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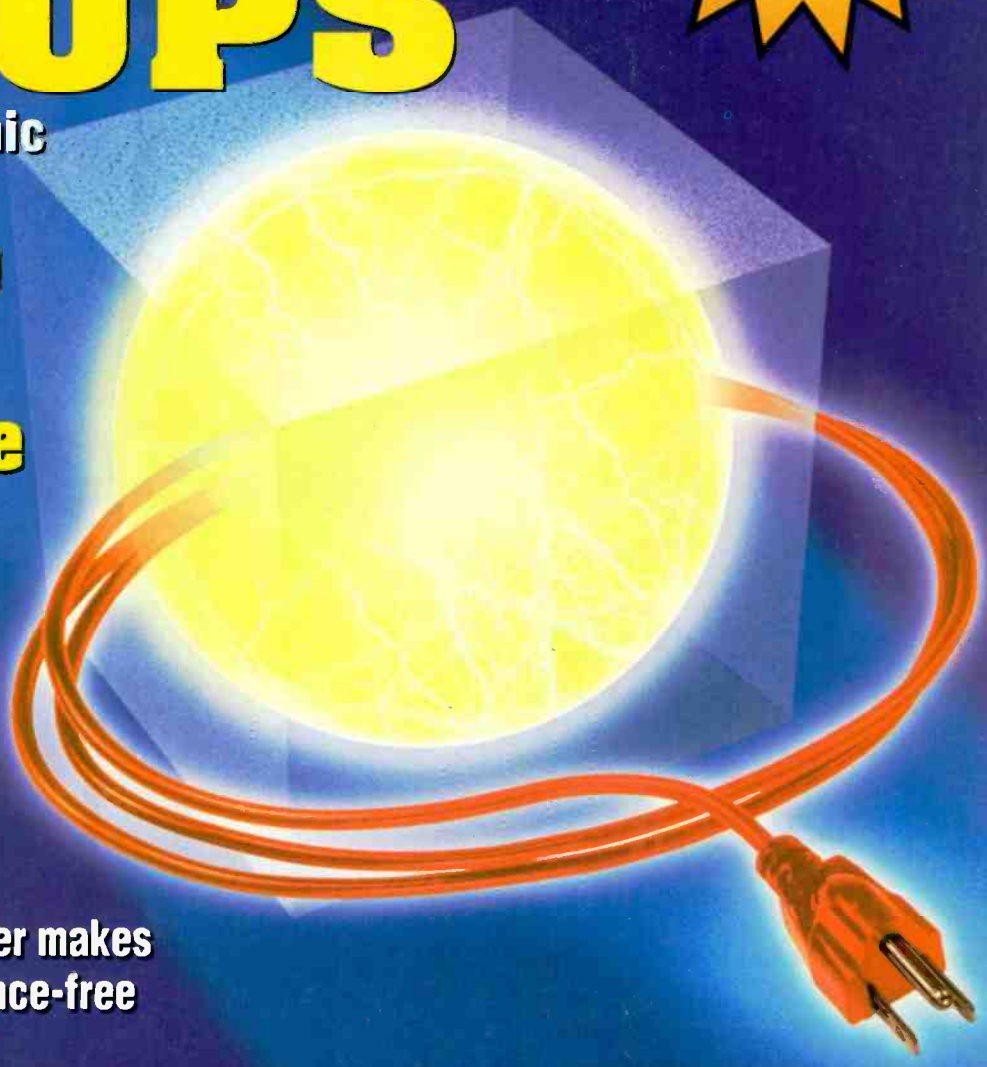

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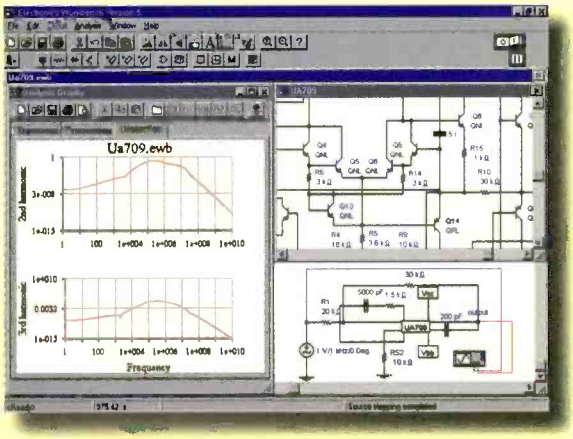

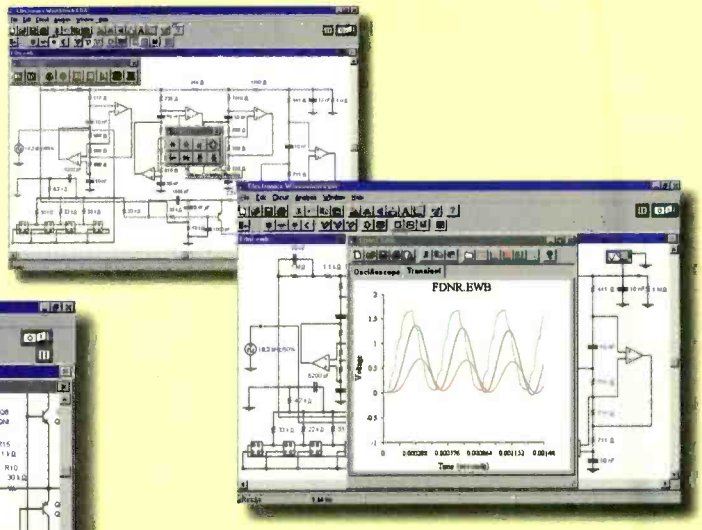

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OCTOBER 1997
Vol. 14, No. 10

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COVER STORY

39 Low-Power DC UPS

Uninterruptible power supplies have been around for a long time helping to keep vital business- and defense- related instruments on-line and ready to go at a moment's notice. Now you can ensure continued operation of your critical electronic equipment during a power failure with the Low-Power DC UPS presented in this article—*Philip Kane*

CONSTRUCTION

42 A Cheap Slave Driver

Build a simple controller circuit that allows you to remotely operate servo-motors to control surveillance cameras, aim your outdoor antenna, actuate robotic arms, and more!—*D. Derek Verner*

44 Ham Radio Code Filter

Here's an interesting "first" project for the budding ham radio operator—an audio filter for making the Morse code station you want to hear stand out from those you don't—*Larry Lisle, K9ZT*

FEATURES

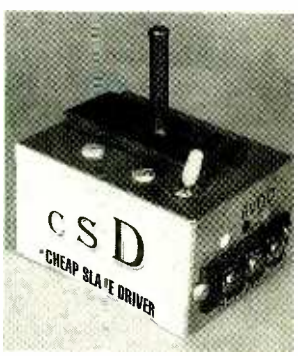
46 All the Time in the World

Some 20,000 years ago, ice age hunters scratched lines in sticks and bones to keep track of the passage of time. Since then the methods have changed, but the need to chart the time of day, day of the week, etc., has not diminished. In this article we'll take a look at the evolution of timekeeping devices, and see how that task is handled in the United States and Canada—*Karl T. Thurber, Jr.*

55 Safety For Electronic Hobbyists

Electrical safety is not just a personal matter. All members of your household should at least be acquainted with some aspects of electrical safety. Your life or that of a family member could depend on it!—*Joseph J. Carr*

Page **39**



Page **42**

Page **44**

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PRODUCT REVIEWS

10 Hands-on Reports
Hewlett-Packard Deskjet 1000C Color Printer

23 Gizmo
Franklin Electronic Publishers Bookman Sidekick Palmtop Organizer, Starfish Software Sidekick For Windows, Terk Technologies TV50 VHF/UHF Antenna, Starfish Software Sidekick 97, Dogbyte Development Frame-It, and much more!

COLUMNS

14 Multimedia Watch
Sights and Sounds of Broadway—*Marc Spiwak*

20 Net Watch
Job Hunting Made Easy—*Dan Karagiannis*

59 Antique Radio
Radio for the Millions!—*Marc Ellis*

62 Ham Radio
Big Loop Antennas—*Joseph J. Carr*

64 Scanner Scene
Cordless Phone Monitoring: A Legal Question—*Marc Saxon*

65 Computer Bits
Adios ISA—*Jeff Holtzman*

68 Circuit Circus
Op-Amps—*Charles D. Rakes*

71 Think Tank
Craig Revisited—*John Yacono*

75 DX Listening
Solomon Islands Calling—*Don Jensen*

DEPARTMENTS

4 Editorial
8 Letters
22 New Products
33 Electronics Library
77 Popular Electronics Market Center
110 Advertising Sales Offices
110 Advertiser's Index
110A Free Information Card

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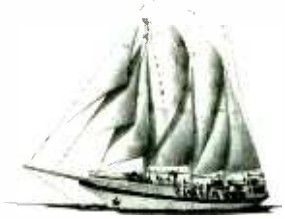

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Editorial

The Year 2000 Hoax

Gloom and doom! That's all you hear about when forecasters talk about computers or data bases and the year 2000. The Social Security System will have to be broken up and completely restored. The Internal Revenue Bureau will have to shut down. (Well, that's not bad news exactly.) Even the lowly PC will have a solid-state hernia and never work again! Woe is us!

I always worry when I hear gloom and doom forecasts. It reminds me that maybe a few more flew over the cuckoo nest. Worse yet, a whole flock escaped in the region of Silicon Valley. But don't despair. We have nothing to fear but gloom-and-doom forecasters.

This past week I received my New York State Driver License. I checked the basic data on the stiff plastic card and everything was correct. Even the expiration date—into the next century. How did they do it?

Earlier, I asked the Internal Revenue Service for information on an amortization plan for electronic equipment I currently own. Most of the items required a five-year plan and allowable percentages were given up to and including the year 2002. How did they do it?

So, I went for the acid test. I asked my local banker for a repayment schedule for a 35-year, $250,000 home loan. It took some computer inputting on his part (he typed with one finger) and the nearby printer delivered a schedule into 2032. How did he do it?

The banker laughed when I told him about the gloom and doom forecast for the year 2000. He said that mortgage bankers were writing 30-year mortgages for some time and encountered the problem and solved it long ago. He said that programmers know what to do, and corrections will be forthcoming for PC users. He pointed out that Sirius Software's GT Accounting for Windows will automatically pump in the year 2000 when a two-digit year 00 is inputted. This is true for all inputs from 00 to 69.

So, in preparation for the year 2000, (which, by the way, is not the turn of the century) join with me is acquiring an expensive bottle of champagne or bottled water (your choice), noisemakers and paper party hats. Let's celebrate at that time without any gloom and doom. It's all a hoax!

Julian S. Martin

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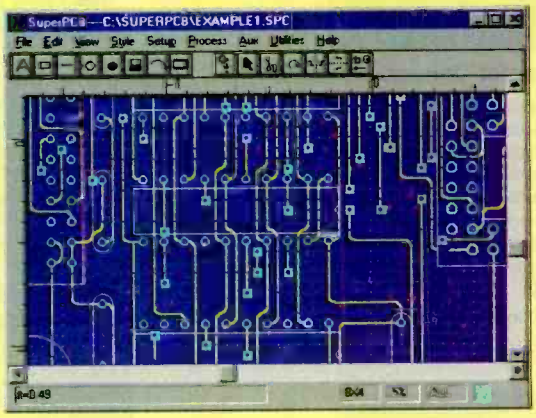

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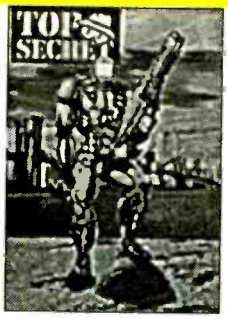

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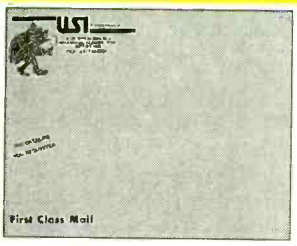

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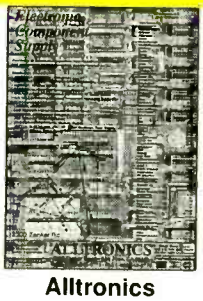

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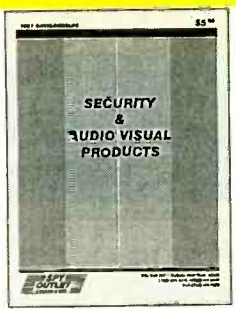

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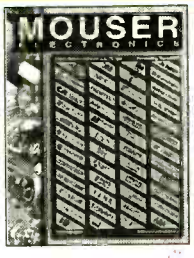

