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Popular Electronics®

October 1995

Ghost Voices

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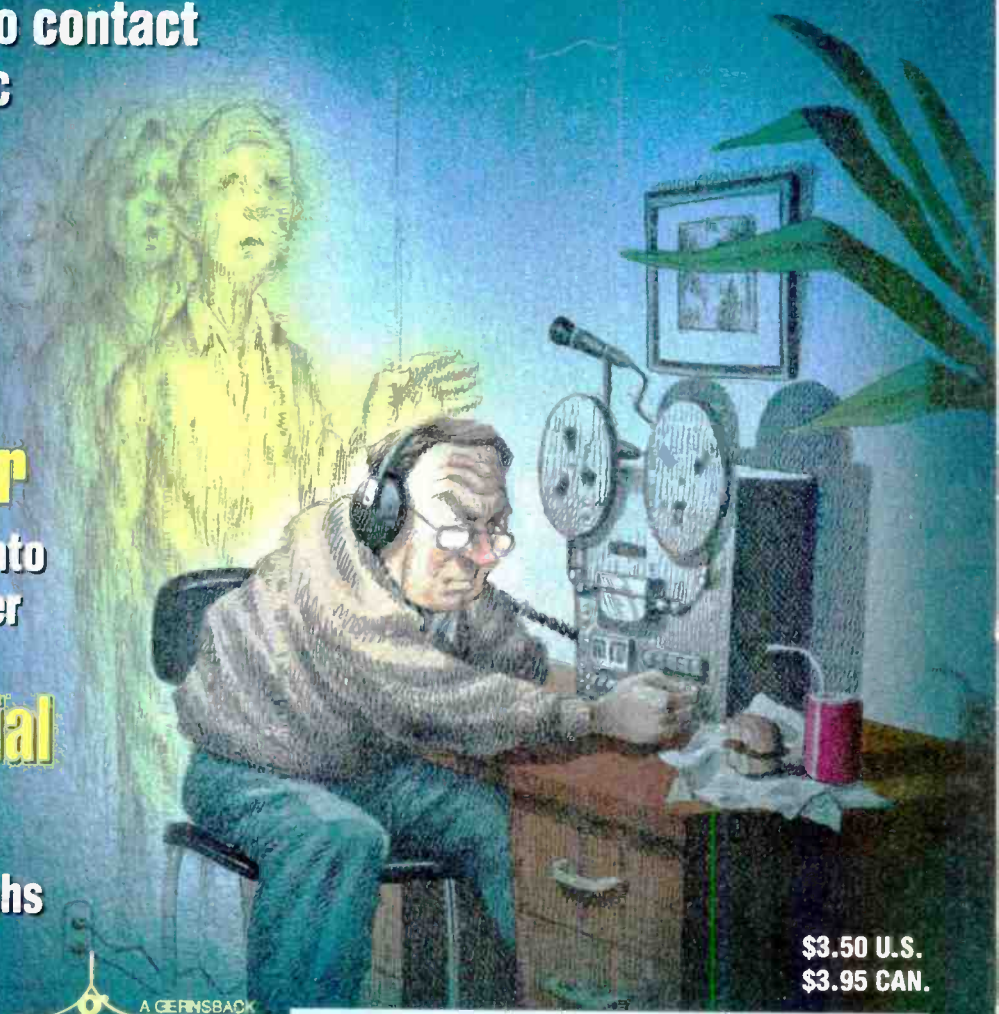

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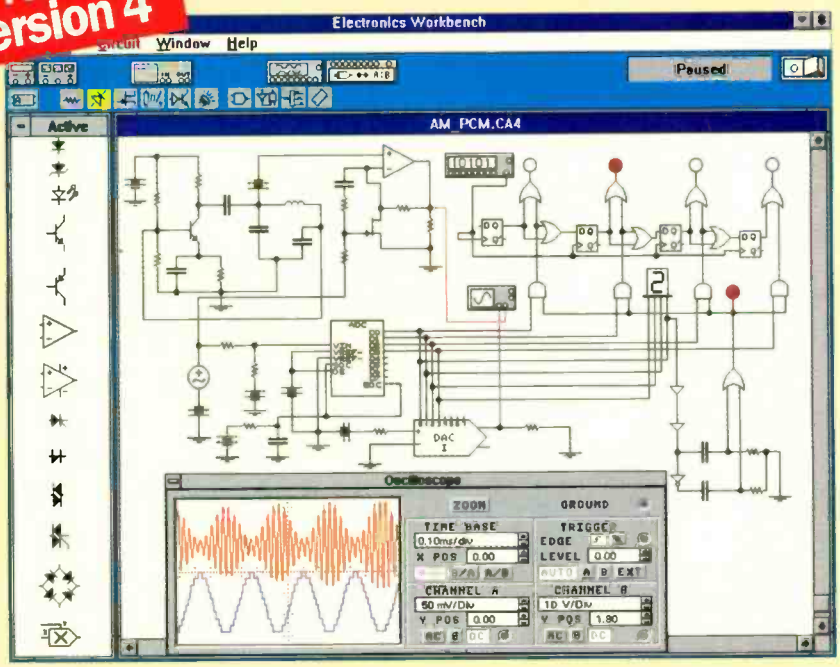

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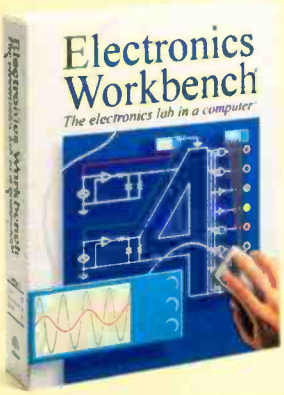

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CIRCLE 169 ON FREE INFORMATION CARD

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OCTOBER 1995
Vol 12, No 10

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COVER STORY

CONSTRUCTION

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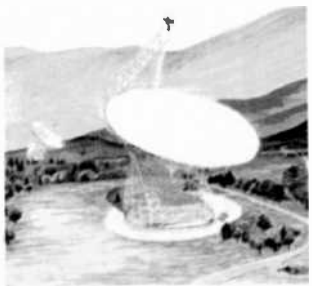

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OCTOBER 1995

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EDITORIAL

VOICES FROM BEYOND

Halloween is fast approaching, and in the spirit of wonderful weirdness that the holiday evokes, this month **Popular Electronics** presents one of its most unusual stories ever. Since the invention of the tape recorder, people have claimed to hear mysterious voices on the tape recordings they have made. Called "electronic voice phenomena" by serious researchers, and "ghost voices" by the popular press and others, there does appear to be something to it.

What that something is, however, is an entirely different question. Are the dead really trying to communicate with us through electronic means, or are the sounds heard of a more mundane nature? That is, are they the product of an overactive imagination or even out-and-out hoaxes?

What's the truth? Well, that's for *you* to decide! In "Ghost Voices" we describe the techniques and experiments researchers have used to record electronic voice phenomena, the results they achieved, and show you how you can duplicate those experiments on your own, if you dare! The story begins on page 37.

On a more earthly note, this month also marks the return of one of our more popular features of the past: Product Test Reports. Each month, we'll select a video, audio, or computer product and put it through the wringer.

Our exhaustive bench tests, performed by Frank Barr and the staff at the Advanced Product Evaluation Laboratories (APEL), one of the foremost electronics-testing facilities in the country, will tell you the true story behind the specifications. And our user tests tell you how well, or how poorly, the product actually performs. The feature is written by Stephen Booth, formerly the Editor-in-Chief of *Video Review* and Electronics Editor of *Popular Mechanics*. Look for it this month on page 30.

Carl Laron
Editor

LETTERS

SUBWOOFER CLARIFICATIONS

*Thanks to all of you who wrote in regarding my article, "Build a Subwoofer" (***Popular Electronics***, July 1995). In order to answer the many questions you asked about it, let me give everyone the following information.*

First, as Fig. 3 of the article shows, it is only a single channel (not "stereo") subwoofer. Two are required for stereo use. Or one can be used with an electronic active (not passive) circuit for summing the two stereo channels' outputs, and with a filter to deliver only the low frequencies to a single amplifier to drive the system. Some Dolby Surround Sound processors for home-theater use have such a circuit built in, which would simplify building your system if you plan to use it as part of a home-theater installation.

In fact, from the beginning the system was designed with the idea that two subwoofers were to be used. Note that the cabinets are rather long and narrow in shape, making the system easy to hide behind a couch, or even to be placed between pieces of furniture in a room, without being immediately noticeable. One of them could even be used as a TV stand when placed on some 4–6-inch legs.

Second, some of you wrote in asking if the particular 8-inch driver used in the article could be further optimized to go down even deeper into the bass. The answer is that the system was already optimized by mathematical analysis before the prototype was ever built. So, no, there is nothing more to be done with this particular system design.

*For those interested in creating their own subwoofer designs, my BASIC programs for IBM-compatible PCs ("Design Your Own Loudspeakers," **Popular Electronics**, February 1994) will be very helpful. The programs are for doing a sealed-type ("acoustic suspension") system.*

I hope this information has been of use to everyone interested in the project.
WILLIAM R. HOFFMAN

"TRICKY" g MACHINE

I enjoyed reading the article "Build the 'g' Machine" (**Popular Electronics**, May 1995) that described building an accelerometer based around the Analog Devices ADXL50. However, it included some inaccuracies that relate more to physics than to electronics.

In essence, acceleration = force/mass, as Newton put it. A change in velocity with time, dV/dT, is something else again.

Specifically, when a car is traveling at a constant speed of 60 miles-per-hour, the accelerometer will *not* record zero, but rather an acceleration that is the equivalent of the rolling and aerodynamic resistance of the car. That will be appreciable for a rubber-tired vehicle at 60 miles-per-hour. Try it!

Also, a car stopping from 60 miles-per-hour in eight seconds will not necessarily record a deceleration of 0.34g, unless the road is absolutely level throughout. Clearly, stopping down grade in eight seconds requires a higher deceleration.

Finally, when the car comes to rest, and the velocity is zero, the accelerometer will record the grade of the road (for example, 0.5g on a 30° slope), not zero, because that is then equivalent to the force exerted by the parking brake.

Ironically, the closest the accelerometer comes to zero on any grade is at the moment the parking brake is released and the car starts to free-roll at a small velocity.

Tricky things, accelerometers!
C.B.M.
Vancouver, B.C., Canada

WHEN IT RAINS . . .

I just finished Walter Schopp's article, "Sprinkler Guardian" (**Popular Electronics**, April 1995), and must disagree with him on one point.

Here in Florida, the sun can be shining on one side of the street while it is pouring on the other. Therefore, if the 555 has been set to run for an hour (or whatever length of time) and the rain moves in, you have sprinklers on in the rain.

That said, the idea is a good one. The version I built was a spin-off of a basement high-water alarm that appeared some years back in **Popular Electronics**.The sensors are simply a short piece of #10–2 vinyl outdoor house wire stripped on one end and shaped to fit in a 1 × 3 × ½-inch homemade pan. A light shower has no effect, but if it gets to about ¼ inch of rain, the sprinklers shut off.

I have enjoyed your magazine for years!. Keep it up!
P.U.
Deltona, FL

SPEAKING OUT FOR "SILENT SAM"

Thank you for the *Hands-on Report* write-up on "Silent Sam" (**Popular Electronics**, April 1995). It was nicely done, but some of the information presented was a bit out of date. As the device's inventor, I'd like to clear up any confusion.

1. Turn-signal reminders are now included on many cars as factory equipment. But, unlike Sam, they take a long time before sounding off—about 100 clicks. Sam's signal is never more than about 18 seconds away.

2. Factory models emit a continuous signal after timing out. That forces the driver to react to quiet it. Sam's short signal can be ignored if the driver so chooses.

3. Factory units work only if you are moving and not when stopped. Sam beeps when you are stopped but not on the brake. That is a common habit that causes premature wear of clutch facings and throw-out bearings.

The most important change is that Sam is now compatible with all electronic, solid-state, and thermal flashers; the same model works with all cars on the road..

, That aside, I appreciate your fine article. Thank you.
HENRY P. GIOVANNI
Columbus, OH

HAVES & NEEDS

I have acquired a beautiful antique radio and would like to know if anyone can identify it and describe the speaker that might have been used with it.

The radio is in a mahogany case about 28 inches long, 10 inches high, and 10 inches deep. It has nine tubes mounted breadboard style. The front-panel escutcheon says "Skyrover." A metal plate says:

SKYROVER ELECTRIC RADIO
Serial 3472 110 volts
Licensed under GE and Westinghouse patents
BUTLER BROTHERS
MFG by A.A.M. Corporation
Chicago USA

The unit is in working condition, but minus its speaker. I have determined that a speaker matching transformer must be used externally.

The tube line up includes: four number 226 RF amplifiers, a 227 detector audio tube, a 227 phase inverter, and two 71A push-pull output tubes. A separate power supply chassis inside the cabinet has a 280 rectifier.

Any information would be appreciated. Thanks!
ART MANNING, N4XNM
104 Landing Road
Brunswick, GA 31520

I would like a copy of the operating manual, circuit diagram, and description of theory of operation (which should be found in the manual) for an EICO model 902 audio distortion analyzer. If anyone can make a copy available, it would be much appreciated. I certainly will pay copy and mailing costs. Thank you.
PAUL FREEDMAN
P. O. Box 286
Florissant, CO 80816 ■

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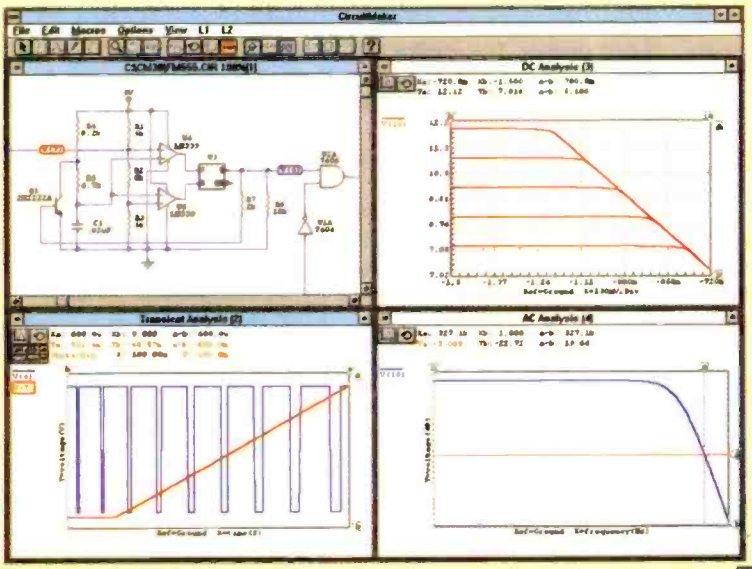

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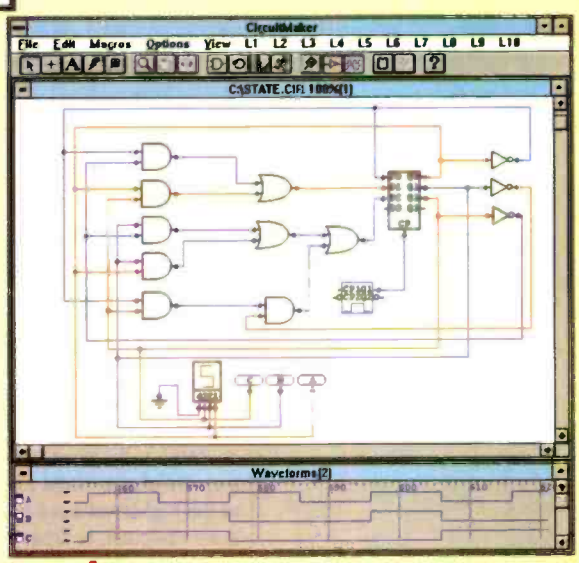

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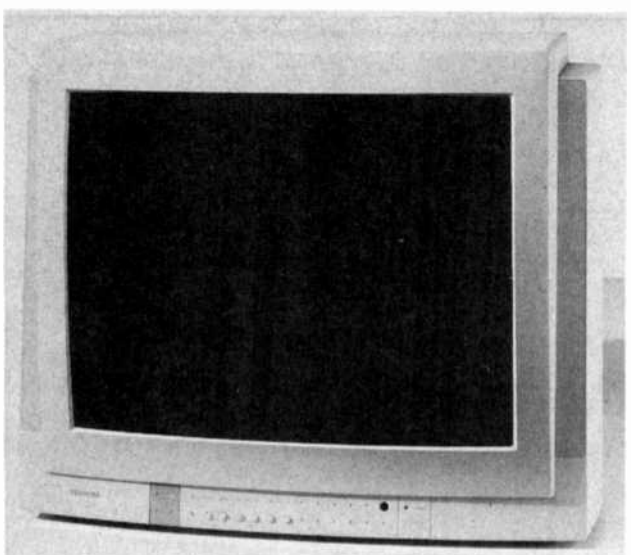
CIRCLE 42 ON FREE INFORMATION CARD

NEW PRODUCTS

TV/ Multimedia Monitor

Designed to address the changing needs for display devices in multimedia environments, the *Toshiba Integrated Multimedia Monitor (TIMM)* is a 20-inch monitor that combines a 181-channel tuner and an FST Black picture tube with a direct VGA input. (An adapter allow hookup to Macintosh computers.) Because TIMM's dot pitch of 0.58 millimeters is up to 36% finer than that of conventional TVs, it is able to reproduce in sharp detail the dramatic color graphics of high-resolution video games and multimedia programs. It also enhances interactive applications including CD-ROM, CD-i, on-line services, and business conferencing.

The newly designed picture tube is capable of handling both multimedia and conventional TV functions. The first Invar Shadow Mask to be used in a 20-inch TV allows TIMM to operate at the higher voltages needed to create brighter, sharper images.



A built-in stereo television tuner offers full TV reception with picture and audio quality unequaled by computer add-on boards. It features 500 lines of horizontal resolution. The FST Black picture tube reduces ambient light reflection to improve contrast and black reproduction. The tuner also offers closed captioning, which is rarely found on TV tuner cards. Composite and S-video inputs allow easy connection of a laserdisc player or VCR. To take advantage of the full potential of digital audio, the monitor features a built-in 100-watt audio system and a tuned-horn structure said to provide improved signal separation and enhanced full-frequency performance. The monitor also offers a Sub Bass System circuit for powerful bass response, as well as an MTS stereo decoder with SAP and dbx noise reduction.

TIMM is the first multimedia monitor to come with a remote control. In addition to directing all TV functions, the remote also controls computer-related features, including picture sizing, which allows users to expand and contract the RGB image vertically and horizontally and to adjust its location on the screen.

The Toshiba Integrated Multimedia Monitor has a suggested retail price of $999. For more information, contact Toshiba America Consumer Products, Inc., 82 Totowa Road, Wayne, NJ 07470.

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CREDIT-CARD-SIZE DMM

Wavetek's DM78A digital multimeter is so small that users can keep it with them at all times, ready to make a measurement at any moment. It is intended for use in all electronic and field-service work—particularly for testing fax, computer, copier, security, and consumer-electronic equipment—as well as for handy home use.

The DM78A offers a 3200-count display with a 32-segment bar graph, useful for measuring peaking and nulling circuits and locating bad diodes. It features data hold, which freezes a reading on display for later evaluation, providing safer operation when in a dangerous area. The meter is designed to meet UL and EN (IEC) safety standards.

The DM78A credit-card-size digital multimeter has a list price of $35.95. For additional information, contact Wavetek Corporation, Instruments Division, 9045 Balboa Avenue, San Diego, CA 92123;
Tel. 619-279-2200;
Fax: 619-565-9558.

CIRCLE 101 ON FREE INFORMATION CARD

MULTIFUNCTION INKJET PRINTER

Crowded small offices and home offices can conserve valuable space with *Sanyo's SFX-P55*, a plain-paper inkjet printer that also serves as a fax, copier, and telephone. With optional fax software and its built-in RS2322C interface, it also offers fax/modem/scanner capabilities.

The SFX-P55 offers plain-paper printing, emulating several leading printers for compatibility with a wide range of DOS and Windows applications. A convenient, 100-page sheet feeder keeps legal- or letter-size paper in ready supply.

Fax features include a 256-Kb reception memory (approximately 17 pages), 32-shade half-tone reproduction, a 10-sheet automatic document feeder, customized header print capability, a 16-character LCD, and timed transmission of up to ten pages with a 24-hour delay. Automatic dial memory accom-

modates up to 30 telephone numbers, including eight one-touch numbers and 22 speed-dial numbers. To switch calls between the fax and an outside answering machine, voice prompts and automatic switch-over capability are built in.

As a copier, the SFX-P55 offers a fine mode with or without halftone, superfine with halftone, and three sizes of image reduction. Up to 99 consecutive copies can be printed at one time. The unit

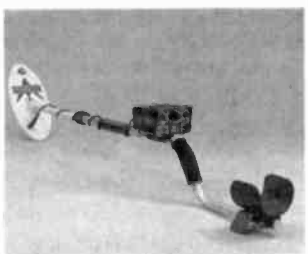
also includes a complete telephone, an ink cartridge, and an instruction manual. A large, wire exit tray is available as an option.

The SFX-P55 multifunction inkjet printer has a suggested retail price of $1099.95. For more information, contact Sanyo, 21350 Lassen Street, Chatsworth, CA 91311-2329; Tel. 818-998-7322; Fax: 818-701-4149.

CIRCLE 102 ON FREE INFORMATION CARD

PROSPECTOR'S METAL DETECTOR

The *Gold Bug-2* metal detector from *Fisher Research Laboratory* is engineered specifically for electronic prospecting. It features an iron-discrimination mode for hot rock and ferrous target identification, an audio-boost mode for faint, deep targets, and three mineralization modes for nugget hunting in just about any ground condition.



According to Fisher, the Gold Bug-2's 17-kHz operating frequency is the highest, by far, of any metal detector made. That makes it easier to find small nuggets buried deep in mineralized soil. The iron-discrimination mode increases its ability to pick out good targets next to iron in any highly mineralized soil.

The Gold Bug-2 weighs less than three pounds and is available with a submersible 6.5-, 10-, or 14-inch elliptical search coil. For rugged durability, it features a dust- and rain-resistant control housing and quartz-crystal locked electronics.

The Gold Bug-2 prospecting metal detector has a suggested list price of $775 with the 6.5- or 10-inch coil, or $795 with the 14-inch coil. For additional information, contact Fisher Research Laboratory, 200 West Willmott Road, Dept. 6MO, Los Banos, CA 93635; Tel. 1-800-M-SCOPE-1; Fax: 209-826-0416.

CIRCLE 103 ON FREE INFORMATION CARD

440-MHz PACKET RADIO

The *PCS-9600D* from *Azden* is a 35-watt, 9600-baud, digital transceiver that offers all the special features required by high-speed packet radios. Included are 35 watts of output, 20-kHz wideband IF, wide frequency range (430–450 MHz), and solid-state diode TX/RX

switching. It offers 20 memory channels plus one temporary memory location. A full DTMF dynamic microphone is included for voice operation when needed.

The PCS-9600 9600-baud packet radio costs $649. For additional information, contact Azden Corporation, 147 New Hyde Park Road, Franklin Square, NY 11010; Tel. 516-328-7500; Fax: 516-328-7506 ■

CIRCLE 104 ON FREE INFORMATION CARD

For twenty years, police have used taser technology to battle crime...now you can, too!

Remarkable new self-defense device is more effective than mace, pepper sprays, stun guns and handguns—and it's perfectly legal and non-lethal!

by Tammy Wallens

Today, too many Americans find themselves confronted with the ever-increasing threat of crime. As the fear of becoming a victim of crime proliferates, the desire to find a method to protect oneself is an issue that more and more Americans, both young and old, will confront. In response to these issues, Air Taser, Inc. has developed a safe and effective method of non-lethal self-protection.

Ultimate non-lethal protection. Air Taser is a hand-held self-defense system that uses compressed air to launch two probes. When it is fired, the probes hit the target as far away as 15 feet. The probes are connected to the launcher by a thin wire that transmits electrical signals called T-waves. These electrical signals enter the assailant through the probes, penetrating the nervous system *regardless of the placement of the probes*. The result? An instant loss of the attacker's neuromuscular control and the ability to perform coordinated actions. These T-waves can be transmitted through as much as two inches of clothing—not even a leather jacket will stop Air Taser.

How does it work? When Air Taser is fired, compressed air projects two probes, up to 15 feet, at a speed of 200 feet per second. Upon contact with the target's body or clothing, an electrical signal is transmitted throughout the region where the probes make contact.

Air Taser uses an automatic timing mechanism to apply the electric charge. Once the probes are launched, Air Taser releases an electric current in a pre-set time sequence of eight seconds, pauses briefly, and then continues administering the electric current in five-second increments for a total of 30 seconds. This ensures that the nervous system of the assailant doesn't recover enough to allow him to remove the probes. Follow-up bursts disrupt the process of re-equilibration of the nervous system, keeping the target disabled. This allows the user to drop the device and run while Air Taser continues to disable the target.

Proven non-lethal. The Consumer Product Safety Commission has found taser® technology to be non-lethal. Its electrical output interferes with communication between the brain and muscular system, resulting in loss of control. Air Taser won't damage muscles, nerves or other body elements. Studies confirm that T-waves do not interrupt the heart beat or damage pacemakers. You can't electrocute the target, even if he's standing in water. And because the output is metered and electrical energy is consistent, the electrical output cannot be transferred from a tasered person to anyone else, even if they touch.

AIR TASER...
- ✔ Works up to 15 feet away
- ✔ Won't cause any permanent or serious damage
- ✔ Effective anywhere on the target's body
- ✔ Has a back-up protection device
- ✔ Excludes the possibility of criminal use

After being "tasered," the target will feel dazed for several minutes, and won't be up to resuming an attack. The electrical output causes involuntary muscle contractions, resulting in a sense of vertigo. While Air Taser can momentarily stun or render an attacker unconscious, this technology is clinically proven not to leave long-term injuries.

Easy to use. Firing Air Taser is easy. With your elbow at your side, hold the unit toward the attacker and fire. The probes will work anywhere on the target, but it's best to aim for the largest area—the torso. In the event that the probes totally miss the target, you can use Air Taser just like a normal stun gun!

Criminal-proof. Air Taser, Inc. has instituted an Anti-Felon Identification system through which criminal use of Air Taser can be traced. Tiny pieces of film (AFIDs) with the unit's registration number are expelled when the unit is fired, leaving evidence at the scene of the crime to identify the user. No other self-defense device in the world can say the same. Plus, Air Taser cannot be modified to become lethal without destroying the device.

Air Taser comes with an instructional video, practice target, two air cartridges, a carrying strap, a 9V battery and a high-impact molded carrying case.

Try it risk-free. Air Taser is backed by our exclusive risk-free home trial. If you're not satisfied, return it within 90 days for a full refund, "No Questions Asked." It also comes with a lifetime manufacturer's warranty. Most orders are processed within 72 hours and shipped UPS. (You must be 18 years or older to order.)

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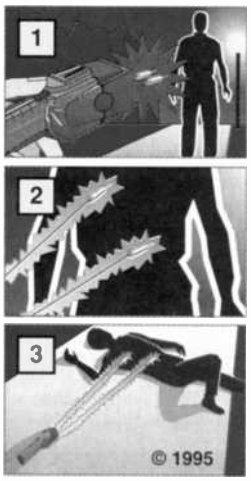

HOW IT WORKS

1 When you fire your Air Taser, compressed air projects the two probes up to 15 feet.

2 Upon contact with the target, an electrical signal is transmitted throughout the region where the probes make contact.

3 This signal is automatically timed, each cycle lasting about 30 seconds. This enables you to drop the unit and flee while your attacker remains disabled.

We all want to protect ourselves from crime, but most self-defense devices pose a serious dilemma. Stun guns and chemical sprays only work within close proximity to an attacker. Handguns work from a safe distance, but the thought of wounding or even killing someone doesn't appeal to most of us. Air Taser is the perfect solution—it disables an attacker from 15 feet away without causing any serious or permanent injury.

EFFECTIVE TARGET AREAS

Unlike other methods, Air Taser's probes will disable an attacker *no matter where they hit.*

GIZMO®

A CHRONICLE OF CONSUMER ELECTRONICS

Staying Connected

PIC-1000 MAGIC LINK PERSONAL COMMUNICATOR. From: Sony Corporation, One Sony Drive, Park Ridge, NJ 07656. Tel. 201-930-1000. Price: $995.

E-mail has become increasingly more important as a way to communicate. It seems that not having e-mail access is becoming equivalent to trying to run a business without a telephone. E-mail has become especially important for mobile professionals who need to be able receive messages reliably when traveling out of town.

The *Sony Magic Link PIC-1000 Personal Intelligent Communicator* provides a way to stay in touch wherever you go. Unlike other personal digital assistants or PDAs—which often seem to be solutions in search of problems—the Magic Link has a single primary purpose: sending and receiving messages. However, it can also do many of the things that other PDAs can do, because it contains built-in address-book, notebook, appointment-book, spreadsheet, and game applications.

The Magic Link is based on General Magic Inc.'s Magic Cap operating system, an object-oriented, multitasking communications platform. The messaging functions of the Magic Link are built around AT&T's PersonaLink service, which allows users to exchange e-mail with all public services, including MCI Mail and the Internet. Messages can be sent with voice-annotation and electronic ink, but only to other devices that support Magic Cap. The Magic Link can also send messages to any fax machine via its 2400/9600 bps fax/modem.

The Magic Link weighs about 1.2 pounds and is powered by 6 "AAA" batteries or an optional ($70) Sony 7.2-volt lithium-ion rechargeable battery pack. The Magic Link, too large for a coat-pocket, measures about 7½ × 5¼ × 1 inch Its front panel is dominated by a large (4¾ × 3¼ inch) touch-sensitive liquid-crystal display. By the top corners are two OPTION-WC buttons. Three small holes by the bottom left indicate where the microphone is, and the speaker is on the right side of the display.

Virtually all user input is accomplished by tapping and writing on the LCD with a plastic stylus. (There is nothing special about the stylus—anything that won't scratch the screen can be used as well, including your finger.) We rarely used the OPTION buttons, which provide shortcuts to some features. Their operation wasn't intuitive, so we preferred the standard input method.

The Magic Link doesn't use traditional menus. Instead, its functions are accessed through a "geography" of rooms along a hallway or buildings on a street. The "main menu," so to speak, is a desktop.

The desktop contains a telephone, Rolodex, postcard, notebook, calculator, and appointment book. On the wall on the far side of the desk is a clock, and an in box and out box for messages. A file cabinet is in front of the wall. Two desk drawers hold stationery and accessories.

On the bottom of the screen are seven "buttons" that are always accessible even as you move through the hallway or the street "downtown." First is a desk icon that always gets you back to the desktop. There's also a rubber stamp that lets you put canned graphic images on your communications with other Magic Cap devices. A genie's lamp calls up a menu of commands that provide quick access to some of the communicator's functions. A tote bag provides a temporary storage location for virtually anything you are working on. A tool holder contains pencils, markers, shapes, erasers, and more. A keyboard calls up an on-screen QWERTY keyboard for text input. A garbage truck provides a place to drag and drop items and files you wish to discard.

From the desk, you can move to the hallway by tapping the pointing-hand icon at the top right corner of the screen. The

A number of accessories are available for the Magic Link personal communicator. Pictured here, counter clockwise from top left are a lithium-ion battery, telephone headset, data-entry keyboard, memory card, and pager card.

pointing hand always points to someplace you're likely to want to go. For example, if you are at the desk, it points to the hallway. If you are in the hallway, it points to downtown. If you are downtown, it points back to the hallway.

The hallway has doors leading to other rooms. One door gets you back to the desk. Another gets you to the library, where you can read a number of "books" by tapping on their icons. A storeroom lets you look at a file directory. Applications and data appear as boxes on shelves. A gameroom lets you play solitaire and MindBender, a pattern-guessing game.

Downtown consists of a main street occupied by several buildings. First is your home. Tap on your home, and you enter the hallway. Other buildings include the AT&T PersonaLink Center and America Online. Although that hardly seems like a very well-populated downtown, the area will expand as new services are offered.

The Magic Cap environment on which the Magic Link is based sports Telescript technology, a communications language or standard that provides "intelligent assistants" or "agents" for users. Those agents are launched into the world of electronics services and screen, route, and deliver electronic correspondence. As new applications are added, they are expected to be able to shop for goods and services and seek out time-critical information. They are basically mobile software programs that go places and carry out their owner's instructions. They are programmed with contingency plans.

Let's say, for example, that you are preparing for an upcoming trip to Chicago. You could commission an agent to negotiate with airlines for ideal flights and seats or hotels for a good rate and convenient location, and even make dinner reservations at area restaurants and rent a car.

After you've booked the trip, your agent could stay in the network and monitor your flight. You could be notified if it has been delayed.

Of course, all of that is dependent on your agent having other agents to negotiate with. As of now, there are precious few companies who are making themselves available on the Magic Cap platform. During our review of the Magic Link, Downtown seemed more like a ghost town. Several companies, however, plan to open up downtown "stores," including the 800-FLOWERS floral gift service, the Computer Express computer catalog service, and Everything Magic, a software and novelty gift shop from eShop. However, the AT&T Market Square Services on which the electronic shops are to be based is apparently well behind schedule.

The one place that we were able to get a feel of just how intelligent agents can work is with the Communicator's main purpose, sending and receiving electronic messages. The AT&T PersonaLink Services mailbox can be personalized with a series of rules. For example, we could forward a copy of all messages to a pager, to another user, or another address. Or we could ignore messages from people we didn't want to hear from.

The Magic Link is an ideal way to stay in touch while you're on the road. An alphanumeric pager PCMCIA card ($250)—along with an appropriate paging subscription—lets you receive messages even if you can't get access to a telephone line. Although the Magic Cap platform shows great promise, the lack of available services makes it difficult to judge fairly. We have no way of knowing whether intelligent agents will live up to their potential.

We found the screen difficult to read because of its low contrast and excessive glare. Sony apparently chose to forego a back light, which would help the screen's readability, because it would decrease the battery life from the currently too short 5 hours when active or 13 hours when idle. (The rechargeable battery pack allows about 10 hours of active battery use.)

Although the Magic Link is a standalone product, it could certainly benefit from being linked to a PC. Unfortunately, the PC interface is an optional accessory available from IntelliLink Corp. We think that such an essential item should have been included as part of the package. Because we had no way to link the Magic Link to our PC, we were unable to test add-on software packages, such as Palm Computing's excellent Graffiti handwriting recognition software. We also had no way to conveniently move name- and address-book data stored on our PC to the Magic Link.

Other accessories that are available for the Magic Link include a telephone headset ($80) that allows the unit to function as a standard telephone, a full-size keyboard ($130) for lengthy data entry, and a one-megabyte static-RAM memory card to expand the device's internal one-megabyte memory ($220).

Although the Magic Link is a real, complete product, it's not for us—yet. We believe that many mobile professionals will fully appreciate its communications power and its relatively small size. However, until its support of Telescript becomes less limited—which will happen only when more services open Downtown—and until its modem speed catches up with that of PCs, we'll find other ways to get our e-mail both at home and on the road. ■

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You Can Take It With You

INNOVA BOOK 200LS NOTEBOOK COMPUTER MODEL IB100/520LS. Manufactured by: Canon Computer Systems, 2995 Redhill Avenue, Costa Mesa, CA 92626. Tel. 714-438-3000. Price: $3633 (suggested), $3199 (estimated street).

Portable computers have come a long way from the days when they were the size

of large suitcases and were more properly called "transportable" computers. Nevertheless, cramming the full functionality and power of a desktop PC into an easily toteable notebook-sized package cannot be done without some compromise. However, the new *Canon Innova Book 200LS Model IB100/520LS* makes those compromises hard to find.

One of the most striking features of the notebook is its 11.3-inch dual-scan color display—that's over 40 percent larger than a standard (9½-inch) display. The 200LS features one megabyte of video RAM and 32-bit accelerated local-bus video. The LCD can deliver a resolution of 640 × 480. Although higher resolution display modes can be selected—up to 1024 × 768 × 256 colors—the entire image cannot be displayed at one time on the LCD. Instead, a virtual desktop pans and scrolls to display the image.

The resolutions above 640 × 480 are primarily intended for display on an external monitor. Using an external monitor is a simple matter of clicking on the CRT button on the display-driver control panel, a provided Windows application. Alternatively, you can choose to display an image on both the LCD and CRT simultaneously. A hot-key combination, can also be used to switch between modes. Other hot-key combinations can be used to access other display features, including the screen's contrast and brightness.

Users of the Innova Book don't have to sacrifice power for portability. The computer is built around an Intel 100-MHz 486DX4 microprocessor, and is supplied with eight megabytes of main memory. (It can be expanded up to 32 megabytes with plug-in modules.)

The Innova Book 200LS is equipped with full audio capabilities. Stereo speakers are located on the base of the unit, on the top corners directly under the LCD. A microphone is built into the top center of the unit, also directly below the LCD. The 16-bit sound system is SoundBlaster compatible.

The Innova Book 200LS is ready to use out of the box, coming with Windows 3.11 and MS-DOS 6.22 pre-loaded on the hard drive. Distribution diskettes are not included with the system, but a provided utility allows you to create a backup set of installation diskettes. A full backup of all supplied software requires 23 diskettes.

Along with Windows and MS-DOS, the Innova Book is loaded with software utilities that are required to use the system to its full capability. They include display-driver software from Chips (V3.11), ESS audio application (V3.0), PhoenixCard Manager Plus (V3.1), and Logitech Trackpoint Mouse Drivers (V6.24).

The other software pre-loaded on the system is specifically targeted toward mobile professionals. Take, for example, City Streets for Windows V3.0. The version shipped with the Innova Book is supplied with limited sample city maps of downtown Washington D.C., midtown Manhattan, and downtown San Francisco. Complete map databases are available for $29.95 each (plus $8 shipping and handling), with prices declining for multiple-city orders.

CompuServe Information Manager V1.3, which provides access to the subscription CompuServe information service, is also provided for mobile users who want to stay in touch via e-mail and the Internet.

Borland's SideKick for Windows provides a number of helpful tools for keeping information on contacts, to-do lists, appointment calendars, and free-form notes. It includes utilities to import and export cardfiles in a number of different formats including dBase, Paradox, Data-Interchange Format (DIF), Microsoft Cardfile, tab-delimited, and comma-delimited. Fortunately, the software is easy to use and has a good help file—manuals are not supplied.

OAG FlightDesk is a travel-information and -planning tool that lets you search airline schedules for more than 650,000 direct and connecting flights. Subscriptions for monthly updates are available. One free update is offered with the installed software. Frequent business travelers will find the travel information provided by FlightDesk to be priceless. Prices for twelve monthly updates are $107 for the Worldwide edition, or $77 for the North American edition. (Normal prices are $248 and $198, respectively.)

Several manuals are supplied with the Innova Book: concise Windows and DOS guides, a Canon user's guide, and a User's manual for the PhoenixCARD Manager Plus.

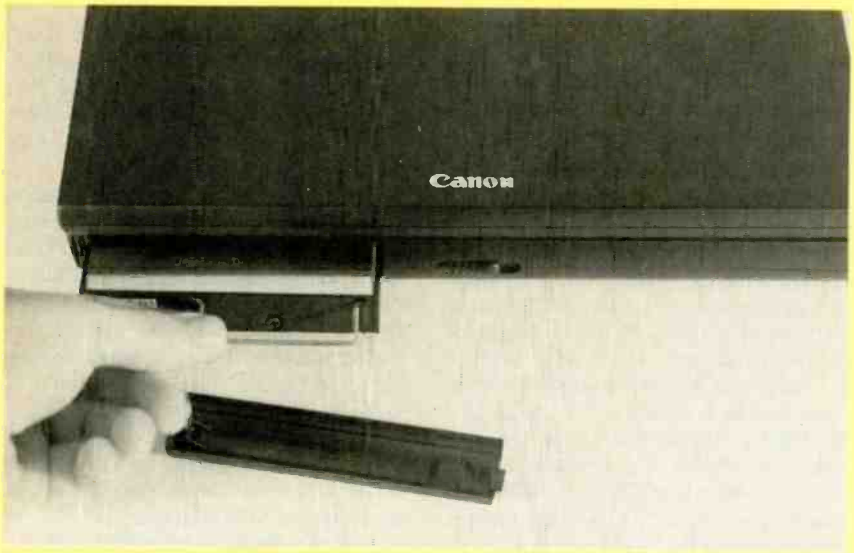
The PhoenixCARD Manager Plus (PCM Plus) software allows the use of a wide range of PC cards that conform to the PCMCIA (Personal Computer Memory Card International Association) standards. The notebook has two PC card slots on its left side. Two Type 2 cards or one Type 3 card can be inserted at a time. (Type 2 cards, 5.5-mm thick, are the thinner of the two. Memory cards, modems, and network adapters are typically found as Type 2 cards. The thicker Type 3 cards are typically PC-card hard-disk drives.)

The Innova Book comes with Card and Socket Services pre-installed. Card Services is a layer of software drivers that allocate and manage system resources for the card. Socket Services is PC Card BIOS (Basic Input/Output System) software that provides a standard interface for manipulating PC Cards, sockets, and adapters. Socket Services hides the hardware specifics from card drivers and applications in much the same way as a computer system's BIOS does.

The PCM Plus software makes it relatively easy for even novices to install and configure a wide variety of cards. It also allows sophisticated users to access advanced features.

The software provided with the notebook is a sensible mix—there is nothing gimmicky about it, perhaps with the exception of City Streets, which is supplied as such a limited package that it ends up as nothing more than an advertisement for the software. However, there are a couple of things that we wish Canon had supplied. First, we would have preferred to see Windows for Workgroups—it would make it easier to integrate the computer into a network when returning to the office from a road trip.

Short of that, we would like to have seen



It's easy to upgrade the Innova Book's hard drive. The removable unit can be pulled out and replaced in a snap!

a better utility for transferring files between the laptop and a desktop computer. Of course, the InterInk file-transfer utility is built into MS-DOS versions 6.0 and higher. Although the manual contains good instructions on how to use it, it's still a clunky way to link two computers together.

The computer sports a small, one-line LCD below the main display that contains icons that serve as caps-lock, Numeric-lock, and scroll-lock; hard-disk access, floppy-disk access, PC-Card access, connection to a DC power supply, charging status, suspend-mode status, and battery status.

The computer is supplied with a NiMH (nickel metal hydride) battery pack. The operating life of the battery is about two hours between recharges, depending, of course, on the kinds of activity that your software performs, and whether you take care to use power-conservation features. Frequent disk access, as you might very well expect, lessens the life span of the battery considerably.

The Innova Book conforms to the EPA's Energy Star guidelines for Green PCs, meaning that the computer can be set to enter a energy-saving "sleep" mode after periods of inactivity. Settings are made through the Phoenix SETUP program, which can be accessed during the unit's boot-up procedure.

The system has four potential energy states: full power, doze, sleep, and suspend. In the system doze mode, the CPU speed changes to a minimum value after a period of inactivity. The feature can be disabled or set to engage after 4, 8, or 16 seconds. A key-press or mouse movement brings the speed up to high virtually instantly.

In the system-sleep mode, more power is saved as the LCD is blanked. The system can enter the sleep mode after the computer has been in its doze mode for 1, 2, 4, 6, 8, 12, or 16 minutes. The feature can also be disabled if the user wishes. Finally, the system offers a suspend mode. The suspend mode does not depend on the sleep or doze modes; even if those two modes are disabled, the suspend mode can still be activated.

In the suspend mode, the system is virtually turned off. It saves the current contents of memory either to RAM or the disk so that when the system is reactivated, it returns you to where you were when it powered down.

If you choose to save to disk, the contents are stored to a separate partition on the hard disk, and the system powers down, providing power only for the CMOS RAM and real-time clock. (The system comes with a 21-megabyte partition configured on the drive for storing the memory contents.) If you choose to save to memory, the memory contents are stored in the system's static RAM. That RAM must also be powered in the suspend mode if the save-to-RAM option is selected, so it is not as efficient in prolonging battery life as the save-to-disk mode.

The power settings can also be used to turn off the hard disk after periods of inactivity of 1, 2, 5, 10, or 15 minutes. The setup program also allows settings for port addresses and interrupts, memory cache setup, and other typical BIOS settings.

The keyboard is comfortable to use, thanks in part to an extended platform on which you can rest your wrists as you type. The platform extends about 3¾ inches below the space bar. Two "mouse" selection buttons are located on the platform below the spacebar.

The "mouse" is actually a pressure-sensitive pointing device that protrudes like a small pencil eraser at the intersection of the G, H, and B keys. The pointing device is, we think, the most practical for a notebook computer. However, it was, at the same time, the source of the biggest complaints from us.

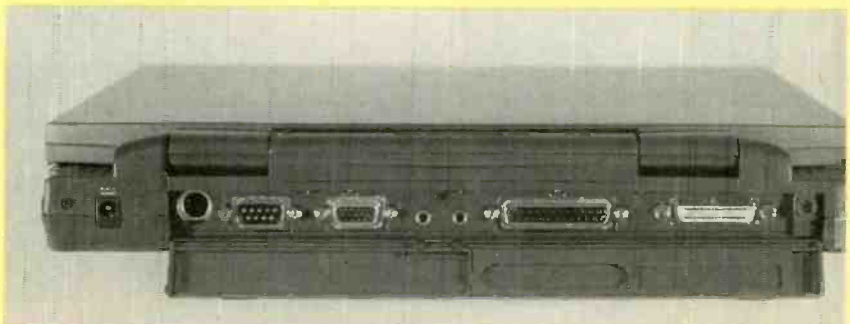
Our sample unit suffered from a manufacturing defect that could make the pointing device virtually unusable. The mouse cursor would not always stay still when the pressure was removed from the pointing device—instead it would drift slowly down the screen. It made it very difficult to use—especially when it began to move faster. It was virtually impossible to double-click on an icon without dragging it along with the cursor.

It became evident to us that the problem with the mouse was heat-sensitive. On initial power-up, it would work fine. It would then begin to drift slowly, getting worse the longer we used the notebook.

We then hit on the idea of setting the power-saving features to their maximums. That reduced the amount of heat that the computer's circuitry generated, and kept the pointer steady as a rock. At other times, we disabled the pointer from the BIOS setup and plugged in an external mouse.

A PS/2 mouse/keyboard connector is provided on the rear panel behind a hinged fold-down door. All of the other connectors that you'd expect to find on a fully configured desktop computer are there, too: serial port, parallel port, VGA port, microphone-in jack, and stereo audio-out jacks. There's also a "port replicator

(Continued on page 18)



The rear panel of the notebook offers, behind a fold-down door, all of the I/O ports that you'd expect to find in a desktop.

How ultrasonic power can safely deter unwelcome animals from your yard...

Yard Gard creates a wall of silent noise that drives away annoying dogs, cats and many wild animals without harming them.

by Charles Anton

Be honest. Even if you're an animal lover, you don't want strange animals in your yard.

You know what I'm talking about... dogs that dig holes and foul your lawn, cats that trample your flowers and sleep on your car. If you live in a rural area, you've probably had trouble with uninvited visitors like raccoons, possums, rabbits, or armadillos.

Until now, there weren't many options. After all, you wouldn't want to harm a stray animal, and your animal control agency may take days to respond, if they ever do.

