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August 1995

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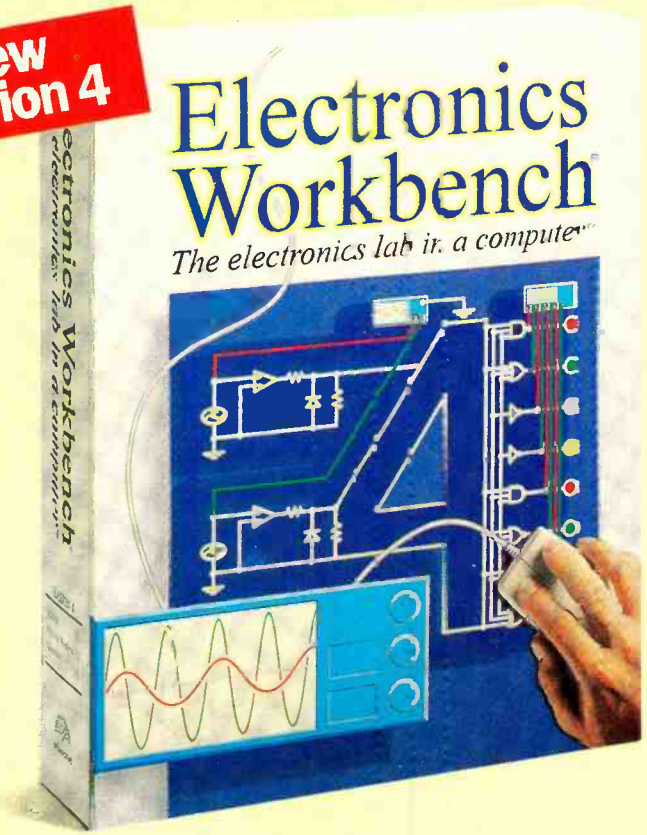

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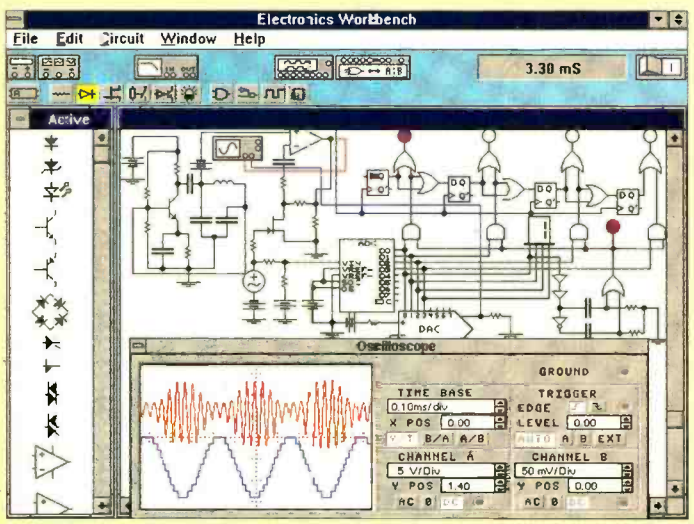

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Vol. 12, No.8

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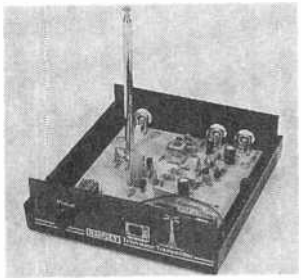
FEATURES



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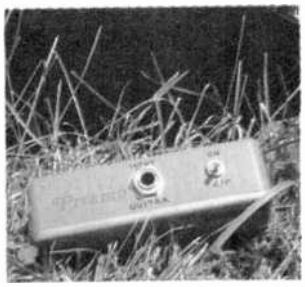

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AUGUST 1995

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ABC AUDITED

EDITORIAL

GETTING CONNECTED

It's everywhere, and no matter where you turn, you can't get away from it. The "it" I am referring to is the Internet. In a relatively short time the Internet has evolved from an obscure computer network—linking students, researchers, scientists, and the like—into an all-encompassing entity whose links in some way reach, or will reach, each and every one of us.

How did that happen? One contributing factor is the interest generated by all of the recent and ongoing "information superhighway" hype. Another is the development of the World-Wide Web. The "web" is a collection of searchable hypertext documents, called pages, that exist on thousands of computers around the world. Using a graphical interface, a user can "point and click" his or her way to those pages and gather all types of information, including images, audio, and even video.

By now, you might be wondering what all that has to do with electronics hobbyists? The answer is plenty. The Internet might be the most important resource today's hobbyist could have. Many electronics manufacturers have web pages. There are also resource lists that can steer you to sources of new and surplus parts, information, and more. Then there are the newsgroup discussions covering electronics, electronics servicing, satellite TV, consumer electronics, ham radio, and much more.

The downside to all of that is the chaos that exists on the Internet. Imagine a superhighway with no lane markings, speed limits, or traffic cops and you begin to get the idea. Finding exactly what you need can be difficult even for experts, and confusing, frustrating, and intimidating for the novice.

That's about to change. In the coming months, **Popular Electronics** will do its part to help you get the most out of the Internet, with a special emphasis on resources for the electronics hobbyist. Watch for our coverage; you won't be disappointed.

Carl Laron
Editor

LETTERS

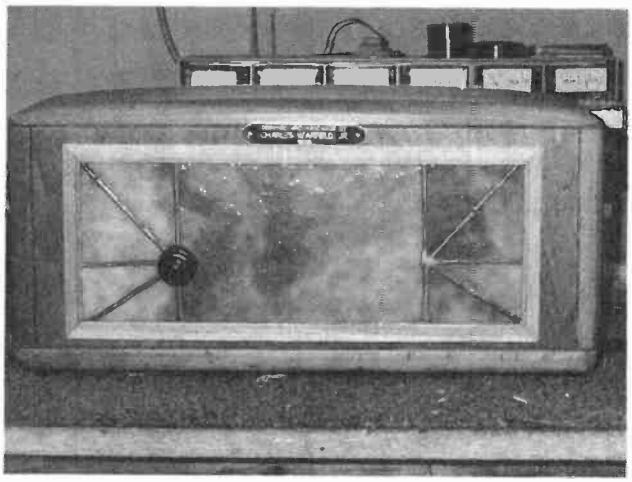
EVERYTHING OLD IS NEW AGAIN

I wanted to tell you about an AM/FM radio that I recently completed, based on the Elenco receiver ("Hands-on Report," November 1994) and the vacuum-tube amplifier ("Build a Vacuum-Tube Amplifier," January 1995).

At first glance, the project looks easy: Connect a simple AM/FM receiver to an even simpler tube amp. But because it was to be a gift to my parents, extra care and work was required.

The radio is housed in a 1930s solid walnut cabinet that I rescued from a friend's junk pile. It was in pretty bad shape, needing complete refinishing and repair to a large crack in the side. The front panel features low-voltage lighting behind a handmade stained glass insert.

The lights and receiver are powered by 12 volts picked off the output of T1 in the amp's power supply, using a common LM317T regulator for the receiver. I found that the Elenco unit works best when the regulator is set at exactly 9.5 volts. To retain the simplicity and beauty of the stained glass, only the unmarked tuning knob is on the front of the set. All other controls are located on the back panel, situated in such a way that they can be used without turning the unit around. I included a tiny muffin fan (available at hamfests for about $4) to keep everything cool.



A resourceful reader combined the information found in two articles with his own ingenuity and know-how, to create this beautiful AM/FM radio housed in a restored 1930s vintage cabinet.

After adding an external antenna and speaker jack, I was ready to go! For my application, a 15-µF capacitor was shunted across the speaker to eliminate excessive high end. My speaker is a Radio Shack Optimus XTS-40 mounted in a homemade cabinet built to match the radio.

Total construction time was about 100 hours, including the stained glass, speaker, and refinishing the cabinet. The end result was a beautiful piece that sounds stunning and looks elegant—a perfect accent to my parents' antique-filled Victorian-era home.

Thank you, **Popular Electronics**, for plotting the map for me!

C.W., JR.
Naperville, IL

SPELLING CORRECTION

Paul Coxwell's article, "Beyond Ohm's Law" (**Popular Electronics**, May 1994), is well written and very understandable. I have taught Electrical Engineering courses on that very subject (for over 35 years—groan!).

What struck me instantly was the spelling of "Kirchhoff." Just a minor point, but the German physicist spelled his name with 2 "h"s. A beginner, seeing the name misspelled about 12 times throughout the article will be lead to believe that "Kirchoff" is correct. "Kirchhoff" is listed in *The American College Dictionary* (1964 edition).

I am not a spelling freak, so please accept this observation as a good-natured comment.

A.C.E.
Professor Emeritus
Worthington, OH

HAVES & NEEDS

I am seeking the manual, schematic, parts list, and tube charts for a Band K Precision Model 666 Dynajet tube tester. I'd appreciate any help from fellow **Popular Electronics** readers.

LARRY COOK
32 East South Street
Richland Center, WI 53581

I am trying to complete my collection of Fact Cards. I have quite a few, but I'm still missing the following numbers: 69–99, 118–126, 145–147, 169–171, 178–180, 184–189, 196–198, 211–222, 229–231, 235–243, 247–249, 256–264, 268–end. Thanks for any and all help.

J.S. (JACK) HILBY
Perry Technical Institute
2011 West Washington Avenue
Yakima, WA 98903

I need the schematics and manuals for a Sierra/Philco Model 219B transistor checker and a Sylvania Model 29 tube tester. I will pay for any postage and copying costs. Thanks in advance.

ROBIN EVANS
622 Stevenson St.
Jacksonville, AR 72076-4848 ■

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NEW PRODUCTS

Electronic Stamp Maker

Brother International's P-Touch StampCreator is an electronic machine that allows consumers to make custom, pre-inked stamps instantly. The device eliminates the need to buy standard stamps at stationery stores or special-order custom stamps from a printer.

The StampCreator is aimed at small businesses as well as consumers. It allows users to mark invoices, checks, envelopes, and documents with attention-grabbing messages. Instead of the usual "Paid in Full" or "Received" messages, documents can be marked with addresses, shipping instructions, special sale notices, and other customized imprints. Parents can use the StampCreator to mark their kid's school supplies and clothing with personalized name tags.

The StampCreator features a QWERTY-style keyboard and a 14-character by two-line graphic LCD readout. Three different sizes of stamps can be created—2¾ × 1⅛ inches, 2¾ × ⅜ inches, and 1¼ × ⅜ inches—with up to nine lines of horizontal or vertical copy, in black or red ink. With 163 available symbols and three built-in fonts, users can get creative when designing stamps. The machine also comes with 20 built-in templates and 25 pre-made stamps.

Each StampCreator stamp unit contains a handle, a leak-proof, pre-filled ink pad, and a thin layer of protective film. During stamp creation, the machine's thermal head melts tiny holes in the film, through which the ink can pass when the handle is pressed. Each stamp, therefore, is like a custom silk-screen or stencil of the desired message.

The StampCreator costs less than $300. For more information, contact Brother International Corporation, 200 Cottontail Lane, Somerset, NJ 08875-6714; Tel. 908-356-8880; Fax: 908-356-4085.

CIRCLE 101 ON FREE INFORMATION CARD

UPDATED AC/DC CURRENT TRANSFORMER

Wavetek's CT-233A current transformer has been upgraded to allow non-invasive measurement of AC and DC current up to 1000 amps when used with a standard digital multimeter, and improved response for AC. The upgrade features increased accuracy, 1-kHz AC-frequency response, zero adjust to compensate for residual magnetic flux, and an LED battery indicator. The newly designed clamp jaws improve alignment and performance. When measuring current with the clamp, there is no need to break a circuit or affect the isolation, allowing for safe high-current measurement.

The CT-233A converts sensed current into a millivolt (mV) output. That output is displayed as a voltage, typically as 1 mV, with 1 amp equal to 1 mV. Typical applications include testing UPS battery packs, measuring generator starter currents, motor start and run currents, and automobile cranking currents, and trouble-

shooting electrical systems.

The CT-233A AC/DC current transformer has a list price of $199. For further information, contact Wavetek Corporation, 9045 Balboa Avenue, San Diego, CA 92123;
Tel. 619-279-2200;
Fax: 619-565-9558.

CIRCLE 102 ON FREE INFORMATION CARD

ELECTRONIC TAPE MEASURE

Aimed at do-it-yourselfers, professional contractors, interior designers, and real-estate salespersons, the *Model HC-500 ProTape 16* from *Seiko Instruments* is a standard-sized, electronic tape measure that acts like a calculator and a computer. Housed in a rugged polycarbonate case, it includes a convenient belt hook and a durable, 16-foot by ¾-inch steel tape that shows 16-inch stud centers, feet, inches, and metric units.

The ProTape 16 measures accurately to 1/16 of an inch. It features an LCD readout and has the ability to freeze a measurement and add cumulative measurements in memory. A "display lock" feature freezes the readout even after the tape has been retracted, and the CASE+ button adds the length of

the case for easy inside measurements. A retractable "pinpoint anchor" can be used to mark circles and arcs as the ProTape is rotated. To conserve battery life, the device automatically shuts off after 30 seconds of inactivity.

The Model HC-500 ProTape 16 has a suggested price of less than $50. For additional information, contact Seiko Instruments, Inc., 2990 West Lomita Blvd., Torrance, CA 90505; Tel. 310-517-7810.

CIRCLE 103 ON FREE INFORMATION CARD

"RANGEMASTER" DIGITAL MULTIMETER

The *Rangemaster* heavy-duty, autoranging digital multimeter from *Extech* measures frequency from 2 kHz to 15 MHz, capacitance from 2 nF to 20 μF, AC/DC voltage from 200 mV to 600 volts, AC/DC current from 20 mA to 10 amps, and resistance from 200 to 2000

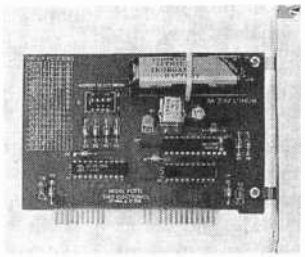
megohms. Its basic accuracy is ±0.8% of the reading. The Rangemaster also can be used for logic, transistor, and diode checks, as well as audible continuity tests. Other features include a 3-1/2-digit LCD readout, an input warning beeper to alert the user if the test leads plugged into the socket do not match the function selected, color-coded safety input jacks, fused protection for current inputs, overload protection on all ranges, and a low-battery indicator. It is drop-proof to four feet, and meets UL 1244 and IEC-348 standards.

The Rangemaster (model number *380262*) digital multimeter, complete with test leads, 9-volt battery, and a hard rubber holster with stand and wrist strap, costs $69. For more information, contact Extech Instruments, 335 Bear Hill Road, Waltham, MA 02154; Tel. 617-890-7440; Fax: 617-890-7864.

CIRCLE 104 ON FREE INFORMATION CARD

STABLE REAL-TIME CLOCK

By adding a stable real-time clock to your computer, you can make it a reliable timekeeper. *B&B Electronics' Model PCRTC* is an accurate, temperature-sta-



ble, real-time clock that is based on a highly stable oscillator circuit. The PCRTC's clock uses a software driver to update the DOS clock every minute. That allows the user and all applications to access the correct time without using any special commands or function calls.

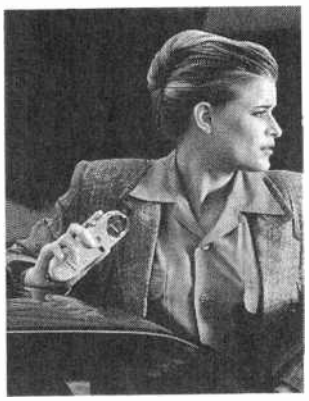
The eight-bit short-slot PCRTC card, which does not require IRQ lines, reduces your computer's clock error to 15 seconds per month, or less than five seconds per month if operating in a temperature-stable environment. When power is off, a 3.6-volt lithium battery maintains the clock. A battery-status function lets you replace a low battery before the time is corrupted, and a register helps you log and determine the time of last power loss or reset.

The PCRTC, including the software driver, a time-setting utility, and a simple command library on a 3.5-inch floppy disk, costs $129.95. For more information, contact B&B Electronics Manufacturing Company, 707 Dayton Road, P.O. Box 1040, Ottawa, IL 61350; Tel. 815-434-0846; 24-hour Fax: 815-434-7094; 24-hour BBS: 815-434-2927; Internet: catrqst@B&B-elec.com.

CIRCLE 105 ON FREE INFORMATION CARD

PERSONAL SECURITY ALARM

The *Radio Shack Personal Security Alarm* is a robbery deterrent that you can carry with you anywhere—when jogging at night, or returning to your car in a deserted parking lot, for instance. Weighing just four ounces (including battery), the alarm can be carried in a purse or pocket with the handstrap worn around the wrist. When the handstrap is pulled out, a 110-dB siren sounds and a bright strobe light flashes to attract attention and discourage thieves. If the Personal Security Alarm is knocked away during a struggle, the strap will also pull out. The strobe light, visible from both the front and sides of the unit, makes it easier for help to find you. Also, the alarm cannot be shut off without reinserting the hand strap's pin in



the alarm slot, and the batteries cannot be easily removed without a screwdriver.

If your vehicle becomes disabled, the strobe light can also be used to summon help without sounding the alarm. A slide switch activates just the strobe.

The Personal Security Alarm is available for $24.99 at Radio Shack stores nationwide. For further information, contact Radio Shack, 700 One Tandy Center, Fort Worth, TX 76102; Tel. 817-390-3300. ■

CIRCLE 106 ON FREE INFORMATION CARD

Space-age speaker defies physics by breaking the sound barrier

Recoton develops wireless speaker technology that "clones" your stereo, providing stereo music 150 feet through walls, ceilings and floors.

Breakthrough wireless speaker design blankets your home with music.

by Charles Anton

If you had to name just one new product "the most innovative of the year," what would you choose? Well, at the recent *International Consumer Electronics Show*, critics gave Recoton's new wireless stereo speaker system the *Design and Engineering Award* for being the "most innovative and outstanding new product."

Recoton was able to introduce this whole new generation of powerful wireless speakers due to the advent of 900 MHz technology. This newly approved breakthrough enables Recoton's wireless speakers to rival the sound of expensive wired speakers.

Recently approved technology. In June of 1989, the *Federal Communications Commission* allocated a band of radio frequencies stretching from 902 to 928 MHz for wireless, in-home product applications. Recoton, one of the world's leading wireless speaker manufacturers, took advantage of the FCC ruling by creating and introducing a new speaker system that utilizes the recently approved frequency band to transmit clearer, stronger stereo signals throughout your home.

Crystal-clear sound anywhere. Just imagine listening to your stereo, TV, VCR or CD player in any room of your home—without running miles of speaker wire. Plus, you'll never have to worry about range because the new 900 MHz technology allows stereo signals to travel distances of up to 150 feet through walls, ceilings and floors without losing sound quality.

A single transmitter, unlimited receivers. The powerful transmitter plugs into an audio-out, tape-out or headphone jack on your stereo or TV component, transmitting wirelessly to speakers or headphones. The speakers plug into an outlet. One transmitter broadcasts to an unlimited number of stereo speakers and headphones. And since each speaker contains its own built-in receiver/amplifier, there are no wires running from the stereo to the speakers.

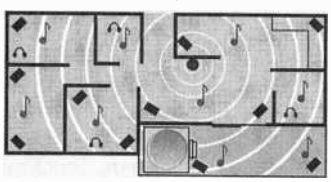
Full dynamic range. The speaker, mounted in a bookshelf-sized acoustically constructed cabinet, provides a two-way bass reflex design for individual bass boost control. Full dynamic range is achieved by the use of a 2" tweeter and 4" woofer. Plus, automatic digital lock-in tuning guarantees optimum reception and eliminates drift. The new technology provides static-free sound in virtually any environment. The speakers are also self-amplified; they can't be blown out no matter what your stereo's wattage.

Stereo or hi-fi, you decide. These speakers have the option of either stereo or hi-fi sound. Use two speakers (one set on right channel and the other on left) for full stereo separation. Or, if you just want to add an extra speaker to a room, set it on mono and listen to both channels on one speaker. Mono combines both left and right channels for hi-fi sound. This option lets you put a pair of speakers in the den and get full stereo separation or put one speaker in the kitchen for hi-fi sound.

150 foot range through walls!

Recoton gives you the freedom to listen to music wherever you want. Your music is no longer limited to the room your stereo is in. With the wireless headphones you can listen to your TV, stereo or CD player while you move freely between rooms, exercise or do other activities. And unlike infrared headphones, you don't have to be in a line-of-sight with the transmitter, giving you a full 150 foot range.

The headphones and speakers have their own built-in receiver, so no wires are needed between you and your stereo. One transmitter operates an unlimited number of speakers and headphones.



Recoton's transmitter sends music through walls to wireless speakers over a 70,000 square foot area.

Factory-direct savings. Our factory-direct pricing allows us to sell more wireless speakers than anyone! For this reason, you can get these speakers far below retail with our 90-day risk-free home trial."

Add headphones and save $100. For a limited time, when you order two speakers and a transmitter, you can add wireless headphones for only $49. That's a savings of $100 off the price of the headphone system. This exclusive offer is available only through Comtrad. Your order will be processed within 72 hours and shipped UPS.

Recoton transmitter.....$69 $7 S&H
Recoton wireless speaker .....$89 $9 S&H
Wireless headphone system.....~~$149~~ $9 S&H
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Please mention promotional code **723-PL6625.**

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COMTRAD INDUSTRIES
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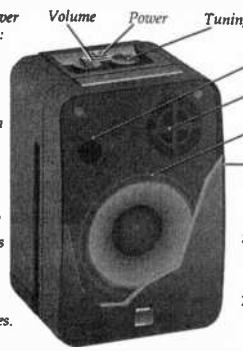
AWARD WINNING WIRELESS SPEAKER

Built-in receiver and amplifier:

The wireless speaker and headphones both contain a built-in receiver and amplifier. Signals are picked up and transmitted as far as 150 feet away through walls without the use of wires.



Size: 9"H x 6"W x 5.5"L
Signal-to-noise ratio: 60 dB
Channel Separation: 30 dB
Two-way bass reflex design
10 watts/channel RMS amps
Frequency Response: 50 Hz-15 KHz

Don't take our word for it. Try it yourself. We're so sure you'll love the new award-winning Recoton wireless speaker system that we offer you the **Dare to Compare Speaker Challenge.** Compare Recoton's rich sound quality to that of any $200 wired speaker. If you're not completely convinced that these wireless speakers offer the same outstanding sound quality as wired speakers, simply return them within 90 days for a full "No Questions Asked" refund.

Recoton's Design and Engineering Award

GIZMO®

Ready to Roll

NEC READY MULTIMEDIA COMPUTER. From NEC Technologies, Inc., 1414 Massachusetts Ave., Boxborough, MA 01719. Tel. 518-264-8759. Price: $2699.

Back when we were in school, having a home computer was not something that we would always admit to. In the right company, of course, we could talk about some new version of BASIC or argue the benefits of adding another two kilobytes of memory. Home computers then were strictly for hobbyists; they were fun only if you were a nerd.

Things have really changed. Today, the PC competes with the TV as an entertainment medium. Surveys by computer manufacturers and market research firms support the idea that computer users are replacing some of the hours that they used to spend in front of their sets with time in front of their computers. Even more telling, some computer users have canceled premium channels to give themselves more time—and more money—to enjoy their new computer hobby.

Don't worry too much about the TV industry, however. Market penetration is still at 98 percent, while only 37 percent of homes have personal computers. Nonetheless, home-PC sales have soared, increasing by 28 percent between 1993 and 1994. They're expected by some estimates to double over the next four years. Almost half of all U.S. households are expected to have a PC by 1997.

The PCs that are being bought are getting increasingly powerful, too, allowing them to be used for more demanding, but user-friendly, applications and increasingly sophisticated games. Perhaps the biggest factor driving sales is that parents view the computer as an essential tool in their children's education.

Even though computer prices have dropped dramatically when considering performance, buying a new computer hasn't really gotten any easier—it can be a daunting task even for experienced "techies." Walk into your local computer superstore and you'll be confronted by a row of thirty or more systems from which to choose.

How do you choose? All of the systems look alike and share many similarities—but they also have many important differences. The microprocessor and its speed are usually the most important factors to consider when choosing a system. Once that is out of the way, other components determine a system's price/performance ratio. What software is bundled with the system? Is the system upgradeable? What other hardware and software do you have to buy before you can *really* use the system for what you want to do?

Two factors are likely to sway your decision: Choose the features that are important to you, and go with a company you know. *NEC Technologies* is betting that its new line of *Ready* systems will answer both requirements.

NEC Technologies became a major player in the computer industry by concentrating on portable computers, servers, printers, CD-ROM hardware, and graphics-display products. It is now making a major push into the consumer market by concentrating on family computing, entertainment, and the small-office/home-office (SOHO) segments. Its offerings are geared toward users who are not sophisticated about assembling computer systems—the new systems strive to include everything that a home-computer user could want and still be easy to use.

NEC is counting on consumers to recognize the NEC name and its tradition of quality. It backs that up by providing toll-free technical support, and all of the features that make multimedia computing possible—and fun.

The new NEC Ready computers are available in five models, ranging in price from $1699 to $2999. An 80486 DX4-100 microprocessor powers the Ready model 5010 at the low end. A 100-MHz Pentium powers the Ready 9520 at the high end. Other features that differ between the five models include the memory, hard-disk size, graphics capability, and external speakers.

We examined the Ready 9510. That computer is powered by a 90-MHz Pentium processor and comes equipped with 16 megabytes of RAM and a 1275-megabyte hard disk drive.

All NEC Ready computers come with an attractive software bundle, including

SYSTEM CONFIGURATIONS

Ready System	5010	7020	9010	9510	9520
Processor	486-DX4	Pentium	Pentium	Pentium	Pentium
Speed	100 MHz	75 MHz	90 MHz	90 MHz	100 MHz
RAM	8 MB	8 MB	8 MB	16 MB	16 MB
Disk Drive	540 MB	850 MB	850 MB	1275 MB	1275 MB
Graphics	32-bit PCI	64-bit PCI	64-bit PCI	64-bit PCI	64-bit PCI
Audio	16-bit, wavetable-upgradeable	16-bit, wavetable-upgradeable	16-bit, wavetable-upgradeable	16-bit, wavetable-upgradeable	16-bit, wavetable included
Speakers	Quickshot	Quickshot	Labtec CS-800	Labtec CS-800	Altec Lansing
Price	$1,699	$1,999	$2,299	$2,699	$2,999

MS-DOS 6.22, Microsoft Windows for Workgroups 3.11, Microsoft BOB, Microsoft Works, Microsoft Encarta95, Intuit Quicken, Broderbund Print Shop Deluxe, MidiSoft Sound Impression, SofNet FaxWorks, Broderbund Arthur's Birthday Party, NetSoft NetCruiser, Prodigy, America Online, Compuserve, and the *Imagination Network.*

Microsoft Bob is intended to give first-time computer users a friendly "social interface" to the computer. It includes eight basic applications: Letter Writer, Calendar, Checkbook, Household Manager, Address Book, E-mail, Financial Guide, and GeoSafari. An in-depth review appears elsewhere in this issue.

Microsoft Works is a suite of the four most popular computer applications. It contains a word processor, a spreadsheet with charting capability, database software, and a communications program. A simple drawing program is also included.

Microsoft Encarta is a fascinating multimedia encyclopedia that combines text articles with videos, animations, music, and sound. It includes more than 26,000 articles, more than eight hours of sound, more than 7000 photographs and illustrations, more than 800 maps, and more than 100 animations and video clips. It's an ideal encyclopedia for any student. Browsing through it is great entertainment for the entire family—and much more educational than watching TV.

Intuit's Quicken is the de facto standard in home-finance software. It allows you to track receipts and expenditures and, in doing so, can give you insight into just where your money goes.

Broderbund's Print Shop Deluxe CD Ensemble allows you to create cards, labels, envelopes, certificates, calendars, banners, business cards, and more. Although much of the capabilities and graphics are aimed at home users, there is plenty available for business users as well, including letterheads and memo forms.

MidiSoft Sound Impression is a Windows application that provides control over CD audio, MIDI devices, and WAV file recording, playback, and mixing.

SofNet FaxWorks is a Windows application that provides control over the fax, phone, answering-machine, and modem features of the computer.

Broderbund's Arthur's Birthday Party is an interactive animated story for children between the ages of 6 and 10. A paper copy of Marc Brown's book is included as well.

NetSoft NetCruiser, Prodigy, AOL, Compuserve, and the Imagination Network software included with the NEC Ready computers allow you to get started with the respective online services.

The NEC Ready consumer PCs come with a full complement of hardware and accessories, too. For graphics, our computer was equipped with a Cirrus Logic 64-bit PCI local-bus graphics controller with 1 megabyte of video RAM (expandable to 2 megabytes). The video controller is integrated onto the motherboard. Upgrading the video memory requires installing two 256-kilobyte by 16-bit video DRAM integrated circuits in sockets on the motherboard. That upgrade would allow the card to display up to 256 colors at a resolution of 1280 × 1024 (as opposed to 16 colors with one megabyte). The maximum number of colors, 16.8 million, can be displayed with a maximum resolution of 800 × 600 when two megabytes are installed, as opposed to 640 × 480 with one megabyte.

For audio, our computer was equipped with a 16-bit, Soundblaster-compatible, stereo sound card, which is upgradeable to wavetable technology. A microphone and a pair of Labtec CS-800 powered multimedia speakers round out the audio capabilities. The sound card supports stereo sample rates up to 48 kHz. It contains a built-in amplifier with an output power of two watts per channel into eight-ohm speakers.

The Ready telephony features include a 14.4 kbps (kilobits per second) fax/data modem that doubles as a hands-free speaker phone and an answering machine with multiple password-protected voicemail boxes.

A 32-bit, PCI-enhanced, IDE disk interface provides high-speed data transfers at a maximum burst rate of 10-megabytes per second. Up to 4 PCI IDE devices are supported by the interface, which is integrated on the motherboard.

Two IDE devices are included with the Ready 9510: a 1.2-gigabyte hard-disk drive and a quad-speed CD-ROM drive. The CD-ROM drive features a data-transfer rate of 600 kilobytes per second, with an access time of 250 milliseconds. That makes the drive MPC level 2 compatible. It is also compatible with multisession Photo CDs.

A single 3½-inch floppy diskette drive is also included in the system. That seems to indicate that 5¼-inch drives have seen their last days.

The computer is housed in a mini tower case that is built with an eye toward quality. The case features three external 5¼-inch drive bays; one holds the CD-ROM drive. The one 3½-inch external drive bay holds the floppy drive. Inside, the case has two additional internal 3½-inch drive bays, one of which holds the hard-disk drive.

The case features a 200-watt power supply, and has two fans for cooling—one is an exhaust fan on the power supply, the other brings in air and blows it across the microprocessor. The microprocessor is heatsinked well enough that it runs cool to the touch.

The main case cover is held on with four large thumb screws. When we first opened the case, we were surprised to find the expansion boards plugged in upside down! Our confusion was short-lived, however. The case is designed to make it easy to insert new expansion cards. When a panel on the bottom of the computer is removed—which is quite easy because it's held on by only one screw—clear access is provided to the expansion slots.

Five slots are available—one dedicated 32-bit PCI slot, three ISA (industry standard architecture) slots, and one slot that shares a 32-bit PCI and an ISA slot.

Because the NEC Ready computers are to be sold in retail sales channels, they have to be easy to set up and run. The Ready computers live up to their name.

A video tape is supplied with the system to explain how all of the various components are connected together. However, things are labeled well enough on the case that the tape is a bit excessive.

The computer is packed in one large

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box, which contains the computer along with another box that holds the keyboard, speakers, cables, and software. The keyboard and mouse plug into the PS/2-type keyboard and mouse port. Two serial ports and a parallel port are provided on the panel.

The Ready 9510 contains a single plug-in expansion card, which holds the modem, sound card, and MIDI/joystick port. The sound section has line-in, line-out, microphone-in, and speaker-out jacks.

The modem section also acts as a home telephone, providing full-duplex operation with echo cancellation. When the computer is in its power-saving mode, an incoming call wakes it up so that it can receive either an incoming fax or incoming voicemail.

The Ready computers are Energy-Star compliant, and offer a suspend/resume feature that can be set to put the computer to sleep after a user-definable amount of time, or at the touch of a button. The computer then awakens at a single keystroke, and resumes at the same location where it went to sleep. The systems have also been designed and tested to work with Windows 95 when it is available.

All of the software that is supplied with the ready computer is pre-installed on the hard drive (with the exception of Arthur's Birthday) so that the system is ready to go as soon as it is unpacked from the box. What if something goes wrong? A CD-ROM supplied with the system allows you to restore the computer to the shipping configuration. If the system crashes, simply insert the supplied recovery floppy disk in the drive to boot it, and the restore CD-ROM is its drive.

The restore program gives you several well thought-out options. First, you can refill the hard drive, which replaces the files currently on the system with the original version from the system-restore CD. Any changes that you made to the files are lost. However, all other directories and files remain unchanged.

The restore program also lets you restore individual files. If, for example, one program is damaged, but Windows is still operating properly, you can click on the Restore Individual Files icon, which lets you select the files to restore.

Also, a do-it-yourself option lets you access MS-DOS from the CD-ROM and restore files using MS-DOS utilities such as XCOPY. Finally, a completely crashed system can be restored to factory settings—all existing files are deleted, and the drive is formatted before the files are reinstalled.

The NEC Ready systems have the fit and finish that indicates quality. The system line seems well thought out, providing capable systems at a wide range of prices. They are not the least expensive systems that you'll see when you make that trip to your local computer superstore, but we wouldn't expect the least expensive systems to leave us as happy as we are with the NEC Ready computers.

The software that is supplied with the systems is also well planned—it has something for everyone from little kids to grownups, and from casual users to business users. Perhaps the only complaint we could make is that we would have preferred to see Microsoft Office instead of Microsoft Works. Yet, considering the intended audience, Works might be the best solution—the Office suite would raise the price enough to take the system out of competition for many consumers.

The hardware complement is top-notch: a 64-bit PCI graphics engine is what you want for acceptable performance—you don't want a slow graphics controller taking the steam out of a Pentium-based system. The easy video DRAM upgrade means that you can get all of the colors you want as well as the speed.

The documentation is also excellent, and should serve both novices and "techies" well. Yet, it's comforting to know that if problems arise, toll-free technical support is available 24 hours a day, 7 days a week. That's just another reason why the NEC Ready systems stand apart from their competition. ■

Good Ol' Bob

MICROSOFT BOB. From Microsoft Corporation, One Microsoft Way, Redmond, WA 98052; Tel. 206-882-8080. Price: $99.

When it comes to using computers, most people fall into one of four groups.

There are the hardcore users, who consider the computer to be an integral part of their work and home lives, and even a major source of entertainment and fun. They often spend their free time on the Internet or playing computer games. Not only can they learn to use new software with a minimum of trouble, but they might even do a bit of programming on their own, just for fun.

Much more common are those folks who regularly use a computer on the job. They are proficient at the several tasks required to get through the business day, for which they have received specific training, but don't understand enough about computers to translate that limited knowledge to other applications. For such people, computers represent work, not play or family life—they believe that computers belong in the office, not in the home.

A rapidly growing segment of computer users has branched off from the work-only group. Spurred largely by their own children—who tend to fall in the hardcore group—they break down and buy a home PC. They usually turn to more experienced friends—or, perhaps, their own children—for advice and help getting started. Unfortunately, once their "mentor" goes home, they often experience frustration as they try to use the software they've selected. The computer ends up being moved from the family room to a kid's room, where it is used more for game-playing than homework.

Finally, there are those who have never used a computer at all. Some simply have no interest in computing, and cannot visualize the role a computer might play in their own lives. Others might be intrigued by the idea of using a computer, but are put off by their preconceived notions of how difficult it will be to learn to use.

There has never been a software inter-

Friends of Bob. Microsoft hopes that every potential computer user can find a personal guide that they can enjoy interacting with.

face that could meet the needs of such disparate groups of users and potential users. Although the Windows graphical user interface has made computing life somewhat simpler by standardizing the way that many functions are accessed, it still assumes that the user has some basic knowledge of computer protocols. And each individual program requires that the user learn some commands, many of which cannot be intuitively guessed. That doesn't present much of a problem for the experienced computer user, but novices can quickly be scared off by unclear, seemingly inexplicable commands and stacks of thick manuals and reference guides.

Microsoft, a company whose goal is to see "a computer in every home," believes it has found a way to accomplish just that, by providing a user interface that anyone can follow. Called *Bob*, it goes beyond the graphical user interface, to provide what Microsoft calls a "Social Interface." The idea is that, whether they are dealing with people or machines, people interact socially. Furthermore, they learn better and faster if they are tutored by a mentor who doesn't have to eventually go home.

Microsoft Bob allows a computer to interact with its users in a social manner, via built-in mentors called personal guides, or "Friends of Bob." Those guides replace the usual paper reference materials. No manual is included with Bob, although a copy of *The Bob Magazine* does provide setup information as well as some helpful hints for those just getting started.

The concept behind Bob stemmed from two years of intensive research into the way that people interact with machines. Microsoft's team collaborated with two leading experts in the field, Stanford University professors Clifford Nass and Byron Reeves, whose studies focus on the automatic, unconscious social responses that all users have to computer programs.

"Our research shows that people deal with their computers on a social level, regardless of the program type or user experience," said Nass. "People know that they're working with a machine, yet we see them unconsciously being polite to the computer, applying social biases, and in many other ways treating the computer as if it were a person. Microsoft Bob makes this implicit interaction explicit and thereby lets people do what humans do best, which is to act socially."

According to Microsoft, Bob—so named because "it is such an unassuming name ... easy for everyone to identify with and use"—is "familiar, approachable, and friendly" software with a "helpful, enjoyable, and fun personality." We don't believe that a program can have a personality, but each of its 14 friends can, and do.

The Friends of Bob are a collection of cartoon-like animated characters that let you know what your options are in any given application, and provide tips, pointers, and shortcuts as you go. Those hints appear in comic-strip style dialog balloons, enhancing the idea that the user is communicating on a social, personal level with the computer.

The personal guides offer different levels of helpfulness and varying degrees of cuteness. The most helpful personal guides include Rover, a dog who wants to "be your best friend"; Java, an excitable, hard-working, caffeine-addicted dragon; Digger, a playful but silly worm; Shelley, an outdoorsy, somewhat shy turtle; and Hopper, a happy, eager-to-please rabbit. We found the last three to be well beyond our cuteness quotient, but they might appeal to younger children.

For those who have had some experience with computers, Orby the planet Earth figure and Blythe the firefly provide somewhat less help—fewer tips and suggestions. Those who prefer still fewer helpful interruptions might opt for Chaos, a sophisticated French cat; Ruby, a grumpy parrot who grudgingly offers minimal advice; or Scuzz, a basketball-dribbling rat, aimed at the MTV generation, who "couldn't care less about you" and seldom offers help.

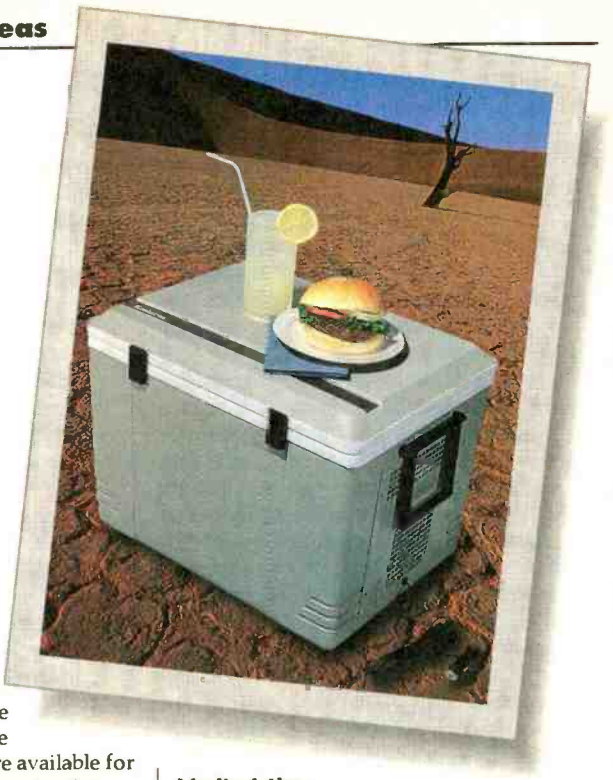
Experienced computer users can opt for the Speaker, a speaker icon with no personality that just offers straight facts, or Invisible, with no help or personality at all. Two specialists appear only during specific applications: Lexi is an expert in finance who helps in the Checkbook application, and Hank the elephant appears during the GeoSafari game.

By offering an assortment of distinct personalities, Microsoft hopes to provide someone for everyone so that all users will be able to find a mentor to suit their own personality as well as their level of experience. Personally, we found the Friends of Bob to range from highly annoying to ac-

TECHNOLOGY UPDATE

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

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



By Charles Anton

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

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

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

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

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

Home refrigeration has come a long way since the days of the ice box and the block of ice. But when we travel, we go back to the sloppy ice cooler with its soggy and sometimes spoiled food. No more! Now for the price of a good cooler and one or two seasons of buying ice, (or about five family restaurant meals), all the advantages of home cooling are available for you electronically and conveniently.

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

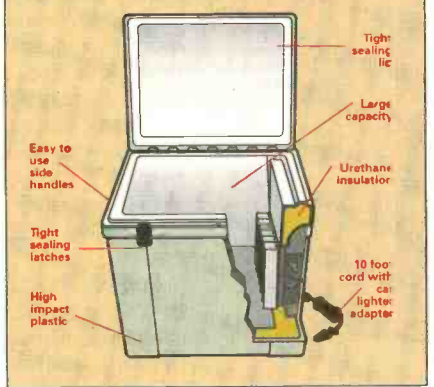
Hot or cold. With the switch of a plug, the Koolatron becomes a food warmer for a casserole, burger or baby's bottle. It can go up to 125 degrees.

And because there are no temperamental compressors or gasses, the Koolatron works perfectly under all circumstances, even upside down. Empty, the large model weighs only 12 pounds and the smaller one weighs just seven. Full, the large model holds up to 40 12-oz. cans and the smaller one holds six.

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

The refrigerator from outer space.

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



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

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

The versatile Koolatron is available in two sizes. The P24A holds 30 quarts and the smaller P9 holds seven quarts. An optional AC adaptor lets you use them in your rec room, patio or motel room. They plug into any regular outlet.

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

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ceptable, but we would not consider any of them to be Friends of Ours.

Besides having personalities and being able to interact on a social level with the user, the Friends of Bob are "intelligent." According to Microsoft, they "take notes on how you work and tailor suggestions to fit your working style and experience level." For instance, once you've mastered one of the hints they've provided, they won't repeat it again.

Bob is a family-oriented program, intended for use in the home, and uses a home metaphor. After entering the program through the "front door," the user can enter shared "family rooms" that are accessible to everyone in the family, or can retreat to his or her own private room within the "house." There are more than 40 different combinations of rooms and home styles. Individual family members can also "decorate" their rooms, changing the furniture, the accessories, the view, and the icons used to represent various applications to suit their own tastes. We opted for a plant-filled, airy sunroom overlooking the ocean for most of our work. Other choices include a medieval castle and a futuristic room that the Jetsons might be happy in. From within any room, users can access Bob programs and can launch any Windows- or MS-DOS-based applications that they have installed.

Bob's eight built-in applications are home-oriented ones that each member of the family can use separately, or share with others. Intended to help a home run more smoothly and to help a family communicate better, they include: Letter Writer, Calendar, Checkbook, Household Manager, Address Book, E-Mail, Financial Guide, and the GeoSafari quiz game. Password protection ensures that an individual's correspondence or personal finances remain private. The integrated nature of the program allows family events (a trip to the circus or a wedding) to be entered on one person's calendar and then exported to everyone else's schedule, or a family address book can be filled in once and everyone can receive a copy of it.

Letter Writer is not a full-fledged word-processing program. Rather, it is intended to facilitate the letter-writing that you might need to do from home—thank-you notes, invitations, letters to the editor, consumer complaints, and the like. To help you get started, 33 sample letters are included. Also included are 70 clip-art items and 30 borders. It's possible to change the type style and size, do drag-and-drop text editing, see a print preview, and do multipage viewing and editing. You can send your clip art-bedecked creations via e-mail to any other Bob user, or send plain text to anyone else online. Bob's integrated nature allows you to create mailing lists from your Address Book to send multiple copies of the same document, or just do a single mail merge to instantly send off a letter.

More than one Address Book can be created by each Bob user. For instance, you could have a master book of all the family contacts, along with one book for your Christmas card list, another for each person's friends, and one for important numbers (gas company, fire department, doctor, and the like). There's also a built-in list of phone numbers of 500 commonly called organizations and businesses. You can print out copies of any Address Book to keep near extension phones throughout the house. You can also add notes to any entry in the book, and include such information as birthdays and anniversaries. Those dates will automatically be transferred to your Calendar to remind you to send a card or create a personal greeting on Letter Writer to send via e-mail.

Bob E-Mail, which carries a base fee of $4.95 a month and requires a modem, allows you to stay in touch, online, with modem-equipped friends around the world. Standard messages can be sent to users of all the major online services (Prodigy, America Online, the Internet, CompuServe), and fancy letters, personalized with clip art and borders, can be sent to other Bob users. Bob E-Mail also includes tips on e-mail etiquette for new users and 100 commonly used e-mail addresses.

The Calendar is used to create schedules and "to-do" lists on personal or shared date books. You can note your daughter's soccer game or dentist appointment on your calendar as well as hers, so that you don't forget your chauffeuring duties. The calendar provides daily, weekly, or monthly views, any of which can be printed out to take along. You can also print out "to-do" lists created from Calendar entries. The Bob Calendar also includes daily words to improve your vocabulary, daily "eco-tips" to improve your social consciousness, and information on the phases of the moon. Besides birthday reminders from the Address Book, notices of bills due automatically appear, linked from the Bob Checkbook, and so do reminders of household tasks (change smoke-alarm batteries, for instance) from the Household Manager.

The Household Manager represents every user's chance to finally get organized. It includes 14 preprogrammed categories, including auto information, health and safety, home maintenance, household records, kitchen information, and vacations. It's also possible to delete any of Bob's categories (personally, we could live without "Cleaning"), and add your own.

In many cases, the pre-entered categories can be personalized to meet your specific needs. For instance, in the vacation category, the Household Manager will help you write a packing list depending on the type of vacation you're taking. Going to a wedding? Don't forget your camera and the gift! Camping? Bring bug spray and your sleeping bag. It also personalizes the to-do-before-leaving list (set light timers, turn off oven) by asking such questions as "Do you have pets?" and "Do you get the newspaper delivered?"

We liked the personal-growth category, which provides a place to list movies to

Bob users can choose one of 40 styles of room to make their own, furnishing it to their own tastes and even selecting the view outside the window.

see, books to read, restaurants to try—we could finally get rid of all the clippings pulled from newspapers and piled around the house, and could even print out lists to bring to the library or video store. And it would be good to have, all in one spot, a listing of credit-card numbers, the location of wills and birth certificates, the dates of our last oil change and chimney cleaning, and the like. Of course, it takes time to enter all that data, and more effort to keep it current and up-to-date, but at least Bob Household Manager offers the potential of getting on top of it all. Password protection keeps the information safe from prying eyes.

Similarly, Bob's two financial programs offer the hope of taking control of your money. The Checkbook is a spending tracker that includes an on-screen checkbook and register that can be used in the same way as your paper ones, or with the option to pay bills electronically for a small monthly fee. The Checkbook also provides an on-screen "box," similar to the shoebox or letterholder that you probably use now, in which to dump your bills. By including their due dates, you can receive automatic reminders on your Calendar. Finally, the Checkbook lets you generate reports on savings and income, credit cards, bank accounts, and cash. To help you determine where all your money goes, you can track spending by category, using 50 pre-defined categories such as food, automotive, mortgage, and gifts.

The Bob Financial Guide provides explanations of financial matters and expert tips for managing your various investments, including your home, your children's college funds, stocks and bonds, savings accounts, and retirement. In addition, it offers advice on buying a home or a car, estate planning, insurance, consumer credit, and savings strategies. The "Life's Milestones" category provides information on the financial and legal steps that you should take when getting married, having children, caring for elderly parents, or getting divorced.

Finally, Bob GeoSafari provides educational fun for the whole family. The multimedia adaptation of an award-winning quiz game offers an interactive way to learn geography.

The eight programs, used together as an integrated package, can go a long way toward getting your household organized and helping you communicate better with other members of the family. The Calendar is certainly a better system for reminders than sticking notes on the refrigerator!

Bob also makes computing easy and non-threatening by offering only those options that are pertinent at any given moment in your computing session. When in your "room," for instance, you can see the available applications, enter any of the applications, drag-and-click objects to change your room, or enter another room in the house. Each of those objectives can be done traditionally (using the mouse to click or double-click) or via the list of options offered by your personal guide. The most helpful guides will even point out to novice users that it's easier to click on an icon than to use the menu. Once you enter an application, the list of options changes to those that are of immediate importance to the task at hand. And the personal guides are always present, making sure that the new user doesn't get "stuck" and frustrated.

The "Social Interface" provided by the Friends of Bob is unlikely to intimidate even the worst technophobe. Just the opposite: The cutesy nature of the program might frighten off the experienced user instead! Of course, if you are an experienced user who would like to get your family involved in personal computing, you could simply set it up so that Bob was accessed through Windows. Other family members would double-click on the Bob icon to reach the "Social Interface" but you would never have to see a Friend of Bob.

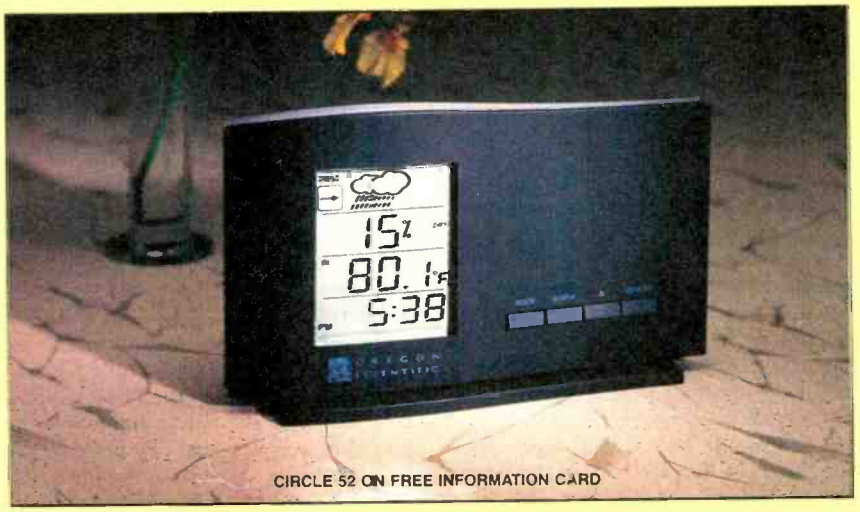
We wouldn't go out and buy Bob for our existing computer systems. However, if we were considering the purchase of a "family" computer to be used by family members who were not computer literate, we would favor one that included Bob (such as the NEC Ready 9510 reviewed elsewhere). Microsoft has already licensed several prominent OEMs, and we suspect that Bob will reach the public largely through being pre-installed on new systems. ■

Weather or Not ...

DESKTOP WEATHER FORECASTER MODEL BA-213. From Oregon Scientific, Inc., 18383 South West Boones Ferry Road, Portland, OR 97224; Tel. 1-800-853-8883 Price: $99.95.

We have increasingly little patience for what passes for television "news" these days—a bunch of pretty faces exchanging idle banter between sensationalized stories of random violence, political misdeeds, and, of course, the ever-present O.J. trial. We'd skip watching entirely, if not for the daily and five-day weather forecast.

Unfortunately, that segment of the show is even more prone to inanities and meaningless chatter. First, we're subjected to "a look at the map," during which we're regaled with tales of snowstorms in the Rockies, tornadoes in Kansas, heatwaves in Phoenix—none of which let us know whether or not to carry an umbrella. Then, before we get to hear the local forecast, they break for a few commercials. Finally, we get to hear their predictions, which might not necessarily come true.



CIRCLE 52 ON FREE INFORMATION CARD

Oregon Scientific offers a way to bypass the television weatherman. Its *Model BA-213 Desktop Weather Forecaster* provides up to the minute forecasts for the following 12- or 24-hour period, with no annoying chatter.

Like the TV forecaster, the BA-213 presents a pretty face. Measuring a slim 7-inches long by 4-inches high by 1-inch wide, the device has a fluid, Euro-style design that is equally at home on a desk or a kitchen counter. For wall mounting, the desktop stand detaches and stores conveniently in the back of the unit.

The most prominent front-panel feature is an LCD screen about 2-inches wide by 2½-inches high. The display is divided into four sections. At the top, the barometric pressure trend is indicated by an arrow that points up, down, or level. The top

segment also displays one of five weather icons—sunny, partly cloudy, cloudy, rainy/snowy, and stormy. Each icon is easy to interpret—a shining sun for sunny, a sun and some clouds for partly cloudy, just clouds for cloudy, clouds with precipitation for rainy/snowy, and flashing lightning-bolt indicators for stormy. The second segment displays the relative humidity indoors, and notes whether the level is wet, dry, or comfortable. The third section displays the indoor or outdoor temperature, and the bottom section houses alternating clock, calendar, and alarm displays.

Rounding out the front panel is a row of four buttons labeled MODE, ALARM, up arrow, and MEMORY. Those are used when setting the time and date and, occasionally, to operate some special functions of the forecaster.

Setup is a breeze (pun intended). Once the three included "AAA" batteries are installed, the unit sets itself automatically within a few hours, as its built-in weather sensors adjust to local conditions. The user need only set the time and date, and select either the Celsius or Fahrenheit temperature scale. The wired outdoor-temperature probe plugs into a rear-panel jack. Its wire is thin enough to allow a window to close around it. You can allow the probe to dangle outside, or mount a nail or screw on the outdoor wall and affix the probe to it. Indoor or outdoor mode is selected using a slide switch on the back of the unit.

With setup complete, the forecaster is ready to keep you posted on current and upcoming weather conditions. Built-in barometric, temperature, and humidity sensors are used to track changing conditions. By monitoring the rate and consistency of barometric pressure changes, the device is able to provide weather forecasts that are "generally 75% accurate for the surrounding 20- to 30-mile area," according to Oregon Scientific.