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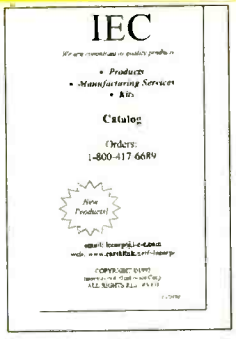

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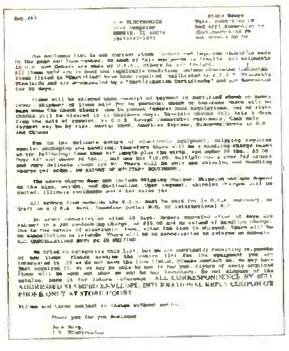

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LETTERS

CORRECTIONS

In the schematic diagram (Fig. 1, page 45) of the June 1997 article, "Soft Switch," the 220k-ohm resistor (R2) was shown incorrectly. It *is drawn properly* in the PCB layout diagram (Fig. 4, page 47)–in series with pin 4 of IC1, *not* the triac, TR1.
Ian McQueen
Saint John, NB, Canada

Thanks for catching this one, Ian. Those readers who purchased the kit from Jameco Electronics, or used our PCB layout, are ***not*** *affected by this schematic error.—Editor*

In the text on page 44 of "The Heartbeat Machine" (July 1997), it says that the wiper of R11 goes to the non-inverting input of pin 9. I always thought that pin 9 of an LM342N Quad Op-Amp was inverting. Who is wrong?
Bob Phillips
Fallbrook, CA

Sorry, Bob, we are wrong! The sentence should read "The output of U2-b is fed through the wiper of R11 to the ***inverting*** *input of IC2-c to set...." Also in Fig. 1 on the same page the designation of IC1-b should be changed to IC2-b.—Editor*

There is an error in the schematic, Fig.1, page 55, that was redrawn for my article "DTMF Frequency Counter" in the August 1997 issue. On the LM555 (IC1), pin 3 does not go to ground–it should be labeled pin 2. Also of lesser importance, the displays, DISPs 1, 2 and 3, do not have any wires going to +5 volts. They get their power through pin 3 when it is needed.
William McKellips
Bolingbrook, IL

Thanks for your feedback, William. You put together a great project and we want to make sure that our readers built it correctly.—Editor

SPEAKER NOSTALGIA

Of the many things I learned from my dad, one was a love for electronics. Through the years we enjoyed reading **Popular Electronics** and built some of the monthly projects you published.

One of those projects was a hi-fi speaker system called "The Sweet Sixteen," which debuted sometime in the early 1960s. I remember my dad enjoyed building it. I looked for a copy of the issue in my library, but the library did not have a listing for that article. I would be interested in obtaining a copy of it, if possible.

Hey, how about a bit of nostalgia? Why not print the article again. You could run a side-bar of ways to update the system using acoustic suspension speakers and ports for improved sound. I think your readers would love such an article, blending the old with the new. Even with the advent of today's sophisticated, technologically superior speaker systems, a bit of the old would be appealing, while still offering very good sound.
R.J.R.
Medford, OR

The progress made in loudspeaker systems since 1960 results in inexpensive store-bought models, cheaper than can be built—including the Sweet Sixteen. However, if you like to "roll your own," why not look at the series of articles by William R. Hoffman in the 1995-1996 issues of ***Popular Electronics****, where we covered all types of speaker construction.—Editor*

MORE MAC, PLEASE!

I second the motion forwarded by M.C. of Hudson, Florida (*Letters*, **Popular Electronics**, July 1997). He listed several good reasons for hating those Window boxes. I wonder if you are aware of the percentage of your readers who are turned off by your articles based 100% on Windows and DOS. Wouldn't it be a good idea for you to find out just how many of your subscribers are Mac users? While I would not like to see **Popular Electronics** turn into just another computer magazine, I suspect you don't really know what you printed—"Mac readers are even scarcer."
R.H.
Scotia, NY

I have been using Macs since using an SE in 1988, and I'd love to see more Mac articles in **Popular Electronics**, please! Thanks!
B.H.
(via e-mail)

Please–more articles covering Mac O/S–especially the new Rhapsody O/S (in pre-alpha development).
S.J.
(via e-mail)

The editor has been using non-Macs since 1979. Nevertheless, we will be fair in our coverage in the future.—Editor

A NEW WRINKLE

I have been a regular reader of **Popular Electronics** since 1967. During these past 30 years, I have enjoyed learning about the many different aspects of electronics. I have built many useful and fun projects, and I have kept up with the latest in technology, all because of your magazine. Keep up the good work!

In the July 1997 issue, reader June Houser asked for help in restoring the wrinkle finish on her father's radio. Wrinkle-finish spray paints are still available from a number of sources. I have purchased them at larger paint supply and automotive supply stores, and electronic supply houses. Lately I have seen them in two different colors: black and gray.

They apply just like a normal spray paint, but as they dry, they form a surface skin that expands and wrinkles up to form the final surface. The spray-can version of this paint does not exactly match the texture of the 1940's finishes. The current version tends to be coarser or rougher than the older finishes. But the final texture of the new paint can be controlled to a degree by drying temperature. If the paint is oven-dried, it will produce a finer or smoother texture.

Here in Chicago, spray paint sales have been banned, so Ms. Houser might have to go to a suburban location to purchase this paint. I hope this information is helpful.
W.T.
Chicago, IL

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FITNESS ARTICLES

Since fitness is a "big thing" these days, I've been searching my back issues looking for a project to build a heart rate monitor with digital display and alarm. Have you ever done one? If not, will such a project be forthcoming?
D.C.
Ontario, Canada

Well we just did our exercise by looking through the annual indexes of ***Popular Electronics*** *for the past five years. Closest article we could find to that subject was "The Heartbeat Machine" in the recent July 1997 issue. As with most of our projects, they are generated out of house. That basically means we usually can publish it if someone out there designs and writes the project up. Any fitness-types out there who are electronically inclined–send us in those stories!–Editor*

OBSOLETE PARTS

A number of our readers have notified us that the dot matrix display units (Hewlett-Packard part HDSP-L203) specified in the article "Build an LED Oscilloscope" (page 33, June 1997) have been obsoleted by the manufacturer. Although the surplus market may turn up a few, the project requires twelve units to make up the final display matrix (plus a couple for spares!). We turned the problem back to the author, Carl Bergquist, who identified a number of alternate parts which should be excellent replacements for the original.

The best option seems to be from Jameco Electronics (800-445-4242). They carry a 0.7-inch red unit, part #118906, that is a cathode row/anode column arrangement and seems like a near replacement, both electrically and price-wise. Other possible sources are Electronic Goldmine (800-445-0697), with part #G8284 red/green display; also Circuit Specialists (800-528-1417), with their part # TC20-11EWA—this is a larger display (2-inch) and costlier.
Carl Bergquist
Montgomery, AL

Carl also mentions a couple of other sources, but these required modifications to the original design, and so we didn't include them in this summary. Those who contacted us by e-mail got this information first-hand as soon as we got word from Carl. Also keep checking our Web site to read online corrections before they are printed in this column of the magazine. That could save a month or more of aggravation in hunting for parts, or if a particular circuit isn't working properly. We won't let you down!–Editor

SPEED CONTROLLER FOR REMOTE-CONTROL MODELS

I'm writing in response to the letter from Mike Criswell ("Haves & Needs," **Popular Electronics**, April 1997), requesting information on inexpensive speed controls for remote-controlled model airplanes. I wrote the "Scale Electric" column for *Scale R/C Modeler* for 10 years.

I wonder if Mr. Criswell ever looks at the model magazines and electronics magazines—the advertisements as well as the projects. There are more than 50 different speed controls available from a large number of manufacturers, including Cermark, Astro-Flight, Novak, Jomar, Cannon, Tamiga, Futaba, Airtronics, ACE R/C, and Hitech, to name just a few that come immediately to mind. Many of the controls are priced in the $35 to $75 bracket. In addition, I've seen many published designs for speed controls. *RCM, Model Builder, Electron Electronics*, and *RCM World* have all published good designs.

I manufacture many different types of electronic devices for radio control, free flight, and U-control—including a speed control, which consists of the microprocessor, two MOSFETS, and Schottky diode at a cost of about $18 when ordered in small quantities. I charge $10 to program the microprocessor. When you consider that you have to make your own board and be responsible for all errors, $35 seems very affordable.
Bill Young
Bill Young Designs
4403 East Rustic Knolls Lane
Flagstaff, AZ 86004

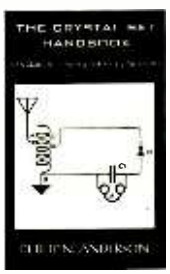
HAVES & NEEDS

I need an operator's manual for a Heathkit Model No. IG-102S RF signal generator, and the wiring harness for a B & K Precision Model No. 465 tube tester. Any help that you can provide will be appreciated.
Larry Cook
362 East South Street
Richland Center, WI 53581-2721

I'm looking for a schematic and parts list for a Telequipment D1011 dual-channel scope. I will pay for the return postage and handling.
Al Learman
242 Third Avenue West
Prince Rupert, BC
Canada V8J 1L1

I need a fog whistle timer for my sailboat. When S1 is turned on, the timer will operate a relay, which in turn triggers a relay. The timer must be able to recycle continuously at the rate of two minutes off and four seconds on. I'd like it to have heavy-duty components for years of lasting service. Can anyone design such a circuit for me?
Thomas Cook
424 Warder Crescent
Qualicum Beach, BC
Canada V9K 2A5 ■

INSIDE CRYSTAL SETS



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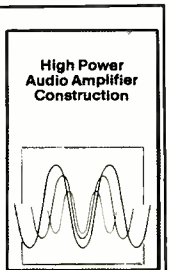
HIGH POWER AUDIO AMPLIFIER CONSTRUCTION



BP277—Here's background and practical design information on high power audio amplifiers capable of 300±400 watts r.m.s. You'll find MOSFET and bipolar output transistors in inverting and non-inverting circuits. To order your copy send **$6.25 plus $3.00** for shipping in the U.S. and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.** U.S. and Canada only. Payment in U.S. funds by US bank check or International Money Order. Please allow 6-8 weeks for delivery. MA03

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A Hands-on Electronics® REPORT

HEWLETT-PACKARD DESKJET 1000C COLOR PRINTER

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If you're looking to add a little color to your business presentations, look no further!

There was a time when computer users had a confusing array of printers from which to choose: dot-matrix, daisy-wheel, ink-jet, and laser printers all competing for the consumer's dollars. Over the past several years, dot-matrix and daisy-wheel printers have all but disappeared, and ink-jet and laser printers have comfortably occupied their own market niches.

Lasers were the printers of choice for business, including SOHO (small-office/home-office) applications. They offered quick and quiet operation, the low per-page costs needed for high-output jobs, and the superior resolution required for professional documents. Ink-jets better matched the needs (and wallets) of families, with resolution adequate for homework assignments, budgets and financial printouts, and the like. As a bonus, many ink-jets featured color printing, which allowed users to jazz up term papers and create snazzy custom calendars and greeting cards. True, for color printing the cost-per-page was high and pages-per-minute (ppm) slow. But home users don't produce anywhere near the amount of pages that busy companies do, and they're usually not facing business deadlines.

The nicely balanced coexistence between ink-jets and laser printers is being threatened by recent technical advances in ink-jet technology. As ink-jet output lost its trademark fuzziness, the once sharp line between top-of-the-line ink-jets and entry-level laser printers has become blurred. And these days, virtually all ink-jets have color capability. You can now get good color output for very little money, which has many business users looking twice at ink-jet printers.

Should they buy a color ink-jet to replace their monochrome laser printers—or just to supplement them? After all, a little color adds a lot of punch to business presentations, brochures, and pamphlets. And the ability to print in color can greatly reduce a business's off-premise printing costs. (In fact, a significant portion of business ink-jet sales are to companies with networked laser printers. The ink-jets serve as individual printers, allowing employees to create colorful presentations and reports when needed, but still use the main printer for most paper-intensive, monochrome jobs.)

HP DeskJet 1000C

Hewlett-Packard Company's *DeskJet 1000C Professional Series* printer is one of today's tempting ink-jet packages. It prints 4 x 6-inch postcards, 11 × 17-inch spread sheets, everything in between, and then some—including billboards, banners, and oversized 13 × 19-inch media. With three specialized paper feeds, it also handles a wide variety of media types and thicknesses. And, as has become the norm with any printer, the DeskJet 1000C includes a software bundle intended to help users learn how to take advantage of the printer's sophisticated features to create professional-looking print jobs.