High-tech solution. Fortunately, modern technology has provided an answer: the new Yard Gard. It uses high frequency sound waves to force unwanted animals to leave the area.

Yard Gard eliminates the need for repellents, trapping or physical attacks. Pests learn to avoid the areas Yard Gard protects.

Ultrasonic Power. Yard Gard's electronic ultrasonic generator broadcasts powerful "silent noise" that repels four-legged yard pests, yet is generally unobtrusive to people. Tones are harmless but animals find the sounds so unpleasant that they flee.

Why it works. Small animals depend on their acute hearing for survival. They can hear in the 18 to 25.5 kilohertz range which is beyond the range of most humans. When critical hearing frequencies are disrupted by strong pulses, animals feel threatened and leave the noisy area. Yard Gard takes advantage of this fact to protect your yard from pests.

Break their habits. Animals are creatures of habit. They establish a territory and generally follow the same travel routes. Yard Gard forces animals to change their patterns and establish new ones. They soon modify their habitual routes to avoid Yard Gard zones.

Cruelty-free pest control that works...

In the past, people relied on poisons or violent means to get rid of unwanted animal pests. Recent environmental awareness has increased the demand for clean, non-lethal methods of pest control. Safe and humane, Yard Gard is the modern solution for pest control.

Humane. *Yard Gard causes no harm to animals. By creating a wall of high frequency sound, it forces them to leave the area and create new habitual routes. While the sound is very annoying to animals, it is virtually unobtrusive to people.*

Nature friendly. *Poisons and pesticides can pollute soil and water sources. Yard Gard deters pests with sound so it causes no damage to the environment.*

Non-toxic. *Chemicals used to eliminate pests can be dangerous to humans or neighborhood pets. Yard Gard poses no health risk when used as directed.*

Just plug it in. Yard Gard's transformer plugs into any standard household outlet. Electricity consumption is very low and costs only about 25¢ a month to operate.

Yard Gard is designed for outdoor operation in all types of weather. You can use your Yard Gard all year.

Mount your Yard Gard on a wall, post, or fence or place it on a flat surface. Yard Gard is essentially maintenance-free and requires only a minimum of care.

Three settings. Yard Gard has three frequency settings. At its lowest frequency setting, one Yard Gard covers an oval area of approximately 4,000 square feet the size of an average city lot. Additional units can be added to especially large yards.

Are animals turning your yard into a zoo?

Do dogs like your yard better than their own?

Are rabbits eating as much from your garden as you are?

Do you have problems with unusual animals?

Do neighborhood cats think your garden is a litter box?

Keep the birds. Do you love to watch and feed birds in your yard? If you have problems with cats chasing birds away or killing them, Yard Gard is the answer. Birds are not affected by the high frequency sound waves. They can't hear it, but cats can't stand it.

Risk-free offer. For a limited time, you can get the new Yard Gard at the introductory price of just $99. Call today to take advantage of this special factory direct pricing. All Comtrad products are backed by our "No Questions Asked" money-back guarantee. If you're not satisfied with the Yard Gard, simply return it within 30 days for a full refund. Yard Gard is also backed by a two year manufacturers warranty.

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We are avid bibliophiles. We enjoy buying books, holding them, reading them, and having them on hand, ready to answer any questions that might arise. If we need to know when to prune a rose bush, how to cook a turkey, what type of bird is nesting in the maple tree, who won the 1972 World Series, what states we'd drive through if we were going to visit friends in Michigan, whether to put a hot or cold compress on a sprain, how to fix a leaky faucet—we pull out the appropriate volume.

It goes without saying that our bookshelves are filled to overflowing. In fact, our book collection takes up far more room than we can spare.

But we can't say that about the last four books that we've collected—a cookbook, two health references, and a dictionary/thesaurus. All four fit in a shirt pocket at the same time, with room to spare.

They are all part of *Franklin Electronics' Bookman* line of electronic books. "Bookman™" is a platform that consists of base units and compatible book cartridges. Every Bookman base unit comes with one book built in. A slot on the back allows other Bookman cartridges to be inserted. Each tiny cartridge—they measure approximately 2¼ × 1½ × ⅛ inch—contains the complete text of a book. Instead of buying separate units, you can add a book to your Bookman library by simply adding a cartridge.

Cartridges slip into a slot on the back of the Bookman unit.

Bookman base units are available in three models: pocket, desktop, and speaking desktop. The pocket-sized unit measures 4⅝ × 3½ × ½ inch, weighs less than four ounces, and has a protective flip-down lid. The desktop-style unit is just slightly larger (5½ × 4 × 1 inch), and has a raised display angled for easy viewing. The speaking version adds a small speaker. Prices for the Bookman base units range from $59.95 to $149.95, depending on the style and which book is built in.

Each Bookman base unit features an LCD readout, QWERTY-style keypad, and assorted function keys arranged virtually identically to those found on any other Bookman product. The only visible hardware difference is the labeling of the four color-coded keys found directly above the alphabet keys. Those take on different functions each time a new cartridge is inserted.

Several titles are currently available on separate Bookman cartridges. So, if you buy a Bookman base unit equipped with the *Total Baseball Encyclopedia*, you can simply plug in *Betty Crocker's Cookbook* when the game's over and it's time to cook dinner. Franklin expects to publish more than 100 Bookman titles by this time next year, ranging in price from $9.95 to $89.95.

We examined the *Pocket Dictionary & Thesaurus* base unit, along with a sampling of cartridges: *Betty Crocker's Cookbook, Parent's Emergency Medical Guide*, and *Diet & Nutrition Guide*.

A POCKETFUL OF WORDS

The Pocket Dictionary & Thesaurus (*MWD-440*, $59.95), which contains more than 83,000 dictionary entries and 41,000 thesaurus entries with 496,000 synonyms, fits the standard Bookman format. Its red, green, yellow, and blue keys are labeled THES, CONF, GAMES, and LIST, respectively. They are used to access the thesaurus, display "confusables" (words that are often confused with others), select a game to play, and show the User List menu.

The MWD-440 offers a major advantage over paper dictionaries in that you don't have to know how to spell a word in order to look it up. For instance, keying in "numonia" will result in a correction list topped by the word we sought: pneumonia. The list also contained several other possible words that we might have meant with our misspelled one: nominee, gnomon, numbing, gnomonic, and mnemonic.

That brings us to the second advantage of an electronic dictionary: the ability to easily look up the meaning of any word that appears on its screen. We already knew the definition of pneumonia; gnomon, however, had us baffled. So we selected that word from the list by highlighting it and pressing the ENTER button, and learned that a gnomon is a pointer on a sundial. (We couldn't, however, come up with an example of how "gnomonic" would be used in a sentence.) It's possible to look up any word that appears on the screen in the same manner, and you can look up a word that appears in some of the other Bookman cartridges, if that book allows such cross-referencing (some do not).

The Pocket Dictionary & Thesaurus lets you know when the word you've looked up has synonyms listed in the thesaurus by flashing "thes" in the upper-right corner of the screen when the definition first appears. A press of the THES key reveals the synonyms for various definitions of the word. For instance, it provided lists of synonyms for 11 different definitions of the word "bear"—none of them relating to the animal. (A small sampling: synonyms for "to put up with something trying or difficult" included abide, brook, endure, lump, stand, and stomach; for "to produce offspring," it suggested procreate, beget, breed, and generate.)

When we looked up the definition of the word bear, "conf" also flashed on the screen, letting us know that the word can be confused with other words that sound and/or are spelled the same. In this case, we found that there were two "confusables" for the noun "bear" (the animal): the verb "bear," meaning to carry, and the adjective "bare," meaning naked.

In another example, the word "bow" (pronounced "bou") had several definitions, including to submit, to bend the head or body, and the front of a ship. Its confusables were "bow" (curve), "beau" (boyfriend), or "bough" (branch).

Unfortunately, the electronic dictionary does not offer pronunciation keys for the words it defines, and that can be more confusing than the confusables. Among

the definitions that the Pocket Dictionary offered for "bow" were "weapon for shooting arrows," "knot with loops," and "rod with stretched horsehairs for playing a stringed instrument." Our trusty pocket *Random House Dictionary* lists all of those definitions separately, under the pronunciation "bo." So we would expect those definitions—as well as "the front of a ship"—to be listed as confusables that are spelled the same but pronounced differently and have different definitions. Perhaps the confusion would be cleared up if we had the speaking version.

The MWD-440 has a few more tricks that are beyond the scope of printed dictionaries. It allows you to find all of the definitions in which a specific word appears. The word "bear" showed up in the definitions of 13 other words, including afford, attest, bruin, fructify, reproduce, sterile, stomach, and yield. It also allows you to "fill in the blanks." You can find missing letters in words by typing in question marks to replace the unknown letters. The Bookman comes up with a "MatchMaker List" of all the possible words, which comes in handy if you're a crossword fan. You can highlight any word in the list and hit ENTER to see if its definition matches the crossword clue. Word games enthusiasts will also appreciate the unit's built-in games: Hangman, Anagrams, and Word Train. Finally, you can create a user list of up to 40 words, even adding words that don't appear in the dictionary. You might use that list as an aid in learning a new word each day, for instance.

The Pocket Dictionary & Thesaurus clearly demonstrates the virtues of electronic books. It allows you quick, easy access to word definitions and synonyms. It also lets you play around with words, perhaps learning as you do so. And because you're not likely to spend time actually reading the dictionary or thesaurus, or typing in long strings of text, the small screen and tiny keypad are not significant drawbacks.

REDUCED-SIZE DIET & NUTRITION GUIDE

The Diet & Nutrition Guide cartridge (*SLM-2013*, $44.95), provides nutritional data for a wide variety of foods, including generic, brand-name, and even restaurant foods. You can place the data for the foods you eat into a personal list that allows you to see the nutritional values of your daily diet. The cartridge also provides nutritional advice and a section on kitchen tips intended to help you eat more healthily.

Once the cartridge is inserted in the slot on the back of the Bookman and the CARD key is pressed, the Diet & Nutrition Guide's logo appears on screen next to the dictionary's logo. Highlighting "Diet & Nutrition" and pressing ENTER takes you into the book. Before actually using the book, you can watch a quick demonstration to see its capabilities, or you can scroll through a textual tutorial that explains the functions of various keys and commands.

With the Diet & Nutrition Guide inserted, the Bookman's four color-coded function keys take on new roles. For quick reference, however, the cartridge itself is adorned with icons representing the four keys and their application-specific labels: FOOD, BRAND, TEXT, and LIST.

The red FOOD key is used to access the list of generic foods, which ranges alphabetically from "abalone, raw" to "zucchini." You can scroll through the list, or you can type in the food you're looking for. There's no need to type in the entire word; the Bookman hones in on the word you want as you type in each letter.

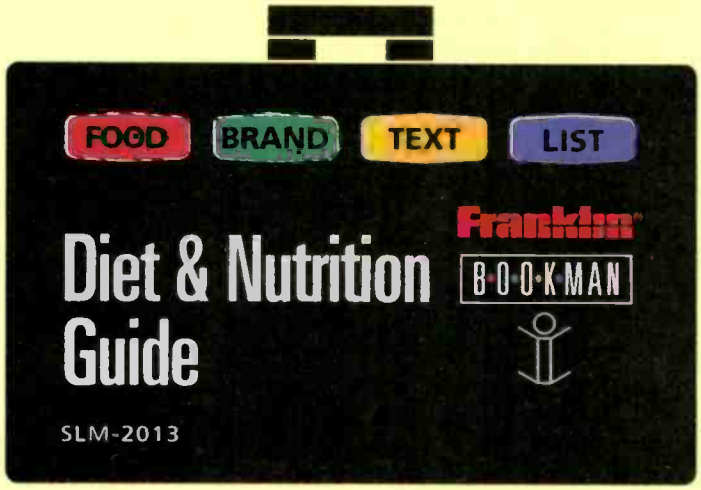
When you find the item you want, pressing the ENTER key will bring up either its nutritional data or a list of more specific options. For instance, there are six choices listed under yogurt: coffee lowfat, fruit lowfat, plain, plain lowfat, plain no fat, and vanilla lowfat. By selecting plain lowfat, you can learn that an 8-ounce serving has 144 calories, 4 grams of fat, 2 grams of saturated fat, 36 calories from fat, 16 grams of carbohydrates, 14 milligrams of cholesterol, 12 grams of protein, and 159 milligrams of sodium; the sugar content has not been calculated.

The generic menu is quite extensive, including all your basic pantry items (flour, butter, sugar, eggs, and the like), and virtually every fruit and vegetable known to mankind. It even offers a wide selection of ethnic foodstuffs, including Indian kebabs, tostadas, matzo, egg-roll wrappers, and risotto. We were able to stump it on a few items, however, including basil. The rest of the ingredients for pesto sauce were listed however, including pine nuts.

Actually, the Diet & Nutrition Guide stumped us much more frequently. We consider ourselves quite knowledgeable when it comes to food, but we've never heard of acerola, akee, or amaranth—and that's just the "A's"! Unfortunately, the Diet & Nutrition Guide is not one of the cartridges that interacts with others, so we were unable to look those words up without exiting the book to use the dictionary.

We were curious enough to do so, but only one of the three appeared in the dictionary: Amaranth is an "imaginary flower that never fades," or an "herb with colorful flowers." We're not sure why that would be included and the ever-popular basil (and the very trendy cilantro) omitted. And we still don't know what akee or acerola are—they weren't in our printed dictionary either.

The green BRAND key is used to find the nutritional values of brand-name and chain restaurant foods, from All-Bran, Kelloggs, to Zings (another item we weren't familiar with). It allows you to compare different brand names of the same food type before you get to the supermarket. And it lets you know just what you're getting when you order a Big Mac, large fries, and a low-fat chocolate shake (1220 calories, 231 from fat; 49 grams of fat; 24 grams of protein; 154 grams of carbohydrates; and 1330 milligrams of sodium) at McDonald's.



If you are content to be consuming a steady diet of fast food, you probably won't be using the Nutrition Guide anyway. But if you find yourself eating at burger joints more often than you'd like due to circumstances beyond your control—because it's a quick, cheap meal that you can squeeze in between errands on your lunch break, or because the kids are clamoring for a Happy Meal with toys and it's easier to give in than to fight with them while cooking, serving, and cleaning up after a real dinner—the Diet & Nutrition Guide can help you make healthier choices while you're there.

It also allows you to keep track of the nutritional content of everything you eat on a day-to-day basis. While the data for any food from either the generic or the brand-name list is displayed, pressing the ENTER key will bring up the question "Add to today? (Y/N)." If you opt to do so, it then asks if you need to adjust the portion size. By inputting everything you eat each day, you can see the precise breakdown of the calories, fat grams, etc. that you've ingested.

The blue function key, labeled LIST, can be used to access your personal list to view today's total, or to start calculating another day's nutritional intake. You can also have the device calculate your weekly average.

The yellow function key, labeled TEXT, provides some interesting reading material. It includes recommendations concerning healthy eating, cholesterol levels, and high blood pressure. Explanations of each of the nutritional categories—calories, protein, fat, etc.—provide a look at how much is needed in the daily diet, what the substance does to help you, and how it can hurt you. Kitchen tips for healthier eating include common-sense ways to lower fat, cholesterol, and sodium (remove the skin from poultry, use milk instead of cream, broil instead of frying, limit the amount of meat you eat, limit the use of prepared foods, eat fresh fruit and vegetables ...). Finally, the guide provides answers to the 20 most commonly asked nutritional questions: Are sugar substitutes safe? Which is better, butter or margarine? Is caffeine dangerous?

While it's nice to have such information on hand, you won't want to spend much time reading it on the Bookman's small screen. Once you've scanned through the text and reached a clearer understanding of what you should be eating—and not eating—the Diet & Nutrition Guide does provide a convenient way to track your food intake, and, perhaps, begin eating in a more healthy manner.

COOKING WITH BETTY

If, horrified at the nutritional content of fast foods, you find yourself inspired to start doing some home cooking, the next Bookman cartridge to plug in is Betty Crocker's Cookbook (*BCC-2007*, $89.95). The 40th anniversary edition of the classic American cookbook has been updated for the 90s, with an emphasis on quick, healthy cooking using less fat, sugar, and sodium and more fresh ingredients.

The cookbook presents a combination of favorite recipes from past editions (denoted by an on-screen symbol supposed to resemble a sheaf of wheat), "fix-it-fast" recipes that take less than 30 minutes to prepare (a clock icon appears on screen), and trendy ethnic-influenced dishes. There are four recipes for good ol' meatloaf, but you can also learn how to prepare beef with chipolte sauce, or bok choy with tofu.

As with the other Bookman cartridges, this one provides an on-screen demo and tutorial to help familiarize new users with its contents and how to access them. In case you get "lost," help is available at virtually every screen, with a press of the HELP key.

There are a few different ways to find recipes in Betty Crocker's Cookbook. You can search by typing in the name of the recipe, if you know it. If you don't know the precise name, typing in part of it will call up a list of "matches"—recipe names in which that word appears. And if you misspell the word, the cartridge will call up a list of possible corrections.

By selecting Index from the menu screen, you can begin a search by typing in the first few letters of the recipe name. The Cookbook locates its matches for you. The same method can be used to initiate a search by ingredient or recipe categories.

You can also select "Recipe Category" from the Contents menu to scroll through an extensive list that includes meats, breads, appetizers, beverages, shellfish, pasta, legumes, soups, and sandwiches, to name a few. Within each of those categories, you'll find not only recipes, but extensive information relevant to the subject.

Under Vegetables, for instance, there's an introduction extolling the virtues of eating your vegetables, a look at vegetable basics that explains the proper "doneness" of various types, and some suggested vegetable accompaniments—flavored butters, sauces, and crumb toppings. For each individual vegetable, there's an in-depth explanation of how to select it at the supermarket and various basic cooking techniques. (You'll never be intimidated by artichokes or spaghetti squash again.) The recipes for each vegetable type are listed following its introduction.

Finally, you can search for recipes by ingredients, using the yellow function key marked INGR. Say, for instance, that on Sunday morning you had eggs, bacon, and potatoes on hand, but didn't feel like having the usual eggs over easy with hash browns and a side of bacon. You might want to whip up Betty's Breakfast Potato Casserole for brunch instead.

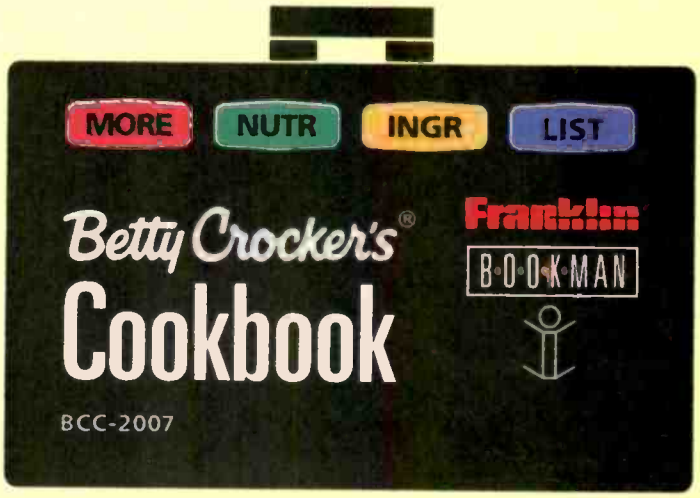
In this case, you could put your fresh potatoes back into the pantry. The recipe calls for a package of hash-brown potato mix instead. Despite the cookbook's claim to use more fresh ingredients and less fat, sugar, and sodium "wherever possible," many recipes—too many for our tastes—call for pre-packaged ingredients and ingredients that could easily be replaced by reduced-fat equivalents.

The Breakfast Potato Casserole contained 19 grams of fat per serving, which isn't bad. But we would probably have substituted reduced-fat cheddar, 2% milk, and three whole eggs and four egg whites for the cheddar, milk, and five whole eggs called for in the recipe. And we would have shredded the fresh potato we had on hand instead of using a packaged mix.

On the plus side, every recipe is accompanied by complete nutritional information—more complete, in fact, than the data offered in the Nutrition & Health Guide cartridge. Besides providing the total calories, fat, protein, carbohydrates, cholesterol, and sodium per serving, the

cartridge lets you know the percentage of the recommended daily allowance of protein, vitamins A and C, thiamine, riboflavin, niacin, calcium, and iron. The green function key, labeled NUTR, can be used from within any recipe to access its nutritional data.

If you are seriously interested in reducing the fat in a recipe, you can find some pointers on how to do so in the "Reducing Fat in Your Diet" chapter located under "Special Helps" in the Contents menu. In it, you'll find basic tips (choose lean cuts of meat and trim all visible fat; use nonstick cookware), as well as suggestions on how to reduce or substitute for fats within recipes.



The Special Helps section contains a wealth of basic information about cooking and related topics. It offers advice on grilling, microwaving, and cooking in high-altitudes; table-setting and entertaining; yields and equivalents (if your recipe calls for 1 cup of chopped apple, you'll need approximately one medium apple); nutrition basics; emergency substitutions (for 1 ounce of unsweetened chocolate, use 3 tablespoons unsweetened cocoa powder and 1 tablespoon vegetable shortening); herbs and spices; and canning.

Also found in the Contents menu is "Cooking with Confidence." It covers the fundamentals, including kitchen setup and equipment, measurements, a glossary of food terms, and the basics of food preparation (how to separate an egg, melt chocolate, peel a tomato).

More advice is available within many of the recipes themselves. If an XREF or FOOT symbol appears within the text of a recipe, that means that more information pertaining to that recipe is available elsewhere. By highlighting the symbol and pressing ENTER, you can view the cross-reference or footnote. Pressing BACK returns you to the recipe.

If you have your own tips that you'd like to jot down "in the margin," you can press the blue LIST key to add a note to a recipe. Depending upon the length of each, approximately eight notes can be stored. (They won't be saved, however, if you remove the cartridge from the Bookman.)

The recipes contain enough details to guide even total beginners step-by-step to a successful dish. The banana-bread recipe, for example, tells the cook where to position the oven rack, what size pans will work, different baking times for differently shaped pans, how to use a toothpick to tell if it's done, and how to cool, wrap, and store the finished loaf. It even offered a tip that experienced cooks might not know of—ripe bananas can be mashed with a little lemon juice and frozen until you're ready to bake with them.

Those details, along with the textual information found in the contents menu, make Betty Crocker's Cookbook an excellent gift for the first-time cook. A college student who is living off-campus, for example, would be able to put it to good use along with various Bookman reference cartridges.

911? INFORMATION, PLEASE

As any parent knows, keeping your kids well fed is only one part of keeping them healthy. In spite of our best intentions, kids manage to get sick or hurt—and they tend to do so in the middle of the night or on holiday weekends, just when we're least likely to be able to reach the doctor.

What do you do when the baby learns to climb at 3 AM, and falls out of his crib? When your five-year-old is running a fever of 104°? When your roller-blading teenager runs into a tree? When your two-month old won't stop crying? When your little girl is covered with little red spots?

You can find the answers to each of those questions, and dozens more, in the Parents' Emergency Medical Guide (*EMG-2006*, $44.95). For each problem, the device uses what it calls "decision trees" to narrow down the problem and give you the proper advice for your particular situation.

Upon selecting the cartridge, you are asked to enter the problem. We typed in "spots," and were asked to respond to a question—Did the rash begin suddenly, and is your child having difficulty breathing?—by pressing Y for yes or N for no. We answered no for our hypothetical situation. The Bookman then asked if the child has a fever, to which we responded yes. It told us to "Call your doctor or clinic or emergency room immediately if the rash is purple spots. Otherwise, see the 'Doctor's Advice' section for Fever, then press CLEAR and type 'rash' for more advice."

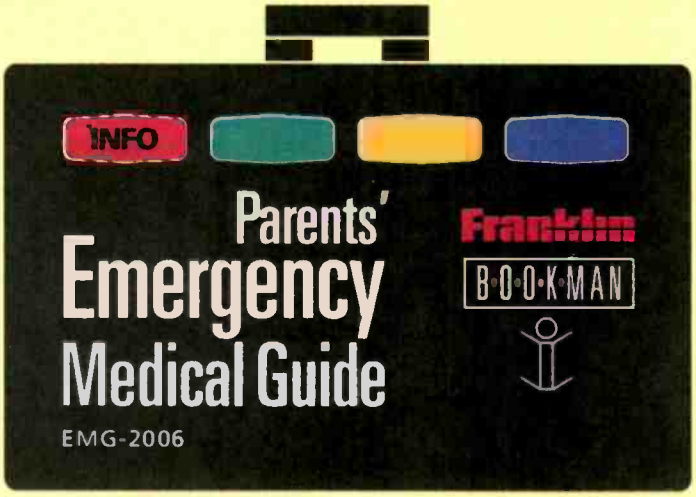
There's no need to start over again by pressing CLEAR and typing in "fever." An XREF symbol next to the word fever let us know that we could go directly to the cross-referenced information—in this case, the section on fever—by pressing the ENTER key.

Once again, we are presented with a decision tree: "Can you answer yes to any of the following questions?" Those asked if the child is experiencing convulsions, delirium, difficulty breathing, stiff neck, or difficulty waking, among other symptoms. If so, we are again directed to call the doctor or go to an emergency room. In that way, we learn the temperature levels considered dangerous at various ages, and what symptoms, in addition to the fever, require immediate attention.

If the answer to that list of questions is no, and the child "seems comfortable, alert, and active and has a normal appetite" despite the rash and mild fever, we learn that she doesn't need fever medicine or medical attention. "She probably has a viral infection such as a cold, mild flu, or a viral rash. Handle these problems as necessary. Do not recheck her temperature unless the situation changes."

In that manner, The Parents' Emergency Medical Guide provides two important services. First, it lets parents know precisely when the situation requires immediate, professional medical attention—something that is often difficult to determine on one's own. Even when faced with seemingly alarming symptoms, many parents are reluctant to call the doctor, particularly in the middle of the night and on weekends, unless it really is an emergency. Other parents reach for the phone or run to the emergency room for problems that could easily be handled at home. Second, the guide usually lets you know how to cope with non-emergency situations on your own.

The above example, however, is an unfortunate exception. Not all parents know how to "handle these problems as necessary" and just what changes in the situation warrant taking the child's temperature



again. There were no easy cross references to cold, mild flu, or viral rash, although each could be found in the guide. And such less-than-helpful answers appear only for those situations in which the child is only mildly ill and doesn't require any immediate intervention by parents or doctor.

If, on the other hand, we had answered the last question in the decision tree affirmatively, we would have received detailed directions on how to treat a child with a fever. The Parents' Emergency Medical Guide lists the symptoms of dehydration, which often accompanies a fever, and offers suggestions on how to prevent it in children of different ages. It tells you how often to take the child's temperature, what over-the-counter medications are all right to give children (with a cross-reference to an age and weight chart for appropriate dosages), how to dress a feverish child, the proper room temperature, and to use lukewarm water (not rubbing alcohol) for a sponge bath. The guide then provides a list of additional symptoms for which you should call the doctor during regular office hours.

While learning about fevers, we could also press the red INFO key to view the information about fever located in the cartridge's general reference section. We could also check the "How to Use a Thermometer" cross-reference.

Such detailed advice is available for just about any ailment you can dream up. The Contents menu is divided into sections titled Emergencies, Common Problems and Concerns, and Prevention. The first two categories each contain general information as well as specific topics.

Under Emergencies, you'll find text on how to handle emergencies, CPR, going to the emergency room, and hospitalization. There are also 15 emergency topics from which to choose, including burns, choking, bone and joint injuries, poisoning, frostbite, and head injuries. Under Common Problems and Concerns, there are sections on how to use medicines and how to choose a doctor for your child, as well as 26 more topics. Those include medical problems—earaches, fever, colds, coughing, rashes, stomach aches, and the like—and other parenting dilemmas, such as dealing with toddlers who say "no" and fussy babies. Other topics include caring for newborn babies, feeding babies and young children, growth and development, and child abuse. Each of the topics listed under Emergencies and Common Problems can be accessed by typing in the topic heading, or its number, which can be found in the manual.

The Prevention section is divided into three main topics intended to help parents ward off as many accidents, illnesses, and injuries as possible. It presents some grim statistics—accidents account for more deaths among American children than the total fatalities caused by the four leading children's illnesses, with vehicular accidents topping the list. With an emphasis on practical precautions, not over-protectiveness, the Parents' Emergency Medical Guide provides information on car, home, toy, bicycle, skating, water, and animal safety; immunizations; and physical fitness.

We liked the way the Parents' Emergency Medical Guide is set up. The questions-and-answers process used in the decision trees is the same method that our pediatrician uses when we call her with a problem.

The Parents' Emergency Medical Guide is not meant to take the place of professional medical help. What it does do is calm parents down enough to handle some of childhood's mild crises on their own, while letting them know when it is time to call on a professional.

We're not ready to replace our stack of printed parents' references, but we will keep the Bookman version of Parents' Emergency Medical Guide with them.

POSTSCRIPT

We have mixed feelings about electronic books. After all, you don't have to worry about a printed cookbook "closing" itself if more than three minutes elapses without it being touched as you're cooking a meal. Yet three minutes is the longest shut-off time delay provided by the Betty Crocker's Cookbook cartridge. And a print book is more likely to be easily found, in its place on a bookshelf, than the pint-sized Bookman—which might be hiding in a briefcase, under a stack of papers on a desk, in the cushions of a couch, or just about anywhere else. (We misplaced our unit several times while testing it.) That could prove disastrous if the book you needed was Parent's Emergency Medical Guide. We'd also like to see a Bookman carrying case with room to store the extra cartridges, which are even more likely to be mislaid.

Right now, the cartridge prices are still quite a bit higher than you'd expect to pay for the hardcover print versions of the same books. According to Franklin, however, "As silicon prices continue to drop, Bookman electronic books will be cheaper than printed reference books in three years or so."

On the plus side, it could be nice not to have stacks of books cluttering up a desk top or the whole house. And, yes, it's terrific to have so much information literally in the palm of your hand. So, although we're not anywhere near ready to give up our library of printed books, we like the convenience having the Bookman on hand as well. ■

CANNON NOTEBOOK

(Continued from page 12)

port." We assume that it's for connection to a docking station—the documentation remained mum about it.

The Innova Book is an ideal computer for mobile professionals and for small-office/home-office (SOHO) workers. The only things missing from the Canon Innova Book 200LS are a fax/modem and CD-ROM drive, both of which can be added easily enough with off-the-shelf solutions. (PC-card modems are readily available, as are portable parallel-port CD-ROM drives, and PC-card SCSI CD-ROM interfaces.)

The notebook could easily be a virtually no-compromise desktop PC for space-starved home offices thanks to its large display. However, if you have more room and if you prefer to use a full-size keyboard and traditional display, they can be accommodated easily enough. The ability to easily insert a new hard-disk drive increases the system's versatility dramatically. ■

Frustrated bartender develops incredible device to clean and disinfect your entire home...

Vapormax, a revolutionary new cleaning system, uses dry vapor to provide versatility and power never before available for home use.

by Annabel Woodward

Lipstick-stained bar glasses and a cappuccino machine. Believe it or not, these two things led to the development of a cleaning system like nothing you've ever seen—Vapormax.

The inventor of this system was a bartender whose hardest task was removing lipstick stains from glasses. He'd scrub and scrub, but to no avail—the stains were almost impossible to remove. Then, one day, on a whim, he passed a lipstick-stained glass under the steam vent of a cappuccino machine. It worked—the stain wiped off easily! The result of this discovery is Vapormax, a system that cleans with high-temperature vapor (low-moisture steam).

Powerful clean. Vapormax doesn't use high pressure, lots of water, a motor, chemicals or vacuum bags. So how does it clean? Vapormax uses water, heat and gentle scrubbing to clean everything in your home from upholstery to your barbecue grill. The heat produced by Vapormax weakens the physical bond that holds dirt and stains to surfaces. Water, converted to "dry vapor" by the heat, is considered to be nature's most perfect solvent. Various attachments *gently* scrub the surface, loosening dirt. The dirt particles are suspended in water droplets that result from condensation of the vapor. And then, because water flows in the direction of the least resistance, the dirt and moisture are absorbed by a cotton towel.

Versatility. With its wide variety of attachments, Vapormax can clean and sanitize virtually anything in your home. Clean bathrooms, upholstery, kitchens, rugs (even oriental rugs can be cleaned carefully), drapes and mattresses. Use Vapormax to clean the interior of your car from the seats to the windows. Take it outside to clean barbecue grills and patio furniture. The high-temperature vapor also sanitizes things like children's toys. You can even use Vapormax as a humidifier or a clothes steamer!

Built for safety. Physics dictates that steam under pressure loses its heat energy almost immediately as soon as it is allowed to expand. So while the steam in the tank reaches 280° F, it cools to 180-200° F at the cleaning surface, and to body temperature six inches from the tip. While it is possible to burn yourself, as it is with an iron, it's unlikely with responsible use.

Vapormax also has other features to ensure your safety. First, every part of the system which is exposed to steam is insulated or made of polycarbonate materials that will not transmit heat to the user. Second, the release of steam is controlled by a valve inside the unit. So if the hose is disconnected from the tank, even accidentally, the valve cuts off the flow of steam instantly. Finally, all the pressure elements have been tested safe to 10 times maximum operating pressure. If internal pressure is too high, an electrical safety device will shut the unit off. The filler cap also releases steam automatically and harmlessly to reduce internal pressure.

For a healthier environment. Not only will your home look and smell cleaner with Vapormax, but germs and irritants including staphylococcus ("staph") and streptococcus ("strep") will be removed from your environment. You will notice a difference immediately after a Vapormax cleaning—especially if you are an allergy sufferer!

Try it risk-free. Vapormax is backed by our exclusive risk-free home trial. Try it, and if you're not completely satisfied, simply return it within 90 days for a full refund, "No Questions Asked." It is also backed by a one-year manufacturer's warranty. Most orders are processed within 72 hours and shipped UPS.

Vapormax (with instructional video) . . . **$499** $29 S&H

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

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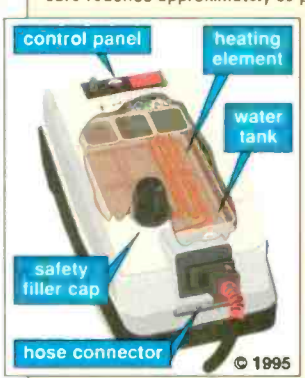
- Children's toys
- Tubs and toilets

- Clothing
- Even humidifies!

HOW VAPORMAX WORKS

Vapormax uses electricity to heat the water in its tank, creating steam under pressure. When the pressure reaches approximately 50 psi, the temperature of the steam reaches about 280° F and the moisture content of the steam goes down to about 5%. An electronically-controlled solenoid valve releases pressure from the tank, and pressure to the tip is regulated with a manual valve similar to a water faucet. The steam travels from the tank to the tip through a pressure line inside an insulated hose. At the tip, the variety of brushes or other accessories allows the steam to reach the dirty surface while a brushing action is applied, releasing and removing dirt and stain particles from the surface you are cleaning.



GIZMO NEWS

Teens Just Wanna Watch TV

Teenagers in the U.S. love high technology, but they're content to sit in front of the tube. According to a survey conducted by Chilton Research Services (Radnor, PA), nearly half of America's teenagers (11-18 years old) use a computer at home, and about twenty percent of them log in to online services or bulletin boards (BBSs) with their home computers. They're not just doing homework and research, however. Playing video games is the main attraction of online services. Chatting online ranks a distant second.

Teenagers are more familiar with high-tech products than the population at large. More than half of them have used a CD-ROM player (most at school) and about six percent of all teens have bought a CD-ROM title in the month in which they were surveyed.

TV, however, is still king. Forty percent—twice as many as go online—say that watching TV is more fun than going online. Sitcoms are the most popular programming genre. The most popular network? Fox. The most popular show? *Home Improvement*.

More than 96 percent of American teenagers have or have access to a VCR. About 79 percent of teenagers had rented or purchased a videotape in the few months before the survey was conducted. Although most teenagers "veg out" thanks to electronics technology, most think that innovations and advances in technology will help them gain a better lifestyle than their parents enjoy.

Keep Those Products Coming!

The electronics industry has a lot of happy consumers. A national survey conducted by the Consumer Electronics Group of the Electronic Industries Association (EIA/CEG) asked owners of audio equipment to compare the value of their systems with other recreational and entertainment products that they own—which included everything from swimming pools to boats to exercise equipment.

We're not surprised that their specialty audio equipment (69%) was judged to be a better value than their exercise equipment. Fourteen percent said that the two were of equal value. More surprising is that more than half of the respondents said that their specialty audio equipment was of better or equal value than their swimming pools—this being written during an early summer heat wave (43% said that audio equipment was a better value, 13% said the two were equal).

Pool tables fared even worse, with 76 percent saying that their audio equipment was a better value, and 14 percent saying that the two were equal. Hot tubs and boats didn't fare all that much better. Because we don't own either, that makes us feel good (59%/70% said that their audio equipment was of better/better or equal value than their hot tub, 49%/63% said that their audio equipment was of better/or better or equal value as their boat).

Radio Sounds Good Today

Another survey conducted by the EIA/CEG tried to find out how our attitudes and practices regarding home entertainment change as we get older. Not much, apparently.

The EIA surveyed 1200 households, 500 of which had home theaters, 500 that had full stereo systems, and 200 that had neither. The results indicate that, for Americans 36 years and older, the radio is a major source of music, much as it was when they were younger. The Beatles are no longer their favorite performers, but songs from the fifties or sixties are still popular, being heard primarily on oldies stations.

When asked for their favorite band or artist when they were 18 to 25 years old, the Baby Boomers, now 26–55 years old, mentioned the Rolling Stones, Beach Boys, Elvis Presley, and Chicago along with the Beatles.

Today, Baby Boomer tastes run to Reba McIntyre, Kenny G, Garth Brooks, the Eagles, and Elton John. Seventeen percent could not name a favorite performer. An even larger number—twenty percent—of those over 55 could not name a favorite performer, indicating that age brings a modest decline in interest in specific performers. The interest in music in general does not drop, however.

Baby Boomers listen most to oldies from the 1950s and early 1960s, with more than 80% saying that they listen to such music. Next in popularity is classic rock, starting with the Beatles and ending with disco.

Today, most music listening is still via radio (89%), followed by compact discs (72%), tapes (70%), and LP records (23%). The amount of time spent listening remains relatively unchanged over time. About 32 percent said that music-listening time increased, 24 percent said it decreased, and 43 percent said it was unchanged.

Supercomputer Centers Linked

In 1987, the National Science Foundation built what became known as the NSFnet, a high-speed backbone linking several Supercomputing Centers across the U.S. The backbone was to provide higher speed than the original ARPAnet—which formed the beginning of what we now call the Internet—was able to. The NSFnet was the primary backbone of the Internet until recently.

The NSF has teamed with MCI Communications to build a new national network connecting five supercomputing sites. The network, called the very high speed Backbone Network Service (vBNS), will be used by major science laboratories for various research-and-development projects such as environmental modeling and weather forecasting.

One of the driving forces behind the network is the ability to solve the Grand Challenges. The Grand Challenges, first

The MCI very high speed Backbone Network Service (vBNS) links supercomputing sites together.

articulated by the U.S. Office of Science and Technology Policy, are fundamental problems in science and engineering with broad economic and scientific importance whose solutions can be advanced by applying high-performance computing techniques and advanced networking resources. Examples include the weather forecasting and environmental modeling already mentioned, along with such other problems as understanding the structure of biological molecules to fight heart disease, building more energy-efficient cars and planes, and understanding how galaxies are formed.

The network will use a combination of asynchronous transfer mode (ATM) and synchronous optical network (SONET) technologies. The vBNS will initially operate at speeds of 155 million bits per second (Mbps) and is planned to operate at greater than 600 Mbps in 1996. According to MCI, new fiberoptic technologies will eventually allow networks to reach transmission speeds of 40 gigabits per second, enough for nearly half a million simultaneous Internet conversations over a single fiber pair.

The five-year, $50-million agreement will tie together the Pittsburgh and San Diego Supercomputing Centers, the Cornell Theory Center, the National Center for Supercomputer Applications in Urbana, Illinois, and the National Center for Atmospheric Research in Colorado. The vBNS will also be accessible to NSF-approved researchers through access points in New York, San Francisco, Chicago, and Washington, D.C. Eventually, the vBNS will be accessible by outside research organizations, government, and commercial networks through those access points, using standard Internet access.

SDTV—A Step Forward?

By the end of this year, the Federal Communications Commission is expected to approve a final specification for high-definition television or HDTV. It now looks as if the standard will include provision for SDTV or—you guessed it—standard-definition TV.

Terrestrial broadcasters see SDTV as a bridge, a way to compete with digital satellite, cable, and (eventual) phone-company video networks. The flexibility that it will provide broadcasters will allow them to deliver picture resolution based on programming, and more channels, perhaps for non-programming services. For example, when broadcasting an old black-and-white sitcom rerun, broadcasters do not want to be forced to use the full channel capacity of 20-megabits per second.

HDTV proponents see SDTV doing nothing more than delaying the acceptance of HDTV and the delivery of HDTV programming.

Third DBS Satellite Launched

DBS-3, the third high-power direct-broadcast satellite for the DirecTv service, was launched successfully in June. When operational, the satellite will expand DirecTv's channel capacity.

The three satellites are co-located at the 101° West longitude orbital location. The program providers, DirecTv and USSB, are licensed to transmit from that location. USSB is licensed to transmit carriers on five frequencies, and DirecTv is authorized to transmit carriers on 27 frequencies. DBS-1, which contains all five of USSB's transponders and nine transponders for DirecTv, transmits at 120 watts per transponder. When DBS-3 is up and running, both it and DBS-2 will be configured to transmit eight carriers each, with 240 watts per transponder.

Digital compression allows about 175 channels to be broadcast via the 32 licensed frequencies. USSB delivers about 25 channels, with DirecTv delivering the rest. Programming can be received only with RCA or Sony DSS Digital Satellite System receivers and satellite dishes. ■

ELECTRONICS WISH LIST

The Ultimate Home Theater

Anyone determined to have the ultimate home theater might consider taking out a second mortgage to buy the *Vidikron/Faroudja VP-400 Video Processor* and *VPF-50HD* projection monitor from *Vidikron of America, Inc.* (150 Bay Street, Jersey City, NJ 07302). The line-quadrupling processor converts conventional 525-line interlaced NTSC video signals to progressively scanned, 2100-lines-per-frame output, completely eliminating scan lines and delivering a stunning improvement in overall picture quality. It incorporates a Super-NTSC Decoder that eliminates color blurring, with anti-artifact comb filters that prevent cross-color interference without digital artifacts. Patented correction circuits prevent dot-crawl and hanging dot errors and bandwidth-expansion circuitry maximizes image detail. The line-quadrupler requires a suitably high-scan-rate monitor, such as the VP-50HD projector, which offers 64-kHz horizontal scanning frequency with scan-deflection circuitry capable of 2.5-microseconds retrace time. It also features a high-precision, dual-yoke design for extremely accurate focus to the edges of the picture, improved-uniformity luminance circuitry for constant edge-to-edge brightness, and higher beam current that yields significantly greater light output with finer-spot tubes. The projector can produce a 5- to 25-foot diagonal image, variable aspect ratios, and on-screen graphic control menus. The top-of-the-line *VPF-50HD/Auto* adds an auto-convergence calibration system that uses a motorized and computer-controlled color video camera to deliver perfectly accurate color convergence in less than five minutes. Either projector, when used with the processor, provides high-resolution images that genuinely rival 35-mm film—what the company calls "Virtual HDTV." Prices: VP-400 Video Processor, $20,000; VPF-50HD, $19,995; VPF-50HD/Auto, $22,995.

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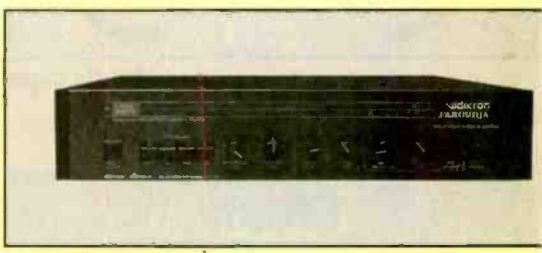

Vidikron/Faroudja Line-Quadrupler

Vidikron Video Projector

ELECTRONICS WISH LIST

AT&T Computer Phone

Computer Phone

The *Computer Telephone 8130* from *AT&T* (5 Wood Hollow Road, Parsippany, NJ 07054) is a phone and software package that combines the power of a PC with the familiarity and simplicity of standard telephone. Designed for use in home offices, the two-line speakerphone is the first phone that connects directly to a PC. The Computer Telephone can store up to 5000 names and phone numbers for one-touch dialing. It gives users access to customer records stored in their computers with a couple of key strokes, even before the customer's call is answered. (When used in conjunction with Caller ID service, the device displays the caller's phone number on the computer screen between the first and second ring, making it possible to access stored notes and files easily.) It provides a call log of all incoming and outgoing calls, which can be sorted by name, phone number, or date, and redialed with the click of a mouse. It allows users to handle all phone functions, such as setting up three-way conference calls, putting calls on hold or mute, or redialing calls, either by phone or computer. The phone holds an 18-call memory to dial the most frequently used numbers, and can store up to 15 incoming call numbers in memory when the PC is off. Those are downloaded to the PC when it is turned back on. The Computer Telephone is compatible with TAPI (Telephone Application Program Interface) standards. Price: $199.

CIRCLE 62 ON FREE INFORMATION CARD

TCI Kid Control

Kid Controls

Give your kids fast access to their favorite television channels—and no access to the rest—with the *TCI Kid Control* from *Telecommunications, Inc. (TCI)* (Terrace Tower II, 5619 DTC Parkway, Englewood, CO 80111-3000). The pre-programmed universal remote control features eight buttons emblazoned not with numbers, but with the highly recognized logos of the channels kids like to watch most: The Disney Channel, Nickelodeon, The Discovery Channel, The Learning Channel, Cartoon Network, The Family Channel, and a local PBS affiliate. The eighth button is left free for local customization. The Kid Control is available in two models, a bright orange dinosaur and a purple puppy sporting sunglasses. Each comes with an activity book and crayons and an offer for a free issue of *Better Viewing*, a magazine geared toward helping families make informed television viewing decisions. Price: $29.95.

CIRCLE 63 ON FREE INFORMATION CARD

Wrist Waterbed

The *Waterbed For Your Wrists* from *Waveco* (P. O. Box 1331, Palmetto, FL 34220; Tel. 813-723-2229) provides comfortable support and shock absorption for computer typists' wrists. The gel-filled wrist cushion supports the wrists during typing, not just during periods of rest. Unlike traditional wrist rests, the Waterbed doesn't create pressure lines across the underside of the wrists. The gel conforms exactly to the contour of the wrists and palms, so that perfect contact between the pad and the user's hands is consistently maintained, regardless of the orientation of the arms and hands. The gel has vibration- and shock-absorbing properties said to help prevent Carpal Tunnel syndrome. If over-exertion still causes aching wrists, the pad can be refrigerated to provide cold therapy. Price: $19.95 plus shipping and handling.

