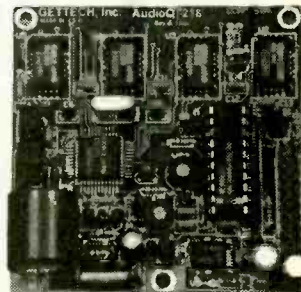
P.O. Box 306, Florissant, MO 63032



Make your projects
speak for themselves...
Ours do!

DIGITAL VOICE RECORDERS

- Record up to 218 seconds
- 1 to 8 messages
- High quality speech 12 bit
- Switch-closure actuation
- Sample rates up to 20Khz
- On-board backup
- Direct speaker output
- Wide operating range
- Small size 2.6" X 2.6"
- Made in U.S.A.



MODEL AudioQ-218

Call or write for more information

OEM price and delivery available

Custom designs and enclosures

Single unit price \$149.00 plus s+h

Quantity pricing as low as \$99.00

GETTECH, Inc.

402 Riley Road, New Windsor, NY 12553
(914) 564-5347

Specifications and price subject to change.

CELLULAR PROGRAMMING SOFTWARE



PROGRAM EXTENSION PHONES, ESN'S & NAMS !
ENJOY THE SAME ADVANTAGES AS SOME CUSTOMERS THAT SUBSCRIBE
TO GTE MOBILNET OR BELL SOUTH MOBILTY FOR CELLULAR SERVICE !
CELLULAR PROGRAMMING SERVICE IS ALSO AVAILABLE !



FOR FREE INFO CALL !!
MOTOROLA ABOVE 9122

**OUR SOFTWARE PROGRAMS MANY NEW CELLULAR PHONES DIRECTLY
FROM THE DATA PORT WITHOUT OPENING THE PHONE , NO SOLDERING !**

DON'T BE FOOLED BY CHEAP IMITATIONS. GUARANTEED & TESTED.
SOFTWARE AVAILABLE FOR MOTOROLA, GE, ERICSSON, SONY, MITSUBISHI, NOKIA,
PANASONIC, DIAMONDTTEL, TECHNPHONE, OTHER PRODUCTS COMING SOON.

SOLD FOR EDUCATIONAL PURPOSES ONLY

CELLSOFT

609-751-2242 EXT # 2 FAX 609-751-5549

JEM MARKETING, LLC 100 SPRINGDALE ROAD A3 SUITE 113 CHERRY HILL NJ 08003

Introducing the Video Communication Terminal

PRICES AS LOW AS
\$199⁹⁵



**Compatible with Jerrold,
Scientific Atlanta
and Pioneer**

Latest high-tech features...

- 750 MHz
- Infra-Red Wireless Remote Control
- Integrated Volume and Mute Control
- On Screen Menu Displays For All User Functions
- Clock
- Favorite Channel Memory Bank
- Programmable Parental Lockout
- Channel 3/4 Switchable
- Last Channel Recall
- Sequential or Direct Channel Access
- HRC / STD / IRC Programmable
- Auto Frequency Control Tuning
- Sleep Timer
- Audio and Video Ports
- Switched Electrical Outlet
- Inview Video Pass-Thru Technology



Add on Descrambler for Jerrold Systems

	1-9	10-19	20*
TVT GOLD (orig)	\$49	\$42	\$39
PURPLE or PINK	\$59	\$49	\$45
TVT (4X4)	\$49	\$42	\$39
STEALTH+ (new)	\$59	\$52	\$45
TNT (orig)	\$75	\$65	\$59

Add on Descrambler for Scientific Atlanta

	1-9	10-19	20*
SADF	\$69	\$65	\$59
SA - 3	\$59	\$55	\$49
M80 (orig)	\$75	\$65	\$59



Add on Descrambler for Pioneer Systems

	1-9	10-19	20*
PIO - GRN	\$79	\$69	\$59
PIO - GRN+ (new)	\$99	\$89	\$79
PIO - TNT (new)	\$75	\$65	\$59

CONVERTERS

Wave Master 5500-3

- Parental Control
- Favorite Channel Memory
- Sleep Timer
- Wireless Remote Control
- Last Channel Recall
- HRC / STD Switchable
- 99 Channel

1-9	10-19	20*
\$75.00	\$69.00	\$63.00

Millenium M-3

- Parental Control
- Favorite Channel Memory
- Wireless Remote Control
- Last Channel Recall
- HRC / STD Switchable
- 99 Channel
- Available With Built In Descrambler
- Available With A/B

1-9	10-19	20*
\$69.00	\$65.00	\$55.00

VCS

VIDEO COMMUNICATION SYSTEMS INC.

ask about our complete line of products

1-800-872-6585



Serving the public since 1981

XANDI ELECTRONICS

201 E Southern # 205, Tempe AZ 85282 • 5140

SATISFACTION GUARANTEED!

BUY WITH CONFIDENCE FROM XANDI

• 30-DAY REFUND POLICY

• TECH SUPPORT NUMBER

(602-894-0992)

- Smallest FM transmitter anywhere!
- Tunes 88-108 MHz.
- Powerful 2 stage audio amplifier.
- Sensitive, picks up sounds at the level of a whisper.
- Up to 1 mile range.



SUPER-MINIATURE FM TRANSMITTER

World's smallest FM transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip (SMT) parts are pre-assembled to the circuit board.

XST500 (E-Z) Kit \$44.95

- Smallest Phone transmitter anywhere!
- Tunes 88-108 MHz.
- No batteries required, powered by phone line.
- Up to 1/4 mile range.
- Attach to phone line anywhere in house, even inside phone.



SUPER-MINIATURE PHONE TRANSMITTER

World's smallest FM phone transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip components are pre-assembled to the circuit board.

XSP250 (E-Z) Kit \$34.95

- Uses sensitive microwave transistor amplifier.
- Covers 1 to 2,000 MHz.
- Compact hand held unit.
- Includes miniature loud speaker for audio indication of detected signals.



SUPER SENSITIVE BUG DETECTOR

When the XBD200 intercepts a signal in the 1 to 2,000 MHz range, it emits a growl that increases to a high pitched squeal as the signal strength increases.

XBD200 (C) Kit \$49.95

- Transmit high quality stereo to any FM stereo receiver.
- Built-in output level monitor for quick and easy tuning.
- Ideal for use with personal CD player.



FM STEREO TRANSMITTER

Transmit full-bodied Hi Fi Stereo to any FM stereo receiver. Separate left and right inputs and gain controls. Includes an output booster stage for greater range.

XFS-CASE KIT \$13.95

XFS108 (C) KIT \$41.95

- Dial your phone from anywhere and listen to the sounds inside your home.
- Two digit Touch Tone code for secure operation



TELEPHONE SNOOP

The latest in home or office security. Call home from anywhere, enter a two digit security code, and hear the sounds in your home. Automatically turns on without ringing the phone, verifies code, then activates for one and a half minutes.

XPS-CASE KIT \$13.95

XPS1000 (C) KIT \$49.95

- Transmits a continuous beeping tone.
- Adjustable from 88 to 108 MHz.
- Up to 1 mile range.
- Works with any FM broadcast receiver.



TRACKING TRANSMITTER

Only 0.7 by 2.4 inches, the XTR100 operates at voltages of 3 to 18 Volts and is ideal for use in locating lost model rockets, bicycles, automobiles, games of hide and seek, and contests.

XTR100 (C) Kit \$33.95

- Works with any FM broadcast receiver.
- Turns off when phone is not in use to extend battery life.
- Adjustable from 88 to 108 MHz.
- Up to 1 mile range.



LONG RANGE PHONE TRANSMITTER

Similar to our very popular XSP250, the XTT100 is battery powered for greater range. It plugs into any phone jack and transmits both sides of conversations on that line.

XTT100 (C) Kit \$32.95

- Use with any FM broadcast receiver.
- Hear every sound in an entire house!
- Up to 1 mile range
- Powerful 2 stage audio amplifier.



MINIATURE FM TRANSMITTER

The XFM100 has a super sensitive microphone and is capable of picking up sounds at the level of a whisper and transmitting them to any FM broadcast receiver.

XFM100 (C) Kit \$32.95

- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Anonymity on any call.
- Button for normal operation.
- 16 levels of voice masking.

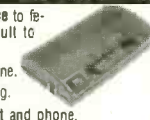


VOICE CHANGING TELEPHONE

STOP THOSE ANNOYING TELEPHONE CALLS! Sound older and tougher when you want to. Not a kit. Fully assembled. Single phone operation only.

TRANSITION 2000 \$89.95

- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Use with any modular phone.
- 16 levels of voice masking.
- Connects between handset and phone.



VOICE CHANGING ACCESSORY

STOP THOSE ANNOYING TELEPHONE CALLS! Sound older and tougher when you want to. Not a kit. Fully assembled. Use with single or multi-line phones.

TRANSITION 2001 \$59.95

- Uninterrupted coverage of 800 to 950 MHz.
- Works with any scanner that can receive 400 to 550 MHz.



800-950 MHz SCANNER CONVERTER KIT

If your scanner can receive 400-550 MHz, just add the XLC900 for uninterrupted 800-950 MHz coverage. It converts all 800-950 MHz signals down to 400-550 MHz so your scanner can receive them! Add our custom case kit for that "Professional" look.

XLC-CASE KIT \$13.95

XLC900 (C) KIT \$49.95

- Works with most any scanner.
- 10 TO 1000 MHz.
- 10 dB typical gain.
- 3 dB typical noise figure.



10 -1000 MHz AMPLIFIER

Designed to help scanners with poor sensitivity pull in those weak signals. Includes OFF/BYPASS switch for returning to normal operation and front panel gain control. Add our custom case kit for that "Professional" look.

XLA-CASE KIT \$13.95

XLA1000 (C) KIT \$24.95



WE ACCEPT VISA, MC, MD, CD SHIPPING & HANDLING EXTRA

TOLL FREE ORDER LINE
1-800-336-7389
ASK FOR FREE CATALOG OF OUR PRODUCTS

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

CIRCLE 134 ON FREE INFORMATION CARD

❖ ATTENTION CABLE VIEWERS ❖

CABLE VIEWERS. . .get back to your BASIC Cable Needs

Call 800-577-8775

For information regarding all of your BASIC cable needs.

5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT

- ❖ PRICE
- ❖ EFFICIENT SALES AND SERVICE
- ❖ WE SPECIALIZE IN 5, 10 LOT PRICING
- ❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)
- ❖ ANY SIZE ORDER FILLED WITH SAME DAY SHIPPING

We handle NEW equipment ONLY - Don't trust last year's OBSOLETE and UNSOLD stock!
COMPETITIVE PRICING—DEALERS WELCOME

HOURS: Monday-Saturday 9-5 C.S.T.

It is not the intent of B.E.S.W. to defraud any pay television operator and we will not assist any company or individual in doing the same.
*Refer to sales personnel for specifications.

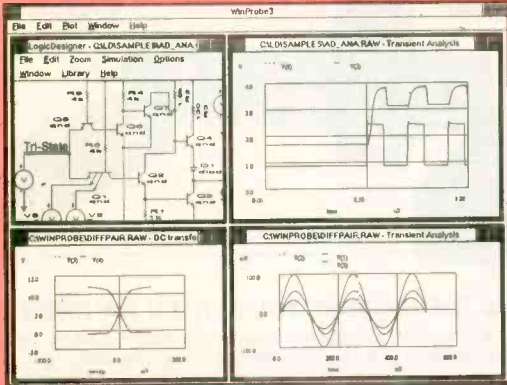
BASIC ELECTRICAL SUPPLY & WAREHOUSING CORPORATION

P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775

Powerful Integrated Digital and Analog (Berkeley Compatible Spice)
Circuit Design and Simulation Software for Microsoft Windows (network compatible)

Best value in town!! Includes 4 Integrated Modules: LogicDesigner + WinSpice + WinScope + Symbol Editor

Perfect For Students, Technicians and Engineers!!