The DeskJet 1000C requires a good bit of desk- or counter-top space. With its paper trays fully extended, it measures 22.8-inches wide by 8.8-inches high by 26.3-inches deep. With the two paper trays closed—the output tray folds upward and the input tray slides under the printer's main body—the printer's depth is reduced to 13 inches. The main feed tray, which rests on the desktop in front of the printer, holds up to 150 sheets of paper up to 13 × 9-inch size. Above it is the output tray, which holds up to 50 sheets. The output tray also serves as the "Alternative Media Feed," holding up to ten sheets of paper or three envelopes. There is a third paper feed on the back of the unit, intended for printing on thick paper that requires a straight paper path.

Set-up and installation are straightforward. The printer is connected to the computer's parallel port via a supplied cable. The DeskJet 1000C is pre-configured for Windows 95—place the "Starter CD" in the CD-ROM drive, and the PC should recognize it and automatically run the setup. On-screen pointers help you complete the installation; the printer driver is installed by simply clicking on the printer driver icon. The printer is also compatible with Windows 3.1, although a few

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How to make your car invisible to radar and laser...*legally!*

Rocky Mountain Radar introduces a device guaranteed to make your car electronically "invisible" to speed traps—if you get a ticket while using the product, the manufacturer will pay your fine!

by Phil Jones

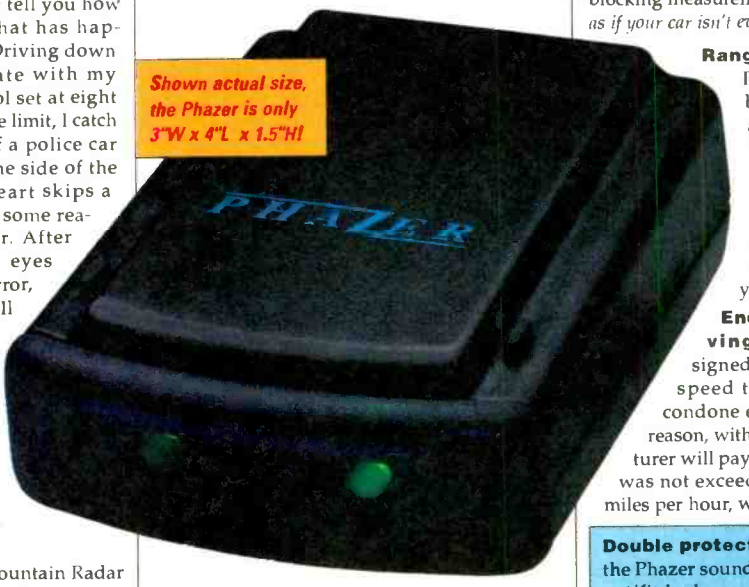
If your heart doesn't skip a beat when you drive past a speed trap—even if you aren't speeding—don't bother reading this. I can't tell you how many times that has happened to me. Driving down the interstate with my cruise control set at eight miles over the limit, I catch a glimpse of a police car parked on the side of the road. My heart skips a beat and for some reason I look at my speedometer. After I have passed the trap, my eyes stay glued to my rear view mirror, praying the police officer will pass me up for a "bigger fish."

■ ***The Phazer will "jam" both radar and laser guns, preventing police from measuring your speed.***

It seems that as speed-detection technology has gotten more and more advanced, speeding tickets have become virtually unavoidable. And although devices exist that enable motorists to detect these speed traps, they are outlawed in many states... including mine.

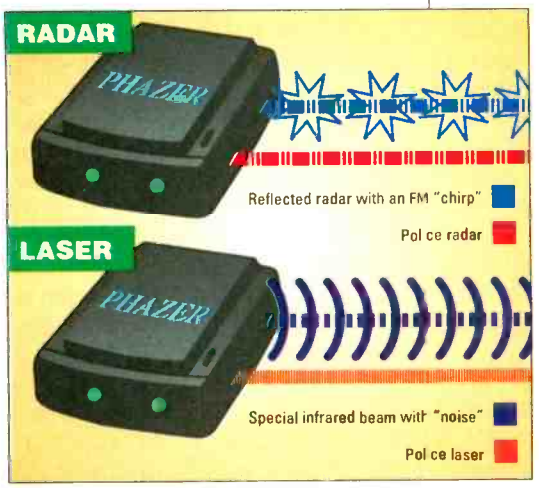
The solution. Today, Rocky Mountain Radar offers drivers like me a perfect solution—the Phazer. Combining a passive radar scrambler with an active laser scrambler, the Phazer makes your automobile electronically "invisible" to police speed-detecting equipment.

The radar component works by mixing an X, K or Ka radar signal with an FM "chirp" and bouncing it back at the squad car by way of a waveguide antenna, effectively confusing the computer inside the radar gun. The laser component transmits an infrared beam that has the same effect on laser Lidar units.



Shown actual size, the Phazer is only 3"W x 4"L x 1.5"H!

Perfectly legal. Some radar devices have been outlawed because they *transmit* scrambling radar beams back to the waiting law enforcement vehicle. The Phazer, however, *reflects* a portion of the signal plus an added FM signal back to the police car. This, in effect, gives the waiting radar unit an electronic "lobotomy." Best of all, unless you are a resident of Minnesota, Oklahoma or Washington, D.C., using the Phazer is completely within your legal rights.



HOW TO MAKE YOUR CAR DISAPPEAR

Radar and laser scramblers are devices that foil speed traps by making vehicles electronically "invisible" to police radar. Radar scramblers mix a portion of the radar signal with background clutter and reflect it back to the squad car. This technique, pioneered by Rocky Mountain Radar, creates an unreadable signal that confuses the computer inside the radar gun.

The laser scrambler in the Phazer works in a similar manner. It transmits a special infrared beam with information designed to scramble the laser signal. The result? Readouts on police radar and laser guns remain blank. As far as the police officer is concerned, your vehicle is not even on the road.

■ ***The Phazer makes your car invisible to police radar and lasers or the manufacturer will pay your speeding ticket!***

How it scrambles radar. Police radar takes five to 10 measurements of a vehicle's speed in about one second. The Phazer sends one signal that tells the radar the car is going 15 m.p.h. and another signal that the car is going 312 m.p.h. Because police radar can't verify the speed, it displays no speed at all. *To the radar gun, your car isn't even on the road.*

Works with laser, too! The Phazer also protects your vehicle from Lidar guns that use the change in distance over time to detect a vehicle's speed. The Phazer uses light-emitting diodes (LEDs) to fire invisible infrared pulses through the windshield. Laser guns interpret those pulses as a false indication of the car's distance, blocking measurement of your speed. *Again, it's as if your car isn't even on the road.*

Range up to three miles. The Phazer begins to scramble both radar and laser signals as far as three miles away from the speed trap. Its range of effectiveness extends to almost 100 feet away from the police car, at which point you should be able to make visual contact and reduce your speed accordingly.

Encourage responsible driving. While the Phazer *is* designed to help you (and me) avoid speed traps, it *is not* intended to condone excessive speeding. For that reason, within the first year, the manufacturer will pay tickets where the speed limit was not exceeded by more than 30%, or 15 miles per hour, whichever is less.

Double protection from speed traps. If the Phazer sounds good, but you prefer to be *notified* when you are in range of a police radar, the Phantom is for you. The Phantom combines the Phazer (including the Ticket Rebate Program) with a radar detector. It's legal in every state except Minnesota, Oklahoma, Virginia and Washington, D.C. Ask your representative for more details!

Risk-free. Thanks to Rocky Mountain Radar, speed traps don't make my heart skip a beat anymore. Try the Phazer or the Phantom yourself. They're both backed by our risk-free trial and three-year manufacturer's warranty. If you're not satisfied, return them within 90 days for a full "No Questions Asked" refund.

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additional steps are required during the initial installation in that operating system. In addition to Windows 3.1 or 95, the printer software requires at least 8 MB of available RAM. The color- and black-ink printer cartridges are inserted, side by side, in cradles located under the printer cover.

The DJ1000C Toolbox utility helps you align the cartridges and run tests to ensure that the black and color inks are in sync. The Toolbox, which appears on your Windows desktop once the printer software is installed, also provides tutorials to help you with basic printing and special effects features, as well as maintenance and troubleshooting tips on everything from clearing a paper jam to cleaning the print cartridges.

Should you need more information on using the printer, the Starter CD offers an on-screen user's guide that demonstrates the many special effects that can be achieved using the DeskJet 1000C, including HP ZoomSmart Scaling, two-sided booklets, billboards, handouts with up to eight pages of a document printed on a single sheet, two-sided pages, banners, and mirror images. All of the special effects are accessed by clicking on the Features tab in the print settings dialog box in the software program you are using. In Microsoft Word, for instance, we selected Print from the File menu, then Printer, then Options. We were presented with a host of choices, including page orientation, print speed/quality (standard, best, and econo/fast), number of copies, and special effects.

HP ZoomSmart Scaling technology lets you enlarge or reduce your document to fit a specific paper size. You select the sizes of the original and the printed copy, and the printer automatically scales the document to fit.

The Booklet feature allows you to print a multiple-page document so that it looks like a book—printed on both sides of the page and ready to be collated and folded. The DeskJet 1000C automatically chooses a paper size double that of the finished booklet, then prints two pages on one side of each sheet. You are then instructed to remove the paper and turn it in the feed tray to print the rest of the document on the reverse sides. If your finished product is to be an 8.5 x 11-inch, eight-page booklet, for instance, the DeskJet will print pages 2 and 7, and 4 and 5, on one side of two 11 x 17-inch tabloid sheets. Flip those pages over, and it will print pages 1 and 8 on the back of 2/7, and 3 and 6 on the back of 4/5. Collate, fold, and you have your 8.5 x 11-inch booklet.

This photograph was taken with a digital camera and printed on the DeskJet 1000C.

Billboard printing lets you create posters as large as 54-inches square using an effect called "tiling." The image is divided into a number of different sections (tiles), which can be pieced together after printing to form one large image.

The Handouts feature is just the opposite. Instead of turning one image into several segments on different pages, Handouts allows you to print two, four, or eight pages onto one sheet of paper. You might want to use it to print copies of your slides to give to your audience before a presentation.

In Two-Sided printing, the DeskJet outputs all the odd-numbered pages. An on-screen message then instructs you to flip the pages and return them to the feed tray. The even-numbered pages will be printed on their reverse sides.

Banner printing requires the use of fold-out banner paper; Hewlett-Packard's is strongly recommended. Mirror-Image printing reverses the image to accommodate such applications as iron-on transfers.

It was easy to access and use all of the special-effects features, and to use the DeskJet 1000C for everyday applications such as word processing or spreadsheets. There were some differences between the DeskJet 1000C and the laser printer we're accustomed to using. The most obvious was the increased noise level; next, we noticed the slower printing speed.

In both color and monochrome printing, there are three print modes available. With the printer set in "best" mode (600 × 600 dots per inch, or dpi), black output is up to 4.5 ppm and color output is up to 0.5 ppm. Of course, the actual speed depends upon the complexity of the material being printed. The photograph accompanying this article took close to four minutes to print in 4 x 6-inch size. In "econo/fast" mode (600 × 300 dpi in black, 300 × 300 dpi in color), print speed is a relatively quick 6 ppm (black) or 3.5 ppm (color). As for print resolution, it was difficult to distinguish the DeskJet's best-mode text output from that of our laser printer. In "econo/fast" mode (300 dpi), the print was visibly fuzzier, but still easily legible and fine for first drafts. We found the "normal" mode to be adequate for most tasks.

Color output quality depends not only upon the mode selected, but also upon the print medium. Try to print a photo you've downloaded from the '"Net" or scanned into your PC onto standard printer paper, and you're bound to be disappointed. (Unless you're totally new to color printing, in which case it will be a bit of a thrill even if it isn't photo-quality.) There's some pixelation, and noticeable scan lines mar the image. But switch to the glossy paper intended for color printing, select best mode, and you'll be truly impressed with the results. The printer uses HP's RealLife Imaging System to automatically deliver vivid colors and sharp black text. The system is a set of technologies including the company's ColorSmart, which automatically adjusts and optimizes color settings; C-REt (Color Resolution Enhancement Technology),

(Continued on page 45)

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2198 Berlin Turnpike
Newington, CT 06111

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North Haven, CT 06473

Georgia

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3653 Clairmont Road
Chamblee, GA 30341

Illinois

Tri State Elex
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Kansas

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Missouri

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Multimedia Watch

Sights and Sounds of Broadway

MARC SPIWAK
COMPUTER RESELLER NEWS
ASSOCIATE REVIEWS EDITOR

Video capture cards are nothing new—I had one by Media Vision back in the early days of Windows multimedia. The exact name of that product escapes me for the moment, and I'm not even sure where it is. I'm not sure what happened to Media Vision either, but that's another story.