When rapidly dropping barometric pressure is detected, the device uses both visual and audible indicators to alert the user to approaching storms. A storm warning triggers flashing lightning-bolts to appear in the upper segment of the LCD and sets off audible beeps. Those warning signals activate for one minute, reset automatically, and then reactivate again every three minutes until the conditions improve. Once you are made aware of the imminent storm, you can turn off the audible indicator manually by pressing any of the front-panel buttons; the lightning-bolt icons will continue to flash.

The weather forecaster's built-in memory stores the minimum and maximum indoor and outdoor temperature readings. Those can be recalled by simply pressing the MEMORY button in either indoor or outdoor mode. The reading indicates the maximum temperature recorded since the unit was last reset. Two presses of the MEMORY button recalls the minimum temperature stored in memory. A third press returns the display to the current temperature reading. To clear the temperature memory, the MEMORY button must be held for approximately two seconds, until a beep is heard. Memory is also cleared—automatically—when the unit is switched between indoor and outdoor temperature modes.

Finally, the BA-213 can serve as an alarm clock. Although it doesn't offer such features as snooze or musical wakeup, the alarm-clock function makes the forecaster an ideal addition to the bedside night stand, where you'd be able to see the weather forecast as soon as you awakened.

The manual included with the weather forecaster provides brief, but concise instructions (in English, French, German, Italian, and Spanish). It also provides pointers on interpreting the weather-forecast symbols and storm alarms. First, of course, it's important to remember that the symbols are forecasting *future* conditions, not current ones (for which you'll just have to look out the window). A rising barometric pressure trend indicates improving weather; a falling one forecasts worsening weather. In terms of indoor relative humidity, the "comfort" indicator will appear when the temperature is between 68°F and 77°F and the humidity is between 40% and 70%. The wet indicator reflects humidity of more than 70%, and the dry indicator less than 40%, over the entire temperature range.

We tested the desktop weather forecaster over a period of unsettled weather ("April showers ..." and all that). The first day dawned sunny and warm—the TV weatherman was predicting highs of 77°, well above average for April in New York. The desktop weather forecaster was predicting rain. We thought at first that perhaps its sensors hadn't acclimated yet. But, sure enough, by 2:00 PM the skies had darkened and rain was falling!

In such changeable conditions, it was difficult to judge the unit's accuracy. However, the 75% accuracy rate cited is reasonable, based on the proven limitations of predicting weather solely by barometric-pressure trends.

The BA-213 has other limitations. For instance, we would have liked an outdoor humidity probe. "It's not the heat, it's the humidity" is all too true come summertime around here. Knowing how humid it is inside an air-conditioned home won't help us judge how comfortable it is outside. We would also have preferred a way to switch between indoor and outdoor readings from the front panel—if the unit is wall mounted, getting access to the rear-panel switch is cumbersome.

Wind direction and speed play a major role in modifying the climatic conditions in our seaside community, but they're not considered by the Desktop Forecaster. And, of course, the forecaster cannot predict future temperature. Waking up to a reading of a steady barometer, partly cloudy conditions, and 55°F at 7:00 AM, there's no way of knowing if the day's weather will be partly cloudy and 65°F or 85°F.

Perhaps a future version will add some additional features and increased intelligence. In the mean time, we fully appreciate how well the desktop weather forecaster does the job for which it is intended: providing, in one quick glance, the current temperature and humidity and the upcoming weather conditions. Considering some of the alternatives—such as listening to Willard Scott wishing little old ladies happy birthday between weather predictions—we'd opt for the desktop weather forecaster anytime! ■

Building a Better Mouse Device

SPECTRUM RING MOUSE POINTING DEVICE. From: Kantek, Inc., 15 Main Street, East Rockaway, NY 11518. Tel. 516-593-3212, 800-536-3212. Price: $99.95

Back when Apple Computer launched its Macintosh, the computer mouse was looked at with scorn by "serious" computer users. Today, mice—and related pointing devices—are big business. There are trackballs for laptops, touchpads for graphics input, and even mice designed just for kids.

All of those pointing devices have one thing in common—they are two-dimensional beasts—they allow you to move a cursor in the x and y directions. The *Spectrum Ring Mouse* from *Kantek* is another kind of rodent altogether, allowing full three-dimensional movement in the x, y, and z directions. It provides wireless convenience, too.

Ring Mouse consists of two main parts: a receiver that mounts on the computer's monitor, and a transmitter, which is worn on the index finger. The receiving unit has "L"-shaped arms which are designed to run along the top and down the side of the monitor. A small box, hinged on the top arm, protrudes from the back. It sits on top of the monitor, and balances the "L" so that no other attachment is required to hold it in place. A cable from the box attaches to

the computer's serial port. The cable ends in a 9-pin connector; a 9-pin to 25-pin adapter is included in the package.

Small ultrasonic transducers are mounted at each end of the L, and at the vertex where the arms meet. Also at the vertex is an infrared detector.

The transmitter is a small, lightweight "ring" that is worn on the index finger, held in place by a Velcro band. Two buttons on the transmitter are positioned so that they can be accessed by the thumb. An ultrasonic transducer is also mounted on the top of the ring, and an infrared emitter is inside.

The receiving unit receives the ultrasonic and infrared signals from the ring, and translates them into cursor motion. The ultrasonic signals are analyzed to track the motion of the ring. The infrared signals indicate button pushes.

Installing the ring mouse is relatively straightforward. The receiver is plugged into the computer's serial port, and the software drivers are installed. The automated installation program automatically installs Ring Mouse for both DOS and Windows.

The manufacturer's suggested minimum system should have an 80386 or better CPU, 1 megabyte of main memory, an available serial port, a hard-disk drive with 1½ megabytes of free space, a 2½-inch disk drive, MS-DOS 3.3 or higher, and a VGA display (for the sample software supplied).

As a traditional mouse, the Ring Mouse takes a little getting used to. Its main benefit is that it's always there, right on your finger—you don't have to take your hand off the keyboard to reach for the mouse. Of course, to move the cursor, you *do* have to move your hand. We found that for some applications, the ring mouse was very efficient—especially if we used it in combination with keyboard shortcuts. With games, the Ring Mouse added a new dimension to the fun.

Two Ring Mouse drivers are supplied for Windows. The first is for standard Ring Mouse operation: If you lift your hand up, the cursor goes up. If you put your hand down, the cursor goes down. Move your hand in front of the monitor from right to left, and the cursor follows.

The second driver for Windows is called the Ring Mouse Desktop Mouse Emulator. In that mode, you can control cursor movement by moving your hand around on the desktop, just as you would if you were using a standard mouse. In essence, that driver turns the Ring Mouse into a two-dimensional mouse—you no longer have to lift your hand to raise the cursor—just move your hand closer to the receiver.

The three-dimensional capabilities of the Ring Mouse become evident with the supplied applications. The first is a game called Rings. The object of the game is simple—just toss the rings onto the poles as in a traditional ring-toss game. The game has three levels. In the first, you must toss as many rings as you can onto seven poles. In the second, the object is the same, but the rings and poles are colored. Tossing a ring onto a like-colored pole gets you extra points. The third level has only one pole, but its position changes to a random location for each toss.

For a computer game, Rings might not sound captivating. However, the *feel* of the game is quite impressive. The required hand motions are exactly those necessary to toss real rings. It's even possible to forget that you're playing a computer game and not tossing real rings.

A 3-D Demo program lets you move a "space shuttle" around in three-dimensional space. Obstacles are provided on-screen so that you can move the shuttle around and behind them. A Draw program is similar to standard two-dimensional paint programs except that the line width

The Ring Mouse is designed to be worn comfortably on the index finger. Its two buttons are within easy reach of the thumb. Note the ultrasonic transducer on the right of the unit.

or color can be chosen by moving the Ring Mouse in the third dimension.

The Ring Mouse receiver obtains its power from the serial port. The transmitter contains a lithium watch battery. According to Kantek, the battery should last about a year in normal use. The transmitter has a built-in power-down feature that shuts it off after about a minute since the last button push. Simply clicking one of the buttons turns it back on.

The Ring Mouse has a resolution of 100 dots per inch, and a sampling rate of 50 updates per second. Also, the receiver can track the transmitter up to distances of about three feet.

In our tests, the Ring Mouse operated without a flaw—the only problem we encountered was that energy-saving fluorescent bulbs interfered with the receiver. Simply moving the light further away from the receiver solved the problem.

Although we're not ready to give up our traditional mouse yet, the Ring Mouse is a nice alternative for many applications—particularly when you need to keep your eyes on the screen, and your fingers on the keyboard. The Ring Mouse is perfect for word processing, for example. However, specialized 3-D applications really make the Ring Mouse come alive. ■

A Different Kind of Mouse

REMOTEPOINT CORDLESS HANDHELD POINTING DEVICE. From: Interlink Electronics, 546 Flynn Road, Camarillo, CA 93012. Tel. 805-484-1331. Price: $129.

Gone, it seems, are the flip chart, overhead projector, and slide projector. Today's presentation tool is the personal computer.

The personal computer is a sensible tool to use for a presentation. After all, most presentations are prepared on a PC. However, the PC has its drawbacks, too. Laptop computers, for example, are ideal for taking a presentation on the road, but they can be used only in front of small audiences. Computer video projectors can be used to give a presentation for a large group, but the presenter must remain tethered to the computer by a mouse cord, and his or her hand can't be used to make gestures when it must remain on the table top, moving the mouse.

The solution for the presenter who wants to be liberated from the desktop, free to move naturally to drive home points, is the *RemotePoint* cordless handheld pointing device from *Interlink Electronics*.

RemotePoint will work on any IBM-PC-compatible computer running MS-DOS 2.0, Windows 3.0, or OS/2 2.0 or greater. It consists of a handheld transmitter and a desktop receiver with a 6-foot cable that terminates in a 9-pin serial connector.

The transmitter, which is powered by two AAA batteries, is designed to fit comfortably in any hand—both right and left. On the top of the RemotePoint is a circular VersaPoint pressure pointing pad, perfectly positioned for the thumb. Below that is the secondary mouse button. The primary mouse button is on the bottom of the device, positioned for trigger-finger access. The transmitter is roughly 5½-inches long and 2-inches wide. It weighs only 3 ounces with batteries.

The receiver obtains its power from the serial port or mouse port. (A serial 9-pin to 6-pin PS/2 mouse port adapter is included in the RemotePoint package.) The device works with a standard Microsoft mouse driver, but VersaPoint drivers are also included. The VersaPoint mouse drivers let you adjust the sensitivity and acceleration of the mouse.

The VersaPoint pressure-pointing technology is the key ingredient that makes RemotePoint work, and provides sure control over the cursor. The key ingredient to VersaPoint is a four-zone force-sensitive resistor or FSR.

The FSR is a resistor whose value changes when a force is exerted in it. When the FSR detects the thumb pressure, it sends the information to a microcontroller that converts the FSR's output into signals that control the cursor direction and speed. The direction of the pressure controls the direction of the cursor; the amount of pressure controls its speed.

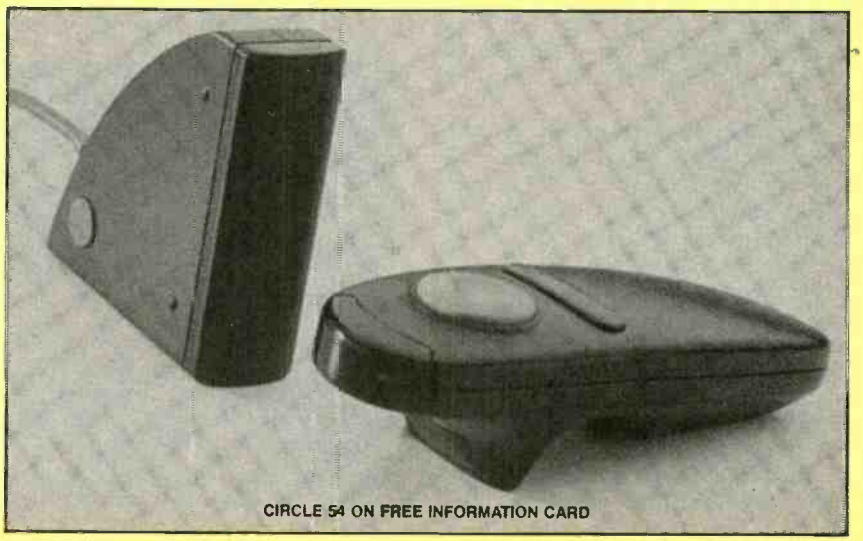
RemotePoint has a range of up to 40 feet, so it's ideal for making a presentation in front of a large group with a video projector. The device's feel is very natural—we felt comfortable with it right away. At first, we made sure to set the mouse sensitivity and acceleration rather low until we were proficient at regulating the amount of thumb pressure required to move the cursor around where we wanted it. After a very short time, we were able to increase both factors. In fact, we ended up setting both the acceleration and sensitivity higher than we normally do with our standard mouse—and we like a fast mouse.

The infrared signal emitted from RemotePoint is very strong. It is not necessary to aim the device precisely at the receiver, so you can really be yourself during a presentation. The orientation of the receiver is also not critical. It can stand up, lay flat, or be mounted on either side.

RemotePoint's transmitter has an automatic power-down feature. Pressure on the pressure pad wakes it up again. A pair of AAA batteries should last about a year.

We liked the feel of the RemotePoint so much that we began using it as our standard desktop mouse. However, we didn't want to have to pick up the device to access the primary trigger button, so we used the VersaPoint driver to swap the function of the two buttons.

Interlink does offer several other pointing devices that use the force-sensing resistor VersaPoint technology. For example, a wired version of the RemotePoint, called the ProPoint is available, as is the PortaPoint, a force-sensitive pointing device that is meant to be at home either on the desktop or in portable and handheld applications. The company also works with original-equipment manufacturers to provide built-in pointing solutions in rugged environments, a great strength of VersaPoint technology because the devices contain no moving parts and can be sealed against the environment. ■



CIRCLE 54 ON FREE INFORMATION CARD

New device turns any electrical outlet into a phone jack

Engineering breakthrough gives you unlimited phone extensions without wires or expensive installation fees

By Charles Anton

You don't have to have a teenager to appreciate having extra phone jacks. Almost everyone wishes they had more phone jacks around the house.

When I decided to put an office in my home, I called the phone company to find out how much it would cost to add extra phone jacks. Would you believe it was $158?

No more excuses. Today, there are a thousand reasons to get an extra phone jack and a thousand excuses not to get one. Now an engineering breakthrough allows you to add a jack anywhere you have an electrical outlet. Without the hassle. Without the expense. And without the miles of wires.

Like plugging in an appliance. Now you can add extensions with a remarkable new device called the Wireless Phone Jack. It allows you to convert your phone signal into an FM signal and then broadcast it over your home's existing electrical wiring.

Just plug the transmitter into a phone jack and an electrical outlet. You can then insert a receiver into any outlet anywhere in your house. You'll be able to move your phone to rooms or areas that have never had jacks before.

Clear reception at any distance. The Wireless Phone Jack uses your home's existing electrical wiring to transmit signals. This gives you sound quality that far exceeds cordless phones. It even exceeds the quality of previous devices. In fact, the Wireless Phone Jack has ten times the power of its predecessor.

Your range extends as far as you have electrical outlets: five feet or five hundred feet. If you have an outlet, you can turn it into a phone jack—no matter how far away it is. The Wireless Phone Jack's advanced companding noise reduction features guarantee you crystal-clear reception throughout even the largest home.

Privacy guarantee. You can use The Wireless Phone Jack in any electrical outlet in or around your home, even if it's on a different circuit than the transmitter. Each Wireless Phone Jack uses one of 65,000 different security codes. You can be assured that only your receiver will be able to pick up transmissions from your transmitter.

Is the Wireless Phone Jack right for you?

The Wireless Phone Jack works with any single-line phone device. Almost anyone could use it, especially if...

- **Few Jacks.** *You want more phone extensions without the hassle and expense of calling the phone company.*
- **Bad location.** *You have jacks, but not where you need them most, like in the kitchen, garage, home office or outside on the deck.*
- **Renting.** *You want to add extensions, but you don't want to pay each time you move.*
- **Other phone devices.** *You have an answering machine, modem or fax machine you want to move to a more convenient place.*

The Wireless Phone Jack System consists of a transmitter (right) and a receiver (left). One transmitter will operate an unlimited number of receivers.

Unlimited extensions—no monthly charge. Most phone lines can only handle up to five extensions with regular phone jacks. Not with the Wireless Phone Jack. All you need is one transmitter, and you can add as many receivers as you want. Six, ten, there's no limit. And with the Wireless Phone Jack, you'll never get a monthly charge for the extra receivers.

Works with any phone device. This breakthrough technology will fulfill all of your single-line phone needs. It has a special digital interface for use with your fax machine or modem. You can even use it with your answering machine just by plugging it into the Wireless Phone Jack receiver.

The Wireless Phone Jack lets you add a phone, modem, fax machine or answering machine almost anywhere.

Special factory-direct offer. To introduce this new technology, we are offering a special factory-direct package. For a limited time, the transmitter is only $49. One transmitter works an unlimited number of receivers priced at $49 for the first one and $39 for each additional receiver. Plus, with any Wireless Phone Jack purchase, we'll throw in a phone card with 30 minutes of long distance (a $30 value) for only $9.95!

Try it risk-free. The Wireless Phone Jack is backed by Comtrad's exclusive 30-day risk-free home trial. If you're not completely satisfied, return it for a full "No Questions Asked" refund. It is also backed by a one-year manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

Wireless Phone Jack transmitter ...$49 $4 S&H
Wireless Phone Jack receiver .....$49 $4 S&H
save $10 on each additional receiver—$39

30-minute long distance phone card.....~~$30~~
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GIZMO NEWS

Games Standards

VESA, the Video and Electronics Standards Association, has established the Game Developers' Advisory Council to address the need for game hardware standards on the PC.

The first task of the Council will be to improve game input devices. VESA plans to define standard interfaces for using such devices as 3-D joysticks, flight yokes, steering wheels, game pads, virtual-reality headgear, and other exotic new game controllers.

"The present game-control interface—the joystick port—is obsolete," according to Ken Nicholson, Director of ATI Interactive!, a VESA member company. Expressing a sense of urgency for manufacturers, he went on to say "When Microsoft releases Windows '95 later this year, it will provide the software support for a myriad of new game controllers."

To kick things off, VESA will survey its members regarding hardware developer requirements for graphics and video, audio, remote-control, and system-level issues. Game developers will also give input regarding their needs.

Giant Displays

The inventor of Texas Instrument's Digital Micromirror Device (DMD) has won the Eduard Rhein Foundation's Technology Award for his work. Although his invention is still years away from consumer application, the DMD promises to make huge, bright, high-resolution video displays practical.

The Digital Micromirror Device is a digital light switch on a silicon chip. A standard DMD microchip contains more than 442,000 switchable mirrors on a surface that is ⅝-inch wide. Mirrors are switched according to memory impulses stored beneath the tiny array—they tilt at angles of plus or minus 10 degrees to reflect light into or away from an imaging lens.

Texas Instruments' Digital Light Processing (DLP) technology integrates the DMD microchip with TI digital signal processors and memory, plus software, optical, and electrical components, and an illumination source to create a digital imaging subsystem. Digital light-processing technology allows traditional analog video to be digitally captured, manipulated, and optically reflected from the mirrored aluminum surface of the DMD display.

Because of the initial high manufacturing costs, the first applications of the new display technology will likely be large stadium-type video displays. However, the technology can be adapted to smaller screens, too.

Digital Video Discs

Two HDCD (high-density compact disc) video disc formats are battling each other to become the next popular video format. Unfortunately, the battle between the Toshiba/Time Warner and Sony/Philips camps is reminiscent of the Beta vs. VHS format wars of more than a decade ago.

A victory will, of course, be a tremendous boon to the winning company. However, the battle will cost the industry tremendously, according to a market forecast by InfoTech, a multimedia market research firm that is located in Woodstock, VT.

By late 1998, the U.S. installed base of HDCD players is expected to break the one million mark. But the numbers could very well be twice that if the standards battle between the formats is resolved quickly. On the other hand, InfoTech President Julie B. Schwerin, painting a somewhat pessimistic picture, contends that "a standards war is in nobody's interest, but even without one, the readiness of consumers to replace VHS, a recordable medium, with a playback-only medium is untested. Adoption will lag even further if HDTV is not commercialized within the next three years."

Videogames will probably be the most robust market for high-density discs, at least at first. Compatibility between competitive systems has never existed in the videogame product category, so yet another new format isn't seen as that large of an obstacle.

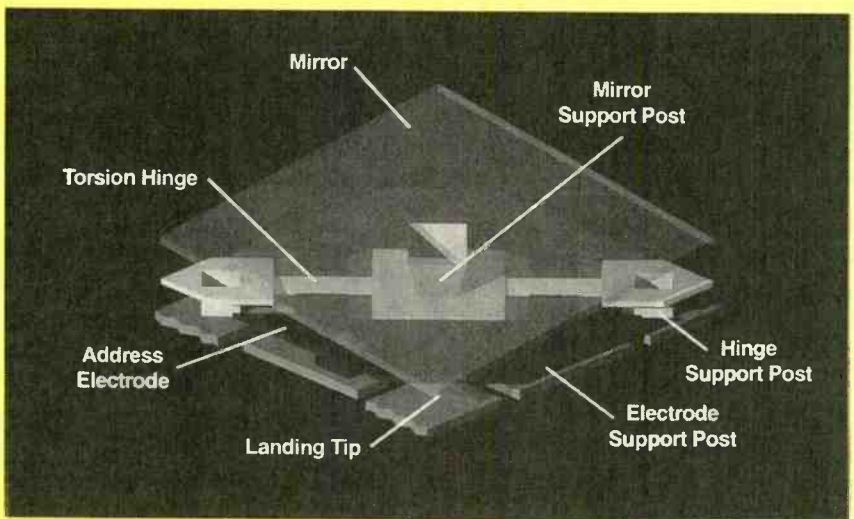
High-Definition VCR

A new, digital high-definition TV (HDTV) VCR standard has been endorsed by the HD Digital VCR Conference, which represents more than 50 members of the worldwide VCR industry. The standard was recommended by the Conference's Advanced Television (ATV) Working Group.

The ATV Working Group began developing the recording and special-feature specifications last year to enable digital HD VCRs to record and play back the transmission signals of the Grand Alliance digital HDTV system, which is now under final test.

The HD Digital VCR Conference was established in late 1993 to determine technical specifications for consumer-use high-definition digital VCRs. The technical documentation of the Grand Alliance system was completed in February by the Advanced Television Standards Committee (ATSC) under the guidance of the FCC's Advisory Committee on Advanced Television Systems.

The development of the digital high-definition VCR in parallel with the development of the transmission of HDTV signals is seen as a key step forward in preparing for digital HDTV broadcasting in the U.S. ■



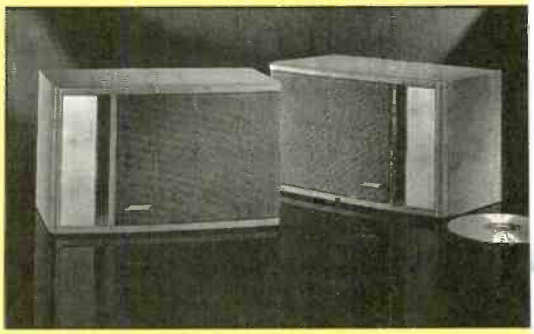
More than 400,000 moveable micro-miniature mirrors are fabricated on a Digital Micromirror Devices from Texas Instruments that measures only ⅝ inch on a side. The DMD is intended to replace CRT and liquid-crystal light valve projectors for large-screen video displays.

ELECTRONICS WISH LIST

Bookshelf Speakers

The compact *141* speakers feature proprietary technology from *Bose Corporation* (The Mountain, Framingham, MA 01701-9168) for lifelike sound reproduction and are tested by computer to ensure their conformance to several performance parameters. The classically styled speakers will fit in any decor from contemporary to traditional. A full, rich stereo sound is produced by the speakers' 4.5-inch StarDriver transducer, which consists of a unique star-shaped butyl-rubber surround and mica-impregnated cone material. The surround is a frequency-shaping element and the cone delivers smooth, extended high-frequency performance, eliminating the need for a separate tweeter and crossover. The ported cabinet design ensures deep bass extension. Price: $139 per pair.

CIRCLE 55 ON FREE INFORMATION CARD



Bose Bookshelf Speakers

Multi-Format Boombox

For those who like to keep their listening options open, *Sanyo* (21350 Lassen Street, Chatsworth, CA 91311-2329) offers the *MDC-100* a portable music system with AM/FM radio, cassette tape, CD player, and Mini Disc (MD) player/recorder. It allows one-touch digital recording from compact disc to Mini Disc; by loading a blank MD and a pre-recorded CD and pressing the record button, a digital recording is made automatically. Record editing allows the user to customize the order in which tracks are recorded, and a disc-title insertion feature allows the name of the disc to be included in the MD recording. The MDC-100 also offers one-touch synchronized dubbing from CD to tape, along with AM/FM digital tuning, dual-cone speakers, bass-enhanced sound, a fluorescent dot-matrix display, and a seven-band spectrum analyzer. Price: $999.99.

CIRCLE 56 ON FREE INFORMATION CARD

Sanyo MD/CD/Tape Boombox

Auto Video Editor

The *V-6331* video editor from *Ambico* (46-23 Crane Street, Long Island City, NY 11101) includes an automatic mode in which the editor displays on-screen instructions on the TV monitor used during the editing process. The auto mode can be used with any camcorder with a Control-L jack. Computerized operation allows the user to mark up to 192 desired scenes on a videotape and delete any material he or she doesn't want to use on the edited version. The desired scenes can then be assembled in any order, regardless of the sequence in which they were shot. Three professional-style scene transitions are available, including cut, fade-to-black, and fade-to-white. Those can be combined in nine different ways for a varied video. Other features include video enhancement circuitry and audio fading. Price: $299.99.

CIRCLE 57 ON FREE INFORMATION CARD

Ambico Automatic Video Editor

Rear-Projection Monitor

Pioneer Electronics' (2265 East 220th Street, Long Beach, CA 90810-1639) 55-inch *PRO-107*, part of the Elite line of "cinema-wide" rear projection monitors, is designed to significantly increase the apparent amount of video information from conventional NTSC programs. The rear-projection set uses "continuous variable expansion technology," which digitally expands the horizontal picture information of conventional 4:3 television broadcasts. That technology, combined with less overscan, allows the picture to be projected on a space 12% larger than that of comparably sized standard TVs and offers consumers 5% more video information than previously available. In addition, the PRO-107 includes a digital zoom feature that provides the option of watching movies in the normal aspect ratio or in full-cinema viewing mode, in which the vertical picture information is expanded to fill the screen. For instance, a movie recorded in the letterbox format and played in full-cinema mode can be viewed with black bands minimized and, on some movies, virtually eliminated. The TV also comes with a built-in, enclosed, two-way speaker system and a removable, protective acrylic screen intended to prevent scratches and further eliminate noticeable scan lines. Price: $5500.

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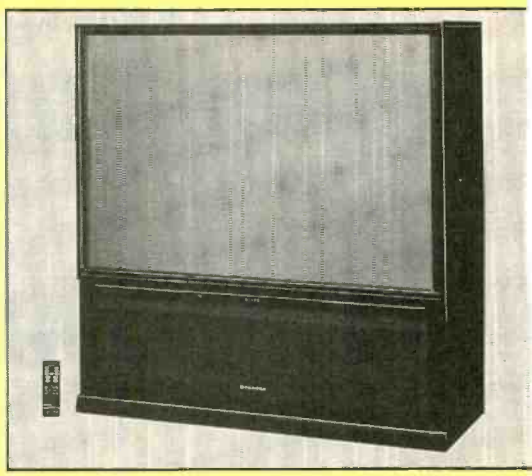

Pioneer Rear-Projection TV

ELECTRONICS WISH LIST

Esoteric Sounds 33/78-rpm Turntable

Record-Collector's Turntable

Aimed at audiophile record collectors, the *BES-2* turntable from *Esoteric Sounds* (4813 Wallbank Avenue, Downers Grove, IL 60515) offers two speeds: 33.33 and 78.26 rpm. The no-frills, belt-drive turntable features a high-quality fixed-cartridge arm. It is fully manual; there are no automatic features to complicate operation. The high-density, polymer platter is virtually inert and provides excellent vibration damping. Because the platter material is impedance matched to the record being played, the record "almost merges with the platter." A low-torque motor minimizes mechanical noise. A hinged dust cover is included. Price: $665.

CIRCLE 59 ON FREE INFORMATION CARD

Kawai Anytime Piano

Quiet A Piano!

What good is an acoustic piano that you can't hear? Well, the *Anytime Piano* from *Kawai America Corp* (2055 East University Drive, Compton, CA 90224) lets you practice playing at a real piano without waking the neighbors. The Anytime Piano is an acoustic/digital hybrid instrument. It contains a photo sensor system that determines how the notes are played electronically instead of mechanically, and it can be played either as a real piano or a digital instrument. In its digital mode, the piano can create three distinct instrument sounds: piano, harpsichord, and vibraphone. MIDI jacks allow the Anytime Piano to be connected to any external MIDI sound device. Although the unique piano is loaded with high-tech features, it looks just like a classic upright model. Price: n/a

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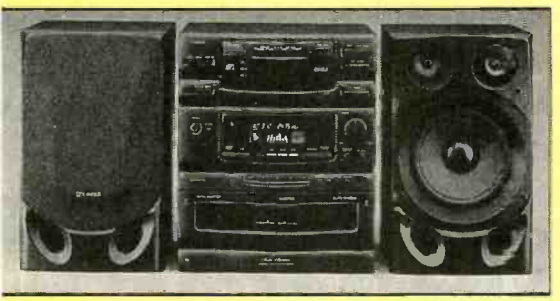

Fisher Mini System

Smart Shelf System

The new *DCS-M27* mini/shelf system from *Fisher* (21350 Lassen Street, Chatsworth, CA 91311) offers a little built-in intelligence to make it easier to use. A press of either the tuner, CD tape, or auxiliary selector buttons turns the system on and sets it to receive input from the selected source. Electronic equalization provides settings for pop, jazz, rock, or classical music; a dynamic bass mode can be used to boost the low end performance. The system offers 32 random presets for the AM/FM tuner, a remote control and motorized volume control, a dual cassette deck with full-logic controls and an electronic tape counter. A 3-disc front-loading CD changer allows CDs to be changed while one is playing. The amplifier can deliver 50 watts of power. Price: $499.

CIRCLE 61 ON FREE INFORMATION CARD

StarSight-Equipped VCR

The first VCR to include the StarSight interactive on-screen program guide is the four-head, stereo *VR8905* from *Samsung Electronics* (105 Challenger Road, Ridgefield Park, NJ 07660). StarSight provides subscribers with an on-screen color grid-style guide of all scheduled television programs for the next seven days. Viewers can select a program of interest on the grid to call up additional information, such as title, plot summary, length, and critic's rating. By pressing the RECORD button, the VR8905 is instantly programmed to record the selected TV program without further instructions or number code input. The RECORD button also lets the viewer record a daily or weekly series in one easy step. Price: $549.

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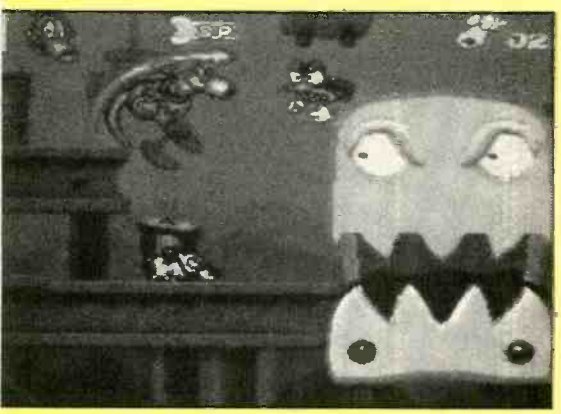

Viacom New Media's Rocko's Modern Life

Rocko's Modern Life Videogame

Based on the popular Nickelodeon cartoon, *Rocko's Modern Life: Spunky's Dangerous Day* a Super Nintendo game from *Viacom New Media* (1515 Broadway, New York, NY 10036) features non-violent themes and amusing characters. In the game, players assume the role of Rocko, a miniature kangaroo, who must protect his absent-minded dog Spunky on a journey through 16 levels of obstacles ranging from "grungy gripes" and garbage rats to crazed washing machines. Players use a variety of inventive methods to transport Spunky to the golden fire hydrant that punctuates each level. Price: $59.95.

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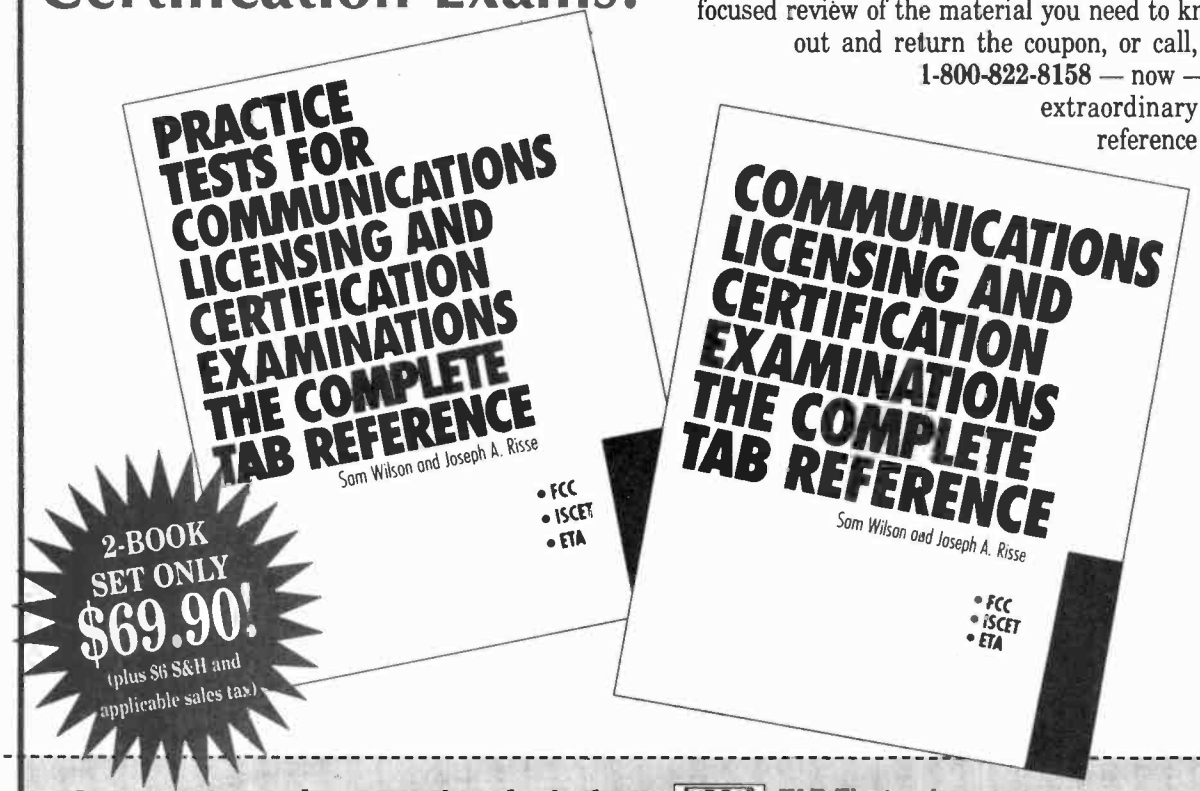

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MULTIMEDIA WATCH

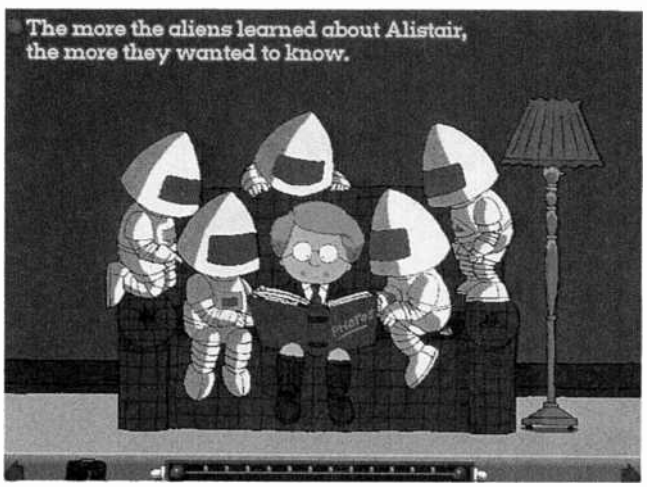
By Marc Spiwak

Kids Like Multimedia, Too

I don't often report in depth on multimedia software for children, even though there is a terrific amount of it out there. However, I recently became a father for the first time, so I figure it's as good a time as any to look at that popular area of CD-ROMs.

CHILDREN'S TITLES

To start off with, *The Wrong-way-around World* from Active Imagination, a Packard Bell subsidiary, provides kids ages 3 to 8 with hours of fun, storytelling, and educational games. Stories take place in worlds that just should not be, such as places where rain pours up. The disc sells for $19.95.



Alistair and the Alien Invasion lets kids travel on a space ship and meet aliens.

I've got two titles from New Media Schoolhouse. *Early Learning Center CD* is five programs for ages 4 to 9 on one disc; Using Money and Making Change, Talking Clock, Pink Pete's ABC's, Vocabulary Builders, and Talking USA Map. The games use a digitized human voice to help kids learn. The disc has a retail price of $69. *Boing Boing & Roger's Learning Adventure* is an electronic board game for up to four players, ages 6 and up. Hundreds of trivia questions teach the players about science, literature, math, history, and more. The title lists for $59.

I've got three new titles from Paramount Interactive. *Lenny's Multimedia Circus* features Lenny the penguin as a circus ringmaster for children ages 5 to 11. Children are allowed to interact with Lenny and the circus. *Lenny's Time Machine* lets children ages 5 to 11 climb aboard Lenny the penguin's time machine and visit 15 of history's most exciting destinations. *Richard Scarry's How Things Work in Busytown* is designed for children ages 3 to 6 and lets them learn how things work together in the community of Busytown.

New children's titles from Simon & Schuster Interactive include *My Favorite Monster* and *Alistair and the Alien Invasion*. My Favorite Monster introduces Mooky the Monster and the characters that inhabit his world to children ages 4 to 10. Kids have free reign to explore Mooky's house and play with his things. Alistair and the Alien Invasion lets kids travel on a space ship and meet aliens, at the same time building vocabulary, reading skills, and hand-eye coordination. The game uses Microsoft's new WinToon technology to produce richer, more fluid animation.

To wind up the children's titles, I've got four of them from MI Publishing. *Ozzie's World* lets kids explore the magical world of Ozzie Otter and learn about science and ecology through puzzles, games, and more. For ages 3 to 8, *What is a Bellybutton* answers a child's first questions about the human body. *AnnaTommy* uses animations based on actual inside-the-body video footage to teach kids ages 8 and up about basic anatomy and biology. Older kids might like *The Virtual Body*, which offers an interactive, self-guided course on human biology and anatomy.

CD-ROM MULTIPAKS

Before we get to the new stuff for this month, I want to comment on an observation I've made on the general availability of CD-ROMs. The fact is, CD-ROMs are everywhere, and they are becoming quite inexpensive. I recently saw an ad for a CD-ROM-of-the-month club, the kind where you get a bunch of them cheap at first and then have to buy x number of titles in the future. Bulk CD-ROM packs for less than $50 are also proliferating. And companies like Essex Entertainment have committed themselves to selling lots of titles for very little money.

Essex Entertainment plans on selling hundreds of titles

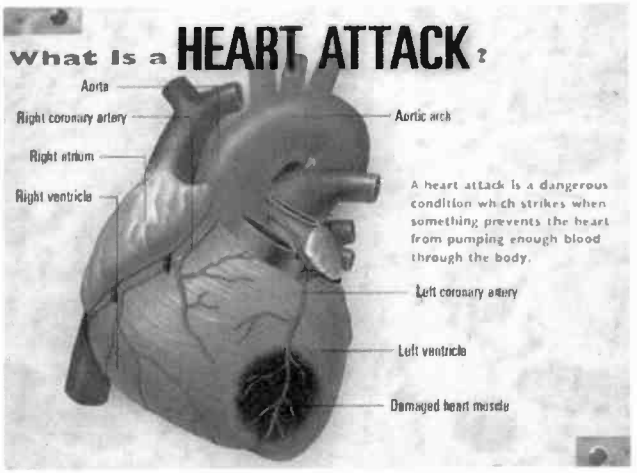
on a wide variety of subjects with retail prices ranging from $9.95 to $14.95. Many of the titles have been available for a while, but at higher prices. The discs will be marketed through the usual software suppliers, as well as music stores and other similar outlets in an attempt to get people to buy CD-ROMs on impulse. With prices that low, and the titles on display at checkout lines everywhere, I think the plan might work.

NEW STUFF

There are 25 planes up in the air, 16 accidents waiting to happen, and only you stand in the way of disaster. *Air Havoc Controller* from Trimark Interactive is a realistic air-traffic-control simulator that includes over 30 minutes of 3D animations that let the player witness planes taking off, landing, and crashing. Crashes include fiery explosions and blood-curdling screams. For $49.95, who could resist trying to prevent those violent crashes from happening—or letting them crash for that matter?

A 2-CD set from Gametek commemorates the first twenty years of the television show *Saturday Night Live*. *Saturday Night Live—The First Twenty Years* includes over 50 Quicktime films of some of the best moments from the show from 1975 to 1995. From "The Blues Brothers" to "Wayne's World," all the best skits are here. This commemorative set is a must-have for any fan of the show.

Last but not least for software this month is the all-time best-selling trivia game in a multimedia edition on CD-ROM. Parker Brothers' *Trivial Pursuit CD-ROM* is now being distributed by Virgin



The Virtual Body offers an interactive, self-guided course on human biology and anatomy.

Air Havoc Controller is a realistic air-traffic-control simulator that includes over 30 minutes of 3D animations.

Interactive. People familiar with the original board game will be immediately at ease with this multimedia version. All the same rules apply except that you have to play on a multimedia computer.

With all the new CD-ROMs I receive each month, I run out of places to put them. Fortunately some new products from Coast Manufacturing Company can help me out. Coast has a complete line of CD-ROM carrying and storage cases. For loose discs that I receive, Coast's wallet- and album-type cases are just what I need. The discs slide into see-through sleeves that make

This CD home-storage album from Coast Manufacturing Company has 12 pages that can hold up to 96 discs. Refill pages can be added.

browsing easy, and fingerprint-damage free. Pocket-sized wallet holders are available in sizes from 12 to 48 discs, and a home-storage album has 12 pages that can hold up to 96 discs (and refill pages can be added). A padded CD carrying case lets me carry up to 30 discs and their jewel boxes wherever I go. All of those cases are very affordable, with none of them listing for more than $29.95. Of course any of them can be used for audio CDs as well. ■

WHERE TO GET IT

Active Imagination
P.O. Box 10870
Canoga Park, CA 91309
CIRCLE 66 ON FREE INFORMATION CARD

Coast Manufacturing Company
200 Corporate Boulevard South
Yonkers, NY 10701
CIRCLE 67 ON FREE INFORMATION CARD

Essex Entertainment
560 Sylvan Avenue
Englewood Cliffs, NJ 07632
CIRCLE 68 ON FREE INFORMATION CARD

Gametek, Inc.
2999 Northeast 191st Street
Suite 500
North Miami Beach, FL 33180
CIRCLE 69 ON FREE INFORMATION CARD

IVI Publishing
7500 Flying Cloud Drive
Minneapolis, MN 55344
CIRCLE 70 ON FREE INFORMATION CARD

New Media Schoolhouse
P.O. Box 390
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Pound Ridge, NY 10576
CIRCLE 71 ON FREE INFORMATION CARD

Paramount Interactive
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New York, NY 10036
CIRCLE 72 ON FREE INFORMATION CARD

Simon & Schuster Interactive
1230 Avenue of the Americas
New York, NY 10020
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Trimark Interactive
2644 30th Street
Santa Monica, CA 90405
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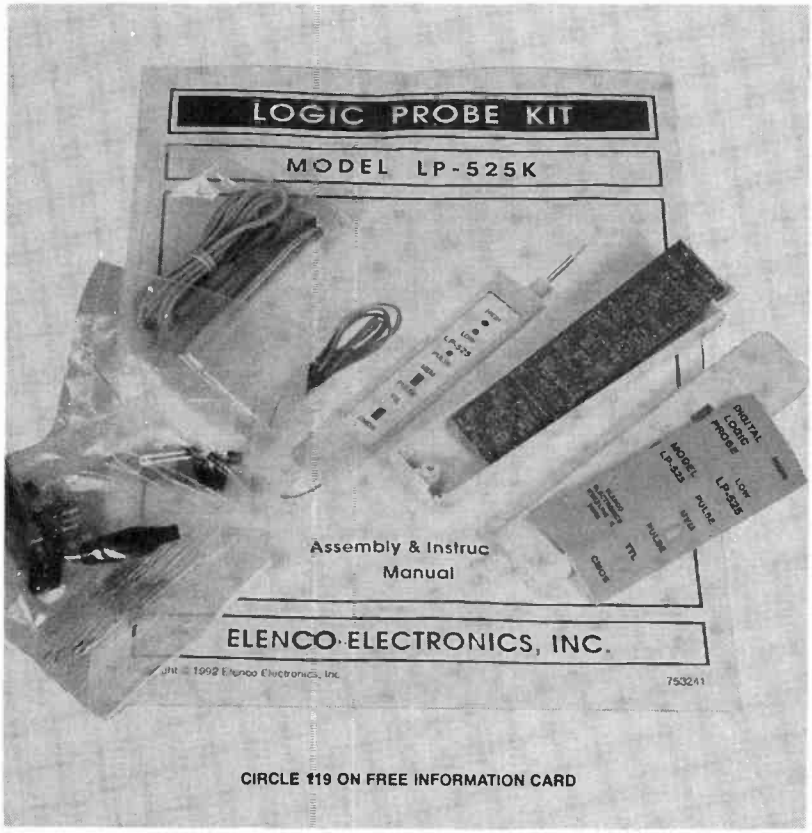
A Hands-on Electronics® REPORT

Elenco Electronics LP-525K Logic-Probe Kit



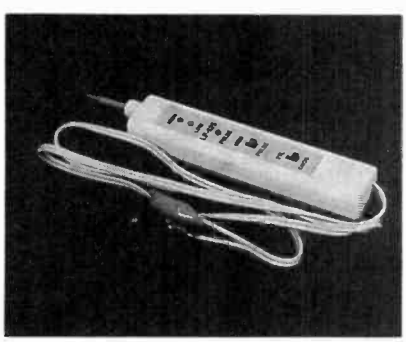
CIRCLE 119 ON FREE INFORMATION CARD

Build the Elenco LP-525K logic probe and add another troubleshooting tool to your arsenal.

To many hobbyists, building in general, and kit building in particular, lies at the very heart of what makes electronics fun. Hobbyists like to build kits of all kinds, but perhaps the best kits are the ones that end up as something useful, and what could be more useful to an electronics hobbyist than a kit that yields a piece of test equipment? Such is the case with the LP-525K logic-probe kit from Elenco Electronics, Inc.

Once built, the LP-525K logic probe can be one of the most useful tools a hobbyist has, especially for working with digital circuits. With just one touch, a logic probe can tell you if a point in a circuit is at logic high, logic low, or open; if a pulse train is present; and if so, the relative frequency of the pulse train. Even better, all of that utility is available for just $19.95. That makes the LP-525K one of the more affordable pieces of test gear you can buy.

Specifications. The LP-525K has an input impedance of 100 kilohms and is input overload protected from 30-volts DC continuous and 120-volts AC for 10 seconds. A switch puts the probe in either its TTL or CMOS mode. In the TTL mode, anything over 2.3 volts is indicated as a high, while in the CMOS mode anything over 70 percent of V_{CC} is high. A TTL low is indicated for anything under 0.8 volt, and a CMOS low is anything under 30 percent of V_{CC}. The logic probe can also detect single pulses of at least 200 nanoseconds and square waves of at least 50 nanoseconds.



Here's how the Elenco LP-525K logic-probe kit looks when it is finished and ready for use. Its usefulness and low cost makes it a must for any workbench.

The Kit. The Elenco LP-525K is a nice one-evening project. The kit includes everything you need to build the probe, including a roll of solder. All you have to supply are a few hand tools and a soldering iron—and, of course, a little of your own time.

An instruction manual included with the kit gives the builder a thorough understanding of the probe. The manual begins with the probe's specifications and a parts list. A description of the probe's circuitry explains how different input signals cause the LEDs to light in different patterns.

Building the probe basically involves stuffing a small single-sided PC board with a handful of components. The assembly instructions are easy to follow, especially for a beginner who'll

find the thorough descriptions of all parts comforting, especially the resistor color codes that are given as each resistor is installed. The kit could actually be built with no knowledge of resistor color coding and without the aid of an ohmmeter.

Once the probe is finished, the manual describes how to test and operate the unit. A chart is included that explains how to interpret the LEDs and how they light. Should there be any trouble in getting the probe to work, a troubleshooting chart will help clear up the problem. And if that doesn't work, Elenco Electronics is always there to help.

The finished LP-525K logic probe, which measures about 7 inches long with the probe tip, will surely find a home on your workbench—or in your toolbox. Like any good logic probe, it is one of the most useful tools you can have when working with digital circuitry. At $19.95, it's the perfect project to put away for a rainy day. And its small price and size make it the perfect gift for any beginner in electronics.

For more information on the LP-525K logic-probe kit, contact Elenco Electronics directly at the address given in the box below, or circle no. 119 on the Free Information Card. ■

FOR MORE INFORMATION

Elenco Electronics, Inc.
150 W. Carpenter Ave.
Wheeling, IL 60090
Tel. 708-541-3800

THINK TANK

By John J. Yacono
Technical Editor
Windows Magazine

Workbench Equipment

Most of this month's letters present interesting test-equipment circuits. But, before we get to those letters, we'll continue our monthly tutorial by discussing average power dissipation, as promised last time.

If a resistor will be subject to quick fluctuations in current or voltage, we don't need to use the maximum value of current or voltage to select the resistor's wattage. In most cases, the current and voltage peaks would occur only momentarily, and would be balanced by moments at which current and voltage are at a minimum. A perfect and common example of that is when current and voltage fluctuate in a pattern called a "sinewave" (see Fig. 1). One reason that is a popular waveform is because it resembles the pattern of AC electricity found in homes.

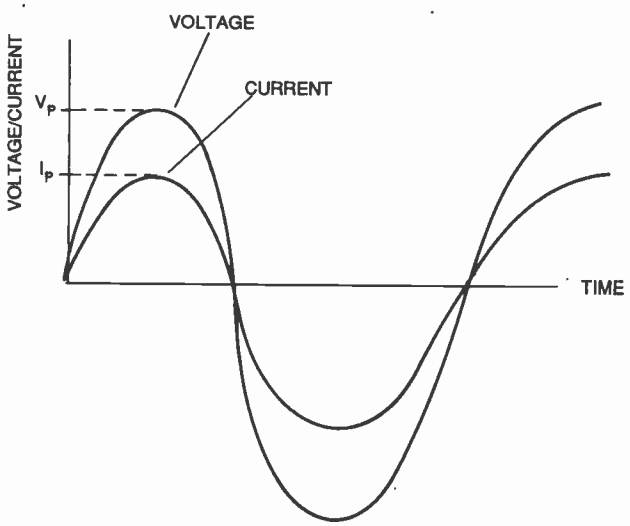


Fig. 1. In a wide number of applications, current and voltage fluctuate as shown in this sinewave pattern.

If the voltage varies up and down as shown, then what value of voltage should we use? One might be tempted to say it should be an "average" value, but because each positive point of a sinewave has a corresponding negative point, the average is zero. We could do a mathematical trick to make the whole waveform positive, though. First we "square" each value on the wave (multiply each value by itself), which would give us all positive numbers. Then we take the average and find the square root of it to undo the effect of squaring. That is called "taking the root-mean square."

For a voltage sinewave, the math yields this relationship:

$$V_{rms} = 0.707V_p$$

where V_{rms} is the root-mean square or effective value of the voltage, and V_p is the peak voltage. The root-mean square value is the value to use for power calculations in resistive circuits. That same analysis can be applied to current:

$$I_{rms} = 0.707I_p$$

where I_{rms} is the root-mean square or effective value of the current, and I_p is the peak current.

To deal with sinusoidal current and voltage, you can simply substitute the root-mean square values of current and voltage into the equations we discussed last month for power, yielding:

$$P = I_{rms}^2R$$
$$P = V_{rms}^2/R$$

That way, you can determine the appropriate power rating for the resistor.

Now let's turn our attention to the letters. My favorite one is the following, which is from a reader who truly understands the spirit of our hobby:

A REAL PAL

According to a letter titled "Ultrasonic Tester" from the May 1995 *Think Tank* column, Christopher Fullerton would like to get his hands on a copy of *Engineers Notebook*, by Forrest Mims. I have an extra copy of that book, which Christopher can have at no cost. Send me his address and I will mail the book to him.

Thank you.

—Kenneth Overland, Lynwood, IL

Actually, thank you! The address and a Think Tank *book are on the way to you, and because you're being so generous, I'm also sending you an MCL1010 chip mentioned in my first column.*

What is really great, however, is that you were not the only one to show your willingness to help another hobbyist. As of this writing, others answering the call for help by offering photocopies and book loans include Steve Stallings, Robert Blum, Thomas W. Grabowski, Julius G. Bekassy, and J. E. Hawthrone. They all will also receive Think Tank *books for their kindness.*

CRYSTAL-COUPLING CIRCUIT

I have found many similar crystal-checker circuits that claim to provide a valid test for crystals of all frequen-

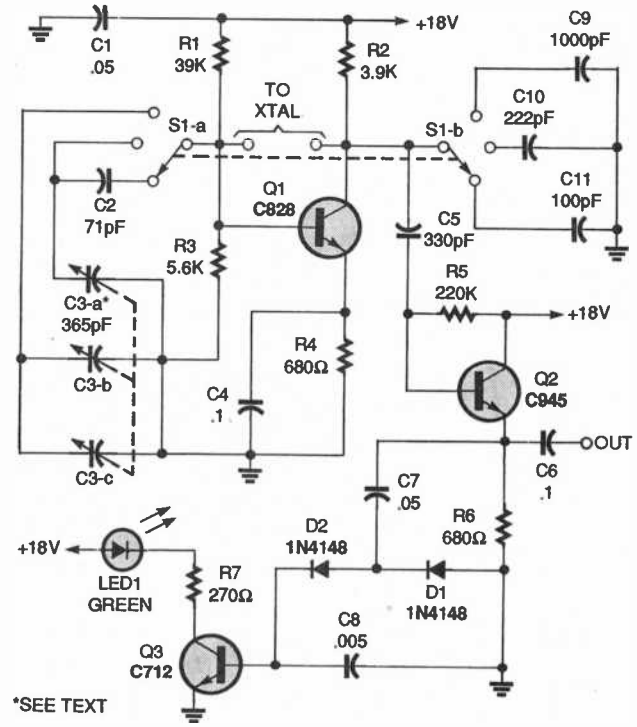


Fig. 2. When checking crystals or just choosing them for your circuits, it's all-too-easy to load them down. This circuit can act as a simple interface for your circuits, or allow you to measure a crystal's value.

cies. However, I have not found those claims to be true, mainly because the coupling components in the circuits would alter a crystal's operating frequency.