CIRCLE 64 ON FREE INFORMATION CARD

Staedtler Erasable Lumolabels

Erasable Labels

If you use your cassette tapes, videotapes, and floppy disks more than once, you've probably experienced labeling problems. Either you get a build-up of new labels over old ones, or you have almost illegible labels with new information written over the original. *Staedtler, Inc.'s* (21900 Plummer Street, Chatsworth, CA 91311) *Lumolabels* solve those problems. The erasable labels come in three shapes and sizes, each designed specifically for use on audio tapes, videotapes, or 3.5-inch disks. Each box of 18 labels includes a special Lumolabel pen and eraser. The writing is essentially permanent unless the eraser (or rubbing alcohol) is used to remove it. The system allows quick, clean labeling of consumer-recordable media, with the ability to change content listings as needed. Price: $4.98/box.

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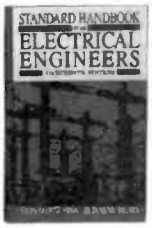

0209847-XXX $110.50
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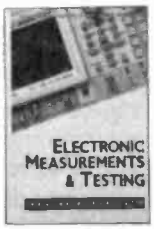

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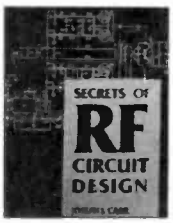

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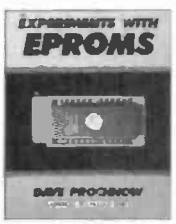

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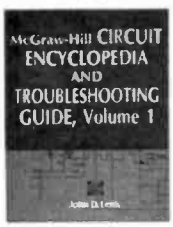

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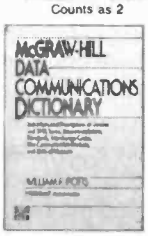

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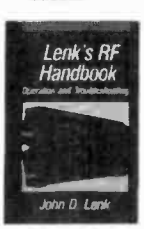

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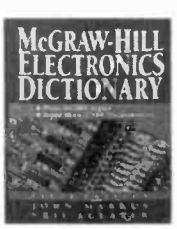

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MULTIMEDIA WATCH

By Marc Spiwak

Slide-Show Software

A while back I reported on a very unusual cordless pointing device that feels more like a TV remote control than a mouse. That unit was the *RemotePoint* from *Interlink Electronics*, and it is a handheld, wireless infrared (IR) mouse.

RemotePoint uses Interlink's force-sensitive resistor (FSR) technology, which is basically a thin film sheet that changes its resistance according to the pressure applied to it. The material can indicate both the amount of pressure applied and where pressure is applied on the sheet. RemotePoint has a circular rubber disc on top that can be "tilted" 360 degrees. The tilting motion replaces a normal mouse's X-Y motion and moves the cursor on the screen in the direction that the disc is tilted in. Cursor speed depends on the pressure applied to the edge of the disc.

SlideWorks lets you highlight and circle things on your computer screen with the RemotePoint wireless mouse.

To use it, you point RemotePoint at a small desktop IR receiver that plugs into your computer's mouse port. The primary (left) mouse button is located on the underside of the transmitter in a comfortable trigger position; it is placed so that the unit can be used in either hand. The secondary (right) mouse button spans the width of the top of the remote. The transmitter will work up to 40 feet away from the receiver.

Now, even though RemotePoint is really neat on its own, you still need to have a good reason to use a mouse that requires batteries. Probably the best reason is to control presentations from a convenient distance. Toward that end, RemotePoint is now available in a bundle that includes a neat little software package called *SlideWorks*; the bundle's list price is $219.95 (The wireless mouse itself has a suggested list price of $159.95).

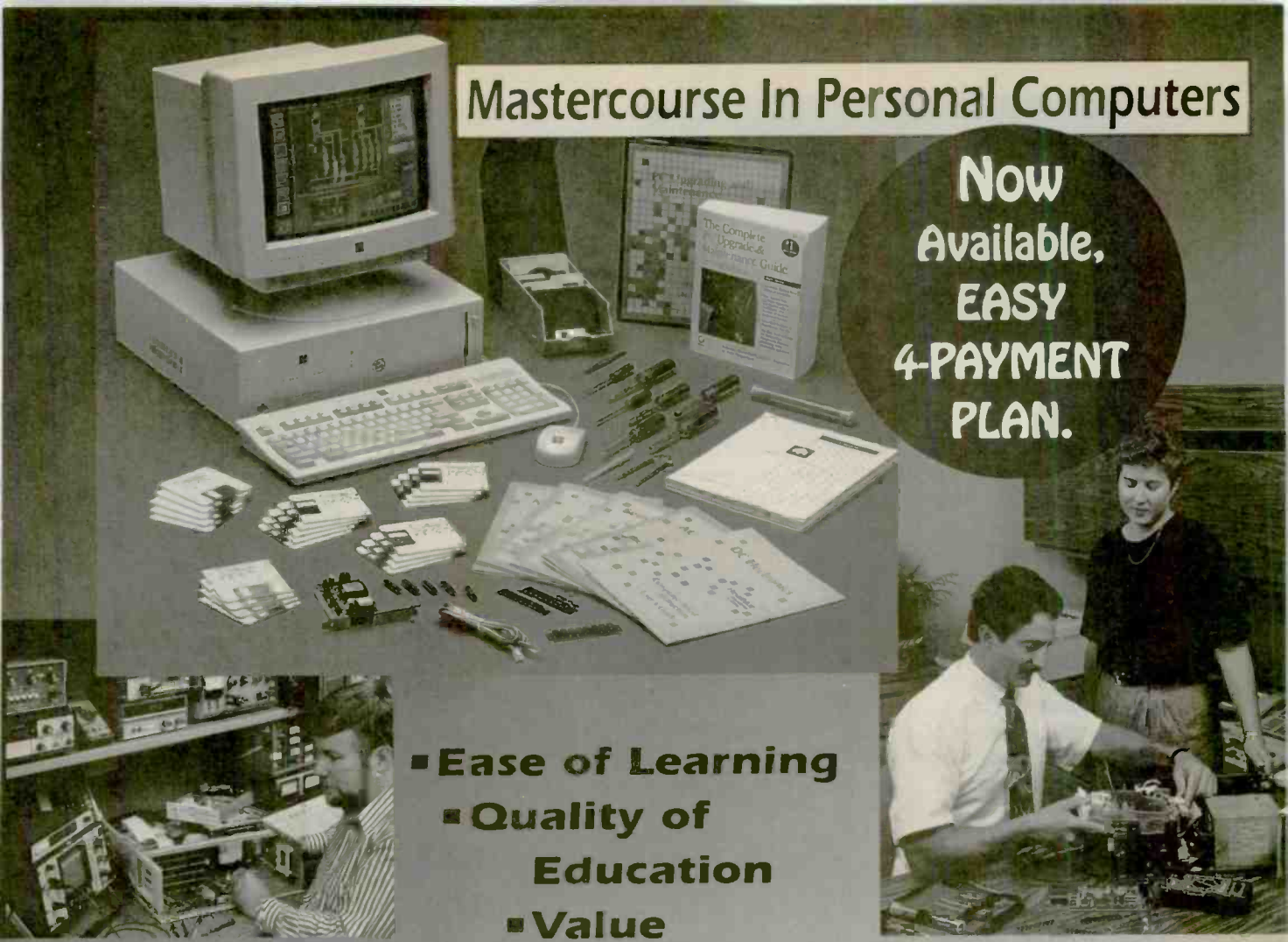
SlideWorks, a perfect companion software for RemotePoint, is a new software toolkit that allows a PC presenter to highlight, underline, or circle elements on the screen; simulate a laser pointer; advance slides; magnify detail; create custom slide shows; and more, all from up to 40 feet away. Specific tools can be programmed to be activated by a click, double click, or click combinations, to make swapping tools as easy as possible. The software runs in Windows and installs in minutes from a single 3½-inch disk.

A pen function "writes" with opaque "ink," hiding whatever it covers. A "highlighter" draws a yellow tint on the screen where you drag it, while allowing whatever was there to still show through. The pen and highlighter can be switched to a "straight" mode where it draws only perfect vertical or horizontal lines. Boxes, ellipses, and bars can be drawn, sized, and dragged around the screen. The screen can be blanked and unblanked or a translucent shade can be pulled over a screen. Even sounds can be activated.

Many more tricks can be performed with the software, including the creating of custom slide shows. That function lets you capture images, windows, areas, and more, and use the captured images to create and display a slide show.

RemotePoint was helpful for doing presentation work all by itself. But with the SlideWorks companion software, it's a much more complete package.

Mastercourse In Personal Computers



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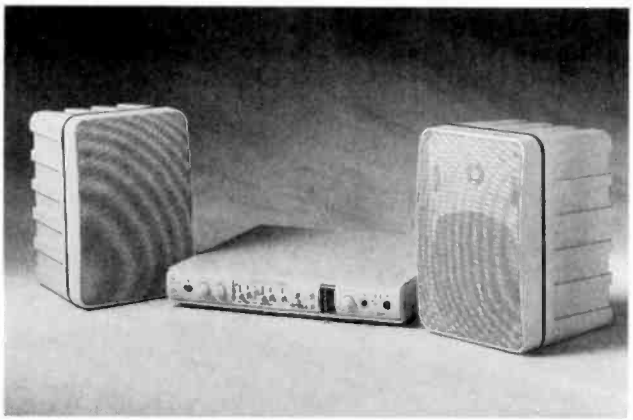

Here's Micro Multimedia Labs' TC 1490SP amplifier/speaker combo. The amplifier is designed to fit under a monitor.

MORE NEW SPEAKERS.

I just checked out a new multimedia speaker system that's a cut above the often disappointing speakers that usually come with a multimedia upgrade package. The *TC 1490SP* amplifier/speaker combo from *Micro Multimedia Labs* consists of the company's TC 1490 40-watt-per-channel amplifier and SP 510 speakers. The combo has a list price of $249.95.

I like that kind of speaker system for multimedia. I prefer to use the line-level output of a sound card and have a separate amplifier with real controls on it; with on-card amplifiers, you must use software controls, which can be a nuisance. The amplifier is designed to fit under a monitor, with a sturdy metal cabinet that's only about 1½-inches high. The unit has a 5-band graphic equalizer, LED level meter, and tone-defeat control. It includes built-in microphone-mixing circuitry and has a microphone and a headphone jack on the front panel. There's also a line-level output jack for a self-powered subwoofer with a separate level control on the front panel.

The matching speakers use a 2-way bass-reflex design with a solid cabinet. Aside from being a little bit bigger in size than I personally like for my desktop, they sound great and are certainly more than adequate for multimedia use.

New from Electronics Arts, 3D Atlas contains images of the globe created from actual satellite data.

NEW STUFF.

American Journey 1896–1945 is an interactive CD-ROM that's loaded with over 1300 vintage photographs, historic maps, charts and graphs, and more. Two hours of audio includes narration, interviews, speeches, and famous radio broadcasts. Video clips are also included. American Journey from *Ibis Communications* has a suggested retail price of $59.95.

Two new discs from *Activision* this month include *Shanghai: Great Moments* and *Atari 2600 Action Pack*. Shanghai contains four tile-matching games on one disc. For $49.95 you can play The Great Wall, where tiles fall as lower ones are removed; Beijing, where you match rows of tiles; Action Shanghai, where new tiles appear if you aren't fast enough; and Classic Shanghai, which can be played with the tiles face up or down. Atari 2600 Action Pack contains 15 of the original Atari 2600 games that many people will love rediscovering in Windows. Included are Boxing, Chopper Command, Cosmic Commuter, Crackpots, Fishing Derby, Freeway, Frostbite, Grand Prix, H.E.R.O., Kaboom, Pitfall, River Raid, Seaquest, Sky Jinks, and Spider Fighter, all for $29.95.

3D Atlas from *Electronic Arts* is an unusual atlas with images of the globe created from actual satellite data. While the images are more interesting than an ordinary atlas, there is less map detail as far as geographical features than you would normally expect to see. But what it lacks in depth is made up for in features that an ordinary atlas wouldn't have. With the disc you can generate maps and charts that compare statistics, play narrated video clips, and play games. 3D Atlas costs $79.95.

Science Sleuths from *Videodiscovery* lets children 12 years of age and older perform over 600 experiments and tests in a virtual science lab. The goal is to solve The Mystery Of The Blob and The Mystery Of The Exploding Lawnmowers through investigative research and laboratory experiments. Interactive tools such as bunsen

(Continued on page 78)

WHERE TO GET IT

Activision
11601 Wilshire Boulevard
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Los Angeles, CA 90025
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Electronic Arts
P.O. Box 7578
San Mateo, CA 94403
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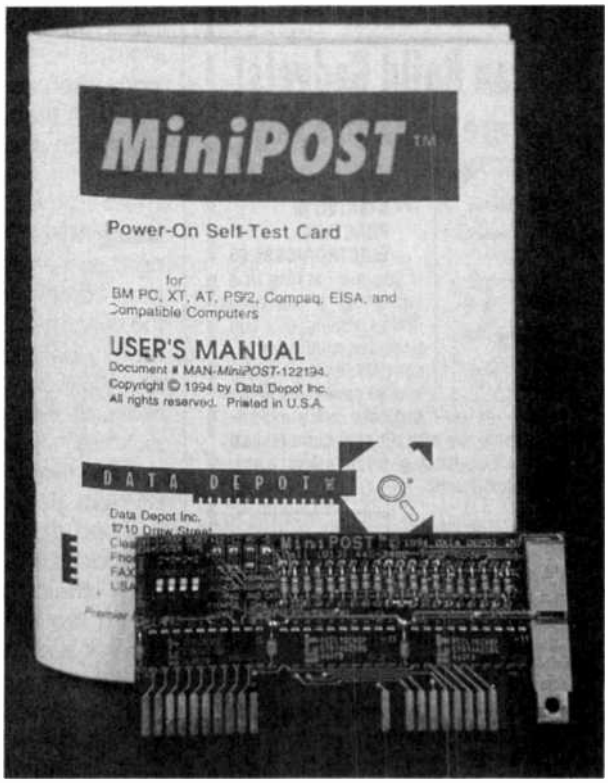


CIRCLE 119 ON FREE INFORMATION CARD

When a PC fails to boot, it's POST codes to the rescue.

Troubleshooting anything, including electronic circuits, is similar to detective work in that one must follow a series of clues to find the cause of a failure. Sometimes things are pretty straightforward, such as when you turn on a stereo receiver and everything works except the FM section; obviously, that's where you start looking. Likewise, if an entire unit is completely dead, then you have to suspect the power supply.

Computers are another story, though. If a computer is up and running and something starts to act up, someone familiar with operating a PC might know what to do. If you are lucky, the problem will turn out to be an annoying setup problem. If you have slightly less luck, your computer will turn on, but something such as the floppy-disk drive will not work and need to be replaced.

If your computer is completely dead, and you suspect the power supply, you can swap it. If it turns out that you were right and your system is up and running again, then three cheers for you because you still had a bit of luck left.

On the other hand, if you've completely run out of luck and there is a problem with your computer's motherboard, a computer will not boot at all. For most people, that's the end of the line.

While many people are technically adept enough to swap a motherboard, the cost of doing so might not be worth it. Other times, a replacement motherboard will simply not be available for one reason or another. In those situations, the only alternative is to have the motherboard repaired by someone who knows how to do it.

However, even someone who knows how to repair motherboards needs something to help pinpoint the problem. A dead motherboard is a tricky thing to troubleshoot because there are so many components on it and a failure in almost any section can bring down the entire board.

Fortunately there's help even for people who have to troubleshoot and repair motherboards. POST codes, or Power-On Self-Test codes, are built into the BIOS of most IBM-compatible PCs. POST codes are generated by a computer at boot-up time, or when the computer is supposed to boot.

Sometimes POST codes will generate patterns of beeps from the motherboard; the meanings of the beeps vary from system to system, but can usually be found in the documentation. However, sometimes the POST codes are evident only as data bits on the expansion bus, and in such cases a POST-code reader will be needed.

MiniPOST, from *Data Depot, Inc.*, is a tiny little POST-code diagnostic card that pops into an empty expansion slot on the motherboard. The card measures only 3¾ inches long by 1½ inches high, yet it contains a 4-segment DIP switch for configuring the card for different motherboard types, four tiny LEDs to indicate whether motherboard voltages are present, two 7-segment hexadecimal LED displays, and all the circuitry it needs to make them display POST codes.

MiniPOST works with all XT, AT, ISA (Industry Standard Architecture), EISA (Extended Industry Standard Architecture), and PS/2 ISA architectures. It will also work in any ISA or EISA bus slot in VESA, PCI, or other local-bus architec-

tures. The primary function of MiniPOST is to help determine why a computer won't boot. But it is also helpful if the computer will boot but won't run properly. The card costs $119.

Using MiniPOST. A DIP switch on the card sets MiniPOST to work with different architectures. Most of the time the switches are simply left in the "000" factory default settings for all IBM AT and XT/AT clones. A chart in the user's manual explains how to set the switches.

While the card installs in any ISA or EISA bus slot, it is best if the card is installed in a slot that allows viewing of the four LEDs that indicate the status of the motherboard voltages. A motherboard should have clean ±12- and ±5-volt supplies.

Next, you turn on power and observe the four power-indicator LEDs. If it is suspected that a power supply is causing intermittent resets, the fourth DIP switch is toggled to the on position after power is applied. Then, if a power glitch occurs, a reset indicator LED (a decimal point on one of the 7-segment displays) will turn on and stay on, flagging the problem.

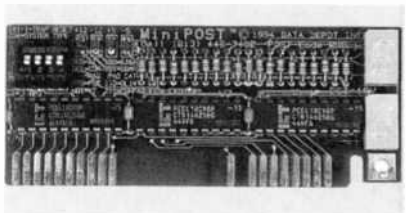
After power is turned on, you must observe the hexadecimal display and jot down any codes that appear. The codes flash until the computer either fails or boots. If no codes appear, either the DIP switches are set wrong, the system BIOS has failed, or the system does not issue codes (a few don't). The last code that appears indicates the section that failed in the boot sequence.

It would be great if every BIOS maker used the same codes to indicate the same things. Of course, that is not the case; each BIOS is unique. The unit's manual lists the codes for a number of popular BIOSes, and the addresses and phone numbers of manufacturers in case yours is not among them. The post codes for your particular motherboard are also usually available in the manufacturer's technical reference.

About POST Codes. As just stated, different computer BIOSes generate different POST codes. That's why it is important to have the right ones for your computer. Tracking a problem using the wrong POST codes is like driving through a state using a map of a different state—certainly you would end up more lost than when you began.

With a list of the right codes, the information that appears on MiniPOST's hexadecimal display can be extremely helpful in locating troublesome parts. POST codes can inform the user of specific problems such as ROM BIOS checksum failure, CMOS RAM shutdown register failure, cache errors, and so on. Of course, it goes without saying that a better designed BIOS will more thoroughly test a motherboard and generate more specific POST codes on power up than a poorly designed one.

MiniPOST can't actively test a computer, as it is a passive device. It also can't display POST results any better than a system BIOS will allow. Problems that can't be detected before boot up, such as bad hard-disk sectors or hardware incompatibilities, can't be detected through POST results. But those limitations aside, just like any other tool, MiniPOST is very useful when used for the right jobs.



If your computer fails to boot, this tiny card could give you the information you need to find the cause.

It is inevitable that an old computer—and maybe even one that's not so old—will eventually break down. Considering that, anyone who owns a lot of computers or fixes a lot of them, might find MiniPOST to be a worthwhile investment.

For more information on the MiniPOST post-code reader, contact Data Depot, Inc at the address given below, or circle no. 119 on the Free Information Card. ■

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PRODUCT TEST REPORTS

Sony CCD-TRV30 Camcorder

By Stephen A. Booth

Sony usually is known for firsts, but the company was a latecomer to the field of compact camcorders equipped with large, monitor-style, color LCD viewfinders. Better late than never, however, as shown by the *CCD-TRV30*, one of three new Handycam 8mm units with that feature. It's the entry-level model in the "TR" line—Sony's smallest and lightest camcorders, designed with the traveler in mind.

The inclusion of a flat-panel color viewfinder brings that Handycam up to 3.25 pounds, yet makes especial sense in the TR line. When deployed from the left side of the camcorder's body, the pivoting LCD may be used as a waist-level viewfinder, in place of or to supplement the conventional, black-and-white, monocular-style viewfinder. But the 3-inch color screen also serves as a playback monitor, for viewing camcorder footage on the go.

In that mode, the display faces outward while lying flush with the body, and a built-in loudspeaker delivers the soundtrack. Families with children might tote a selection of entertainment programming, either prerecorded or dubbed onto 8mm cassettes. An AC power adaptor/charger for the NiCd batteries is included; a DC cord for car/RV cigarette-lighter receptacles is an available option. Unlike other companies that market camcorders with color LCD screens, Sony does not offer an accessory TV-tuner pack.

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The Sony CCD-TRV30 camcorder features a 3-inch, monitor-style, color LCD viewfinder.

FEATURES

With up to two and a half hours of recording time available on 8mm videocassettes in the "Standard Play" mode, it ought to be easy to keep the kids amused. Meanwhile, the CCD-TRV30 has enough tricks to keep adults interested—but not so many tricks as to confuse.

Although it's an entry-level model, the Handycam has most of the desirable moviemaking and playback features, including infrared remote control for lens-zooming and tape-transport functions. As you might expect, focus is automatic (TTL contrast-detection), as is white-balance (or color-temperature setting). There are no manual options here, although the backlight-compensation is user-selectable. Power zooming over the 12× -range can be slow or fast, depending on the finger-pressure applied to the rocker-switch.

That's the only digital aspect of the lens: Otherwise, it's a purely optical zoom—no electronic magnification. (So-called "digital zooms" simply enlarge a smaller piece of the optical image, and sharpness is lost because fewer lines of resolution appear on your TV screen.) There's no digital or optical image-stabilization either—but because the LCD viewfinder encourages waist-level, two-hand shooting with the camcorder, camera-shake isn't much of an issue.

The "Program AE" (auto exposure) feature in the model covers the important bases for home moviemaking. The press of a button activates preprogrammed settings that optimize shutter speed and lens aperture for some typical shooting situations. Those include portrait closeups; a twilight mode for sunsets, fireworks, and other tricky-lighting scenes; a setting for sports action, and even a high-speed shutter mode (up to 1/4000-sec.).

The latter is the proverbial "golf-and-tennis" setting, designed to yield clear images for slow-motion playback (but only when recorded in bright light). A more important consideration, for professional-looking movies, is the Handycam's fade-in/fade-out feature. When the fader's activated (before recording and before pausing), sound and image appear and recede gradually. Other "trick" optical special-effects include mosaic pattern, psychedelic-like solarization, sepia tone, black-and-white, and negative reversal.

The crisp, 3-inch color LCD will be the focal point of the camcorder; the videographer may use that as a viewfinder when recording from behind the camcorder. When the LCD is deployed so, the conventional, eye-level monochrome viewfinder is disabled. The LCD also flips over 180-degrees so that subjects, perhaps even a remote-control videographer, can monitor the composition from in front of the camcorder (despite the flip, the image in the LCD automatically rights itself). Only when the LCD faces the subject are both viewfinders active—on the assumption that the moviemaker might want to get back behind the camera to refine the composition.

The choice between LCD or conventional viewfinder is a smart move on Sony's part, for the sake of battery conservation. The downside of monitor-style color LCD viewfinders is power consumption. The supplied NiCd battery is good for up to 70 minutes when playing back through the LCD. In moviemaking, though, using the LCD can cut that time by half; you can expect 45 to 50 minutes if you use the eye-level viewfinder only. Those times reflect typical hands-on use—zooming, pausing, multiple starts and stops, etc. The battery takes about 90 minutes to charge from empty, and should be trickled-down before recharging. Sony does offer optional power-packs with greater capacity.

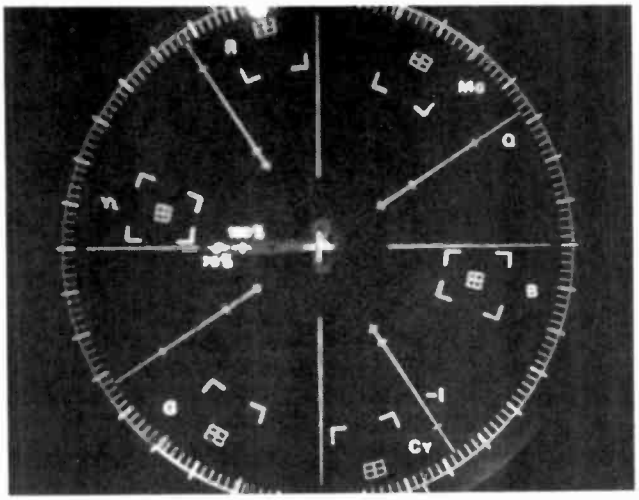

Fig. 1. As this vectorscope photo shows, phase is dead-on while chroma—just above the cross-hairs—is a bit oversaturated.

TEST RESULTS

The CCD-TRV30 endured through the usual battery of performance tests—cruel but fair—at the Advanced Product Evaluation Laboratory (APEL), an independent testing facility located in Bethel, Connecticut. Overall, the camcorder checked out as an able performer, though not a

TABLE 1—TEST RESULTS

Video Measurements	
Minimum Illumination:	0.9-lux
Resolution	
Video Output:	240 lines
Camera:	350 lines
Signal-to-Noise Ratio (Video Output)	
Chroma AM:	42.6 dB
Luminance:	42.2 dB
Signal-to-Noise Ratio (Camera)	
Chroma AM:	48.3 dB
Luminance:	41.9 dB
Color Contamination:	14 IRE
White Balance:	6 IRE
Streaking/Lag, Image Retention:	Excellent
Color Quality (see vectorscope photo)	
Phase Accuracy:	Excellent
Chroma Saturation:	Slight oversaturation
Minimum Focus Distance	
Telephoto:	30 inches
Macro:	⅛-inch
Audio Measurements	
Signal-to-Noise Ratio:	57.8 dB
Maximum Output (built-in mic):	0.52-volts
Input Sensitivity (external mic):	2.2-m/volts

record-setter. Sony already has plenty of those. As you examine the test results in the accompanying chart, keep the following in mind.

Minimum illumination rates the camcorder's ability to record in low light and still capture a viewable image. It won't, however, be a great image: There'll be snowy noise and murky color, and depth of focus will be very limited. But something will register.

Manufacturers specify minimum light in lux—the lower the number, the better. But it's a meaningless specification and a moot point, besides. Meaningless, because manufacturers don't all measure lux the same way, making comparison of "advertised" specs impossible. That might soon change, as a standardized rating for lux is in the works—in fact, APEL is one of the companies developing that specification with the Electronic Industries Association. Meanwhile, APEL's lux measurements are at least consistent and comparable. Sony's excellent 0.9-lux rating here is par for the course nowadays.

As for the lux specification being moot in this reviewer's eyes, it is because you'll seldom shoot in near-darkness. Even average household lighting yields better pictures. An accessory lamp is a good investment, if only to punch up colors.

Perhaps a more meaningful measurement for camcorders is signal-to-noise. It's measured under optimal lighting conditions and shows the amount of usable signal, for color (chroma AM) and brightness (luminance, black-and-white), above the threshold of electrical noise. On both video output (the on-tape recording) and camera (straight through-the-lens operation), the CCD-TRV30 is average here.

The signal-to-noise ratio for the camcorder's FM monaural audio is quite good. Moreover, the input sensitivity for the external microphone jack means you can equip this camcorder with just about any accessory mike, at a reasonable cost.

White balance rates a camcorder's ability to adjust to different temperatures of light, for example, sunshine or incandescent, and to reproduce white purely (and thereby, produce correctly-balanced colors). No problem here with the Sony's automatic adjustment.

Color contamination, on the other hand, was a bit high compared to other units. That test reveals the presence of unwanted color specks as found in a black-and-white test pattern. In a moving picture, though, the Sony's performance shouldn't be objectionable. The color contamination will probably be negligible even if you're doing close-up stills in the macro-mode (you can shoot from as close as ⅛-inch away; great for shooting those butterflies, coins, or stamps in your collection). Actually, APEL's Frank Barr suspects the unit's mediocre color-contamination rating is a by-product of this camcorder's excellent resolution.

At 240 lines of horizontal resolution recorded to tape at the video output, the CCD-TRV30 hits the theoretical ceiling for the conventional 8mm format (Hi8, or high-band 8mm, can handle 400 lines). Resolution means sharpness, and it's gauged by the number of image-making lines the camcorder records, in picket-fence fashion across your TV screen.

By way of comparison, a live TV broadcast, the sharpest kind, delivers about 330 lines of resolution. That is the quality you can expect from the CCD-TRV30's resolution in camera mode. Normally, test reports don't make much of camera resolution, because it's the videotaped image most people care about. However, given the popularity of home multimedia computers, and the proliferation of video boards that permit frame-capture (and even motion-video recording), APEL and **Popular Electronics** believe that the camera resolution will be an item of serious concern to computer and video enthusiasts on a go-forward basis.

Image retention, APEL's test for streaking/lag, looks for flares or tails of light and color that trail behind the highlights of a moving subject. You'll see that on live TV, particularly in ball games when light reflects off shiny helmets. That artifact is virtually nonexistent in home camcorders.

That brings us to color quality, defined by phase accuracy and chroma saturation. Each is measured using the color red—the most difficult for video to reproduce. The phase-accuracy portion of the test looks for deviation from true red, toward magenta or yellow. Chroma saturation gauges depth, or intensity of hue.

As the vectorscope photo in Fig. 1 shows, phase is dead-on while chroma—just above the cross-hairs—is a bit oversaturated. Saturation, over and under, does affect a picture visibly. If you find the slightly-richer red image that results to be bothersome, you can fix it in the mix by resorting to the color controls on your TV monitor.

Otherwise, sit back and enjoy some very nice pictures—not a little bit influenced by the CCD-TRV30's angle of view. The wide-angle setting (5.4mm) is the equivalent of a 39mm lens in a still-photo 35mm film camera; slightly wider than normal—just enough to squeeze in all the family during tight-quarters shooting indoors—yet not so wide as to distort, contort, or insult those relatives on the periphery.

The Sony CCD-TRV30 camcorder has a suggested retail price of $1099. For more information on the unit, contact the manufacturer directly at the address given below, or circle no. 120 on the Free Information Card. ■

TABLE 2—FEATURES

Format:	8mm/NTSC
Record Modes:	SP only
Playback Modes:	SP and EP
Image Sensor:	½-in. CCD
Zoom Ratio:	12× (optical)
Focal Length:	5.4mm-64.8mm (video) 39mm-468mm (35mm equivalent)
Viewfinders (2):	3-inch color LCD monitor (active matrix, 324×234 pixels) 1-inch monochrome electronic

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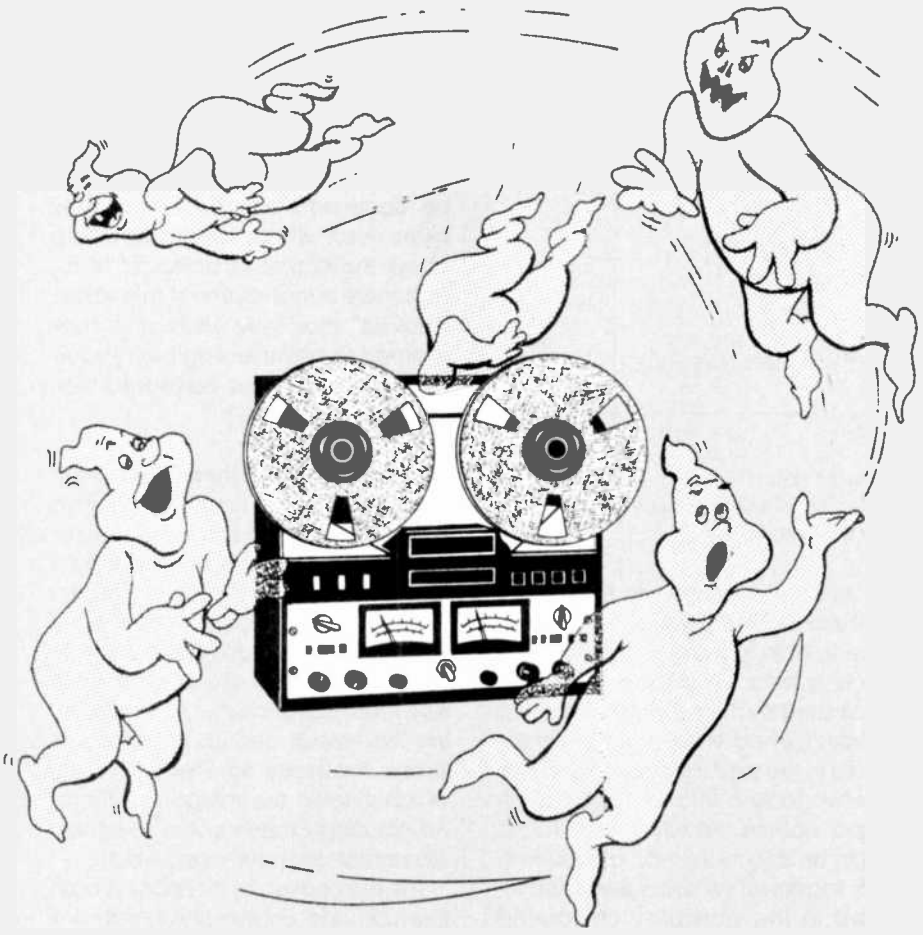


GHOST VOICES:

Exploring the Mysteries of Electronic Voice Phenomena

Are the dead communicating with us through electronic means?

BY KONSTANTINOS

Since the invention of the tape recorder, people all around the world have taped various sounds for various reasons. But occasionally, what's heard on the resulting tapes is not exactly what was expected. Sometimes, phantom voices appear.

What do the voices say? Well, those who research Electronic Voice Phenomena (EVP) claim that the paranormal voices are relaying information about the "afterlife." That's right, many believe that through such recordings, we can receive messages from the dead. However, there are those investigating the voices on the tapes who think that psychokinesis, or the ability to affect physical matter with the mind, might explain the phenomena. Some feel that the voices were simply auditory hallucinations caused by a noisy tape recorder. And of course, there are those who consider EVP tapes to be pure hoaxes.

What's really going on here? Are the dead trying to break through the veil between the worlds? We'd like to let you be the judge. You see, it's possible to recreate the experiments carried out by EVP researchers right in your own home. So, this Halloween, break out the old tape recorder; you just might be able to solve the mystery.

The Beginning. It's not possible to know for certain when the first "ghost voices" were recorded, because the first individuals to accidentally record the voices might not have recognized the bizarre speech patterns that EVPs can assume. As a result, the first people to record the phenomena probably discarded their recordings as "being filled with noise." We do know, however, of two separate instances of *documented* first recordings of EVPs. We'll look at the most famous of those first.

On a summer day in 1959, a producer of documentaries by the name of Friedrich Jurgenson took his tape recorder out to the Swedish countryside to record some birds singing. When he played his tape back later, however, Jurgenson found that the chirping birds on his tape were accompanied by a mysterious commentator (speaking in Norwegian) who had much to say on the subject of bird song. Jurgenson was instantly fascinated, and checked to see what radio programs were broadcast in his vicinity at that time, just in case his recorder was somehow picking up radio signals. His search came up empty—he could find no program having to do with bird song that was broadcast at the appropriate time.

Faced with a mystery, Jurgenson started holding open-air taping sessions in hopes of catching more phantom voices on tape. He was successful on many occasions, and published his results in Sweden, claiming that not only was he getting messages from voices that called him by name, but from those that claimed to be deceased individuals that he knew or was related to! With those claims, an absolute obsession filled many in Europe, who immediately started holding their own taping sessions.

In 1965, Jurgenson's research attracted the attention of a psychologist by the name of Dr. Konstantin Raudive, and the two began to work together. Using some of the methods described in this article, those two EVP researchers began to gather hundreds of ghost voices on tape. Many

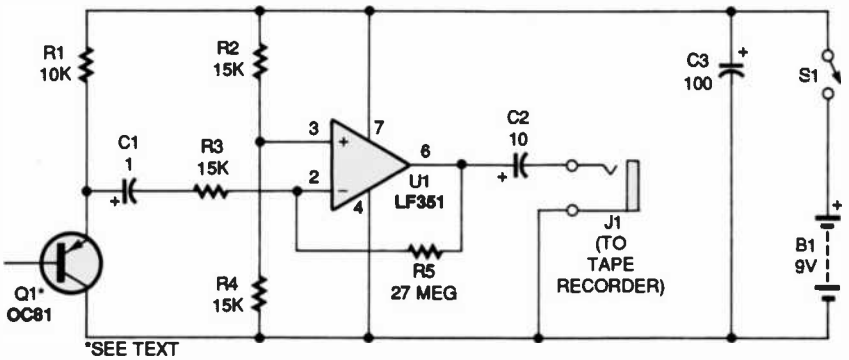


Fig. 1. Instead of recording ghost voices off an unused radio frequency, you can use this white-noise generator to simulate the noise. The OC81 transistor can be replaced with any PNP germanium transistor, or with a germanium diode.

of the voices called the two by name, and related pieces of information that were of personal interest to the researchers. Later on, as the two began to drift apart in their research, Raudive began working with physicist Alex Schneider to improve his taping results (we'll look more at the work of Raudive later).

The results of Raudive's experiments with Jurgenson, as well as those of his later work with various physicists and technicians, were published in his book, *Breakthrough* (see the Suggested Reading Box for more information). When the book was published in 1971, Raudive also made available to the public a recording of some EVPs. He did that for two reasons: First, he wanted to prove that he was actually getting results. Second, the voices are hard to recognize at first, and Raudive knew that the record would familiarize listeners with the bizarre rhythms of EVPs (see the listening tips at the end of this article).

As a result of the publication of *Breakthrough*, most EVP researchers in the world consider Jurgenson to be the discoverer of the phenomena. However, there is evidence suggesting that a "supernatural" taping session might have occurred in the United States years before the famous bird-song tape was made. What is that evidence? Well, approximately two months before Jurgenson announced his findings in 1959, two psychical investigators, Raymond Bayless and Attila von Szalay, published a paper in the *Journal of the American Society for Psychical Research*, describing the results of a three-year experiment they completed.

It all started when the two men heard that a psychic in their area, named Sophia Williams, was allegedly able to make a disembodied voice appear on a tape. They were fascinated by the possibility, because Szalay claimed to have gotten similar results in the past, accidentally. When the two looked into Ms. Williams' alleged abilities, however, they found her to be little more than a fraud who had mastered ventriloquism. Their interest in the possibility of causing voices to appear on a tape did not go away with that setback, though.

Bayless and Szalay set up a studio in 1956 to carry out their research. In it, they built what they called a "special wooden cabinet." It was in that reduced-noise environment that they set up a microphone, the cable of which ran out to a tape recorder and speaker in the main room. While the tape recorder was recording, Szalay would sit in the cabinet; Bayless would sit outside and listen for strange noises coming over the speakers. The two were not sure what caused the voices they were looking to record, but Szalay was sure that he had somehow "caused" them to manifest on tape before, and by sitting in the cabinet, hoped to do so again.

Bayless would hear strange noises come over the speaker, but never anything distinct. Finally, on December 5, 1956, after a typical session of hearing little more than bizarre noise, the two played back their session tape to find a clear voice saying: "This is G." Bayless did not hear that voice while Szalay was in the cabinet, but only during playback.

Soon after, the two discovered that they could record the strange voices without Szalay being in the cabinet at all. Similar to the discoveries of Jurgenson and Raudive, Bayless and Szalay found that the voices would answer questions and even claim to be deceased individuals that they knew. Also, what's most interesting about the claims of both sets of researchers is that many of the voices "proved" that they were who they claimed to be, revealing bits of information that only the deceased individuals would know.

Raudive's Breakthroughs. Even though Jurgenson and Raudive were not the first to document the recording of EVPs, they are still considered the first men responsible for the serious scientific study of the phenomena. That is mostly because of Dr. Raudive's constant efforts to come up with more advanced ways of recording the voices, and his publishing of those methods in *Breakthrough*, which carried the intriguing subtitle: *An Amazing Experiment in Electronic Communication with the Dead.*

The publication of that book in both German and English ensured that a good majority of the scientific community (and a great number of casual readers) would be exposed to both the existence of the voices and the several different methods of recording them. In fact, the book contained much more than details of Raudive's experiments; it contained various letters from scientists all around the world who tried those experiments on their own and got the same results!

Modern equivalents of the experiments carried out in the late 60s and early 70s will each be examined closely later on, so that you could repeat them for yourself. But for now, let's cover some basic facts that Raudive uncovered, and the system of analysis he used to do so.

In a period of nine years, ending with his death in 1974, Raudive managed to record and catalog well over 70,000 voices. In fact, a good portion of his book (approximately 270 pages of it) consists of transcriptions of selected voice recordings. Each session would begin with Raudive (or on occasion, another researcher) stating the date and time on the tape. Then, someone in the room would either ask for the voices to speak, or would ask a particular question, sometimes addressed to a particular entity (whether

it was previously contacted or not). Strangely, the best results were achieved when the researchers present asked in all seriousness for the voices to speak. You might want to keep that in mind for when you do your own experimenting.

Of course to many, the initial questioning that Raudive often did seemed to resemble a sort of seance. A traditional seance is when a group of people gather to help a psychic person—who acts as a medium—contact spirits. Raudive's sessions definitely had the same motive, and even had a non-living medium—the tape recorder. But what separates the Raudive sessions from seances is obvious: scientific evidence. When Raudive completed a taping, he had tapes that evidently contained voices.

Raudive felt certain that the voices he was receiving were in fact from the dead, and made his feelings very clear to the scientific community, both in person and through his book. As I mentioned earlier, there were those who attributed Raudive's recorded voices (and all EVPs) to either unconscious, psychokinetic manipulation of the tape, hallucinations caused by background noise, or just plain hoaxes. Raudive maintained that his recorded voices could not be explained by any of those theories.

Let's look at the first explanation—psychokinesis. A strong argument against that explanation is that the mind of the researcher could not be responsible for any voices that are recorded in foreign languages. Although the majority of voices received by Raudive and his colleagues were in languages that at least some of them could understand, there were instances when the language used was foreign to all present. Also, it seems improbable that the subconscious mind could relate verifiable facts to the researcher, without his or her prior knowledge of them. Many individuals record voices that tell them of things they never even heard of, let alone knew anything about.

As for the possibility that the voices are little more than complex hallucinations, statistically, it is improbable that seven or eight people listening to a tape in a room could all imagine that the same words were being spoken. The odds of mass hallucination become even more remote when we consider the fact that Raudive played certain tapes for hundreds of people. Of course, all who listen to EVPs have to grow accustomed to the bizarre speed and rhythm of the voices (more on that later), but once that initial "training" is completed, hearing them is easy. Also, the chance that the voices are mere hallucinations was ruled out by the voice-print analysis performed by several independent scientists over the past two decades—the sounds carry the distinct characteristics of voices.

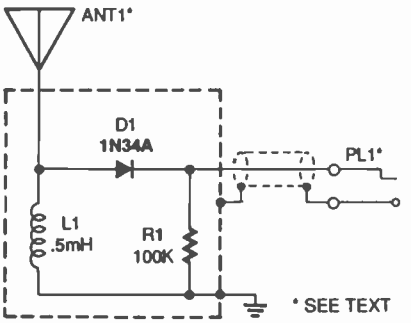


Fig. 2. While how or why it works can not be easily explained, this diode circuit can be used to record the clearest ghost voices. Make sure to use a good earth-ground connection for best results.

Now, for the argument that EVPs are hoaxes. Researchers have been accused of perpetrating hoaxes both intentionally and unintentionally. An intentional hoax would be if a researcher somehow generated the voices and claimed that they came "from beyond." Raudive and others have used, in the presence of many skeptics, brand-new tape recorders and tapes to prove that they were recording right on the spot whatever would manifest on the tape, thereby minimizing any chance of fraud.

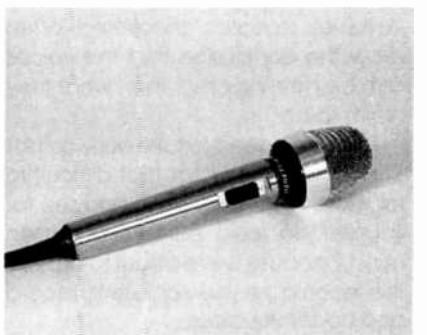
What about an unintentional hoax? That would be if a researcher were somehow picking up radio broadcasts and was immediately attributing them to the voices of spirits. To prove that was not the case, Raudive and others have simply pointed to what the voices are saying. A ghost voice will often actually address individuals in the room using their first, and sometimes last, names. The chances of such statements coming from a broadcast station are virtually nonexistent.

So what did the voices say? Considering the enormous number of messages Raudive and others have received, perhaps asking what they *didn't* say would be a more appropriate question. The information those voices relayed varies from hints of better recording techniques that Raudive should try, to personal messages from familiar voices of loved ones, to descriptions of the surroundings the voice-entities "live" in!

Here are sample quotes of entities, taken from Raudive's book. This first group is from relatives. Note how bizarre the phrasing of some of the sentences used by voice-entities is:

"Konstantin, here is your mother."
"Don't cry, here is Tekla... Tekla, your sister."
"Flying in earnest to earth to Konstant. Brother, this interests mightily. Alexis!"

That last name was indeed that of Raudive's brother. It's interesting to note that among all the tapes, the voices used several different nicknames for Raudive that the people they claimed to be used when they were alive: Kosta, Kosti, and Konstant were some of them.



Can an ordinary microphone like this be used to record the voices of the dead? Try it and see!

Let's look at some more voices from various entities, commenting on different topics:

Once, a psychologist was in the room with Raudive, and was acting very skeptical, to the point where the voices said: "Chase the old man away, Konstantin!" The voices on other occasions commented on the skepticism that was being displayed as the tape was rolling. They said: "There are no people, no attentive people."

The voices often gave recording advice to Raudive and his assistants as well, mostly in the form of simple tips. Once, an experimenter in the room was considering keeping his radio

tuned to a particular frequency for use as white noise (more on that later). The voice on the tape agreed, saying: "Hold the wavelength, brother! Marvelous!" Another time, when there was only a little tape left during a session, the researchers felt they should go on using it after they played back their latest take. The voice apparently disagreed, saying, "Good Morning! Take a new tape, dear Konstantin."

Finally, before we move on, let's look at some mixed views on the afterlife, which the voices had to share:

"The dead live, Konstantin."
"God, Konstantin, we are happy."
"It's terribly good here."
"Kosti, it is really strict here."
"...we are all forgotten."
"City of the dead."
"There are many moments here."

Those who have heard the voices for themselves, and who have examined the preceding facts that Raudive's research uncovered, often draw the conclusion that the voices can be nothing other than what they claim to be.

There's no need to take our word for that, however. It is not that difficult to recreate the experiments and see for yourself. So read on with an open mind, because we're about to explore the techniques you can use to record and hear the voices.

Microphone Method. The "microphone method" is by far the easiest of the techniques that you can use. In its most basic form, that technique of recording the voices consists of simply plugging a good-quality microphone into the mic input of a tape recorder, moving the microphone far away from the recorder (to cut down on machine noise), inserting a tape into the machine, and hitting the record button. Then ask the voices to speak, and try to keep the room as quiet as possible during the rest of the recording process.

The first EVPs were recorded using that method, and clear voices can be caught on tape with it. However, you will have to go through a lot of tape before you find the real loud ones. For the most part, you will be left with many whispery voices that are difficult to understand, with only an occasional clear one popping up.