If I can pinpoint the exact time that my old video capture card became obsolete, I'd say it was with the introduction of Windows 95. For the most part, no pre-Windows 95 multimedia hardware is of any use today. For that matter, the systems that we ran Windows 3.1 on really stink today, especially if you're interested in multimedia. I ran that card in a non-local bus 486DX2/50, with a display limited to 256 colors. That was a hot system in its day, and it died with a 3X CD-ROM installed—another hot product in its day. It doesn't matter that my 486 died, because today it's of no use to me—no matter what the box says; multimedia software does not run well on any 486. Even the early Pentiums are too slow in my opinion.

Video capture cards have advanced just as much as computers. My old video capture card generated choppy .AVI files in small windows with poor sound. My new video capture card—*Broadway 2.0* by Data Translation—captures video that I can play full screen. It can capture video in .AVI or MPEG format, the latter being much better quality. To run Broadway, you need at least a Pentium 90 with 16 MB of memory running Windows 95 or Windows NT. It must have a Super VGA graphics card that should include color space conversion and video scaling, a Sound Blaster 16-compatible sound card to digitize audio, and a CD-ROM drive.

The system also needs one free PCI slot and what some people would consider to be an enormous amount of hard disk space. You need 5 MB for the Broadway application and 20 MB for MediaStudio—which lets you edit video. You also need 9 MB for each minute of fully-compressed video in MPEG-1 format. Although you can capture MPEG directly to disk, which is really cool, you can't edit it direct capture. That's why there's the additional 60 MB-per-minute capture option that lets you edit captured video first and then turn it into fully compressed MPEG.

Broadway can turn any composite or S-Video signal into quality MPEG-1 digitized video that can be added to presentations, saved on a hard drive, or even burned onto a CD. Broadway captures full-color and full-motion video at 30 frames per second, and synchronizes the audio digitized by your sound card with the captured video. Video is digitized in real time and stored on your hard drive in an editable .AVI format. You can watch the video source in real time before capturing, so you know exactly when to record—in effect your PC behaves just like a VCR.

Broadway 2.0 captures video that can be played back full screen. You have the option to capture video in .AVI or MPEG format.

You can edit video in near real time because Broadway uses hardware to accelerate editing. Broadway is also Video-for-Windows-compliant, so it works with an editing package like MediaStudio Pro or Premiere. Broadway compresses edited video clips into MPEG-1 format at about three times real time—three minutes for a one minute clip. You can also compress existing .AVI files that weren't captured with Broadway. The compression ratios for audio and video can be set so that each minute takes up more or less disk space, depending on the desired playback quality.

The Broadway package installs in minutes, just like any other plug-and-play card. I had no problems getting it to work. I just plugged the Broadway MPEG board into an available PCI slot, installed the plug-and-play driver and application software, and then connected the board's input port to the video output on a VCR (connected to cable TV). Audio from my VCR connects to the input on my sound card. This way I can capture video and audio directly off TV or a VHS tape, which I can even make on a camcorder. If I wanted to, I could connect my camcorder directly to Broadway.

By the time you read this, *Broadway 2.5* will be available. This newer version will have an output to tape, allowing digital video editing and the recording of finished clips back onto VHS tape. It will have other new features that I'll talk about after I see it. Broadway 2.5 will sell for the same $995 that version 2.0 does. Broadway is not cheap, but hardware MPEG compression is not easy.

I've been having a lot of fun with Broadway. I actually captured one of my favorite movies, Terminator2-Judgment Day, to MPEG—about 900 MB worth! Even though I still have over 2 GB free disk space, I'm not going to leave the movie on my hard drive. I'm going to transfer it to CD-ROM, so I can play my favorite movie on PCs wherever I go. If I were publishing multimedia software, Broadway would become a powerful tool rather than a toy, but what a useful tool it would be. If you need a tool to produce MPEG video, then contact Data Translation today.

New Stuff

If you're wild about the Old West and cyberspace, then this game's for you—LucasArts' *Outlaws*. This adventure game pays homage to 1960's spaghetti westerns. In it you are the loner riding into town, seeking vengeance when you uncover the no-good plot of a railroad baron and his outlaws. This realistic shoot-em-up game is loaded with action. A multiplayer network mode lets

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Why pay for cellular phone service if you only want it for emergency use?

The SOS Phone offers a 24-hour call center to connect you with your emergency roadside service, 911 service or family members in the event of an emergency.

Press the Tow button and your emergency road service will be dispatched to tow your automobile.

To tell you the truth, I am not interested in owning a cellular phone...*except for use in an emergency.* What would I do if my car broke down on the interstate or ran out of gas on some deserted back road? How would I get help? Like most women, I have the safety of my children to consider.

Last month, I inquired about cellular phone service. I was surprised to find out how expensive it was, even for the most basic calling plans! I just couldn't justify spending that much for something I may never need. Then a good friend told about a product she thought would solve my problem. It's the SOS Phone—a cellular phone service designed exclusively for emergency use!

What does it do? With the touch of a button, the SOS Phone will connect me to a roadside emergency service, a 911 service or a trained SOS operator, 24 hours a day. If I ever need help, I know it's just a phone call away.

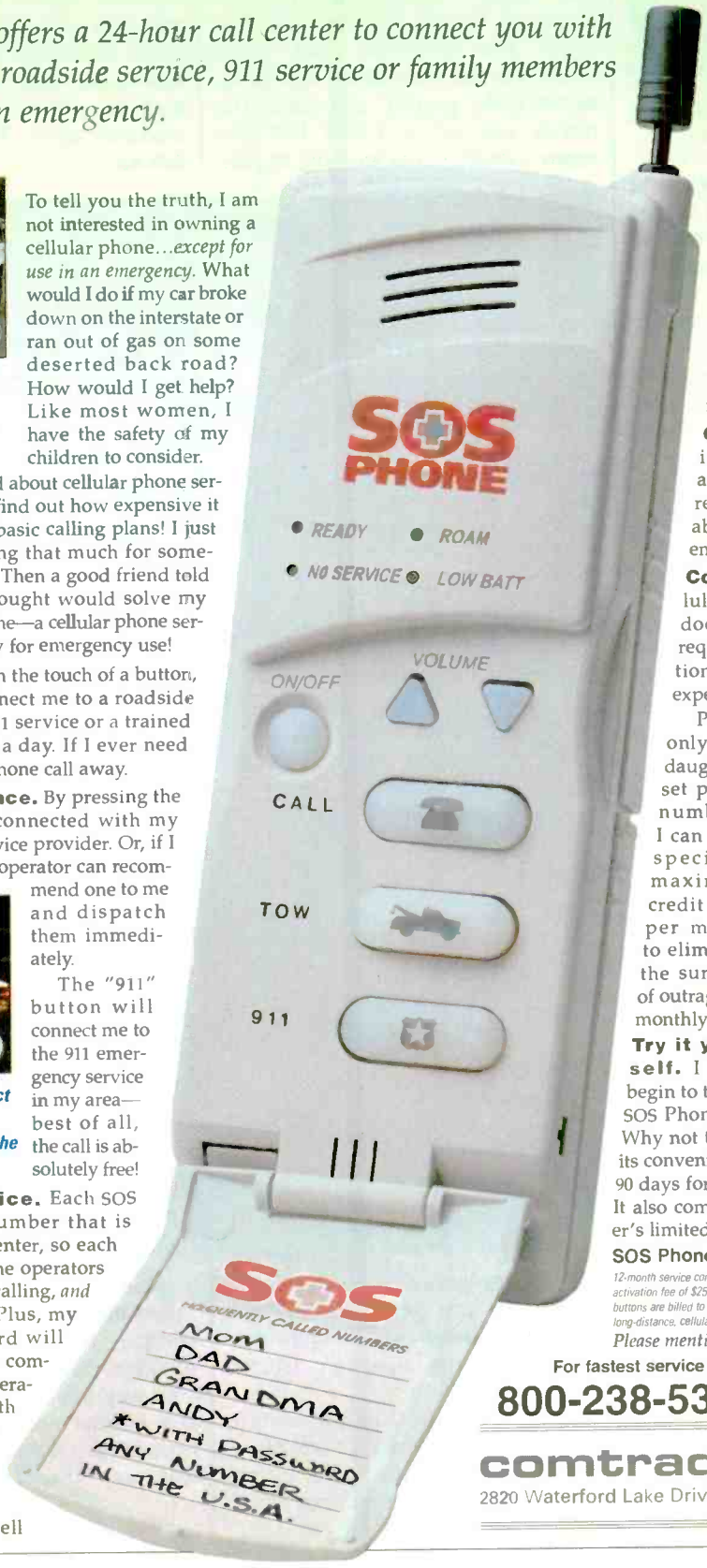
Emergency assistance. By pressing the "tow" button, I'll be connected with my emergency roadside service provider. Or, if I don't have one, the SOS operator can recommend one to me and dispatch them immediately.

The 911 button will connect you to 911 police or other emergency services, and the call is absolutely free!

The "911" button will connect me to the 911 emergency service in my area—best of all, the call is absolutely free!

Personalized service. Each SOS Phone has a serial number that is recorded at the Call Center, so each time I use my phone, the operators will know that it is me calling, *and will greet me by name.* Plus, my SOS Emergency Record will appear instantly on the computer screen and the operator will connect me with the person or emergency service I need.

Not just for emergencies. If I just want to call home to tell my husband that the kids and I are running late, I can! By pressing the "call" button, I'll reach an operator. When I ask the operator to call home, I'll be connected automatically. And because the Call Center has my list of 10 most-used phone numbers, I don't even have to recite the number!



Great for teens. The SOS Phone is also a great thing to have around for my stepdaughter. I can rest assured that she'll always be able to get in touch with us (or an emergency service) if she needs to.

Cost control. Unlike ordinary cellular phone plans, the SOS Phone doesn't have any minimum usage requirements or any other stipulations that could change the price I expect to pay each month.

Plus, without my password, the only non-emergency calls my stepdaughter can make are to our 10 preset phone numbers. I can even specify a maximum credit limit per month to eliminate the surprise of outrageous monthly bills!

Use the Call button to talk to an SOS operator or be connected to someone on your preset list of numbers.

Try it yourself. I can't begin to tell you how much confidence the SOS Phone has given me and my family. Why not try it yourself? If you don't enjoy its convenience and security, return it within 90 days for a "No Questions Asked" refund. It also comes with a three-year manufacturer's limited repair or replacement warranty.

SOS Phone . . . . . **$99** $8 S&H

12-month service contract required for this price. Requires a one-time non-refundable activation fee of $25 and a monthly charge of $9.95. Calls made on the Call and Tow buttons are billed to your credit card at $1.45 per minute. (That rate includes all local, long-distance, cellular and roaming fees.) For outgoing calls only.

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The Marvel Creativity Center teaches you the basics of drawing comics—from working with the shapes to creating final characters.

each player choose from six of the 12 outlaws, each with their own unique characteristics. The graphics are hand-drawn animation with great detail. You really feel like you're in the Old West—and in danger. You will have to ante up $42.95 for this program.

The Last Express from Broderbund is an adventure game filled with mystery, danger, romance and international intrigue. The game takes place on a train crossing Europe in July 1914, in a world on the brink of war. You play an American summoned by a friend to join him on a departing train. You get there late only to find your friend murdered. Moving freely throughout the train, you assume his identity to find the killer. If you're clever enough, you will ultimately unlock the secrets of The Last Express. Tickets to board The Last Express cost $39.95.

Like science fiction games? Try exploring a 3-D universe in *Sentient* from Psygnosis. You are sent to the Icarus space station to investigate the outbreak of radiation sickness. When you arrive, radiation sickness is the least of your worries—the captain has been murdered by an on-board assassin. A power struggle has begun, and the ship is careening dangerously toward the sun. Your decisions determine what happens next. Sentient will run you $49.95.

Those familiar with The City of Lost Children (a French art-house film) will recognize many of the characters in *The City of Lost Children* CD-ROM game from Psygnosis. In this game, 17 characters from the film are brought to life in a strange story and an unusual game. The basic story is that a mad scientist kidnaps children to steal their dreams to prevent his own premature aging. Admission to The City of Lost Children costs $49.95.