The circuit in Fig. 2 is one that I have used for some time. It overcomes coupling problems, working for all the crystals I own (starting at the near-audible frequencies and going up from there). The output connection allows you to connect the circuit to other devices, so that it can be used as a signal generator or attached to a frequency counter. Crystal activity is indicated by the brightness of LED1.

The transistors I used for Q1–Q3 are Japanese-series parts as shown in the schematic, but if you can't find them, you can substitute ECG85 transistors for all three. The 3-section, 365-pF tuning capacitor is of the type used in AM/FM radios. For that and other parts, you could probably find a good supply in salvaged AM/FM stereo units from garage sales or even neighborhood trash at the curbside! Elementary checks will give a good idea of the condition of those parts.

—Clinton E. Willis, Orlando, FL

Nice work. While building the circuit, remember to keep all component leads short. Use shielded wire for the connections to S1 and the output. Also, use only high-quality (low tolerance, zero-drift) capacitors.

COMPONENT TESTER

The circuit in Fig. 3 checks diodes, bipolar transistors, and SCRs, and tests for continuity. Two sections of a 4049, U1-a and U1-b, along with R1, R2, and C1 form a squarewave oscillator whose frequency is around 350 Hz. Inverters U1-c and U1-d are buffers that provide the complementary outputs needed for testing both NPN and PNP devices. Inverters U1-e and U1-f, along with R3, R4, and C2 form a squarewave oscillator whose frequency is around 2 Hz. The output of that oscillator is used to control one switch in a 4066 quad bilateral-switch integrated circuit, U2-a. That switch is used to gate the alternating signal through current-limiting resistor R5 to the "B" (base) terminal of the tester. Resistor R6 limits current to LED1 and LED2.

To test a bipolar transistor, connect the emitter, base, and collector leads of the transistor to their respective terminals on the tester and press S1. If LED1 blinks, the transistor is a good NPN device; if LED2 blinks, the transistor is a good PNP device.

To test diodes, LEDs, and other semiconductor junctions, connect the leads of the device between the E and C terminals of the tester and press S1. If the device is good, LED1 or LED2 will glow continuously. If LED1 glows, the anode (positive side) is connected to the "C" (collector) terminal of the tester; if LED2 glows, the cathode (negative side) is connected to the collector terminal of the tester.

To test SCRs, connect the cathode, gate, and anode leads of the SCR to the E, B, and C terminals of the tester, respectively, and press S1. LED1 will blink if the SCR is "good."

Continuity checks can be made using the E and C terminals of the tester. When LED1 and LED2 are glowing, continuity is indicated.

—Nelson L. Moye, Indianapolis, IN

I really like all-in-one testers like that. I once made something similar out of a 555 timer used as an oscillator. Its output was sent through a tri-color LED to one terminal on the tester. The junction of a resistor divider was the other terminal. I like your circuit better, though, because mine

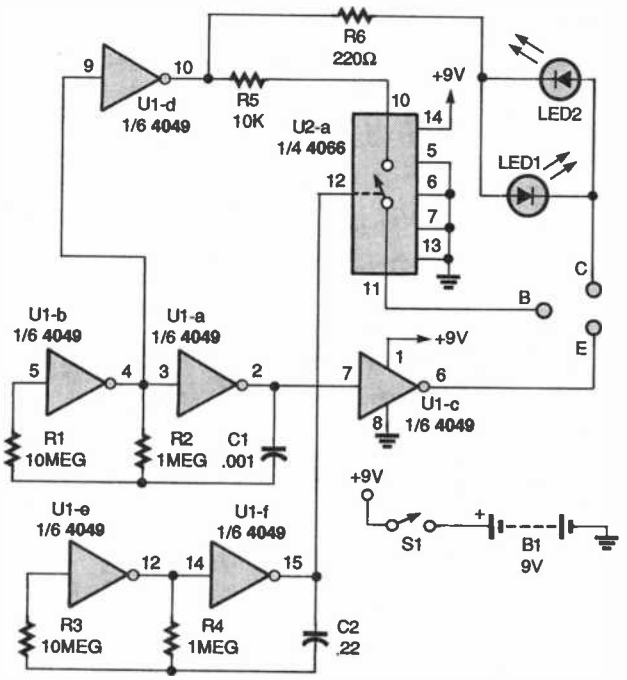


Fig. 3. Testing diodes, LEDs, transistors, or SCRs is a snap with this circuit. It can also act as a continuity tester.

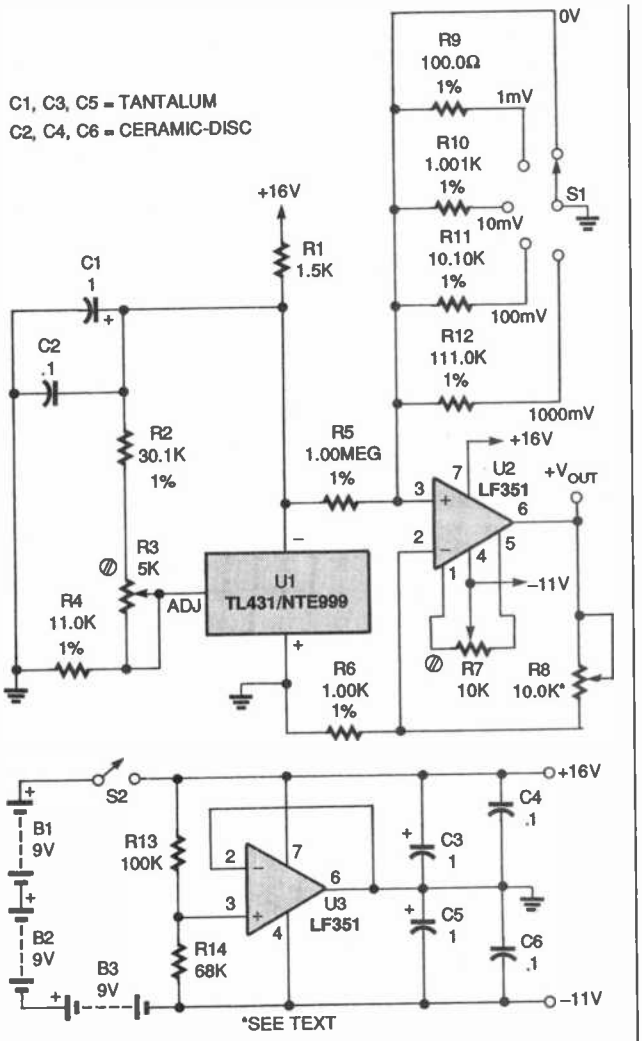


Fig. 4. A precision voltage source is valuable for calibrating test equipment or sensors. This unit, which goes up to 11 volts, is good enough for most precision applications.

could only test one semiconductor junction at a time.

PRECISION VOLTAGE SOURCE

Figure 4 shows an extremely handy and accurate voltage source with a temperature-compensated output from 1.00 mV to 11.000 volts. It has four ranges: 1 to 11 mV; 10 to 110 mV; 100 to 1100 mV; and 1000 to 11,000 mV. A ten-turn potentiometer (R8) with a 15-turn counting knob is used as the multiplier for the range switch, S1. The circuit operates from three 9-volt batteries, which might seem like overkill, but they are necessary. Besides, mine have not been replaced since 1982, when I first built this project. A maximum output current of 10 to 15 mA, plus the low current drain, lets the batteries last, with occasional use, for close to their expected shelf life.

For construction, layout is not critical—any small board will do nicely. Also, don't let the unusual resistor values throw you, as they are easily "built" using combinations of standard 1-percent metal-film units. If you have access to a 4½-digit DMM, you can make fast work of building those resistors. An example is R11, which can be a 10,000-ohm unit in series with a

100-ohm unit. However, measure the actual value of R8 and select R6 to be exactly 1/10 of R8's value.

When attaching the knob to R8, the counter should be set to 1.00 with R8 at its minimum resistance. Advancing R8 will multiply the range value by ×1.00 to ×11.00, as read on the counter dial.

To calibrate the unit, set S1 to 0 volts and R8 to ×11. Then adjust R7 (a 10,000-ohm multi-turn trim-pot) for a 0.0-mV output at pin 6 of U2. That nulls the output-offset voltage. Then set R8 to ×10 and S1 to 1000 mV, and adjust R3 (a 5000-ohm multi-turn trim-pot) for a 10.000-volt output at pin 6 of U2. The instrument is now ready for use.

Resistor R8 and the turns counter are available for about $16 from Circuit Specialists (Tel. 800-528-1417). Integrated circuits U2 and U3 are also available from Circuit Specialists, and U1 plus all of the resistors and capacitors are available from Johnson Shop Products (Tel. 408-257-8614).

If you do a good job selecting the resistors, the only limiting factor on overall accuracy is the linearity of R8 itself. Most 10-turn pots have a guaranteed linearity of + mi0.25 percent; mine appears to be better than + mi0.1 percent, thus, I get very high accuracy from the circuit. I've also never needed to recalibrate my circuit since it was built. If you dabble in analog circuitry and/or test instruments, this device will be a welcome addition to your bench.

—Skip Campisi, South Bound Brook, NJ 08880

Once again, some really cool work, Skip. The circuit looks solid enough to calibrate test equipment with. Thanks for the source advice, too.

12-VOLT-DC AND CONTINUITY TESTER

This dual-function 12-volt-DC and continuity tester (see Fig. 5) is ideal for security-alarm installers or even automotive-electronics testing. Switch S1 is an SPDT type. When it is in position "A," the unit functions as a voltage tester that sounds buzzer BZ1 in the presence of voltage. Because the buzzer circuit is polarized by diode D1, the tester can also be used to identify the polarity of a 12-volt DC source. When S1 is in position "B," the circuit is a continuity tester.

The tester is very simple and inexpensive to build because it consists of only a few parts. Buzzer BZ1 can be any 12-volt-DC unit. However, it must be capable of oscillating at approximately 8 volts, because when the circuit functions as a continuity tester, it is powered by a 9-volt battery (B1) through D1, which drops some of the voltage. The diode protects buzzer BZ1 from damage due to reversed-polarity connections.

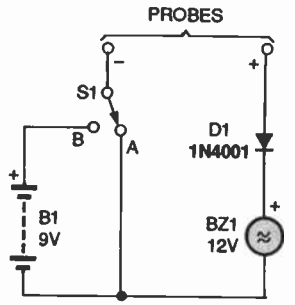


Fig. 5. This 12-volt-DC and continuity tester can do wonders around the garage, when installing alarms, or just during general troubleshooting.

Probes or alligator clips can be used as leads for the tester. When packaging the circuit, I kept the housing as small and thin as possible so that the unit can be carried conveniently in a shirt pocket.

—Mike Wilson, Welland, Ontario, Canada

Short, sweet, and useful. The only thing that I might do different for mine is to use a buzzer capable of operating over a range of voltages. I've got one handy that works from 3 to 24 volts, stretching the device's applications.

Well, that's another month of fun for us all. If you'd like to participate in this column, and perhaps receive a book as a thank you, write to *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

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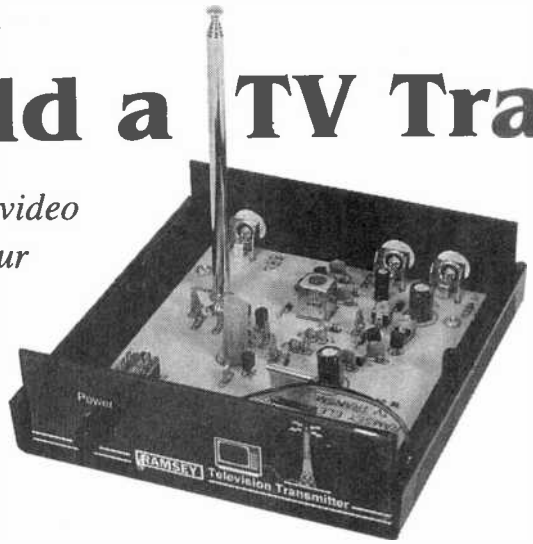


BY MARC SPIWAK

One of the most useful gadgets a video enthusiast can have is a TV transmitter. Such a device can transmit a signal from a VCR to any TV in a home or backyard. Imagine the convenience of being able to sit by the pool watching your favorite movie on a portable TV with a tape or laserdisc playing indoors. Videotapes can also be dubbed from one VCR to another without a cable connecting the two machines together. Further, when connected to a video camera, a TV transmitter can be used in surveillance for monitoring a particular location.

The main problem a video enthusiast has in obtaining a TV transmitter, though, is that a commercial unit can be somewhat expensive. However, we have some good news for all you video enthusiasts who are electronics enthusiasts as well: You can build the *TV Transmitter* presented in this article for less than $30, in one evening! The easiest way to do that is to order the kit that's available from the source given in the Parts List (a custom case for the kit is also available). However, we present enough information here to build the TV Transmitter from scratch, if you wish.

The TV Transmitter combines line-level audio and video signals and transmits the resulting signal up to 300 feet. Although the circuit can be powered from a 9-volt battery, it is best to use a 12-volt DC supply during alignment, and also to obtain the maximum transmission range and best possible picture. Aligning the TV Transmitter requires no special equipment whatsoever, and it is a very simple procedure. The Transmitter's output can be tuned to be received on any TV channel from 2 to 6. That range of channels should be wide enough not to interfere with other TV viewers who are nearby. To comply with FCC rules, it is mandatory that nearby TV viewers are not disturbed by the transmission. If your activities interfere with the reception of a licensed station, regardless of the reason, you must shut down the unit.

Circuit Description. Figure 1 is the schematic of the TV Transmitter circuit. Video signals input at jack J1 are first terminated by resistor R6 and coupled through capacitor C1 to clamping-diode D1. The clamping forces the sync pulses to a fixed DC level to reduce blooming effects. Potentiometer R3 is used to set the gain of the video signal; its effect is similar to that of the contrast control on a TV set. Bias-control R7 can be used to adjust the black level of the picture so that

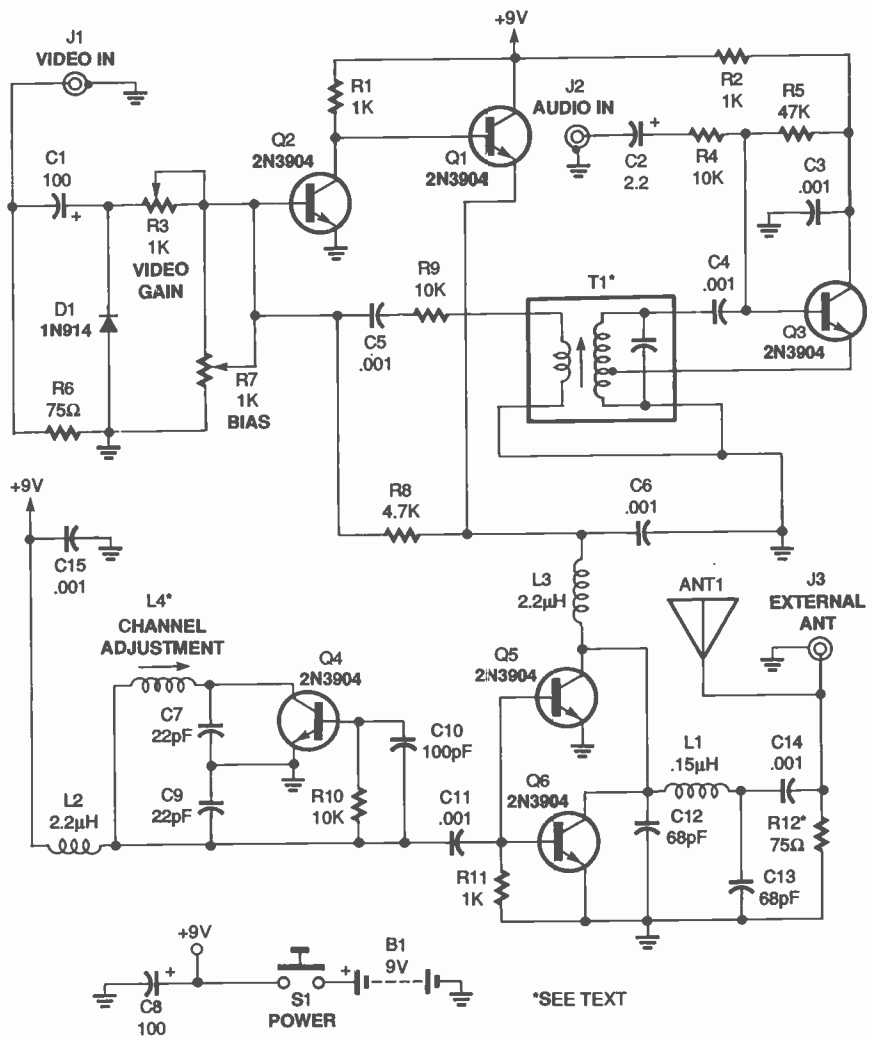
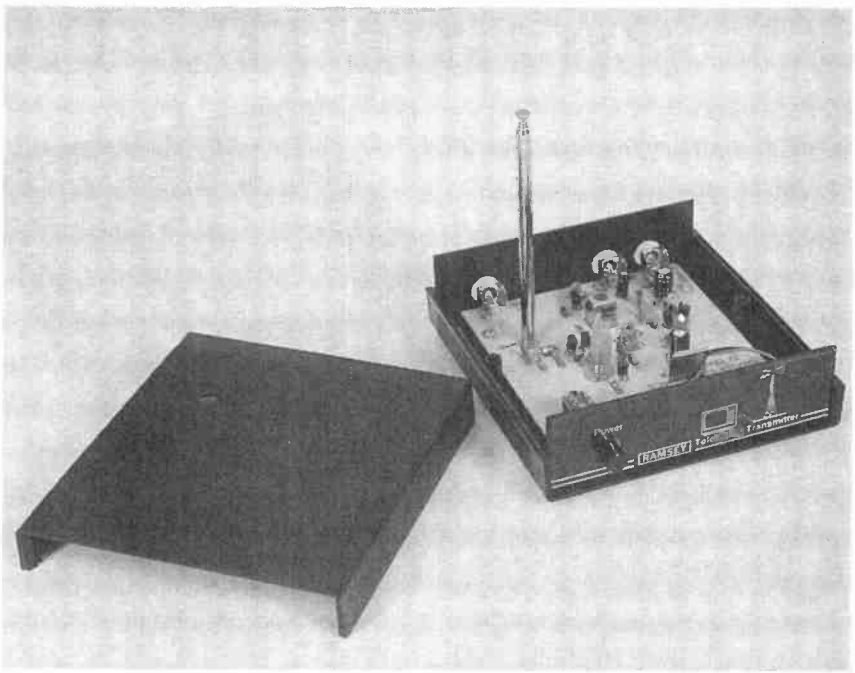


Fig. 1. As this schematic shows, hooking up the Transmitter to other equipment is easy. There's a video-input jack, J1; an audio-input jack, J2; and an external-antenna jack, J3 (although the unit works fine with ANT1, a telescopic-whip antenna).

some level of signal is transmitted, even for a totally dark picture. That way, a TV receiver can maintain proper sync. As we'll get to later, potentiometers R3 and R7 are adjusted in conjunction for the best all-around performance.

RF-transformer T1 and its internal capacitor form the tank circuit of a Hartley oscillator that's tuned to 4.5 megahertz. Audio signals input at J2 are coupled to the base of Q3 via C2 and R4; the audio signal modulates the base signal of Q3 to form an audio subcarrier that's 4.5-megahertz higher than the video-carrier frequency. The FM modulated subcarrier is applied to the modulator section through C5 and R9. Resistor R9 adjusts the level of the subcarrier with respect to the video signal.

Transistors Q1 and Q2 amplitude-modulate the video and audio signals onto an RF-carrier signal. The operating frequency is set by coil L4, which is



This Transmitter case designed for this project allows easy access to the circuit board for alignment purposes.

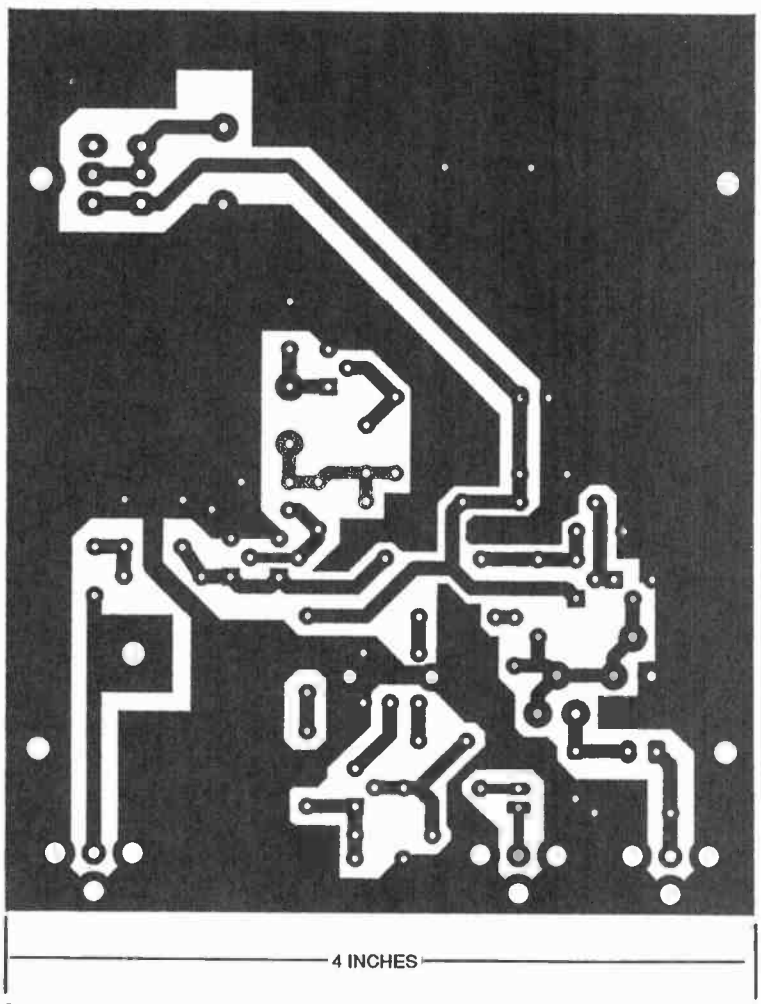


Fig. 2. If you wish, you can use this foil pattern to make your own PC board for the TV Transmitter.

3.5 turns of 24-gauge enameled wire on a form containing a standard ferrite slug. That coil is part of a Colpitts tank circuit also containing C7 and C9. The tank circuit forms Q4's feedback network, so Q4 oscillates at the set frequency.

The RF output from the oscillator section is amplified by Q5 and Q6, whose supply voltage comes from the modulator section. Antenna matching and low-pass filtering is performed by C12, C13, and L1. Resistor R12 is optional; it is added to help match the output signal to any kind of antenna (more on that in a moment).

Construction. Before we go on, while it is certainly possible to build the unit from scratch, unless you are an experienced builder and an accomplished parts scrounger, it is strongly recommended that you purchase the complete kit, or, at the very least, the

WARNING!!

The publisher makes no representations as to the legality of constructing and/or using the TV Transmitter referred to in this article. The construction and/or use of the transmitter described in this article may violate federal and/or state law. Readers are advised to obtain independent advice as to the propriety of its construction and the use thereof based upon their individual circumstances and jurisdiction.

PARTS LIST FOR THE TV TRANSMITTER

RESISTORS

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

R1, R2, R11—1000-ohm
R3, R7—1000-ohm trimmer potentiometer, PC-mount
R4, R9, R10—10,000-ohm
R5—47,000-ohm
R6—75-ohm
R8—4700-ohm
R12—75-ohm (optional, see text)

CAPACITORS

C1, C8—100-µF, 16-WVDC, electrolytic
C2—2.2-µF, 50-WVDC, electrolytic
C3–C6, C11, C14, C15—0.001-µF, ceramic-disc
C7, C9—22-pF, ceramic-disc
C10—100-pF, ceramic-disc
C12, C13—68-pF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

Q1–Q6—2N3904 NPN transistor
D1—1N914 silicon diode
T1—4.5-MHz IF-can-style RF transformer (see text)
L1—0.15-µH miniature inductor
L2, L3—2.2-µH miniature inductor
L4—0.14- to 0.24-µH adjustable slug-tuned coil (see text)
S1—SPST pushbutton switch, normally open
J1–J3—RCA jack, PC-mount
ANT1—Telescopic-whip antenna
B1—9-volt battery
Printed-circuit materials or board, battery holder and connector, pair of RCA patch cords, solder, hardware, etc.

Note: The following items are available from Ramsey Electronics, Inc. (793 Canning Parkway, Victor, NY 14564, Tel. 716-924-4560): TV-6 TV Transmitter Kit (includes PC board and all components except R12)—$27.95; kit of all components (except R12)—$17.95; PC board only—$10.00; CTV matching-case set—$14.95. NY residents please add appropriate sales tax.

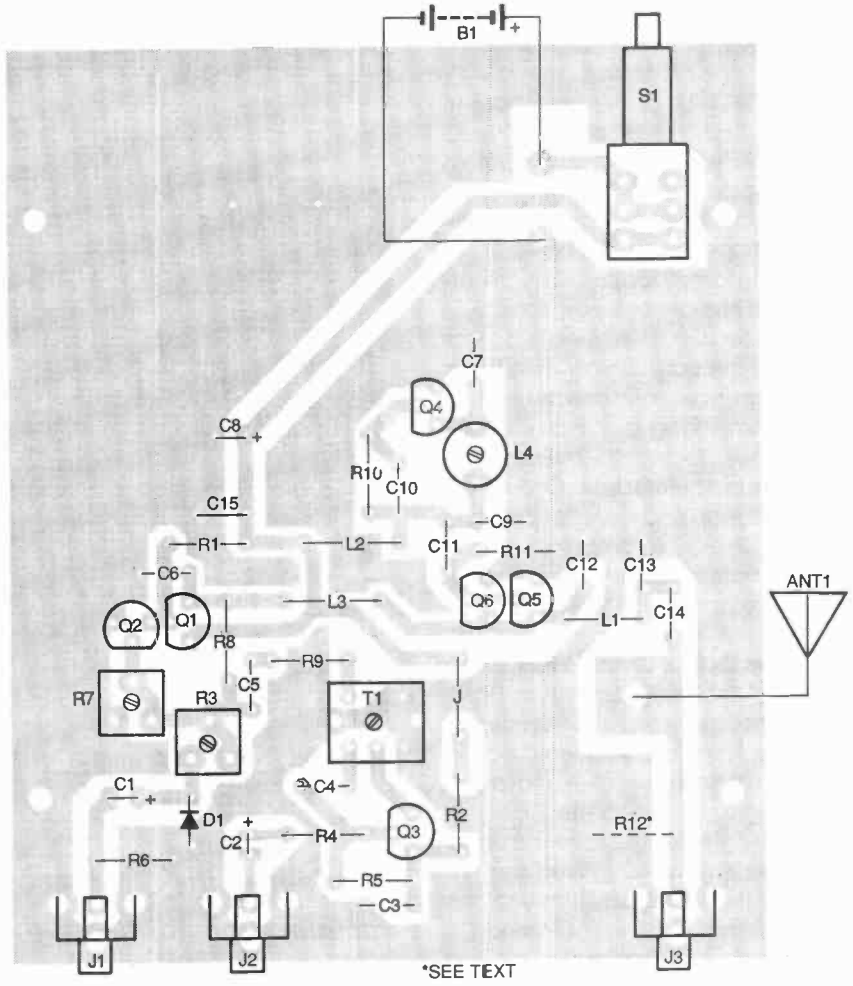


Fig. 3. Building the project is easy if you use this parts-placement diagram. Resistor R12 must be tack soldered on the solder side of the board between the antenna output and ground.

component kit from the source mentioned in the Parts List. While most of the parts are readily available, two can be a real headache to obtain.

The 4.5-MHz RF transformer (T1) used in the kit is an OEM Toko part that is not available via traditional sources. While just about any 4.5-MHz RF transformer that is similar to the one described in the article (internal capacitor, tapped secondary) can be used, such units are hard to obtain from hobbyist-friendly sources. If you are determined to go that route, your best bet is to contact Toko directly (1250 Feehanville Dr., Mt. Prospect, IL 60056; Tel. 708-297-0070) to obtain the location of your nearest full-line distributor. Also, coil L4 is a custom unit. It can, however, be home made using the parameters given earlier.

The TV Transmitter should be built on a PC board for best performance. You can make a board from the foil pattern provided in Fig. 2, or use the one that's included with the kit.

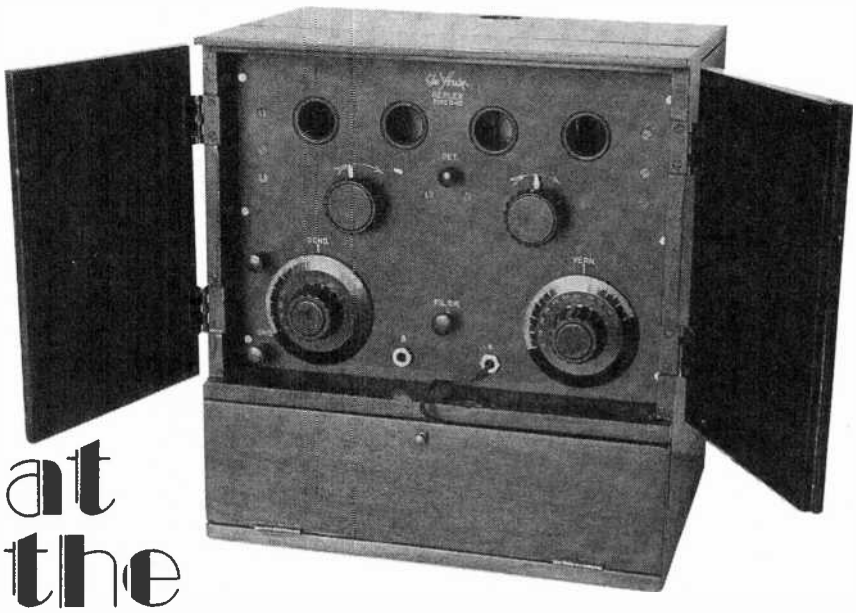
Parts are installed on the board as shown in the parts-placement diagram (see Fig. 3). Pay careful attention to the orientation of the transistors, electrolytic capacitors, and the diode. If resistor R12 (not included in the kit) is used, it must be tack-soldered on the solder side of the board between the antenna output and ground. That resistor should be installed if you intend to use anything other than the built-in whip to provide proper matching between the antenna and the circuit.

The outline of the switch (S1) that is shown in Fig. 3 is the same as the one that comes with the kit, an SPST pushbutton switch that is normally open. However, you can use any kind of toggle switch as a replacement. A simple whip antenna mounts to the board with a single machine screw; the whip antenna is suitable for most applications. The battery holder can be soldered to the board with scraps of jumper wire or mounted with double-sided tape or screws.

When the board is finished, it must be mounted in a case. The case avail-

(Continued on page 92)

Looking Back at the REFLEX RADIO



Here's how the old-time radio engineers made one vacuum tube do the work of two.

BY DAVID RUTLAND

For a short time in 1923 and 1924, there was great interest in a circuit that was originally invented in 1917 by Marius Latour in France. That "reflex" circuit allowed one tube to simultaneously act as both a radio-frequency (RF) amplifier and an audio-frequency (AF) amplifier, and opened up the possibility of providing amplification with an affordable number of tubes.

The reflex circuit was used in a great many of the early radios when tubes were expensive, and it was used by Edwin Armstrong and Harry Houck when they developed their famous *AR-812* superheterodyne. One of the early sets that used the reflex principle to save one audio amplifier was the *Tridyn* manufactured by the Crosley Radio Corporation in 1924.

How the Reflex Circuit Works. The circuit of the Tridyn, shown in Fig. 1, illustrates how simple reflex circuits operate. The first tube performed the function of an RF amplifier and, at the same time, amplified the AF signal from the detector. The antenna signal was coupled to the grid of the first tube in the usual way, through the tuned circuit made up of L1 and C1. Unlike ordinary RF amplifiers, the grid circuit also contained the secondary of the AF transformer, T1. That transformer had no effect on the RF operation of the tube because the RF signal was effectively connected to ground through C4. Similarly, the plate circuit contained the primary of AF transformer, T2, and radio frequencies were bypassed through C5. Therefore, as far as the RF signals were concerned, the two tubes formed a receiver with a single-stage RF amplifier followed by a regenerative detector.

The audio-frequency output of the detector was coupled to the grid of the first tube by transformer T1. The AF signal was not affected by the RF tuned circuit formed by L1 and C1, or by the relatively small RF-bypass capacitor, C4. The amplified AF voltage at the plate of the first tube passed through transformer T2 to the final AF stage, V3. Again the inductance of radio-frequency coil L3 and capacitor C5 had a negligible effect on the AF signal. Therefore both the RF and AF signals passed through the first tube and the circuit performed as a four-tube set with an RF amplifier, a regenerative detector, and a two-stage AF amplifier.

Latour's Multi-stage Reflex. Latour extended the reflex concept beyond the simple one-tube reflex of the Tridyn. The block diagram in Fig. 2 shows how Latour planned to reflex the first three stages of a four-tube set. The antenna signal was amplified by the first three tubes, V1, V2, and V3, which were coupled by the RF transformers, T1, T2, and T3. The amplified signal was

A three-tube version of Grimes' Inverse Duplex circuit was marketed by him in kit form.

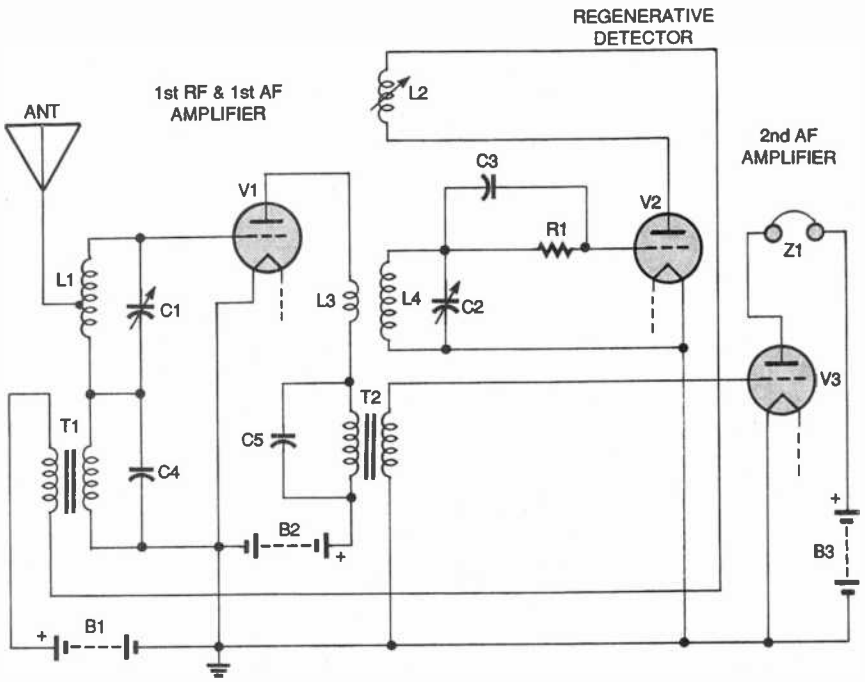


Fig. 1. One of the earliest sets to use the reflex principle was the Crosley Trirdyn. The schematic of that simple radio is shown here.

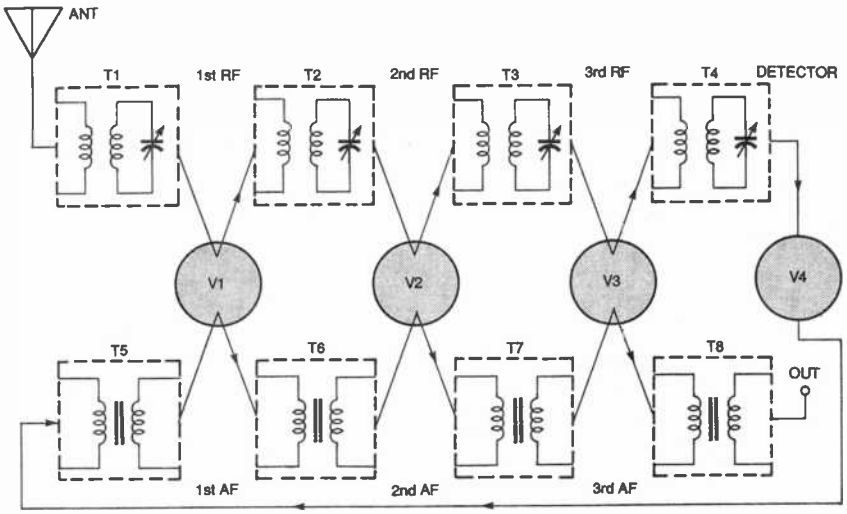


Fig. 2. This block diagram shows how the reflex circuit's inventor, Marius Latour, planned to extend the concept to reflex the first three stages of a four-tube set.

then coupled to the detector, V4, through transformer T4. The AF signal from the detector was then reflexed back to the first tube and amplified along with the RF signals through the AF transformers, T5, T6, and T7. As you can see, all three amplifier tubes did double duty amplifying both the RF and the AF signals.

Problems with Latour's Circuit. The Trirdyn reflexed one tube, and in so doing saved one tube. Latour's circuit, on the other hand, saved three tubes, using just four tubes to do what would ordinarily have taken seven. Because tubes were expensive in the 1920s most radios had only five tubes, so Latour's design seemed attractive to many radio designers. Unfortunately, it soon became apparent that a practical radio receiver using Latour's circuit was very difficult to build due to three major problems:

The first was overloading. Both the RF and AF signals were amplified by the first two stages. Therefore both the strongest RF and the strongest AF signals passed together through the last reflexed tube, V3. It was not unusual for the combined signals to become so large that the tube was driven out of its normal operating range, causing the signals to interfere with each other. Overloading wasn't a serious problem when only one stage was reflexed as in the Trirdyn, but became critical in Latour's three-tube circuit and was more difficult to avoid.

Latour's circuit was also prone to regeneration, or positive feedback. Any residual RF signal appearing at the output of the detector, V4, would immediately be passed back to V1 and amplified over again. That feedback would cause the whole set to oscillate.

Finally, Latour's circuit easily picked up stray interference from household power wiring. Like an unshielded microphone lead, the antenna would pick up the 60-Hz power-line frequency. Although that frequency could not pass through the RF transformers, it was readily amplified by the three audio stages. An objectionable hum would then appear in the audio output.

Overcoming the Problems. The drawbacks of the Latour circuit were overcome by a reflex circuit developed by David Grimes, an electrical-engineering graduate of the University of Minnesota. Like Latour's circuit, Grimes' "Inverse Duplex" circuit, shown in Fig. 3, used three amplifier stages, V1, V2, and V3, followed by the detector, V4. However, instead of connecting the AF signal from the detector back to the first tube, Grimes sent it to the third tube, V3. From V3 the AF signal went through T6 back to the second tube, V2, and then through T5 to the first tube, V1. That circuit solved the three basic design problems outlined earlier. Let's see how:

In Grimes' circuit, unlike Latour's, the third tube amplified the weakest AF signal and the strongest RF signal. The first tube amplified the weakest RF signal and the strongest AF signal. In that way, the signal levels were more evenly distributed between the tubes and they were less prone to overloading.

In Latour's circuit, much care had to be taken to ensure that any residual RF signal from the detector was very small, or the whole set would oscillate. Grimes' circuit reduced the possibility of oscillations by connecting the detector output, not to the first tube, but

to the tube immediately preceding the detector. Therefore, the overall gain back to the detector was reduced and oscillations were more easily prevented.

Finally, in Latour's circuit the three stages of AF amplification, cascaded from the antenna to the detector, readily amplified the 60-Hz household power-line frequencies. The Inverse Duplex design cascaded the AF amplifier in the reverse direction so that the first tube, connected to the antenna, was the final AF stage. The 60-Hz power-line frequency from the antenna was therefore amplified only by that one stage and the hum was not audible.

Commercial Sets. A three tube version of Grimes' Inverse Duplex was marketed by him in kit form and, towards the end of 1923, Sleeper Radio used the circuit in their *Monotrol* receiver. The receiver circuit used untuned RF transformers between stages, relying solely on the tuned loop antenna for selectivity. As a result, only one tuning control was required, hence the name "Monotrol." The sensitivity or volume control was provided by a rheostat in series with the tuned loop-antenna circuit and the grid of the first tube. That resistance reduced the signal but did not reduce the loop's selectivity. By reducing the strong signals before the first amplifier stage, the reflex amplifiers were prevented from overloading.

Using a Crystal Detector. Other variations on the reflex circuit were generated by an announcement of a "$225 Reflex Prize Contest" in the magazine *Radio News*. The announcement encouraged experimenters to build a reflex set around a crystal detector and a single tube. The crystal detector eliminated the need for a separate detector tube and freed the single tube so that it could provide a stage of both RF and AF amplification. Regeneration could even be added to the RF amplifier to increase the sensitivity. Many experimenters responded with ingenious designs to try to win the prize. The editors said that they had tested many good circuits but there still must be some that are even better.

Commercial sets using a crystal detector were made by the Electrical Research Laboratories, ERLA, in 1923. Their set, the *Superflex*, used three tubes and a crystal detector. The first stage was a straightforward RF amplifier. It was followed by a reflex stage that performed as both an RF and AF amplifier. The third tube provided an additional stage of AF amplification.

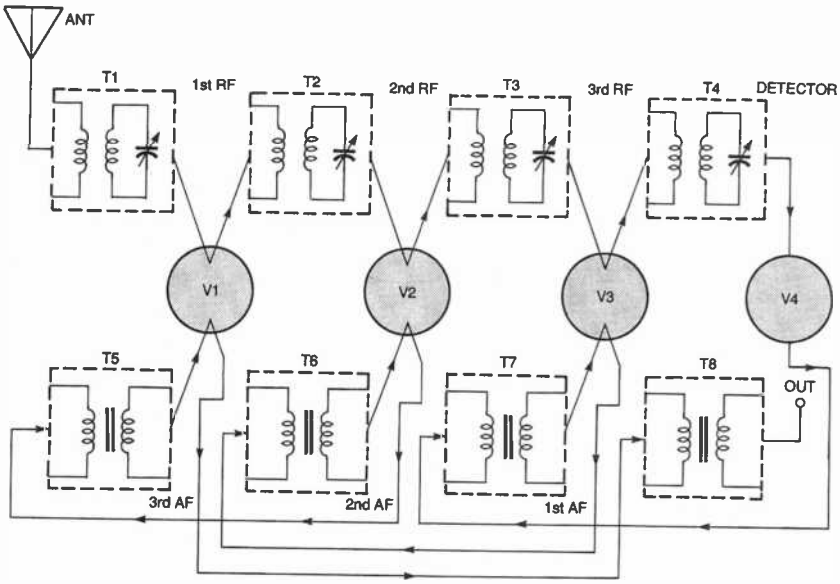
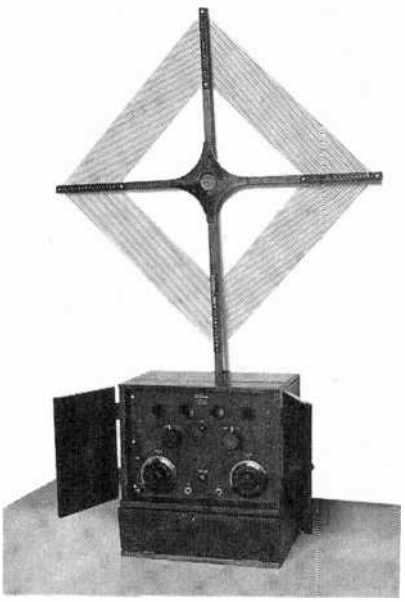


Fig. 3. The problems that arose from Latour's design were overcome by the Grimes Inverse Duplex circuit. A block diagram for that circuit is shown here.



Here's a view of the DeForest D-10 reflex radio with its large loop antenna.

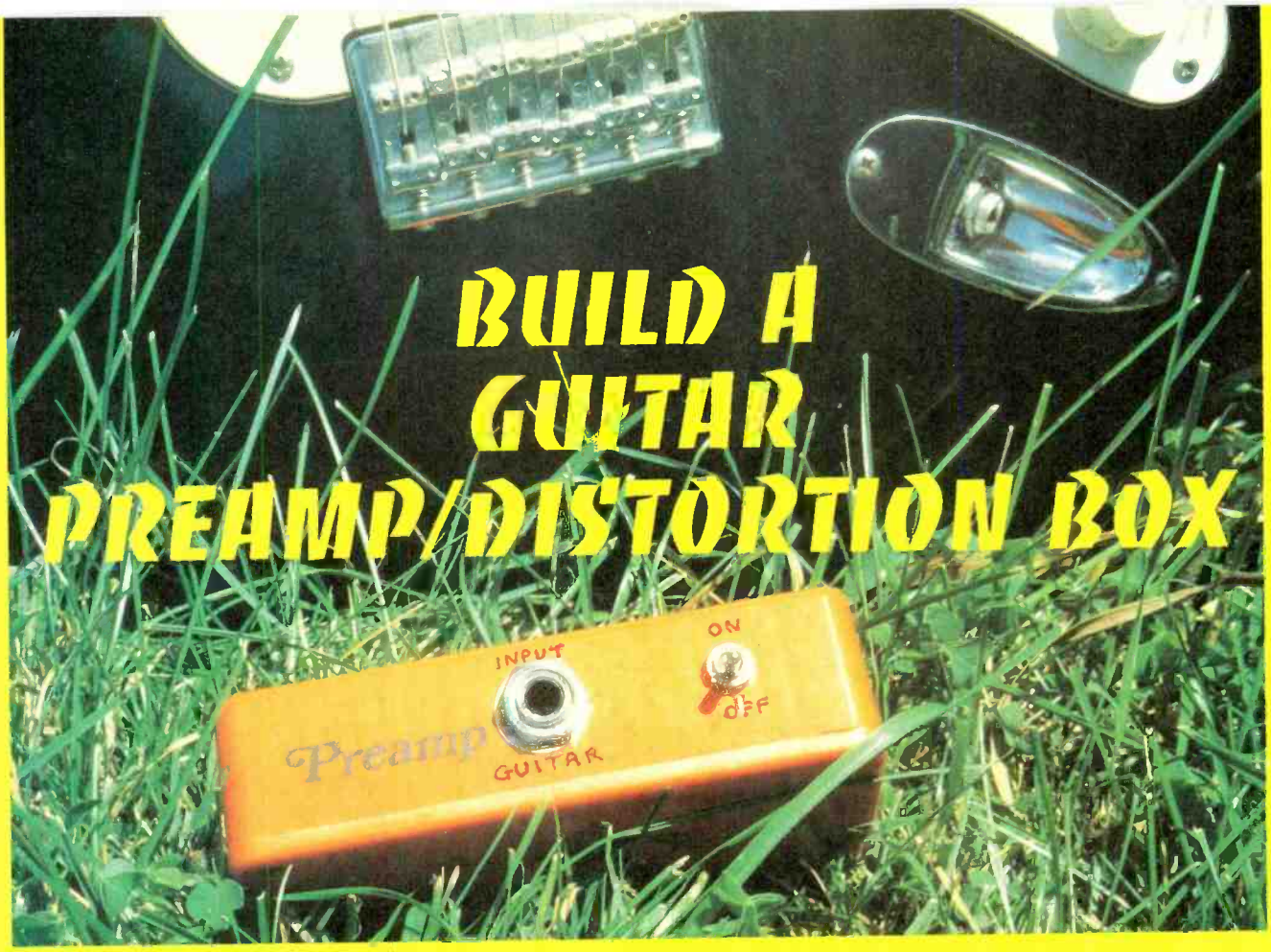
De Forest Reflex. The crystal detector in ERLA's Superflex did not provide any amplification and so most manufacturers of reflex sets used a tube detector. Lee De Forest, the inventor of the triode tube, was looking for a company to manufacture radios, and in 1922 he bought Radio Craft. That company had been founded by Frank M. Squire, who had previously been a draftsman with well known manufacturer A. H. Grebe and Co. Squire was introduced to reflex circuits by William Preiss who had worked on them with the Navy during World War I. Preiss called himself "father of reflex," although Latour already had his patent in 1917. Squire designed the DeForest *D7* receiver, and it was on the market by late 1922. The set used three tubes reflexed to give the same performance as five.

Squire kept improving the reflex sets and brought out new models with more tubes. By 1925 they were making the *D17*, which was a five-tube receiver with one reflexed AF stage. Two RF amplifiers preceded the reflex stage providing a total of three RF-amplifier stages. A large loop antenna and tuning capacitor formed the input circuit of the first RF stage, which was coupled through a tuned RF

(Continued on page 88)

For More Information

This article is based on a chapter from the book *Behind the Front Panel* by David Rutland, available for $18.95 plus $2.00 shipping and handling from Wren Publishers, P. O. Box 1084, Philomath, OR 97370. ■



BUILD A GUITAR PREAMP/DISTORTION BOX

Give your guitar-and-amp setup the heavy, grunge edge it needs for today's music.

BY KEN WILLMOTT

I have played electric guitar for many years, and have often toyed with ideas for circuits that would modify the sounds that come out of my amp. As most guitar players know, there are many guitar effects available commercially. And, because most of those are relatively affordable, I have never been too interested in duplicating them. So, you might ask, why would I build something as simple as the *Guitar Preamp/Distortion Box* described in this article?

It all began when my brother gave me a Fender Super Reverb tube amp for Christmas. I tried to coax a little rock-and-roll distortion out of it, but it turned out that turning up the volume was the only way I could get it to sound "heavy." Well, needless to say, it didn't take the neighbors long to start complaining about the excessive noise. So I figured there were two possible solutions to the problem: I could either place a heavy-duty resistive attenuator between the amp output and the speakers, or build a distortion box. I opted for the latter.

My first guitar distortion-box project was a neat design based on an op-amp, but I was never happy about its appetite for batteries. I had once built a guitar preamplifier to fit inside a Fender Stratocaster, and it had the same problem. However, an FET preamp I built for a friend's banjo worked great, largely because of its amazing battery life. That convinced me that I would have to consider a low-power design for my new Preamp/Distortion Box. The resulting prototype draws only 65-μA from a 9-volt battery, allowing it to run continuously off the battery for a few months (as I learned by accident when I forgot to turn the unit off).

A Word on Distortion. There is an almost religious debate about distortion, usually in the context of whether tubes are superior to transistors in musical-instrument applications. Indeed, in this solid-state era, tube guitar amps (most notably those made by Marshall) are often preferred by guitarists in hard-rock bands. According to them, a tube amp that has warmed up for a good half hour "really screams."

Well, in terms of electronics theory, the basic difference between a transistor amp and a tube (especially a triode) amp, is that the transfer function of a tube is "softer." In other words, as a signal approaches its maximum limit in a tube amp, it does so smoothly, compared to the "brick wall" response of a transistor. Also, the asymmetry of a tube circuit tends to generate more even harmonics than odd ones; and that contributes to the difference in sound.

It occurred to me that a tube-like response was what I wanted for my design. Right away, a transfer function that I had admired in college popped into my mind—that of the bipolar differential amp, or "long-tailed pair." It has the nice property of "saturating" gradually rather than suddenly, as in the case of a single transistor, and does that for both positive- and negative-going signals.

Circuit Description. Figure 1 shows the schematic for the Guitar Preamp/

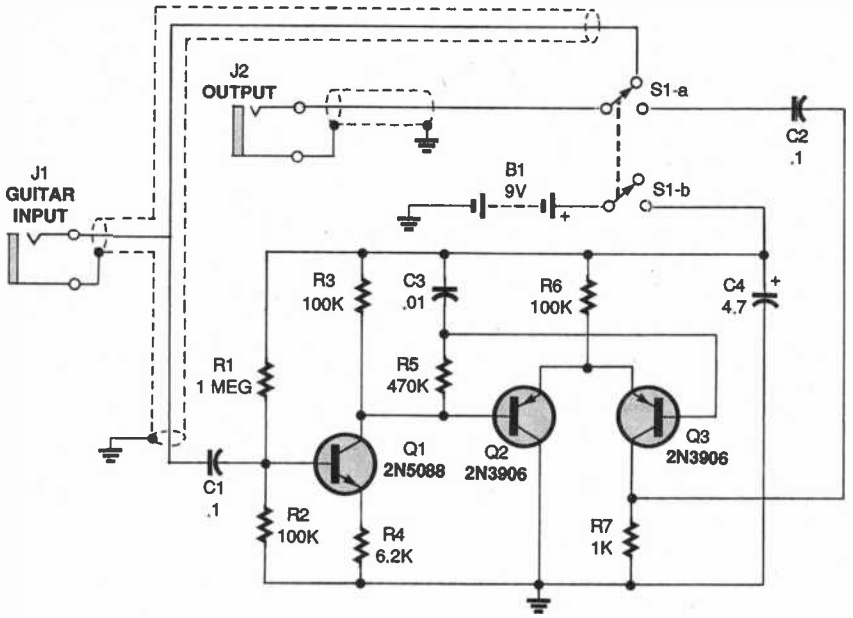


Fig. 1. Here's the circuit diagram for the Preamp. Basically, there are two stages that the input signal goes through: Transistor Q1 is in a common-emitter configuration with a gain of 24 dB. That drives the following stage, where the amplified signal is fed to the differential pair composed of Q2 and Q3.

Distortion Box. Transistor Q1 is a low-noise transistor in a common emitter configuration with a gain of 24 dB. That gain boosts the guitar signal to a sufficient level to drive the following stage, where the amplified signal is fed to the differential pair composed of Q2 and Q3, which is biased as a limiter.

