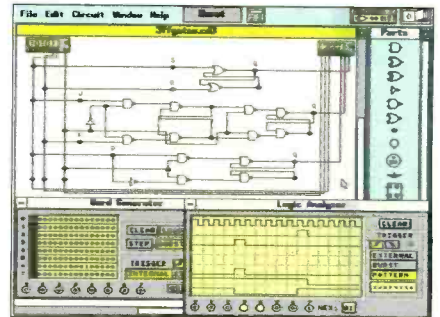


“Electronics Workbench – As an affordable tool for performing design trade-offs, you can’t beat it.”

M.A. Chapman
Oceanside, California

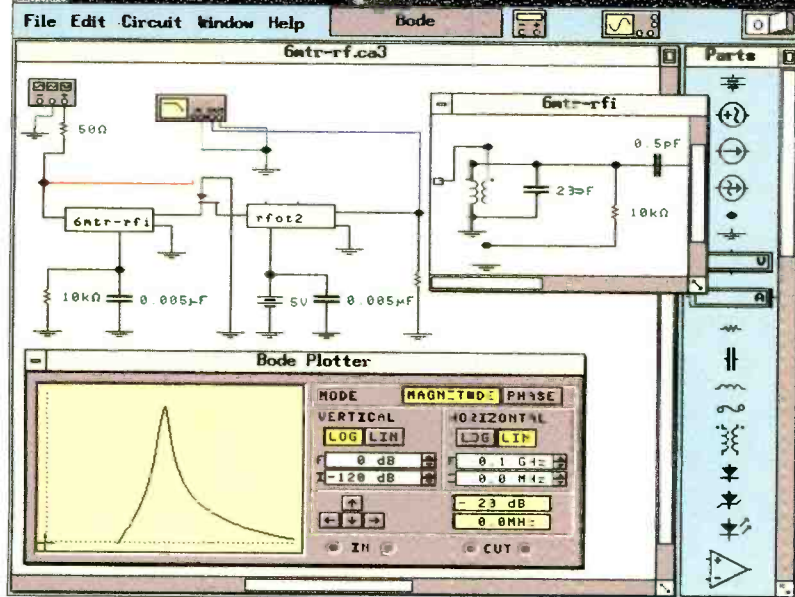
Electronics Workbench gives you the freedom to quickly translate your design concepts and specs into a workable circuit. Fine tune effortlessly. Play 'what if' scenarios. And monitor the circuit response. The simulated components and test instruments work just like the real thing.



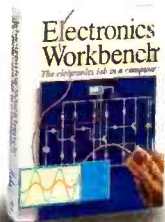
Digital Module: Analyzing a logic circuit.

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.**



Analog Module: Tuning an RF front end.



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



Electronics Workbench[®]

The electronics lab in a computer[™]

Call: 800 263-5552

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®

JANUARY 1995

Vol. 12, No. 1

A
GERNSBACK
PUBLICATION

COVER STORY

31 Build a Telephone-Line Simulator

A complete telephone-system-in-a-box; you can use this telephone-line simulator to test telephones, Fax machines, answering machines, and more, or set up your own simple two-station phone system—
Thomas E. Black

CONSTRUCTION

49 Build a Simple WWV Receiver

Get time, weather, frequency, and other information whenever you need it—*Brian McKean*

53 Build a Vacuum-Tube Audio Amplifier

Experiment with the warm sound of vacuum-tube audio without putting a dent in your wallet—*Larry Lisle*

FEATURES

40 A DX Beam-Aimer Program

Accurately aim your beam antenna with this easy-to-use program—
Fred Blechman

45 A Hobbyist's Guide to Surface-Mount Technology

The information, tools, techniques, and parts sources you need to make working with surface-mount components easier than you ever imagined—*Ronald A. Reis*

56 Popular Electronics 1994 Annual Index

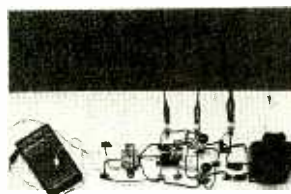
Your guide to a year of electronics information, projects, and fun



Page 9



Page 31



Page 53

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. © 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 61054-0932.

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.

PRODUCT REVIEWS

9 Gizmo

Apple Computer Newton MessagePad, Oldsmobile Aurora with Bose Audio System, California Audio Systems CD Player, and much more

24 Hands-On-Report

Elenco Electronics Telephone-Line Analyzer

COLUMNS

6 Multimedia Watch

This and that—*Marc Spiwak*

28 Think Tank

Temperature-controlled projects—*John Yacono*

64 Antique Radio

Tel-Ohmike wrap-up—*Marc Ellis*

68 Computer Bits

Buy or upgrade?—*Jeff Holtzman*

71 Circuit Circus

More ultrasonic circuits—*Charles D. Rakes*

75 DX Listening

Helping out the newcomers—*Don Jensen*

77 Ham Radio

A step-attenuator project—*Joseph J. Carr*

82 Scanner Scene

Monitoring VIP military aircraft—*Marc Saxon*

DEPARTMENTS

3 Editorial

4 Letters

80 Electronics Market Place

84 Electronics Library

86 New Products

95 Popular Electronics Market Center

126 Advertiser's Index

127 Free Information Card

Larry Steckler, BHF, 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
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 Torrillo,
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 126**

Composition by Mates Graphics

Cover by Loewy Design
Illustration by Kerry Kehoe



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

HOBBYISTS AND SMT

By now, most readers of this magazine are familiar with the revolution in electronics assembly called "Surface-Mount Technology." If you are not, and if you are like most hobbyists, let me tell you now that you are going to hate it.

Developed to make automated assembly of electronics devices and products easier, quicker, and more reliable, surface-mount technology is a manufacturer's dream-come-true, but can be a hobbyist's nightmare. PC-boards without holes, tiny rice-grain-sized components, and ultra-compact component spacing are just some of the "features" of SMT. Add to that the fact that many surface-mount components are available only on reels or in strips, and not in quantities of one or two, and it's almost enough to drive one to take up knitting instead.

But don't despair! Things are not as bad as they look at first glance. Surface-mount circuitry can be assembled using pretty much the same tools and materials you presently use, although you will have to learn some new techniques. What's more, as SMT gains in popularity, more and more distributors are adding items to their product lines, and at prices that are affordable to the majority of hobbyists.

As with every change in technology, there are going to be hobbyists who will rage against surface mount. Unfortunately, if industry dictates the change, hobbyists will either have to adapt, or eventually become extinct. Personally, I don't intend to go the way of the dinosaurs.

If you agree, and want to learn what you need to know to become a successful surface-mount hobbyist, check out "A Hobbyist's Guide to Surface-Mount Technology." That article gives you the information you need to make the transition, including some background on the different surface-mount components available; the techniques, tools, and materials you need to do surface-mount assembly; and a list of sources that sell surface-mount components in quantities and prices that are reasonable for hobbyists. The story begins on page 45.



Carl Larson
Editor

SURVEILLANCE & SECURITY

FM TRANSMITTERS MINI (KITS)

- 3-VOLT FM XMTR, up to 300 ft. indoors, 1500 ft. outdoors
- PHONE XMTR, range to 500 ft., uses phone-line power
- Sound-Activated XMTR, range to 500 ft.
- 2-STAGE XMTR, 9-Volt, very powerful

All above require simple soldering at 2 to 4 places.
\$29.95**

TELE CALL FORWARDER. Transfers incoming calls. **\$99.00***

CALLER ID. Registers incoming number. **\$99.00***

TEL REGISTER WITH PRINTER. Records dialed number, duration, and prints record. **\$169.00***

TEL REGISTER W/O PRINTER. Records dialed number & time. 16-digit display. **\$99.00***

12-HOUR LONG-PLAY RECORDER. Modified Panasonic. Records 6 hrs. on each side of 120 tape (supplied). Compatible with VOX and Tel Rec Adapter. **\$119.00***

VOX VOICE-ACTIVATED SWITCH. Makes recorder self-activating with voices or other sounds. **\$28.50****

TELE RECORDING ADAPTER. Records incoming and outgoing calls. **\$28.50***

TELEPHONE SCRAMBLERS. Over 4,000 separate codes. **\$199.00***

VOICE CHANGER. Changes man's voice to lady's and vice versa. **\$49.00****

For Shipping & Handling add **\$5.00 and **\$2.00 per item. Colo. residents add sales tax. Mail Order, VISA, M/C, C.O.D.'s o.k. Inquire for dealer prices. Free catalog.

MUCH, MUCH MORE — OUR 25TH YEAR!

TOLL FREE 1-800-926-2488

A.M.C. SALES, INC.

193 Vaquero Dr., Boulder, CO 80303

Tel: (303) 499-5405, Fax: (303) 494-4924

Mon.-Fri. 8 a.m.-5 p.m. Mtn. Time

CIRCLE 151 ON FREE INFORMATION CARD

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



4251 CYPRESS DRIVE
JACKSON, MISSISSIPPI 39212

CIRCLE 14 ON FREE INFORMATION CARD

LETTERS

AC OR DC OMISSIONS

Congratulations to James P. Rybak on his account of the war of the currents, "AC or DC" (*Popular Electronics*, September 1994). However, his omission of Nikola Tesla's part in the history of AC development remains a mystery. Prior to Tesla, AC transmission lines carried single-phase currents and were limited to lighting. There was no self-starting induction motor for power. Tesla's polyphase patents changed all that. The Westinghouse Company gained the edge when it purchased the Tesla patents.

Also omitted in Rybak's account was General Electric's attempt to circumvent the Westinghouse polyphase patents. It was only through cross-patent agreements that GE was able to get in on the breakthrough in AC developments.

The omission of the name Tesla as well as the word polyphase in a history of alternating current development is unacceptable. Lord Kelvin, the famous British physicist, stated

that "Tesla had contributed more to electrical science than any man up to his time." Pretty strong talk when considering the long list of giants in this field of engineering. However, other leaders in electrical engineering made similar public statements. B.A. Behrend, who did so much work with AC and induction motors, stated that without "Tesla's work, the wheels of industry would cease to turn . . . our towns would be dark, our mills would be dead and idle." H.G.

Queensbury, NY

50-MHz FREQUENCY COUNTER CORRECTION

I just received the November 1994 issue of *Popular Electronics*. It contained several interesting articles, including "Build a 50-MHz Frequency

Counter," by Terry Weeder.

There is, I believe, an error in the schematic on page 34. It appears that the junction of R2, D1, and D2 should be grounded. The description of the input circuit, in the paragraph headed "About the Circuit," also implies that the point would be grounded.

I found all of the construction articles interesting, as I like to build test equipment and additions to test equipment.

B.S., CET
Hillsboro, MO

MONITORING AUTO AIR-CONDITIONERS

In the August 1994 issue of *Popular Electronics*, I found the article "Build An Air-Conditioner Monitor For Your Car" to be of interest. However, on many cars, a much simpler device can be used to warn of low refrigerant.

On most cars, a normal refrigerant charge will produce a pressure on the low side (the line from evaporator to accumulator to compressor in the article's Fig. 1) of about 35 psi, for a temperature of about 38°F with the engine idling. At driving speed, with the compressor running faster, both the pressure and the temperature will drop. To prevent freeze-up of the evaporator, the pressure switch will turn off the compressor when the pressure gets below about 25–30 psi (about 28°F). Then the pressure in the low side will rise, and the pressure switch will turn back on at about 40 psi.

Thus a simple tester can be made using only R1 and LED1, although I would increase R1 to 560 or 680 ohms. LED1 will indicate when power is applied to the compressor. At idle (stopped at a traffic signal, for instance), the compressor should seldom, if ever, cycle off. At driving speed, the rate of cycling on and off will vary, depending on driving speed, outside temperature, etc. If LED1 cycles off at idle, the air-

conditioning system is almost certainly low on refrigerant.

I made a simple portable tester using a similar principle. I used a six-foot length of 22-gauge stranded zip cord (speaker wire). I attached a pair of small, insulated alligator clips to one end and a 12-volt incandescent lamp to the other. (Using an incandescent lamp instead of an LED makes polarity unimportant.) The clips can be attached to the compressor lead under the hood, and the wire routed out of the hood and in the front edge of the door to place the lamp inside the car.

On many General Motors cars, there is a two-wire plug to the compressor. Under tape next to the compressor plug is a diode connected to the two wires. The leads of the diode are a convenient place to connect the alligator clips.

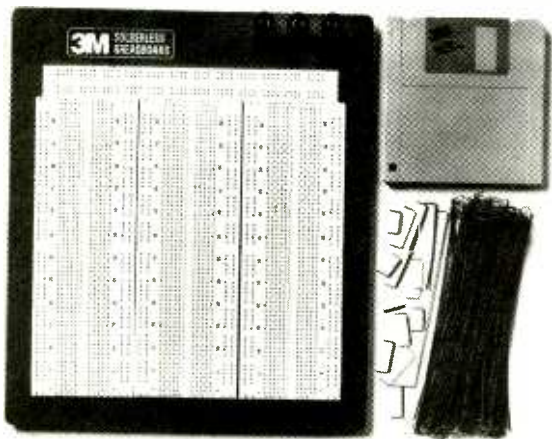
Some cars do not have the pressure switch; the compressor continues to run even if the pressure is low. In that case, the complete circuit of the Air-Conditioner Monitor would be most useful. There are, however, a couple of simple checks that can be made.

First, on a warm, but not extremely hot, day, after the car has been driven for several miles with the air-conditioner on, stop the car, but leave the engine and AC running. Raise the hood. If there is any ice visible on the accumulator or the low-pressure lines from the evaporator to the accumulator or the accumulator to the compressor, the system is low on refrigerant.

The second check is to feel the low-pressure line where it enters the compressor. It will be warm if the refrigerant is low, cool if there is sufficient refrigerant. If refrigerant is being lost, the low-pressure pipe at the compressor will get warm before enough refrigerant is lost to make the low-pressure pipe warm where it comes through the firewall.

B.S., CET
Hillsboro, MO

3M breadboards for less dough.



Lower prices, plus jumper wires and a diskette. No wonder interest is rising.

Remember, 3M Breadboards carry a lifetime warranty. For more information, call 1 (800) 328-0016, ext. 103.

© 3M 1994

3M Reliability

CIRCLE 164 ON FREE INFORMATION CARD

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, tele-communications, 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
WAH16

MULTIMEDIA WATCH

By Marc Spiwak

This and That

I've got a mixed bag of stuff this month, ranging from hardware to accessories to software. With so much to cover, let's get right to it.

ULTRASOUND MAX

We'll start with a new sound card from Advanced Gravis, the *UltraSound MAX*. Functionally, that card is very similar to the older *UltraSound*, although many things that I considered a nuisance with the older card have been eliminated from the new one.

The original *UltraSound*

ing capability and more, was added to the *UltraSound*.

Now, while I don't do very much recording with my sound card, I do like to have my CD-ROM drive's audio output patched directly through my sound card, so that I can control the volume level of CD audio with my software mixer. Unfortunately, the only way to do that with the older *UltraSound* was to buy the daughterboard, which also added the CD-ROM audio input. Without the daughterboard, those mixer controls simply could not be used. While the daughterboard was a reasonable solution, it added extra expense to the setup and also blocked an adjacent motherboard adapter-card socket. That's unacceptable in my book, especially when extra motherboard expansion slots can be so dear in a loaded PC.

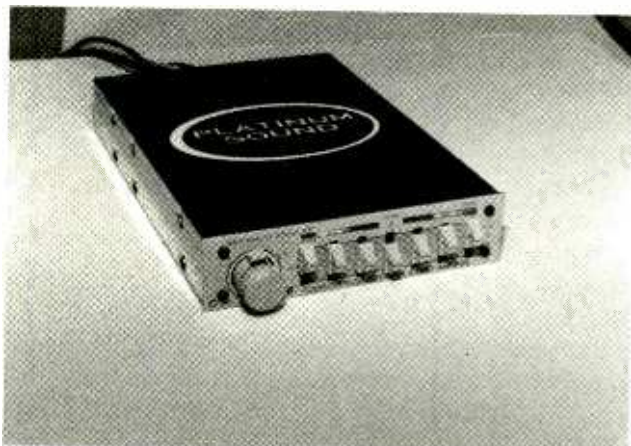
The new *UltraSound MAX* has the daughterboard built-in, which is much better aesthetically, and functionally as well. The *UltraSound MAX* is a full-length card (at the time of this writing), but a half-length multilayer board is due to replace it soon. The half-length card is supposed to be functionally identical to the full-length one, and should be available by the time you read this. I'm supposed to receive a demo of the new card as soon as it's available, so I'll let you know about it as soon as I can.

Anyway, the *UltraSound*

MAX I have now is a beauty of a sound card that's fully functional, while taking up only one slot. Separate interrupts are required for record and playback, but the new install software is improved and the card isn't difficult to get working. Sampling rates for 16-bit digital recording are normally limited to about 44 kilohertz, but the *UltraSound MAX* is capable of 48-kilohertz sampling for even better performance.

The card features 16 stereo digital channels that allow up to 32 voices to play at the same time. Built-in compression lets you fit more audio in less disk space. The card also features an expandable 5.6-megabyte general midi patch set with 192 instruments. Those patches remain on your hard drive until requested by software, at which point they are loaded into the card's memory. That hard-disk patch caching makes for a more professional card with great versatility; new patches can be made and stored on disk with the rest of them. As far as on-board memory goes, 512K RAM is standard, and it can be upgraded to 1 megabyte.

The card does not directly emulate a *Sound Blaster*, and so emulation software, included with the board, must be run to provide *Sound Blaster* support in DOS (Windows sound is fully supported). That used to be more of a problem. Most of the top games did (and still do) run under DOS



The Equalizer-Amplifier Pro is a 30-watt-per-channel amplifier/equalizer that fits into a 3½-inch drive bay.

was a 16-bit, wave-table synthesis, stereo sound card with a reasonable list price of \$199—actually, that was a bargain considering the card's excellent sonic performance. By itself, the *UltraSound* could play back 16-bit CD-quality audio, but only 8-bit recording was possible unless an optional daughterboard, which mounted on the main board added 16-bit record-

Measure It All!

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

only, and most did not initially provide direct UltraSound support. Unfortunately, running the emulation software often caused problems, both major and minor. Today, however, most good software packages provide direct UltraSound support, which is compatible with any UltraSound, MAX or otherwise, and more are adding it all the time. With direct UltraSound support, you'll hear some of the best digital sound you've ever heard, especially for MIDI.

The card also has a few goodies that go beyond its excellent sound support. A speed-compensating joystick port is built into the card. That is a must for anyone with a fast PC, simply because the standard PC game port is too slow for today's PCs. (Unfortunately, I understand that even this speed-compensating port has speed problems with some of the new and extremely fast Pentiums.) The speed-compensating port is also available in a separate game-controller card from Advanced Gravis, but having the feature built into the sound card saves an expansion slot.

The UltraSound MAX also has three built-in CD-ROM interfaces for Mitsumi, Sony, and Panasonic drives; the card does not support SCSI devices. External connectors on the card include stereo line-in, line-out, a 4-watt amplified output, and a joystick/MIDI adapter. A full suite of audio-related software is included with the card, allowing you to do anything you want with sound. With its improved design, better software, list price of just \$299, and more popular direct support, the UltraSound MAX is a sound card that I highly recommend.

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



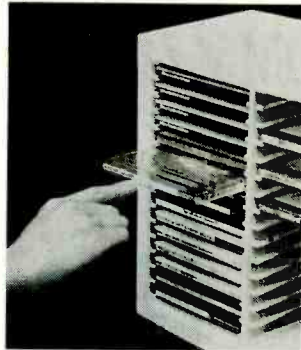
AN ACCESSORY SOURCE

Accessories are often used to solve problems or add new features to something you already have, and multimedia is an area where accessories are surely welcome. A company called SC&T² markets lots of multimedia accessories that address some common problems.

Often, when a multimedia PC is set up from scratch, there is no convenient way to adjust volume levels on amplified speakers without getting up and turning the volume control on one or both speakers, or exiting your software and adjusting a volume level from a software control panel. Sometimes a volume control is located on the back of the sound card—a location that's usually difficult to reach.

SC&T²'s *Platinum Sound Multimedia Volume Controller* is a handy little gadget that solves those problems and more, and has a list price of only \$24.95. That simple device, about half the size of a mouse, mounts on the side of a monitor with double-sided tape and has a volume control knob on its face. A four-foot cable connected to the controller splits into a "Y" at the end where a stereo input plug and stereo output jack are located. The plug plugs into the output on your sound card and your speakers plug into the jack. After initially setting the volume level on your sound card and speakers, the Multimedia Volume Controller makes it easy to readjust the volume.

Amplified speakers are quite popular in the multimedia market because many sound cards have no built-in amplification, and many cards with built-in amplification don't pack



Up to 30 discs automatically pop out of Elecom's CDR-001 at the touch of a finger.

much power. On the other hand, many people might want to use speakers that aren't self-amplified, or are unhappy with the amplifying power or sound quality of a pair of amplified speakers. If that last statement describes you, check out SC&T²'s *Platinum Sound Equalizer-Amplifier Pro*. That unit packs 60 watts of power (30 per channel) and an equalizer into a standard 3½-inch computer drive bay. The device will also fit in a 5¼-inch bay with an adapter.

The front panel of the unit contains a volume control, a balance control, a 7-band slide-control equalizer, and stereo LED volume-level indicators. It is easily connected to a sound card or CD-ROM drive at a back-panel plate or inside your computer. The Equalizer-Amplifier Pro runs off 12 volts DC, which it gets from your PC's (or Mac's) power supply. While many people would have no need to spend \$119.95 on this device, many others could find it to be a valuable addition to their multimedia set-up. An external version is also available for \$149.95.

Another problem that comes up when mixing and matching multimedia components is finding the right cable that will connect audio from a CD-ROM drive to a sound card. SC&T² mar-

kets a full line of *Platinum Sound Audio Cables* that save you the trouble of making your own. Cables are also available that allow the connection of

Where To Get It

Advanced Gravis
1790 Midway Ln.
Bellingham, WA 98226
Tel. 800-663-8558

AmSoft
P.O. Box 666
New Cumberland, PA 17070
Tel. 717-938-8249

Blue Mountain Software, Inc.
P.O. Box 1648
Port Angeles, WA 98362
Tel. 206-452-1251

Broderbund Software
500 Redwood Blvd.
Novato, CA 94948
Tel. 800-521-6263

Davidson & Associates, Inc.
19840 Pioneer Ave.
Torrance, CA 90503
Tel. 310-793-0600

Elecom Computer Products,
Inc.
17316 Edwards Road,
Suite B-225
Cerritos, CA 90703
Tel. 310-802-0077

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

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

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

Multicom Publishing
1716 Locust Street
Des Moines, IA 50309
Tel. 800-850-7272

Pro CD, Inc.
8 Doaks Lane, Little Harbor
Marblehead, MA 01945
Tel. 508-750-0000

SC&T² International, Inc.
3837 Lasalle Street
Phoenix, AZ 85040
Tel. 602-470-1334

WexTech Systems, Inc.
310 Madison Ave., Suite 905
New York, NY 10017
Tel. 212-949-9595

multiple CD-ROM drives to a single sound card. Contact SC&T² for prices.

Another multimedia problem is where to put all the CD-ROM's. SC&T²'s *CD3 Compact Disc Storage System* holds up to 40 discs (but not their jewel-box cases) on edge in a horizontal cylinder-shaped case. The case folds open at the middle with the discs resting in the bottom half. Discs fit in numbered slots and disc labels fit in numbered spaces behind a clear plastic window. A cover slides over the window. To retrieve a disc, you simply slide a selector knob to the desired disc number, open the case, and the requested disc is "stuck" to the lid, ready for you to grab. The case can also be "locked" and carried around by a folding handle that's built-in. The disc holder has a list price of about \$35.

Coincidentally, I also received a new CD-ROM holder from another company called Elecom. The *CDR-001* holds up to 30 discs in their jewel boxes. What's neat is that the discs slide into slots with springs in the back. To retrieve a disc, you simply lift the front of the disc over a small lip and it pops right out of the holder and into your hand. As your CD-ROM collection grows, multiple CDR-001 holders can be ganged together side-by-side or vertically. The CDR-001 retails for \$24.95.

NEW STUFF

Being that this is the first **Popular Electronics** issue of 1995, I guess I'm a month too late with news of two discs sent to me from Grolier Electronic Publishing: *The New Grolier Multimedia Encyclopedia*, and the *1994 Guinness Multimedia Disc of* (Continued on page 92)

GIZMO[®]

A CHRONICLE OF CONSUMER ELECTRONICS

Apple's Newton

NEWTON MESSAGEPAD 110. Manufactured by: Apple Computer, Inc., 20525 Mariani Avenue, Cupertino, CA 95014. Price: \$599.

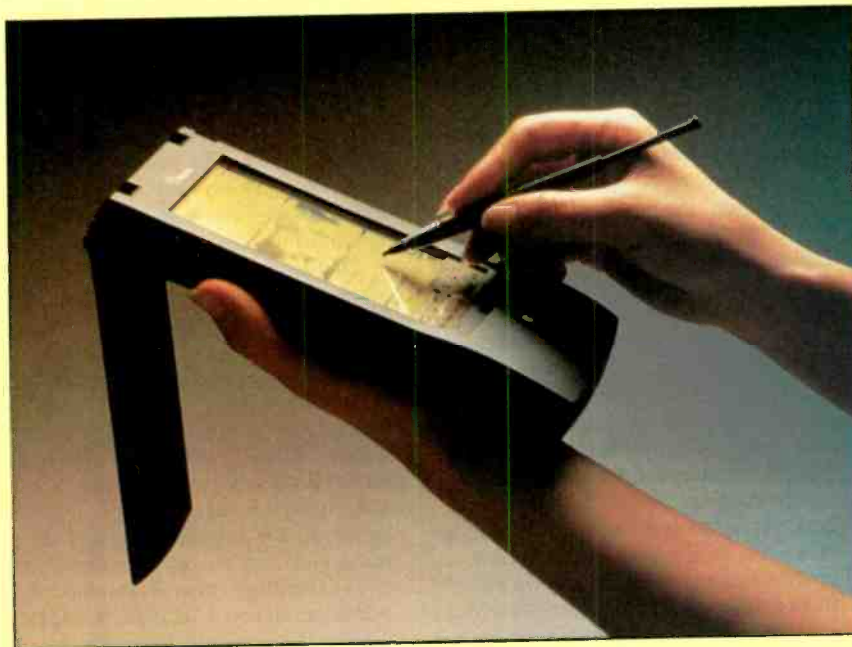
Almost one year ago, in a special issue of *Gizmo*, we reviewed the first crop of personal digital assistants or PDA's. We were less than enthusiastic about the Sharp Newton Expert Pad, the Tandy/Casio Zoomer, and the AT&T Eo Personal Communicator. Although we appreciated the technology and vision that was evident in each one, we were ultimately disappointed with how all of the products worked.

What a difference a year makes. The Eo is already dead—AT&T closed down its Eo subsidiary in the second half of 1994. The Zoomer platform will apparently be orphaned—no product upgrades are in the works. On the other hand, *Apple Computer* has significantly improved its *Newton MessagePad* and has greatly expanded its Newton Product family of both hardware and software.

The weaknesses of the original Newton PDA were its limited memory, short battery life, awkward input, and several bugs as well. All of the product's deficiencies seemed even worse in the face of the huge amount of hype from John Scully—who has since departed Apple—that preceded the release of Newton by a couple of years. Expectations of the product's ability were so high that there was no way the real device could live up to them.

The original Newton also suffered from its high price and its inability to do very much. Few applications were available for it and its communications ability was poor. Before the MessagePad was introduced, the press was full of complaints from pundits who felt that Apple was taking too long to get the product to market. After it was introduced, the general consensus was that the product was released too soon.

Users who were unfortunate enough to purchase the original Newton can take part



in an Apple upgrade program, in which the Newton MessagePad will get the same internal software as the new Newton. The upgrade costs \$99, and comes with two Newton software products: The user can choose from Newton Connection Kit, Dell Crossword Puzzles, DrawPad, and Dyno NotePad.

The MessagePad 110 looks slightly different than its predecessor. It's a little slimmer, measuring 8 x 4 x 1/4 inches. It weighs just over 1 1/4 pounds. The best improvement in its housing is the cover, which flips up away from the screen and folds over the back—something very much like the Zoomer.

The MessagePad is still available with its original form factor as the MessagePad 100. It sells for \$100 less than the MessagePad 110.

The three most important improvements that were made to the MessagePad are increased memory, improved battery life, and deferred handwriting recognition.

The size of the built-in RAM was in-

creased by a factor of three, to one megabyte. The MessagePad also offers one PCMCIA type-2 card slot, which can be used for additional storage or for dedicated application cards.

The new MessagePad is significantly better with respect to battery life. Estimated life is as much as 20 hours in active use when alkaline batteries are used. Rechargeable nickel-cadmium cells will provide about 12 hours.

Another huge improvement made in the MessagePad is that it now allows for deferred recognition—users can take notes in electronic ink, and then go back and turn them into text. The one problem with deferred recognition is that the user doesn't get immediate feedback, and therefore doesn't learn the proper way to write. The big advantage is that you can write quickly, without worrying whether Newton will make sense of what you are writing.

The basic built-in software that comes with the MessagePad includes the Note-

pad, the Name File, and the Date Book. All entry to the device is made by writing or tapping on the LCD screen with a stylus. In the new MessagePad, the stylus is a round, telescoping plastic-tipped "pen" that stores away in a hole in the side of the unit. It's a big improvement over the one supplied with the original Newton. The stylus isn't absolutely essential, however. An ordinary pencil works well in a pinch as does a plastic capped pen—or almost anything else that won't scratch the glass. We often found ourselves even using our index finger—although more often to point to an item to select it than to actually write.

The Notepad is for keeping free-form notes and memos. It is always running when the machine is on, although it is sometimes covered by other applications. The notes can consist of letters, numbers, and even drawings. The writing can be converted into text by the recognizer, or it can be left as "electronic ink." Unlike the first Newton, the ink does not have to be converted to text immediately. Instead, it can be converted at a later time. That's an important advantage, because you don't have to worry about writing too fast and having to wait for the recognizer to "catch up" to you.

Like the original MessagePad, the 110 has a menu where you can set your preferences and customize the recognition engine. The recognizer, for example, can be set to recognize words, letters, or numbers. As in the original MessagePad, the Newton is most efficient when it looks at entire words and matches them with words in its dictionary. After practice—the MessagePad includes a practice mode—we became reasonably proficient at writing the way that the Newton wanted us to.

The MessagePad does a pretty good job of recognizing words in its dictionary if you write properly. However, if a word isn't in the dictionary, the resulting translations can be bizarre. That problem led to almost universal criticism of the original Newton. Fortunately, it is possible to add words to the Newton dictionary, so that words that you use frequently will be recognized.

Word recognition is not always desirable. For example, entering names in the Name File can be particularly cumbersome. Naturally, the Newton dictionary is not filled with surnames, so virtually every name that is entered will have to be corrected. Correcting a word consists of tapping on it to bring up a list of possible

choices. If none matches, you can tap a keyboard icon to bring up a "keyboard" on which you can tap the word.

A big improvement in the new MessagePad is that if it gets a word wrong, and if the word that you want doesn't appear on the word list, you can tell Newton to reexamine the word using letter-by-letter recognition. The original MessagePad did have character-based recognition, but not like this. Here you can switch back and forth between word- and character-based recognition with a single pen tap. We found that it could often do a great job at it. The feature removes a lot of the frustration that was inherent in the original product.

The MessagePad also features a shape recognizer. When that feature is turned on, sloppy sketches are cleaned up so that circles are round, rectangles have square corners, and so on.

With the original MessagePad, we complained that we really couldn't do anything with it except keep notes and some names and addresses. Apple promised far greater functionality than it delivered in that unit. That wasn't the case this time. The hardware and software accessories that were only a promise the first time we reviewed Newton are available in abundance now.

One convenient accessory is a charging station that can recharge the internal batteries in two or three hours. The charging station can also hold an extra set of batteries. Both sets can be recharged at the same time—it takes about four to six hours. In the original MessagePad, the recharging took almost 14 hours!

The charging station fits comfortably on a desktop, and even holds a full-sized stylus. The MessagePad can be used while it is recharging.

Perhaps the most important accessory for the MessagePad is the Newton Connection Kit. The kit consists of software that runs under Microsoft Windows, a manual, and a cable that lets you connect the Newton to your PC's serial port. (A Macintosh version is also available.) That not only lets you backup and save data, but lets you transfer data from your computer to the Newton.

Say, for example, that you want to use your MessagePad to keep a record of business contacts—contacts that you already had on a database on your PC. With the Connection Kit, you could download the names and other information into the Newton Name File. As long as the database can export in a standard delimited file (SDF) format, you can use the information.

If you add names and other information while you use the Newton portably, you can update your computer's database by exporting the information from the Newton.

The Newton Connection Kit is so important that it is virtually indispensable. In

fact, much of the software that is available for the MessagePad comes on floppy disk and is installed through the Connection Kit. The Connection Kit is also valuable for backing up information, which it does automatically on each connection.

The Connection Kit allows the MessagePad to be used more efficiently. It allows programs to be loaded and unloaded from memory so that the user can make the most out of what he or she has. It also allows data to be entered in a much less cumbersome way.

The Newton Print Pack is another essential accessory. It allows the MessagePad to print to any printer that can emulate an HP LaserJet, Canon Bubble Jet, or Epson printer. The print pack consists of a "smart" serial-to-parallel converter that has printer drivers built-in.

Another accessory that we tried was the Newton Fax modem model H0005. The shirt-pocket sized modem is powered by two AA batteries and connects to the MessagePad's serial port. It adds greatly to the functionality of the MessagePad.

Of course, all the hardware in the world is of little use if it is not accompanied by good software. Unlike our first experience with the MessagePad, software is now available. Descriptions of some of the software we examined follows. ■

SOLITAIRE AND OTHER CARD GAMES. From StarCore, Apple Computer, Inc., 5 Infinite Loop, Cupertino, CA 95014. Price: \$39.95

The Solitaire package is supplied on a floppy disk, so the Newton Connection Kit is required. It offers players four different card games: traditional solitaire, blackjack, baccarat, and video poker. In all the games, money is on the line.



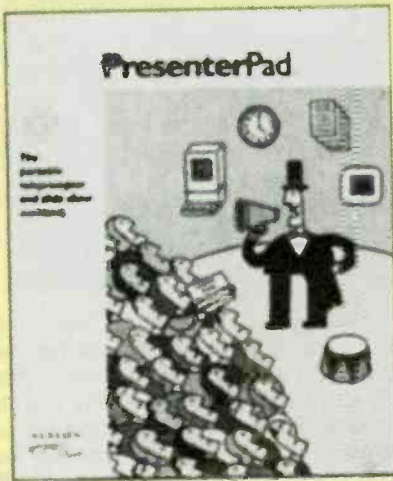
Built-in help explains how the games are played, which we found helpful to learn the rules of Baccarat. Unfortunately, the package is somewhat addicting—we spent far too much time playing when we

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 1994 by Gernsback Publications, Inc. Gizmo is a registered trademark. All rights reserved.

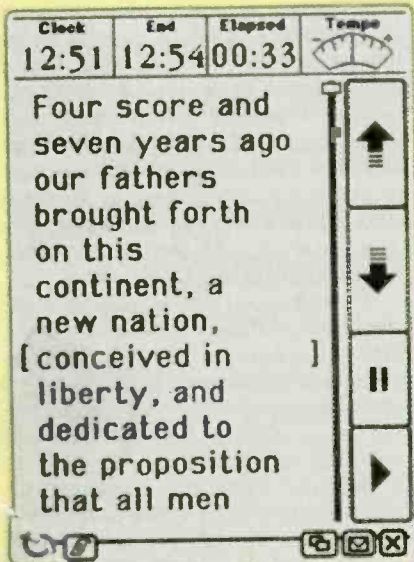
should have been working. In any case, we're glad that we weren't playing with real money! ■

PRESENTERPAD. From Avalon Engineering, Inc., 45 Newbury Street, Boston, MA 02116. Price: \$89.

PresenterPad bills itself as "the world's first truly portable teleprompter." The aim of this disk-based product is to help anyone who ever speaks to a group of people to give better presentations. It has three basic functions: The Slide Manager, which is designed to help deliver presentations that are accompanied by slides or overhead transparencies; the Teleprompter, which scrolls text either manually or at a preset speed; and the Outliner, which helps to prepare and edit the information that is displayed in the Slide Manager and Teleprompter.



Gas-gauge-style indicators provide easy-to-see time information. That is particularly helpful for speakers who are constantly running out of time before the key points have been presented—or running



out of words before their allotted time is up. Both the overall presentation length, and the time for each slide can be tracked.

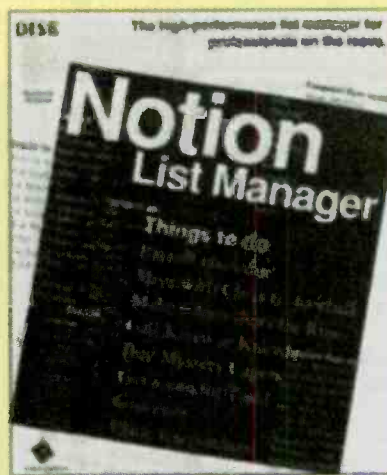
Oversized buttons allow the user to move forward or backward through the presentation—and they can be set for either right- or left-handed operation.

In the Slide Manager, key points for each slide can be displayed at once, or they can be expanded as each bullet item is discussed. It even allows presentation equipment to be controlled with Newton's built-in infrared transmitter. However, an infrared receiver is required for that feature to work. It is expected to be available later this year. ■

NOTION: THE NEWTON LIST MANAGER. From Eidetic, Inc., 15 SW Colorado Ave., Bend, OR 97702. Price: \$59.

Notion allows the Newton to keep track of virtually anything from agendas and trip plans to ATM withdrawals. The list templates provided with Notion include up to fifteen different data fields for dates, flights, hotels, names, numbers, or other data.

Over 100 templates are provided with Notion. They can be used directly, or they can be modified to create new ones. Searches for information through keywords can be made through multiple lists, so you can't "lose" information that you

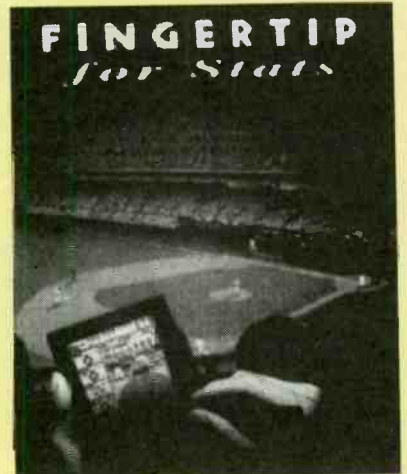


enter, even if you forget what list you put it in. For example, there's no need to worry if you put information about your airline tickets in your "things to buy" list instead of your "vacation planning" list. In a way, Notion becomes a value-added replacement for the MessagePad's built-in Names, Dates, and Notepad applications.

If you are someone who has to keep track of projects, expenses, or other data—or if you're just someone who loves to make lists—Notion is a package that will make the Newton MessagePad invaluable. ■

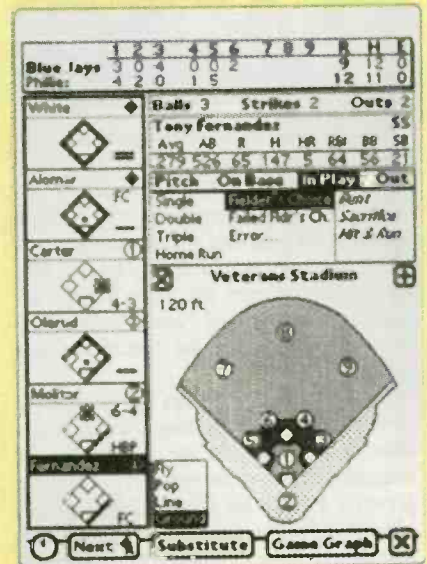
FINGERTIP FOR STATS—BASEBALL. From Fingertip Technologies, Inc., 140 Newport Center Dr., Suite 200, Newport Beach, CA 92660. Price: \$129.

If you are serious about sports, you'll love Fingertip for STATS, a sports-information tool that delivers statistical analysis of every team in the majors. STATS—Sports Team and Analysis Tracking Systems, Inc.—has been a staple for baseball reporters for years. The software helps to bring the same information to Newton users.



With access to the STATS online service, you never have to worry about not having up-to-date information. Access costs \$0.25 per minute; an average update requires about 4 minutes. Included in the price of purchase is two hours of online time. The software, with its mass of statistics, requires a two-megabyte storage card to install. That can be reduced somewhat by deleting, for example, the layouts of the 28 Major League stadiums.

The software's main menu offers five



options. First is Play Ball, which provides the tools to review in-depth statistics and to track player performance while scoring a game. Second is Major League Update, which provides up-to-the-minute news stories, league standings, and analysis from around the league.

A Fantasy Favorites program allows you to review the latest stats on individual player performance while you are building your own fantasy teams. The Bill James Encyclopedia provides detailed information on the careers of all of the players in the Baseball Hall of Fame. Finally, Trivia and Tournament challenges your baseball knowledge with trivia contests as well as a daily tournament throughout the season where you can compete against others. ■

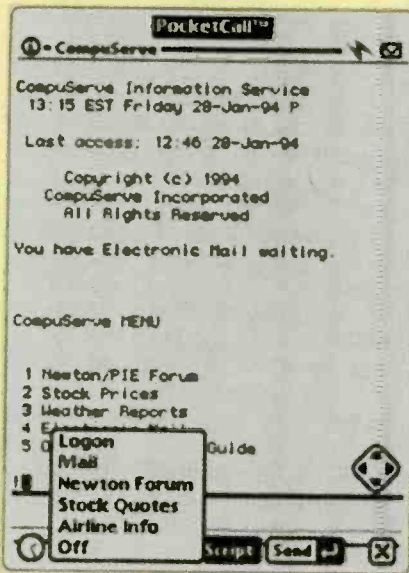
POCKETCALL. From Ex Machina, 45 East 89th Street, Suite 39-A, New York, NY 10128. Price: \$149.

PocketCall is a communications program that gives the Newton MessagePad the ability to connect to any text-based online service, including CompuServe, GEnie, Delphi, MCI Mail, and many independent BBS's. It will not work with services that require proprietary graphic-based software, such as America Online and Prodigy.



PocketCall comes in two parts: PocketCall itself, and Services, which is used to configure PocketCall to connect to different information providers. It stores such information as phone access numbers and modem-setup information. Users who don't want to enter the setup themselves can purchase optional PocketPacks which come pre-configured for specific remote services.

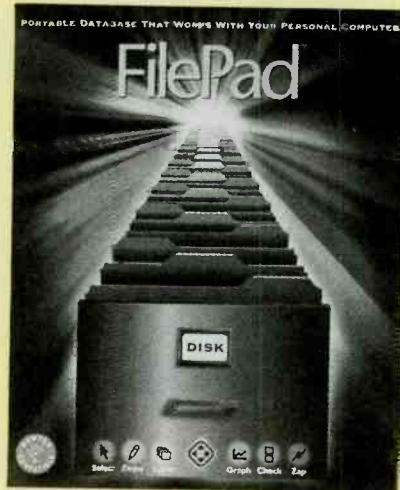
PocketCall allows users to store scripts of frequently used comments that you can send at the touch of the screen. So for example, a user who regularly visits the Newton Forum on CompuServe could store "Go Newton" and visit the forum by tapping on the script instead of having to



write (or tap the on-screen keyboard) to issue the command. ■

FILEPAD. From HealthCare Communications, 300 South 68th Street, Suite 100, Lincoln, NE 68510. Price: \$139.

FilePad is a flat-file database program for the Newton. It allows users to create custom database layouts, and enter data using handwritten text, pop-up menus, and buttons. A filing-cabinet icon represents each database that is created. Data that is stored in other file cabinets is accessible from any other file cabinet.



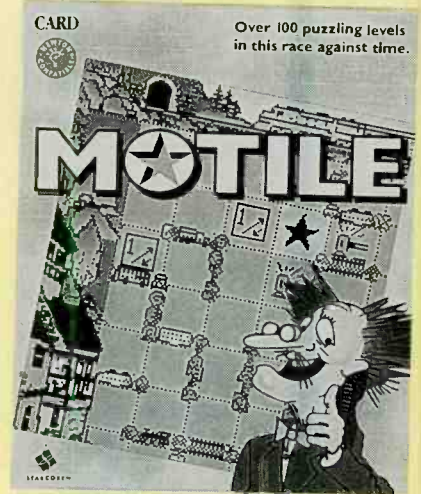
Included with FilePad is FilePad Link—computer-connection software that allows records to be transferred between the Newton and the PC. Formats that are supported include Lotus 123, Quattro, Symphony, Excel, and dBase. Data can also be output in ASCII as either tab-delimited, comma separated, or quoted strings.

Any information that is stored in FilePad can be printed, Faxed, or sent as E-mail. ■

MOTILE. From StarCore, Apple Computer, Inc., 5 Infinite Loop, Cupertino, CA 95014. Price: \$59.95.

Motile is a PCMCIA card that turns the MessagePad into a challenging puzzle of mazes. The object of the game is to help Motile Moe in a race against time as he tries to reach the star in each of the mazes.

It's not as simple as it sounds. Moe follows predictable rules as he moves: He turns the corner when two walls form an "L." He bounces backward from a single wall or when walls form a "U."



Each puzzle begins with a time limit and a limit to the number of walls you can place and remove. Moe has only three "lives" in each game. Fortunately, as each level is completed, a four-letter key is given. The key brings the player to the correct level when a new game is begun. ■

FODOR'S 94 TRAVEL MANAGER: TOP U.S. CITIES. StarCore, Apple Computer, Inc., 5 Infinite Loop, Cupertino, CA 95014. Price: \$119.95.

The Fodor's PCMCIA card has all the information that travelers would find in eight separate hardcopies of Fodor's city guides. Within each city, users can view their location and actually receive driving directions from one place to the next. Restaurant information, including menus, is also available. You can find a restaurant based on a variety of categories, from cuisine to location, to price.

The eight cities that are covered in the guide are: Atlanta, Boston, Chicago, Dallas, Los Angeles, New York, San Francisco, and Washington, D.C. Up to 250 entries are provided for each city, including the locations of fast-food joints and automatic teller machines.

Once the desired city is selected, the main menu offers such choices as: Map, Introduction, Airport, Dining, Lodging, Free Time, Services, and Directions. ■

TECHNOLOGY UPDATE

500 miles from nowhere, it'll give you a cold drink or a warm burger...

NASA space flights inspired this portable fridge that outperforms conventional fridges, replaces the ice chest and alternates as a food warmer.

By Charles Anton

Recognize the ice cooler in this picture? Surprisingly enough, there isn't one. What you see instead is a Koolatron, an invention that replaces the traditional ice cooler, and its many limitations, with a technology even more sophisticated than your home fridge. And far better suited to travel.

What's more, the innocent looking box before you is not only a refrigerator, it's also a food warmer.

NASA inspired portable refrigerator.

Because of space travel's tough demands, scientists had to find something more dependable and less bulky than traditional refrigeration coils and compressors. Their research led them to discover a miraculous solid state component called the thermo-electric module.

Aside from a small fan, this electronic fridge has no moving parts to wear out or break down. It's not affected by tilting, jarring or vibration (situations that cause home fridges to fail). The governing module, no bigger than a matchbook, actually delivers the cooling power of a 10 pound block of ice.

From satellites to station wagons.

Thermo-electric temperature control has now been proven with more than 25 years of use in some of the most rigorous space and laboratory applications. And Koolatron is the first manufacturer to make this technology available to families, fishermen, boaters, campers and hunters—in fact anyone on the move.

Home refrigeration has come a long way since the days of the ice box and the block of ice. But when we travel, we go back to the sloop ice cooler with its soggy and sometimes

spoiled food. No more! Now for the price of a good cooler and one or two seasons of buying ice, (or about five family restaurant meals), all the advantages of home cooling are available for you electronically and conveniently.

Think about your last trip. You just got away nicely on your long-awaited vacation.

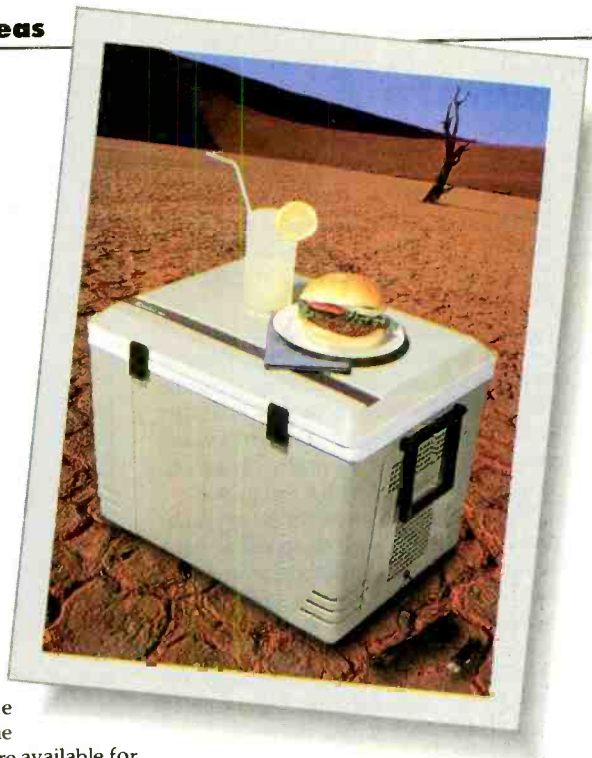
You're cruising comfortably in your car along a busy interstate with only a few rest stops or restaurants. You guessed it... the kids want to stop for a snack. But your Koolatron is stocked with fruit, sandwiches, cold drinks, fried chicken... fresh and cold. Everybody helps themselves and you have saved valuable vacation time and another expensive restaurant bill.

Hot or cold. With the switch of a plug, the Koolatron becomes a food warmer for a casserole, burger or baby's bottle. It can go up to 125 degrees.

And because there are no temperamental compressors or gasses, the Koolatron works perfectly under all circumstances, even

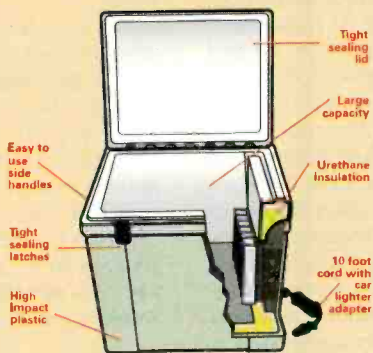
upside down. Empty, the large model weighs only 12 pounds and the smaller one weighs just seven. Full, the large model holds up to 40 12-oz. cans and the smaller one holds six.

Just load it up and plug it in. On motor trips, plug your Koolatron into your cigarette lighter; it will use less power than a tail light. If you decide to carry it to a picnic place or a fishing hole, the Koolatron will hold its cooling capacity for 24 hours. If you leave it plugged into your battery with the engine off, it consumes only three amps of power.



The refrigerator from outer space.

The secret of the Koolatron Cooler/Warmer is a miniature thermo-electric module that effectively replaces bulky piping coils, loud motors and compressors used in conventional refrigeration units. In the cool mode, the Koolatron reduces the outside temperature by 40 degrees F. At the switch of a plug, it becomes a food warmer, going up to 125 degrees.



Limited time offer.

Because Comtrad is bringing this offer to you directly, you save the cost of middlemen and retail mark-ups. For a limited time only, you can get this advanced, portable Koolatron refrigerator at the introductory price of \$99. Call today to take advantage of this special promotional pricing. Most orders are processed within 72 hours.

Try it risk free.

We guarantee your satisfaction with any product from Comtrad Industries. With the Koolatron you get our complete "No Questions Asked" 30 day money-back guarantee. Plus you get a full one year manufacturer's limited warranty. If you are not satisfied for any reason, just return the product for a complete refund.

Koolatron (P24A) holds 30 quarts.....	\$99	\$16 S&H
Koolatron (P9) holds 7 quarts.....	\$79	\$8 S&H
Optional AC Adapter (AC 10).....	\$49	\$6 S&H

Please mention promotional code 025-PL1106. 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 expiration date.

COMTRAD INDUSTRIES

2820 Waterford Lake Drive Suite 106
Midlothian, Virginia 23113

Aurora Bosealis

OLDSMOBILE 1995 AURORA WITH BOSE AUDIO SYSTEM. From Oldsmobile, 920 Townsend, Lansing, MI 48921 and Bose Corporation, The Mountain, Framingham, MA 01701. Price: \$32,000.

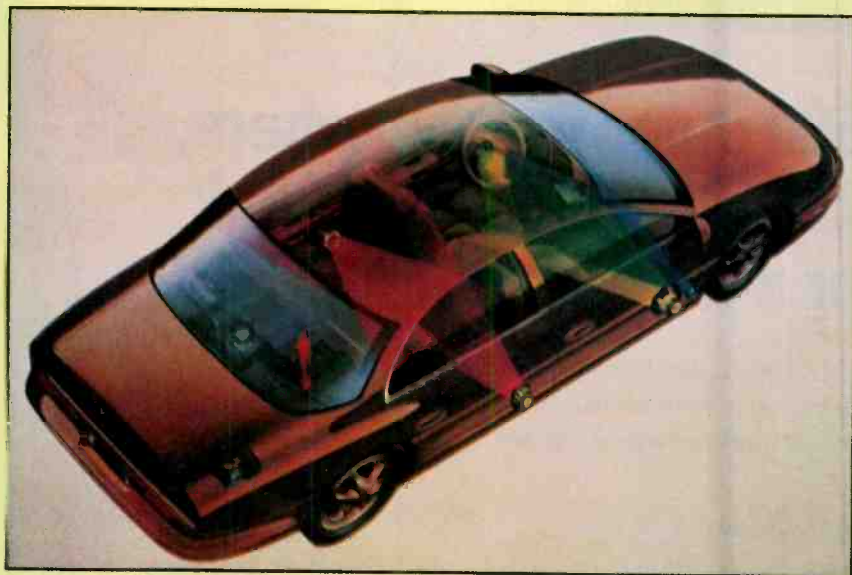
Only a couple of years ago, General Motors reportedly was thinking of closing Oldsmobile division because of lackluster performance. However, if our recent test drive of a 1995 Aurora is any indication, Oldsmobile is back with a vengeance.

The Aurora is a four-door luxury automobile that is targeted to appeal to baby boomers who might otherwise consider the Infinity J30 or Acura Legend. It's powered by a 4-liter V-8, and is as far removed from its immediate predecessors as a Pentium-powered PC is from an XT. Perhaps to distance the Aurora from Oldsmobile's recent past, the car does not have an Oldsmobile badge anywhere on its outside. The only Oldsmobile nameplate is inside, on the radio's trim.

A host of electronic goodies is supplied as standard equipment in the Aurora, including traction control, antilock brakes, and cruise control. Also included is an automatic day/night rearview mirror that helps to reduce annoying glare during nighttime driving. A 4-speed, electronically controlled transaxle offers selectable (normal or power) shift points. A trip computer, which Oldsmobile calls a driver information center, allows the driver to track his or her fuel economy, speed, engine oil pressure and life, battery life, transaxle fluid life, distance to destination, estimated time of arrival, and more. Remote-controlled door and trunk locks are also standard.

As a luxury car, the Aurora also offers such creature comforts as upper and lower lumbar supports for both the driver and the front-seat passenger, and dual temperature control so that both the driver and passenger can be comfortable. The driver's seat offers two position memories so that if two people regularly share the car, each can store a preferred seat position. Even more important, the outside rear-view mirror positions are also stored with the seat location in the memories. As an added convenience, pressing both memory buttons simultaneously causes the seat to move completely down and back for easier exiting.

The Aurora's power steering offers what Oldsmobile calls magnetic speed-variable assist. That feature keys the strength of the power-steering assist to road speed—maximum assist is provided during parking maneuvers, and minimum assist is provided at highway speeds so that the driver



always has a comfortable feel of control. Best of all, the adjustment is continuously variable, so it is transparent to the driver; we were never consciously aware that the assist level was changing, even though it was obvious that it did.

In general, the Aurora is fantastic. It provides a quiet, comfortable ride while still providing a good feel for the road, and V-8 performance that we normally wouldn't associate with Oldsmobile. On the twisting roads of upstate New York, the car's performance made it a thrill to drive. On the other hand, its luxurious surroundings made the slow, rush-hour traffic of New York City bearable and maybe even enjoyable.

To be honest, however, we must plead ignorance when it comes to luxury cars—our real-world experience with them is, shall we say, limited. So we turned our attention to one of the three pieces of optional equipment that we do know something about. No it's not the V-rated Michelin tires or the engine block heater. It's the Bose Acoustimass audio system that we spent most of our time examining.

Oldsmobile selected Bose in an attempt to persuade Aurora customers to buy a factory-installed sound system instead of an aftermarket system. The auto-sound aftermarket is an extremely strong industry. A survey conducted by the Electronic Industries Association found that more than 70 percent of all U.S. households own at least one piece of aftermarket car-stereo equipment. Twenty-three percent of those surveyed intended to buy an aftermarket auto-sound product in the next 12 months.

However, a factory system can provide a distinct advantage over aftermarket installation. Specifically, the sound system can be custom tailored to the vehicle. The system designer knows what the interior is like, where the speakers will be mounted, where the passengers will sit, and even how big the trunk is. Using that informa-

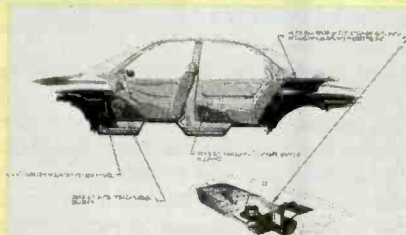
tion allows him to design a complete system that, in theory, should out-perform a system assembled from stock components.

The Bose audio system installed in the Aurora consists of an AM/FM/cassette head unit, a 12-disc trunk-mounted CD changer, six speakers, and an Acoustimass enclosure.

Bose's Acoustimass speaker technology is the same that is used in several of the company's home products, including its AM-5 and AM-3 speaker systems. The Acoustimass enclosure launches sound in the form of a mass of air, rather than directly from a vibrating surface like a speaker cone. A speaker cone is still used, of course—in this case a 6½-inch woofer—but it is the air that is sent forth from the enclosure's port, after passing through resonant cavities, that does the work.

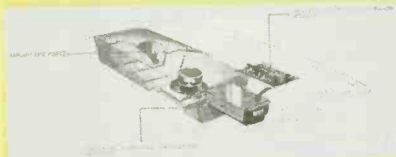
The Acoustimass enclosure acts as an acoustic bandpass filter, and it also helps to limit the speaker cone's excursion, thus reducing distortion.

The Acoustimass enclosure delivers bass response that is surprisingly clean, smooth, and powerful despite the module's relatively modest size. In fact, the module is quite inconspicuous—it is integrated in to the rear package shelf. Even when you open the trunk you won't notice it unless you look for it.



The Bose Acoustimass system consists of six speakers plus the Acoustimass enclosure.

GIZMO NEWS



The Powered Acoustimass enclosure is an integral part of the Aurora's package shelf.

Mounted to the Acoustimass enclosure is the power-amplifier module, which contains one amplifier for the Acoustimass enclosure and four other amplifiers for the main speakers. Each amplifier includes active and dynamic equalization networks that work together to provide accurate sound and tonal balance at any listening level. For example, at low volume levels, the deep bass is automatically boosted.

The beauty of the Acoustimass enclosure is not that it is visibly inconspicuous. More important, the module—despite its impressive bass output—is *acoustically* inconspicuous. Whether we were in the front seat or back—even with our head directly in front of the Acoustimass port—we never localized on the bass. We could carry on conversations with front- or rear-seat passengers comfortably even while enjoying the music. No one felt as if they were being beaten over the head by an aggressive stereo system.

Six other speakers round out the Bose system. Each front door holds a 6½-inch Bose woofer, and each front kick panel houses a 1½-inch tweeter. In each rear door is a 3½-inch Bose "Twiddler" speaker. The speakers are mounted to create a cross-fire pattern that provides what Bose calls a "Stereo Everywhere" effect.

Bose certainly was effective with "Stereo Everywhere." Sounds seemed to emanate from every corner of the car! Unfortunately, that's not how we like our imaging—it isn't realistic. It was disconcerting to hear trumpets blaring from what seemed like the floor behind us. Yes, the system washed the car in sound, and we're sure that that is what Bose's engineers intended.

Except for our displeasure with the imaging, the system performed very much to our liking. The head unit was well designed and easy to use. All of the controls were obvious with one exception: The button for random CD-track playback was unlabeled. Controls mounted on the steering wheel for basic functions were easy to adapt to, but the placement of the head unit, curved slightly toward the driver, didn't require undue attention.

Although the Bose system performed admirably, it was not as much to our liking as other Bose auto implementations. An aftermarket system, we think, could probably do a better job—but whether it could match the \$1000 price premium of the Bose system is uncertain. ■

Balance of Trade

The Electronic Industries Association reports that U.S. exports of electronic products reached more than \$48 billion in the first half of 1994. That represents a growth rate of about 16% over the previous year. However, U.S. imports of electronics were up even more: 18%. The resulting negative balance of trade for electronics in the first half of 1994 was \$7.9 billion.

When he announced the trade statistics, EIA President Peter F. McCloskey said, "U.S. exports are continuing to exhibit substantial vitality and improvement in global market share. This is particularly true of outstanding performing sectors such as telecommunications and solid-state products."

The category where the U.S. had the largest positive balance of trade, \$2.5 billion, was in industrial electronics. The worst performance, as might be expected, was in consumer electronics, where the U.S. had a \$6.4 billion negative balance. Other negative categories include computers and peripherals and passive components.

Meanwhile, the U.S. Semiconductor Industry Association reported that success "can be achieved by sustained efforts to improve foreign access to Japan's semiconductor market." The association reported that the foreign share of Japan's semiconductor market exceeded 20% for the first three quarters of 1994.

Speaking of the 1991 U.S.-Japan Semiconductor Trade Agreement, the association said, "The foreign share increase is a result of the sincere efforts being made by all parties to provide competitive products to Japanese customers, coupled with the movement offshore of low-end consumer electronics, which have a relatively small foreign market share. However, no one should be satisfied until the notion of a truly open Japanese semiconductor market becomes a reality."

In July, 1994, Japan made an effort to terminate the 1991 agreement. The association said that it hoped "that Japan's effort ... is not an indication of a lack of commitment to continue to improve market access. Instead, we are once again calling upon the Japanese industry to match our commitment to provide choice to Japanese consumers, and ensuring a truly open market for all semiconductor competitors."

Theft-Proof Radios

Car alarms have become mere noise-makers instead of theft deterrents. However, Eclipse (Torrance, CA) has so

much confidence in the theft-deterrence provided with its new ESN (Eclipse Security Network)-equipped AM/FM/CD players that the company guarantees to provide free replacement of the unit if it is stolen up to a year after purchase.



The units, when stolen from the vehicle, become inoperative. Thus, according to the company, "ESN-equipped units simply will not have any fence value." Unlike similar theft-deterrence systems, users don't have to remember any secret codes. Instead, they just have to remember their "Key CD." When the Eclipse unit is originally installed, the customer selects a CD from his collection. The CD player is then programmed to recognize that CD as the key.

After ten attempts to reactivate the system using incorrect CDs, the unit's display prompts the user to contact Eclipse for free repair and shipping. Once the unit is delivered for the "free repair," technicians can read an electronic serial number to identify the unit's registered owner.

Info Highway?

A survey conducted by the Times Mirror Center for The People and The Press found that 11-million U.S. homes are "already equipped to travel the information highway." Nearly one third of U.S. households own a personal computer, and about 23-million adults use a home computer every day. Twelve percent of all households have a modem-equipped computer, and as many as 6% of all Americans go online.

People who enjoy high-technology products are "voracious consumers of information," the study found. "They read more, follow the news more, and know more about the world than people who are not as technologically experienced." However, people who do access information using such high-tech methods as online services do not forsake such traditional information sources as newspapers and magazines.

The dominant home-technology device? Well, it's the TV, of course. Less than 60% of those surveyed, however, were satisfied with what's on, even though only 7% of all households used their TV for broadcast reception only. ■

Mushrooms of Music

S-35 LOUDSPEAKERS. Manufactured by: Canon U.S.A., Inc, One Canon Plaza, Lake Success, NY 11042. Price: about \$425 per pair.