Casino gaming is fun, especially if you can't lose any real money, that is. *Golden Nugget Casino* from Virgin Interactive Entertainment lets you experience Las Vegas-style gaming with all the amenities. The 16 classic games of chance include Pai Gow Poker, Seven Card Stud, Blackjack, Five Card Texas Hold-em, Mini-Baccarat, Craps, Roulette, Big Six, Keno, Slot Machines, and Video Poker. Games are realistic right down to the odds, payoffs, and rules. The money you win isn't real, but then again it doesn't cost anything to play. Well actually there's a one-time fee of $39.95, but you get to gamble and explore the lavish and elegant surroundings of the legendary Golden Nugget casino.

Fans of the game Quake will want to check out Quake Mission Pack No. 1 and Quake Mission Pack No. 2 from Activision. *Quake Mission Pack No. 1: Scourge of Armagon* features three new enemy-infested episodes, two new monsters, a vicious final Boss, and three new weapons to wreak havoc. You'll encounter Gremlins, Centroids, Proximity Mines, Laser Cannons, Mjolnir, or Thor's war hammer, and more. *Quake Mission Pack No. 2: Dissolution of Eternity* leads you down a path of no return through seven terrifying levels in a dark, unforgiving medieval world. These add-ons cost $29.95.

Also from Activision comes *Interstate 76*, where all-out muscle car combat rages '70's-style in the American Southwest. Here you battle your way through 17 missions in unique combat environments and drive hopped-up muscle cars loaded with weaponry. There's plenty of skidding,

(Continued on page 74)

WHERE TO GET IT

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NET WATCH

Job Hunting Made Easy

DAN KARAGIANNIS

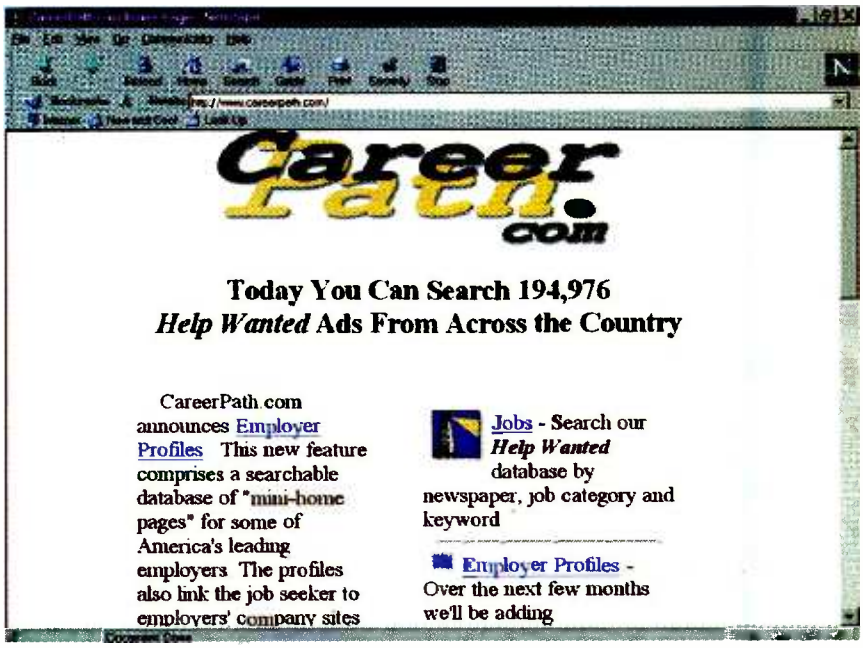
People get laid off. Employees want to get better positions in other companies. Families move to other states and need new jobs. College graduates enter the search for a place to put their newly learned skills to work.

Sound familiar?

Chances are you've been in one of these circumstances or are in one of them right now. If the former describes you, don't think for a minute that you won't be in such a position again. You should always have an idea of what you will do if you are faced with the need to get a new career. And if the latter describes you, perhaps it's time to try a better way of finding a new job.

What is that better way?

Well, if you're a regular reader of this column, or just someone who's figured out its subject matter by reading the name *Net Watch*, you know the answer to that question. Instead of shuffling through hundreds of pages of classified ads, consider pointing your Web browser to some of the better job-hunting sites on the Net.



An aptly named site, CareerPath can help you find the direction your job search has been missing.

CAREER PATH

Now, I realize I just said you shouldn't waste your time shuffling through pages of classifieds, but I won't feel too badly if I amend my words a bit. How about searching through thousands of pages of classifieds without getting any ink on your fingers and without skimming through completely inappropriate entries? If it sounds good, read on!

CareerPath.com provides Internet links to more than 350,000 new jobs every month, and is updated daily by newspapers across the U.S. For this reason, the site claims to be the most visited job-related site on the Internet. To back up these claims the site explains that more than four-and-a-half million searches are conducted by users every month. Note that these are not hits, but actual searches conducted through the site. To put this in perspective, this means that even a job category like Human Resources, with only 3.9% of the total CareerPath.com searches, is searched over 100,000 times each month. In short, someone out there is finding the site useful.

At the heart of the CareerPath site is a search engine the likes of which you rarely see. Found under the Jobs link, this engine gives you online access to classified-ad job listings from newspapers all around the country, including big metropolitan papers such as the *New York Times*, *Los Angeles Times*, *Atlanta Journal–Constitution*, and *Washington Post*, as well as almost thirty more. Basically, if you live near a major city, there is a very good chance CareerPath has you covered. But just how many ads does that really translate to. Well, if you consider the entire continental United States as your search region, you'll find on any given day close to 200,000 listings (listings are fresh and come and go, hence this number doesn't equal the value of 350,000 mentioned earlier as the total new jobs posted in a month). You can search through those ads by newspaper name, job type, and keyword.

Another nice feature of the site is its Employer Profiles. This new feature comprises a searchable database of "mini-home pages" for some of America's leading employers. The profiles also link you to employers' company sites and e-mail addresses. Over the next few months, the site is planning on adding more and more comprehensive profiles.

If you are reading this from the other end of the job-hunting game, you might want to read what is in the HR Information link. Here you will find Human Resources tips for using the site to help find employees. After all, the site does claim to attract more job seekers, more frequently than any other site.

Remember, if a job is being advertised in one of the major newspapers, you can read about it at CareerPath.

CAREER RESOURCE CENTER

The Career Resource Center claims to be the "Internet's most complete and extensive index of career-related Web sites." And with 11,000 links to jobs, employers, colleges, libraries, and state employment offices, the site

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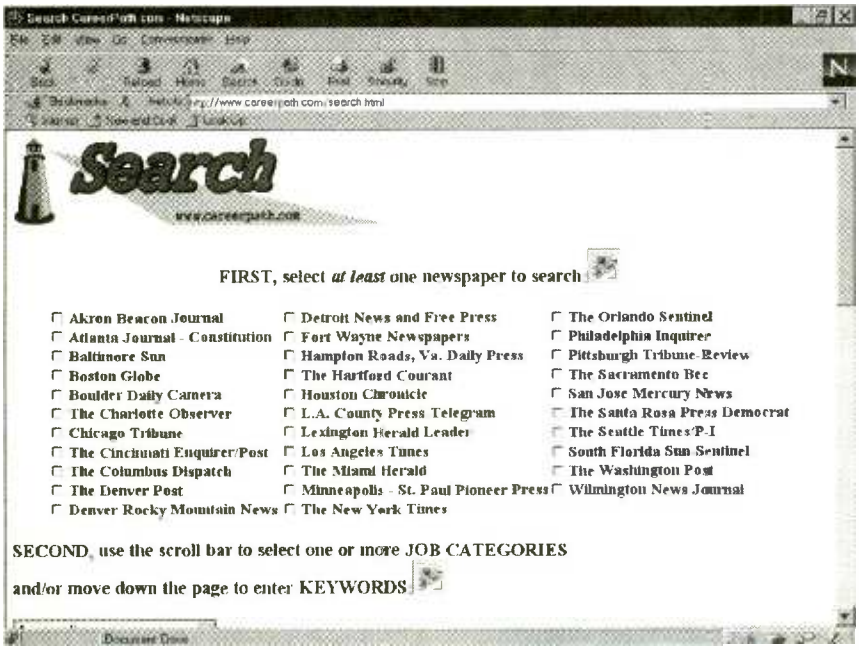
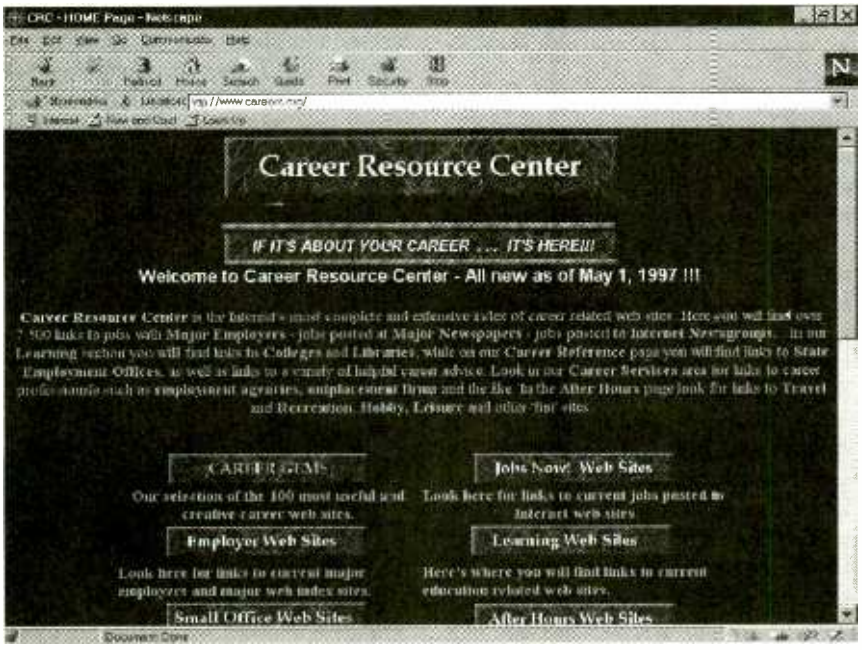


With the classified ads from over thirty national papers at your disposal, CareerPath makes it easy to find a job that's right for you.



The Career Resource Center has links to over 11,000 jobs, employers, colleges, libraries, and state employment offices, helping with all phases of your job search.

might just be telling the truth with its claim (keep in mind the site we just looked at is different than this one, and they aren't stepping on each other's toes with their claims). While not a very visual site, the information is easy to access, which is of the utmost importance when you are dealing with something like a job search. You'll have plenty of category links to choose from at the site, with each containing specific links. Let's look at some of them now.

The first is Career Gems, which is a collection of the 100 most useful and creative career Web sites, including links to USENET newsgroups where jobs are posted regularly. It's odd to have as your first selection a link that takes you to completely different sites, but this is a resource center, after all.

Next up is Jobs Now! Web Sites, where you can look for links to current jobs posted to Internet Web sites. Here you will find over 7,500 links to jobs with Major Employers, jobs posted at Major Newspapers, as well as another link to jobs posted to Internet Newsgroups. Other categories found here include Jobs on College Campuses, Jobs in Federal Government, Jobs with Technology Organizations, and Jobs with Various Specific Industries. The list goes on, by the way.

HOT SITES

CareerPath
http://www.careerpath.com

The Career Resource Center
http://www.careers.org

Employer Web Sites gives you links to current major employers and major Web index sites. Among others, you will find Health Care Employers, Media Employers, Technology Employers, Financial Services Employers, and Official State Government Web Directories.

Under Learning Web Sites you will find links to current education-related Web sites. If you are finding a lot of the job listings require skills you don't have yet, you might want to use the resources here to help you take care of that problem.

Career Services helps you find career-service professionals, including temp agencies and recruiters. If you are not doing too well looking for work on your own, and want to enlist the help of a "headhunter," then this is the place to look.

If the fact that this site contains listings from the U.S. and Canada bothers you, have no fear. You can stick to sites that are only within your area. Simply click on the Regional Web Index. This lets you access all the Career Resource Center sites by U.S. State and Canadian Province.

In addition to all these great features, a great new one will be coming to the site soon (at the time of this writing they were still dead links). Career References will gather reference materials and Web sites including dictionary and database sites, links to State Employment Offices, as well as general helpful career advice.

Well, that about wraps it up once again. For those of you looking for a new place to call work, I wish you the best of luck. Until next time, feel free to drop me a line via e-mail at netwatch@comports.com or via snail-mail at *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735.

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New Products

HOME MONITORS

To facilitate the merging of home-office and family-room technologies, Princeton Graphic Systems' *Arcadia Home Monitors* work equally well as home-theater and personal-computer displays. Designed for use with current and emerging technologies such as PCs, cable TV, VCRs, DVD, WebTV, and DSS, the monitors can be used to surf the 'Net, watch television programs, play video and computer games, and complete homework and business assignments. Available in 27- and 31-inch sizes, they deliver a high-resolution picture that combines the saturated colors of a television set with the clarity of a computer monitor. The monitors also feature built-in speakers for home-theater applications.