The RC network made up of R5 and C3 performs several functions. For one, it allows the differential pair to get its DC bias from the output of Q1, by low-pass filtering the AC signal at the base of Q3. The network also provides an approximately 30-mV offset between the bases of Q2 and Q3, which is crucial to obtaining a higher percentage of even harmonics at low signal amplitudes. Last but not least, the RC network forces Q3 to turn on gradually when power is first applied. That prevents turn-on transients from reaching the output, which is important because the Preamp will most likely be switched on and off while plugged into the guitar amp.

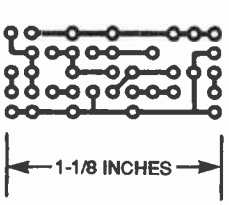


Fig. 2. If you plan on using a PC board to build the Preamp, use this full-size template to etch your own.

Capacitors C1 and C2 AC couple the input and output signals to the circuit. Bypass-capacitor C3 is intended to stabilize the battery voltage and prevent turn-off transients by supplying power long enough for audio switching to occur. Resistor R7 is of a relatively low value, both in order to match the "on" and "off" signal levels, and to reduce noise on the signal path between the unit and the amp.

Construction. The author's prototype for the Preamp was built on a perforated board, but for those who wish to make a printed-circuit board, a template is provided in Fig. 2. If you do build the circuit on the PC board, use the parts-placement diagram in Fig. 3 as a guide.

Install the resistors on the board first; to keep the board as small as possible, the resistors mount vertically. Try to leave a space between the end of each resistor and the board. Then, solder the rest of the on-board components, making sure to check the orientation of the transistors and capacitor C4.

Once the board is built, proceed with the off-board wiring and shielding. Again, refer to Fig. 3. The switch and jacks mount on the project enclosure itself, so it would be easiest to do the wiring inside the enclosure (any reasonably sized project enclosure can be used). Just drill the holes for the jacks and switch, mount the components, and then measure how long each piece of hookup wire should be. At this point in the project's assembly, you could (if you wish) replace toggle-switch S1 with a footswitch for easier operation while you are playing guitar.

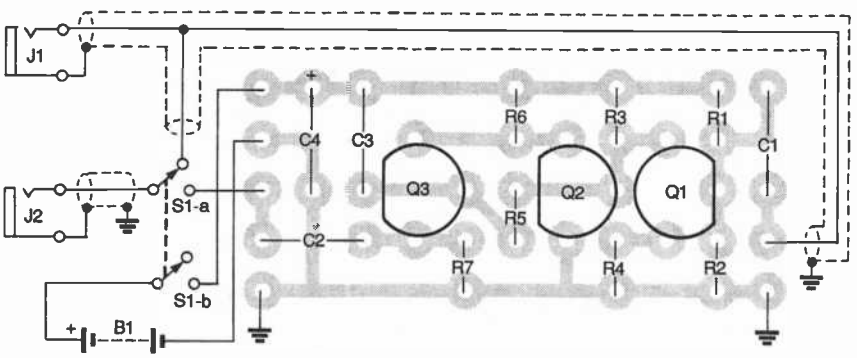
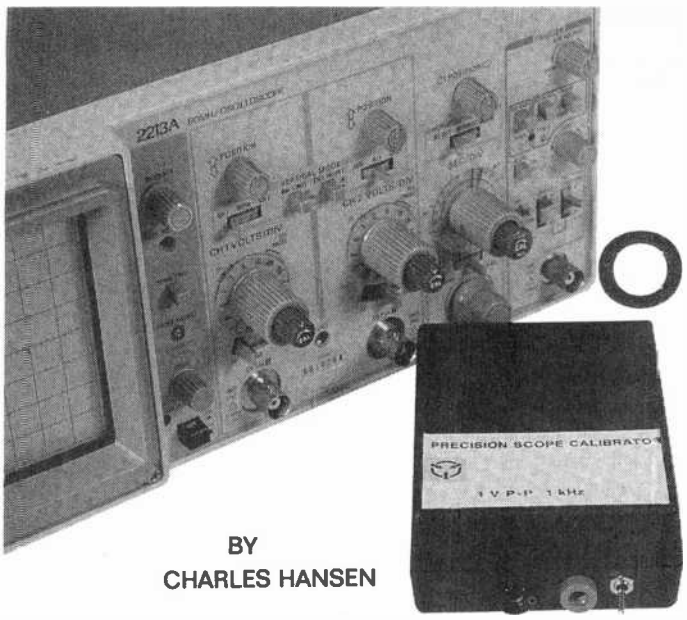


Fig. 3. Off-board wiring could get tricky, unless you follow this parts-placement diagram.

When the project is finished you could apply labeling or dry-transfer decals to give the Guitar Preamp/Distortion Box a professional look. A permanent pen was used to label the jacks and switch on the author's prototype; decals were used for the "Preamp" logo. Spray any labels with a clear sealant to protect them.

Checkout and Use. Connect the unit to a guitar and an amplifier, and turn on the power. Turn the guitar volume down quite low, and adjust the amp's volume so that you hear a clean, fairly undistorted guitar sound. Then, increase the guitar's volume until the distortion also increases (you might have to turn the volume down a little at the amp). While playing an

(Continued on page 89)



BUILD THIS OSCILLOSCOPE CALIBRATOR

Use it to check your scope's vertical gain and horizontal time base.

BY
CHARLES HANSEN

Many oscilloscopes do not have an internally generated calibration signal. Sure, some older models have 1-volt, peak-to-peak, 60-Hz calibrator outputs; however, those outputs are little more than clipped, 60-Hz sinewaves, and are not precise enough for calibration purposes. For that reason, you might want to build and use the *Oscilloscope Calibrator* described in this article. The unit provides an accurate squarewave of 1-volt-DC peak-to-peak, at a frequency of 1 kHz, which can be used to check the vertical gain and horizontal time base of your oscilloscope.

The Calibrator can also be used to adjust scope-probe compensation and can serve as a signal source for checking the transient response of audio equipment. It is battery powered for portability and is relatively insensitive to voltage fluctuation—the frequency output remains constant at a battery voltage of anywhere from 7.7- to 9.8-volts DC. Also, the minimal 2-mA current draw ensures long battery life.

Circuit Description. Figure 1 shows the schematic diagram for the Calibrator. The oscillator portion of the Calibrator consists of two sections of a 4049 CMOS hex inverter (U2-a and U2-b), and timing components C2, R2, R3, and R4. That portion of the circuit determines the output frequency. The exact frequency value can be found using the formula:

$$f = 2.2C2(R2 + R3)$$

Assume that pin 5 of U2-b is initially low, causing the output at pin 4 of U2-b to be high. Because the input at pin 3 of U2-a is also high, the output at pin 2 of U2-a is therefore low. The high output at pin 4 charges C2 through R2 and R3. When the voltage across C2 gets to the high input threshold at pin 6 of U2-c, the output at pin 4 and the input at pin 3 will go low. That causes the output of pin 2 to go high. Because the voltage across C2 cannot change instantly, the voltage at the input of U2-b is greatly increased to approximately 150% of battery voltage. That positive feedback reverses the logic level at the maximum rate that the CMOS gate is capable of achieving.

With the logic levels reversed on U2-a and U2-b, C2 is charged in the other direction, with the voltage at pin 5 decreasing. When the C2 voltage gets to the low input threshold at pin 6, the output at pin 4 and the input at pin 3 will go high. That causes the output at pin 2 to go low. Again, the voltage across C2 cannot change instantly, and the voltage at the input of U2-b is reduced to about 50% of battery voltage. That once again reverses the logic level at the maximum rate.

Resistor R4 limits the input current to U2-b when the voltage across C2 exceeds that of the power-supply rails, thereby protecting the gate-input diodes. The resistor also prevents the RC-timing circuit from being loaded

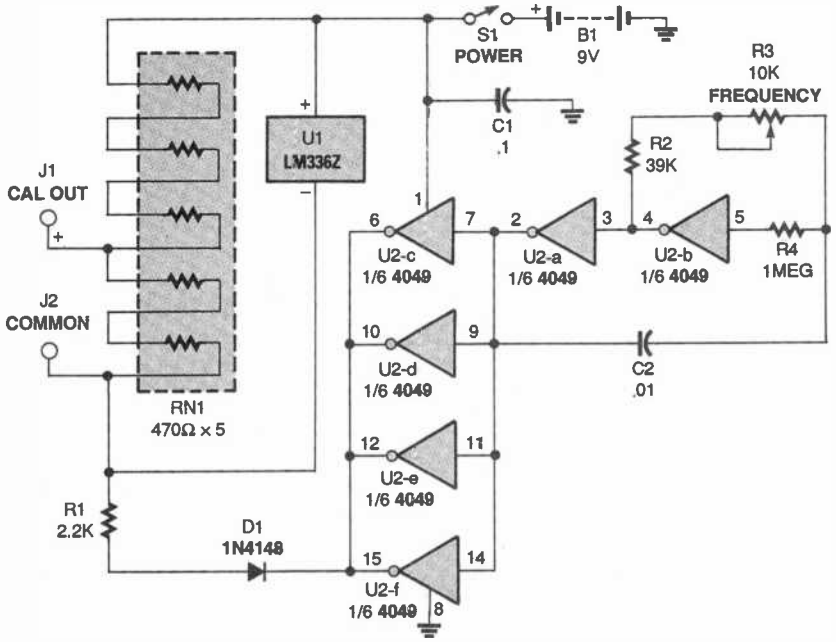


Fig. 1. Here's the schematic for the Oscilloscope Calibrator. To lower the long-term drift of the oscillator portion of the circuit, use a 2% metal-oxide resistor for R2, and a Mylar capacitor for C2.

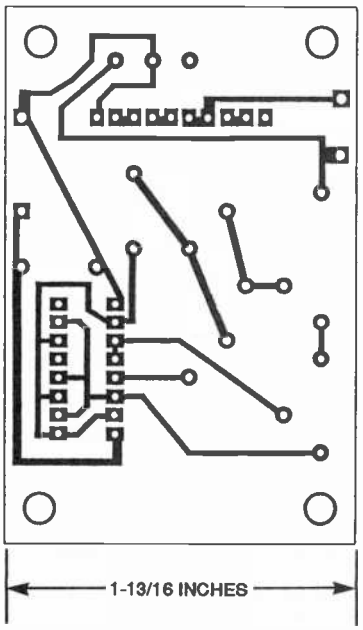


Fig. 2. Use this template to etch your own Calibrator PC board.

down by those internal diodes, which would tend to round off the edges of the squarewave. That results in a 50%-duty-cycle squarewave whose frequency is relatively independent of the battery voltage.

The squarewave output from pin 2 is connected to the parallel-connected inputs of the four remaining inverters in the 4049, whose outputs are also connected in parallel. When the squarewave output of the 4049 is low, U1, the LM336Z 2.5-volt DC reference (available from several hobbyist sources, including Digi-Key, P.O. Box 677, Thief River Falls, MN 56701-0677; Tel. 800-344-4539), is turned on through R1 and D1. That causes the Calibrator's output squarewave to go high.

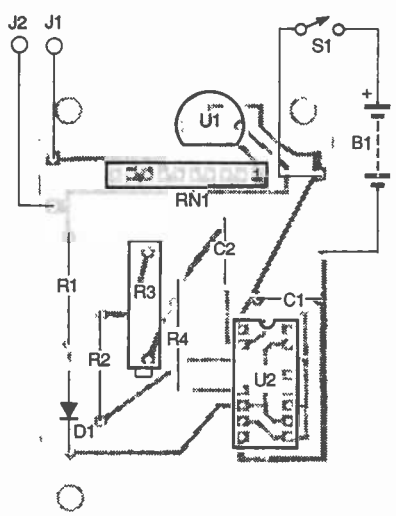


Fig. 3. When mounting the components on the board, use this parts-placement diagram as a guide.

The combined current-sink capability of U2-c through U2-f is over 14 mA. Only 2 mA of that capability is used, assuring a very fast rise time for the output squarewave. In order to provide the 1-volt-DC, calibration output voltage, a 2% resistor network, RN1, is used. Each of the five elements in RN1 is rated at 470 ohms. The network is tapped at 40% of its overall resistance to provide the desired 1-volt-DC output at jack J1 (CAL OUT)—jack J2 is the COMMON.

When the squarewave output is high, the cathode of D1 is pulled to within ½-volt of the 9-volt DC supply. Therefore, no residual current flows through RN1 or U1, and the Calibrator output is a true zero. Waveform flatness is more than adequate due to both the 0.2-ohm, dynamic, "on" impedance of the LM336Z, and the complete turn-off of the drive current during a high output from the four drivers, U2-c–U2-f.

The voltage accuracy of the squarewave is maintained within 1% by U1. While the value of the network resistance is specified at 2%, the variations between each resistor element in the network are much smaller. That accurate voltage division provides a precise output-voltage level. Output impedance is approximately 1000 ohms.

The output squarewave depends greatly on the current through RN1, so a large filter capacitor is not required for the 9-volt battery, B1. Capacitor C1 is used to provide glitch filtering for U2 during logic transitions.

Construction. The author's prototype circuit was wire-wrapped on a perforated board. Layout of the parts is not critical, and for that reason, any standard project-building method can be used. However, for those who wish to build the Calibrator on a printed-circuit board, a foil pattern is shown in Fig. 2. Follow the parts-placement diagram shown in Fig. 3 if you choose to make your own PC board.

In keeping with good assembly practice, install the least-sensitive parts first, followed by the more-sensitive parts. Install the battery connector, an IC socket for U2, and the switch, followed by the potentiometers and jacks. Next, mount the other passive parts—resistors first, then capacitors. To keep long-term drift in the oscillator portion of the circuit to a minimum, C2 should be a Mylar capacitor, R2 should be a 2% metal-oxide timing resistor, and R3 should be a wire-wound multi-turn trimmer potentiometer. Finally, install D1, U1, and U2. Double check the orientation of the polarized components, and if you aren't using a PC board, double check your wiring.

Depending on the sensitivity of your scope, you might need a higher reference voltage for the Calibrator. If that is the case, keep the following possible customization in mind when building the unit. Connect two LM336Zs in series, and use a reduced value resistor for R1 to maintain 1 mA in the divider and the LM336Zs. That will provide a reference based on 5-volts DC.

Checkout and Calibration. The output voltage of the Calibrator can be

(Continued on page 91)

PARTS LIST FOR THE OSCILLOSCOPE CALIBRATOR

SEMICONDUCTORS

U1—LM336Z precision 2.5-volt DC reference, integrated circuit (Jameco 23771 or equivalent)
U2—4049 CMOS hex-inverter, integrated circuit
D1—1N4148 silicon diode

RESISTORS

(All fixed resistors are ¼-watt, 5% units, unless otherwise noted.)
R1—2200-ohm
R2—39,000-ohm, metal-oxide, 1%
R3—10,000-ohm trimmer potentiometer (see text)
R4—1-megohm
RN1—470-ohm × 5, 2% resistor network

ADDITIONAL PARTS AND MATERIALS

C1—0.1-μF, ceramic-disc capacitor
C2—0.01-μF, Mylar capacitor
S1—SPST mini toggle switch
J1, J2—Binding post
B1—9-volt battery
Printed-circuit materials, project enclosure, battery snap with leads, wire, solder, hardware, etc.

Upgrading and Maintaining your Personal Computer

This time around we add multimedia peripherals to our PC.

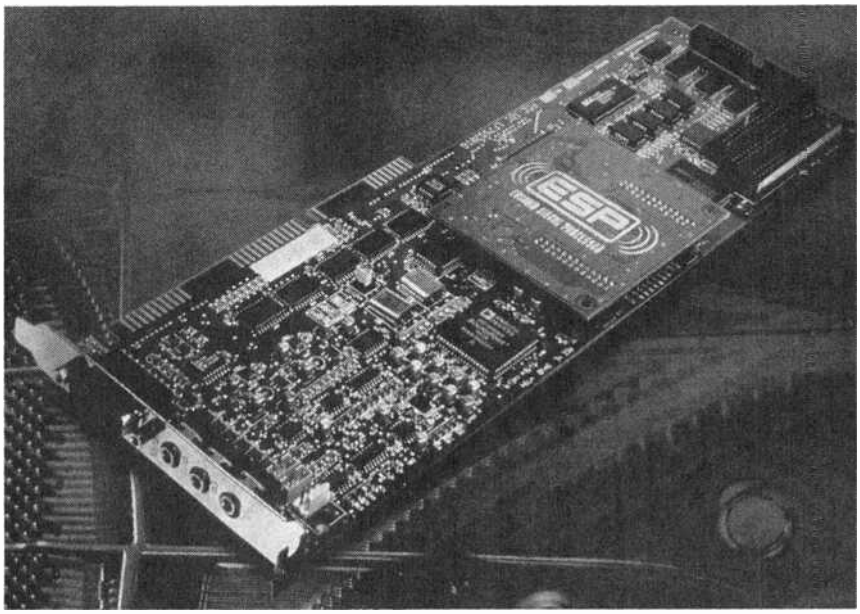
BY MARC SPIWAK

If you've been following this occasional series on PC servicing and hardware upgrades, then you know what we started with: a very basic and stripped down 486 SX/25 that was included as part of a PC servicing course available from Heathkit. See the box at the end of this article for more information on that course.

We added memory to the unit in one installment (**Popular Electronics**, April 1995). That brought the machine's RAM up to 8 megabytes, increased video memory to a total of 2 megabytes, and added a secondary cache of 128K. In the second installment (**Popular Electronics**, June 1995) we added a 5¼-inch floppy drive (something that some people still need these days!) and a second hard drive to bring the PC's total storage capacity up to around 300 megabytes—nothing to laugh at just yet, but nothing worth bragging about either.

Most of what has been covered so far is included as part of the course, but this month we will turn our attention to a subject that is not: multimedia upgrades. While our trainer PC now has enough memory and storage space to be considered adequate for multimedia, it really lacks the CPU horsepower necessary for multimedia both because of low speed and the absence of a numeric co-processor. That's probably at least one of the reasons why Heathkit did not cover multimedia hardware. But we're using the machine as a demonstration platform only, and it's perfectly suited for that job.

The Right Stuff. We'll be adding a CD-ROM drive and a sound card to turn our plain-old PC into an MPC (Multimedia PC). If you're still reading along, then you probably have a



A sound card looks pretty much like any other expansion card, but what sweet music it makes.

computer at home that doesn't already have those features, and are thinking of adding them.

If you are in the market for a completely new machine, you should only consider a computer that already contains multimedia hardware. That is both the easiest and the least-expensive way of obtaining a multimedia-equipped computer. With mail-order and local "computer-barn"-type outlets selling 486 DX2/66's with 8 Megs of RAM, half-gig hard drives, double-speed CD-ROMs, sound cards, 14.4 modems, 15-inch monitors, speakers, microphones, software, and more, all for around the $1500 mark, one would be crazy to buy anything less.

Anyway, you should have at least a 486 *DX* to bother with multimedia—an SX is just too slow. Not that most software doesn't run on one. As a matter of fact, many games are *more* stable on the upgraded SX-25 that we'll describe in a moment than on my "old" DX2/50, due to the DX2/50's "dinosaur" non-local-bus, 256-color video system—the games just run slower on the 25.

Many new games, however, will not run at all on an SX. Some software wants at least a 486/66, and sometimes even a Pentium is recommended for best performance. Therefore, if you have anything less than a 486 DX, you're probably better advised to opt for an entire new system rather than investing time and money in the old one. If you still want to add multimedia hardware to a 486 SX—or, dread the thought, a 386—go ahead. The hardware is not that expensive. Just keep in mind that everything will run pretty slow, and eventually, none of the new software will run on it at all.

If you are purchasing a CD-ROM drive for your computer, you must buy one that's at least a double-speed unit. Watch out for single-speed bargains if there are any still lurking out there in the dark corners of the mail-order zone. Very few if any of the current multimedia titles will run on those drives, and they are even too slow for some data searches.

A double-speed drive spins the disc at double the speed of an audio CD player when accessing data. That yields access times under 300 milliseconds and data transfer rates of around 300 kilobytes per second. Even so, for that drive to be part of an MPC system, it can't expend more than 40 percent of the CPU's resources. That's why slow PCs have a tough time with multimedia, even with a fast drive installed.

Today, to really speed things up, you might want to consider purchasing a quad-speed drive that spins a disc at four times the speed of an audio CD. Those are available for as little as $200 nowadays. Quad-speed will be the next standard; oddball triple-speed drives haven't really caught on and will be eclipsed by the quads.

Next, you must decide whether to go with a SCSI CD-ROM drive, a proprietary system, or one of the newer IDE CD-ROM drives. Working with SCSI can be difficult, especially if you are trying to control a CD-ROM drive from an unrelated SCSI controller. If you purchase a multimedia upgrade package with its own SCSI controller or one built into the sound card, then

```
C:\MEDVSN\mscdex.exe /D:MVCD001 /M:10 /V
@ECHO OFF
SET BLASTER=A220 D1 I7 T1 H5 P330
SET LSOUND=C:\SOUNDMAN
C:\SOUNDMAN\SMWVOL
PROMPT $P$G
PATH C:\SOUNDMAN;C:\WINDOWS;C:\DOS;C:\MEDVSN
LOADHIGH C:\WINDOWS\SMARTDRV.EXE /X 2048 128
SET TEMP=C:\DOS
SET MOUSE=C:\MOUSE
LOADHIGH C:\MOUSE\MOUSE
CD \
C:\CLUTIL\CLMODE t6=1 t8=2 t1=3 t2=1
```

CD-ROM

SOUND CARD

Fig. 1. The changes made to the computer's AUTOEXEC.BAT file for both the CD-ROM drive and the sound card are shown here.

you should have no trouble getting it to work with the included install software. Popular name-brand drives with proprietary controllers are fine too, just as long as you don't ever plan on replacing just the drive or just the controller—it will be hard to get either to work with other equipment. Some sound cards have multiple CD-ROM interfaces built in for popular brands; those usually work fine.

The new IDE CD-ROM drives are easy to get to work off any IDE controller, and don't require additional interrupts. Interrupt conflicts are the single largest headache when it comes to adding peripherals; more on them a little later on. An IDE CD-ROM drive tricks the controller into thinking that it's a hard drive. The hitch is that you can still only have two devices connected to the IDE controller, either two hard drives or one hard drive and one CD-ROM. The new Enhanced IDE controllers can handle up to four devices, but it is unlikely that your older PC has that type of controller in it.

The best advice when it comes to sound cards is to get yourself a 16-bit wavetable board with direct Soundblaster compatibility. Wavetable sound is much better than older FM-synthesis sound, and you don't pay extra for wavetable anymore. The Soundblaster-compatibility part will ensure that the board will work with virtually any piece of software.

Note that there are non-Soundblaster cards out there that actually provide superior performance (or at least that's the claim). However, only certain software packages support such cards. To get the benefit of their performance without sacrificing Soundblaster compatibility, it is possible to run two sound cards simultaneously in the machine; however that is a tricky proposition, and one that is outside the scope of this article.

Regardless of the card you select, if you are interested in doing recording work, look for a sampling rate of 44 kHz. That gives you CD-quality sampled sound, which is what any audio enthusiast wants. To record sound with any sound card, you do need a microphone, which usually comes bundled with a complete multimedia package. You'll also need a fast computer to sample and record stereo sound at 44 kHz.

Some sound cards require that you add an amplifier and speakers, or amplified speakers. Other cards have an amplified output, or even both. In general, the more audio inputs and outputs on a sound card, the better. Versatility is always good.

```
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\DOS\EMM386.EXE NOEMS x=d800-dbff
BUFFERS=15,0
FILES=40
DOS=UMB
FCBS=4,0
DEVICEHIGH C:\DOS\SETVER.EXE
DOS=HIGH
DEVICEHIGH C:\WINDOWS\IFSHLP.SYS
STACKS=9,256
DEVICEHIGH=C:\SOUNDMAN\SMWSET.SYS
DEVICEHIGH=C:\MEDVSN\aspi3x80.sys /MD800
DEVICEHIGH=C:\MEDVSN\adtc-cd.sys /D:MVCD001
DEVICEHIGH=C:\MEDVSN\ascsi.sys
LASTDRIVE=E
```

CD-ROM
SOUND CARD

Fig. 2. Here are the changes made to the computer's CONFIG.SYS file for both the CD-ROM drive and the sound card.

There are many different models of speakers on the market intended for use with a PC. They are usually specially shielded to protect your computer monitor and magnetic media from magnetic interference. While the smallest amplified speakers are adequate for casual use, you might find their power and bass response to be less than ideal. If that is a concern, opt for larger units or one of the combination satellite/subwoofer systems.

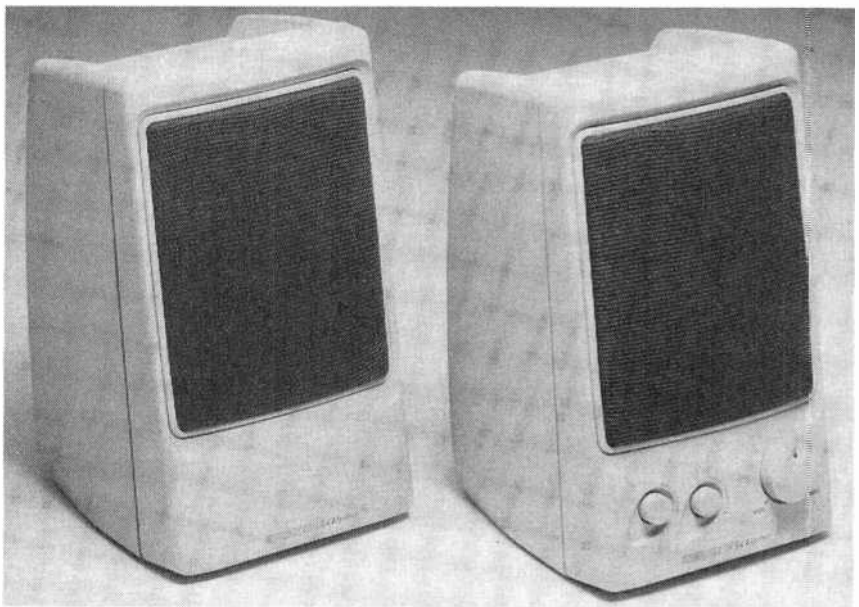
If you are considering installing only a CD-ROM drive and no sound card, think again. You can buy an entry-level, double-speed package that includes a sound card for little more than a drive alone costs. A complete multimedia upgrade package should contain at least a CD-ROM drive, a sound card, and speakers, and perhaps a microphone and some CD-ROMs to get you started.

Another benefit of buying everything in one package is that most likely the sound card will also be the controller card for the CD-ROM drive. And you might as well have the option of sound when you use up an expansion slot, instead of just filling the slot with a controller card for the CD-ROM drive. Even if you don't think you'll ever want sound from your PC, you'll probably appreciate it once you have a CD-ROM drive and discover multimedia.

A multimedia upgrade package will include all the necessary software and drivers for the CD-ROM drive and sound card, for both Windows and DOS. Software installation disks make installing the multimedia hardware easy, compared to trying to get mix-and-match components to work with one another.

There are multimedia upgrades to fit every budget. If you're on a tight budget, you can buy a package that has wavetable sound, a double-speed CD-ROM drive, and decent speakers, all for less than $300. Quad-speed systems are available for as little as $400. Keep in mind that many computer discount stores will install the hardware they sell for free or for a modest fee. That saves you time, and if the stuff doesn't work in your system you don't pay for it or hassle yourself with it.

Of course, this is a magazine for "electronics activists," and there is nothing that is so difficult that it could



A simple pair of amplified speakers like these are all you really need for a PC.

not be tackled by a moderately-skilled hobbyist on his or her own. That said, lets see how you can do some basic multimedia upgrades for yourself.

Adding CD-ROM. Installing a CD-ROM drive is basically a straightforward affair. You need the CD-ROM drive and its controller, whether it be a separate expansion card, a sound card, an IDE controller, or whatever. You also need the install software that accompanies the hardware.

In addition to the type of drive you will install, you also must decide on either an internal or an external model. All internal CD-ROM drives must be installed horizontally in an external 5¼-inch drive bay. A standard four-pin power connector plugs into the back of an internal drive. The drive also connects internally to the controller.

It is impossible to explain the mechanical details involved in installing an internal CD-ROM drive in all computers because of the different chassis layouts. Just as is the case with hard drives, older PCs usually require that rails be attached to the sides of a drive. The rails fit into slots in the sides of a bay. Newer, more compact machines have drives installed without rails, although other hardware is often in the way of the mounting screws.

If no drive bay is free, then an external CD-ROM drive must be used. That type of drive has its own cabinet and it connects externally to the back of an expansion card. That is what I am installing in the trainer PC. The trainer has a very compact chassis, with only two external bays, and one of them is already occupied by the 5¼-inch floppy drive that I installed in the second installment of this series. Besides, I had this external drive available at the time, and so that's what I used.

The drive I installed is the *Reno*, Media Vision's portable CD-ROM drive. That drive can be powered by batteries and it doubles as a portable music CD player. For desktop use it is powered by an AC adapter. Reno is a fully capable CD-ROM drive on the desktop or on the go.

The drive can be controlled by anything with a SCSI2 interface, which many sound cards contain. I am using a tiny SCSI2 interface card that came with the drive. The card installs in a motherboard expansion slot and a cable connects from the back of the card to the back of the drive. The drive features an audio-output jack that can be used with either headphones or amplified speakers.

Install software that comes with the drive configures the AUTOEXEC.BAT and CONFIG.SYS files to allow the computer to use the new drive. Changes to the AUTOEXEC.BAT file are shown in Fig. 1. The top line calls MSCDEX.EXE from a MEDVSN subdirectory. The MSCDEX.EXE (MicroSoft's CD-rom EXtension) program allows drivers that talk to the CD-ROM drive to communicate with DOS. Also changed in AUTOEXEC.BAT is an addition to the path statement. Changes to the CONFIG.SYS file are shown in Fig. 2, and include a statement (x=d800-dbff) that excludes that portion of upper memory from use by EMM386, and three lines that load SCSI and other device drivers high.

At this point when the computer is turned on, a new drive, E: in this case (C: and D: are already hard drives), is accessible. Discs placed in the new drive can be read and software can be run from it.

Adding Sound. Installing most sound cards is a snap these days, especially if you stick to one of the better-known companies. I am installing Logitech's *SoundMan Wave*, a great wavetable sound card that I have installed and had working in several different machines in less than five minutes. Among the features of that card are that there are no jumpers to set and all configuration is done via software. Also, the card is 100% Sound Blaster, Sound Blaster Pro, and AdLib compatible, so it has always been trouble-free.

The card has all of the features you should look for to get the best results. It is a 16-bit stereo card that can record and play back at a 44.1-kHz sampling rate. It uses wavetable synthesis for more realistic sound than FM-synthesis sound cards. FM synthesis uses mathematical algorithms to create sound waves while wavetable synthesis uses short recordings of instruments stored in memory to interpolate the other notes. That sounds much better, especially for MIDI stuff.

Install software for the sound card also makes changes to AUTOEXEC.BAT and CONFIG.SYS. Changes to AUTOEXEC.BAT are again shown in Fig. 1. The

(Continued on page 92)

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This series of articles on PC servicing follows, in part, the Personal Computer Servicing Course offered by Heathkit. The $2495 course includes a 486 SX25 PC trainer, full documentation, software, tools, books, upgrade parts, and more. Contact Heathkit (The Heath Company, Benton Harbor, MI 49022, Tel. 800-253-0570) directly for more information.

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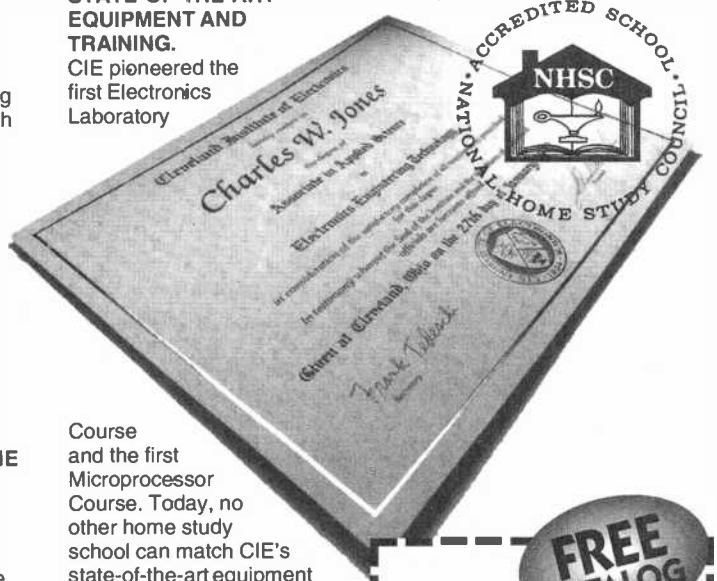

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Long-Delayed Echoes:

A close-up look at one of radio's all-time strangest unsolved mysteries.

BY
KARL T. THURBER, JR.

What are the chances that, if you're a shortwave listener or TV DX fan, you'll hear a signal from a distant location seconds, minutes, hours, or even days after it's been sent, rather than almost instantaneously? Or, if you're an amateur-radio operator, what are the odds that you'll hear your *own* signal, albeit weak, return to you long after it's been sent?

The chances are small indeed, but such echoes do occur. And the people reporting those "long-delayed echoes," or LDEs, are not necessarily the same ones who report unidentified flying objects (UFOs) and little green men (LGMs).

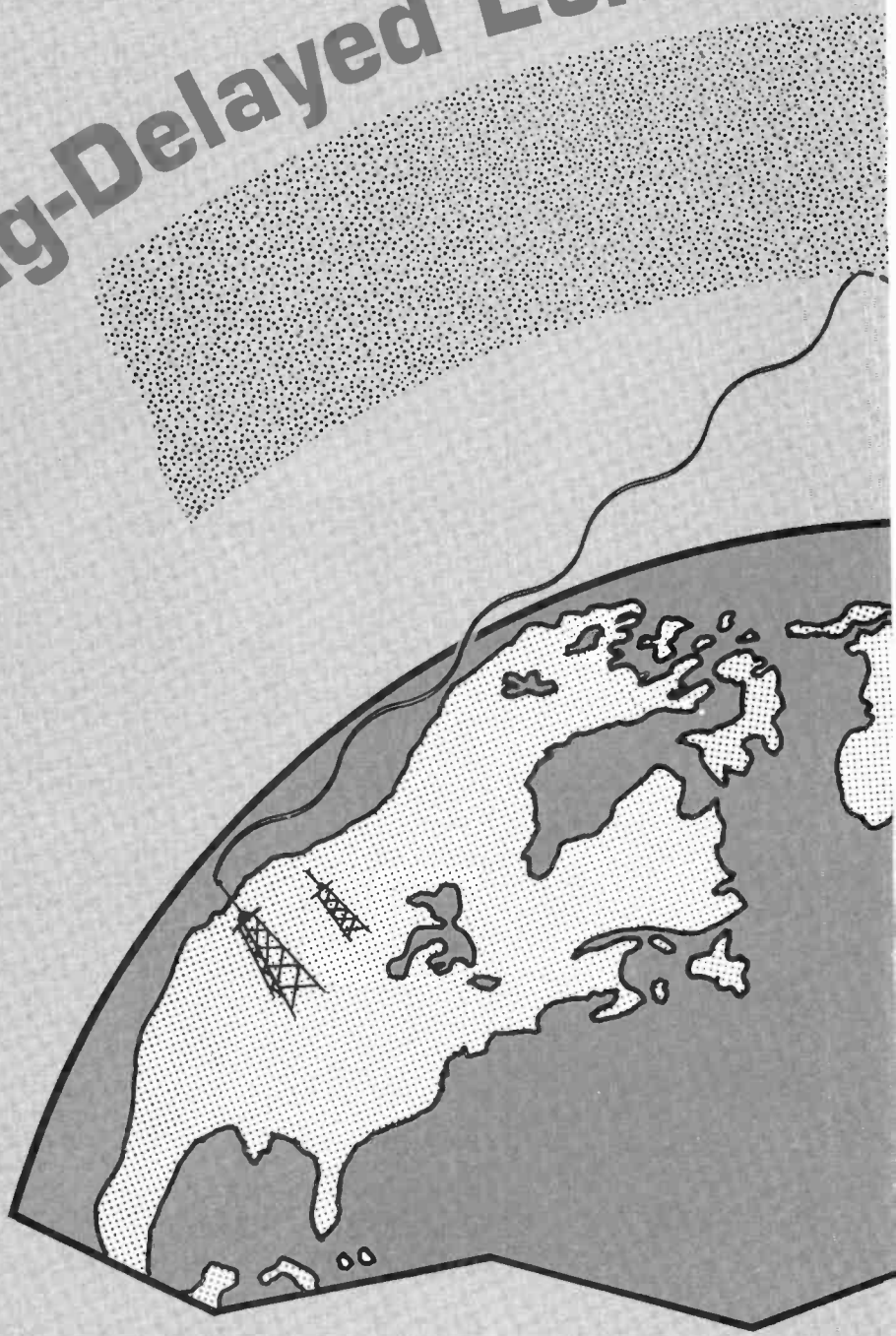
Are LDEs Real? If someone could fabricate the long-accepted story of the Piltdown Man, or fake the amazing photos of the Loch Ness Monster, why couldn't someone just as easily fabricate LDEs? Most likely, many high-frequency (HF) LDE reports, especially the longer-duration ones that suggest an extraterrestrial connection, are indeed falsified. It's fairly easy to perpetrate a hoax or play a practical joke with HF-signal delays and echoes, especially considering the availability of modern, high-tech recording and playback equipment.

But on much higher frequencies, and especially in the case of microwaves, hoaxes are less likely. There, the routine use of high-gain, narrow-beam antennas and the ability to conduct carefully controlled signal-path experiments minimize the hoax potential.

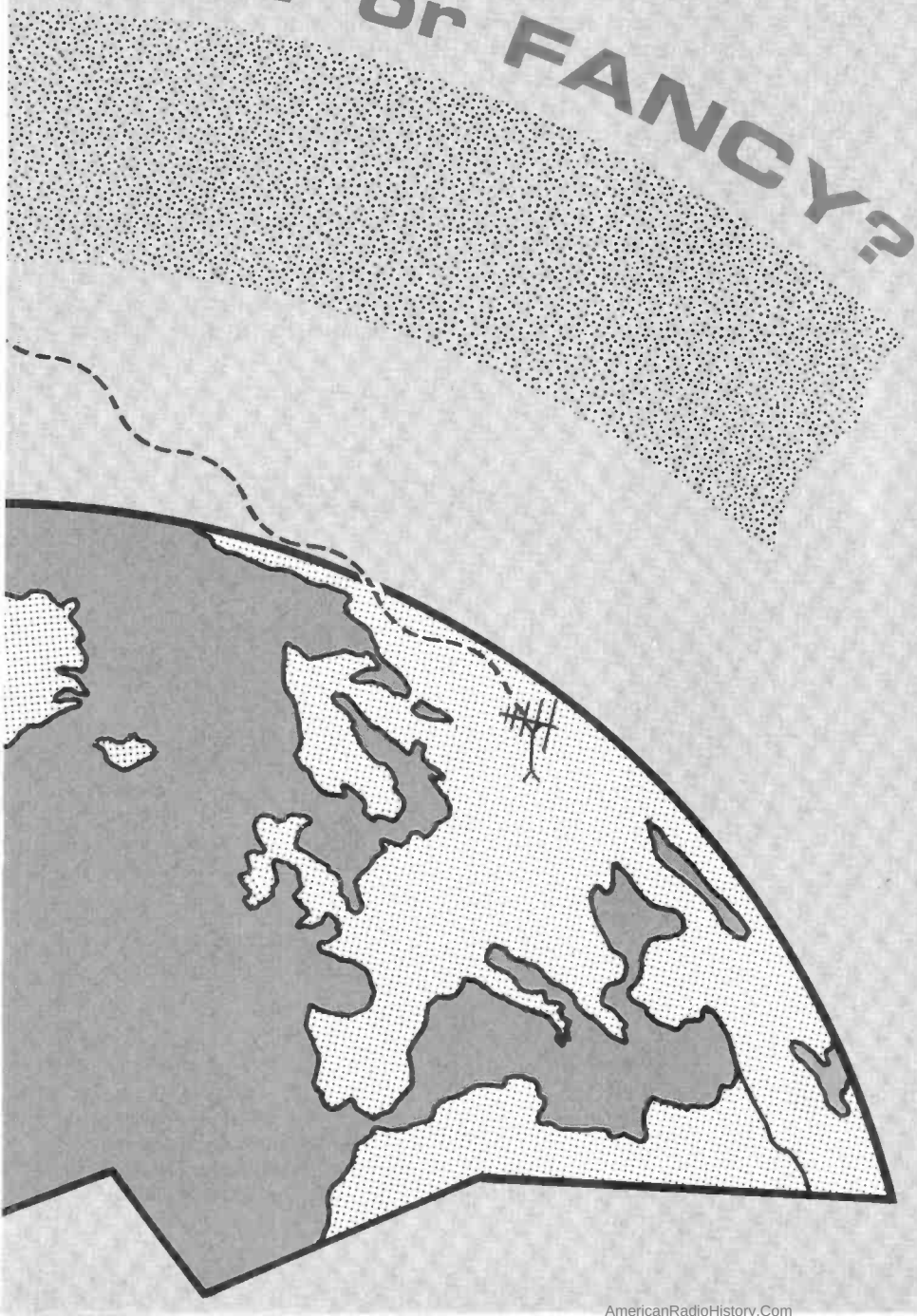
Obviously, phony reports, practical jokes, and outright pseudoscientific scams make interpreting many LDE reports uncertain and difficult. But at the bottom line, we're left with the realization that at least some LDE reports are genuine, and their ultimate solution might lead us to an understanding of electrical and physical phenomena that we presently don't have.

Some Classic LDE Reports. Spark and Morse-code radio operators from the earliest days of radio probably heard echoes of their own signals and those of others. However, they didn't report them, maybe for the same reasons many people tend not to report UFOs today. Perhaps they assumed that they would be thought crazy, or lose their jobs if they reported signal echoes—especially suspicious echoes that persisted much longer than could be logically accounted for by expected ionospheric propagation and around-the-world signal delays.

But eventually, the LDE phenomena came to light. In fact, there were some well-documented LDE reports beginning around 1927, including some where the academic and scientific communities became involved. In a letter to the editor of *Nature* magazine in the November 3, 1928 issue,



FACT or FANCY?



Professor Carl Stormer, a Norwegian radio scientist, reported an echo that an Oslo engineer, Jorgen Hals, had experienced. In the summer of 1927, Hals repeatedly heard echoes on the signals from the powerful, Dutch transmitting station, PCJJ at Eindhoven.

At the same time Hals heard the station's telegraph signals directly, he also heard a strong echo, which he calculated went around the earth in about ⅐ second. That he expected. The strange thing was that Hals also heard a much weaker echo 3 seconds after the main PCJJ signal; he estimated the echo to be between 1/10 and 1/20 as strong as the main signal. Hals and Stormer couldn't understand why the signals didn't just die away after their around-the-world trip.

The two Norwegians later conducted tests with the Dutch station and Dr. B. van der Pol of Philips Radio at Eindhoven, and they found the distinct echoes again. This time the interval between the main signal and the echo varied between 3 and 15 seconds, with most of the echoes heard around 8 seconds after the main signal. Sometimes *two* echoes were heard, 4 seconds apart.

Stormer had no real explanation for the anomalous delays. But he favored the idea that the echoes were possibly due to reflections of radio waves from clouds of ions or electrons at some distance from the earth—perhaps in what we now call the exosphere (the region approximately 600 miles above the surface).

Stormer also speculated that the echoes were somehow connected with the *aurora borealis* of the Northern Hemisphere and the *aurora australis* of the Southern Hemisphere, in which visual displays occur at heights ranging from about 50 to 600 miles. We've since learned that the auroras often are associated with magnetic storms whose forces, also guided by the lines of force of the earth's magnetic field, periodically disrupt radio communications as a direct result of the sun's activity.

In the December 8, 1928 *Nature*, Dr. van der Pol speculated on possible causes of LDEs, or "long temporal retardations of shortwave signals." Both he and Professor E. V. Appleton of the Wheatstone Laboratory in England thought that the echoes were related to long signal-transit times in the ionosphere. The echoes could be due to a slowing up and reflection of radio waves by a peculiar distribution of ionization in the ionosphere.

In the October 1929 *Proceedings of the Institute of Radio Engineers*, Dr. P. O. Pedersen, of the Royal Technical College in Copenhagen, Denmark, suggested that the geometry of the ionized layers of the earth's atmosphere and variations in the earth's magnetic field could cause delays of 30 or even 60 seconds. That could occur as the result of radio waves being guided along belts or bands of ions extending over large curved paths starting and ending near the earth. Pedersen also thought that even longer delays or echoes of up to several minutes might be the result of reflections from ionization bands lying well outside the influence of the earth's magnetic field.

Five years later, in the July 1934 *Proceedings of the Institute of Radio Engineers*, N. Janco of New York University (NYU) discussed "radio echoes of long delay." He thought that such long delays were the product of signals that repeatedly are reflected between the E and F layers of the

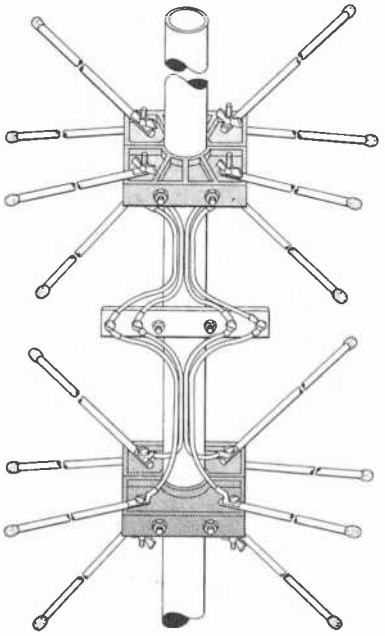


Fig. 1. At the end of the FCC's four-year freeze on new TV stations, people used "powerful" TV DX antennas like this one to receive the new UHF channels the FCC had authorized.

ionosphere, and that travel around the earth and finally back to ground.

After a lull of about 18 years, the academic community again became interested in LDEs. Two scientists of the Cavendish Laboratory of Cambridge University, K. G. Budden and G. G. Yates, published an article in the *Journal of Atmospheric and Terrestrial Physics* in 1952, summarizing LDE research to date. Their goal was to see if there was anything to the earlier LDE reports, thinking that such echoes might arise from some form of "ionized corpuscular streams from the sun."

Unfortunately for the future of serious LDE research, their year-long study, involving some 27,000 test signals using high-power transmitters on 13.455 and 20.675 MHz, didn't result in their finding a single LDE. The negative results, while not outright debunking LDEs, tended to discourage further serious study of happenings that could easily take on some of the rather dubious status of UFOs and close encounters with aliens.

There was little serious research for many years until, in the December 1, 1970 *Journal of Geophysical Research*, controlled observations in the HF range of 5 to 12 MHz were reported by scientists F. W. Crawford, D. M. Sears, and R. L. Bruce (from the Stanford University Institute for Plasma Research). Unlike Budden and Yates, they were able to obtain and document some LDEs. Helped by data from ionosonde measurements, they even suggested a new mechanism for the phenomenon. They proposed that radio signals might travel through the ionosphere at a very low velocity and be the result of some kind of interaction with something they called "beam-plasma waves."

Little serious academic research on LDEs has been published since 1970, and few commercial spectrum users have reported anomalous echoes. But LDEs have persisted and have been reported in recent years in the amateur-radio press, especially in *QST*, the journal of the American Radio Relay League. Much *QST* coverage has been by scientists and radio amateurs associated with the Radioscience Laboratory at Stanford University. Perhaps radio amateurs are the only ones who are interested enough in LDEs to still report them!

Some Basics. Many readers of this magazine are probably familiar with modest radio-signal delays; those are common and show up in several easily explained ways. On HF, most amateurs and SWLs have heard short echoes on received radio signals, and rather modest echoes are even responsible for "ghost" images on TV sets. But is there more?

First, the math. Radio signals travel at the speed of light: 186,281 miles- (or 300,000 kilometers-) per-second. Contrast that with the speed of sound. Longitudinal vibrations in the air, taking the form of "vibrational energy," are propagated at about 1088 feet-per-second at sea level.

If you multiply the speed of light by 60, you'll find that light travels 11,176,860 miles in 60 seconds—a figure approaching interplanetary magnitude. However, to measure interstellar distance, the light year is normally used. That is the distance traversed by light (and radio signals) in one year: about 5,880,000,000,000 miles.

To put those figures into the perspective of one-way radio signal trips and echoes, it's about a 125-milli-

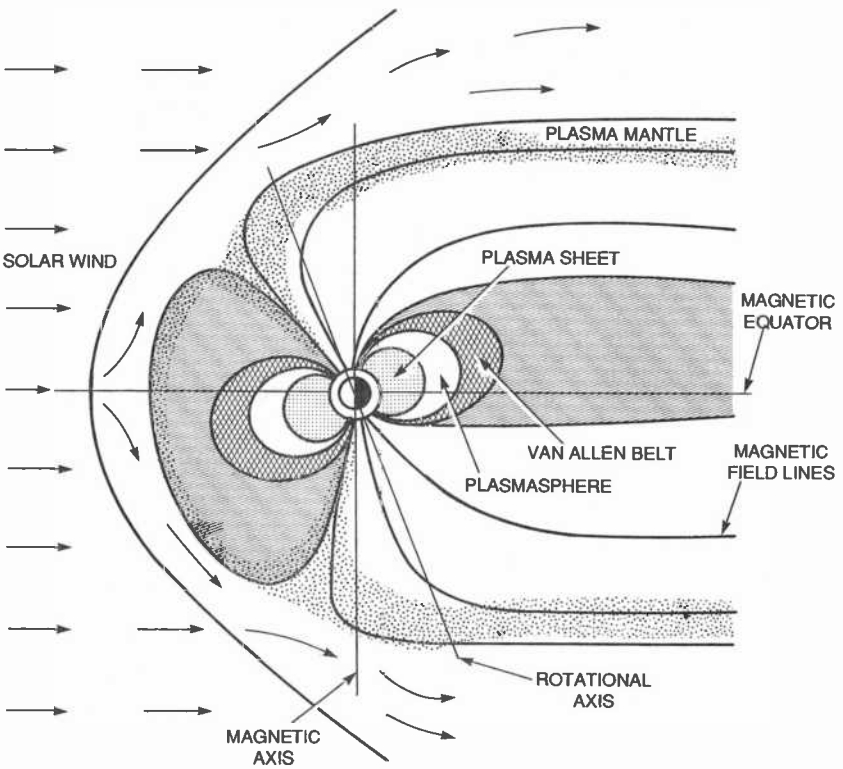


Fig. 2. Scientists believe the magnetosphere looks like a cavity carved out of the Solar Wind stream of plasma going by. This model resembles the wake behind an object fixed in a stream, complete with a "magneto-tail" pointing away from the sun. The Solar Wind has a marked effect on the magnetosphere, which might result in LDEs and "natural radio" emissions.

second one-way trip to a geostationary relay satellite, 1.25 seconds from the earth to the moon, 500 seconds (8.3 minutes) to the sun, and from 2 to 14 minutes from the earth to Mars, depending on their orbital positions.

Extending our horizons further, it's 5½ hours to Pluto, 4 light years to the nearest star, and 30,000 light years from our sun to the center of the Milky Way galaxy. Double those figures for a two-way trip, and there is some potential for echoes or signal delays, indeed!

Now let's turn to propagation basics. Radio waves are typically described as traveling in neat rays directly from the transmitter to the receiver. But only a small fraction of the radiated signal reaches the receiver directly; the rest of it goes elsewhere.

Part of the signal might be bounced off reflective objects, or bent back toward the earth by the ionosphere (at least at shortwave frequencies). At VHF and higher frequencies, the signal might be "ducted" by the troposphere, the region of the earth's atmosphere just below the tropopause, which varies in height but generally lies at about 25,000 to 60,000 feet. The signal also might be propagated by fancier forms of ducting, or by methods that we don't understand. When reflections are involved, it's possible that listeners might hear both the main signal and the reflected signal, and radio amateurs might hear their own signal and the reflected signal.

Four Types of LDEs. While there are several different types of LDEs, we can classify them for purposes of discussion by the relative length of signal delay or echo:

Short: These echoes really aren't LDEs in the strictest sense, because the delays are actually quite "short"—yet they nevertheless are echoes. Ranging from less than 0.001 second to about 0.15 second or so, those "millisecond echoes" are far more common and easier to explain than the longer types. They are the types of echoes that early observers like Stormer, Hals, van der Pol, and Appleton initially expected to hear.

For a simple ionospheric echo, the expected delay is on the order of 0.001 second or so. That is roughly the time it takes for signals to go from the earth to one of the layers of the ionosphere and return to earth. The delay will be longer if multiple ionospheric "hops" are involved.

Another expected but longer delay, on the order of 138 milliseconds, corresponds to the signal delay you might encounter when hearing a "long-path" signal from a station. The around-the-world signal takes considerably longer to reach you than does the "short path" signal, and if you hear both signals, you'll perceive an echo. Typically, those echoes are weak and have a characteristically raspy or watery sound.

TV "ghosts"—we've all seen them—are actually signal echoes. Those involve even shorter delays that are not heard but are seen on your TV screen. A strong direct RF signal arrives first; the echoes, caused by reflections from large objects, such as buildings, mountains, and airplanes, arrive a fraction of a second later. The result: a visible, annoying ghost-video image.

Also, if you're a broadcast-band (BCB) listener, you might have experienced echoes by listening to a network program simultaneously on two radios—one tuned to a nearby station and the other tuned to a distant one. You're likely hearing the closer station by groundwave, and the other by one or more bounces. If you listen to the signals from both radios, you'll hear an echo, up to about 15 milliseconds if coast-to-coast distances are involved. You often can hear similar but longer echoes on telephone conversations routed through a satellite; those are on the order of ¼ second.

Medium: Now we enter the realm of echoes that are apart from the everyday type of expected, easy-to-explain signal delay. We're no longer talking about millisecond delays but, rather, delays of several seconds or even longer. Remember the early Stormer, Hals, and van der Pol HF tests? In those, the interval between the

LOW-FREQUENCY RADIO PHENOMENA

Atmospherics and Tweaks: Almost everyone is familiar with the snapping, crackling, and popping radio "sounds" generated by the more than 2000 electrical storms that rage daily worldwide. The millions of lightning strokes generated by those storms are sources of strong radio emissions throughout the electromagnetic spectrum. However, the greatest energy is released in the region from 100 Hz to 10 kHz. Those low frequencies tend to follow the surface of the earth as groundwaves, and are called atmospherics.