There have been many technological advances in audio over the last dozen years or so. But since the introduction of the CD player, it's not electronics that is advancing the most rapidly. Instead, it's the loudspeaker—the most mechanical component of an audio system—that continues to undergo the greatest refinement.

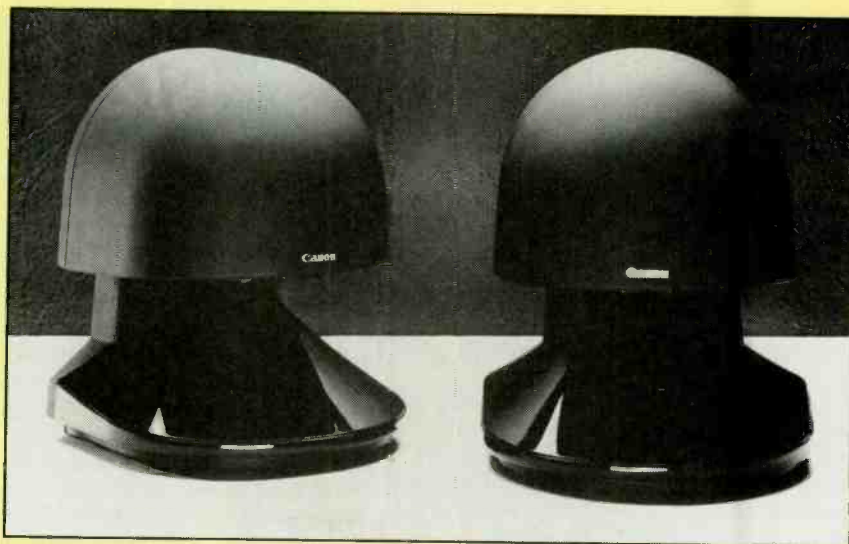
To a degree, the changes in speakers have been driven more by changes in fashion and lifestyle than because of new technological discoveries. But the continuing evolution in loudspeakers has come about for another reason as well. With the introduction of the compact disc and its uniformly good ability to accurately reproduce audio, the loudspeaker has unquestionably become the most important link—we should say the weakest link—in the audio-reproduction chain.

The bookshelf speaker—first introduced in the 1950's—is booming well into its middle age. There is one reason why bookshelf speakers are so popular: They allow flexibility in placement while still providing good performance, although they can't produce the deep bass response that only large, floor-standing speakers and subwoofers offer.

Canon U.S.A.'s S-35 loudspeakers—designed and built by Canon Audio in the U.K.—represent Canon's first entry in the U.S. audio market. They are also unlike any speaker system that has come into the Gizmo offices. First, they don't look as much like speakers as they look like oversized black mushrooms. A black matte-finished dome is suspended over a conical black plastic base. Nowhere is there a grille or grille cloth to be seen, or any other indication that these mushrooms are actually speakers, and not some funky modern sculpture.

In reality, the speaker drivers are mounted in the top dome. They don't fire into the room. Instead—in an unusual departure from standard speaker design—they fire downward. That is the secret to the wide image that the speakers are able to produce. You could say that it's done with mirrors. The conical black plastic base is not there just for aesthetic purposes, but is an acoustic mirror that reflects the drivers' outputs into the room.

The enclosure, which is built of plastic and internal zinc, has two rear-facing ports. The ports are located in the back of the top dome. However, the enclosure



chamber includes both the top dome and the base.

The objective of the speakers' unique design is to provide a true stereo image up to six times larger than a conventional speaker so that more listeners, over a wider area, can enjoy stereo without crowding into the typical small "sweet spot" that is generated by conventional speakers. The Canon Wide Imaging Stereo technology is patented and it is, indeed, impressive.

The S-35 is a two-driver system. A 130 mm (5-inch) full-range driver provides the bass and midrange frequencies, while a 19-mm (¾-inch) dome tweeter is suspended in front of the bass driver and provides the treble frequencies. The rated frequency response is 70 Hz to 22 kHz, ± 3 dB.

The S-35's tweeter is cooled with ferrofluid, which helps to give the speakers a power-handling rating of 75 watts maximum. The minimum power recommended is 10 watts, with 50 watts recommended as optimum. An overload protector, which integrates the speaker current over time (it gets hot, in other words), is provided to prevent damage to the speakers from misuse or amplifier malfunction. In an overload condition, attenuators will markedly reduce the volume of one or both speakers. The protection circuit automatically resets when the fault is corrected. However, the protection system has a "memory," and according to the manual, it will operate at progressively reduced levels if it suffers repeated overload.

The speakers' sensitivity is rated at 88 dB (for 2.83 volts at 1 meter), and their nominal impedance is six ohms. Their total harmonic distortion (THD), measured between 120 Hz to 12 kHz, is rated at less than 0.3%.

The S-35 loudspeakers are designed for a variety of applications, and they have a variety of mounting options. Dedicated

stands or wall brackets are one option; direct-coupled attachment points are provided on the rear panel to maintain the rigidity of the structure. They can also be placed on top of a shelf or other furniture; six anti-slip stick-on feet are supplied for that purpose. Although not an optimum position, the speakers can even be placed on the floor.

Like all speakers, the frequency response of the S-35's depends greatly on their placement. The S-35's, perhaps because of their rear-facing ports, seem even more sensitive than most. For optimum imaging, Canon recommends positioning the speakers six to ten feet apart and tilted inward toward the listening area at an angle between 30 and 45 degrees.

We auditioned the speakers in an assortment of locations with an assortment of program material. In general, they performed quite well. They did suffer from the lack of deep bass that is inherent in small speakers, but when they were placed near room boundaries, the bass was firm and the speakers' response was balanced and even well into the treble range. The sound was neither boomy nor boxy.

What was truly impressive about the speakers, however, was their wide imaging. When positioned properly, the acoustic mirrors truly did spread the stereo image so that it was not confined to a small "hot spot" at a location that would be at the apex of a triangle (with the speakers at the two other corners). Instead, we were able to walk across the room without being aware of the speakers' placement, yet the stereo performance was superb throughout an angle of better than 90 degrees.

The imaging performance truly showed itself when we pressed the speakers into service as part of our video system. The S-35's are well suited to act as video speakers because they are magnetically shielded. They can be placed directly next to a video monitor without causing any distortion. ■

TECHNOLOGY UPDATE

Put the remote back into your remote control!

Amazing new device attaches to your existing remote control giving it the power to transmit anywhere, even through walls!

By Charles Anton



It's Thursday evening and you have dinner guests. The kids are watching TV but it's too loud. Without embarrassing yourself or the kids by yelling to turn it down, you pick up your remote with Leapfrog long range power and turn it down without a hassle.

Until now remote control has never been very "remote." Even with the best equipment you had to be right in front of your stereo, TV, VCR, etc. to make it work. Now you can operate your entire entertainment system from anywhere in your home with Leapfrog, the next generation in remote systems.

How "remote" is it?

Imagine yourself at home enjoying a relaxing evening of movies on your VCR. You decide to stop the movie so you can get yourself a snack. You aim the remote and click, but nothing happens! You grow more and more irritated, and finally have to stand right in front of the VCR before you can get it to stop the movie. You find yourself wondering why they call it a "remote" in the first place.

Why all the hassle?

Typical remotes use infrared technology. In order for the process to work, the remote must be in direct line-of-sight with the audio-visual equipment. The equipment must "see" the signal.

Radio revolution. The Leapfrog transmitter never needs to be perfectly "lined-up" with the TV, etc. Why? Because the transmitter doesn't rely on an infrared signal. You can even point it in the wrong direction and it still works. Leapfrog overcomes all the headaches of obsolete remote controls through the use of radio waves.

Radio waves work anywhere within a 150 foot range. The signals pass through walls, doors, ceilings and floors, letting you control your equipment from any room of your home. You cannot aim and miss.

Infrared to radio.

The Leapfrog transmitter, which attaches to your existing remote control, sends radio signals to the Leapfrog receiver. This receiver then transmits the signal to your audio-visual equipment with infrared technology.

Versatile uses.

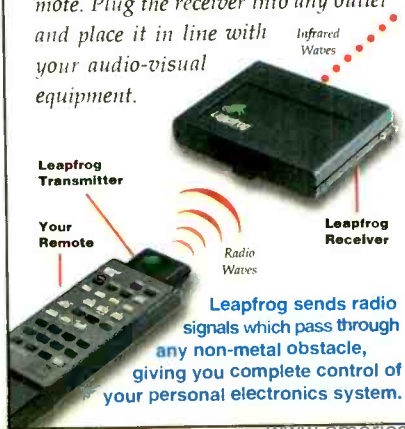
This amazing new remote control modifier works with any infrared remote. Just imagine the convenience of controlling your VCR, TV, stereo, cable converter box, speakers in multiple rooms, or any other audio-visual system throughout your home.

Leapfrog is also ideal for use with universal remotes. Control it all with just one remote.

How does Leapfrog work?

Leapfrog converts your infrared remote signal to radio frequency. Radio frequencies enable the signals to pass through walls and other obstacles. It also allows signals to transmit up to 150 feet without staying in line-of-sight with your equipment. Leapfrog then re-transmits the signal to the receiver, which forwards it to your audio-visual equipment.

Leapfrog installs in minutes. The transmitter attaches to your current remote. Plug the receiver into any outlet and place it in line with your audio-visual equipment.



Talented remote.

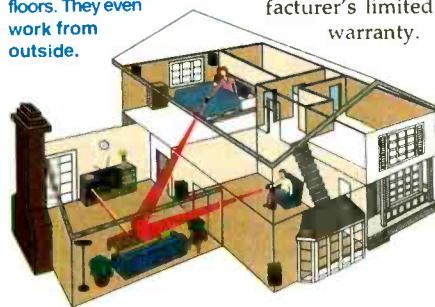
The Leapfrog is not another hand-held remote control. This powerful innovation actually modifies your current remote, thus enhancing its value. You can control your stereo, your VCR, your TV, etc. from anywhere. From across the room or from across the house.

You can even use Leapfrog from outside. This is a fantastic feature to have when you're out by the pool, on your patio, or in your garage.

Factory direct. You would expect an innovative device like this to cost several hundred dollars. That might be the case if we sold only through exclusive high-end audio-visual dealers. But we bring the good news straight to you. You save money with factory direct prices.

Try it risk free. We are so confident that you will love Leapfrog that we've backed it up with our "No Questions Asked" 30 day money-back guarantee. If you are not completely satisfied for any reason, just return it for a full refund. Plus, it comes with a full one year manufacturer's limited warranty.

Leapfrog transmits signals in a range of up to 150 feet. Signals actually pass through walls, ceilings and floors. They even work from outside.



Leapfrog Remote Range Extender \$79 \$6 S&H

Please mention promotional code 192-PL1107.

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, enclose your account number and expiration date.

COMTRAD INDUSTRIES

2820 Waterford Lake Drive Suite 106
Midlothian, Virginia 23113

Why Leapfrog beats infrared

■ **Range.** You can control electronics from up to 150 feet away.

■ **Aim.** You can't miss. Point your remote in the wrong direction and it'll still work.

■ **Value.** It lets you get the most out of your audio-visual equipment by making use of it throughout your home.

■ **Flexibility.** Because it sends signals through barriers, it lets you store your equipment behind cabinet doors.





High-End CD for the Masses

DX-1 COMPACT DISC PLAYER. Manufactured by: California Audio Labs, 16812 Gothard St., Huntington Beach, CA 92647. Tel: 714-841-1140. Price: \$595.

Choosing a CD player can be one of the most difficult decisions you'll have to make about your audio system. CD players have, in a sense, become the great democratizer of hi-fi audio reproduction. The reproduction quality that was once available only to enthusiasts who could afford to lay out many hundreds, or even thousands, of dollars is now available to anyone who can afford an inexpensive CD player.

But are all CD players created equal? No they are not, although the differences separating the best from the worst are less conspicuous than with other audio equipment. Some differences, such as quality physical construction, are easily evident. Some differences are hidden, including the attention paid to the interior construction that increases a CD player's immunity to bumps. Some differences are subtle—reduced error rates that improve the accuracy of reproduction, for instance.

When we first unpacked the *California Audio Labs DX-1* single-disc CD player, we noticed that it had a look and feel that indicates quality. Housed in an attractive, black metal cabinet with a plastic front panel, the DX-1 has a balanced look. The CD drawer is at the center of the upper front panel, above the unit's display. Six pushbuttons are arranged in elegant symmetry, with three on each side of the display. The power button is at the upper left.

Some signs of the unit's quality aren't seen by the end user. For example, the AC line (which enters via an IEC power cable)

is filtered to reduce the possibility of electromagnetic interference (EMI) entering the unit from the power line. The transformer is encased in a potting resin that is designed to reduce the emission of EMI interference that can affect low-level signals. An internal steel subchassis isolates the transport mechanism from external vibration to reduce potential read errors. Even the disc clamp is specially designed to support one third of the CD's surface.

The lenses in the DX-1's optical system are glass, rather than the usual plastic. They are mounted in a diecast housing to improve heat dissipation, and the assembly is transported by a linear worm-drive. The tracking, focusing, and rotational speed servos are digital instead of analog, which, according to California Audio Labs, provides a tenfold improvement in servo speed and accuracy. Thanks to the improved servo accuracy, the DX-1 is said to reduce the amount of error correction that is usually required to compensate for lost bits.

The digital-to-analog converter (DAC) in the DX-1, custom designed for California Audio Labs by Matsushita, is a delta-sigma (1-bit) design with 16-bit resolution. (One-bit converters can provide reduced quantization errors as compared with multi-bit converters, yet they don't require expensive calibration and trimming.)

According to a company spokesman, the DAC design was chosen to allow the high-frequency signal to be equalized in the analog stage. The intent of the equalization is to simulate the frequency response of a moving-coil phono cartridge, and thus give the DX-1 an analog-like sound. We're not sure how to reconcile that intent with the DX-1's virtually flat frequency response.

Unlike most CD players, the DX-1 has the DAC circuitry mounted to the transport mechanism. The rationale for that is to reduce the length of the digital transmis-

sion path to eliminate the introduction of clock jitter. Because of that, the analog signal path, which we would normally consider to be more prone to the effects of interference, is longer. Perhaps the longer signal path is not an important factor because the DX-1 "avoids the use of performance-limiting integrated circuits, using only premium-grade, discrete components in its analog section."

Operating the DX-1 is straightforward. The three buttons to the left of the display are to open the disc tray, and to play and pause the disc. To the right of the display are buttons to select the next or previous track, and a welcome but somewhat unusual stop function. The stop mode allows you to keep the DX-1's power on continuously without running the spindle motor needlessly. The display shows the track number, the track time (elapsed or remaining) or disc time (remaining), and a 15-track "music calendar."

The display can be read easily from directly in front, but becomes indistinct at an angle. Unless you mount the CD player at eye level, expect to do some neck craning to see the display. If you prefer not to be distracted by the glowing display, you can turn off the backlight with a push of the LIGHT BUTTON on the remote control.

The remote control provides access to a number of other functions as well, including two-speed audible search (backward and forward), and random track play. The display's time mode can be changed only from the remote, and tracks can be accessed directly from the numeric keypad.

The remote also allows the DX-1 to be programmed. Up to 20 tracks can be programmed to play in a chosen or random order. Finally, the remote allows access to a music scan mode in which the first 15 seconds of each track on the disc is played.

The rear panel of the DX-1 offers an IEC power connector, standard phono jacks for left- and right-channel outputs, and a digital audio output. The digital output supports connection via a 75-ohm coaxial cable; an optical output is not provided.

Does all the extra care taken by California Audio Labs show up when listening to the DX-1? Although we listened in a wide variety of situations, with different amplifiers and speakers, we auditioned the DX-1 mainly in one comfortable listening room. The music we listened to was varied, ranging from a Glen Gould recording of Bach's Goldberg Variations to recent recording of jazz saxophonist Henry Threadgill, and everything in between.

The DX-1 seemed to disappear from the audio-reproduction chain in a way that many CD players don't. All that was left was its very musical performance. We weren't listening to a CD player, we were listening to the music. What more can you ask from a CD player? ■

ELECTRONICS WISH LIST

Traveling Scale

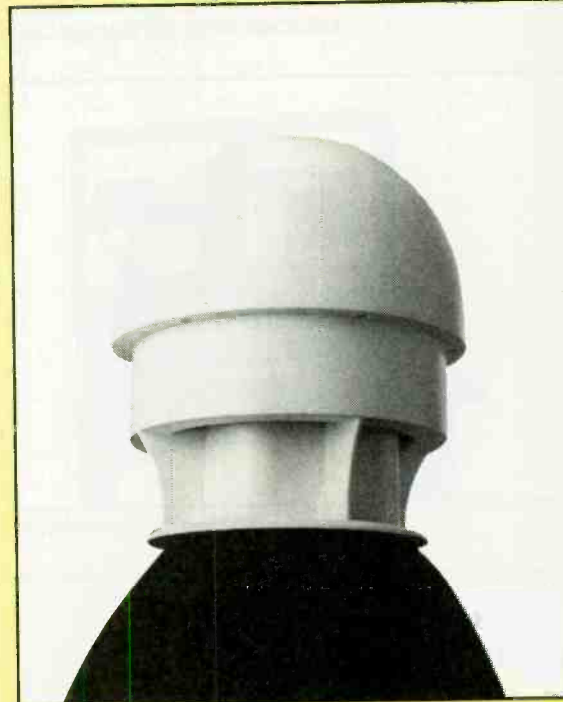
How do you keep track of your weight when you need to most—when you're on the road, eating in restaurants three times a day? Pack the *MiniScale* from *Norix International, Ltd.* (575 Grove Street, #C9, Clifton, NJ 07013). Weighing just 13 ounces, and measuring a compact 4½ inches in diameter, the *MiniScale* fits easily into any suitcase, briefcase, or gym bag. When you place the ball of one foot on the scale (while supporting yourself lightly with both hands on the wall) and lean forward, the microprocessor-based device precisely determines your weight in one second. By pressing the mode button, the weight display is replaced by a time display—the *MiniScale* does double-duty as a travel alarm clock. Price: \$69.95.



Digital Travel Scale/Alarm Clock

Outdoor/Indoor Speaker

Intended for both indoor and outdoor applications, the *Sound Mushroom Model 410* from *Recoton* (46-23 Crane Street, Long Island City, NY 11101) is a portable 900-MHz wireless amplified speaker that takes its name from its distinctive domed enclosure. Powered by a rechargeable sealed lead-acid battery that lasts for more than 10 hours on a single charge, the speaker can be used far from the nearest electrical outlet. Its high-impact copolymer enclosure sheds rain, is indifferent to heat or cold, and resists both cracking and discoloration. The *Sound Mushroom* has its own on/off switch, volume control, and a tuning control that locks precisely on the 900-MHz-range frequency used by the included transmitter to send signals to the speaker. When the signal is locked in, an LED indicator glows to confirm it. Price: \$199.99.



Recoton Sound Mushroom Outdoor/Indoor Speaker

Home-Theater TV

The 35-inch *RCA 3571MB* from *Thomson Consumer Electronics* (10330 North Meridian Street, Indianapolis, IN 46290-1024) couples big-screen action and the SRS Sound Retrieval System with convenience features designed to enhance viewer enjoyment. The SRS system "fills the room with sound without the aid of external speakers, wires, or other equipment." The set features Thomson's optimum-contrast dark-glass picture tube and 110-degree very high performance (VHP) system. Those two technologies combine to provide outstanding picture contrast even in brightly lit rooms. Convenience features include color-coded monitor panels for easy connection of video and audio components; advanced color picture-in-picture, which allows the viewer to adjust the inset picture size and position; and channel guide, for previewing up to 12 channels at the same time. A remote-controlled on-screen menu system visually guides consumers through TV features and operations. Price: \$2199.

Television Antennas

The four new television antennas in *Jasco Products'* (311 N.W. 122nd, Oklahoma City, OK 73114) *Optima* line are said to feature the same advanced microwave technology used in military radar systems. As *Jasco* explains it, conventional indoor antennas receive only the horizontal component of incoming electromagnetic waves, while *Optima* antennas use a circularly polarized element to receive the vertical component as well. Supposedly, that results in up to twice the signal reception, with no need to aim the antenna at the incoming signal. The line includes the amplified *Model 8229*, which is equipped with a built-in "OptiAmp," a tilt/swivel hinge, and black dipoles. The antenna features a stabilizing base weight and four suction-cup base supports for secure placement on any flat surface. Prices: \$24.99 to \$89.99.



Jasco Optima Antennas

ELECTRONICS WISH LIST



Klik!Case CD12 CD Storage Case



SnapEase Home-Office Furniture



Personalized Mouse Pads

Klik!Case CD Holder

Recently awarded a Bronze prize in the 1994 Industrial Designers Society of America Industrial Design Awards Competition, the *Klik!Case CD 12* carrier provides maximum protection for 12 CD's without their jewelbox cases. The *Klik!Case* has a molded plastic outer shell that is "virtually indestructible," according to *Outer Circle Products, Ltd.* (860 West Evergreen Avenue, Chicago, IL 60622). Six individually hinged trays hold two discs each and flip up or down for easy disc selection. The trays lock to hold the CD's firmly in place. A center grip raises the discs above the tray surface for easy pop-up release. Price: less than \$10.

Rubbermaid Office Furniture

When you think of *Rubbermaid* office products, what probably comes immediately to mind is the traditional "round file cabinet" in which you toss trash. Think again. Rubbermaid now furnishes complete offices, with its line of *SnapEase* ready-to-assemble furniture. The line, marketed by a division of Rubbermaid called *MicroComputer Accessories, Inc.* (9920 La Cienega Blvd., Inglewood, CA 90308-7032), includes a 46-inch computer desk, a matching hutch, and a printer cart. Aimed at home and small offices, the furniture features contemporary design, scratch-resistant materials, and simple assembly. *SnapEase* products assemble with a snap-lock mechanism that requires no tools. The desk, *Model 7300*, can hold a computer, monitor, and printer. It has a full-width, glide-out keyboard drawer that includes a storage area for diskettes. The desktop inlay is reversible; one side is solid gray, the other has a maple woodgrain pattern. The hutch, *Model 7305*, frees up desk space by providing extra storage for manuals and supplies, and features a movable shelf. The *Model 7105* printer cart has two rear wheels and nests beneath the desk when not in use. Prices: desk: \$299; hutch: \$89.95; printer cart: \$59.95.

Video-GameSaver

Don't you hate it when you're "killed" while playing a high level of a video game, and then have to play through all the lower levels again to get back to that point? The *GameSaver* from *Naki International* (Century City North, 10100 Santa Monica Blvd., Suite 1400, Los Angeles, CA 90067) is a patented, plug-in cartridge that allows Sega or Super Nintendo players to pinpoint, save, and return to exact moments in a game to conquer new levels faster and eliminate frustrating, repetitive game play. For example, if a player conquers the first three levels of a game and keeps losing at the same obstacle in level four, he simply pushes the *GameSaver* button to mark and return to that spot. Even if the system is accidentally unplugged, the cartridge will save the instructions. *GameSaver* plugs into the video game cartridge slot and then any game can be inserted into the *GameSaver* cartridge slot. The *GameSaver* unit can even be transferred to another Sega or SNES system without losing the data. The point saved is remembered for up to 30 hours using four "AA" batteries or a Game Boy-compatible rechargeable battery pack. Price: \$49.99.

Personalized Mouse Pads

You can get your favorite pictures out of your wallet and onto your desk with a *Personalized Mouse Pad*. Send your photograph, drawing, or computer art to *V.I.P. Communications* (P. O. Box 35790, Tucson, AZ 85740), and they will professionally reproduce your image on a mouse pad using state-of-the-art laser printing technology. Computer artwork can be reproduced directly from postscript files. You can also advertise your business by putting the company's logo on mouse pads that are distributed to new or existing clients. All original photos, art, or disks will be returned with the order. Price: \$19.95 each in small quantities; large orders are discounted.

ELECTRONICS WISH LIST

Motion Sensor Security Light

Bell-shaped lamp holders add a distinctive look and increased lamp protection to the *Reflex Designer Motion Security Light Model SL-5315* from *Heath Zenith* (455 Riverview Drive, P. O. Box 1288, Benton Harbor, MI 49022). The fixture senses heat in motion, and produces a sudden shower of light to startle intruders or unwelcome guests. A selectable dusk timer turns lights on for up to four hours after dusk. Users can also turn the lights on at night from a standard wall switch. At daylight, the sensor resets the unit to the automatic motion-sensing mode. Another safety feature is the selectable security flasher, which sets the lights flashing when motion is detected in the sensor's field. The user can choose the amount of time (from one to 20 minutes) before the unit automatically stops flashing. The security light controls two 150-watt floodlights and detects motion as far as 70 feet away. Three overlapping detection zones provide an effective coverage area of up to 4000 square feet. Price: \$35.



Reflex Motion-Sensor Security Light

Cordless Digital Answering System

The *Cordless Digital Answering System 5650* from *AT&T* (Consumer Products Division, 5 Wood Hollow Road, 3L11, Parsippany, NJ 07054) combines a cordless telephone and a digital answering system in one unit. Users can retrieve messages remotely from either the cordless handset or any touch tone phone. The answering system records incoming messages and an outgoing announcement on a memory chip with 26 minutes of recording time. The 10-channel cordless telephone features a speakerphone with dial in the base, two-way page and intercom, and nine-number memory. Price: \$259.



AT&T Digital Answering System/Cordless Phone

Plain-Paper Printer/Fax/Copier

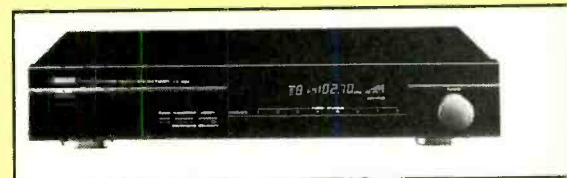
Home offices are notoriously short on space, so multifunction devices are particularly appealing. The *PFC Model KX-SP100* from *Panasonic Communications & Systems Company* (Two Panasonic Way, Secaucus, NJ 07094) fits the bill, serving as a plain-paper printer, Fax, and copier in one compact unit. With its unique, upright design, the PFC can fit on a desk beside a computer and doesn't require additional office furniture. The unit's telephone/Fax switch eliminates the need for a dedicated phone line for the Fax. The Energy Star-compliant PFC saves on electricity by cutting down the number of office machines drawing power. And having the copier, Fax, and printer right on the desk allows workers greater privacy and control over their documents. The printer is a full-featured, laser-quality (300-dpi) personal page printer with a 70-page input tray that holds either letter- or legal-sized paper. The plain-paper Fax features a 10-page automatic document feeder, auto-reduction mode, and a journal-print function that lists the last 35 transmissions and/or receptions. It connects to a desktop phone and such Fax functions as speed dial and redial are accessed directly from the phone's handset. The PFC will accept an incoming Fax while the printer is in operation and store up to 18 pages (or up to 104 pages with optional RAM expansion boards) in memory for later retrieval. As a copier, the PFC features a 10-page automatic document feed; medium, light, and dark settings; and fine and halftone modes. Price: \$999.



Panasonic PFC Plain-Paper Printer/Fax/Copier

Entry-Level AM/FM Stereo Tuner

The *TX-480* is the first entry-level AM/FM tuner from *Yamaha Electronics Corporation, USA* (6660 Orangethorpe Avenue, Buena Park, CA 90620) to feature rotary electronic tuning. Other convenience features include preset exchange, which allows a user to easily change or reassign any or all of the 40 preset stations, and a three-way, multi-status station name display. Incorporating Yamaha's "Alpha" (Absolute Linear Phase IF) circuitry, the TX-480 offers improved selectivity without sacrificing linearity. High adjacent-station rejection is important in urban areas where stations might impinge on each other's prescribed frequency. A wireless remote control is available optionally. Price: \$199.



Yamaha AM/FM Stereo Tuner

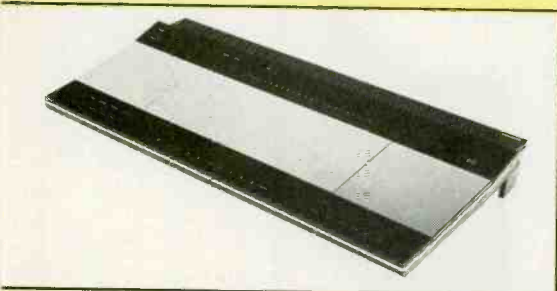
ELECTRONICS WISH LIST



Pioneer Bodysonic Speaker



Sony Handycam with LCD Screen



Bang & Olufsen Beocenter 9300



Sigma Designs ReelMagic

"Bodysonic" Car-Audio Speaker

Pioneer Electronics' (2265 East 220th Street, Long Beach, CA 90810-1639) BSS-C1 Bodysonic Speaker System allows consumers to "feel" the music playback of their car-audio systems. The speaker, which is designed primarily to improve bass sound reproduction and listening enjoyment in the noisy environments found in convertibles, hatchbacks, and sport utility vehicles, fits onto the backs of driver and passenger seats. The system consists of a small, easily installed amplifier unit, a remote control, and the seat-fitting speaker pad. Price: \$300.

Camcorder with Built-In Color Monitor

Sony's (1 Sony Drive, Park Ridge, NJ 07656) CCD-FX730V Handycam 8mm camcorder allows users the choice of framing their shots on a three-inch color LCD screen or by using the camcorder's traditional viewfinder. Video footage can be played back immediately using the built-in LCD screen and speaker, or by connecting the camcorder to a TV to view the video on a larger screen. The LCD monitor is mounted on the side of the camcorder, where it can be folded out when needed. The screen can be tilted and turned, allowing users to capture shots from difficult or unusual angles. When not in use, the LCD folds flush against the side of the camcorder. The CCD-FX730V also features an optical 12:1 variable-speed power zoom; four-mode program auto-exposure control; age insert, an electronic calendar that can automatically update and superimpose age information for up to three children; quick record, to begin recording in one-fifth of a second; an audio/video digital fader; and AFM hi-fi sound. Price: \$1099.

Multi-Room Music Center

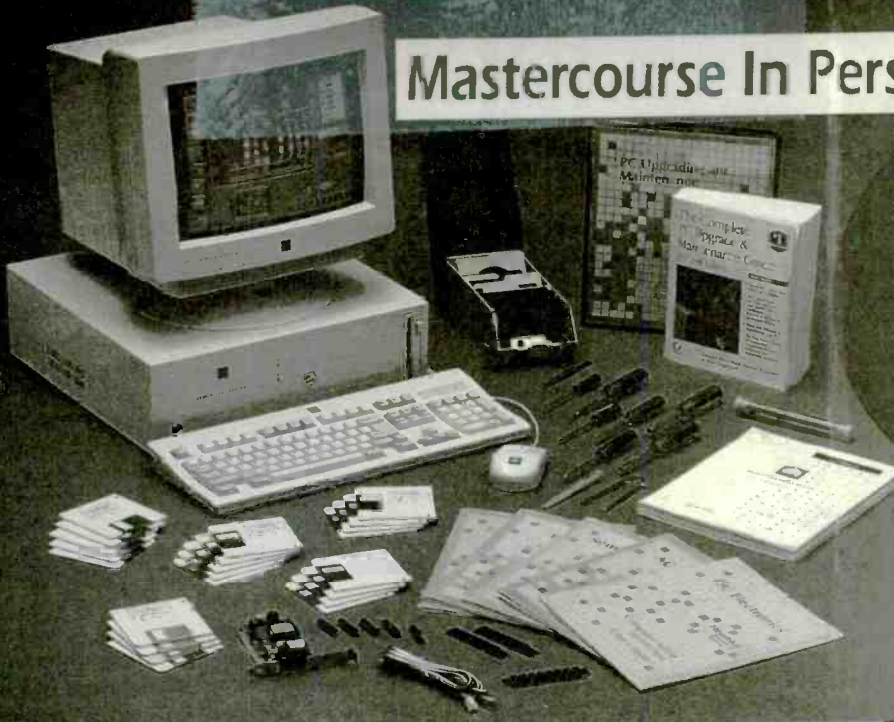
The Beocenter 9300 from Bang & Olufsen of America, Inc. (1200 Business Center Drive, #100, Mt. Prospect, IL 60056) is a remote-controlled, compact music center that offers multi-room communication. It contains an FM/AM radio, a stereo amplifier, an auto-reverse cassette recorder, and a compact-disc player in a single, elegant cabinet. The slender, tapered cabinet, which is surfaced in highly polished aluminum and black glass, features "sensi-touch" glass panels instead of conventional buttons or knobs. Proprietary operational menus controlled by a microcomputer work as a "guided tour" of all functions including timer programming—with 15 events for timed play and recording of all internal sources—for one-time or multiple programs for different times and days of the week. Two pairs of passive Beovox loudspeakers or up to ten pairs of Beolab powered speakers can be connected to the Beocenter 9300 for home-theater or multi-room use. Line-in and -out connectors allow the addition of accessory equipment such as surround sound processors. Price: \$2995.

MPEG Multimedia Plug-in Board

ReelMagic from Sigma Designs (46501 Landing Parkway, Fremont, CA 94538) is the first consumer-priced MPEG playback card for the PC. Based on the MPEG standard for compression, ReelMagic decompresses video and audio in real time, allowing up to 74 minutes of full-screen, full-motion video and CD-quality audio sound to be played from a standard CD-ROM drive. More than 50 ReelMagic-compatible titles will be ready by Christmas. Scheduled for shipping this past summer were 20 new titles, including *Space Ace* from ReadySoft, *Return to Zork* from Activision, *Lord of the Rings* from Interplay Productions, *World Cup Soccer* from CD-Vision, *Sporting News Football* from Compton's NewMedia, and *World Atlas* and *20th Century Video Almanac* from The Software Toolworks. ReelMagic can also play Video CD movies on 5-inch discs. Price: \$449 with 16-bit DSP sound controller.

Mastercourse In Personal Computers

Now Available,
**EASY
4-PAYMENT
PLAN.**



- Ease of Learning
- Quality of Education
- Value

You've Grown to Expect from Heathkit

Heathkit is Better

We Teach You, Take Care Of You,
And We Put Our Money
Where Our Mouth Is

Using real-world exercises and easy-to-understand lessons, you will learn all the theory, the skills and the trade secrets to confront and conquer the practical and technical aspects of the PC revolution. And unlike others, we back it up with a guarantee of satisfaction—or your money back.

Heathkit is Better

Our Exclusive Computer-Aided
Instruction Makes Learning
Easy, Fast, & Fun

The truly qualified PC Technicians possess knowledge of the inner workings of a computer right down to the electronics level. This is the only type of technician we are interested in producing—the kind that ends up "truly qualified." So Heathkit

provides an electronics curriculum in our exclusive computer-aided instruction format—which is today the fastest, most effective learning media around, and is the most extensive electronics curriculum of it's kind in the world.

Heathkit is Better

We Send You

"The Good Stuff"

On Day-1
With Heathkit, from day 1 you have the entire training package including a fully loaded Zenith Data Systems 486 computer including a SVGA color monitor, 2MB of memory, Windows®, and diagnostic software.

Other home study schools string you along for dozens of weeks before they send you what is by then obsolete pieces of a no-name clone that *might* work if assembled correctly into a computer.

Our computer is fully assembled and tested, and covered by a 1 - year on-site warranty.

Heathkit is Better

You Be

The Judge

Call today for more information!

1-800-253-0570

Yes! Send me more information on Heathkit's Mastercourse in Personal Computers.

Name _____

Address _____

Address _____

City _____

State _____ Zip _____

Phone (____) _____



• P.O. Box 288 • Benton Harbor, MI 49023-1288
• 1-800-253-0570

• Please mention this code when calling 107-033

CIRCLE 155 ON FREE INFORMATION CARD



ELENCO ELECTRONICS TELEPHONE LINE ANALYZER



CIRCLE 119 ON FREE INFORMATION CARD

Buy it or build it, because you'll need one in this information age.

While the telecommunications revolution started way back when the telegraph was hot, it is far from over. The fact that Fax's and modems are migrating from the work place to the home is evidence that the battle field is only getting larger.

If your home, office, or home-office communications hardware is growing as a result (an answering machine here, a Fax there), you are likely to encounter an installation problem sooner or later. For example, you might load the phone line with too many devices. It's also possible that one of your phone-line jacks has its polarity wrong and will cause trouble with a newly purchased device.

Of course the phone company will gladly service your needs, but you must pay an extra monthly fee, every month, whether you place a service call or not. Alternatively, you can maintain your internal phone lines yourself. For that you'll need two things: some idea of how a phone works, and a phone-line analyzer.

You get both of the above with the *Elenco Model 400K Telephone Line Analyzer* kit, available for \$21.50 from Elenco Electronics (150 West Carpenter Ave., Wheeling, IL 60090-6062;

Tel. 708-541-3800). It comes with a thorough tutorial on phone technology, and everything you need to build an analyzer. For those who would just like to use the analyzer without having to build it or understand its workings, it is available pre-assembled, without a tutorial, for \$33.25 as the Model 400.

Regardless of which model you choose, the analyzer is novice-friendly. For all but one of the tests it performs, you simply plug a phone into the analyzer's front-panel jack, and plug the analyzer (which comes with its own cord) into a phone-line jack. It only has one control: a two-position switch that you set according to which test you're performing. The test indicators are a simplified meter (which has colored "regions" instead of a numbered scale) and an LED used to indicate polarity.

Use. To give you an idea of the analyzer's usefulness, let's discuss the tests it performs. First, there is a "line test" that detects overloading from a defective phone or shorted wiring. During that test, an overload is indicated by a low reading on the meter. Also, if the unit's polarity LED lights up, it means the phone-line wires are reversed, which

can cause problems for some equipment.

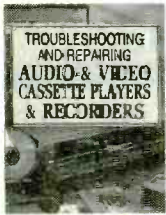
Second, a "ring test" determines whether a phone's ringer, the phone line, or line loading is to blame for a lack of audible ringing. To do that, the meter is used to rate the quality of the incoming ring signal. That test is very useful, as it is easy to misconstrue missed calls as a telephone-company problem, when in fact you've just got too many telecom goodies on the line.

Third, a "loop test" helps you find out if the problem is in your internal wiring or in the outdoor phone line. That is obviously a *must* for determining the responsible party.

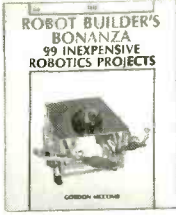
Last, a "telephone-cord test" allows you to check phone cords for loose connectors and such. For that, the suspect cord is left connected to the wall jack of the phone line, and the other end is plugged into the analyzer's front-panel. Next, the cord of the analyzer is plugged into the phone. If the meter reading varies while the suspicious phone cord is jiggled, the cord is bad.

To expedite the tests, the documentation contains both simplified and detailed instructions. The simplified in-

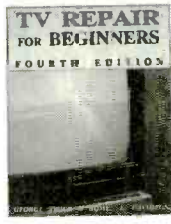
(Continued on page 89)



3795P \$19.95



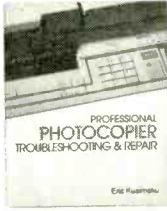
2800P \$17.95



3627P \$19.95



4179H \$24.95 Hardcover



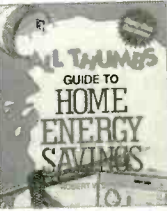
4331H-XX \$29.95 Counts as 2/Hardcover



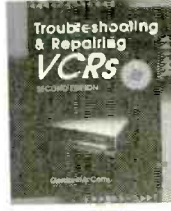
3279P \$26.95



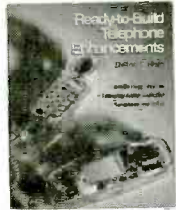
4270H \$29.95 Hardcover



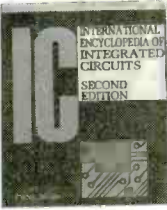
4244P \$9.95



3777H \$22.95 Hardcover



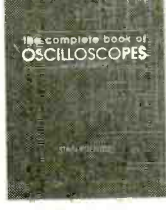
4362P \$16.95



3602H-XXX \$84.95 Counts as 3/Hardcover



1604P \$17.95



3825P \$17.95



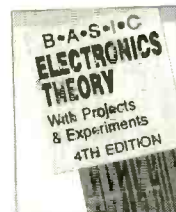
3711P \$19.95



4334H \$29.95



3258P \$19.95



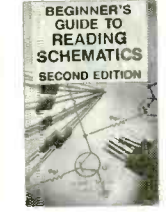
4261H-XX \$35.00 Counts as 2/Hardcover



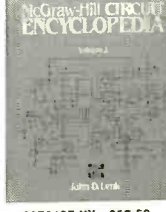
4283H \$26.95 Hardcover



0487375P \$24.95



3632P \$10.95



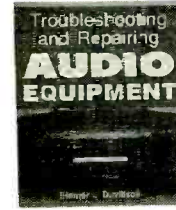
0376107-XX \$59.50 Counts as 2/Hardcover



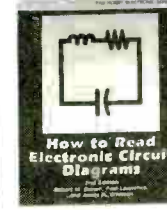
4139P \$16.95



4110H \$27.95 Hardcover



4112H-XX \$25.95 Counts as 2/Hardcover



2880P \$15.95



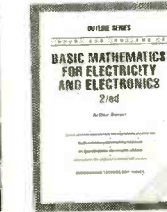
4061P \$9.95



4122H-XX \$36.95 Counts as 2/Hardcover



4209P \$19.95



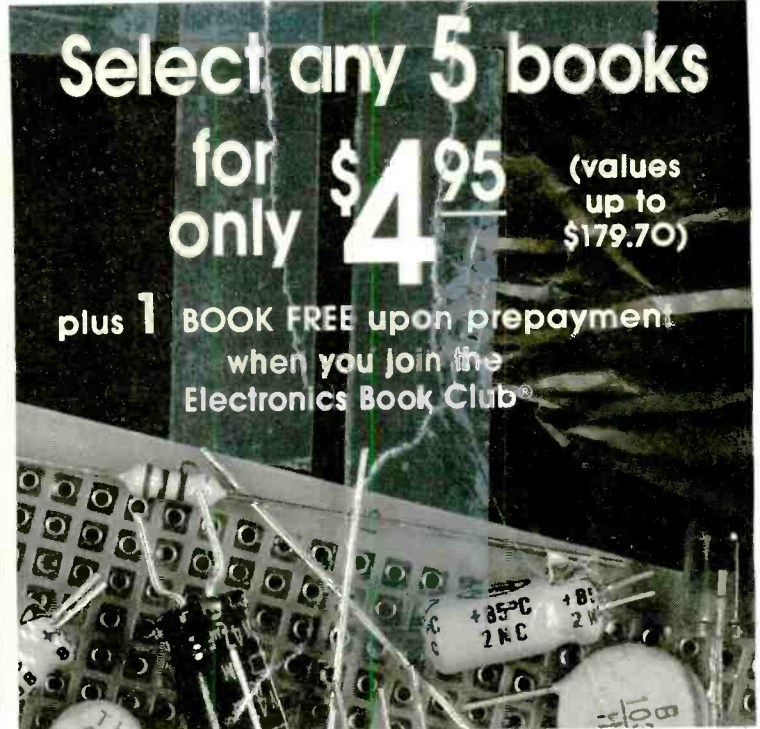
0044392P \$12.95



1367P \$29.95



0404348H-XX \$49.50 Counts as 2/Hardcover



Select any 5 books
for only \$4.95 (values up to \$179.70)
plus 1 BOOK FREE upon prepayment
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 do 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. 1994 Electronics Book Club PE195

If card is missing, write to: Electronics Book Club, Blue Ridge Summit, PA 17294-0810

THINK TANK

By John J. Yacono
Technical Editor,
Windows Magazine

Temperature- Controlled Circuits

Over the last three months, I covered enough ground to explain the concepts of current and voltage (or potential), as well as other electrical phenomena. As promised, this month I'll explain resistance and its relationship to current and voltage. To please the more savvy readers, I'll also present letters containing some temperature-sensing circuits.

to flow (like current) from the outlet of the pump (the negative battery terminal), through the pipes (wires), and back to the pump's inlet (the positive battery terminal).

Now let's upset that harmonious picture by placing a valve somewhere along the pipe network. If we partially close the valve, the current decreases and the pressure difference between the pump's inlet and

That relationship is called "Ohm's Law," and resistance is measured in units called "ohms." Both are named in honor of a pioneering scientist. That law is perhaps the most fundamental rule in all of electronics. All hobbyists commit that rule to memory as a matter of course.

In next month's column we'll discuss our first component: the "resistor." I'll describe its effect on current flow, and some of the different types of resistors you're likely to encounter. Now, its letter time.

FAN ACTUATOR

In a building with high ceilings, which is heated with a wood-burning stove, a ceiling fan was installed to circulate the heat. But the fan had to be manually switched on when the stove was lit. Since I'm a bit lazy at times, I built this circuit (see Fig. 1) to automate the fan.

The op-amp, U1, is placed in a comparator configuration with two thermistors—one located at the ceiling, one at the floor. The IC senses the temperature difference between the ceiling and floor, but is unaffected by the overall room temperature. When the temperature differential increases, the upper thermistor will decrease in resistance, eventually causing the voltage at pin 2 of U1 to exceed that at pin 3. That causes the output of U1 to go low and trip the timer, which adds hysteresis to the op-amp's output, preventing the motor from chattering. When tripped, the timer activates the relay, which activates the fan.

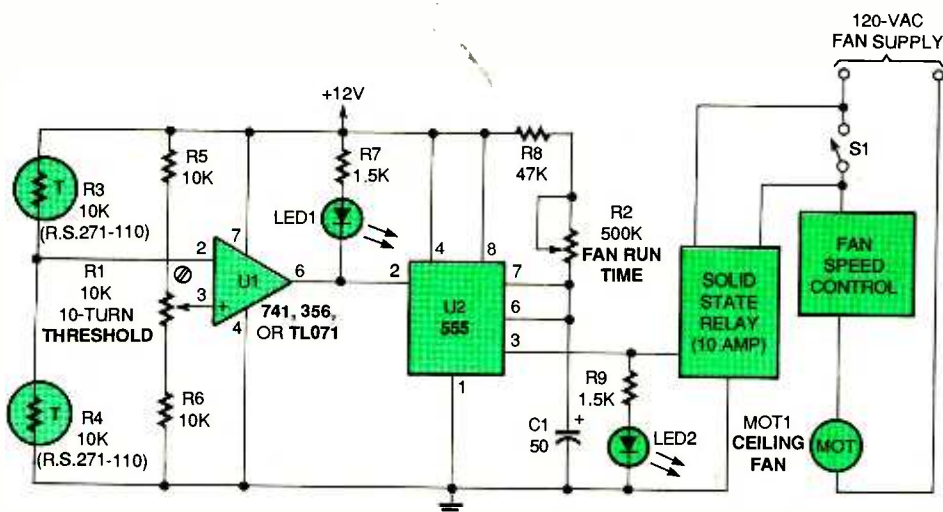


Fig. 1. This circuit measures temperature differences, not temperature. Once the difference passes a certain threshold, the timer is triggered, activating the solid-state relay.

Let me start by re-introducing last month's "water-in-a-pipe analogy." In that analogy, water represents electrons, the flow of water is current, a series of pipes are like a wire, a water pump is a battery, and the difference in pressure between the pump's inlet and outlet is the battery's voltage.

Let's say the pump's inlet and outlet are connected to the ends of a series of pipes. If the pipes and pump are full of water, turning on the pump (battery) causes the water (electrons)

outlet increases. In fact, the change in pressure is proportional to the change in water current. The action of the valve on water current (or electron current) and pressure (i.e., voltage) is so precise, we can give it a name. In fluid dynamics it's called "pressure head," but in electronics it's called "resistance."

Of course, the relationship between resistance, current, and voltage didn't go unnoticed by early scientists, and led to the famous equation:

$$R = E/I$$

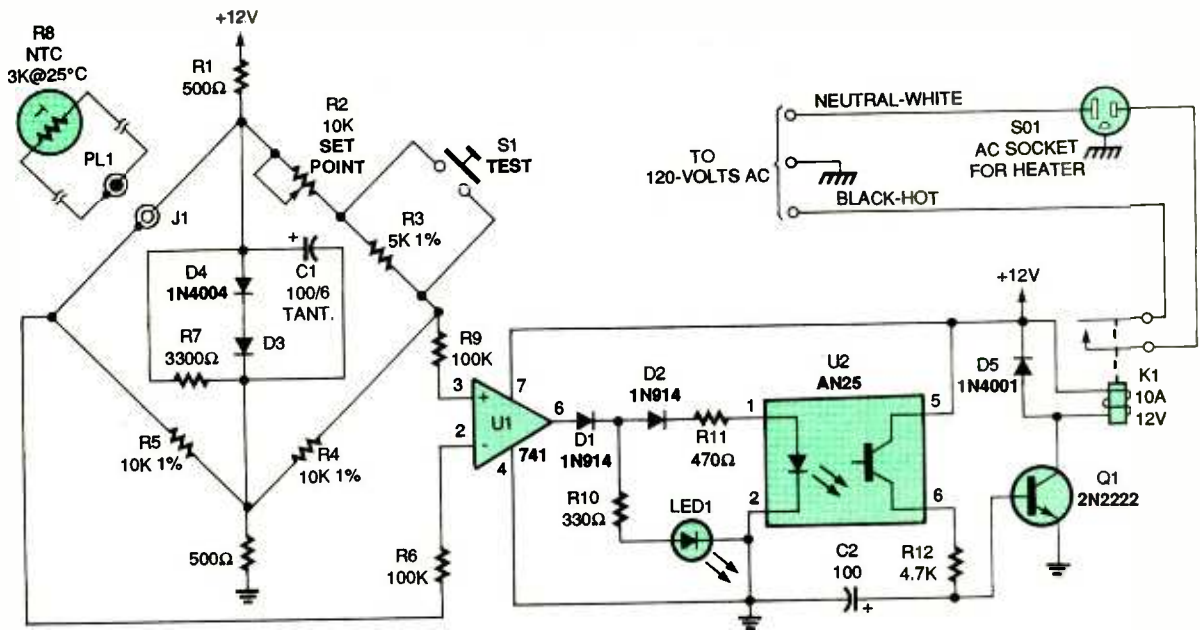


Fig. 2. Using a bridge circuit to provide an accurate activation temperature, this circuit will turn on a heating unit or other device when the temperature drops below the trip point set by R2. Use a 10k resistor in place of the thermistor to calibrate it for 32°F activation.

The vertical position of the thermistors, and the threshold trim control (R1), will affect how sensitive the circuit is to a temperature differential. The timer control (R2) will affect how often the system cycles as the room approaches temperature equilibrium. Although I'm sure a bit of trial-and-error adjustment, will be necessary, for a single floor, the thermistor connected to the 12-volt supply should be placed near the ceiling, but away from the fan, and the other thermistor should be placed beneath it, a few feet above the floor.

—David L. King,
Chicago, IL

Although David didn't provide more information on the solid-state relay he used, that's not too much of a drawback since you'll have to specify one to meet your own needs anyway. Just find one that handles the load current you have in mind, and requires a 12-volt DC input signal.

The circuit might be useful for me. I have gable fans, controlled by a thermostat, that remove hot air from my attic when the temperature in the attic is high. They work on the theory that there is cooler air under the eaves that will replace the hot air. Of course, if the air entering the eaves isn't that much cooler, it's hardly worth keeping the fans on. The circuit could keep the fans from activating unless it's truly beneficial.

FREEZE SENSOR

This circuit activates a heater to hold the temperature a little above 32°F. I use it during Northern Michigan winters to prevent freezing in water pipes, etc.

Diodes D3 and D4, which are forward biased, establish an operating voltage of about 1.65 volts across the bridge. That ensures that the small thermistor bead operates without any appreciable self-heating.

The diodes at the output of the 741 ensure crisp, sure

turn-on operation. Capacitor C2 was added to prevent relay chatter or buzz as the circuit slowly comes on. Make sure, for heater applications, that the relay contacts can handle the current required by your heater. Also, precision (1%-tolerance) resistors should be used for the bridge circuit.

Be careful with the fine thermistor wires. I used small heat-shrink tubing and epoxy to attach it to an old ball-point-pen case so the thermistor just protrudes out one end. At the other end, I attached approximately 6-feet of 2-conductor cable with an RCA plug to mate with J1. In operation, don't position the probe directly in front of or too close to the heater, as that causes a short cycling rate.

For quick calibration, replace the thermistor assembly with a 10K 1% resistor connected across an RCA phone plug, then set the 15-turn trimmer potentiometer, R2, to just light LED1. The resistor simulates

the thermistor's value of approximately 10K at 32°F. That way you don't have to wait for freezing temperatures to set the unit.

—Roger W. Hamel,
Cedarville, MI

Very nice work. I would recommend that the calibration resistor replace the thermistor at the far end of the cable, not at the bridge end. The reason for that is to take the cable resistance into account during calibration. Also, be sure to use heavy-gauge wire for all AC connections as appropriate.

THERMOSTAT CIRCUIT

I have been experimenting with temperature-control circuits and came up with this differential thermostat. With the component values shown (see Fig. 3), my thermostat operates between 32° and 86°F.

I have used two sections of an LM324 quad op-amp configured as comparators. The reference voltage of each comparator is set by two multi-turn potentiometers.

(Continued on page 70)

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 _____

All payments in U.S.A. funds. Canadians add \$4.00 per VHS cassette. No foreign orders.

Build a Telephone-Line Simulator

Mr. Watson, come here; I want you. Ever since those famous words were spoken over the first telephone instrument by Alexander Bell, we've discovered unlimited uses for the telephone. Now we can communicate not only with our trusty telephone, but we can also use PC modems, Fax machines, answering machines, and the like.

But those gadgets have become complicated, and they occasionally break down. Testing them can be a real chore, unless you have access to multiple phone lines so that you can conveniently place test calls. Of course, there are commercial phone-line simulators that can be used instead of a phone line, but they can cost several hundred dollars.

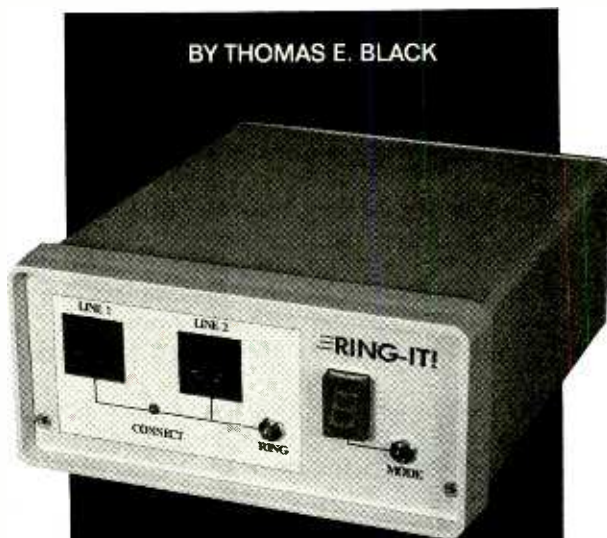
Well, with *Ring-It!* you can now have a complete telephone system in a box. Forget about tying up your telephone line; simply plug in the telephone device that you want to check, and do your tests.

All of the standard telephone-system features that you need are supported. You can ring-up telephones, Fax machines, modems, and answering machines. Just about anything that you can connect to a standard phone line can be activated with Ring-It!

Because the standard telephone-call progress sounds are generated (dial tone, busy signal, ringing, etc.), you can even use Ring-It! to demonstrate telephone equipment. Don't ever tie up your home or business phone again while you show off your telephone products. In fact, with Ring-It!, it's almost impossible to tell that you aren't using a real phone line.

You can even connect a pair of standard phones and create a simple phone system. In that configuration,

BY THOMAS E. BLACK



Use it to test or demonstrate telephone equipment, to set up your own mini telephone system, and more.

the phone on line 2 automatically rings when the phone on line 1 is picked up. The lines are connected when both phones are in use, and the conversation ends by hanging up.

The flexibility of Ring-It! is provided by a single-chip microprocessor, which allows us to keep the component count to a minimum. An on-board ring generator provides the precise voltages required to activate the phone equipment, and a call-progress tone-generator IC creates the normal telephone-related sounds (busy signal, ring signal, etc.).

Features. Ring-It! has five different operational modes that can be invoked through one of the front-panel-mounted push switches. There is even an LED readout that displays the current mode that is in use.

The LED display is used to indicate mode, cycle time, and dialed-digit information. Its decimal point is illumi-

nated only when the mode or cycle time is shown; a decoded DTMF (Dual-Tone Multi-Frequency) digit is shown as a value without the decimal point.

The five modes can be invoked by pressing the Mode switch; the active mode is shown in the LED display. The modes are summarized as follows (the bracketed value indicates the corresponding LED display):

- [n.] Normal Ring Mode
- [A.] Automatic Ring Mode
- [b.] Beep Tone Mode
- [c.] Cycle Ring Test Mode
- [d.] Dumb Mode

The normal ring mode is used when you want standard telephone-system emulation. When you take the line-1 (main) phone off-hook, a dial tone is heard. If you do nothing for twenty seconds, a "reorder" sound is heard. If you tone dial any

seven-digit phone number, the line-2 (test) phone will start to ring. When line 2 answers, the front-panel connect LED will light up.

While you press the DTMF keys of your phone, the corresponding digit will appear in the LED display for up to two seconds. Because of limitations in our display, the * tone is shown as "A" and the # key is shown as "P"

If you attempt to ring the test line and it is off-hook, then a busy signal will be heard. Please note that because it is a one-way device, line 2 can not be used to ring line 1.

There are some shortcuts in the normal mode that can be used to ring the test line. For example, pressing the main phone's DTMF * key will immediately start the ring request. The front-panel Ring switch will also start the ring cycle, which can be used if the main line's phone is not DTMF compatible.

The normal mode is perfect for

demonstrating telephone equipment such as answering machines, Fax systems, voice mail, modems, and more. Because the standard call-progress audio tones are heard, your demonstration will appear more natural to your audience and equipment.

The automatic ring mode is similar to the normal ring mode, except that in the automatic mode, ringing begins immediately after the line-1 phone is picked up. That operation is sometimes called a "Ring-Down line" by phone-system manufacturers. If either line is off-hook when the other is picked up, the two lines will be automatically connected together.

The automatic mode, besides being used to test phone equipment, is also perfect for use as a front-entry intercom for home or office use. Place a phone near you and one near your entry. Be sure to post a note near the entry phone that instructs your visitors to "lift the receiver for assistance."

The beep tone mode is specially designed for cycle testing answering machines and other types of telephone equipment. That mode does not start until the Ring button or the DTMF * key is pressed.

It is not necessary to have the line-1 phone off-hook during the beep mode. Whenever line 2 is taken off-hook the two lines will be automatically connected together and a series of repeating test tones will be generated.

During the beep mode, the test line automatically rings after a short adjustable delay (the delay is skipped on the first cycle). If the test line is answered, staggered beep tones are played. Those tones have been designed to keep a voice-controlled answering machine from hanging up. The ring-up cycle repeats (after the requested delay) until the mode is canceled by pressing the Mode switch.

For example, if the delay is set for thirty seconds, the device being tested will be rung-up thirty seconds after the last answer/disconnect cycle. The test tones will be played as long as the test line is off-hook. If the test line goes on-hook, the delay cycle starts up again.

The cycle ring-test mode provides most of the features of the beep mode, except that in the former, the beep tones are not played and a

TABLE 1—DTMF TONE PAIRS

Low Group	High Group		
	Column 0 1209 Hz	Column 1 1336 Hz	Column 2 1477 Hz
Row 0, 697 Hz	1	2	3
Row 1, 770 Hz	4	5	6
Row 2, 852 Hz	7	8	9
Row 3, 941 Hz	*	0	#

Note: In 16-digit DTMF, there is an eighth tone (1633 Hz, Column 3).

phone must be plugged into the main line. To start the cycle you must pick up the phone attached to line 1. Again, if either line is off-hook when the other is picked up, the two lines will be automatically connected together.

When line 2 answers, your conversation may begin. If line 2 hangs up and the main phone remains off-hook, the test line is automatically rung up after the delay time. That cycle repeats until the main phone is hung up.

The dumb mode provides a silent talk path and allows a manual ring. You will not hear any call progress tones; however, you can converse normally.

Line-2 ringing is controlled by using the Ring switch or the main phone's * key. The ring signal will follow the key presses. Unlike the other modes, they do not continue to ring when the keys are released.

The dumb mode is perfect for testing the basic operation of equipment. And because you can control the duty cycle (cadence) of the ring signal, non-standard equipment can be tested for ring operation.

How it Works. A schematic diagram of the Ring-It! telephone-line simulator is shown in Fig. 1. The circuit's intelligence is provided by U9, a PIC16C57-XT/P microcontroller IC. That chip is a member of Microchip Technology's family of high-performance, low-cost 8-bit microcontrollers.

A microcontroller is a small, general-purpose computer chip that contains a microprocessor-type, Central Processing Unit (CPU), similar to the one found in your personal computer. However, it also incorporates Random-Access Memory (RAM), Read-

Only Memory (ROM), and digital Input/Output (I/O) lines. In other words, it's a complete computer system that is housed in one IC.

Because the PIC16C57-XT/P is a computer, it needs software to operate. The internal ROM holds the software program, which is called firmware. The firmware is permanently programmed and is non-volatile, which means that it isn't lost when power is turned off. The RAM is used by the program for storing temporary data variables and state conditions. Although there are only 72 bytes of RAM, it's more than enough for our application.

The firmware-controlled functions, such as ring generation, tone detection, LED and relay control, etc., are event-driven, so all features work seamlessly together. Unlike simple loop-controlled programs, our software design uses a time-based task scheduler to control the hardware operations.

Installing the firmware into ROM involves a process called prom burning, and special equipment is used to perform that task. For those without the required equipment or expertise, a preprogrammed microcontroller is available from the source given in the Parts List. On the other hand, for those of you who want to "roll-your-own," we have made the compiled object-code file, in Intel 8-bit merged (INHX8M) format, available on this magazine's BBS (516-293-2283, 8N1). Although the software is copyright protected, you are free to download a copy for your personal use. For other uses, consult the source given in the Parts List.

Getting back to the circuit, U9's RTCC input is used to emulate an adjustable-time-delay timer. The frequency of the oscillator formed by

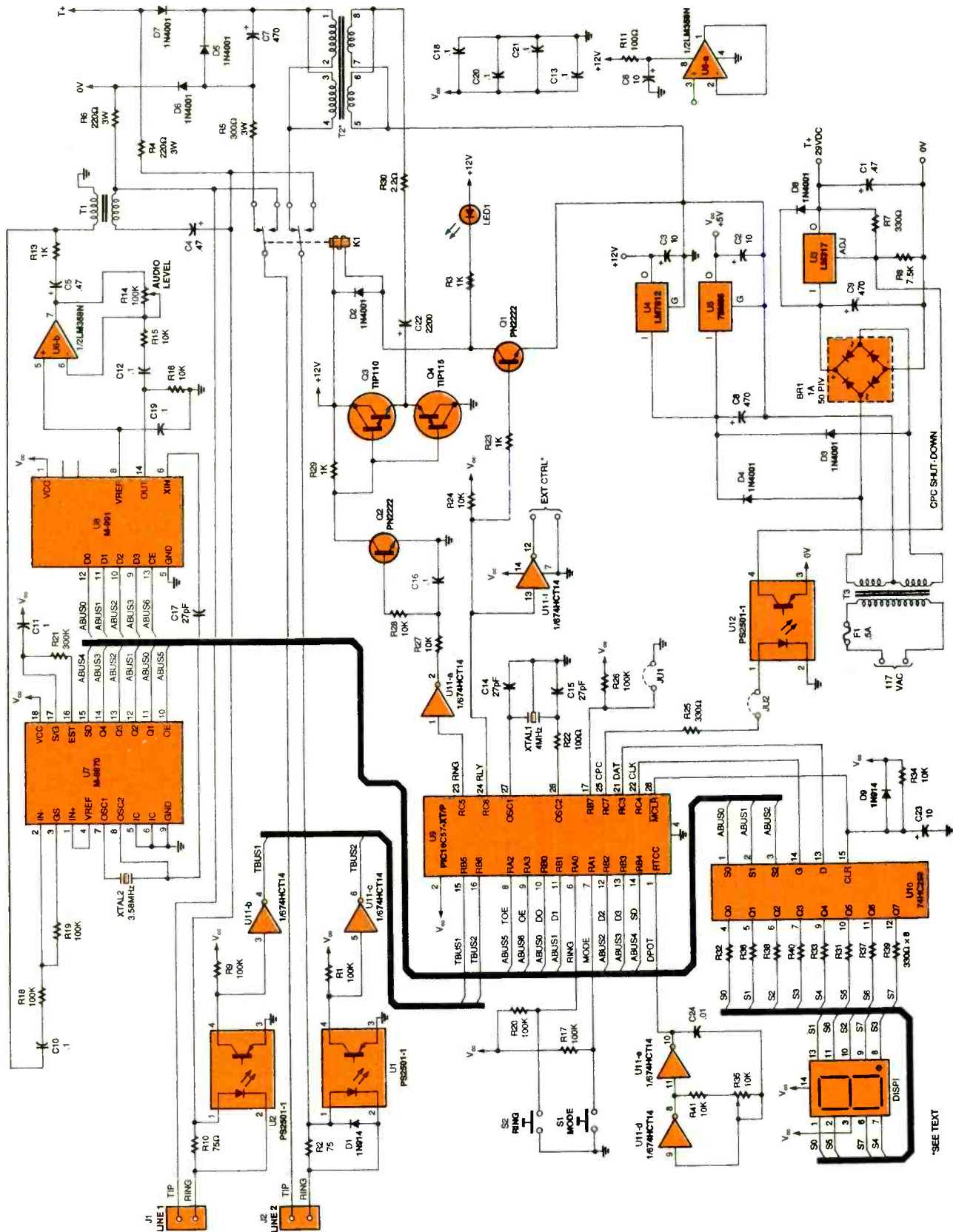


Fig. 1. Here's the complete schematic for the Ring-It! telephone-line simulator. The microcontroller (U9) gives the unit its sophistication but keeps circuit complexity to a minimum.