The Arcadia's wireless infrared keyboard allows users to operate the Arcadia Home Monitor from the sofa or easy chair for "couch-top computing" with the ease of a remote control. With a TV card installed in a PC or Macintosh, the monitors can be used to watch TV while using the computer, to make working more enjoyable. Users can balance their checkbooks or send faxes while watching a ball game, using the wireless keyboard to type and to change channels.

Suggested retail prices for the Arcadia Home Monitors begin at $799. For more information, contact Princeton Graphic Systems, 2801 South Yale Street, Suite 110, Santa Ana, CA 92704; Tel: 800-747-6249; Fax: 714-751-0168; Web: *http://www.prgr.com.*

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DUAL-DISPLAY MULTIMETER

Extech's *Model 380232* dual-display, true-RMS multimeter provides a 40,000- and 4,000-count dual display

with 1-µv or 10-nA resolution and 0.06% basic DCV accuracy. Bargraph, range, and function are displayed in addition to primary and secondary measurement values. Measuring capabilities include true-RMS AC voltage and current with a 5-20-kHz ACV frequency range, DC voltage and current, resistance, conductance, capacitance, frequency, and temperature. Other functions include dBm, duty cycle, pulse width, and time stamp. The dual display shows a combination of volts or amps with frequency, dBm with frequency or volts, or DC and AC ripple with either volts or amps. Additional features include dynamic internal data-log recording, 1-ms (40-digit) peak hold for capturing glitches, data hold, and 20-ms bar-graph response. An RS-232 interface and Windows data-acquisition software are available optionally.

The Model 380232 dual-display multimeter, complete with test leads, thermocouple probe with adapter plug, 9V battery, and protective holster, costs $299. For more information, contact Extech Instruments Corporation, 335 Bear Hill Road, Waltham, MA 02154; Tel: 617-890-7440; Fax: 617-890-7864; e-mail: extech@extech.com; Web: *http:// www.extech.com.*

CIRCLE 81 ON FREE INFORMATION CARD

CELL-PHONE CHARGER KIT

ORA Electronics' *Power Kit* provides cellular-phone users with the ability to power and charge their portable phones wherever they are, indoors or in-vehicle. The Power Kit includes a travel charger that allows the user to power a portable cellular phone and charge the phone's battery from a standard AC outlet, and a vehicle power cord that allows a vehicle's cigarette lighter receptacle to be used. Both products enable unlimited talk and standby time, without using the phone's battery power. A carrying case is also included.

The Power Kit is available for use with Motorola Micro TAC Series portable cellular telephones and has a suggested retail price of $59.95. For further information, contact ORA Electronics, 9410 Owensmouth Avenue, Chatsworth, CA 91313; Tel: 818-772-2700; Fax: 818-718-8626; Web: *http:// www.orausa.com.*

CIRCLE 82 ON FREE INFORMATION CARD

DUAL-CHANNEL OSCILLOSCOPE

Designed for a wide variety of applications in service and industry, Hameg's *HM1505 150-MHz, dual-channel analog oscilloscope* offers an "auto set" function that allows for signal-related automatic setup of measuring parameters. On-screen alphanumeric readout and cursor functions for voltage, time, and frequency measurement provide extraordinary operational convenience. Ten different user-defined instrument settings can be saved and recalled without restriction. The built-in RS-232 serial interface allows for remote-controlled operation via PC.

(Continued on page 61)

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BOOKMAN SIDEKICK PALMTOP ORGANIZER WITH STARFISH SOFTWARE'S SIDEKICK 2.0 SOFTWARE. From Franklin Electronic Publishers, Inc., One Franklin Plaza, Burlington, NJ 08016-4907; Tel: 609-386-2500; Fax: 609-387-7420; Web: http://www.franklin.com. Price: $149.95.

It makes no difference whether you're a stay-at-home mom or a corporate bigwig—life today is complicated. There are soccer games and ballet lessons, sales meetings and term-paper deadlines, birthday parties to plan or attend, dry cleaning and library books to drop off and pick up, business trips to take and dental appointments to meet.

How in the world do people stay organized (or even sane, for that matter)? Many of us just barely manage. We remember today that the article deadline is tomorrow. We have overdue library books and video rentals. We should have booked our plane tickets yesterday to get the best rates, and now we'll be lucky to get hotel rooms in the next town for the big convention. How could we have scheduled our kid's doctor's appointment on the day of the big field trip—and where did we put the consent form for it?

Traditionally, businessmen had secretaries to handle all those little details at the office, and wives to tend the home front. That's rarely the case nowadays. Downsizing has trimmed a good deal of the support staff in many offices, and in today's two-career families, Mom's not at home to pick up the slack any more. In fact, working mothers have it the worst—they have to deal with all of the above as they juggle their schedules with their husband's and their kids', not to mention the school's and caregiver's.

Have you had it with reminders slipping off the refrigerator, to-do lists getting lost in piles of books and laundry? Is the phone number of the person you need to call after the kids are in bed only found in your Rolodex at work?

Maybe it's time to seek some help. We're not suggesting a therapist, but something more along the lines of a personal secretary—a faithful "sidekick" who would help you keep your life in order. A personal information manager, or PIM, might be an electronic solution.

It's a reflection of our times that there are dozens of PIMs on the market. They come in all shapes and sizes, but all have several features in common. They provide a place to store scheduling information and contact numbers and addresses, and generally allow you to make to-do lists, perform simple calculations, and set alarms to remind you of important events that are on your calendar. Most can hold multiple databases and cross-reference between the information entered. Some offer convenience features like automatic-phone dialing, and some are even Internet ready.

There are PIMs for desktop PCs, intended to keep your business life under some semblance of control. There are palmtop organizers, designed to be carried by people on the go. And there are combinations of the two: portable units that can interconnect with their desktop compatriots.

This month, we examine one such combo: The *Franklin Bookman Sidekick* palmtop organizer and *Starfish Software's Sidekick 2.0*. Together, they can help you keep your life on an even keel, at home, in the office, and on the road.

We also take a look at Sidekick 97, a more recent version of the best-selling PIM program. It's a PIM for the Information Age, Internet-ready and offering a host of advanced telephony capabilities.

POCKET BOOKS

The Bookman is a portable, expandable electronic book. (For an in-depth look at the Bookman format, see *Gizmo*, October 1995.) Each pocket-sized Bookman comes with one built-in application, and has one or two slots on the back into which additional matchbook-sized Bookman cartridges can be inserted. In this case, the Sidekick personal organizer is built-in, and two slots are available for other Bookman titles.

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The Bookman Sidekick measures 5½×3½×¾ inches, weighs just five ounces, and runs on two AAA batteries. It comes with Sidekick software and a PC connectivity kit. The Bookman has a protective lid that opens to reveal a small QWERTY-style keyboard and a three-line display that measures approximately 1×4 inches. Above the keyboard is a row of different-colored function keys. Inside the lid are printed brief instructions for Sidekick's basic functions and for connecting to a PC, as well as a guide to the functions of each Bookman key.

Those keys are labeled CLEAR, MENU, FILES, CALEND, NOTES, EDIT, and CARD. The black CLEAR brings you back to the main data-entry screen from any other application. A second black key is used to access various menus within applications. Pressing the red FILES key allows you to scroll through the cardfiles (address-book entries) that you've input, and the green CALEND brings up your daily, weekly, or monthly schedule. To look through your note folders, press the yellow NOTES button, and to change or delete an entry, press the blue EDIT key. A third black button is used to select alternate Book-man cartridges when those have been installed in the back of the unit.

The biggest drawback to any personal organizer is that before it can be of any help to you, you must feed it data. Setting up the Bookman Sidekick involves a series of largely intuitive tasks, beginning with setting the proper time and date using the arrow keys—simple enough.

It's when you start inputting the important stuff—contact information and calendar data—that the tiny keypad can really bog you down. It's an awkward and time-consuming job to type each one on the Bookman's necessarily cramped keypad, but it can be done. It makes more sense, however, to simply download the Cardfiles from the desktop version of Sidekick to the Bookman. (More on that process later.)

However you choose to input the data, address-book information is entered into "Cardfiles." The Bookman offers several Cardfile categories. In addition to the standard business and personal address books, there are also Cardfiles in which to store e-mail addresses, hotels/restaurants, a wine list, and a music/CD collection. If those don't match your needs or interests, you can rename the Cardfiles.

For instance, we renamed one "books to read" and another "movies to rent." We keep the Bookman on hand when we read *The New York Times Book Review*, and jot down titles and authors. Ditto when reading movie reviews. When films are released on video six months down the road, we know which ones looked to be interesting.

The personal Cardfile provides space to enter each person's salutation; name; address; home, office, and alternative phone numbers; spouse's and children's names; birthday; hobby; group; and additional notes. The business Cardfile adds company, position, department/mail stop, an extra address line, phone extension, fax number, mobile phone, pager, Internet address, and other e-mail. It doesn't provide dedicated lines for spouse, children, birthday, or hobbies, but does have room for freeform notes.

The Calendar function also offers several options. Pressing CALEND once calls up the daily calendar; two presses, the weekly calendar; and three presses shows a full month. In the weekly or monthly mode, you can use the arrow keys to point to a date, then press enter to select it to enter or read information. When inputting a new calendar entry, you can store it as appointment, to-do, call, multi-day event, or special day. Within each of those categories, you'll be presented with still more options. You can set up an appointment, for instance, as a one-time-only event, or as one that will recur weekly or monthly. An alarm can be set to remind you of your appointments and other events.

The Bookman Sidekick's Notefiles allow you to write down your thoughts—anything from a grocery list to the opening for your sales presentation—in a place where you'll later be able to find them. Notes are stored in "folders" that you name in ways that will be meaningful to you. It's a much more sensible method than sticking things on the refrigerator door, or simply scrawling things on easily misplaced scraps of paper.

If, somehow, you do manage to lose a note (or name, or date) that you're sure you've entered into the Bookman Sidekick, you can use its search and retrieval functions to locate it. Enter a key word or phrase, and the Bookman will display all entries in which it is found. That also comes in handy if you can't remember how to spell someone's name, or are not quite sure which person you need to contact at a certain company.

The Bookman Sidekick also can serve as a pocket calculator and an expense tracker. In calculator mode, the top row of letter keys serve as numbers one through zero; the arrow keys become plus, minus, multiplication, and division signs. It's a bit awkward for anyone accustomed to a standard calculator, but it will do in a pinch—and it beats having to carry around yet another electronic device.

Okay, you might say, but what does the Bookman Sidekick offer that I can't get from any of the many other (mostly cheaper) pocket organizers on the market? Two things: the ability to add a whole library of other reference and entertainment books, and PC connectivity to Sidekick.

Those other "books" are actually tiny cartridges that can be inserted into slots in the back of the main unit. Dozens of Bookman titles are available from Franklin, in subjects ranging from the Bible to a wine guide, from sports trivia to cookbooks. Carry the Bookman Sidekick, and you have the potential to carry a library in your pocket. We added to our Bookman Sidekick the Word Games and Math Blaster Mystery cartridges, and when we found ourselves with a bit of free time, we could keep ourselves entertained with word or math games. More serious-minded folks might opt to equip their Sidekicks with reference books such as a dictionary, thesaurus, or encyclopedia.

The Bookman comes with Sidekick 2.0, connectivity software, and a serial cable to connect the unit to a PC's serial port. Version 2.0 runs on Windows 95, with barely a glitch. (Although Sidekick's logo tends toward wanting to take over the screen.) Ditto for the install software. On-screen directions lead you through the process of linking the two units, checking connections, and transferring or merging files. It's a bit time-consuming, but definitely a lot better than trying to type the entire contents of your desktop card file into the Bookman unit!

And, let's face it—you're not always at your desk when you meet a new contact, learn that a meeting was rescheduled, or incur an expense. We'd much rather temporarily trust that information to the Bookman than to a random scrap of paper, until we could transfer it to our PC version of Sidekick. And how nice not to have to call the office to get a phone number, or to double check the time of your next appointment—the Bookman puts all that information right in your pocket. ■

SIDEKICK 2.0 FOR WINDOWS. From Starfish Software, 1700 Green Hills Road, Scotts Valley, CA 95066; Tel: 408-461-5800; Web: http://www.starfishsoftware.com. Price: Free with Bookman Sidekick.