At night, the sound of atmospherics could take on a semi-musical pinging or dripping characteristic, and so are known as tweaks. They're believed to be made by lightning impulses that travel and disperse in a resonant duct or waveguide formed by the earth's surface and the lower (D and E) layers of the ionosphere. The tweak effect, which is centered around 1.5 to 2 kHz, is similar to what happens to sound waves traveling in a pipeline.

Whistlers: These sound like falling musical notes, and result when lightning-bolt electromagnetic impulses travel within ducts formed by ions aligned along the magnetic field lines that envelop the earth (in its magnetosphere). Whistlers are heard a few seconds after the lightning stroke's familiar "pop" of atmospherics.

Usually, whistlers sweep downward in frequency from about 6 to 0.5 kHz. Some "natural radio" listeners have described them as swishy or breathy sounds descending in pitch over a period of one-half to 4 or 5 seconds. That's because the higher frequencies of the stroke travel faster in the duct and arrive before the lower frequencies. You'll hear the most whistlers in the hours between midnight and about an hour after sunrise. In the Northern Hemisphere, they're best heard between 40- and 50-degrees North latitude.

The Dawn Chorus: This phenomena is typically heard shortly after sunrise, and could extend well into the mid-morning hours. Dawn-chorus trains occur in bursts of chirps and squawks over the course of 2 to 5 seconds (the sound can resemble a flock of birds chirping, or just multiple whistlers). Those "trains" are produced by lightning-stroke impulses interacting with the earth's magnetic field.

The dawn chorus typically occurs several times a month during years of high sunspot activity, after solar flares or coronal ejections on the sun barrage the earth's magnetosphere with charged particles, causing a geomagnetic storm and producing enthralling auroral displays. The more severe the magnetic storm, the more pronounced the dawn chorus and the farther from the polar zones it occurs. You'll find that the chorus tends to be strongest between sunrise and one hour after and is best heard by listeners living above 40-degrees North latitude. ■

main signal and the echo was 3 to 15 seconds, with most echoes being heard at about 8 seconds. Sometimes, two echoes were heard about 4 seconds apart.

In the 1970s, a European radio amateur, Hans Rasmussen, OZ9CR, reported the simultaneous reception of both ordinary, expected lunar echoes (about 2.6 seconds) and unanticipated 4- to 5-second echoes on the 1296-MHz UHF amateur band. That frequency is too high and the delays are too long to be explained easily by ionospheric or around-the-earth means. The longer delays also are too long to be simply the reflection of signals off the moon, which is at a mean distance of 238,857 miles from the earth.

Instead, something occurring some 500,000 or more miles in space would have to be responsible for the 4- to 5-second echoes Rasmussen observed. What could cause those strange but well-documented delays? We'll look at a few possibilities later.

Long: If you recall, Pedersen suggested that the geometry of the ionized layers of the earth's atmosphere and variations in the earth's magnetic field could cause delays of up to 30 or even 60 seconds, because the waves are guided along "belts" or "bands" of ions that extend over large curved paths. Pedersen also contemplated even longer delays or echoes, up to several minutes, that might be the result of reflections from ionization bands lying outside the influence of the earth's magnetic field.

Such signals would have to be reflected by something millions of miles away in space—from something even more distant than, say, 500,000 miles. But a delay of even 60 seconds is less than the minimum delay expected with signals traveling to the nearest planets, Venus and Mars (2-3 minutes). Apparently, we have another mystery.

Very Long: These "very long" LDEs (let's call them "VLLDEs") are different from the ones we discussed. They usually aren't reported by radio amateurs but by TV DXers. The TV DX reports claiming VLLDEs longer than 60 seconds seem to have been much more common in the early days of TV broadcasting (in the late 1940s and early 1950s) than at any other time.

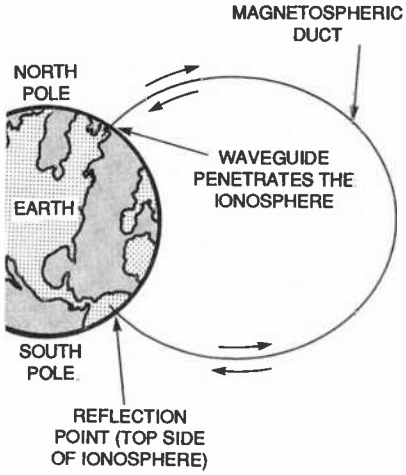


Fig. 3. It's possible for HF signals to become trapped in tubular or columnar magnetospheric ducts—channel-like "waveguides" that stretch from the Northern to the Southern Hemispheres along the earth's magnetic field lines. Those ducts could in effect be LDE-causing magnetospheric "echo boxes" 40,000 or more miles long.

In the late 1940s, TV broadcasting grew by leaps and bounds. Unfortunately, the Federal Communications Commission (FCC) placed TV stations much too close together for good viewing when the ionosphere "got crazy" with sporadic-E and tropospheric propagation. By September 1948, viewers were complaining about co-channel interference between stations. The chaos prompted the FCC to clamp a hard freeze on new TV-station construction permits that wasn't lifted until nearly four years later, when the FCC created a less-prone-to-interference, UHF TV range (initially from 475-890 MHz).

During the four-year period, however, a TV DX craze developed, with viewers using tall towers, big antennas (see Fig. 1), and high-gain signal boosters to pull in over-the-horizon stations. However, they also reported pulling in VLLDEs. While many of those were simply the result of mistaken station IDs, and a few were outright hoaxes and practical jokes, the TV press was full of articles, some with photos, reportedly of long-delayed images from distant TV stations. There was even a report of one station's TV signal being seen many months after it had gone off the air!

The Possible Causes of LDEs. Now, let's look at some of the possible causes of LDEs. More than one mechanism appears to be responsible for the phenomenon, and many of the explanations, especially those relating to solar and magnetospheric effects, are closely related to one another. We'll begin with the simplest and move to the most complex tentative explanations:

Ionospheric Propagation Delay: With the possible exception of TV ghost images, this is the simplest and most common signal delay you'll encounter. For an HF ionospheric echo, the delay you would expect to encounter is a small fraction of a second, around 1/1000 (.001) second, which is roughly the time it takes for signals to go from the earth to the ionosphere and return. "Multiple hops" from the higher F layers will produce somewhat longer-delayed echoes. (The ionosphere's lowest D layer extends up to about 55 miles above the earth; above it is the E layer, or Kennelly-Heaviside layer, from 55-100 miles. Still higher are the two subsidiary layers in the F region, called the Appleton layer, which is roughly 100 to several hundred miles above the surface.)

Simultaneous Long- and Short-Path Reception: On HF, most amateurs and SWLs have heard longer echoes on received signals. That delay, about 1/7 second, corresponds to what you might hear, either as an amateur or an SWL, when you're hearing both short- and long-path signals from a DX station. The around-the-world signal takes considerably longer to reach you; if you receive both signals simultaneously, you hear an echo.

That is primarily an HF happening, and there's nothing mysterious about it. If you're a radio amateur, you can increase your chances of hearing LDEs on your own signals if you try your favorite band just as it's opening for DX propagation. Another time to try is in the typically disturbed atmospheric period, known as the "grayline," around sunrise and sunset. Pause for several seconds between transmissions to listen for echoes. But you might have a long wait: some researchers estimate that an active radio amateur might hear as little as one HF LDE per year!

Ionospheric and Magnetospheric Ducting: For short- and medium-duration HF LDEs, both types of ducting,

THE ELECTROMAGNETIC SPECTRUM

If you want to listen for LDEs and "natural radio" sounds, it's important to know how they fit in, spectrum-wise. For the record, the total usable electromagnetic spectrum generally is considered to extend from a few hertz (Hz) to approximately 300 gigahertz (GHz). Scientists break up that almost unimaginably immense range of frequencies into smaller groupings or ranges for discussion and ease of understanding.

The spectrum is often arbitrarily classified into nine frequency bands. Most of those bands are each ten times as high in frequency as the band lying just below in the spectrum. The lowest range is the group of frequencies known as the ultra-low frequencies (ULF), which spans 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). Climbing higher, next are the low frequencies (LF), from 30 to 300 kHz, which are the "top end" of what are considered the longwaves.

From 3 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 to 30 GHz are the super-high frequencies (SHF), and from 30 to 300 GHz, the extremely high frequencies (EHF).

Radio astronomers and SETI investigators are concerned mainly with UHF and higher frequencies. They conduct most of their work in the promising spectrum region between wavelengths of 1 millimeter (just below the infrared region) and 30 centimeters (radio astronomers prefer to use wavelength rather than frequency designators). That 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. The cosmic window is narrowed for radiotelescopes on earth, the upper half of the window being partially obscured by the earth's atmosphere. ■

ionospheric and magnetosphere, are possible LDE explanations. One idea has it that signals become trapped in a duct, possibly between the E and F regions of the ionosphere. By that reasoning, the signals might circle the world several times, traveling back and forth repeatedly from one end of the ionospheric duct to the other.

LDEs on VHF and higher frequencies are harder to explain in terms of the ionosphere. That is because the ionosphere is essentially transparent to VHF, UHF, and microwave signals. So the explanation for higher-frequency, longer-duration reflections might lie elsewhere, perhaps in the realm of magnetospheric (rather than ionospheric) ducting. The magnetosphere is a magnetic envelope that shelters the earth from the ionized blast of the Solar Wind by deflecting it. The ionosphere lies much closer to the earth, but there is considerable coupling between the two, both electric and magnetic (see Fig. 2).

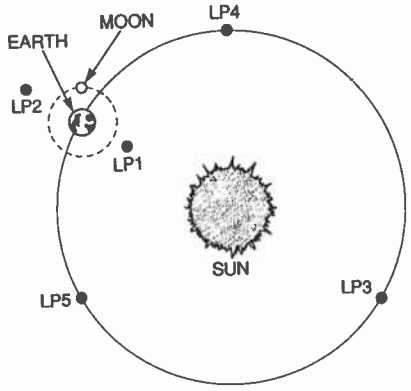


Fig. 4. There are five points in the earth's orbit where a body can revolve without being disturbed by the earth's gravitation. The closest two of those Lagrangian points, LP 1 and LP 2, are about 750,000 miles from Earth. That distance makes it seem likely that frequently occurring 8-second LDEs are caused by reflection from large concentrations of plasma at those points.

One magnetospheric-based explanation holds that signals might become trapped in tubular or columnar magnetospheric ducts, channel-like "waveguides" that stretch from the northern to the southern hemispheres along the earth's magnetic field lines. Those ducts might in effect be "echo boxes" 40,000 or more miles long (see Fig. 3). Many LDEs of 4 seconds or less reported by amateurs on the 75-, 80-, and 160-meter bands might be the result.

Plasma-Cloud Reflections: Another possible explanation, especially for LDEs on VHF and higher, as well as some of the longer-duration LDEs, has been advanced. It holds that ionized clouds of electrons (often called plasma or solar clouds) located in space and the earth's magnetosphere, might be responsible for signal reflection.

When a gas is heated by intense temperatures, its individual atoms collide and knock electrons free. That results in a collection of positively charged ions and free, negatively charged electrons. In other words, the gas is said to be ionized; when a sizable number of atoms are ionized, the gas is known as a plasma. That plasma—consisting of ions, electrons, and neutral particles—exists in and around the stars (including our sun) and throughout space. Because the free electrons tend to recombine with the ions to again form a neutral gas, a plasma can be maintained only if energy is continuously applied, such as from the sun.

The many 8-second, medium-duration LDEs suggest that there might be a plasma cloud in space at a distance from the earth of around 750,000 miles. That also is the approximate distance of the closest two of the five "Lagrangian points" (see Fig. 4). Named for the French mathematician, those are the five points in the earth's orbit where a body can revolve without being disturbed by the earth's gravitation. The 8-second LDEs could possibly be explained by reflec-

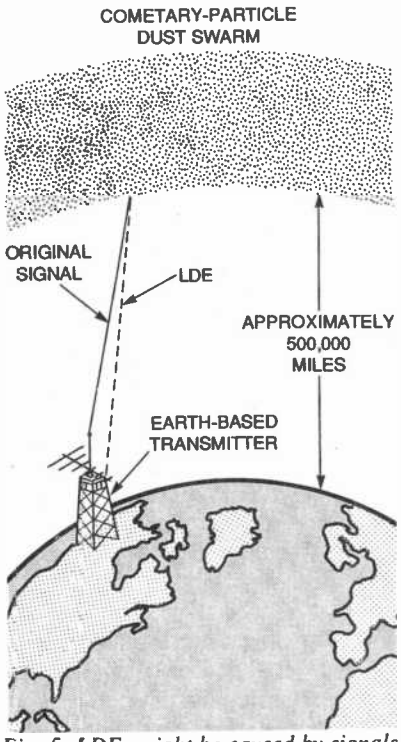


Fig. 5. LDEs might be caused by signals being reflected off of cometary particles in dust swarms lying some 500,000 miles or more in space. The swarms are also believed to cause the zodiacal light and the gegenschein.

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tion from large concentrations of ionized gases (plasmas) that might form at those points.

Cometary and Interstellar Dust: Another theory to explain longer LDEs is that sizable swarms of cometary or other space dust, lying at great distances from the earth, could also reflect radio waves and cause echoes of long delay (see Fig. 5).

There are large areas in space that contain small (one-half micron) particles that are of meteoric or cometary origin. Those dust swarms can last for hundreds of years and even form fairly stable orbits in the solar system. The swarms are believed to cause the optical phenomena known as the *zodiacal light* and the *gegenschein*. (The zodiacal light is a luminous, nearly ecliptic region on the horizon, seen in the west after sunset or in the east before sunrise. The gegenschein is a faint patch of light about ten degrees in diameter that lies directly opposite the sun, a faint glow that you often can see on clear, dark nights.)

Could those swarms be responsible for some of the longer LDEs? Doubters feel that swarms of cometary dust alone might not provide sufficient ionization to cause detectable LDEs. However, something else could act as a catalyst or "trigger" on such interstellar dust clouds. That trigger might be the Solar Wind.

The Solar Wind: The Solar Wind might be directly or indirectly responsible for some LDEs. As an extension of the sun's tenuous outer atmosphere (the corona, which is expanding into space), the Solar Wind is the continuous emanation of charged particles from the Sun, which travel across the vast open expanse between the earth and the sun. It's possible that when the Solar Wind hits the dust swarms described earlier, the particles could become ionized sufficiently to reflect signals.

The Solar Wind also impacts orbiting swarms of charged particles that move in broad belts around the earth in its magnetosphere, and appears to have a significant effect on some unusual ELF and VLF "natural radio" emissions. In those lonely lower outposts of the spectrum, especially from about 100 Hz to 10 kHz, you might hear all sorts of "naturally occurring emissions," or "natural radio" sounds. Those include what are known as whistlers, atmospherics, tweaks, and the dawn chorus (see the "Low-Frequency Radio Phenomena" box for more information on each). You can easily hear such "sounds" on longwave radios and even on some long, high-gain audio lines.

Those "sounds" have their origins in ionizing electrical emissions in, around, and from the earth's magnetosphere. One example is lightning discharge, which disturbs the earth's magnetic field and results in the generation of electromagnetic signals. The Sun's powerful Solar Wind also interacts strongly with the magnetosphere. That energy can be

(Continued on page 91)

All About Crystal-Oscillator Circuits

BY JOSEPH J. CARR

An assortment of precision oscillators for you to build.

All oscillator circuits need some means for setting the frequency of oscillation. In the audio range, resistor and capacitor (RC) elements are typically used. As the frequency rises above 20 kHz, or so, into the radio-frequency (RF) range, the components of choice for frequency setting are inductors and capacitors. But LC circuits are difficult to make with precision, and are subject to thermal drift and other problems. For operations where "rock solid" operation on a single frequency is needed, a crystal-based oscillator circuit is the way to go.

The semiconductors used in the circuits in this article are commonly available from a wide variety of sources. In consideration of the types of reader feedback received from other articles, also included are part numbers from radio-TV-service replacement lines such as ECG and NTE, both of which are widely available from local electronic-parts distributors. The NTE-xxx semiconductors can also be purchased from Ocean State Electronics (6 Industrial Drive, P.O. Box 1458, Westerly, RI, 02891; Tel. 401-596-3080).

Piezoelectric Crystals. Crystal resonators are based on the phenomenon called piezoelectricity, which is the generation of an electrical potential from mechanical deformation of the crystal surface. If a slab of the right kind of crystal at rest (Fig. 1A) is deformed in a certain direction, a positive potential will appear across one side (Fig. 1B). And when the same crystal is deformed in the other direction, the polarity of the voltage across its faces reverses (Fig. 1C). Therefore, when the crystal is wiggled back and forth, an AC voltage appears across the faces.

The inverse action also occurs: when an AC voltage is applied to the faces of the crystal, it will deform in alternating directions, determined by the polarity. Something special happens when the frequency produced by the oscillator matches the natural mechanical resonance of the crystal—the process become very efficient, and little energy is required to keep the process going. That aspect of piezoelectricity is the basis for acoustic transducers, phono pickups, and the crystal filters used in radio receiver sets.

Here's another aspect of the phenomenon that is also sometimes seen: When a crystal is pinged by a momentary pulse, it will vibrate back and forth at its resonant frequency, producing a sine-wave AC signal across its faces at that same frequency. Because of losses in the crystal, the oscillation dies out fairly quickly in an exponentially decaying manner. But if the pulse that pings the crystal is repeated often enough to prevent the oscillation from dying out, then the oscillation is sustained. Those are the aspects of piezoelectricity that make it possible to use the piezoelectric crystal as a frequency-control element in an oscillator circuit.

A number of different materials exhibit piezoelectric traits. Rochelle Salt is a very active material that produces a large voltage per unit of strain when deformed. However, while it is used in crystal phonograph pick-ups, Rochelle Salt crystal is not suitable for RF-crystal oscillators. It seems that the material is very sensitive to heat, moisture, aging, and mechanical shock. The next best material is Tourmaline. That material works well at all frequencies, and works better than other materials over the 3- to 90-MHz range. There's only one problem with Tourmaline: it costs a lot, as you will discover quickly enough if you buy a Tourmaline necklace. It seems that Tourmaline crystals are very popular as a variegated (red, yellow, green), semiprecious gemstone.

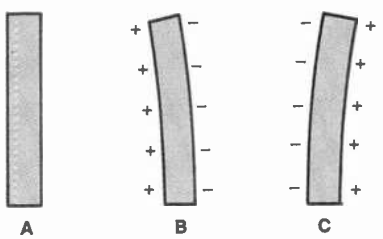


Fig. 1. The basics of piezoelectricity: An undeformed crystal (A) produces no potential. Deformation in one direction (B) produces a positive potential, while deformation in the other direction (C) produces the opposite-polarity potential.

The best practical material for crystals used in electronics is quartz. It behaves much like Tourmaline over a wide frequency range, is relatively stable, and is easily available. Although it is used in jewelry, it is low in cost because it is not rare. Quartz is often mislabeled "Cape May Diamond," "Herkimer Diamond," or "Arkansas Diamond" in the colorless varieties,

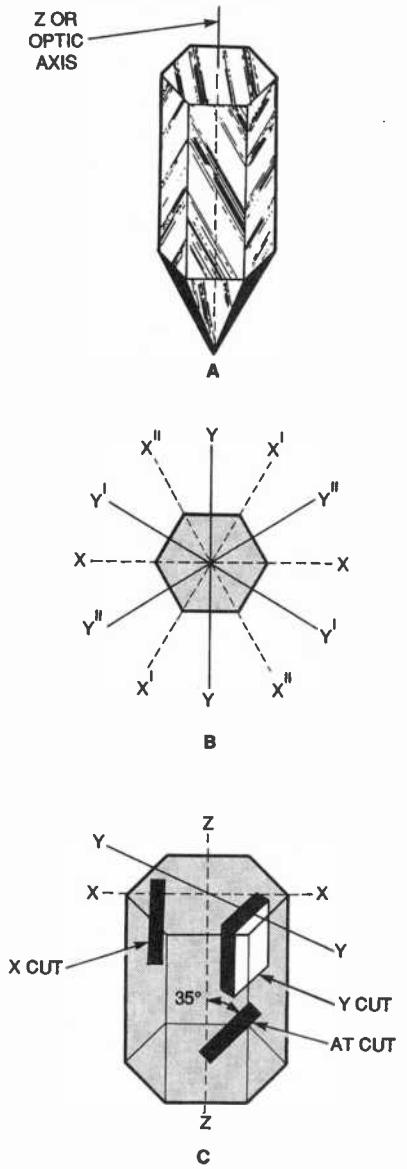


Fig. 2. A quartz crystal is hexagonal in shape (A). An axis scheme (B) is created in a crystal with the Z-axis reference being from one tip point to the other. Crystal slabs intended for use as resonators are given different "cuts" through the crystal body (C).

"Topaz" (which it's not) in the yellow variety, and "Smokey Quartz" in the variety that looks like smoked glass.

The quartz crystal is hexagonal in shape (Fig. 2A), and pointed at both ends if perfect; however, as shown, natural crystals are often broken or cut off on at least one end. As the crystal forms, a series of axis (Fig. 2B) are created; note that the Z-axis, which runs from one tip point to the other, is also called the optic axis. Crystal slabs intended for use as resonators are given different "cuts" through the crystal body (Fig. 2C). The X and Y cuts are made through the X and Y axis, respectively. Those are not favored, however, because they have undesirable temperature characteristics. The AT cut is made at an angle of about 35 degrees from the Z axis. There is also a BT cut (not shown) that is sometimes used. The AT-cut has a better temperature coefficient by an order of magnitude, but the BT cut is usually thicker (which means that it is more robust at higher frequencies where AT-cut "rocks" are very thin).

A crystal's resonant frequency is a function of its dimensions. The dimensions for a typical quartz-crystal resonator for a frequency of 1000 kHz (1 MHz) are approximately 0.286-centimeters thick, and 2.54-centimeters square. If a crystal is ground to uniform thickness, then it will have one series-resonant and one parallel-resonant frequency. Those are fundamental frequencies. But if the thickness is not uniform, then there might be spurious resonances other than the fundamental frequency.

Historically, there have been two basic forms of mounting for a crystal. The older method used a pair of springs to hold a brass or silver-covered-copper electrode against the surface of the crystal slab. World War II vintage "FT-243" crystal mounts (once popular with Novice-class hams, who were required to use crystal control on their transmitters) were of that type. Some people made "rubber crystals" by installing a pressure screw to vary the tension on the slab. Those devices allowed the frequency to be adjusted slightly. The other form of mount, more popular today, uses silver electrodes deposited onto the crystal surface. Wire connections can then be soldered to the surface.

The equivalent circuit for a crystal resonator is shown in Fig. 3A, while the reactance vs. frequency characteristic is shown in Fig. 3B. There is a series resistance (R_s), and a series inductance (L_s) in the circuit. The series capacitance (C_s) combines with the series inductance to form a series-resonant frequency. At that frequency, because $-X_c$ and $+X_l$ cancel each other, the impedance of the crystal is the series resistance. That is, the impedance is minimum at the series-resonant frequency, F_s (see Fig. 3B). Because there is a parallel capacitance (C_p) there will also be a parallel-resonant frequency (F_p). At that frequency, the impedance is maximum, and a 180-degree phase shift occurs. The parallel- and series-resonant frequencies are typically 1 to 15 kHz apart.

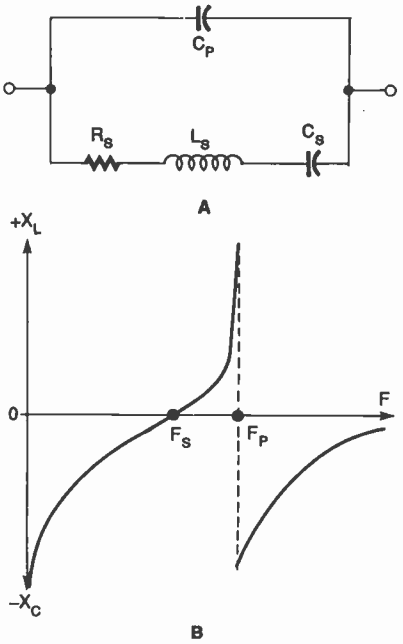


Fig. 3. In the equivalent circuit for a crystal resonator (A), a series-resonant frequency is created. The impedance of the circuit is a function of the frequency (B).

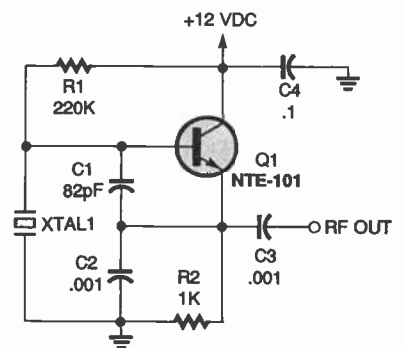


Fig. 4. This Colpitts, parallel-mode, crystal oscillator has a range of 1 to 20 MHz. The circuit contains a capacitive voltage-divider network, consisting of C1 and C2, which is shunted across XTAL1 to provide feedback.

The design of any particular oscillator is selected to take advantage of either a series- or parallel-resonant frequency. When parallel-resonant crystals are used, the load capacitance of the crystal has to be specified (an external capacitance can alter the parallel-resonant frequency

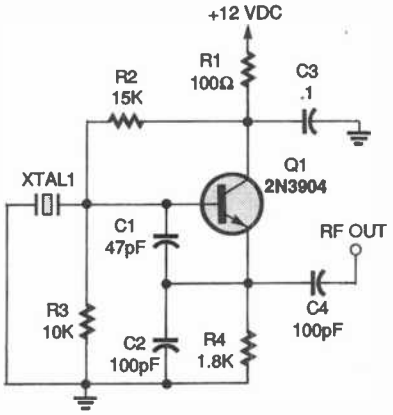


Fig. 5. This parallel-mode oscillator uses a silicon transistor, which lets it operate over a slightly wider frequency range than a circuit that uses a germanium transistor.

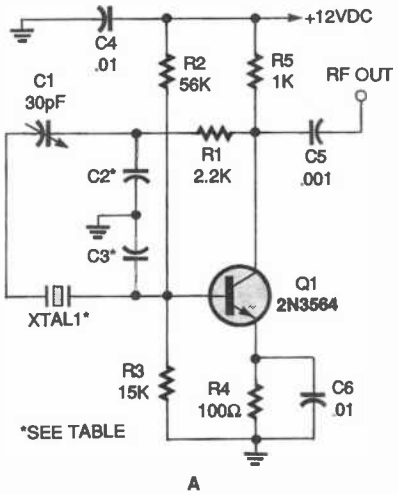
by a small amount). Typical values are 20, 30, 50, 75, or 100 pF, although for most applications a value of 30 (or 32) pF is specified. It is common to form a frequency adjuster by placing a small trimmer capacitor in series or parallel with the crystal.

When a crystal is operated at the natural series- or parallel-resonant frequency of the oscillator, it is said to be a fundamental-frequency oscillator. The fundamental mode is used up to frequencies of 20 MHz or so. In some cases, the oscillator is operated on or near a harmonic of the fundamental frequency. Those are called overtone oscillators, and typically the third, fifth, or seventh overtone are used over a range of 20 to 90 MHz. When ordering overtone crystals, be sure to specify the actual operating frequency, not the apparent fundamental frequency. That's because dividing the actual frequency of, say, a fifth-overtone crystal by five does not yield the parallel-mode fundamental frequency.

Crystals typically need a certain minimum-drive power in order to operate reliably, that is, to start when the circuit is turned on. But drive power can be overdone, and could result in fractures in the crystal. Crystals typically have a maximum drive power of 200 microwatts (μW), although those under 1000 kHz might have maximum dissipations of 100 μW. It is common practice to operate the crystal at power levels about one-half the maximum in order to improve stability.

Crystal-Oscillator Circuits. Now let's take a look at some oscillator circuits that use either fundamental-mode or overtone-mode crystals as the frequency-controlling resonator element. All of the circuits will work with common, "garden-variety" silicon transistors, JFET's, or MOSFET's, with the exception of the TTL-based oscillator circuit.

Figure 4 shows a 1- to 20-MHz-crystal Colpitts oscillator that is easy to build. It is based on an old-fashioned germanium NPN bipolar transistor and a crystal operated in the parallel



A

XTAL1 MHz	C2 (pF)	C3 (pF)
0.5-3	470	820
3-10	220	470
10-20	120	330

B

Fig. 6. The fundamental oscillator shown here (A) has an adjustable drive and is designed to operate over the 500-kHz to 20-MHz range. The exact frequency is determined by the values of crystal XTAL1 and capacitors C2 and C3, typical values for which are shown in the table (B).

mode. The transistor selected is the NTE-101 (also ECG-101), which is sold as a replacement for older transistors when repairing consumer electronic equipment. If you want to use the more common NTE-100 (also ECG-100), a PNP germanium unit, then reverse the power supply and apply −12-volts DC to the collector.

The feedback network that allows the circuit to oscillate is the capacitive voltage-divider network, consisting of C1 and C2, which is effectively shunted across the crystal (XTAL1). Capaci-

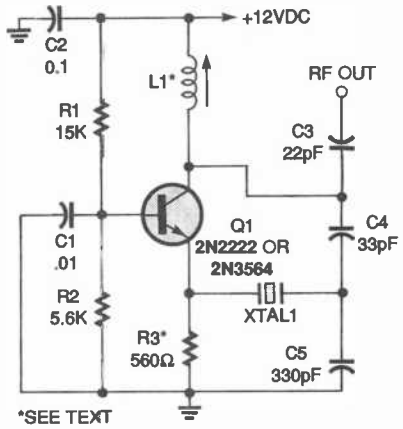


Fig. 7. This fundamental-mode, 1- to 20-MHz oscillator circuit is capable of providing 10 PPM frequency stability. The drive level of crystal XTAL1 can be adjusted by making R3 any value between 100 and 1000 ohms.

tors C1 and C2 should be silvered-mica or NPO-ceramic-disc types. The collector of the transistor is bypassed to ground for RF, but is at a DC potential of +5- to +15-volts. Output is taken from the emitter of the transistor through a 0.001-μF capacitor, C3.

A variation on that same circuit using a silicon device is shown in Fig. 5. That version of the parallel-mode oscillator is able to operate over a slightly wider frequency range. Also, some claim that oscillators using silicon transistors might begin their oscillations more reliably than ones that use germanium devices (like the one

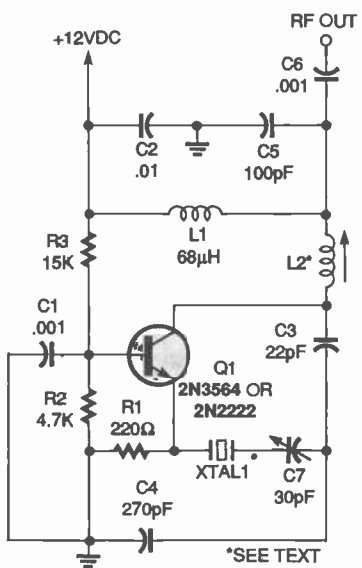


Fig. 8. Here's a third-overtone-oscillator circuit. Using this circuit with a buffer amplifier is recommended.

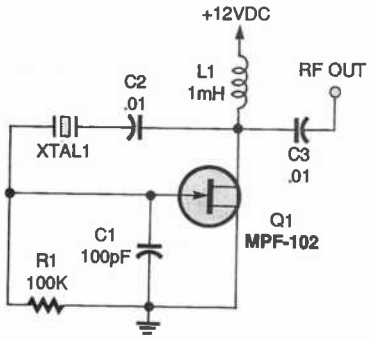


Fig. 9. Like all Pierce oscillators, this circuit has a crystal, XTAL1, connected between the output and input of the active device.

in Fig. 4). However, the author has used both circuits and found no starting problem with either. If you discover a problem, then experiment with the values of the bias resistors and the feedback capacitors (C1 and C2).

The circuit shown in Fig. 6A is designed to operate over the 500-kHz to 20-MHz range, depending on the values of the capacitors used in the feedback network (C2 and C3). Typical values for those capacitors (depending upon which crystal is used) are given in the table in Fig. 6B. A frequency-trimming capacitor (C1) is provided to adjust the operating frequency to the exact required value.

The circuit will operate with superior stability and lower harmonic distortion if the feedback resistor (R1) is replaced with one of a greater value (the exact value can be found experimentally). However, that tactic should only be used when the oscillator is free-running. If it is keyed, or otherwise turned on and off, then a problem can occur if the value of R1 is too high. Under that condition, the oscillator will not rise to its full output amplitude as rapidly as when the resistor value is lower. Using a resistor with a value lower than 2200 ohms, however, might have the effect of overdriving the crystal.

A fundamental frequency-oscillator circuit, that is capable of providing 10 parts-per-million (PPM) frequency stability, is shown in Fig. 7. In that circuit, the crystal is connected between the emitter of the transistor and the junction point on the capacitor voltage-divider feedback network. Both series- and parallel-mode crystals can be used. The ratio of the feedback-network capacitors can be adjusted by trial and error for best (most stable) operation.

The drive level of the crystal, XTAL1, can be adjusted by replacing R3 with a resistor of any value between 100 and 1000 ohms. The lower the value of R3, the lower the crystal dissipation and the better the stability. Inductor L1 is resonated to the crystal frequency by C4. The circuit will fail to start if that coil is misadjusted; it is almost always possible to find a setting near resonance where the crystal oscillator will start reliably every time it is powered up.

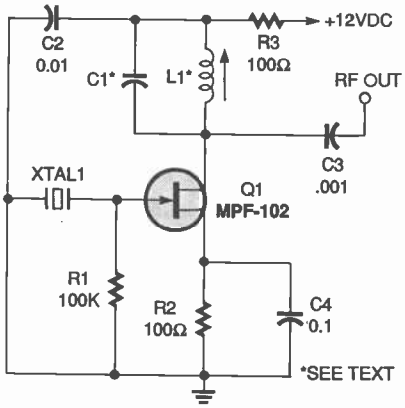


Fig. 10. In this Miller-oscillator, the output tuned circuit (L1/C1) should be set to either a third, fifth, or seventh overtone.

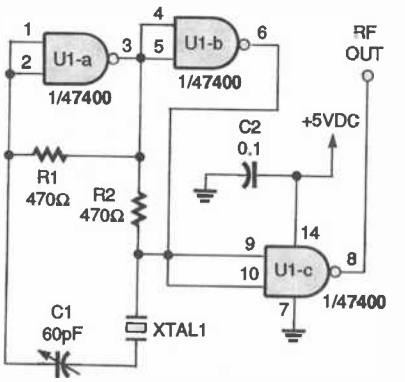


Fig. 11. The TTL-compatible crystal oscillator shown here is of the type used as a clock in digital circuits and computers. The two inputs of each gate of U1 are connected together, so they operate as inverters.

An overtone-oscillator circuit is shown in Fig. 8. Although the circuit is similar to the fundamental oscillator in Fig. 7, it produces an output frequency at the third-overtone frequency of the crystal. As with the previous circuit, crystal-drive power can be adjusted by changing the value of R1 to some value between 100 and 1000 ohms.

In that circuit, L2 resonates with C3, and must be adjusted to resonate on the third-overtone frequency. Set L2 to a point where the oscillator reliably starts and remains stable. That coil will pull the frequency somewhat, so don't adjust the frequency-trimmer capacitor (C7) for the final time until after the correct adjustment point for L2 is found. After that, don't change the setting of L2. For best results, a buffer amplifier is highly recommended.

A Pierce-oscillator circuit is shown in Fig. 9. Like all Pierce oscillators, the circuit has a crystal connected between the output and input of the active device. Because a JFET is used in the circuit, the crystal is connected between the drain and gate; in a circuit using a bipolar transistor, the crystal is connected between the collector and base. The capacitor (C2) in series with the crystal is used in a DC-blocking function (in some low-voltage transistor circuits that capacitor can be eliminated, but should remain for our application).

The Miller-oscillator circuit shown in Fig. 10 uses a capacitor in its output circuit. Again, a JFET is used as the active device, even though a properly biased bipolar NPN or PNP device can also be used. The Miller-oscillator circuit is identified by having the crystal in a parallel-mode connection, with a parallel resonant-output tuned-tank circuit, and no capacitive voltage-divider feedback network. Although the Miller oscillator is quite popular, it seems that it is subject to frequency and output-amplitude instabilities, and suffers badly from load-impedance variations. The setting of the output tuned circuit (L1/C1) is critical to proper operation; as explained earlier, either a third, fifth, or seventh overtone should be used.

A TTL-Compatible Oscillator. The circuit shown in Fig. 11 is a TTL-compatible crystal oscillator—the type used as a clock in digital circuits and computers. That circuit can be built with any set of TTL inverters; in the case shown, U1 is a 7400 NAND quad two-input gate. Because the two inputs of each gate are connected together, they operate as inverters. Of course, there are four NAND gates inside each

(Continued on page 88)

THE DELTA-WYE CONVERSION PROGRAM

Let your computer handle those repetitive electronics calculations.

BY JAMES E. TARCHINSKI

Admit it, you've gone insane before. Back when you bought your first personal computer, you immediately began filling disks with reams of data that had absolutely no business on a computer. Family medical records, checking-account data, and maybe even recipes were all part of that initial data flood. If you followed the standard pattern for new PC owners, as time passed you slowly came to your senses. By now you should have a much clearer idea of what belongs on a computer and what doesn't.

There are three primary reasons to place data on a computer. If a particular application does not fall into one of those categories, then conventional data-collection and cataloging methods (i.e. pen, paper, and books) should be used instead of a computer. The three reasons are: (1) the information must be manipulated in a complex manner once entered, (2) the information changes rapidly and must be constantly modified, and/or (3) the information might be difficult to locate if it is not placed on a computer.

Although it clearly meets the first criteria, DELTA-Y.BAS, the BASIC program given in Listing 1, was originally written to meet the third criteria. It was written one Saturday morning after the author spent nearly 30 minutes looking in a number of electronics books for the formulas to perform a delta-Y conversion. Now the equations are safely stored on disk and can be retrieved and used in a matter of moments.

As listed, the program will run on IBM PCs and PC-compatible computers that support either the BASICA or GWBASIC versions of BASIC. Because it uses just text display screens, however, the program can easily be modified to run on any computer that supports the BASIC language.

The Delta-Wye Conversion. Before examining DELTA-Y.BAS in detail, let's look at the conversion process that the program automates. The two partial resistor networks shown in Fig. 1 will aid in this discussion.

Figure 1A shows three resistors, R_A, R_B, and R_C, arranged in what is known as a "delta" configuration. Imagine that those resistors are only a small part of a more extensive circuit and that the circuit is connected to the resistors only at the three nodes labeled X, Y, and Z.

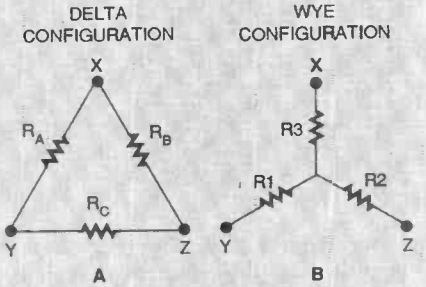


Fig. 1. A resistor network in a delta configuration is shown in A, while a wye configuration is shown in B.

Figure 1B shows another arrangement of three resistors that also connect to an external circuit only at nodes X, Y, and Z. The resistors in that figure, R1, R2, and R3, are connected in a "wye" (sometimes written as just a "Y") configuration.

The Delta-Wye conversion theorem states that if the values of resistors R_A–R_C and R1–R3 are properly chosen, the external circuit will not be able to distinguish which of the two configurations are connected to it at nodes X, Y, and Z. In other words, if you have a circuit with three resistors connected as shown in Fig. 1B, but you don't have the appropriate resistor values, you can substitute the circuit of Fig. 1A if you properly choose the new resistor values. Of course, you can also use the transformation in the other direction when necessary.

The DELTA-Y.BAS program automates the delta-wye conversion process by calculating the appropriate resistor values for either delta-to-wye or wye-to-delta conversions. It does the conversions based on the following equations:

$$R1 = (R_A)(R_C)/(R_A + R_B + R_C)$$
$$R2 = (R_B)(R_C)/(R_A + R_B + R_C)$$
$$R3 = (R_A)(R_B)/(R_A + R_B + R_C)$$

and

$$R_A = [(R1)(R2) + (R1)(R3) + (R2)(R3)]/R2$$

$$R_B = [(R1)(R2) + (R1)(R3) + (R2)(R3)]/R1$$

$$R_C = [(R1)(R2) + (R1)(R3) + (R2)(R3)]/R3$$

Entering DELTA-Y.BAS. If you are not familiar with the process of entering a BASIC program into your computer consult either your DOS manual or, if you have one, your BASIC book. The process should advance something like the following.

First, boot your machine from the DOS disk that was supplied with your computer. When you get to the A prompt, type either the command "BASICA" if you have a true IBM machine, or "GWBASIC" if you have a PC compatible. After entering the appropriate command for your machine press the Return key; after a few seconds you should see BASIC's "OK" prompt appear on the screen.

When that prompt appears, type the program into the machine exactly as it appears in Listing 1. Be sure to press the Return key after you complete each line, otherwise the line will not be correctly recognized.

When you finish entering the program immediately save it to a previously formatted disk by executing the command:

SAVE"DELTA-Y.BAS"

Your version of the program should now be safely stored on disk. If you have access to a modem, an executable version of the program, DELTA-Y.EXE, along with a text listing of it are available in the PE Library of our BBS (516-293-2283, 8-N-1).

Program Description. As shown in Listing 1, the DELTA-Y.BAS program consists of three main sections of code coupled with three support subroutines. The main sections are the printing of the menu screen, the delta-to-wye conversion section, and the wye-to-delta conversion section.

Program execution begins with the main menu portion of the code, which includes lines 1000–1310. Line 1000 clears the program variables and initializes the screen to its 80-column, color mode of operation. Lines 1010 through 1150 then proceed to print a title banner and a reference diagram on the screen.

In lines 1180–1250 DELTA-Y.BAS gets down to business, printing the Main Menu (lines 1180-1240) and then inputting the user's selection in variable V (line 1250). If an invalid response is entered, line 1260 catches the error and responds with a beep and a reprinting of the Main Menu. Similarly, if the user asks to exit the program by selecting item 3, the program gracefully halts execution at line 1270. For a

(Continued on page 88)

LISTING 1

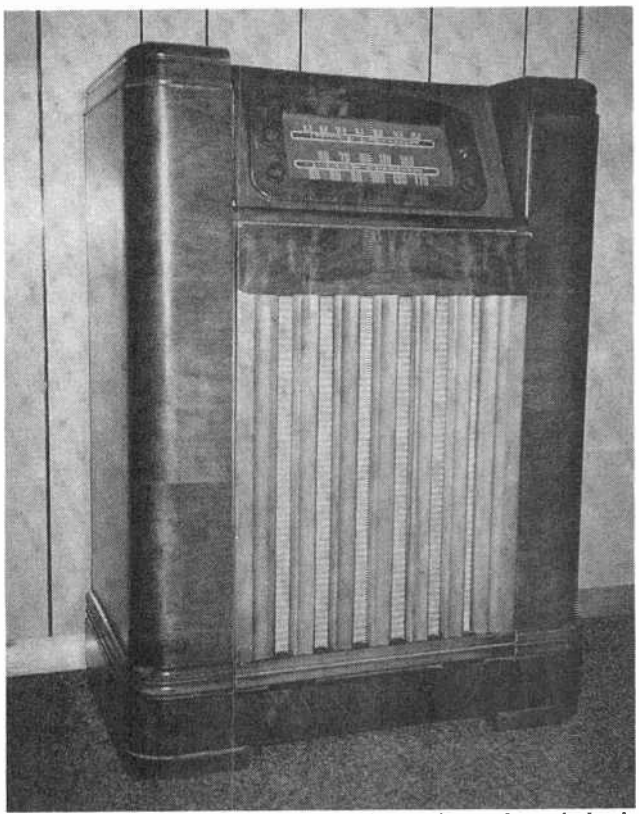
```
1000 CLEAR : WIDTH 80: SCREEN 0, 0, 0, 0: KEY OFF: CLS : COLOR 10
1010 PRINT "*************************************************************"
1020 PRINT "*          DELTA-Y:  The Delta-Wye Calculation Program      *"
1030 PRINT "*                (c) 1989 by James E. Tarchinski            *"
1040 PRINT "*************************************************************"
1050 COLOR 11
1060 PRINT
1070 PRINT "            D E L T A                    W Y E      "
1080 PRINT "                                                    "
1090 PRINT "                /\                        |         "
1100 PRINT "               /  \                      R3         "
1110 PRINT "              /    \                     |          "
1120 PRINT "          Ra          Rb                 +          "
1130 PRINT "         /              \               /   \        "
1140 PRINT "        /                \           R1       R2     "
1150 PRINT "       --------- Rc ---------        /             \  "
1160 '
1170 GOSUB 1690
1180 LOCATE 17, 1: COLOR 11
1190 PRINT "Would you like to:": COLOR 10
1200 PRINT "  1. Convert from DELTA to WYE"
1210 PRINT "  2. Convert from WYE to DELTA"
1220 PRINT "  3. Exit the program"
1230 '
1240 COLOR 11: PRINT "Your Choice: "; : COLOR 7
1250 INPUT "", IN$: V = ABS(VAL(IN$)): COLOR 10
1260 IF V < 1 OR V > 3 THEN BEEP: GOTO 1170
1270 IF V = 3 THEN CLS : END
1280 GOSUB 1690
1290 IF V = 2 THEN 1470
1300 '
1310 '
1320 '------------------ DELTA -> WYE --------------------------------
1330 '
1340 P$ = "Ra": GOSUB 1610: RA = V
1350 P$ = "Rb": GOSUB 1610: RB = V
1360 P$ = "Rc": GOSUB 1610: RC = V
1370 IF RA*RB*RC=0 THEN PRINT "ERROR: Illegal value(s).": GOSUB 1760: GOTO 1170
1380 '
1390 GOSUB 1690: LOCATE 17, 1
1400 SABC = RA + RB + RC
1410 R1 = RA * RC / SABC: PRINT "R1 = "; R1; " ohms."
1420 R2 = RB * RC / SABC: PRINT "R2 = "; R2; " ohms."
1430 R3 = RA * RB / SABC: PRINT "R3 = "; R3; " ohms."
1440 GOSUB 1760: GOTO 1170
1450 '
1460 '
1470 '----------------- WYE -> DELTA --------------------------------
1480 '
1490 P$ = "R1": GOSUB 1610: R1 = V
1500 P$ = "R2": GOSUB 1610: R2 = V
1510 P$ = "R3": GOSUB 1610: R3 = V
1520 IF R1*R2*R3=0 THEN PRINT "ERROR: Illegal value(s).": GOSUB 1760: GOTO 1170
1530 '
1540 GOSUB 1690: LOCATE 17, 1
1550 S2 = R1 * R2 + R1 * R3 + R2 * R3
1560 RA = S2 / R2: PRINT "Ra = "; RA; " ohms."
1570 RB = S2 / R1: PRINT "Rb = "; RB; " ohms."
1580 RC = S2 / R3: PRINT "Rc = "; RC; " ohms."
1590 GOSUB 1760: GOTO 1170
1600 '
1610 '---------------------- INPUT SUBROUTINE ------------------------
1620 '
1630 LOCATE 21, 1: COLOR 11: PRINT "Enter the value of "; P$; "."
1640 COLOR 7: LOCATE 23,1
1650 PRINT "Value (Ohms):"+STRING$(20,32) :LOCATE 23,16
1660 INPUT "",IN$: V = ABS(VAL(IN$))
1670 RETURN
1680 '
1690 '---------------------- CLEAR BOTTOM SUB ------------------------
1700 '
1710 FOR I = 17 TO 23
1720   LOCATE I, 1: PRINT STRING$(79, 32);
1730 NEXT I
1740 RETURN
1750 '
1760 '---------------------- PRESS ANY KEY SUB -----------------------
1770 '
1780 COLOR 7: LOCATE 23, 1
1790 PRINT "Press any key to continue...";
1800 IN$ = INKEY$: IF IN$ <> "" THEN 1800
1810 IN$ = INKEY$: IF IN$ = "" THEN 1810
1820 RETURN
1830 '
1840 'END OF LISTING
```

ANTIQUE RADIO

By Marc Ellis

Time to Read the Mail

Those readers who have been closely following our Minerva Tropicmaster restoration project know that the set is now in working condition and are expecting a report on its realignment. Regrettably, I wasn't able to accomplish that last month. We're doing some home remodeling involving the spaces I use for my office, workshop, and photography studio, so I really didn't have access to the required tools and facilities.



This handsome Philco Model 46-1226 console was brought back to life by F. Wayne Coston.

That being the case, this is a perfect time to share the many letters that have been accumulating. Next month should see us back on track with the completion of the Minerva project.

HELP WANTED

Let's begin the way we usually start these "mailbag" columns—with requests for schematics and/or general information on specific sets. Here's a list of readers and the sets they are looking for information on: Arthur S. Jones (775 Ridge Rd., Lewiston, NY 14092-1117), Fisher D-391 "Diplomat;" Brian Carusella (3241 Bellefontaine, Houston, TX 77025-1401), RCA Theremin; Randall D. Thacker (4216 East Hano St., Phoenix, AZ 84044), dial-cord stringing diagram for RCA 3-BX-671; Steve Riggs (P.O. Box 949, Geneva, FL 32732), RCA Victor "New Orthophonic High Fidelity" upright radio and record player; Michael Walaszewski (6629 Commonwealth Blvd, Parma Heights, OH 44130), Knight "Star Roamer" (4-tube, 3-band); Henry S. Wypa (3800 Cicotte/Rear, Detroit, MI 48210-2925), Paco Model T-60 tube tester; Frank I. Frattali (3714 Meadowvale Rd., Ellicott City, MD 21042), Jackson Electrical Instrument Model 637 Dynamic Output Tube Tester; Doug Dungan (605 School St., P.O. Box 137, Clio, IA 50052), Heathkit OP-1 Oscilloscope; John H. Rodriguez (123 Colonels Lane, Weymouth, MA 02189), Hysteresis Synchronous Motor Type HC-CD B-2, as used in Akai reel-to-reel tape recorder; H.D. Fogle, Jr. (35 Wildwood Rd., Katonah, NY 10356), Electronic Measurements Corp. Model 209 tube tester.

SHOW-AND-TELL TIME

Bill Jackson (6331 Old Forsyth Road, Macon, GA 31210) recently restored a Columbia Phonograph Co. Model 31-33 radio that once belonged to his grandfather and had been stored in a barn for many years. The chassis was covered with rust, as well as a thick layer of fat from hams that had once been stored overhead. Many components were missing, the tuning capacitor was bent, and the speaker cone was gone. "Many people, initially including myself, would have considered it junk ... the more I looked at it, however, the more I was challenged—how amazing it would be to listen to the same radio that my grandfather had!"

Lack of space prevents us from going into detail, but suffice it to say that Bill now has a working chassis. The cabinet is too far gone to restore, and Bill's brother, a master carpenter, is going to duplicate it. However, he needs a reference for the speaker grille—which has been long since lost. Can someone supply a photo? The cabinet apparently was black, lacquered, and with an oriental design on the front.

F. Wayne Coston (1404 Olive, Durant, OK 74701) sent a photo of a handsome Philco Model 46-1226 that he restored for a friend. The chassis was perhaps not as bad as the one Bill Jackson dealt with, but it sounds bad enough! Mice had relieved themselves on it—causing a short from one of the tube's plate pins to ground!

After giving the chassis a good cleaning, replacing all caps, and lubricating the

controls, the set came to life. "I had forgotten how good these old consoles could sound ... needless to say, it was a very exciting event." One of the set's four control knobs is missing, and Wayne is still searching for a replacement. Can someone help?

From time to time, Terry Schwartz (Shoreview, MN) sends us photos of some of his new acquisitions. The ones pictured in this column don't qualify as "new" anymore because we've been holding the photo for over a year waiting for a good opportunity to show it.

We antique-radio nuts are getting quite common, but Neal A. Haight (4516 Hillsborough Dr., Castro Valley, CA 94546) is one of a rarer breed that specializes in restoring old black-and-white TVs. He estimates that "... around 90% of those built now lie in ashes 20-50 feet below the ground." That's why he enjoys the challenge of finding and fixing those sets. His latest project is a 1957 Packard-Bell Model #8853. Can someone help Neal find a deflection yoke (Packard Bell #2959C or Stancor #DY-23A) and back (rear cover) for that set?

CAPACITOR COMMENTS

Bill Stiles (4599 Jarvis Rd., Hillsboro, MO 63050) writes that he found the recent series on the Sprague Tel-Ohmike capacitor checker interesting. However, he doesn't completely agree with a remark I made about the leakage-testing function of those instruments being relatively unimportant. My point was that, because the condition of most old capacitors is highly suspect, most people now replace them without bothering to check. Bill replies:

"... It is true that wax-coated capacitors should be replaced, no testing is needed. It was common, in the 1950s, to replace the smaller sizes of paper capacitors with ceramics, which also are sometimes leaky and might require testing. However, the largest need for leakage testing would be for testing sets that had been repaired with the early molded capacitors.

"When molded capacitors were first introduced, in the middle 1950s, they were a large improvement over the wax-coated units, but they had a much shorter life than later (since about 1970) units. Even then, it was a common practice to replace all wax-coated capacitors. If you are restoring a set in which the capacitors have been replaced, some of the replacements might be leaky, and a capacitor analyzer, using a high voltage for testing, is the only reliable test for leakage."

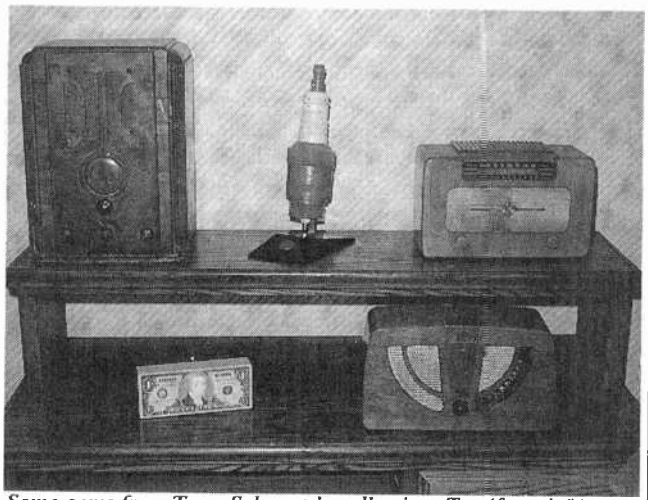
Incidentally, Bill has two items to give to anyone who will pay for shipping: A Hickock 288X signal generator and a TEC S-15 solid-state stereo amplifier (1962 vintage) with Sams Photofact sheet.