U11-d, U11-e, R41, and C24 can be varied using potentiometer R35. Its repetition cycle is sampled by the microcontroller and then translated by the software into a 10- to 90-second end-of-cycle timer. The delay feature is used in the beep and cycle modes.

Input/Output Control. The microcontroller's input/output control lines are used to monitor the mode, ring, and hook-switch switches. They also control the LED display, line relay, and call-progress tone generator.

Those twenty I/O lines are labeled on the microcontroller as RA0-RA3, RB0-RB7, and RC0-RC7. Under software control, RA2-RA3 and RC3-RC7 are configured as outputs, RA0-RA1 as well as RB4-RB7 are configured as inputs, and RB0-RB3 are used as both inputs and outputs; RC0-RC2 are unused.

Microcontroller-input RA0 monitors S2 (ring) and input RA1 is used to read S1 (mode). Software is used to debounce those momentary switches, which ensures that contact bounce does not cause multiple operations.

Under microcontroller control, RB0-RB3 can be configured to read (input) the decoded DTMF codes from U7. They can also output call-progress tone codes to U8 or LED codes to U10. We will discuss the DTMF decoder, call-progress generator, and LED interface in just a moment.

The direction of those four I/O data bits is also accompanied by microcontroller outputs RA2 and RA3. Normally low bit RA2 is set high to read the DTMF values. Normally high bit RA3 is set low to write the current call-progress tone code into U8.

The RB4 input is normally low, but goes to a logic high when a valid

DTMF is detected. The microcontroller uses that signal to determine when to decode a new DTMF digit.

The RB5-RB6 inputs are used to monitor the line 1 and line 2 optoisolated, loop-current hook switches (U2 and U1 respectively). Those act as normally open switches and detect when the attached telephones have been taken off-hook. For example, if line 2 is off-hook, current will flow through optoisolator U1's input, which will force its output at pin 4 low. The microcontroller can read the output of U1 and U2 and act appropriately.

The input at RB7 is used to read the circuit-board mounted, power-up configuration jumper, JU1. If the jumper is not installed, Ring-It! will default to the normal (n) mode upon AC power up. If the jumper is installed, the automatic (A) mode will be used as the power-up default.

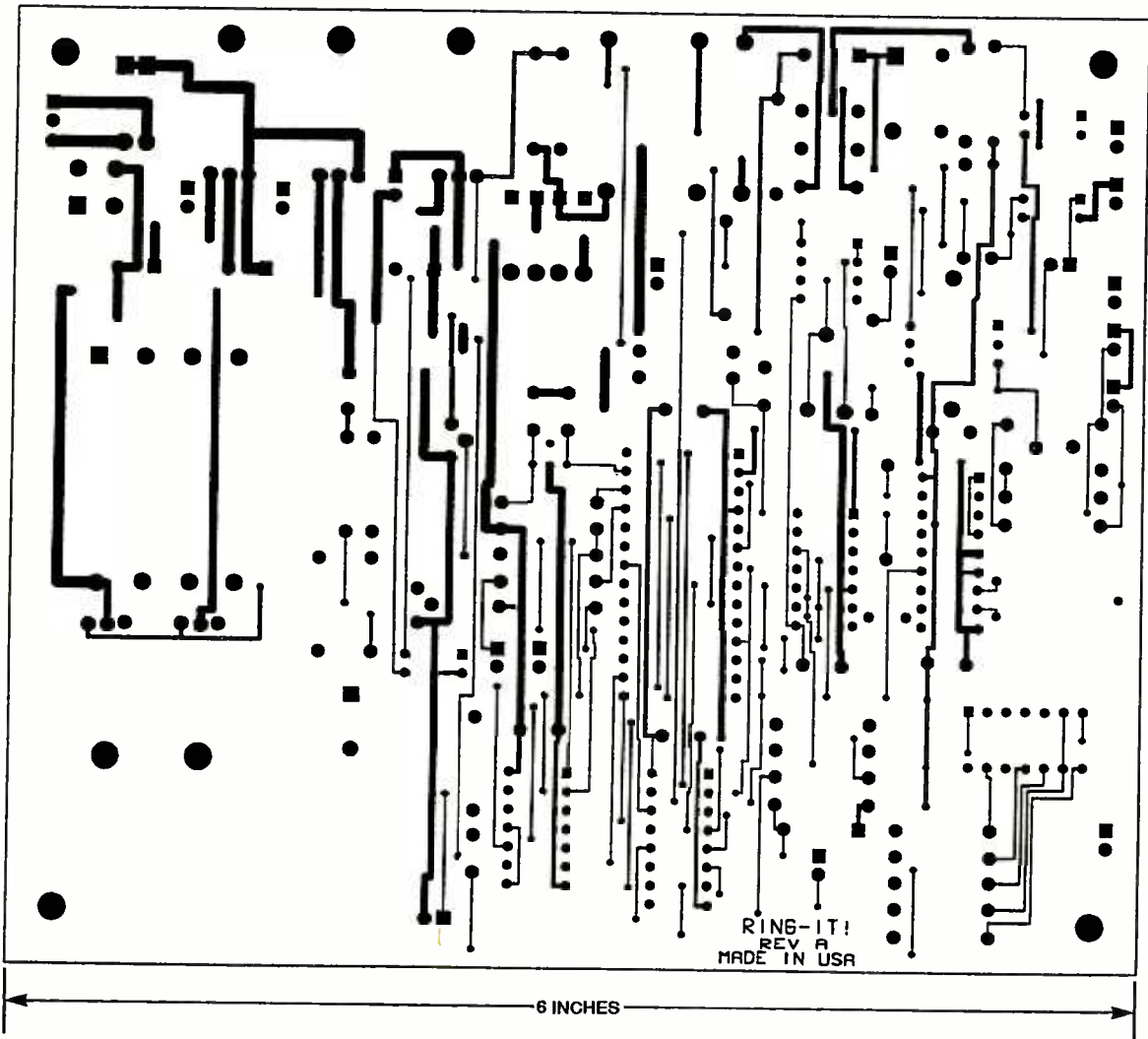


Fig. 2. The bulk of the circuitry is located on the main PC-board. The foil side of that board is shown here.

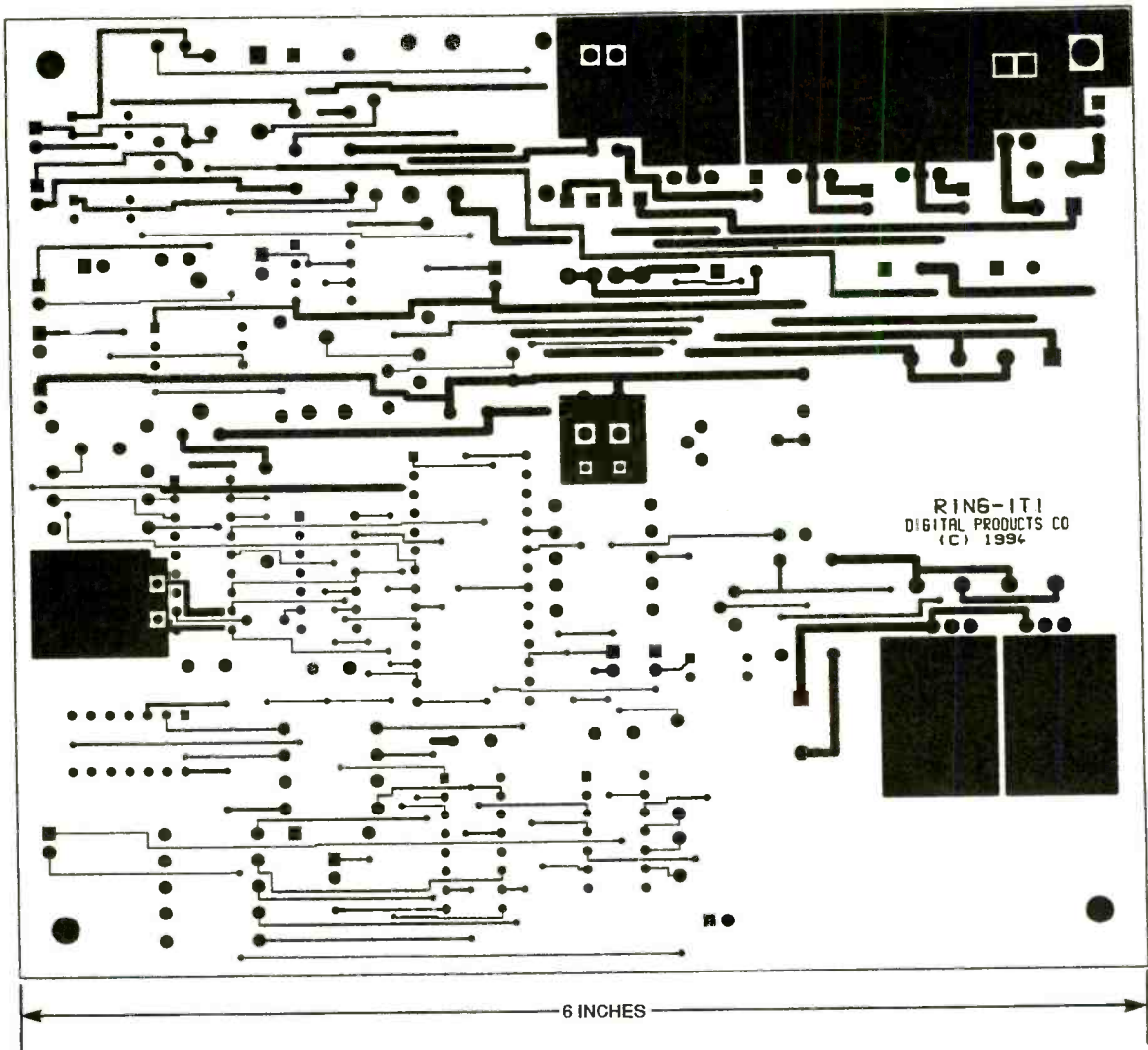


Fig. 3. Here is the foil-pattern for the main board's component side.

The RC0-RC2 port bits are unused. The RC3-RC7 bits are configured as outputs and are used to control the line relay, ring-voltage generator, and CPC pulse. When used in conjunction with the RB0-RB3 output bits, they can send new LED display values to U10, a 74HC259 8-bit addressable latch.

LED Display. Microcontroller output bits RB0-RB2 and RC3-RC4 are used to control the single-character, seven-segment LED display, DISP1. (Note that the display actually has eight segments if you count the decimal point.) Like most LED readouts, it was originally designed for displaying numbers 0-9. But by using a combination of upper and lowercase, and a little imagination, it is possible for us to get a limited number of alphabetic characters.

We use the alpha characters to dis-

play the current test mode and some of the DTMF tone values (* and #). As mentioned earlier, the * and # DTMF characters are not displayable, so we show them as "A" and "P"

The LED segments are enabled by the addressable latch, U10. The microcontroller uses RB0-RB2 to address which of eight LED segments are to be modified. The RC3 output selects how the LED segment will be illuminated (on/off) and RC4 latches the addressed value.

To update the display, the microcontroller must step through all eight bits of U10 and set or clear them as required. Of course, that is done so fast that it appears to happen as a single action. Eight 330-ohm series resistors are used to safely limit the current into each segment of the display.

Ring Generator. Microcontroller

output-bit RC5 is used to provide the 20-Hz frequency used by the step-up ring-voltage transformer, T2. Because American and many foreign phone companies use 20-Hz ring frequencies, we have provided the same in the Ring-It! design. Note that some low-end commercial telephone simulators use 60-Hz ring frequencies because they are easily derived from the AC power line. However, some phone equipment will not operate correctly with them. To maintain compatibility with all standard telephone equipment, a software-controlled, standard 90-volt AC, 20-Hz ring generator is used.

The 20-Hz generator provides reliable ring activation for at least two standard telephones. The high voltage (approximately 90 volts AC) is generated by T2, a step-up ring-voltage transformer, which is driven by

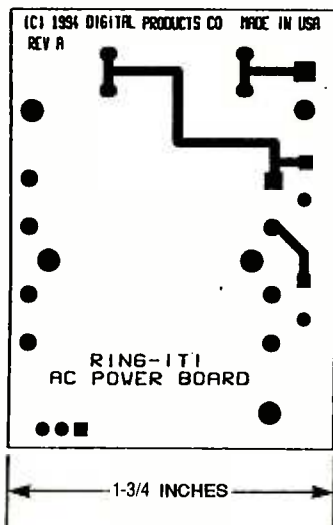


Fig. 4. For better performance, the power-supply circuitry is located on a separate board. The foil side of that power board is shown here.

push-pull power transistors Q3 and Q4. Because square-wave-derived ring voltages are used, some specialized telephone equipment may not respond correctly. However, all standard telephone equipment will work with the unit.

Please note that T2 is used "backwards" in this circuit. That is, the low voltage input is at its secondary and the output is taken from the transformer's primary.

Calling-Party Control. To help disconnect some telephone equipment, Ring-It! uses a method called CPC (calling-party control). On most phone lines, the phone voltage is in-

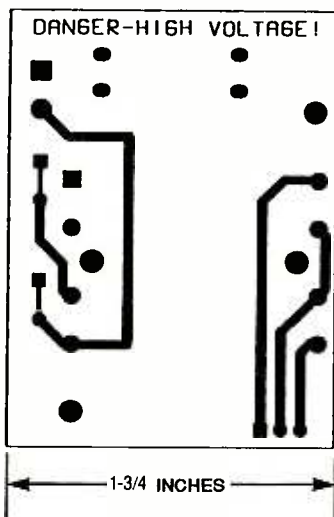


Fig. 5. The component side of the power board is shown here full size.

terrupted for a few hundred milliseconds after the phone call ends. That causes a current-interruption pulse that is sensed by some devices such as answering machines, which causes them to disconnect immediately.

Microcontroller port bit RC7 is used to control the CPC pulse. Normally low, that bit will be set high for about 500 ms to turn on optoisolator U12, which shuts down voltage regulator U3. Because U3 supplies the talk voltage to the phones, when it temporarily shuts down, the attached phone equipment senses a CPC interruption. The CPC feature can be disabled by removing the JU2, the CPC-configuration jumper.

Line-Connect Relay. While the phone lines are idle or during line-2 ringup, microcontroller port pin RC6 is a logic low and relay K1 is de-energized. That places T2, the high-voltage ring transformer, in series with line 2. That allows power for the talk path and/or microcontroller-controlled ring voltage.

Energizing relay K1 connects the two phone lines together and disables the ring-voltage signal path. The relay is switched whenever port pin RC6 is a logic high.

You can monitor pin 12 of U11 if you have an application that needs to know when the two lines are connected. That signal is available at the external-control output (labeled EXT CTRL on the schematic) and is a logic low when the relay is energized. It could be used to turn on an external audio source, relay, or whatever. It is a TTL-compatible signal and can sink or source about 10 mA.

DTMF Decoder. Decoding the dialed phone-number digits is a simple exercise because of the use of the industry-standard M-8870 DTMF tone-receiver for U7. That popular IC is made by the Teltone Corporation, Mitel Semiconductor, and others.

The receiver decodes only DTMF-type telephone digits; rotary-pulse-dialed digits are ignored. The DTMF feature allows you to conveniently test the tone dialing feature of your phone equipment.

As long as a DTMF tone is present the display will show its value; speed dialers may operate too quickly to al-

DIGIT	D3	D2	D1	D0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
0	1	0	1	0
*	1	0	1	1
#	1	1	0	0

low adequate viewing. To help see some very short DTMF digits, the microcontroller extends the viewing time of the last digit for about two seconds.

The DTMF encoding standard defines up to 16 dual-tone combinations, but standard phones only generate 12 of them. In a telephone, those 12 keys are arranged in four rows and three columns, and those in a given row or column have one tone in common.

For example, if you press the 3 digit, a 697-Hz tone and a 1477-Hz tone are combined. Seven frequencies are involved in standard DTMF generation and they are separated into two groups. The row information is called the low group and has the frequencies that range from 697 Hz to 941 Hz. The column information is called the high group and it covers frequencies from 1209 Hz to 1477 Hz. Table 1 shows the layout of the DTMF tone pairs.

DTMF Decoder U7 incorporates switch capacitor filtering to separate the low- and high-frequency tone groups. Qualified DTMF digits are decoded into a four bit code as shown in Table 2.

Call-Progress Tone Generator.

Phone-company generated sounds that are heard on the phone, such as dial tone, busy signals, telephone ringing, etc., are considered comfort tones. They are present only to confirm the progress of the telephone call. Although foreign countries use similar tones, they are slightly different than those heard in the U.S. In Ring It!, the comfort tones are largely produced using U8, a Teltone Corporation M-991 call-progress tone-generator chip.

Actually, Ring-It uses both software

PARTS LIST FOR THE TELEPHONE-LINE SIMULATOR

SEMICONDUCTORS

- U1, U2, U12—PS2501-1 optoisolator (NEC), integrated circuit
 U3—LM317T 1.2—37-volt adjustable regulator, integrated circuit
 U4—LM7812 12-volt regulator, integrated circuit
 U5—LM7805 5-volt regulator, integrated circuit
 U6—LM358N low-power dual op-amp, integrated circuit
 U7—M-8870, CMOS DTMF receiver (Telton Corporation), integrated circuit
 U8—M-991, CMOS call-progress tone-generator (Telton), integrated circuit
 U9—PIC16C57-XT/P CMOS 8-bit microcontroller (Microchip Technology), integrated circuit
 U10—74HC259 or 74HCT259 CMOS addressable latch, integrated circuit
 U11—74HCT14 CMOS hex inverter, integrated circuit
 Q1, Q2—PN2222 NPN transistor
 Q3—TIP110 NPN Darlington transistor
 Q4—TIP115 PNP Darlington transistor
 BR1—1 amp, 50 PIV, bridge rectifier
 D1, D9—1N914 or 1N4148 general-purpose silicon diode
 D2—D8—1N4001 silicon rectifier diode
 DISP1—7-segment LED, 0.56-inch, common anode, RH decimal point
 LED1—Green LED, T1¼ size

RESISTORS

(All fixed resistors are ¼-watt, 5% units unless otherwise specified.)

- R1, R9, R17—R20, R26—100,000-ohm
 R2, R10—75-ohm
 R3, R13, R23, R29—1000-ohm
 R4, R6—220-ohm, 2-watt, metal oxide
 R5—300-ohm, 2-watt, metal oxide
 R7, R25, R31—R33, R36—R40—330-ohm
 R8—7,500-ohm

- R11, R22—100-ohm
 R12—not used
 R14—100,000-ohm, trimmer potentiometer, PC mount
 R15, R16, R24, R27, R28, R34, R41—10,000-ohm
 R21—300,000-ohm
 R30—2.2-ohm
 R35—10,000-ohm, potentiometer, panel-mount, linear-taper

CAPACITORS

- C1, C4, C5—0.47-µF, 50-WVDC, radial-lead, electrolytic
 C2, C3, C6, C23—10-µF, 16-WVDC, radial-lead, electrolytic
 C7, C8—470-µF, 35-WVDC, radial-lead, electrolytic
 C9—470-µF, 50-WVDC, radial-lead, electrolytic
 C10—C13, C16, C18—C21—0.1-µF, 50-WVDC, radial-lead, monolithic-ceramic
 C14, C15, C17—27-pF, ceramic-disc, see text
 C22—2200-µF, 16-WVDC, axial-lead, electrolytic
 C24—0.01-µF, radial-lead, polyester

ADDITIONAL PARTS AND MATERIALS

- K1—DPDT relay, 12-VDC coil, DIP Package, P&B T83S11D212-12, Aromat DS2YE-S-DC12V, or similar
 S1, S2—SPST switch, normally open, momentary-contact pushbutton, panel mount
 T1—Telephone-coupling transformer, 600-ohm:600-ohm, PREM Magnetics SPT130 or equivalent
 T2—Ring transformer, split bobbin, dual 115-VAC primary to dual 6.3-VAC secondary, Magnetek/Triad FS12-200 or equivalent
 T3—AC power transformer, split bobbin, dual 115-VAC primary to dual 14-VAC secondary, Magnetek/Triad FS28-200 or equivalent
 XTAL1—4.00-MHz crystal, HC18 or HC49 package, or 4.00-MHz ceramic resonator, see text

- XTAL2—3.5795-MHz crystal, HC18 or HC49 package J1, J2—RJ11 6/2 or 6/4 modular telephone jacks
 F1—0.5-amp fuse, 5 × 20 mm
 Printed-circuit boards, IC sockets, right-angle socket, fuse clips (Keystone 3521 or similar), AC line cord and plug, enclosure, heat sinks, wire, solder, etc.

The following parts are available from: Digital Products Company, 134 Windstar Circle, Folsom, CA 95630; Tel./Fax: 916-985-7219; Complete Ring-It! kit, including pre-programmed microcontroller, PC-board set, relay, transformers, IC's, resistors, capacitors, seven-segment LED socket, documentation, etc. (case not included); \$145.00. Basic Ring-It! kit, including PC-board set, programmed microcontroller, complete documentation; \$53.95. Transformer/relay kit, including K1, T1, T2, and T3; \$38.95. Hard-to-get IC kit, including U1, U2, U7, U8, U10, U11, U12; \$24.50. Printed-circuit board set; \$34.95. Programmed PIC16C57-XT/P microcontroller (licensed copy); \$20.00. Seven-segment LED socket; \$3.75. Complete documentation package with schematic; \$6.00. Software disk, R1.OBJ object code, INHX8M format (disk provides single-use license; specify 3.5- or 5.25-inch size); \$8.00. Please add \$6.50 (\$14.00 Canada) to all kit orders and \$5.00 (\$9.50 Canada) to all component/documentation/software orders for shipping and handling. Other countries, please write/Fax for shipping information. California residents must add local sales tax. Checks, money orders, Visa, Master Card, and Discover accepted; checks must clear before shipping. Payment in U.S. funds only.

and hardware to create the call-progress tones. Under microcontroller control, U8 can simulate a number of the audio tones that are normally heard while using a phone. Some of the sounds are composed of two frequencies mixed together; others are simple single tones. Table 3 lists a few of the four bit codes that are sent to U8 to create the call progress sounds.

Because the tones may need to be

gated on and off, such as in a busy-signal pattern, the microcontroller must occasionally get involved. To create the cadence heard in the ring and busy tones, the microcontroller must set pin 13 of U8 to a logic high to mute the audio during the silent periods. Our task-based software program is used to schedule those time sensitive operations.

The progress tones are generated

whenever pin 13 of U8 is at a logic low. Because the four-bit code is latched at the falling edge of waveform presented to pin 13 of U8, the RB0—RB3 bits can be immediately freed for use by the DTMF receiver or the LED display latch.

Power Supplies. There are three different low-voltage, DC power supplies in the design. Common three-

TABLE 3—CALL-PROGRESS-SOUND CODES

Tone	Frequency	D3	D2	D1	D0
Dial	350/440	0	0	0	0
Special	400/off	0	0	0	1
Alert	440/off	0	0	1	0
Ring	440/480	0	0	1	1
Busy	480/620	0	1	1	0

terminal IC regulators are used to derive the required digital, analog, and talk-path power.

The digital logic and analog circuitry is powered by LM7805 (U5) and LM7812 (U4) fixed voltage regulators. Those popular devices provide excellent voltage regulation and have internal over-current and over-temperature protection.

The power supply uses a center-

tapped, full-wave rectifier design that begins with diodes D3 and D4. Capacitor C8 is used as a bulk filter to the raw DC (about 16–20 volts DC) before being applied to the IC regulators. Regulator U5 provides 5 volts DC for the digital logic and U4 provides 12 volts DC for the relay and analog circuitry.

We only need a few hundred milliamps of current to operate the circuit-

ry, so either the 0.5-amp (78Mxx) or 1-amp (78xx) type regulators can be used. Because they are series-pass-type regulators, they can run very warm while in operation. You must use a heatsink on U5 to maintain a comfortable operating temperature.

The simulated phone-line talk-path power ("battery" voltage) is provided by an LM317 IC (U3), another popular three-terminal regulator. Unlike the 78xx-series regulators, that device can provide an adjustable range of voltages as selected by resistors R7 and R8. The chosen resistor values set the output to about 29 volts DC. Although most phone lines use a 48-volt DC talk voltage, our 29-volt DC supply will work correctly with all standard telephone equipment.

The talk supply begins with rectifier

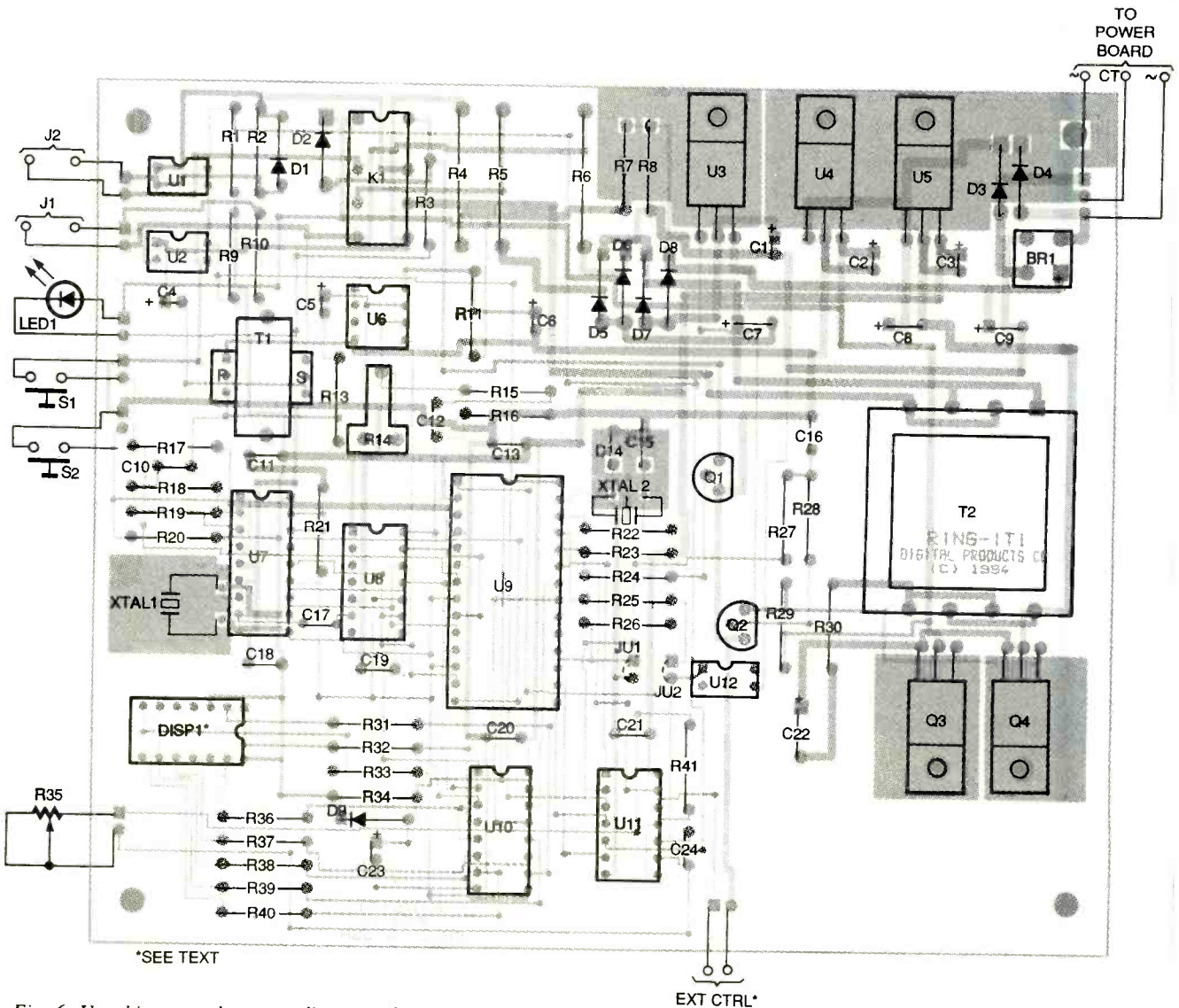


Fig. 6. Use this parts-placement diagram when mounting components on the unit's main board.

BR1, the full-wave bridge, which converts the incoming low-voltage AC to unregulated DC (about 36-volts DC). Capacitor C9 is used to bulk filter the raw DC voltage before it is applied to the regulator.

You may also notice that the regulator's ADJ terminal is connected to optoisolator U12. That optically isolated switch is used to shut off the voltage regulator during the CPC (calling-party control) pulse. When enabled by the microcontroller, U12 reduces the talk voltage to about 1.2-volts DC, which is low enough to simulate the CPC condition.

Construction. Although Ring-It! is a fun project to assemble, it certainly is *not* for beginning electronics-kit builders. If you don't have experience with CMOS IC's and PC-board assembly, please obtain help before starting.

We have provided PC foil patterns for the main board (Figs. 2 and 3) and the power board (Figs. 4 and 5) so that you can etch your own boards if you wish. You may find it more convenient to purchase a commercial-quality PC board from the source listed in the Parts List. If you do purchase the board, *do not* clean it before soldering; the boards available from the supplier have a special tin plate coating that prevents oxidation.

The parts-placement diagrams for the two boards are shown in Fig. 6 (main board) and Fig. 7 (power board). The AC transformer (T3) and fuse (F1) are installed on the power board; the bulk of the remaining components, including all of the digital circuitry, are installed on the main board. Among other things, the two board approach was used to promote safety. Always exercise caution when working near the power board's high voltages.

Use a 25–47-watt soldering-iron; temperature-controlled irons set to 700°–800° work best. Do not use a soldering gun! Use only rosin-core solder with a 60/40 tin/lead content.

Part substitutions are not recommended. Use the components shown in the Parts List and only substitute those that you know are exact replacements. For correct cycle-delay operation, do not substitute U11 with a non-HCT type IC.

Use care in handling the IC's; they are CMOS devices and are sensitive

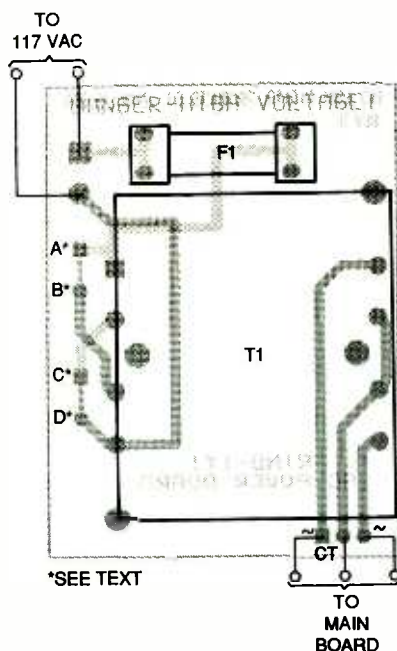


Fig. 7. The power board is set up for 117-volt operation, but can be modified for 220-volt use by cutting traces and adding jumpers as described in text.

to static. They can be damaged through mis-handling!

Component XTAL1 can be either a quartz-type crystal as specified, or a ceramic resonator. Delete capacitors C14 and C15 if using a ceramic resonator with built-in capacitors.

Use a socket to mount the microcontroller (U9). A special right-angle IC socket (made by Vertisocket and available from Digi-Key Electronics, 701 Brooks Ave. South, PO Box 677, Thief River Falls, MN 56701-0677; Tel. 800-344-4539) is used at DISP1 to vertically mount the seven segment LED for proper viewing. Sockets should be used for the other IC's, but are not absolutely required. Install two-pin headers with shorting blocks at the JU1 and JU2 positions.

Transistors Q3 and Q4 as well as the three voltage-regulators (U3–U5) should be anchored to the PCB with 4-40 x 1/4-inch machine screws and nuts. Use a heatsink and thermal grease (heatsink compound) on U5, the 7805 regulator. Please note that it's normal for that regulator to feel warm during operation.

Install and label LED1 as CONNECT on your enclosure's front panel. Wire it to the PC board using 5-inch-long pieces of 22–24 AWG stranded wire. Be sure to observe proper polarity.

Install and label S1 as MODE and S2 as RING on your enclosure's front panel. Again, connect them to the PC board using 5-inch-long pieces of 22–24 AWG stranded wire.

Install modular jacks at the J1 and J2 positions. Each jack's green wire is connected to the square pad on the board and the red wire is connected to the other pad. Cut off any extra wires that may be on the connector.

Install potentiometer R35 on the rear panel of your enclosure and label it as DELAY. Connect the potentiometer to the appropriate points on the PC board using stranded wire.

If after testing your finished project you find that the delay control works backwards, merely reverse the connection to the potentiometer's wiper. If installed correctly, the delay time should increase as the control is moved clockwise.

If you find that you can not achieve a 10–90 second delay range, then C24 or R35 are out of tolerance (check them). Although the software has been designed to allow correct operation over a wide range of component tolerances, it may be necessary to try different components at U11, C24, or R35 to get the desired range.

The power transformers, T2 and T3, are split bobbin types with dual 50/60Hz primaries and secondaries. Using standard power transformers is not recommended, especially at the T2 location. Such transformers are available from sources such as Microtran, Magnetek/Triad, Signal Transformer, PREM Magnetics Inc., and others.

Be sure to observe the orientation of the transformers. On T1, match the "P" and "S" references on the parts-placement diagram. It may be necessary to cut off the frame's mounting tabs on some transformer designs. Install T2 and T3 so that the transformer's pin 1 is in the square pad.

The power board layout is already set for 117-VAC operation. However, it can be converted to 230-VAC operation for use outside the U.S. For 230-VAC operation perform the following cuts and jumps: Cut the trace between the pads designated A and B in Fig. 7, cut the trace between the pads designated C and D, and add a jumper between pads B and C.

(Continued on page 90)

A DX Beam-Aimer Program

Here's a nifty program that allows you to enter latitude and longitude of two points, and calculates the true direction and true nautical distance between them.

BY FRED BLECHMAN K6UGT

Whether you are a ham-radio operator or a serious short-wave listener, your antenna is one of the most important elements of your radio equipment. Furthermore, since most antennas are directional, for long-distance communication you need to "aim" your antenna properly.

This is not as simple as it sounds, since the Earth is a sphere and flat maps are notoriously inaccurate. When I went through navigation courses as part of my flight training to become a Naval Aviator, I became aware of the compromises made in trying to reduce a spherical surface (the Earth) to a flat sheet of paper (a map). It just can't be done with accuracy over long distances. If the angles are correct, then the distances are distorted, and vice-versa.

Probably the most common map of the world, or large areas of the Earth, is a Mercator Projection, where all the latitude (horizontal) and longitude (vertical) lines are shown straight and perpendicular to each other. While this is easy to read, it is notoriously inaccurate for navigational purposes. Although the old expression that "the shortest distance between two points is a straight line" is certainly true in spatial relations, it is totally false on most maps.

In the case of a spherical object, which the Earth approximates, the shortest distance along the surface is the arc of "a great circle." The intersection of the surface of the Earth with a flat plane that passes through the

center of the Earth is a great circle.

You can estimate the length of an arc on a great circle by placing a string between the origin and the destination on a globe, but the accuracy is limited by the size of the globe. However, the DX Beam-Aimer Program that we'll present in this article is accurate to a small fraction of 1 percent! It can be used to determine the shortest distance and direction between virtually any two points on Earth, given the location of each. Many charts are available that give the distance and

direction between major cities-but not necessarily from where you are to where you want to go. With this program, you can "start" and "stop" anywhere!

While hams and SWL's will benefit the most from the program, it can also be used for long-distance boating and aircraft flight planning. And, although the program is written in IBM PC GWBASIC, it has intentionally been designed so it will run on most micro-computer BASIC interpreters with little or no changes.

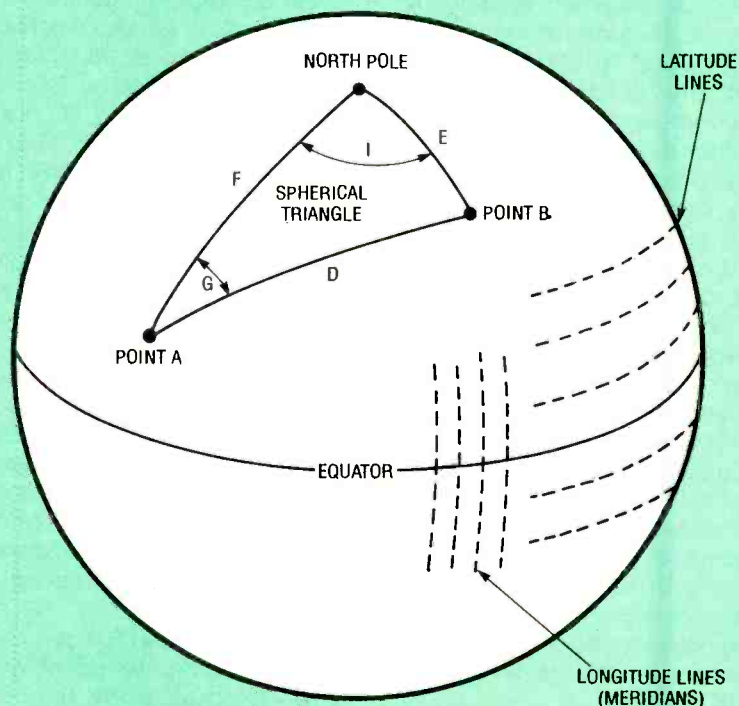


Fig. 1. Since the Earth is a sphere, all paths between points on its surface are really arcs with their origins at the Earth's center.

LISTING 1

```

100 REM *****
110 REM * "DX Beam-Aimer" *
120 REM * (C) Copyright Fred Blechman 1993 K6UGT *
130 REM *****
140 DIM A(11): REM * SET ARRAY SIZE FOR VARIABLES *
150 CLS : PRINT
160 PRINT TAB(14)"*** BE SURE KEYBOARD IS IN CAPS-LOCK MODE! ***":PRINT: PRINT
170 PRINT TAB(20)"GREAT CIRCLE DISTANCE AND DIRECTION"
180 PRINT : PRINT TAB(10)"TO DETERMINE THE SHORTEST DISTANCE FROM POINT A TO"
190 PRINT TAB(10)"POINT B, AND THE DIRECTION FROM A TO B, ENTER THE"
200 PRINT TAB(10)"LATITUDE AND LONGITUDE IN DECIMAL DEGREES OF EACH POINT."
210 PRINT TAB(10)"THESE CAN BE FOUND FROM A MAP, GLOBE OR ENCYCLOPEDIA."
220 REM * SPHERICAL TRIANGLE HAS ANGLE G AT POINT A,
230 REM * SIDE E OPPOSITE POINT A, SIDE F OPPOSITE POINT B,
240 REM * AND SIDE D OPPOSITE NORTH POLAR ANGLE I. *
250 PRINT : PRINT TAB(10);:INPUT "WHEN READY TO PROCEED, PRESS ENTER";:AS
260 CLS : PRINT : PRINT
270 PRINT TAB(14)"*** BE SURE KEYBOARD IS IN CAPS-LOCK MODE! ***": PRINT: PRINT
280 INPUT "POINT A NAME ";:AS
290 INPUT "POINT B NAME ";:BS
300 REM * TRIANGLE DIRECTION *
310 PRINT "IS ";:BS;" EAST OR WEST OF ";:AS;: INPUT " (E OR W)";:PS
320 REM * INPUT LOCATIONS *
330 PRINT : PRINT "LATITUDE OF ";:AS;: INPUT A(1)
340 INPUT "NORTH OR SOUTH (N OR S)";:JS
350 PRINT "LONGITUDE OF ";:AS;: INPUT A(2)
360 INPUT "EAST OR WEST (E OR W)";:KS
370 PRINT : PRINT "LATITUDE OF ";:BS;: INPUT A(3)
380 INPUT "NORTH OR SOUTH (N OR S)";:LS
390 PRINT "LONGITUDE OF ";:BS;: INPUT A(4)
400 INPUT "EAST OR WEST (E OR W)";:MS
410 CLS : PRINT : PRINT
420 PRINT : PRINT AS;" IS";A(1);"DEGREES ";
430 IF JS="N" THEN PRINT "NORTH";
440 IF JS="S" THEN PRINT "SOUTH";
450 PRINT " AND";A(2);"DEGREES ";
460 IF KS="E" THEN PRINT "EAST";
470 IF KS="W" THEN PRINT "WEST";
480 PRINT BS;" IS";A(3);"DEGREES ";
490 IF LS="N" THEN PRINT "NORTH";
500 IF LS="S" THEN PRINT "SOUTH";
510 PRINT " AND";A(4);"DEGREES ";
520 IF MS="E" THEN PRINT "EAST";
530 IF MS="W" THEN PRINT "WEST";
540 PRINT BS;" IS";
550 IF PS="W" THEN PRINT " WEST";
560 IF PS="E" THEN PRINT " EAST";
570 PRINT " OF ";:AS
580 REM * DETERMINE F & E IN DEGREES *
590 F=90-A(1)
600 IF JS="S" THEN F=F+2*A(1)
610 E=90-A(3)
620 IF LS="S" THEN E=E+2*A(3)
630 REM * DETERMINE NORTH POLAR ANGLE I *
640 IF ((KS="W") AND (MS="W")) THEN I=A(4)-A(2)
650 IF ((KS="E") AND (MS="E")) THEN I=A(4)+A(2)
660 IF I<0 THEN I=-I
670 IF ((KS="E") AND (MS="W")) THEN I=A(4)+A(2)
680 IF ((KS="W") AND (MS="E")) THEN I=A(4)+A(2)
690 IF I>180 THEN I=360-I
700 IF I<0 THEN I=-I
710 PRINT : PRINT "NORTH POLAR ANGLE TO POINT A (" ;:AS;") IS";F;"DEGREES."
720 PRINT "NORTH POLAR ANGLE TO POINT B (" ;:BS;") IS";E;"DEGREES."
730 PRINT "NORTH POLAR ANGLE BETWEEN POINTS IS";I;"DEGREES."
740 REM * FIND ARC D IN DEGREES *
750 J=.0174533: REM * CONVERTS FROM DEGREES TO RADIANS *
760 REM * COS D= COS E * COS F + SIN E * SIN F * COS I *
770 A(5)= COS (E*J)
780 A(6)= COS (F*J)
790 A(7)= SIN (E*J)
800 A(8)= SIN (F*J)
810 A(9)= COS (I*J)
820 D=(A(5)*A(6))+A(7)*A(8)*A(9)
830 REM * ARCCOSINE CALCULATION FOR D FOLLOWS *
840 Y=- ATN (D/ SQRT (-D*D+1))+1.5708
850 REM * CONVERT RADIANS TO DEGREES *
860 Y=Y*57.2958:A(10)=Y
870 REM * CONVERT ARC D DEGREES TO MILES *
880 REM * 1 DEGREE=60 NAUTICAL MILES ON GREAT CIRCLE *
890 PRINT : PRINT "DISTANCE A-B IS";Y*60;"NAUTICAL MILES (" ;:A(10);"DEGREES)."
900 REM * STATUTE MILE=1.1515 NAUTICAL MILE *
910 Y=Y*60*1.1515
920 PRINT "DISTANCE A-B IS";Y;"STATUTE MILES."
930 REM * DETERMINE G IN DEGREES *
940 REM * COS G=(COS E-COS D * COS F)/(SIN D * SIN F) *
950 X=A(10)
960 A(11)= SIN (X*J)
970 G=(A(5)-(D*A(6)))/(A(11)*A(8))
980 Y=- ATN (G/ SQRT (-G*G+1))+1.5708
990 Y=Y*57.2958
1000 IF PS="W" THEN Y=360-Y
1010 PRINT : PRINT "DIRECTION A-B IS";Y;"DEGREES CLOCKWISE FROM NORTH."
1020 END

```

the "destination," then side D would be the great circle distance between them, and angle G would be the direction measured clockwise from the north. Side F would represent the angle from Point A to the North Pole, side E the angle from Point B to the North Pole, and angle I would be the angular distance between them at the Pole. These are not important to use the program, but they are used in the solution of the spherical triangle, as you'll see.

To give you a feel of the program's operation, a screen print-out of a typical program session is shown in Fig. 2. It starts with some instructions, then you're asked for the names of the starting point (Point A) and destination (Point B), and their latitudes and longitudes. Longitude "lines" are parallel lines going north and south and passing through the poles. These are "great circles" used to specify angles east or west of Greenwich, England, which is considered zero longitude. A typical longitude, specified in decimal degrees, might be "longitude 115.35 E." By contrast, "latitude" lines run east and west, parallel to the equator, but, with the exception of the equator, they are not great circles. They are used to specify an angle north or south of the equator, such as "latitude 37.5 N."

You'll find that better maps and encyclopedias give locations in latitude and longitude, using degrees and minutes of arc. If a map or encyclopedia is not handy, you can use a globe, but you'll have to estimate the latitude and longitude of Points A and B from the markings on the globe.

The program was designed to handle inputs from either the northern or southern hemisphere, and longitudes east or west of Greenwich. If both the origin and the destination are on the same longitude, you don't need the program at all, since longitude lines are great circles. In such a case, one degree of arc is equal to 60 nautical miles, and the direction between them must be 0 or 180 degrees. To use the program in this circumstance anyway, you may offset either the origin or destination longitude by around one degree; the error that introduces will be insignificant.

Although Earth coordinates are usually specified in degrees, minutes, and seconds of arc for longitude and

Program Summary. The program uses spherical trigonometry to calculate the lengths and angles of a spherical triangle between the starting point, the destination and the

North Pole, as shown in Fig. 1. That involves some fairly sophisticated math, but you needn't use any math skills to run the program.

If Point A is the "origin" and Point B

TABLE 1—PROGRAM VARIABLES

Name	Use
A(1)	Point A latitude
A(2)	Point A longitude
A(3)	Point B latitude
A(4)	Point B longitude
A(5)	COS (E*J)
A(6)	COS (F*J)
A(7)	SIN (E*J)
A(8)	SIN (F*J)
A(9)	COS (I+J)
A(10)	Arc D; X
A(11)	SIN (D+J)
A\$	Point A
B\$	Point B
D	Point A to Point B arc; COSine D
E	Point B to North Pole arc
F	Point A to North Pole arc
G	Point A to Point B angle measured clockwise from North; COSine G
I	Angle at North Pole between Point A and Point B
J	Degree-to-radian conversion factor
J\$	Point A North/South flag
K\$	Point A East/West flag
L\$	Point B North/South flag
M\$	Point B East/West flag
PS	Triangle direction East/West flag
Y	Arc whose COSine is D; arc whose COSine is G
X	A(10)

TABLE 2—TYPICAL CITIES

Origin	Destination	Approx. Latitude	Approx. Longitude	Nautical Miles	Statute Miles	Direction from North
Los Angeles 34N 118.5W	Hong Kong	22N	112E	6373.69	7339.3	311.83
	Tokyo	35N	140E	4759.13	5480.14	305.228
	Sydney	35S	151E	6544.01	7535.43	240.073
	Zanzibar	8S	40E	8839.03	10178.1	42.2297
	Miami	26N	81W	1995	2297.24	93.6929
	New York	41N	74W	2135.83	2459.41	65.3378
	London	53N	0	4677.82	5386.56	32.7365
	Moscow	55N	37E	5312.82	6117.71	13.7649
Paris	45N	2E	5062.99	5830.03	37.7492	
Tokyo 35N 140E	Sydney	35S	151E	4245.01	4888.13	170.47
	Miami	26N	81W	6462.68	7441.77	38.2432
	Moscow	55N	37E	4118.69	4742.67	323.124
Paris 45N 2E	Hong Kong	22N	112E	5260.23	6057.15	60.6908
	Zanzibar	8S	40E	3782.39	4355.42	136.842
	New York	41N	74W	3217.27	3705.27	294.569
Moscow 55N 37E	New York	41N	74W	4051.52	4665.32	310.315
	Sydney	35S	151E	7882.36	9076.54	94.2849

as Listing 1) was written in Microsoft GWBASIC for the IBM PC, which uses line numbers, and is essentially the same as IBM's BASICA. It will run fine in QuickBASIC or QBASIC, which do NOT need line numbers. For our purposes, the line numbers will make it easier to provide a line-by-line explanation of the program. Also, the varieties of BASIC for older microcomputers (TRS-80, Commodore, Apple, etc.) use line numbers.

The program is identified in lines 100-130. Line 140 sets the size of the A array to eleven elements, A(1) to A(11). These array elements will be used later as a convenient place to hold variables in a simple and organized fashion. Table 1 shows how each of the program variables is used.

Why did I use arrays? I originally wrote this program for a computer that only had 26 single-letter variables (A-Z), and it was convenient to use arrays as variables to keep some sense of order. When I translated the program to the IBM I retained this approach so that the most spartan BASIC variants could still accept and run the program.

Line 150 clears the screen and prints a blank screen line. Line 160 reminds you to place your keyboard in "caps-lock" mode, since some entries you make from the keyboard will not be recognized by the program if in lower-case. Lines 170-210 provide a program introduction, using the TAB statement to format the screen printing. Lines 220-240 contain remark statements that identify the spherical triangle angles and sides (as were shown back in Fig. 1).

Line 250 uses an INPUT statement to preserve the screen until you hit the ENTER key (actually, any key will do) to continue. Line 260 clears the screen and prints two blank screen lines. Line 270 reminds you again that you'll need to be in caps-lock mode to avoid lower-case character entries. Then lines 280-400 ask you for origin Point A and target Point B names and locations in longitude and latitude.

Line 410 clears the screen and prints two blank lines. Lines 420-570 summarize the information you've given the program about Points A and B and their relationship. Now the computer goes to work performing the calculations.

latitude, we will use decimal degrees only. That greatly simplifies the calculations without significantly affecting the accuracy. There are 60 minutes in one degree of arc, and 60 seconds in one minute of arc. For our purposes, you can ignore seconds.

You'll need to convert minutes of arc to decimal parts of a degree for use in this program. One minute of arc equals .01667 degrees. For example, 16 degrees and 42 minutes would be 16.7 decimal degrees (you multiply 42

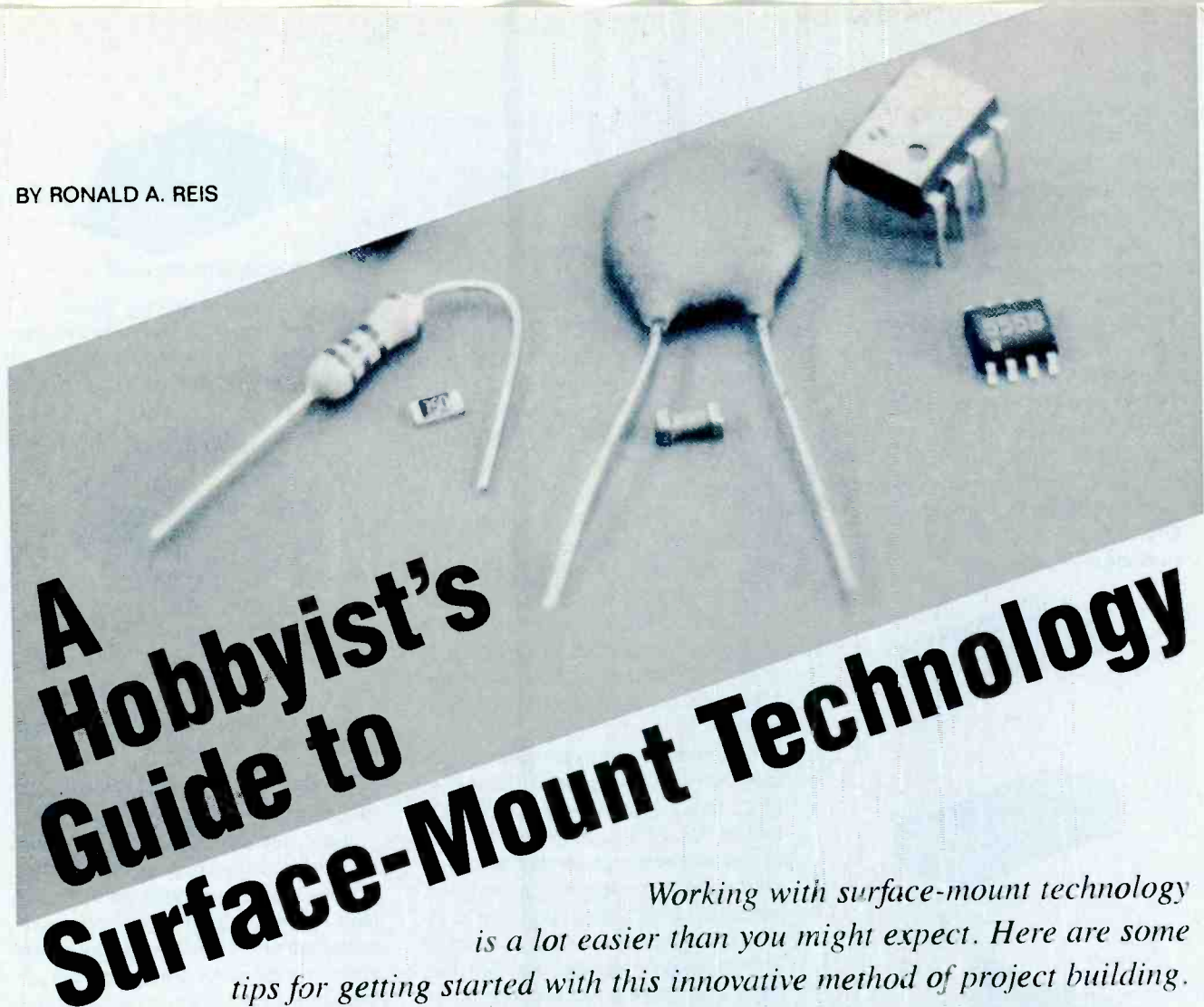
times .01667 to get 0.7). To convert the decimal part of a degree to minutes, divide the decimal by .01667.

When finished with its calculations, the program summarizes your input information, then quickly gives you the angles of each point from the North Pole, the nautical and statute miles between the two points, and the direction in degrees, measured clockwise from the North Pole.

The Program. The program (shown

(Continued on page 94)

BY RONALD A. REIS



A Hobbyist's Guide to Surface-Mount Technology

Working with surface-mount technology is a lot easier than you might expect. Here are some tips for getting started with this innovative method of project building.

Looked inside the latest consumer electronic product lately? If you have, then chances are the printed-circuit board and components in your camcorder, pager, or CD player are not at all similar to what you have been building at your workbench. The leadless, discrete electronic components in these products have shrunk to the size of rice grains; the integrated circuits are often flea-size bugs with pins that are practically touching each other; and the printed-circuit board itself has no holes, except, perhaps, for mounting inside the case. Welcome to the fascinating, miniature world of surface-mount technology (SMT)—a world that sooner or later you, the electronics experimenter, will have to enter.

When looking at SMT-based consumer products, you might have wondered how it is possible to build a project using such tiny, surface-mount components (SMC's). At a glance,

picking up SMC's, let alone soldering them in place, looks hard enough. Also, this basic question might come to mind: Are SMC's even available to experimenters?

Don't fret, and don't despair. Not only is it possible to build electronic projects using SMT, it can be accomplished easily, quickly, and, most importantly, with many of the traditional tools and materials probably sitting on your workbench. In addition, every month, electronics distributors are expanding their surface-mount component offerings. So, read on. Your days as a new kind of project builder might be just beginning.

The What and Why of SMT. Surface-mount technology is a packaging revolution that involves the attachment of tiny, essentially "leadless" components to pads on the printed or etched surface of a printed-circuit board—hence the name, "surface-mount technology." That contrasts

with traditional "insertion-mount technology" (IMT) familiar to most hobbyists, which uses components with leads that are inserted through the PC board.

The SMT approach results in significant advantages, such as circuit board size and weight reduction, enhanced circuit performance and reliability, easier manufacturing, considerable cost reduction, and the development of entirely new products that would not be possible without the use of SMT. Consequently, it is estimated that by 1996, 70 to 80 percent of all electronic assemblies will be surface mount.

Can You Handle Them? The commercial assembly of SMT circuit boards is a fully automated process. Surface-mount components were designed from the beginning to be packaged in reel dispensers, put in place by X-Y pick-and-place machines, and soldered onto the PC

board using flow (wave) or reflow methods. In a fully automated SMT assembly line, no human hands ever touch the components or the printed-circuit boards.

Yet, throughout the life of an SMT product, rework is often required, and that does necessitate human intervention. Skilled electronics technicians often must manually remove or replace SMC's during initial assembly, testing, troubleshooting, or repair. Furthermore, project prototyping, the sort of thing electronics experimenters do all the time, is obviously done by hand, where one component at a time is positioned on the PC board and soldered into place.



A

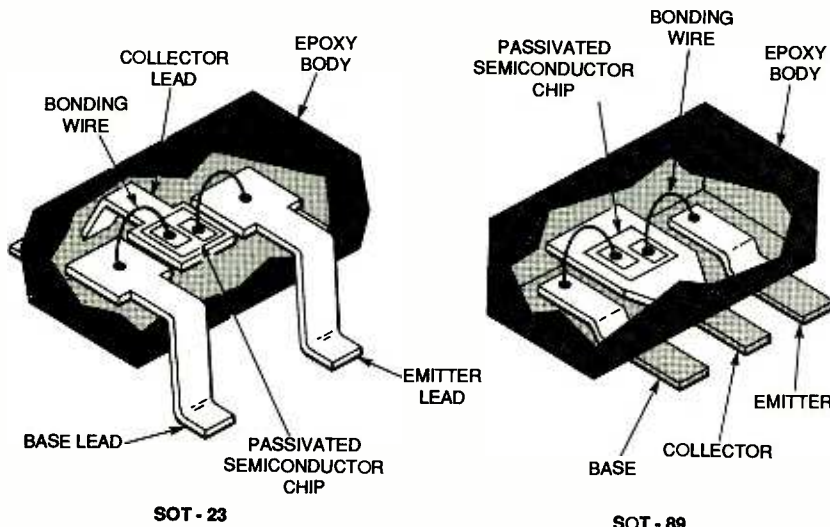


B



C

Fig. 1. Here are three discrete passive surface-mount components: (A) The leadless-chip resistor, (B) the similar-looking leadless-chip capacitor, and (C) the MELF leadless-cylinder diode.



SOT - 23

SOT - 89

Fig. 2. The SOT-23 and SOT-89 are low- and high-power transistor packages, respectively. Note the difference in lead shape between these two discrete active SMC's.

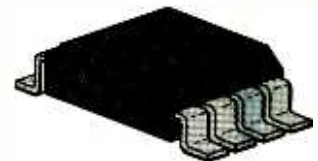
True, specially designed tools and equipment are available for those tasks, and they should be used whenever possible. Nonetheless, much can be done with traditional tools, though they must be used in somewhat non-traditional ways.

Teeny, Tiny, SMC's. Several different types of SMC's are available. There are discrete passive components, such as resistors and capacitors; discrete active components, such as diodes and transistors; integrated circuits; and a few SMC's that do not fall into any of the other categories, such as trimmers and LED's.

Not surprisingly, the leadless chip resistor is the most popular discrete passive surface-mount component. It is available in standard values from 10 ohms to 10 megohms, and in wattage ratings as low as $\frac{1}{16}$, and as high as $\frac{1}{4}$, watt.

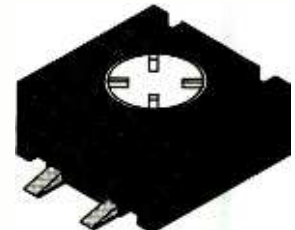
The resistors are extremely tiny, the average size being just 0.080 inches long, 0.050 inches wide, and 0.050 inches tall. As shown in Fig. 1A, they come with external electrodes or terminals. Since the resistors are so small, colored bands cannot be used to indicate their value. A simple three-digit system is used instead. The first two digits indicate the first two significant numbers of the resistance value; the third digit, the number of zeros.

For example, a code number 220 indicates a 22 ohm resistor. A code number 221 would designate a 220 ohm resistor. If the resistance value is less than 10 ohms, an "R" is used to



SOIC PLASTIC PACKAGE

Fig. 3. The SOIC gull-wing, plastic integrated-circuit package is so tiny, the leads have only a 0.050-inch space between them.



TRIMMER POTENTIOMETER OR CAPACITOR PACKAGE

Fig. 4. Trimmer potentiometers and trimmer capacitors come in this type of surface-mount package.

indicate a decimal point. Therefore, 2R2 specifies a 2.2 ohm resistor.

The ceramic-chip capacitor is the second most widely used discrete, passive, surface-mount component (see Fig. 1B). It comes in both non-polarized and polarized versions. The former range in value from 1 pF to 1 μ F; the latter (most often tantalums) are available from 0.1 μ F to 100 μ F. Voltage ratings go as high as 1000 volts.

Surface-mount capacitors look a lot like SMC resistors. They are the same size (some tantalums are larger) and the terminals are almost identical. There is one major difference in appearance, however. In most cases, no value designation is printed on the capacitor—there is no room. Instead, the thin cardboard backing that runs the length of a strip of packaged capacitors has a value printed on it about every inch, or so.

Turning to discrete active SMC's, the two-terminal diode in an MELF (metal-electrode face) leadless cylinder is popular. The package, shown in Fig. 1C, is also known as an SOD, for small-outline diode, and is but $\frac{1}{16}$ of an inch in diameter and $\frac{1}{8}$ of an inch long.

Low-power transistors come in SOT-23 (small-outline transistor) packages, as shown in Fig. 2. The devices are only 0.118 inches long, 0.05 inches wide, and 0.04 inches tall. Note the gull-wing lead configuration. With that shape it is much easier to solder

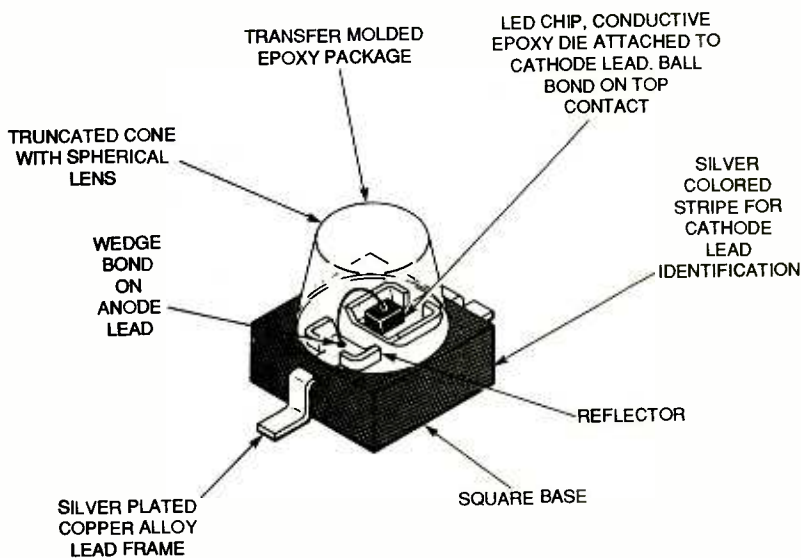


Fig. 5. Subminiature surface-mount LED's, like this one, are useful in a wide variety of applications, due to their high reflection efficiency.

the leads, as you will discover shortly. Transistors required to dissipate more power than the general-purpose type are available in an SOT-89 package, also shown in Fig. 2.