Sidekick 2.0, while lacking some of the bells and whistles of *Starfish Software's* latest offerings, has far more functionality than its portable counterpart. And, unless you really need high-tech features

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like Internet conference scheduling, version 2.0 should be more than adequate for all your personal information management needs.

(For those who already have later versions of the program, the Bookman Sidekick is compatible with Sidekick 95, Sidekick 97, and Internet Sidekick. Upgraded connectivity software can be downloaded from Franklin's Web site at no charge.)

Like the Bookman version, Sidekick 2.0 offers Cardfiles, Calendar, Note folders, and a calculator. With its full-screen display and its full-size keyboard, the PC version provides much more information at a glance, is much easier to use, and allows several ways to manipulate information within and between contact cards, calendar, and other applications.

Entries from one area of the program can be dragged and dropped to another area—including the trash can icon at the bottom right side of the screen, if you've completed the task and want to erase it. Even more convenient, you can drag a card file to the phone icon and have the number dialed automatically.

But we're getting ahead of ourselves. Let's take a minute to get acquainted with Sidekick's user interface.

The main screen is divided into several areas, depending upon the application. In the Cardfile, for instance, the left side of the screen is an index of all the cards in the file, the top right portion displays the current card, and the bottom right is the View in View window—Sidekick's version of picture-in-picture, which lets you see a different part of the software than the one on which you're currently working—for instance, view the Calendar while you're in the Cardfile, and vice versa.

You're not stuck with Starfish's idea of how the screen should look. You can change the layout by resizing and moving the various areas, and you can close the View in View window with a click. In most cases, you also have some choice over what's in that window.

At the top of the screen, just below the menu bar, is a row of buttons called the SpeedBar. It provides quick access to commonly used Sidekick commands (new, open, save, print, undo, make call, calculator, instant note, and the like). The SpeedBar can be customized to reflect your style of using Sidekick, and can be moved around the screen.

The program offers the same type of versatility within each of its main functions. For instance, besides the old standby business and personal address books, you can create as many Cardfiles as you like. List your favorite restaurants, catalog your CD collection, or keep track of "Kids' Contacts" such as friends, coaches, sitters, and scout leaders. Within each Cardfile, you can customize the fields to reflect your needs, and choose the field used to index the cards in that Cardfile. It's also possible to move cards between files, merge them with notes, search for them using key words or conditions (clients from New York and New Jersey, for example).

The Contact Manager feature keeps you informed of interactions with people listed in your Cardfile. Enter the person's name and a range of dates, and Sidekick will show you when you met him for lunch, called him, played tennis with him, or sent him a memo.

Sidekick provides four calendar views —daily, weekly, monthly, and yearly—to help you keep on top of your appointments, special events, phone calls, and to-do-list items. Appointments, to-do items, and calls to make are entered and displayed on the daily planner. You can schedule as many as three appointments at any given time, set audible and/or visual alarms to remind you of them, attach a note with additional information, make any appointment recur at specified intervals, and can check each one off when it's completed. To-do-list items can be prioritized and assigned due dates, and crossed off when done.

Phone calls can be included in the to-do list, or kept in a separate Calls list. That list provides a space to enter the status of each call (busy, call, call back, returned your call, voice mail message, will call back). Sidekick can be set up to speed-dial your calls when connected to a modem.

The Sidekick Calendar also has provisions for creating a Goals list for projects that don't have specific due dates, which might not require immediate attention but should be kept in mind. The Goals list can be displayed in the View in View window. Personal Lists use activities that you have predefined to automatically fill in those activities' descriptions.

The Calendar's weekly and monthly views are also customizable. You can choose what things to display (multi-day events, special days, appointments, calls, and to-do items), opt to wrap the complete text of items onto the next line or have only as much text as can fit on one line appear, and change the first day of the week (in monthly view only). The yearly view, which displays the months in a vertical or horizontal yearly planner format, shows only multi-day events, such as vacations or conferences. Occasions such as birthdays and anniversaries can be added as special days. They'll appear in red on the daily, weekly, and monthly views, and alarms can be set to remind you several days in advance, so you won't get caught without a card or gift (or at least you won't have an excuse for it anymore!).

Sidekick allows you to create several calendars—a major plus in a busy family. Only one can be open at any given time. You can even coordinate activities between any two calendars with the "reconcile appointments" tool, which allows you to transfer the appointments noted on one into the other.

Sidekick's Notes view is a tool for writing, editing, and organizing text—memos, personal thoughts, project descriptions, etc.—which are stored in folders that you create and label appropriately—letters, journal, projects, etc. The left side of the screen displays an index of notes stored in the current folder, the top right screen is the working window, and View in View displays your Cardfile index in the bottom right corner. Cards can be dragged from View in View to merge data into a note. Text files from other applications can be imported into Notes. Existing notes can be exported, merged with other notes or with Cardfiles, moved to different folders, sorted by subject or date, and searched by date.

Material from the Cardfile, Calendar, or Notes can be printed using Sidekick's preprinted forms or ones that you customize. You can print Cardfiles to almost any size label or address book, import graphics from other programs, specify which fields to print, and opt to have field names printed or not. From the Calendar, you can print appointments, tasks, and calls in Sidekick's standard daily format, or print to the paper forms of a variety of popular organizers, including Franklin planner, Day-Timers, Day runner, and Filofax.

Sidekick can also be used to generate reports. You can create a history of all the contacts you made with individuals in your Cardfile. If you've been scheduling appointments during a business trip, making a free-time report can show you at a glance the time slots remaining for last-

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minute meetings. The Reports feature can also be used to summarize activities, phone calls, and time spent on various jobs.

Once you have entered all pertinent data into Sidekick, you'll find yourself lost without it. Don't take any chances of losing the data—take advantage of the easy back-up and restore functions to make duplicate files, or to copy data to the laptop you're bringing to that conference.

With a little bit of effort on your part, Sidekick can make a big difference in your time management capabilities. Just think how much time you'll save simply by not having to search for all those little scraps of paper on which you used to scrawl important messages, reminders, and phone numbers! Make the extra effort to input your spouse's and children's schedules, and you stand a good chance of not missing a sales meeting, school play, doctor's appointment, or dinner date again.

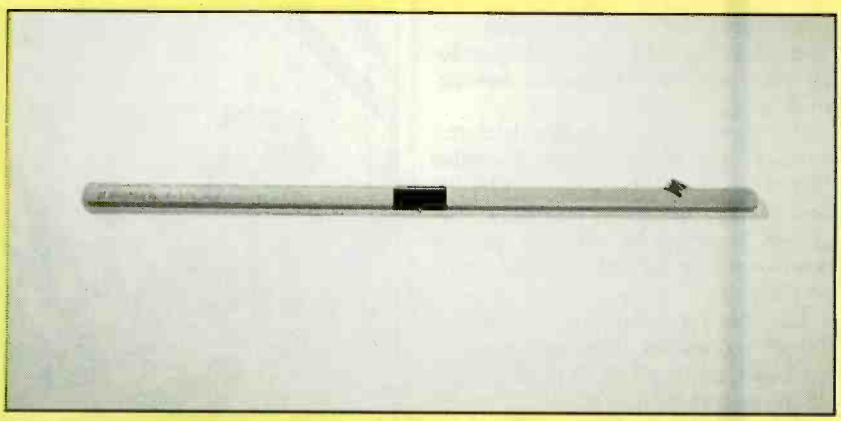
Having the Bookman Sidekick as well makes it that much easier to input everything that comes up. Together, the desktop and portable versions merge to form a truly faithful sidekick—available at all times and in all places. And, by adding extra Bookman cartridges, it can also keep you entertained. ■

Free TV Should be Free

TERK TV50 VHF/UHF ANTENNA. From Terk Technologies, 63 Mall Drive, Commack, NY 11725; Tel: 1-800-942-8375; Web: http://www.terk.com. Price: $129.

The earliest television sets, introduced back in the 1930s, used antennas of foil inside the set's rear panel to help improve reception. They soon switched to rabbit ears—a familiar and nostalgic image for anyone over the age of 35—which reigned supreme until, and for some time after, the outdoor antenna appeared on the scene. In the early years of the Baby Boom, when former GIs were moving in droves to burgeoning suburbs, outdoor antennas brought watchable TV reception to the pioneers settling in the "fringe" areas some 40 miles out from the city.

For several decades, antennas underwent continuous improvements. At the same time, however, the penetration of cable TV threatened to make antennas obsolete. It's gotten to the point where some homeowner's associations have even banned the installation of outdoor antennas.



Television antennas seem to be enjoying a bit of a resurgence in popularity these days. There are a couple of reasons for that. First is the fast-growing popularity of small-dish direct broadcast satellite systems, which don't deliver local broadcasts. Second is the general displeasure that many consumers have with their local cable companies.

Remember when all TV was free? All you need to return to those days of getting something for nothing is a decent antenna. Perhaps *Terk's TV 50* is the antenna for you.

When we first heard about the TV50, a powered, or amplified, antenna, we were a little skeptical. We have ample opportunities to try several amplified TV and FM antennas, and have never found them to be adequate. If an amplified antenna is not receiving an adequate signal, then it will just end up amplifying the noise along with the signal, with predictably bad results.

We were happy to find that Terk took a sensible approach with its TV50. The amplifier is located up inside the antenna body, where it can do the most good. There, it can compensate for losses in the coaxial cable downlead and splitters. Those losses usually aren't too serious in home situation where cable lengths are generally under 100 feet. Splitters can often be a bigger problem—each two-way split cuts the available signal power by one half, or 3 dB. Add together fringe-area reception, lossy cable, and bunches of splitters, and you have little hope of achieving a watchable picture without an amplifier to compensate for the losses.

You can choose whether or not you want to use the amplifier in the TV50. The amplifier can be turned off and taken out of the circuit with the flick of a switch on the "power injector," which is designed to be located near the TV set. That small module, about the size of a typical signal splitter, receives its power from a wall adapter and connects between the set's antenna input and the coaxial cable leading up to the antenna. When the power injector is turned on, a small LED on the antenna, near its F-type coaxial connector, lights.

We commend Terk for providing an easy way to switch the amplifier off and to actually take it completely out of the circuit. We should point out, however, that it's not necessarily convenient. For example, anyone who has more than one TV—in other words, most homeowners in the U.S.—will have to decide where to place the power injector. If it's located at one set, and a second set is being watched, then someone who wishes to turn the amplifier on or off will have to go to the other set to do it.

Our particular installation proved just how inconvenient it could be. We have a distribution amplifier located in our basement. The antenna feeds the distribution amp—so that's where the power injector is—and each set in the house is home-run to that panel. To turn the antenna's amplifier on or off, someone would have to run down to the basement to flip the switch. In our case (which, we admit, is more complex than most), the only way to make things more convenient would be to install a remote-controlled X-10-compatible module at the power injector.

Why would you want to turn the amplifier on and off? Well, our installation gave us a perfect reason. Some stations, it turns out, were received better with the amplifier on, while others were better with the amplifier off. Over-amplification can worsen co-channel interference, causing diagonal lines in the picture. Other stations benefit from the amplifier. We found this to be true particularly in the UHF band. But that's understandable. The cable losses at those ultra-high frequencies are far greater than in the VHF band. The amplifier can overcome those cable losses.

The antenna itself is just over six feet long and about 2½ inches tall, and about an inch thick (or should we say thin?). It is designed to be mounted horizontally with three screws—one at the center and one at each end cap. The outer case of the antenna is beige with a black center section and a bold "TERK TV50" emblazoned on the

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left end. The plastic case is designed to resist degradation from ultraviolet radiation, and it can be painted as well.

Why would you want to paint an antenna? Well, one of the advantages of the TV50 is that it can be mounted unobtrusively—even in those elitist homeowner's associations that don't allow outdoor antennas. With the TV50 mounted up along the eaves and painted to match the siding, it becomes invisible for all practical purposes.

Since the antenna is basically a half-wave folded dipole, it is bi-directional, exhibiting a broad figure-eight pattern. In other words, it favors stations located in front and in back of it broadside. However, the antenna was designed to have as wide a pattern as possible, so that—assuming that you're in close enough—it can exhibit seemingly omnidirectional reception. For true omnidirectional reception, it's possible to mount two TV50s at 90° angles to each other.