BRITISH BABY BOOMER

Paul Coxwell (Sutton-On-Sea, England), who contributed the photo and specifications of the Bush 22 series we discussed in the October, 1994 column ("A Baby Boomer From Britain") sent some comments on the write-up. He noted that, although I pointed out a few of the British radio terms used on the spec sheet, I left out a couple of important ones: *anode* for "plate" and *earth* for "ground."

Paul also fills us in on the Mullard tube code used by British manufacturers. Limited space prevents us from giving all the details, but the first letter in the designation refers to the heater current or voltage rating; that is followed by one or two letters referring to the type of tube (diode, diode-triode, etc.); then comes a two-digit number identifying the specific tube. The latter numbers are assigned in ranges, depending on the type of base (for example, tubes numbered 30 through 39 have an octal base).

The "U" prefix on the tubes that are used in the Bush 22 series indicates that they are designed for use in a 100-mA series string. The voltages dropped across each tube might vary from type to type. That's why the tubes in the Bush were operated in series even when powered by the alternate transformer configuration. Otherwise, several transformer windings might have been needed to power each tube with its correct heater voltage.



Some gems from Terry Schwartz's collection. Top (from left): Crosley 635; promotional radio by Champion; Farnsworth ET-069. Bottom "money talks" set (Washington's mouth moves in sync with the audio); Zenith 6D030.

NOTE FROM A REPAIRPERSON

A retired antique-radio repairperson, who asked that her name and address not be published, writes the following in response to my little profile on reader Cindy Cookston (February, 1995 issue).

"Isn't it unusual that a writer of antique-radio columns considers repairwomen a rarity? There are many women doing this work. True, they are a minority, but by no means as unique as you insinuate.

"You asked the background of such women. Marital status and number of children are irrelevant. The pertinent attributes of a good repairperson are intelligence, knowledge, and manual dexterity. This is the 20th Century. The eras when women were hired only in low-paying menial jobs are over. Today females teach sciences in universities, work as engineers and technologists in aerospace, automotive, computer, television and medical facilities to name a few examples. They take pride in their ability to do meticulous tasks.

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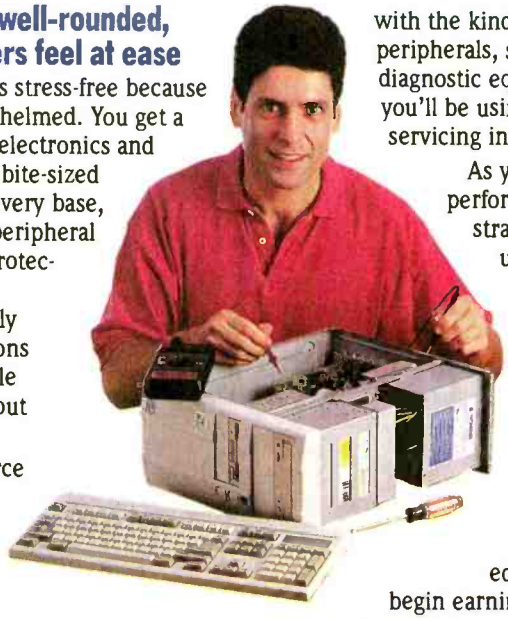

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construction of old radios and related equipment attract the attention of some of these women. They begin to collect and repair as a hobby. A few open their own repair shops either part or full time after retiring from big industry careers.

"If you really are unaware of the existence of women working on old electronics, try attending radio-club swap meets and ask antique dealers and collectors who does their restoration work. Very few professional repair women will write a magazine columnist asking for schematics or advice. They either own, or have access to, Rider's, ORSM. Sams and manufacturer's service data printed in the years the old sets were sold originally."

When I received that letter, I was really taken aback. Had I really come off as an insensitive clod with no clue that women are now successfully and happily pursuing all sorts of technical careers? Looking over Cindy's profile again, I realized that I really hadn't acknowledged, in print, that I was aware of those facts (although I certainly did so during my phone interview with Cindy).

I'm definitely not an "MCP," but just curious about why so relatively few women seem to be involved in radio collecting and restoring. That is all the more interesting because so many *are* now deeply involved in the technical occupations.

If the reason so few women write this column is that, as a group, they are much more self-sufficient than guys and don't need help, that's interesting in itself and I'd like to know more about it. I admit, I've asked very few antique dealers and collectors who does their repair work and perhaps if I did, I'd uncover a lot of restorers of the other sex. However, I certainly *have* attended a lot of radio meets and never noticed large numbers of women dickering for old sets and parts. I'll look more carefully at the next couple of meets I attend and see what I come up with!

In the meantime, if anybody (of either gender) wants to send in their interpretations of sex differences (if any) in radio collecting, I'd be delighted to hear them!

STUFF FOR SALE

To save yourself disappointment when contacting any of the following folks, keep in mind that much of the information in this column is several months old. As long-time readers know, I hold all letters until there are enough for a column and there is an appropriate break point in the restoration project, or other series of articles, that might be in progress. Another few months pass between the time I send in the column and the time the magazine hits the newsstands and mailboxes.

Some of the items being offered might not still be available. But don't be afraid to inquire! If you write, include a long S.A.S.E. with your letter to facilitate the seller's response.

Budd Mayer (105-10 65 Ave., Flushing, NY 11375; Tel. 718-459-3491) has an inventory sheet, with prices, listing a variety of "builder-oriented parts, test equipment, tools and the like that I feel should have a home." Michael T. Sheehan (1610 Delaware Ave., Reading, PA 19610) purchased the 15,000-volume stock of a used book store. It included 80-some titles on electronics subjects and he is offering them for sale. Glancing at his list, I found that most of the books seem to date from the late 1950s through early 1970s, but a few of the titles are a bit older.

Richard Jacobs (6610 Bunker Rd., North Royalton, OH 44133; Tel. 216-237-4662) would like to dispose of some antique radios and parts from the 1930-1936 period. Gary A. Micanek (226 Henry Ave., Manchester, MO 63011; Tel. 314-227-7046) deals in photocopies of radio literature. He has a large collection of original factory service data, including RCA-issued service bulletins (some as lengthy as 40 pages on a single set) on most pre-1930 Radiolas and most RCA-Victor service bulletins from 1931-1961. But there's much more, so please write your needs! ■

By Jeff Holtzman

Emergency Disk

Do you ever get called on to help diagnose problems with someone else's PC? I don't know about you, but I constantly get requests from friends, family, and colleagues to help debug PC-configuration problems, to help recover lost data, and to deal with similar problems.

Over the years, I've developed different strategies and tool kits for dealing with different problems. For example, my debug tool kit contains an RS-232 breakout box with LEDs and jumpers. It contains a multitude of adapters with nearly every permutation of male/female, 9-pin/25-pin, Centronics, VGA-to-SVGA, PS/2-to-AT keyboard, null-modem cables, and so on. One critical component is an emergency diskette. It's nothing more than a bootable DOS diskette with some critical system programs and DOS-based utilities. This month I'll show you what's contained on it and how to make your own. The accompanying program listings show a pair of standard DOS batch files that can create the disk (almost) hands free.

Listing 1 shows the main batch file; if you only use DOS's COMMAND.COM (and not a third-party shell such as 4DOS), you only need to run Listing 1. Listing 2 is for 4DOS users; it runs the Listing 1 program under DOS's COMMAND.COM.

HOW IT WORKS

The batch file in Listing 1 consists of eight major sections: 1) verify target disk, 2) allow user to exit, 3) optionally format target disk

LISTING 1

```
@echo off
if (%1) == () GOTO SYNTAX
ECHO About to create an emergency boot disk
ECHO containing critical DOS and utility
ECHO programs. The disk must be 1.44 MB.
ECHO.
ECHO Don't forget to run this under COMMAND.COM!!!!!
ECHO.
ECHO Press Ctrl-C to quit or
pause

if (%2) == (/f) GOTO DOFORMAT
if (%2) == (/F) GOTO DOFORMAT
if (%2) == () GOTO DOCOPY

:DOFORMAT
format %1 /f:1.44 /s /u /v:IA_Boot_JKH
ECHO.
ECHO Now deleting dblspace.bin ...
attrib -r -h -s %1*.bin                 > NUL
del %1*.bin                             > NUL

:DOCOPY
ECHO.
ECHO Now copying DOS files; patience ...

copy C:\bat\make_utl.bat                %1 > NUL
copy C:\bat\mu.bat                      %1 > NUL

copy C:\dos\choice.com                  %1 > NUL
copy C:\dos\diskcomp.com                %1 > NUL
copy C:\dos\diskcopy.com                %1 > NUL
copy C:\dos\doskey.com                  %1 > NUL
copy C:\dos\format.com                  %1 > NUL
copy C:\dos\loadfix.com                 %1 > NUL
copy C:\dos\mirror.com                  %1 > NUL
copy C:\dos\mode.com                    %1 > NUL
copy C:\dos\more.com                    %1 > NUL
copy C:\dos\sys.com                     %1 > NUL
copy C:\dos\tree.com                    %1 > NUL
copy C:\dos\unformat.com                %1 > NUL
copy C:\dos\attrib.exe                  %1 > NUL
copy C:\dos\chkdsk.exe                  %1 > NUL
copy C:\dos\comp.exe                    %1 > NUL
copy C:\dos\debug.exe                   %1 > NUL
copy C:\dos\deltree.exe                 %1 > NUL
copy C:\dos\fc.exe                      %1 > NUL
copy C:\dos\fdisk.exe                   %1 > NUL
copy C:\dos\find.exe                    %1 > NUL
copy C:\dos\label.exe                   %1 > NUL
copy C:\dos\mem.exe                     %1 > NUL
copy C:\dos\move.exe                    %1 > NUL
copy C:\dos\mscdex.exe                  %1 > NUL
copy C:\dos\share.exe                   %1 > NUL
copy C:\dos\smartdrv.exe                %1 > NUL
copy C:\dos\undelete.exe                %1 > NUL
copy C:\dos\xcopy.exe                   %1 > NUL

ECHO.
ECHO Now copying utility files; patience ...
xcopy C:\utl\*.*                        %1 > NUL

GOTO DONE

:SYNTAX
ECHO This program creates a bootable diskette
ECHO that contains crucial DOS files and system
ECHO utilities. It does not include any network
ECHO startup files. You must specify a
ECHO destination drive. The program currently
ECHO assumes a 1.44 MB diskette exists in the
ECHO specified drive.
ECHO      Syntax:  make_utl destination [/f]
ECHO The destination can be a drive or a directory
ECHO (for testing). Include "/f" if you wish to
ECHO format the target drive.
GOTO END

:DONE
ECHO.
ECHO Complete!
:END
```

with system files (if user specified "/f") and delete unnecessary system files, 4) copy batch files, 5) copy DOS files, 6) copy utility files, 7) display help message, and 8) display "Done" message. We'll discuss each of those in turn.

Section 1 expects one parameter: a disk-drive letter. If you don't specify a drive, the program displays the help text in Section 8 near the bottom of the program and exits. Section 2 prints a message about the purpose of the program, then allows you to quit (by pressing Ctrl-C) or proceed. (The warning about running under COMMAND.COM is necessary, because I use 4DOS and NDOS on various machines, and DOS's FORMAT command doesn't work properly under anything but COMMAND.COM.)

If you proceed, and if you specified "/f" when starting the program, Section 3 then formats the diskette in the specified drive, adding required system files. A 1.44 MB diskette is required to hold everything in my configuration; you might be able to get away with less, depending on which utilities you include. Section 3 then makes DOS's DBLSPACE.BIN file readable and deletes it. Even if you don't use DoubleSpace, FORMAT /S always puts a copy on the target drive.

Section 4 then copies two batch files, the ones used to create the emergency disk. That way the disk can be used to clone itself. At the end of each line in that section and the next two sections, you'll see a string that reads "> NUL." The purpose of that string is simply to avoid cluttering up the screen with a bunch of useless DOS messages.

Section 5 copies the 28 most important DOS files, the ones that allow you to do system-level maintenance: Fdisk, Format, Xcopy, Sys, Debug, Undelete, Unformat, etc. Running DOS 6.20, those files occupy about 430K of space.

Section 6 copies my utilities directory to the target disk. That directory contains critical system utilities, including my text editor (Semware's TSE, a wonderful piece of work, by the way), a slimmed-down version of the Norton Commander, a file finder, several compression utilities, a file-print utility, several file-conversion utilities, etc. The utility files occupy another 900K.

Section 7 is the help text. That text is only displayed if the user forgets to specify a target drive.

Section 8 displays a message stating that the program is done. It also alerts you of that fact by sounding the PC's speaker with a beep.

LISTING 2

```
@command /c C:\bat\make_utl.bat %1 %2 %3 %4 %5
```

USING IT, IMPROVING IT

To create the program, type Listing 1 in using any ASCII text editor, and save the file as MAKE_UTL.BAT. If you use 4DOS or NDOS, enter Listing 2 and save it as MU.BAT. Then you can run either MU or MAKE_UTL.

Either way, the program takes two parameters. The first is the destination where files will be copied. The second allows you optionally to format the destination. Normally, the destination will be A: or B:, but it could also be a subdirectory on your hard disk, for testing. (No, the program doesn't check if you're trying to format a subdirectory; you'll just get an error message.)

You'll almost certainly have to customize the program before running it. For one, you'll have to specify the location of the directory where you store your critical utility files. Or you might prefer to skip the third-party utilities, and copy some of DOS's larger built-in utilities, such as MSD and Scandisk. Another possibility would be to include network drivers and log-in utilities. Yet another would be third-party test and recovery utilities such as the Norton Utilities.

Let me know if you come up with any useful enhancements; e-mail jkh@acm.org. I'll publish any good ideas I receive in a future column. ■

CIRCUIT CIRCUS

By Charles D. Rakes

More ISD1000A Circuits

Last month, as you probably remember, we were playing around with Information Storage Devices' fantastic little "voice recorder/playback IC" and ran out of time. So, everyone, pull out last month's issue, refresh your memory, and let's continue with more ISD1000A circuits. Incidentally, that chip is available from your local Radio Shack store, as well as other sources.

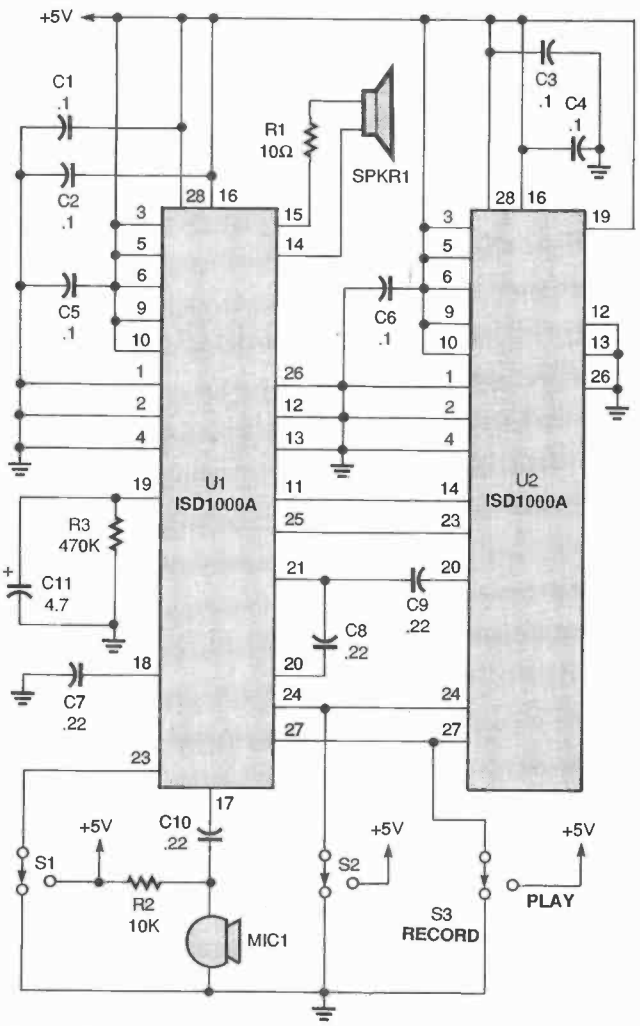

Fig. 1. Keep track of twice as many phone numbers or memos with this time-doubler recorder.

TIME DOUBLER

Our first entry, shown in Fig. 1, places two ISD1000A IC's in a record/playback circuit that doubles the total possible record/playback time. If you recall, the chip can hold up to 20 seconds on its own, so this circuit increases that to 40 seconds.

Using the circuit is simple. To record a message, set S3 to the RECORD position and S1 to the +5-volt position. Then, to stop recording, turn S1 to the ground position. To play back a message, set S3 to the PLAY position, momentarily close S2 to the +5-volt position, and turn S1 to the +5-volt position to play.

TONE-CONTROLLED LOCK

Our next application places the voice recorder/playback chip in an electronic-key circuit for a tone-controlled, sequential-lock system. The lock's sequential decoder circuit is shown in Fig. 2. As configured, the circuit is set up for a four-tone sequence. We'll get to how to select those tones later on in the column when we discuss the tone-generator circuit.

Chip U1 is a 567 phase-locked-loop, tone-decoder IC. The input of that IC, pin 3, connects directly to the AF input circuit through C1. Without an in-band tone, the PLL's output (pin 8) is high, and the output (pin 2) of U9-a (one-fourth of a 4049 inverting buffer) is low.

When U1 decodes the correct tone frequency, the output at pin 8 goes low, lighting LED1 and producing a positive output at pin 2 of U9-a. As long as the tone is present, those outputs are unchanged. When the tone ceases, though, U1's output goes positive again and U9-a's output returns to ground potential, sending a negative pulse through C3 to the input (pin 2) of U5, a 555 timer IC. The timer's output (pin 3) goes positive for a pre-set time period of about 1½ seconds. That positive output connects to one of U8's

PARTS LIST FOR THE TIME DOUBLER (Fig. 1)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—10-ohm
R2—10,000-ohm
R3—470,000-ohm

CAPACITORS
C1–C6—0.1-μF, ceramic-disc
C7–C10—0.22-μF, ceramic-disc
C11—4.7-μF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
U1, U2—ISD1000A voice record/playback, integrated circuit
MIC1—Electret microphone element SPKR1—8-ohm speaker
S1–S3—SPDT switch
Wire, solder, etc.

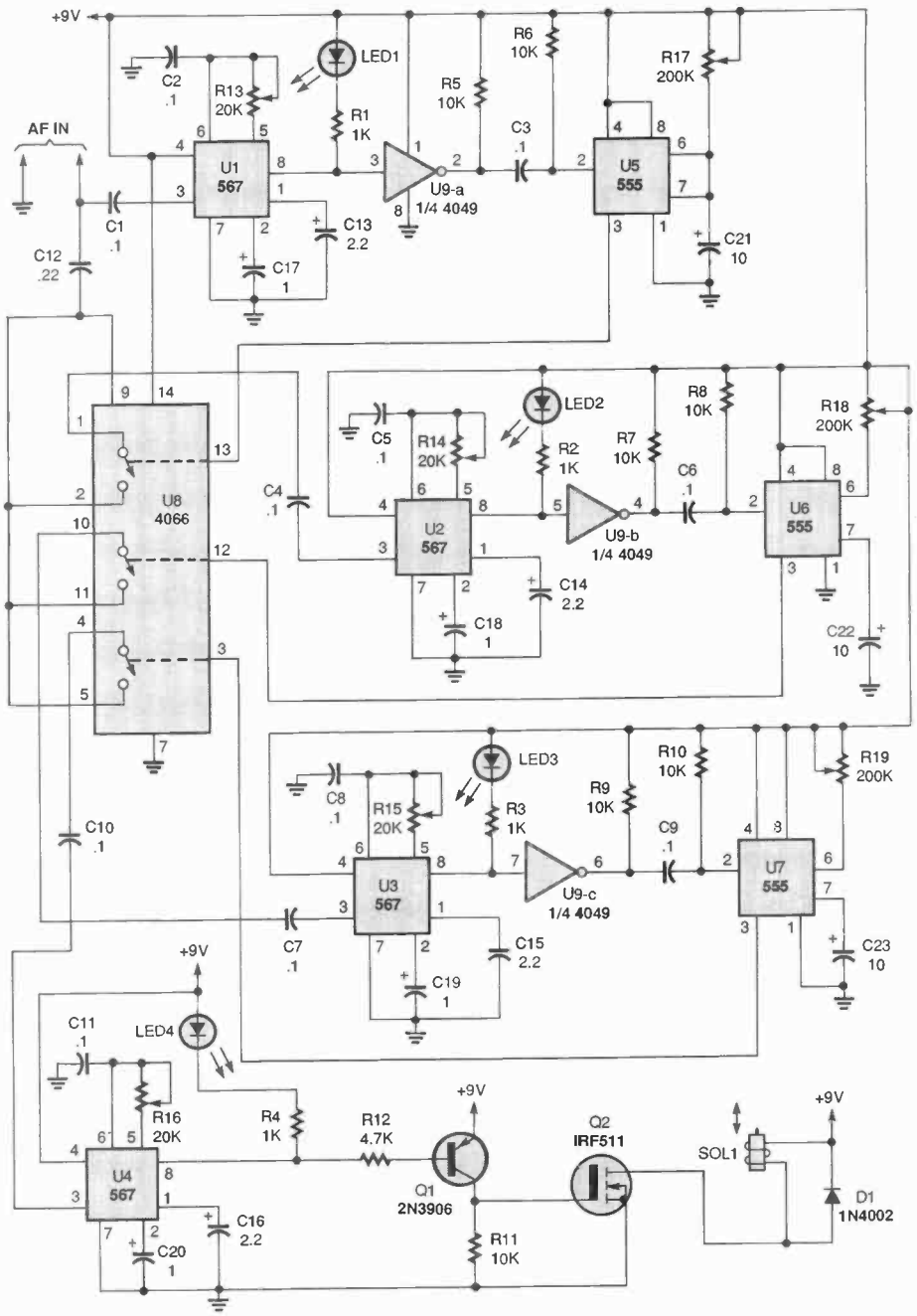

Fig. 2. With a tone-controlled lock like this one, even high-tech thieves would have a hard time accessing a restricted area.

control inputs (pin 13), closing the analog switching circuit between pins 1 and 2. The next sequential tone signal can then pass through C4 into the input of the second 567 PLL, U2.

Before we proceed, let's take a brief look at U8's operation. The chip is a quad bilateral switch. Each of the four separate switches (only three are used in this circuit) are operated by a control-voltage input. To close a switch, the control voltage must equal the IC's positive supply voltage; to open the switch, the control voltage must equal the IC's voltage at pin 7, which in this case equals zero.

If the second tone in the sequence is of the correct frequency, U2, U9-b, and U6 will function in the same manner as U1, U9-a, and U5 to produce a timed switch closure between pins 10 and 11 of U8. That allows the third tone to reach the input of U3.

Assuming the third tone is of the correct frequency, U7's timed output completes the circuit between pins 4 and 5 of U8. Once that occurs, the next tone is sent to the input of U4.

If the fourth tone is correct, U4's output (pin 8) goes low, lighting LED4 and turning Q1 on. That transistor's collector then goes positive, turning Q2 on. As a result, SOL1 is activated, which opens the lock.

The length of the last tone sets the solenoid's closure time. If an independent or longer time period is desired, just add another buffer (U9-d) and 555-timer circuit, as in the three previous circuits, and drive the gate of Q2 with the output (pin 3) of the added 555 timer.

A phone jack or any suitable connectors can be attached to the tone-controlled lock's AF input. Later we'll take a look at an encoder that will work with the lock, but first we need a way to program the tones themselves.

TONE GENERATOR

The tone-generator circuit shown in Fig. 3 can be used to program the correct tone frequencies and timing information into an encoder for use with the lock we just examined. However, the tone-generator circuit does not record tones. For that, you'll need to use one of the ISD1000A record/playback circuits shown last month. But more on that in a moment.

The tone generator acts as a sequential encoder; a 4017 decade counter/divider IC, U2, produces the sequential steps for each of the tones. Gates U1-a and U1-b are connected in a simple, low-frequency oscillator circuit that "toggles" U2's clock input.

The outputs of U2 drive the control inputs of U3, another 4066 quad bilateral switch. Each of the four output switches in U3 is connected to a 20,000-ohm potentiometer that sets the frequency for each output tone. Transistor Q1 buffers U4's output and drives U5, the power-amplifier circuit.

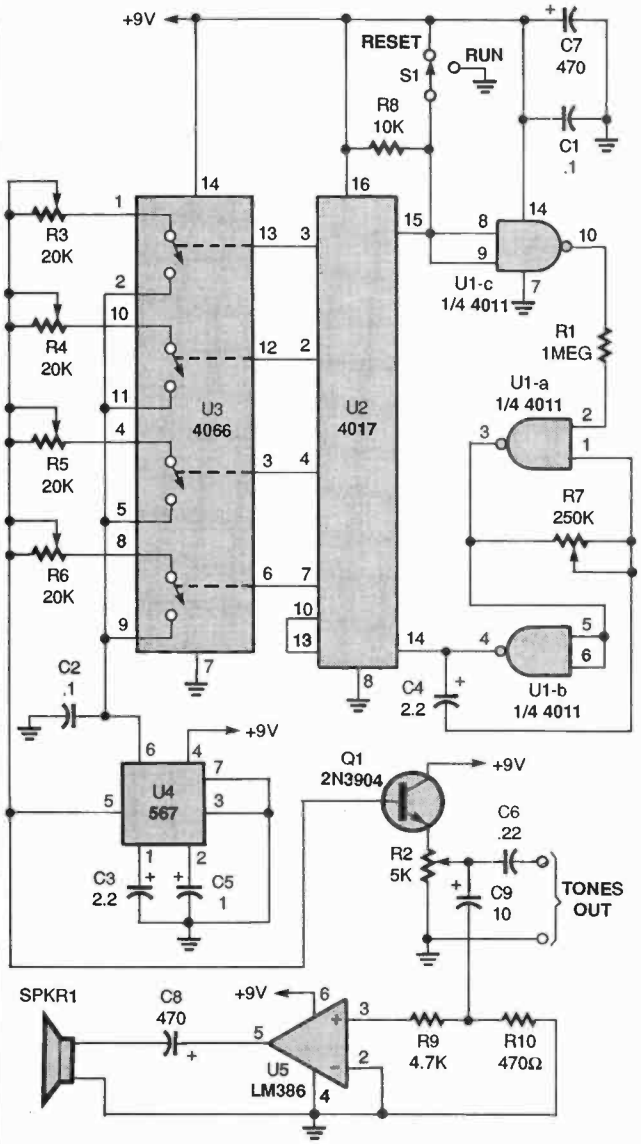

Fig. 3. The four tones that open the tone-controlled lock are generated by this circuit. They can be set using R3–R6 and a frequency counter.

To set the encode frequencies, begin by selecting any four frequencies from 300Hz to 3000Hz that have at least a 20% separation between them. Those will be the encoder tones. Use a jumper to connect pins 1 and 2 of U3 together. Leave S1 in the RESET position, set R2 to about half rotation, and power up the circuit. Adjust R2 for a low, level-tone output at the speaker. Set the first tone frequency by turning potentiometer R3 and using a frequency counter. Then, turn the power off and move the jumper to connect pins 10 and 11 of U3 together. Apply power and adjust R4 to set the second tone frequency. The third tone and fourth tone are set in a similar manner. For the third tone, adjust R5, making sure a jumper connects pins 4 and 5; for the fourth tone, R6 should be adjusted, and a jumper should connect pins 8 and 9.

To record the sequence, first adjust R7 for a tone output timing of about 1 to 1½ seconds. Turn S1 to the RUN position; you should hear the four selected

(Continued on page 87)

PARTS LIST FOR THE TONE-CONTROLLED LOCK (Fig. 2)

SEMICONDUCTORS
U1–U4—567 phase-locked loop, integrated circuit
U5–U7—555 timer, integrated circuit
U8—4066 quad bilateral switch, integrated circuit
U9—4049 inverting hex buffer, integrated circuit
Q1—2N3906 NPN transistor
Q2—IRF511 hexFET transistor
LED1–LED4—Light-emitting diode, any color
D1—1N4002 silicon rectifier diode

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1–R4—1000-ohm
R5–R11—10,000-ohm
R12—4,700-ohm
R13–R16—20,000-ohm potentiometer
R17–R19—200,000-ohm potentiometer

CAPACITORS
C1–C11—0.1-µF, ceramic-disc
C12—0.22-µF, ceramic-disc
C13–C16—2.2-µF, 16-WVDC, electrolytic
C17–C20—1-µF, 16-WVDC, electrolytic
C21–C23—10-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
SOL1—Solenoid lock
Wire, solder, etc.

PARTS LIST FOR THE TONE GENERATOR (Fig. 3)

SEMICONDUCTORS
U1—4011 quad two-input NAND gate, integrated circuit
U2—4017 decade counter/divider, integrated circuit
U3—4066 quad bilateral switch
U4—567 PLL, integrated circuit
U5—LM386 audio power amplifier, integrated circuit
Q1—2N3904 NPN transistor

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—1-megohm
R2—5000-ohm potentiometer
R3–R6—20,000-ohm potentiometer
R7—250,000-ohm potentiometer
R8—10,000-ohm
R9—4,700-ohm
R10—470-ohm

CAPACITORS
C1, C2—0.1-µF, ceramic-disc
C3, C4—2.2-µF, 16-WVDC, electrolytic
C5—1-µF, 16-WVDC, electrolytic
C6—0.22-µF, ceramic-disc
C7, C8—470-µF, 16-WVDC, electrolytic
C9—10-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
SPKR1—8-ohm speaker
Wire, solder, etc.

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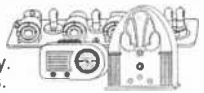

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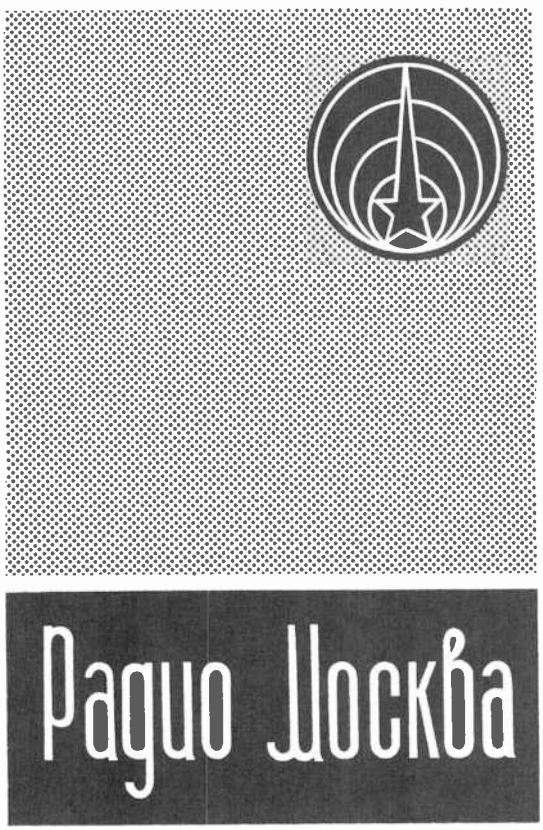
DX LISTENING

By Don Jensen

A Russian Radio Revolution

If Rip Van Winkle had been a shortwave listener who fell asleep listening to Radio Moscow in 1975, what a shock he'd have today, 20 years later. Nowhere, perhaps, have there been as many changes in shortwave broadcasting in the 1900s as in Russia. Gone is all trace of Cold-War-era programming. Also gone, at least to English-speaking listeners, is the old *Radio Moscow* name.



An old QSL card from "Radio Moscow." Today, that station identifies in English as "The Voice of Russia."

Today, Rip would find something much different: a dramatically scaled-back shortwave operation and a station that is no longer the relentless voice of Soviet Communism. Even its World Service identification is different: the *Voice of Russia*.

English SW broadcasting from the old Soviet Union began in 1929, and by the time World War II began, the foreign service easily could be heard worldwide. By the 1980s, Radio Moscow was broadcasting in 80 languages.

The sudden breakup of the USSR, though, left Radio Moscow floundering. It lost its separate identity, being merged into a large, Russian domestic-broadcasting entity. Things went from bad to worse as funding and audience dwindled.

Some semblance of order returned in the fall of 1993, when Russian President Boris Yeltsin restored separate broadcasting status to what was renamed *Radio Moscow International*. Its assigned mission is to serve as an informational link between Russia and other nations worldwide. Solid funding was promised, but, so far, has been lacking.

Radio Moscow International's staff has shrunk drastically with its funding. Russia's foreign SW service has been cut to 46 languages, and a number of those are threatened by the financial problems. Twenty-eight frequency-hours of English programming now are aired daily.

Radio Moscow International leases air time on 200 shortwave transmitters from the Russian Ministry of Communications, but there it must compete with other world broadcasters, including some of its Cold-War adversaries, which are also renting SW air time.

Also, some transmitters used during the Soviet Era have been taken over by the new governments of the Commonwealth of Independent States, regions once part of the USSR. According to information in the World DX Club's "Contact" newsletter, Radio Moscow International has lost transmitter access completely in such places as the Ukraine, Kazakhstan, and Lithuania. Some are being used by those newly independent states themselves to air their own programming; at least 75 frequency-hours daily in 31 languages.

With Russian government underfunding, the station is seeking revenues where it can. One department that is making money is Air Digest, an SW monitoring service comparable to the British Broadcasting Corporation's Monitoring Service.

Like BBCMS, Air Digest tunes in worldwide SW broadcasts, transcribing and digesting news and commentaries logged. Established in 1939, the monitoring branch originally reported only to the Communist regime. Now, though, Air Digest's summary of monitored programs is sold to the news media in Russia and elsewhere.

The English-language programs of RMI's Voice of Russia World Service do still reflect the position of the Russian government, and particularly, the Foreign Ministry. But the station vows to objectively present other viewpoints as well.

Despite its problems, Radio Moscow International

still airs 156 program hours of broadcasting daily. It surely has lost listenership since its glory days. But with an estimated audience of 100 million in 160 countries, the Russian broadcaster still is one of the top five listened-to shortwave stations in the world.

At this writing, I find the Voice of Russia World Service easy to hear at about 0200 UTC (which is equivalent to 10 p.m. Eastern Daylight Time) on 7,105 kHz. But the station is notorious for changing frequencies on short notice. *Passport To World Band Radio*, the reliable SW-reference annual, suggests that during the summer season, listeners check frequencies such as 9,530, 9,750, 9,765, 11,750, 11,805, 12,050, 15,410, or 15,425 kHz.

You might want to write or Fax for the Voice of Russia's World Service current schedule. The address is Radio Moscow International, u1. Pyatnikskaya 25, 113326 Moscow, Russia. Its international Fax number is 7-095-230-2828.

IN THE MAIL

"When is a good time to tune *Kol Israel* these days?" writes Dan Silverstein, New York City.

As I write this, Dan, the proposed reduction in funding of Israel's foreign broadcasts has been at least postponed. But nonetheless, there have been some cuts in English-language programming. For now, I suggest you look for Kol Israel in English at 0500 UTC on 7,465, 9,435, or 17,545 kHz. Or tune at 2000 UTC on 9,435, 11,603, or 17,575 kHz.

The next letter this month is from a shy reader in Churchbridge, Sask., Canada, who is looking for answers but has asked for anonymity. "I'm a newcomer to SW," he writes, "and in just a few days, I've logged a number of stations. But I've some questions too. What SW stations have comedy programs? And what stations play country music?"

Welcome to the world of SWLing, Mr. X. You ask some interesting questions! When it comes to humor on SW, the offerings are pretty slim. But, over the years, it seems to me that the best funnybones belong to your own country's *Radio Canada International*, as well as the *British Broadcasting Corp.*

I suggest you contact them for current program information on specific shows, times and frequencies. RCI's address is P.O. Box 6000, Montreal, Quebec H3C 3A8, Canada. The Fax number is 514-284-0891. The BBC's New York address for inquiries is 630 Fifth Avenue, New York, NY 10020. Their Fax is 212-245-0565.

As for country music, curiously, American country music seems to be popular in, of all places, Papua New Guinea, although the stations of that Pacific nation's *National Broadcasting Commission* network might be difficult to hear over here. Pre-dawn, though, you might try for the NBC National programming on 9,675 kHz. Good Luck!

Next, we hear from a new old-timer who has returned to shortwave listening. Richard Madison of Ashtabula, OH, writes that back in his early teens, he avidly listened to SW radio. "A big old Hallicrafters 10-tube monster brought me uncounted hours of enjoyment and wonder," he recalls.

Then came a stint in the Navy, followed by college, marriage, and a career. His SWL hobby was put on hold for a long time. But then, 20-some years later, Richard says, he rediscovered shortwave.

"Trolling the airwaves again for only two months, the old spark is back. It's just as neat finding a new station now as it was when I was 15! Speaking of which, when I was 15, I was an avid reader of **Popular Electronics** magazine. So I purposely picked up the March 1995 issue to check out the shortwave column. Interesting topics, good writing, and just never enough for the avid reader."

Richard sent along some of his loggings for our "Down the Dial" section. Some of them, he says, he hasn't heard for a couple of decades. "And more will follow," he promises.

If you have some loggings that you would like to report as well, feel free to send them to us at *DX Listening*, **Popular Electronics**, 500-B Bi-County Boulevard, Farmingdale, NY 11735.

DOWN THE DIAL

Here are some of Richard's loggings:

COSTA RICA—9,400 kHz. *Radio for Peace International* operates in English on this channel in the upper-sideband mode. It was noted at 2250 UTC with environmental news.

EGYPT—12,050 kHz. *Radio Cairo* was heard at 2000 UTC with a news program, mostly in Arabic but with some English too.

SLOVAKIA—5,930 kHz. *Radio Slovakia International* was logged with European news in English at 0110 UTC.

TAIWAN—4,875 kHz. *Voice of Free China* was heard on this frequency and also on 5,810 kHz at 2230 UTC with the program, "Let's Learn Chinese." ■

By Joseph J. Carr, K4IPV

Dynamic Receiver Specifications

Last month we looked at selectivity, one of the primary receiver specifications. But, as important as that specification is when buying, building, or designing a receiver, it is not necessarily the most important one. Somewhat more important than selectivity and sensitivity (the other static measure of performance) are the dynamic measures of receiver performance. This month, we will look at two of those specifications, 1-dB compression point and third-order intercept point, and why they are important.

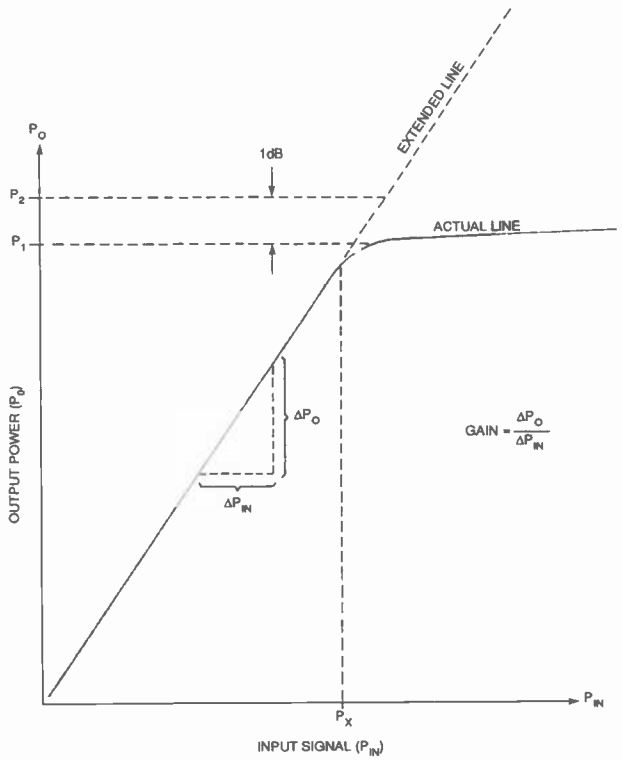


Fig. 1. The 1-dB compression point is the output level at which the theoretical gain exceeds the actual gain by 1 dB.

OVERLOAD PROBLEMS

At one time, we didn't need to be concerned about dynamic specifications, but today the bands are crowded, and there are far more local sources of interference than ever before. If you build a poor 40-meter receiver, for example, it will see a huge amount of signal energy in the front-end, and its performance will deteriorate badly.

You might even begin to see signals that aren't even there. One amateur operator in England reported that he was told by another 2-meter station that he was bleeding all over the band. That's a real serious issue, and it could indicate that one or more stages of the transmitter are in spurious oscillation, producing illegal signals that clobber others. On a hunch, the "G-land" ham asked the other fellow to describe his receiver situation. The fellow was using a cheap rig with two (count 'em two!) broadband preamplifiers ahead of the antenna input. That receiver was generating internal spurious signals; the transmitting amateur was perfectly clean!

I can recall an event a number of years ago when I repaired medical equipment at a university hospital. Heart patients who were no longer in critical condition were sent to a unit where the electrocardiograph (ECG) monitoring was in the form of VHF radio telemetry, rather than hard wiring. One night, at about 3 a.m., the nurse called me at home, claiming that the ECG from one patient was coming in on both his own and another patient's channel. Not quite believing her, I went into work and set about finding the cause.

In the telemetry set up, each patient was equipped with a 4-milliwatt transmitter that was frequency modulated with the patient's ECG waveform. At the nurses' station, the VHF single-channel receivers were racked together in a console. The outputs of those receivers went to a multichannel oscilloscope where the waveforms were displayed.

The problem was in the antenna system. Situated throughout the area were several 60-dB broadband amplifiers hidden above the false ceiling; each amplifier was connected to a 17-inch whip antenna that hung down from the false ceiling. One of the amplifiers and its antenna was immediately above the console where the receivers were located.

On the night shift, unless someone "codes" (has a heart attack and needs resuscitation), monitoring those displays gets pretty boring. The night nurse was in the habit of bringing in an FM-broadcast radio receiver. She would set it on the console, and extend the whip antenna for best reception. That antenna was only a few inches from the 17-inch whip antenna for the telemetry system.

So how does that cause a problem? Well, the FM radio has a local oscillator inside. That local oscillator (LO) runs 10.7-MHz higher than the frequency being tuned, so for an FM radio it tunes 98.7 MHz to 118.7 MHz. Because the radio was a "cheapie," the LO radiated through the antenna, overloading the receiver and creating intermodulation

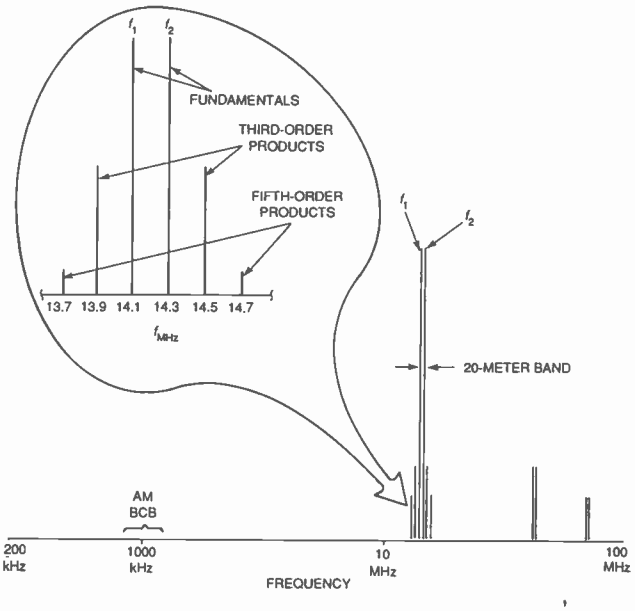


Fig. 2. The third-order intermodulation products for 14.1-and 14.3-MHz signals fall within the 20-meter amateur band and could interfere with a signal that you want to monitor.

products in the receiver.

Because of the particular station that the radio was tuned to, and the particular frequencies that the ECG transmitters were tuned to, they combined in the cheap, TV-master-antenna type of amplifier used for broadband amp and produced new frequencies, and one of those caused the output of one patient's ECG to appear in the channel of the other. Turning off the FM radio, or retuning it to a different channel, returned everything to normal.

In any event, the dynamic specifications of receiver performance are the parameters that tell us something of how the receiver will perform when strong signals are present in the front end. Let's now look at our two specifications, how they relate, and what they tell us about a receiver's performance.

1-DB COMPRESSION POINT

The transfer function for a receiver front-end is shown in the graph of Fig. 1. It displays output power level (P_O) as a function of input signal level (P_{In}). If the receiver or front-end amplifier was ideal, then there would be no limit to output level. The transfer function would continue upwards as shown by the dashed "extended line." But real amplifiers and receivers begin to saturate at some input signal level point (P_X), beyond which no further output is realized from continued increases in input power.

The 1-dB compression point is the output level at which the actual gain departs from the theoretical gain by 1 dB (*e.g.* a 3-dB increase in input signal produces only a 2-dB increase in output signal level).

THIRD-ORDER INTERCEPT POINT

The third-order intercept point (TOIP) is a direct measure of how well the receiver handles overloading signals. I suspect that it's in the area of TOIP that the telemetry receivers discussed earlier failed. When two strong signals combine in the front-end of a receiver or a preamplifier, intermodulation products might be produced if the amplifier is overloaded. If the applied fundamental signals are *f*1 and *f*2, the second-order products are *f*1 ± *f*2, the third-order products are 2*f*1 ± *f*2 and 2 *f*2 ± *f*1, and the fifth-order products are 3*f*1 ± 2*f*2 and 3*f*2 ± 2*f*1. Of those, the third-order products are of most interest to us because the second-order products tend to be too far outside the passband to be a problem, and the fifth-order are usually too small in amplitude to be a problem.

Some of the third-order products fall very close to the passband of the receiver, and in some cases might fall directly on the passband of a signal you want to monitor. Figure 2 shows an example from the 20-meter ham band where a 14.1-MHz signal (*f*1) and 14.3-MHz signal (*f*2) are combined. The close-in products include 13.7 MHz, 13.9 MHz, 14.5 MHz, and 14.9 MHz (that's why good front-end filtering is needed in receivers).

The graph in Fig. 3 shows what happens when the front-end is overloaded. The third-order output products increase at a faster rate than the fundamental outputs. Both saturate, but we can extend their "ideal" gain lines above the saturation point. Because those two lines have different slopes, they eventually intersect at the TOIP.

When shopping for a receiver, look for as high a TOIP as possible. The TOIP is measured in dBm (decibels relative to 1 mW dissipated in a 50-ohm resistive load). A specification of +5 dBm to +15 dBm is excellent, while anything greater than +15 dBm is superb. Receivers with a TOIP of −5 dBm to +5 dBm are less preferable. A unit with a TOIP lower than −5 dBm is to be shunned. ■

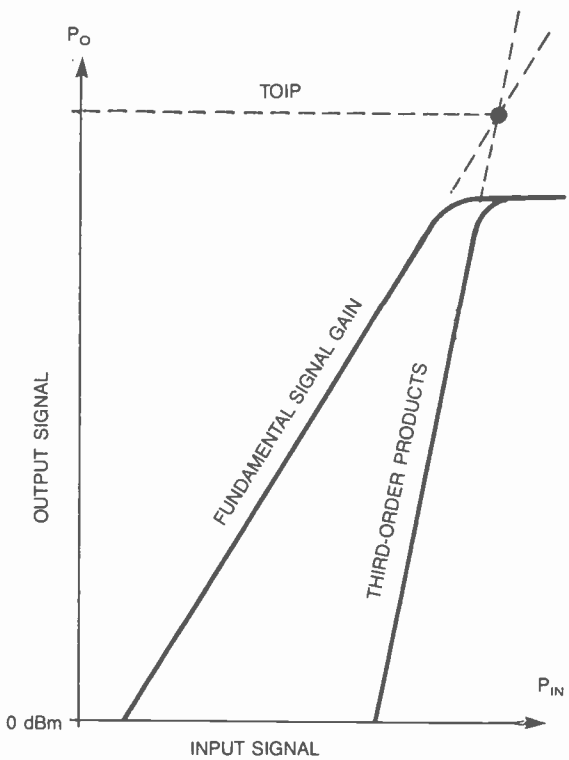


Fig. 3. The third-order intercept point is the point where the gain of the fundamental signal and its third-order product intersect.

SCANNER SCENE

By Marc Saxon

Banishing "Nightmare" Signals

Don't let me hear you say that there aren't any innovative high-tech items on the market for VHF communications buffs like us! What about the *Optoelectronics Scout*? It's the first handheld device intended solely to detect radio transmitters in the near field.

Take your scanning activities into the high-tech age with the Optoelectronics Scout, which can automatically detect radio transmitters in the near field and can download those frequencies into a computer.

Intended for security, surveillance, law enforcement, and hobbyist monitoring markets, the Scout automatically detects and records 200 unique frequencies and up to 250 repeat hits on any that it previously recorded. When used with a miniature antenna, it will fit into your pocket, operate automatically, and signal you (with a page or vibration) when a frequency is recorded.

After a frequency is recorded on the Scout, the frequency can be downloaded into computer software using an optional TTL to RS-232C interface converter. To monitor those frequencies recorded, certain scanners (such as the Radio Shack 2005/2006 and PRO-2035, and the Icom R7000 or R7100) can be connected to the Scout and tuned to each recorded frequency in recall mode.

In drive-by mode, the built-in pager signals with a double beep when the Scout records a new frequency. A single beep indicates a hit on a previously recorded frequency. Operation is completely automatic and hands-free; it requires no attention from the operator. A vehicle driver is not distracted, but can continue to monitor its operation through the audible beeps.

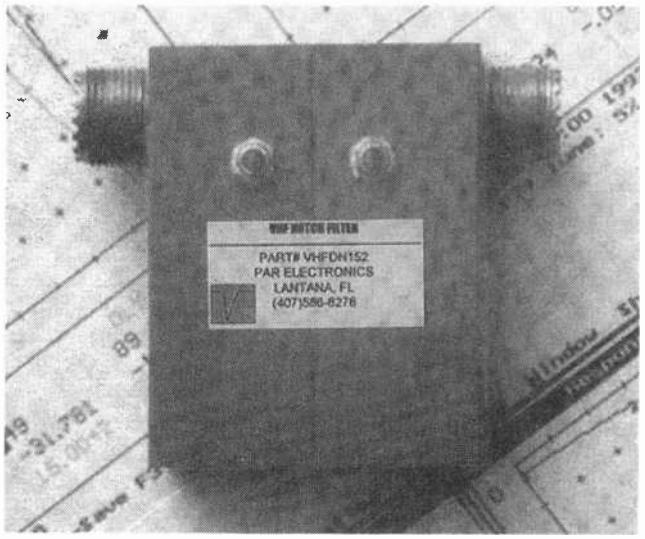
To distinguish active frequencies from background noise, a special digital filter/capture technology was developed by the manufacturer. The beeper and LCD backlight activate when you turn the unit on, but the backlight shuts itself off to conserve power. When a frequency comes through, the LCD comes on again for ten seconds. You get more than six hours of operating time from a one-hour battery charge, or you can power the unit from a vehicle cigarette-lighter plug.

The basic Scout, with its charger and PC-compatible utilities, sells for approximately $400. There are optional accessories available, too, from Optoelectronics, Inc., 5821 N.E. 14th Avenue, Ft. Lauderdale, FL 33334; Tel. 305-771-2050.

GOBBLEDYGOOK?

One of the more popular complaints heard from scanner users relates to strange, unearthly sounding tones superimposed on a desired signal, or hearing those odd sounds mixing with known stations on frequencies where they don't belong. In one example, the weird tones mixed with police transmissions received on 128-MHz aeronautical channels. Readers write in to ask about stopping the "gobbledygook," or "nightmare" signals.

In the VHF spectrum, the biggest offenders are the high-powered, non-voice, radio-paging beeper services operating between 152 and 153 MHz. Those signals consist of tones. When the antenna input of



The VHFDN153 from PAR Electronics minimizes "nightmare" signals caused by beeper services operating between 152 and 153 MHz.

a scanner is overloaded by signals that are too strong to be linearly amplified, the result is interference known as intermodulation distortion, or "intermod."

One effective approach is to sharply reduce the clout of incoming signals in the 152–153-MHz portion of the spectrum. A special dual-stage filter, the *VHFDN153*, can be easily installed in a scanner's antenna lead-in to cut the strength (only) of those 152–153-MHz signals up to 50 dB. It uses UHF connectors. The VHFDN153 costs $62 plus shipping, and is available from PAR Electronics, 6869 Bayshore Drive, Lantana, FL 33562; Tel. 407-586-8278.

BETTER LATE THAN NEVER

In the aftermath of the Exxon Valdez environmental disaster, the U.S. Coast Guard has now designated VHF-FM channel 11 (156.55) as its dedicated and mandatory Vessel Traffic Services (VTS) channel for Prince William Sound, around Valdez, Alaska. VTS is an advisory communications service to coordinate the movements of large vessels and prevent collisions in large, busy port areas. Vessels report, by voice, information related to position, navigation, and conditions affecting their ability to navigate. The Coast Guard uses that information to track all of the vessels.

Other active U.S. Coast Guard VTS channels include 156.25 and 156.70 MHz in Seattle, Washington; 156.55, 156.60, and 156.70 MHz in New York City; and 156.55 and 156.60 MHz in Houston, Texas.

SCANNER TIP

Matt Tucker, of Escondido, California, passed along a tip that he found useful. He observed that handheld scanners are fine, but that their tiny speakers don't always sound so great. Often, static comes in better than the human voice. He suggests, if you listen at home, that you try using your stereo speaker for sound by running a shielded cable between an eight-inch plug and a male RCA plug. The low-output impedance of the headphone jack should work well for that application.

The audio is even harder to hear in a moving car, so use your car's speakers if you have a cassette player. The cassette adapters made for listening to portable CD players in a car will do fine. Plug the eight-inch connector into the headphone jack and put the "cassette" into your player. The adapters are readily available from Radio Shack and other sources.

The audio level of both the scanner and the stereo will need to be adjusted for optimum sound in either setup. If you have a good-quality, aftermarket audio amplifier in your car, Matt says to remember that its pulse with modulated power supplies can cause interference to a scanner if you are using an antenna located inside the vehicle. However, the 30- to 60-kHz, switching power supplies of the amps normally have no effect, he reports, if the antenna is placed outside of the car.

We remind readers that stereo speakers are designed to reproduce a wider range of the audio spectrum than those specifically designed for maximum two-way radio voice communication readability. Stereo speakers might be an improvement over what's in a handheld, but for home use, you still might do better by buying an inexpensive communications speaker, which is available from many mail-order and local sources.