Surface-mount integrated circuits are available in a number of packages with a variety of lead configurations. The type most likely to be encountered by the electronics experimenter, however, is the small outline integrated circuit (SOIC) shown in Fig. 3. Note, again, the gull-wing lead configuration. While SOIC's look like miniature DIP's (traditional through-hole IC's), they are barely $\frac{1}{4}$ the size of their larger cousins. Furthermore, their lead spacing is only 0.050 inches, half that of the traditional DIP.

Many other electronic components, in addition to the ones discussed above, come in surface-mount configurations. While all can not possibly be discussed here, two deserve particular note. Trimmer potentiometers and trimmer capacitors come in the type of package seen in Fig. 4, and are quite common. Typical potentiometer values range from 100 ohms to 2 megohms. Trimmer capacitors are found in values from 1.4 pF to 50 pF.

Subminiature surface-mount LED's, of the type shown in Fig. 5, are now finding wide application in electronic circuits. Due to their high reflection efficiency, the brightness of these LED's does not decrease with size. Note, once more, the popular gull-wing lead configuration.

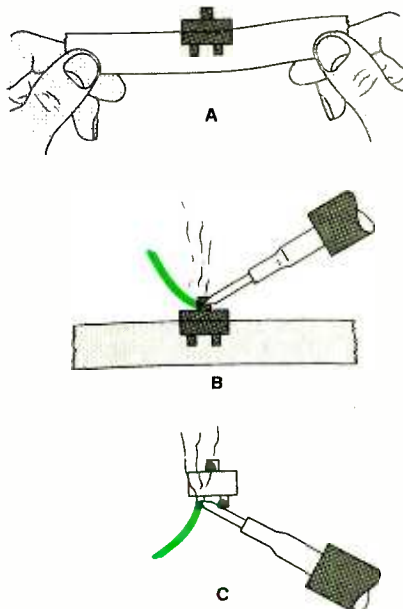


Fig. 6. To hold an SMC in place by taping, (A) begin by touching the tape to the SMC. (B) After taping the component to the PC board, solder the exposed terminal(s). (C) Finally, remove the tape and then solder the remaining terminal(s) to their pads.

Tools and Materials. Below, you will find three methods used to hold SMC's in place while hand-soldering with solder wire. Since you will undoubtedly be experimenting with all three approaches, you should obtain all of the tools and materials listed in the Tools and Materials box.

For SMT work, the soldering iron needs to be from 25 to 40 watts and have a tinned tip with a conical shape, $\frac{1}{16}$ of an inch or less in diame-

ter. A tweezers is mandatory for picking up tiny SMC's. It should have forceps-style tips. A vise is a must for securing the PC board while components are being attached. Smooth-jaw type vises work well. If you don't have a desk-top magnifying glass, you should consider purchasing one. At the very least, an inexpensive hand-held one should be used.

As for the materials listed in the box, they are fairly self-explanatory. Solder should be 63/37 (tin/lead) or, better yet, silver-bearing solder at 62/36/2 (tin/lead/silver). A diameter of 0.020 inches works well, but 0.015 inches is better. A noncorrosive liquid flux and drop dispenser are necessary. So is a light-duty spray defluxer. A general-purpose plastic cement, the kind used for plastic, wood, or metal, is fine. When choosing solder wick, select a diameter of 0.030 inches. Finally, ordinary clear tape, $\frac{1}{2}$ an inch in diameter, will work well. Any other materials that you might need are probably lying around you: house.

Putting SMC's in Their Place.

There are three easy ways to hold SMC's down in preparation for soldering them permanently in place. You can tape, stick, or tag them to the PC board.

To temporarily hold an SMC in place by taping, begin by simply grasping a short strip of clear tape and "touching" it to the SMC, picking up the latter. See Fig. 6A. You then tape the SMC onto its PC board pads. With the component held securely in place by the tape, solder the exposed terminal(s) (Fig. 6B). Remove the tape, then solder the remaining terminal(s) to their pads (Fig. 6C).

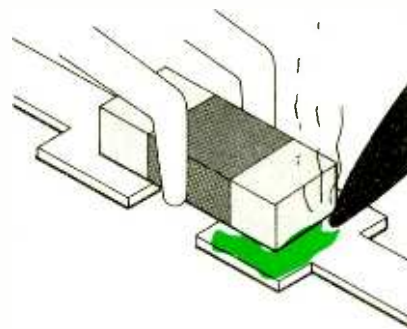


Fig. 7. To tag solder an SMC in place, create a pool of solder on a pad, place the component above it, and reheat the solder so the SMC can "sink" close to the board surface.

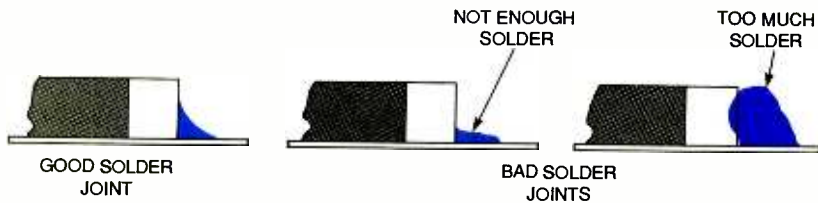


Fig. 8. Here are examples of good and bad solder joints. Use them as a guide when soldering to make sure your connections are good ones.

Another way to hold an SMC to the circuit board in preparation for final soldering is to glue it in place. A general-purpose glue (that comes in a jar), such as the General Purpose Plastic Cement, 10-324, from GC Electronics, works well.

When working with the glue, the best way to dispense the material is with a toothpick. Dip the pick into the liquid so it just touches the surface. Then place a dot of glue on the PC board, being careful not to get any of it on the copper pads. Gently press the component into place and let the glue dry for about 30 minutes. Be careful not to apply too much glue; remember, its purpose is only to secure the SMC for soldering. The rule is: "A little dab'll do you."

Even though I often use the tape and stick methods just described, I prefer the tag soldering approach. It's easy, quick, and involves no additional materials such as tape or adhesives. All you need are tweezers, and the solder wire and soldering iron that

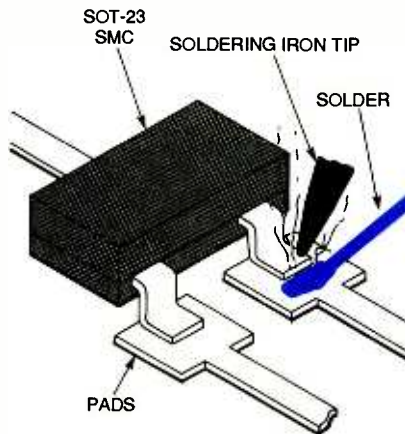


Fig. 9. Soldering gull-wing leads to a PC board is not impossible if the right solder and soldering iron tip are used. Try a silver-bearing, 62/36/2 solder, with a 0.015-inch diameter, and a conical soldering iron tip, 1/16 of an inch or less in diameter.

Tools and Materials For Attaching SMC's

You probably have most of these tools on your workbench right now.

Tools

- Soldering iron
- Tweezers
- Vise
- Magnifying glass

Materials

- Solder
- Liquid flux
- Drop dispenser
- Defluxer
- Adhesive
- Solder wick
- Clear tape

you would use anyway.

First, apply a dab of liquid flux to one PC board pad. Then create a pool of solder on that pad. Allow the solder to solidify.

Next, with the SMC held in a tweezers, rest the component on its PC board pads and hold it in place. Using a soldering iron held in your other hand, reflow the solder, causing the component terminal to "sink" close to the board surface. See Fig. 7.

Remove the iron, allow the solder to cool again, and release the tweezers. Then, with the component held in place, solder the other terminals or pins in a traditional manner.

The Solder Connection. Once an SMC is held down by one of the three methods just described, it's time to solder the remaining terminals or leads in place. For two-terminal discrete SMC's, begin by cleaning the PC board pads with steel wool. Next, using the tag method, because it will give you quick practice in soldering, solder one component terminal to its pre-tinned pad as described earlier. Now solder the other terminal as you would any traditional joint, but apply just a dab of solder at the junction of the iron tip and component terminal. See Fig. 8 for examples of good and bad solder joints.

To solder gull-wing leads on three- and four-lead components, proceed as above, only be sure to apply plenty of liquid flux before you actually solder. Doing so makes for a much more effective solder connection. See Fig. 9.

Hand soldering DIP gull-wing SOIC's to a circuit board is not difficult. Just follow these ten steps:

1. Make sure all pads are clean and ready for soldering.
2. Create a pool of solder on a corner pad in preparation for tag soldering.
3. Hold the IC with a tweezers.
4. Place the IC onto the copper pads. Be sure to center the IC right-to-left as well as top-to-bottom. Hold the IC in place.
5. Apply the soldering iron tip to the pre-tinned pad. Hold the iron in place just long enough to flow the solder.
6. Pivot the IC about the soldered pin as necessary to again align all pins with their respective pads.
7. Solder a second pin in the opposite corner to the first. In doing so, don't forget to apply a small amount of liquid flux.
8. Bathe one line of pins with liquid flux.
9. Solder the line of pins, one at a time. Move quickly, yet adhere to the four traditional soldering steps: apply heat, apply solder, remove solder, and remove heat. Apply liquid flux to the opposite row of pins and solder as just described.

(Continued on page 91)

SMC Distributors

Here is a sampling of electronics distributors that carry a wide selection of SMC's.

Digi-Key Corp.
701 Brooks Ave. South
Thief River Falls, MN 56701-0677
Tel. 800-344-4539
FAX: 218-681-3380

Electronic Goldmine
P.O. Box 5408
Scottsdale, AZ 85261
Tel. 602-451-7454
FAX: 602-451-9495

Jameco
1355 Shoreway Road
Belmont, CA 94002
Tel. 800-831-4242
FAX: 800-237-6948

Unicorn Electronics
10010 Canoga Ave. Unit B-8
Chatsworth, CA 91311
Tel. 818-341-8833
FAX: 818-998-7975



Build A WWV Receiver

Get time, weather, frequency, and other information with this easy-to-build receiver.

BY BRIAN MCKEAN

Next to the crystal detector and super-regenerative receivers, the direct-conversion receiver is the simplest radio that any experimenter can build. Despite its being immune to spurious IF signals, which plague super-heterodyne receivers, the direct-conversion receiver has been shunned in the past because of component limitations that make first-trial receivers sensitive to 60-Hz hum, microphonics, and low-frequency noise generated by active components. But ever-evolving electronics technology has produced low-noise/low-power amplifiers and mechanically stable components that promise to revive the direct-conversion receiver. Low-power active elements allow battery operation, significantly improving 60-Hz suppression.

The *WWV Receiver* described in this article (which contains only one tuned circuit) is comprised of readily available parts and its operating frequency can be easily modified, allowing you to monitor other signals.

WWV/WWVH Broadcasts. Radio stations WWV (Fort Collins, CO) and WWVH (Kauai, HI), operated by the National Institute of Standards and Technology (NIST), broadcast vast amounts of information 24 hours a day. The most obvious are the frequency standards of the carrier (2.5, 5, 10, 15, and 20 MHz), the 1-second time interval, and the standard audio tones (440, 500, and 600 Hz), which modulate the carrier at regular intervals.

Voice announcements, broadcast at one-minute intervals, give the time of day based on a cesium clock and expressed in "Coordinated Universal Time" (UTC). The radio stations are identified by voice on the half hour

and the hour, and continuously via audio tones. WWV transmits 500 Hz on even minutes while WWVH transmits 600 Hz on even minutes. The 5-, 10-, and 15-MHz carriers operate at 10 kW, making them easily audible throughout the continental US.

Special voice announcements, providing Global Positioning Satellite status, Geophysical data, OMEGA navigation system status, and Pacific and Atlantic storm warnings, are broadcast in regular time slots. UTC to UT1 conversion information is also broadcast.

Those stations also broadcast the time of day, day of year, year, daylight saving's time status, leap second status, and UTC to UT1 conversion in a digital format. The digital code is transmitted at a rate of 1-bit-per-second on a 100-Hz subcarrier that is pulsed on and off, with the duration of the pulse representing the bit value "1" or "0" at the beginning of each second. The 100-Hz subcarrier is typically below the bandwidth provided by commercial shortwave receivers, so the pulses are not audible.

The direct conversion receiver does not have a high cutoff frequency on the HPF so the 100-Hz pulses will be clearly audible on the direct-conversion receiver described in this article. Although intended for digital decoding, the low bit rate allows the BCD code to be decoded by ear with a little practice and a strong signal.

The most useful data transmitted by the NIST stations are the frequency standards. Those carriers allow worldwide frequency calibration to an accuracy of 1 ppm. The direct conversion receiver can serve in a secondary capacity as a 10-MHz, local-frequency standard since the local oscillator must be zero beat for

best reception. The voltage-stabilized crystal oscillator will allow the receiver to maintain its calibration under varying conditions.

Shortwave listeners will find the geophysical alert messages useful in correlating radio propagation conditions with solar activity and geomagnetic field disturbances. The NIST signals themselves provide direct information on band conditions. Poor reception in an otherwise good local-reception time period is usually indicative of some geophysical disturbance, which will be noted in the alert message. The geophysical bulletins (18 minutes after the hour for WWV and 45 minutes after the hour for WWVH) provide a daily summary of past 24-hour's solar and geomagnetic-field activity with 3-hour updates of current geomagnetic field conditions.

The solar-flux measurement is a measure of the solar emission at 2800 MHz, and is related to the solar constant, which is a measure of the total solar flux at the Earth. Solar flux is responsible for ionizing the upper atmosphere and, as such, affects long-distance high-frequency communications, which rely on ionosphere propagation modes.

The "A" and "K" indices in the message provide information on geomagnetic-field activity. The "K" index is measured at 3-hour intervals, and the "A" index is derived by taking the weighted average of the K index for a 24 hour period. From 0 UT to 2100 UT, the "A" index represents the previous day's measure. Between 2100 and 2400 UT, the "A" index is estimated from the 7 "K" indices for that day. The "A" index is finally produced at 2400 UT and remains unchanged until 2100 the following day.

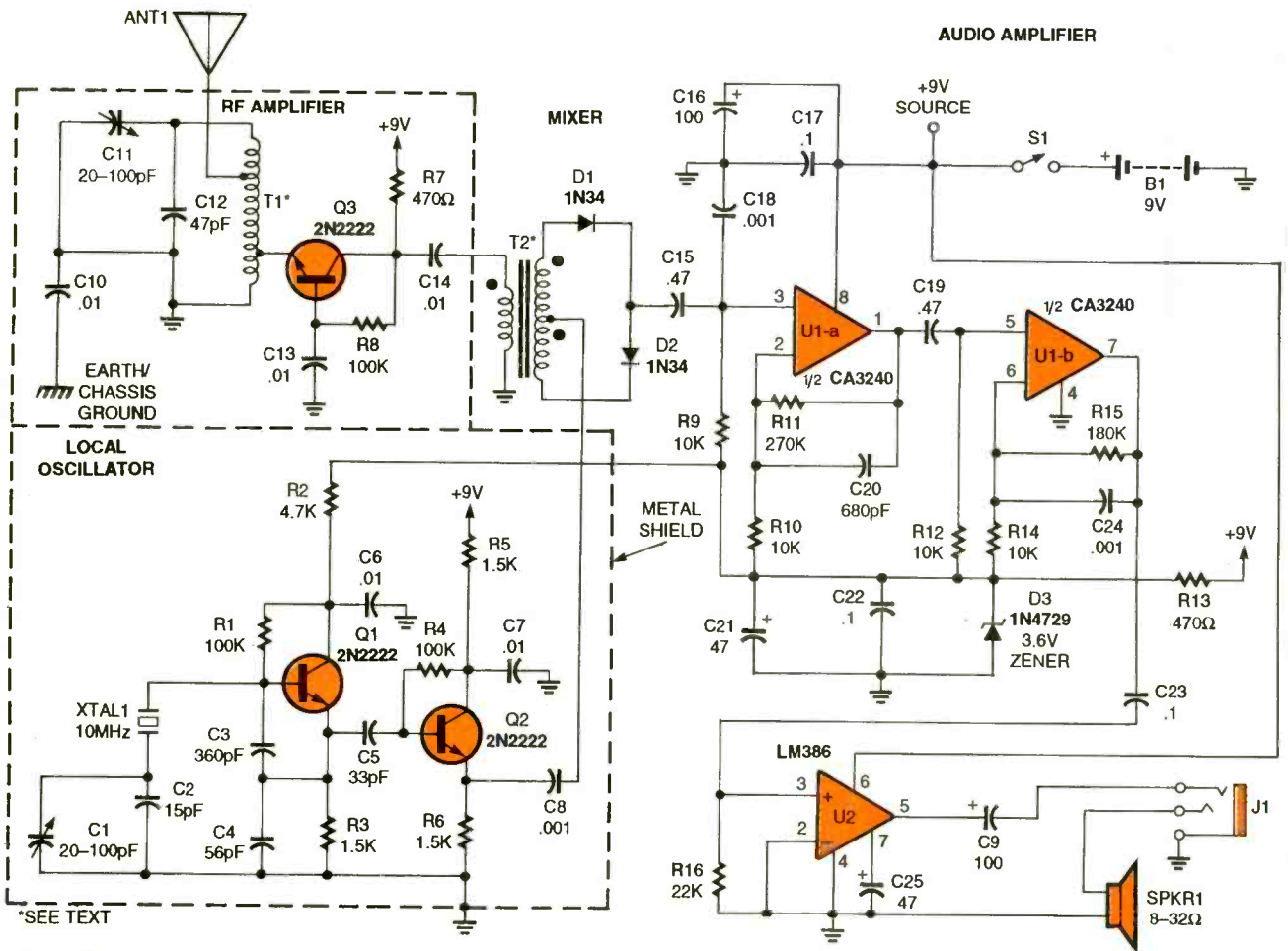


Fig. 1. The single balanced-diode mixer used in the WWV Receiver includes a transformer to phase shift the RF input, while a pair of oppositely oriented diodes are used to phase shift the LO signal. The LO amplitude must be sufficient to forward bias the diodes.

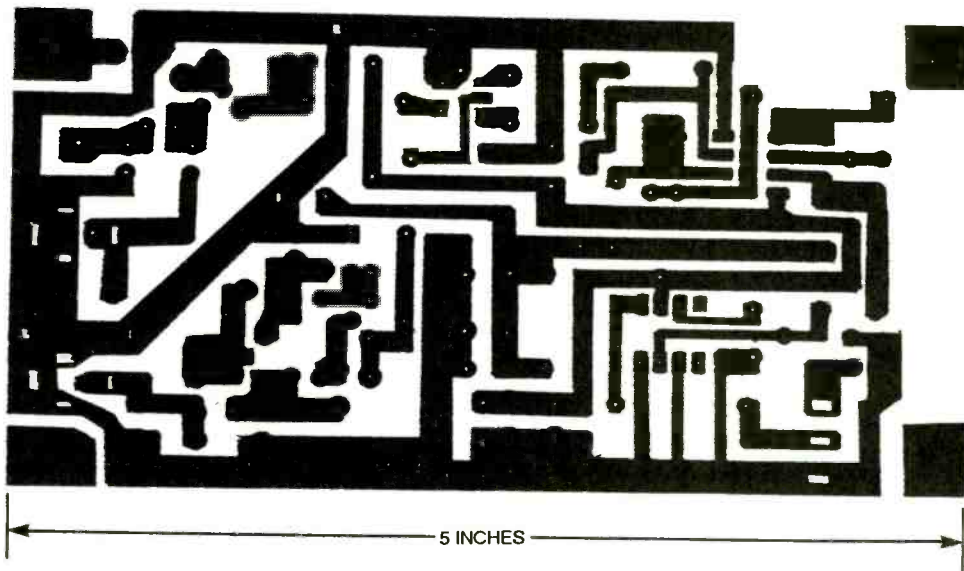


Fig. 2. The author's prototype was assembled on a small printed-circuit board, measuring about 5 by 2½ inches, and is shown here on a 1:1 scale.

Geomagnetic-field activity is described in broad terms such as "quiet," "unsettled," "minor storm," etc., which

are selected based on the current "K" and "A" indices. Solar activity describes the solar-flare activity by mea-

surements of peak X-ray emissions from a flare event.

Note: Further information regarding

NIST broadcasts can be obtained by writing to: National Institute of Standards and Technology, Radio Station WWV, 2000 East County Road, Fort Collins, CO 80524. Ask for NIST publication SP 432.

Circuit Detail. Figure 1 shows a schematic diagram of the WWV Receiver. Incoming RF is picked by the antenna (ANT1) and is coupled via an auto-transformer to a grounded-base amplifier (Q3), before being applied to a diode-mixer network that is comprised of T2, D1, and D2. Best mixer performance is obtained when both secondary windings of T2 are identical, and D1 and D2 are matched.

The output of the local oscillator (LO)—a grounded-collector Colpitts oscillator (built around Q1)—is applied to emitter-follower/buffer Q2, which provides a low impedance drive signal for the mixer.

The demodulated signal is capacitively coupled, through high-pass RC networks to a pair of high gain op-amp stages (U1-a and U1-b). The op-amps provide a 50-dB gain and incorporate low-pass filter capacitors in the feedback path. Amplifier U2 provides a 20-dB gain, thereby producing sufficient output drive for an 8-ohm speaker, or 32-ohm headphones.

Note that our receiver lacks a volume control and AGC circuitry. That simplifies the circuit without introducing operational problems. The volume is controlled merely by adjusting the length of the whip antenna.

When driving 32-ohm headphones, the circuit consumes less than 25 mA; however, the current drain increases to 40 mA when driving an 8-ohm speaker. That current drain is close to the limit of 9-volt alkaline batteries, so headphone operation is preferred, especially under weak-signal conditions.

Assembly. The WWV Receiver was assembled on a printed-circuit board, measuring about 5 by 2½ inches. A template of the author's printed-circuit layout is shown in Fig. 2. The parts-placement diagram for the author's layout is shown in Fig. 3. All the parts except power switch S1, battery B1, speaker SPKR1, and antenna ANT1 are located on the board.

The crystal can be any of a number

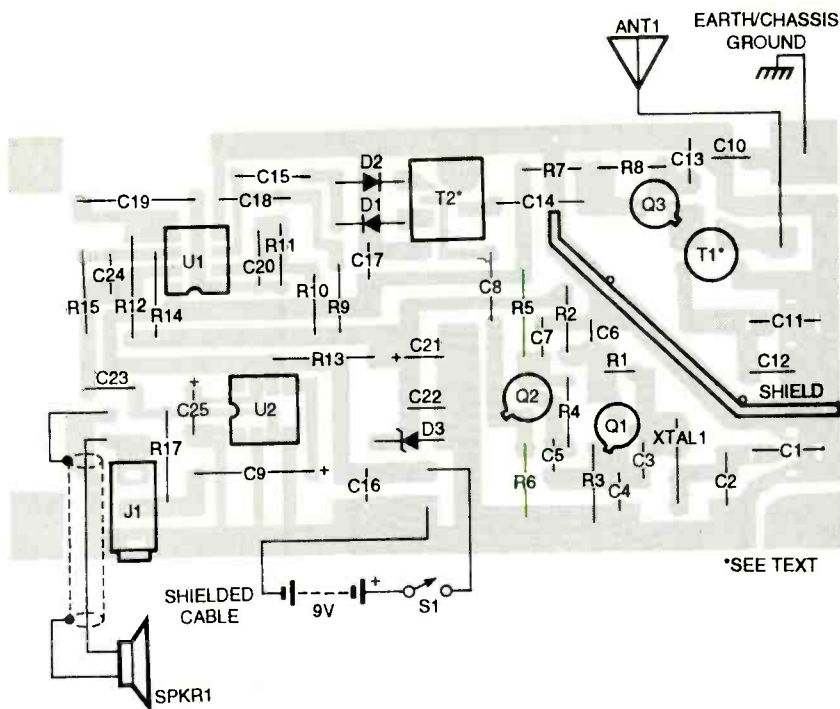


Fig. 3. All the parts that comprise the WWV Receiver (except the battery, the power switch, the antenna, and the headphone jack) are mounted directly to the circuit board. A metal shield (see text for details) is added to the board at the position shown to isolate the RF input section from the local oscillator.

PARTS LIST FOR THE WWV RECEIVER

SEMICONDUCTORS

- U1—CA3240, HA3-5152, HA7-5222, or similar, dual op-amp, integrated circuit
- U2—LM386 low-voltage, audio-power amplifier, integrated circuit
- Q1—Q3—2N2222, 2N3904, or similar general-purpose NPN silicon transistor
- D1, D2—1N34 germanium or NTE112 Schottky, small-signal diode
- D3—1N4729, or similar 3.6-volt, 1-watt Zener diode

RESISTORS

- (All resistors are ¼-watt, 5% units, unless otherwise noted.)
- R1, R4, R8—100,000-ohm
- R2—4700-ohm
- R3, R5, R6—1500-ohm
- R7, R13—470-ohm
- R9, R10, R12, R14—10,000-ohm
- R11—270,000-ohm
- R15—180,000-ohm
- R16—22,000-ohm

CAPACITORS

- C1, C11—20- to 100-pF ceramic or mica trimmer (Mouser 242-3610-100 or equivalent)
- C2—15-pF mica or ceramic-disc
- C3—360-pF mica or ceramic-disc
- C4—56-pF mica or ceramic-disc

- C5—33-pF mica or ceramic-disc
- C6, C7, C10, C13, C14—0.01-μF, ceramic-disc
- C8, C18, C24—0.001-μF, ceramic-disc
- C9, C16—100-μF, 16-WVDC, electrolytic
- C12—47-pF mica or ceramic-disc
- C15, C19—0.47-μF, polystyrene, mylar, or multilayer ceramic
- C17, C22, C23—0.1-μF, ceramic disc
- C20—680-pF mica or ceramic disc
- C21, C25—47-μF, 10-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

- ANT1—50- to 100-cm telescoping antenna
- J1—Closed circuit ⅛-inch headphone jack
- SPKR1—8- to 32-ohm, 0.5-watt or less, speaker
- S1—SPST power switch
- B1—9-volt alkaline, transistor-radio battery
- T1, T2—See text
- XTAL1—10-MHz, 30-pF crystal
- Printed-circuit materials, metal enclosure, metal shield material (see text), headphone (32 ohm), battery holder and connector, wire, solder, hardware, etc.

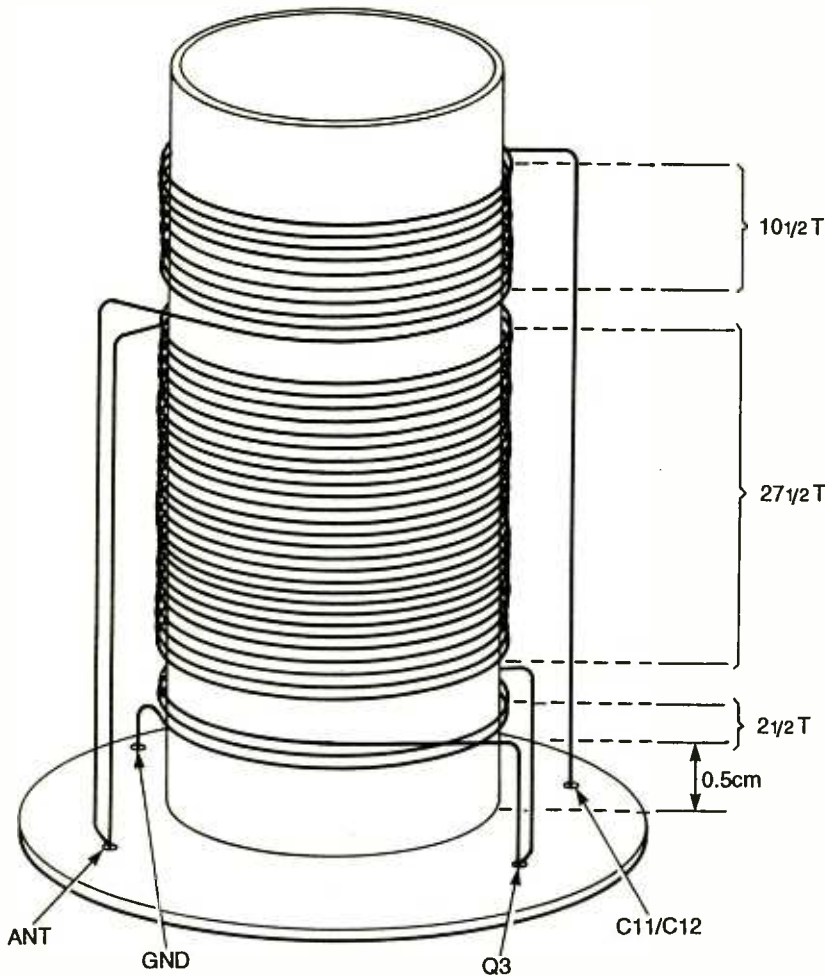


Fig. 4. Transformer T1 is a home-made unit comprised of 40 closely wound turns of #26 AWG enameled wire on a 1/4-inch diameter air-core form, with taps at 2 1/2 and 10 1/2 turns from each end; after each tap, the winding continues in the same direction.

of physical sizes (note that the board layout is designed to accommodate the most common crystal-package sizes; the HC-49 and HC-33). To minimize microphonics—the generation of an electrical noise signal by mechanical motion (vibration) of parts within a device—after soldering XTAL1 in place, secure it to the board with RTV or similar silicone cement.

Tuning capacitors C1 and C11 should be installed with the tuning screw connected to ground to allow use of a metal tuning tool. The holes for T1 are arranged for use with a 1/4-inch diameter, plastic coil form with a molded base of the type commonly found in older TV sets. The holes for T2 are sized for a common subminiature IF can. The leads of T2 should be cut as short as possible and secured to minimize vibration.

Install a solderable-foil metal shield (approximately 1-inch high) between the local oscillator (Q1 and Q2) and RF

amplifier (Q3), as shown in Fig. 3. Solder the shield to the ground trace using short segments of stiff wire as supports. Once all of the board-mounted components have been installed, connect the off-board components to the printed-circuit board through short lengths of hook-up wire.

Mount the whip antenna on the proposed case for the unit; if the antenna that you choose for your unit has a pivoting base, the unit can be mounted in just about any convenient location on the enclosure using a low capacitance mounting method; or you can connect the antenna (vertically mounted) directly to the board. Many whip antennas are equipped with a threaded base that can be secured directly to the appropriate printed-circuit pads using a screw. If that arrangement is used, use a large grommet to isolate the whip from the metal case where the antenna passes through.

Component Notes. The crystal is used in its parallel (anti-resonant) mode in the Colpitts oscillator. Parallel-mode crystals are specified for a particular circuit load-capacitance—usually 20 to 40 pF—for the crystal to oscillate on frequency. Capacitors C1 and C2 provide series coupling to reduce the relatively large load capacitance of Q1 and

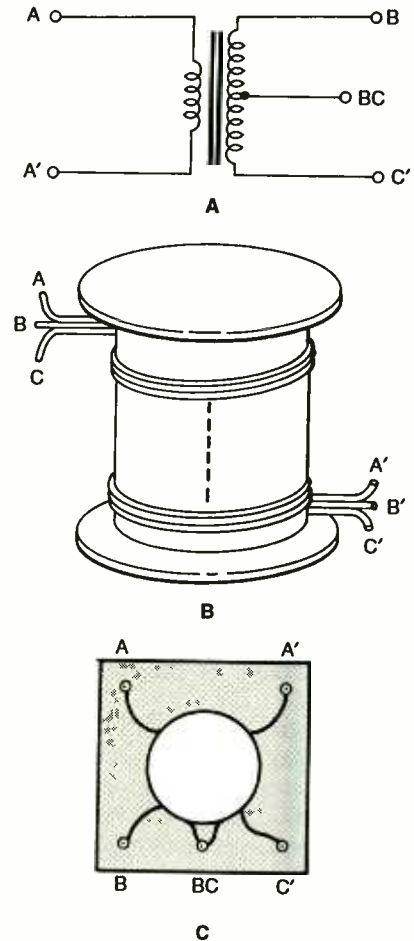
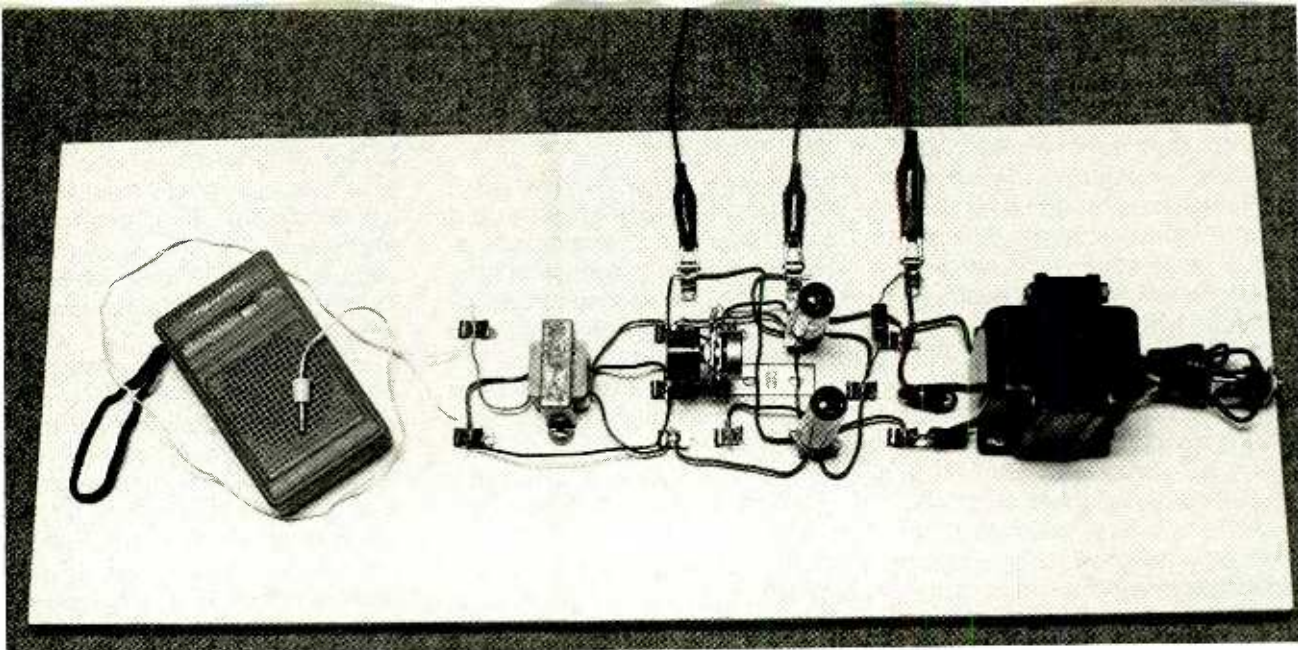


Fig. 5. Construction details for T2 (the mixer transformer) are shown here. The diagram in A is a schematic representation of the unit once completed; B illustrates how the three lengths of wire are wound as a set on the bobbin; and C shows how the bobbin is connected to the pinned base.

allow tuning the crystal frequency. The trimmer range specified for C1 should satisfy most crystals. If you have no information about your crystal, try it anyway. The oscillator's operation can be checked by any number of methods, but the easiest way is to listen to the receiver itself.

The mixer diodes should be small-
(Continued on page 93)



Build a Vacuum-Tube Audio Amplifier

Build this audio amplifier and hear the difference tubes make in sound, without making a big difference in your wallet.

BY LARRY LISLE

Vacuum tubes seem to have a glowing future in expensive, high-end audio equipment. How come? What makes people shell out good money for amplifiers using devices that most thought were obsolete years ago?

Those who like them say that tubes sound better. They use words like "mellow" and "warm" to describe the tube sound. On the other hand, there are also those who don't like tube audio, or say that there's no difference in the sound at all.

How do you tell if you like the sound of tubes without making a big investment? Build the super-simple amplifier described below and hear what tube sound is like at a reasonable cost. That way, you can get some experience working with tubes while building a nice little amp you'll be proud to own.

Circuit Description. The circuit shown in Fig. 1 is the classic push-pull tube amplifier used for generations.

That amplifier is flat within ± 1 dB from 20 to 20,000 Hz into a resistive load, and is deceptively uncomplicated considering its performance. As explained below, the amplifier's design prevents hum and unwanted feedback—two of the toughest problems in the home construction of tube-audio systems.

Hum is minimized in two ways: First, a nickel-core input transformer, T1 (available from Antique Electronic Supply, 6221 S. Maple Avenue, Tempe, AZ 85283, Tel. 602-820-5411; FAX: 602-820-4643) is used. Then, any remaining hum can be further reduced by balancing the two sides of the circuit via R1, located in the cathode circuit.

Unwanted feedback is avoided because the circuit is designed as a single-stage amplifier. The sensitivity of the 60FX5 vacuum tubes, V1 and V2, makes that possible.

The amplifier can be driven to full output with less than 3 volts of audio input on the grids, making it ideal for

use with a battery-operated radio or tape player. At about 3 watts, the output of the amp is adequate for quiet listening on a 15-inch speaker, and is great for earphones. Of course, the tubes can be pushed slightly beyond the linear portion of their operating curve (overdriven) to give a kind of distortion that some "tube-philes" like; more on that later.

The amplifier operates on a 120-volt power supply. That is low for tubes and was selected for safety reasons. The "60" in the designation of the 60FX5's indicates the filament voltage. Connecting the filaments of the two tubes in series permits them to be wired directly across the 120-volt DC output of the power supply. The filaments of audio tubes should be operated with DC whenever possible.

The 60FX5 is a sensitive, inexpensive tube (currently selling for under \$3) that works well in the circuit, but other tubes could also be used without changing the socket connections. If you want to substitute tubes with 50-

volt filaments, the 50FK5, the 50EH5, and the very common 50C5 are good choices. However, a resistor will be needed in series with the filaments, and the values of cathode resistors R2 and R3 might have to be changed.

Transformer T2 is a good quality, 10-watt, tube-type audio-output unit that is also available from Antique Electronic Supply (as model PT-1608). Its primary has an impedance of about 8000 ohms, center tapped, and the secondary has taps for 4, 8, and 16 ohms. The 220-ohm screen resistor, R4, is used to drop the screen voltage to a little below the plate voltage. Bypass capacitors were not found necessary

in either the cathode or screen circuits.

The power supply, shown in Fig. 2, uses two low-voltage transformers, T1 and T2, connected back-to-back, although a conventional isolation transformer could be used instead. Bridge rectifier BR1 rectifies the input AC, and capacitor C1 filters the resultant DC. The filament voltage is taken from that 120-volt point. Resistor R1 then drops that voltage, and capacitor C2 filters it further. The plate and screen voltages are then taken from the resulting 92-volt output. For safety and for hum-control reasons, ground the circuit as shown.

Construction. The amplifier prototype was built on a 24- by 10-inch laminated board that is sold at home improvement centers for shelving. A smaller board could be used, but the large one provides room for experimenting and for the input radio or tape player.

To wire the circuit, use insulated wire and make connections with fahnestock or similar clips; fasten the clips to the board with wood screws. Mount R1 on a corner bracket so it is raised above the surface of the board. That prevents you from coming into contact with the exposed connections when making adjustments.

When connecting the tube sockets, it is easiest to wire them, screw them to the board, and then trim the wires to an appropriate length. As for the leads of T1 and T2, don't trim them too short—you might want to use the transformers in other projects. The audio output from T2 can either be wired to fahnestock clips, or connected to an audio jack, depending on the nature of your speaker's leads.

The power-supply prototype was built on a separate 9- by 4-inch pine board so it could be physically separated from the amplifier. That is a good practice in audio work because hum might be radiated by the magnetic fields of the transformers and

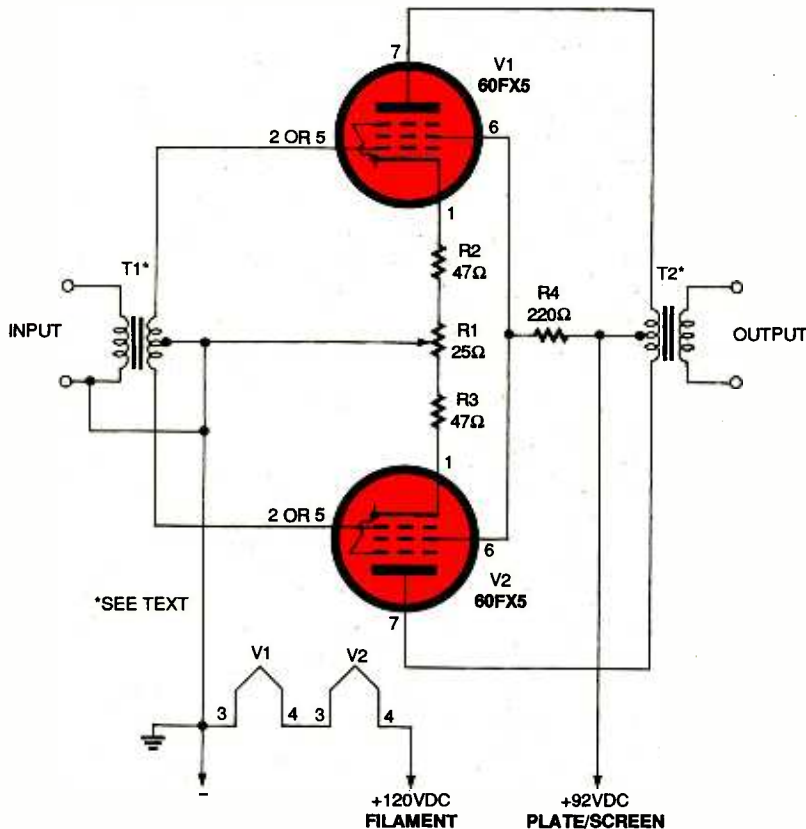


Fig. 1. Here is the schematic for the tube amplifier. Its single-stage design, which eliminates unwanted feedback, was made possible by the sensitive 60FX5 vacuum tubes.

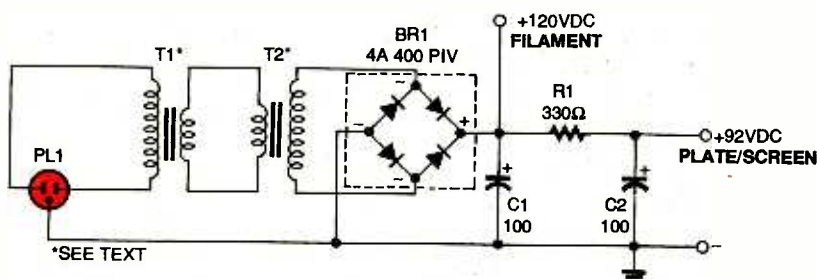


Fig. 2. The power supply for the amplifier uses two low-voltage transformers connected back-to-back. The full-wave bridge rectifier, BR1, provides DC for the filaments, plates, and screens.

PARTS LIST FOR THE TUBE AMPLIFIER

RESISTORS

(All fixed resistors are 5% units.)
 R1—25-ohm, 2-watt, potentiometer
 R2, R3—47-ohm, 1/2-watt
 R4—220-ohm, 1-watt

ADDITIONAL PARTS AND MATERIALS

T1—Tube interstage transformer, 1:1 to 1:3 turn ratio, Antique Electronic Supply PT-157 or equivalent
 T2—Tube-type audio-output transformer, Antique Electronic Supply PT-1608 or equivalent (see text)
 V1, V2—60FX5 vacuum tube
 24- by 10-inch baseboard, corner bracket, knob for variable resistor, two 7-pin miniature tube sockets, fahnestock clips, audio-output jack (optional), speaker or headphones, alligator clips, screws, insulated wire, solder, hardware, etc.

hash (RF noise) might be given off by the rectifier.

Like the amplifier, you can wire the power supply using insulated wire and fahnestock clips. A small terminal strip can be used to mount BR1. To prevent strain on T1 and T2, use a couple of cable clamps on the power cord.

If you're new to tube voltages, be careful! **Do not touch any part of the amplifier except the knob of R1 while the power supply is plugged in.** After unplugging the amplifier, short the two positive-output fahnestock clips on the power supply to the negative clip to make sure the capacitors have discharged. If the amplifier and power supply are to be placed in regular service where others might come in contact with them, they should be enclosed. Exposed high voltages are not the only danger present—tubes get hot!

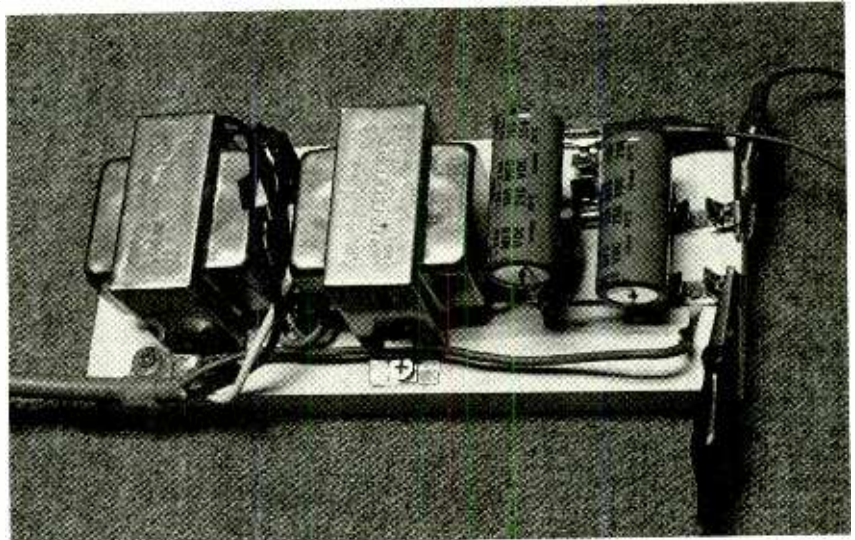
Checkout and Use. Double-check all wiring to make sure it is correct. Then, make the following connections between the amplifier and power supply using insulated wires that have insulated alligator clips on both ends.

Begin with the power supply *unplugged*. Temporarily connect the plate/screen lead clip from the amplifier to the filament clip on the power supply. Properly connect the negative ground lead to the power supply. Then, short the input of the amplifier with a piece of wire, and connect a speaker to the output of T2.

Plug in the power supply and wait a minute or so for the tubes to warm up. If the tubes warm up at a slightly different rate, however, the hum level might be too loud. To prevent that, balance the circuit by adjusting R1 for minimum hum.

After the circuit is balanced, unplug the power supply. Connect the amplifier plate/screen lead clip to the proper clip on the power supply. Then, plug in the power supply and wait for the tubes to warm up again. When they do, the hum should be inaudible or nearly so. If it isn't, try moving the power supply away from the amplifier or change the physical orientation of the two circuits.

Unplug the power supply and remove the short from the input of the amplifier. Connect a battery-powered radio or tape player with an audio cable from its earphone jack to



This power-supply prototype was built on a separate board from the amplifier. It's usually wise to build audio power supplies as separate units to prevent unwanted noise.

PARTS LIST FOR THE POWER SUPPLY

BR1—4-amp, 400-P[V, full-wave bridge rectifier
R1—330-ohm, 5-watt, 10% resistor
C1, C2—100- μ F, 250-WVDC, electrolytic capacitor
T1, T2—117 volt to 12.6 volt, 3-amp. power transformer
PL1—3-conductor power cord and plug
9- by 4-inch pine board, terminal strip, fahnestock clips, screws, cable clamps, insulated wire, solder, hardware, etc.

the amplifier input. Then, connect the filament-lead clip on the amplifier to the proper clip on the power supply. Plug in the power supply, adjust the volume control on the radio, and enjoy the music.

Any distortion in the radio or tape player will, of course, be passed on to the amplifier (though "tube-philes" say tubes make it sound better!). Also, you'll find some music played over-the-air has built-in distortion—especially on "oldies" stations. Sound quality is also affected by sources that use bass boost, as they will sound "bassier" through the amplifier. So consider the above when making evaluations in the experiments that follow.

Some Experiments. There's long been a debate in tube-audio circles about pentodes vs. triodes. If you

would like to hear the difference, try reconfiguring the amplifier for triode operation. To do that, disconnect the screen of each tube from R4. Then, connect the screen of each tube to its own plate at the appropriate fahnestock clip. The output and distortion should be less in the triode mode. Try both modes to see which you like better.

The idea of pushing a tube slightly beyond the linear portion of its operating curve was mentioned earlier. Some authorities say that tubes sound best when slightly over-driven that way. That is easy enough to try, just turn up the volume!

The push-pull arrangement of the tubes tends to cancel the even harmonics. You can put the harmonics back in by disconnecting the plate of one tube; however, hum might increase.

There is no "tone" control on the amplifier, but you can cut the highs and thereby boost the bass by connecting a 0.1- μ F capacitor across the secondary of the input transformer. A variable resistor can be placed in series with the capacitor to make the effect adjustable.

You can sometimes cause subtle variations in amp and speaker performance by connecting a small resistor between the output transformer and the speaker system. Also, resistors can be used to experiment with the various forms of negative feedback. The open construction of the amplifier makes it easy to try them all. ■

The Magazine for the Electronics Activist!

© Gernsback Publications, Inc.

Abbreviations: (AR)Antique Radio, (C)Construction, (CB)Computer Bits, (CC)Circuit Circus, (D)Department, (DX)DX Listening, (ED)Editorial, (HOR)Hands-On Reports, (HR)Ham Radio, (LTR)Letter, (MW)Multimedia Watch (PTR)Product Test Report, (SS)Scanner Scene, (TT)Think Tank

3DO Interactive Multiplayer, Panasonic FZ-1 REAL (Scaduto & O'Brian)(G)	Jun 49	Audio-Technica MMS557 Multimedia Speakers (Scaduto & O'Brian)(G)	Aug 55	Bogen Communications Friday Personal/Office Receptionist (Scaduto & O'Brian)(G)	Jun 54
3DO Software Roundup (Scaduto & O'Brian)(G)	Jun 50	Bose Acoustic Wave Receiver/Alarm Clock (Scaduto & O'Brian)(G)	Feb 47	BookMaker ClickBook (Holtzman)(CB)	Aug 75
555 Astable Roundup (Rakes)(CC)	Jan 72	Design Acoustics PS-24 Shielded A.V. Speakers (Scaduto & O'Brian)(G)	Feb 50	Bose Acoustic Wave Receiver/Alarm Clock (Scaduto & O'Brian)(G)	Feb 47
A					
ABC's of PDAs, The (Scaduto & O'Brian)(G)	Mar 51	Fisher Studio 24 CD Management System (Scaduto & O'Brian)(G)	Jan 49	Broadcasters SWL's Love to Hate, The (Jensen)(DX)	Mar 84
Printers, The (Thurber)	Apr 43	JVC JX-S700 A.V. Selector (Scaduto & O'Brian)(G)	Jul 56	Brother P-Touch PC Labeling System (Scaduto & O'Brian)(G)	Oct 67
AC or DC? (Rybak)	Sep 42,(LET)Nov 4	McIntosh Laboratories MC7100 Power Amplifier (Feldman)(PTR)	Jul 20	Build A AnTheThis (See Construction)	
AC-Noise Detector (Rakes)(CC)	Oct 82	Onkyo TX-SV717PRO A.V. Receiver (Scaduto & O'Brian)(G)	Feb 48	Build Your Own Text Editor (Holtzman)(CB)	Apr 74
Accessories for Radio Listening (Thurber)	Feb 68	Schosche Industries Accumat Sound Barrier and Dampng Material (Scaduto & O'Brian)(G)	Apr 58	Building Stable RF Oscillators (Carr)	Nov 40
Accumat Sound Barrier, Schosche Industries (Scaduto & O'Brian)(G)	Apr 58	Sharp Model MD-D10 MiniDisc Player (Feldman)(PTR)	Aug 21	Bumps Along the Road (Laron)(ED)	Jun 2
Add-on LED Circuit (Rakes) (CC)	Jan 72	Sonance S3500 in-Wall Loudspeakers (Scaduto & O'Brian)(G)	Oct 65	Buying Used Test Equipment (Fonte)	Jun 67
Addresses and Questions (Yacono)(TT)	May 26	Sony MDS-101 MiniDisc Recorder (Feldman)(PTR)	Apr 22	C	
Age of Information, The (Laron)(ED)	Feb 2	Sony MZ-RS MiniDisc Walkman Player/Recorder (Scaduto & O'Brian)(G)	Aug 47	Calculations, Thermal (Olivieri)	Dec 55
Air-Conditioner Monitor for Your Car, Build An (Caristi)(C)	Aug 43	Team Monitor and Bass Subwoofer Speakers, Rock Solid Sounds (Scaduto & O'Brian)(G)	Nov 20	Call Blocker, Build the (Weeder)(C)	Jun 31
Alarm Circuit (Rakes)(CC)	Jun 76	Technics SC-CH555 Mini Component Stereo System (Feldman)(PTR)	Jun 21	Camcorder Sharp ViewCam VL-E30U Camcorder with LCD Viewfinder (Scaduto & O'Brian)(G)	Apr 55
Alarm-Clock Adapter (Yacono)(TT)	Sep 24	Universal Noise-Reduction System, The (Panosh)(C)	Jul 31	Sony Handycam Snap! CCD-SC4 (Scaduto & O'Brian)(G)	Apr 56
All About					
Crash Protection (Siuru)	Nov 57	Yamaha RX-V870 Stereo Receiver (Feldman)(PTR)	Mar 22	Can You Pass This FCC Exam? Feb 63	
Nightvision Scopes (Rakes)(C)	Apr 33	Audio-Technica MMS557 Multimedia Speakers (Scaduto & O'Brian)(G)	Aug 55	Car-Audio Supply (Yacono)(TT)	Dec 30
Piezoelectric Elements (Singmin)	Mar 69	AudioAccess MRX Multi-Room Controller (Scaduto & O'Brian)(G)	Sep 58	Car-Battery Minder (Yacono)(TT)	Jul 25
Radio Control (Spiwak)	Aug 39	AudioSource Model SS Three-III Surround Sound Processor (Feldman)(PTR)	Jan 18	Car Security System, Build a Multi-Function (Caristi)(C)	Oct 41
Transistors: FETs (Young)	May 71	Automotive		Casino, Electronic, Build This (Kirschenbaum)(C)	Mar 47
All-Band Delta-Loop Antenna, An (Carr)(HR)	Aug 86	All About Crash Protection (Siuru)	Nov 57	Casio	
AM FM Radio Kit, Elenco Electronics (HOR)	Nov 24	Build a/an		CMD-408 Wrist Controller Watch (Scaduto & O'Brian)(G)	Aug 53
American Technology FM Sounds Miniature FM Radio (Scaduto & O'Brian)(G)	Oct 71	Air-Conditioner Monitor for Your Car (Caristi)(C)	Aug 43	Zoomer (Scaduto & O'Brian)(G)	Mar 57
Analog First-Response Monitor (Rakes)(CC)	Apr 78	Low-Cost Motorcycle Alarm (Kasper)(C)	Feb 37	CD-ROM, Step Up to (Spiwak)	Feb 31
Analog-to-Digital Converter for Your PC, A Low-Cost (Sanpitak)(C)	Apr 47	Multi-Function Car Security System (Caristi)(C)	Oct 47	Channel-Output Display (Yacono)(TT)	Jan 22
AND Gate Cut-Off (Yacono)(TT)	Jul 25	Electrical-System Analyzer for Your Car (Caristi)(C)	Mar 66	Chirping Security Add-On (Yacono)(TT)	Aug 24
Anemometer, Build a (Simcox)(C)	Jan 37	More Muscle and Vehicle Projects (Yacono)(TT)	Jul 25	Christmas Stocking Stuffer (Saxon)(SS)	Dec 82
Antenna					
All-Band Delta-Loop Antenna, An (Carr)(HR)	Aug 86	Navigation Systems Go Mainstream (Siuru)	Oct 75	Christmas Tree, Build the "LED-Tric" (Panosh)(C)	Dec 35
Funny Little Antenna, A (Carr)(HR)	Dec 80	Police Cars Go High-Tech (Siuru)	Aug 59	CIRCUIT CIRCUS (D)(Rakes)	Jan 72, Feb 80, Mar 83, Apr 78, May 79, Jun 76, Jul 81, Aug 78, Sep 81, Oct 82, Nov 74, Dec 72
Topics (Carr)(HR)	Jul 86	Smart Vehicles are Here, The (Siuru)	Jan 41	555 Astable Roundup	Jan 72
Wire Antennas (Carr)(HR)	Jun 84	Auto Auto Lamps (Yacono)(TT)	Jul 25	Fluid Detectors	Jan 76
ANTIQUÉ RADIO (Ellis)(D)					
Jan 67, Feb 73, Mar 75		A.V.		Game Circuits	Jan 76
Apr 74, May 75, Jun 71, Jul 73, Aug 73		Circuits (Yacono)(TT)	Dec 30	Inductive Transmitters	Sep 81
Sep 21, Oct 22, Nov 68, Dec 66		Receiver, Onkyo TX-SV717PRO (Scaduto & O'Brian)(G)	Feb 48	Light Your Fire	Aug 76
Baby Boomer from Britain, A	Oct 22	Selector, JVC JX-S700 (Scaduto & O'Brian)(G)	Jul 56	Making Waves	Jul 81
Crystal Set Lore	Jan 67	Speakers, Shielded, Design Acoustics PS-24 (Scaduto & O'Brian)(G)	Feb 50	Monitor/Detector Circuits	Nov 74
Firing Up the Tel-Ohmike TO-4	Dec 66	B			
Getting Started on the NBS Crystal Set	May 75	B + K Precision Model 1686 DC Power Supply (HOR)	Jan 17	Oscillator and Bridge Circuits	Oct 82
Mailbag Time!	Sep 21	Baby Boomer from Britain, A (Ellis)(AR)	Oct 22	Plenty of Oscillators	Mar 82
Mother of All Radio Museums, The	Mar 75	Barometer, Build a Portable (Caristi)(C)	Jan 31	Some Assorted Circuits	Feb 80
NBS Crystal Set, The	Apr 74	Basic Ultrasonic Generator (Rakes)(CC)	Dec 72	Take the Speed Test	May 75
NBS Post Scripts	Aug 73	Battery Amp-Hour Meter (Caristi)(C)	Nov 51	Ultrasonic Circuits	Apr 78
Putting Together the NBS Set	Jun 71	Beginner's Course and Motion-Detecting Alarms, A (Yacono)(TT)	Aug 24	ClarisWorks for Windows (Holtzman)(CB)	Mar 80
Resurrecting a Capacitor Analyzer	Nov 68	BellSouth Simon (Scaduto & O'Brian)(G)	Mar 51	Clock, Digital, Build a (Spiwak)(C)	Jul 61
Testing the NBS Set	Jul 73	Beyond Ohm's Law (Coxwell)	May 66	Closed Caption Decoder, International Computers (Scaduto & O'Brian)(G)	Jun 58
Trip to Mecca, A	Feb 73	Honeywell Mouse (HOR)	Apr 67	Code-Practice Oscillator (Rakes)(CC)	Jun 78
Antique Wireless Association Museum (Ellis)(AR)					
Mar 75		Infonite MP100 Writing Pad (Scaduto & O'Brian)(G)	Apr 60	Colorizing Movies—Much Ado About Nothing (Steckler)(ED)	Mar 2
Apple Newton (Scaduto & O'Brian)(G)					
Mar 51					
Arc Igniter (Rakes)(CC)					
Jul 81					
Astable Multivibrator (Rakes)(CC)					
Jan 72					
ATI Graphics Pro Turbo (Holtzman)(CB)					
Nov 72					
AT&T EO Personal Communicator (Scaduto & O'Brian)(G)					
Mar 62					
Audible Voltmeter (Rakes)(CC)					
May 79					
Audio					
Accessories for Radio Listening (Thurber)	Feb 68				
American Technology FM Sounds Miniature FM Radio (Scaduto & O'Brian)(G)	Oct 71				
AudioAccess MRX Multi-Room Controller (Scaduto & O'Brian)(G)	Sep 58				
AudioSource Model SS Three-III Surround Sound Processor (Feldman)(PTR)	Jan 18				

Low-Cost Analog-to-Digital Converter for Your PC, A (Sanpatik)(C)	Apr 47
Media Vision Memphis Multimedia Upgrade Kit (HOR)	May 22
MicroCode Engineering CircuitMaker (HOR)	Mar 16
Nikon Coolscan 35-mm Slide Scanner (Scaduto & O'Brian)(G)	Feb 45
Tandy Sensation! Multimedia Personal Computer (Scaduto & O'Brian)(G)	Jul 49
COMPUTER BITS (D)(Holtzman)	Jan 70, Feb 75, Mar 80, Apr 76, May 77, Jun 74, Jul 76, Aug 76, Sep 76, Oct 77, Nov 72, Dec 70
Build Your Own Test Editor	Apr 76
Clarix/Works for Windows	Mar 80
Crosstalk for Windows	Feb 75
FrontRunner	Sep 76
IdeaFisher	Oct 77
It May Not Be Sexy—But It Sure is SCSI	Jun 74
Just a Click Away	May 77
Just for Kids—Not!	Dec 70
Oddis and Ends	Aug 76
Shred Your Manuals!	Jan 70
Va Va Va Video	Nov 72
Word 6.0 for Windows	Jul 76
Computer Interface Trainer, Elenco (HOR)	Jul 18

CONSTRUCTION

All About Nightvision Scopes (Rakes)	Apr 33
Build A An The This	
50-MHz Frequency Counter (Weeder)	Nov 33
125-MHz Logic Probe (Yost)	Feb 57
Air-Conditioner Monitor for Your Car (Canstl)	Aug 43
Anemometer (Simcox)	Jan 37
Auto-Ranging Digital Capacitance Meter (Bolles)	Nov 62
Battery Amp-Hour Meter (Carlisti)	Nov 51
Call Blocker (Weeder)	Jun 31
Digital Clock (Spiwak)	Jul 61
Digital Combination Lock (Stephens)	Jul 70
Distinctive Ring Switch (Layne)	May 33
Electronic Casino (Kirschenbaum)	Mar 47
Electronic Paint Shaker (Covington)	Apr 70
"Gate-Dip" Meter (Veronese)	Nov 37
Home Security System (Taylor)	Oct 31
"LED-Tric" Christmas Tree (Panosh)	Dec 33
Low-Cost Motorcycle Alarm (Kasper)	Feb 37
Low-Voltage Power Controller (Rehman)	Dec 58
Micro Messenger (Edwards)	Sep 31
Motion Memory (Edwards)	Aug 63
Multi-Function Car Security System (Caristi)	Oct 47
Nine-Band Shortwave Receiver (Williams)	Mar 33
One-Tube Radio Receiver (Liste)	Oct 62
Packet-Radio Tuning Indicator (Pliiter)	Jul 68
Portable Barometer (Caristi)	Jan 31
Radio-Controlled Car (Sheets & Graf)	Aug 31
Relative-Humidity Gauge (Carlisti)	Jan 62
Remote-Control Relay Station (Yacono)	May 69
SCA Adapter (McCormick)	Jun 44
Scanner Silencer (Pliier)	Sep 73
Smart Charger (Caristi)	Sep 64
Solid-State Cooler (Spiwak)	Apr 37
Versatile Data Logger (Malone)	Jul 35
"Z-Dice" (Edwards)	Dec 46

Design Your Own Loudspeakers (Hoffman)	Feb 40
Electrical-System Analyzer for Your Car (Caristi)	Mar 66
How to Split a Power Supply (Covington)	Jun 47
Low-Cost Analog-to-Digital Converter for Your PC, A (Sanpatik)	Apr 47
Time-Delayed Model-Rocket Launch Control, A (Becker)	May 41
Universal Noise-Reduction System, The (Panosh)	Jul 31
Variable Frequency RF Oscillators (Carr)	Oct 41