Simply connect your circuit on the screen, enter simulation options, then kick back and watch it work! Comes with two **Spice** libraries plus 5 more libraries of **Active** Digital Devices CMOS, 74xx, 7400x, ALUs, counters, MUX, FFs etc. Plus a **Passive** symbol library of **Microprocessors** and more. Use the **Symbol Library Editor** to **Design your own symbols** and symbols to represent Sub-circuits, True Bussing, Buss pins can be assigned Unique Names, Parts Billing List, Legends, Nested **Subcircuits** for **Hierarchical Top Down or Bottom Up Design**, Checks Fan Out Violation and Electronic Rules, Device Unit Numbers/Chip Pinouts Automatically added as per Data Books, Connectors, Spice Netlist Generation, Continuous **ZOOM In/Out, Cut/Copy/Paste**, Multiple Rotatable Fonts, Rotatable Symbols, Multipage Zoomed In/Out Printouts to any Windows Printer. **ON LINE HELP**

LogicDesigner Digital Simulation/Schematic Capture Module

Interactive Digital Simulation and Schematic Capture, Single Step Mode, Variable Speed Simulation, Programmable Digital Delays, Multi Waveform Scrolling Timing Diagram Memorizes up to 30000 Ticks Worth Of Timing Data, Truth Table Generation, Binary to 7 Segment Displays, Hex Keypads, Programmable Clock Sources, Logic Probes. Built in **Logic Analyzer** can be set up to generate Edge or Level Sensitive **Breakpoints**, or when Signals are Equal To, Greater Than, or Less Than a Certain Value or any AND/OR Combination. Sequential Breakpoints help Track Down and Debug Circuit Race Conditions **Glitches, Setup and Hold Violation** and other **Circuit Design Errors**. Simulates Tri State, Open Collector & Don't Care Logic, RAM/ROM, One Shot, Carry Look Ahead, Shift reg, Pull Up/Down Resistors.

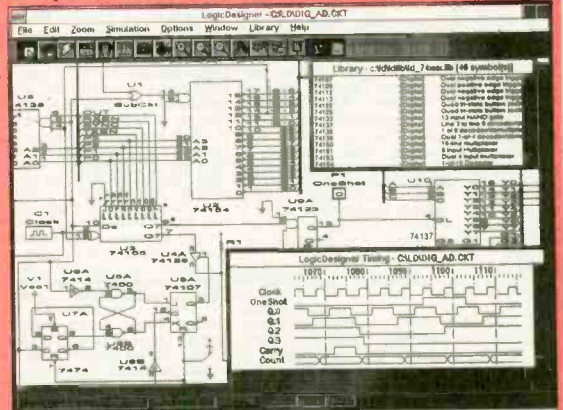
WinSpice Simulator & WinScope Data Analyzer Modules

SPICE LIBRARY: MOSFET, GaSFET, BJT, FET, Diode, OpAmps, Comparitors, 555 Timer, Resistor, Cap, Inductor, Transmission Line, Controlled, Independent, Dependent, Arbitrary Source, Pulse, Sin, Piece Wise Linear, and FM Sources, Current and Voltage Controlled Switches. All models Expandable And User Modifiable. Imports **MACRO MODELS** of Your Favorite Manufacturer Supplied Parts.

ANALYSIS TYPES: AC, DC, TRANSIENT, POLE-ZERO, NOISE, SENSITIVITY, FOURIER, TRANSFER FUNCTION, AND OPERATING POINT ANALYSIS.

DATA ANALYZER: Graphs Simulation Results using Multiple Plot Windows and Waveforms. Plots Linear, Logarithmic, Polar, Smith Chart, **BODE** Type Plots + More. **ZOOM** In and out of Plot Waveforms. **Plots Complex Math Expressions** Using Plot Variables As Arguments, Calculates Derivatives, Log, Trig functions, Define Macros of Complex Math Formulas.

Price \$99.99 reg \$179.99 S&H \$3.00 VISA/MC
ISLAND LOGIX Inc.
920 South West 95 Terrace
Pembroke Pines, Florida 33025 U.S.A.
PH (305) 435-7665 FAX (305) 435-7891



CIRCLE 144 ON FREE INFORMATION CARD

New and Pre-Owned Test Equipment

SALES • RENTALS • SERVICE

Substantial Savings on new & pre-owned Fluke, Hewlett Packard, Leader, Tektronix and more ...

LEADER
FOR PROFESSIONALS WHO KNOW
THE DIFFERENCE



We buy surplus Electronic Equipment. Fax us your list!

*** Pre-Owned Oscilloscope Specials ***

- Tektronix 465 100 MHz.....\$499.00
- Tektronix 465B 100 MHz.....\$599.00
- Tektronix 475 200 MHz.....\$679.00

Fully refurbished and calibrated to original specifications

- | | | |
|--|--|----------------|
| OSCILLOSCOPES | | Reg. \$ |
| 8020 | 20 MHz 2-Ch. High Sens., TV Sync..... | \$525.00 |
| 8060 | 60 MHz 3-Ch. Dlyd. Swp., TV Sync..... | \$1,345.00 |
| 8100 | 100 MHz 2-Ch. Dlyd. Swp., TV Sync..... | \$1,595.00 |
| FREQUENCY COUNTERS | | |
| LDC-822 | 80 MHz, 7 digit, 5 ppm..... | \$395.00 |
| LDC-823S | 250 MHz, 8 digit, 1 ppm..... | \$585.00 |
| FUNCTION & RF SIGNAL GENERATORS | | |
| LFG-1300S | 2 MHz Sweep/Function Generator..... | \$575.00 |
| LFG-1310 | 10 MHz Sweep/Function Generator..... | \$1,095.00 |
| POWER SUPPLIES | | |
| LPS-151 | Triple Output, +6V/3A, +/- 25V/0.5A..... | \$655.00 |
| LPS-152 | Triple Output, +6A/5A, +/- 25V/1.0A..... | \$645.00 |

Sale
Call for latest sale price!

Full line of Oscilloscopes, Video & Audio Test Equipment, Power Supplies, Probes and Accessories. Call for a FREE Line Catalog!

TOLL FREE 1-800-99-METER

FOTRONIC CORPORATION

For more GREAT VALUES Call, Write or FAX • P.O. Box 708, Medford, MA 02155 • FAX (617) 665-0780

March 1995, Popular Electronics

TOP SECRET

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

Voice: (505) 434-0234, 434-1776, 439-1776 (orders only) 8AM-6PM MST, Mon-Sat

Fax: (505) 434-0234 (orders only; if you get voice, enter #11 #11 any time) 24-hour, 7 days/wk

Free Tech Support (relates directly to your order or prospective order): Tues. and Thurs. only.

10% OFF on orders \$100+ 15% OFF over \$200

Add \$5 total SH (US, Canada). All items in stock. VISA, MCcard OK. No COOs or "bill me". New Catalog (150+ offers) \$2 w/ order, \$4 w/ check or MO. NO free catalog. NO dealers. Since 1971. As seen on CBS "60 Minutes", Forbes, etc. by John Williams - former Lockheed Senior Engineer, NMSU Computer Science Professor, NIH Health Physicist. **Wanted: 9 MAC I/ct, PC386, better - buy, trade.**

*All software supports all IBM-PC compatible x86 systems (8086 - Pentium)

Off-The-Shelf HARDWARE

Van Eck System, Data Card Reader/Writer, ATM2, KX Radar Emitter, Street Sweeper (radar), Lidar, Carjack/Kidnap Puffer, Voice Disrupter, Hearing Assistant, Shrik Module, EM Lab & Countermeasure, TENS, 6th Sense Communicator, Phone Color Box, Lineman's Handset, DTMF Decoder, Bug & Tap Detector/Blaster, Subliminal Mixer/Amp, Neurophone/Rife/Hieronymus/Resonant Crystal Radionic, Magnetometer, Levitator, Vortex Generator, RF & Microwave, Ultrasonic Jammer & Receiver, Infrared Detector, Long-Range Eavesdropper, Noise Cancelling System, Unknown Presence Detector, Electronic Downer - many more devices. See Catalog.

CELLPHONE MODIFICATIONS

See our Catalog for our infamous cellphone modification guide (169) - detailed, comprehensive, covers all makes - 10 times more info than competitor's "guides", (Do Special Projects (below) for up-to-date hardware/software).

SPECIAL PROJECTS

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

The HACKER FILES

Compilation of 100s of the best articles written (in ASCII) by top hackers & phreakers. Covers every major topic in hackerdom & 3 HD Disks* \$59.

VOICE MAIL HACKING

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

PBX HACKING

1,000s of PBXs are hacked to the tune of \$ Billions/yr! White "VOICE MAIL HACKING" details how VMBs are hacked for "ohun" and profit - including VMS methods for hacking PBXs themselves - "PBX HACKING" addresses ALL issues relating to PBX hacking, including countermeasures! Can your business or agency afford a \$90,000 phone fraud loss (the average loss due to hacked PBXs)? As described in Forbes Magazine. \$39

PHREAKING CALLER ID & ANI

Details on how they work and dozens of effective ways of defeating Caller ID, ANI, *69, *57, and Call Blocking and *67. Also describes Caller ID, Orange, Beige, Cheese and CF Boxes, ESS, SS7, E-911, various CLASS services, CNA, NON PUB DA, CAMA, DNR, 800-ECR, Diverters, Extenders, Centrex - more. \$29.

Beyond PHONE COLOR BOXES

Dozens "phone color boxes" described - many circuits. Plus Call Forwarding, Conferencing, Phreak History, Glossary, Diverters, Extenders, Loops, REMOBS, Bridging Heads & Cans, Dtopcom, 3rd Party and many other non-box methods - more. \$39.

ROBOFONE AUTODIALER

Powerful, versatile, menu-driven "Wargames" autodialer lets you dial any quantity (up to 10K) or mix of local/long distance numbers in any order, over any length of time, whether busy or answered (your choice) and log the times, commands and results to monitor, printer and/or disk. Quick-dial directory of up to 600 numbers. BUSHY retail options. Direct modem command and control. All Result Codes, including VOICE and RINGING. Optional shell to terminal program upon CONNECT. Exit to menu or OOS (for batching). Manual + Disk* \$29.

COMPUTER PHREAKING

Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS, etc are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary FLU-SHOT+ protection system (Ed. Choice, PC Magazine). BBS advice, password defeats, glossary - much more! Manual + Disks* \$39.

Beyond VAN ECK PHREAKING

Eavesdropping on TV and computer video signals using an ordinary TV! Includes security industry reports. Range up to 1 KM. Plans include both the Consumertronics and the original Top Secret Van Eck design \$29.

Order Today! (808) 438-1776

STOPPING POWER METERS

As reported on CBS "60 Minutes": How certain devices can slow down - even stop - wathour meters - while loads draw full power! Device simply plugs into one outlet and normal loads into other outlets. Also describes meter creep, overload droop, etc. Plans \$29. **L.O. MANUAL:** External magnetic ways (applied to the meter itself) to slow down and stop wathour meters while drawing full loads. Plans \$19. **KW-HR METERS:** How wathour meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow and stop meters by others. \$18. Any 2 \$38. All 3 \$59.