Well, that's it for now. But remember, we depend on you for questions, ideas, frequencies, and scanner-related news clippings. Write to *Scanner Scene*, **Popular Electronics**, 500-B Bi-County Boulevard, Farmingdale, NY 11735. ■

ELECTRONICS LIBRARY

Auto Audio: Choosing, Installing & Maintaining Car Stereo Systems

by Andrew Yoder

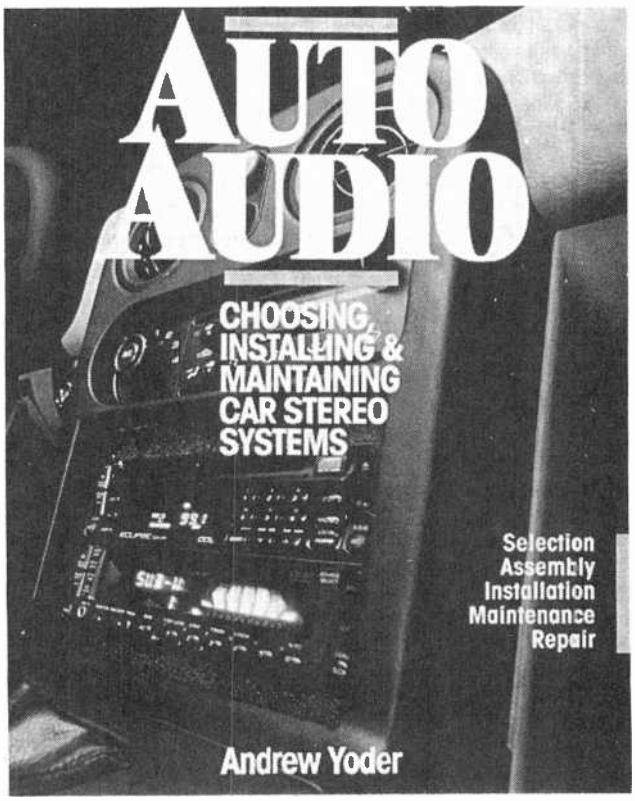
Today's automotive audio gear is light-years ahead of what was available in the 1980s, thanks to recent advances in technology. Those same advances, however, have lead to a mind-boggling selection of components that make shopping a confusing proposition.

This information-filled book contains practical, straight-forward advice not only on how to select the components that will make up your car-stereo system, but also on how to install, maintain, and repair those components. Everything is presented in terms that the layman can understand.

The book begins with a look at how to determine what sort of audio system best suits your individual needs. Next, it covers installation procedures, with tips on soldering, grounding, making electrical connections, and running cables. The book goes on to provide tips on identifying and locating problems and making simple repairs. Separate chapters are devoted to detailed discussions of amplifiers; speakers and speaker enclosures; filters and crossovers; antennas; and wire, cabling, connectors, and transmission systems. Technological breakthroughs in CD players, MiniDisc changers, DCC decks, and shortwave radio are discussed, and the names and addresses of equipment sources are listed.

Auto Audio costs $24.95 and is published by McGraw-Hill Book Company, 11 West 19th Street, New York, NY 10011; Tel. 800-2-MCGRAW.

CIRCLE 90 ON FREE INFORMATION CARD



PROTECTION AND SECURITY ON THE INFORMATION SUPERHIGHWAY

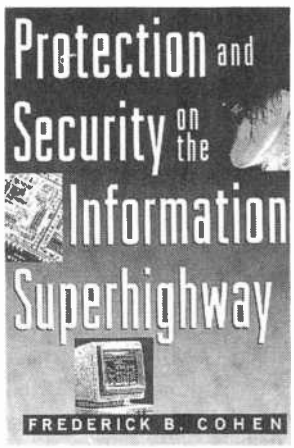
by Frederick B. Cohen

In February, computer hacker Kevin Mitnick was arrested and charged with two federal crimes: illegal use of a telephone access device and computer fraud. He faces a possible 35 years in prison and $500,000 in fines—half the amount of money that he stole from the Digital Equipment Corporation in 1988.

His crime spree is just one example of how hackers and phreakers (phone hackers) are costing Americans $5 billion each year. A growing force of "cyberthugs" destroy computer systems, retrieve classified information, and gain access to credit-card numbers for fun and personal gain. Each year there are an estimated 900 million security attacks on the Internet.

This book exposes the risks you and your company face by being online, and explains how to protect a business' information assets. It explores the entire information superhighway, including the Internet, cable television, microwave and satellite communications, electronic banking, and investing.

The book offers practical solutions based on real-world case



studies. It helps networkers recognize their level of dependency on computerized systems and the weakness of their computing infrastructure. It then shows them how they can protect themselves from outside security breaches by making information security a top priority.

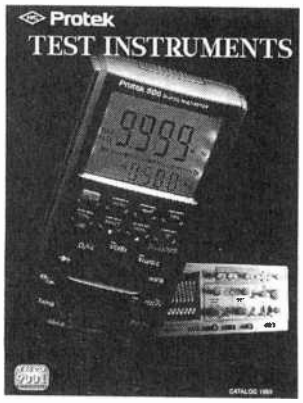
Protection and Security on the Information Superhighway costs $24.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-CALL-WILEY.

CIRCLE 91 ON FREE INFORMATION CARD

TEST INSTRUMENTS CATALOG

from HC Protek

The latest catalog from HC Protek features more than 70 test instruments and



accessories, including digital storage scopes, function generators, analog meters, and multifunctional digital multimeters. Its 44 pages also include easy reference selection guides for choosing the proper test gear. It offers expanded specifications data for all products, as well as an updated index that cross references page location to items.

The Test Instruments catalog is free upon request from HC Protek, 154 Veterans Drive, Northvale, NJ 07647; Tel. 201-767-7242; Fax: 201-767-7343.

CIRCLE 92 ON FREE INFORMATION CARD

THE ARRL ANTENNA COMPENDIUM: Volume 4

edited by R. Dean Straw, N6BV

The fourth book in this popular series contains 38 articles covering a wide range of antenna topics, from simple, practical antenna projects to heavy-duty, theoretical treatments of complex arrays (including some huge arrays). Articles for mobile work include an interactive computer program to analyze all the compromises necessary to make a short mobile whip work on HF, as well as detailed theoretical treatments of the subject and a section on portable or temporary antennas.

The book also offers six articles on modeling by computer that will help the novice avoid common traps and pitfalls. One article describes the history of the "Method of Moments" modeling technique, and another revisits the quad-vs.-Yagi controversy, with detailed computer models.

Because of its focus on computer modeling, Volume 4 is the first in the series to include a 3.5-inch diskette. The disk contains the source data files and the resulting antenna-pattern display program (PLOT) files created by the authors to model their antennas. It also includes a PLOT program to view the pattern plots. The program lets you change from polar to rectangular presentations, zoom them, overlay other patterns for instant on-screen comparison, and print out the patterns. The data files can be used with widely available commercial modeling software.

The ARRL Antenna Compendium: Volume 4 costs $20 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111; Tel. 203-666-1541; Fax: 203-665-7531.

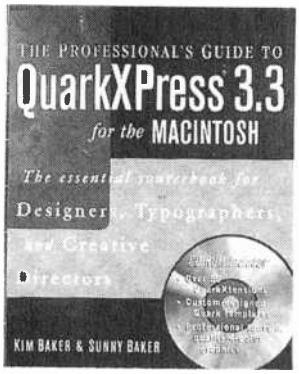
CIRCLE 93 ON FREE INFORMATION CARD

THE PROFESSIONAL'S GUIDE TO QUARKXPRESS 3.3 FOR THE MACINTOSH

by Kim Baker & Sunny Baker

Many graphics professionals have made QuarkXpress their program of choice for designing page layouts for books, magazines, catalogs, and brochures. The program can be used to create black-and-white, four-color, and even more complex printed material.

This book/CD-ROM package shows artists, typographers, designers, and all desktop-publishing professionals how to get the most out of QuarkXpress when designing sophisticated printed materials. Aimed at intermediate and advanced users, the book offers a wealth of practical guidelines, as well as tips and tricks of the trade, for using QuarkXpress and a Macintosh computer to design page layouts and manipulate fonts; work with four-color graphics; prepare pre-press work; use Xtensions to add features to QuarkXpress;



and setup and manage a successful desktop-publishing business. The included CD-ROM provides users with more than 50 QuarkXtensions—all fully functional, with professional fonts, templates, and high-quality graphics—along with an interactive Xtensions catalog.

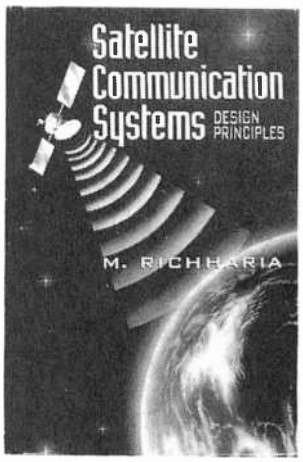
The Professional's Guide to QuarkXpress 3.3 for the Macintosh costs $39.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-CALL-WILEY.

CIRCLE 94 ON FREE INFORMATION CARD

SATELLITE COMMUNICATION SYSTEMS: Design Principles

by M. Richharia

This up-to-the-minute guide offers an in-depth treatment of the elements and components that make up satellite communication systems, including geosynchronous satellites used in global mobile communications. With an emphasis on the fundamentals of design rather than the particulars of specific systems, the book avoids long mathematical derivations in favor of practical design concepts, guidelines, and models. It focuses on the issues involved in the design of satellite communications systems, shows the relationship of different elements to the



overall system, and provides step-by-step explanations of the principles and methods of system design.

After providing an overview of the field, the book examines such topics as radio-link design, the basics of satellite orbits, baseband signal and multiplexing techniques, and multiple access techniques. In addition, it describes earth-station system design and spacecraft technology, and suggests some likely trends for the future of satellite communications. Dozens of practical examples, useful references, and helpful orbit-related formulas supplement the discussions.

Satellite Communication Systems: Design Principles costs $55 and is published by McGraw-Hill Book Company, 11 West 19th Street, New York, NY 10011; Tel. 800-2-MCGRAW. ■

CIRCLE 95 ON FREE INFORMATION CARD

"Very nice, but it will work a lot better if you use a little solder next time."

CIRCUIT CIRCUS

(Continued from page 76)

tones played in the sequence that they were set in.

Now you're ready to use one of the record/playback circuits described in last month's column. Position the speaker of the tone generator so that it faces the microphone of the record/playback unit, at a distance of about six inches. Set the record/playback unit to record, and in about two seconds, turn S1 of the tone generator from RESET to RUN. When the final tone ceases to play, stop the recorder. Then play back what you recorded to make sure all four tones are heard.

Now, take a look again at the tone-controlled-lock circuit in Fig. 2. Setting the tone frequencies for that circuit is easy. Connect a frequency counter to pin 5 of each 567 chip (U1–U4) and adjust each 20,000-ohm potentiometer (R13–R16). Match each tone frequency in the lock circuit with its corresponding one in the tone generator. Make sure that the tone frequency set by R3 in the tone generator matches the one set by R13 of the lock, and so on (R4 matches R14, R5 matches R15, and R6 matches R16).

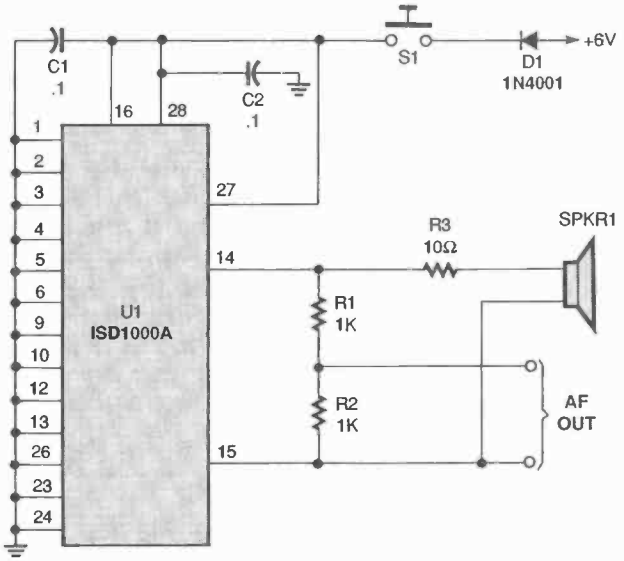


Fig. 4. After your security tones are recorded onto the ISD1000A, plug the chip into this circuit and use it to feed the tones to the lock in Fig. 2.

PARTS LIST FOR THE TONE ENCODER (Fig. 4)

U1—ISD1000A voice record/playback, integrated circuit
D1—1N4001 silicon rectifier diode
R1, R2—1000-ohm, ¼-watt, 5% resistor
R3—10-ohm, ¼-watt 5% resistor
C1, C2—0.1-μF, ceramic-disc capacitor
S1—Pushbutton switch, normally open
SPKR1—8-ohm speaker
Wire, solder, etc.

TONE ENCODER

Our last circuit, the tone encoder shown in Fig. 4, will let you unlock the tone-controlled lock shown back in Fig. 2. Note that the ISD1000A shown for U1 is the same chip that you used earlier to record the four tones. Just transfer that chip to this circuit. The tone encoder produces both an acoustical and a direct electrical output so that you can monitor the signal through SPKR1 while the encoder drives the lock's input circuitry.

To connect the tone encoder to the lock circuit, you will need to attach a connector to the AF output points of the encoder. Any type of connector can be used; just make sure that you have a cable that matches both the tone encoder's connector and the connector attached to the AF input points of the lock.

When the two circuits are connected, all you have to do is hold down pushbutton-switch S1 for the duration of the four tones. After the sequence of tones finishes playing, the lock will open.

Well, that's all for this month. Be sure to join us next month for another *Circus* full of projects for you to build and enjoy. Until then, good luck with all of your circuitry. ■

"Don't worry! We'll be fine as soon as I find a place to plug this in!"

CRYSTAL OSCILLATORS

(Continued from page 64)

7400 package, so there will be a free NAND gate for use elsewhere in the circuit if the oscillator is built.

Some crystals don't "like" to work with the circuit shown in Fig. 11. The author has experienced some difficulty making them work properly at higher frequencies (over about 10 MHz). If you want a very stable TTL-clock frequency, or experience reliable-start problems, then it might be better to use one of the other fundamental-mode circuits and then convert the signal to TTL with a voltage comparator that has a TTL output. For example, you can use an LM311 with a 2700-ohm pull-up resistor and +5-volt DC supply, a 4050B or 4049B CMOS operated at +5 volts, or a TTL Schmitt trigger chip.

You should find that the crystal oscillators in this article are relatively easy to build, and "well-behaved" for the most part. The circuits provide a superior way to produce stable, accurate RF frequencies. ■

DELTA-WYE PROGRAM

(Continued from page 66)

2 selection at the Main Menu, the program jumps to line 1470, the beginning of the code that performs the wye-to-delta conversion. Finally, if selection 1 is requested the program merely falls through to the code beginning at line 1320, the delta-to-wye conversion section.

Both of the conversion sections of the program, the delta-to-wye section (lines 1320–1440) and the wye-to-delta section (lines 1470–1590), have the same basic structure. They both begin by clearing the lower quarter of the screen via a subroutine call to line 1690. Next, the values of the three known resistors are entered using the input subroutine beginning at line 1610. Finally, the output resistor values are calculated and then displayed.

```
TEST RUN #1

Would you like to:
   1. Convert from DELTA to WYE
   2. Convert from WYE to DELTA
   3. Exit the program
Your Choice: 1


Enter the value of Ra.
Value (Ohms):  6409.6

Enter the value of Rb.
Value (Ohms):  13353.33

Enter the value of Rc.
Value (Ohms):  4552.273


R1 =  1200  ohms.
R2 =  2500  ohms.
R3 =  3520  ohms.

Press any key to continue...


TEST RUN #2

Would you like to:
   1. Convert from DELTA to WYE
   2. Convert from WYE to DELTA
   3. Exit the program
Your Choice: 2

Enter the value of R1.
Value (Ohms):  1200


Enter the value of R2.
Value (Ohms):  2500

Enter the value of R3.
Value (Ohms):  3520


Ra =  6409.6  ohms.
Rb =  13353.33 ohms.
Rc =  4552.273 ohms.

Press any key to continue...

Would you like to:
   1. Convert from DELTA to WYE
   2. Convert from WYE to DELTA
   3. Exit the program
Your Choice: 3
```

Fig. 2. Once the program is entered, duplicate the two test runs shown here to make sure everything is working properly.

Testing And Using DELTA-Y.BAS. The best way to test your version of the program is by parroting the two test runs given in Fig. 2. The first run calculates a delta-to-wye conversion based on the input data R_A = 6409.6, R_B = 13353.33, and R_C = 4552.273. The second test run then proceeds to perform a wye-to-delta conversion based on the output of the first run. As you would expect, the final outputs are the three resistor values listed above.

If the values generated by your version of the program do not match those shown in Fig. 2, check to see that you entered the program correctly. Often times it helps to run a printed version of your copy and then compare it to Listing 1 one line at a time. Correct any typos that you find and then re-test the program. ■

REFLEX RADIO

(Continued from page 42)

transformer to the second stage. The reflex RF stage used untuned RF transformers on the input and output so that only two tuning capacitors were required, one on the loop antenna and one on the output of the first RF amplifier. The reflex stage amplified the AF-detector output and the final AF stage drove a horn loudspeaker that was mounted below the set itself. The set, speaker, and batteries were all self-contained in an attractive table-top cabinet.

The Last Days. The reflex circuit was popular while tubes and the storage batteries for filament power were expensive, but the five-tube TRF receivers soon replaced them. Even so, the technique continued to be used to save a tube and make a design more affordable. That's why Armstrong and Houck used a single tube for an RF and an IF amplifier in RCA's *AR-812*. It reduced the tube count to six, making that superhet an affordable radio in 1924. ■

DISTORTION BOX

(Continued from page 44)

PARTS LIST FOR THE GUITAR PREAMP/ DISTORTION BOX

RESISTORS

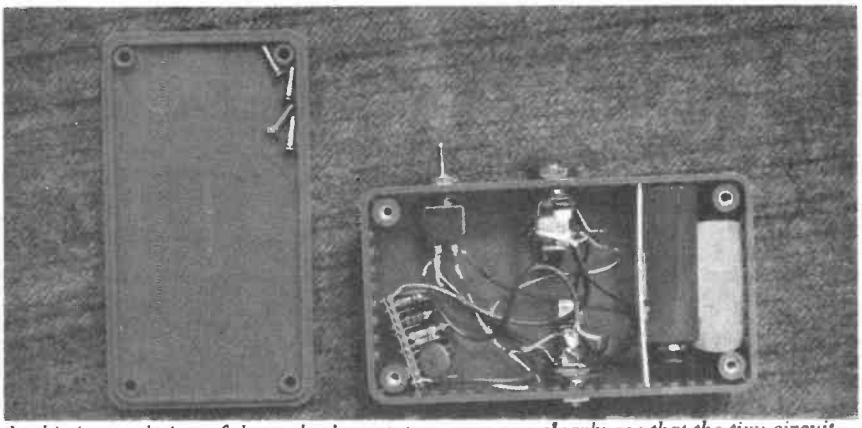
(All resistors are ¼-watt, 5% units.)
R1—1-megohm
R2, R3, R6—100,000-ohm
R4—6200-ohm
R5—470,000-ohm
R7—1000-ohm

CAPACITORS

C1, C2—0.1-μF, ceramic-disc
C3—0.01-μF, ceramic-disc
C4—4.7-μF, tantalum

ADDITIONAL PARTS AND MATERIALS

Q1—2N5088 NPN low-noise transistor
Q2, Q3—2N3906 PNP general-purpose transistor
J1, J2—¼-inch phone jack
S1—DPDT panel-mounted toggle switch
B1—9-volt battery
Printed-circuit materials, project enclosure (see text), shielded audio cable, wire, solder, hardware, etc.



In this internal view of the author's prototype, you can clearly see that the tiny circuit board takes up very little space. Mostly, it's the off-board wiring that could fill the case. Note that the prototype circuit was built on perfboard.

open string, turn the unit on and off a few times. The changeover should be smooth and quiet, and the volume in both states should be similar.

If you've gotten this far, you're ready to rock and roll (or whatever it is you do with those strings). But first, you'll have to secure the printed-circuit board to the case. You could use several methods to accomplish that; in the author's prototype, the board was mounted to the project case using a dab of silicone caulk. If you wish to do the same, make sure to work in a well-ventilated area. Also, don't put the lid on the enclosure until about 24 hours after you apply the caulk; while the caulk is curing, it emits fumes that might damage the components.

After using the unit for a while, you might be pleased to find that with your guitar volume turned low the Preamp sounds a bit "tubey," although not distorted. Then, if you turn your guitar higher, it should sound more like a hive full of angry bees. ■

What Do These Prestigious Companies Have In Common?

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

AMP

Electrical/Electronic Connectors, IC Sockets, PCB Switches

AM RAD Engineering, Inc.

Motor Run Capacitors, HID Lighting Capacitors, Power Factor Correction Capacitors

AEP

Miniature and Subminature Coaxial Connectors and Cable Assemblies.

AVX CORPORATION

MLC, Tantalum and Thin Film Capacitors, Resistors, Networks, Integrated Passive Components, Trimmers, Oscillators, Resonators, Filters, Piezo Devices, and Connectors

BERG ELECTRONICS

High Density and Industry Standard Connectors/Subsystems

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COLE FLEX

Tubing, Conduits, Hose, Sleevings, Splices, Insulation and Cable Harness Products, Power Cords and Cordsets

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CII Midtex

Relays and Solenoids

COOPER Bussmann

Fuses, Fuseholders, Fuse Blocks, and Fuse Accessories

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Capacitors-Aluminum Electrolytics, Mica, AC Oil, Film, MICA Paper and Relays

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Dale Electronics, Inc.

Resistors, Networks, Oscillators, Displays, Inductors, Thermistors, Connectors, & Transformers

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Eaton Corporation, Commercial & Military Controls Operation

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KEMET Electronics Corporation

Multilayer Ceramic and Solid Tantalum Capacitors

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Resistors, SMT Tantalum Capacitors Inductors, Resistor Networks, SMT Thermistors

MALLORY

North American Capacitor Company

Tantalums, Aluminums, SonaltertsR Ceramics, Films and AC's

M-tron

Quartz Crystal

Hybrid Oscillators

muRata

Fixed Ceramic Capacitors, Variable Capacitors and Resistors, Crystal Oscillators, Ceramic Filters, Resonators, EMI Filters, Hybrid Circuits and more.

Panasonic Industrial Company

Resistors, Resistor Networks, Ceramic, Film, Electrolytic, Double Layer Capacitors, Potentiometers, Switches, Inductors, Filters, Resonators, Varistors, Thermistors

Philips Components

Philips Electronics North America Corporation

Resistors, Ferrite Components

Alluminum Electrolytic, Film & Ceramic Capacitors

They sell through distributors.

They belong to the E.I.A.

They belong on your vendor list.

Quam

Loudspeakers and Commercial Sound Products

ROHM

Rohm Electronics Division

Resistors, Ceramic Capacitors, Transistors/Diodes, Opto Components and IC's

SELECTA

Switches, Relays, Terminals, Indicator/Pilot Lights, LED Indicators, Test Clips, Test Leads, Cable Ties and Heat Shrinkable Tubing

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Leadership in electronics is not just a matter of designing products better and manufacturing them better, but also of marketing them better. And the sponsors of this message understand that better service to customers requires effectively involving distributors as part of their marketing teams.

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LONG-DELAYED ECHOES

(Continued from page 60)

electrically ducted and even amplified within the earth's magnetosphere, traveling from one hemisphere and polar area to the other.

Cosmic Probes and Repeaters: Could some LDEs, especially the extremely long ones, be of an intelligent nature? The real question is, are there extraterrestrial civilizations in our galaxy that are somehow repeating our signals back to us?

With that speculative interpretation in mind, one possible explanation for the longer and more difficult to explain LDEs is that our solar system is being visited by intelligent visitors from the stars. According to that belief, the visitors send probes to the areas in which they expect to find life. Also expecting to find some form of electromagnetic radiation, they inform the civilization that sent them of our existence by repeating the signals encountered, "phoning home" with a sample of the radio waves. By doing so they also alert us because we can hear their "cosmic repeater" transmissions loud and clear.

Is Something Out There? There is a strong human tendency to explain the unknown in terms of "something out there" being responsible. Usually, that's not the case, as some elaborate hoaxes have shown. But there *could* be something out there, couldn't there? Is it reasonable to assume that of the estimated 10^{22} stars in the universe, our Sun is the only one that has spawned intelligent life on one of its planets? Are we singularly unique, a distinctive cosmic curiosity?

Logic and math are actually on the side of our having company in the universe, if we take stock in the so-called "Green Bank Equation." That equation, devised by astrophysicist F. D. Drake, attempts to estimate the number of technically advanced civilizations that might be found in our own Milky Way galaxy.

The equation expresses mathematically the relationship of a number of parameters. Those include the number of stars, the number of stars with planetary systems, the number of planets in each system having conditions suitable for developing life, and the number of planets on which life could actually develop. Also included are the number of planets on which intelligent life could evolve, the number of intelligent populations that could develop civilizations capable of interstellar communications, and, finally, the average lifespan of technical civilizations.

Depending on how estimates for various terms in the equation are made (opinions differ wildly), the number of advanced civilizations in our Milky Way alone might well be in the hundreds of thousands. Could at least one of those civilizations be attempting to contact us by sending us signals, LDEs or otherwise? Today, no one knows the answer to that question for sure, so we're still searching.

Many efforts have been undertaken to answer that question in a profoundly significant (but erratically funded) "Search for Extraterrestrial Intelligence," or SETI. Most searching is done by radio astronomers because many large radiotelescopes used as radio-source search instruments are also suited to searching for signals from other civilizations. Those high-powered radiotelescopes convert an astronomical problem to a problem of radio communication over an extremely long transmission path.

Most of that knowledgeable searching is conducted not on HF but in the promising region between wavelengths of 1 millimeter and 30 centimeters. That region forms a sort of "cosmic window" of minimum sky noise and the least absorption to let signals get through from deep space. Special focus in the search has been on the 21-centimeter (1420 MHz) natural-line-emission of hydrogen, the most abundant element in the universe and thus considered by many to be the best wavelength to use in the search. Various paper studies, proposals, and actual SETI listening projects have been undertaken over the years. Those include Cyclops, Argus-Big Ear, META, SERENDIP III, Ozma, Phoenix, and others. With all the searches, however, nothing unusual has been discovered.

So what's the bottom line on LDEs? Are they exclusively terrestrial, or is there an extraterrestrial connection? The jury is still out on that one, and we might have to wait a long time for the verdict. ■

SCOPE CALIBRATOR

(Continued from page 46)

checked with any good-quality digital multimeter. Temporarily connect a jumper from the junction of R1 and D1 to ground. That will hold the calibrator output at exactly 1-volt DC. Check to make sure that is so.

To check the output frequency, you could use a digital frequency counter, but there is another very accurate method you can try. Acquire an audio-test CD and use the 1-kHz sine-wave track as a frequency standard. With the calibrator output connected to one channel of the stereo, and the CD playing on the other channel, adjust the calibrator frequency for a near-zero audible-beat frequency. That process of sound-matching is familiar to anyone who's used a piano or guitar tuner.

Using The Calibrator. A scope's vertical amplifier gain can be checked by using the 1-volt-DC height of the Calibrator squarewave and comparing it with the vertical display graticule. The time base can be checked by comparing the 1-millisecond cycle time for the squarewave against the horizontal display graticule.

It's also easy to check passive, high-impedance scope probes (×10, ×100) against the Calibrator's squarewave output. Because the Calibrator rise time is very fast, any distortion in the waveform is due to a mismatch of probe compensation. The compensation should be adjusted until the squarewave is restored on the scope's display. ■

"It's an emergency. The battery in my TV remote control died."

PC SERVICE

(Continued from page 50)

"set blaster" line, the key to having sound in nearly any game imaginable, configures the Sound Blaster portion of the card according to your system.

The SoundMan Wave card has four jacks on the back: Microphone, Line In, Line Out, and Speaker. The microphone jack is, of course, for connecting a microphone. If you have an internal CD-ROM, the Line-In jack is not really needed. Instead, the CD-ROM drive will have either a three- or four-pin audio line-out connector on the back that connects internally to a three- or four-pin audio line-in connector on the sound card. Finding the right cable for that can be difficult if the equipment didn't come together in one package. Fortunately you can make them yourself with shielded cable if you can find the right connectors.

With an external CD-ROM drive like the Reno, the Line In jack on the back of the sound card connects to a line-out jack on the drive via a shielded cable with a stereo mini plug on each end. The Line Out jack lets you feed the sound card's audio output to a pair of amplified speakers or any other standard stereo equipment. The Speaker jack is the output of a small amplifier built into the sound card. That can drive a pair of unpowered speakers or eliminate the need to use batteries with some speakers that normally need them. Some sound cards don't have as many inputs and outputs as that, making them much less versatile.

Troubleshooting. Okay, you've now installed your CD-ROM and sound card, and hooked up a pair of speakers or headphones. You boot up your computer and (1) it locks up or otherwise performs erratically, (2) your new multimedia gear fails to work, or (3) everything seems fine at first, but either the new equipment or something else installed in the machine fails to operate or locks up after a while. What gives?

Sound cards, CD-ROM controllers, and other peripherals usually require that such things as IRQs, I/O base addresses, and DMAs be set. If those are set improperly, hardware conflicts can develop that cause the new hardware, the old hardware, or both to malfunction. Even with devices that use install software that searches for and selects available IRQs, etc., things can easily go wrong. So let's see what those settings are, and how to fix any conflicts that might occur.

A peripheral needs an interrupt request, or IRQ, so that it can signal the computer when it needs to talk to it. When the interrupt is generated, the computer runs a routine that lets it get data from the device and then return to what it was doing. The I/O base address lets the computer know where in its memory map the device is located. A DMA, or direct memory access, is a channel that allows data to be exchanged between the peripheral and RAM without burdening the CPU.

The key to getting a peripheral to work is to make sure that any selected IRQ, base address, or DMA isn't used by any other device in your computer. Also, it's sometimes necessary that the parameters be set to the same values on the peripheral's jumpers and in software that makes use of them.

If you have a piece of hardware that is acting flaky or not working at all, it is likely that you have an IRQ or other similar conflict. The first step in resolving those conflicts is to document the settings of all other peripherals in your computer. Sometimes a piece of software, such as Microsoft's MSD.EXE (Microsoft Diagnostics) can be helpful in locating conflicts. Other times, cards must be removed so that jumper settings can be noted. Devices that can cause conflicts are mice, sound cards, printers, modems, I/O cards, and more. One possible solution if you're at the end of your rope is to disable some device that you don't use, such as a serial port, if it's conflicting with the new one. But that should be a last resort only. With enough perseverance, you should be able to find happy settings for all of your computer's peripherals. Note that if your machine is particularly "loaded," you might need to change the settings on several peripherals to find a workable combination.

As we're shown, adding multimedia gear is not difficult if you know the pitfalls and how to avoid them. Why not give it a try! ■

TV TRANSMITTER

(Continued from page 39)

able from Ramsey Electronics allows the board to be mounted in the bottom half, and by lifting the top off, still be aligned. That also protects the underside of the board against shorts during alignment. You should inspect the solder side of the board carefully before mounting it in the case.

Alignment. To align the TV Transmitter, you'll need a TV set and a source of video such as a VCR or camcorder. You'll also need a non-metallic tool to adjust coil L4 and transformer T1. A fresh 9-volt battery can be used for alignment, but if you find it difficult to align, try doing it with a 12-volt supply. Note that during alignment and testing, we found that the unit operated much better from 12 volts. If you find the same to be true, it is a simple matter to add an external power jack to the unit and wire it to the appropriate points on the PC board.

Tune a TV set to an unused channel between 2 and 6. The TV must have an indoor antenna connected directly to it; an outdoor antenna or cable won't work. Make sure both potentiometers are in mid-position and apply power to the Transmitter. Adjust L4 with a non-metallic tool until the TV screen goes blank. Then fine-adjust L4 for the "most-blank" picture.

Connect the video and audio outputs from a VCR to jacks J1 and J2 (respectively) of the Transmitter. Then set a tape to play. You should see a picture on the TV screen; if you do, readjust L4 for the best picture; if you don't, check the board for any bad connections. Next, adjust R3 for the best picture brightness and R7 for the best overall picture. You might have to make another minor adjustment to L4 after R3 and R7 are set. Finally, adjust T1 with a non-metallic tool for the best-sounding audio. That's all there is to it.

The whip antenna should be fine for most in-home use. If you need more range, an external antenna can be connected to J3 (remember to install R12). But always keep in mind that it is your responsibility to make sure that your operation does not interfere with your neighbor's TV viewing. Besides, someone might be watching what you are watching! ■

Popular Electronics

Supplement to Popular Electronics
August 1995

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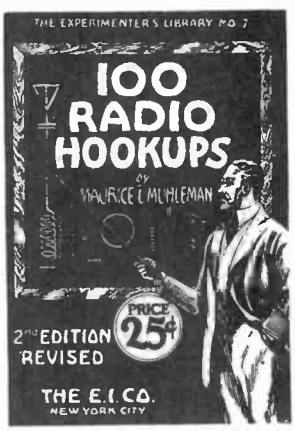

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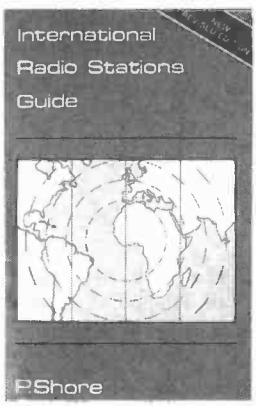

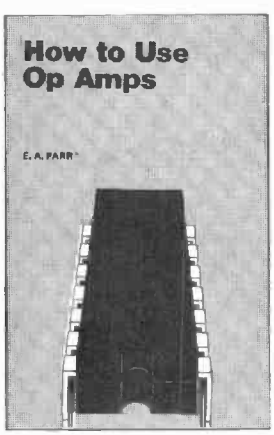

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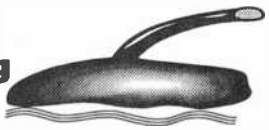

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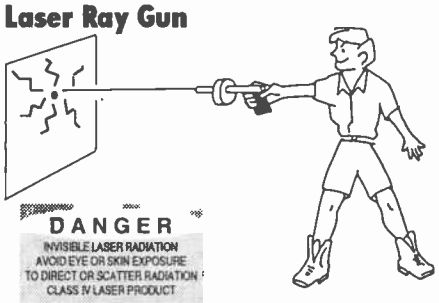

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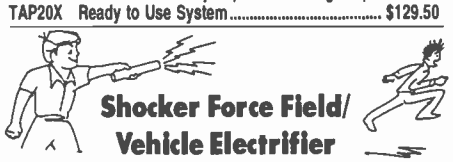

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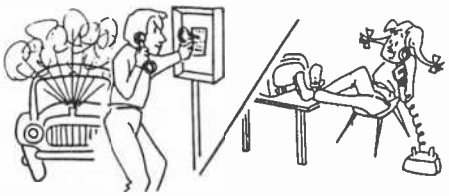

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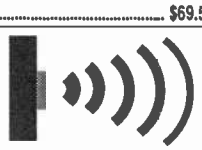

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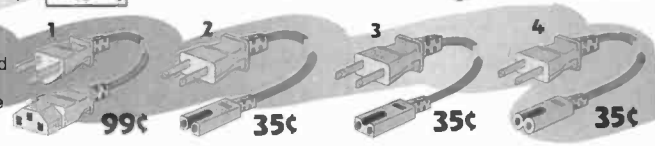

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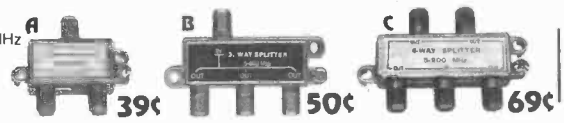

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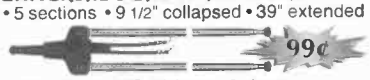

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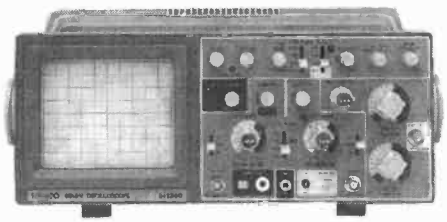

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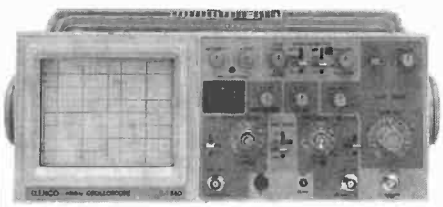

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- Sweep to 5ns/div
- Dual time base
- Signal delay line
- Component tester
- V mode-displays 2 signals unrelated in frequency

100MHz THREE-TRACE

Model 2190

$1,379.95

- 1mV/div sensitivity
- Sweeps to 2ns/div
- Dual time base
- Signal delay line
- 19kV accelaerating voltage
- Calibrated delay time multiplier

20MHz ANALOG with DIGITAL STORAGE

Model 2522A

$869.95

- 20MHz analog bandwidth
- 20MS/s sampling rate
- 2k memory per channel
- 20MHz equivalent time sampling

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V-212 - 20MHz, 2 Channel	$425.00
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V-523 - 50MHz, Delayed Sweep	$995.00
V-525 - 50MHz, w/ Cursor	$1,069.00

HITACHI COMPACT SERIES SCOPES

V-660 - 60MHz, Dual Trace	$1,375.00
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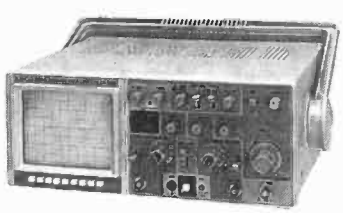
V-1060 - 100MHz, Dual Trace	$1,549.00
V-1065A - 100MHz, DT, w/cursor	$1,695.00
V-1085 - 100MHz, QT, w/cursor	$2,125.00
VC-6045A - 100MHz, Digital Stor	CALL
VC-6025A - 50MHz, Digital Stor	CALL

Elenco DS-203 20MHz, 10MS/s Digital Storage Oscilloscope



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2K Word Per Channel • Plotter Output 8 Bit Vert. Resolution • 2048 Pts Hor. Resolution • Much More.....

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A handheld instrument that combines a 50MHz, 25MS/s dual channel digital storage oscilloscope with feature-packed 3000 count digital multimeter.

Model 93 - $1,225
Model 95 - $1,549
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- Autoset, automatically sets voltage, time & trigger
- Multimeter display; 3-2/3 digits (>3000 counts)
- True RMS volts; AC or AC+DC up to 600V

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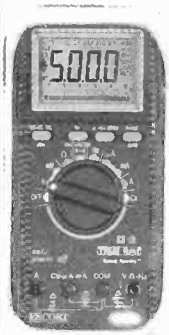

DMM 89 $199.95

Most Advanced DMM

All Purpose & Communication

-80.7 to 81.4 dBm with 4Ω–1200Ω
20 reference impedances
True RMS
Frequency counter: 0.01Hz-10MHz
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Measure AC volt to 20kHz
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Min/Max/Ave/DH/Relative/Zoom
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Volt, amp, ohm, logic, diode, continuity
Ruggerdized case
Rubber holster included

DMM 2360 $119.95

DMM+LCR Meter

Very Versatile DMM

Inductance: 1μH-40H
Capacitance: 1pF-40μF
Frequency: 1Hz - 4MHz
Temperature: -40-302 °F
TTL Logic Test: 20MHz
Diode, Continuity
Volt, Amp, Ohm
3999 count display
Peak Hold
Auto power off
Ruggerdized case.
Temperature probe included
Rubber Holster $8.00

DMM 20 $74.95

Inductance: 1μH-40H
Capacitance: 1pF-200μF
Frequency: 1Hz-20MHz
Volt, amp, ohm, diode,
20 Amp AC/DC current
Transistor HFE
Continuity, duty %
Peak hold/Max
Ruggerdized case
Rubber holster $8.00

Full line of DMMs, economy, compact, ruggerdized, solar cell, automotive, heavy duty, industrial, starts from $15.95

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Fluke 73 II	$94
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Fluke 83	$225
Fluke 85	$259
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LCR Meter 131D $229.95

Most Advanced LCR

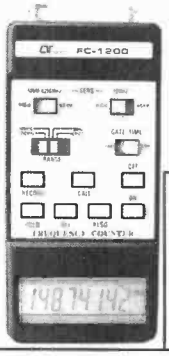
Dual display:L/Q or C/D
Inductance: 0.1μH-1000H
Capacitance:0.1pF-10,000μF
Impedance:1mΩ-10MΩ
0.7% basic accuracy
Auto/manual range
Dissipation factor & Q factor
Serial & parallel mode
Relative mode for comparison and to remove parasitics
Statistics, tolerance,
Best for design, incoming testing & production
SMD and chip component test probe $25.00

LCR Meter 814 $189.95

Best Resolution LCR

Inductance: 0.1μH-200H
Capacitance: 0.1pF-20,000μF
Resistance: 1mΩ-20MΩ
1% basic accuracy
Dissipation factor indicates leakage in capacitor and Q factor in inductor
Zero adjustment to reduce parasitics
Best for high frequency RF
SMD and chip component test probe $25.00

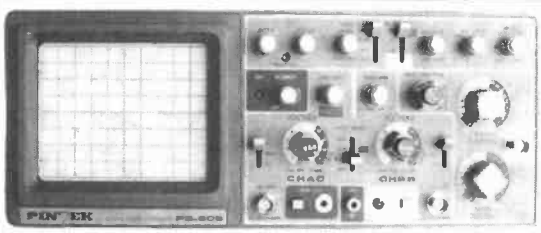
LIMITED QUANTITY SPECIAL
DIGITAL LCR METER $74.95
0.1pF, 1μH, 10mΩ resolution



Frequency Counter FC-1200 $129.95

Frequency:0.1Hz-1.25GHz
Display: 8 digit LCD
Period: 0.1μs-0.1s
Records Max/Min/Average
Data hold, relative mode
Telescoping antenna $8.00
Deluxe case $5.00

Also Available:
AC/DC clamp meter,Light meter, Thermometer, pH meter, High voltage probe, Digital caliper, Anemometer, Electronic scale, Force gauge,Tachometer, Stroboscope, Humidity & EMF adapter, Sound level meter, Frequency counter, SWR/field strength/power meter, Dip meter



20 MHz Oscilloscope with Delay Sweep PS-205 $429.95

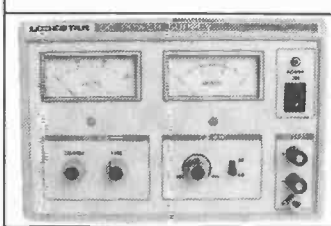
Dual Trace, Component test, 6" CRT, X-Y Operation, TV Sync, Z-Modulation, CH2 Output, Graticule Illum, 2 probes each has x1,x10 switch. Best price with delay sweep.

PS-200 20 MHz DUAL TRACE	$339.95
PS-400 40 MHz DUAL TRACE	$494.95
PS-405 40 MHz DELAY SWEEP	$569.95
PS-605 60 MHz DELAY SWEEP	$769.95

Scope Probe: 60MHz x1, x10 $15, 100MHz x1, x10 $22
250MHz x1, x10 $29, 250MHz x100 $39

Digital Storage Scope

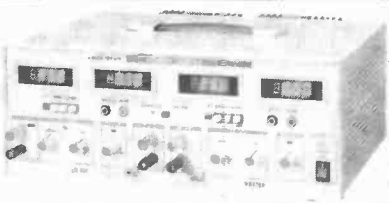
DS-203 20MHz, 10M Sample/sec $729.95
DS-303 30MHz, 20M Sample/sec $849.95
DS-303P with RS-232 interface $1,049.95
Switchable between digital and analog modes
2 K word per channel storage
8 bit vertical resolution (25 Lerel/div)
Expanded Timebase 10ms/div - 0.5 s/div
Refresh, Roll, Save all , Save CH2, Pre-Trig
Plotter control



DC Power Supply PS-303 $159.00

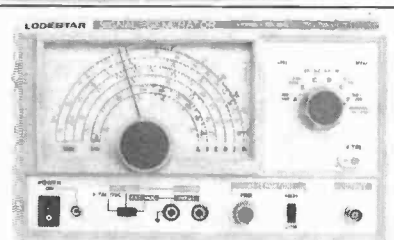
0-30 VDC , 0-3A output

Constant voltage & constant current mode
0.02% + 2mV line regulation
0.02% + 3mV load regulation
1 mVrms noise and ripple
Short circuit and overload protected
PS-8200 with digital voltmeter $179.00
Also available: 30V/5A, 60V/3A, 60V/5A 16V/10A, 30V/10A



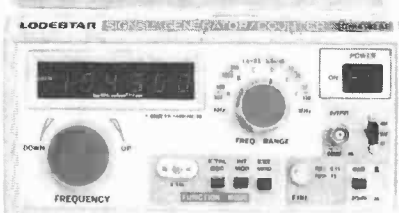
DC Power Supply Triple Output PS-8202 $499.95

Two 0-30 VDC , 0-3A outputs
One fixed 5VDC, 3A output
Capable of independent or tracking operation
Constant voltage and constant current mode
Four digital meters for volt and current display
Excellent regulation and low ripple
Short circuit and overload protected
Also available: 30V/5A triple output $549.95
Dual tracking 30V/3A, 30V/5A, 60V/3A, 60V/5A



RF SIGNAL GENERATOR SG-4160B $119.00

100 kHz-150MHz sinewave in 6 ranges
RF Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz AM modulation
Audio output 1 kHz, 1 Vrms



RF SIGNAL GEN./COUNTER SG-4162 AD $229.95

Generates RF signal same as SG-4160B
6 digit frequency counter 1Hz - 150 MHz for internal and external source Sensitivity <50mV

AUDIO GENERATOR AG-2601A $119.00

10Hz - 1MHz in 5 ranges
Output: 0-8Vrms sinewave
0-10Vp-p squarewave
Synchronization: ±3% of oscillation frequency per Vrms
Output distortion:
0.05% 500Hz - 50kHz
0.5 % 50Hz - 500kHz
Output impedance: 600 ohm

AUDIO GEN./COUNTER AG-2603AD $229.95

Generates audio signal same as AG-2601A
6 digit frequency counter 1Hz-150MHz for internal and external sources Sensitivity <50mV

FUNCTION GENERATOR FG-2100A $169.95

0.2 Hz -2 MHz in 7 ranges
Sine, square, triangle, pulse and ramp
Output: 5mV-20Vp-p
1% distortion, DC offset ± 10V
VCF: 0-10V control frequency to 1000:1

FUNCTION GEN/COUNTER FG-2102AD $229.95

Generates signal same as FG-2100A
Frequency counter 4 digits
Feature TTL and CMOS output

SWEEP FUNCTION GEN./COUNTER $329.95

0.5Hz to 5 MHz in 7 ranges
Sweep: Linear 10:1/Log 10:1 20ms to 2s
AM Modulation
Gated Burst, Voltage Control Generator
Generator Control Voltage & 6 digit counter
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Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101RE	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
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

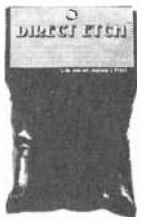
Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GS101RE	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
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

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GD101RE	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114RE	114mm x 185mm/4.6" x 6.6"	5.95	4.29	3.99
GD152RE	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153RE	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30

Etching Chemicals/Ferric Chloride



A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	PRICE EACH 1	5
ER-3RE	Makes 1 pint	$3.50	$2.75

Developer

This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
POSDEVRE	Positive Developer	$ .95	$ .80	$ .50

Etching Tank

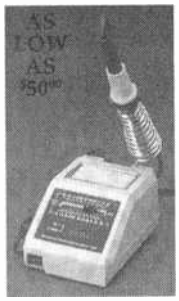
REDUCES ETCHING TIME!

This attractive injection moulded designed tank is ideal for etching your PCBs. It includes a thermostatically controlled glass heater, electric agitator and PCB hanging accessories. Measuring graduations are included. Maximum PCB size is 160mm x 250mm or 200mm x 250mm w/o heater. Typical etching time is 4 minutes.

CAT NO	DESCRIPTION	PRICE
ET10RE	Etch Tank System	$52.00

QUANTITY PRICING DOES NOT APPLY TO MIXED ITEMS!

Electronic Soldering System



Here's the ideal solution when **Temperature Control** is required. Easy to use slide control allows user to set system from 300°F to 840°F. Voltage to iron from control unit is 24V. Iron heating power is 48W. Replaceable 5.3mm tip is standard. Replacement irons and tips are available.

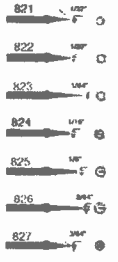
CAT NO	DESCRIPTION	PRICE EACH 1	5
SL10RE	Temperature Controlled Soldering Iron	$56.00	$50.00
SL24VRE	Spare 24V Soldering Iron	10.50	7.50

Electronic Soldering System with LED Display

AS LOW AS $75.00

Deluxe temperature controlled system with LED display for maximum accuracy. Temperature is adjustable from 160°-480°C (320°-900°F). Iron heating power is 48 Watts. Runs on 24V from controller unit. Replacement irons and tips are available. Tip size is 5.3mm.

CAT NO	DESCRIPTION	PRICE EACH 1	5
SL30RE	Deluxe Soldering System	$86.00	$75.00
SL24VRE	w/LED Spare 24V Soldering Iron for SL10 or SL30	10.50	7.50



Replacement Tips for SL10/SL30

We now offer a variety of replacement tips for the SL10/SL30 soldering stations.

CAT NO	DESCRIPTION	PRICE EACH 1	5
821RE	1/32" Pencil Tip	$1.39	$1.19
822RE	1/32" Pencil Tip	1.39	1.19
823RE	1/64" Pencil Tip	1.39	1.19
824RE	1/16" Chisel Tip	1.49	1.29
825RE	1/8" Chisel Tip	1.49	1.29
826RE	3/64" Chisel Tip	1.49	1.29
827RE	3/64" Pencil Tip	1.59	1.39

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TR1200XLT
AM Broadcast to Microwave 1000 Scan Channels $389.00

500KHz to 1300MHz coverage in a programmable hand held. Ten scan banks, ten search banks. Lockout on search and scan. AM plus narrow and broadcast FM. Priority, hold, delay and selectable search increments. Cell Lock. Permanent memory. 4 AA ni-cads and wall plus cig charger included along with belt clip, case, ant. & earphone. Size: 6 7/8 x 1 3/4 x 2 1/2. Wt 12 oz. Fax fact document # 205

TRIDENT
TR4500 $449
2016 Channels
1 to 1300MHz
Computer Control

62 Scan Banks, 16 Search Banks, 35 Channels per second. Patented Computer control for logging and spectrum display. AM, NFM, WFM, & BFO for CW/SSB. Priority bank, delay/hold and selectable search. Cell Lock Permanent memory. DC or AC with adaptors. Mtng Brkt & Antenna included. Size: 2 1/4H x 5 5/8W x 6 1/2D. Wt. 1lb. Fax fact #305

TRIDENT
TR980 $279.00
125Channels
5MHz to 999MHz

Most Economical receiver in its class, offers AM, NFM Wide FM, modes. 5KHz increments. Delay & hold & Search. Cell Lock NiCads, chger & whip ant. Size: 5 7/8H x 1 1/2W x 2 D.Wt 14oz.

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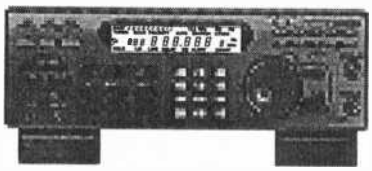

Three new Bearcat units offer expanded coverage and more memory than before. The 890 offers 200 channels, base/mobile operation, VFO tuning, service search, weather alert, search and store, and more. The 2500 hand held has 400 channels, fast scan and more. The Bearcat 8500 has 500 channels in 20 banks, VFO, auto store, alpha numeric display, 10 priority channels, aux tape output jacks, and coverage to 1.3 Gigahertz.

Bearcat 2500XLTA hand held.....$349.95
Bearcat 8500XLTC mobile.....$389.95
Bearcat 890XLTB mobile.....$259.95
25-1300MHz, 500 ch. in 8500, 400 in 2500. 890 has 200 ch.& 29-956MHz. All cell locked. Features include turbo scan, VFO, search and store, Priority, LCD display, and more. Fax Facts474,475,476

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Scans police pre-programmed by state channel *plus* the CB channel of your choice. Also has Mobile Repeater and Weather. Extra cost option of CB and laser detectors built in. Compact size allows for dash or visor mounting. Mtng hardware and power connectors included. Size: 5 5/8 x 4 7/8 x 1 3/4. Wt: 1.5lbs. Fax fact #580

Bearcat 700AX 50Ch w/800..... $159.95
Bearcat 350A 50 Ch H/L/U..... $119.95
Bearcat 560XLJ 16 Ch H/L/U..... $ 89.95
Bearcat 760XM100Ch H/L/U/Air/800 $219.95
Bearcat T2 state/state scan..... $144.95

TRIDENT Winner of the 1994 INNOVATIONS Design & Engineering Honors, Electronic Industries Association. Trident TR2400 Total Coverage Receiver

Trident TR2400: 100KHz to 2060MHz. Ten scan banks of 100 channels each, ten search banks. Tuning increments as low as 1KHz. Beat Freq. Oscillator for SSB and CW modes. Search lockout and store. VFO tuning knob. Permanent memory. Bank lock and linking. Attenuator switch. Backlit LCD. 1 Yr Warranty. AM/NFM/WFM. Selectable increments . Delay, Hold, Priority. 5 7/8H x 1 1/2D x 2W. Wt 14 oz. **$499.00**

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Sangean ATS-818..... $184.95
Sangean ATS-803A..... $169.95
Sangean ATS-808..... $179.95
Sangean ATS-606..... $149.95
Sangean ATS-606P..... $169.95
Sangean ATS-800..... $89.95
Grundig YB400..... $219.00
Grundig Satelit 700..... $399.00

Hand Held Scanners

Bearcat 200XLTN
$209.95 200 Channels 800 MHz

Ten scan banks plus search. Covers29-54, 118-174, 406-512 and 806-956MHz (with cell lock). Featuresscan, search, delay, 10 priorities, mem backup, lockout, WX search, keylock. Includes NiCad & Chrgr. Size: 1 3/8 x 2 11/16 x 7 1/2.