Consumer Electronics Show	
Summer 1994 (Scaduto & O'Brian) (G)	Nov 9
WCES 94: Where's the Hype? (Scaduto & O'Brian)(G)	May 51
Cooler, Build a Solid-State (Spiwak)(C)	Apr 37
Corel SCSI (Holtzman)(CB)	Jun 74
Crash Protection, All About (Sluru)	Nov 57
Crosstalk for Windows (Holtzman)(CB)	Feb 75
Crystal Set Lore (Ellis)(AR)	Jan 67
Custom Installation, Do-It-Yourself (Scaduto & O'Brian)(G)	Sep 56
CyberMan at Your Command (Spiwak)(MW)	Sep 4
CyberSoft NutriBase Personal Nutrition Manager (Scaduto & O'Brian)(G)	Apr 61

D

Darkness Monitor (Rakes)(CC)	Oct 82
Data Logger, Build the Versatile (Malone)(C)	Jul 35
DBM Oscillator (Rakes)(CC)	Feb 80
DC Power Supply, B + K Precision Model 1686 (HOR)	Jan 17
DC-to-DC Converter (Rakes)(CC)	Jan 72
Design Acoustics PS-24 Shielded A/V Speakers (Scaduto & O'Brian)(G)	Feb 50
Design Your Own Loudspeakers (Hoffman)(C)	Feb 40

Digital

Analog First-Response Monitor (Rakes)(CC)	Apr 78
Capacitance Meter Auto-Ranging, Build an (Bolles)(C)	Nov 62
Clock, Build a (Spiwak)(C)	Jul 61
Combination Lock, Build A (Stephens)(C)	Jul 70
First-Response Monitor (Rakes)(CC)	Apr 78
Video Mixer, Videonics MX-1 (Scaduto & O'Brian)(G)	Oct 63
Diode Matching Circuit (Rakes)(CC)	Oct 82
Directional Discontinuity Ring Radiator Antenna (Carr)(HR)	Dec 60
Displays and Discrepancies (Yacono)(TT)	Feb 24
Distinctive Ring Switch, Build This (Layne)(C)	May 33
Do-It-Yourself Custom Installation (Scaduto & O'Brian)(G)	Sep 56
Documentation (Cunkeiman)	May 37
Door Ajar Unit (Yacono)(TT)	Sep 24
Double Balanced Mixers, Using (Carr)(HR)	Oct 87
Dual-tone Generator (Rakes)(CC)	Jan 72
DX LISTENING (Jensen)(D)	Jan 76, Feb 82, Mar 84, Apr 84, May 84, Jun 82, Jul 84, Aug 84, Sep 84, Oct 85, Nov 80, Dec 76

Broadcasters SWL's Love to Hate, The DX on the Tropical Bands	Mar 84
E.C.S.S.	Oct 85
Maritime CW Disappearing Money Crunch, The!	Jan 76
Radio Jamming in the 1990's	Apr 84
Radio St. Helena Day	Aug 84
Shortwave-Broadcast Finding	Nov 80
Shortwave-Broadcasting in Singapore	Sep 84
South-American SW Broadcasters	May 84
Viennese DX	Dec 76
Will Ireland Return to Shortwave?	Jun 82

E

E.C.S.S. (Jensen)(DX)	Jan 76
Easy-to-Remember Frequencies (Saxon)(SS)	Sep 88
EDITORIAL (Laron)(D)	Jan 2, Feb 2, Mar 2, Apr 2, May 2, Jun 2, Jul 2, Aug 2, Sep 2, Oct 3, Nov 3, Dec 3
Age of Information, The	Feb 2
Bumps Along the Road	Jun 2
Colorizing Movies—Much Ado About Nothing (Steckler)	Mar 2
Fun and Games	May 2
Getting a Backbone	Jan 2
Holiday Gift, A	Dec 3
Issue for All Seasons, An	Aug 2
Matter of Security, A	Oct 3
Special Issue, A	Jul 2
Test Gear for Your Workbench	Nov 3
Watching Multimedia	Apr 2
You Can't Please Everyone	Sep 2

Education and Alarms (Yacono)(TT)	Sep 24
Elan Showcase Home (Scaduto & O'Brian)(G)	Sep 53
Electrical-System Analyzer for Your Car (Caristi)(C)	Mar 66
Electronic	
Casino, Build This (Kirschenbaum)(C)	Mar 47, (LET) Apr 3
Coin Toss (Rakes)(CC)	Sep 81
Craps Circuit (Rakes)(CC)	Sep 81
One-Arm Bandit (Rakes)(CC)	Sep 81
Twenty-One (Rakes)(CC)	Sep 81
ELECTRONICS LIBRARY (D)	Jan 6, Feb 6, Mar 6, Apr 8, May 8, Jun 8, Jul 8, Aug 10, Sep 8, Oct 10, Nov 88, Dec 84

Electronics Technician's Day	Apr 40
Electronics Workbench, Interactive Image Technologies (HOR)	Jun 18
Electroscope (Yacono)(TT)	Nov 30
Elenco Electronics	
AM FM Radio Kit (HOR)	Nov 24
Basic Electronics Components Course (Yacono)(TT)	Aug 24
Computer Interface Trainer (HOR)	Jul 18
MM-8000 Microprocessor Trainer (HOR)	Sep 18
SP-1 Soldering Practice Kit (HOR)	Feb 18
Engineering CircuitMaker, MicroCode (HOR)	Mar 16
EO Personal Communicator, AT&T (Scaduto & O'Brian)(G)	Mar 62
Equipment and Chips (Yacono)(TT)	Apr 26
Expanded Digital First-Response Monitor (Rakes)(CC)	Apr 78
Expert Pad, Sharp PI-7000 (Scaduto & O'Brian)(G)	Mar 57
Exploring New Horizons (Saxon)(SS)	Nov 86

F

FCC Exam, Can You Pass This?	Feb 63
FET-Based Sparker Light Your Fire (Rakes)(CC)	Jul 81
FET Oscillator (Rakes)(CC)	Feb 80
FETs: All About Transistors (Young)	May 71
Fitters: An Introduction to (Young)	Aug 69
Field-Strength Meter, IC Engineering Digi-Field (HOR)	Dec 24

Finng Up the Tel-Ohmike TO-4 (Ellis)(AR)	Dec 66
Fisher Studio 24 CD Management System (Scaduto & O'Brian)(G)	Jan 49
Flash Circuit (Rakes)(CC)	Jul 81
Fluid Detectors (Rakes)(CC)	Jun 76
FM Sounds Miniature FM Radio, American Technology (Scaduto & O'Brian)(G)	Oct 71
Fox FoXapper TV/Cable Remote Control (Scaduto & O'Brian)(G)	Feb 53
Frequency Counter, Build a 50-MHz (Weeder)(C)	Nov 33
Friday Personal/Office Receptionist, Bogen Communications (Scaduto & O'Brian)(G)	Jun 54
FrontRunner (Holtzman)(CB)	Sep 76
Fun and Games (Laron)(ED)	May 2
Funny Little Antenna, A (Carr)(HR)	Dec 80

G

Game Circuits (Rakes)(CC)	Sep 81
"Gate-Dip" Meter, Build a (Veronese)(C)	Nov 37
Gemstar VCR Plusc Control Tower Universal Remote Control (Scaduto & O'Brian)(G)	Oct 69
George H. Heilmeyer and the LCD (Rybak)	Dec 36
Getting a Backbone (Laron)(ED)	Jan 2
Getting Started on the NBS Crystal Set (Ellis)(AR)	May 75
GIZMO (Scaduto & O'Brian)(D)	Jan 49, Feb 45, Mar 51, Apr 55, May 51, (LET) Jul 3, Jun 49, Jul 49, Aug 47, Sep 49, Oct 63, Nov 9, Dec 9

3DO Software Roundup	Jun 50
ABC's of PDAs, The	Mar 51
American Technology FM Sounds Miniature FM Radio	Oct 71
AT&T EO Personal Communicator	Mar 62
Audio-Technica MMS557 Multimedia Speakers	Aug 55
AudioAccess MRX Multi-Room Controller	Sep 58
Bogen Communications Friday Personal/Office Receptionist	Jun 54
Bose Acoustic Wave Receiver/Alarm Clock	Feb 47
Brother P-Touch PC Labeling System	Oct 67
Casio CMD-408 Wrist Controller Watch	Aug 53
CyberSoft NutriBase Personal Nutrition Manager	Apr 61

Design Acoustics PS-24 Shielded A/V Speakers	Feb 50
Do-It-Yourself Custom Installation	Sep 56
Issue for All Seasons, An	Sep 53
Fisher Studio 24 CD Management System	Jan 49
Fox FoXapper TV/Cable Remote Control	Feb 53
Gemstar VCR Plusc Control Tower Universal Remote Control	Oct 69
Gizmo's Holiday Gift Guide	Dec 9
Hitachi VT-S772A S-VHS VCR with VCR Plusc	Jul 52
Hylon Products Phonedex Autodialing Card File	Jan 52
Infinite MP100 Writing Pad	Apr 60
International Computers Closed Caption Decoder	Jun 58
JVC JX-5700 A/V Selector	Jul 56
Lil' Orbits ScanTrak 18 Golfball Finder	Jan 55
Media Vision Pro Movie Spectrum Video Capture Card	Jan 56
MindMaster TV Allowance Television Time Monitor	Jan 51
MultiLink The Stick Voice/Fax/Modem Call Processor	Jan 54
Multiplex Technology Channel Plus 9020 Video Distribution System	Sep 60
Nikon Coolscan 35-mm Slide Scanner Noise Cancellation Technologies	Feb 45
NoiseBuster Headset	Jun 53
Onkyo TX-SV717PRO A/V Receiver	Feb 48
Palm Computing PalmConnect Connectivity Software	Apr 63

Panasonic FZ-1 REAL 3DO Interactive Multiplayer	Jun 49
ProPhone CD-ROM Telephone Directories	Aug 51
Samsung FX40 Home Facsimile	Jun 56
Schosche Industries Accumul Sound Barrier and Damping Material	Apr 58
Sharp OZ-9600II Wizard Pen-Based Organizer View-7000 Expert Pad	Feb 51
ViewCam VL-E30U with LCD Viewfinder	Mar 57
Sonance S3500 In-Wall Loudspeakers	Oct 65
Sony Handycam Snap! CCD-SC4 Camcorder	Apr 56
ICF-SW100S World-Band Radio Receiver	Nov 18
MZ-RS MiniDisc Walkman Player/Recorder	Aug 47
Summer Consumer Electronics Show 1994, The	Nov 9
Tandy Sensation! Multimedia Personal Computer	Jul 49
Z-PDA Zoomer	Mar 59

Team Monitor and Bass Subwoofer Speakers, Rock Solid Sounds	Nov 20
TMC M2000 Programmable 2-Line Intercom/Speakers	Jul 55
Videonics MX-1 Digital Video Mixer	Oct 63
Voice Powered Technology Voice Organizer	Aug 56
WCES 94: Where's the Hype?	May 51
Whole-Home Entertainment Systems	Sep 49
Glitch Detector (Rakes)(CC)	Oct 82
Golng Online with Your PC (Thurber)	Jun 37

Golf-Stroke Counter (Yacono)(TT) Jan 22
 Ground Zero: The Other End of the Radio Spectrum (Thurber) Oct 55
 Guide to Better Soldering, A (Thurber) Sep 37

H

HAM RADIO (Carr)(D) Jan 84, Feb 84, Mar 86, Apr 88
 May 86, Jun 84, Jul 86, Aug 86
 Sep 87, Oct 7, Nov 84, Dec 80

All-Band Delta-Loop Antenna, An Antenna Topics Aug 86
 Funny Little Antenna, A Dec 80
 Mechanical Things for Builders Nov 84
 More Ham Miscellanea Apr 88
 Operating in the Low Bands Jan 84
 Preamp/Filter Oscillations Sep 87
 Radio and the Solar Eclipse Feb 84
 Receiver Performance Today May 86
 Using Double Balanced Mixers Oct 87
 Want to Operate WIWAW? (Carr)(DX) Mar 86
 Wire Antennas Jun 84

Hamming in the Fabulous Fifties (Thurber) Mar 41
 Handycam Snap! Camcorder, Sony CCD-SC4 (Scaduto & O'Brian)(G) Apr 56

HANDS-ON REPORT (D) Jan 17, Feb 18, Mar 16, Apr 17
 May 22, Jun 18, Jul 18, Aug 18
 Sep 18, Oct 18, Nov 24, Dec 24

B + K Precision Model 1686 DC Power Supply Jan 17
 Elenco Electronics

AM/FM Radio Kit Nov 24
 Computer Interface Trainer Jul 18
 MM-8000 Microprocessor Trainer Sep 18
 SP-1 Soldering Practice Kit Feb 18
 Honeywell Mouse Apr 17
 IC Engineering Digi-Field Field-Strength Meter Dec 24
 Interactive Image Technologies Electronics Workbench Jun 18
 Logisym V3.2 Logic Simulator Software Aug 18
 Media Vision Memphis Multimedia Upgrade Kit May 22
 MicroCode Engineering CircuitMaker Mar 16
 OrCad Schematic Design Tools 386+ Oct 18

Headlights/Turn-Signal Reminder (Yacono)(TT) Jun 24
 Heavy-Duty Transmitter (Rakes)(CC) Aug 78
 Heilmeier, G. H., and the LCD (Rybak) Dec 36
 Hewlett-Packard DashBoard (Holtzman)(CB) May 77, Aug 76
 High-Level Detector (Rakes)(CC) Jun 76
 High-Level Handles (Saxon)(SS) Jan 86
 High-power flasher add-on (Rakes)(CC) Jan 72
 High-Tech War on Crime, The (Siuru) Dec 51

History
 AC or DC? (Rybak) Sep 42
 George H. Heilmeier and the LCD (Rybak) Dec 36

Hitachi VT-S772A S-VHS VCR with VCR Plus+ (Scaduto & O'Brian)(G) Jul 52
 Holiday Gift Guide.
 Gizmo's (Scaduto & O'Brian)(G) Dec 9
 Holiday Gift, A (Laron)(ED) Dec 3
 Home Facsimile, Samsung FX40 (Scaduto & O'Brian)(G) Jun 56
 Home Security System, Build a (Taylor)(C) Oct 31
 Honeywell Mouse (HOR) Apr 17
 How to Split a Power Supply (Covington)(C) Jun 47
 HV Static Detector (Rakes)(CC) Mar 82

Hyton Products Phonedex Autodialing Card File (Scaduto & O'Brian)(G) Jan 52

I

IC-Based Ignitor (Rakes)(CC) Jul 81
 IC Engineering Digi-Field Field-Strength Meter (HOR) Dec 24
 IdeaFisher (Holtzman)(CB) Oct 77
 Igniter (Rakes)(CC) Jul 81

Improved
 Sawtooth Generator (Rakes)(CC) Nov 74
 Ultrasonic Generator (Rakes)(CC) Dec 72

In-Wall Loudspeakers, Sonance S3500 (Scaduto & O'Brian)(G) Oct 65
 Inductive Transmitters (Rakes)(CC) Aug 78
 Infrared-Beam Alarm (Yacono)(TT) Aug 24

Inforte MP100 Writing Pad (Scaduto & O'Brian)(G) Apr 60

Interactive Image Technologies Electronics Workbench (HOR) Jun 18

Intercom Speakerphone, TMC M200 Programmable 2-Line (Scaduto & O'Brian)(G) Jul 55

International Computers Closed Caption Decoder (Scaduto & O'Brian)(G) Jun 58

Introduction to
 Filter Circuits, An (Young) Aug 69
 Reactance, An (Coxwell) Sep 69
 Schematic Symbols, An (Young) Nov 46

Intuit Quicken for Windows (Holtzman)(CB) Aug 76

Issue for All Seasons, An (Laron)(ED) Aug 2
 It May Not Be Sexy—But It Sure is SCSI (Holtzman)(CB) Jun 74

J

JASC Paint Shop (Holtzman)(CB) Aug 76
 JP Software 4DOS 5.0 (Holtzman)(CB) Aug 76
 Just a Click Away (Holtzman)(CB) May 77
 Just for Kids—No!! (Holtzman)(CB) Dec 70
 JVC JX-S700 A/V Selector (Scaduto & O'Brian)(G) Jul 56

K

Kit Building
 Elenco Electronics

AM/FM Radio Kit (HOR) Nov 24
 MM-8000 Microprocessor Trainer (HOR) Sep 18
 LEGO for the 1990's: The Lego Dacta Control Lab (Spiwak) Jun 64
 Robix Robot Construction Set, The (Spiwak) Jun 46
 The Word on Kits (Thurber) Jul 43

Kodak Model PCD 5870 Photo CD Player (Feldman)(PTR) Feb 20

L

Latching Motion Detector (Yacono)(TT) Aug 24
 LC Oscillator (Rakes)(CC) Feb 80
 LCD, George H. Heilmeier and the (Rybak) Dec 36
 LED circuit (Yacono)(TT) Jan 22
 LED Flasher (Yacono)(TT) Feb 24

LEGO for the 1990's: The Lego Dacta Control Lab (Spiwak) Jun 64

Let's Get Into Something New! (Spiwak)(MW) Apr 4

LETTERS (D)
 Jan 4, Feb 4, Mar 4, Apr 3
 May 3, Jun 3, Jul 3, Aug 4
 Sep 3, Oct 4, Nov 4, Dec 4

Light
 Beam Circuit (Rakes)(CC) Jun 76
 Detector (Rakes)(CC) Oct 82
 Timer (Yacono)(TT) Feb 24
 Your Fire (Rakes)(CC) Jul 81

Lightning and the Radio Listening Post (Thurber) May 44
 Lights On Circuit (Yacono)(TT) Jul 25

Lil' Orbits ScanTrak 18 Golfball Finder (Scaduto & O'Brian)(G) Jan 55
 Lock, Digital Combination (Stephens)(C) Jul 70
 Logic Probe, Build a 125-MHz (Yost)(C) Feb 57
 Logic Simulator Software, Logisym V3.2 (HOR) Aug 18
 Logisym V3.2 Logic Simulator Software (HOR) Aug 18
 Look At Mobile Extenders, A (Saxon)(SS) Jun 86
 Loudspeakers, Design Your Own (Hoffman)(C) Feb 40

Low-Cost Analog-to-Digital Converter for Your PC, A (Sanpitak)(C) Apr 47
 Low-Level Detector (Rakes)(CC) Jun 76
 Low-Pass Filter (Rakes)(CC) Aug 78
 Low-Voltage Power Controller (Rehman)(C) Dec 58

M

Mac and the PC Worlds are Similar, The (Spiwak)(MW) Oct 6
 Mailbag Time! (Ellis)(AR) Sep 21
 Making Waves (Rakes)(CC) Nov 74
 Maritime CW Disappearing (Jensen)(DX) Apr 84
 Matter of Security, A (Laron)(ED) Oct 3

McIntosh Laboratories MC7100 Power Amplifier (Feldman)(PTR) Jul 20
 Mechanical Things for Builders (Carr)(HR) Nov 84

Media Vision
 Memphis Multimedia Upgrade Kit (HOR) May 22
 Pro Move Spectrum Video Capture Card (Scaduto & O'Brian)(G) Jan 56
 Meter Adapter (Yacono)(TT) Nov 30
 Micro Messenger, Build the (Edwards)(C) Sep 31
 MicroCode Engineering CircuitMaker (HOR) Mar 16
 Microprocessor Trainer, Elenco MM-8000 (HOR) Sep 18

Microsoft
 Bookshelf '94 (Holtzman)(CB) Dec 70
 Creative Writer (Holtzman)(CB) Dec 70
 Fine Artist (Holtzman)(CB) Dec 70
 Word 6.0 for Windows (Holtzman)(CB) Jul 76
 Word Developers Kit (Holtzman)(CB) Jul 76

MindMaster TV Allowance Television Time Monitor (Scaduto & O'Brian)(G) Jan 51

Mini Component Stereo System, Technics SC-CH555 (Feldman)(PTR) Jun 21
 Mini-Megaphone (Rakes)(CC) May 79

MiniDisc
 Player, Sharp MD-D10 (Feldman)(PTR) Aug 21
 Recorder, Sony MDS-101 (Feldman)(PTR) Apr 22

Walkman Player/Recorder, Sony MZ-RS (Scaduto & O'Brian)(G) Aug 47
 Mitsubishi HS-US7 VCR (Feldman)(PTR) May 24
 Mobile Extenders, A Look at (Saxon)(SS) Jun 86

Model Railroad
 Crossing Flasher (Yacono)(TT) Oct 24
 Track-Control Signal (Yacono)(TT) Oct 24

Model-Rocket Launch Control, A Time-Delayed (Becker)(C) May 41
 Money Crunch, The! (Jensen)(DX) Aug 84
 Monitor/Detector Circuits (Rakes)(CC) Oct 82
 More Ham Miscellanea (Carr)(HR) Apr 88

More Muscle and Vehicle Projects (Yacono)(TT) Jul 25
 Mother of All Radio Museums, The (Ellis)(AR) Mar 75
 Motion Memory, Build the (Edwards)(C) Aug 63
 Motion-Detecting Alarms and A Beginner's Course (Yacono)(TT) Aug 24
 Motorcycle Alarm, Build a Low-Cost (Kasper)(C) Feb 37

Multi-Room Controller, AudioAccess MRX (Scaduto & O'Brian)(G) Sep 58
 MultiLink The Stick Voice/Fax/Modem Call Processor (Scaduto & O'Brian)(G) Jan 54

Multimedia (See Also Multimedia Watch)
 Personal Computer, Tandy Sensation! (Scaduto & O'Brian)(G) Jul 49
 Speakers, Audio-Technica MMS557 (Scaduto & O'Brian)(G) Aug 55
 Upgrade Kit, Media Vision Memphis (HOR) May 22

MULTIMEDIA WATCH (Spiwak)(D) Apr 4, May 4
 Jun 4, Jul 4, Aug 6
 Sep 4, Oct 6, Nov 6, Dec 6
 Sep 4
 Apr 4
 Oct 6
 May 4
 Nov 6
 Aug 6
 Jun 4
 Dec 6
 Jul 4

CyberMan at Your Command
 Let's Get Into Something New!
 Mac and the PC Worlds are Similar. The
 My PC Gets Terminated
 PC Expo, and More!
 Put Some "ReelMagic" in Your PC
 Research on CD-ROM
 Sounding Off
 Virtual Reality By the Seat of Your Pants

Multiplex Technology Channel Plus 9020 Video Distribution System (Scaduto & O'Brian)(G) Sep 60
 Muscle Wire and Auto Stuff (Yacono)(TT) Jun 24
 My PC Gets Terminated (Spiwak)(MW) May 4

N

Navigation Systems Go Mainstream (Sluru) Oct 75

NBS Crystal Set
 Getting Started on (Ellis)(AR) May 75
 Post Scripts (Ellis)(AR) Aug 73
 Putting Together the (Ellis)(AR) Jun 71
 Testing the (Ellis)(AR) Jul 73
 The (Ellis)(AR) Apr 74

Neon-Light Driver (Yacono)(TT) Jan 22

NEW PRODUCTS (D) Jan 12, Feb 10, Mar 12, Apr 14
 May 14, Jun 12, Jul 12, Aug 15
 Sep 12, Oct 16, Nov 90, Dec 86

Nightvision Scopes, All About (Rakes)(C) Apr 33
 Nikon Coolscan 35-mm Slide Scanner (Scaduto & O'Brian)(G) Feb 45
 Noise Cancellation Technologies NoiseBuster Headset (Scaduto & O'Brian)(G) Jun 53
 Noise-Reduction System, The Universal (Panosh)(C) Jul 31
 Not-So-Private Security (Saxon)(SS) Oct 89
 NutriBase Personal Nutrition Manager, Cybersoft (Scaduto & O'Brian)(G) Apr 61

O

Odds and Ends (Holtzman)(CB) Aug 76
 Ohm's Law, Beyond (Coxwell) May 66
 On Displays (Yacono)(TT) Jan 22
 One-Chip Alarm (Yacono)(TT) Sep 24
 One-Chip Receiver (Rakes)(CC) May 79
 One-Tube Radio Receiver, Build a (Liste)(C) Oct 62
 Onkyo TX-SV717PRO A/V Receiver (Scaduto & O'Brian)(G) Feb 48
 Operating in the Low Bands (Carr)(HR) Jan 84
 Optoelectronics CD440 CTCSS Decoder (Saxon)(SS) Jun 86
 OrCad Schematic Design Tools 386+ (HOR) Oct 18
 Oscillator and Bridge Circuits (Rakes)(CC) Mar 82
 Oscillators, Plenty of (Rakes)(CC) Feb 80

P

Packet-Radio Tuning Indicator, Build a (Piller)(C) Jul 68
 Paint Shaker, Build An Electronic (Covington)(C) Apr 70
 Palm Computing PalmConnect Connectivity Software (Scaduto & O'Brian)(G) Apr 63
 Panasonic FZ-1 REAL 3DO Interactive Multiplayer (Scaduto & O'Brian)(G) Jun 49

PC Expo. and More! (Spiwak)(MW)	Nov 6
PC Labeling System, Brother P-Touch (Scaduto & O'Brian)(G)	Oct 67
Personal Digital Assistants	
ABC's of PDAs, The (Scaduto & O'Brian)(G)	Mar 51
AT&T EO Personal Communicator (Scaduto & O'Brian)(G)	Mar 62
Palm Computing PalmConnect Connectivity Software (Scaduto & O'Brian)(G)	Apr 63
Sharp PI-7000 Expert Pad (Scaduto & O'Brian)(G)	Mar 57
Tandy Z-PDA Zoomer (Scaduto & O'Brian)(G)	Mar 59
Pest Repeller (Rakes)(CC)	Jun 76
Phantom of the Airwaves, The (Saxon)(SS)	Apr 90
Phar Lap Software FrontRunner (Holtzman)(CB)	Sep 76
Phonedex Autodialing Card File, Hylon Products (Scaduto & O'Brian)(G)	Jan 52
Photo CD Player, Kodak PCD 5870 (Feldman)(PTR)	Feb 20
Photography	
Nikon Coolscan 35-mm Slide Scanner (Scaduto & O'Brian)(G)	Feb 45
Photo CD Player, Kodak PCD 5870 (Feldman)(PTR)	Feb 20
Screen Shots and Project Photography Made Easy (Blechman)	Dec 62
Piezoelectric Elements, All About (Singmin)	Mar 69
PIN Diodes, Switching with (Carr)	Dec 40
Pinouts and Tools (Yacono)(TT)	Mar 26
Plenty of Oscillators (Rakes)(CC)	Feb 80
PLL Ultrasonic Generator (Rakes)(CC)	Dec 72
Police Cars Go High-Tech (Siuru)	Aug 59
Poor Man's Alarm (Yacono)(TT)	Sep 24
Power Amplifier, McIntosh Laboratories MC7100 (Feldman)(PTR)	Jul 20
Power Controller, Low Voltage, Build a (Rehman)(C)	Dec 58
Power-Failure Monitor (Rakes)(CC)	Oct 82
Power Supply	
B + K Precision Model 1686 DC Power Supply (HOR)	Jan 17
How to Split a (Covington)(C)	Jun 47
Preamplifier Oscillations (Carr)(HR)	Sep 87
Printers, The ABC's of (Thurber)	Apr 43
Pro Movie Spectrum Video Capture Card, Media Vision (Scaduto & O'Brian)(G)	Jan 56
PRODUCT TEST REPORTS (Feldman)(D)	Jan 18
	Feb 20, Mar 22, Apr 22
	May 24, Jun 21, Jul 20, Aug 21
AudioSource Model SS Three-ii Surround Sound Processor	Jan 18
Kodak Model PCD 5870 Photo CD Player	Feb 20
McIntosh Laboratories MC7100 Power Amplifier	Jul 20
Mitsubishi HS-US7 VCR	May 24
Sharp Model MD-D10 MiniDisc Player	Aug 21
Sony MDS-101 MiniDisc Recorder	Apr 22
Technics SC-CH555 Mini Component Stereo System	Jun 21
Yamaha RX-V870 Stereo Receiver	Mar 22
ProPhone CD-ROM Telephone Directories (Scaduto & O'Brian)(G)	Aug 51
Proximity Sensor (Rakes)(CC)	Jun 76
Put Some "ReelMagic" in Your PC (Spiwak)(MW)	Aug 6
Putting Together the NBS Set (Ellis)(AR)	Jun 71
Q	
Quit Smoking Circuit (Yacono)(TT)	Feb 24
R	
Radio (See Also Antique Radio, DX Listening, Ham Radio, Scanner Scene)	
American Technology FM Sounds Miniature FM Radio (Scaduto & O'Brian)(G)	Oct 71
Build	
a Nine-Band Shortwave Receiver (Williams)(C)	Mar 33
a One-Tube Radio Receiver (Lisle)(C)	Oct 62
a Packet-Radio Tuning Indicator (Piller)(C)	Jul 68
an SCA Adapter (McCormick)(C)	Jun 44
the Scanner Silencer (Piller)(C)	Sep 73
Control, All About (Spiwak)	Aug 39
Elenco Electronics AM/FM Radio Kit (HOR)	Nov 24
Ground Zero: The Other End of the Radio Spectrum (Thurber)	Oct 55
Hamming in the Fabulous Fifties (Thurber)	Mar 41
Lightning and the Radio Listening Post (Thurber)	May 44
Listening, Accessions for (Thurber)	Feb 68
Sony ICF-SW100S World-Band Radio Receiver (Scaduto & O'Brian)(G)	Nov 18
Radio Shack	
PRO-2027 Desktop Scanner (Saxon)(SS)	Aug 88
PRO-2030 Desktop Scanner (Saxon)(SS)	Oct 89
PRO-37 Handheld Scanner (Saxon)(SS)	Jan 86
PRO-51 Handheld Scanner (Saxon)(SS)	Sep 88
PRO-2028 Desktop Scanner (Saxon)(SS)	Apr 90
PRO-2032 Scanner (Saxon)(SS)	May 88
PRO-44 Handheld Scanner (Saxon)(SS)	Feb 86

Radio-Controlled Car, Build A (Sheets & Graf)(C)	Aug 31
Random House Unabridged Dictionary (Holtzman)(CB)	Aug 76
Reactance, An Introduction to (Coxwell)	Sep 69
Receiver/Motor Interface (Yacono)(TT)	Oct 24
Receiver Performance Today (Carr)(HR)	May 86
Relative-Humidity Gauge, Build a (Caristi)(C)	Jan 62
Remote Control	
FoXapper TV/Cable (Scaduto & O'Brian)(G)	Feb 53
Receiver (Rakes)(CC)	Aug 78
Relay Station, Build A (Yacono)(C)	May 69
Transmitter (Rakes)(CC)	Aug 78
Repetitive Sparker (Rakes)(CC)	Jul 81
Research on CD-ROM (Spiwak)(MW)	Jun 4
Resurrecting a Capacitor Analyzer (Ellis)(AR)	Nov 68
RF Oscillators, Building Stable (Carr)	Nov 40
Robix Robot Construction Set, The (Spiwak)	Jan 46
Robot Construction Set, Robix (Spiwak)	Jan 46
Rock Solid Sounds Team Monitor and Bass Subwoofer Speakers (Scaduto & O'Brian)(G)	Nov 20

S

Samsung FX40 Home Facsimile (Scaduto & O'Brian)(G)	Jun 56
Save a Bundle with Toner-Cartridge Recycling (Blechman)	Mar 71
Sawtooth Generator (Rakes)(CC)	Nov 74
SCA Adapter, Build an (McCormick)(C)	Jun 44, (LET) Aug 4
SCANNER SCENE (Saxon)(D)	Jan 86, Feb 86
	Mar 86, Apr 90, May 88
	Jun 86, Jul 88, Aug 88
	Sep 88, Oct 89, Nov 86, Dec 82

Christmas Stocking Stuffer Easy-to-Remember Frequencies	Dec 82
Exploring New Horizons	Sep 88
High-Level Handles	Nov 86
Look At Mobile Extenders, A Not-So-Private Security	Jan 86
Phantom of the Airwaves, The Scanning Sky-High Surveillance Operations	Jun 86
Scanning Under Fire	Oct 89
Summer Sports and Games	Apr 90
Tracking Smokey Bear Underground Chatter	Aug 88
Scanner Silencer, Build the (Piller)(C)	May 88
Scanning Sky-High Surveillance Operations (Saxon)(SS)	Jul 88
Scanning Under Fire (Saxon)(SS)	Mar 86
ScanTrak 18 Golfball Finder, Lil' Orbits (Scaduto & O'Brian)(G)	Feb 86
Schematic Design Tools 386+, OrCad (HOR)	Sep 73
Schematic Symbols, An Introduction to (Young)	Aug 88
Schosche Industries Accumat Sound Barrier and Damping Material (Scaduto & O'Brian)(G)	Jan 55
Screen Shots and Project Photography Made Easy (Blechman)	Oct 18
Security	Nov 46
Build a Home Security System (Taylor)(C)	Apr 58
Build a Multi-Function Car Security System (Caristi)(C)	Oct 47
SemWare Editor, The (Holtzman)(CB)	Apr 76, Aug 76
Servo Driver (Yacono)(TT)	Oct 24

Sharp	
Model MD-D10 MiniDisc Player (Feldman)(PTR)	Aug 21
OZ-9600ii Wizard Pen-Based Organizer (Scaduto & O'Brian)(G)	Feb 51
PI-7000 Expert Pad (Scaduto & O'Brian)(G)	Mar 57
ViewCam VL-E30U Camcorder with LCD Viewfinder (Scaduto & O'Brian)(G)	Apr 55
Short-Circuit Protector (Yacono)(TT)	Nov 30
Shortwave	
Broadcast Finding (Jensen)(DX)	May 84
Broadcasting in Singapore (Jensen)(DX)	Dec 76
Receiver, Build a Nine-Band (Williams)(C)	Mar 33
Shred Your Manuals! (Holtzman)(CB)	Jan 70
Simple Amp (Yacono)(TT)	Dec 30
Slide Scanner, Nikon Coolscan (Scaduto & O'Brian)(G)	Feb 45
Smart Charger, Build the (Caristi)(C)	Sep 64
Smart Vehicles are Here, The (Siuru)	Jan 41
Software (See Also Multimedia Watch)	
ClarisWorks for Windows (Holtzman)(CB)	Mar 80
CyberSoft NutriBase Personal Nutrition Manager (Scaduto & O'Brian)(G)	Apr 61
Interactive Image Technologies Electronics Workbench (HOR)	Jun 18
Logisym V3.2 Logic Simulator Software (HOR)	Aug 18
OrCad Schematic Design Tools 386+ (HOR)	Oct 18
Palm Computing PalmConnect Connectivity Software (Scaduto & O'Brian)(G)	Apr 63
Soldering Practice Kit, Elenco SP-1 (HOR)	Feb 18
Soldering, A Guide to Better (Thurber)	Sep 37

Some Assorted Circuits (Rakes)(CC)	May 79
Some Hobby Circuits (Yacono)(TT)	Oct 24
Some Shop Circuits (Yacono)(TT)	Nov 30
Sonance S3500 In-Wall Loudspeakers (Scaduto & O'Brian)(G)	Oct 65
Sony	
Handycam Snap! CCD-SC4 Camcorder (Scaduto & O'Brian)(G)	Apr 56
ICF-SW100S World-Band Radio Receiver (Scaduto & O'Brian)(G)	Nov 18
MDS-101 MiniDisc Recorder (Feldman)(PTR)	Apr 22
MZ-RS MiniDisc Walkman Player/Recorder (Scaduto & O'Brian)(G)	Aug 47
Sounding Off (Spiwak)(MW)	Dec 6
South-American SW Broadcasters (Jensen)(DX)	Jun 82
Sparker (Rakes)(CC)	Jul 81
Special Issue, A (Laron)(ED)	Jul 2
Squarewave Generator (Rakes)(CC)	Jun 76
Step Up to CD-ROM (Spiwak)	Feb 31
Stepped Triangle Generator (Rakes)(CC)	Nov 74
Starter Cut-Off (Yacono)(TT)	Jun 24
Stereo Receiver, Yamaha RX-V870 (Feldman)(PTR)	Mar 22
Stick, The, Voice/Fax/Modem Call Processor, MultiLink (Scaduto & O'Brian)(G)	Jan 54
Studio 24 CD Management System, Fisher (Scaduto & O'Brian)(G)	Jan 49
Summer Consumer Electronics Show 1994, The (Scaduto & O'Brian)(G)	Nov 9
Summer Sports and Games (Saxon)(SS)	Jul 88
Super Simple Car Alarm (Yacono)(TT)	Jul 25
Surround Sound Processor, AudioSource Model SS Three-ii (Feldman)(PTR)	Jan 18
Switching with PIN Diodes (Carr)	Dec 40

T

Take the Speed Test (Rakes)(CC)	Apr 78
Tandy	
Sensation! Multimedia Personal Computer (Scaduto & O'Brian)(G)	Jul 49
Z-PDA Zoomer (Scaduto & O'Brian)(G)	Mar 59
Team Monitor and Bass Subwoofer Speakers, Rock Solid Sounds (Scaduto & O'Brian)(G)	Nov 20
Technics SC-CH555 Mini Component Stereo System (Feldman)(PTR)	Jun 21
Telephone	
Bogen Communications Friday Personal/Office Receptionist (Scaduto & O'Brian)(G)	Jun 54
Build	
the Call Blocker (Weeder)(C)	Jun 31
this Distinctive Ring Switch (Layne)(C)	May 33
Directories, ProPhone	Aug 51
CD-ROM (Scaduto & O'Brian)(G)	Jan 52
Hylon Products Phonedex Autodialing Card File (Scaduto & O'Brian)(G)	Jan 54
MultiLink The Stick Voice/Fax/Modem Call Processor (Scaduto & O'Brian)(G)	Jan 54
TMC M2000 Programmable 2-Line Intercom/Speakerphone (Scaduto & O'Brian)(G)	Jul 55
Temperature Shift Meter (Rakes)(CC)	Mar 82
Test Equipment	
B + K Precision Model 1686 DC Power Supply (HOR)	Jan 17
Build a/an the	
125-MHz Logic Probe (Yost)(C)	Feb 57
50-MHz Frequency Counter (Weeder)(C)	Nov 33
Auto-Ranging Digital Capacitance Meter (Boiles)(C)	Nov 62
Battery Amp-Hour Meter (Caristi)(C)	Nov 51
"Gate-Dip" Meter (Veronese)(C)	Nov 37
Buying Used Test Equipment (Fonte)	Jun 67
IC Engineering Digi-Field Field-Strength Meter (HOR)	Dec 24
Test Gear for Your Workbench (Laron)(ED)	Nov 3
Testing the NBS Set (Ellis)(AR)	Jul 73
Text Editor, Build Your Own (Holtzman)(CB)	Apr 76
THD Adapter (Yacono)(TT)	Nov 30
The Wave, Bose (Scaduto & O'Brian)(G)	Feb 47
The Word on Kits (Thurber)	Jul 43
Thermal Calculations (Olivieri)	Dec 55
THINK TANK (Yacono)(D)	Jan 22, Feb 24, Mar 26, Apr 26
	May 26, Jun 24, Jul 25, Aug 24
	Sep 24, Oct 24, Nov 30, Dec 30
Addresses and Questions	May 26
AV Circuits	Dec 30
Beginner's Course and Motion-Detecting Alarms, A	Aug 24
Displays and Discrepancies	Feb 24
Education and Alarms	Sep 24
Equipment and Chips	Apr 26
More Muscle and Vehicle Projects	Jul 25
Muscle Wire and Auto Stuff	Jun 24
On Displays	Jan 22
Pinouts and Tools	Mar 26
Some Hobby Circuits	Oct 24
Some Shop Circuits	Nov 30

Time-Delayed Model-Rocket Launch Control, A (Becker)(C) **May 41,(LET)Aug 3**
 TMC M2000 Programmable 2-Line Intercom/Speakerphone (Scaduto & O'Brian)(G) **Jul 55**
 Toner-Cartridge Recycling, Save a Bundle with (Blechman) **Mar 71**
 Touch Switch (Rakes)(CC) **Jun 76**
 Tracking Smokey Bear (Saxon)(SS) **Mar 86**
 Transistor Matching Circuit (Rakes)(CC) **Oct 82**
 Triangle Waveform Generator (Rakes)(CC) **Nov 74**
 Triangular Waveform Generator (Rakes)(CC) **May 79**
 Trip to Mecca, A (Ellis)(AR) **Feb 73**
 TTL Audio Oscillator (Yacono)(TT) **Nov 30**
 TTL Oscillator (Rakes)(CC) **Feb 80**
 TV Allowance Television Time Monitor, MindMaster (Scaduto & O'Brian)(G) **Jan 51**
 Two-Stage Receiver (Rakes)(CC) **Aug 78**

U

UJT Oscillator (Rakes)(CC) **Feb 80**
 Ultrasonic Circuits (Rakes)(CC) **Dec 72**
 Ultrasonic Receiver (Rakes)(CC) **Dec 72**
 Underground Chatter (Saxon)(SS) **Feb 86**
Uniden
 Bearcat Bear Tracker BCT-2 Scanner (Saxon)(SS) **Mar 86**
 BC-2500 Handheld Scanner (Saxon)(SS) **Dec 82**
 BC-890 Continuous Band Scanner (Saxon)(SS) **Nov 86**
 SC-150XL1 SportCat Scanner (Saxon)(SS) **Jul 88**
 Universal Noise-Reduction System, The (Panosh)(C) **Jul 31**
 Universal Remote Control, Gemstar Control Tower (Scaduto & O'Brian)(G) **Oct 69**
 Using "Binocular" Coil Forms (Carr) **Apr 67**
 Using Double Balanced Mixers (Carr)(HR) **Oct 87**

V

Va Va Va Video (Holtzman)(CB) **Nov 72**

Variable Frequency RF Oscillators (Carr)(C) **Oct 41**
VCR
 Mitsubishi HS-U57 (Feldman)(PTR) **May 24**
 Hitachi VT-S772A (Scaduto & O'Brian)(G) **Jul 52**
 VFO Oscillator (Rakes)(CC) **Mar 82**
Video
 -Distribution System, Channel Plus 9020 (Scaduto & O'Brian)(G) **Sep 60**
 Fox FoxXapper TV/Cable Remote Control (Scaduto & O'Brian)(G) **Feb 53**
 Hitachi VT-S772A S-VHS VCR with VCR PlusC (Scaduto & O'Brian)(G) **Jul 52**
 International Computers Closed Caption Decoder (Scaduto & O'Brian)(G) **Jun 58**
 JVC JX-S700 A/V Selector (Scaduto & O'Brian)(G) **Jul 56**
 Kodak Model PCD 5870 Photo CD Player (Feldman)(PTR) **Feb 20**
 Media Vision Pro Movie Spectrum Video Capture Card (Scaduto & O'Brian)(G) **Jan 56**
 MindMaster TV Allowance Television Time Monitor (Scaduto & O'Brian)(G) **Jan 51**
 Mitsubishi HS-U57 VCR (Feldman)(PTR) **May 24**
 Onkyo TX-SV717PRO A/V Receiver (Scaduto & O'Brian)(G) **Feb 48**
 Sharp ViewCam VL-E30U Camcorder with LCD Viewfinder (Scaduto & O'Brian)(G) **Apr 55**
 Sony Handycam Snap! CCD-SC4 Camcorder (Scaduto & O'Brian)(G) **Apr 56**
 Videonics MX-1 Digital Video Mixer (Scaduto & O'Brian)(G) **Oct 63**
 Video-Signal Detector (Yacono)(TT) **Dec 30**
 Videonics MX-1 Digital Video Mixer (Scaduto & O'Brian)(G) **Oct 63**
 Viennese DX (Jensen)(DX) **Feb 82**
 ViewCam Camcorder with LCD Viewfinder, Sharp VL-E30U (Scaduto & O'Brian)(G) **Apr 55**
 Virtual Reality By the Seat of Your Pants (Spiwak)(MW) **Jul 4**
 VLF Oscillator (Rakes)(CC) **Feb 80**
 Voice Organizer, Voice Powered Technology (Scaduto & O'Brian)(G) **Aug 56**
 Voltage Calibrator (Rakes)(CC) **May 79**
 Volume Meter (Yacono)(TT) **Feb 24**
 VXO Oscillator (Rakes)(CC) **Feb 80**

W

Walkman Amp (Yacono)(TT) **Dec 30**
 Want to Operate W1AW? (Carr)(DX) **Mar 86**
 Watching Multimedia (Laron)(ED) **Apr 2**
 WCES 94: Where's the Hype? (Scaduto & O'Brian)(G) **May 51**
Weather Forecasting Build A/An
 Anemometer (Simcox)(C) **Jan 37**
 Portable Barometer (Caristi)(C) **Jan 31**
 Relative-Humidity Gauge (Caristi)(C) **Jan 62**
 Wheatstone Resistance Bridge (Rakes)(CC) **Mar 82**
 Whole-House Entertainment Systems (Scaduto & O'Brian)(G) **Sep 49**
 Wien-Bridge Oscillator (Rakes)(CC) **Mar 82**
 Will Ireland Return to Shortwave? (Jensen)(DX) **Jul 84**
 Wire Antennas (Carr)(HR) **Jun 84**
 Wizard Pen-Based Organizer, Sharp OZ-9600II (Scaduto & O'Brian)(G) **Feb 51**
 Word 6.0 for Windows (Holtzman)(CB) **Jul 76**
 World-Band Radio Receiver, Sony ICF-SW100S (Scaduto & O'Brian)(G) **Nov 18**
 Wrist Controller Watch, Casio CMD-408 (Scaduto & O'Brian)(G) **Aug 53**
 Writing Pad, Inforite MP100 (Scaduto & O'Brian)(G) **Apr 60**

Y

Yamaha RX-V870 Stereo Receiver (Feldman)(PTR) **Mar 22**
 Year-Round Charger (Yacono)(TT) **Jun 24**
 You Can't Please Everyone (Laron)(ED) **Sep 2**

Z

"Z-Dice," Build the (Edwards)(C) **Dec 46**
 Z-PDA Zoomer, Tandy (Scaduto & O'Brian)(G) **Mar 59**

NOW Find the Right Part for Your VCR!



The 320-page, Fourth Edition of the VCR Cross Reference contains both model and part number cross references. Over 1300 new parts and 360 new models have been added.

Only \$36.00 for pages
 \$69.95 diskette

VCR's are made in a few factories from which hundreds of different brand names and model numbers identify cosmetically-changed identical and near-identical manufactured units. Interchangeable parts are very common. An exact replacement part may be available only a few minutes away from you even though the original brand-name supplier is out of stock. Also, you may be able to cannibalize scrap units at no cost.

Claggk Inc.
 VCR CROSS REFERENCE OFFER
 P.O. Box 4099
 Farmingdale, New York 11735

Name _____
 Business _____
 Address _____
 City _____
 State _____ Zip _____
 Phone _____

Enclosed \$36.00 for the IS CET VCR Cross Reference, Fourth Edition.
 Enclosed \$69.95 for the diskette containing the IS CET VCR Cross Reference, Fourth Edition. Please specify:
 5 1/4 Diskettes (2) 3 1/2 Diskette (1)
 Include \$3.00 for shipping each Cross Reference (Pages or Diskette)
 The total amount of my order is \$ _____
 Check enclosed—do not send cash.
 Visa MasterCard Exp. Date ___/___/___
 Signature _____
 New York State residents must add applicable local sales tax to total.

with the **IS CET VCR CROSS REFERENCE**

NEW! The Fourth Edition is contained on a diskette for IBM PC AT/XT compatibles, DOS 2.1 or higher. The disk software allows technicians to search by manufacturer for model numbers and description of part numbers. A parts editing sequence gives an on-screen view of all substitutes for parts entered. With the diskette, the technician can update files by adding model and parts

crosses of future models. The Fourth Edition can be printed on pages completely from the diskette.

The IS CET VCR Cross Reference, Fourth Edition, is on 8 1/2 x 11-in., pre-punched pages and sells for \$36.00. The 3 1/2 inch diskette sells for \$69.95 and you can view listings from a monitor or printed page.

Take control of your future with electronics training from CIE.

Learn in your own home, at your own pace.

With training from CIE, you could be working at the job you want, earning the money you deserve. CIE lets you learn electronics right in your own home, at your own speed. You can complete your CIE coursework while you're still at your current job. You can complete it as fast or as slowly as you choose. And the faster you finish, the more CIE can help you save money.

Take your place on the Information Superhighway.

CIE training or a CIE degree will qualify you to be part of one of the hottest, fastest-growing fields around — electronics. And you'll play a major role in keeping the nation's much-discussed Information Superhighway up to speed and running smoothly.

Learn from the world leader in home-study electronics.

At CIE, we teach electronics, and nothing but electronics. We're not only the biggest home-study electronics school, but also the best. And why not? We've been teaching it for 60 years. We've graduated more than 150,000 people from over 70 countries. And we're fully accredited. That's why employers and CIE graduates alike know the value of electronics training from CIE.

Concentrate on your own area of interest.

CIE gives you 12 courses and a proven degree program to choose from. CIE training qualifies you for work in broadcast engineering, communications systems, digital logic and systems training, automotive electronics, computer maintenance, microprocessor technology, and much



Learn electronics from the world leader, right in your own home.

more. In fact, CIE pioneered the very first Electronic Laboratory course and the first Microprocessor course.

Even if you're not sure what you'd like to specialize in, we can get you started on the basics. And once you've successfully completed one CIE course, you can apply academic credits and tuition credits to any new CIE courses you take. Each and every CIE course counts toward earning your degree.

A patented method of personalized instruction.

Through CIE's exclusive AUTO-PROGRAMMED® teaching method, your instructors give you prerecorded, easy-to-follow, step-by-step instructions. Some courses are geared toward beginners and some toward professionals already familiar with the electronics field.

No matter which course you take, you'll have everything you need to learn on your own at home: lesson guides, books, even lab equipment. All materials you can use at your current job or keep for your new job after you've earned your degree.

And if you ever need any help at all, just call your instructor toll-free.

What are you waiting for?

Isn't it time you joined one of the fastest-growing professions around? Isn't it time you earned a salary well above the national average? **Then now's the time to find out more about CIE.**

Contact CIE today for more information.

Call us toll-free at 1-800-243-6446, or call 216-781-9400. You may also fill out the attached postage-paid card or the coupon below and drop it in the mail, or fax it to CIE at 216-781-0331. We'll send you our FREE 40-page CIE home study course catalog with details on CIE courses and the CIE associate's degree.

Take Control Of Your Future.

Send me a FREE CIE course catalog and details on a CIE associate's degree.

(Please Print Neatly)

Name _____

Address _____

City _____

State, Zip _____

Phone () _____

Age _____



1776 East 17th Street • Cleveland, Ohio 44114
A School of Thousands. A Class of One.
Since 1934.

AH61

ANTIQUE RADIO

By Marc Ellis

Tel-Ohmike Wrap-Up

For those of you who have just joined us, we've been in the process of rehabilitating and checking out a Sprague Tel-Ohmike Model TO-4 capacitor/resistor analyzer. Units similar to that one, intended for use by radio service technicians, were marketed by the major capacitor/resistor manufacturers, including Sprague, Aerovox, and Solar. Hobbyist-grade units, often sold in kit form, were offered by such companies as Heath, Allied Radio, and Eico.

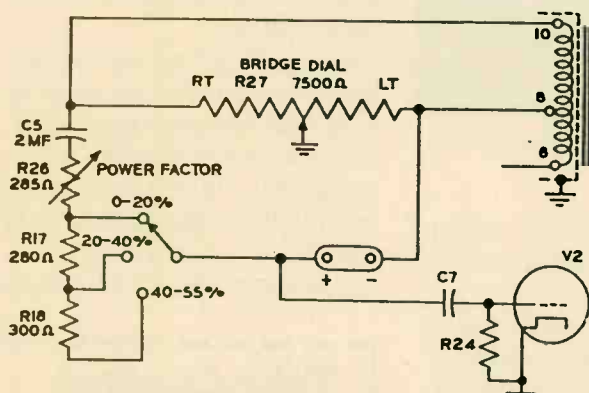


Fig. 1. This simplified schematic shows how the TO-4 is configured as a capacitance bridge on the 0.1–50- μ F range. C5 (2 μ F) is the reference capacitance for the range; V2 is the tuning-eye tube used to balance bridge.

Those analyzers are commonly available at hamfests and antique-radio meets, not too difficult to put in good working order, and make excellent additions to the antique-radio restorer's workbench. It's very handy to have the means to find the value of an unknown capacitance and to check an electrolytic or paper capacitor for leakage. Most analyzers will also measure resistance, but that's a function that I don't find too useful because it's more easily

handled by a standard analog or digital multimeter.

LET'S CONTINUE

At the close of last month's column, we had checked most of the capacitance ranges, but were still in doubt about the next-to-highest (0.1 to 50 μ F) and lowest (1 to 100 pF) ones. The former was tested with a decade capacitance box providing values from 1 to 10 μ F, and it appeared that all of the Tel-Ohmike's measurements were about 1- μ F low. The latter couldn't be tested because I didn't have any capacitors in the right size range to serve as "guinea pigs."

I began this month's work session with the thought that the reference capacitor for the 0.1–50- μ F range had probably shifted in value and that I'd have to replace it. The capacitor (2 μ F) is labeled C5 in Fig. 1, which is the schematic for the bridge circuit used in that capacitance range. (See last month's column for a detailed explanation of how bridge circuits are used to measure unknown capacitors or resistors.)

My first move was to re-measure each of the capacitances offered by the 1–10- μ F decade box to verify that the TO-4 was as far off as I had thought. To my surprise, the measured values were now much closer to the nominal ones, with the percentage error quite consistent with that observed on the other ranges. The only explanation I can offer is that I was getting a bit tired at the close of last month's session

and may not have been careful enough in setting up and reading the instrument. It does take a bit of getting used to.

THE LOWEST RANGE

Being a firm believer in the "if it ain't broke, don't fix it" philosophy, I immediately abandoned my plans to yank out and replace the 2- μ F reference capacitor for the range in question. That meant I could move right along to the next piece of unfinished business, checking out the TO-4's lowest (1–100-pF) capacitance range.

In preparation for doing this month's column, I had stopped at the local Radio Shack store to pick up some 4.7-, 47-, and 100-pF ceramic capacitors. Those would allow me to check out both ends and the middle of the range. I found that the tuning-eye shadow wasn't as distinct on this range, but after learning how to interpret it, I was able to get satisfactory—and repeatable—results when measuring the 47- and 100-pF capacitors.

The measurement at 4.7 pF was a different story, however. The shadow was really vague here and difficult to read the same way each time. If I had to guess, though, I'd say that the TO-4 measured this capacitance as somewhere around 10 pF. Luckily, one isn't often faced with the necessity of checking such a low value!

CHECKING LEAKAGE IN ELECTROLYTICS

A very valuable feature of the TO-4 is its ability to check the leakage current

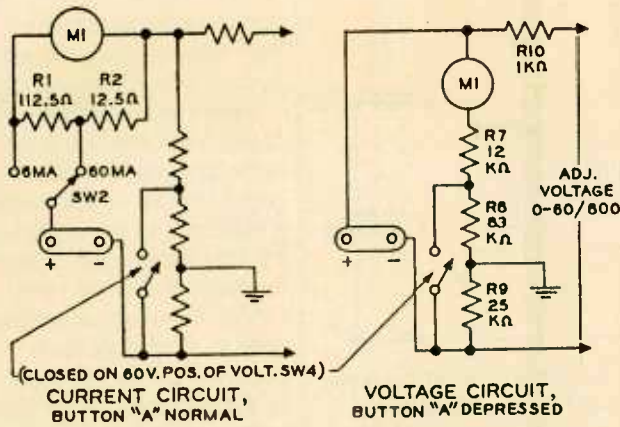


Fig. 2. Here are circuits for measuring the leakage current of electrolytic capacitors. The configuration depends on the position of button "A" (see text).

in electrolytic capacitors at actual working voltages up to 600 volts. The circuitry that accomplishes that is shown in Fig. 2. It could be configured as at left or as at right, depending on the position of front-panel button "A."

The terminals labeled "+" and "-" are the binding posts for the capacitor under test. The two circuit points terminated in arrows are connected to the adjustable voltage output of the 1619 grid-controlled rectifier tube. M1 is the front-panel meter.

When button "A" is depressed, M1, with its associated series resistors, becomes a 0-600 volt-meter connected across the capacitor-test binding posts (in the right-hand version of circuit). Using the voltmeter, the operator can set the voltage delivered by the rectifier to match the working voltage of the capacitor under test. When closed, the switch just to the right of the capacitor-test binding posts shorts out resistors R8 and R9, converting M1 to read 0-60 volts.

After setting the voltage appropriately, button "A" is released, changing the circuit to the one shown at left. The resistors formerly connected in series with M1 still remain across the volt-

age source, loading it down as before so that the supply voltage does not change. However, the M1, paralleled by shunt resistors R1 and R2, is now connected as a milliammeter in series with the capacitor-test binding posts and the voltage source.

Connected that way, M1 reads any leakage current that might pass through the capacitor being tested. By switching R1 in or out of the meter shunt, switch SW2 sets M1 to read 0-6 mA or 0-60 mA—accommodating a wide range of currents.

I checked several electrolytics from my "junk box" using that function, and found that the results were within the tolerances suggested in the TO-4's manual. As expected, capacitors that were very old exhibited much higher leakage than newer ones. In such cases, the operator is advised to reduce the voltage to a lower amount, then to advance it slowly to the nominal working voltage, giving the capacitor a chance to "reform."

If the capacitor is still in good shape, the leakage current will then be reduced to an acceptable value. Such was the case with the high-leakage capacitors that I happened to test.

Earn Your B.S. Degree in COMPUTERS or ELECTRONICS



By Studying at Home

Grantham College of Engineering, now in our 44th 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

CHECKING INSULATION RESISTANCE

While the TO-4 checks electrolytic capacitors for leakage by direct measurement of the current flowing through them at working voltage, typical current flow through paper, mica, and ceramic capacitors is so small that leakage must be tested by more indirect means. The test circuit for that purpose is shown in Fig. 3.

As before, M1 is the front-panel meter, the terminals labeled "+" and "-" are the capacitor-test binding posts, and the circuit points terminated in arrows are connected to the adjustable voltage output of the 1619 grid-controlled rectifier tube.

Tube V1 is a 12J5 triode connected as a simple amplifier. Meter M1 measures V1's plate current, which, at the start of the leakage test, is set to a standard value through adjustment of the voltage supplied by the 1619. That is accomplished by adjusting the voltage (with nothing connected across the test binding posts) so that M1's pointer falls on a "set" mark located at the meter's full-scale position.

The capacitor to be tested is now connected across the binding posts. Even the most minute leakage through the capacitor will increase the negative bias on V1, thereby decreasing the tube's plate current and dropping the meter pointer from its full-scale position. The greater the drop, the greater the leakage through the capacitor (and the lower its insulation resistance). A scale is provided on the meter (calibrated from 150–20,000 megohms) so that the insulation resistance of the capacitor can be read directly.

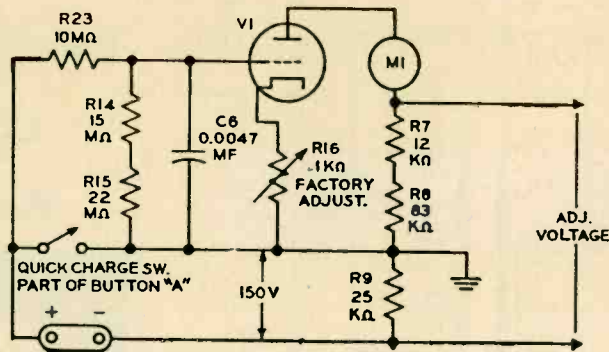


Fig. 3. The circuit for measuring insulation resistance of paper, mica, and ceramic capacitors uses a 12J5 triode amplifier.

Potentiometer R16, wired in series with V1's cathode, is a factory-adjusted calibration control located inside the instrument. The single-pole switch located above the capacitor-test binding posts, however, is a user-operated "quick charge" button located on the front panel.

The quick charge button is necessary because a stable insulation resistance reading can't be obtained on a capacitor until it is fully charged. Capacitors larger than 0.1 μ F or so would take too long to reach that state, if the "quick charge" button were not held down for a few seconds. The button temporarily shorts out several series resistances, allowing 150 volts to appear across the capacitor under test.

I tested the insulation-resistance measuring function on several paper, mica, and ceramic capacitors and obtained readings consistent with the guidelines published in the manual. However, I don't consider it as useful to the restorer as the electrolytic capacitor leakage check.

In general, the non-electrolytic capacitors encountered during a restoration will be paper or mica. Mica capacitors almost never give trouble and don't have to be checked. The early wax-coated paper capacitors,

however, are subject to deterioration because moisture and other contaminants in the atmosphere can penetrate their less-than-perfect seals.

Most restorers wouldn't bother to check the wax jobs. They are considered so unreliable that they are automatically replaced, even if they are good, with modern molded capacitors. Molded capacitors are well-sealed and rarely give trouble, even if stored for long periods of time prior to their use.

POWER FACTOR

A capacitor that is leaky can be imagined as having a resistor equal in value to the leakage resistance wired in parallel with it. Another capacitor quality problem can be represented by a capacitor having a *series* resistance. Such a resistance could be caused by poor internal connections, or by capacitor "plates" (or electrodes) that are not perfect electrical conductors.

In the case of electrolytic capacitors, series resistance can be appreciable because one of the "plates" is actually the paste film separating the two metallic surfaces that make up the capacitor. Not only does the paste have a much higher resistance than a metallic conductor, but it tends to dry out over time—

and through exposure to high temperatures—thereby increasing its resistance.

The series-resistance type of loss is not important for capacitors used in DC circuits because, unless there is leakage, no current flows through those capacitors to be dissipated in the resistance. However, capacitors used in AC circuits (or in pulsating DC circuits such as power supply filters) do pass current during charge/discharge cycles and can have such losses.

A perfect capacitor would use no power, even in AC circuits, because during a discharge cycle, it would give back to the circuit as much power as it had absorbed during the charge cycle. The extent to which a capacitor is *imperfect*—that is, the extent to which it uses power through the combined effects of leakage and series resistance—is represented by the *power factor*, which is a number representing the percentage of power loss. The power factor must be measured at the frequency at which the capacitor will actually be used.

Because electrolytic capacitors are especially subject to losses through aging and exposure to heat, and are most frequently used in pulsating DC circuits as power supply filters, any quality test conducted on electrolytics should include a power factor check. In the TO-4, power factor (at the AC line frequency) is measured through adjustment of power-factor control R26 (see Fig. 1), as the bridge is balanced to determine the capacity of an electrolytic capacitor. The power factor, typically between 10 and 60, is read directly from a scale associated with the control.

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 Electronics 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 PCB's...\$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 modern 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 Electromagnetic 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!

COMPUTER BITS

By Jeff Holtzman

Buy or Upgrade?

Should you buy a new machine or upgrade your current one? During the past year and a half or so, I have gone through the upgrade process. That process had its pluses and minuses. Although I certainly ended up with something that was better than what I started with, by the time I was finished, I spent about as much on upgrading as I would have on a new machine. Further,

in ZIF socket, the ability to hold up to 64 MB of memory, two VESA local-bus (VLB) slots, power management, and an Award BIOS.

Don't get me wrong; there was nothing wrong with my old 486 motherboard—a 486/25 for which I paid around \$2200 a couple of years ago. Does it pain me that I got a new, better, faster board for 1/5th of what I originally paid? A little. But that's always the way it is in the computer business.

Of course, I could have just upgraded the video system (once seemingly speedy, it now seemed about as fast as fresh molasses in the Yukon), replaced the eight 1-MB SIMM's with four 4-MB jobs, wait another year, then buy some sort of Pentium screamer. But I just couldn't wait.

For one, I figured that by buying a new motherboard, I could pass the old one on to my kids, whose old Dell 386 was simply unable to keep up with the demands of multimedia Windows computing. From that point of view, I wasn't just selfishly upgrading my own computer; this was a family-wide upgrade as well! Of course, the \$139 board then tripled in price because I had to pick up a new CPU as well. Not to mention the 16-MB SIMM for the new board, which set me back another \$700.

After picking up the new motherboard, I backed up all the files on my present system to a Colorado 250-MB tape drive. Luckily, I made two full backups, because it turned out that there were some bad files

in the middle of the first.