AUTOMATIC TELLER MACHINES

ATM crimes, abuses, vulnerabilities and defeats exposed! 100+ methods detailed, include: Physical, Reg. E, cipher, PIN compromise, card counterfeiting, magnetic stripe, false front, TEMPEST, Van Eck, tapping, spoofing, inside job, super-cool, vibration, pulse, high voltage - others. Case histories, law, countermeasures, detailed security checklist, labeled internal photos, figures. ATMs contain up to \$250,000 in cash! Recent \$350,000 ATM crime spree still unsolved! \$39.

CREDIT CARD SCAMS

Cardholders, merchants, banks suffer \$ Billions in losses annually because of credit card fraud. Describes every known means of credit card fraud and scams. Protect yourself! \$29.

CONS, SCAMS & SWINDLES

Cons & scams and related swindles fleece Americans of \$100+ Billion per year! The most comprehensive survival manual on cons & scams of all kinds - from the classic to hi-tech. Details on 100s and their many variations, and countermeasures. Protect yourself! \$39.

STEALTH TECHNOLOGY

Police radar is fascinating! It also has error rates of 10-20%! Every known error mode - stealth method and material used to minimize radar reflections - tactic and strategy to fight unjust radar tickets (that cost you \$100s in insurance and risk cancellation) - methods to detect and lam signals - fully described! \$29.

SECRET & SURVIVAL RADIO

Optimum survival and security radio equipment, methods, freq allocations and voice/data scrambling/encoding. Includes small receivers/transmitters, telemetry, antenna optimizations, remote monitoring and control, security, surveillance, and ultrasonic, fiber-optic and infrared comms. 70+ circuit plans, tables. \$29.

HIGH VOLTAGE DEVICES

HV devices plans: Stun Gun, Taser, Prod, Cane, Flasher, Blaster, Zapper, Audio/Radar Jammer, Jacob's Ladder, Plasma & Van de Graaff Guns, Fence Charger, Galger Counter, Ozone Gen, Fish Stunner, Plant Stim, Kirlian, more! All plans for only \$29.

UNDER ATTACK!

Electromagnetic interference and Electronic Weapon Attacks cause: Cancer, birth defects, and profound psychological, neurological, cardiovascular and immune system disorders! Destructive to people, animals, plants, equipment! Includes ACTUAL CASES OF EM ATTACKS ON PEOPLE (we investigated!) includes how to verify and pinpoint EMi and electronic attack sources, and specific countermeasures. \$29. **EM BR/INFLASER/ETC** Tutorial and plans for powerful ELECTROMAGNETIC WEAPONS and LAB DEVICES. Optimum circuits, freqs, waveforms, duty cycles, intensities. Thorough. \$29. Both \$49.

RADIONICS MANUAL

Exciting electrical, electronic, electromagnetic therapeutic, diagnostic & preventive devices (mostly experimental). History, descriptions, plans (dozens), availabilities of Radionics Devices from early to modern. While drugs cost \$ Hundreds, electricity costs pennies! \$29. **HEAL YOURSELF!** Plans for 3 major electronic therapeutic devices of types approved by FDA. \$19. Both \$39.

By an ORDER of the MAGNITUDE

The most comprehensive, hard-hitting, hi-tech survival book ever written! Topics include electronics, computers, energy, weapons, concealment, revenge, alarms, etc to survive today's dangerous world. We all face increasingly financially and physically brutal times! Field-expendent use of technology in various threat and conflict environments and scenarios. \$49.

CRYPTANALYSIS TECHNIQUES

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

SOFTWARE PROTECTION SYSTEM

Unique system that highly discourages costly software piracy while permitting legit archival copies. No known way to defeat. No special equipment required. Simple and automatic to install on your distributed software. Compatible with all other copy-prevention systems. Manual + Disk* \$59.

ROCKET'S RED GLARE

How to design and build solid-propellant amateur and survival rockets. Emphasis on formulation, manufacture, installation of propellants, motors, igniters, etc. Includes list of commonly available materials, and the design of launch pads and test beds and their electronics. \$29. **FIREWORKS:** How firecrackers (M-80s, blockbusters, cherry bombs), small rockets, volcanos, fountains, sparklers and safety fuses are made and colored. Simple, cheap, common ingredients. \$9. Both \$36.

ULTIMATE SUCCESS MANUAL

Underpaid? Harassed or abused? Manipulated? Taken for granted? Stuck in a dead-end job? Can't find a good job? Expect to be laid off, fired or transferred soon? The ultimate no-holds-barred, looking-after-#1 Machiavellian techniques to find, obtain, optimize and keep top jobs, pay and benefits. THE RULES OF THE GAME FOR A GAME WITHOUT RULES! From resume to CEO. \$29.

Sold for educational purposes only

DESKTOP MANUFACTURING!



Made in USA!

only \$595!

*free CAD/CAM

18"x18"x4.6" WORK AREA

THIS IS THE MACHINE YOU'VE BEEN WAITING FOR!

Have you ever dreamed of letting your computer manufacture products directly from your CAD drawings? If so, the Neuractor CNC-4+ Desktop Manufacturing System may be just the edge you need! This fourth-generation CNC machining center can automatically drill, mill and route three-dimensional products in wood, plastic and light metals DIRECTLY FROM YOUR CAD DRAWINGS! You've seen the rapid-prototyping and "Santa Claus" machines that cost thousands of dollars, but did you know that as an electronic technician you can assemble one yourself from this inexpensive kit? Utilizing patent pending technology the Neuractor CNC-4+ kit provides you with everything you need to machine products in three dimensions with a resolution of .001". All mechanical components are pre-fabricated, pre-machined, plated and painted. Includes four 83 oz/in digital CY-MOTORS, interface card, 5 amp power supply, 10 pitch steel lead screws, 4 proprietary Slide Block actuator mechanisms, 4 aluminum linear actuator channels, polished steel guide-rods, Dremel bracket, hardware, etc. (You provide Dremel MotoTool(tm) or flex-shaft router and work surface.) It's a complete kit! All you do is put it together and calibrate it! IF THAT'S NOT ENOUGH, WE'RE THROWING IN A FREE FULL-FEATURED 3D CAD/CAM SOFTWARE PACKAGE WITH EACH UNIT! Large 18"x18"x4.6" cutter travel for crafts, electronics and printed circuit board drilling and routing, not to mention mold-making, mold-making and even painting! Get started by ordering your own Neuractor CNC-4+ today! ACT NOW! Kit \$595 + \$24.95 UPS S/H. (For heavy-duty upgrade add \$149) Allow 4-8 weeks for delivery. U.S. CYBERLAB, 14786 Slate Gap Rd., West Fork, AR 72774 (501) 839-8293. **Free Info! X-Y Power/Rotary Tables and larger CNCs now available!**

DC/CAD
introducing...

THE TERMINATOR

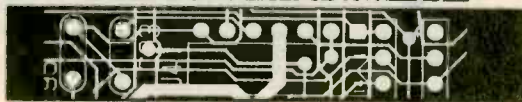
Super High Density Router
(Complete with Schematic & PCB EDITOR)

Features the following powerful algorithm & capability:

- Rip - up and Retry
 - Pre-routing of SMT components
 - Real-Time via minimization
 - Real-Time clean up passes
 - User defined strategies
 - Window 3.0 capability as DOS Task
 - 1-mil Autoplacer and Autopanning
 - Two-way Gerber and DXF
 - Automatic Ground Plane w/ Cross-Hatching
 - Complete w/ Schematic & Dolly Libraries
 - Optional simulation capability & protected mode for 386 users
- * PCB LAYOUT SERVICE AT LOW COST *

Call for
DC/CAD - \$95
(available for students only)
normal price range
\$295 - \$2500

LEASE PROGRAM & SITE LICENSE AVAILABLE



Design
Computation

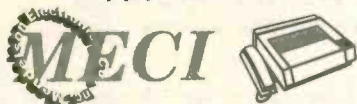
1771 State Highway 34
Farmingdale, NY 07727
(908) 681 - 7700 • (908) 681 - 8733 (FAX)

* DC/CAD . . . The focal point of future CAD market *



If you are not getting this catalog you are missing out on some of the best deals in electronics today! We have thousands of items ranging from unique, hard-to-find parts to standard production components. Call, write, or fax today to start your free subscription to the most unique catalog in the industry, filled with super values on surplus electronic and hobbyist type items. If you have a friend who would like to receive our catalog, send us their name and address and we will gladly forward them a complimentary 56 page catalog.

Why pay more? Call today.



340 East First Street Fax Order Line
Dayton, Ohio 45404 1-800-344-6324

Order Toll-Free
1-800-344-4465

CIRCLE 149 ON FREE INFORMATION CARD

CABLE TV DESCRAMBLERS

Best Prices in the U.S.A.! Guaranteed to Work!

WE WILL BEAT ANY PRICE!



JERROLD, SCIENTIFIC ATLANTA, PIONEER, FTB-3, SA3
THE NEWEST & THE LATEST

Stealth - Jerrold Impulse & Starcom Series (advanced version of TNT & TVT)

M80 - Scientific Atlantas incl. 8536/+, 8580, Drop-Field

Super-Pio - Pioneer Systems (advanced version of Pioneer "Green")

PANASONIC TZPC145G 99 Channel Wireless Cable Converters
ZENTEK XL2100 99 Channel Wireless Cable Converters

1-800-818-9688 M-F: 9-6 EST

U.S. Cable TV, Inc. Dept.: KPE025

4100 N. Powerline Rd, Bldg. F-4 Pompano Beach FL 33073
NO FLORIDA SALES!

IMPROVE YOUR IMAGE!

WITH OUR VIDEO STABILIZERS

BEFORE



AFTER



SUPER VHS MODEL AVAILABLE!
The clearest picture possible playing back movies. **GUARANTEE** to eliminate copy protection.

- No Rolls/Jitters/Flickers/Fading
- Works on all TV's, VCR's Beta & Cable
- Gold Video Connectors & Cables Included
- 2 Year Warranty
- Money Back Guarantee



VISION ELECTRONICS

1-800-562-2252

2125 S. 156TH CIRCLE • OMAHA, NE 68130

Technicians Professional Tool Case



~~\$38.95~~

\$29.95

(Limited Offer)

This hi-tech, case is designed for versatility, to protect and transport costly tools, electronic devices and instruments. Case is available with aluminum finish (281 TC) or black finish (282 TC).

Thousands of cases already sold to satisfied technicians.

• Other cases also available. • Dealer inquiries welcome.