A way of improving the results of the microphone method is to use an electret condenser microphone connected to a low-noise, high-gain preamplifier. However, before looking into acquiring such equipment, keep in mind that most researchers only use the microphone method as an introduction to EVP recording. There are much better ways to get those elusive voices.

Radio Method. The "radio method" is another simple way of obtaining paranormal voices, and like the microphone method, you most likely have all the equipment you need. In Raudive's day, that technique required connecting the output of a radio to a reel-to-reel tape recorder. Now, you can find in almost every home some kind of radio with a tape recorder built in, whether it's part of a large stereo system or a portable.

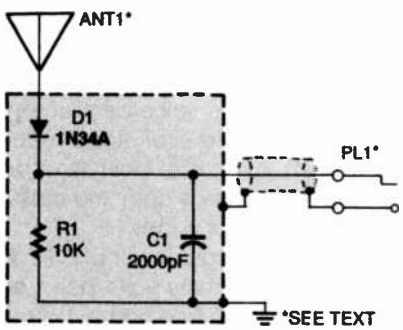


Fig. 3. Some researchers prefer this diode circuit to the one shown in Fig. 2. They claim that voices of "higher frequencies" can be received with it.

Place a fresh cassette into the recorder and turn on the radio. Tune on either the AM or FM bands and try to find a part of the band with nothing but "white noise" (the familiar rushing sound you hear when you tune to an unused frequency). When you're sure that no stations are broadcasting there, press the record button. For reasons we'll get into later, keep your sessions to about five minutes.

The quality of the voices received using this method are certainly much better than that of the ones recorded by microphone. Some of the weaker EVPs sound as if they are created by a "bending" of the white noise, but they are often still understandable. The louder voices received this way sound as if they are speaking over the noise itself.

As we saw earlier, critics of the radio method of recording argue that the voices could be stray broadcasts. Of course the nature of the messages received makes an argument against that assumption. But still, it might be easier to prove to others that what you're getting are truly paranormal voices if you don't use a radio. For that reason, you might want to use a different source of white noise.

White-Noise Method. Figure 1 shows the schematic for a simple white-noise generator. The circuit is powered by a 9-volt battery, B1. An LF351 op-amp, U1, is configured as a high-gain amplifier. Unstable noise generated by the OC81 germanium transistor, Q1, is amplified by U1, filtered by C2, and output at jack J1.

The circuit can be built on either perforated board or on a PC board, if you can design your own. All the parts, except for the germanium transistor, should be simple to find. If you can't locate the OC81, any other PNP germanium transistor can be used; or, you could substitute a 1N34A germanium diode, which is available from Radio Shack (catalog no. 276-1123) as well as some other sources. Install the resistors and capacitors, and then the transistor and IC. Double-check the orientation of the components before attaching a cable to J1 and connecting it to the line input of your tape recorder. Then, turn on power switch, S1.

The unit should now be producing white noise. Press the record button on your tape recorder, record a few seconds, and play it back to make sure. You should hear an irregular noise "stream" on the tape. If not, check your circuitry again. When you have it working, try a five minute session to see what voices you get.

Diode Method. According to Raudive and the researchers who would come after, the "diode method" is the best way to record EVPs without using advanced filtering (definitely a topic for another article). Several different circuit designs were used for that method, but we will only look at two of them here.

The first of those is shown in Fig. 2. A paranormal signal is believed to be picked up by ANT1, which is made of a three-inch piece of stiff wire (a straightened paper clip is ideal). What

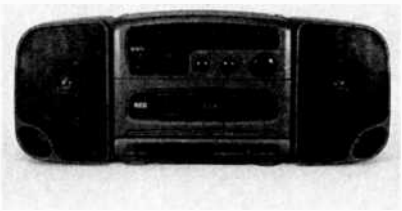
Raudive considered a slightly tuned coil, L1, is a 0.5-mH choke coil. How those components work with the resistor and germanium diode is pretty unclear. The whole circuit resembles an early "cat-whisker" radio design, but you will most likely find that the messages received on the miniature antenna are not being broadcast by a radio station. If for some reason you do pick up something that sounds like radio interference, try either shortening the antenna or moving to another room.

The whole circuit should be enclosed in an aluminum project case, to provide shielding. You could still get results without shielding, but there will be a lot of hum heard on the tape. Wire the components as shown, and drill a hole in the case for the antenna to stick out. Wrap some insulating material around the base of the antenna so that it does not come into electrical contact with the enclosure. Connect the shielded cable to the circuit and case as shown in the figure; use a plug for PL1 that matches your tape recorder's input.

A good earth ground is required for the circuit to work properly. Solder an alligator clip to one end of an insulated wire, wrap the other end around a screw on the enclosure and solder it (that will ensure a good mechanical and electrical connection). Before you use the unit, attach the alligator clip to something that will provide a ground connection (*i.e.* a cold-water pipe). Then, all you have to do is plug the unit in, and hit record.

Another diode schematic is shown in Fig. 3. That unit does not use a coil at all, but includes a capacitor. The antenna insulation and grounding tips given for the other diode circuit still apply here. Once again, the entire circuit is mounted in an aluminum project enclosure, and is connected to a tape recorder in the same fashion as the last one. According to Raudive's colleagues, the second unit helps you pick up "higher-frequency voices," although what was meant by that statement is unclear.

How to Hear the Voices. Once you've done your recording, using one of the previously mentioned methods, you will have to have some idea of what you will be listening for on the resulting tapes. Most EVPs are



Combination radio/tape recorders like this one make the radio method of recording voices simple to experiment with. Just insert a tape, tune in an unused frequency, and press record.

faint and difficult to make out, and you won't want to accidentally pass over them.

First of all, no matter which of the methods described in the preceding sections are used, keep your recording sessions short. You will need to play back each minute of tape several times in order to "catch" the sometimes elusive voices. The ideal time for each recording period after each question you ask is approximately five minutes. And you might go over that section of tape for an hour before you make out any of the voices for the first time!

Of course, not every "take" will result in your "catching" any EVPs. In an experiment carried out by New York City's CBS affiliate, WCBS, and aired as part of their late news, it took a couple of hours before a really clear voice could be heard. But as that demonstration showed, with perseverance, experimenters can get results. So, don't get discouraged if you can't make out the voices right away.

SUGGESTED READING

Bander, Peter. *Voices from the Tapes: Recordings from the Other World.* Drake Publishers, New York. 1973.

Raudive, Konstantin. *Breakthrough: An Amazing Experiment in Electronic Communication with the Dead.* Taplinger Publishing Company, New York. 1971.

Rogo, D. Scott. *In Search of the Unknown.* Taplinger Publishing Company, New York. 1976.

Sherman, Harold. *The Dead are Alive: They can and do Communicate with You.* Fawcett, New York. 1993.

Welch, William. *Talks with the Dead.* Pinnacle Books, New York. 1975.

The voices are difficult to recognize at first, for a couple of reasons. One of the biggest ones is that they often seem to be talking at twice the speed that we normally do. That is only made worse by the fact that the syllables of each word are pronounced in a monotonous, metered fashion, with almost no accent or emphasis on any particular syllable.

You'd have the best chance of hearing the voices during playback if you put on headphones—preferably the type that cover the ear completely, as you don't want any outside noise distracting you. Turn up the volume to the loudest comfortable level. However, make sure that the volume isn't too loud, because that would tire your ears, resulting in a temporary loss of some of your ability to discern between subtle differences in sound. And you'll need all the sensitivity of hearing you can get for your first attempt at trying to make out those elusive EVPs on tape.

If you used the microphone method, listen for any faint rhythms against the silence. When you find one, play it back repeatedly. That is known as "developing" a voice. Unlike normal taped signals, an EVP will become stronger in volume and clarity if it is played several times or copied onto another cassette. The same holds true for voices recorded with the other methods.

For tapes made with either the radio or white-noise methods, just listen for anything in the background that sounds different than whatever noise you are using. As mentioned earlier, some voices will sound as if they are made from a manipulation of the noise, and some will sound louder. Again, develop any different-sounding noises through repeated playback, and maybe by copying them to another tape. That should make the messages somewhat easier to understand.

Finally, for tapes made with the diode method, prepare to be surprised. You should have the easiest time picking out the EVPs caught on tape with that method. However, you will still have to develop them somewhat for maximum clarity.

And that's all there is to it. If you still are skeptical, why not give it a try and see for yourself if those voices have anything to say to you! ■

Learn how and why astronomers are listening to the sounds of space.

BY KARL T. THURBER, JR.

RADIO ASTRONOMY

Most people know that astronomy is the study of the universe and the objects in it. When many of them hear the word "astronomy," however, they automatically assume that a form of "optical" science is being discussed—in other words, images of telescopes and eyepieces come to mind. But the study of the cosmos is not limited to visual means alone.

While the visible sky contains all the familiar constellations and the faint glow of our own Milky Way galaxy, there's another window to the universe open to anyone with the proper equipment. We are referring to the "radio sky," which is speckled with radio sources that only rarely match the positions of visible stars. The branch of science that deals with the detection and study of those sources is radio astronomy.

Radio Astronomy—A History. In the early 1930s, a radio engineer named Karl G. Jansky tried to determine the causes of radio communications static on transoceanic telephone connections for Bell Telephone Laboratories. Jansky didn't locate any specific source of the static and interference. But he did note that as he turned his Bruce curtain antenna toward the galactic plane of the Milky Way, he recorded an increase in static "hiss." After much testing and verification, he concluded that the source of the interference was from the direction of the center of the Milky Way.

Jansky's discovery didn't conclusively establish the existence of radio emissions from the sky (then quite a novel idea), and the broad beam of his antenna only vaguely suggested any details of those emissions on 20.5 MHz. As a result, his work didn't appear to create much interest, and Jansky

Photo courtesy of NRAO/AUI.

didn't immediately have the opportunity to pursue his discovery in depth.

Then, beginning in 1937 and continuing into the 1940s, an amateur radio operator, Grote Reber, W9GFZ, of Wheaton, Illinois built a backyard, 31-foot, parabolic dish antenna to continue Jansky's work. By "observing" VHF and UHF as high as 500 MHz, Reber discovered discrete regions of intense radio emissions, or static hiss.

Greber then plotted regions of the sky according to the intensity of the radio sources ("bright" radio objects that emit large amounts of radio waves over a characteristic spectrum). He ultimately published a map of a large part of the sky in 1944 based on his work. Jansky's and Reber's efforts are considered by many to represent the very foundations of modern radio astronomy.

In 1942, radar operators in England reported a new kind of "enemy jamming" observed on their then-new radar. Weak radar echoes became lost in the "grass" on their screens, as though swamped by noise from a powerful transmitter. Scientist J. S. Hey examined the reports and determined that the source of the "jamming" wasn't from an enemy station, but was coming from the sun, having noticed that a very large sunspot was crossing the sun's face at the time.

In the late 1940s, it was found that the radio waves picked up by Jansky and Reber came not only from the "nearby" Milky Way galactic neighborhood, but also from definite, more-distant points in the sky. It was as if individual stars were transmitting to us, even though there were no visible stars at those points. It was not until 1952 that those "radio stars" were correlated with visible objects. Even then, the objects were so faint that only the largest optical telescopes could find them.

Galactic Radio Emissions. There are several galactic radio emissions. The first type, discovered in 1932 by Jansky, is spread over a wide band of radio frequencies. It's produced when free electrons are scattered by collisions with heavier ions in the ionized interstellar gases surrounding hot, bright stars. (Some of the planets in our own solar system, including Venus, Jupiter, and Saturn, emit intense radio waves of thermal origin.)

A second type, synchrotron radiation, is emitted by energetic electrons as they rapidly spiral within the strong magnetic fields in the vicinity of supernova remnants. Some of the strongest radio sources in our galaxy are of that type.

A third type originates in interstellar matter. It radiates at discrete frequencies characteristic of the quantum jumps made by electrons in atoms and molecules, such as hydrogen and helium, in the interstellar medium.

Radio waves also come from beyond the Milky Way. Some extragalactic radio sources are detected only by their radio emissions, while others are correlated with optically observed galaxies and other objects. Radio sources produce either "continuum radiation" that covers a broad range of wavelengths, or "line radiation" that is radiated at one specific wavelength, much like an optical spectral line.

Besides localized radio sources, there is also uniform low-level cosmic radio noise coming from every direction in the sky. That cosmic background radiation (CBR) lends support to the theory that the universe began with an explosive "big bang," rather than always having existed in an unchanging steady state having isotropic (uniform in all directions) characteristics.

The Electromagnetic Spectrum. Before we go any further in our discussion, we should discuss the electromagnetic spectrum, which is an array of radiant energies. All those energies are electromagnetic particle-waves (photons) that propagate through space (see Fig. 1). Let's take a look at those energies in order of decreasing wavelength and increasing frequency:

Radio and Microwaves: The total usable radio and microwave electromagnetic spectrum generally is considered to extend from a few hertz (HZ) to at least 300 gigahertz (GHz). Scientists break up that almost unimaginably immense range of frequencies into smaller groupings for discussion and ease of understanding.

The radio and microwave spectrum is often classified into nine frequency bands; most bands are ten times as high in frequency as the band lying just below them in the spectrum. The lowest range is the group of frequencies known as the ultra-low frequencies (ULF), from zero to 3 Hz. Just above ULF lie the extremely low frequencies (ELF); they cover 3 Hz to 3 kHz. Above that, from 3 to 30 kHz, are the very low frequencies (VLF). Higher still are the low frequencies (LF), from 30 to 300 kHz.

From 3 MHz to 30 MHz are the high frequencies (HF). Above them are the very-high frequencies (VHF), from 30 to 300 MHz. The ultra-high frequencies (UHF) extend from 300 to 3000 MHz, or 3 GHz. From 3 GHz to 30 GHz are the

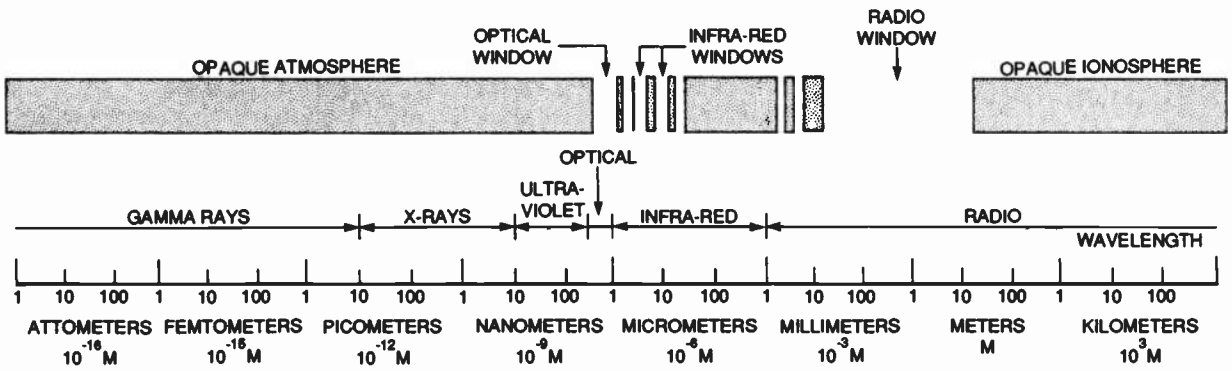


Fig. 1. The electromagnetic spectrum is an array of radiant energies. This illustration depicts the relative transparency of the earth's atmosphere and ionosphere at various wavelengths.

super-high frequencies (SHF), and from 30 GHz to 300 GHz, the extremely high frequencies (EHF). EHF often is referred to loosely as the millimeter-wave band, corresponding to frequencies between 30 and 300 GHz, or wavelengths between 1 millimeter and 1 centimeter.

Radio astronomers are concerned mainly with UHF and higher frequencies, notably microwaves. Microwaves are electromagnetic radiation having a frequency range from 1 to 300 GHz, corresponding to wavelengths from about 300 millimeters (30 centimeters) to 1 millimeter.

Radio astronomers conduct much of their work in that very promising region between wavelengths of 1 millimeter (just below the infrared region) and 30 centimeters—they generally prefer to use wavelength rather than frequency designators. That region is the so-called "cosmic window" of minimum sky noise. Signals on longer wavelengths (lower frequencies) tend to be obscured by background galactic noise; shorter wavelengths (higher frequencies) are obscured by photon noise. That window is narrowed for radio telescopes on earth, the upper half of the window being partially obscured by the earth's atmosphere (see Fig. 2).

Infrared: The common unit of measurement in this region is the Angstrom. The Angstrom is a unit of length equal to 10^{-10} meters that is used to measure the wavelengths of light and of other forms of radiation. Scientists generally prefer to use the nanometer (nm), often called a millimicron; 1 nm = 10 Angstroms, or 10^{-10} meters.

Infrared radiation (IR) is electromagnetic radiation similar to, but of a somewhat longer wavelength than, visible light, which ranges from 400 nm (extreme violet) to 770 nm (extreme red). Infrared has a wavelength in the range of about 770 nm to 1,000,000 nm (1 millimeter). That range lies at frequencies less than that of red visible light and greater than that of microwaves. IR is thermal-based radiation, produced by a body having a temperature above absolute zero.

X-rays and Gamma Rays: X-rays are invisible, highly penetrating electromagnetic radiation (photons) of much shorter wavelength than visible light. The wavelength range is from about 0.01 to 10 nanometers. Among other applications, x-rays are used in diagnostic medicine and in the study of crystal structure. In radio astronomy, x-rays come mainly from outside the solar system.

Gamma rays have very short wavelengths—less than 10^{-10} meters—and are the most energetic form of electromagnetic radiation known. They essentially are very energetic x-rays.

Cosmic Rays: Cosmic rays are streams of ionizing radiation of extraterrestrial origin. They consist chiefly of protons, alpha particles, and other atomic nuclei, but include some high-energy electrons. Those electrons might produce secondary radiation, mainly pions, muons, electrons, and gamma rays.

Radio-Astronomy Equipment. Two main problems face the radio astronomer seeking to study waves from some stellar object or region of the sky, which might be billions of light-years away. First, the signals usually are quite faint: the power level of the signals processed by radio telescope receivers is on the order of only 10^{-15} to 10^{-20} watts.

Second, the beam width of the antenna is usually much greater than the angular size of the object, and the radiation it picks up might have come from many other objects in the region. Both difficulties, of signal strength and resolving power, call for very large,

ASTRONOMICAL MEASUREMENTS

The Speed of Light: Radio signals travel at the speed of light. That is the speed of propagation of electromagnetic waves in a vacuum, a physical constant that's nominally 186,282 miles (or 299,793 kilometers) per second.

The Astronomical Unit: The astronomical unit (AU) is the basic unit used by scientists to measure distances within the solar system. It's the mean distance between the center of the earth and the center of the sun. One AU is about 92,956,000 miles (149,598,480 kilometers).

The Parsec: The AU is also used to a limited extent for interstellar distances through definition of the parsec (pc). Essentially, it's a unit of distance derived from parallax, being the distance at which a hypothetical star would have a parallax equal to 1 second of arc. In a distance-measurement sense, the parsec is a unit of length that's approximately equal to 206,265 Astronomical Units, 3.258 light-years, 1.917×10^{13} miles, or 3.085×10^{13} kilometers.

The Light-Year: Essential to convenient expression of interstellar distances is the light-year. The light-year is the distance traversed by light in one sidereal (star-based) year. That is about 5,879,000,000,000 (nearly six trillion, or 5.879×10^{12}) miles, or 9.461×10^{12} kilometers. ■

AMATEUR RADIO ASTRONOMY

Is there anything left for the amateur to discover in radio astronomy? For microwave observations you'd need some special equipment, such as a parabolic dish antenna, a low-noise amplifier (LNA), and a low-noise microwave receiver—much like what you'd need in a good satellite TV setup.

On the other hand, less-complex gear is needed to observe radio emissions from the planet Jupiter. The Jovian signals are to be found mainly in the 18- to 26-MHz HF band. Many radio amateurs and shortwave listeners (SWLs) have successfully intercepted and recorded those signals using simple directional antennas and ordinary shortwave radios.

If you have an interest in radio astronomy and would like to become an amateur radio astronomer, consider joining the Society of Amateur Radio Astronomers, or SARA. SARA is inspired by the pioneering work of amateur radio astronomer and ham-radio operator Grote Reber.

SARA was organized in 1981 and has about 275 members worldwide. Though small, it probably is the largest amateur radio-astronomy group in the world. Its members are involved in solar radio astronomy, sky surveys, and other experiments. The group's yearly conference normally is held in June at the National Radio Astronomy Observatory (NRAO) in Green Bank, West Virginia.

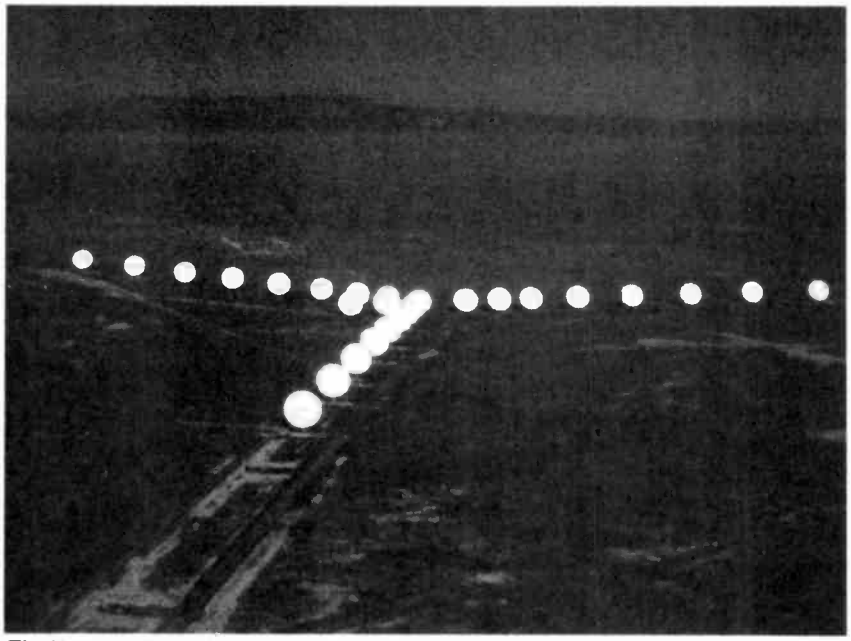
Yearly membership is $20 and includes a year's subscription to the SARA Newsletter. For more information, contact the SARA Membership Service, Vincent Caracci, 247 N. Linden St., Massapequa, NY 11758. ■

narrow-beam antenna systems.

To complicate matters, the character of the signals from the stars is similar to "receiver noise." That is, the signals usually consist of incoherent radiation whose properties don't differ appreciably from the noise originating in the receiver or from background radiation coupled to the receiver by the antenna.

Various sophisticated methods of detecting small-noise signals are used. In radio astronomy it's often necessary to select only that part of the noise that's coming from a small source in the sky, while disregarding a large proportion from a diffuse background of other sources.

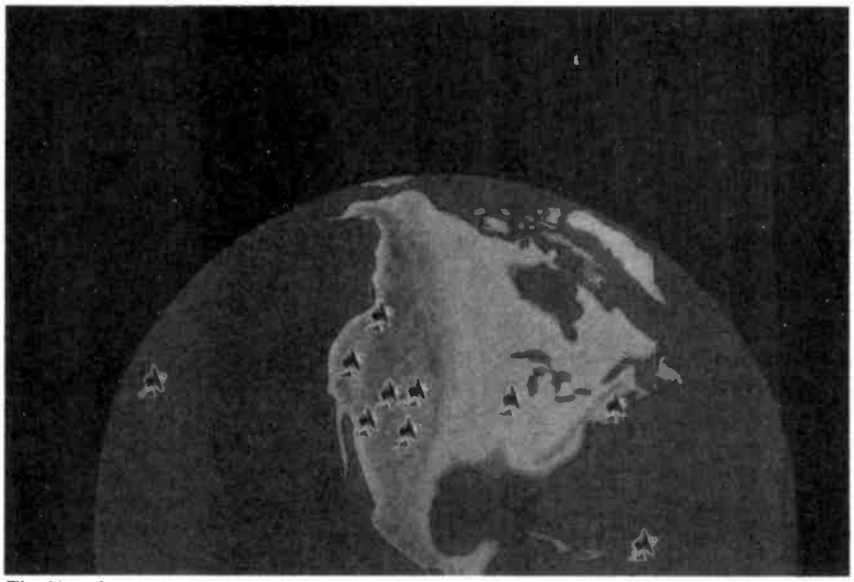
The antennas and receivers used in present-day radio astronomy vary widely, so it's difficult to describe a "typical" arrangement. However, in general, the antenna—of whatever type—intercepts and collects the radio signal from the celestial source. After preamplification at the feedpoint, the signal is carried by cable to the main receiver, where it's selected according to frequency and amplified.



The National Radio Astronomy Observatory's Very Large Array near Socorro, New Mexico, has the equivalent resolution of a 22-mile-diameter telescope and consists of 27 radio dishes, each 85 feet in diameter (Photo courtesy of NRAO/AUI).

The intercepted signal is amplified further, detected, and integrated, and the output is displayed on an analog recorder or other device. It also can be recorded in digital form on magnetic tape for further processing by high-speed computers. The final result usually is displayed by a large plotting machine.

Radio interferometers are special-purpose radio telescopes in which the mutual interference or reinforcement of signals is made to yield information. Interferometers consist of two or more separated antennas connected by transmission lines to one



The Very Long Baseline Array interferometer is an array of ten identical antennas, each about 82 feet in diameter, located at ten independent sites spread across 5,000 miles from the Virgin Islands to Hawaii. This system of coordinated telescopes can produce image resolutions better than any other instrument (Photo courtesy of NRAO/AUI).

receiver. The antennas used by interferometers can be placed close together or they can be thousands of miles apart.

The physical separation of antennas causes parts of the radio waves to reach the antennas at slightly different times. That offers the potential for high resolving power so the signals can be used to determine the position or diameter of a radio source, or to separate two closely spaced radio sources.

Another type of observation tool is a phased-array radio telescope, which has large numbers of relatively small antenna elements arranged in various configurations over a large area. That setup yields the effective sensitivity and resolution of a much larger antenna.

Finally, there are also radio telescopes, of American and European origin, that are in orbit above the Earth's surface and its atmosphere. Some are also carried aloft on Space Shuttle missions. Those telescopes are very useful because far-infrared radiation, far-ultraviolet radiation, x-rays, and gamma rays cannot easily penetrate the earth's atmosphere.

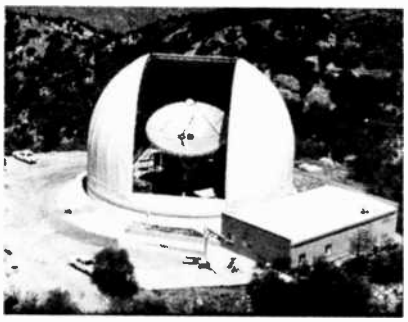
Major Radio Telescopes. A number of observatories worldwide investigate extraterrestrial radio phenomena. Overseas, those include the Radio Astronomy Center at Ootacamund, India; the Max Planck Institute for Radio Astronomy at Effelsberg, Germany; the Nuffield Radio Astronomical Laboratories at Jodrell Bank, England; the Mullard Radio Astronomy Observatory at Cambridge, England; and the Special Astrophysical Observatory at Zelenchukskaya, Russia. There also are many others—over 25 countries have major, world-class radio telescopes.

Various arrays of radio telescopes can provide unprecedented image resolution and signal sensitivity. In the United States, such observatories include the National Radio Astronomy Observatory (NRAO) Very-Large Array (VLA), on the plains near Socorro, New Mexico that reportedly is the most powerful phased-array radio telescope system in the world. The VLA has the equivalent resolution of a 22-mile-diameter telescope and consists of 27 radio dishes, each 85 feet in diameter. When the dishes, which can be moved along 12-mile-long railroad tracks, are connected together electronically, they effectively act as a single antenna over 3000 feet across.

Another array is the new Very-Long Baseline Array (VLBA) interferometer. It's an array of ten identical antennas, each about 82 feet in diameter, centered in New Mexico but actually located at ten different interconnected sites spread across 5000 miles from the Virgin Islands to Hawaii. That system of coordinated telescopes can yield image resolutions better than any other instrument.

Some telescopes, such as those designed for the "millimeter-wave" region, are studying ultra-short-wave parts of the spectrum for the first time. One of those is the 36-foot millimeter-wave radio telescope at the Kitt Peak National Observatory near Tucson, Arizona. It's the first radio telescope to look at the universe at wavelengths as short as 1 millimeter.

Not to be overlooked is the Arecibo Observatory in Puerto Rico, with its 1000-foot dish. That dish is actually a fixed spherical reflector suspended



Some telescopes, such as those for the millimeter-wave region, are studying ultra-short-wave parts of the spectrum for the first time. One of those telescopes is the 36-foot millimeter-wave radio telescope at the Kitt Peak National Observatory near Tucson, Arizona (Photo courtesy of NRAO/AUI).

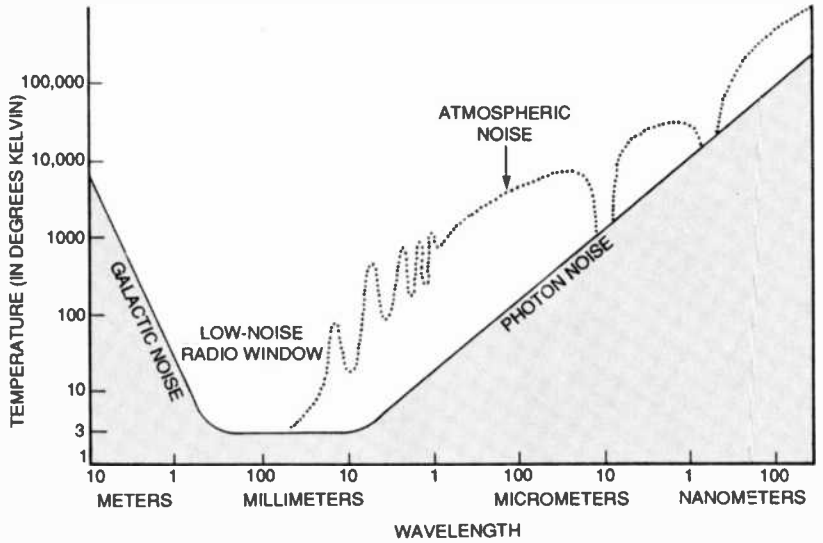


Fig. 2. Radio astronomers conduct much of their work in the promising region between wavelengths of 1 millimeter and 30 centimeters. This is the so-called "cosmic window" of minimum sky noise. Signals on longer wavelengths tend to be obscured by background galactic noise; shorter wavelengths are obscured by photon noise. The window is narrowed for radio telescopes on earth, the upper half of this window being partially obscured by the earth's atmosphere.

AMATEUR RADIO-ASTRONOMY SUPPLIES

If you want to pursue amateur radio-astronomy projects, it's normally pretty expensive stuff—at least as expensive as amateur radio. However, a small Georgia firm offers everything from radio telescopes to amplifiers, bandpass filers, feed horns, mixers, A/D converters, noise sources, software, and various "how to" publications on amateur radio astronomy.

Two popular radio telescopes are offered. One is a 1420-MHz hydrogen-line radio telescope. It consists of a cylindrical feed horn, low noise amplifier (LNA), converter, 70-MHz IF amplifier, detector and integrator, and DC amplifier, for $625.

A similar system for 600 MHz, which uses a dipole instead of a feed horn and a slightly different converter, is $600. Spectral-line radio telescopes are also available.

For a brochure, contact Jeff Lichtman, 190 Jade Cove Dr., Roswell, GA 30075; Tel. 404-992-4959. ■

over a large sinkhole; it's also equipped with a radar transmitter to study radar signals reflected from planets and other objects in our solar system.

Some Remarkable Objects. Radio astronomy has led to the discovery of many remarkable objects and phenomena, or has contributed greatly to their understanding. Let's take a look at some of those:

Pulsars: Pulsars are "lighthouse beacons," or radio sources that emit brief, intense, periodic pulses of radio waves, X-rays, or visible light; those pulses recur at precise intervals. They are believed to be rotating neutron stars that radiate in a narrow beam. Because of such a star's rotation, the beam sweeps across the line of sight, causing the observed pulses.

Quasars: These are faint, blue, star-like "quasi-stellar" objects that are believed to be the most distant and most luminous objects in the universe. They might, in fact, be as distant as 8 billion light-years and as luminous intrinsically as 100 galaxies combined.

The spectral lines of quasars have enormous red shifts (Doppler shifts). Those shifts suggest that quasars are receding or moving away from our galaxy with speeds as great as 80% of the speed of light. Quasars emit a powerful blue light and often give off radio waves.

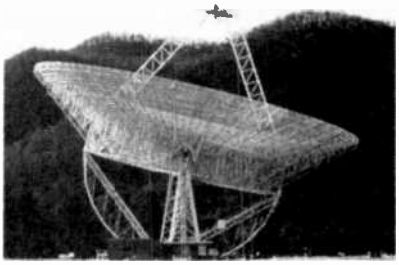
Supernovas: A supernova is an exploding star that suddenly increases its energy output as much as a billion-fold and then slowly fades to less than its original brightness. At its peak intensity, it can outshine the entire galaxy in which it occurs.

Supernovas represent a catastrophic stage of stellar evolution. A sudden implosion of the core of certain massive stars produces a rapidly rotating collapsed stellar remnant, the explosive ejection of the stellar envelope at great velocity, and the release of tremendous energy.

Over 120 galactic radio sources have been identified as supernova remnants. Of those, only four have been positively associated with explosions that were observed optically in history. Those events occurred in 1006, 1054 (the remnant of which now is visible as the Crab Nebula), 1572, and 1604.

Black Holes: A black hole is the core of a massive star that has "gone supernova." Its collapse has continued past the neutron star stage to densities so extreme that matter can't exist in normal forms. Under those conditions, matter and energy are drawn in and can't escape.

The most remarkable feature of a black hole is its surface, called the horizon, which completely pockets or encloses the collapsed matter. That horizon is an ideal one-way membrane: particles and light can go inward through the surface, but none can go outward. As a result, the object is dark (black), and it hides from view a finite region of space (a hole).



Here's the former 300-foot radio telescope dish at the National Radio Observatory in Green Bank, West Virginia. The dish collapsed in 1988 due to stresses on the metal, but a new, 320-foot replacement should be ready by 1996. That will be the world's largest, fully steerable radio telescope (Photo courtesy NRAO/AUI).

Because black holes are unobservable, their presence can only be detected as a result of their effects on other matter. Thus scientists must construct a theoretical model to explain the observational data and show that the most reasonable explanation is that a black hole is responsible for the observed effects. Such is the case with the binary, x-ray star system, Cygnus X-1, which is a weak radio source in which the smaller and invisible companion of the blue supergiant star might actually be a black hole.

Other Phenomena: In the last generation, many other strange phenomena and stellar objects have been postulated, discovered, classified, and discussed. Some of those include gravitational lensing, or light distortion caused by galaxies; cosmic strings, which are energetic defects in the geometry of space and time that make for a "lumpy" universe; and great "bubbles," or balloon-like groups or superclusters of galaxies around huge, megaparsec-size "great voids" in space that are devoid of galaxies.

Yet to Come. We have only discussed pieces of the cosmic puzzle so far, but there are many loose ends. Still unanswered are some fundamental, tantalizing questions relating to the origin, composition, and age of the uni-

(Continued on page 89)

SUGGESTED READING

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Lemonick, Michael D. and J. Madeleine Nash. "Unraveling Universe." *Time*, March 6, 1995, p. 76.

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McDonough, Thomas R. *The Search for Extraterrestrial Intelligence*. New York: Wiley, 1987.

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Build a Vocal Sound-Effects Generator

BY DAVID WILLIAMS

Create a truly ghoulish voice for yourself and get into the spirit of Halloween with this fun project.

If you want to add some scary sound effects to this year's Halloween fun, try building the *Vocal Sound-Effects Generator* described in this article. With it, you can add both reverb and echo to make yourself sound like a creepy ghost, shift the pitch of your voice higher to sound like a shrieking banshee, or shift the pitch lower to create a ghoulish monster voice. Plus, a warbling vibrato can be combined with any of the previous effects to create even stranger effects!

The battery-powered project, including its small microphone and remote speaker, is very portable. You can easily incorporate it into any costume or use your imagination and have a talking pumpkin greet the trick-or-treaters at your front door. However it is used, the Effects Generator will provide hours of fun and entertainment!

Circuit Description. The schematic diagram for the Vocal Sound-Effects Generator is shown in Figure 1. Four AA batteries supply 6 volts to the LM386 audio amplifier, U2. Resistor R4 and Zener-diode D1 convert and regulate the battery voltage to 3.6 volts to power the HT8950 signal-processor chip, U1. The power switch, S1, is part of the volume-control potentiometer, R5. Capacitors C8 and C5 provide power filtering for the circuit.

During operation, the user's voice is picked up by electret-microphone MIC1 and the signal is AC coupled by C1 to pin 6 of U1 (which is the input of the chip's preamplifier stage). Resistors R8 and R9 set the gain of the internal preamplifier at approximately 8, which is figured out by:

$$V_{out} = (R9/R8) \times V_{in}$$

The output of the HT8950's preamplifier stage is buffered and fed into the chip's internal, 8-bit, analog-to-digital converter. That A/D converter samples the speech signal at 8 kHz under the control of a time-base generator, and the 8-bit digital values are stored in internal SRAM memory. Simultaneously, the chip's control circuit clocks the SRAM data out to a digital-to-analog converter (DAC) that restores the analog signal and outputs it at pin 9. The signal then passes through a low-pass filter formed by R2 and C2. Amplifier U2 provides the final amplification and drives speaker SPKR1; potentiometer R5 controls the volume.

If the speech data is clocked in and out of U1's SRAM at the exact same rate, the original signal gets reproduced with no changes. But if the digital data is manipulated before it passes though the DAC, some pretty weird effects can be created! The four-position DIP switch, S2, is used to set the operating modes of the HT8950 (see Table 1).

The HT8950 can be set for NORMAL VOICE, ROBOT VOICE, and several pitch-shift-up and pitch-shift-down modes; vibrato can be added to each of those modes. The normal setting requires no explanation. As for the ROBOT VOICE mode, that adds echo and reverb effects by delaying part of the digitized audio then adding the delayed signal to the original. The pitch-shifting modes are analogous to speeding up or slowing down a tape recording during playback. Voice pitch is shifted by changing the clocking ratio of the internal time-base generator. Vibrato is created when the HT8950 automatically shifts the pitch of the input signal up and down alternatively at a rate of 8 Hz.

Construction. The simplest way to build your own Vocal Sound-Effects Generator is to use a printed-circuit board. A template for that is shown in Fig. 2. If you don't want to fabricate your own board, a pre-etched and drilled board can be purchased from the source mentioned in the Parts List (you can also purchase other parts, and even a complete kit, from the same source). Of course, the circuit can also be built on perforated board. Most of the parts for the project are fairly easy to find. The one exception is the HT8950 (U1); if you can't find it locally, it can be purchased from the source given in the Parts List or from Alltronics (2300-D Zanker Road, San Jose, CA 95131; Tel. 408-943-9773).

If you do build the circuit on a PC board, use the parts-placement diagram in Fig. 3 as a guide. First, install

TABLE 1

DIP-SWITCH SETTINGS				
S2-a	S2-b	S2-c	S2-d	MODE
*	X	X	0	NORMAL VOICE
*	0	0	X	PITCH-SHIFT UP1
*	X	0	X	PITCH-SHIFT UP2
*	0	X	X	PITCH-SHIFT UP3
*	0	X	0	PITCH-SHIFT DOWN1
*	X	0	0	PITCH-SHIFT DOWN2
*	0	0	0	PITCH-SHIFT DOWN3
*	X	X	X	ROBOT VOICE

*SW1 Toggles VIBRATO mode ON & OFF in combination with all other modes.
Note: X=OFF, 0=ON

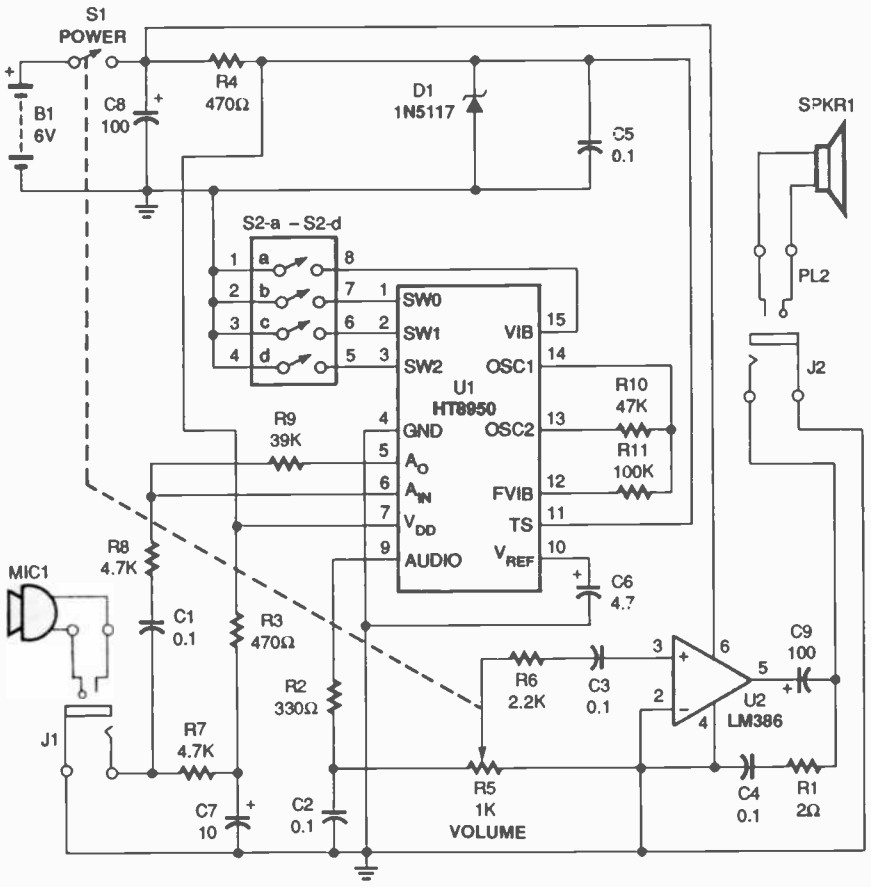


Fig. 1. As this schematic shows, the heart of the Vocal Sound-Effects Generator is the HT8950 sound modulator IC, U1. An audio signal fed to that chip from MIC1 is converted to a digital signal, modulated by a variety of effects (which you can select using S2), and converted back to analog for output to SPKR1.

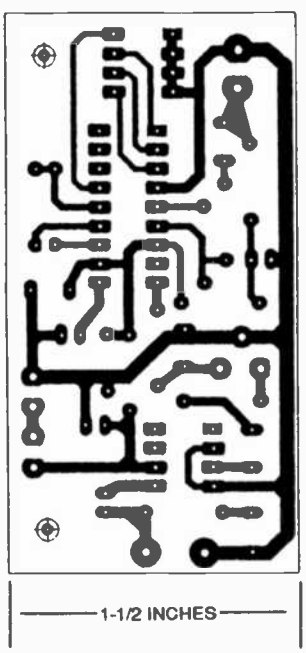
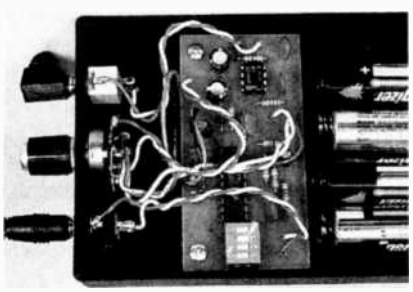


Fig. 2. You can use this full-size foil pattern to etch your own printed-circuit board. The board is also available from the source given in the Parts List.



As this internal view shows, twisting the wires connecting the jacks and potentiometer to the board will yield a neater assembly.

the Zener diode, D1, paying close attention to the proper orientation. Then, solder all the fixed resistors to the board, and trim the excess leads before proceeding to the next step. Potentiometer R5 will be installed later.

Next, install IC sockets for U1 and U2. Make sure that the sockets are oriented properly by double-checking the parts-placement diagram.

Solder the non-polarized capaci-

PARTS LIST FOR THE VOCAL SOUND-EFFECTS GENERATOR

SEMICONDUCTORS

U1—HT8950 sound modulator, integrated circuit
U2—LM386 audio amplifier, integrated circuit
D1—1N5117 3.6-volt Zener diode

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1—2-ohm
R2—330-ohm
R3, R4—470-ohm
R5—1000-ohm potentiometer with SPST switch
R6—2200-ohm
R7, R8—4700-ohm
R9—39,000-ohm
R10—47,000-ohm
R11—100,000-ohm

CAPACITORS

C1–C5—0.1-μF, ceramic-disc
C6—4.7-μF, 16-WVDC, electrolytic
C7—10-μF, 16-WVDC, electrolytic
C8, C9—100-μF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

MIC1—Electret microphone (see text)
SPKR1—8-ohm speaker (VANCO Model: SPB-3 or equivalent; see text)
J1, J2—3.5-mm mono miniature jack
PL1, PL2—3.5-mm mono miniature plug (optional; see text)
S1—SPST switch (part of R5)
S2—4-position DIP switch
B1—6-volt battery (four AA batteries wired in series)
Printed-circuit materials, project enclosure, IC sockets, AA-battery holder (four-battery type), plastic knob, wire, solder, hardware, etc.

Note: The following items are available from LNS Technologies (20993 Foothill Blvd., Suite 307P, Hayward, CA 94541-1511; Tel. 800-886-7150): sound-modulator U1 (ICHT8950)—$10.00; etched and drilled circuit board (VEP-PCB)—$7.00; complete kit of parts including PC board, plastic case, microphone, speaker, and all other components listed above (VEP-KIT)—$49.00. Please add $5.00 shipping/handling. California residents please add local sales tax. Mastercard and Visa orders are accepted. Sorry, no C.O.D. orders.

(Continued on page 90)

Build the PATHFINDER

A navigational aid for the visually impaired that can be modified for other applications.

BY LUTHER M. STROUD

Anyone who has a visually impaired friend or relative is well aware of the difficulties that day-to-day routines can present to such individuals. Simple things that most of us take for granted (such as navigating unfamiliar territory) can be major obstacles to blind people. To aid the blind in their quest for independence, the *Pathfinder*—a navigational aid for the blind—was developed.

The Pathfinder, which requires no special skills for effective use, is an easy-to-build, light-sensing circuit that can be used to sweep an area to locate the direction of light sources. As light intensity changes, Pathfinder's audio output varies in pitch, allowing visually impaired persons to determine the location of windows and doors, or of lights that were left on for other individuals.

Circuit Description. Figure 1 shows the Pathfinder schematic diagram. The circuit is little more than a simple two-transistor oscillator (a relaxation type) whose frequency is controlled by a light-dependent resistor (LDR). The oscillator can be built using nearly any NPN and PNP transistor combination desired, and its operation is as simple as its parts count is low.