Then I swapped in the new motherboard (complete with the new, faster CPU and a single SIMM holding 16 MB), and, holding my breath, turned on power. My heart was literally pounding as I thought, "This cheap clone board is going to fry my whole system." But it didn't. In fact, the system came up the first time with absolutely no trouble, and has worked just fine since.

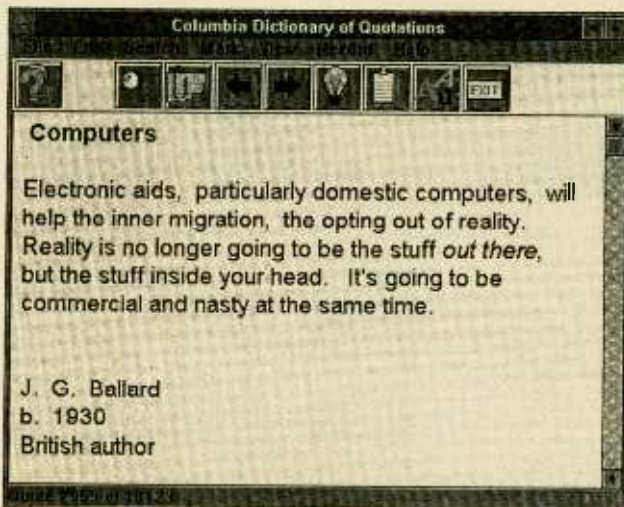
It seemed a little faster, but not nearly what I had hoped, so it was back to the drawing board. As for the kids' computer, after swapping in the old 486 board, it was a heck of a lot faster—just perfect for using CD-ROM-based learning tools such as the new *Columbia Dictionary of Quotations*.

DISK UPGRADES

I next attacked the disk subsystem. My old SCSI adapter was an 8-bit affair made by Always Technology. It had served me well, but part of my system upgrade involved using a copy of Corel SCSI to control a CD-ROM drive off the same controller as the hard disks.

That was the dark part of my adventure. The set up basically worked, but had a very nasty habit of just stopping dead in its tracks in a totally unpredictable fashion. For a while I just ignored the problem. Eventually I realized it was not going to go away, so I started doing some troubleshooting. It wasn't too hard to track down the source of the problem.

If I didn't load the man-



The *Columbia Dictionary of Quotations*, though not CD-based, provides a more varied set of quotations than is typical of most CD products.

while I got the exact components I wanted, I had to assume the responsibility for making it work together. Was it worth it? To me, yes. But I wouldn't recommend it for everyone. To help you make up your own mind, here's the logic I followed:

One of the first things that attracted me to the idea of upgrading was the emergence of super low-cost 486 motherboards. I ended up paying \$139 for a board with: 256K of cache memory, the ability to install 11 different types of 486 and 486-clone chips via a built-

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.

7AE50

ufacturer-supplied CD-ROM device driver, everything worked fine. I tried upgrading the drivers, several times in fact, but to no avail. Eventually I learned that the Always drivers disable software interrupts for a short time, and that could cause Windows to crash.

The solution was to upgrade the SCSI adapter, and my contacts indicated that Adaptec cards were the standard for reliability and compatibility. The next question was whether to buy a 16-bit (ISA) or a 32-bit (VLB) card. The 16-bit card cost around \$200, and the 32-bit card around \$400. I ended up springing for the VLB card (an Adaptec 2840). The good news was that using the Adaptec card and drivers, I no longer needed the Corel drivers; in addition, the random crashes unequivocally stopped. The bad news was that there was no discernible speed increase.

Later I found out that although the card conformed to the SCSI-II standard, the three hard drives I had were all of SCSI-I vintage, including one I

bought just a few months earlier. To get the speed increase promised by the 32-bit VLB bus, I would need to get SCSI-II drives. That has yet to happen. However, my local clone shop is currently selling brand new 2.4-gig SCSI-II Micropolis drives for about \$1100, complete with a five-year factory warranty. I've got one of those targeted for later in 1995.

At that point in my upgrade binge, I had noticeably better Windows performance (due to the faster CPU and double the memory), and a reliable system. But I still lacked the speed increase that was the object of the whole exercise. Next time we'll pick up where this leaves off, and I'll point out a way of drastically increasing system performance for a more modest investment than I made. See you then. ■

Where To Get It

The Columbia Dictionary of Quotations
 AApeX Software
 P.O. Box 13379
 Reno, NV 89507
 Tel. 702-324-4580

THINK TANK

(Continued from page 29)

ters, R6 and R7. The threshold voltage is supplied through R5, which is connected to a voltage divider made up of R4 (a temperature-adjust potentiometer), R3 (a series resistor to set the range), and R1 (a negative-temperature-coefficient thermistor).

Let's assume R6 and R7 are set so that the voltage

That removes current from the SCR and the relay turns off. Now the thermistor begins to cool to the point where U1-b turns on. As cooling continues, U1-a turns on and the output circuit is complete, closing the relay.

To calibrate the circuit, I used a 60-watt light bulb connected to the relay. It was a simple procedure to use the heat from the bulb and a digital thermometer to set the trip points of the

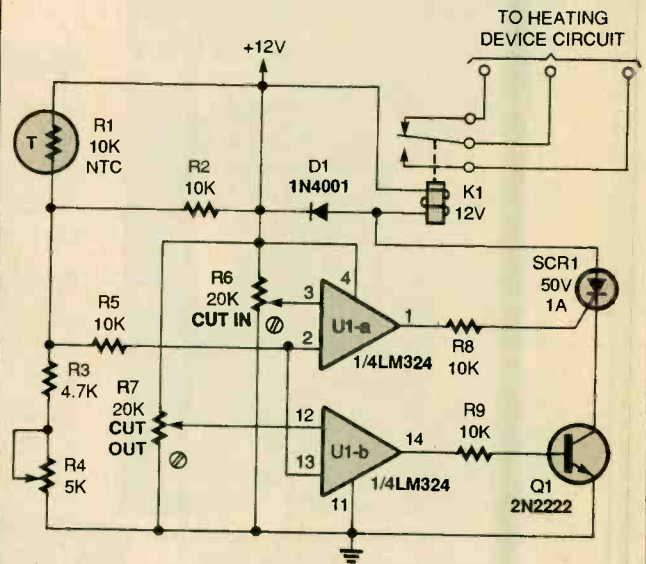


Fig. 3. Since the SCR latches once it is turned on, and will not activate without Q1 on, this circuit has built-in hysteresis.

at pin 3 of U1 is lower than that at pin 12. As the temperature drops, the resistance of R1 increases and the voltage at the inverting inputs (pins 2 and 13) decreases. When the temperature is low enough, both comparators are saturated, so Q1, SCR1, and the relay (K1) are activated.

As the temperature rises, the voltage at pin 2 increases. When the voltage at pin 2 is greater than that at pin 3, the gate current to the SCR is removed. However, the SCR will continue to conduct until its anode-to-cathode current is interrupted. As the temperature continues to rise, U1-b turns off, thereby turning off Q1.

comparators. The differential is determined by the difference in the trip-point voltages. Setting the voltage at pin 3 100-millivolts higher than that at pin 13 produced a differential of about 3 degrees. Resistor R2 is used to help straighten out the very non-linear response of the thermistor. If the input comparator inputs are transposed, the circuit can be used to control a cooling device.

—Bob MacIsaac, Nova Scotia, Canada

As with our other circuits, select K1 to handle the load you have in mind. By the way, you should set R4 according to the cut-in temperature you want. ■

There is a good time to call the IRS.

The best time to call 1-800-TAX-1040 is between 8 and 10 a.m., or after 2:30 p.m. on Wednesday, Thursday or Friday. It's just one more way we're giving you helpful advice.



Internal Revenue Service
 Answers. Assistance. At Your Service.



CIRCUIT CIRCUS

By Charles D. Rakes

More Ultrasonic Circuits

Circuiters, gather around the old work bench and join me in celebrating our 100th get-together here at the Circus. We certainly have shared a number of circuits since our first meeting back in August of 1986, and it's my hope to do even better as we speed toward the next century. But to do so, I need your help. Let me know, through your letters to me via **Popular Electronics**, what circuits you would like to see appear, and any ideas that you would like to share in making our visits more useful, educational,

ULTRASONIC TRANSMITTER

Our first entry takes to the air waves in the form of a CW (Morse code) transceiver. The circuit, see Fig. 1, uses the versatile, 567 phase-locked-loop IC as the transmitter's signal-source generator as well as the receiver's detector. The 567's dual circuit functions allow for a much simpler transceiver design.

Here's a close look at the CW transceiver's receiver operation. With the telegraph key at S2 "up" (open), the 567 PLL's input at pin 3 is coupled to the

and a 680-ohm isolation resistor.

In the receive mode, the piezo speaker operates as a sensitive microphone. Ultrasonic signals travel from the microphone through the two-stage amplifier to the input of the 567, and, if the signal's frequency is within the IC's bandwidth, the LED will light and piezo-sounder BZ1 will sing out for each "dit" and "dah" received. The receiver may be tuned to the incoming ultrasonic signal by adjusting R17. Of course, adjusting that potentiometer also changes the transmitter's frequency.

In receive, transistor Q2 is biased on through R3 and R4, with its collector clamping the 567's square-wave output, at the junction of R12 and R18, to ground. No signal can pass to the base of Q1 in the receive mode. The collectors of Q5 and Q6 are like open circuits in the receive mode and do not load the speaker's (microphone's) output.

The transmitter operates each time the S2 is closed. When the key is closed, diode D3 supplies a path to ground for BZ1, causing that sounder to produce an audible signal for each dit and dah transmitted. Also, Q2's bias is taken to ground through D2, allowing Q1 to pass the 567's square-wave signal on to the input of the power amplifier and out through the speaker.

You will need to build two transceivers to carry on a CW "rag chew" with a friend. The transceivers will operate inside or out, but the range can be affected by the wind, as well as

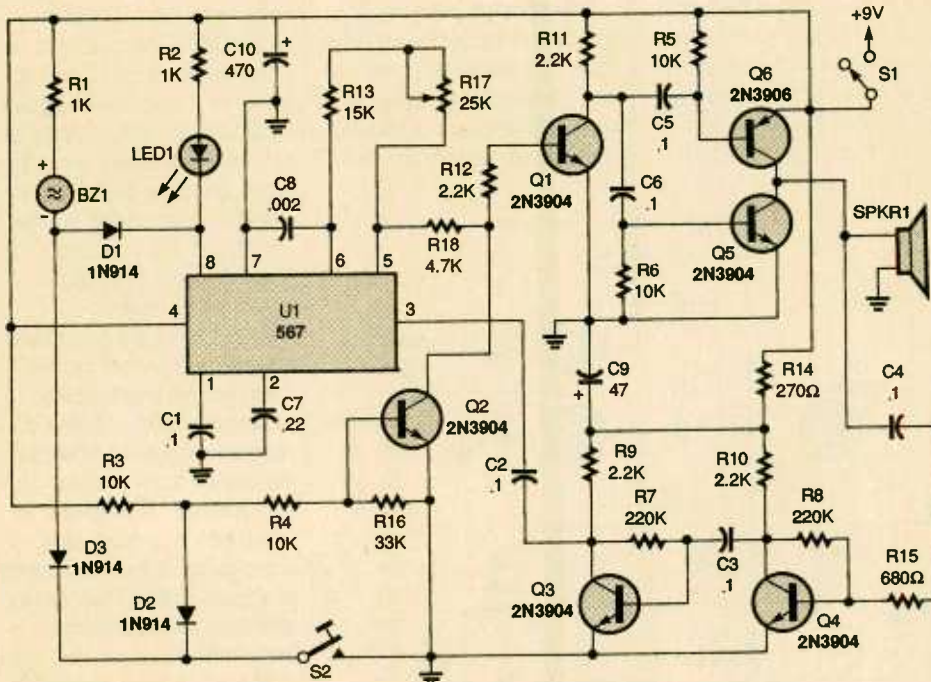


Fig. 1. Get on the "air" with this ultrasonic CW receiver. For the greatest flexibility, its receive and output frequency can be adjusted via R17.

and just plain fun. If you would like a personal reply, please enclose a self-addressed, stamped envelope. Now let's carry on where we left off last month with more ultrasonic circuits.

output of Q3. Transistors Q3 and Q4 are operating in a high-gain, two-stage audio-amplifier circuit. The piezo speaker is coupled to the input of the amplifier through a 0.1- μ F capacitor

PARTS LIST FOR THE ULTRASONIC TRANSCEIVER (Fig. 1)

SEMICONDUCTORS

U1—567 phase-locked loop, integrated circuit
 D1—D3—1N914 silicon diode
 LED1—Light-emitting diode, any color
 Q1—Q5—2N3904 NPN transistor
 Q6—2N3906 PNP transistor

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)

R1—R2—1000-ohm
 R3—R6—10,000-ohm
 R7, R8—220,000-ohm
 R9—R12—2,200-ohm
 R13—15,000-ohm
 R14—270-ohm
 R15—680-ohm
 R16—33,000-ohm

R17—25,000-ohm, potentiometer
 R18—4,700-ohm

CAPACITORS

C1—C6—0.1- μ F, ceramic disk
 C7—0.22- μ F, Mylar or similar
 C8—0.002- μ F, Mylar or similar
 C9—47- μ F, 16-WVDC, electrolytic
 C10—470- μ F, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

SPKR1—Piezo-tweeter speaker
 BZ1—Piezo buzzer
 S1—SPST switch
 S2—Telegraph key
 Wire, solder, IC sockets, etc.

heating or air-conditioning air currents. You can transmit around corners by bouncing the ultrasonic signal off walls, doors, or anything solid. If you wish, you can experiment by changing the circuit's frequency to obtain the greatest operating distance and reliability. You can even tune the CW transceiver to a high (audible) frequency.

MOTION DETECTOR

Our next entry is a motion detector circuit. The circuitry, shown in Fig. 2, is in some ways similar to our previous circuit. A 567 PLL IC operates in a dual-function mode as a signal generator and an FM receiver. Here, however, both functions are performed simultaneously. Here's how that is done:

The 567's square-wave

output at pin 5 is coupled to the base of Q1, and from Q1's emitter to the input of the power amplifier made up of Q2 and Q6. The output drives the piezo speaker, SPKR1.

The receive portion of the circuit operates as follows: Transistors Q3 and Q4 are connected in a two-stage, high-gain, audio-frequency amplifier circuit,

with the input connected to a second piezo speaker (SPKR2) operating as a sensitive microphone. The amplifier's output is coupled to the 567's input at pin 3. When an in-band signal is received, the LED lights.

The 567's FM output is coupled from pin 2 to the input of a very-low-frequency single-transistor amplifier, Q5. The amplifier's output at Q5's collector drives a voltage-doubler circuit made up of C11, D1, D2, and C12. The DC output feeds a 0–1-mA analog meter.

By placing the two piezo speakers one foot apart and aiming them in the same direction, toward a non-moving solid object, the signal from the transmitter's speaker will reflect back into the receiver's speaker, and the frequency at the 567's input will be the same as the one being transmitted.

The AC output at pin 2 is zero when the outgoing and incoming frequencies are the same. However, when the signal is reflected from a moving object, the received frequency will be either lower or higher than the transmitted one. If the object is moving away from the speakers, the received

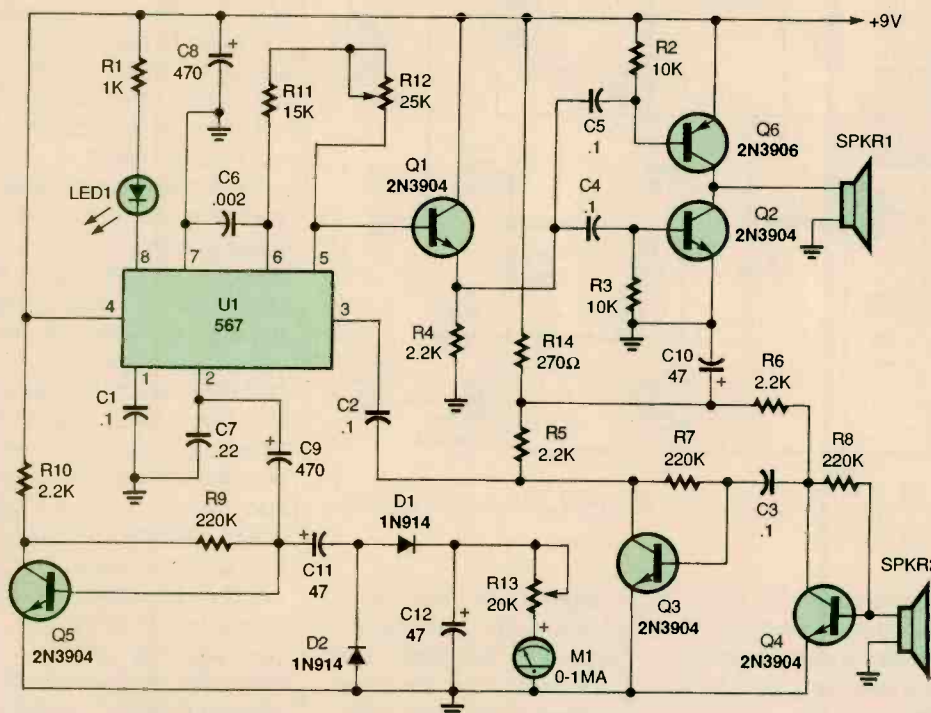


Fig. 2. In this ultrasonic motion detector, if an object moves in front of the speakers, a signal is produced at pin 2 of the 567 PLL.

frequency will be lower; if the object is moving toward the speakers, the frequency will be higher. That is due to the Doppler effect.

Regardless of the direction of the movement, the difference in the received and transmitted signal will cause a low, audio-frequency difference output to appear at pin 2. That pin-2 signal is fed through a 470- μ F capacitor to the base of Q5, where the signal is amplified and fed to a voltage doubler, and

PROXIMITY SENSOR

Our last entry this visit is an audible proximity circuit that can be used as a liquid-level detector, a proximity-operated switch, or as a sensor for robotics projects.

The circuit is shown in Fig. 3. The pick-up sensor, BZ1, is a Mallory Sonalert solid-state signaling device that is normally used as a low-level alarm sounder. But in our circuit it is used as a variable-“Q” load-sensitive oscillator.

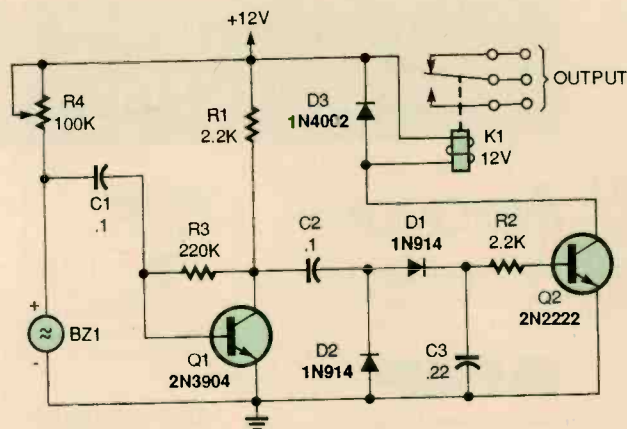


Fig. 3. This proximity sensor uses a common piezo sounder, a Mallory Sonalert, in a rather unusual way.

PARTS LIST FOR THE MOTION DETECTOR (Fig. 2)

SEMICONDUCTORS

U1—567 phase-locked loop, integrated circuit
D1, D2—1N914 silicon diode
LED1—Light-emitting diode, any color.
Q1—Q5—2N3904 NPN transistor
Q6—2N3906 PNP transistor

RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)
R1—1,000-ohm
R2, R3—10,000-ohm
R4—R6, R10—2,200-ohm
R7—R9—220,000-ohm
R11—15,000-ohm
R12—25,000-ohm, potentiometer
R13—20,000-ohm, potentiometer
R14—270-ohm

CAPACITORS

C1—C5—0.1- μ F, ceramic disk
C6—0.002- μ F, Mylar or similar
C7—0.22- μ F, Mylar or similar
C8, C9—470- μ F, 16-WVDC, electrolytic
C10—C12—47- μ F, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

M1—0—1-mA meter
SPKR1, SPKR2—piezo-tweeter speakers
Wire, solder, IC sockets, power source, etc.

then on to a meter circuit.

If you wish, the voltage-doubler and meter can be removed and replaced with headphones connected between the negative side of C11 and circuit ground. That will allow you to listen to the difference-frequency signal as objects move in front of the speakers.

Here's how the simple alarm sounder is turned into a useful proximity sensor. A 100K potentiometer, R4, sets the current fed to the Sonalert sounder. The potentiometer is adjusted to a point where the sounder just begins to make an audible sound. A single-transistor audio amplifier (Q1) is coupled to the

PARTS LIST FOR THE PROXIMITY SENSOR (Fig. 3)

SEMICONDUCTORS

Q1—2N3904 NPN transistor
Q2—2N2222 NPN transistor
D1, D2—1N914 silicon diode
D3—1N4002 silicon diode

RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)
R1, R2—2,200-ohm
R3—220,000-ohm
R4—100,000-ohm, potentiometer

CAPACITORS

C1, C2—0.1- μ F, ceramic disk
C3—0.22- μ F, Mylar or similar

ADDITIONAL PARTS AND MATERIALS

K1—12-volt relay
BZ1—Mallory Sonalert sounder, model SC628
Wire, solder, power source, etc.

positive side of the sounder and its output is fed to a voltage-doubler circuit. The doubler's DC output drives the base of Q2, which, in turn, operates the relay (K1). As long as the Sonalert is producing a sound, the relay stays energized.

When a solid object is moved in close proximity to the front of the sounder, the “Q” of the piezo element is lowered and the Sonalert's internal oscillator circuit ceases to operate; as a result, the relay drops out. By carefully adjusting R4, the circuit can be made quite sensitive. The proximity sensor is a fun circuit to play with, so why don't you give

it a try and see what unusual application you can find for it.

Looks like we've just about used up our allotted space for this month. Before we finish, however, I want to correct an error in one of the circuits that appeared in October, 1994. In Fig. 7 that month, resistors R2 and R3 are reversed. A few sharp-eyed readers wrote in to tell me about that one. I hope it didn't cause anyone too much confusion.

Until next time, you can send your letters to me at Circuit Circus, *Popular Electronics* Magazine, 500-B Bi-County Blvd., Farmingdale, NY 11735.

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.

CII Midtex
Relays and Solenoids

COOPER

Bussmann
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

DI 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

Popular Electronics
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, SonalertsR 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

Philips Electronics North America Corporation
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

A Raytheon Company
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

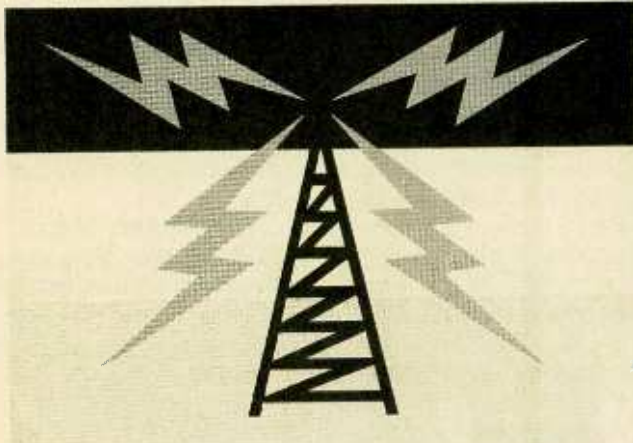
Electronic Industries Association/Components Group
2001 Pennsylvania Avenue, N.W., 11th Floor
Washington, D.C. 20006
Phone: (202) 457-4930
Fax: (202) 457-4985

Committed to the competitiveness of the American electronics producer.

DX LISTENING

By Don Jensen

Helping Beginners



Though most clandestine SW stations are quite secretive, some have replied to SWL's reports. In past years, this QSL card was sent out by Radio Vatan, a clandestine that targeted its anti-regime political broadcasts at Iran.

Sometimes it is hard to remember that not everyone who reads this column is an experienced shortwave listener. In fact, the ranks of this wonderful hobby are swelling all the time with newcomers. Well, because this is the first column for 1995, I'd like to make all the newcomers a promise: During the coming year, I'll try to include in each column at least some basic information about SWL'ing that may help you.

Probably the best way to do that is to respond to your questions about shortwave listening. You can send them to me, Don Jensen, at DX Listening, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. I look forward to hearing from you!

In the meantime, I've got a few questions on hand to start the ball rolling. So, let's not waste any more time and get right to them.

A MATTER OF TIME

Here is a basic question about a subject that con-

fuses a lot of new listeners: "Can you explain the international time used by shortwave listeners?" asks Leif Anderson, Mankato, MN.

Sure, Leif. In this column you regularly will see time information given like this: 0215 UTC, or 2130 UTC. There are two things you need to know to use that information.

The first is the 24-hour (sometimes referred to as the "military") time system. To prevent confusion between a.m. and p.m., the hours from 1 a.m. to 11 a.m. are designated 0100 to 1100 hours. Those from 1 p.m. to 11 p.m. are designated as 1300 to 2300 hours. Noon is 1200 hours. Midnight is 2400 hours, but one minute past midnight is 0001 hours. Therefore, 0215 is 2:15 a.m., and 2130 means 9:30 p.m.

The second thing to know is that UTC stands for Universal Coordinated Time (the old term for that was Greenwich Mean Time, or GMT, and ex-GI's will know it as Z or Zulu time). Because the stations we listen to on shortwave are located all over the globe, and the listeners to which they broadcast are likewise widely scattered, it is useful to give all time references in a single standard time, the hour at the 0-degree, or Greenwich meridian. That is UTC.

Listeners in North America should know that UTC is equivalent to Eastern Standard Time plus 5 hours, Central Standard Time plus 6 hours, Mountain Standard Time plus 7 hours, and Pacific Standard Time plus 8 hours. During daylight sav-

ings time, the differences are EDT + 4, CDT + 5, MDT + 6, and PDT + 7 hours. So, in our example above, 0215 UTC means 2:15 a.m. at the 0-degree (Greenwich) meridian, which is equivalent to 9:15 p.m. EST (9:15 EST plus 5 hours = 0215 UTC).

The only other factor to remember is that when the UTC hour passes midnight, the day/date moves ahead. So 9:15 p.m. EST Monday is equal to 0215 UTC Tuesday. If a station's schedule says that a certain program is aired at 0215 UTC on Tuesdays, you should tune in at 9:15 p.m. Mondays, if you live in the eastern time zone. If you live in the CST, MST, or PST zones, of course, your local listening times would be 8:15 p.m., 7:15 p.m., or 6:15 p.m., respectively.

Though their local clocks will read differently, SWL's in New York, Chicago, Denver, and San Francisco will all be tuned in to the program at the very same time, 0215 UTC. I hope that straightens things out for you.

LISTENERS' CLUBS

Next, we hear from Willie Martin, Lancaster, CA who is both a newcomer and an old timer. He writes: "I was an active shortwave listener in the mid 1960's and early 1970's, but military service overseas caused an interruption of more than 20 years.

"Now I have retired from the Air Force and would like to resume SWL'ing. I've been reading **Popular Electronics** and I saw a reference in your column to the Southern California Area DX'ers and the Ameri-

can Shortwave Listeners' Club. I'd like to know the addresses of those clubs so I can contact them."

Welcome back, Willie! SCADS, a hobby radio club whose membership is limited to southern California listeners, can be contacted by writing to 6398 Pheasant Drive, Buena Park, CA 90620. The address of ASWLC, which accepts members from anywhere in the world, is 161 Ballad Lane, Huntington Beach, CA 92649.

Those two are among 16 organizations affiliated with the Association of North American Radio Clubs (ANARC). Various clubs cover the different aspects of the listening hobby, including shortwave, medium wave and longwave bands; FM and TV DX signals; and

scanner monitoring.

For a list of all 16, with their addresses, membership fees and other pertinent information, send a stamped, self-addressed business-size envelope to ANARC Club List, Association of North American Radio Clubs, Dept. PE, 2216 Burkey Drive, Wyomissing, PA 19610.

CLANDESTINE BROADCASTERS

Next, Luis Garcia, San Antonio, TX, writes, "Last month, a Margaret Lewin asked about clandestine broadcasters. I've never heard one of them. Are there any of those guerrilla stations operating in Central or South America? Where can I hear them?"

How about an anti-government Guatemalan

clandestine shortwave voice, Luis? Canadian DX'er, Robert Ross reports that *Voz Popular* operates in Spanish on 7,000 kHz on Tuesdays and Fridays from 2300 to 0045 UTC, and on 3,500 kHz from 0200 to 0300 UTC.

Ross has spoken with one of the station's representatives in Canada who says that *Voz Popular* operates a 2,000-watt transmitter from a secret site within Guatemala, in the jungles of the Sierra Madres near the Tajulmulco volcano.

VOA AUDIENCE PROFILE

Approximately 92-million adults regularly listen to the *Voice of America's* short-wave and medium-wave programs, the U.S.-government-sponsored broadcaster reported last year. That breaks down to some 25-million listeners in South Asia and the Near East; 21-million in Europe and the former Soviet Union; 20-million in Africa; 19-million in China; 6-million in Latin America; and 1-million in East Asia (other than China) and the Pacific. About 20 percent of those listeners tune in to English programming—the rest to VOA's various language services.

Research, the VOA says, indicates that the American international broadcaster attracts an audience that is generally young, male, and well-educated, though that does vary in different parts of the world.

DOWN THE DIAL

What's an SWL to do? Well, try tuning in to some

*CREDITS: Brian Alexander, PA; Jim Lane, ONT CAN; William Mayer, PA; William McGuire, MD; Ed Rausch, NJ; Doug Robertson, CA; North American SW Association, 45 Wildflower Road, Levittown, PA 19057

of these stations, which others have been hearing recently.

CROATIA—5,920 kHz. *Croatian Radio* is noted at 0600 UTC with Croatian music followed at 0605 UTC with English news.

CYPRUS—6,195 kHz. The BBC English language programming heard on this frequency at 0220 UTC reportedly is broadcast from relay transmitters on this Mediterranean Island.

FRANCE—9,805 kHz. *Radio France International* airs English programming at 1220 UTC on this frequency and also, in parallel, on 15,530 kHz.

JAPAN—3,925 kHz. *Radio Tanpa* is a home-service broadcast in Japanese. It has been logged on the west coast of North America with jazz music and identification announcements around 1015 to 1030 UTC.

NEW ZEALAND—6,100 kHz. *Radio New Zealand International* signs on at 0735 UTC, relaying the domestic radio-service programming.

TURKEY—9,445 kHz. *The Voice of Turkey's* English transmission from 2200 to 2250 UTC features news, commentary, historical features, and Turkish music. You can find it on 11,710 kHz at the same time.

UKRAINE—11,950 kHz. *Radio Ukraine International* is heard in a one hour English transmission beginning at 2100 UTC. That includes news and commentary, as well as Ukrainian folk music. ■

NEXT MONTH

In the February, 1995

Popular Electronics®

Build your very own FCC Part 15 FM-stereo transmitter and become a sports announcer, DJ or soap actor in your home or at school.

You can troubleshoot your personal computer, and get it up and running like the pros do. Big buck savings here!

The Editors reveal what the automotive industry's upcoming technology can do to avoid accidents while you are at the wheel.

Our home-brew, low-cost frequency counter is small in size and super accurate. Our plans are goof-proof!

PLUS outstanding columns and departments like Gizmo, Think Tank, DX Listening, Scanner Scene, Computer Bits, Circuit Circus, Multimedia Watch and a whole lot more!

On Sale
December 15, 1994

Pick up *Popular Electronics* at your favorite
Newsstand, Bookstore, Convenience Store
or Supermarket



"Jack, I think there are still a few bugs in this automotive navigation system."

HAM RADIO

By Joseph J. Carr, K4IPV

A Step Attenuator Project

An attenuator is a device or circuit that reduces a signal level by a specified amount. The attenuation factor is usually expressed in terms of decibels (dB). For RF circuits, an attenuator's input and/or output impedance is 50 ohms. That is, a circuit looking into either the input side or the output side of an attenuator would see a 50-ohm resistive load (by the way, most attenuator circuits are bilateral, *i.e.* either port could be used as either an input or an output).

be to prevent overdriving some circuit or device. Another reason is to make comparison measurements. A number of receiver measurements require comparing two signal levels, or the levels of two or more signals, for a standard output level.

Yet another use for fixed attenuators is to "swamp" the inputs and outputs of circuits. Some circuits, such as LC filters, double-balanced mixers, and others, don't work as intended when faced with input or

output circuit.

A main use for an attenuator, and one of my own principal interests, is in the front-end of radio re-

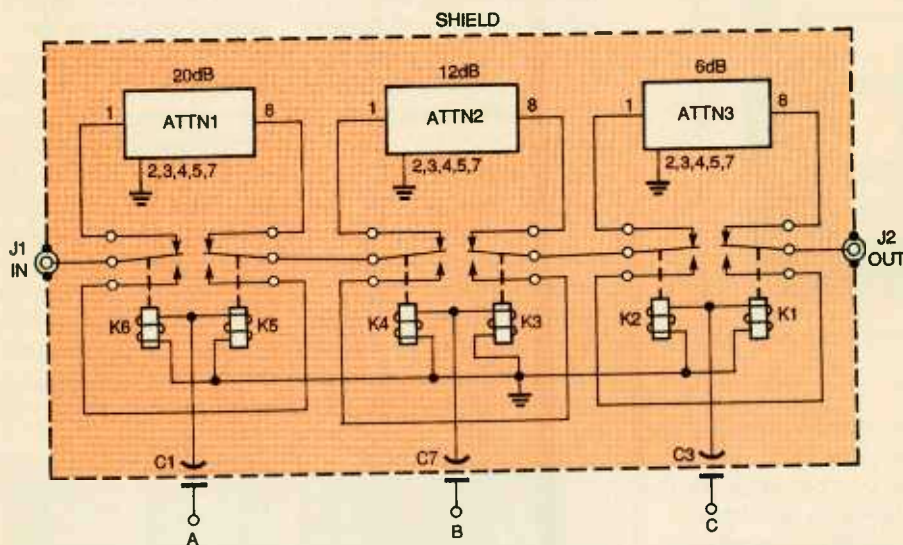


Fig. 1. Here's the schematic diagram for the basic step-attenuator circuit. The level of attenuation depends on which of the three attenuator pads are selected via the inputs at A, B, and C.

FIXED ATTENUATORS

A fixed attenuator provides only one level of attenuation. For example, a 6-dB attenuator reduces the power of the input signal by 6 dB. Fixed attenuators are commonly available with 1-, 3-, 6-, 10-, 12-, 20-, and 40-dB attenuation factors.

The main use of fixed attenuators is to reduce the signal level by a fixed amount. One reason might

output loads other than the designed 50-ohm system impedance. To overcome, at least somewhat, problems caused by load-impedance variations, some designers place a 1-dB attenuator in series with the signal. Similarly, oscillators will pull in frequency if the load impedance varies, so, in lieu of a proper buffer amplifier, some designers will put an attenuator in line with the

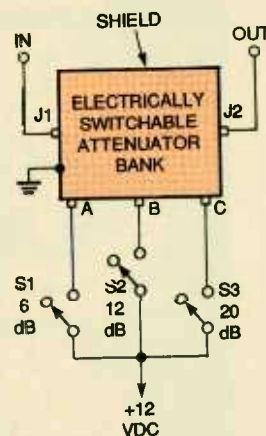


Fig. 2. The control-signal voltage (shown here as +12VDC) should be changed to +5VDC if 5-volt relays are used.

ceivers. By being able to switch an attenuator in or out of the circuit, one can effectively raise the dynamic range of the receiver by the amount of the attenuation factor while suffering only a small increase in the noise floor. Most modern ham and SWL H.F.-band receivers have at least one fixed attenuator, and many use a 6-, 12-, and 20-dB array that is similar to one that will be presented later in this column. In some receivers, the attenuator can be switched in or out of the signal path according to the automatic gain-control (AGC) level.

A STEP ATTENUATOR PROJECT

A step attenuator consists of several fixed attenuators that can be switched in or out of the circuit as needed. For example, the

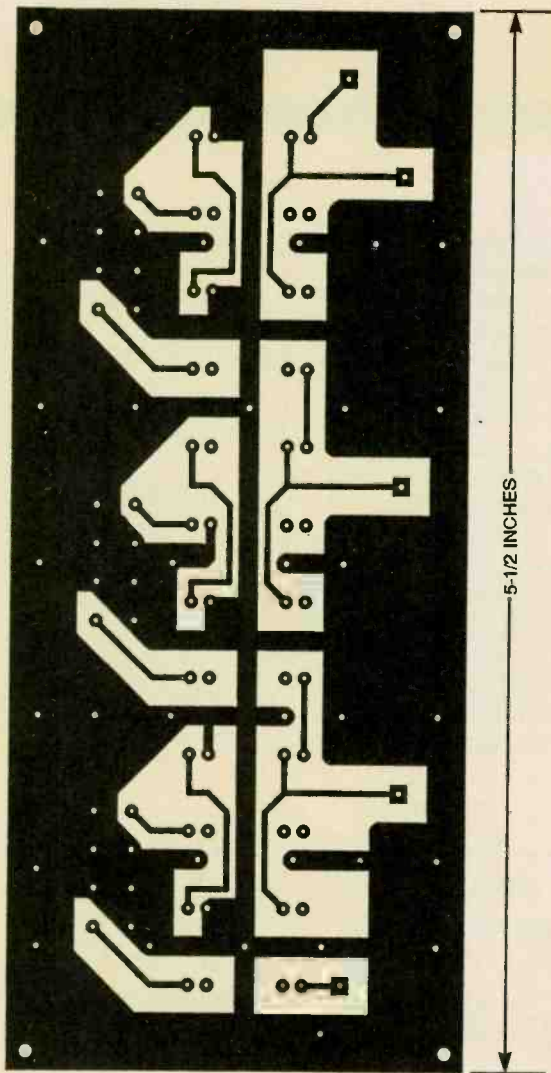


Fig. 3. This foil pattern for the step-attenuator project is shown here full sized.

step attenuator project that we are presenting this month (see Fig. 1) has 6-, 12-, and 20-dB attenuator pads, allowing the user to select attenuation levels of 6-, 12-, 18-, 20-, 26-, 32-, or 38-dB. Signals presented to inputs A, B, and C are used to set the attenuation level; more on that later.

Turning to the circuit itself, attenuators ATTN1, ATTN2, and ATTN3 are Mini-Circuits AT-20 (20-dB), AT-12 (12-dB), and AT-6 (6-dB) units. Those fixed attenuators are housed in IC-like packages with 0.100 inch pin spacing so they will fit onto perforated board intended for DIP integrated circuits. If you

do not have a convenient source for those devices, they can be obtained at a reasonable cost from Ocean State Electronics (P.O. Box 1458, 6 Industrial Drive, Westerly, RI, 02891; Tel. 401-596-3080, Orders: 800-866-6626, Fax: 401-596-3590).

The attenuators are switched in and out of the circuit by relays K1 through K6. Those relays can be any SPDT DIP delay, but if you wish to use the printed circuit board (more on that in a moment), they must be EAC D1C05H (5-volt) or D1C12H (12-volt) units, which are available from Digi-Key (P.O. Box 677, 701 Brooks

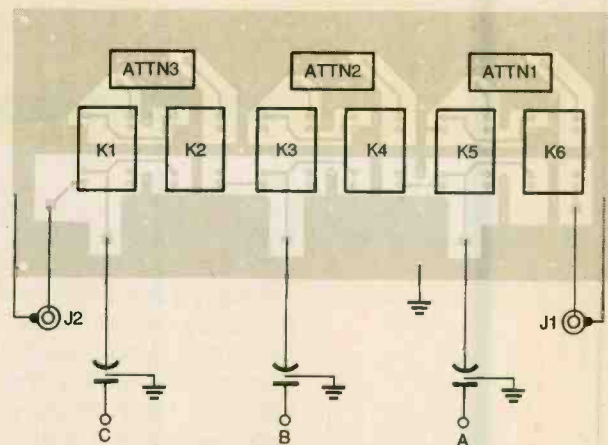
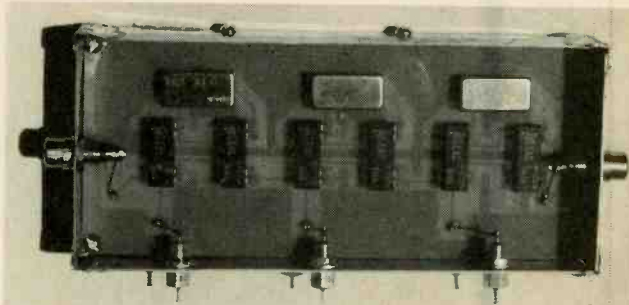


Fig. 4. Use this parts-placement diagram when assembling your board. The finished project should be placed in a metal enclosure; see text.

Avenue South, Thief River Falls, MN, 56701-0677; Tel. 800-344-4539) as part numbers Z663-ND (5 volt) and Z664-ND (12 volt). I used 12-volt units in my prototype because that is compatible with an AM BCB DX receiver that I am building; if you want it compatible with digital systems use 5-volt relays.

Capacitors C1, C2, and C3 are ceramic feed-through capacitors. Look for these parts in catalogs under the heading "EMI filters." Any value from 500 pF to 2000 pF is usable. If it is inconvenient to use the panel feedthrough capaci-

Figure 2 shows the external connections to the attenuator circuit. The entire circuit is built inside of a shielded box or container (mine was homebrew), in order to prevent signal from leaking around the attenuator. The input and output jacks are whatever form of coaxial connector that suits your needs. Although I used RCA phono jacks, any BNC, SO-239, or other coaxial connector can be used. Switches S1-S3 are toggle switches. Note that the diagram indicates a +12-volt control voltage; that voltage should obviously be +5 volts if 5-



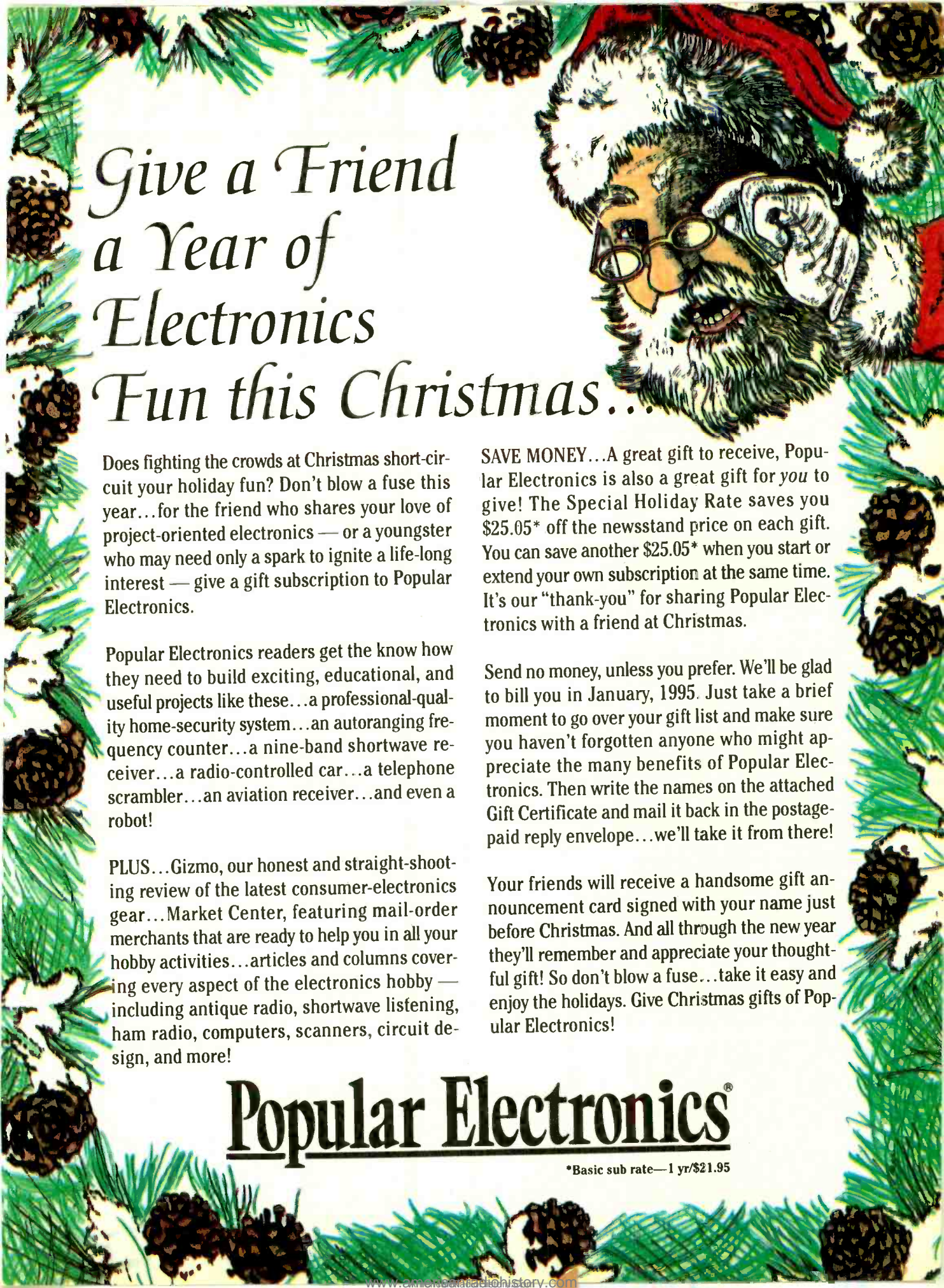
This photo shows the completed project ready for use. The feedthrough capacitors are shown along the lower edge of the enclosure.

tors, or if the parts prove to be too expensive for your budget (they can cost as much as \$7 each from some sources!), then use 0.001- μ F ceramic-disk capacitors instead.

volt relays are used in your circuit.

A printed-circuit-board layout is shown in Fig. 3, and its corresponding parts-placement diagram

(Continued on page 83)



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

Does fighting the crowds at Christmas short-circuit your holiday fun? Don't blow a fuse this year...for the friend who shares your love of project-oriented electronics — or a youngster who may need only a spark to ignite a life-long interest — give a gift subscription to Popular Electronics.

Popular Electronics readers get the know how they need to build exciting, educational, and useful projects like these...a professional-quality home-security system...an autoranging frequency counter...a nine-band shortwave receiver...a radio-controlled car...a telephone scrambler...an aviation receiver...and even a robot!

PLUS...Gizmo, our honest and straight-shooting review of the latest consumer-electronics gear...Market Center, featuring mail-order merchants that are ready to help you in all your hobby activities...articles and columns covering every aspect of the electronics hobby — including antique radio, shortwave listening, ham radio, computers, scanners, circuit design, and more!

SAVE MONEY...A great gift to receive, Popular Electronics is also a great gift for *you* to give! The Special Holiday Rate saves you \$25.05* off the newsstand price on each gift. You can save another \$25.05* when you start or extend your own subscription at the same time. It's our "thank-you" for sharing Popular Electronics with a friend at Christmas.

Send no money, unless you prefer. We'll be glad to bill you in January, 1995. Just take a brief moment to go over your gift list and make sure you haven't forgotten anyone who might appreciate the many benefits of Popular Electronics. Then write the names on the attached Gift Certificate and mail it back in the postage-paid reply envelope...we'll take it from there!

Your friends will receive a handsome gift announcement card signed with your name just before Christmas. And all through the new year they'll remember and appreciate your thoughtful gift! So don't blow a fuse...take it easy and enjoy the holidays. Give Christmas gifts of Popular Electronics!

Popular Electronics[®]

*Basic sub rate—1 yr/\$21.95

ELECTRONICS MARKET PLACE

FOR SALE

CABLE test chips. Jerrold, Tocom, S.A., Zenith. Puts cable boxes into full service model \$29.95 to \$59.95. 1 (800) 452-7090, (310) 802-0841.

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 repair most cable equipment, and pay cash for unwanted cable boxes. No Florida sales. (305) 425-0751.

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.

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**, PO Box 669, Seabrook, TX 77586. For CODs (713) 922-3512 any time!

300 Experimenters Circuits — Complete in 6 practical books using diodes, relays, FETs, LEDs, 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.

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 1/2" — \$225.00; 2" x 2 1/2" — \$450.00; 3" x 2 1/2" — \$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.

NU-TEK ELECTRONICS Video Stabilizer **\$49⁹⁵**

FREE Catalog

CABLE TV EQUIPMENT



1-800-228-7404

NEW PICTURE IN PICTURE Stereo

PIP WORKS ON ALL TV'S. 181 CHANNEL CAPABILITY. REMOTE CONTROL. 4 SOURCE INPUTS.

UPS FEDERAL EXPRESS

3250 Hatch Cedar Park TX 78613

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

PRINTED circuit boards — etched, drilled, tin plated. Single sided \$1.25/sq. inch. Free shipping. **CHELCO ELECTRONICS**, 61 Water Street, Mayville, NY 14757. 1 (800) 388-8521. Fax (716) 753-3220.

PROTECT yourself and cash in on crime, security devices catalog and special offer, \$5.00, write **GEMINI ENTERPRISES**, PO Box 1558, Bristol, CT 06011-1558.

LOW prices on electronic parts since 1970. Get our monthly flyer. Phone/fax (702) 795-7151. **STAR-TRONICS**, Box 98102, Las Vegas, NV 89193.

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.

RESTORATION tubes New, used, antique. Many types. All tested before shipping. Send request and SASE to: **TUBES**, PO Box 882, Niceville, FL 32588.

REAL ESTATE

FORECLOSED properties! HUD, VA, RTC, and bank owned! Special financing! Free guide with order! Call now for list in your area! 1 (800) 278-4663. 24 hrs.

INVENTIONS

FREE Invention package: **DAVISON & ASSOCIATES** offers customized development, patenting, and licensing for new products and ideas. Proven results: 1 (800) 677-6382.

EDUCATION/INSTRUCTION

ELECTRONIC engineering. 8 volumes complete. \$109.95. No prior knowledge required. Free brochure. **BANNER TECHNICAL BOOKS**, 1203 Grant Avenue, Rockford, IL 61103.

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.

GADGET lovers dream! Part time effort, full time pay! Info: PO Box 8000-123, Basalt, CO 81621.

**HOW FAR
YOU GO
DEPENDS ON
WHERE
YOU GET YOUR
START.**



1-800-854-CLUB



**BOYS & GIRLS CLUBS
OF AMERICA**

The Positive Place For Kids.

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

OF INTEREST TO ALL

MEXICO TRADE DIRECTORY \$15.00 Postpaid. Box 661, Dallas, GA 30132.

RECYCLE PERSONAL COPIERS Cartridges. Instructions \$14.95. Charles Bruns, Box 543, Applegate, CA 95703.

BOOKS — CATALOGS — MAGAZINES

PINBALL MACHINES BOOKS, Parts, Supplies. Catalog \$1.00. MARCO, 2401-(PE) Sunset, West Columbia, SC 29169-4717.

EDUCATION — INSTRUCTION — SCHOOLS

RADIO!! ON THE Job Training in Local Radio Stations. Part time, Nights, Weekends. No experience required. Free Brochure and Recording tells how. Toll free 1-800-858-4241.

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. Rush \$1.00 and SASE For information. Steve Smith, Box 2233, Whiteville, NC 28472.

RECIPES

25 EASY DELICIOUS desserts \$3.00. TTT Publications, PO Box 219-(PE), Dunedin, FL 34697-0219.

PERSONAL — MISCELLANEOUS

PENPAL DIRECTORIES! WITH Addresses: Corbett, 26085 Shaub Court, Clarksville, TN 37042.

ANTIQUE RADIO CLASSIFIED

Free Sample!

Antique Radio's

Largest Circulation Monthly.

Articles, Ads & Classifieds.

6-Month Trial: \$16.95. 1-Yr: \$31.95 (\$47.95-1st Class).

A.R.C., P.O. Box 802-L12, Carlisle, MA 01741

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.

GAUSS meter plans — measure potentially harmful electromagnetic fields in and around your home. \$10.00 to **THOMPSON ENGINEERING**, PO Box 3043, W. Lafayette, IN 47906.

THE Only Catalog Needed! Kits, plans, surveillance, test, radios, more! Part locating. Best prices! Send \$1.50 (refundable) **NEUTRONICS**, 4 Croydon Ct., Englishtown, NJ 07726.

BUILD 28-PIN-PLCC program adapters 87C750/751 or 87C752 PCBs \$15.00. **SMTLOGIC**, PO Box 12202, Huntsville, AL 35815.

BOOKS

ROBOT books! Free catalog by mail! Write: **COGNITIONS**, Dept. 1200, 71 WidowSweets Rd., Exeter, RI 02822.

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.

SCANNER SCENE

By Marc Saxon

Monitoring VIP Military Aircraft

A smart-looking, new handheld scanner, the Trident TR-2400, carries "Innovations '94" honors awarded by the Electronic Industries Association. Those honors are given to the most innovative electronic products of the year.



Proving that "good things come in small packages," the Trident TR-2400 offers 1000 memory channels and much more in a handheld 14 ounce unit.

Get this: The Trident TR-2400 has 1000 memory channels! It also has 10 search/scan ranges. The frequency coverage starts at 100 kHz, and it goes to 2060 MHz. That means it covers low-frequency beacons, as well as all AM, FM, SW, and TV broadcast frequencies, and more, in addition to the regular scanner frequencies. Wait, there's more!

The handheld scanner operates in AM, NFM, and FM modes, and can also receive single sideband (SSB) mode signals. Tuning increments are selectable, and go as low as 1-kHz steps for extra-fine tuning. The unit scans at 25 channels per second.

Despite its many features, the Trident TR-2400 weighs in at only 14 ounces, and measures approximately 6 inches high by 2 inches wide by 1.5 inches deep. It runs on four AA batteries. A lot of potential in a small package!

For more information on the versatile Trident TR-2400, call ACI at 1-800-445-7717 or 317-849-2570.

PLAY IT AGAIN, SAM

To many monitoring enthusiasts, SAM is more than the name of the world's most memorable piano-bar performer. SAM is the military acronym for "Special Air Mission," which is how the U.S. Air Force classifies those particular VIP flights carrying heads of state, cabinet members, senators and congressmen, and high-ranking officers.

Communications monitors know that it's easy to sort out SAM flights from the others because their callsigns consist of the distinctive word "SAM," followed by digits representing the individual aircraft—for example, SAM-972 or SAM-345. The aircraft used by the President and Vice President are also SAM flights, and may be heard identifying as SAM-26000 and SAM-27000 when the President and Vice President are not aboard. Otherwise, they normally identify as Air Force One and Air Force Two.

VIP travelers get special attention from the media, baggage handlers, and everyone else. The use of a SAM callsign announces to ground stations that there is a priority status. Some scanner owners know that SAM flights turn up on certain frequencies set aside for their exclusive use. You might want to try them, as they can get interesting.

Many people know that Air Force One has an air/ground telephone downlink on 415.70 MHz. That is almost always operated in the clear, and sometimes you can also (poorly) hear the voice of the other party replying, when it is repeated through the aircraft's system. The uplink frequency is 407.85 MHz, and there are more than 60 ground transmitters located throughout the U.S. and Canada. That ensures that Air Force One and Two, or any SAM flight, will always

be able to make contact via the private "Echo-Fox-trot" phone circuit. The ground transmitters are all remotely controlled from the White House Communications Center ("Crown").

When Air Force One and Two are on the ground, or flying in a local area, they have available the "Yankee-Zulu" private telephone circuit, which has seldom been reported. The aircraft operates on 171.2875 MHz, with the ground station, located locally, on 162.6875 MHz.

While in flight, Air Force One and Two are sometimes accompanied by civilian aircraft, such as commercial charters or airliners used by the media. Communications between the pilots takes place on 129.525 MHz.

The home base for all SAM flights is Andrews Air Force Base in Maryland. At that base, several scanner-band frequencies are reserved exclusively for communications with SAM aircraft, and they can be copied working Andrews from hundreds of miles away. Listen for Andrews to identify as "SAM C.P." (Command Post) on 141.55, 361.6, 372.5, and 378.1 MHz. VIP helicopters at Andrews use 141.70, 292.2, and 375 MHz.

Some of the more esoteric communications believed to be from Air Force One have been noted on 246.95, 305.55, 322.75, 326.0, 336.8, 345.5, 361.6, 362.35, 366.0, 390.0, and 397.05 MHz. Those frequencies have variously been observed by scanner users as using AM, WFM, USB, LSB, and multiplex downlink transmissions. Not long ago, I tuned in 361.6 MHz and observed a multiplex operation going on. That meant that it was a single wide signal that contained several independent

simultaneous conversations.

The signal extended to ± 50 kHz from the center frequency. Putting the scanner into AM mode, I slowly sifted upward and downward through the garbled maze in 5-kHz steps. I was able to extract a few of the conversations, although with poor quality and with some heterodyning.

This column has received a lot of mail over past months providing information on, and asking questions about, SAM VHF/UHF communications. Looks like it's a topic that interests our readers. I hope that this month's column provides a good start for those who want to know more. Remember, also, that SAM missions outside of North America operate in SSB mode on long-range communications frequencies below 30-MHz.

MESSAGE FROM THE BERMUDA TRIANGLE

Reader William G. Cave lives on Summerland Key, Florida, which he points out is at the intersection of Hurricane Alley and the Bermuda Triangle. William started listening to police radio stations back in the days when the stations operated around 2400 kHz. Then he followed them to the 30-50-MHz band, and to the 150-160-MHz range. Now he writes that the police agencies he wants to monitor have gone to 860 MHz with digital scrambling, trunking, data terminals, and whatever. He asks if this all could mean the end of police scanning.

I don't believe so, although it certainly inhibits the ability to monitor police in the largest and most active agencies. Thousands of medium and small agencies don't feel that those costly systems are needed for their purposes. ■

HAM RADIO

(Continued from page 78)

is shown in Fig. 4. An etched PC board is also available. You can either build this board yourself, or buy one from FAR Circuits (18N640 Field Court, Dundee, IL, 60118). The price isn't available as of this writing, but Fred at FAR made my prototype for a very reasonable price (indeed, FAR tends to be a low-cost source of PC boards, and will make your design without the terrible set-up fees that many other sources charge).

Because my version of the digital attenuator is going to be mounted inside of a receiver chassis, it was not necessary to buy a wonderful manufactured cabinet for it. I made a shielded enclosure out of 1.5-inch width, 22-gauge, brass

sheet stock. That material is available from hobby shops, model shops, and shops that cater to amateur jewelers (typically called "rock shops" or "lapidary shops" in the Yellow Pages). I bent the stock into the shape of the box, and then soldered the joints using a standard 150-watt soldering gun.

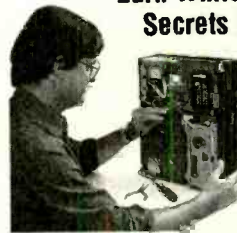
NEW PARTS CATALOG

When preparing this column, I called Frank Pellicano at Ocean State Electronics to make sure they carry the attenuators, along with some of the other Mini-Circuits products. Frank told me that they now have their 1994-1995 catalog on the street. If you are an electronics hobby builder, especially a ham-radio builder, then that catalog is sure to be of real interest to you. ■

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

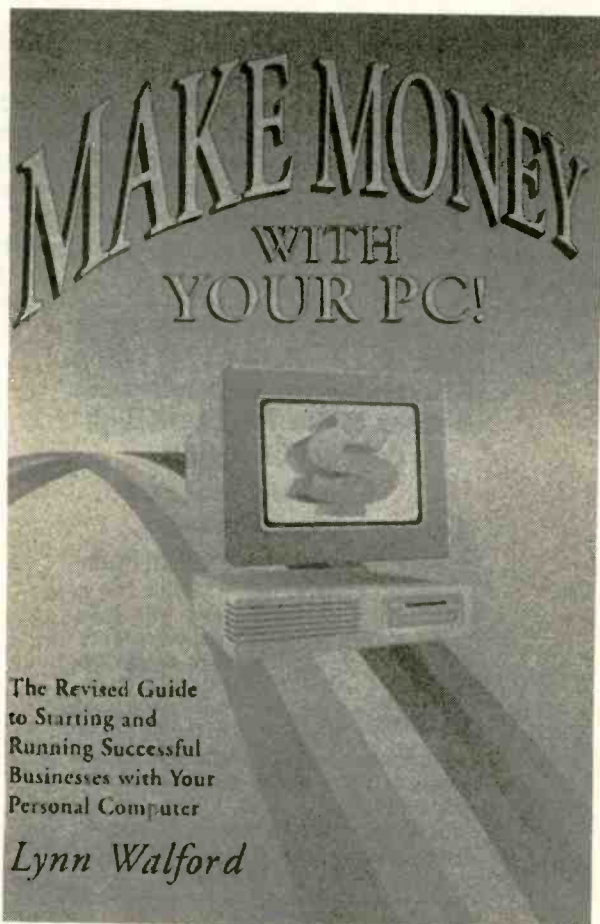
Check VCR or another High Paying Career Field  Since 1926	(Check One Box Only)
	<input type="checkbox"/> VCR Repair, Dept. 62239
	<input type="checkbox"/> Computer Repair, Dept. 64139
	<input type="checkbox"/> TV/Satellite Dish, Dept. 31036
	<input type="checkbox"/> Advance VCR Repair, Dept. 65027
	<input type="checkbox"/> Camcorder Repair, Dept. 66037
	<input type="checkbox"/> Fax Repair, Dept. 67037
<input type="checkbox"/> Printer Repair, Dept. 68036	
Name _____	
Address _____	
City _____	
State _____ Zip _____	

CIRCLE 154 ON FREE INFORMATION CARD

ELECTRONICS LIBRARY

Make Money With Your PC

by Lynn Walford



This book can help make your dream of starting your own home-based business a reality. It provides the facts on how to choose, plan, market, and manage a computer-based business using either a Macintosh or an IBM-compatible PC.

The book helps you determine if you have what it takes to become an entrepreneur, how to decide what business best suits your skills and talents, and how to evaluate and choose software and hardware. It offers plenty of successful business ideas along with practical advice to get your business off the ground—including how to get

established; how to market and manage your business; how to price, bill, and get paid for your services; and where to go for help.

Exercises at the end of each chapter make it easy to develop business marketing and management plans, and to set and accomplish goals. Brainstorming sessions are also included to inspire sessions with friends, colleagues, or family members and stimulate new and exciting ideas.

The revised edition of the book also contains examples of how other computer-based business owners became successful, and illustrations of common mistakes. For those who already are running computer-based businesses, the book provides new ideas on increasing business and profits and avoiding potential client problems.

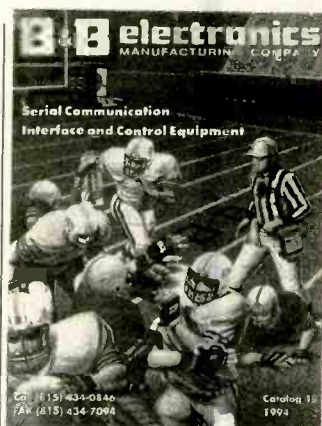
Make Money With Your PC! costs \$7.95 and is published by Ten Speed Press, P. O. Box 7123, Berkeley, CA 94707; Tel. 510-559-1600 or 800-841-2665; Fax: 510-524-4588.

CIRCLE 90 ON FREE INFORMATION CARD

SERIAL COMMUNICATION INTERFACE AND CONTROL EQUIPMENT CATALOG

from B&B Electronics

This 26-page catalog offers affordable solutions to your connectivity problems, including RS-232, 422, 423, 485, 530, and current-loop interface converters. It also features stand-alone converters, PC cards, smart switches, control products, and software. Most of the products are manufactured on-site and sold directly to the end user, which allows you to develop and integrate systems at a considerably lower cost. A technical support team is avail-



able before you purchase to help you select the proper product, and after you purchase to help you install it. Their consultation is free. If the exact product you need is not available, a special product can be designed for you.

The Serial Communication Interface and Control Equipment Catalog is free upon request from 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 91 ON FREE INFORMATION CARD

APPLICATIONS HANDBOOK

from Burr-Brown

This handbook provides designers with more than 400 pages of techniques and tips for using D/A and A/D converters, operational and instrumentation amplifiers, and isolation products. Also included are a variety of special-function applications featuring photodiode-amplifier combinations, multiplexers, and filter-design programs.