To order call:

(713) 395-8370 Fax (713) 395-8372

Terms: Visa • M/C • C.O.D.'s or send check or money order to: **RATTNER NORTH AMERICA, Tool Utility Cases, 5090 Richmond, Ste. 334, Houston, Texas 77056**

- Commercial quality
- Removable, reversible tool pallet
- Case bottom consists of six adjustable compartments
- Foam lined interior
- 2 keyed locking latches
- Adjustable shoulder strap
- Reinforced steel corner braces
- Size 18" x 6 1/4" x 13" (Tools Not Included)



Shoreline
INSTRUMENTS
**Automotive Meter with
Auto-Ranging DMM**

- RPM, Dwell, Frequency, Temp. (°C & °F)
- AC/DC Voltage & Current
- Continuity Beeper, Ohms
- **Standard Accessories**
- Multi-tip Probe Set, Large Alligator Clips, Temp. Probe, Rubber Boot, Inductive Pick-Up
- 9V Batt.-2 Year Warranty



Sale \$159.95

◀ **Item# Z6000**

Sale \$44.95
Item # Z3910

**Versatile DMM
w/ Capacitance**

- Large LCD Display
- DCV accuracy 0.5%
- Diode test, continuity check with buzzer sound
- Transistor hFE test
- All ranges overload protected
- Rugged case, drop proof
- Capacitance measurement 1pF-20µF in 6 ranges
- Resistance measurement up to 200M
- Auto power off
- Yellow Case
- 1 Year Warranty**



Dealer List

Sunex Electronic Supply, Inc.
4 Locations in FL
(813) 885-4074

Lyntronics
Phoenix, AZ
(602) 841-3900

Minute Man Electronics
Fremont, CA
(510) 791-5036

Gateway Elec., Inc.
3 Locations
(314) 427-6116

ACE Electronics
San Jose, CA
(408) 297-1383

Alltronics
San Jose, CA
(408) 943-9773

Weirdstuff
Sunnyvale, CA
(408) 746-1100

AL Electronics & Robotics
Englewood, CO
(303) 693-6585

REM Electronics
Warren, OH
(216) 373-1300

Electrotex, Inc.
8 Locations in TX
1 Location in TN
(713) 526-3456

**Additional Dealers
Welcome**



**Auto-Range DMM
w/Capacitance**

- CPU controlled with auto power off function
- 3.75 digit jumbo LCD (max reading 3999)
- 42 segment high speed bar graph
- Full auto-ranging measurement
- Offset adjustment
- Data hold and data memory
- MIN/MAX hold function
- Auto capacitance measurement 1pF to 40µF in 5 ranges
- Auto frequency measurement up to 1 MHz in 5 ranges
- Safety design according to IEC Publication 348
- **1 Year Warranty**

◀ **Sale \$105.95**
Item # Z3500

**See Your Local Dealer or Call
9am to 5pm Pacific Standard Time
800-470-WIND (9463)**

Windward
Products

*We Stand Behind our Products
Satisfaction Guaranteed*

P.O. Box 378, Moffett Field, CA. 94035

FEI Forest Electronics Inc.

**Are you overpaying . . .
. . . your cable company?**

**You are if . . .
. . . you are leasing their equipment.**

- Forest Electronics, Inc. offers a complete line of New Cable Decoders and Converters that are fully Compatible with your cable system.
- All systems come with: Remote Control, & Parental Guidance Feature. Volume Control is also available.
- All Equipment is fully guaranteed & comes with a 30 day money back option.

For More Information Call Us 24 Hours a Day At:

800-332-1996
FAX: 708-860-9048

GENUINE
Electronics, Inc.

**Cable TV &
Electronic Equipment**

*Genuine Electronics, Inc.
can help you with virtually
any electronic need:*

- Cable TV Descramblers/Converters
- Bullet Protectors
- Immunizers
- Voice-Mail Systems
- Digital On-Hold Announcers
- Laser Pens

GUARANTEED & LOWEST PRICES!

CALL GENUINE
ELECTRONICS INC.

1-800-833-2915

CONTROL
RELAYS • LIGHTS • MOTORS
MEASURE
TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY
INPUT
SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79



- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL- 8 BIT A/D/IN
- 12 BIT COUNTER
- UP TO 14K BPP/SEC

MODEL 30 SOFTWARE

- SCHOONER . . . \$39
- REAL TIME DATA PLOT • DISK DATA LOGGING
- SOFTWARE CALIBRATION
- PROTEUS (REQUIRES SCHOONER) . . . \$39
- GRAPHICAL DATA VIEW • ANALYSIS OF DATA

MODEL 150-02 \$179



- RS-232 INTERFACE
- TENSIL 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

MODEL 45 \$189



- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 40 \$99



- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 \$239



- RS-232 INTERFACE
- 18 BIT A/D
- 8.5 DIGIT
- UP TO 68 BPP/SEC

Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754
846 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

CIRCLE 145 ON FREE INFORMATION CARD



CABLE TV
Converters & Descramblers

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

BRAND NEW!

6-MONTH GUARANTEE

LOWEST PRICES

Volume Control & Parental Lockout Available

Greenleaf Electronics

1-800-742-2567

NO ILLINOIS SALES

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

**EARN
MORE
MONEY!**

**Be an FCC
LICENSED
ELECTRONIC TECHNICIAN!**



**Earn up to
\$60 an hour
and more!**

**Learn at home in spare time.
No previous experience needed!**

No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost! **GUARANTEED PASS**—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

Or, Call 1-800-932-4268 Ext. 240

COMMAND PRODUCTIONS

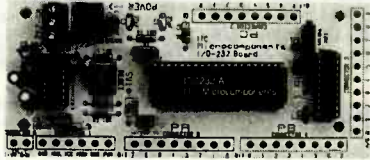
FCC LICENSE TRAINING, Dept. 240
P.O. Box 2824, San Francisco, CA 94126
Please rush **FREE** details immediately!

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

CONTROL AND DATA ACQUISITION FROM A COMPUTER SERIAL PORT (RS232 or RS485)

I/O-232 SMART BOARDS DO NOT REQUIRE PROGRAMMING! These boards connect directly to your computer serial port. Commands are very simple e.g. PRA [Enter] reads Port A. Results are sent back to the computer as an ASCII string allowing the use of PROCOMM, MAC240, or your own programs. In addition to interfacing, the I/O-232 boards have the following embedded functions:

- Uses ITC232-A IC.
- All standard Baud rates (300-115KB) supported.
- Bin, Hex or Dec formats.
- 24 I/O lines configurable individually as Inputs or latched Outputs.
- 8, 10 or 12 bit, 10 channel Analog to Digital converter.
- 10-10,000 Hz, 0-100% Pulse Width Modulation output.
- 3 EASY to use stepper motor logic interfaces (Muxable to more).
- Relative resistance or capacitance measurements using an RC network (ideal to read temperatures using a thermistor).



DESCRIPTION	KIT	ASSEMBLED
I/O-232-12 (12 bit ADC)	\$ 109	\$ 119
I/O-232-10 (10 bit ADC)	\$ 99	\$ 109
I/O-232-8 (8 bit ADC)	\$ 79	\$ 89

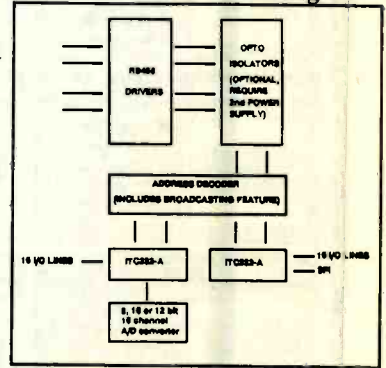
Enclosure: \$14, Serial cable: \$9 (specify connector), Power Supply: \$11
Add \$10 for manuals, diskette containing program examples and Shipping & Handling. Pay by cheque, M. Order, VISA or Master Card.

ITC MICROCOMPONENTS INC.

814 West 15th St. Unit 206, North Vancouver, B.C. Canada.
V7P-1M6. PHONE US TOLL FREE AT: (800) 474 7644
Fax: (604) 985 6417. Explore our BBS: (604) 985 1380

THE I/O-485 BOARDS are multiple addressable units containing 2 ITC232-A chips and a 10 channel, 8, 10 or 12 bit Analog/Digital converter each. The ITC232-A chips used ensure great simplicity of commands. 32 of these units can be ganged-up on a single RS485 line attached to a computer. A smaller board which plugs onto the computer serial port allows for RS232/RS485 conversion. **I/O-485 boards block diagram**

- 32 I/O lines configurable individually as Inputs or latched Outputs organized in 4 x 8 bit ports.
- 10 analog inputs, 8, 10 or 12 bits resolution.
- 32 different addresses plus broadcasting which allows commanding all the boards at once.
- Individual stations or the entire network is software resettable
- Direct or optoisolated link
- Speeds of up to 115200 Bauds.
- All the stations can be hooked onto a single 4 wire cable up to 1 mile long using standard phone jacks.



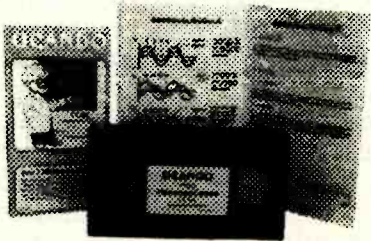
All of the following boards are pre-assembled and tested.

I/O-485-8 (8 Bit ADC)	\$ 139
I/O-485-10 (10 Bit ADC)	\$ 159
I/O-485-12 (12 Bit ADC)	\$ 179
432/485 Converter	\$ 49

For optoisolated option: Add \$19 to each item.

NEW!

Electronics made Easy with UCANDO



UCANDO's unique computer animation makes learning electronics fast and easy. These videos will...allow you to learn at your own pace...help you remember more of what you learn ... give you years of quality use... become a valuable source of reference material...make your understanding of electronics complete ... and help you build your future today. Call today and see how UCANDO is...

"Changing The Way The World Learns Electronics."

VT102 Introduction to VCR Repair	\$44.95	VT205 Amplifiers	\$44.95	VT305 Digital 5	\$44.95
VT102 VCR Maintenance & Repair	\$44.95	VT206 Oscillators	\$44.95	VT306 Digital 6	\$44.95
VT201 Direct Current	\$44.95	VT301 Digital 1	\$44.95	VT401 AM Radio	\$44.95
VT202 Alternating Current	\$44.95	VT302 Digital 2	\$44.95	VT402 FM Radio Part 1	\$44.95
VT203 Semiconductors	\$44.95	VT303 Digital 3	\$44.95	VT403 FM Radio Part 2	\$44.95
VT204 Power Supplies	\$44.95	VT304 Digital 4	\$44.95	VT501 Fiber Optics	\$44.95

New Release!!! VT404 Television Part 1 \$44.95

SAVE!!! Buy any 6 videos for only \$240 ... SAVE MORE!!! Buy any 12 videos for only \$450

Call toll free 1-800-678-6113

or mail check or money order to:

UCANDO Videos, P.O. Box 928, Greenville, OH 45331

FREE Shipping ... FREE Catalog

CIRCLE 136 ON FREE INFORMATION CARD



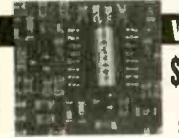
MIRACLES NEVER CEASE



MICRO TX2000 KIT

\$59⁹⁵

- SMALLEST 120 MW FM VOICE/PHONE TRANSMITTER
- SMALL SIZE 1-7/16" x 2 1/32"
- 88-110MHz ON ANY BROADCAST RECEIVER
- ROCK SOLID TUNING, DOESN'T DRIFT
- 5 MIN. ASSEM., HEAR A WHISPER UP TO 2 MILES
- SMT PARTS PREASSEMBLED
- INCLUDES TXMTR, MIC, ANTENNA, BATTERY CLIP, TUNING TOOL, AND INSTRUCTIONS



VOICE SCRAMBLER/DESCRAMBLER KIT

\$69⁹⁵
2 FOR
\$129.95

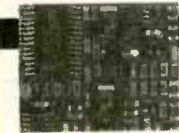
- WORLDS SMALLEST AUDIO SCRAM./DESCRAM.
- TALK IN PRIVACY ON AUDIO, SPKR. OR MIC LINE
- HEAR THOSE GARBLED SCANNER VOICES
- SMALL SIZE 1-7/8"x1 1/4"
- CRYSTAL CONTROLLED DIGITAL SPEECH INVERSION
- 7-15 VOLT DC SUPPLY
- LOUD HALF WATT AUDIO AMPLIFIER
- EXCELLENT AUDIO QUALITY
- INCLUDES FULL DOCUMENTATION
- DUPLX SCRAMBLE & DESCRAMBLE AT THE SAME TIME