While pushbutton-switch S1 is depressed, C1 begins charging through R1 (the LDR) until the capacitor's charge reaches about 0.6 volts. That charge is sufficient to turn on Q1, which in turn supplies forward bias for Q2; transistor Q2 responds by drawing battery current through BZ1. As Q2 reaches saturation, C1 is discharged and the circuit relaxes as both transistors turn off. Then C1 once again begins to charge through R1 to repeat the process.

The resistance of R1 and the value of C1 determine the oscillating frequency of the circuit, which varies from a slow tick in darkness (when R1 is about 100,000 ohms) to a high-pitched tone in bright light (when R1 is 1000 ohms). The change in frequency is heard through the transducer, BZ1. Power for the circuit is furnished by a single, 1.5-volt AA battery; because the Pathfinder draws so little power, it will function normally until the battery voltage drops to about 0.9 volt.

Construction. There is nothing critical about the building of the circuit, so it can be assembled using any standard project-building method.

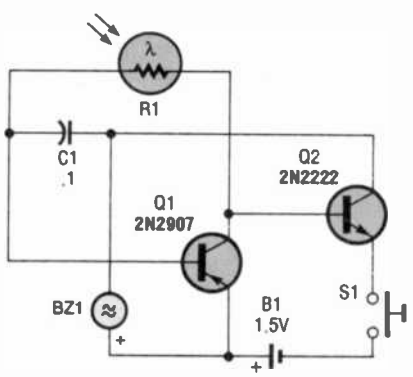


Fig. 1. The Pathfinder is little more than a simple two-transistor oscillator with a frequency that's controlled by light-dependent resistor R1.

The author's prototype unit was assembled on a small, L-shaped section of perfboard, with the components interconnected using point-to-point wiring. That board was housed in a clear, plastic, pillbox-like enclosure, producing a compact assembly. Because the author used a clear enclosure, an additional hole was not needed to allow light to reach the R1. A short piece of black heat-shrink tubing was placed around the lens of R1 to make the unit respond to light coming only from the direction in which it is aimed.

When connecting the miniature audio transducer, BZ1, to the circuit, be sure to observe proper polarity—the positive side of the transducer should be connected to the emitter of Q1. No damage will be done to the device if the transducer is wired incorrectly, but the output volume will be diminished. The transducer can also be replaced with an 8- to 16-ohm speaker for greater volume.

No special skills are needed to use the Pathfinder effectively. Just hold down S1, and wave the unit back and forth to sweep the area of interest. As light intensity varies, due to light-obstructing objects or the lack thereof, the Pathfinder's output tone will also vary.

Modifications and Applications. While the Pathfinder was originally designed to aid the visually impaired, it can easily be modified to perform useful tasks for those who can see. For

(Continued on page 92)

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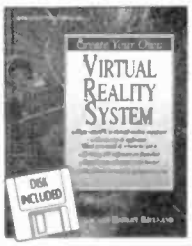

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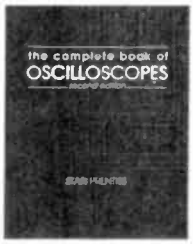

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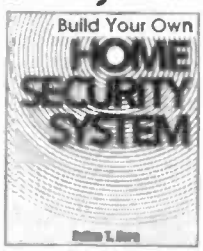

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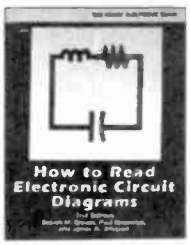

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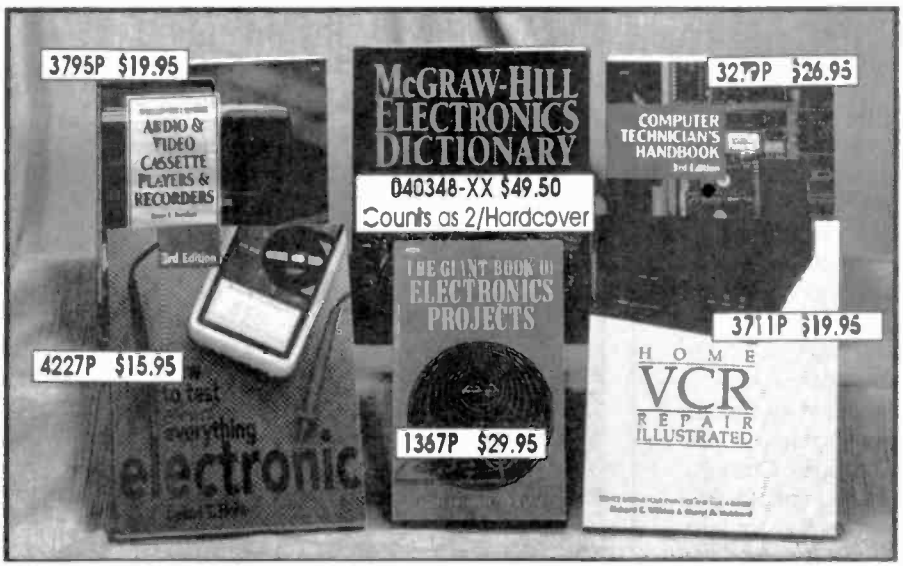

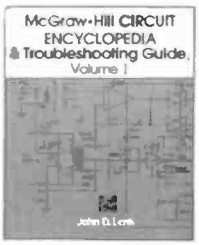

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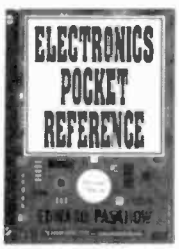

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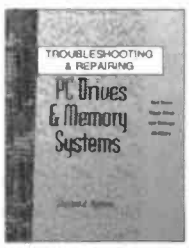

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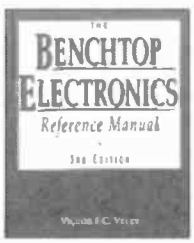

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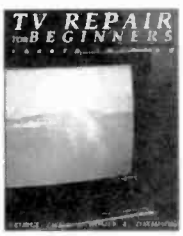

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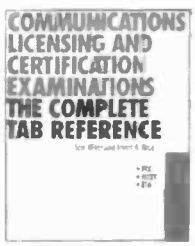

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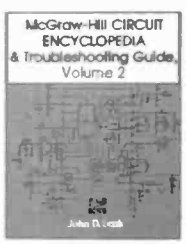

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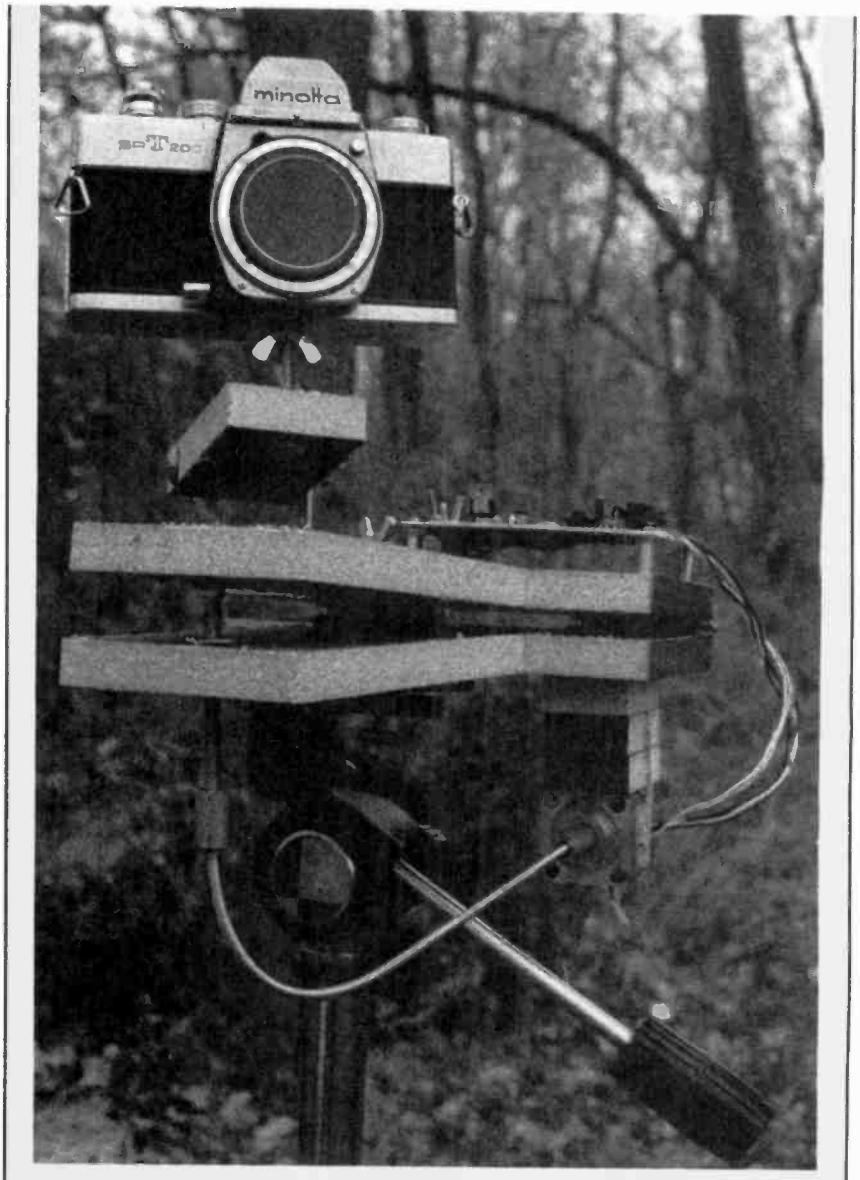


Build an Equatorial Camera Mount

Use it to take long-exposure photographs of the nighttime sky.

BY JOHN IOVINE

We have all seen photographs of the night sky. While some of them only seem to show what we can expect to see with the naked eye, some photos reveal what seem to be millions of stars and, on occasion, brilliantly colored gaseous nebulae. The magnificence of such advanced photos might drive you outside in the middle of the night to attempt to capture similar "spacescapes" for yourself. But don't go running off with just your tripod and trusty 35-mm camera just yet. Because after the film is developed, you will most likely be completely disappointed with what's there.

As you might have guessed, extra time is needed for the faint light of the stars to be caught on film. But if you keep a camera shutter open for more than 10 seconds, the stars will begin to make circular trails on the photograph due to their apparent motion. That time restraint severely limits the quality of photographs you can take. While shorter exposures do eliminate star trails, they also eliminate most faint stars and all nebulae.

So, what can you do to get those impressive astrophotographs? You can build the *Equatorial Camera Mount* described in this article. Because the Mount moves the camera at the same rate as the stars appear to move across the sky, you can take exposures as long as about 30 minutes without any star trails. Those longer exposures will allow you to capture details in the night sky you ordinarily can't see.

Following the Stars. Most who read this probably know that the apparent motion of stars is caused by the rotation of the earth. As a result, the stars seem to move across the sky at a speed of approximately 15.041 degrees per hour. The motion of the stars will appear greatest at the horizon and least near Polaris, the pole star of the Northern Hemisphere.

To explain that better, imagine the earth as being surrounded by a transparent sphere that has celestial objects printed on its inside surface (see Fig. 1). Now picture that the earth rotates in a counter-clockwise direction (with respect to the North Celestial Pole) on a pivot point located at Polaris. As a result of that rotation, the celestial objects appear to move in a clockwise direction.

To make up for the perceived motion of the stars when trying to take a sky photo, a mount must be used that moves the camera on an axis similar to that of the earth—in other words, an equatorial mount. The Equatorial Camera Mount we will be looking at in this article is one of the simplest types—the barn-door type.

Basically, a barn-door-type mount is made of two boards of some material, connected at the ends with hinges, that can open and close like a book. The bottom board must be aligned to the star Polaris (more on that later), while the top board moves upward via a drive screw attached to a stepper motor. The resulting upward motion keeps a camera mounted on the top board moving in sync with the stars with enough accuracy to make long exposures possible.

Circuit Description. Let's take a look at the electronics that control the stepper motor just mentioned. The schematic for the Mount's control circuitry is shown in Fig. 2. Power is provided by a 12-volt source, which is fed directly to stepper-motor MOT1 and dropped to 5 volts by a 7805 regulator (U3) for use by the rest of the circuit.

A 555 timer circuit, U1, generates a squarewave with a 3.2-Hz pulse. That output is fed to pin 11 of U2, a UNC5804B stepper-motor controller. Stepper-motor MOT1 will then run at half step, which doubles the unit's resolution (an important consideration for photography).

Switch S1 is used to set MOT1 to run either slow or fast. When S1 is set to SLOW, the unit will move at the proper speed to take astrophotos. The FAST setting can be used to rewind the screw, preparing the unit for a new photo. Of course, before MOT1 can be used to rewind the drive screw, the direction of the motor's rotation will have to be reversed; switch S2 is used to accomplish that. When S1 is set to SLOW, MOT1 should turn at 1 rotation per minute; potentiometer R4 is used to fine-adjust the speed of the motor.

Construction. There is nothing critical about the layout of the circuit, so it can be built on perforated board. However, for those who prefer to use a PC board, a full-size template is shown in Fig. 3. You can use that pattern to etch your own board, or you can order a pre-etched and drilled board from the source mentioned in the Parts List.

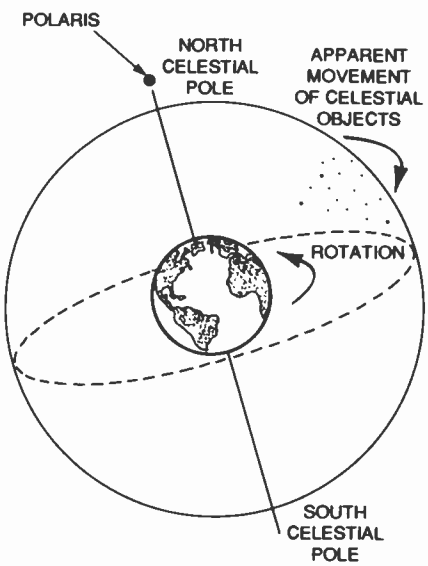


Fig. 1. Imagine the earth as rotating within a transparent sphere that has celestial objects printed on its inside surface. To someone standing on the earth, those objects appear to move.

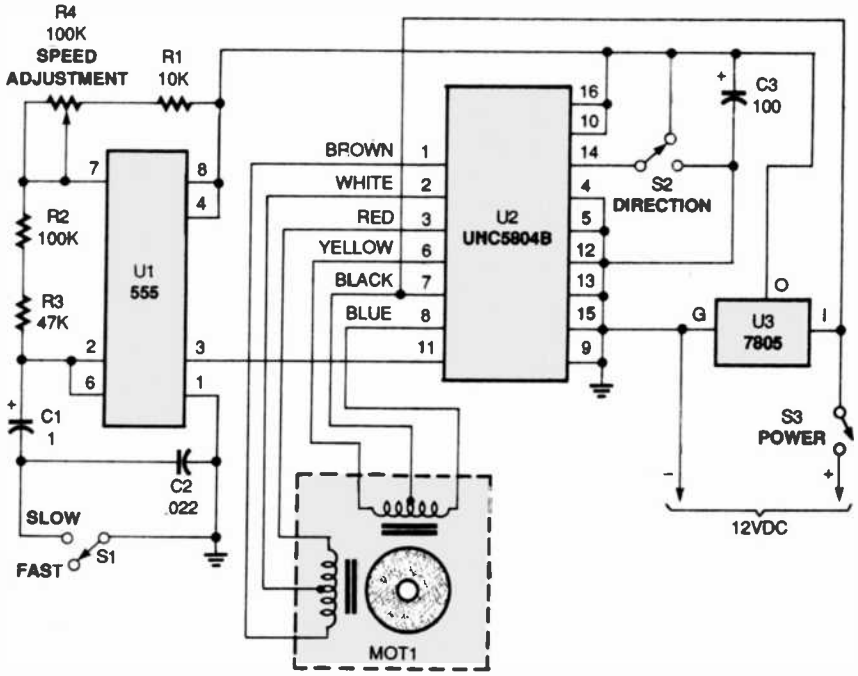


Fig. 2. Here's the schematic for the stepper-motor control circuitry. The low parts count is a result of the integrated functions of the UNC5804B stepper controller, U2.

For those who do use a PC board, a parts-placement diagram is shown in Fig. 4. There are relatively few components in the circuit, so assembly should be simple. Install the resistors and capacitors first, making sure to check the orientation of the two polarized capacitors. Mount IC sockets for U1 and U2, checking that the sockets are oriented properly. Finally, insert U1 and U2, and solder U3 to the board.

The three switches should be mounted off the circuit board, to make it easy to control the unit from a distance. Just run wires from the appropriate points on the board to a remote panel containing the switches.

The stepper motor can be connected to the circuit using PC board wire terminals, or by simply soldering the appropriate wires to their respective pads. Use the parts-placement diagram as a guide when doing so.

When the circuit is finished, check and adjust the speed of the motor before proceeding to assemble the mount itself. Set S1 to SLOW, and time one revolution of the stepper motor; you might want to attach a wire indicator arm to the stepper motor shaft with clay or putty to make it easier to time a revolution. Remember, you want the motor to spin at one revolution per minute. If it doesn't, adjust potentiometer R4 to speed up or slow down the stepper motor.

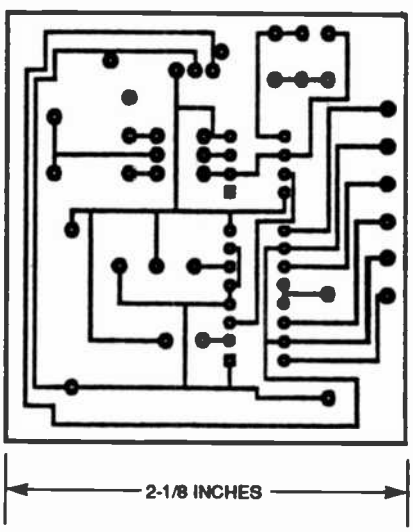


Fig. 3. If you'd like to etch your own PC board for the Mount's control circuitry, use this full-size foil pattern.

Now it's time to build the Mount itself. Start by cutting two 8- by 12-inch pieces of ¾-inch-thick lumber (plywood or pressboard is fine). Then cut them into T shapes using the dimensions shown in Fig. 5. Save the scrap wood cut from those pieces for use in other parts of the Mount.

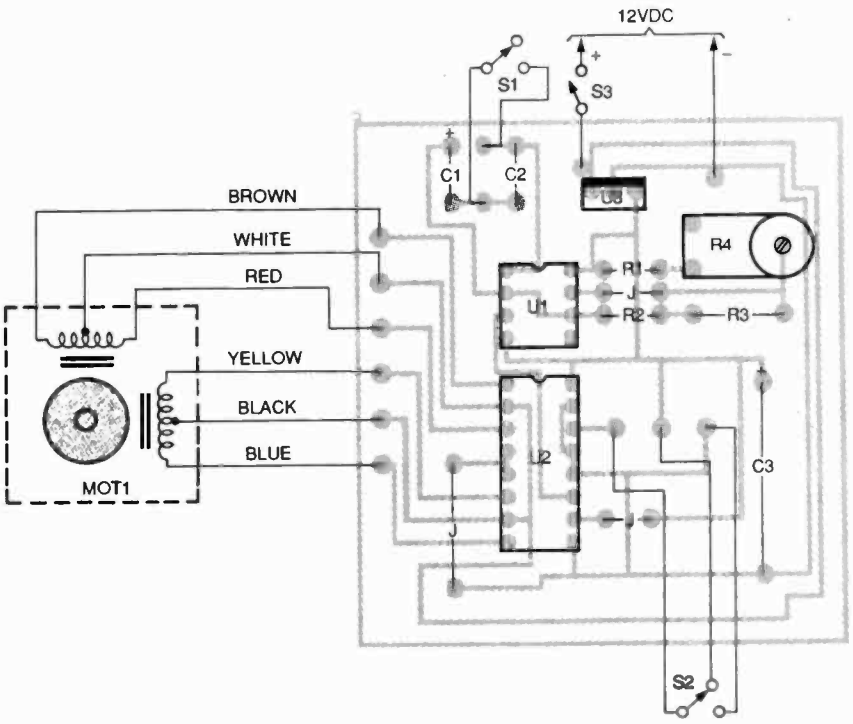


Fig. 4. This parts-placement diagram should make building the control circuit easier.

Join the two pieces of wood at their 8-inch sides with a pair of 3-inch brass hinges; the two wood pieces can then open and close like a book (see Fig. 6). On one board, which will become the bottom, measure exactly 11⅜ inches from the pins of the hinges. Drill a hole at that point, centered from side to side, that will accept a ¼-20 T-nut. Hammer a T-nut into that hole from what will be the inside when the boards are folded together. That hole is where the 2½-inch drive screw will be placed (see Fig. 6).

Drill another hole on the bottom board in the position indicated in Fig. 6. Hammer another T-nut from the inside into that hole. That hole is where the Mount will be secured to a camera tripod. Note that the ¼-20 thread of the T-nut is a standard for camera tripods.

Finally, drill a hole on the top board about 6 inches from either end, centered side to side. Hammer another T-nut in from the inside. That hole is for securing the camera to the Mount.

The camera arm can be made from one of the scraps of wood you saved. Cut the piece so that it measures about 2 × 3 inches. Drill a hole on one end through the width of the wood, and on the other end, drill another hole through the thickness (see Fig. 7). Secure an L-shaped bracket to the T-nut on the top board of the Mount using a ¼-20 bolt and matching wing nut. Pass another ¼-20 bolt through the hole going through the width of the camera arm, and attach it to the other end of the L bracket with a wing nut (see Fig. 7). By adjusting the wing nuts at each end of the L bracket, you can position the camera arm at any desired angle.

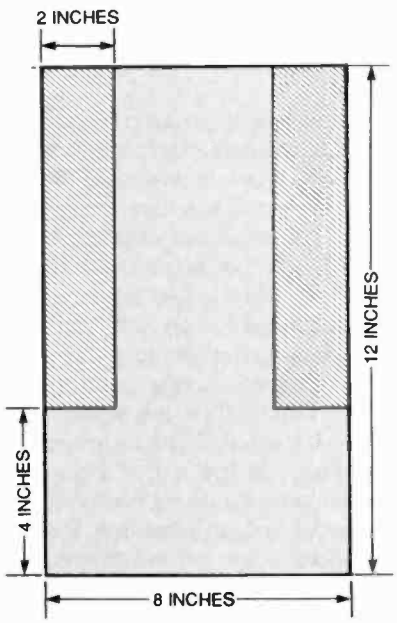


Fig. 5. Use this template as a guide when cutting the two boards for use in the Mount.

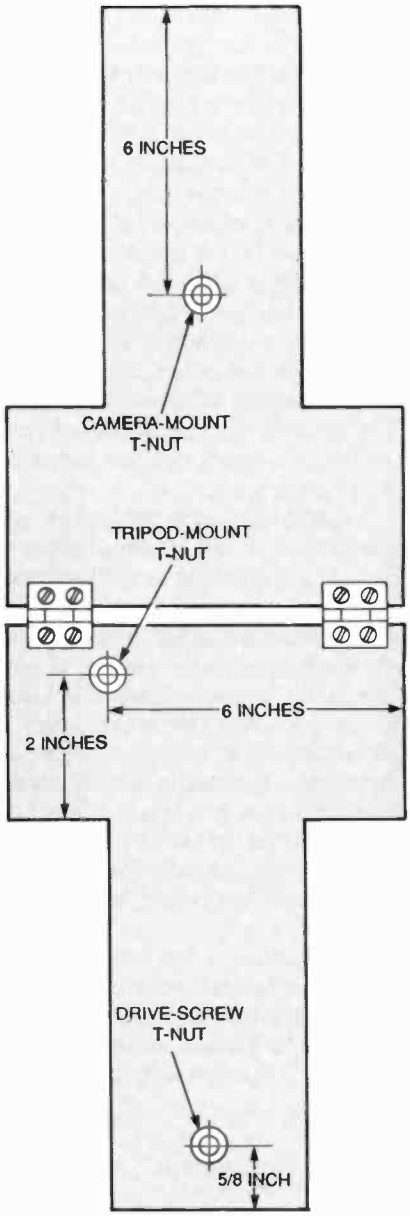


Fig. 6. The two pieces of wood that make up the barn-door mount are joined at their 8-inch sides with hinges. Note the placement of the three T-nuts.

Pass a 2-inch ¼-20 bolt through the other camera-arm hole. Secure it with one wing nut. Then, screw another wing nut, wings pointing towards the camera arm, onto the bolt. Place the camera onto the same bolt and lock it into place by tightening the wing nut up to the base of the camera (see Fig. 7).

Now it's time to secure the circuit board and stepper motor to the Mount. The circuit board should be attached to the top side of the top board. You can use a few machine

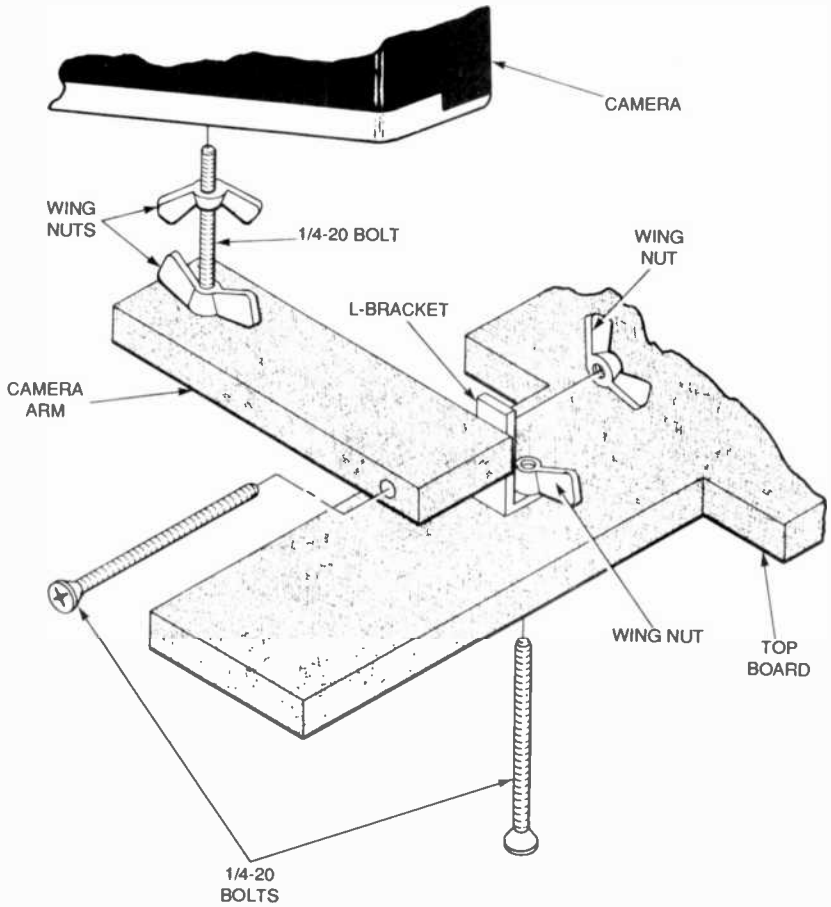


Fig. 7. Because the camera arm is mounted this way, it can be adjusted using the wing nuts on both ends of the L bracket.

screws and aluminum spacers to accomplish that.

As for the stepper motor, that's secured to the bottom side of the bottom board (see Fig. 8). Position the motor on the opposite side from where the T-nut was placed for the tripod. The flexible shaft that will connect the motor to the drive screw (more on that later) shouldn't be made to bend up too much, so you will have to position the stepper motor a bit lower than the bottom board. Make a spacer out of three 2- × 1½- × ¾-inch wood blocks (cut from some of the scrap wood). Just pile them on top of each other, and secure them to each other with hot glue or epoxy.

Glue the spacer to the bottom board, and drill two small holes on the bottom board, one on each side of the spacer. You can then secure the stepper motor by threading wire through the holes and around the stepper motor. Then just twist and tie the wire. To make the assembly more secure, glue the wire to the spacer and motor.

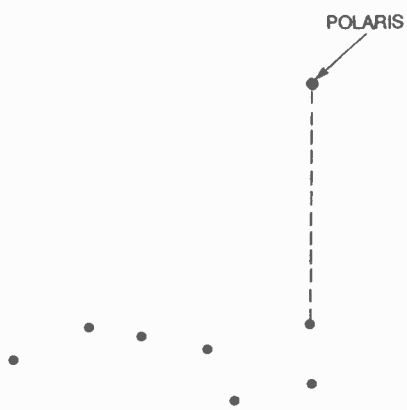


Fig. 8. Finding Polaris is pretty easy. Just follow the line made by the front two stars of the Big Dipper.

All that remains is to attach the flexible shaft. For that you will need two identical couplers, which are available from the source mentioned in the Parts List. They have a ¼-inch-diameter opening on one end, and a 3/16-inch-diameter opening on the other end. Attach the stepper-motor shaft and a 2½-inch-long, ¼-20 driver bolt to the ¼-inch ends of the couplers (you can see the actual assembly in the photo shown at the beginning of this article). The flexible shaft itself has a diameter of about ⅛-inch, so you need to use a small piece of plastic tubing over the shaft to increase its diameter before connecting it to the 3/16-inch ends of the

PARTS LIST FOR THE EQUATORIAL CAMERA MOUNT

SEMICONDUCTORS

U1—555 timer, integrated circuit
U2—UNC5804B stepper controller, integrated circuit
U3—7805 5-volt regulator, integrated circuit

RESISTORS

(All fixed resistors are ¼-watt, 5% units)
R1—10,000-ohm
R2—100,000-ohm
R3—47,000-ohm
R4—100,000-ohm potentiometer, PC-mount

CAPACITORS

C1—1-µF, 16-WVDC, electrolytic
C2—0.022-µF, polyester
C3—100-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

S1, S2—SPDT toggle switch
S3—SPST toggle switch
MOT1—Stepper motor, 24-volt
Printed-circuit materials, 12-volt power supply, wood, hot glue or epoxy, hinges, ¼-20 T-nuts, ¼-20 bolts and wing nuts, L bracket, screws, brackets, flexible shaft, couplers (see text), wire, solder, hardware, etc.

Note: The following are available from Images Company (P.O. Box 140742, Staten Island, NY 10314; Tel. 718-698-8305): UNC-5804B stepper controller—$8.00; stepper motor—$10.00; pre-etched and drilled PC board—$10.00; 2 couplers—$10.00 ($5.00 each); flexible shaft—$5.00. When ordering all items together, the shipping and handling charge is $7.50. For information on shipping charges on individual items, contact the Images Company. New York residents, please add appropriate sales tax.

couplers. In a pinch, wrap a few layers of electrical tape around the flexible shaft to build up the necessary diameter.

The circuit and stepper motor operate from a 12-volt power supply. You can use any 12-volt battery capable of delivering 500 mA. Eight 1.5-volt, "D"-cell batteries strung in series will do the trick. However, the author used an old, 12-volt, lead-acid car battery. Although that is a little more bulky to carry around, it drives the mount for hours and, of course, it is rechargeable.

Alignment and Use. The Equatorial Mount has to be aligned before it is used. First, attach the Mount to the tripod. Then stand to the south of the Mount, and point it due north with its hinges on your left side. The next step is to align the Mount with Polaris; if you don't know where that star is, you can find it by using the pointing stars on the front edge of the Big Dipper (see Fig. 8). Use the tripod to "sight" Polaris along the hinge pins. When the unit is aligned in that way, fasten the tripod head firmly in place.

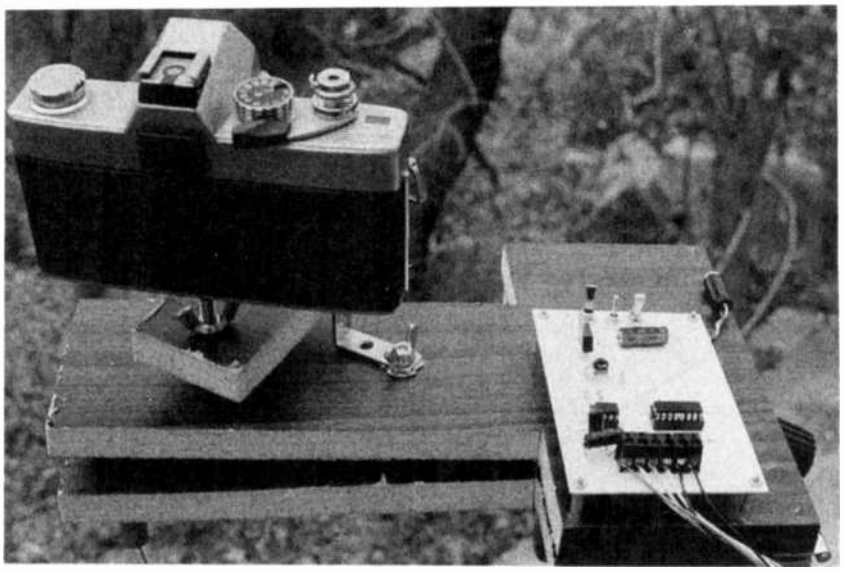
You can put a small-diameter tube along the hinge pins to use as a sighting scope for Polaris. A 2-inch piece of a plastic straw was used on the author's prototype.

At this point, the Equatorial Mount is aligned and you're ready to go. The driver screw should be all the way down (don't bind the drive screw into the wood, leave ⅛-inch clearance). Switch S1 should be set to SLOW, and the direction switch should be set so that the screw will turn counter-clockwise and slowly raise the upper board when the motor is started.

Now, align the camera to any area or star you want to photograph. Then start the stepper motor. The motor will turn the drive screw at one revolution per minute, which will slowly lift the upper board (and camera) in sync with the movement of the stars.

You should start your testing of the Equatorial Mount with exposures of 1 to 10 minutes. Work towards longer exposures as you gain experience. You might also want to try using a telephoto lens on the camera. The mount should be accurate enough to use a 200-mm lens for approximately 30 minutes.

When the exposure is complete, turn off power to the circuit. Reverse the direction using S2, and set S1 to FAST. Then apply power to the circuit again; that will quickly lower the board to reset the Equatorial Mount for another photo.



The circuit board is mounted using four metal spacers.

Some people find that equatorial mounts will track more smoothly with the top board moving downwards instead of up. You could try that with the Equatorial Mount if you'd like. Just make these changes: When you align the unit with Polaris, have the hinge pins to your right. Set the controls to turn the drive screw clockwise, and start the Mount with its boards opened. The boards will then slowly close, following whatever celestial objects you select.

Film Speed and Aperture. There is a large variety of film available. To get the best results, use a fast ASA color print or slide film, like a 1600 or 3200 ASA speed. The aperture setting on the camera controls the amount of light entering the camera. Keep in mind that the smaller the F stop, the more light that enters. You want to set the aperture to its widest opening (lowest stop number), which is usually around 2 or 2.4.

With the camera set at its largest aperture setting, the lens might not produce the sharpest picture. If you get blurry pictures, you might need to close down the aperture to get the sharpest picture possible.

It's a good idea to start each roll of film with a few standard photographs, that way the photo-lab that does the developing will have frame markings to use. Otherwise they might end up inadvertently cutting some pictures in half. Also, tell the photo-lab to print all the pictures. Otherwise, they might take your star photographs as errors and not print them.

Light Pollution. If you live in or near a large city, then you might be a little discouraged by the photos you take with the Mount. That's because of the common problem of light pollution. The author lives in New York City, and the preliminary photos he took of the sky looked like a dirty brown soup with a couple of stars floating in it.

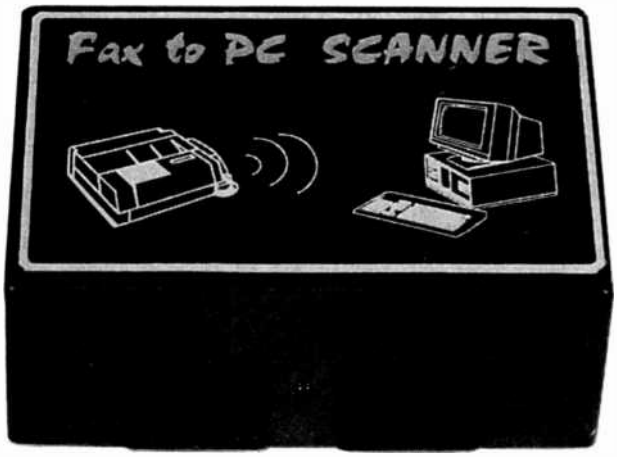
To prevent such disasters from befalling your photos, you have two options: Either take the Mount away from the city lights to take your pictures, or purchase a light-pollution filter. Light-pollution filters are available from most photography-equipment suppliers.

Those filters block out the parts of the visual spectrum that are emitted by street lamps and other artificial light sources. At the same time, they allow the transmission of the rest of the visual spectrum for your exposures.

If you don't want to make the initial investment in a commercial light-pollution filter (they can cost as much as $100) you can try your hand at using an improvised one. Use an extreme red filter, like a #25 or #29 filter. You are restricted to using black and white film with that simple filter, however.

Well, with that said, grab your gear and go get those astrophotos! ■

Build the "Faux-Fax" Scanner



Use an ordinary fax machine as a full-page scanner for your PC.

BY THOMAS E. BLACK

Adding custom black-and-white graphics to your documents is easy if you own a grayscale scanner. However, if you don't have access to a scanner, but do own a fax machine and a computer with a fax/modem, you have another option—just send the photo or document from your fax machine to your computer's fax/modem. Now, ordinarily you'd need two phone lines to accomplish that feat, but even if you had them, you might not want to "tie up" both lines.

So, how can you use your fax machine as a scanner without closing yourself off to communication with the rest of the world? Build the *Faux Fax Scanner* described in this article. It allows you to directly connect your fax machine to your computer's fax/modem. Best of all, it can be built in about an hour, and for less than ten dollars.

Computer Requirements. As mentioned, the Faux Fax Scanner requires that your computer has a fax/modem (internal or external). The computer system used can be an IBM PC (PC/XT/AT or compatible) or an Apple (MAC or equivalent) system. Because most fax machines use the Group-3 signaling standard, your fax/modem should be a Class-2 type in order to support the Group-3 transmission mode.

You will also need a fax-application software package. Usually such a package comes bundled with a fax/modem; if you are using a PC, your software might operate either under DOS or Windows. Some popular fax software packages are *QuickLink II for Windows* and *Winfax*, as well as many others.

The software must have a "manual receive" feature, which might not be available on some fax software programs (if necessary, consult your software supplier for upgrade availability). For example, *QuickLink II for DOS* does not have a manual receive feature, but the Windows version does.

The software must also include a file-export function so that you can convert the received image into a standard file format that is compatible with your word-processing or graphics-editing programs. Typically, fax/modem software will let you convert the received file into the TIFF format, which is compatible with most popular programs.

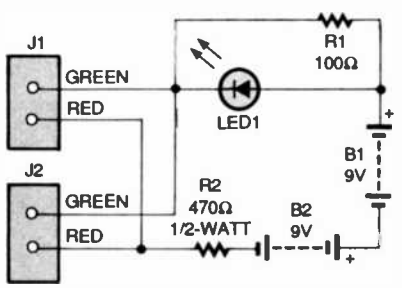


Fig. 1. As this schematic shows, the circuit for the Faux Fax Scanner is incredibly simple. The circuit provides a talk path for any telephone equipment hooked up to the two jacks, letting you connect your fax machine directly to your fax/modem.

Once you have your received image on disk, you can use a graphics-editing program to modify it. For example, most popular editing programs will allow you to reverse the image, remove defects, change the scale factor, and crop the image. Some programs will even allow you to modify the grayscale, which can help improve the appearance of scanned photographs.

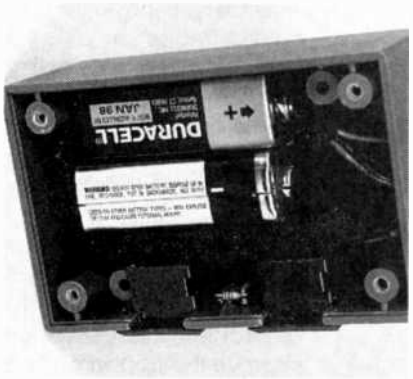
Of course you can omit the graphic-editing step altogether, but for professional results you should consider touching-up your scanned images. My favorite software for that purpose is *Corel PhotoPaint*, but you should experiment to find what program you like best.

Circuit Description. The schematic for the Faux Fax Scanner is shown in Fig. 1. Two 9-volt batteries, B1 and B2, wired in series provide the necessary voltage to simulate a telephone talk path. Current is limited by resistors R1 and R2 (you need not be concerned about damaging your fax machine or modem, because the talk-path current is limited to just a few milliamps).

A typical phone connection is established by modular-telephone-jacks J1 and J2. The unit can not generate a dial tone or ringing voltages, but such features are not necessary to transmit data between your fax machine and fax/modem.

The LED glows when a connected fax machine or PC is in use. An on/off switch is not needed because the only time power is consumed is when your fax machine is actually transmitting to your computer's fax/modem.

Construction. A printed-circuit board is certainly not needed to build this project. In fact, simple point-to-point wiring works great and helps keep the cost low. Another economical step would be to check your junk box for the resistors and LED. If you also happen to have a couple of modular telephone jacks lying around, your Faux Fax Scanner could cost next to nothing.



As shown here, no board was used in the author's prototype.

Start by mounting the two modular jacks to a suitable enclosure (the author used a 3.25- × 2.25- × 1.5-inch case). If necessary, use five-minute epoxy to secure the jacks. The project only uses the jacks' red and green wires, so if your jacks have wires already connected, leave only the red and green ones attached.

Next, mount the LED. You can use either epoxy to hold it in place, or use an LED holder. Trim the LED leads so they are about ¼-inch long. Be sure to note which lead is adjacent to the LED's flat spot (on the lens edge), because that marks the cathode end.

Solder R1 directly to the LED. Be sure to insulate the resistor's leads using heatshrink tubing or an equivalent material. Solder both green wires from the modular jacks to the cathode end of the LED.

You will need two battery snaps with leads. Solder the anode lead of the LED to the red (positive lead) of one of the battery-snap connectors. Then solder the black (negative) lead of that battery snap to the red lead of the other battery holder.

Solder both red wires from the modular jacks to one end of R2. Next, solder the other end of that resistor to the remaining black wire of the battery connector. Insulate all solder connections to prevent accidental shorts.

Note that it is not necessary to actually mount the components to a circuit board, because the LED and two jacks are mounted to the enclosure. Just mount the two resistors to the inside of the case with a bit of epoxy, and your circuit is secure.

Install a fresh set of 9-volt alkaline batteries and screw the lid onto the enclosure. A piece of padding or double sided tape on the batteries will prevent them from rattling around.

Checkout. Plug a pair of telephones into the modular jacks. You should see the LED glow only if a phone is off-hook. If the LED does not glow, there might be some kind of wiring error. Of course if the batteries need to be replaced, the LED will no longer light up either, so make sure the batteries in the unit are fresh.

You should be able to talk on the connected phones and hear high-quality speech. Do not be concerned if the phone's dial-pad does not work; the available current might not be high enough to reliably operate some electronic phones. If you experience problems and have verified that the adapter is wired correctly, then try different phones. Western Electric 500 or 2500 series desk phones are considered an industry standard and will work as test phones if your project is assembled correctly.

Using the Scanner. Because the Faux Fax Scanner only provides a talk path and can not ring up the fax/modem, you will have to rely on a simple, manual, send/receive technique to transmit data.

PARTS LIST FOR THE FAUX FAX SCANNER

LED1—Light-emitting diode, green
R1—100-ohm, ¼-watt, 5% resistor
R2—470-ohm, ½-watt, 5% resistor
J1, J2—Modular telephone jack, RJ11-type
B1, B2—9-volt alkaline battery
Battery-snap connectors (2), plastic enclosure, telephone cords (2), wire, solder, hardware, etc.

Start out by connecting your fax machine and fax/modem to the unit using telephone cords. The circuit is bi-directional, so it does not matter which jack you use for either of the two devices.

Next, prepare your computer by starting up your fax/modem application software. Do not select any operating modes at this time. Insert the document you wish to scan into the fax machine. Set the fax machine's resolution to its grayscale "photo" mode if you are scanning a B/W photo or drawing. Use the machine's "super fine" resolution if you are scanning text or a non-grayscaled image. Note that both of those modes can take several minutes to send a single page.

Then, lift the handset of your fax machine and press its Start (send) button. The fax machine is now in the manual send mode; you should see the adapter's LED light up. Most fax machines require that you hang up the handset at this time.

Immediately choose the manual receive feature in your PC's fax software program. You must perform this step before the fax machine times-out (about 30–60 seconds). Your image is now being scanned. The image will be ready as soon as the LED on the Faux Fax Scanner goes out.

Fax-Resolution Information. Some fax machines can transmit fairly high resolutions (about 200 dpi), and most can support 16 grayscale levels (some as high as 64). As you can see, the quality you can expect depends on the fax machine that you use as the page scanner.

So how do the scans look when they are done? A sample is shown in Fig. 2. In many cases, the results look as good as from an expensive page scanner! ■

Fig. 2. This familiar portrait of President Washington should give you an idea of the type of output you can expect from your Faux Fax Scanner setup.

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Using a Spectrum Analyzer

Use a spectrum analyzer and "see" the presence of signals.

BY BILL CLARKE

About 35 years ago I was introduced to the fine art of radio-signal analysis using a spectrum-display unit (SDU), commonly referred to as a "Spectrum Analyzer." Such a device resembles an oscilloscope, with the horizontal scale indicating the frequency and the vertical scale showing the relative signal strength of all signals along the display range. Some units have screen displays as large as a computer monitor, while others are smaller. Modern portable units have LCD displays.

When I was operating a spectrum display back in those days, I was searching for clandestine military-aircraft operations, where the basic band of frequencies was known, but not the exact operating frequency. A tour of duty consisted of mind-numbing and eye-burning staring at the spectrum-display screen, watching for signals to pop up where there should not have been any. When I saw a signal (called a spike), we would take a photo of the screen for later analysis, and then attempt to tune a separate receiver to the frequency, which could be interpreted from the location of the spike on the screen (as read from a grid scale that was located on the screen's face).

If the transmission was of a long enough duration, we could often successfully tune a receiver and record the transmission. If not, the receiver would have to be set close to the unknown frequency and the waiting game restarted.

SDUs Today. Modern equipment now consists of SDUs that indicate on-screen the exact frequencies of spikes, along with other data such as relative signal strength. Those displays also have receivers slaved to them, which allows for instant signal monitoring. Of course that modern equipment is great to use, but it is costly. Typical government equipment falls in the price range of $30,000 to $100,000 per unit—not exactly what a hobbyist would generally spend on something for a radio shack.

Luckily there are affordable, receiver-controlling SDUs with LCD readouts. Such SDUs make modern spectrum analysis a reality for the professional technician and the hobbyist. We'll look at a particular one later on in the article.

But why should one perform spectrum analysis? Generally, searches are made either for a single signal (or group of like signals), a stretch of heavily or sparsely used spectrum, or for signs of unusual propagation-related activity. Let's take a look at how such a search can be accomplished.

Public Service Searches. Ask any scanner user and you will quickly be told that not all public-safety radio communications take place on published frequencies. It is not unusual for police departments to use unlisted frequencies as tactical or special-purpose channels. For example, a police department might use a frequency licensed to another agency (highway, water, etc.) within their jurisdiction for a drug task force's use. The only indication of such a channel heard on the scanner tuned to the published dispatcher's frequency might be a phrase instructing a unit to switch to the special channel.