The Applications Handbook is free upon request from the Burr-Brown Literature Hot Line, Tel. 1-800-548-6132.

CIRCLE 92 ON FREE INFORMATION CARD

Take this GIANT CIRCUIT LIBRARY for only \$9.95

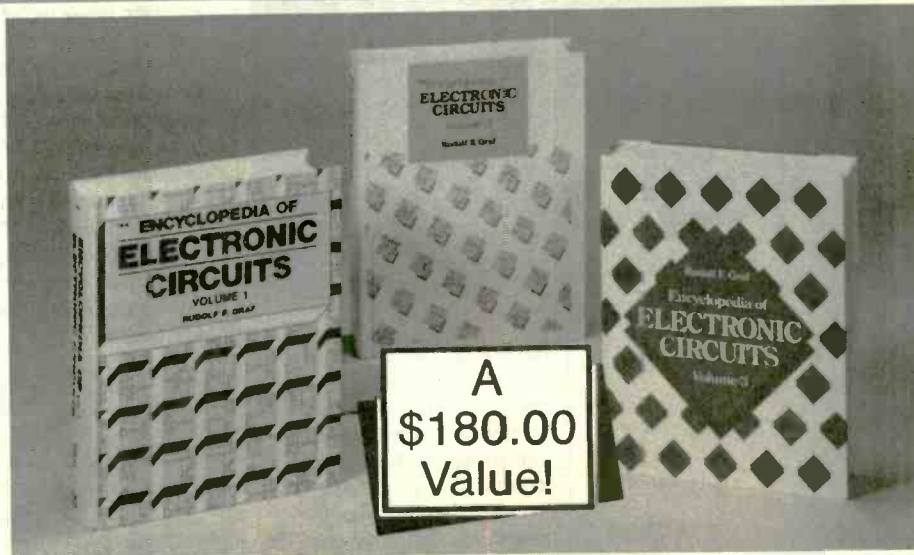
when you join the *Electronics Engineers' Book Club*®

THE ENCYCLOPEDIA OF ELECTRONIC CIRCUITS —Vols. 1, 2 & 3 by Rudolf F. Graf

Hundreds of circuit ideas alphabetically arranged — from Alarm circuits to Zero crossing detector circuits!

... includes schematics for the latest electronics circuits from industry leaders... —Popular Electronics

Turn to this comprehensive circuit library for hundreds of project ideas . . . valuable troubleshooting and repair tips . . . and concise pinout diagrams and schematics. In each volume you'll find more than 700 electronic and integrated circuits and 100+ circuit categories right at your fingertips to give you ideas you can use on the job or at your workbench.



2,344 total pages 3,490 total illustrations

Book No. 5489C Hardcover

If coupon is missing, write to: Electronics Engineers' Book Club, Blue Ridge Summit, PA 17294-0860

As a member of the Electronics Engineers' 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 do 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. And you'll be eligible for **FREE BOOKS** through the Bonus Book Plan. Your only obligation is to purchase 3 more books during the next 2 years, after which you may cancel your membership at any time.

Publisher's price shown. © 1995 EEBC

ELECTRONICS ENGINEERS' BOOK CLUB

Blue Ridge Summit, PA 17294-0860

YES! Please send me *The Encyclopedia of Electronic Circuits—Vols. 1, 2 & 3 (5489C)*, billing me \$9.95 plus shipping/handling & tax. Enroll me as a member of the **Electronics Engineers' Book Club** according to the terms outlined in this ad. If not satisfied, I may return the books within 10 days and have my membership cancelled.

Name _____

Address _____

City _____

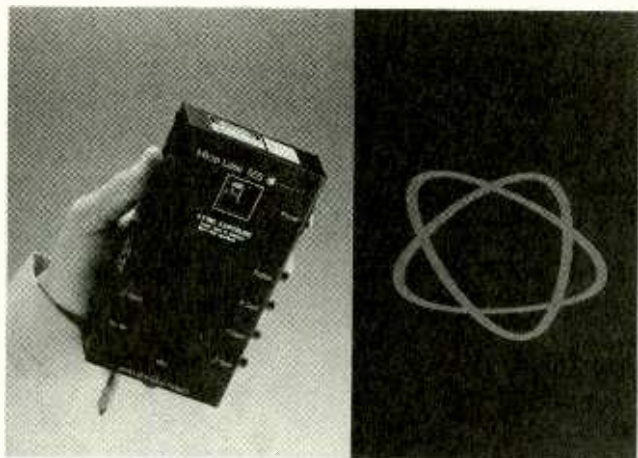
State _____

Zip _____ Phone _____

Valid for new members only, subject to acceptance by EEBC. Canada must remit in U.S. funds drawn on U.S. banks. Applicants outside the U.S. and Canada will receive special ordering instructions. A shipping/handling charge & sales tax will be added to all orders. PPIF195

NEW PRODUCTS

Portable Laser Light Show



You can create fantastic laser light effects anywhere with the handheld *Micro Lase 650* from *Edmund Scientific*. About the size of a portable radio, the compact device uses diode laser technology to create effects that pulsate and change in response to musical input.

The unit can be connected directly to your stereo system's amplifier output, or its own internal microphone will pick up ambient sound. Four separate controls allow you to vary the pattern design and size to create unlimited variations. The light show is most effective at projection distances of up to 50 feet, but the *Micro Lase 650* will project as far as 200 feet. It is most dramatic in darkened areas. It runs on four "AA" batteries, or with the included 117-volt power supply.

The *Micro Lase 650* (order number E52 570) costs \$499. For more information, contact Edmund Scientific Company, Department 14A1, C999 Edscorp Building, Barrington, NJ 08007; Tel. 609-573-6250; Fax: 609-573-6295.

CIRCLE 101 ON FREE INFORMATION CARD

HIGH-VOLTAGE OSCILLOSCOPE PROBE

The *Model P5100* 2.5-kV probe from *Tektronix* is the first high-voltage (above 1.5-kV) os-

cilloscope probe to win safety certification from Underwriters Laboratory (UL). UL certification also qualifies the probe for safety certification by two international standards-setting organizations: the European Economic Community's IEC (International Electrotechnical Commission) and Canada's CSA (Canadian Standards Association). The probe can be used by industrial motor and power supply designers as well as automotive and aircraft service personnel and consumer-electronics repair technicians.

The P5100 high-voltage probe offers a bandwidth of 250 MHz and the lowest input capacitance (less than 2.75 pF) of any probe in its class. Those capabilities allow users to exploit the high-bandwidth capacity of Tektronix' TDS300-, 400-, and 500-series digitizing oscilloscopes, or maximize the performance of other manufacturers' scopes.



The probe has accessories designed for safely gripping large, high-voltage test points. Those accessories include a retractable hook tip, useful for gripping bolts up to 1/4-inch in diameter, and for holding the probe in place while making signal measurements. Using the hook tip, rather than securing the probe with wires, eliminates a high-voltage-testing safety hazard.

The P5100 high-voltage probe costs \$199. For further information, contact Tektronix, Measurements Group, P. O. Box 1520, Pittsfield, MA 01202; Tel. 1-800-426-2200.

CIRCLE 102 ON FREE INFORMATION CARD

INDOOR/OUTDOOR TEMPERATURE ALARM

The *Model 401012* indoor/outdoor temperature alarm from *Extech* provides simultaneous readings of indoor and outdoor temperatures on a large 1.5-inch LCD. The compact unit offers a wide measuring range of -58°F to 170°F (accurate to 0.1°). The indoor temperature sensor is built in; the external sensor includes adhesive backing for easy mounting and ten feet of cable. A single-point



alarm for the external sensor warns the user that the temperature is either above a high limit or below a low limit. A dual-point alarm for the external sensor alerts the user that the temperature is either within or outside the range of two set points. The alarms are both audible and visible (red/green LED).

The 401012 indoor/outdoor thermometer, complete with waterproof outdoor sensor, cable, built-in stand, and AAA battery, costs \$19. For additional information, contact Extech Instruments Corporation, 335 Bear Hill Road, Waltham, MA 02154-1020; Tel. 617-890-7440; Fax: 617-890-7864.

CIRCLE 103 ON FREE INFORMATION CARD

MINIATURE SOLDERING IRON

Designed for user comfort, the *Antex Model G/3U* miniature soldering iron from *M.M. Newman* features a protective heat shield. The heating element is located under the tip for optimum thermal efficiency. The pencil-thin plastic handle always stays cool, and the iron fits



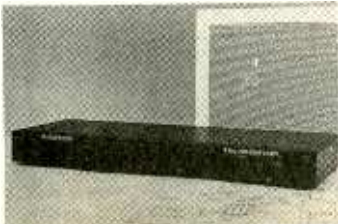
comfortably in the hand for hours of electronic assembly work. The 18-watt unit puts out the same power as a bulkier 30-watt iron. It heats up to 750°F in only 45 seconds and recovers rapidly. The G/3U measures 6½ inches in length and weighs ¾ of an ounce. It uses slide-on tips that come in more than 40 styles, including needle points, spades, cones, and chisels.

The Antex Model G/3U miniature soldering iron, including a standard tip, has a list price of \$21.95. Replacement tips are priced from \$1.95. For additional information, contact M.M. Newman Corporation, 24 Tioga Way, P. O. Box 615, Marblehead, MA 01945; Tel. 617-631-7100; Fax: 617-631-8887.

CIRCLE 104 ON FREE INFORMATION CARD

SPEAKER BOOSTER

Bookshelf, in-wall, and compact speaker systems don't have to sound small, according to *AudioControl*. The *Architect* electronic processing system is designed to improve the performance of small loudspeakers. The heart of the device is its speaker optimizer system, described as "a sort of tool kit for building better sound from 2- and 3-way speaker systems with 4-, 6-, or 8-inch woofers. 45-Hz (low bass), 150-Hz (mid bass), 700-Hz (midrange), and 12-kHz (treble) band centers are provided to optimize small speakers at where adjustment is most advantageous. Bass output can be carefully enhanced, and strident midrange can be mellowed. Highs can be tailored to a particular room—



boosted in heavily carpeted and upholstered rooms or reduced in rooms filled with hard surfaces.

Intended for use with virtually any receiver, preamplifier, or integrated amplifier, the *Architect* is a "set and forget" component. Because it should be adjusted only during information, it uses rotary potentiometers instead of sliders, which are more prone to being fiddled with by the curious. Plus and minus 12-dB adjustments provide ample control for reducing acoustic problems and maximum output at usable frequencies.

The *Architect* speaker optimizer has a suggested retail price of \$189. For more information, contact *AudioControl*, 22410 70th Avenue West, Mountlake Terrace, WA 98043; Tel. 216-775-8461; Fax: 206-778-3166.

CIRCLE 105 ON FREE INFORMATION CARD

WEARABLE "HEADLIGHTS"

Bright Eyes Pro Headlights from *Wahl Clipper Corporation* provide a practical solution to repair and maintenance situations, in dimly lit areas, that require both hands for the job—and none for holding a flashlight. Worn like eyeglasses, the lightweight headset features a small bright flashlight on either side of the head. As the technician moves from task to task, so does the light, always aimed directly at the job at hand.



The *Bright Eyes Pro Headlights* have a suggested retail price of \$13.95. For additional information, contact *Wahl Clipper Corporation*, 2900 North Locust Street, P. O. Box 578, Sterling, IL 61081-0578; Tel. 815-625-6525; Fax: 815-625-1193.

CIRCLE 106 ON FREE INFORMATION CARD

Electronic Security

2 for 1 SALE!



Mini Long Range FM Voice Transmitter (3 mi) Ultra Sensitive - with fine tune, range control, more! Detects even whispers! FMX1 Kit and Plans.....~~\$49.50~~

Tiny Telephone FM Transmitter



(3 mi) - 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

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 603-672-5405 Tel 603-673-4730



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).

Popular Electronics

The HDTV Revolution

Photoflash Power System

The Changing World of Home Radio

Surrounding Security Systems

Laser Printer

Shaky!

Don't let the wobbles in your photographs ruin the fun—get the young-in-heart

DX Listening

Plans for the world's zaniest plaything—
September 1989

Build a Super-Simple Laser Printer Supply

Popular Electronics

Make a Mac

The Electronic Crayon

All About Receiver Sensitivity

Build the Socknet Sentinel

What Do Electrical Engineers Do?

Build a Super-Simple Laser Printer Supply

Put together your own Macintosh computer—
September 1991

Popular Electronics

Build the Tesla Coil

5.6 in. Level Monitor

Build the Tesla Coil

Build the Tesla Coil

Build the Tesla Coil

Build the Tesla Coil

Build the Tesla Coil

Build the Tesla Coil

Build the Tesla Coil

Build the Tesla Coil

Build the Tesla Coil that went square!—
August 1989

Popular Electronics

Build the Dice-Roulette Game

Lucky Lotto Selector

Build the Dice-Roulette Game

Build the Dice-Roulette Game

Build the Dice-Roulette Game

Build the Dice-Roulette Game

Build the Dice-Roulette Game

Build the Dice-Roulette Game

Build the Dice-Roulette Game

Build the Dice-Roulette Game

Build the Dice-Roulette Game

Take a chance on our Dice-Roulette project—
April 1989

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										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.

TELEPHONE LINE ANALYZER

(Continued from page 24)

structions only show you how to perform each test to get a go/no-go result. The detailed instructions, however, fully describe each test and show you how to correct problems that give bad test results.

The Tutorial. For those interested in thoroughly understanding phone technology, the tutorial offered with the analyzer kit is invaluable. The tutorial's first section—Telephone Operation—describes the connection between a phone and the phone company's central office. It also describes, in general terms, what happens when you place a call.

The next section, which is on rotary-dial telephones, presents a simple diagram of an old-style phone for use with most of the later sections. Of course, it explains how contemporary phones are more modern in design, but the remainder of the text is written in such a way that the diagram is useful nonetheless.

The next section discusses a phone's hook switch, which detects if the phone is off-hook. In that section, the values of both off-hook current and voltage are presented.

Both rotary and tone dialers are discussed next. During the discussion of old-style pulse dialers, the timing of dial pulses for both the US and Europe is supplied. A mechanical explanation of how pulses are generated is also given. The section on tone dialers covers the frequencies used to generate DTMF (dual-tone, multi-frequency) signals, and how they are generated in a touch-tone type phone.

Next, a phone's transmitter is discussed. Both carbon granule and electret-microphone mouth pieces are reviewed separately. For contrast purposes, the section on receivers uses a speaker analogy to explain how all types of receivers work.

The section on ringers, like the other sections in the tutorial, is thorough. Both the electromechanical and piezoelectric types are discussed in depth.

The little-understood, induction-coil balancing network is covered in the last section. As the instructions explain, that part of a phone allows the user to



The completed kit, with its custom panel meter and label, looks as good (and works as well) as any manufactured unit.

hear his or her own voice through the receiver at an acceptable volume level.

Kit Assembly. From the soldering tips in its beginning to the assembly instructions that follow, the manual included with the kit is thorough and easy to follow. There's a checklist-style parts list for inventory checking, as well as step-by-step assembly instructions with pictorial diagrams (*a la* Heathkit). Like the parts list, there is a box next to each assembly step so you can check it off when it is completed.

The first set of instructions describes how to install parts on the PC board. It then goes on to explain the process for mounting the meter onto the cabinet. The next two sections show you how to connect the modular jack and modular socket to the PC board. Next, instructions for wiring the meter to the board are given. The final-assembly instructions describe the physical construction of the unit.

After the assembly sections, the manual provides calibration instructions. For calibration, all you need is a small screwdriver, a 20- or 40-volt DC source, a 20-mA current source (which can be improvised by using an adjustable voltage source), and a meter to measure voltage and current. You only need to adjust two potentiometers to complete the calibration procedure.

A component-check section comes after the calibration procedure. The component-check section guides the user through the examination of the polarity of components and connections, and is a precursor to the troubleshooting section that follows. Because the kit is pretty simple to put together, troubleshooting is reduced to nothing more than checking your soldering.

At the very end of the manual (after the instructions for use), there is a 10-question multiple-choice quiz, so you can gauge your understanding. Rather than asking questions about the analyzer, the quiz focuses on how phone systems work.

On the whole, the kit is easy to build and functions well. The instructions for construction and use are clear and concise. When you build the analyzer, you end up with a device that looks and acts like a commercial unit, and learn a lot in the process. Add to that the fact that the unit can save you some money, and the kit's cost is more than justified.

If you want more information on the Telephone Line Analyzer, contact Elenco Electronics, Inc. at the address given earlier, or circle No. 119 on the Free Information Card. ■

Invest a stamp



Save a bundle

For the price of a stamp, you can get the latest edition of the federal government's free **Consumer Information Catalog**. It lists more than 200 free or low-cost publications on federal benefits, jobs, health, housing, education, cars, and more, to help you save money, make money, and spend it a little more wisely.

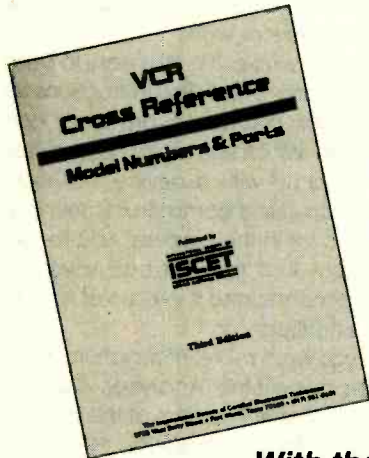
So stamp out ignorance with our free **Catalog**. Send your name and address to:

**Consumer Information Center
Department SB
Pueblo, Colorado 81009**

VCR

Cross Reference

**NOW Find the right Part
for your VCR**



With the

ISCET VCR

CROSS REFERENCE

This 270-page reference contains both model and part-number cross-references updated to include 1992 units.

VCR's are made in a few factories from which hundreds of different brand names and model numbers identify cosmetically-changed identical and near-identical manufactured units. Interchangeable parts are very common. An exact replacement part may be available only a few minutes away from you even though the manufacturer supplier is out-of-stock. You may be able to cannibalize scrap units at no cost!

The ISCET VCR Cross Reference is pre-punched for standard loose-leaf binding. . . \$38.00 plus \$3.00 for shipping for each Reference.

**Clagck Inc.
VCR CROSS REFERENCE OFFER
P.O. Box 4099
Farmingdale, New York 11735**

Name _____

Business _____

Address _____

City _____

State _____ Zip _____

Phone _____

Enclose \$38.00 for the Third Edition of the ISCET VCR Cross Reference and \$3.00 for shipping for each Reference.

The total amount of my order is \$ _____

Check enclosed—do not send cash.

or please charge my credit card.

Visa MasterCard Exp. Date ____/____/____

Card No. _____

Signature _____

New York State residents must add applicable local sales tax to total.

TELEPHONE-LINE SIMULATOR

(Continued from page 39)

A power switch was not used in the prototype. Although a power control is not necessary, you can add an SPST type toggle switch in series with the primary of T1.

Connect the main board to the power-supply board using short lengths of insulated wire. Wire the square pad to the square pad, the center-tap (ct) pad to the center-tap pad, and the remaining pad to the remaining pad.

Be sure to trim any long component leads. After assembly, clean the solder flux off the circuit boards. Commercial solvents are available that do a terrific job of removing the flux residue.

Mount the two circuit boards on short standoffs in an enclosure of your choice. Be careful when mounting the power board; do *not* allow it to come in contact with the conductive surfaces of your cabinet! Position the power board in your enclosure so that T3 is a minimum of two inches from T1 and T2. If they are placed too close together you may hear power-line AC hum on the telephone audio.

Test and Check-Out. Disconnect any telephone equipment plugged into the line-1 and line-2 phone jacks. Remove the JU1 power-up-mode configuration jumper. Install the JU2 CPC-configuration jumper. Adjust R14 (which sets the audio level) to about the middle of its range.

Turn on AC power and verify that the LED display shows "r." for a moment then shows "n." (normal mode). Press the mode switch and verify that it can be cycled through the five different modes (n, A, b, c, and d).

Remove power and install the JU1 configuration jumper. Turn on AC power and verify that the LED display shows "r." for a moment then shows "A." (automatic mode).

Set the unit to the normal mode ("n."). Connect a standard telephone to the line 1 (main) modular phone jack. Pick up line 1 and verify that a dial tone can be heard. If you are using a DTMF phone, dial a digit and verify that the dial tone stops and the digit is shown on the LED display.

Hang up the phone; then lift the handset again. Verify that you can

hear a dial tone again. Press the ring switch once and verify that a ringing sound can be heard in the telephone handset (it should sound like an authentic ring signal). Pressing the Ring switch again or hanging the phone up will terminate the ring sound and return the dial tone.

Plug a second telephone into the line 2 (test) jack. Pick up the line-1 phone and again press the ring switch. Verify that the line-2 phone's bell is activated. It should ring with a cadence similar to a standard ring pattern.

Try the remaining operational modes. For example, set the mode to "A" to have line 2 ring whenever line 1 is lifted off-hook.

Beep- and Cycle-Mode Operation.

To use the beep or cycle modes with the delay feature, connect an answering machine or telephone to line 2. If you are using the cycle mode, be sure to also install a phone in the line-1 jack. Start line-2 ringing by lifting the line-1 phone off-hook (cycle mode) or pressing the ring switch (beep mode).

While the test line is ringing, you can adjust the delay potentiometer from 10–90 seconds by viewing the LED display; the display will show a readout of 1 to 9. If the delay cycle has already started (as seen by the chasing LED pattern), you can press and hold the ring switch to review the delay-count setting.

When line 2 is answered, a series of beeps will be generated that will make most voice-operated (VOX) answering systems stay on the line (if they are operating correctly). If you want to force the answering system to periodically hang up, just use that unit's VOX time limit switch.

Keep line 1 off-hook if using the cycle mode. After the answering machine (or telephone) hangs up, it will be cycled on again every 10–90 seconds, depending on the R35's setting. At any time you can cancel the beep or cycle modes by pressing the Mode switch.

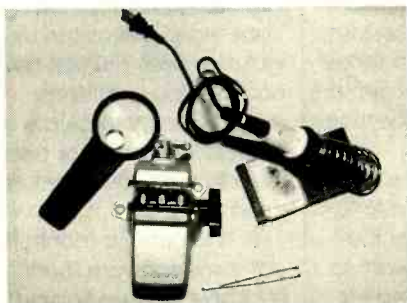
Conclusion. Using Ring-It! couldn't be easier. Plug the equipment to test or demonstrate into line 2 and use the line 1 telephone to place calls to it. Now that you're ready to use your Ring-It! project, reach out and touch someone. ■

SURFACE-MOUNT

(Continued from page 48)

10. Inspect your work under a magnifying glass. Especially look for solder bridges.

Unfortunately, there will be times when you'll need to remove a component (wrong component, component in backwards, component severely misaligned, etc.). As a general procedure, dip solder wick into liquid flux, place it over the lead or pin, and apply heat with a soldering iron. When all possible solder has been removed, the component should lift up with a slight pull.



A soldering iron, a tweezers, a vise, and a magnifying glass are the only tools you need to get started.



You might already have these necessary materials on your workbench.

Getting Your Hands on SMC's.

Hopefully, you're eager by now to obtain some surface-mount components and see what the excitement is all about. Doing so will probably be easier than you might have thought. There are two factors to consider: cost and availability. The good news is that with regard to both, things are definitely moving in the right direction.

During the late 1980s, SMC's were 20 to 30 percent higher in price than equivalent, through-hole components. Today, however, pricing is at parity with traditional components, at least for the more common devices.

In the near future, SMC's should cost less than their insertion mount equivalents.

Availability is of more concern than price. Yet the situation is improving daily. Most electronics mail-order distributors have a line of SMC's that they sell in single-lot quantities. True, not all of your favorite transistors, IC's, diodes, and indicators are yet available in surface-mount configurations. But most are. The box entitled "SMC Distributors" lists a few of the major distributors where the author has purchased SMC's. Call, fax, or write to those and other companies for a catalog. You will be surprised at the extent of their SMC offerings.

Practice, Practice, Practice. So far, the basic characteristics of the most popular surface-mount components, the knowledge of how to handle and solder them, and sources for their purchase have all been dealt with. But there is still one important step left to complete the SMT learning experience: SMC soldering practice. After you have practiced awhile, you can move on to SMT project building—the subject of a future article. So for now, how do you get a hold of both SMC's and a PC board to practice surface-mount assembly techniques? There are two ways to go about it.

One, you can disassemble a stuffed, surplus SMT PC board—that is, remove the SMC's from it and solder new ones in place. Be sure, however, to use new SMC's. Never attempt to reattach a previously removed SMC—it just isn't worth it.

Two, Electronics Goldmine, listed in the "SMC Distributor" box, sells two low-cost SMT "Learn to Solder" kits that contain a PC board and a teaspoon full (which means hundreds) of SMC's. They're great kits to practice with. Contact the company for details.

Whichever way you choose to practice your SMT assembly techniques, try getting started as soon as possible. A whole new world of project building is waiting to open up to you.

Note: For a more in-depth discussion of surface-mount technology for electronics experimenters, you might want to pick up a copy of the author's Third Edition of *Electronic Project Design and Fabrication*, Macmillan Publishing Co., 445 Hutchinson Ave., Columbus, Ohio 43235.

3 NEW BOOKS for the Project Builder

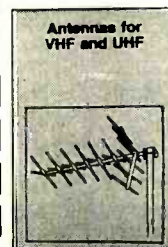


BP350—ELECTRONIC BOARD GAMES...\$6.00

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.

MULTIMEDIA WATCH

(Continued from page 8)

Records. But I only had these discs a couple of months at the time of this writing (early September!). The New Groller Multimedia Encyclopedia is a valuable multimedia reference source containing photos, charts, maps, video, animation, and more. With a low price of \$149.95, it's a terrific investment for the whole family.

Everyone has heard of the *Guinness Book of Records*. That book has probably delivered the final verdict in more bets than any other. The answers to what's the biggest, the smallest, the fastest, and the tallest are all there. However, you might not be aware that the book is available on CD-ROM, as well. It's a whole new way of looking at world records. The 1994 Guinness Multimedia Disc of Records contains every single word, record, and picture from the book, plus video clips, audio, and sound effects, not to mention the search capabilities of CD-ROM. In addition, the CD-ROM also comes packaged with a paperback copy of the book. The disc/book combo has a list price of \$49.95.

If you have an interest in armchair traveling through Medieval France and other places during the Middle Ages, then check out *MindQuest: Medieval France* from Blue Mountain Software. That \$79.95 disc lets you take a multimedia tour of European architecture from the middle ages while listening to Medieval music. The disc also gives you access to maps, timelines, definitions, and narrated tours. Medieval France is the perfect break from your regular work.

If you or your business depends on making phone calls all around the country or the world, then three new discs from Pro CD will be of interest and great use to you. *Select Phone* is a 4-disc set that contains every telephone directory in the United States, business and residential, all linked to complete addresses. The information can be used as you see it, or it can be exported to other programs. *Free Phone* is AT&T's toll-free directory on one disc, and *Canada Phone* contains every business and residential white-page directory in Canada. *Euro Pages* is a similar directory on a single disc that contains listings for 150,000 European companies. That is great if you do business overseas. All of Pro CD's new discs can now run in Windows as well as DOS.

Multicom Publishing has a CD-ROM for everyone in the family. Mom will probably like *Better Homes and Gardens Healthy Cooking* with its detailed recipes, directions, and printable shopping lists. Ingredient proportions can be scaled automatically based on the number of servings. Mom should also like *Better Homes and Gardens Complete Guide to Gardening*, the comprehensive guide to gardening fundamentals. Dad might like those two discs, too! Children between the ages of 3 and 9 will love *Dandy Dinosaurs*, which includes stories, arts and crafts projects, and more. A cute stuffed dinosaur is also included.

A while back I looked at a CD-ROMIX multimedia comic book from Davidson & Associates, *Freex #1*, the first story in the Freex series from Malibu Comics' Ultra-verse line. I recently enjoyed two other CD-ROMIX's just as much as

Freex. Prime #1 is about a 13-year old boy-turned-hero who defends school-girls, fights crime, and more. *Hardcase #1* is about a super-human who gives up crime-fighting to pursue a movie career, and then confronts his past and returns to fighting crime. Those comic books are brought to life using brilliant graphics, real voices, visual effects, music, and sound effects. Each disc contains only one comic book, but each is well worth its list price of \$24.95 as the discs really show off what multimedia is all about. Besides, I think these #1-in-the-series CD-ROMIX will be collector's items, so I'm even keeping the boxes intact.

If you're a baseball fan, and the 1994 strike didn't ruin your appetite for the game, you will not want to miss Microsoft's *Complete Baseball 94*. The history of the game, its teams, and over 1000 of its players, from the earliest days to the past season, are all presented in an entertaining and easy-to-use format. A full complement of player and team statistics from 1901 to 1993 will settle any argument in a hurry. There's even a trivia challenge with more than 900 questions of varying difficulty. Strike or no strike, that \$79.95 title is a definite hit.

If you are interested in multimedia games, you without a doubt have already heard about *Myst* from Broderbund Software. Well, I finally got around to checking it out for myself, and I am happy to say that everything you've heard is true. The game is beautiful to look at, easy to play, and a breeze to install. Its leisurely pace will not, however, appeal to die-hard fans of action games. In short, you are deposited on a seemingly deserted

island without a clue to your whereabouts or purpose. The story emerges in bits and pieces from clues left scattered about various locations. Just one hint: There is more to this game than first meets the eye. I've only spent a few hours with it, and I've barely scratched the surface. Fans of adventure games will become addicted in short order. *Myst* sells for about \$55.

If you're into ham radio, then you might want to subscribe to AmSoft's *The World of Ham Radio* on CD-ROM for \$99. Published three times a year, the disc includes over 750,000 new and previous call signs, making it easy to create mailing lists. The discs also include over 7000 ham-related programs.

To finish up this month I've got some software that's available only on floppy disk, but I think it deserves mention anyway. First, a couple of utilities for Word for Windows, *Doc-To-Help* and *Quicture*, both from WexTech Systems, Inc. I'm a big fan of Word for Windows, and those two utilities make it even more versatile. *Doc-To-Help* lets you create Windows on-line help using Word for Windows, and *Quicture* reduces the time required to load, scroll, print, and save Word for Windows documents that contain graphics.

Last but not least, *TIE Fighter* from LucasArts is a mind-boggling, Star Wars action game, but this time you work for the Dark Side, and your mission is to destroy the Rebel Alliance. *TIE Fighter*, the sequel to *X-Wing*, contains dazzling action graphics and hours of fun. The best action games still must be played from a hard drive, and *TIE Fighter* is no exception. It is well worth the disk space, though. ■

WWV RECEIVER

(Continued from page 52)

signal germanium or Schottky units. Selecting two diodes with matched forward-bias characteristics is not absolutely necessary; however, don't mix completely different types of diodes in the mixer!

The CA3240 op-amp was specified because of its low cost and moderately low, input-noise characteristic; the alternative HA series units listed in the Parts List are preferred for their lower noise figures. The MC1458 and other "741" derivatives should be avoided. With a single RF-amplifier stage, the receiver is noise limited by the op-amp, so lowest-noise units are beneficial to the overall operation of the receiver.

As for component replacement and substitution, most passive components are not critical and can be replaced with close values. If you can't find the Zener diode, it can be simulated by connecting five 1N914's in series.

Transformer Winding. Transformer T1 is a home-made unit, consisting of 40 closely wound turns of #26 AWG enameled wire on a ¼-inch diameter air-core form, as shown in Fig. 4, with taps at 2½ and 10½ turns from each end; after each tap, the windings proceed in the same direction. Hot-melt glue can be used to secure the windings to the form. The coil does not require a tuning slug in the core.

Fig. 5 shows the assembly details for T2 (the mixer transformer). Shown electrically in Fig. 5A, T2 is wound on a ferrite bobbin taken from a sub-miniature 10.7-MHz IF transformer or detector coil universally used in older pocket, auto, and console FM radios. IF transformers are typically color-coded brown, green, or blue, and the detector coils are typically black or white. The 10.7-MHz detector coils are easily confused with 455-kHz transformers, which also use black and white as identifying codes. The internal arrangement of the detector coil differs from that of a 455-kHz transformer in that it has a single winding, while the 455-kHz unit has two.

Disassemble the transformer or coil, remove the tuning sleeve, the windings, and any tuning capacitor in the

base. The bobbin is a dumb-bell shaped piece of ferrite material glued to the base. Lay out three 13 cm lengths of #32 to #38 AWG enameled wire in parallel. Wind the three wires 10 times around the bobbin as a set, as shown in Fig. 5B. Solder the wire ends to the base pins as shown in Fig. 5C.

The core permeability and the winding inductance are not critical as long as the winding acts as a transformer at 10 MHz with low inter-winding capacitance. The windings should not be glued within the bobbin.

Test. After completing the assembly, apply power to the circuit and check the voltage across Zener diode D3; the voltage across it should be between 3.0 and 3.6 volts. Connect a good ground to the receiver—a cold water pipe is preferred. Static should be heard through the speaker. Adjust trimmer capacitor C11 until a WWV signal is audible; then peak C11 for the best reception. The local-oscillator frequency will initially be offset from WWV, so you'll probably hear the beat note. Adjust trimmer capacitor C1 zero beat.

If a WWV signal is not heard, verify that the audio circuit is functioning; check the input of U1 pin 3 to U2 pin 3 with an audio signal injector, while listening to the receiver output. Check the local oscillator's operation using an oscilloscope, dip meter/monitor, or other frequency-test device, or listen for the 10-MHz, local-oscillator signal on another 10-MHz receiver.

If the audio amplifiers are functioning, but no signal is heard, verify the winding polarity of T2 and the winding order on T1. If you have a dip meter, use it to verify and set the resonant frequency of C11/T1 to 10 MHz. Check the receiver with a marker generator calibrated for 25-, 50-, or 100-kHz increments. If a signal is still not heard, wait a few hours and try again. Verify your ground connection at both ends—the ground is essential for the short antenna.

After the initial circuit test, it may be necessary to re-trim capacitor C11 for optimum reception. If C11 does need re-trimming, re-examine your antenna attachment to the case and see if you can't reduce the stray capacitance by increasing insulation width or separation. ■

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. VRA341, 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. JJA341, Atlanta, Georgia 30328

TANDY NATIONAL PARTS

Start off the New Year with us!

Semiconductors
Tools/Test Equipment
Led's/Lamps Filters
Crystals Inductors
Sockets Capacitors
and much more.....

**NO MINIMUMS
ORDER TOLL FREE
1-800-322-3690**

"CATALOG KNOCKS SOCKS OFF"

For our free Catalog, just send your name and address to:

Consumer Information Center
Department KO
Pueblo, Colorado 81009

DX BEAM-AIMER

(Continued from page 42)

Lines 580–620 first determine the lengths of arcs F and E, even if they are in different north-south hemispheres. Similarly, lines 630–700 calculate the angle at the North Pole (point I) between the origin and the destination, taking into consideration their east-west locations. These calculations are also designed to define the smallest of two possible spherical triangles, since one triangle could go around the globe in a reverse direction!

The remainder of the program is concerned with solving for the spherical triangle between the North Pole, the origin and the destination, and then printing the results. The remark statements show the formulae used.

Lines 710–730 print the North Polar Angles, and then lines 740–820 do the calculation for the length of the arc D. The computer uses "radians" for the calculations. A radian equals 57.2958 degrees. Therefore, one degree equals 0.0174533 radians (1 divided by 57.2958).

This conversion is shown in line 750 and is used in lines 770–810. The formula to calculate the COSine of arc D is shown in line 760, and used in line 820.

Now it is necessary to get the "inverse cosine," usually called the "arccosine," to convert the calculated variable D (actually COSine D) to an angle in radians. Some computers have the arccosine function in BASIC, but most don't, so a conversion formula is used in line 840, instead.

Line 860 converts the value of angle D from radians to the more familiar degrees, then line 890 calculates nautical miles by multiplying degrees by 60, since there are 60 nautical miles in one degree on a great circle. Line 910 converts nautical miles to statute miles (which are 1.1515 times nautical miles.) Lines 890 and 920 print the results on the screen.

Lines 930–1010 calculate the direction between the origin and destination, using the spherical trigonometry formula in line 940. Here again the arccosine formula is used to determine the angle G in radians, which is then converted to degrees by line 990. Line 1000 assures that the smaller of two possible triangles is used, and

*** BE SURE KEYBOARD IS IN CAPS-LOCK MODE! ***

GREAT CIRCLE DISTANCE AND DIRECTION

TO DETERMINE THE SHORTEST DISTANCE FROM POINT A TO POINT B, AND THE DIRECTION FROM A TO B. ENTER THE LATITUDE AND LONGITUDE IN DECIMAL DEGREES OF EACH POINT. THESE CAN BE FOUND FROM A MAP, GLOBE OR ENCYCLOPEDIA.

WHEN READY TO PROCEED. PRESS ENTER?

*** BE SURE KEYBOARD IS IN CAPS-LOCK MODE! ***

```
POINT A NAME ? LOS ANGELES
POINT B NAME ? ZANZIBAR
IS ZANZIBAR EAST OR WEST OF LOS ANGELES (E OR W)? E
```

```
LATITUDE OF LOS ANGELES? 34
NORTH OR SOUTH (N OR S)? N
LONGITUDE OF LOS ANGELES? 118.5
EAST OR WEST (E OR W)? W
```

```
LATITUDE OF ZANZIBAR? 8
NORTH OR SOUTH (N OR S)? S
LONGITUDE OF ZANZIBAR? 40
EAST OR WEST (E OR W)? E
```

```
LOS ANGELES IS 34 DEGREES NORTH AND 118.5 DEGREES WEST
ZANZIBAR IS 8 DEGREES SOUTH AND 40 DEGREES EAST
ZANZIBAR IS EAST OF LOS ANGELES
```

```
NORTH POLAR ANGLE TO POINT A (LOS ANGELES) IS 56 DEGREES.
NORTH POLAR ANGLE TO POINT B (ZANZIBAR) IS 98 DEGREES.
NORTH POLAR ANGLE BETWEEN POINTS IS 158.5 DEGREES.
```

```
DISTANCE A-B IS 8839.028 NAUTICAL MILES ( 147.3171 DEGREES).
DISTANCE A-B IS 10178.14 STATUTE MILES.
```

```
DIRECTION A-B IS 42.22884 DEGREES CLOCKWISE FROM NORTH.
```

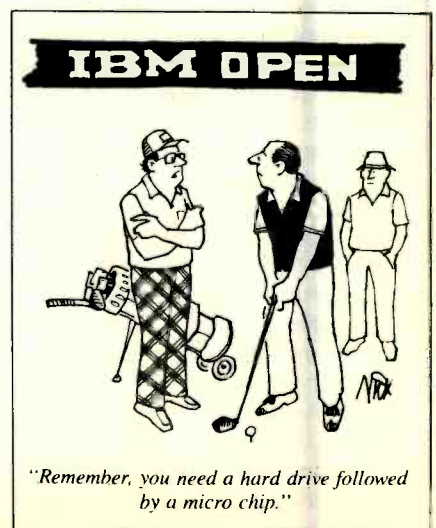
Fig. 2. The program begins by presenting a brief overview of how to enter location data. Then it requests the data, processes it, and returns its results.

the direction from A to B, measured clockwise from north, is printed by line 1010. Line 1020 ends the program.

Modifications. If you are a true perfectionist, you'll probably want to modify the program to accept input in degrees, minutes, and seconds rather than decimal degrees. Also, you might wish to add a DATA statement to declare typical locations and their latitudes and longitudes, so that you can type in the city name and have the program look for the coordinates. To assist you, Table 2 shows the approximate geographic coordinates of some well-known cities, and typical results from using this program. Bear in mind that different types of BASIC will calculate slightly different results beyond one or two decimal places.

For the convenience of readers who would like to use this program on an IBM PC or compatible, the author is willing to supply a disk with both DX-

BEAM.BAS (GW BASIC source code) and DXBEAM.EXE (executable from DOS) for \$5, postpaid in the US, \$7 for foreign orders. Order from Fred Blechman, 7217 Bernadine Ave., West Hills, CA 91307. Specify 5.25- or 3.5-inch disk.

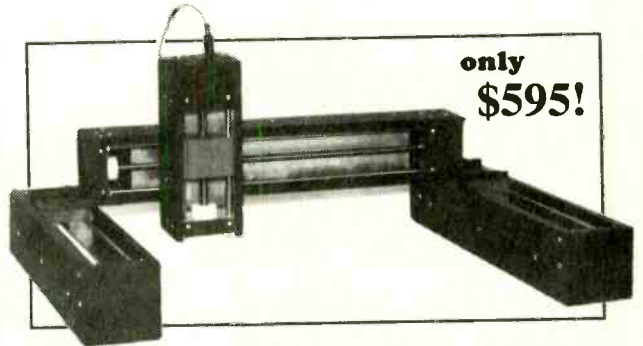


Popular Electronics Market Center™

MACHINE YOUR DREAM!

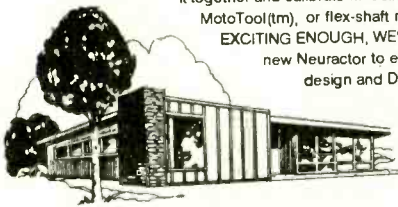
THIS IS THE MACHINE YOU'VE BEEN WAITING FOR!

Have you ever dreamed of manufacturing and marketing your own products? 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 build 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 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 or flex-shaft router and work surface.) It's a complete kit! All you do is put



only
\$595!

it together and calibrate it! Using 32 screw-type micro-calibrators, you calibrate your machine and then TURN IT LOOSE! Designed to be used with a Dremel MotoTool(tm), or flex-shaft router for more cutting power, the Neuractor translates your 3D CAD files directly into actual working parts! IF THAT'S NOT EXCITING ENOUGH, WE'RE THROWING IN A FREE, FULL-FEATURED 3D CAD/CAM SOFTWARE PACKAGE WITH EACH UNIT! Imagine using your new Neuractor to experiment with different product designs and concepts BEFORE taking the business plunge! By working out your product's design and Desktop Manufacturing processes, you can virtually automate the "proof-of-concept" phase of your projects! Built-in fonts for custom sign-making and panel engraving, 18"x18"x4.6" cutter travel for crafts, electronics, and printed circuit board drilling, not to mention model-making, mold-making, and painting. These are but a few opportunity areas others are already exploring with their Neuractors. You build it, you calibrate it, you customize it for your applications! Don't miss out on your chance to cash-in on your own at-home business! Get started by ordering your own Neuractor CNC-4 today! ACT NOW! Kit \$595 +\$24.95 UPS S/H. Allow 4-8 wks for delivery. U.S. CYBERLAB, 14786 Slate Gap Rd., West Fork, AR 72774 (501) 839-8293



KASCO DISTRIBUTING
12338 Martin Alexander Rd. Sardinia, OH 45171 (513) 446-2562

9:00-5:00 EST
Mon-Fri

ELECTRONIC TOOLS AND SUPPLIES WAREHOUSE

24HR FAX
513-446-2609

1-800-575-2726

30 pc Screwdriver Kit
#49140 \$36.55

Soldering Station
#49150 \$59.95

Pin Extractor Interlock Connector
#48855 \$5.25

RS232 Breakout Box
#09676680 \$26.80

Serial Loopback Tester
#08679200 \$6.90

Parallel Loopback Testers...DB25/M...#08742035...\$6.50
EE Check Receptacle Tester...#09448450...\$15.20
Modular Cable Tester...RJ11/RJ12...#09047680...\$29.70
Coaxial Cable Tester...#09147695...\$53.90

HARDWARE

Floppy Drive Screw...#10542155...\$85
 Mounting Rail Screw...#10642160...\$85
 Hard Drive Screw...#10742165...\$1.25
 Expsn Card Hex Scw...#10842170...\$1.50
 Comp Case Hex Screw...#10942175...\$1.50

Anti-Skid Feet
#11146460 \$1.80

Thumbscrews
#48985 \$.41/bag

D-Sub Hex Posts...#04945030...\$1.05
 D-Sub Barrel Nuts...#05345025...\$.95
 PC Case Hanger Brackets...\$.80
 Mthbrbd Spacer Sprts...#10446400...\$1.50

• CABLES • SURGE/SPIKE PROTECTORS • TOOL KITS
• BOOKS • STATIC CONTROL
• CONNECTORS & MORE!

**** FREE CATALOG ****

CIRCLE 152 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

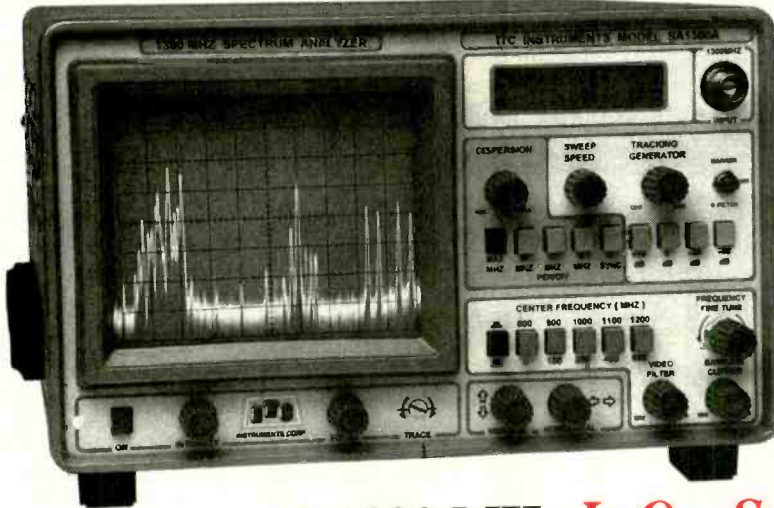
SPY SUPPLY, 1212 Boylston St. #120, Chestnut Hill, MA 02167

(617) 327-7272

Sold for educational purposes only

500 MHz **SPECTRUM ANALYZER** \$895.

MADE IN THE USA ITC SA500A is a full function Spectrum Analyzer covering all Ham Radio, Two way Radio, TV, & CATV frequencies bands to over 500 MHz. * Add Opt. 3 Narrow Band Filter for only \$200 and the SA500A becomes a full range *Pan Adapter / Spectrum Display Monitor** The SA500A Includes Center Frequency Display, 50 MHz Marker Generator, 50 MHz Tracking Generator, -100 dB Dynamic Range, 80dB on Screen, and -100 dBm Sensitivity.



INTRODUCTORY OFFER

SA500A With Center Frequency Display, 500 MHz Tracking Generator plus: 50 MHz Marker Generator
ONLY \$895.00 *

SA1850S Covers 850 to 1850 MHz in One Sweep, LNB Power Supply, 110/220/2vdc/Battery Operation, Carrying Case Center Freq. Display. The lowest cost Satellite Analyzer available.
ONLY \$1295.00*

SA1300B & OPT.'s 1, 3, 4, 6
ONLY \$1895.00*

SA1800C & OPT.'s 1, 3, 4, 6
ONLY \$2295.00*

SA600A	\$1295.00
SA1300B	\$1595.00
SA1800C	\$1895.00
OPT. 1 50MHz Marker Generator	\$200.00
OPT. 3 +/- 5KHz Res. B. W. Filter	\$350.00
OPT. 4 12 VDC Inverter Adapter	\$100.00
OPT. 5 1000 MHz Tracking Generator	\$250.00
OPT. 6 7 Digit Center Frequency Display	\$300.00

* Note: Introductory Prices for limited time only

AS SHOWN **1-1300 MHz In One Sweep** \$1,895.

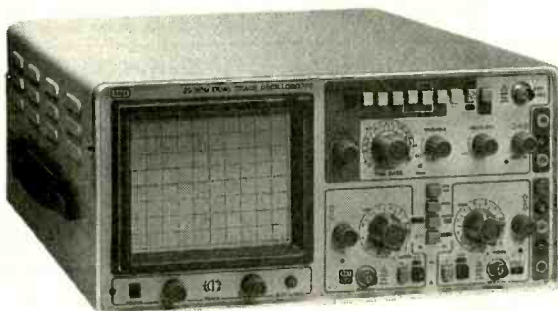
MADE IN USA +/-5KHz Resolution Band Width - 7 Digit Center Freq. Display - 12vdc operation -110 dBm Sensitivity, 120 dB Dynamic range, **80 dB ON SCREEN**, Exclusive **DISPERSION ZOOM** Allows scan widths 0 MHz to 1300 MHz at any Dispersion preset stop, Total flexibility and ease of operation.

All New ITC *Low Cost High Performance* Oscilloscopes

25 MHz Dual Trace w/ 3 in 1 TestLab \$429.
+5/1A, +/-12V/.2A DC Outputs Dual Component Tester

25 MHz Dual Trace \$339.

40 MHz Dual Trace Delayed Sweep \$549.



25 MHz Scope / Tester
model ST3324

1 mV Vertical Sensitivity
X - Y modes, Z Axis
(intensity modulation)

Dual Component Tester
Dual Component Comparator
Triple Output DC Supply
+5 / 1A, +/- 12 / .2A

6" Bright 2KV CRT
Rise Time <14 nS
Full TV Trigger TV-H, TV-V

25 MHz less tester same spec.

model SO3304 **\$339.00**

40 MHz Delayed Sweep
model SD3315

Delayed Sweep nS -1 Sec.
6" Very Bright 12kV CRT
Rise Time < 8 nS

40 MHz special \$549.00

ITC Oscilloscopes fill the bill without emptying the pocket book ITC Scopes are a cut above all other low cost scopes on the market today. You can depend on ITC Quality - Performance & Dependability. Plus a full Two Year warranty parts and labor.

Take **ADVANTAGE**
Call 800-566-1818 Today

ADVANTAGE INSTRUMENTS CORP.

3817 S. CARSON ST. # 818 CARSON CITY NV. 89701
702-885-0234 FAX 702-885-7600

PRICES & SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE OR OBLIGATION. F.O.B. CARSON CITY NV. NV. RESIDENTS ADD SALES TAX.

CIRCLE 148 ON FREE INFORMATION CARD



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.
Rubber Holster \$8.00
Temperature probe \$7.00



DMM 21 \$74.95

Inductance: 1μH-40H
Capacitance: 1pF-200 F
Frequency: 1Hz-1MHz
Volt, amp, ohm, diode, continuity
3999 count display
TTL logic, HFE
Peak hold
Ruggedized case
Rubber holster \$8.00

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

Full line of DMMs, economy, compact, ruggedized, solar cell, automotive heavy duty, industrial starts from \$15.95



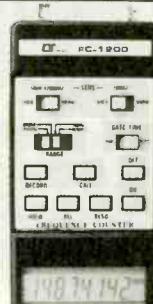
LCR Meter 131D \$229.95

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
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 from test fixture
Best for high frequency RF and surface mount components.
SMD and chip component test probe \$25.00, Deluxe carrying case \$5.00



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

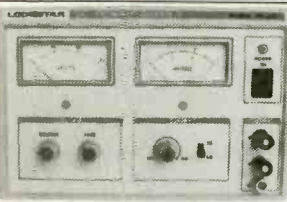


20 MHz Oscilloscope with Delay Sweep PS-205 \$429.95

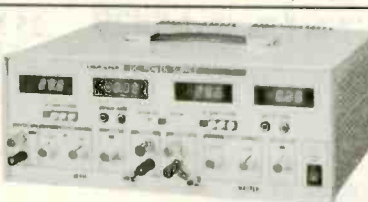
Dual Trace, Component test. 6" CRT, X-Y Operation, TV Sync, Z-Modulation, CH2 Output, Graticule Illum, 2 probes each has x1, x10 switch. Best price with delay sweep.
PS-200 20 MHz DUAL TRACE \$339.95
PS-400 40 MHz DUAL TRACE \$494.95
PS-405 40 MHz DELAY SWEEP \$589.95
PS-605 60 MHz DELAY SWEEP \$789.95
Scope Probe: 60MHz x1, x10 \$13, 100MHz x1, x10 \$22

20 MHz Digital Storage Oscilloscope DS-203 \$729.95

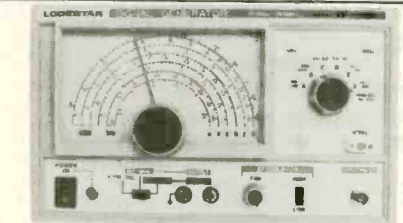
Switchable between digital and analog modes
2 K word per channel storage
Sampling rate: 10 M sample /sec
8 bit vertical resolution (25 Level/div)
Expanded Timebase 10ms/div - 0.5 s/div.
Refresh, Roll, Save all, Save CH2, Pre-Trig
Plotter Control
250MHz x1, x10 \$29, 250MHz x100 \$39



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



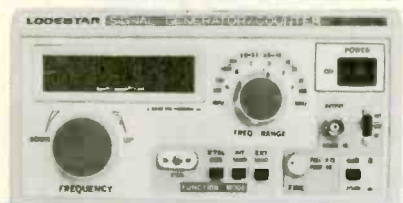
DC Power Supply Triple Output PS-8202 \$499.95
Two 0-30 VDC, 0-3A outputs
One fixed 5VDC, 3A output
Capable of independent or tracking operation
Constant voltage and constant current mode
Four digital meters for volt and current display
Excellent regulation and low ripple
Short circuit and overload protected
Also available: 30V/5A triple output \$549.95
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 100mVrms 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
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
Frequency counter 1Hz-150MHz for internal and external sources
Sensitivity <50mV

FUNCTION GENI/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

FAX: (609) 520-2007

15 DAY MONEY BACK GUARANTEE. 1 YEAR WARRANTY
Visa, Master Card, American Express, COD, Purchase Order Welcome

CALL OR WRITE FOR FREE CATALOG AND BEST OFFER.

CIRCLE 26 ON FREE INFORMATION CARD



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.

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



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.



Continuous Coverage



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.

- 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

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



Hand Held Scanners

Bearcat 200XL TN

\$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 150XLT 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.






FLY IT! ONLY \$9.95

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 25W
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
1µH 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 accy
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	70 Series
Model 97 \$1,795	Model 7011 \$69.95
10 Series	Model 7311 \$97.50
Model 10 \$62.95	Model 7711 \$149
Model 12 \$84.95	Model 7911 \$175
20 Series	80 Series
Model 2911 \$175	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.

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

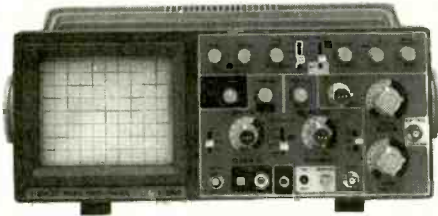
CIRCLE 32 ON FREE INFORMATION CARD

**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

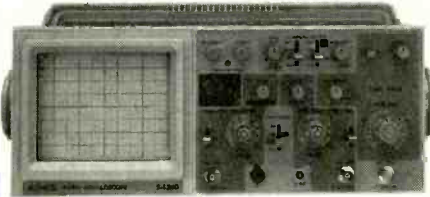
S-1360 \$775

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
- Z 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**

- Autoset, 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**

PRICE'S SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 32 ON FREE INFORMATION CARD

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 Diskettes 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



CALL TOLL FREE 1-800-543-4330
FAX 1-915-434-0958

For Your Free Catalog

1-800-543-4330

Product questions...1-800-824-TECH(8324)



MCM ELECTRONICSSM

650 CONGRESS PARK DR.
CENTERVILLE, OH 45459-4072

A PREMIER Company

POP-14

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!**



**Forest
Electronics
Inc.**

Are you overpaying . . .
. . . your cable company?

You are if . . .

. . . you are leasing their
equipment.

- Forest Electronic, Inc. offers a complete line of New Cable Equipment that is 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 At:

800-332-1996

FAX: 708-860-9048



FOTRONIC

QUALITY ELECTRONIC
TEST EQUIPMENT

Sales • Service

- Specialists in - Fluke,
Hewlett Packard, Tektronix

We buy surplus
Electronic Equipment
FAX your list!!!

- NIST Traceable/Mil Spec 45662A
Calibration Available

TECHNICAL SUPPORT

Oscilloscope Specials

Tek 465	100 MHZ	\$499.00
Tek 465B	100 MHZ	\$599.00
Tek 475	200 MHZ	\$699.00
Tek 475A	250 MHZ	\$799.00

ALL EQUIPMENT SOLD WITH WARRANTY

For more GREAT VALUES Call, Write, or FAX
P.O. Box 708, Medford, MA 02155

(617) 665-1400 FAX (617) 665-0780

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.

Electronics made Easy with UCANDO



**Complete Course in Basic Electronics
Includes 6 one hour videos and 6 workbooks.**

Everything you need to learn basic electronics. You will learn about Direct Current, Alternating Current, Semiconductor devices, Power supplies, Amplifiers, and Oscillators. These videos are **100% computer animated**. Don't waste any more of your valuable time reading and re-reading the same material to try and understand these simple concepts when you can "see it happen." These videos will...teach you more in less time...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 more complete...and help you build your future today. **Your future is too important to gamble with**, so order your course in Basic Electronics today.

Call Now...ask about our other popular UCANDO videos in Digital, AM Radio, FM Radio, and Fiber Optics. These videos are currently being used by Tech-Schools, CET's, Military branches, Ham Operators, Industry, and are sold in six foreign nations. After you have seen your first UCANDO video, you will understand why UCANDO is....

*"Changing The Way The
World Learns Electronics."*

Part 1 DC	\$44.95
Part 2 A	\$44.95
Part 3 Semiconductors	\$44.95
Part 4 Power Supplies	\$44.95
Part 5 Amplifiers	\$44.95
Part 6 Oscillators	\$44.95

Save...buy all 6 for only \$240.00



Call toll free 1-800-678-6113

or mail check or money order to:

UCANDO Videos

P.O. Box 928

Greenville OH 45331

Call for our FREE catalog.

CIRCLE 136 ON FREE INFORMATION CARD

GENUINE Electronics, Inc.

Cable TV & Electronic Equipment

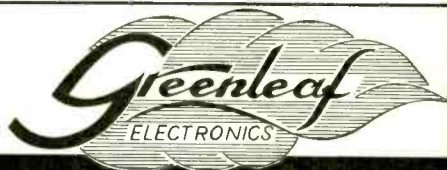
*Genuine Electronics, Inc.
can help you with virtually
any electronic need:*

- 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



CABLE TV Converters & Descramblers

Compatible with

**Jerrold, Scientific Atlanta,
Pioneer, Oak, & Hamlin
Equipment**

BRAND NEW!

90-DAY 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.

Are Cable Companies Sucking You Dry?



**FREE
Catalog!**

**All Major
Brands!**

Take a Bite out of High Rental Fees
with your own

Converters & Descramblers



Everquest • Panasonic • Jerrold • Zenith • Pioneer
Scientific Atlanta • Oak • Eagle • Hamlin • Tocom



Order
Toll-Free **1 800 624-1150**

Call today for a FREE catalog!

MD Electronics

875 S. 72 Street • Omaha, NE 68114



Double Your Income! Own your own computer repair business or add computer repair to your existing business.

TechServ can put you into your own computer repair business quickly, economically and efficiently. Research indicates that during a recession, computer repair businesses will grow at twice the rate of hardware sales. TechServ's complete support program gives you the opportunity to be a part of this fast growing industry.

• Proven Marketing Plan

• Recognition

Nationally recognized trademarks and logos give you immediate recognition as a professional computer repair specialist in your area.

• Training

- Level 1 286/386/486/586
Troubleshooting, upgrades, advanced diagnostics
- Level 2 Networking/Novel/Unix/Multi-user/
Multi-tasking configuration/Installation/
Maintenance. Prepare for C.N.E.
(Certified Network Engineer) test

• Parts and Board Repair

Single source for OEM/generic parts and board repair. Order 7 days a week/24 hours a day. \$45 million in parts in stock, ready to ship any where, overnight if required.

• Documentation

We provide manuals, documentation and advanced diagnostic software.

• New Hardware

We provide new hardware for IBM, Compaq, Apple and compatibles at huge discounts. Custom build your own systems.

Over 300 dealers worldwide

Find out why the Wall Street Journal and Fortune Magazine call computer repair the business opportunity of the 1990s.

Call TechServ at (212) 967-1865

or fill out coupon below and mail to:

techserv AUTHORIZED DEALER
SM

*America's largest chain of independent,
licensed computer repair centers*

253 West 28th Street, New York, NY 10001

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

TELEPHONE _____ [PE 2/93]

CIRCLE 130 ON FREE INFORMATION CARD



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

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

Altronics
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

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 5 ranges
- Resistance measurement up to 200M
- Auto power off
- Yellow Case

1 Year Warranty



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)

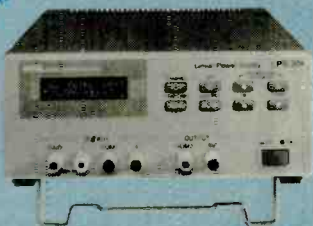
Windward
Products

*We Stand Behind our Products
Satisfaction Guaranteed*

P.O. Box 378, Moffett Field, CA. 94035

AMERICAN RELIANCE

AMREL Offers Lowest Prices & Best Warranties on DC Power Supplies ANYWHERE!



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	\$499	\$599
Sale Price	\$149	\$179	\$199	\$375	\$469	\$219	\$199	\$285	\$350	\$379	\$569

PRINTTM
Products International Inc.



Call: 1-800-638-2020



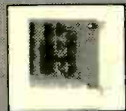
8931 Brookville Road • Silver Spring, Maryland 20910 • Fax: 800-545-0058 • Technical Support: 800-654-9838

CIRCLE 150 ON FREE INFORMATION CARD

CONTROL MEASURE INPUT

RELAYS • LIGHTS • MOTORS
TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY
SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79



- PLUGS INTO PC BUS
- 34 LINES DIGITAL I/O
- 8 CHANNEL
- 8 BIT A/B IN
- 32 BIT COUNTER
- UP TO 14K SMP/SEC

MODEL 30 SOFTWARE

- SCHOONER... \$25
- REAL TIME DATA PLOT • DISK DATA LOGGING
- SOFTWARE CALIBRATION
- PROTEUS (REQUIRES SCHOONER) ... \$95
- GRAPHICAL DATA VIEW • ANALYSIS OF DATA

MODEL 150-02 \$179



- RS-232 INTERFACE
- TENS, 20 AMPS
- 12 BIT A/B
- 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
- 20 LINES DIGITAL I/O
- 3 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 \$239



- RS-232 INTERFACE
- 18 BIT A/B
- 8.5 DIGIT
- UP TO 60 SMP/SEC

Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754
346 BEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

CIRCLE 47 ON FREE INFORMATION CARD

Motion Control System

\$249.95

Includes Stepper Controller Card, 12VCT Transformer, (2) 4 Phase Stepper Motors, Easy to use I.B.M Software! Connects to any I.B.M. Compatible LPT Port (1,2,3)....



* Nothing more to Buy!

- * Easy Installation 15 minutes or Less!
- * No Tools Required!
- * Design Robots, Plotters, Laser Systems!
- * Drives (2), 4 Phase Stepping Motors!
- * Bi-Directional 8 Bit Read and Write Port!
- * Board Addressable, 16 Possible Choices!
- * Fits in Standard 19" inch Card Rack!
- * With Additional Cards Control 32 Motors on 1 LPT Printer Port!
- * Features Include: Variable Speed, Step, Range, Direction, and On/Off Control!
- * Free QBasic & Gwbasic Source Code \$ 59.95 value! *

Send Check or M.O. to:

CYBERMATION

"Intelligent Controllers"

1943 Sunny Crest Dr., Suite 288,
Fullerton, CA 92635

Call Us Today!
Tel (714) 992-2266
Visa/Master Charge Accepted

* Add \$12.00 S&H; CA residents please add sales tax *

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-RE
Elgin, IL 60121

708-697-0600

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

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

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

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 \$1⁰⁰

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).

\$11⁷⁵ 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.



\$3⁰⁰ each

CAT # VCU-8

10 for \$28.00 • 100 for \$250.00

MINIATURE TOGGLE



D.P.D.T. (ON-ON)

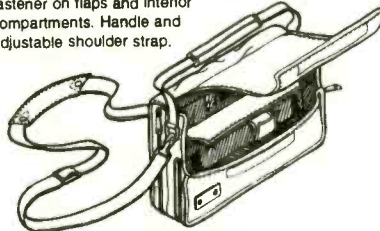
ALCOSWITCH # MTM206NPC
Short bat handle,
0.25" long.
PC terminals
CAT # MTS-92PC

\$1²⁵ each

25 for \$25.00 • 100 for \$90.00

PADDED CASE

Great looking, high quality, black padded carrying case. Originally made for portable cellular phones, the main interior compartment is 10" X 2 3/4" X 7". Ideal for pull-out stereos, phones, cameras or test equipment. Zippered compartment for thinner items such as handbooks, tapes, CDs and batteries. Velcro fastener on flaps and interior compartments. Handle and adjustable shoulder strap.