MICRO 1.2 VOICE RECORDER

\$69⁹⁵

- SMALL SIZE 1-1/4"x1 5/16"x1 1/4"
- HUNDREDS OF APPLICATIONS
- EXCELLENT AUDIO QUALITY
- 90 SECONDS REC/PLAY
- 8 OHM SPEAKER OUTPUT
- 7-15 VOLT DC SUPPLY
- 100 YEAR MEMORY WITHOUT POWER
- INCLUDES MIC, SWITCHES AND FULL DOCUMENTATION



MICRO 2B VOICE RECORDER

\$109⁹⁵

MICRO 2B FEATURES

- SAME AS 1.2 PLUS:
- MULTI MESSAGES (UP TO 600 MEM.)
- SMALL SIZE 1-5/16"x1-5/8"x1/8"
- VARIABLE AUTO PLAY TIMER
- 5 VOLT KEY OUT DURING PLAYBACK

ORDER BY PHONE OR MAIL
IN U.S.A. ADD \$5 FOR S&H

C.O.D. CHARGES APPLY
NYS RESIDENTS ADD SALES TAX

VFC400 VHF/UHF FM VOICE TRANSMITTER KIT

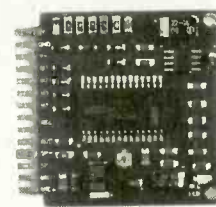


ONLY
\$99⁹⁵

NEW

- SMALLEST 400 MILLIWATT VOICE TRANSMITTER ANYWHERE! (1.5" x .56")
- RECEIVE ON ANY SCANNER OR VHF/UHF SURVEILLANCE RECEIVER
- RELIABLE CRYSTAL CONTROL OSCILLATOR
- 5 MILE RANGE (OR BETTER)
- SUPER SENSITIVE OP-AMP PICKS UP SOUNDS AT WHISPER LEVEL
- LINE LEVEL AUDIO INPUT FOR DATA, STATION ID, OR INTERFACE TO OUR POPULAR VOICE RECORDERS
- SIMPLE 5 MINUTE ASSEMBLY, ALL CHIP COMPONENTS ARE PRE-ASSEMBLED
- CUSTOM FREQUENCIES AVAILABLE FOR LAW ENFORCEMENT
- INCLUDES TRANSMITTER, CRYSTAL, BATTERY HOLDER, MICROPHONE, ANTENNA, & INSTRUCTIONS
- CHANNEL A) 148.565 MHZ B) 149.000 MHZ (SELECT ONE WHEN ORDERING)

MICRO-4 MULTI-MESSAGE VOICE RECORDER



NEW

- EXACT SOUND REPRODUCTION
- SMALL SIZE 1-3/4" x 1-5/8"
- NEW EDGE CARD DESIGN IS STANDARD .100 SPACING
- 4 MESSAGE MAX. UP TO 20 SECONDS
- LED INDICATES RECORDING IN PROGRESS
- 6 VOLT INPUT ONLY DRAWS .5 uA STANDBY
- 7-13.8 VOLT REGULATED INPUT @ 30mA
- 8 OHM 50 MILLIWATT SPEAKER OUTPUT
- LINE LEVEL AUDIO OUTPUT (VARIABLE)
- FULLY ASSEMBLED (NOT A KIT)
- 100'S OF APPLICATIONS, ALARMS, PRODUCT DISPLAY, NOTE PAD, HAM, CB, MUSEUMS, ETC
- SWITCHES, MICROPHONE, & INSTRUCTIONS INCLUDED

ONLY **\$89⁹⁵**

COMING SOON



1145 CATALYN STREET
SCHENECTADY, NY 12303

MICRO-3
REPLAY UP TO 4.5 MINUTES
UP TO 1800 MESSAGES (NO DIODES)
MESSAGE CUEING (FAST FORWARD)

TECH. FAX: 518-381-1058

TO ORDER: CALL 1-(800)-588 4300

TECH. SUPPORT: 518-381-1057

PE MARKET CENTER CLASSIFIEDS

CABLE TV

"BULLET" BUSTER. Protect your cable box against the infamous cable "bullet." The "Bullet" Buster acts as an electronic shield. Installs in-line in seconds. Don't wait until it's too late! \$19.95 + \$3.00 S&H. Visa/MC. **ELECTROMAN**, Box 24474, New Orleans, LA 70184. (504) 482-3017.

CABLE - SAFE. Guarantee cable privacy. The one way valve for your cable TV signal. Cable signals come in, but they don't go out! \$29.95 + \$3.00 S&H. Visa/MC. **ELECTROMAN**, Box 24474, New Orleans, LA 70184. (504) 482-3017.

DESCRAMBLER SCHEMATICS REVEALED. A powerful guide to descrambling schemes. \$10.00. Visa/MC. **ELECTROMAN**, Box 24474, New Orleans, LA 70184. (504) 482-3017.

CABLE UNSCRAMBLED. Everything you want to know about cable, but are afraid to ask. \$10.00. Visa/MC. **ELECTROMAN**, Box 24474, New Orleans, LA 70184. (504) 482-3017.

UNIVERSAL DESCRAMBLER. Unscramble signals using your VCR as the tuner. Works with virtually any system, this is the only one you need. Declare cable box independence! \$129.95 + \$5.00 S&H. Visa/MC. **ELECTROMAN**, Box 24474, New Orleans, LA 70184. (504) 482-3017.

DIGITAL VIDEO STABILIZER. Eliminates all video copyguards during playback of pre-recorded tapes. \$23.95. For information send a SASE to: Marketing by Design, PO Box 84, Port Murray, NJ 07865.

CABLE DESCRAMBLERS bargain headquarters, all major brands. Absolutely the lowest prices! Nobody beats us. RP Electronics 1 (800) 304-3604.

CABLE DESCRAMBLERS, build your own, SSAVI, gated sync, sinewave, \$14.95. Cabletronics, Box 30502PE, Bethesda, MD 20824.

SATELLITE EQUIPMENT

VIDEOCIPHER II Descrambling manual. Schematics, video and audio, \$18.95. Software, \$25.00. Videocipher II 032, \$15.00. Videocipher II Plus, \$20.00. VCII Plus software, \$30.00. Cabletronics, Box 30502PE, Bethesda, MD 20824.

SATELLITE RADIO BOOK AND GUIDE. New book covers all audio services, SCPC, subcarriers, FM squared, facsimile, press services, weather services. Simple how-to-receive instructions. \$16.95 plus \$3.00 Priority Mail. UNIVERSAL ELECTRONICS, 4555 Groves Road, #12, Columbus, OH 43232. (614) 866-4605.

EDUCATION

LEARN IBM PC ASSEMBLY LANGUAGE. Disk \$5.00, Book \$18.00. ZIPFAST, Box 12238, Lexington, KY 40581-2238.

Cable Test Aids Information
Orders only 1-800-452-7090 (310)902-0841

Test chips for JERROLD, TOCOM, ZENITH, S.A. & more. Puts cable boxes in full service mode. Easy installation. Zenith only \$39.95. Most others under \$50ea. FAX: (310)902-0851. Quantity prices available.

No Ch. sales. Not for use in cable co. owned equip. For use as a test aid only.

CABLE TV CHANNELS
EQUIPMENT **GUARANTEED**
Direct! **FREE 30 DAY TRIAL**

The nationwide source for cable TV equipment.

"BUY WHERE THE DEALERS BUY."

FREE TV Cable Descramblers and Converters Catalog. Open Every Day!

YOUR VCR TAPES CAN PLAY AS CLEAR AS DAY! Why put up with inconsistent Color, Flashes and Streaking and Interference!

UNJAM NOW WITH Video Decoder

- Easy Connections
- Eliminates "jamming"
- Copy any tape
- RC Plugs included
- 2 Year Warranty
- 30 Day Money Back Guarantee

MEGA ELECTRONICS SAVE 1000's
VISA MC C.O.D. **1-800-676-6342**
21 S. Main St., Winter Garden, FL 34787

SURVEILLANCE
& COUNTERSURVEILLANCE Electronic Devices

Covert Video Cameras • Transmitter Kits • Voice Changers
Bug and Phone Tap Detectors • Shotgun Mics • Micro Recorders
• Vehicle Tracking • Locksmithing • AND MORE!

16 - Hour Telephone Recorder! silently tapes incoming/outgoing phone calls automatically. **\$199.00**

CHREDIT CARDS WELCOME
FOR CATALOG SEND \$5.00 TO...
SDY OUTLET P.O. Box 337, Buffalo, NY 14226 (716) 691-3478

March 1995, Popular Electronics

Radiotelephone - Radiotelegraph

FCC Commercial License

Why Take Chances?

Discover how easy it is to pass the exams. Study with the most current materials available. Our **Homestudy Guides, Audio, Video or PC "Q&A"** pools make it so fast, easy and inexpensive. No college or experience needed. The new commercial FCC exams have been revised, covering updated Aviation, Marine, Radar, Microwave, New Rules & Regs, Digital Circuitry & more. We feature the Popular "Complete Electronic Career Guide" 1000's of satisfied customers **Guarantee to pass or money back.** Send for **FREE DETAILS** or call

1-800-800-7588

WPT Publications
4701 N.E. 47th Street
Vancouver, WA 98661

Name _____

Address _____

City _____ St. _____ Zip _____

1-800-800-7588

PE MARKET CENTER CLASSIFIEDS

MISCELLANEOUS ELECTRONICS FOR SALE

THE CASE Against Patents. Thoroughly tested and proven alternatives that work in the real world. \$28.50. **SYNERGETICS PRESS**, Box 809-C, Thatcher, AZ 85552. (602) 428-4073. Visa/MC.

TURBO CHARGE your amplifier. Guide to increase wattage of existing power amplifiers. Send \$7.50 for complete book. **JAM Electronics**, 7391 St. Hwy 78, Gratiot, WI 53541.

Quality Microwave TV Antennas

WIRELESS CABLE - IFTS - MMDS - Amateur TV
Ultra High Gain 50db(+) • Tuneable 1.9 to 2.7 Ghz.

- 55-Channel Dish System \$199.95
- 36-Channel Dish System \$129.95
- 20-Channel Dish System \$124.95
- Optional Commercial Grid Antenna (not shown) Add \$50.00
- Vag Antennas, Components, Custom Tuning Available
- Call or write (SASE) for "FREE" Catalog

PHILLIPS-TECH ELECTRONICS
P.O. Box 8533 • Scottsdale, AZ 85252
(602) 947-7700 (\$3.00 Credit all phone orders)
MasterCard • Visa • American Express • COD's • Quantity Pricing

Dish System
LIFETIME WARRANTY

SMALL COMPANY • BIG DISCOUNTS!

CABLE TV DESCRAMBLERS AND CONVERTERS

Discover Top Brands Available American Express

MasterCard SATISFACTION GUARANTEED! COD

Visa 1-800-775-0444 Check by Phone

T.C. ELECTRONICS

Decoders and Descramblers must be not used without authorization by your local cable operator. No Tennessee sales.

BUGGED??

EAVESDROPPING is unbelievably widespread! Electronic Devices with amazing capabilities can be monitoring your telephone and room conversations **RIGHT NOW!** Are you sure you're safe? **FREE CATALOG** tells you fast! Includes Free Bonus details on fantastic opportunities now open in Counter-Surveillance field. Exciting, immensely interesting and **EXTREMELY** profitable (up to \$250/hr) full/part-time income. Call Now! **1-800-732-5000**

!! BROADCAST & SURVEILLANCE !!