If the scanner user was viewing a spectrum display at the time that phrase was heard, it would be possible to see a spike indicating communications on another frequency that was timed with the approximate dispatcher announcement. Using a "grab," a means of locking onto a specific spike, it would be possible to change the receiver's frequency and monitor the communications. If that turns out to be the channel sought, the frequency is displayed on the spectrum-display unit's screen and

The AOR SDU-5000A Spectrum-Display Unit is shown here with its slave all-band receiver, the AOR-3000A. The combination provides excellent performance at an affordable price.

The two AOR units make a small operating package and could easily be used portably out of a large brief case.

the receiver's readout. It can then be entered into a log or the receiver/scanner memory, as appropriate.

A similar scenario applies to rescue-squad frequencies. Often you will hear the dispatcher assign a channel or frequency number to a specific vehicle on, or going to, the scene. That frequency is where talk between the EMTs and the hospital will take place. If you don't have the frequency, the spectrum-display unit can be used as in the previous example.

The process of "spike and grab" just described is made easier when an SDU with a slaved receiver is used, because the operator can select frequencies based upon the displayed spikes and directly control the receiver. It is a fast and accurate way to search for a single signal or a group of like signals.

A Repeater-Operator Aid. There are a number of problems facing today's commercial- or amateur-repeater operator. Probably the biggest difficulty encountered is interference from other radio signals, either in the form of intermodulation or direct nearby-channel interference.

Using an SDU allows an operator to examine the immediate nearby portion of the band for signals that might be interfering with repeater operation. While you monitor the repeater, spikes are grabbed and tuned whenever interference is noted, allowing the offending signals to be identified.

Finding Scattered Activity. Often a band is known to be used; however, the activity is so spread out that it is difficult to find any signals. An example of that is the 118- to 136-MHz aviation band.

Most aviation transmissions are relatively short, so that an operator will miss them if he or she isn't on the exact frequency at the exact time the transmission(s) are made. Using an SDU, an operator can visually see the spikes for each of those speedy transmissions, and can tune the receiver using the spike and grab manner discussed earlier.

Ham Operators. The most common use of an SDU for ham-radio operators is a quick examination of a band to see if it is open. In other words, is there propagation supporting communication activity? That is extremely important for the DX operator, and more so during the current low portion of the sun-spot cycle.

With only a receiver, the operator must change to the band in question and manually tune through it to determine if there is activity, and if so, what frequency it's on. With the use of an SDU, the operator inputs the center frequency of the band to be examined and watches the display for spikes indicating signals. An advantage of that method is that the larger the spike the stronger the signal.

The AOR Spectrum-Display Unit. For the purposes of this article, I used the AOR SDU-5000A Spectrum-Display Unit connected to the AOR-3000A all-band receiver (which acts as a slave). I used that setup for HF, VHF, and UHF studies (frequency coverage of the AOR-3000A is 100 kHz to 2036 MHz). The equipment combination provides an excellent level of results at an affordable price—around $2000.

The setup just described provides a level of capability that even professionals did not have just a few years ago. The two units make a small operating package and could easily be used on-the-go out of a large brief case, with power being supplied by batteries.

The AOR SDU-5000A has an LCD color display, measuring about 3 × 3 inches, with easy operator control of brightness and contrast. Its center frequency is pushbutton selectable and is always indicated on the display; that setting can be scrolled up or down in operator-selected size steps. The receiver, being slaved, follows as the displayed frequency changes. The scanwidth of the displayed spectrum is selectable from 1 kHz to 10 MHz.

A panel-controlled marker can be moved from spike-to-spike in signal-strength order or manually. When selected, the marker will set the slave receiver to the frequency of the spike indicated.

Another feature of the SDU-5000A is its monitor output; a PAL or NTSC composite monitor can be connected to that when a larger display is desired. That output could also be fed to a VCR.

The AOR Spectrum-Display Unit is also available in versions to work directly with certain ICOM receivers. AOR products are distributed by EDCO (323 Mill Street, NE, Vienna, VA 22180) and are available through most shortwave and scanner dealers. Contact your favorite dealer for current product information, pricing, and availability. ■

By Jeff Holtzman

System Resource Management

System resources in today's PCs must be managed carefully. Without careful resource management, your system might not operate optimally; it might be unstable, mysteriously crashing at inopportune moments, or it might not operate at all.

That could soon change. A recent initiative by Microsoft and Intel, called Plug-n-Play (PnP), aims at automating much of the system configuration process. But PnP will only work in a completely automatic way with new systems that contain a PnP BIOS, a PnP operating system (primarily Windows 95 at this point), and PnP expansion cards and peripherals.

In the absence of total PnP support, tracking resources manually is the only way. However, with a clear understanding of what resources are required, used, and available, performing maintenance and installing upgrades can be a quick and efficient process, guaranteed to impress family and friends.

System Resource Configuration

Device	DMA	I/O	IRQ	Memory
COM1				
COM2				
LPT1				
LPT2				
Network				
Sound (DOS)				
Sound (Win)				
Game				
SCSI				
Scanner				

Notes

Fig. 1. Track system resource usage easily by printing a table on a 3 × 5 Post-It and affixing it to the back of each PC. Update the table whenever you perform system maintenance or upgrades, and relieve a big headache.

RESOURCE TYPES

There are four types of resources that must be tracked: DMA channels, I/O ports, IRQ lines, and physical memory address ranges. DMA stands for Direct Memory Access. The purpose of DMA is to allow peripheral devices, such as disk controllers, optical scanners, sound cards, and network interface cards, to read and write main memory directly, without help from the CPU. That allows the CPU to do other things in the meantime, and helps increase overall system throughput.

The CPU uses I/O ports to communicate with nearly all peripheral devices. That includes all those just mentioned, as well as serial, parallel, and game ports.

IRQ lines allow peripheral devices to issue an interrupt request (hence the name) to the main CPU. When an IRQ occurs, the CPU stops what it is doing, services the device that caused the interrupt, and then returns to its original task. The system uses IRQs for all sorts of tasks, ranging from hardware timing to serial-port management and more.

Physical-memory address ranges contain normal RAM and ROM. Some devices have fixed ROM addresses. For example, the system BIOS usually (but not always!) occupies the upper 64K of the first megabyte of memory, from F000:0000 to F000:FFFF. Video adapters typically occupy 32K of space at C000:0000 to C000:7FFF. Finally, hard-disk adapters often occupy 16K of space at C800:0000 to CBFF:000. There are exceptions to all those rules; you absolutely must check your system documentation to be certain!

There are eight DMA channels, 64K of I/O ports, 16 IRQ lines, and potentially 4GB of address space to keep track of. However, not all of each type of resource is available for general-purpose use. For example, DMA channel 0 is used by the system's DRAM-refresh circuitry, and channel 3 by the floppy-disk controller. For detailed information on other pre-assigned system resources, I highly recommend a small but dense little book, *The XT-AT Handbook Fifth Edition (1995)* by John P. Choisser and John O. Foster (Annabooks, 11838 Bernardo Plaza Court, San Diego, CA 92128-2414) ISBN: 0-929392-26-4. There are few true bargains in life, but $10 for this book is one.

A SIMPLE SYSTEM

Through years of hard experience, I've found that it's best to keep an explicit list

of system resources used by a computer on a sticker taped to the back or side of the machine. To simplify the process and make record keeping somewhat consistent, I created a document in my word processor that I can print at any time. The document, which is shown in Fig. 1, contains a simple table listing resource types in the columns, and actual devices in the rows. Documenting system resource usage is then as simple as filling in a few blanks. The table contains predefined rows for common devices such as COM ports, printer ports, and so on. It also contains half a dozen rows for custom devices.

There are a couple of tricks that make the process particularly nice. One is that I print the table directly on a 3- × 5-inch *Post-It* sticker, which can then be transferred easily to the machine itself. To do so, first I print the table on a normal 8.5- × 11-inch piece of paper. Then I peel a Post-It from the pad, and overlay it exactly over the table as printed on the paper. Then I print another copy of the document and run the same sheet of paper through the printer again. *Voila*: a perfectly aligned system configuration resource table, ready to go whenever you need it.

Okay, it's not the highest-tech solution, but it's simple, it works on every machine from my oldest XT to the latest and greatest, and it is convenient enough that I actually use it! If you would like to give it a try for yourself, you can get a copy of my system resource table in Word for Windows 6.0 format from the Gernsback BBS (516-293-2283); look for file SYSRESMG.DOC. ■

ANTIQUE RADIO

By Marc Ellis

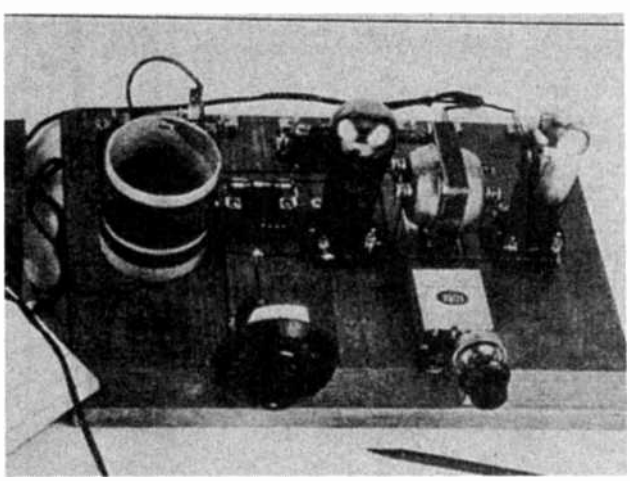
Building a Starter Ham Receiver—1930 Style

Back in 1930, as today, the American Radio Relay League (ARRL) was a highly influential, national organization for amateur-radio operators. Besides voicing the interests of the radio amateur in the halls of Congress, the ARRL vigorously promotes the use of cutting-edge technology and operating techniques in the amateur-radio community. But the organization has also sought to keep the hobby a dynamic and growing one by encouraging new and prospective hams.

Among its many reference books and texts, the ARRL has always included several aimed specifically at the newcomer. One of those, *How To Become a Radio Amateur*, was published for decades—going through many editions—until superseded by other publications in the 1970s or 1980s. The mission of the book was to assist the newcomer in qualifying for a ham license and to guide him or her in putting together a first, basic station.

The 1930 edition of *How to Become a Radio Amateur* included a simple 2-tube regenerative receiver covering the 80- and 160-meter ham bands. That has to have been one of the most popular starter shortwave sets ever introduced. It was most certainly built and used by thousands of hams—both new and experienced.

Because of its simple construction and the fact that it coula be built using parts cannibalized from obsolete, battery broadcast receivers, the radio was quite easy on the pocketbook. That was quite an important consideration during those cash-starved depression years.



A receiver from the 1930 edition of the ARRL's How To Become A Radio Amateur. *Note the bracket-mounted controls (tuning at left, regeneration at right). The grid-leak assembly is behind the tuning control, between the coil and the detector tube.*

THE SET'S LONG HISTORY

The 1930 *How To Become a Radio Amateur* set used two 01-A tubes configured, respectively, as a regenerative detector and audio amplifier (see schematic). Coil "L1–L2" is actually a single 160-meter coil, close-wound on a cardboard form and tapped for a ground connection. Not shown in the schematic, but detailed in the accompanying text, is another tap for operation on the 80-meter band. Wound separately on the same form is the "tickler" coil, L3, which is used to obtain regeneration.

The 1928 edition of *The Radio Amateur's Handbook*, another ARRL publication, showed a predecessor of the 1930 circuit (also using 01-As) that was similar in design but employed a series of plug-in coils to achieve wider frequency coverage. Those were free-standing (no form) coils made on a jig, and look like they'd be quite annoying to construct. You had your choice between basket-wave or space-wound styles.

I've seen spinoffs of the 1928 and 1930 sets—sometimes credited to the ARRL and sometimes not—in shortwave "how to" manuals published as late as 1940. The later sets tended to use plug-in coils, and generally substituted the type-30 tube (a triode introduced for use in farm sets operating from 2-volt wet cells) instead of the archaic 01-A.

The influence of the 1928–1930 design is also evident in the 2-tube regenerative starter set included in the fifteenth edition (1956) of *How To Become A Radio Amateur*, though the radio used 6AQ5 beam power tubes rather than 01-As or type 30 triodes.

It's not surprising that the 1956 construction article included a disclaimer. Pointing out that the radio was regenerative, a design long-ago rendered obsolete by the superheterodyne, it continued: "... Nevertheless, the regenerative receiver represents a very worthwhile project for the beginning amateur because good sensitivity is obtained with simple circuit and construction ...."

However, even the 1930 article had to acknowledge that it was an old design! "Some of our readers may notice that the circuit is simply the old familiar 'three-circuit' tuner so commonly built by broadcast listeners in the early days of broadcasting. Do not think, for this reason, that it is not a particularly good amateur receiver. It may surprise you to know that this tuner, with occasional slight modification, is used in probably 90% of the amateur stations in this country ... ."

We have to go back to the 1928 article for a guilt-free introduction to this venerable circuit: "A regenerative-detector circuit and one stage of audio amplification is practically standard for short-wave work. A couple of UX-201-A (C-301-A) make the best set ... ."

For those not familiar with early nomenclature, both of the tube types mentioned are 01-As—the first made by RCA and the second by Cunningham. Tube designations were simplified in the early 1930s, with the deletion of codes indicating manufacturer and base style.

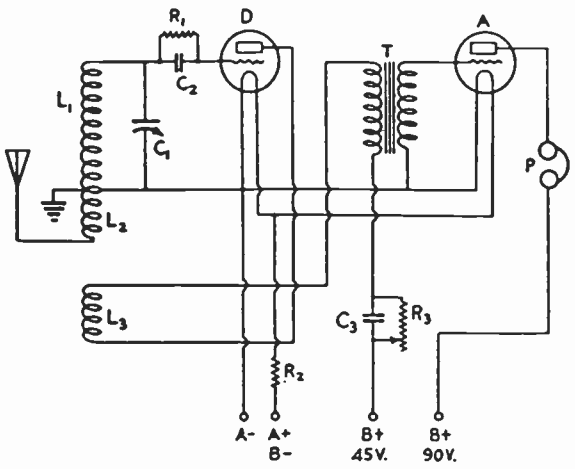
The 1928 intro goes on to say that the "new" UX-200-A (otherwise known as the 00-A), which is a "soft" (low vacuum) tube, makes a sensitive detector of weak signals because it will oscillate at a low voltage on short wavelengths. However, it also points out there might also be an objectionable hissing noise. The 00-A is a fairly rare tube, but I think I have one and am looking forward to comparing its performance as a detector to that of the 01-A.

BUILDING A REPLICA

I felt that building a replica of the ARRL shortwave starter set would be a great project for the column and, without much hesitation, decided to tackle the 1930 version. The 1930 set has a lower parts count and simpler coil construction than the earlier or later versions. Besides using more parts, the newer sets tend to use components, or component values, not found in the old "three dialer" broadcast radios—and hence harder to come by.

Those of you who followed the construction of the NBS crystal radio replica in an earlier series of *Antique Radio* columns know that I've never been guilty of doing things the hard way if an easier way existed! Of course, if it's easier for me, it should also be easier for those of you who would also like to build one. But, unless you are in an experimental frame of mind, I'd advise you not to build yours until I complete and test mine. That way you'll be less likely to fall into any pitfalls I might encounter.

Some of the problems I expect to have to deal with relate to the coil. In the first place, I want to modify its frequency coverage, making the set tune 80 and 40 meters rather than 160 and 80 meters. There will then be more stations (ham and commercial) for us to listen



The schematic diagram of the 1930 set. The tap for bandswitching (see text) is not shown.

to. That's an important advantage in view of the fact that we'll have only the one permanently-installed coil instead of a series of plug-in ones.

Second, the double cotton-covered wire specified is all but unobtainable now, and I'll undoubtedly be substituting enamel-covered magnet wire. That is likely to affect the frequency coverage of the radio (it did with the NBS set built earlier), and I might have to rewind the coil with a different number of turns.

CIRCUIT ANALYSIS

Looking at the diagram again, you'll note that the signal flows from antenna to ground through the short (L2) section of coil L1–L2 but that the tuning capacitor and detector tube are connected across the longer (L1) section. The resulting transformer action makes the signal voltage at the detector tube larger than that between antenna and ground, effectively amplifying the received signal.

Components R1 and C2 are in the familiar "grid leak detector" configuration as used by DeForest in his original Audion circuit and employed in almost all receivers for many years thereafter. The presence of L3 tells us that this detector also has *regeneration*, which is an improvement to the grid leak detector invented by Edwin Armstrong in 1914.

Part of the energy in the plate circuit of the detector tube (labeled "D") is coupled back into coil L1–L2 (and hence into the grid circuit of the detector tube) via "tickler" coil L3. Thus the same signal passes through the tube over and over again and is amplified more with each pass—greatly improving the performance of the detector. Rheostat R3 controls the degree of regeneration so that it can be adjusted for maximum effect.

Transformer "T" steps up the signal from the detector plate and couples it to the grid of the audio-amplifier tube ("A"). After passing through "A," the signals are loud enough to be comfortably heard in the headphones ("P"), which are in the tube's plate circuit.

R2 represents a "Lynch equalizer," which was a specialized resistor designed to keep the filaments at constant voltage as battery voltage declined. However, that function can also be performed manually by substituting the more conventional rheostat for R2 and—not having an equalizer at hand—that's what I plan to do.

The receiver is intended to be powered by batteries (6 volts to light the filaments, 45 volts for the detector plate, and 90 volts for the amplifier plate). Those are connected to the receiver via the terminals labeled A–, A+/B–, B+45V and B+90V.

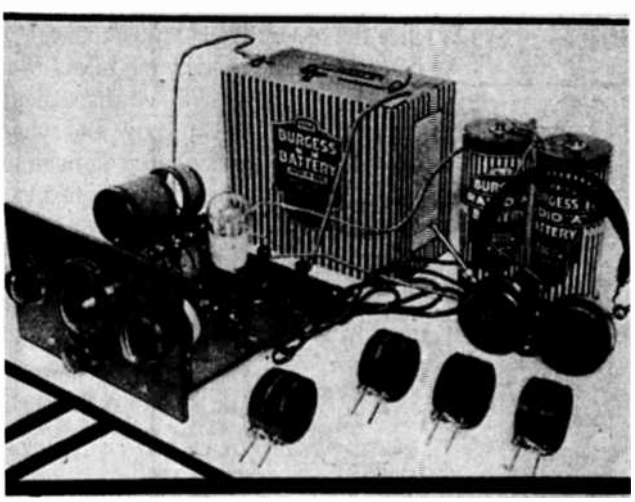
CONSTRUCTION STYLE

The set is constructed on a 10- × 14-inch board, representing half of a standard-sized breadboard of the era. What's a breadboard? Think back and you might remember having seen your grandma use one to roll out dough. The other half of the breadboard was set aside for later construction of the accompanying transmitter. I might look around for a real breadboard, just to be authentic. But if I have the slightest difficulty in finding one, I won't hesitate to substitute a piece of knot-free pine lumber cut to the appropriate dimensions.

The construction specifications suggest that the controls (tuning, regeneration, and—in my case—filament voltage) be mounted on metal angle brackets fastened to the top of the breadboard or on small sections of panel attached to the front edge of it. I'd rather not have to fabricate the brackets, and I think the individual panels would be messy looking. I'm planning to install a one-piece panel over the entire front of the board, probably using the black Lucite material (which closely resembles old-time Bakelite) available from Antique Electronic Supply.

As to the wiring, I'll keep it authentic by using heavy insulated bus-bar running parallel to the edges of the board and, of course, making perfect right-angle turns. AES is helpful here, too, stocking both appropriate bus-bar and authentic-looking black spaghetti insulation. If you don't have the very useful AES catalogue, by the way, write for a free one: Antique Electronic Supply, 6221 S. Maple Ave., Tempe, AZ 85283.

That's all the space for this time. See you again next month, when the project will continue. ■



This 1940 spinoff of the ARRL starter shortwave radio has type-30 tubes, a Bakelite front panel, and plug-in coils.

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THINK TANK

By John J. Yacono
Technical Editor
Windows Magazine

Circuits of Yore

I really did it this time. By the time I finished with all this month's letters and artwork, I ran out of space and time for my tutorial. Oh well, we'll pick it up again next month. But now, let's look at letters that deal with comments and revisions to circuits gone by, starting with some comments from a disgruntled "critic."

PAN MAIL

This is just a short note to let you know that Dwight Eggleston is correct on all counts in his evaluation of the Walkman amp circuit (see Fig. 1) presented in the July 1995 issue. Your explanations show either a great sense of humor or an abysmal lack of knowledge of elementary electronics. But don't take my word for it, build it and see.

By the way, I have been convinced for years that there is a group of engineers who send nonfunctional circuits to *Think Tank* just to laugh at you when you unwittingly publish them.

—Michael Eck, Martinsville, NJ

Thanks for keeping it short. As it turns out, I do have a good sense of humor. To prove it, I'll follow your letter with one that I received from a possible "conspirator."

THE LITTLE AMP THAT CAN

I am writing about the explanation of the Walkman amp in *Think Tank*, **Popular Electronics**, July 1995 . First, the output level of the Q1 is important, if it is wrongly set the amplified signal will be distorted.

Second, Q1 and Q2 do have a bias: The base/collector-leakage current flows also from the base to the emitter and is amplified that way. That can be easily demonstrated with germanium transistors: Connect a voltage across the emitter and collector and measure the current. It will be about 50 to 100 µA when the base is floating. Connect the base to the emitter and the current will be reduced to about 10 µA. In that situation you are measuring only the collector/base leakage. I tried that with a 2N3904 and I could not measure anything; the currents were well below 1 µA. Silicon transistors have a very low leakage. I suspect Q2 (2N31A) is a germanium transistor, giving a higher bias as it would be needed to handle the amplified signal fram Q1.

Third, the time constant of R1 and C5 is 1 millisecond, thus suppressing frequencies obove 1 kHz. With good reason, the signal amplified by Q1 is in all likelihood very distorted because Q1 is operating at an extremely low bias. Replacing Q1 with a germanium transistor would help, or one could connect the base of Q1 with a 1- or 2-megohm resistor to the positive voltage.

Finally, a very long time ago, I built a circuit like this to amplify my "cat's whisker" radio. I used germanium transistors and, of course, it worked just fine.

—Otto Baade, Minneapolis, MN

Thank you for your truly insightful analysis. I agree with all your points, but let me just clarify my old expla-

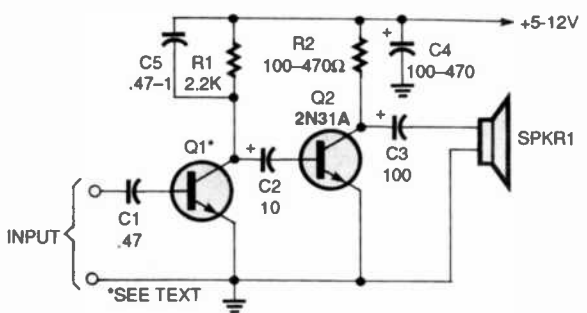

Fig. 1. If a down and dirty audio amp is what you need, try this miniature unit. Among other things, it can be used to boost the output of an earphone for the hearing impaired. Just be sure to use germanium transistors for Q1 and Q2.

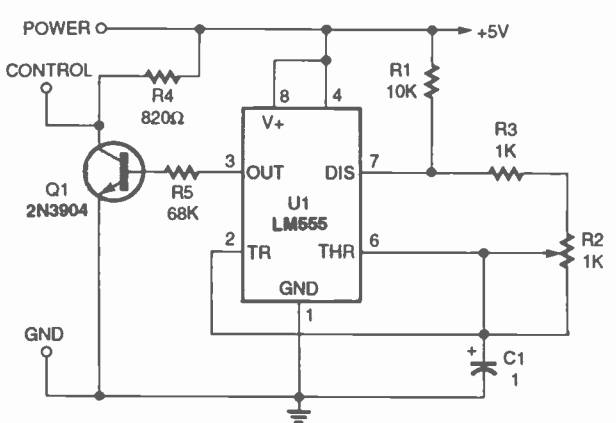

Fig. 2. These servo drivers connect to a servo's three terminals (power, control, and ground) to control it throughout a 90-degree rotation.

nation. When I said the output level of Q1 wasn't important, I was talking about its DC level, not amplitude. I agree the transistors need and have bias current, I only said they required no biasing network. Finally, you hit the nail on the head when you said Q1 and Q2 are germanium transistors. The schematic I received did not have a label for Q1 and, in a rush, I scribbled down a silicon part number.

I think you might be the only reader that wasn't thrown by my error. Thanks again.

RC FUN

Great column you have (*Think Tank*) for us experimenter types. I am into radio-controlled aircraft, and find your column very helpful when I want to put an idea to use in one of my planes.

The October 1994 *Think Tank* was devoted to Hobby Circuits (I love to see that stuff). One circuit was of a servo driver. I couldn't get it to work, however, until I swapped pins 2 and 3 (see Fig. 2). Was there an error in the drawing of the 555?

The servos I'm using are a Futaba 148 and an RCD Hitec Apollo 10. Those servos seem to operate like you had intended, sweeping through a 90° arc, but are sluggish. Servo torque is way down. When I measured the signal voltage I found it to be less than a volt. But when I measured it from my receiver, I found it to be about 4 volts.

How could I change this circuit to truly drive a servo to its torque rating? I would like to install this device, controlled by a switch, in a plane on the throttle servo, to help warm up the engine. The switch would make it so I wouldn't have to turn on my transmitter.

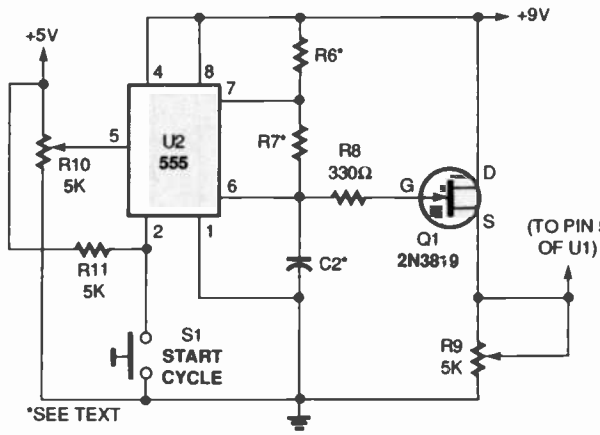

Fig. 3. This circuit should sweep the circuits in Fig. 2, causing the servo to rotate and return.

Also, is it possible to modify the circuit so that when power is applied it will operate the servo from one extreme to the other with a travel time of about 15 or 20 seconds, and then return to its start position? That would allow the engine to run through its RPM range and return to idle.

I feel that would be a great safety feature for myself and the other club members. It never fails, every year someone turns a transmitter on when they shouldn't. Your help will be greatly appreciated, and I will look forward to reading your column; keep up the good work.

—*Carmen Florio, Prescott, Ontario, Canada*

I'm very glad to be of service. You're right about the pins. The labels were swapped when the artwork was redrawn for publication. Sorry.

Your circuit request is a tall order to fill, but I can point you in the right direction. Pin 5 of the 555 can be used to modulate the high time of the pulse at pin 3. By supplying that pin with a varying voltage, you can vary the position of the servo. A voltage signal tapped off a timing capacitor in another 555 circuit (see Fig. 3) set up to only charge and discharge once might just do the trick. Use R10 to set the maximum voltage provided by the circuit; use R9 to set the minimum.

One sticky detail is the value of C2. For the cycle duration you want, you'll have to use a leaky electrolytic. Try to keep the cycle time as low as possible to minimize the effects of leakage current. With that in mind, you'll also have to choose the values of R6 and R7 to give you the timing you want with R10 set appropriately.

REVISED LOCK

This is in regards to Mr. Chieh's "Simplified Digital Lock"in the April 1995 *Think Tank*. I made the change you suggested, using one resistor to return to the gate of the BS170 (see Fig. 4). I got more reliable operation by using a 22k resistor (R6) for that job. Also, I changed R2 from 220k to 100k.

I found that if you use a number twice in a sequence they have to be decoupled by a diode as shown, otherwise the Q-output that should go high is being held low by the sec-

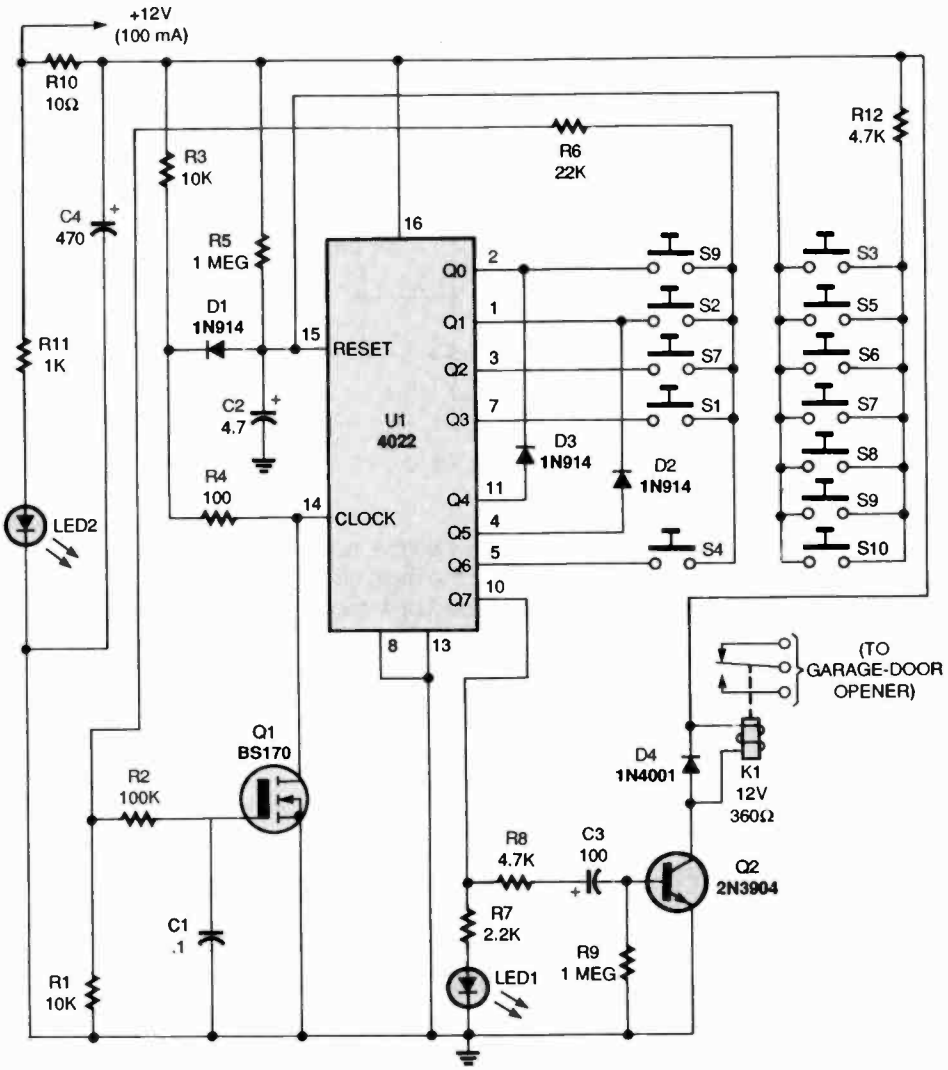

Fig. 4. Here's a one-IC answer to your digital lock needs. The circuit will not activate a lock unless it receives the correct 7-digit code.

ond same number in your code sequence.

By using a smaller capacitor, C2, at the reset pin, you must key-in your correct sequence code in a shorter time frame. Shown also is the circuit I attached to pin 10 (the Q7 output) of the 4022. It operates my garage-door opener. With the values shown, the relay will close for approximately one second.

I used the unused keys on the pad as a return to reset pin 15. That narrows the chance of trying to figure out the correct code to open the lock. Incidentally, the code for the setup in Fig. 4 is 9271924.

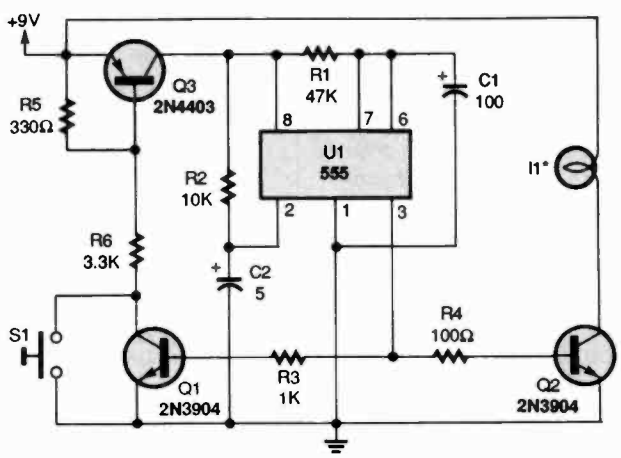

Fig. 5. If you've banged one of your big toes on the dresser enough times to form it into a ping-pong ball shape, then this circuit can at least save your other big toe from the same fate.

I added LED1 to indicate the Q7 output as I was wiring the circuit; LED2 was mounted on the keyboard location to indicate that the circuit is powered up. I found the best supply voltage to be anywhere from 12.5- to 16-volts DC.

—Roger W. Hamel, Cedarville, MI

Thanks for giving my idea a whirl. By the way, Roger needs an inexpensive circuit to convert the matrix (row and column) output of a phone keypad into 12 discrete outputs. I sat and thought about it for a while, but didn't come up with anything worth committing to paper. Anybody out there have any ideas?

REVAMPED NIGHTLIGHT

After seeing the "Timed Night Light" circuit by J. dePrisco in *Think Tank*, October 1991, I thought that removing the relay would increase battery life. This is the circuit I came up with (see Fig. 5). By using a transistor instead of a relay, the use of multiple poles for other items is obviously out of the question. In this version, pushbutton S1 turns on Q3, which supplies power only to the 555. After releasing the button, transistor Q1 keeps power applied to the circuit. Note that power for the type-47 lamp comes directly from the battery and not through the 2N4403. In the relay version, lamp power came through the relay.

—Dennis Hewett, Pittsburgh, KS

Definitely some worthwhile changes. A 9-volt NiCd battery connected via a jack to a wall transformer could keep this circuit at the ready for a power outage.

That's all for now. If you'd like your work to be included here too, write to *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

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CIRCUIT CIRCUS

Charles D. Rakes

Some LED Fun

Welcome fellow circuiteers! In this month's visit we are going to have some fun and light up a number of LEDs.

Not too long ago, I was asked, by a young fellow just getting into electronics, how to determine the value of the resistor that's connected between an LED and its power source. He became somewhat confused after looking over several circuits that operated from similar supply voltages, but used different valued resistors in series with the LED. Some of the circuits operated with resistor values as low as 100 ohms, while others used values as high as 4700 ohms.

Let's see if we can help our young friend unravel his resistor dilemma by taking a look at the simple LED circuit shown in Fig. 1. Of course, before we can determine the resistor value

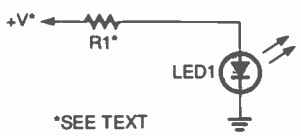

Fig. 1. The purpose of R1 is to limit the current the LED sees to a safe level. Its value is determined by the supply voltage, the LED's forward voltage drop, and the desired current through the LED.

needed for that or any circuit design, we must know several facts about the LED and the circuit in which it is used.

The forward voltage drop that occurs across an LED while operating can vary from about 1.75 to 2.8 volts. The exact voltage drop for a particular unit can usually be found in the specification data supplied by the manufacturer. But if you're using surplus or grab-bag LEDs, the forward voltage drop is likely to be unknown. While the drop can be found by supplying a 20-mA current through the device and measuring the voltage drop across it, in most cases the LED's average forward voltage drop is about 2 volts, and that value can almost always be used to determine the proper value for the series current-limiting resistor (although, due to their chemical make up, blue LEDs have a much higher forward voltage drop).

Here's how that's done: Subtract the forward voltage drop (2 volts) from the supply voltage and divide the desired LED current into that voltage. In other words, R1 = (supply voltage − 2)/I. If the calculated resistance is not a standard 5% value, select the next higher standard resistor value for R1. As an example, if the supply voltage is 9 and the current is 20 mA, the calculated value is 350 ohms, and a 360-ohm resistor should be used.

Note that any number of

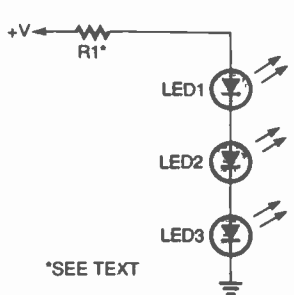

Fig. 2. A single current-limiting resistor can be used to feed several LEDs in series.

similar LEDs may be connected in series, as shown in Fig. 2, and operated from a single supply with a shared current-limiting resistor. To calculate the needed current-limiting resistance, just add together each LED's forward voltage drop, subtract the total from the supply voltage, and divide the resulting voltage by the desired LED current.

LED CONSTANT-CURRENT SOURCE

Our next entry, see Fig. 3, solves the current-versus-operating-voltage problem by turning a 7805 voltage-regulator IC into a constant-current source. As long as the supply voltage is greater than 8 volts and less than 24 volts, the LED will always see the same current and will shine at the

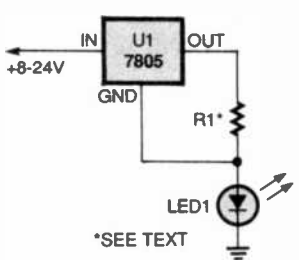

Fig. 3. This setup ensures that the LED will glow with equal brightness as long as the input voltage remains between 8 and 24 volts.

same brilliance. To figure R1's value, divide the IC's regulated output voltage (5 volts) by the LED's operating current. That's R1 = 5/I.

The constant-current circuit could also be used in measuring an LED's forward voltage drop. Set the circuit up for the desired test current (that is, select the appropriate value for R1)

PARTS LIST FOR THE CONSTANT-CURRENT SOURCE (Fig. 3)

U1—7805 5-volt regulator, integrated circuit
LED1—Light-emitting diode, any color
R1—See text
Wire, solder, etc.

and measure the voltage drop across the LED under test.

LED PILOT LAMP

Our next circuit (Fig. 4) places an LED in an AC circuit where it operates as a pilot lamp. The capacitor value sets the LED's current. For 120-volt AC operation, a 0.1-µF, 400-volt capacitor

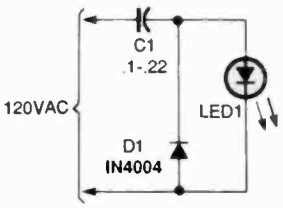

Fig. 4. Who needs a neon lamp? This circuit will let an LED function as a pilot lamp in an AC circuit.

will result in a 5- to 10-mA current, and a 0.22-µF unit will produce approximately 20 mA of current.

PARTS LIST FOR THE LED PILOT LAMP (Fig. 4)

D1—1N4004 silicon diode
LED1—Light-emitting diode, any color
C1—0.1- to 0.22-µF, Mylar capacitor
Wire, solder, etc.

LED FLASHER

In case you haven't been exposed to the neatest little LED flasher/oscillator IC ever made, take a look at the LM3909-based circuit shown in Fig. 5. The LM3909 operates from a single 1.5-volt cell and will flash an LED for over two years using a single "D" cell for power.

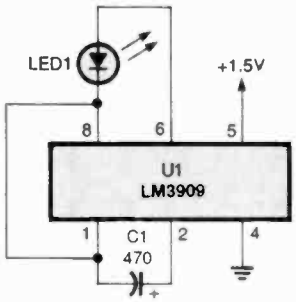

Fig. 5. The LM3909 is one of the easiest-to-use LED flashers around. It could run for years using a standard "D" cell.

The timing capacitor, C1, also serves as a voltage booster to supply over 2 volts to the LED. With the 470-µF unit shown, the circuit will flash at a rate of about ½ Hz. To increase the flash rate, reduce the capacitor value; to decrease the rate, increase the value.

PARTS LIST FOR THE LED FLASHER (Fig. 5)

U1—LM3909 LED flasher/oscillator, integrated circuit
LED1—Light-emitting diode, any color
C1—470-µF, 16-WVDC, electrolytic capacitor
Wire, solder, etc.

DC-LEVEL INDICATOR

The next circuit, shown in Fig. 6, is a simple DC-level indicator. In it, four LEDs are each connected in series with a 1k current-limiting resistor. When slightly over 2 volts is connected to the input, LED1 lights; when the voltage reaches 4 volts, LED2 lights; LED3 lights when the voltage level reaches between 6 and 7 volts; and LED4 turns on when the voltage level reaches 9 volts. At the 9-volt level, all four of the LEDs are lit.

That's all for now. There's just enough time to say so long till we meet here again next issue. ■

PARTS LIST FOR THE DC LEVEL INDICATOR (Fig. 6)

LED1–LED4—Light-emitting diode, any color
R1–R4—1000-ohm, ¼-watt, 5% resistor
Wire, solder, etc.

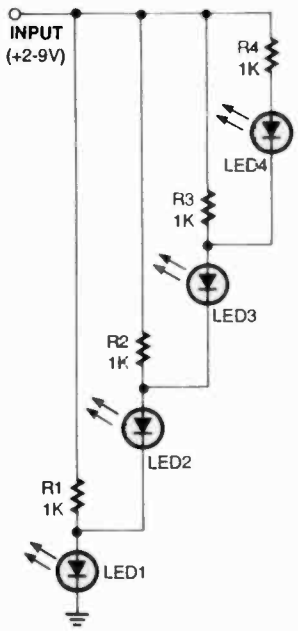

Fig. 6. Here's a simple DC-level indicator.

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Larry Steckler, EHF, CET
Publisher, Editor-in-Chief

LS/ce

MULTIMEDIA WATCH

(Continued from page 26)

burners and Geiger counters are used.

Technology Solutions' new title, *Jewels of the Oracle*, is set in an ancient civilization filled with artifacts and hieroglyphs. There are many puzzles to discover and decipher, some that date back thousands of years. Graphics and sound create this unusual environment. Jewels of the Oracle is recommended for ages 12 and up, and has a suggested retail price of $69.95.

Last this month is the multimedia version of Edgar Allen Poe's classic tale, *The Fall of the House of Usher* on CD-ROM from *Westwind Media*. Filled with animation, graphics, and sound, the disc livens up the story of one man's madness. Users can also enter a 3D maze with 16 levels of questions that can be answered with the newly learned knowledge of the story. The Fall of the House of Usher is for ages 12 and up and sells for 24.95. ■

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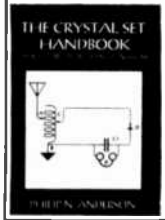

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DX LISTENING

By Don Jensen

Radio Still Reigns

Certain communications pundits keep trying to tell us that shortwave radio is dying. Shortwave, they say, is a septuagenarian in failing health. Soon it will gasp its last breath in a 21st Century dominated by the computer and a worldwide "Information Superhighway." Satellite broadcasting will shove aside old-fashioned shortwave radio.

It's true that we have seen a number of major international SW broadcasters struggling, but their problems seem more tied to government funding than outmoded technology. Despite problems, it seems, shortwave listening just won't go away, no matter the predictions from those of little faith.

Despite predictions to the contrary, even after all these years, there are still a lot of shortwave broadcasters, and listeners, around.

Bearing that out is a recent observation by Larry Magne, publisher of *Passport To Worldband Radio*, the respected shortwave reference annual. "For all the talk about 'dead' shortwave," says Magne, "in the U.S., listening to shortwave is almost at a historic high."

That is true, he notes, even when today's SWL activity is compared to the pre-WWII era, considered by some radio historians to be the golden age of SWLing. "While the market for shortwave receivers flattened out after the Gulf War, several years ago, when it increased considerably and suddenly, major manufacturers tell me that sales are once again on the rise."

So what is the attraction of shortwave radio that remains strong after so many decades? It seem to me that there are a number of reasons. First there is the ability of shortwave to deliver the news globally. That might seem odd in a world with CNN and satellite-video links, but nevertheless, the attraction remains.

Perhaps that is because radio is a medium of the mind, in which the spoken word triggers pictures within one's head that are more vivid and dramatic than anything on a TV screen. Keeping up with the news and views aired in real time from other countries overseas is a strong reason why SW radio lives on.

Likewise, shortwave radio remains a viable window to the cultures and music of other lands, a way to learn or brush-up on another language. Most Americans have ethnic roots in other countries. For many of them, SW offers a chance to tune in to the "old country," even if it's the old country they know only through stories of an elderly grandparent.

Often I get questions from listeners who want to know when and where they can tune in SW broadcasts from the "homeland." That might be Germany, Greece, the Ukraine, Italy, Poland, or wherever. I try to include a good sampling of such listeners' tips in the "Down The Dial Section" of the column each month. Maybe, though, the particular stations you're interested in haven't been included recently. If so, drop me a line. The address is DX Listening, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735.

RADIO ROYALTY

Longtime listeners will remember the Zenith Trans-Oceanic with great fondness. For more than four decades, that receiver was the most expensive, and romantic, of portable radios.

Who listened to the world on a Trans-Oceanic? Kings, presidents, yachtsmen, world explorers, American troops during three wars, and ordinary shortwave listeners.

Two university professors, and not incidentally, expert DX listeners, John H. Bryant and Harold N. Cones, have thoroughly researched the background of that famed receiver, which was manufactured from the 1940s to the 1980s. Now they have written a newly published history, *The Zenith Trans-Oceanic: The Royalty of Radios* (Schiffer Publications).

The book traces the history of SW portables from the 1920s, leading to the development of the Trans-Oceanic. The vacuum-tube portable, originally about the size of a small carry-on piece of luggage, was first

sold in 1942, after years of development by the Chicago-based electronics company.

The stylish Trans-Oceanic carried a hefty price tag for its day, but it opened up world communications for both travelers and armchair travelers. During its 40-year history, the company continued to improve its design and electronics. As vacuum tubes gave way to solid-state circuitry, the receiver's size and weight shrank, while its performance improved.

Zenith produced 10 basic Trans-Oceanic models, 24 if you consider variations and sub-models, according to Bryant and Cones. Those included the classic Clipper, introduced back in 1942, various sets dubbed Royal in the 1960s, and the R-7000 sets of the line's final decade.

The 160-page softcover book is loaded with great photos, including historic shots of Mt. Everest conqueror Sir Edmund Hillary with his Trans-Oceanic Royal 1000, and Frank Sinatra posing with his Clipper model. Other black-and-white and color illustrations depict the long history of that shortwave portable.

For the collector of old-time SW gear, the book has plenty of reference information and charts. For the would-be collector, the authors include a chapter on what to look for and how to restore these old sets. For the rest of us, it is a fascinating read and is well recommended. The book is available for $24.95 plus $2 shipping/handling ($3 in Canada), from Radio Professors, P.O. Box 592, Stillwater, OK 74076.

IN THE MAIL

"I'm both a shortwave listener and licensed ham," writes Phil Morrison, Raleigh, NC. "One day, a while back, I caught part of a QSO in which a couple of hams were talking about an SWL ham network on 40 meters. Later I got to wondering about this SWL net. Have you got any details?"