CANVAS COVER

CAT # CSE-1 \$5.00 each

VINYL (SIMULATED LEATHER) COVER

CAT# CSE-2 \$6.00 each

3" SPEAKER W/ BAFFLE

We don't know the original application for these speakers, but they're well made and will handle a lot more power than their size would indicate. According to our primitive tests they provide good mid range response at 30 watts or better. The well-constructed 3" 6 ohm speaker has a heavy magnet and a foam-edged paper cone. It's conservatively rated at 7 watts, but the 7" deep, fiberglass filled baffle enables it to sound good at much higher power. Give them a try for car or home applications.



\$6⁰⁰ each

CAT # SK-31

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 \$5²⁵ each

LASER POINTER



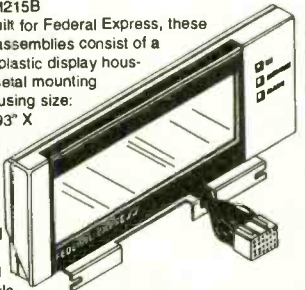
The "Infiniter"™ # QPON-670-210 Projects a bright red spot up to 100 meters. An excellent business or educational aid. Settings for continuous or flashing beam. LED indicator. Low battery indicator. Includes 2 AAA batteries. Hi-tech ergonomic gun-metal gray and black case.

CAT # LP-210

\$69⁹⁵ 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 standard 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.



\$32⁰⁰ each

CAT # LCD-24

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

INSTEK Test & Measuring Instruments

DC POWER SUPPLIES

PR-Middle Series (Analog/Digital)

ISO 9002
CERTIFICATION
#934163



MODEL #PR6030D (Digital)
Regular \$500.00
Sale \$399.95

MODEL #PR6030 (Analog)
Regular \$379.00
Sale \$299.95

- 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	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 46 ON FREE INFORMATION CARD

**Earn \$4,000 Per Month
From Your Home
With A Computer!**



FREE CBSI 486 Computer

Begin part-time and still retain the security of your present position. This is a proven turnkey business an individual or couple can run. If you purchase our software and business program, we will give you the computer and printer. If you already own a computer, you may receive a discount. You do not need to own, or know how to run, a computer—we will provide free, home office training. Financing available. We accept AMEX, MC, Visa and Discover.

To receive free cassettes and color literature, call:

1-800-343-8014, ext. 1681

Or Write:

Computer Business Services, Inc.
CBSI Plaza, Ste. 1681, Sheridan, IN 46069



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 _____

CircuitMaker[®] vs. Electronics Workbench[®]

A NEW STANDARD HAS JUST BEEN SET!

State-Of-The-Art Analog Simulation

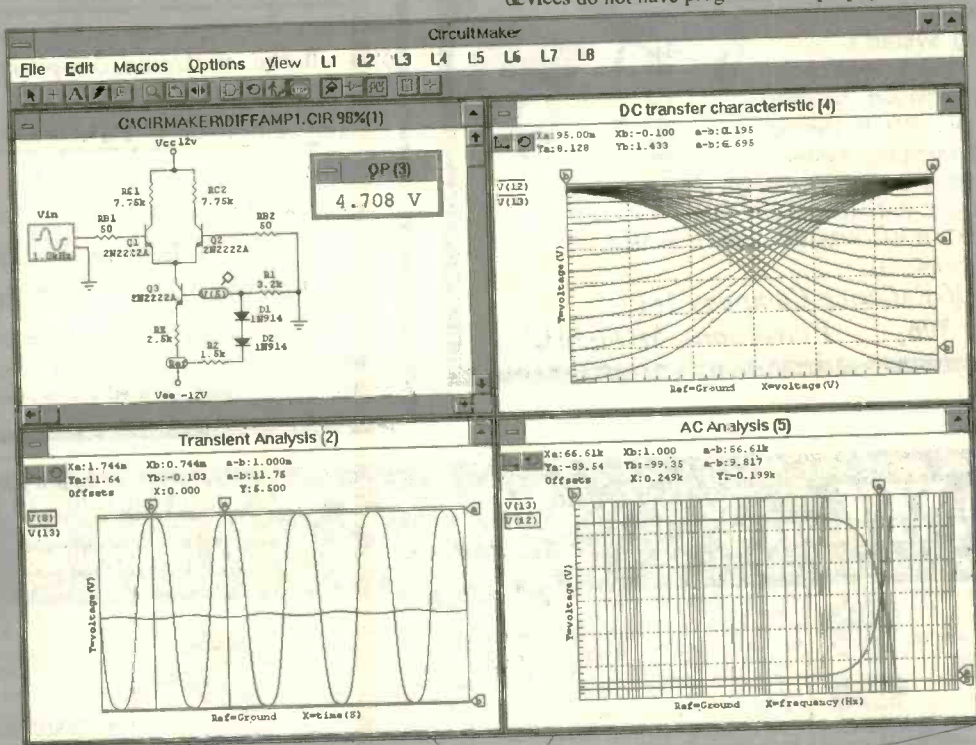
CircuitMaker's analog simulation results are shown in graph windows that provide powerful, interactive analysis options. You can plot multiple waveforms by clicking on the desired nodes and can select linear or logarithmic axes. Horizontal and vertical cursors facilitate quick and accurate measurements. 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.

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
or sent direct for \$10 s&h

CIRCLE 42 ON FREE INFORMATION CARD

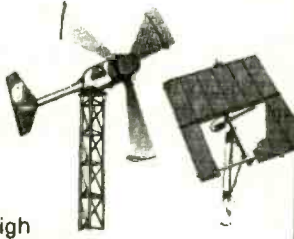
Tap into a World of...

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



CABLE TV Descrambler

New Product Announcement

New Video Circuits COD

Universal 5000

***\$189.95**

This new Fully Assembled unit with our latest technology circuits is guaranteed to work on your system. Order now while supplies last!

FREE In-House Technical Support

Universal Kit 4000

***\$79.95**

Includes our new advanced custom PC board plus all the electronic components, with full documentation.

Kit Enclosure Pak 4000A

\$44.95

Includes custom enclosure, AC adaptor, nuts screws, knobs, momentary switch.

1-800-664-6999



No Florida Sales!

***Limited Time**

It is not the intent of The Halcyon Group to defraud any pay tv operator and we will not assist anyone in doing the same. Kits should be used for educational purposes only.

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
 Worlds 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
 Worlds 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.

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

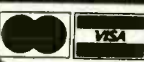
- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Use with any modular phone.
- 16 levels of voice masking.
- Connects between handset and phone.



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



WE ACCEPT VISA, MC, MO, COD
 SHIPPING & HANDLING EXTRA

TOLL FREE ORDER LINE

1-800-336-7389

ASK FOR FREE CATALOG OF OUR PRODUCTS

SEND MAIL
 ORDERS TO:

XANDI ELECTRONICS
 BOX 25647
 TEMPE, AZ 85285-5647

CIRCLE 134 ON FREE INFORMATION CARD

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	\$65.00

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

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!



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

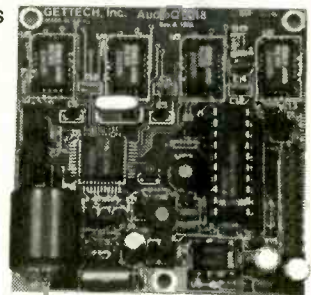
FCC LICENSE TRAINING, Dept. 240
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

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.

PCBoards

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

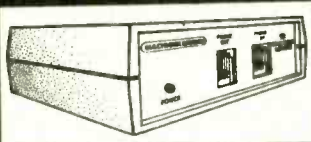
Call or Write for Full Product Line, Prices & Demo Packages

PCBoards
2110 14th Ave. South
Birmingham, AL 35205

(800) 473-7227
Fax (205) 933-2954
Phone (205) 933-1122

RAINBOW KITS

The Exciting New TELEPHONE MONITOR



Monitors your phone system, See how accurate your phone company really is!

1. 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.

2. RECORDS INCOMING CALLS :

- Date & time of call.
- How many times phone rings.
- If answered the length of call.

3. 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.

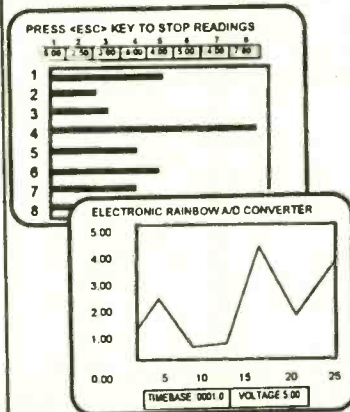
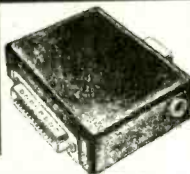
All software included!

TM-1 ONLY **\$99⁹⁵** KIT

BUILT **\$169⁹⁵**

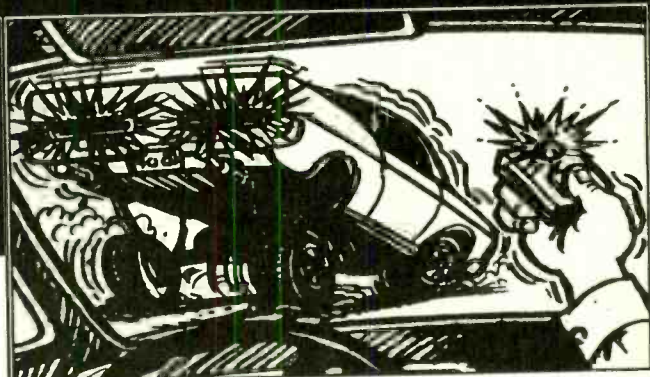
8 CHANNEL A to D CONVERTER KIT

Complete with Software. Over 20 DOS programs provided!



- Connect your computer to the outside world through a parallel port!
 - Monitor eight separate 8 bit analog inputs simultaneously and display them digitally or graphically.
 - Use your computer as an oscilloscope using the provided DOS software!
 - Hardware selectable 0-2.5 VDC or 0-5 VDC input range. Chart provided to calculate scaling resistors (resistors not included).
- SIZE: 3"x2.5"x1" case. Mates to parallel port on back of PC.

AD-8 ONLY **\$89⁹⁵**

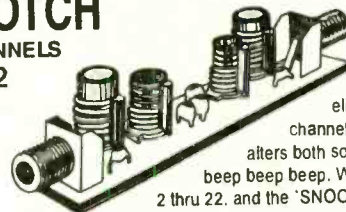


THE ZAPPER activates any radar detector within 3/4 of a mile. Check the brake lights of that sports car that just went by 90 miles an hour. Back off that 18 wheeler trying to eat your back bumper. Put the fun back in driving. THE ZAPPER is a 10GHz amateur transmitter the size of a cigarette pack, operates on a 9v battery, when the button is pushed, brake lights and radar detector light the skies. Complete with the rules of the new ROAD WARRIOR GAME...TROLLING FOR TAIL LIGHTS, Americas fastest growing highway participatory sport.

Built **\$49⁹⁵**
Kit **\$39⁹⁵**

TV NOTCH

FOR CHANNELS 2 thru 22 ONLY

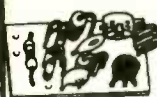


FILTERS

Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep beep beep. Works on cable channels 2 thru 22. and the 'SNOOPER & BULLET'.

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**



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**

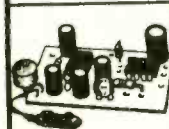


WIRELESS FM MICROPHONE

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-1 **\$14.95**



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**



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 **\$89.95**



This Manual contains all schematics, parts lists & P.C. board layouts for all 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



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 68 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 146 ON FREE INFORMATION CARD

CABLE DIRECT

CONVERTERS
DESCRAMBLERS
VIDEO STABILIZERS
FILTERS



100%
MONEY BACK
GUARANTEE!

30 DAY
FREE
TRIAL!

FREE Cable TV Catalog.

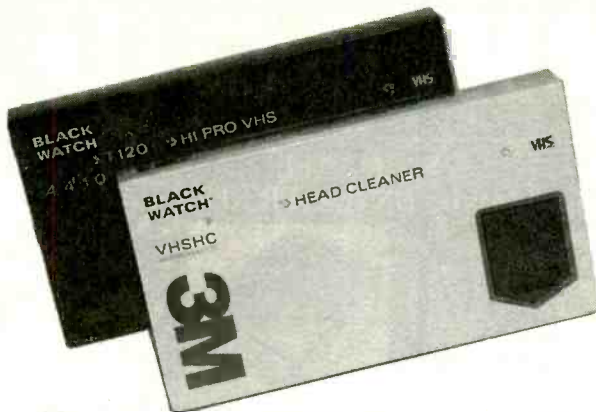


Now you can tune-in your favorite cable TV programming and SAVE \$100'S - EVEN \$1000'S on premium CABLE TV EQUIPMENT.

MODERN ELECTRONICS

1-800-906-6664

2125 S. 156TH CIRCLE • OMAHA, NE 68130



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 _____

**PE MARKET CENTER
CLASSIFIEDS**

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.

FREE INFORMATION! Allow the Government to finance your electronics, small business. Loans/grants to \$687,900.00. Call 24 hour, free recorded message: (810) 825-6700, Dept. 1490.

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.

YOUR OWN electronics supermarket. Pagets, security, automotive, healthcare, entertainment. The opportunity you've been looking for! Info write PO Box 8000-123, Basalt, CO 81621.

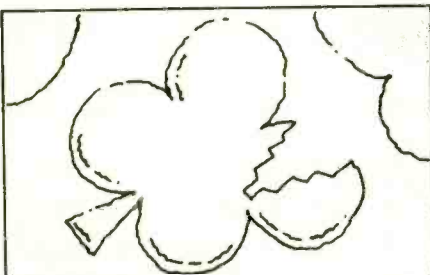
COMPUTER SOFTWARE

FREE CATALOG Thousands of quality IBM shareware programs at super low prices, bonuses, latest releases, cdroms fast service. Prestige Distributors, PO Box 27, Yaphank, NY 11980-0027.

IVY — INVENTORY and electronic cataloging software for replacement parts. \$299.00. Free literature. Rossknecht Software (503) 885-2197.

COMPONENTS

HIGH VOLTAGE transformers, Tesla parts, enamelled wire, plans. Catalog \$1.00 K&D Electric, PO Box 659, Newcastle, OK 73065.



**THERE'S NO SUCH THING AS
A STROKE OF GOOD LUCK.**

Know the warning signs. Early detection may save your life.



**American Heart
Association**

© 1992, American Heart Association

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

1-800-772-6244 M-F: 9-6 EST

U.S. Cable TV, Inc. Dept.: KPE015

4100 N. Powerline Rd, Bldg. F-4 Pompano Beach FL 33073

NO FLORIDA SALES!

Technicians Professional Tool Case



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)

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, DIAMONDTel, 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

SMALL MIRACLES



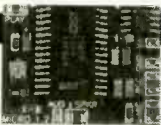
NEW MICRO TX2000 KIT

\$59⁹⁵ -SMALLEST 120 MW FM VOICE/PHONE TRANSMITTER
 -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"x7/8"x1/4"
 -CRYSTAL CONTROLLED DIGITAL SPEECH INVERSION
 -7-15 VOLT DC SUPPLY
 -LOUD HALF WATT AUDIO AMPLIFIER
 -EXCELLENT AUDIO QUALITY
 -INCLUDES FULL DOCUMENTATION
 -DUPEX SCRAMBLE & DESCRAMBLE
 AT THE SAME TIME



MICRO 1.2 VOICE RECORDER

\$69⁹⁵
 -SMALL SIZE 1-1/4"x15/16"x1/4"
 -HUNDREDS OF APPLICATIONS
 -EXCELLENT AUDIO QUALITY
 -60 SECONDS REPLAY
 -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 800 MEM.)
 -SMALL SIZE 1-3/16"x1-3/8"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 7% SALES TAX
TECH. SUPPORT: 518-381-1057
TECH. FAX: 518-381-1058



1145 CATALYN STREET
 SCHENECTADY, NY 12303

TO ORDER: CALL 1-(800)-588 4300



**Coil Design and
 Construction
 Manual**

E. S. SAGAN



YOU CAN WIND YOUR OWN COILS?

There's no trick to it except knowing what you are doing. In a unique, 106-page book you can become expert in winding RF, IF, audio and power coils, chokes and transformers. Practically every type of coil is discussed and necessary calculations are given

with the mathematical data simplified for use by anyone. Get your copy today!

Mail coupon to:

Electronics Technology Today, Inc.
P.O. Box 240 • Massapequa Park, NY 11762-0240

Please send me my copy of *Coil Design and Construction Manual* (BP160). I enclose a check or money order for \$8.45 to cover the book's cost and shipping-and-handling expenses. NY state residents must add local sales tax.

Name

Address

City State ZIP

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery.

PE MARKET CENTER CLASSIFIEDS

MISCELLANEOUS ELECTRONICS FOR SALE

VIDEO GAME training videos for NES, Super NES and SEGA Genesis, tools, parts, schematics. Send SASE for free catalog. **Irata Systems**, 2562 East Glade Ave., Mesa, AZ 85204-6208.

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.

1500 PIECE resistor assortment, at least 30 different values at 5% or better tolerance in a divided clear plastic case, for only \$11.00 plus \$5.75 shipping and handling. **Findley Digital Equipment**, 1010 Columbia Avenue., Lancaster, PA 17603.

TECHNICIAN'S ELECTRONIC assortment, over 2400 Components & parts, some new, some pulls, some surplus, all useable. Includes: resistors, capacitors, transistors, diodes, ICs, LEDs, EPROMs, RAM, CPU, motor, relays, microphone, buzzer, and other parts, all in a divided clear plastic box. Send \$19.95 plus \$5.70 for shipping and handling to: **Findley Digital Equipment**, 1010 Columbia Avenue., Lancaster, PA 17603.

VOICE RECORDER — 10 seconds of high-quality audio reproduction, 100 year zero power storage, automatic gain control, 50 milliwatt speaker amplifier, automatic power-down, all on a STAMP size board! (25mm X 25mm) Send \$29.95 + \$3.95 (S&H) to **S.F.A. Electronics**, 8668 Limonite Ave., Riverside, CA 92509.

NEWS NETWORKS, sport, uninterrupted music, radio reading services are available on SCA sub-carriers. **SAP** offers weather bulletins, TV related audio, and radio reading. For catalog of SCA/SAP receivers and other unique items, send \$1.00 (refunded on first purchase) to **AJL Enterprises**, PO Box 5354, High Point, NC 27262.

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 \$149.95
- 20-Channel Dish System \$124.95

• Optional Commercial Grid Antenna (not shown) Add \$50.00
• Yagi 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)

Dish System
LIFETIME WARRANTY
MasterCard • Visa • American Express • CDD's • Quantity Pricing

EDUCATION

COMPUTER COMMUNICATIONS video, modems and data bases. Explained in a manner designed to entice even the novice computer owners into this beneficial area of use \$29.95: **R. Rao Group**, Box 325, Dunedin, FL 34697.

LEARN IBM PC ASSEMBLY LANGUAGE Disk \$5.00, Book \$18.00. ZIPFAST, Box 12238, Lexington, KY 40581-2238.

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.

**Home Automation &
Computer Control**

Two Way IR,
Two Way X-10,
& Hardwire.

Control many I/O devices
from one serial computer link
or stand-alone operation.

CompCo Information
(615) 436-5189

Call our BBS [28.8,n,8,1]
(615) 244-4445

Download RIBinfo.ZIP

CIRCLE 144 ON FREE INFORMATION CARD

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 TX-90
- RF POWER: 20 mW @ 9 VOLTS FREE CATALOG \$49.95

AUDIO INVESTIGATIVE EQUIPMENT
1936 Rinaldi Street, Bldg. 146, Unit G
Northridge, CA 91326 (818) 831-0515

SURVEILLANCE
& COUNTERSURVEILLANCE Electronic Devices

Cover Video Cameras • Transmitter Kits • Voice Changers
Bug and Phone Tap Detectors • Shotgun Mics • Micro Recorders
• Vehicle Tracking • Locksmithing • AND MORE!

"IMPROVED" 7-Hour Telephone Recorder
Tapes incoming/outgoing phone calls automatically. **\$125.00**

FOR CATALOG SEND \$5.00 TO... **SPY OUTLET**
P.O. Box 337, Buffalo, NY 14226 (716) 691-3476

**MULTIMEDIA
on the PC!**

What is Multimedia? What can it do for you? It can do lots of nice things! This 184-page book helps you create your own multimedia presentation. Multimedia applications by people like you can revolutionize educational and business applications as well bring more FUN, FUN, FUN into your leisure computer activities.

Mail coupon to:

Electronics Technology Today, Inc.
P.O. Box 240
Massapequa Park, NY 11762-0240

Please send me my copy of *Multimedia on the PC* (PCP120). I enclose a check or money order for \$18.45 to cover the book's cost and shipping-and-handling expenses. NY state residents must add local sales tax.

Name _____

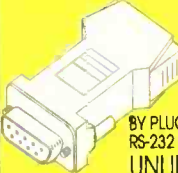
Address _____

City _____ State _____ ZIP _____

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery.

BUILDING BLOCK

FOR YOUR
CONTROL & MONITORING
NET WORK SYSTEMS



DINEX
DISTRIBUTED
INTELLIGENT
NETWORK
CONTROLLER

BY PLUGGING DINEX INTO YOUR PC
RS-232 YOU CAN CONNECT ALMOST
UNLIMITED I/O.

DIO-STD-SM \$69.95
5 TTL DIGITAL I/O

ADFC-SM \$96.65
4 CHANNEL 8 BIT 0-5V A/D
1 CHANNEL FREQ INPUT

D-M232-SM \$79.95
RS-232 TO 485 INTELLIGENT
CONVERTER

LIMITED TIME

INTRODUCTORY OFFER:
\$199.95/kit +S/H

P/N SM-KIT Including:
DIO-STD-SM/ADFC-SM/D-M232-SM, POWER
ADAPTER, NETWORK PHONE LINE SOFTWARE,
DEVICE DRIVER, AND UTILITY. OVER \$450 VALUE.

ALSO AVAILABLE:
8 CH. 12BIT A/D, 12 BIT D/A STEPPER MOTOR
SERVO, DISPLAY, CODE INPUT, NETWORK
CONTROLLER, ETC.
PLS CONTACT FACTORY FOR DETAIL.

TO ORDER CALL: **I/O CONTROLS CORPORATION** 15 DAYS MONEY BACK GUARANTEE
1359 W. FOOTHILL BLVD. AZUSA, CA 91702 VISA/MC/MC CARD ACCEPTED.

(818) 812-5333 FAX: (818) 812-5332

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

Weeder Technologies

FREE
construction plans for
any of these kits
Call 513-752-0279 (24hrs)

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.

Vocal/Effects Mixer

An audio device which hooks up to the "tape monitor" jacks of any home component stereo, and allows you to mix your own voice with the program source (CD, tape, record, FM, etc.) as its being played through your stereo. Features Bass, Treble, and Reverb controls for your voice. Great for having your own karaoke party.

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.

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 (not included) and hook it up! Compatible with all VCR's and TVs. 30 day money back guarantee.

ONLY \$29.95 + \$3.00 S/H Order Now!
WARNING: The DVS is not intended to copy rental video tapes that may constitute copyright infringement.
A-PLUS ELECTRONICS 1-800-877-7587

FREE! 100 PAGE CATALOG WITH PRICES!

- Communications Receivers
 - Portable Receivers
 - Amateur Transceivers
 - HT's & Mobile Transceivers
 - Amateur & SWL Antennas
 - Scanners
 - RTTY and FAX Equipment
 - Computers
 - Test Equipment
 - Books, Manuals, Accessories
- CALL TOLL FREE: 800-527-4642**

TUCKER
ELECTRONICS & COMPUTERS
24-Hour Fax: 214-348-0367
P.O. Box 551419
Dallas, TX 75355-1419

You Need Tree City USA

City trees add the soft touch of nature to our busy lives.

Support Tree City USA where you live. For your free booklet, write: Tree City USA, The National Arbor Day Foundation, Nebraska City, NE 68410.

 **The National Arbor Day Foundation**

EPROM+ PROGRAMMING SYSTEM USES PARALLEL PORT

EPPROMS (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 EPPROMS 28F256, 28F512, 28F010
28F020, 29C257, 29C010, 29F010
EPPROMS & NVRAMS (18,24 & 28 PIN+CXX)
2210, 2212, 2804, 2816, 2816A, 2817, 2864, 2865, 28256
28C010, DS1220, DS1225, DS1230
SERIAL EPPROMS* (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



SYSTEM INCLUDES:
PROGRAMMING UNIT
PRINTER PORT CABLE
POWER PACK, MANUAL
AND SOFTWARE.

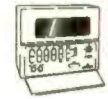
\$289

ADD \$5.00 SHIPPING
\$5.00 C.O.D.
VISA/MASTERCARD

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

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 56 page Color Catalog

800-FOR-XTEN (800-367-9836)
HOME AUTOMATION SYSTEMS, Inc.
151 Kalmus Dr., Ste M6, Dept. PE1, Costa Mesa, CA 92626
Questions 714-708-0610 Fax 714-708-0614

PE MARKET CENTER CLASSIFIEDS

!! BROADCAST & SURVEILLANCE !!
70-120MHz FM Transmitters & RF Amplifiers
RF Power/SWR Meters, Stereo Generator, DC Power Supplies,
Frequency Counters, Audio Limiters, Amature 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
VISA/MC (909) 626-4FAX

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**

FASCINATING DEVICES! FREE plans with parts
special! Super spy microphone \$19.50! Super FM
transmitter varactor tuned \$22.50! Vocal truth de-
tector \$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.

SILENT SAM. Patented vehicle turn signal re-
minder. Outshines others. Brief, timely alerting
signal doesn't bug you. Kit complete w/case
\$15.00 Visa/MC 1 (800) 398-5605, literature. Also,
\$22.00/\$27.00 wired models. Silent Sam, 1627
Basir Dr., Columbus, OH 43227.

Prototype it..... FAST!
with ProtoQuick 8051 or 28
- Complete single board computers
- Up to 30K EPROMs and SR RAM
- 18 pins in plated-through proto area
- P1/P2 C serial port w/ DB25 conn.
- Can type in EPROMs w/ source code
- Assembled, ready to run - \$5. only
- MS-DOS cross assembler included!
ProtoQuick 28 and 8051
\$99.00 each
Software Science
378A Roundbottom Road
Chesham, OH 43024 USA
(513) 561-2060
Run prototype applications or experimental hardware
from the serial port - WITHOUT PROGRAMMING!

CRYSTAL SET Handbook — Visit antiquity by
building the radios your grandfather built. Assem-
ble 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 Tech-
nology Today, Inc., PO Box 240, Massapequa
Park, NY 11762-0240. US funds only! USA and
Canada — no foreign orders.

MUSIC VISION kit displays dynamic multicolor
Lissajous patterns on any unmodified television,
generated from any audio source. PCB and parts
\$140.00 check, moneyorder. USA, Canada only.
VHS demo tape \$9.00. **ELECTROKRAFT**, dept.
13B, PO Box 598, Louisville, CO 80027.

CABLE DESCRAMBLERS Build your own,
SSAVI, gated sync, sinewave. \$14.95.
Cabletronics, Box 30502PE, Bethesda, MD
20824.

WAVEFORM VIEWER Simplify RF circuit con-
struction. FCL and coil winding computer program
and RF applications converter. View results on TV
screen. SASE for information or \$19.95 for book.
Waveform Viewer, PO Box 142042, Gainesville,
FL 32614-2042.

**CHEAP EXOTIC sensors & real surface mount
kits w/tools, manual, & PCBs.** Free catalog.
pcSMT Co., 9047 Willis #3, PC., CA 91402.

**Get your copy of the
CRYSTAL SET HANDBOOK**
Go back to antiquity and build the
radios that your grandfather built.
Build the "Quaker Oats" type rig,
wind coils that work and make it
look like the 1920's! Only \$10.95
plus \$3.50 for shipping and han-
dling. **Claggk Inc., P.O. Box
4099, Farmingdale, NY 11735**
USA Funds ONLY! USA and
Canada—no foreign orders.

PLANS-KITS-SCHEMATICS

BUILD — FIVE-digit, ohms, capacitance, fre-
quency, pulse, multimeter. Board and instructions
\$9.95. Bagnall Electronics, 179 May, Fairfield, CT
06430.

ALL-IN-ONE catalog. AM/FM/ham/spy, trans-
mitters, 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-H1, 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. **CAT-
ALOG** \$2.00 — Garrett Plans, Box 155,
Jamesburg, NJ 08831.

SURVEILLANCE TRANSMITTER kits. 65 to 305
MHz. **Quick & Easy.** Partially assembled units.
Five minutes completion. 110-volt duplex recepta-
cle, room battery types, and telephone. Counter-
surveillance. Catalog: \$2.00. **SHEFFIELD ELEC-
TRONICS, PO Box 377940-B, Chicago, IL**
60637-7940.

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.

BUY BONDS

Bill Nave
saved these
kids from
drowning.



He's not a
lifeguard—he's a
teacher. But to the
kids he's reached,
he's a hero.

**BE A TEACHER.
BE A HERO.**

Call
1-800-45-TEACH.



Photo: Robin Sachs

Reach for the Power
TEACH
RECRUITING NEW TEACHERS. ®

TOP SECRET

CONSUMERTRONICS
2011 Crescent Dr., P.O. Drawer 537
Alamogordo, NM 88310

Voice: (505) 434-0234, 434-1778, 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.**
Add \$5 total SH (US, Canada). All items in stock. VISA, MC card OK. No C.O.D.s or "bill me's". New Catalog (150+ offers) \$2 w/order, \$4 w/b (check or MO) - no. free catalog.
Since 1971. As seen on TV, etc. John Williams - former Lockheed Senior Engineer, NMSU Computer Science Professor, NIH Health Physicist. **WANTED: 9 MAC IIcd, PC386 or better.**
*All software supports all IBM-PC compatible x86 systems (8086 - Pentium)

Off-The-Shell HARDWARE

Van Eck System, Data Card Reader/Writer, ATM2, KX Radar Emitter, Street Sweeper (radar), Lidar, Carjack/Kidnap Foiler, Voice Disguiser, Hearing Assistor, Strike Module, EM Lab & Countermeasure, TENS, 6th Sense Communicator, Phone Color Box, Lineman's Handset, DTMF Decoder, Bug & Tap Detector/Blaster, Subliminal Mixer/Amp, Rifle Device, Hieronymus Machine, Neurophone, Resonant Crystal, Magnetometer, Levitator, Vortex Generator, RF & Microwave, Ultrasonic Jammer & Receiver, Infrared Detector, Long-Range Eavesdropper, Noise Cancelling System, Unknown Presence Detector, Electronic Dowsing - many more devices. See Catalog.

CELLPHONE MODIFICATIONS
See our catalog for our infamous cellphone modification guide (\$69) - 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.

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, SPYDIE, PHONE MAIL, AUDIX, CINDY, CENTAGRAM, 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! While "VOICE MAIL HACKING" details how VMSS are hacked for "phun" and profit - including VMS methods for hacking PBXs themselves - "PBX HACKING" addresses ALL issues relating to PBX hacking, including countermeasures! Can your business or agency afford a \$90,000 phone fraud loss (the average loss due to hacked PBXs)? As described in Forbes Magazine. \$39

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, LD Extenders, Centrex - more. \$29.

PHONE COLOR BOXES

As designed by Phone Phreaks! 15 phone color boxes described. Dozens of circuits, simulator programs. Plus call-forwarding, conferencing, phreak history, 50 useful and legal phone circuit plans - more. \$29.

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. BUSY redial options. Direct modem command and control. All Result Codes, including VOICE and RINGING. Optional shell to terminal program upon CONNECT. Exit to menu or DOS (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 + Disk* \$39.

BEYOND VAN ECK PHREAKING

Eavesdropping on IV 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 designs! \$29.

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.

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-expedient use of technology in various threat and conflict environments and scenarios. \$49.

STOPPING POWER METERS

As reported on CBS' 60 MINUTES - How certain devices can slow down - even stop - watt-hour 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. **I.O. MANUAL:** External magnetic ways (applied to the meter itself) to slow down and stop watt-hour meters while drawing full loads. Plans. \$19. **KW-HR METERS:** How watt-hour meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow and stop meters by others. \$19. Any 2, \$38. All 3, \$59.

AUTOMATIC TELLER MACHINES

ATM crimes, abuses, vulnerabilities and defeats exposed! 100+ methods detailed. Includes: Physical, Rep. 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, lab, 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.

HIGH VOLTAGE DEVICES

HV devices plans: Stun Gun, Taser, Prod, Gane, Flasher, Blaster, Zapper, Audio/Radar, Jammer, Jacob's Ladder, Plasma & Van de Graaff Guns, Fence Charger, Gelgel Counter, Ozon Gen., Fish Stunnet, 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 BRAINBLASTER:** Tutorial and plans for powerful ELECTROMAGNETIC WEAPONS and LAB DEVICES. Optimum circuits, freqs, waveforms, duty cycles, intensities. Through. \$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. **HEALTHYSELF:** Plans for 3 major electronic therapeutic devices of types approved by FDA. \$19. Both \$39.

HARD DRIVE MANUAL

Covers all hard drive and controller implementations (emphasis on PCs). How to select, interface, initialize, set up, use, maintain, troubleshoot and repair them. How to protect them from mistakes, sabotage, prying eyes and sticky fingers. How to recover damaged and lost files. How to prevent crashes. Includes software reviews. Loaded with info, advice, tips. \$29. **DISK SERVICE MANUAL:** Maintain, adjust, align, troubleshoot, repair floppies without special equipment or software. 3.5"/5.25"/8". PCx86, MAC, Apple, Atari, Commodore, etc systems. All floppies need some upkeep. \$29. **DISK DRIVE TUTORIAL:** Theory, practical facts on floppy drives, disks, including many tips, recommendations, formatting, interfacing, FDC, etc. \$24. Any 2, \$49. All 3, \$69.

SOFTWARE PROTECTION SYSTEM

Unique system that highly discourages costly software piracy while permitting legal 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.

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 jam 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 commo. 70+ circuit plans. Tables. \$29.

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.

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.

Sold for educational purposes only.

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.

CBTV DOCTOR Stop the Bullet and ID signal in cable lines. Send \$20.00 to: R.R. Enterprise, PO Box 3532, Easton, PA 18043.

UNSCRAMBLE CABLE. New simple easy build circuits, parts list, instructions. \$5.00 Abate Electronics, Box 143, Hillsdale, NJ 07642.

DIGITAL VIDEO STABILIZER. Eliminates all video copyguards during playback of pre-recorded tapes. \$29.95. For information send a SASE to: Marketing by Design, PO Box 84, Port Murray, NJ 07865.

ANTI-ZAPPER "New!" High tech in-line "Bullet" blocker prevents cable descrambler damage. Special price \$8.95, +\$2.00 S/H. Abate Electronics, Box 143, Hillsdale, NJ 07642.

CABLE DESCRAMBLERS bargain headquarters. all major brands. Absolutely the lowest prices! Nobody beats us. RP Electronics 1 (800) 304-3604.

SATELLITE EQUIPMENT

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.

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.

TEST EQUIPMENT

ELECTRONIC TEST equipment and parts. Free catalog. EF Electronics, Box 326, Aurora, IL 60507.

MUSIC & ACCESSORIES

MIDI ADAPTOR for soundcard, parts & PCB \$12.00. Box for \$5.00. Assembled \$25.00, 6-foot midicables \$8/pair. S&H \$4.00. PME, 112MSC#8, W. Lafayette, IN 47906-3436. Email: pmc@holonct.net.

450 MHz SPECTRUM ANALYZER

Adapted from Nov. '85 QST article by Al Helfrick K2BLA



Features: Three digit LED center frequency readout. 12 position calibrated scan width 1 KHz to 50 MHz, switchable bandwidth; wide = 300 KHz, narrow = 15 KHz. Use your low frequency scope for the display. Switchable 10 KHz video filter; Variable IF attenuator, LOG output calibrated in 10 db steps.

Complete Kit Only \$459.95
Assembled & Tested \$799.95

Smart Battery Charger



JUN 87 QST

BY WARREN DION N1BBH

FOR GEL-CELLS or LEAD ACID BATTERIES. Features: Precision temperature tracking voltage reference & three mode charging sequence. Standard kit is for 12V @ 1/2 or 1 Amp, user selectable. Can be connected to the battery indefinitely, will not overcharge. Weighs 2 pounds and measures 4"W x 5 1/2"D x 2 1/2"H. Finished enclosure included in kit.

Complete Kit Only \$59.95
Assembled & Tested \$79.95

CA Residents add 7.75% sales tax. S&H: \$5.00 (insured). Foreign orders add 20%. For more info or price list, send legal size SASE (52¢) to:

A & A Engineering
2521 W. La Palma #K • Anaheim, CA 92801
(714) 952-2114 • FAX: (714) 952-3280

Cable Aids Test

Orders only Information
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. Quantity prices available. FAX: (310)902-0851

No Ch. sales. Not for use in cable co. owned equip. For use as a test aid only.

CABLE TV DESCRAMBLERS

Never rent again! Save \$100's on premium Cable TV Descramblers & Converters compatible with major brands including Jerrold, Scientific Atlanta, Pioneer, Panasonic & more. Full line of cable accessories. Get your best prices and call us last! Quantity discounts. Satisfaction guaranteed. 1 year warranty and 30 day money back guarantee!

ALLSTAR ELECTRONICS 800-782-7214

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

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.

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!

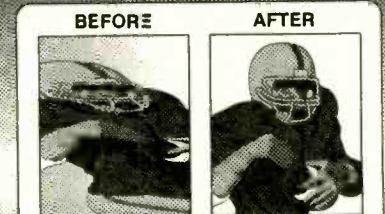
UNJAM NOW WITH Video Decoder

• 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

IMPROVE YOUR IMAGE!

WITH OUR VIDEO STABILIZERS



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

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

USE PE MARKET CENTER CLASSIFIEDS

READ BY 87,877 BUYERS OF ELECTRONIC EQUIPMENT ACCESSORIES AND PARTS

INSTRUCTION FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy **CLEARLY** (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is \$1.00 per word. Minimum charge is \$15.00

per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT

All classified advertising in the **PE Market Center** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March, 1995 issue that is on sale January 17. The PE Market Center is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. **NO REFUNDS**, advertising credit only. No phone orders.

AD RATES: \$1.00 per word, Minimum \$15.00.

Send your ads with payment to:

Popular Electronics Market Center, 500-B Bi-County Blvd. Farmingdale, NY 11735

CATEGORIES

100 — Antique Electronics	270 — Computer Equipment Wanted	450 — Ham Gear Wanted	630 — Repairs-Services
130 — Audio-Video-Lasers	300 — Computer Hardware	480 — Miscellaneous Electronics For Sale	660 — Satellite Equipment
160 — Business Opportunities	330 — Computer Software	510 — Miscellaneous Electronics Wanted	690 — Security
190 — Cable TV	360 — Education	540 — Music & Accessories	710 — Telephone
210 — CB-Scanners	390 — FAX	570 — Plans-Kits-Schematics	720 — Test Equipment
240 — Components	420 — Ham Gear For Sale	600 — Publications	

CLASSIFIED AD COPY ORDER FORM

Ad No. 1—Place this ad in Category # _____

1 - \$15.00	2 - \$15.00	3 - \$15.00	4 - \$15.00
5 - \$15.00	6 - \$15.00	7 - \$15.00	8 - \$15.00
9 - \$15.00	10 - \$15.00	11 - \$15.00	12 - \$15.00
13 - \$15.00	14 - \$15.00	15 - \$15.00	16 - \$16.00
17 - \$17.00	18 - \$18.00	19 - \$19.00	20 - \$20.00
21 - \$21.00	22 - \$22.00	23 - \$23.00	24 - \$24.00
25 - \$25.00	26 - \$26.00	27 - \$27.00	28 - \$28.00

29 - \$29.00	30 - \$30.00	31 - \$31.00	32 - \$32.00
33 - \$33.00	34 - \$34.00	35 - \$35.00	36 - \$36.00
37 - \$37.00	38 - \$38.00	39 - \$39.00	40 - \$40.00

Ad No 1—Total words _____ x \$1.00 per word = \$ _____
 All Caps words _____ x .20 per word = \$ _____
 Bold words _____ x .20 per word = \$ _____
 Bold Cap words _____ x .40 per word = \$ _____

TOTAL COST OF AD No. 1 \$ _____

Card # _____

Expiration Date ____ / ____

Signature _____

Name _____ Phone _____

Address _____ City State Zip _____

Total classified ad Payment \$ _____ enclosed.

Check MasterCard Visa (\$15.00 minimum credit card order)

ELECTRONICALLY MAINTAIN YOUR PHONE SECURITY!

Electronically monitor the security of your Fax, Modem & Voice Communications. The SC 1100 Wiretap Alarm System was specifically designed to protect your on-premise dedicated phone line from the flood of cheap, easy to use wiretap equipment available from most electronic outlets.

The SC 1100 Wiretap Alarm System:

- Is a self-contained diagnostic instrument employing a programmed microprocessor, fail-safe microelectronics and printed circuit board.
- Automatically isolates on-premise line for greater testing sensitivity.
- Alerts you when changes caused by wiretapping or tampering occur
- One year warranty



Now Only

\$139

(Plus \$7 shipping)
VISA * MC * AMEX

SECURITY CALL INC, 15425 Los Gatos Blvd, Los Gatos CA 95032-2541

ORDER TODAY 1-800-334-0074, Dept 451 SECURITY CALL™

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.

<p>AD-F300 Gorgeo us 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)</p>	<p>AD-700 Mic Range: up to 5 Mile Power 750MW \$272</p>	<p>AD-80 Mic Range: up to 1.8 Mile Power 80MW \$187</p>	<p>AD-550 Tel. Range: up to .5 Mile Power 35MW \$150</p>	<p>AD-400 Mic Range: up to 2.5 Mile Power 400MW \$163</p>
--	--	--	---	--

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. tool

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

Surface Mount Chip Component Prototyping Kits

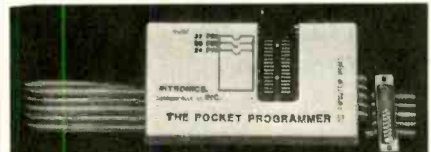


CC-1 Capacitor Kit contains 365 pieces, 5 ea. of every 10% value from 1p1 to .33µf. CR-1 Resistor Kit contains 1540 pieces; 10 ea. of every 5% value from 10Ω to 10 megΩ. Sizes are 0805 and 1206. Each kit is ONLY \$49.95 and available for immediate One Day Delivery!

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



The Pocket Programmer

The portable Eeprom programmer that uses the printer port of your PC instead of an internal card. The software has 24 easy to use functions and programs 27125/28/68764 & 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.

\$129.95
INTRONICS, INC.
Box 13723
Edwardsville, KS 66113
(913) 422-2094

Add \$3.00 for shipping.
Add \$3.75 for COD.
Visa/Master Charge

Universal Programmers

Largest Selection In The World
Also Buy, Sell & Program
Plus Never Undersold

- \$1399 DATA I/O CHIPLABS 4800
 - \$ 849 DATA I/O CHIPLABS 3200
 - \$ 579 EETOOLS ALLMAX
 - \$ 479 EETOOLS PROMAX
 - \$ 479 XELTEK SUPERPRO II
 - \$ 350 XELTEK SUPERPRO (R)
 - \$ 499 LOGICAL DEVICES 3000
 - \$ 499 ADVANTECH PC-UPROG
 - \$ 429 NEEDHAMS EMP-20
 - \$ 779 DATAMAN S4
 - \$ 499 AMERICAN RELIANCE 9860
 - \$ 699 NEEDHAMS SA-20 S/ALONE
 - \$ 139 EETOOLS 1 GANG
 - \$ 199 EETOOLS 4 GANG
 - \$ 159 SUNSHINE 4 GANG
 - \$ 399 SUNSHINE 8 GANG
 - \$2499 STAG PP42 8 GANG S/ALONE
- General Device Instruments
(408) 241-7376 Fax 241-6375

CALL FOR
DEVICE
LISTS

\$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

MARYMAC® The New Realistic® PRO-43 Scanner

Radio Shack®

PHONES

Our 18th year of DISCOUNTS
Toll Free 800-231-3680

PRO-43 List \$349.95

Our Delivered Price \$288.00
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

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
164	3M Electrical/Electronic Products . . . 4	-	I/O Controls Corp. 119
-	A & A Engineering 121	-	Information Unlimited 87
-	A & D Electronics 125	167	Interactive Image Technologies . CV2
-	A-Plus Electronics 120	-	Intronics 125
25	Ace Communications 99	-	ISCET 87
-	Agrelo Engineering 118	148	ITC Instruments 97
26	Alfa Electronics 98	152	Kasko Distributing 95
28	All Electronics 109	-	M & G Electronics 120
-	Allen Engineering 108	-	Marymac Industries 125
-	Allstar Electronics 124	149	MCM Electronics 102
151	AMC Sales 3	-	MD Electronics 105
-	Andromeda Research 124	-	Mega Electronics 121
-	Antique Radio Classified 81	146	Mendelson's 116
-	Audio Investigative Equip. 119	42	MicroCode Engineering 111
147	B & S Sales 103	-	Modern Electronics 116
-	C & C Electronics 121	-	NRI Schools 43
-	C & C Specialties 121	-	Nu-Tek Electronics 80
32	C & S Sales 100	-	PC Boards 114
-	Cellsoft 118	-	Phillips Tech 119
-	CLAGGK, Inc. 30,60,90	47	Prairie Digital Inc. 107
-	Cleveland Inst. of Electronics 63	46	Print 110
-	Command Productions 114	150	Print 107
166	Communications Electronics, Inc. CV3	-	Progressive Concepts 124
-	Communication Specialists 125	-	Rattner North America 117
144	CompCo 119	-	School of VCR Repair 93
-	Computer Business Services 110	-	Security Call 125
-	Comtrad Industries 13,17,CV4	-	Self-Reliance Co. Inc. 112
-	Consumertronics 123	-	Silicon Valley Surplus 125
14	Cooks Institute 3	-	Skyvision (Small) 121
-	Cybermation 107	-	Software Science 121
-	EDE Spy Outlet 119	-	Spy Supply 96
-	EIA 72	-	TAB Books 27,85
140	Electronic Rainbow 115	-	Tandy National Parts 93
-	Electronics Tech. Today 67,91	130	Tech Serv. 106
-	Electronics Tech. Today 110,118	-	Tele View Distributors 108
154	Foley Belsaw Institute 83	-	Tucker 120
-	Forest Electronics 102	136	UCANDO Videos 104
-	Fotronics 102	-	United Electronic Supply 108
-	General Device Instruments 125	-	US Cable (Zentek) 117
-	Genuine Electronics 104	-	US Cable Supply 121
-	Get-Tech Inc. 114	-	US Cyberlab 95
-	Grantham College 65	-	Vision Electronics 121
-	Great Southern Security 124	-	Weeder Technologies 120
-	Greenleaf Electronics Inc. 104	-	Windward Electronics 106
-	Halcyon Group 112	-	World College (Div. of C.I.E.) 5
155	Heath Company 23	-	WPT Publications 119
-	Home Automation Systems 124	134	Xandi Electronics 112
-	Home Tech Communications 80		

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

Scanners/CB/Ham/Shortwave

COMMUNICATIONS ELECTRONICS INC.
Emergency Operations Center



Bearcat 8500XLT-K Radio Scanner

Mfg. suggested list price \$689.95/CE price \$368.95
500 Channels • 20 banks • Alphanumeric display
Turbo Scan • VFO Control • Priority channels
Auto Store • Auto Recording • Reception counter
Frequency step resolution 5, 12.5, 25 & 50 KHz.
Size: 10-1/2" Wide x 7-1/2" Deep x 3-3/8" High
Frequency Coverage:
25,000 - 28,995 MHz. (AM), 29,000 - 54,000 MHz. (NFM),
54,000 - 71,995 MHz. (WFM), 72,000 - 75,995 MHz. (NFM),
76,000 - 107,995 MHz. (WFM), 108,000 - 136,995 MHz. (AM),
137,000 - 173,995 MHz. (NFM), 174,000 - 215,995 MHz. (WFM),
216,000 - 224,995 MHz. (NFM), 225,000 - 399,995 MHz. (AM),
400,000 - 511,995 MHz. (NFM), 512,000 - 549,995 MHz. (WFM),
760,000 - 823,987.5 MHz (NFM), 849.0125 - 868.9875 MHz (NFM),
894.0125 - 1,300,000 MHz. (NFM).

The new Bearcat 8500XLT gives you pure scanning satisfaction with amazing features like Turbo Scan. This lightning-fast technology featuring a triple conversion RF system, enables Uniden's best scanner to scan and search up to 100 channels per second. Because the frequency coverage is so large, a very fast scanning system is essential to keep up with the action. Other features include VFO Control - (Variable Frequency Oscillator) which allows you to adjust the large rotary tuner to select the desired frequency or channel. Counter Display - Lets you count and record each channel while scanning. Auto Store - Automatically stores all active frequencies within the specified bank(s). Auto Recording - This feature lets you record channel activity from the scanner onto a tape recorder. You can even get an optional CTCSS Tone Board (Continuous Tone Control Squelch System) which allows the squelch to be broken during scanning only when a correct CTCSS tone is received. 20 banks - Each bank contains 25 channels, useful for storing similar frequencies in order to maintain faster scanning cycles. For maximum scanning enjoyment, order the following optional accessories: PS001 Cigarette lighter power cord for temporary operation from your vehicle's cigarette lighter \$14.95; PS002 DC power cord - enables permanent operation from your vehicle's fuse box \$14.95; MB001 Mobile mounting bracket \$14.95; BC005 CTCSS Tone Board \$54.95; EX711 External speaker with mounting bracket & 10 feet of cable with plug attached \$19.95. The BC8500XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited warranty from Uniden. Order your BC8500XLT from Communications Electronics Inc. today.

CB/GMRS Radios



A National Weather Service (NWS) receiver with automatic emergency broadcast activation has been added to the legendary Cobra 29 CB radio. The integrated NWS receiver in the Cobra 29LTDWX will automatically activate to receive emergency announcements about severe weather and travel conditions. A special tone-alert signal broadcast by the NWS activates the weather receiver and overrides any CB radio reception for monitoring the warning message.
Cobra 29LTDWX-K CB/Weather Alert... \$129.95
Cobra 2000GTL-K SSB Deluxe CB Base \$389.95
Cobra HH40-K CB 40 ch. Handheld \$99.95
Uniden GMR100-K GMRS Handheld \$159.95
Uniden WASHINGTON-K SSB CB Base. \$189.95
Uniden GRANTXL-K SSB CB Mobile \$139.95
Uniden PRO538W-K CB & Weather \$59.95



CIRCLE 166 ON FREE INFORMATION CARD

Weather Stations

Now you can be your own weather reporter with the Davis Weather Monitor II. Our top-of-the-line weather station combines the most advanced weather monitoring technologies available into one incredible package. Glance at the display, and see wind direction and wind speed on the compass rose. Check the barometric trend arrow to see if the pressure is rising or falling. Push a button and read indoor and outdoor temperature, wind chills, humidity and barometric pressure. Our package deal includes the ultra high resolution 1/100 inch rain collector part #7852-K and the external temperature/humidity sensor, part #7859-K. The package deal is order #DAVI-K for \$479.95 plus \$15.00 shipping. If you have a personal computer, when you order the optional Weatherlink computer software for \$139.95, you'll have a powerful computerized weather station at an incredible price. For the IBM PC or equivalent order part #7862-K. Apple Mac Plus or higher including PowerBook, order part number 7866-K.

The Weather Monitor II (7440-K) comes complete with anemometer with 40 feet of cable, external temperature sensor with 25 feet of cable, junction box with 8 feet of cable, AC-power adapter, detailed instruction booklet and one year limited factory warranty.



- Davis Weather Monitor II 7440-K \$334.95
- Davis Weather Wizard III 7425-K \$154.95
- Davis Remote Display Unit 7815-K \$84.95
- Davis Rain Collector III 0.01" 7852-K \$59.95
- Davis Rain Collector II 0.2 mm 7852M-K \$59.95
- External Temperature/Humidity Sensor 7859-K \$99.95
- Davis Anemometer Mast Mount 7890-K \$15.95
- Weatherlink Software for IBM PC-Version 3.0 7862-K \$139.95
- Weatherlink Software for Apple-Version 3.0 7866-K \$139.95
- 4-Conductor 40' (12.2 m) extension cable 7876-K \$17.95
- 6-Conductor 40' (12.2 m) extension cable 7878-K \$21.95
- 8-Conductor 25' (7.6 m) junction box cable 7880-K \$14.95
- 8-Conductor 50' (15.2 m) junction box cable 7881-K \$24.95
- 8-Conductor 100' (30.5 m) junction box cable 7882-K \$44.95
- Modem Adapter 25-pin for communications port 7870-K \$9.95
- Car/Boat/RV Lighter Cord 7873-K \$9.95
- 2400 baud modem for Weatherlink MEX-T \$39.95
- Weatherlink language disks: Française, Deutsche, Italiana, Española 7863-K \$24.95

Other neat stuff

- Grundig Satellit 700-K portable shortwave receiver with 512 memory & AC adapter \$389.95
- Grundig Yacht Boy 406-K digital portable shortwave receiver - 40 memory presets \$199.95
- Grundig Yacht Boy 230-K portable shortwave receiver \$139.95
- Sangean AT5800-K portable 20 memory shortwave receiver \$169.95
- Sangean AT5800-K portable shortwave receiver w/AC adapter - 9 memory presets \$148.95
- Sangean AT5808-K portable 45 memory shortwave receiver \$159.95
- Sangean AT5818-K portable shortwave receiver with cassette recorder \$209.95
- Uniden EXP9200-K 900 MHz. 2 line cordless phone \$269.95
- Cobra CP912-K 900 MHz. spread spectrum cordless phone \$249.95
- Bogen FR2000-K Digital two-line advanced voice mail system & answering machine \$279.95
- Bogen FR0018-K memory expansion module, doubles recording time to 36 minutes. \$79.95
- FANS P161F-K 60 name/number caller ID, unattended call blocker, automatic paging \$149.95
- SNH D200E-K Buzzer name/number caller ID, call reject, forward to machine \$89.95
- Cobra CP22-K handheld global positioning system (GPS) \$59.95
- WR200-K weather radio with National Weather Service storm alert \$39.95
- RELM WH5150-K VHF handheld 5 watt, 16 channel transceiver \$339.95
- RELM RH256NB-K VHF 25 watt, 16 channel synthesized transceiver \$289.95
- Banger RC12970-K 25 watt 10 meter ham radio transceiver \$329.95
- Banger RC12970-K 100 watt 10 meter ham radio transceiver \$569.95
- Uniden LD9100SW-K Super Wideband Laser/Radar Detector \$139.95
- ME-X Map Expert CD Rom for IBM PC by DeLorme Mapping \$299.95
- HCPC-K HamCall CD Rom for IBM PC by Buckmaster Publishing \$39.95
- ANTK-K VHF scanner/VHF transmitting antenna PL259 connector \$29.95
- ANTMMNB-K magnet mount scanner antenna w/ BNC connector \$29.95
- ANTMMOT-K magnet mount scan antenna w/ Motorola plug \$29.95
- ANTMMPLE-K magnet mount scan antenna with PL259 connector \$29.95
- ANTSGBHC-K glass mount scanner antenna with BNC connector \$29.95
- ANTSMT-K glass mount scanner antenna with Motorola jack \$29.95

Buy with confidence

It's easy to order from CEI. Mail orders to: Communications Electronics Inc., Emergency Operations Center, P.O. Box 1045, Ann Arbor, Michigan 48106 U.S.A. Add \$15.00 per radio or telephone product for U.P.S. ground shipping and handling in the continental U.S.A. unless otherwise stated. Add \$8.00 shipping for all accessories and publications. Add \$8.00 shipping per antenna. For Canada, Puerto Rico, Hawaii, Alaska, P.O. Box, or APO/FPO delivery, shipping charges are two times continental U.S. rates. Michigan residents add state sales tax. No COD's. No returns or exchanges after 31 days. 10% surcharge for net 10 billing to qualified accounts. All sales are subject to availability, acceptance and verification. Prices, terms and specifications are subject to change without notice. We welcome your Discover, Visa, American Express or MasterCard. Call 1-800-USA-SCAN to order toll-free. Call 313-996-8888 if outside the U.S.A. FAX anytime, dial 313-663-8888. For technical assistance to solve your communications problem, call the Communications Electronics technical support hotline for \$2.00 per minute at 1-900-555-SCAN. Scanner Distribution Center and CB logos are trademarks of Communications Electronics Inc. Sale dates 12/1/94 - 1/31/95 AD #12159-GEN Copyright © 1995 Communications Electronics Inc. * New product - available 60-90 days after receipt of order.

For credit card orders call
1-800-USA-SCAN
Communications Electronics Inc.
P.O. Box 1045, Ann Arbor, Michigan 48106-1045 U.S.A.
For information call 313-996-8888 or FAX 313-663-8888

26th Anniversary Special Save \$30.00 on Bearcat 8500XLT scanner or RELM WHS150 VHF transceiver.

Celebrate our 26th anniversary with special savings on your choice of a new Bearcat 8500XLT scanner or RELM WHS150 VHF five watt transceiver. This coupon must be included with your prepaid order. Offer valid only on orders mailed directly to Communications Electronics Inc., P.O. Box 1045 - Dept. PED195, Ann Arbor, Michigan 48106 U.S.A. Coupon expires January 31, 1995. Limit one coupon per item. Coupon may be photocopied. Coupon may not be used in conjunction with any other offer. Credit cards are excluded from this offer. Void where prohibited.

Bearcat Scanners

Bearcat 200XLT-K Radio Scanner

Mfg. suggested list price \$509.95/CE price \$198.95
200 Channels • 10 Banks • Cellular Modifiable
Heavy duty carry case • Illuminated LCD • Search
Size: 2-3/4" Wide x 1-1/4" Deep x 7-1/2" High
Frequency Coverage: 29,000 - 54,000, 118,000 - 174,000, 406,000-512,000,
806,000 - 823,987.5, 849,0125 - 868,9875, 894,0125 - 956,0000 MHz.

Recently, the FCC amended Parts 2 and 15 of its rules to prohibit the manufacture and importation of scanning radios capable of intercepting the 800 MHz. cellular telephone service. The Electronics Communications Privacy Act prohibits the intentional interception of cellular telephone transmissions. Supplies of scanners that are capable of being easily modified to receive full 800 MHz. coverage such as the Bearcat 200XLT are in critically short supply. Today could be your last chance to buy your Bearcat 200XLT scanner. Signal intelligence experts, public safety agencies and people with inquiring minds that want to know, depend on the Bearcat 200XLT handheld scanner to intercept just about any radio transmission. You can also program frequencies such as police, fire, emergency, race cars, marine, weather, and other broadcasts into 10 banks of 20 channels each.

A modification sheet with instructions to restore full 800 MHz. coverage for our Bearcat 200XLT or Bearcat 2500XLT may be ordered for \$8.00. To order your Bearcat scanner, call 1-800-USA-SCAN.

Other Bearcat Scanners

- Bearcat 8500XLT-K base/mobile \$368.95
- NEW Bearcat 3000XLT-K handheld *\$379.95
- Bearcat 890XLT-K base/mobile \$228.95
- Bearcat 855XLT-K base \$148.95
- Bearcat 760XLT-K base/mobile \$198.95
- Bearcat 700A-K info mobile \$148.95
- Bearcat 560XLA-K base/mobile \$83.95
- Bearcat 220XLT-K handheld \$228.95
- Bearcat 200XLT-K handheld \$198.95
- Bearcat 178XLT-K base/WX alert \$133.95
- Sportcat 150-K handheld \$178.95
- Bearcat 148XLT-K base/WX alert \$88.95
- Bearcat 120XLT-K handheld \$148.95
- Bearcat BCT2-K info mobile \$138.95

TECHNOLOGY UPDATE



1-6-94 8:07 p.m.
Situation: Mother and two children in mall parking lot

The first alarm system designed to protect you as well as your car...

Revolutionary new vehicle security system is the first of its kind to focus on the safety of the vehicle driver as well as the vehicle itself.

By Charles Anton

Do you wonder why car alarms have countless features to protect your car, but nothing to protect you? After all, what's more important your car or the safety of you and your family?

Now there is a car alarm that will protect you and your family. It is the first of its kind to focus on the safety of the vehicle owner as well as the vehicle itself.

Protect yourself. It all begins with the panic button. Imagine you're walking to your car at night and a person approaches. Pushing the panic button on your transmitter lets your car come alive with a shrieking siren and flashing headlights. While the panic alarms of other vehicle security systems have a range of 100 feet, the Smart Alarm's panic alarm lets you call for help or scare away potential attackers from up to 400 feet!

Exclusive feature. Unlike other car alarm systems that begin and end their focus on per-

sonal protection with the panic alarm, that's just the beginning of the Smart Alarm. In addition to the panic alarm, the Smart Alarm also has a car finder feature. You'll never again have to wander around a dark and dangerous parking lot searching for your car. You will be able to know where your car is from anywhere within 400 feet by flashing its lights and briefly sounding the siren. You can activate and deactivate your car's headlights by remote control to light your way in a dark driveway or parking lot.

Carjacking. The Smart Alarm also addresses a growing hazard for today's motorists—carjacking. It's alarming how often drivers are hurt in their cars because they refuse to give them up to carjackers. Because of its anti-carjacking device, the Smart Alarm allows you to safely retain your car when confronted by a carjacker. This is made possible by a delayed panic alarm.

What makes Smart Alarm better?

- **Range.** Most car alarm features only work up to 100 feet away—all Smart Alarm features work up to 400 feet away.
- **Panic button.** Smart Alarm lets you call for help or scare away potential troublemakers by controlling a piercing alarm and your car's headlights.
- **Car finder.** Your car will be able to let you know where it is by flashing its lights and briefly sounding the siren.
- **Carjacking.** Its delayed panic alarm allows you to safely prevent theft of your car when confronted by a carjacker.
- **Easy installation.** Other car alarms are complicated or cost hundreds of dollars to install. Smart Alarm is inexpensive, and you can install it in just minutes.



Smart Alarm is the first car alarm that will protect you and your family.

Easy installation. Installing the Smart Alarm requires no fumbling with wires. Special Plug-In Connectors let you install the Smart Alarm without a single wire-cutter! Simply unplug the headlight connector, plug in the Smart Alarm connector, and then plug the headlight connector to the Smart Alarm. Connect the Smart Alarm to the battery cable with the special clip. In minutes, you and your car can enjoy complete 24-hour protection. Away from your car, you'll feel safer knowing that your car is protected! Near your car, you'll feel safer knowing that you are protected!

All you do is give up your car and activate the delayed panic alarm. When the assailant has reached a safe distance and is no longer a threat to you, a deafening 120dB siren and flashing lights will force him to flee your car, letting you recover it safely.

Vehicle protection. Smart Alarm's current sensor triggers the siren if the trunk or any of the doors are opened while the alarm is armed. To supplement the current sensor, a shock sensor triggers the siren when it detects a blow to your car. Together, these sensors provide your car with blanket protection.

An adjustable shock sensor prevents the siren from being triggered, eliminating false alarms. You can also adjust the shock sensor and the siren with your remote control at any time you choose. The siren's tone and volume can be adjusted to six separate tones. As a result, you'll never confuse it with any other alarm. You can also customize the siren, making it louder in noisy neighborhoods and quieter in more peaceful neighborhoods.

Risk-free home trial. With the Smart Alarm, you get a complete "No Questions Asked" 30-day money-back guarantee. If it's not everything we say, just return it for a full refund. The Smart Alarm is also backed by a two-year warranty. Your order will be shipped UPS in seven to ten working days.

The Smart Alarm Car Alarm..... \$99 \$9 S&H

Please mention promotional code 483-PL1108. 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, enclosing your account number and expiration date.

COMTRAD INDUSTRIES

2820 Waterford Lake Drive Suite 106
Midlothian, Virginia 23113