70-120MHz FM Transmitters & RF Amplifiers
RF Power/SWR Meters, Stereo Generator, DC Power Supplies, Frequency Counters, Audio Limiters, Amateur and Pro Radio Gear, Electronic & RF Components, Plans, Kits, and more! Send \$2 (refundable on first order) for complete catalog.

Progressive Concepts
1434 N. MILLS AVE., SUITE B
CLAREMONT, CA 91711 (909) 626-4969 (909) 626-494X

PLANS-KITS-SCHEMATICS

BUILD — FIVE-digit, ohms, capacitance, frequency, pulse, multimeter. Board and Instructions \$9.95. Bagnall Electronics, 179 May, Fairfield, CT 06430.

ALL-IN-ONE catalog. AM/FM/ham/spy, transmitters, amplifiers, receivers. Voice scramblers/disguisers, audio, TV, Tesla coils, plans, "secret" books, kits, imports, exports and more. Start your own licensed or unlicensed radio station, 60 full pages for \$1.00. **PAN-COM INTERNATIONAL**, PO Box 130-H3, Paradise, CA 95967.

FM STEREO TRANSMITTER kit broadcasts any audio signal to FM stereo radios throughout your home. Uses unique BA1404 IC. Complete kit: PC board/components — \$24.00. Visa/MC. **TENTRONIX**, 3605 Broken Arrow, Coeur d'Alene, ID 83814. (208) 664-2312.

HOBBYIST CIRCUITS — Remote room monitor, tone decoder, long distance circuit control and more. Simple experiments for the beginner. **CATALOG \$2.00** — Garrett Plans, Box 155, Jamesburg, NJ 08831.

HC11 KITS

LOW COST kits feature HC11 processor, RS-232, 4-R/C servomotor jacks, 8 analog inputs, EEPROM, RAM, I/O lines, **FREE** PC software, manuals & more: \$47.00 plus S/H. Parts available separately.

Call or write for free brochure.

ZORIN, Unit D, POB 30547, Seattle, WA
98103-0547 (206) 282-5179. zchris@askimo.com

SURVEILLANCE TRANSMITTER kits. 65 to 305 MHz. **Quick & Easy.** Partially assembled units. Five minutes completion. 110-volt duplex receptacle, room battery types, and telephone. Counter-surveillance. Catalog: \$2.00. **SHEFFIELD ELECTRONICS**, PO Box 377940-B, Chicago, IL 60637-7940.

ROOM TRANSMITTER

BATTERY LIFE: 8 DAYS
• KIT REQUIRES 10 MINUTE SOLDER & ASSEMBLY
• COMES WITH PLASTIC CASE & INTERNAL BATT.
• 72-90 MHz (TV SOUND & FM BROADCAST)
• PICKS UP CONVERSATION FROM 60 FEET
• RANGE: UP TO 1/4 MILE ADVERSE CONDITIONS
• RF POWER: 20 mW @ 9 VOLTS **FREE CATALOG \$2.95**



AUDIO INVESTIGATIVE EQUIPMENT
19360 Rinaldi Street, Bldg. #14, Unit 2
Northridge, CA 91326 (818) 831-0318

Prototype it..... FAST!

Run prototype applications or experimental hardware from the serial port. **WITHOUT PROGRAMMING!**

with ProtoQuick 8051 or Z8
• Complete single board computer
• Up to 32K EPROM and 8K RAM
• 18 pin IC, plated-through proto area
• RS232 Cramer port or RS25 serial
• Op. sys in EPROM or source code
• Assembled - ready to run - 5v only
• ME-OCX cross assembler included

ProtoQuick Z8 and 8051
\$99.00 each

Software license
2700 Northpark Road
Cincinnati, OH 45244
(513) 561-2080

FASCINATING DEVICES! FREE plans with parts special! Super spy microphone \$19.50! Super FM transmitter varactor tuned \$22.50! Vocal truth detector \$39.50! Bug detector 10 GHz bargraph, audible \$47.50! Universal IC tester tests any IC \$24.50! Hypersonic dazer defend yourself \$34.50! Radar cloaker electronic shield \$29.50! Laser jammer \$39.50! PC Boards \$10.00 each. Package of all 8 plans \$25.00! S&H \$5.00, catalog \$4.00 (creditable) or included with order! **QUANTUM RESEARCH**, 17919 - 77th Avenue, Edmonton, Alberta, Canada T5T 2S1.

YOU WON'T be caught flashing with **SILENT SAM**. Patented vehicle turn signal reminder warns when not to. Kit w/case \$15.00. Also, \$22.00/\$27.00 wired models plus \$2.50 S&H. Visa/MC. Money back guar. Toll free 1 (800) 398-5605, free flyer. **Silent Sam**, 1627 Basil Dr., Columbus, OH 43227.

CRYSTAL SET Handbook — Visit antiquity by building the radios your grandfather built. Assemble a "Quaker Oats" rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$3.50 for shipping and handling. **Electronic Technology Today, Inc.**, PO Box 240, Massapequa Park, NY 11762-0240. US funds only! USA and Canada — no foreign orders.

SPY EQUIPMENT! Transmitters! Surveillance, countersurveillance! Scramblers! Catalog, free plan \$5.00. **KDT WHOLESALERS**, 2219 Paliswood Place SW, Calgary, Alberta, Canada, T2V 3R3.

XMAS MUSIC chips & more. \$2.00ea! SASE for catalog w/plans. Thumb, Box 344, Marysville, MI 48040.

MOTOR GENERATOR gasoline bid for less than \$100.00. Must for camping, hunting, fishing, picnics, parties, construction fun simple easy. Plans \$12.95. **Sparky**, 13164 Memorial Drive, #124, Houston, TX 77079.

CABLE DIRECT CONVERTERS

DESCRAMBLERS VIDEO STABILIZERS FILTERS



100% MONEY BACK GUARANTEE!

30 DAY FREE TRIAL!

FREE Cable TV Catalog.



Now you can tune-in your favorite cable TV programming and **SAVE \$100'S - EVEN \$1000'S** on premium **CABLE TV EQUIPMENT.**

MODERN ELECTRONICS

1-800-906-6664

2125 S. 156TH CIRCL • OMAHA, NE 68130

March 1995, Popular Electronics

EPROM+ PROGRAMMING SYSTEM USES PARALLEL PORT

EPROMS (24,28,32 & 40 PIN*) PLUS 27CXXX
1702* 2708, TMS2716*, 32,32A, 64, 64A, 128, 128A
256, 512, 513, 011, 010, 101, 1001, 1000, 1024, 210, 020
2001, 220, 2048, 4001, 040, 240, 4096, 25XX, 68764/66
FLASH EPROMS 28F256, 28F512, 28F010
28F020, 29C257, 29C010, 29F010
EEPROMS & NVRAMS (18,24 & 28 PIN+CXX)
2210, 2212, 2804, 2816, 2816A, 2817, 2864, 2865, 28256
28C010, DS1220, DS1225, DS1230
SERIAL EPROMS* (8 & 14 PIN PLUS CXX)
ER1400, M58657, 2401.02, 04, 08, 16, 2444, 59C11
9306, 46, 56, 66, 8572, 82, 92
BIPOLAR PROMS* (16 THROUGH 24 PINS)
74SXXX AND 82SXXX FAMILY
MICROCONTROLLERS* 8741, 42, 48, 49, 8751
C51, 8752, 87C52, 87C5XXX, 87C751, 87C752, 68705
68HC705, 68HC711E9, PIC16C5X, TMS7742
*ADAPTER REQ'D - DIAGRAMS INCLUDED

SOFTWARE - READ, VERIFY PROGRAM, COPY
DISK FILE LOAD/SAVE, CHECKSUM, FULL
SCREEN BUFFER EDITOR W/20 COMMANDS
READS HEX, S-RECORD AND BINARY FILES
FAST-DEVICES PROGRAM IN UNDER 60 SEC
RUGGED (8" X7" X3") ENCLOSURE W/HANDLE
MADE IN USA - 1 YEAR WARRANTY

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150
(513) 831-9708 FAX (513) 831-7562



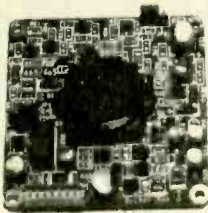
SYSTEM INCLUDES:
PROGRAMMING UNIT
PRINTER PORT CABLE
POWER PACK, MANUAL
AND SOFTWARE.

\$289

ADD \$5.00 SHIPPING
\$5.00 C.O.D.
VISA/MASTERCARD

MICRO CAMERA

Sees an entire room through an 1/8" hole



\$215 introductory price

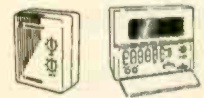
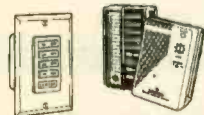
Only 1.65 x 1.65 x .5 inches
90° field of view
operates on 12 volts DC
380 lines of resolution
built in electronic iris
low light .5 lux
standard video output

NortheastMicro

(201) 794-1132

Po box 175 Elmwood Park NJ 07407

AUTOMATE YOUR HOME



Hundreds of hard-to-find home automation and wireless control products. Computer control of your home, security systems, surveillance cameras, audio/video control, HVAC, pet care automation and much more. Easy do-it-yourself installation on most products. Affordable, systems start at about \$20.



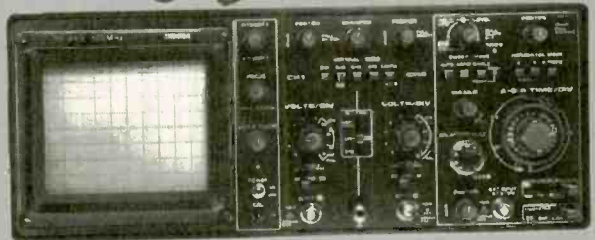
Largest Selection of X10 Compatible Products in the World
Call for our Free 64 page Color Catalog

800-SMART-HOME (800-762-7846)
HOME AUTOMATION SYSTEMS, INC.

151 Kalmus Dr., Ste M6, Dept. PE2, Costa Mesa, CA 92626
Questions 714-708-0610 Fax 714-708-0614

MCM ELECTRONICS

•Service •Selection •Value



- Wide Variety of Test Equipment for the Enthusiast or Professional
- Vast Selection of Consumer Electronics Repair Parts
- Computer Products From Cassettes to Board Level Components
- Over 21,000 Items Stocked and Ready to Ship
- 99% of All Orders Are Shipped Within 24 Hours

FREE

324 Page Catalog
With Over 2500
New Items

**MCM
ELECTRONICS**

For A FREE Catalog, Call...

1-800-543-4330

Technical questions... 1-800-824-TECH(8324)



MCM ELECTRONICSSM

650 CONGRESS PARK DR.
CENTERVILLE, OH 45459-4072

A PREMIER Company

POP-16

NEW HOURS: M-F 7a.m.- 9p.m., Sat. 9a.m.- 6p.m. EST

GET FAST DELIVERY FROM OUR DISTRIBUTION
FACILITIES IN DAYTON, OH AND RENO, NV!

CIRCLE 148 ON FREE INFORMATION CARD

Surface Mount Chip Component Prototyping Kits—

Only \$49.95



CC-1 Capacitor Kit contains 365 pieces, 5 ea. of every 10% value from 1pf to .33µf. CR-1 Resistor Kit contains 1540 pieces; 10 ea. of every 5% value from 100 to 10 megΩ. Sizes are 0805 and 1206. Each kit is ONLY \$49.95 and available for immediate One Day Delivery!