Surely you're referring to the ANARC SWL Ham Net—ANARC stands for the Association of North American Radio Clubs, the umbrella organization for SWL and other radio-listening clubs in the U.S. and Canada. The net has been in operation for a number of years now, convening on 7,240 kHz, lower sideband, every Sunday morning at 10 a.m. Eastern time. You'll hear a number of ham/SWLs exchanging logging tips on new stations, program schedules, frequencies, and other shortwave listening subjects of interest.

What's nice about the net is that non-hams aren't left out. Obviously, you can simply listen in if you wish. If you want to participate, though, you can telephone (they'll announce the number) one of the "gateway" stations, which will then relay your information or tips over the net. Incidentally, the ANARC SWL Ham net is best heard east of the Mississippi; it is difficult to hear in the Far West.

DOWN THE DIAL

Here are some stations you might like to try. What are you hearing? Why not write and tell the rest of us!

AUSTRALIA—9,510kHz. *Radio Australia* was heard from 1300 UTC sign on with the Southeast Asian Night Service in English, including news and features.

CANADA—6,005 kHz. *CFCX*, Montreal, was noted with French programming, including pop music and commercials from about 1400 UTC.

ECUADOR—4,920 kHz. *Radio Quito* programs here in Spanish, with a DJ playing popular Spanish- and English-language ballads around 0130 UTC.

FRANCE—15,365 kHz. *Radio France International* was heard on this frequency at 1230 UTC in English with a news actuality from a reporter in Somalia.

INDONESIA—9,680 kHz. *Radio Republik Indonesia*, Jakarta, broadcasts here in Indonesian at 1230 UTC with exotic sounding music, then news at 1300 UTC.

MEXICO—2,390 kHz. *Radio Huayacocotla* has great Latin music here at 1200 UTC. Programming is, of course, in Spanish. Some RTTY interference is noted.

NAMIBIA—3,270 kHz. *Namibia Broadcasting Co.* was logged here in English at 0500 UTC, including a promotion for the Miss Namibia beauty contest.

POLAND—7,285 kHz. *Polish Radio* in Warsaw has English at 1825 UTC, but a better frequency at this time is 7,270 kHz.

SOUTH AFRICA—4,810 kHz. *Radio 2000*, a South African SW home-service outlet has been heard at 2300 UTC with cricket commentary in English.

UGANDA—4,976 kHz. *Radio Uganda* was reported here at 0405 UTC with a talk in English about public health and agriculture. ■

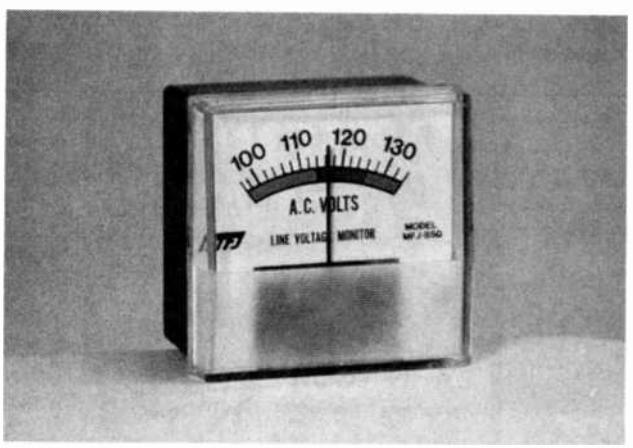
*Credits: Mark Anderson, MI; Dean Bianco, NY; Jim Ducharme, MA; Bill Flynn, OR; Rufus Jordan, PA; Jerry Klinck, NY; Marie Lam, NY; William McGuire, MD; Ed Newbury, NE; Robert Pietraszek, MA; Ed Rausch, NJ; World DX Club, c/o 2216 Burkey Dr., Wyomissing, PA 19610; North American SW Association, 45 Wildflower Road, Levittown, PA 19057.

HAM RADIO

By Joseph J. Carr, K4IPV

Shop Stuff

Not long after I put together my first ham-radio station (a Heathkit DX-35 transmitter, a borrowed World-War II surplus BC-342 receiver, and a 40-meter dipole antenna), I started the process of collecting tools and instruments for an electronics/ham-radio workbench . . . that's lots of collecting for lots of years! Over those years, I've developed some ideas of what I need on that bench. While some items are obvious to anyone who knows anything about electronics, others are not. Let's take a look at a few of those.



When looking for a meter to monitor the AC line, choose one intended for that purpose and featuring an expanded scale.

AC LINE-VOLTAGE METER

The power source to all but a tiny minority of homes in the U.S. is 110 volts, 60 Hz, alternating current (AC). That 110 volts is the root-mean-square (rms) value of the AC potential, so the peak voltage is nominally 156 volts, and the peak-to-peak voltage is 311 volts.

That nominal "110-volts rms" actually varies quite regularly from 105- to about 125-volts rms, and most equipment is designed to operate normally over that range. (However, at times, I've noted as high as 128 volts, and during a summertime "brownout," one ham told me he saw 95 volts at his location.)

In some cases, however, calibration of dials, especially frequency dials, is only guaranteed to be within the best specification at certain specific voltages, or over a much narrower range than the proper operation range, especially in older equipment. In other cases, circuits such as crystal oscillators as well as some pieces of test gear don't work properly at voltages near the extremes.

One answer is to provide an AC line-voltage meter on the workbench. While that instrument doesn't adjust the voltage to the proper level, it allows you to know what the actual voltage is at any given time. It's relatively easy to find 0- to 150-volt AC (rms) meters, but those are hard to read at distances of a yard or two. The best meter is one intended for monitoring the AC line voltage and featuring an "extended scale." In such a meter, the bottom end is just a little below 100 volts, while the upper scale is a bit more than 130 volts. Those expanded-scale voltmeters are easier to read at normal working distances, and are easier to interpret.

ISOLATION TRANSFORMER

The 110-volt AC line can be lethal. Tangle with it and you might die. And please, please, please don't listen to any "yahoo" who tries to tell you that 110 volts isn't dangerous because "it's the current that kills." I actually heard a medical doctor say that once. I asked him if he'd ever heard of Ohm's law, and reckoned that if he hadn't, then he could get a real harsh lesson by sticking his finger in the wall outlet: **110 volts will kill!**

It's difficult to work on electronic equipment without coming into close proximity with 110-volts AC. If your shop is like mine, down in the basement on a concrete floor (or in a garage), then the floor is somewhat conductive. Because the AC-power system in the U.S. is grounded on one side, current can and will flow dangerously and painfully to ground . . . through you!

There are several partial solutions to the safety problem in your workshop. One partial solution is to put down a non-conductive floor covering of rubber, masonite, or some other material (and keep it dry!). That will insulate you from the conductive concrete floor.

Another partial solution is to power every AC outlet on the workbench from an isolation transformer. An isolation transformer is either a 1:1-ratio transformer for isolating 110-volt outlets from the 110-volt line, or a 2:1 unit to isolate 110-volt outlets from the 220-volt AC line (you have both 110- and 220-volt service in your home if it was built in the last 50 years). The isolation transformer provides two

lines for the AC, just like the lines from the power company, but neither line is grounded (*i.e.* they are "floating" above ground). That arrangement means that there is no path to ground if you accidentally touch one of those floating lines. I have a 1500-volt-ampere-rated, 1:1-ratio isolation transformer that powers the bench in my basement workshop.

Keep one thing absolutely clear in your mind: An isolation transformer reduces the danger, but does not eliminate it. In other words, it is a whole lot less likely that you will be shocked, injured, or killed by touching a single AC-power point. However, if you come across two points, with 110 volts between them, then you are still at risk despite the isolation transformer!

RADIO RECEIVER

Believe it or not, I've got two receivers on my workbench and plan to add a third in the near future. One receiver is a digitally synthesized modern unit that operates from 100 kHz to 38 MHz. The other is an antique Hallicrafters SX-100 made in the 1950s. I bought that radio at a hamfest several years ago, and then refurbished it. I also modified it to allow me to input signals directly to the IF (for testing), and to bring the DC voltage from the automatic gain control to an outside port (also for certain types of tests).

Receivers can be used on the workbench for a number of chores. One principal chore is to find an oscillator's frequency, or to discover whether or not it is even operating. A simple probe, made by connecting a piece of wire to the end of a piece of coax that feeds the antenna input on the receiver, will allow you to safely probe around the oscillator circuit, while tuning for the frequency on the dial. The receiver can also be used to test receiver accessories, band converters, antenna tuners, and so forth.

Here is one of my bench receivers—a salvaged old war horse. Also seen here (behind the receiver) are two elderly, but working, RF signal generators, and my oscilloscope.

But, please don't do anything silly. Many years ago I saw a guy (no, not me!) who wanted to test his 75-watt Novice transmitter to see if it was working, so he connected the antenna output of the transmitter to the antenna input of the receiver, and then pressed the key down. The results were quite impressive, though there was not much left of the receiver!

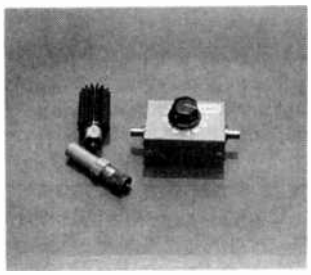
MULTIMETERS

I own a number of multimeters, all but one of which is digital. One of them measures inductance and capacitance, in addition to the usual ohms, volts, and milliamperes. I also own a new Radio Shack digital multimeter that has a PC computer interface. I can plug it into the RS-232 serial-communications port, and with the supplied software, use the meter as a data acquisition system.

Everyone should have at least one good digital multimeter. But multimeters have one significant drawback for hams—they can be useless around operating transmitters. Even if the transmitter is operating into a dummy load, there is usually enough RF leakage getting onto the meter's test leads to drive the unit off scale.

So what's the alternative? Well, actually, it's the same one your grandpa might have used: an old-fashioned analog volt-ohm-milliammeter (VOM). Those meters are completely passive, so one will not respond to an RF field until it gets strong enough so that you don't want to be around it anyway.

Not all analog meters are true VOMs, and that includes some that are called "VOMs." Many meters are electronic analog voltmeters, and those suffer the same problem as digital meters. If the meter tests FETs or any other type of transistor, avoid it when searching for an RF-proof instrument. Another good hint is the battery. The true VOMs used a single 1.5-volt cry cell to power the ohmmeter section. If there are two batteries, or if the battery is higher than 1.5 volts, then it's a good bet that there is an amplifier in the instrument. Models to look for include the Simpson 260 or 270, or the Triplett 630. Those are all old, but they are still useful.



Here's part of my collection of dummy loads. The switch-selectable unit contains a series of non-inductive resistances ranging from 6 to 300 ohms.

DUMMY LOADS

There are many RF circuits that will not work properly unless terminated in their proper impedance (usually 50 ohms, except for TV circuits in which case 75 or 300 ohms is used). I keep four 50-ohm dummy loads on my bench. Two of the loads are fixed, CB-style, dummy loads. They contain a 50-ohm, noninductive resistor (and in one case a heatsink), connected to a PL-259 UHF coaxial connector. Another unit I own is selectable, containing a dozen or so carbon (*i.e.* noninductive) resistors with values from 6 to 300 ohms. I can switch-select any resistance I need, or pass the input straight through to an output connector. Another load I own is a simple, male, BNC coaxial connector with two 100-ohm resistors connected in parallel (forming a 50-ohm load). That load is real convenient when working on filters and other small circuits.

That's all for now. Until next month, if you have any questions, kudos, brickbats, or suggestions for future topics, then contact me at P.O. Box 1099, Falls Church, VA 22041. ■

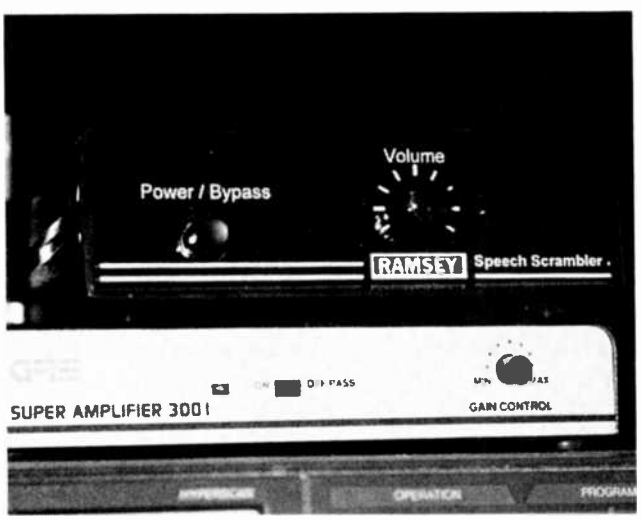
SCANNER SCENE

By Marc Saxon

The Good, the Bad, and the Scrambled

There's good news and bad news relating to the ever-popular world of cordless-telephone monitoring. The good news is that the FCC has allocated new channel pairs not far from the existing 46/49-MHz channels. The bad news is that a number of the better cordless phones operating on those frequencies will most likely use analog voice-scrambling circuits to thwart eavesdropping by scanner owners.

Analog scramblers are nothing new in certain more expensive models of 46/49-MHz cordless phones. Radio Shack, Motorola, and others already sell them. You might have encountered their strange, unreadable signals on cordless-phone frequencies. Raymond (Glendale, Avoca, PA) is only one of the many readers who have asked about those signals.



The Ramsey SS-70—the small, simple unit shown sitting atop a GRE Super Amplifier—enables any scanner to decode analog-scrambled cordless-phone conversations.

Did you know that there is an analog speech scrambler and descrambler available that you can add to any phone in order to scramble voice transmissions? The good news for Raymond and other scanner owners is that the very same device can be added to any scanner to make sense out of all those received signals that use analog scrambling.

The device is called the *Ramsey SS-70*. To use it with a scanner, you merely insert it in the cable that runs between a scanner's external speaker connection and its external speaker. The SS-70 requires an internal 9-volt battery, or can be powered by an external 9-volt source. When a signal using an analog scrambler is observed, you press the front-panel button, and the SS-70 turns that signal into something you can understand. When you're listening to regular signals, you pop out the button, and the SS-70 shuts off. There's a volume control that regulates only the descrambled signals. The SS-70 is not intended to decode digitally scrambled transmissions, which are not encountered with 46/49-MHz cordless phones, anyway.

The SS-70 is available as a kit with a matching case. It also comes factory wired and tested. Complete instructions for wiring and hookup are provided. It's from Ramsey Electronics Inc., 793 Canning Parkway, Victor, NY 14564; Tel. 716-924-4560.

WHAT NEW CORDLESS FREQUENCIES?

To relieve congestion on the 10 existing 46/49-MHz paired cordless-phone frequencies, the FCC made available 15 new channel pairs. Newly made cordless phones can have 25-channel capability. Some of the new channels are shared with stations long licensed in other radio services that were previously allocated the use of those frequencies. The FCC said that they felt the risk of interference between those stations and the cordless phones was "very low."

The newly created cordless base frequencies are: 43.72, 43.74, 43.82, 43.84, 43.92, 43.96, 44.12, 44.15, 44.18, 44.20, 44.32, 44.36, 44.40, 44.46, and 44.48 MHz. The handset frequencies that match up with those are: 48.76, 48.84, 48.92, 49.02, 49.08, 49.10, 49.16, 49.20, 49,24, 49.28, 49.36, 49.40, 49.46, and 49.50 MHz.

We might add that our own listening on the 48-MHz channels has turned up several commercial dispatchers, so we'll keep our fingers crossed about the low risks of interference. If you monitor the frequencies between the 10 existing "old" 46-MHz cordless-phone channels, you might hear a surprising amount of two-way traffic.

BIG APPLE, BIG APPETITE

The frequency band between 482 and 488 MHz is really TV channel 16. In the area in and around New York City, there is a shortage of communications frequencies for use by public-safety agencies, and not much need for telecasting on TV Channel 16.

The FCC has therefore decided to allow that band to be used for the next five years by public-safety agencies in the metropolitan New York area, which includes northern New Jersey and Long Island. The arrangement could be allowed to continue for longer than five years, but the FCC will most likely want to clear those stations out when advanced television technology (such as HDTV) is ready to go. HDTV is frequency hungry, and will have first call on those frequencies at that time.

That might be a long way down the road. Meanwhile, if you are in monitoring range of the New York metro area, you can start searching there. The bases will be operating between 482 and 485 MHz; mobiles and handhelds will operate from 485 to 488 MHz.

HOW ABOUT THOSE NEWBIES?

John Difloure, of Nebraska, dropped us a line asking if the latest scanners lend themselves to modifications that will restore the locked out 800-MHz cellular bands.

The FCC decreed that newly designed scanners released after April of 1984 were not supposed to be able to have the cellular bands restored by means of simple user modifications. Inasmuch as scanner models must have FCC approval before they can be offered for sale, it's not likely that any of the latest models can have those bands restored. However, there are many other worthwhile modifications that users can make to them, as with earlier models scanners.

EYES IN THE SKY

A note from Ronald J. (Farmington Hills, MI) wonders about directly monitoring traffic helicopters used by radio stations. Ron feels that the information is passed down from the 'copters to the stations as much as 10 to 15 minutes before they get it on the air.

The two primary bands to search for that activity in all U.S. areas are 450–451 MHz and 455–456 MHz. In some instances, a helicopter will use the 455-MHz frequencies, while the radio station's ground station operates in the 450-MHz band. One thing to remember is that there might be restrictions or limitations to using a scanner in a vehicle in some areas.

Several radio stations in my own area run "live" broadcasts from their traffic aircraft. It was only when I happened to check them out on my scanner that I realized that at least one station actually plays a tape of a communication made about five minutes earlier, although they don't say that it's a delayed recording. Well, the same station broadcasts listener phone calls and doesn't announce that they are recordings, either. So, apparently that's the way they do those things!

We are always looking for your questions, loggings, frequencies, and clippings about scanners and scanning. Help keep us tops by writing to *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

ELECTRONICS LIBRARY

Step Into Virtual Reality

by John Iovine

For most people, virtual reality remains an intriguing, but inaccessible technology. They've seen it on TV, and read about it in newspapers and magazines, but they haven't been able to actually experience virtual worlds. Consumer VR gear is all but nonexistent, and the cost of commercial equipment is prohibitive.

This book brings virtual reality into the real world. It shows readers how to build a complete VR system using their own PCs and available software. The book offers a dozen simple projects that teach readers how to build their own VR equipment and interfaces to create and enter a virtual environment. Projects include a head-mounted display unit, LCD stereoscopic shutter glasses, a data glove, a telepresence robot car explorer (T-bot), tactile actuators, and a VR exercise bike.

The included companion diskette provides 3DBENCH, a benchmark program that tests the capabilities of the user's computer; 3DV, which allows the user to move and rotate 3D models in real time; BIKE, a stand-alone VR world created with the Virtual Reality Study program for use with the VR bike; and GIF, which contains two stereographic pairs of .GIF images that can be used with the LCD shutter glasses.

The book also provides convenient listings of virtual reality vendors and suppliers.

Step into Virtual Reality costs $32.95 and is published by Windcrest/McGraw-Hill, Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128; Fax: 717-794-2103.

CIRCLE 90 ON FREE INFORMATION CARD

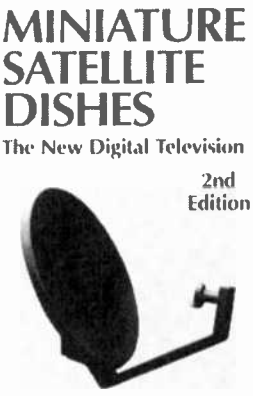
MINIATURE SATELLITE DISHES: The New Digital Television, Second Edition

by Dr. Frank Baylin

This book covers all aspects of the new direct broadcast satellite (DBS) industry, including the technology, the players, and the programming. Issues such as signal security are discussed, and practical considerations such as installation methods are explored.

The book's first three chapters provide an overview of the field and cover the underlying technology of satellite systems. Topics include digital video compression, bit error rate, receiver design, and compatibility of large- and small-dish systems.

The DBS providers, including DirecTv, USSB, Primestar, and EchoStar, along with their satellites and systems, are examined



in the fourth chapter. Detailed discussions of how DBS differs from large-dish satellite TV and cable TV, the origins of DBS, and DBS frequency allocations are included. Topics such as rain fade and solar outages are explored.

Subsequent chapters cover the encryption systems used for signal security in large- and small-dish systems and the program packages and prices offered by the various vendors. The book provides step-by-step instructions for the installation of both small- and large-dish satellite systems, and demonstrates the methods used to hook up and interface home-entertainment systems—including off-air antennas, stereos, and VCRs—with home satellite TV receivers.

Miniature Satellite Dishes: The New Digital TV is available for $20 plus $4 for shipping and handling from Baylin Publications, 1905 Mariposa, Boulder, CO 80302; Tel. 303-449-4551; Fax: 303-939-8720.

CIRCLE 91 ON FREE INFORMATION CARD

THE AUDIO SOURCE CATALOG

from Sescom, Inc.

If you have an audio problem,

you can probably find the solution in this catalog of audio specialty and construction products—and find it on sale until August 31, 1995. Sescom's 14-page summer sale brochure features devices designed for "plug-n-play" real-world applications. The line of "rackem'n'stackem" products, for instance, includes a four-channel audio-distribution amplifier, a stereo-buffer amplifier, and a stereo combiner, all of which are easy to connect and easy to use, and are designed to fit in rack systems or just about anywhere else. Also featured are a selection of in-line

devices that eliminate hum and buzz; XLR adaptors; and audio SIPs. Portable audio equipment includes mic-line drivers, a dual interface box, and a stereo line driver.

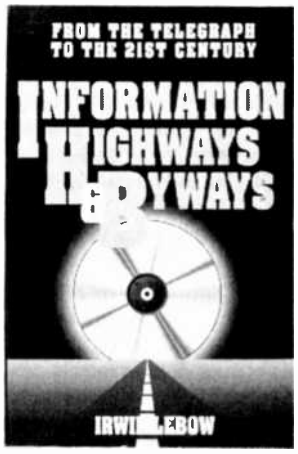
The Audio Source catalog is free upon request from Sescom, Inc., 2100 Ward Drive, Henderson, NV 898015-4249; Tel. 702-565-3400 or 800-634-3457; Fax: 702-565-4828 or 800-551-2749.

CIRCLE 92 ON FREE INFORMATION CARD

INFORMATION HIGHWAYS AND BYWAYS: From the Telegraph to the 21st Century

by Irwin Lebow

Spanning the entire history of electrical communications, this book traces the history, and forecasts the future, of communication technologies. It examines how such inventions



have driven cultural changes in the past, and how the future of our society might be affected by the Internet and the information superhighway.

The book uses anecdotes, historical recreations, and non-technical explanations to illustrate the impact that communications have had on our world during the past 150 years—since Samuel Morse introduced the telegraph. It tells the stories of the inventors and entrepreneurs who brought the technologies to the public, and even discusses the litigators, antitrust lawyers, and regulators who influenced the course of technology's progress. The book provides non-technical readers with an understanding of the communications systems of yesterday, today, and tomorrow, and provides insight into the turmoil of today's information and entertainment industries.

Information Highways & Byways: From the Telegraph to the 21st Century (order number PP4275) lists for $29.95 and is available to IEEE members for $25. It is published by the Institute of Electrical and Electronics Engineers (IEEE), 445 Hoes Lane, P. O. Box 1331, Piscataway, NJ 08855-1331; Tel. 1-800-678-IEEE.

CIRCLE 93 ON FREE INFORMATION CARD

RADIO COMMUNICATION EXCITEMENT

from C. Crane Company

This 80-page catalog goes beyond radios and antennas to also offer a selection of fax machines, telephones, audio equipment, and weather stations. In most product categories, the catalog offers two basic lines of each item: the "best made" and the "best for the money."

The catalog features radios and antennas for regular AM/FM broadcast listening, as well as shortwave, CB, and scanner gear. Other product categories include satellite-receiving equipment, alternative power sources, lightning protection, home-theater and audio equipment, car radios, and books. Accessories include headphones, adaptors, and batteries and chargers. The catalog also

provides convenient information on the radio spectrum, frequency allocation, radio noise, and even the design for a "cheapo" do-it-yourself shortwave and AM antenna.

Radio Communication Excitement (Catalog No. 6) is free upon request from C. Crane Company, 558 10th Street, Fortuna, CA 95540-2350; Tel. 1-800-522-8863.

CIRCLE 94 ON FREE INFORMATION CARD

THE NORTH AMERICAN REPEATER ATLAS 1995/96 Edition

by Bob Martin, N7JXN

Written for the ham on the go who wants to keep in touch with nearby repeaters, this book contains complete repeater maps for every U.S. state and Canadian province, as well as for Mexico, Central America, and the Caribbean. You'll want to bring it along on business trips and vacations, or keep a copy handy in your RV.

The book provides street maps that show repeater frequencies for most U.S. metropolitan areas. It lists repeater information, including frequency, subaudible tone (if necessary), and indications of

which repeaters have autopatch capability. Repeater listings are provided for 10 meters, 2 meters, 220 MHz, 440 MHz, 900 MHz, and 1.2 GHZ. The book also provides information for a number of "linked" repeater systems.

The North American Repeater Atlas, 1995/96 Edition costs $10 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111; Tel. 203-666-1541; Fax. 203-665-7531

CIRCLE 95 ON FREE INFORMATION CARD

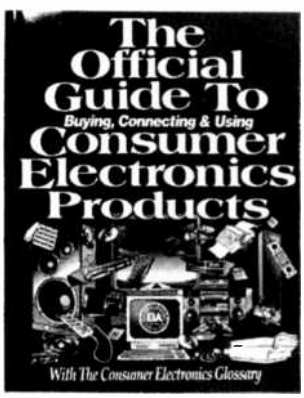
THE OFFICIAL GUIDE TO BUYING, CONNECTING & USING CONSUMER ELECTRONICS PRODUCTS

from the Electronic Industries Association/Consumer Electronics Group (EIA/CEG)

Each year, Americans spend more than 80-billion dollars on consumer-electronics products. That's quite an investment in televisions, VCRs, audio equipment, camcorders, home-theater components, personal computers, telephones, home-office equipment, mobile electronics, and all the accessories that go with them. This book is

intended to help consumers invest their money, time, and effort wisely. It can take the place of that knowledgeable friend who, you drag along to the electronics store to advise you before buying and then beg to come over to help you hook up your new purchases.

The book opens with an overview of consumer electronics that includes a history from Edison's time up to the 1990s, along with a discussion of the



basics of today's consumer electronics. The rest of the book is divided into sections on audio, auto sound, mobile electronics, video, home theater, telecommunications, computers, home office, and home control. The main sections are divided subsections that deal with individual products. For each product, the book provides the information needed to make a wise purchase decision. In most cases, it discusses features, explains installation, describes available accessories, defines "tech talk," and explains proper maintenance procedures.

The Official Guide to Buying, Connecting, & Using Consumer Electronics Products is available for $9 (including shipping and handling) from the Electronic Industries Association/Consumer Electronics Group, CE Book, 2500 Wilson Blvd., Arlington, VA 22201; Tel. 703-907-7636; Fax: 703-907-7690.

CIRCLE 96 ON FREE INFORMATION CARD

SOLDERING IRONS CATALOG

from M.M. Newman Corporation

This catalog includes miniature and standard soldering irons, temperature-control stations, tips, and stands for electronics and industrial assembly and field-service repair work. It features Antex precision soldering irons, with heating elements located directly under their tips for maximum efficiency. Also featured is a power-supply unit that operates on 115 VAC and converts line voltage to a safe 24 VDC, an independent soldering-iron controller, and control stations for precisely controlling tip temperatures. The catalog provides photographs and specifications for each product, and offers a fully illustrated chart of slide-on replaceable tips to help users select the best tip for the job.

The Soldering Irons Catalog is free upon request from M.M. Newman Corporation, 24 Tioga Way, P. O. Box 615, Marblehead, MA 01945; Tel. 617-631-7100; Fax: 617-631-8887.

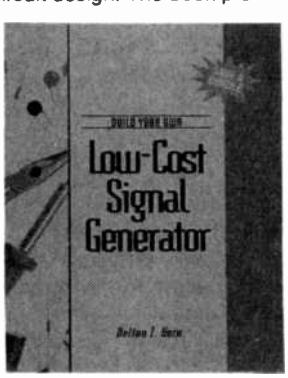
CIRCLE 97 ON FREE INFORMATION CARD

BUILD YOUR OWN LOW-COST SIGNAL GENERATOR

by Delton T. Horn

A signal generator is an important piece of electronic test equipment, but a commercial signal generator can put a big dent in your wallet. This book shows you how to save money and improve your electronic skills by building your own signal generator.

Filled with interesting and useful sub-assembly projects, the book features one complete project—an inexpensive signal generator with a wide array of electronic applications, including troubleshooting, repair, and circuit design. The book provides complete circuits and parts lists for generating all types of signals, ranging from direct current to complex digital synthesis. Some of the signals covered include sine waves, amplitude and frequency modulation, op-amp-generated square and rectangular waves, sawtooth and staircase waves, special-purpose waveforms, pink-noise and white-noise generators, and IC-based signal generators. Sub-assembly projects include sound generators, power supplies, and test gear useful for typical hobbyist applications.



Build Your Own Low-Cost Signal Generator costs $19.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.

CIRCLE 99 ON FREE INFORMATION CARD

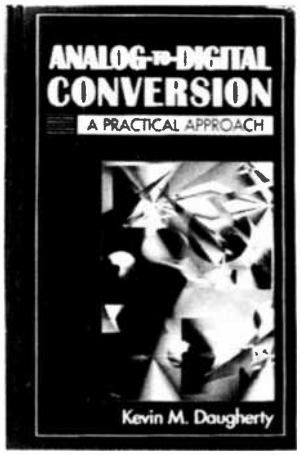
ANALOG-TO-DIGITAL CONVERSION: A Practical Approach

by Kevin M. Daugherty

This comprehensive guide focuses on viable, cost-effective techniques and procedures that demystify analog-to-digital (A/D) conversion. Its thorough examinations of design considerations, trade-offs, and limitations are intended to enable cost-conscious engineers to analyze and adjust a design for both performance and cost. The book is filled with in-depth information on useful A/D techniques, from low-cost discrete converters to high-performance flash converters.

The book takes the reader through a step-by-step process that shows how specific techniques work and which type of A/D conversion will be the most effective for use in particular real-life situations. Its emphasis is on practical applications, and many helpful examples of the various techniques involved.

A wide variety of topics are discussed. The book reports on microcontroller A/D techniques, giving economical examples that could mean the difference between success or failure in the marketplace. It provides complete explanations of single and multislope A/D and shows how to make the procedures



both workable and cost-effective. The book also explores the delta-sigma/oversampling A/D technique.

Analog-to-Digital Conversion: A Practical Approach costs $55 and is published by McGraw-Hill Book Company, 11 West 19th Street, New York, NY 10011; Tel. 1-800-2-MCGRAW.

CIRCLE 66 ON FREE INFORMATION CARD

ELECTRONIC KITS CATALOG

from North Country Radio

This 32-page catalog offers a selection of ready-to-build electronics kits, most based on articles published in **Popular Electronics** and *Electronics Now* (or *Radio-Electronics*). The kits include everything necessary to build the printed-circuit boards for each project. All designs are professionally engineered and tested, and, in general, require only commonly available test equipment to complete. Projects include Amateur TV (ATV) transmitters and receivers, ATV amplifiers and downconverters, a wireless FM stereo transmitter, a shortwave converter for car radios, and many others. Also included are kit enclosures and lenses for video cameras.

The Electronic Kits Catalog is available for $1 plus a self-addressed 6 × 9-inch envelope with $.75 postage from North Country Radio, P. O. Box 53, Wykagyl Station, New Rochelle, NY 10804-0053; Tel. 914-235-6611; Fax: 914-576-6051. ■

CIRCLE 67 ON FREE INFORMATION CARD

RADIO ASTRONOMY

(Continued from page 47)

verse; the true nature of quasars; and how much of distant galaxies' mass is invisible (some scientists believe that "dark matter" or "missing mass" might represent 99 percent of the universe's mass, which could explain the motion of galaxies in clusters).

Science still hasn't determined how galaxies formed in the earliest stages of the universe; and what the universe might be like many billions of years in the future. Also unresolved are questions of how the process of galactic evolution can be modeled, whether the universe is open or closed, and what the values of its parameters are.

As you might imagine, the universe's countless riddles and mysteries probably won't be solved conclusively anytime in the near future. But radio astronomy will most likely do much to revolutionize our present and future views of both ourselves and the universe of which we are a part. ■

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.

VOCAL EFECTS GENERATOR

(Continued from page 49)

tors (C1–C5) to their respective pads. Then install the electrolytic capacitors (C6–C9); be sure to properly orient those components on the board.

Next, solder the 4-position DIP switch, S2, to the circuit board; check the orientation of that component. To connect the jacks and potentiometer to the circuit, use pieces of 24-gauge stranded hookup wire. After you've done that, attach the battery holder to the PC board.

Now you can insert U1 and U2 into their respective sockets. Use care when handling the ICs; they are static sensitive.

Drill three holes for J1, J2, and R5 in the top edge of the enclosure you plan on using. Also cut an opening on the back cover to allow access to the DIP switch. If you plan to wear the unit on your belt, you can also attach a belt clip to the cover at this point.

Mount the PC board inside the plastic case with screws. Then install J1, J2, and R5 into their holes on the enclosure. You might need to remove the small metal tab sticking up from the potentiometer body so that it will not interfere with the component's mounting. Secure the three parts with the appropriate mounting hardware.

The next step is to use hot-melt or epoxy glue to attach the battery holder inside the plastic enclosure below the PC board. Finally, slide the control knob onto the shaft of R5 and tighten the set-screw.

Note: If you are using the parts included in the kit (see the Parts List for details), then your speaker and microphone will come already connected to their respective plugs. If you wish to use your own parts for MIC1 and SPKR1, however, you will have to connect them to two plugs—PL1 and PL2. For that reason, the plugs are indicated in the Parts List as being optional.

Using the Generator. Install four AA batteries and set the DIP switch (S2) to the desired mode, referring of course to Table 1. Plug the electret microphone into J1 and the remote speaker into J2. Turn the unit on and set the volume at about half-way. Keep the microphone away from the speaker, or you will experience a loud feedback squeal.

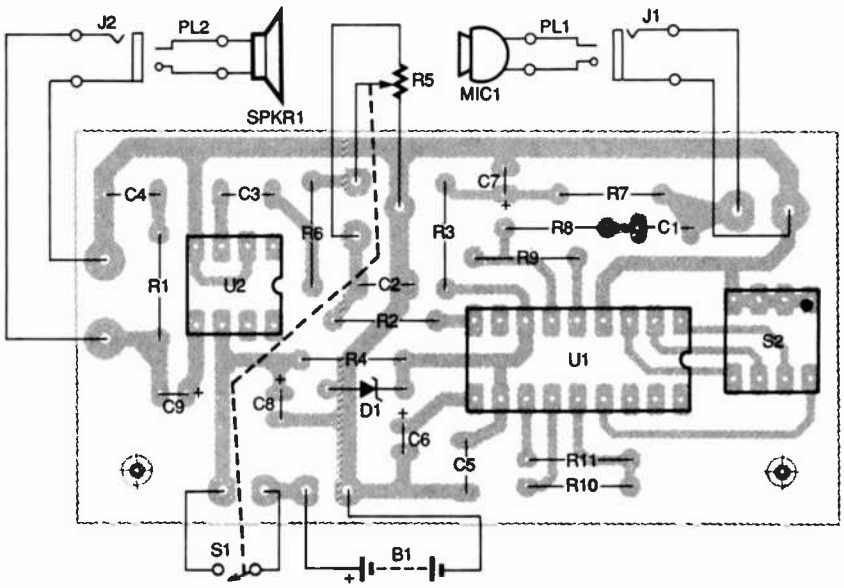


Fig. 3. If you build the Effects Generator on a PC board, use this parts-placement diagram as a guide. Note the off-board connections to J1, J2, and R5/S1.

Each time that the Vocal Sound-Effects Generator is turned on, it will initialize to the mode selected by S2. As you speak into the microphone, you can change the settings of S2 and experiment to see how your voice sounds when the unit is in each of the modes.

With a little experimentation, you should be able to find the perfect sound to enhance whatever your Halloween plans are this year. So, go out and have some ghastly fun! ■

BUILD THE PATHFINDER

(Continued from page 50)

instance, replacing the light-dependent resistor with a 10,000-ohm fixed resistor, and installing Q1 and Q2 in sockets yields a simple transistor checker. To use the circuit that way, simply remove either Q1 or Q2 from its socket and insert the suspected "bad" transistor in its place. If the transistor is "good," pressing S1 will produce an output from the transducer.

That first modification to the circuit can also be used to check transistor type and lead configuration; a PNP transistor will not allow oscillation to take place if it is installed in the NPN socket (or *vice versa*). Also, the circuit will not oscillate if the transistor's terminals are improperly oriented. The circuit can even give a relative indication of gain; for example, the audio tone will increase in pitch as the device's gain increases. And if test leads are inserted into one of the transistor sockets, Pathfinder can be used for in-circuit transistor checks, using a voltage so low that you need not worry about damage to the circuit (or unit) under test.

Replacing the light-dependent resistor with other types of sensors can result in some useful applications as well. One possibility is to replace R1 with a thermistor, thereby creating an audible thermometer. With a little bit of experimentation, you might even be able to get a humidity-sensing resistor to work with the circuit.

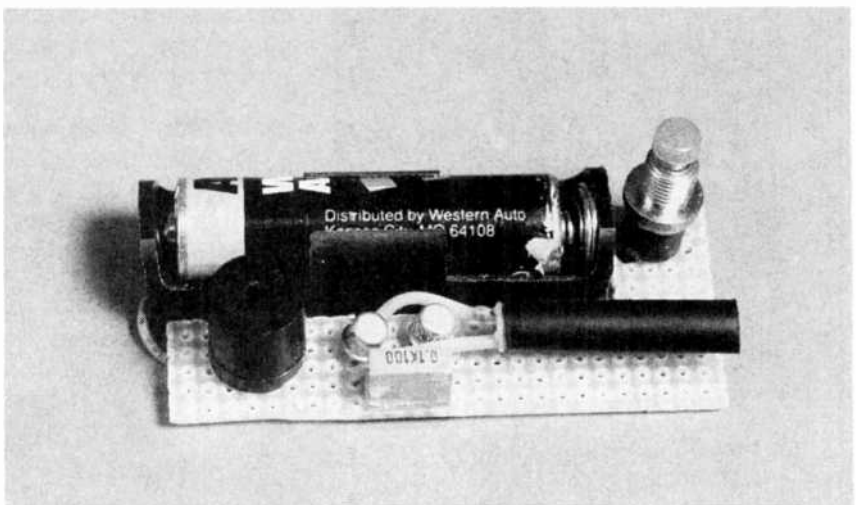
Finally, the circuit can easily be used by those who enjoy the great outdoors. If you like fishing, adjust the Pathfinder for a ticking sound and seal it in a weighted, waterproof container. When submerged, it will act as a fish caller.

Note: Some of the aforementioned applications will require you to replace S1, the pushbutton switch, with an SPST toggle or slide switch. That is necessary if you wish to keep the circuit on for long periods of time, without having to hold S1 down.

As you can see, there's a myriad of things that the Pathfinder can do either with or without modification. We're sure you'll find others. ■

PARTS LIST FOR THE PATHFINDER

Q1—2N2907 general-purpose PNP transistor
Q2—2N2222 general-purpose NPN transistor
R1—Cadmium-sulfide light-dependent resistor (1000 ohms in full light, 100,000 ohms in full dark)
C1—0.1-μF, ceramic-disc capacitor
S1—Miniature pushbutton switch, normally open
BZ1—Miniature, polarized audio transducer
B1—1.5-volt "AA" battery
Perfboard materials, battery holder, suitable enclosure, black heat-shrink tubing, wire, solder, hardware, etc.



Here's the author's prototype board. It was assembled on a small section of perfboard and housed in a clear, plastic, pillbox-like enclosure.

Supplement to Popular Electronics
October 1995

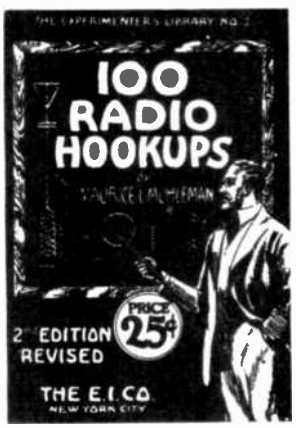
Popular Electronics Market Center™

Paperback Books

GREAT BOOKS AT BUDGET PRICES

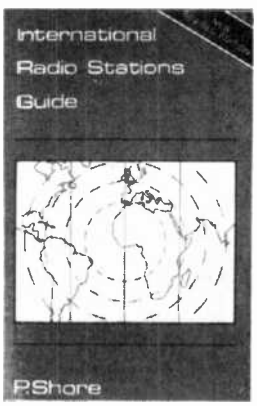
☐ 100 RADIO HOOKUPS —#7—$3.00

First published in May, 1923 this popular booklet went into reprint editions nine times. It is packed with circuits, theory, antenna installation and tips on consumer radio receivers that were popular in the early 1920's. Antique radio buffs and those inquisitive about the early days of radio will find this booklet an exciting, invaluable and excellent reference into the minds of early-day radio listeners. Sorry, we cannot honor the original 25-cent cover price.



☐ INTERNATIONAL RADIO STATIONS GUIDE—BP255 —$9.95

Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed as a guide for listening tothe complex radio bands. Includes coverage on Listening to Shortwave Radio, ITU Country Codes, Worldwide Radio Stations, European Long Wave and Medium Wave Stations, Broadcasts in English and more



☐ HOW TO USE OP AMPS —BP88—$5.95

The engineer's best friend is the op amp. This basic building block is found in many circuits, analog and digital alike. The op amp finds many useful purposes such as: oscillators, inverters, isolators, high- and low-filters, notch and band-pass filters, noise generator, power supplies, audio, MIDI, and much more. Prepared as a designer's guide, some limited math is used, however engineers and hobbyists alike find it a useful text for their design needs.

☐ WIRELESS & ELECTRICAL CYCLOPEDIA —ETT1—$5.75

A slice of history. This early electronics catalog was issued in 1918. It consists of 176 pages that document the early history of electricity, radio and electronics. It was the "bible" of the electrical experimenter of the period. Take a look at history and see how far we have come. And by the way, don't try to order any of the radio parts and receivers shown, it's very unlikely that it will be available.

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ET01

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GoldStar Precision

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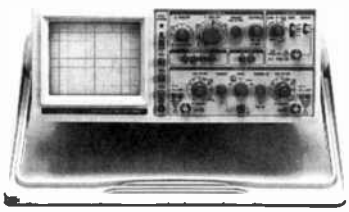

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Bandwidth	20 MHz	40 MHz	60 MHz
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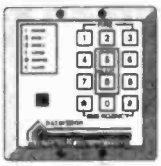
CONTROL PANEL KEYBOARD

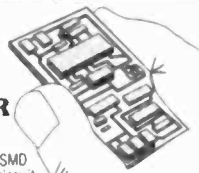


Keyboard with 6 LEDs and ribbon cable. Make fake alarms as this is the same unit found on the front door control panels for many professional home alarms. Size: 4 9/16" sq.

G2904

~~$3.00~~ SALE! **NOW ONLY $2.75!**

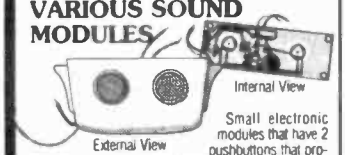
BASIC SMD LEARN TO SOLDER KIT



Contains 1 small SMD single sided circuit board which is etched (ready for component mounting), and over 50 various SMD components. ICs, resistors, capacitors. There isn't room to mount all the parts, but we give you extra ones in case you ruin them. The circuit is totally nonfunctional, but it is a tremendous way to introduce yourself to this exciting new technology which industry all over the world is adopting. Size of board about 1 1/2" x 3/4"

G3113 $3.00

HUMAN VOICE AND VARIOUS SOUND MODULES

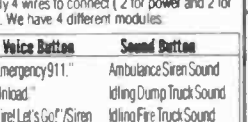


Small electronic modules that have 2 pushbuttons that produce human voices and various sounds. You need only to provide a speaker and 4.5VDC (3AA batteries connected in series work fine). Size of the modules about 4" x 2 1/4". Only 4 wires to connect (2 for power and 2 for the speaker). We have 4 different modules.

Stock#	Voice Button	Sound Button
G6664	"Emergency 911."	Ambulance Siren Sound
G6665	"Unload."	Idling Dump Truck Sound
G6666	"Fire! Let's Go!"/Siren	Idling Fire Truck Sound
G6667	"Load em up!"	Race Car Revving Up Sound

YOUR CHOICE $1.25 ea.
100/$100.00

UHF WIRELESS REMOTE



These compact remote controls were designed to choose satellite type and satellite number remotely, but they are also a great experimentors item! These are complete miniature UHF tone transmitters and contain a 4069 IC, 2 transistor circuit with a ferrite slug tuned coil. Also contains 2 pushbutton switches, trimmers, diodes, capacitors and resistors. Size of circuit board: 1 3/16" x 2 1/4". Features an attractive black plastic case. Size: 4 7/8" x 1 1/2" x 15/16". Has a Panasonic 9V battery installed inside, however the battery has gone dead from storage (simply remove 1 screw to access the battery and circuit board). *NOTE. Wording on outside case may vary from picture shown.*

G2962 39¢

10/$3.00 • 1000/$250.00

PIR (PASSIVE INFRARED) PEOPLE DETECTING ALARM

Brand new pocket-sized PIR alarm is perfect to take with you on vacations. Protect your hotel room, car, campsite vacation home, etc. The unit is called the Travel Alert by Snapir®. It detects people using a sensitive PIR detector, and sounds a loud electronic alarm when they intrude into its field of view. Compact unit is only 4" x 3" x 1 1/4". Operates on one 9V battery (not included).

G6954 $9.95

9V Alkaline Battery ($tock# G6955): $1.79

SECRET ALERT ALARM

Hide this attractive small size alarm in briefcases, medicine chests, drawers, cabinets, etc. and it will silently "stand guard". As soon as someone opens the briefcase drawer, cabinet, etc. it will start sounding a loud beeping sound. Operates on one 9V battery (not included) and uses a light sensitive IC circuit with built-in arming delay. The arming delay allows you 5 seconds to put the unit in a dark place after you arm it. Then, as soon as light strikes it (from someone opening the cabinet door etc.) the alarm sounds until it's once again in the dark. Great for warning you of intrusions into areas that children and intruders should stay out of. These have a Velcro® peel and stick piece on the back of each unit, that allows you to securely hold the unit to the back of a cabinet. Although these alarms are new, they were manufactured several years ago and the adhesive on the double stick velcro surface has dried out on the G6948 units which means on those units you'll have to use glue on the adhesive sides of the velcro it you wish to mount them (mounting is totally optional). The G6949 do not have this problem. Both types are electrically perfect it's only the velcro adhesive problem. Red plastic case is approximately 3" x 2 1/2" x 7/8".

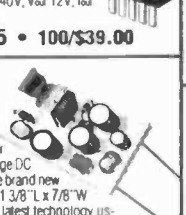
G6948 (Bad Adhesive) $2.00
G6949 (Good Adhesive) $2.49

LM2575T-12 P+ REGULATOR IC

Switching regulator type LM2575T-12 P+ for 12V applications. These are prime new marked units but their leads are slightly shorter than normal length so we are selling them cheap. Made by National. V_{in} 14V-40V, V_{out} 12V, I_{out} 1 amp. Application "buck".