Bearcat 120XLTJ 100Ch H/L/U..... $149.95
Bearcat 150XLT 100Ch H/L/U/8..... $199.95
Bearcat 220XLTJ 200 Ch H/L/U/8.... $249.95
Coverage of above hand helds is: 29-54, 136-174, 406-512, and 800MHz band as indicated. Fax facts #475

Table Top Scanners

Bearcat 855XLTE 50 Ch w/800..... $159.95
Bearcat 142XLM 10Ch H/L/U..... $ 73.95
Bearcat 147XLJ 16 Ch H/L/U..... $ 89.95
Bearcat 172XM 20Ch H/L/U/Air..... $124.95
Bearcat 145 16Ch H/L/U..... $ 79.95

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Base Discone Ant DA300..... $ 89.00
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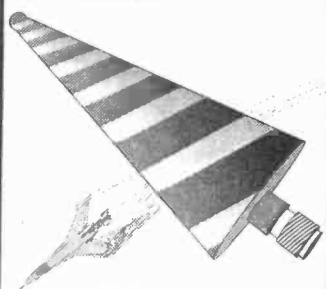
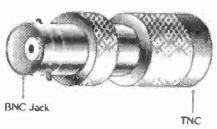
A7 JET COUNTERMEASURES ANTENNA



We were told that these were made for Navy A7 jets. They are brand new (part# 23473 G2) and are in sealed military packaging. The antenna looks like a 5 1/4" ice cream cone with 2 foil spirals. At the base of the cone is a TNC female connector. We used an adaptor to connect this antenna to a scanner and the increase in sensitivity of the scanner to frequencies above 800MHz was amazing! Antenna is encapsulated for rugged use, very high quality and if nothing else, makes a great conversation piece. Can you imagine what the Navy must have paid for these things? Own a piece of high tech military history before we run out!

G6662 **$8.00**

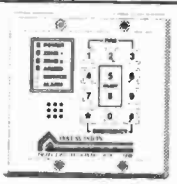
TNC - BNC JACK ADAPTOR (FOR ABOVE)



Allows you to simply connect the above antenna to your scanner using a BNC - BNC cable.

G6663 **$4.00**

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 SALE! ONLY **$2.75!** ~~WAS $3.00~~ **10/$23.00**

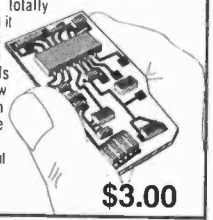
ULTRABRIGHT SMD RED LED

Very Intense clear lens tiny SMD ultrabright red LED made by Panasonic. Type LN1261CAL. Prime-on tape and reel.

G6447 **4/$1.00**

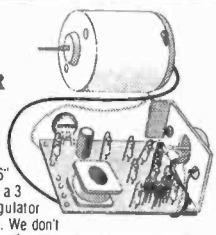
BASIC SMD LEARN TO SOLDER KIT

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**

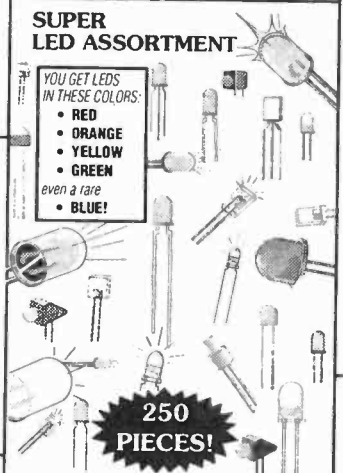
HEAVY DUTY 12VDC MOTOR WITH REGULATOR



Precision 1 7/16" Dia. motor has a 3 transistor regulator board attached. We don't have the hookup diagram on these, but they look like sophisticated electronic regulator boards. Size of board: 1 1/2" x 2 1/8". Size of motor: 1 7/16"Dia. x 1 7/8" L. The shaft is a "D" type and 1/2" long. Brand new-no other info available except that these were made by Sonar Radio Corp., part# 27-030-008.

G6540 **$1.50**

SUPER LED ASSORTMENT



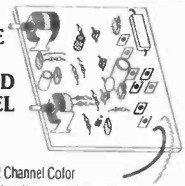
Assortment of all types, colors, sizes and shapes of prime high quality LEDS. This large assortment even contains a clear LED that lights up blue! Our largest and most spectacular assortment contains 250 pieces.

G6554 **$10.00**

NOTE: All sale prices advertised are valid only through the month of the cover date.

IF YOU CAN'T FIND WHAT YOU ARE LOOKING FOR, CALL FOR A FREE COPY OF OUR LATEST CATALOG. THIS CATALOG CONTAINS OUR ENTIRE PRODUCT LINE OF OVER 3,500 ITEMS AND IT IS STILL GROWING!

SUPER SENSITIVE SOUND ACTIVATED 2 CHANNEL COLOR ORGAN



This ultra sensitive 2 Channel Color Organ produces brilliant flashes of light (from any incandescent lamps of your choice - up to 200W) in response to music or other sounds. This is probably the best and brightest color organ we have ever seen. 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 120VAC and requires only that you solder your line cord and 2 outlets (for your 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. Connect up a couple of your brightest, colorful lamps and watch the fireworks with each beat of the music! 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. Hurry, these will sell very fast!

G3319 ~~WAS $5.95~~ SALE! ONLY **$4.95!**

DC TO DC CONVERTER

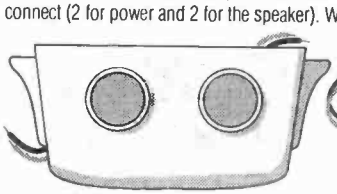
Super efficient tiny DC to DC converter converts lower voltage DC to a higher voltage DC (see table below). These are brand new made by TDK and are only 1 3/8"L x 7/8"W x 3/8"T. Very efficient and latest technology using SMD and standard technology. Power a 9V transistor radio from 1 AA battery, charge 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 Input DC	Voltage Output DC	Current Output
0.5VDC (solar)	3V	1mA
1.5VDC	9V	15mA
3VDC	9V	40mA

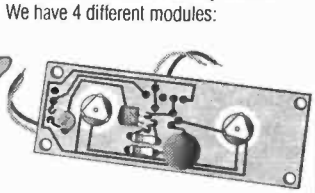
G6344 **$3.98**

HUMAN VOICE AND VARIOUS SOUND MODULES

Small electronic modules have 2 pushbuttons that produce human voices and various sounds. You need only to provide a speaker and 4.5VDC (3 AA batteries connected in series works fine). Size of 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:



Module: External View

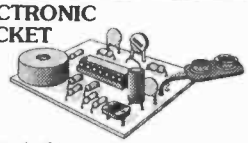


Module: Internal View

Voice Button	Sound Button	STOCK#
1) "Emergency 911."	Ambulance Siren Sound	G6664
2) "Unload."	Idling Dump Truck Sound	G6665
3) "Fire! Let's Go!"/Siren	Idling Fire Truck Sound	G6666
4) "Load em up!"	Race Car Revving Up Sound	G6667

YOUR CHOICE $1.25 each **100 for $100.00**

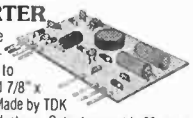
ELECTRONIC CRICKET KIT



This electronic cricket starts "chirping" every time it gets dark. Of course, if you turn on the lights to look for the "cricket" it becomes silent again. Loads of fun. Uses 9V battery (not included). Skill level 1

C6707 **$5.30**

TDK VOLTAGE CONVERTER



Brand new voltage converter converts 3VDC to 9VDC. Size only 1 7/8" x 1 3/16" x 1/4". Made by TDK for a major manufacturer. Output current is 60 ma at 9VDC. Use 2 penlight batteries to operate transistor radios, calculators, etc, or any electronic device that can operate on 9VDC at up to 60ma. With hookup diagram (only 3 leads are used).

G6546 **$2.00**

DIGITAL PLANET DIGITAL DP-91 TUNER

These are complete infrared controlled FM digital tuners. The 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 26 when you press the buttons on the remote control. After a while the display shows EE indicating that the cable TV signal is not present. Inside the 9 3/4" x 6 5/8" x 2 3/8" main unit are various IC's, 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 for 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 **$15.95**

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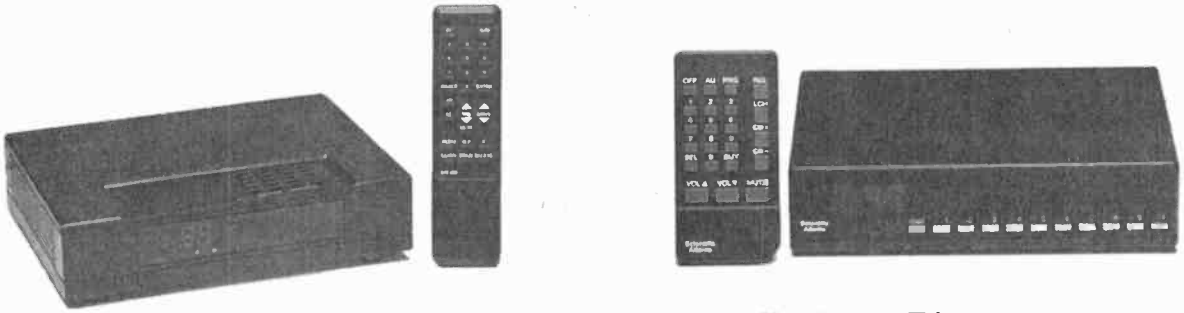

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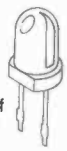
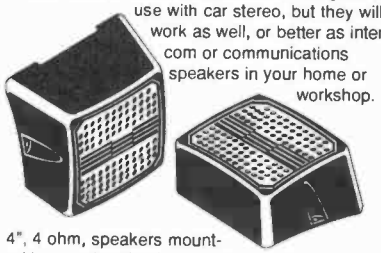


Liton # LTL 327C - 8MM
Ideal for eye-catching indicators and displays. A recent quantity purchase of these BIG, 8mm diameter, red diffused LEDs enables us to provide some very special pricing. The leads on these devices are 0.325" long with plenty of room for soldering.

5 for $1.00 CAT# LED-23
100 for $ 15.00
1000 for $ 120.00

GREAT DEAL! SURFACE MOUNT SPEAKERS

These surface mount speakers were designed for use with car stereo, but they will work as well, or better as intercom or communications speakers in your home or workshop.

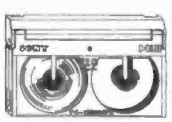


4", 4 ohm, speakers mounted in an unbreakable black plastic, slant-faced enclosure. They are rated 5 watts. Enclosure measures 4.82" X 4.5" X 2.45"h. Each pair is boxed and includes two short pieces of hook-up wire.

CAT# SK-411 **$3.75 per pair**

"HI-8" VIDEO CASSETTE (USED)

8 mm Video Camcorder Users!.



SONY Hi-8
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Nintendo
SNS-002
New, orlginal wall transformer with 9 foot cord and co-ax plug with center pin positive.

Output 10 Vdc @ 850 ma.
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CAT # SPL-960

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Matsushita
MMX- 7AC O 8A
1.25" diameter x 1.25" high motor. Prepped with 1.61" diameter flywheel, pulley and fiberglass mounting board.

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THAT'S RIGHT! 6 INCHES...Standard 3 prong grounded male one end and 3 prong IEC receptacle on other end. CSA listed. Large quantity available.

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0.32" od, SJT insulation. Standard 3 prong grounded plug one end, molded strain relief on other end. Pigtail leads. CSA listed. Large quantity available

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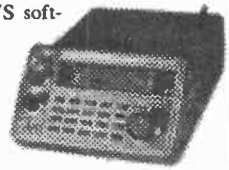

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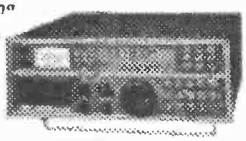

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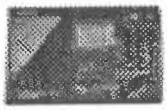
SONY ICF SW7600G



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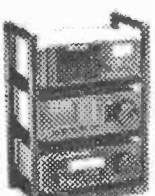

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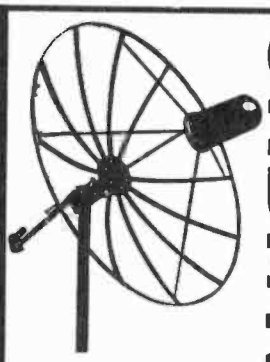
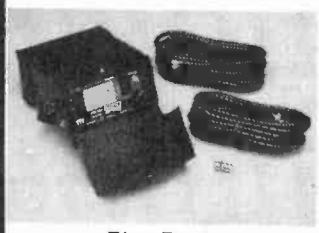
ORBITRON



Known the world over for their superior reception and picture quality, the Orbitron satellite dish features an exclusive Spinclination mount, which allows declination to be set by rotating the antenna to correct the latitude setting on the scale. Their compact shipping cartons allow these antennas to be shipped very economically to any point in the world. Let Orbitron help you expand your viewing choices.

1514001	6.7'	SX-7	Polar/Spin	$45 (S&H)	$259
1514002	8.3'	SX-8.5	Polar/Spin	49 (S&H)	319
1514004	10.0'	SX-10	Polar/Spin	63 (S&H)	449
1514005	11.7'	SX-12	Polar/Spin	84 (S&H)	649

and many more...



Pico Peaker

You can now accurately aim your satellite dish to receive *all* the satellites using a tool the experts use. Whether installing a new system, moving your dish, or realigning your dish due to wind or frost, the Pico Peaker will save you both time and money. This unit can be used on any receiver system with block down-converted frequencies between 400 and 1450 MHz. It will also eliminate the need for those expensive service calls. The unit includes everything you need—even the cables. A *"must"* for every satellite enthusiast.

900038 Pico Peaker S&H $5 $89.95

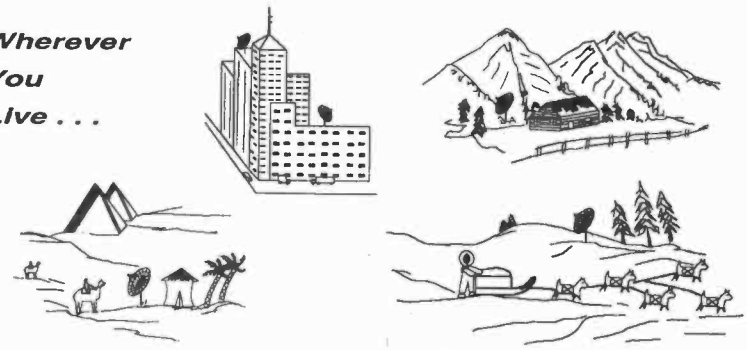
Superjack Actuators

Is your actuator no longer doing its job because of wear and tear? As the hardest working part of your satellite system, the actuator must move your dish from east to west across the entire satellite belt. Each time you change satellites, your actuator sends pulses to the receiver telling the receiver when to stop moving the dish. Most older actuators sent only 10-16 pulses for each inch of travel, which may not be enough to stop the dish at the maximum signal strength. Today's new heavy duty actuators with high resolution reed sensors send 48 pulses per inch of arm travel. So if your old actuator is getting tired, let a new SuperJack insure the finest picture possible.

18" arm	1019018	S&H $15	$ 89
24" arm	1019026	S&H $16	139

Satellite Television

Wherever You Live . . .



. . . at down to earth prices!!!

Ultra

The Ultra is Uniden's newest, smallest fully-integrated C/KU receiver ever. This unit includes the ability to control dish movement and is ready for an optional Internal program decoder. The Ultra comes preprogrammed for 49 satellite positions and allows you to add satellites as they are launched. Move directly to the satellite by entering the abbreviation from the included infrared remote control. Forty programmable favorite channels can be accessed immediately from your easy chair. Run across something you don't want your kids to see? Just touch a button and eliminate that channel from their access. A complete variety of color menus allow you to control everything from your remote control. The Uniden Ultra is an ideal receiver to get you started in Direct-To-Home Satellite TV.

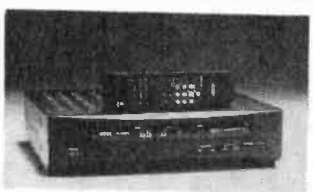
4527008 Ultra S&H $22 $379.00

uniden®

The UST 4600 sets a standard in value and performance for home satellite receivers. This unit features automatic satellite programming, 160 favorite channels can be instantly recalled for easy access. All 160 can be changed or updated at any time. This IRD features a stereo processor, enabling you to tune both left and right channels for a full stereo effect from over 100 radio stations found in satellite. The QuikTune feature quickly optimizes the satellite picture for the sharpest image. The 4600 offers other features including IR/UHF remote, 55 satellite position memory and direct satellite access. The versatility makes this an excellent choice.

UST 4600

4527009 UST4600 S&H $22 $499.00



UST 4900

The Uniden UST 4900 is one of the most sophisticated satellite television receiver systems available today. This receiver will open your home to the universe of satellite viewing and is designed to be one of the most user-friendly IRDs available anywhere. Sophisticated microcomputer technology brings in crystal clear audio and video broadcasts with a minimum of user effort. The UST 4900 front display features easy-to-read icons that show you vital information including satellite, channel, polarity, timer status, antenna position and much more. This receiver is capable of storing the positions of the satellites, as well as the tuning details for each channel. The picture-in-picture feature allows you to view two video sources at the same time. You can have it all, including advanced technology and lasting quality, with the UST 4900.

4527010 UST4900 S&H $22 $689.00

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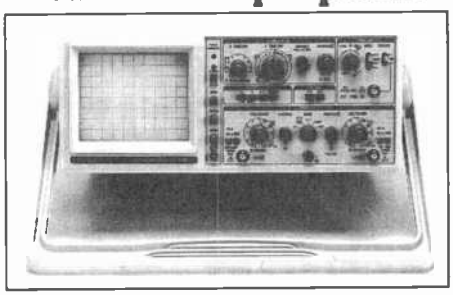

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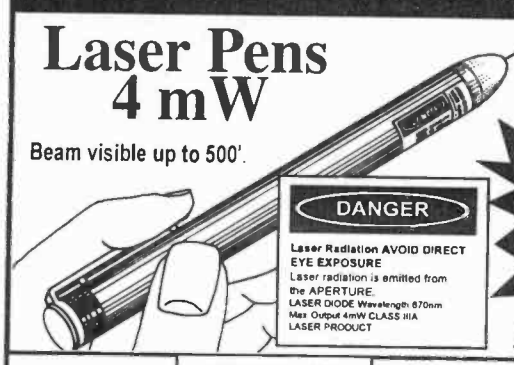
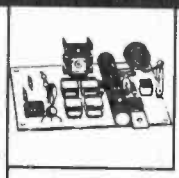


INCLUDES
2 AAA Batteries
Pen Size: 5 1/2" x 1/2"

SUPER NEW LOW PRICE
$59.95



STROBE LIGHT

Do you need an attention getter, warning light,or flashing light for model airplanes? Then this kit is for you. Use it as an emergency light for your auto, radio tower, even use it on your bicycle. Has a variable flash rate. Size 3.5"x1.8" operates on 6 or 12v DC only.

ST-1 $9.95

The Exciting New TELEPHONE MONITOR

Monitors your phone system, See how accurate your phone company really is!

1. **RECORDS OUTGOING CALLS :**
   - Date & time of each call.
   - Length of the call.
   - What number was dialed.
   - If you use a credit card it records the card number.
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   - How many times phone rings.
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3. **RECORDS ANY DTMF TONE :**
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Records to Screen or Floppy Disk

EASY TO INSTALL
- Connects to parallel port
- Phone line in.
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All software included!

TM-1 ONLY $99.95 KIT

BUILT $169.95

WIDE BAND PREAMP

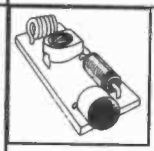
The ideal preamp for scanners, hand held radios, frequency counters. Amplifies low level (weak) signals. If the signal is extremely low 2 amps can be used in series. 1MHz to 2.5MHz @ 2.8dB nf 1dB compression = +0 dBm gain: 1MGHz-20dB to 2.5Hz-6dB Requires 12vDC @ 16Ma

WBA-6 $19.95

MICRO-MINIATURE PHONE TRANSMITTER

We haven't seen a smaller phone transmitter than the MMPT2 kit. Powered by the phone, it requires no battery. Transmits both sides of a phone conversation to an FM radio up to a 1/4 mile away.Tunable from 88 to 108MHz FM. Attach it to one phone or add it to the line to pick up all incoming calls. The MMPT2 is undetectable if properly installed. Unit has surface mounted parts, you install the leaded parts.Size .45"x.6"

MMPT2 $29.95



MICRO-MINIATURE WIRELESS MIKE

So small you could hide this one on some real bugs! It's the smallest we've ever seen. With it's super sensitive mike it transmits a whisper or a room of conversation to an FM radio, tunable from 88 to 108MHz FM. With a proper antenna & 9v it transmits about 1 mile. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. Can operate on 6 to 12v DC. Size .35"x.9"

MMWM5 $34.95

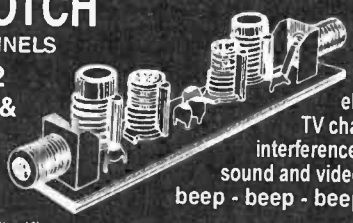
WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-1 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM , the frequency of any broadcast FM radio. Includes a mini-electret mike. SIZE: .8"x1" 6 to 12vDC

WM-2 $14.95

TV NOTCH FILTERS

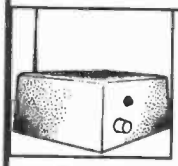
FOR CHANNELS
2 thru 22
SNOOP &
BULLET



Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep - beep - beep.

NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

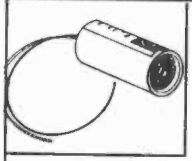
DF-222 Kit $14.95



FM STEREO TRANSMITTER

Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your cd's while mowing the lawn,Play music on one channel sing on the other. Clarity is excellent, 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

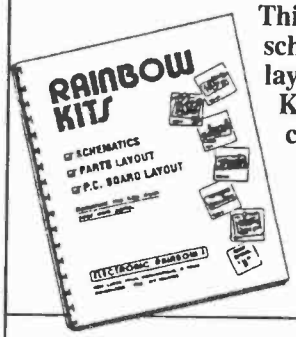
FMST-100 $29.95 / FMSTC cabinet $8.95



5.0 mW Laser Diode

Great for making a gun sight, use as a transit, makes a super experimenters project. The beam is visible with a wavelength of 670 nm. Size of beam is 6mm at 5 meters. Operates on 3 volts DC at 85mA. Size: 10.5mm x 18.5mm with an adjustable collimating lens.

LDM-5 NEW LOW PRICE $59.95



This Manual contains all schematics, parts lists , P.C.B., layouts for most of the Rainbow Kits. Use your own parts to construct any of our kits.

KIT BOOK $14.95

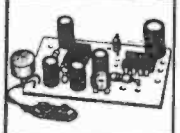
$9.95 with the purchase of any kit.

PHONE TRANSMITTER

Small but mighty,it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz to 130MHz FM. You can also use it as a speaker phone. SIZE .5"x1"

TEL-B1 $12.95

BUILT $29.95



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Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. SIZE: 1"x.75" 6 to 12vDC .

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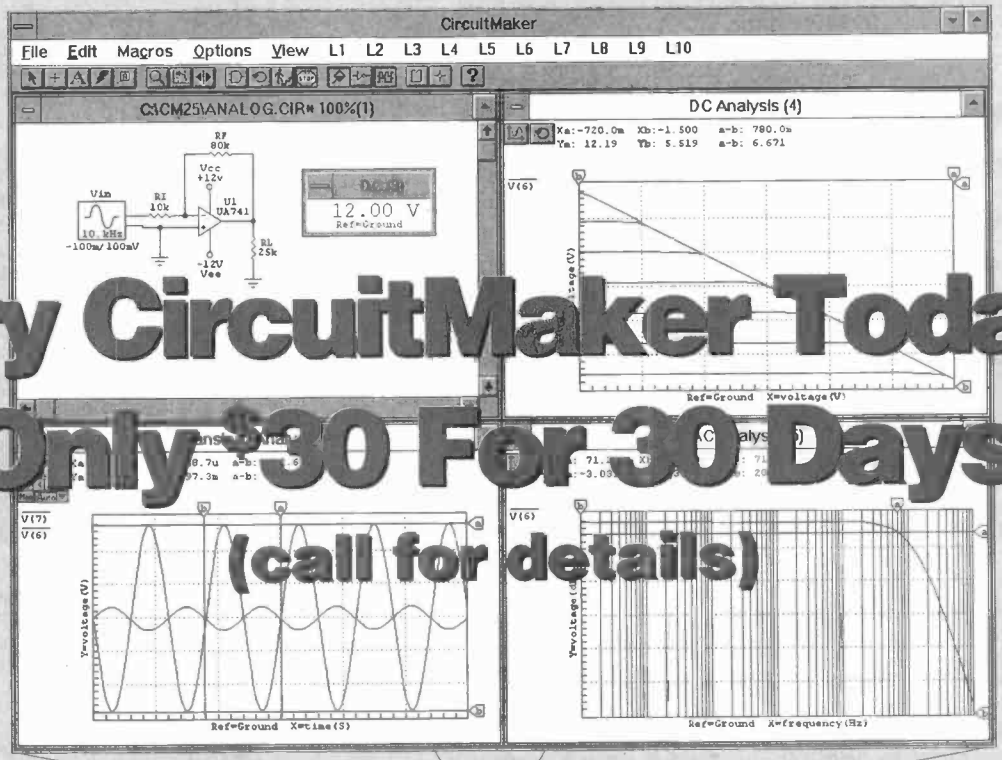
Electronic Workbench has no interactive logic probe or Trace capability and no Hex or ASCII keys. Their "word generator" is limited to 16 words. EWB does not have tri-state devices and digital devices do not have programmable propagation delays.



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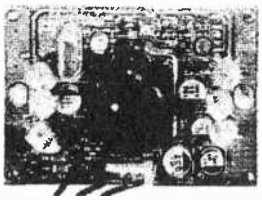
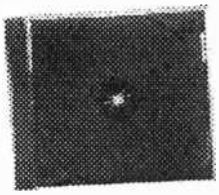


MINI TV CAMERA

I/R LED allows this camera to "see" in the dark. Mfg.: Kocom CA-H34A. Element: 1/3" monochrome CCD. Lens: Fixed 3.5mm, f:1.8. Field of view: 76° horiz., 55° vert. Electronic iris/shutter: automatic 1/60 to 1/32000 sec. Resolution: 360 horiz., 420 vert. Illumination: Ambient light and/or I/R LED supplies additional light in low light conditions. Sensitivity: 0.1 lux @ f1.8. Video output: EIA std 75 Ohm 2/1 interlace. 1.0 VoltP/P composite video. Output connections: 7" video and power leads. Power: 12 VDC ±1V @ 150 mA. Size 2.125" x 2.5" x 1.2". (95V004) **$119.95 each**

100° LOW NOISE AMPLIFIER

For TVRO applications. 3.8-4.2 GHz input, 70 MHz output. Amplica P\N MTI-AG1021.
(95G002) **$9.95 each**



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Use for CD-ROMs sold without a case or as a replacement for a broken one. These have been salvaged from unsold, obsolete software. *Large quantity available!* (95U004) **Three for $1.00**

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60mm (2.375") square.
(94F004)
$4.95 each

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Used, mixed manufacturers. (94E017)
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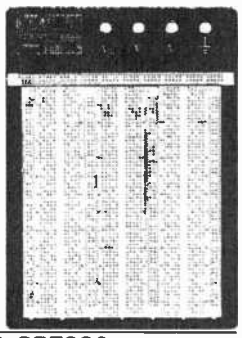
MICRO-SWITCH WITH LEVER

Single pole, double throw, normally open and normally closed. 5 Amp, 125 Volt contacts. 2½" long lever. (95B006) **99¢ each**

PUSHBUTTON SWITCH

SPDT normally open. Has approx. one foot wires attached. Mixed black and red switch caps. (95B007) **100 for $14.95**

PROTOBOARD SB2390



9.1" x 6.9" x 1.2". Five distribution strips; 500 distribution points. Three terminal strips; 1,890 terminal points. Four binding posts.
(SB2390)
$22.00 each

PROTOBOARD SB3220

9.5" x 8.3" x 1.2". Seven distribution strips; 700 distribution points. Four terminal strips; 2,520 terminal points. Four binding posts.
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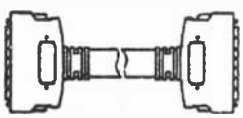
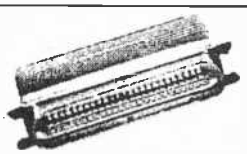
RG-178 COAX

50 Ohms. 2mm diameter. 250-Foot spool.
(95W009) **$100.00/spool**
(95W010) **59¢/foot**



SCSI-II EXTERNAL CABLE

Six feet long. (95W004) **$24.95 each**



ACTIVE SCSI TERMINATOR

Centronics 50-pin male. (95C013)
$9.95 each - 5 for $45.00

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Surplus goodies from Silicon Valley. This is not junk, just material we've acquired in quantities too small to catalog - electronic and mechanical subassemblies for everything from robots to rockets. Assortments may include ICs, caps, connectors, bearings, diodes, hardware, circuit boards, cables. Weird and wonderful stuff. Most folks are happy with the assortments we send and we often get re-orders. Try one. (92U034)
50 Lbs. for $49.95

WALL WART ASSORTMENT

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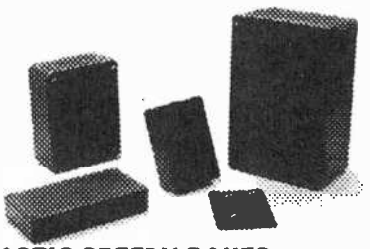

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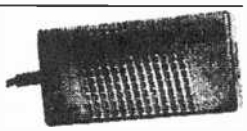

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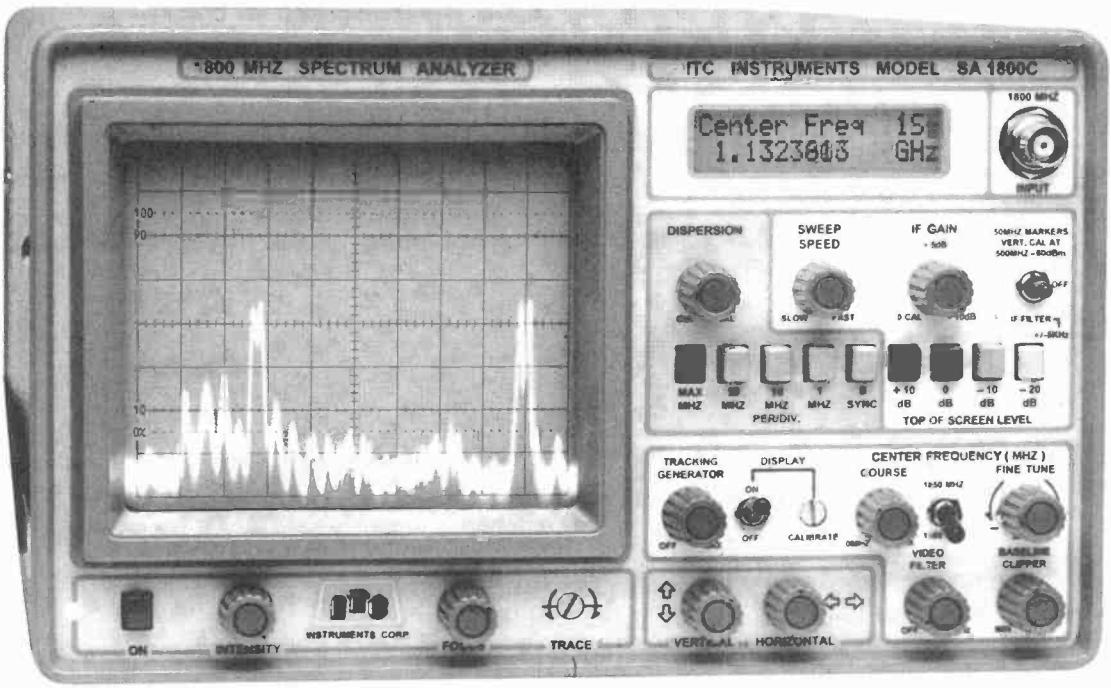

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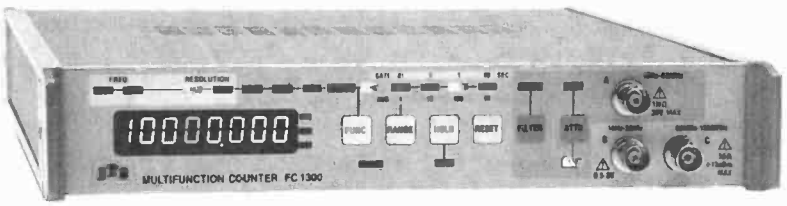

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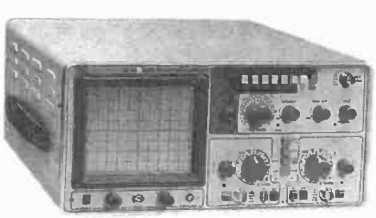

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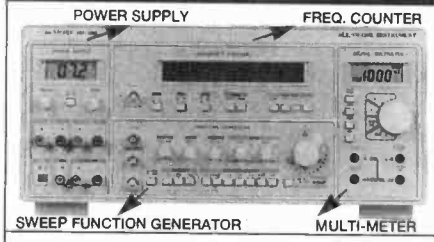

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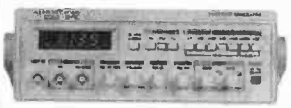

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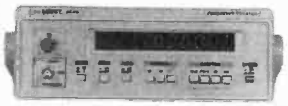

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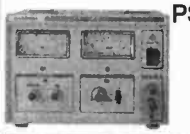

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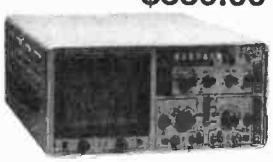

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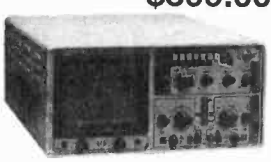

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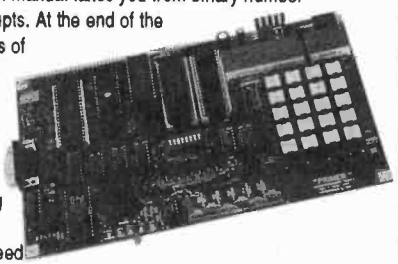

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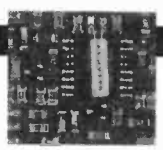

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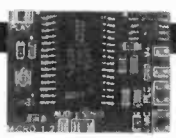

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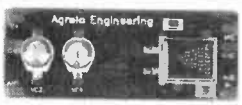

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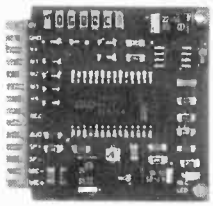

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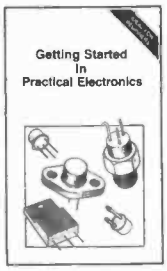

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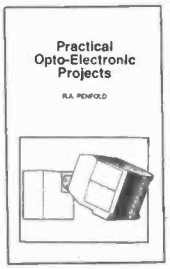

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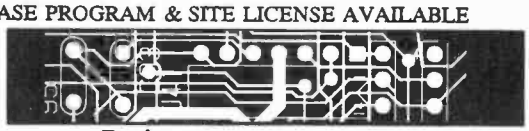

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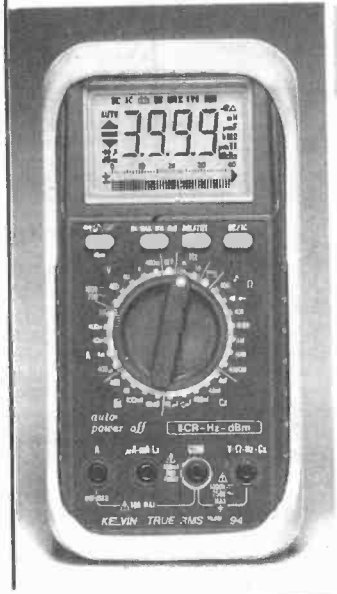

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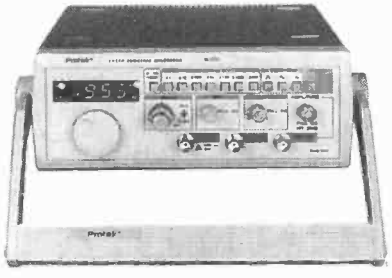

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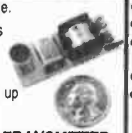

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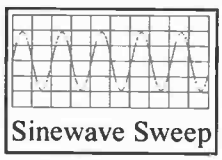

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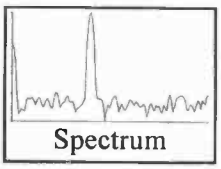

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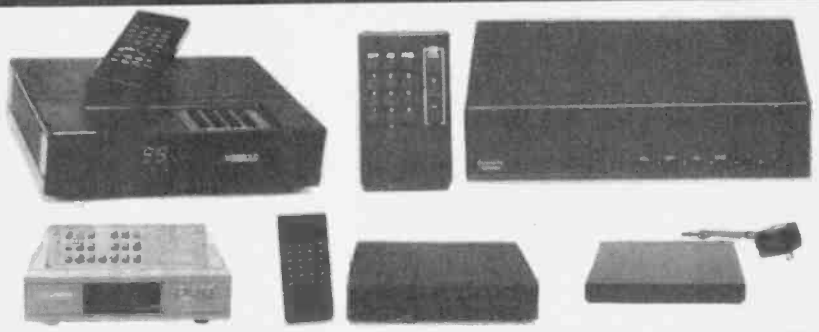

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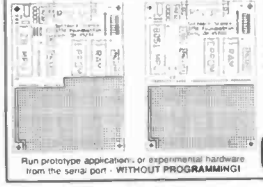

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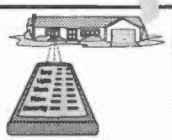

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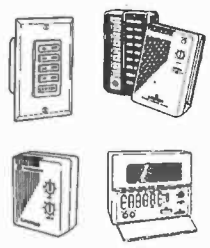

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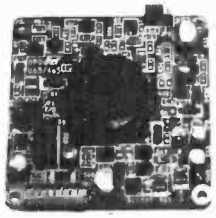

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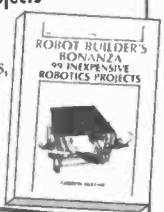

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#3-114 $17.95

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USE PE MARKET CENTER CLASSIFIEDS

READ BY 87,877 BUYERS OF ELECTRONIC EQUIPMENT ACCESSORIES AND PARTS

INSTRUCTION FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.00per word. Minimum charge is $15.00 per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT

All classified advertising in the **PE Market Center** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March, 1995 issue that is on sale January 17. The PE Market Center is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

AD RATES: $1.00 per word, Minimum $15.00.

Send your ads with payment to:
Popular Electronics Market Center, 500-B Bi-County Blvd. Farmingdale, NY 11735

CATEGORIES

100 — Antique Electronics
130 — Audio-Video-Lasers
160 — Business Opportunities
190 — Cable TV
210 — CB-Scanners
240 — Components
270 — Computer Equipment Wanted
300 — Computer Hardware
330 — Computer Software
360 — Education
390 — FAX
420 — Ham Gear For Sale
450 — Ham Gear Wanted
480 — Miscellaneous Electronics For Sale
510 — Miscellaneous Electronics Wanted
540 — Music & Accessories
570 — Plans-Kits-Schematics
600 — Publications
630 — Repairs-Services
660 — Satellite Equipment
690 — Security
710 — Telephone
720 — Test Equipment

CLASSIFIED AD COPY ORDER FORM

Ad No. 1—Place this ad in Category # _____

_____ 1 - $15.00	_____ 2 - $15.00	_____ 3 - $15.00	_____ 4 - $15.00
_____ 5 - $15.00	_____ 6 - $15.00	_____ 7 - $15.00	_____ 8 - $15.00
_____ 9 - $15.00	_____ 10 - $15.00	_____ 11 - $15.00	_____ 12 - $15.00
_____ 13 - $15.00	_____ 14 - $15.00	_____ 15 - $15.00	_____ 16 - $16.00
_____ 17 - $17.00	_____ 18 - $18.00	_____ 19 - $19.00	_____ 20 - $20.00
_____ 21 - $21.00	_____ 22 - $22.00	_____ 23 - $23.00	_____ 24 - $24.00
_____ 25 - $25.00	_____ 26 - $26.00	_____ 27 - $27.00	_____ 28 - $28.00
_____ 29 - $29.00	_____ 30 - $30.00	_____ 31 - $31.00	_____ 32 - $32.00
_____ 33 - $33.00	_____ 34 - $34.00	_____ 35 - $35.00	_____ 36 - $36.00
_____ 37 - $37.00	_____ 38 - $38.00	_____ 39 - $39.00	_____ 40 - $40.00

Ad No 1—Total words _____ × $1.00 per word = $ _____

All Caps words _____ × .20 per word = $ _____

Bold words _____ × .20 per word = $ _____

Bold Cap words _____ × .40 per word = $ _____

TOTAL COST OF AD No. 1 $ _____

Total classified ad Payment $ _____ enclosed.

[ ] Check [ ] MasterCard [ ] Visa ($15.00 minimum credit card order)

Card # _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Expiration Date _ _ / _ _

Signature _____

Name _____ Phone _____

Address _____ City State Zip _____

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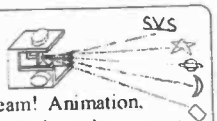
1-800-929-2485

$139* Laser LightShow



Draw with a laser beam! Animation, text, music & more! Includes galvos, servo amp, oscillators, software listing, analog & digital computer interfaces. Call for details

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Includes: 2 Stepper motors, computer interface, 32 page training manual, & software listing. Expandable system! Up to 12 motors, up to 3 amps per phase. Call for details

* Add $6 for shipping. Computer with parallel printer port. Assembly, Power supply, & Laser are required

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Hayward CA 94545-0125

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Fax 510-582-6603

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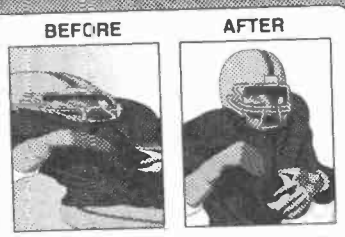
WITH OUR VIDEO STABILIZERS



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GUARANTE to eliminate copy protection.

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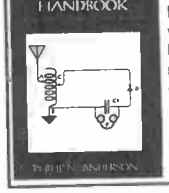
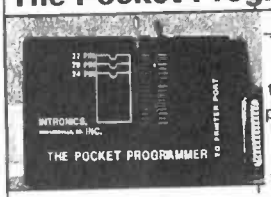


Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only $10.95 plus $4.00 for shipping and handling. **Claggk Inc., P.O. Box 4099, Farmingdale, NY 11735.** USA Funds ONLY! USA and Canada—no foreign orders. Allow 6-8 weeks for delivery. MA01

The Pocket Programmer

$129.95



The portable programmer that uses the printer port of your PC instead of a internal card.

Easy to use software that programs E(E)prom, Flash & Dallas Ram. 27(C)/28(C)(F)/29(C)(F)/25 series from 16K to 8 Megabit with a 32 pin socket. Adapters available for MCU's 874X, 875X, Pic, 40-Pin X 16 & Serial Eprom's, PLCC, 5-Gang and Eprom Emulator to 32K X 8.

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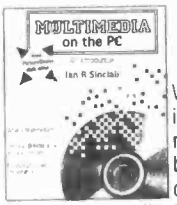

What is Multimedia? What can it do for you? It can do lots of nice things! This 184-page book helps you create your own multimedia presentation. Multimedia applications by people like you can revolutionize educational and business applications as well as bring more FUN, FUN, FUN into your leisure computer activities.

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Please send me my copy of *Multimedia on the PC* (PCP120). I enclose a check or money order for $18.95 to cover the book's cost and shipping-and-handling expenses. NY state resident must add local sales tax.

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To become a member and to receive your free trees, send a $10 membership contribution to Ten Blue Spruces, National Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE 68410.

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The National Arbor Day Foundation™

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ADVERTISING INDEX

POPULAR ELECTRONICS magazine does not assume any responsibility for errors that may appear in the index below.

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President

Christina Estrada
Assistant to the President

For Advertising ONLY
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Fax 1-516-293-3115

Larry Steckler
publisher

Arline Fishman
advertising director

Denise Mullen
advertising assistant

Kelly Twist
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Order Entry
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7:30 AM - 8:30 PM EST

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Northfield, IL 60093-1214
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Fax 1-708-559-0562

PACIFIC COAST/Mountain States

Anita Bartman
Hutch Looney & Assoc., Inc.
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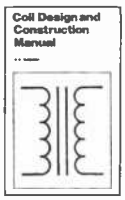
Suite 360
Los Angeles, CA 90048
1-213-931-3444
Fax 1-213-931-7309

Hobbyist's Paperback Budget Books

☐ BP80/98—Popular Electronic Circuits-Books 1 and 2...$11.90. Contains a wide range of circuits which are accompanied by text giving a brief introduction, circuit description and special notes on construction and setting-up that may be necessary.



☐ #160—Coil Design and Construction Manual...$5.95. A complete book for the home builder on how to make RF, IF, audio and power chokes and transformers. Practically every possible type is discussed and calculations are explained in detail.

☐ BP271—How to Expand, Modernize and Repair PC's and Compatibles...$7.75. All the practical information you are likely to need to upgrade your PC and compatible. Also contains useful information and illustrations to help you with repairs.

☐ BP276—Shortwave Superhet Receiver Construction...$6.95. Provides construction details, including coil winding, of a number of advanced-design receivers which should have performance levels at least equal to commercial sets of similar complexity.

☐ #223—50 Projects Using IC CA3130...$5.00. One of the more practical and useful operational amplifiers (opamp), the CA3130 integrated circuit chip is the heart of several easy-to-assemble projects covered in the book. The projects are divided into five categories: audio projects, RF projects, test equipment, household projects and a catch-all miscellaneous group. Ideal for all skill levels.

☐ BP122—Audio Amplifier Construction...$5.75. Practical designs are featured and include circuit diagram and description, Veroboard or printed-circuit board layout and construction notes. The text is divided into two parts. The first deals with many types of preamplifiers. The second covers power amplifiers from a simple low-power battery type to a 100-watt DC-coupled amplifier using four MOSFETs in the output stage.

☐ BP107—30 Solderless Breadboard Projects-Book 1...$5.95. Each project is designed to be built on a "Verobloc" breadboard and is presented with a brief circuit description, circuit diagram, component layout diagram and components list. Notes on construction and applications are provided. Wherever possible, the components are common to several projects to keep project costs down.

☐ BP266—Electronic Modules and Systems for Beginners...$7.25. Shows the reader how to build a number of simple analog and digital circuit modules, all suitable for battery operation, and all based on only 1 or 2 transistors or ICs.

☐ BP329—Electronic Music Learning Projects...$6.25. A beginner's book that will assist you in assembling such projects as the Elexylophone, Gildaphone, Melody Ranger, Cordmaker, Appealing Handbells, Electronic Sol-Fa, Tune-up Box and more.

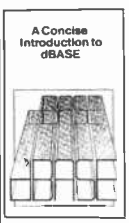
☐ BP319—Making MS-DOS Work for You—$6.50. What you need to know first, comes first, however the text is written in a circular style so that the reader can start anywhere in the text. This book is relevant to all versions of both MS-DOS and PC-DOS.

☐ BP303—Understanding PC Software ...$6.95. Covers main types of PC software, giving details of typical uses, the basics of how they are used and their limitations. Each chapter covers popular software and programs of a similar type.

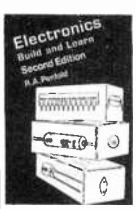
☐ BP105 Aerial (Antenna) Projects...$5.50. In this book the author has considered practical antenna designs, including active, loop and ferrite antennas which perform well and are relatively simple and inexpensive to build. The complex theory and mathematics of antenna design have been avoided. Also included are construction details of a number of antenna accessories including a pre-selector, attenuator and filters.

☐ BP33—Electronic Calculator Users Handbook...$5.75. The book eliminates the mysteries of the calculator and offers unique ideas for the simplest to most complex calculators. Covers the basic functions plus trigonometric, hyperbolic, logarithms, square roots and powers. Included are formulas and data for VAT, discounts, and mark up, currency conversion, interest, binary and octal numbers, and much more!

☐ BP125—25 Simple Amateur Band Antennas...$5.50. Plans to build antennas that are simple and inexpensive to construct and perform well. From the simple dipole to beam, triangle and even mini-rhombic types made from four TV masts and about 400 feet of wire. After the antenna discussion you will find a complete set of dimension tables that will help you "tune" an antenna on a particular frequency.

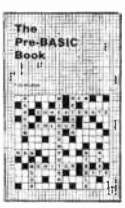


☐ BP263—A Concise Introduction to dBASE ...$6.95. The most popular data-base program, dBASE, is difficult to master without help. This book helps you spend your time using dBase, not setting it up. A user's guide that covers all the basics up to dBase IV.



☐ PCP104—Electronics—Build and Learn... $9.95. Construction details are given to build a circuit demonstrator that is used throughout the book to introduce common electronic components and how these components are built up to useful circuits.

☐ BP302—A Concise Users Guide to Lotus 1-2-3 Release 3.1... $6.25 . Written to help existing spreadsheet users upgrade to 1-2-3 Release 3.1, which has the ability to work 3-dimensionally with both multiple worksheets and files.



☐ BP146—The Pre-BASIC Book...$6.95. Another book on BASIC but with a difference. It concentrates on introducing technique by looking in depth at the most frequently used and more easily understood computer instructions.

Just What the Project Builder Is Looking For!

☐ #160—Coil Design and Construction Manual $5.95
☐ #219—Solid State Novelty Projects $4.95
☐ #222—Solids State Shortwave Receivers for Beginners.....$5.50
☐ #223—50 Projects Using IC CA3130.....$5.00
☐ #225—Practical Introduction to Digital ICs.....$5.25
☐ PCP111—Electronic Test Equipment Handbook.....$13.95
☐ 1596T—24 Silicon-Controlled Rectifier Projects.....$9.95
☐ BP58—50 Circuits Using 7400 Series ICs.....$5.50
☐ BP69—Electronic Games.....$5.50
☐ BP71—Electronic House Projects $5.00
☐ BP84—Digital IC Projects.....$5.50
☐ BP93—Electronic Timer Projects.....$5.50

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SORRY No orders accepted outside of USA & Canada

Number of books ordered ☐

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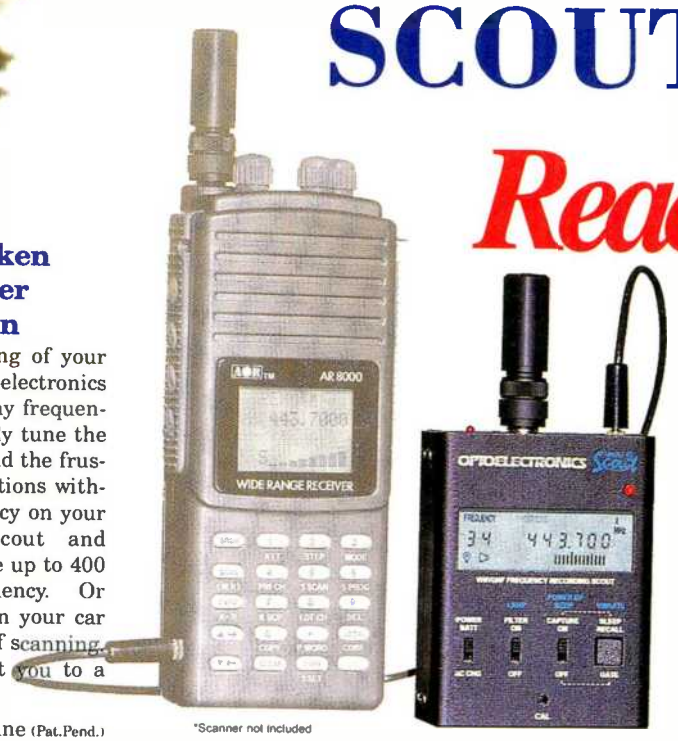

*Scanner not included

The SCOUT™ Has Taken Tuning Your Receiver To a New Dimension

Featuring Automatic Tuning of your AR8000 and AR2700 with the Optoelectronics Exclusive, Reaction Tune (Pat.Pend). Any frequency captured by the Scout will instantly tune the receiver. Imagine the possibilities! End the frustration of seeing two-way communications without being able to pick up the frequency on your portable scanner. Attach the Scout and AR8000/2700 to your belt and capture up to 400 frequencies and 255 hits per frequency. Or mount the Scout and AR8000/2700 in your car and cruise your way into the future of scanning. A simple interface cable will connect you to a whole new dimension of scanning.

The Scout's unique Memory Tune (Pat.Pend.) feature allows you to capture frequencies, log into memory and tune your AR8000/2700 at a later time. A distinctive double beep will inform you when the Scout has captured a new frequency, while a single beep indicates a frequency that has already been recorded. For discreet monitoring, a pager style vibrator will inform you of any hits the Scout captures.

The Scout will also Reaction Tune and Memory Tune Icom CI-V receivers: (R7000, R7100, and R9000) and (Pro 2005/6 equipped with OS456, Pro 2035 equipped with OS535). Download the Scout frequencies to a PC with the Scout Utility Disk and CX-12AR (optional), then compare them to the Spectum CD-ROM/PerCon FCC Database (optional).

Act Now!! Let the Scout Reaction Tune you into The World of Scanning

SCOUT™ $449

Features

- Automatically tunes these receivers with Reaction Tune (Pat Pend.) CI-V receivers (ICOM's R7000, R7100, and R9000). (Pro 2005/2006 equipped with OS456, Pro 2035 equipped with OS535) or AOR models (AR2700 and AR8000).
- Records and saves 400 unique frequencies
- Records 255 hits on each frequency in memory
- Digital Filter and AutoCapture (Pat Pend.)
- 10MHz-1.4GHz single frequency range
- View frequencies in RECALL mode
- 10 digit LCD with EL Backlight
- 16 Segment RF signal strength bargraph
- CX-12AR Computer Interface (optional)
- PC Utility Disk for downloading memory to PC
- Rapid charge NiCads with 10 hour discharge time
- Scout Spectrum CD-ROM/PerCon FCC database (optional)
- AC Adaptor/Charger
- DB 32 VHF/UHF mini-antenna shown with Scout (optional)
- Distinctive Beeper/Vibrator indicate frequency hits

At right: Scout shown with CLIPMATE™. A handy windshield mount for Scout, for quick access and visibility.

CLIPMATE™ $25.00

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