Order by toll-free phone, FAX, or mail. We accept VISA, MC, COD, or Pre-paid orders. Company PO's accepted with approved credit. Call for free detailed brochure.

COMMUNICATIONS SPECIALISTS, INC.
426 West Taft Ave. • Orange, CA 92665-4296
Local (714) 998-3021 • FAX (714) 974-3420
Entire USA 1-800-854-0547

MARYMAC® The New Realistic® PRO-43 Scanner

Radio Shack®

PHONES

Our 19th year of DISCOUNTS

Toll Free 800-231-3680

PRO-2035 List \$449.99

Our Delivered Price \$385.00

IF ON SALE, WE ARE CHEAPER!

We discount everything in the RS catalog

22511 Katy Fwy.

Katy (Houston), TX 77450

1-713-392-0747 FAX 713-574-4567

PROFESSIONAL SURVEILLANCE EQUIPMENT Used By Law Enforcement Agencies

VHF-FM CRYSTAL CONTROLLED TRANSMITTERS
A - 139MHz, B - 139.970 MHz, C - 149 MHz, D - 149.450 MHz
All kits assemble in less than 5 mins.

AD-F300 Gorgeous brass plant with 6 mirrors and concealed B&W video camera and video transmitter. Great for monitoring in living room, conf. room, office, or anywhere. Range 150 ft. \$880 (\$990 w/aud)	AD-700 Mic Range: up to 5 Mile Power 750MW \$272	AD-80 Mic Range: up to 1.8 Mile Power 80MW \$187	AD-550 Tel. Range: up to .5 Mile Power 35MW \$150	AD-480 Mic Range: up to 2.5 Mile Power 400MW \$163
--	---	---	--	---

If you need our technology in a diff. configuration for your needs, call! We can probably build it for you. We have other state-of-the-art surveillance equip. too!

We sell a variety of cameras, bug detectors, night vision equipment, video transmitters, time lapse recorders, remote video monitoring systems, and many more...

A&D ELECTRONICS

P.O. Box 601, Monsey, NY 10952
914-356-7541 • Fax 914-356-7505
Request our full catalog for \$6, get \$10 off your first order.
Credit Cards accepted



The Pocket Programmer

The portable Eprom programmer that uses the printer port of your PC instead of an internal card. The software has 24 easy to use functions and programs 27/25/28/68764 & Cmos from 16K (2K × 8)—2M (256K × 8) Eproms (32 pin socket, UpGradeable to 8Meg). Adapters available for MCU's, 40-Pin Eproms, 5-Gang and Eprom Emulator to 32K × 8.

INTRONICS, INC. **\$129.95**
Box 13723 Add \$4.00 for shipping.
Edwardsville, KS 66113 Add \$4.50 for COD.
(913) 422-2094 Visa/Master Charge

NEW EASY PC

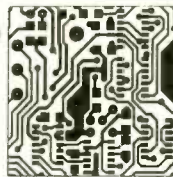
BRITISH DESIGN AWARD

SCHEMATIC and PCB C.A.D

ONLY **\$195**

Includes

- MGA, CGA, EGA & VGA compatible.
- Design large multi layer boards.
- One level pull down menu and quick keys for fast layout.
- Dot matrix, laser, plotter, Gerber & N.C. drill output.
- 6 Month Free update Free Demo



7840 ANGEL RIDGE ROAD
ATHENS, OHIO 45701
(614) 592-1810

Visa & MasterCard Accepted

DIGITAL VIDEO STABILIZER

Get clear videos every time! Enjoy a clear picture with pure color and clarity on all your rented video tapes. The Digital Video Stabilizer (DVS) eliminates darkening and shifting of colors, unwanted lines and flashing or jagged edges caused by copygards. State of the art digital circuitry completely eliminates all copy protection and jamming signals. The DVS is ultra compact and fully automatic. Just pop in one 9V battery and hook it up! Com patible with all VCRs and TVs. 30 day money back guarantee. Order Now!

ONLY \$29.95 + S/H

WARNING: The DVS is not intended to copy rental video tapes that may constitute copyright infringement.

A-Plus Electronics 800-877-7587

CABLE TV EQUIPMENT

We carry a complete line of all major brands including test chips and all accessories
BELOW WHOLESALE PRICES • QUANTITY DISCOUNTS
30 DAY MONEYBACK GUAR. • 1 YR. WARRANTY
YEARS OF CUSTOMER SATISFACTION
C & C ELECTRONICS
CALL NOW 1-800-995-1749

Immed. Delivery from Giant Stock! Sorry No California Sales

\$129* Laser Light Show

This kit displays animation, text, drawings, & music! Includes 2 Galvos, VCO, Computer Interface, Manual & Software listing. Works from parallel printer port.

Computerized Motors \$39*

Includes: 2 Stepper or 4 DC servo motors, Computer interface kit, 32 page training manual & Software listing. Works from parallel printer port.

* Add \$5 for shipping. Computer and Laser not included.

Call for **FREE** Flyer

SVS
Light & Motion
in kit form

1273 Industrial Pky. W#460
P O Box 55125
Hayward CA 94545-0125
510-582-6602

Device Programmers

W	\$1349	DATA I/O CHIPLABS 4800
E	\$ 799	DATA I/O CHIPLABS 3200
W	\$ 579	EETOOLS ALLMAX
I	\$ 479	EETOOLS PROMAX
L	\$ 350	XELTEK SUPERPRO (R)
L	\$ 599	LOGICAL DEVICES 3000
B	\$ 599	ADVANTECH PC-UPROG
E	\$ 269	SUNSHINE UNIVERSAL
A	\$ 129	PAL PROGRAMMER
T	\$ 429	NEEDHAMS EMP-20
A	\$ 679	NEEDHAMS SA-20 S/ALONE
N	\$ 139	EETOOLS 1 GANG
Y	\$ 199	EETOOLS 4 GANG
	\$ 49	SUNSHINE 1 GANG
P	\$ 99	SUNSHINE 4 GANG
R	\$ 169	SUNSHINE 8 GANG
I	\$ 349	SUNSHINE 16 GANG
C	\$ 38	UV ERASER 4 PROM

General Device Instruments
(408) 241-7376 Fax 241-6375

Satellite-TV

SAVE 40% - 60%
800-334-6455
218-739-5231 Int'l
218-739-4879 Fax
Skyvision Inc.®
1048 FRONTIER DRIVE • FERGUS FALLS, MN 56537

PE MARKET CENTER CLASSIFIEDS

ANTIQUE ELECTRONICS

EDU-KITS Vacuum tubes, parts, instruction, books. Progressive Edu-Kits, PO Box 238, Hewlett, NY 11557.

AUDIO-VIDEO-LASERS

LASERS, LIGHTSHOWS, Holography. Lowest prices. For free catalog write: Midwest Laser Products, PO Box 2187, Bridgeview, IL 60455. Or call: (708) 460-9595.

INSTEK Test & Measuring Instruments

DC POWER SUPPLIES PR-Middle Series (Analog/Digital)

ISO 9002
CERTIFICATION
#934163



- Continuous or Dynamic load for internal selectable
- Low ripple and noise
- 0.01% high regulation
- Overload and Reverse polarity protection
- Constant voltage and constant current modes
- 3½ Digits 0.5" LED display (Digital type only)

MODEL #PR6030D (Digital)
Regular \$500.00
Sale \$399.95

MODEL #PR6030 (Analog)
Regular \$379.00
Sale \$299.95

	Model	Output Volts (V)	Output Amps (A)	Weight (kg)
Analog	PR-6030	0~60	0~3	11.5
Digital	PR-6030D	0~60	0~3	11.5

PRINT™

Products International

Test Instruments, Equipment and Tools, Training and Supplies for Electronic Maintenance and Repair
8931 Brookville Road • Silver Spring, Maryland, 20910 • 800-638-2020 • Fax 800-545-0058



TOLL FREE
800-638-2020

NEW 84 PAGE CATALOG!!!
Call Today For Your FREE Copy
Of The 1994 Print Test
Equipment Catalog!

CIRCLE 151 ON FREE INFORMATION CARD

PE MARKET CENTER CLASSIFIEDS

SECURITY

SURVEILLANCE, LASERS. Home automation, security, Tesla. For catalog send 5 dollars to Cyber Tech Systems, PO Box 977, Lubbock, TX 79408.

BURGLARS IN L.A. are breaking car windows without activating alarms!! Free, simple, 100% effective method described. Protect your car and valuables. Send \$5.00 to PO Box 24188, Ventura, CA 93002.

BUSINESS OPPORTUNITIES

START your own technical venture! Don Lancaster's newly updated **Incredible Secret Money Machine II** tells how. We now have autographed copies of the Guru's underground classic for \$18.50. **SYNERGETICS PRESS**, Box 809-C, Thatcher, AZ 85552. (602) 428-4073. Visa/MC.

LOOK HERE! We need your help to process our mail. Rush stamped envelope to: **MONEYMASTER-PE**, PO Box 89, Schenectady, NY 12301.

GREAT EXTRA income! Assemble products at home. Easy and fun to do. Guaranteed! 1 (800) 377-6000 ex7930.

HOME AUTOMATION. Become a dealer in this fast-growing field. Free information. Send name, address, phone to ECS, Box 407, Fairbury, NE 68352 or call 1 (800) 838-4051.

ASSEMBLE TEDDY BEARS AT HOME. NO SEWING. FOR INFO SEND \$4.00 + SASE TO SHC, PO BOX 97683, PEARL, MS 39288.

PUBLICATIONS

HISTORIC AND Classic hardware support magazine. *The Computer Journal* provides how-to information on keeping S-100, Kaypro, Z80, 6809, CP/M, and PC/XT systems running. Over **TEN** years of hardware, software projects. 6 issues \$24.00. Free sample. 1 (800) 424-8825. TCJ, PO Box 535, Lincoln, CA 95648.

COMPUTER HARDWARE

PENTIUMS FOR PEANUTS! Upgrade your system to pentium power and save 50%. Digital design engineer tells all. Free details. Digatek, Suite 65, 2723 West Butler Drive, Phoenix, AZ 85051.

COMPUTER SOFTWARE

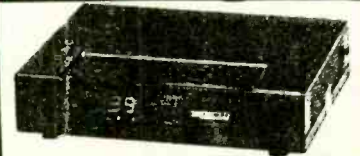
IVY — INVENTORY and electronic cataloging software for replacement parts. \$299.00. Free literature. Rossknecht Software (503) 885-2197.

SHAREWARE SOFTWARE Call or write for catalog disk. (615) 837-8352, 213 Holly Ave., S. Pittsburg, TN 37380.

COMPONENTS

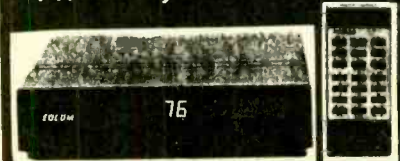
ELECTRONIC FASTENERS. Stainless Steel. Kits available. Free catalog. "Rusty Bolt," Box 708X, North Attleboro, MA 02761.

CABLE TV DESCRAMBLERS



We have Descramblers for:

- Jerrold Systems
- Scientific Atlanta Systems
- Pioneer Systems



- Panasonic TZPC145 99 ch converter w/ Parental Guard

**GUARANTEED TO WORK
OR YOUR MONEY BACK!**

CALL FOR FREE CATALOG
Please have the **MAKE & MODEL #** of your area's cable box ready when you call.