G6953 3/$1.25 • 100/$39.00

DC TO DC CONVERTER



Super efficient tiny DC to DC converter converts lower voltage DC to a higher voltage DC (see table below). These are brand new made by TDK and are only 1 3/8"L x 7/8"W x 3/8"T. Very efficient and latest technology using SMD and standard technology. Power a 9V transistor radio from 1 AA battery. Charge several AA batteries from one solar cell, power a 9V project using 1 or 2 AA cells, etc. Has only 4 leads (±in and ±out). With hookup diagram.

POWER TABLE		
Voltage In DC	Voltage Out DC	Current Out
0.5VDC(solar)	3V	1mA
1.5VDC	9V	15mA
3VDC	9V	40mA

G6344 $3.98

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DIGITAL PLANET DIGITAL DP-91 TUNER

SALE!

These are complete infrared controlled FM digital tuners. They were made to decode digital CD music that was transmitted from satellites to your local cable company. We were told that the satellites these were set up for are no longer transmitting - we don't know. We do know that the main unit consists of a sophisticated tuner circuit and readout circuit that displays any channel number 00 to 25 when you press the buttons on the remote control. After a while the display shows EE indicating the cable TV signal is not present. Inside the 9 3/4" x 6 5/8" x 2 3/8" main unit are various ICs, readouts, a custom microprocessor IC, tuner module, power transformers, resistors, caps, diodes, etc. Use this for experimenting with digital tuners, IR remote control, etc. We have absolutely no info except the instructions of operation that came with the units. You get the complete DP-91 digital stereo tuner and 1 infrared remote control which uses 2 AA batteries (not included). These look new but probably were taken out of service when the satellite programming ended. Looks like a great hobbyist item but to take apart the main unit you will need to use a torx type screwdriver. Hurry, Limited quantity.

G6506 NOW ONLY
~~$15.95~~ **$12.95!**

FLUORESCENT LIGHT STRIP WITH 3 POWER OUTLETS

Very useful fluorescent light strip features 4 watt replaceable light bulb and 3 handy power outlets. Add light to any counter, shelf or workbench and have power outlets also. Rated 13 amps 125VAC for outlets. Has on/off switch and 3 ft. long SPT-3 power cord. Brand new - made by Leviton.

G6951 $9.95

SUPER SENSITIVE SOUND ACTIVATED 2 CHANNEL COLOR ORGAN

This ultra sensitive 2 channel color organ produces brilliant flashes of light (from any incandescent lamp of your choice - up to 200W) in response to music or other sounds. It is fully assembled (except for line cord and outlets) and features 2 response controls, on/off switch, sensitive FET microphone (no hookup to stereo needed) and 3 transistor, 2 SCR circuitry. Operates from standard 120 VAC and requires that you solder your line cord and 2 outlets (for lamps) to the board. We strongly recommend that you install the color organ in an insulated case for safety reasons as it operates from the AC line. Great for DJ's as there is no connection to the sound source. Size of board: 3 3/4" x 4 1/4". Color organ board only - you supply lamps, line cord, knobs, case and outlets.

G3319 $4.95

EXTRA STRONG MUELLER PEEWEE CLIP

This alligator has jaws that really grip. Made by Mueller part# 45, this clip features screw terminal for wire, and heavy duty spring to provide a secure electrical/mechanical grip. Rated 10amps - plated steel finish. Size about 1 1/2"L x 1/4"W. Brand new in sealed foil pouch made for the government.

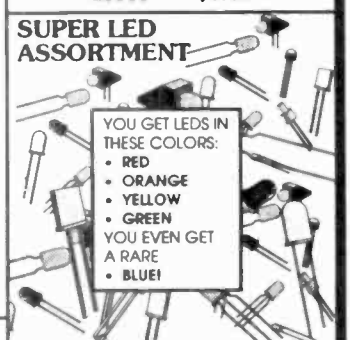
G6952 39¢ea.
10/$3.00

LARGE "STICK-ON" CLOCK

This large "stick-on" clock features easy to read 3/4" tall digits - not like the small round clocks. Displays time, date and seconds. Overall size: 2 1/4"L x 1 1/4"T x 3/8"W. Great for placing on dashboards, phones, computers, etc. Has "Peel-N-Stick" mount on back. These are new in a box with instructions, however the battery has gone dead from storage. Uses 1 type 186 watch battery. Easy to replace, just unscrew battery cover. Buy a new battery and you'll have a nice timepiece.

G6950 $1.89

SUPER LED ASSORTMENT



Assortment of all types, colors, sizes and shapes of prime quality LEDs. This large assortment even contains a clear LED that lights up blue! Our largest and most spectacular assortment contains 250 pieces.

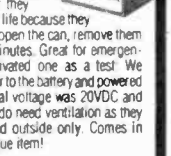
G6554 $10.00

RADIOSONDE

Very late model Radiosonde made for all types of weather data. These were to be sent aloft attached to a weather balloon (not included). Each is about 10 1/2" L x 8"W x 3 3/8"D. Inside the removeable cardboard sleeve is a styrofoam chamber housing a sophisticated 8 IC circuit board which has sensors attached to measure atmospheric pressure, temperature and humidity. As it gathers, it transmits the data at about 1.677 GHz. These are prime, brand new units that were awaiting shipment from the manufacturer (Space Data Corporation) to the government when the contract was cancelled. These are complete except for battery (see G6850 below). We connected two 9V batteries in series and the unit worked perfectly from them. Each Radiosonde has a complete calibration data sheet. They were made in Feb. of 92. Sorry no schematic available. The main board contains the following ICs: 7555, CD4051, CD4520, LM324, 4151, TLC27L (2 pcs.) and a 78M15C voltage regulator. It also has the precision T05 case pressure sensor, hygristor sensor holder (humidity) sensor plate in a sealed container ready to insert into the holder), thermistor for temperature measurements and nose cone transmitter antenna assembly. Hurry, get your Radiosonde today!

G5058 $6.95

WATER ACTIVATED BATTERY IN A CAN



Made for radiosondes (above) these batteries are about 2 1/2"T x 2"W x 1 1/2"D. They were made in 1982 but they have almost an unlimited shelf life because they are not activated until you cut open the can, remove them and immerse in water for 2 minutes. Great for emergencies, camping, etc. We activated one as a test. We connected a 250Ω load resistor to the battery and powered the load for 10 hours. Terminal voltage was 20VDC and current flow was 80ma. These do need ventilation as they discharge and should be used outside only. Comes in sealed factory cans. Very unique item!

G6850 $2.00
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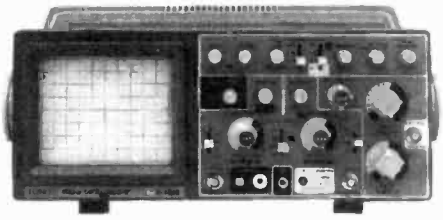


60MHz

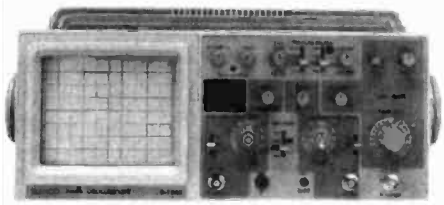
S-1360 $775

Delayed Sweep

S-1365 $849

Cursor Readout

- Voltage, Time
- Frequency differences displayed on CRT



40MHz

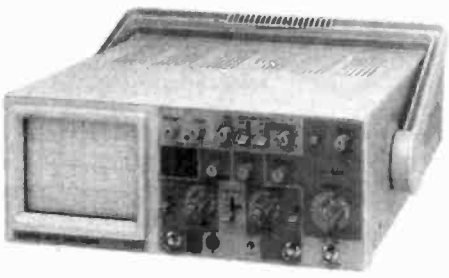
S-1340 $495

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

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- Signal delay line
- Component tester
- V mode-displays 2 signals unrelated In frequency

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- Sweeps to 2ns/div
- Dual time base
- Signal delay line
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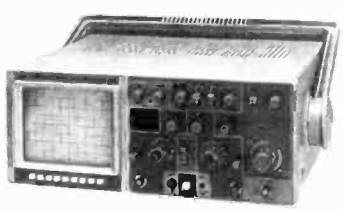

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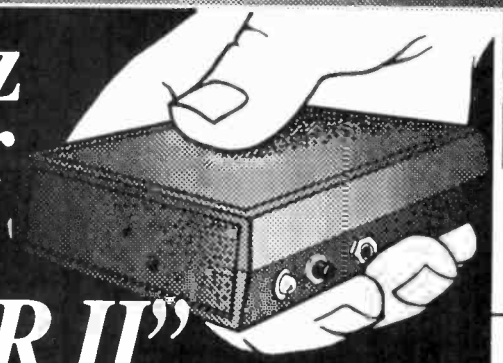
The "ZAPPER II"



Rainbow's new amateur radio transmitter.

With it's new and improved design it will not only test your radar detector... BUT it's tuned to the amateur radio band.

- While your out on American highways personally test yours and your fellow travelers radar detectors.

The "ZAPPER II" is a 10.450 GHz to 10.550 CW oscillator. It has a code key jack installed for those who want to send Morse code.

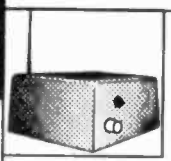
BUILT $49.95

KIT $39.95

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:1.25" x .6".

TEL-B1 KIT $12.95 BUILT $29.95



FM STEREO TRANSMITTER

Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your CD's while mowing the lawn, Play music on one channel sing on the other. Clarity is excellent, aprox. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls & crystal for stereo separation. 9v battery operation. SIZE: 1.5" x 2.5" x 3"

FMST-100 KIT $29.95 / Cabinet $8.95

A stand alone D•T•M•F decoder display unit

Connects to any phone, scanner,or amateur radio.

DECODES ANY DTMF SIGNALS

- Decodes digits 0 thru 9, #, *, A, B, C on a 2 line 16 character LCD display.
- Use the scroll switch to display all 490 digits last stored in its memory bank
  - See what numbers people are calling on your phone?
  - Is someone hiding the numbers they are calling by using another credit card?
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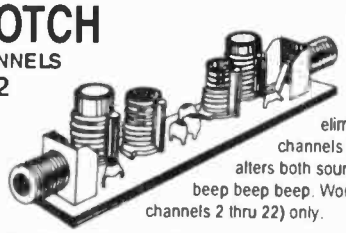
  - Great for telephone installers
  - Who's using secret codes on the air waves. The DTMF DECODER can grab them from the air. Power requirement 9v DC. SIZE: 3.5" x 4" x 1"
  - Decode the thousand of secret numbers sent over your scanner daily,

COMPLETE WITH BLACK ANODIZED CABINET

DTMF-DIS KIT $119.95 / BUILT $159.95

TV NOTCH FILTERS

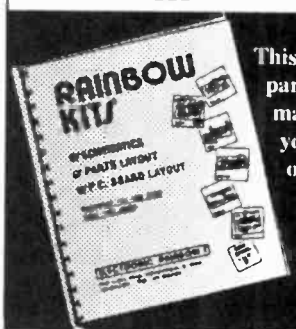
FOR CHANNELS 2 thru 22 ONLY



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) only.

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.

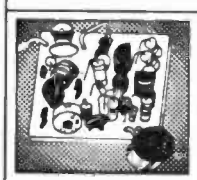
DF-222 KIT $14.95



This Manual contains schematics, parts lists & P.C. board layouts for many of the Rainbow Kits. Use your own parts to construct our kits.

KIT BOOK

$14.95 $9.95 with the purchase of any kit.



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. 6 to 12v DC. SIZE: 1.25" x 1"

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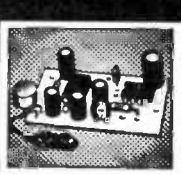

SUPER SNOOPER BIG EAR

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. Power requirement 6 to 12v DC. SIZE: 1" x .75"

AA-1 KIT $10.95 BUILT $29.95

YOU ASKED FOR IT WE'VE GOT IT

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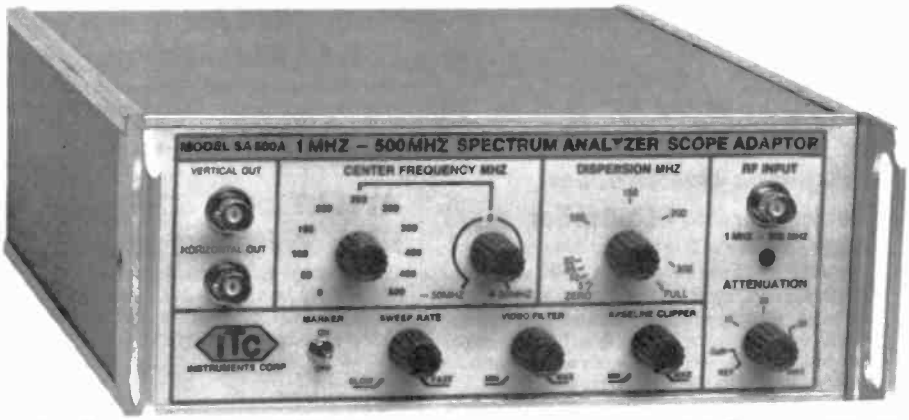
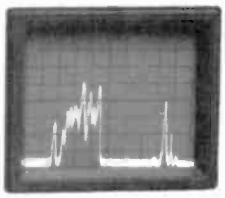


1 MHz TO 500MHz SPECTRUM ANALYZER



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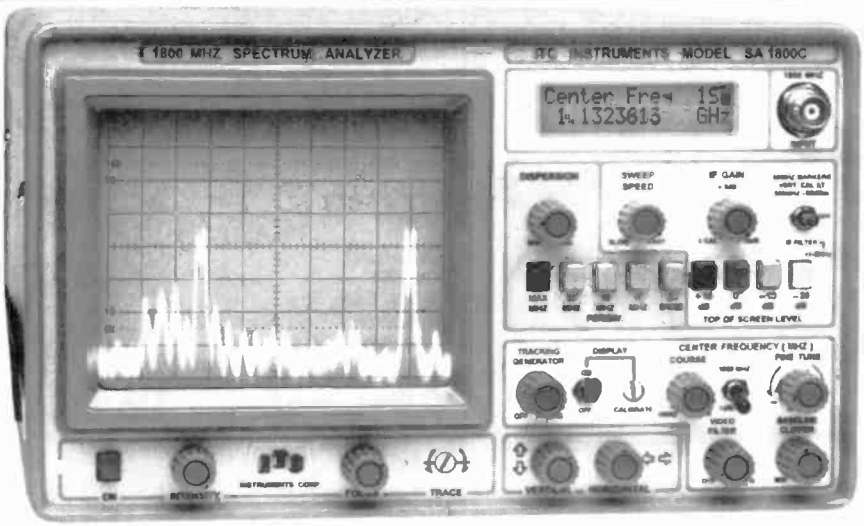

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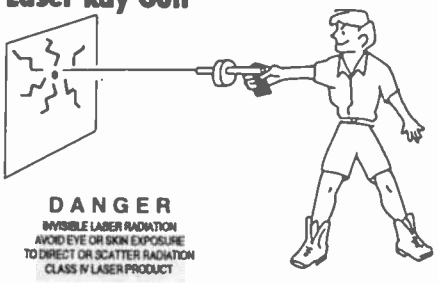

Advanced project produces a burst of light energy capable of burning holes in most materials. Hand-held device uses rechargeable batteries. 500 joules of flash energy excite either a neodynium glass, yag or other suitable 3" laser rod. This is a dangerous CLASS IV project (individual parts/assemblies available). LAGUN1 Plans $20.00
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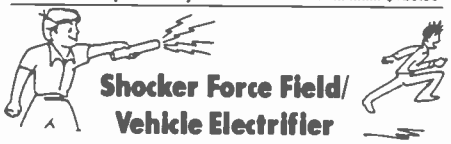

Neat little device allows you to make hand and shock balls, shock wands and electrify objects, charge capacitors. Great payback for those wise guys who have wronged you!

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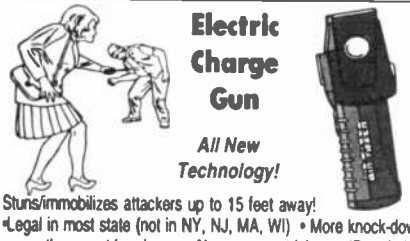
Electric Charge Gun



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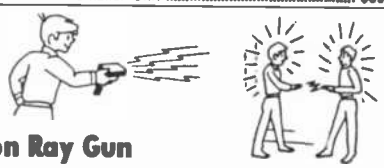

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Projects charged ions that induce shocks in people and objects without any connection! Great science project as well as a high tech party prank. IOG3 Plans $8.00
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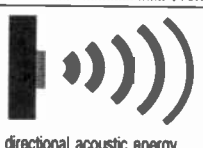

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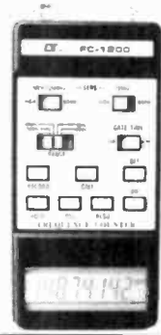

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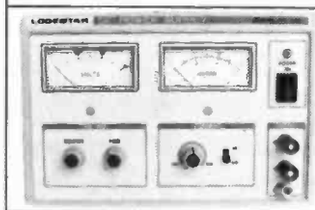

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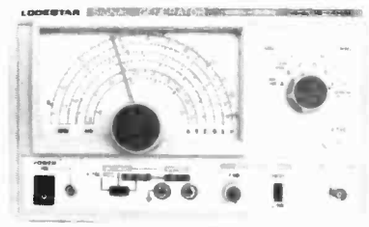

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29¢ Minimum 10 pieces per Item

Low Frequency Power Transistors

(AF driver, VCBO : 180V, 1.5A, 100 hFE)

BD-135	*(NPN-Si)*	Repl. ECG : 373
BD-136	*(PNP-Si)*	Repl. ECG : 374

(Voltage Regulators) Item No.		Repl. ECG N°
7805	*(Pos VR, 5V, 1A)*	960
7806	*(Pos VR, 6V, 1A)*	962
7809	*(Pos VR, 9V, 1A)*	1910
7812	*(Pos VR, 12V, 1A)*	966
7818	*(Pos VR, 18V, 1A)*	958
7824	*(Pos VR, 24V, 1A)*	972
7905	*(Neg VR, 5V, 1A)*	961
7906	*(Neg VR, 6V, 1A)*	963
7912	*(Neg VR, 12V, 1A)*	967
7915	*(Neg VR, 15V, 1A)*	969
7918	*(Neg VR, 18V, 1A)*	959
7924	*(Neg VR, 24V, 1A)*	971

Up to 60% Off On all replacement

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Order N°			
63-0425	CURTIS-MATHES	471-05200	$19.00
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62-490	PANASONIC	TLF-14617F	14.50
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63-0126	SHARP	RTRNF-0011PED	12.50
63-840	SHARP	RTRNF-0015CEZZ	12.50
63-0112	SONY	1-439-254-13	12.50
63-0170	SONY	1-439-254-00	12.50
63-0113	SONY	1-439-273-00	15.99
63-0346	SONY	1-439-235-00/11/21	17.00

ROCK BOTTOM PRICES ON POPULAR SEMI'S *(Minimum 10 pieces per Item)*

BU-208	$1.49	2SD 1398	1.49	STK-4273	6.49
2N-3055	0.99	2SD 1426	1.69	STK-5481	7.99
2N-3773	1.49	2SD-1427	2.25	TA-7777	6.95
2SD-871	2.29	2SD-1650	1.69	TDA-2005	1.99

CONNECTORS

F Male for RG 59/U Cable 4¢

- 1/4" ring included

Order N° 15-0459
Minimum 100 pieces

D Sub Connector 22¢

- 25 Pins • Solder Type

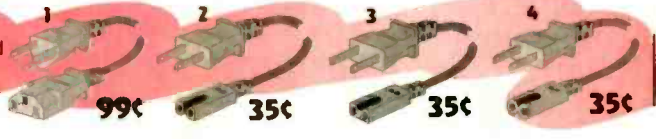
Order N°15-0976 ----Male
Order N°15-0973 ----Female
Minimum 10 pieces per Item

CABLES

6 feet long

Order N°		
1	17-1298	3 Prong AC cord
2	17-1299	SONY Type
3	17-1297	Panasonic Type
4	17-1460	Universal Type

Minimum 10 pieces per Item



99¢ 35¢ 35¢ 35¢

Dual RCA Plugs Minimum 10 pieces per Item

17-130	3 ft	39¢
17-135	6 ft	49¢
17-140	10 ft	70¢
17-145	15 ft	89¢
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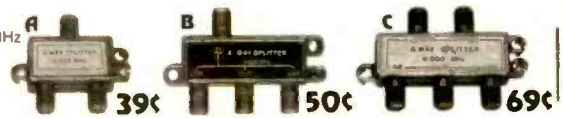
SPLITTERS

Zinc die cast • UHF/VHF/FM • 75Ω • 5-900 MHz

Order N°		
A	55-610	2Way
B	55-640	3Way
C	55-670	4Way

Minimum 10 pieces per Item



39¢ 50¢ 69¢

UHF/VHF/FM

- Indoor usage
- 75-300 Ω

19¢

Order N° 55-120
Minimum 10 pieces

Matching Tarnsformers

- F-59 push on to twin lead • 4-ft cable w/F-59 Conn.
- 75-300 Ω
- VHF

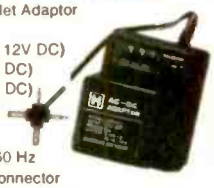
69¢

Order N° 55-170
Minimum 10 pieces

UNIVERSAL AC/DC CONVERTERS

- Multi-Output AC/DC Wall Outlet Adaptor

Order N°
40-001 (1.5, 3, 4.5, 6, 7.5, 9, 12V DC)
40-002 (3, 4.5, 6, 7.5, 9, 12V DC)
40-003 (3, 4.5, 6, 7.5, 9, 12V DC)



- LED power indicator
- Polarity Reversing Switch
- Switchable 110/220VAC 50/60 Hz
- 6' Molded Cable with Multi-connector

Minimum 5 pieces *(No Mixing Please)*

Order n°	Specs	Now
40-001	18W -1000mA	$2.75
40-002	9W - 500mA	2.25
40-003	5W - 300mA	1.99

3' TEST TIP TO BANANA PLUGS

- Black and Red set

Minimum 10 Pieces
Order N° 56-1006

UNIVERSAL DUAL TV ANTENNA

- 5 sections • 9 1/2" collapsed • 39" extended

99¢

Order N° 58-205 Minimum 10 pieces

DIGITAL MULTIMETER

- Overload protection on all ranges
- Diode test function • Built-In tilt stand.
- Polarity & Overload Indicators
- Withstands 5' drop.• Includes Fuse & spare
- 2000 Hr Battery life(9V)• Test leads.
- DC Voltage range: 200mV-1000V.
- AC Voltage range: 200V,750V.
- DC Current: 2-200mA,20A
- Resistance: 200Ω-20MΩ.
- Dim.: 6 1/2"(H) x 3 1/4"(W) x 1 1/2"(D).

Order N° 50-047 $22.99

10 COLOR CODED LEADS HEAVY DUTY

Order N° 56-500

- 10 Total Leads 2 each Black, Green, Red, Yellow, White
- 11" Long Wire Lead
- Insulated 1 1/2" Alligator Clips
- 20 Gauge Wire Size

Minimum 5 pieces

$1.49

6 OUTLETS POWER STRIP

- A.C. 125Volt, 15 Amp.(4 feet Cord)
- Lighted Switch
- Reset Circuit Breaker

Minimum 2 peces
Order N° 40-029

$4.49

INDOOR TV ANTENNA

- UHF / VHF / FM • 10" metal dish
- Antenna Length 37" extended
- Tuning / Rotator Knobs
- Base dimensions (6 3/4" X 9")

Order N° 58-1025 "Ivory Color"
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Minimum 2 pieces per item

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Please mention this ▶▶ CODE REO6 when ordering

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EEB NATIONS LARGEST RECEIVER OUTLET

SUMMER SUPER SALE!!!

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AR3000A[1-3]		$1029
SDU5000A/I		$997.95

GRUNDIG

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PRO62	(CALL)	$239.95
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Bearcat® SALE!!!

BC3000XLT 25-550/760-1300MHz[1]

• Scan 100ch/sec, search 300ch/sec, 400 memory channels, 20 x 20 banks.

LIST $499.95 **EEB $369.95**

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• Alpha numeric LCD on all 500 memory ch. Scan 100 ch/sec, search 300 ch/sec, data skip, attenuator 15dB, COR recorder control.

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BCT-7 All Band 26-956MHz[1]

• A must for the frequent highway travellers. 7135 pre-programmed chs., search by state & service. Police, HP, DOT, Fire, News, WX, CB, plus 100 User memories, scan 100 ch/sec.

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Other BEARCAT Scanners...

BC120XLT	$129.95	BC760XLT[1-2]	$199.95
SC150Y/B[1]	$169.95	BC860XLT[1]	$169.95
BC148XLT-1[1]	$99.95	BC890XLT[1-2]	$229.95
BC220XLT[1]	$224.95		

(1) Cellular Block (not restorable)
(2) Cellular Block, but can be restored
(3) Un-Blocked O.K. to qualified buyers (Govt., Export, etc.)

☛ *Check out EEB's NEW BBS!!!*
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JOIN THE OPTO/AOR REVOLUTION!!!

• **OPTO Electronics and AOR are revolutionizing the scanner world.** The new Scout 40 version 3.1 and the AOR AR2700/AR8000 scanners gives you the intercept power in your hands, that just a few years ago could only be a dream. Imagine having your scanner hop on a signal the instant someone presses the mic button. The Scout will reaction tune your AOR scanner in a blink of an eye to any locally generated signal.

☛ **WHERE is the Scout most effective?** Sporting events, car races, air shows, NEWS gatherings, accident scenes, air ports, railroads, marinas, fast food drive-thrus, many more applications. Everywhere you turn today there's a walkie-talkie in use. Listen in, it's your world.

☛ **WHO needs the Scout/AOR System?** NEWS service, local TV/Radio stations, Police, DEA, Air ports, anyone that wants to know what is being transmitted in the immediate area, plus thousands of scanner listeners, FBI, Law enforcement, SWAT team, and surveillance.

☛ **WHAT do you need?** 1. Scout 40 version3.1
2. AOR AR2700/AR8000 3. Input jack, modification to scanner
4. Interconnect cable. 5. Scout 40 V3.0 requires CB-AR cable $49.00

SAVE up to $300 OFF list price

EEB SPECIAL PACKAGE DEAL

• AR2700, Scout 40 version3.1, Mod to AR2700, cable, (regular discount price $899.90)...**Package Deal $839.95**

• AR8000, Scout 40 version3.1, Mod to AR8000, cable, (regular discount price $1090)...**Package Deal $1039.95**

EEB will install jack and wire in scanner, assure that your AOR warranty is good for one year and completely check out your system on our lab prior to shipping.
FREE with system purchase.

FREE AR2700/AR8000 Modification ($50 value)		
• AR2700	list $499.95	EEB $399.95
• AR8000	list $799.95	EEB $599.95
• MODS		EEB $50.00
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Special SONY Summer SALE!!!

• ICFSW55 •

"Among the best performers in compact portables, audio quality among the best, a superior performer in it's size class". (IBS Passport)

• 150kHz - 30MHz, 76 - 108MHz • AM, FM, CW, LSB, USB • 125 station memory preset • Factory preset name tuning provides easy access to popular SWL stations • Direct keyboard entry • World clock rotary tuning dial for roaming the dial • Power 6VDC, or 4 AA (not incl.) AC adaptor is included.

Other SONY's at Special Summer Prices

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Limited Time... **$319.95**

3 year Extended Warranty $39.95

WJ HF1000 World's Ultimate Receiver

$3799

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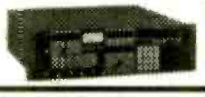

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Puts the fun back into AM Radio!!!

Everyone needs a good AM/FM DX radio. Great audio, large ferrite antenna, 4 I.F. stages.

$59.95

DRAKE R8A

Improved and upgraded version of the world famous R8.

- Improved Ergonomics
- Dynamic range (+100dB)
- 3rd OIP +20dBm
- Increase memory to 440 ch.
- Scan 40 ch/sec.

It's time to trade-in your R8, call for Quote.

R8A $1085.00

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96 Pages, SWL, Scanners, Antennas, Books, Lots more.

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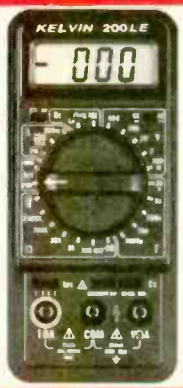

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AC/DC Voltages
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Freq. Counter
up to 20MHz
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10 Amp
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Inductance
resolution of 1uH
Freq. Counter
up to 20MHz
Cap. from
1pF to 200uF
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Transistor
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STANDARD FEATURES: ▲ AC/DC Voltages ▲ DC Current ▲ Resistance ▲ Continuity Tester Buzzer ▲ Diode Test ▲ 10M ohm Input Imp. ▲ Accuracy +/– 0.5% RDG

Protective Meter Cases for 100-300LE ....990088 ..... $4.95
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The Ultimate Meter

Popular Electronics (reviewed 5/93)

"Not only does the Kelvin 94 boast a lot of features...the features go the extra distance."

"If we had to run into a burning building to do some emergency trouble-shooting and could carry only one piece of equipment, the Kelvin 94 would be it!"

★ True RMS, LCR, Hz, dBm ★ 0.1% Accuracy ★

12 INSTRUMENTS IN ONE!

DC Voltmeter, AC Voltmeter, Ohmmeter, AC Current, DC Current, Diode Tester, Audible Cont. Tester, dBm, Freq. Counter, Capac. Meter, Inductance Meter, Logic Probe

#990111

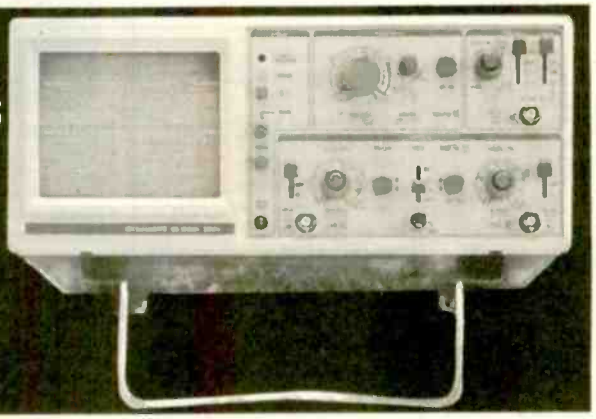
$199.95

GoldStar Precision

ANALOG OSCILLOSCOPES

OS-9020A
20Mhz, 2-Ch.
Dual Trace

#740085 **$385**



COMMON FEATURES

- 6" Rectangle CRT (8x10 Division)
- Variable Hold-off Function
- Ch 2 Polarity Inversion Switch
- Level Control for superior triggering
- High Sensitivity X-Y Operation
- Z-Axis (Intensity Modulation)
- Vertical Gain Sensitivity
- Horizontal Sweep Time X10 mag.
- TV Sync Circuit
- Automatic Focus
- 100-240V, 50/60 Hz Power Source
- Meets IEC-348 Safety Req.
- 2 Year Warranty
- Includes: operator's manual, spare fuses, power cord and probe set

100 MHz Analog w/ delayed sweep (Model OS-9100P).....*#740111* $1079
40 MHz Analog w/ delayed sweep (Model OS-9040D) .....*#740086*..... $695
20 MHZ Analog w/ 1 MHz function gen. (Model OS-9020G) .....*#740112*..... $559

GoldStar Precision

2MHz Sweep Function Generator

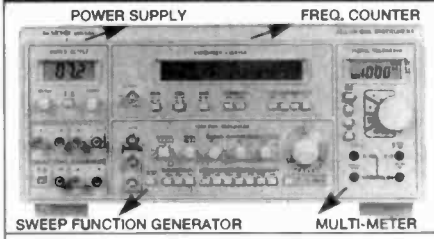
FEATURES

- 0.02 Hz - 2 MHz Sine, Triangle, Square, Ramp, Pulse, and TTL
- Variable Symmetry
- VCF
- DC Offset
- Maximum Attenuation: 40 dB

(Model FG-8002) *#720098* **$199**

Solutions for the Test Instrument

1 YEAR WARRANTY
15 DAY MONEY BACK GUARANTEE



MT-100

Reg. $599.

$399.00

Four Instruments in One Instrument

1 Function Generator
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- 0.2 Hz ~ 2MHz

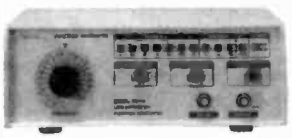
2 Frequency Counter
- 8 Digit LED
- 1 Hz ~ 100MHz
- ± (1 Hz + 1 dgt. + Time Base Error)

3 Power Supply
- 3-1/2 Digit LCD
- Triple output: #1. 0~50V, 0.5A MAX #2, 15V, 1A #3. 5V, 2A

4 Digital Multimeter
- 3-1/2 Digit LCD
- DCV, ACV, Ω, DCA, ACA
- ± (0.5% + 2 dgts)

FG-140 2MHz Function Generator

Reg. $249. **$149.00**



- 0.2 Hz ~ 2.0 MHz, 7 Decades
- Sine, Square, Triangle, Pulse, Ramp, Skewed Sine
- VCF, Symmetry
- Variable DC Offset Control

2MHz Sweep Function Gen. w/Freq. Counter

FG-150

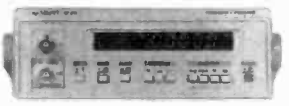
Reg. $399. **$229.00**

- 4 Digit LED Display
- Sine, Square, Triangle, TTL, Pulse, Ramp, Skewed Sine
- Linear/Logarithmic Sweep
- 10 MHz Freq. Counter

1.0GHz Frequency Counter, High Resolution

FC-200

Reg. $399. **$219.00**

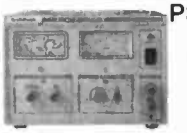


- 1.0 Hz ~ 1.0 GHz
- 8 Digit LED Display
- Auto & Manual Range
- 4 Selectable Gate Times
- 1MΩ & 50Ω Input Impedance

GoldStar O'scopes

Cursor Readout & Digital Storage

Call for BMC Unbeatable Prices



PS-500 DC Power Supply

Reg. $249. **$159.00**

- 0 - 30 VDC
- 0.1 ~ 3A
- Short & Overload Protection

PS-540 DC Power Supply

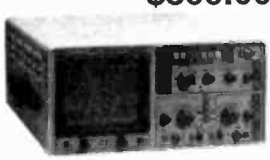
Reg. $399. **$289.00**

- 0 - 16 VDC
- 0.1 ~ 10A
- Short & Overload Protection

Deluxe O'scopes w/Phillips CRT. 2 yr. Parts/Labor Warranty

OS-3304 Reg. $499. $339.00

OS-3324 Reg. $599. $399.00



OS-3344 Reg. $899. $649.00

OS-3304 25MHz, Dual Trace

- 1 • DC to 25 MHz. Dual Channel
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 14n Sec. or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 2kV
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

OS-3324, 3 Function

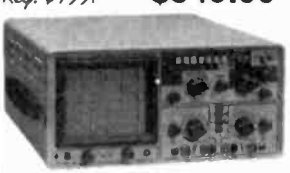
- 1 • OS-3304
- 2 • Dual Component Tester/Comparator
- 3 • Triple DC Power Supply 5VDC, +12 VDC, -12VDC

OS-3344, 5 Function

- 1 + 2 + 3 • OS-3324
- 4 • Frequency Counter 100MHz, 7 Digit LED Display
- 5 • Function Generator 0.02 Hz to 2.0 MHz

OS-3315 40MHz, Dual Trace Sweep Delayed

Reg. $799. **$549.00**



- DC to 40 MHz. Dual Channel
- Delayed Sweep 100nS to 1.0S 7 decade
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncallbration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 8.5nS or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 12kV
- Variable Hold Off
- 16ns ~ 1.0s Time Base
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

BelMERIT DM5050C DM5100

Reg. $149.

$89.00

including Deluxe Holster

Features (DM5050C/DM5100)

- Basic DCV Accuracy: ± 0.25%
- AC/DC Volt & Amp, Ohm
- Diode, Continuity Beeper
- Alligator Clip Test Leads
- Lead Holders/Velcro Strap Holster

DM5050C, DMM + Capacitance

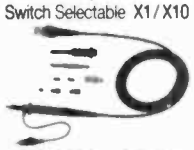
- 9 Function / 42 Range
- Multimeter
  - Ohm: Up to **2000MΩ**
  - Amp: AC/DC 2 Amp
- Extended Capacitance Meter (9 Range)
  - **0.1pF - 20,000µF**
  - Zero Adjust Knob
- Trig Lamp

DM5100, Wide Range w/Logic

- 11 Function / 45 Range
- Auto Power Off
- Data Hold & Peak Hold
- Freq: Up to **20MHz**
- Amp: Up to **20A AC/DC**
- Ohm: Up to **200MΩ**
- Capacitance: **1p - 200µF**
- Logic: TTL, TR hFE

Oscilloscope Probe Kit

Switch Selectable X1 / X10



HP-9060, 60MHz Reg. $29. **$19.00**

HP-9150, 150MHz Reg. $49. **$29.00**

HP-9250, 250MHz Reg. $59. **$39.00**

Capacitance Meter

Reg. $79. **$49.00**

CM210
- 3 1/2 Digit LCD
- 0.1p-20,000µF 9 Ranges
- 0.5% basic Accu.
- Zero Adjust Knob
- Test Leads & Built in Socket

Pen-Type DMM w/Logic

Reg. $79. **$59.00**

DM150
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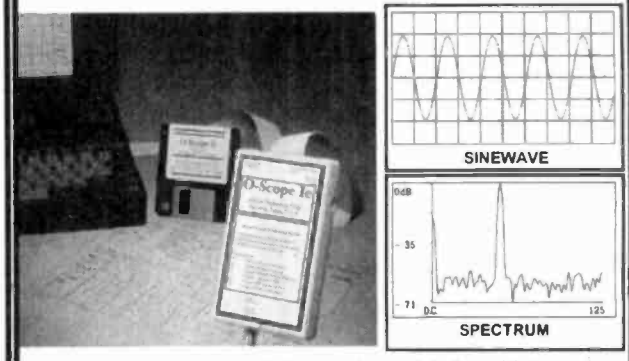

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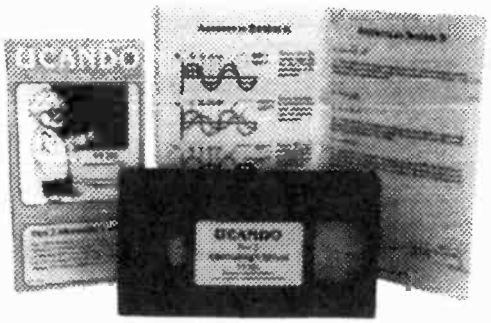

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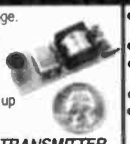

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- Transmits at 143 MHz.
- Amazing audio sensitivity, picks up sounds at the level of a whisper.

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PP114RE	114mm x 185mm/4.6" x 6.6"	2.98	2.45	1.98
PP152RE	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153RE	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10

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CAT NO	DESCRIPTION	PRICE EACH 1	10	50
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GS114RE	114mm x 185mm/4.6" x 6.6"	4.80	3.49	3.20
GS152RE	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153RE	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80

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CAT NO	DESCRIPTION	PRICE EACH 1	5
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CAT NO	DESCRIPTION	PRICE EACH 1	10	25
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CAT NO	DESCRIPTION	PRICE EACH 1	5
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823RE	1/64" Pencil Tip	1.39	1.19
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OT-3	7k	4,8,16	B	ELM 20 WATT	18.00	21.00

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OUTPUT TRANSFORMERS DESIGNED FOR SIMPLE OUTPUT STAGES AND FEATURE FREQUENCY RESPONSE ±2 dB 40-15k Hz.

Power Supply

MODEL	SECONDARY #1	#2	#3	CASE STYLE	USE	PRICE $ A	B
PT-1	125V 25mA	6V3 3A		B	PRE AMP	9.00	11.00
PT-2	250-0-300 70mA	5V 2A	6V3 2A	B	5W AMP	18.00	24.00
PT-3	300-0-300 70mA	5V 2A	6V3 2A	B	10W AMP	20.00	26.00
PT-4	400-0-400 180mA	5V 3A	6V3 4A	B	20W AMP	24.00	30.00

Pots

PART #	Ω	TYPE	PRICE $ A	B
APOT-1	100k	S LIN	2.75	3.00
APOT-2	100k	S LOG	2.75	3.00
APOT-3	100k	D LIN	5.50	6.00
APOT-4	100k	D LOG	5.50	6.00
APOT-5	470k	S LIN	2.75	3.00
APOT-6	470k	S LOG	2.75	3.00
APOT-7	1M	S LIN	2.75	3.00
APOT-8	1M	S LOG	2.75	3.00
APOT-9	1M	D LIN	5.50	6.00
APOT-10	1M	D LOG	5.50	6.00
APOT-11	100k	D LOG	6.50	7.00

(FOR BALANCING)

MOUNTING HOLES 10mm (.393") DIA., SHAFTS 6mm (.236") DIA. BLACK MATTE KNOBS 15mm (.590") DIA. 14mm (.551") SUPPLIED. B = SINGLE D = DUAL

Sockets

PART	TYPE	PRICE $ A	B
TS-1	7 PIN S	1.80	2.10
TS-2	7 PIN P	1.90	2.10
TS-3	9 PIN S	1.90	2.10
TS-4	9 PIN P	1.90	2.10
TS-5	8 PIN OCTAL S	2.50	2.70
TS-6	8 PIN OCTAL P	2.50	2.70

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MPB-2	1 x 4 x 1	2.40	2.75
MPB-3	1 x 6 x 1	2.85	3.25
MPB-4	1.5 x 2 x 1.5	2.05	2.25
MPB-5	1.5 x 4 x 1.5	2.55	2.85
MPB-6	1.5 x 6 x 1.5	3.00	3.50
MPB-7	1.5 x 2 x 3	2.25	2.55
MPB-8	1.5 x 4 x 3	2.75	3.15
MPB-9	1.5 x 6 x 3	4.00	4.50
MPB-10	1.5 x 2 x 5	2.50	3.00
MPB-11	1.5 x 4 x 5	2.95	3.55
MPB-12	1.5 x 6 x 5	4.25	5.05
MPB-13	2 x 2 x 2	2.20	2.60
MPB-14	2 x 4 x 2	2.65	3.15
MPB-15	2 x 6 x 2	4.40	5.00
MPB-16	2 x 8 x 2	6.65	7.35
MPB-17	3 x 2 x 3	2.45	2.95
MPB-18	3 x 4 x 3	2.80	3.50
MPB-19	3 x 6 x 3	4.20	4.90
MPB-20	3 x 8 x 3	4.65	5.45
MPB-21	4 x 6 x 3	4.55	5.15
MPB-22	4 x 10 x 3	4.75	5.45
MPB-23	4 x 12 x 3	5.70	6.30
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RSR-10-19	10	70.00	80.00
RSR-12-19	12	70.00	80.00

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We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but, in all cases, full payment must accompany your order.

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The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

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Our classified ad rate is $1.75 per word. Minimum charge is $26.25 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

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General Information: A copy of your ad must be in our hands by 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.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. POPULAR ELECTRONICS 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.

CONTENT

All classified advertising in POPULAR ELECTRONICS is limited to electronics items only. All ads are subject to the publishers approval. WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.

AD RATES: $1.75 per word, Minimum $26.25

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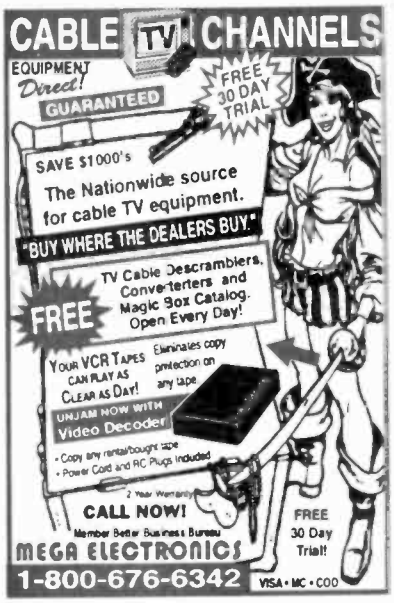

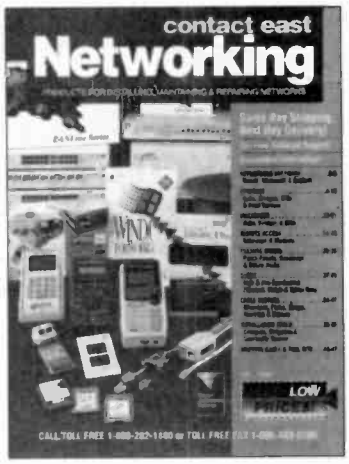

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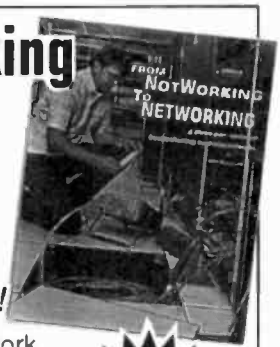

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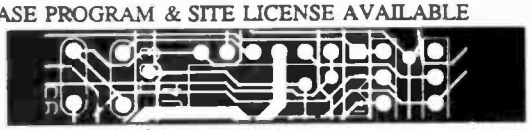

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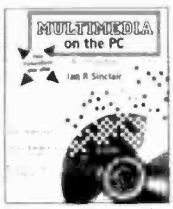

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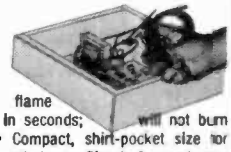

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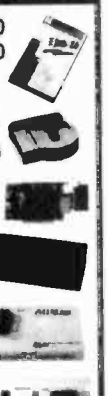

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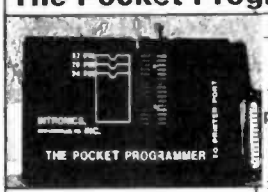

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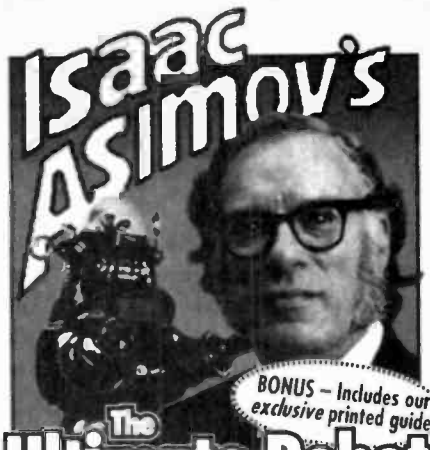

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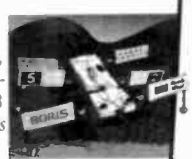

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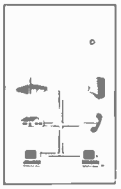

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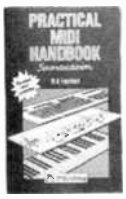

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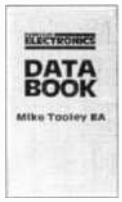

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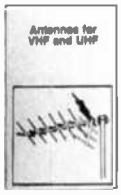

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