ALLSTAR ELECTRONICS
800-782-7214

It is not the intent of ALLSTAR ELECTRONICS to defraud any pay TV operator and we will not assist any company or individual in doing the same. Prices subject to change without notice.

ADVERTISING INDEX

Popular Electronics does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
- A&D Electronics	126	- ITC Microcomponents Inc.	111
- A-Plus Electronics	126	- ITC Microcomponents Inc.	112
125 Ace Communications	110	38 Kelvin Electronics	107
- Agrelo Engineering	123	- M&G Electronics	97
26 Alfa Electronics	102	- Marymac Industries Inc.	126
28 All Electronics	98	148 MCM Electronics	125
- Allen Engineering	112	- Mega Electronics	123
- Allstar Electronics	127	149 Mendelson's	119
- Andromeda Research	125	- Mental Automation	111
- Antique Radio Classified	73	42 MicroCode Engineering	108
- Audio Investigative Equip.	124	- Modern Electronics	124
146 B&S Sales	101	- NRI Schools	45,79
- Basic Electronic Supply	116	- Northeast Micro	123
- Black Feather	106	- Nu-Tek Electronics	73
- C&C Electronics	126	- Ohio Automation	126
- C&C Specialties	123	- PC Boards	112
132 C&S Sales	104	- Phillips Tech	124
- Cellsoft	114	145 Prairie Digital Inc.	121
- CLAGGK, Inc.	CV4.95	151 Print	127
- Cleveland Inst. of Electronics	27	46 Print	113
- Command Productions	121	- Progressive Concepts	124
- Communication Specialists	126	- Rattner North America	119
- Consumertronics	118	- The School of PC Repair	69
- Comtrad	12,23	- The School of VCR Repair	69
14 Cooks Institute. of Elec. Eng.	77	- Silicon Valley Surplus	126
162 Davis Instruments	29	- Skyvision (Small)	126
- Design Computation	118	- Software Science	124
- EDE Spy Outlet	123	- Spy Supply	100
159 The Electrician School	71	- TAB Books	5,63
147 Electronic Rainbow	103	- Tandy National Parts	93
- Electronics Tech. Today	69,83	130 Tech Serv.	106
154 Foley Belsaw Institute	65	- Tele View Distributors	111
- Forest Electronics	120	136 UCANDO Videos	122
- Fotronic Corporation	117	- United Electronic Supply	112
- General Device Instruments	126	- US Cable (Zentek)	119
- Genuine Electronics	120	- US Cable Supply	124
- Get-Tech Inc.	114	- US Cyberlab	113
- Grantham College	3	- US Cyberlab	118
- Great Southern Security	124	- Vision Communication Systems	115
- Greenleaf Electronics Inc.	121	- Vision Electronics	119
- Halcyon Group	113	168 Wavetek Corp.	7
- Home Automation Systems	125	- Weeder Technologies	97
- Home Tech Communications	73	- Weka Publishing	109
- Information Unlimited	65	- Windward Electronics	120
157 Interactive Image Technologies	CV2	- World College (Div. of C.I.E.)	67
- Intronics	126	- WPT Publications	124
144 Island LogiX Inc.	117	134 Xandi Electronics	116
150 ITC Instruments	99	- Zorin	124

ADVERTISING SALES OFFICE

Gernsback Publications, Inc.
500-B Bi-County Blvd.
Farmingdale, NY 11735
1-(516) 293-3000

Larry Steckler, EHF/CET
President

Christina Estrada
Assistant to the President

For Advertising ONLY
516-293-3000
Fax 1-516-293-3115

Larry Steckler
publisher

Arline Fishman
advertising director

Denise Mullen
advertising assistant

Kelly Twist
credit manager

**Subscription/
Customer Service/
Order Entry**
1-800-827-0383
7:30 AM - 8:30 PM EST

ADVERTISING SALES OFFICES EAST/SOUTHEAST

Stanley Levitan
Eastern Sales
1 Overlook Ave.
Great Neck, NY 11021
1-516-487-9357, 1-516-293-3000
Fax 1-516-487-8402

MIDWEST/Texas/Arkansas/ Oklahoma, Colorado, Arizona

Ralph Bergen
Midwest Sales
One Northfield Plaza, Suite 300
Northfield, IL 60093-1214
1-708-446-1444
Fax 1-708-559-0562

PACIFIC COAST/Mountain States

Anita Bartman
Hutch Looney & Assoc., Inc.
6310 San Vicente Blvd.
Suite 360
Los Angeles, CA 90048
1-213-931-3444
Fax 1-213-931-7309

What Do These Prestigious Companies Have In Common?

Aerovox®

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

AMP

Electrical/Electronic Connectors, IC Sockets, PCB Switches

AMRAD Engineering, Inc.

Motor Run Capacitors, HID Lighting Capacitors, Power Factor Correction Capacitors



Miniature and Subminiature Coaxial Connectors and Cable Assemblies.

AVX CORPORATION

MLC, Tantalum and Thin Film Capacitors, Resistors, Networks, Integrated Passive Components, Trimmers, Oscillators, Resonators, Filters, Piezo Devices, and Connectors

BERG ELECTRONICS

High Density and Industry Standard Connectors/Subsystems

CAROL

Electronic and Electrical Wire and Cable and Power Supply Cords

COLE FLEX

Tubing, Conduits, Hose, Sleeveings, Splices, Insulation and Cable Harness Products, Power Cords and Cordsets

Communications Instruments, Inc.

Relays and Solenoids

COOPER

Fuses, Fuseholders, Fuse Blocks, and Fuse Accessories

CORNELL DUBILIER

Capacitors-Aluminum Electrolytics, Mica, AC Oil, Film, MICA Paper and Relays



Dale Electronics, Inc.

Resistors, Networks, Oscillators, Displays, Inductors, Thermistors, Connectors, & Transformers

DANTONA INDUSTRIES, INC.

Batteries: Computer, Cordless Phone, Laptop, Scanner, Alarm and Medical
Antennas: Cordless Phone and Scanner

DEARBORN WIRE AND CABLE L.P.



EATON

Eaton Corporation, Commercial & Military Controls Operation
Switches, Relays, Displays and Keyboards



Quartz Crystals, Clock Oscillators, Surface Mount Products, Programmable Devices

GERNSBACK PUBLICATION

Electronics Now Magazine

GUARDIAN

Relays and Solenoids

KEMET

Electronics Corporation
Multilayer Ceramic and Solid Tantalum Capacitors

KOA SPEER

Resistors, SMT Tantalum Capacitors Inductors, Resistor Networks, SMT Thermistors

MALLORY

North American Capacitor Company
Tantalums, Aluminums, Sonalerts® Ceramics, Films and AC's

M-tron

Quartz Crystal
Hybrid Oscillators

muRata®

Fixed Ceramic Capacitors, Variable Capacitors and Resistors, Crystal Oscillators, Ceramic Filters, Resonators, EMI Filters, Hybrid Circuits and more.

Panasonic Industrial Company

Resistors, Resistor Networks, Ceramic, Film, Electrolytic, Double Layer Capacitors, Potentiometers, Switches, Inductors, Filters, Resonators, Varistors, Thermistors

Philips Components

Resistors, Ferrite Components
Aluminum Electrolytic, Film & Ceramic Capacitors

They sell through distributors.

They belong to the E.I.A.

They belong on your vendor list.

Quam

Loudspeakers and Commercial Sound Products

ROHM

Rohm Electronics Division
Resistors, Ceramic Capacitors, Transistors/Diodes, Opto Components and IC's

SELECTA

Switches, Relays, Terminals, Indicator/Pilot Lights, LED Indicators, Test Clips, Test Leads, Cable Ties and Heat Shrinkable Tubing

SPRAGUE

Tantalum Capacitors, Wet & Foil Capacitors, Resistor Networks, Resistor Capacitor Networks, Filters

Switchcraft

Switches, Connectors, Jacks, Plugs, Jackfields & Audio Accessories, Cable Assemblies

Leadership in electronics is not just a matter of designing products better and manufacturing them better, but also of marketing them better. And the sponsors of this message understand that better service to customers requires effectively involving distributors as part of their marketing teams.

Distributor involvement means lower prices, quicker deliveries, better service over-all. The Buyer wins...the Seller wins.

Distributors help achieve marketing leadership. So does the manufacturer's involvement in the Components Group of the Electronic Industries Association. EIA fosters better industry relations, coherent industry standards, and the sharing of ideas, which helps one another and serves customers better.

In choosing your component supplier, look for the marks of leadership--

availability through distribution membership in E.I.A.



Our 70th Anniversary Year

Electronic Industries Association/Components Group
2001 Pennsylvania Avenue, N.W., 11th Floor
Washington, D.C. 20006
Phone: (202) 457-4930
Fax: (202) 457-4985

Committed to the competitiveness of the American electronics producer.

Countersurveillance

Never before has so much professional information on the art of detecting and eliminating electronic snooping devices—and how to defend against experienced information thieves—been placed in one VHS video. If you are a Fortune 500 CEO, an executive in any hi-tech industry, or a novice seeking entry into an honorable, rewarding field of work in countersurveillance, you must view this video presentation again and again.

Wake up! You may be the victim of stolen words—precious ideas that would have made you very wealthy! Yes, professionals, even rank amateurs, may be listening to your most private conversations.

Wake up! If you are not the victim, then you are surrounded by countless victims who need your help if you know how to discover telephone taps, locate bugs, or “sweep” a room clean.

There is a thriving professional service steeped in high-tech techniques that you can become a part of! But first, you must know and understand Countersurveillance Technology. Your very first insight into this highly rewarding field is made possible by a video VHS presentation that you cannot view on broadcast television, satellite, or cable. It presents an informative program prepared by professionals in the field who know their industry, its techniques, kinks and loopholes. Men who can tell you more in 45 minutes in a straightforward, exclusive talk than was ever attempted before.

Foiling Information Thieves

Discover the targets professional snoopers seek out! The prey are stock brokers, arbitrage firms, manufacturers, high-tech companies, any competitive industry, or even small businesses in the same community. The valuable information they filch may be marketing strategies, customer lists, product formulas, manufacturing techniques, even advertising plans. Information thieves eavesdrop on court decisions, bidding information, financial data. The list is unlimited in the mind of man—especially if he is a thief!

You know that the Russians secretly installed countless microphones in the concrete work of the American Embassy building in Moscow. They converted



**CALL
NOW!**

1-516-293-3751

**HAVE YOUR
VISA or MC CARD
AVAILABLE**

what was to be an embassy and private residence into the most sophisticated recording studio the world had ever known. The building had to be torn down in order to remove all the bugs.

Stolen Information

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

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

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

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

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

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

The Dollars You Save

To obtain the information contained in the video VHS cassette, you would attend a professional seminar costing \$350-750 and possibly pay hundreds of dollars more if you had to travel to a distant city to attend. Now, for only \$49.95 (plus \$4.00 P&H) you can view *Countersurveillance Techniques* at home and take refresher views often. To obtain your copy, complete the coupon or call.

CLAGGK INC. PE
P.O. Box 4099 • Farmingdale, NY 11735

Please rush my copy of the Countersurveillance Techniques Video VHS Cassette for a total cost of \$53.95 each (which includes \$4.00 postage and handling).

No. of Cassettes ordered _____

Amount of payment \$ _____

Sales tax (N.Y.S. only) _____

Total enclosed _____

Bill my VISA MasterCard

Card No. _____

Expire Date _____ / _____

Signature _____

Name _____

Address _____

City _____ State _____ ZIP _____

www.americanradiohistory.com