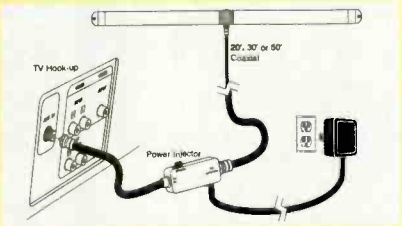
Our installation was located on Long Island, about 40 miles east of New York City. The main challenge was to find the right orientation for the antenna so that it received all stations adequately. At first, it seemed that it should be easy. After all, most of the stations we wanted to watch are located in New York. But then again, there's WTNH, Channel 8, out of New Haven, which is to our north. And there's public broadcaster WLIW, Channel 21, located northwest of us. And WWOR, Channel 9. It's antenna is located in New York, but favors New Jersey over points east. Other stations that we knew would be a challenge are WNYE, Channel 25, run by the New York Board of Education, and WBIS (Sports+) Channel 31, which bought the former public station WNYC from New York City and turned it into a commercial station featuring sports and business news.

In our case, we weren't able to find a perfect orientation. The direction that gave us the best VHF reception and pretty good UHF reception also provided terrible reception for Channel 13, New York's PBS affiliate, WNET—and a staple in both our TV-viewing and that of our Elmo-loving two-year-old.

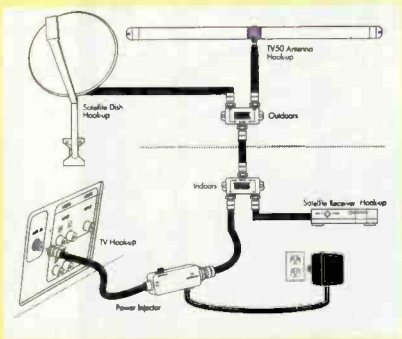
In the end, we had to compromise somewhat, getting less than crystal-clear pictures on most channels, while getting watchable pictures on virtually everything we were likely to watch.

You might wonder why we didn't use a rotator to obtain clear reception on all channels. The main reason is that there's no practical way to do that—the TV50 has no way to be mounted to a mast. Terk has told us that the company is working on a bracket that will allow mast mounting, but it doesn't yet exist. On the other hand, one of the advantages of the antenna is that it can be mounted unobtrusively on the side of a house. If you're going to mount it on a mast with a rotator, then you might as well put up a full sized Yagi-type antenna.

The antenna can also be mounted inside—and that's where we put ours. We



The power injector provides power to the TV50's internal amplifier and passes signals from the antenna to the TV.



The diplexers provided with the TV50 allow a single cable to bring signals from both a satellite dish and the TV50 inside using a single cable.

stuck it up in our attic, just placed across a couple of stringer beams. As it turns out, we wouldn't have been happy if we had mounted it outside. Our preferred orientation put the antenna at a 45-degree angle with the front and side walls of the house.

As we mentioned previously, one of the main intended customers of the antenna are people who are using one of the small-dish satellite systems and subscribing to such providers as DirecTV, Primestar, Echostar, or AlphaStar. To make such installations more convenient, Terk provides the "one-wire solution." The TV50 kit includes an inside and an outside diplexer.

The diplexer looks like a typical two-way splitter, but it's not. The outside diplexer—a signal combiner—accepts signals from a dish and from the TV50. From there, a single cable runs into the house to the inside diplexer—a signal splitter. One output of the diplexer runs to the satellite receiver, the other to the power injector, and then to the TV set.

The diplexer allows the TV50, whose amplifier requires a source of power, and a satellite system, whose LNB (low-noise block downconverter) also requires a source of DC power, to work together.

Although we verified that the diplexers did their jobs, the one-wire solution didn't work for us. Our C-band satellite dish is mounted on top of our garage, about 40 feet behind the house. Our DSS dish is mounted about six feet above the ground, about 20 feet behind the house. The TV50 is in the attic, about 25 feet above the ground. Regardless, we could foresee many installations in which the one-wire solution would be a godsend.

One of the most impressive features of the TV50 is that it's not just an antenna. It's a complete kit consisting of the TV50, the power injector and its power adapter, mounting screws, one 30-foot length of RG-6 coax, one 20-foot length, one 6-foot length, and two 3-foot lengths of RG-6, each of which have rubber weather insulators on either end. Two diplexers and one male-to-male barrel connector are also provided in the box.

Is the TV50 for you? It's a surprisingly good alternative to a medium-sized Yagi or log-periodic antenna. It won't work in fringe areas, but it will do very well at least 40 miles out—especially if all signals that you want to watch arrive either from one direction or two directions 180 degrees apart. So if you're paying for free TV, the TV50 is worth serious consideration. ■

Souped-Up Sidekick

SIDEKICK 97. From Starfish Software 1700 Green Hills Road, Scotts Valley, CA 95066; Tel: 1-888-STARFISH; Web: http://www.starfishsoftware.com. Price: $49.95.

If you, your business contacts, and your family communicate online as much as or more than by phone or snail mail, you'd be much better off upgrading to Sidekick 97. Today's office is no longer bounded by four walls and a roof. Coworkers might be found traveling on airplanes or in cars, staying in hotel rooms or home offices. There are dozens of product categories intended to make it easier to work on the go, including pagers, fax machines, modems, cell phones, portable organizers, laptop PCs—and Sidekick 97.

The program retains the flexible Cardfile, Calendar, and Notes features found in version 2.0 and the interim Sidekick 95, but adds a message-based Internet scheduler and more powerful advanced communications functions. It even serves as a link to other Starfish programs that allow users to easily create

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Web pages that incorporate the information stored in Sidekick.

We've already described Sidekick's main user interface—it hasn't changed much (although "Notes," which is now called "Write," lets you edit all kinds of formatted documents and offers a spell checker). Most of the differences are in the form of new menus and screens to access new functions. The "EarthTime" view presents local times for more than 540 cities around the world. The "Activities" view, complete with animated icons, summarizes all scheduled Internet events, appointments, to-do items, and calls. Users of earlier versions will have no trouble adjusting to Sidekick 97, and existing files can be transferred from earlier versions to it.

Just as Sidekick 2.0 allows you to drag and drop contact information from your Cardfiles to your Calendar or Notes, Sidekick 97 lets you drag and drop URLs (uniform resource locators, or Web "addresses") from a Web browser directly into your Cardfile. You can launch your Web browser and then jump directly to the URL of any Web site stored in the Cardfile. Sidekick 97's e-mail address book supports Netscape Navigator, Microsoft Exchange, and Eudora Pro (32-bit) address books.

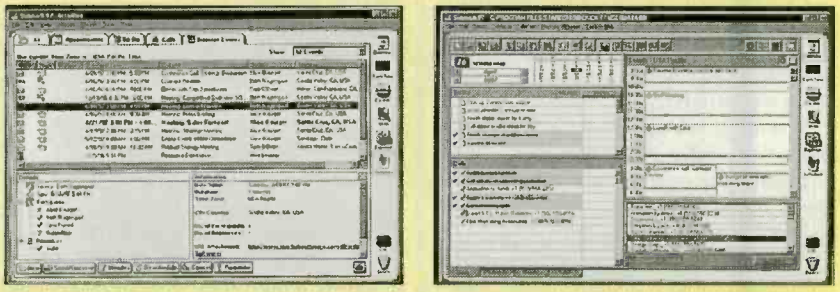
Sidekick 97's main claim to fame is its Internet scheduling ability, which lets you schedule appointments with anyone, anywhere, who has an Internet e-mail account. The program automatically sends invitations to everyone on the list, collects RSVPs, and places the event on your calendar. If some of the invitees do not have e-mail addresses, Sidekick will fax them the message or remind you to phone them. You can add names to your Cardfile while you are scheduling an event, and add all the names to your invitation list at once. What an easy way to set up a tele-conference—or even to inform your whole family that they're expected to be available for Sunday dinner at their grandparents' house.

Sidekick 97 takes advantage of Windows telephony support and new-generation TAPI (telephony application programing interface) technology to provide advanced calling features. It's compatible with Caller ID service, and if the number detected is in your Cardfile, the program displays details about the caller. A "While You Were Out" feature logs information about calls that went unanswered. (Those functions require the installation of a Microsoft UnimodemV driver and a modem compatible with it, and Caller ID service from the local phone company.)

There are a few other upgrades and additions to the program. The Calendar can now be printed in At-A-Glance format as well as the other formats available in version 2.0. An enhanced Expense View lets you use folders to organize expenses by trip or by time period, and adds new categories, flexible reporting periods, and custom printouts. Sidekick 97 performs English/metric conversions of units of measurement, including technical and scientific units.

Finally, Sidekick 97 is designed for use with two other Starfish programs: Sidekick Web Publisher and Starfish TrueSync. Web Publisher makes it easy for even a novice to transform calendars and contact lists from Sidekick 97 into professional-looking Internet or intranet pages, complete with HTML files. The program can automatically launch your Web browser so that you can see the finished page. TrueSync lets you coordinate the information in your desktop Sidekick with U.S. Robotics' Pilot handheld organizer, without having to retype any data.

But those features are just the icing on the cake—and Sidekick 97 is a mighty tasty morsel without any extras. ■



Sidekick 97's user interface remains similar to that of earlier versions. Shown here are the Calendar daily view (left) and an Activities list.

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We've Been Framed!

Frame-It. From Dogbyte Development, Inc., 612 Moulton Street, Suite 7, Los Angeles, CA 90031; Tel: 1-800-9-DOGBYTE; Fax: 1-213-276-5275; e-Mail: DogByteDev@aol.com; Web: http://www.dogbyte.com. Price: $69.95.

Every winter, we take our little boy down to the photographer's studio to have his pictures taken, and have the best one made into our family Christmas card. Although the photos always come out great, we're never entirely satisfied with the selection of stock postcard-style greeting cards offered in the shop.

This year, we plan to do things differently. We'll still use the same photographer, but we're going to use *Dogbyte Development's Frame-It* software to design a card centered around the picture, customize our holiday message, and create matching envelopes. And, having played around with the program, we expect the venture will be a fun, quick, and easy project that the whole family will enjoy.

Aimed at kids as well as adults, this is a truly user-friendly craft program. It allows you to create frames, albums, scrapbook pages, ornaments, and photo cards with matching envelopes to showcase your family photos.

The Frame-It package includes a CD-ROM, an instruction manual, and an art directory. The manual is heavily illustrated and assumes no prior knowledge of computers or Windows. For neophytes, it explains the basics of toolbars, menus, and other Windows basics. Detailed, step-by-step instructions are provided, with handy tips interspersed throughout the pages. The art directory is a separate book that serves as a quick reference to the frame borders provided in the program. It saves you the time and hassle of selecting and viewing each one on screen, and the printed versions are much easier to see.

Frame-It delivers dozens of border designs for framing your photos; cutout shapes, dialog boxes, and small graphics, called "stamps," that can be placed anywhere on a page; an address book with mail merge; and customized text complete with a spell checker. It allows you to frame regular photos, or incorporate scanned images or digitized photos.

On the "hardware" side, the package provides all the craft supplies needed to create a complete photo album or scrapbook, or inserts for a standard album—specialty papers, corner tabs to hold photos in place, and even ribbon and raffia for decorating your creations.

Less tangible, but equally important, the package includes a wealth of design pointers and suggestions to get your creative juices flowing. Don't stop at Christmas cards! Use the same design for customized thank-you notes that include under-the-tree, opening-the-gift shots. Make one-of-a-kind gifts that Grandma will treasure. Use the themed borders to matte your vacation, graduation, wedding, baby, reunion, or christening photos for placement in standard frames. Create frames for Polaroid snapshots before the birthday party or family reunion, and send all of your guests home with unique favors.

The program allows the creation of "Frameations"—stand-alone, easel-backed frames assembled entirely out of paper. You can create Frameations to hold photos in sizes ranging from 2¾ inches to 8×10 inches, in either portrait (vertical) or landscape (horizontal) position.

Like origami projects, Frameations require a lot of creative folding. Unlike origami, however, they also call for scissors, tape, and glue. Frameations for photos smaller than 5×7-inches can be made from a single sheet of paper. Larger photo frames require two sheets; 8×10s need three sheets. While Frameations made out of regular printer paper will stand and hold a photo, if your printer accepts heavier stock, we'd recommend using it.

The manual provides full folding, cutting, and gluing instructions. If you don't have the manual on hand when you're ready to print out your Frameation creation, you can opt to have folding instructions printed out along with it.

You can end up doing quite a bit of folding and gluing with Frame-It. "French-fold" cards feature printing on the front, left and right inside pages, and even a small "created by" label on the back (not that anyone will be checking for the "Hallmark" on these home-made goodies). They must be folded in half lengthwise and then widthwise. Envelopes are also created out of single pages, and require cutting, folding, and gluing to reach their final form.

But we're getting ahead of ourselves. Before you can start all that snipping and pasting, you have to make a frame.

Frame-It is a breeze to use. The main screen is divided into two windows. On the right is the document page, the main workspace in which you can see your designs take shape. The left window con-

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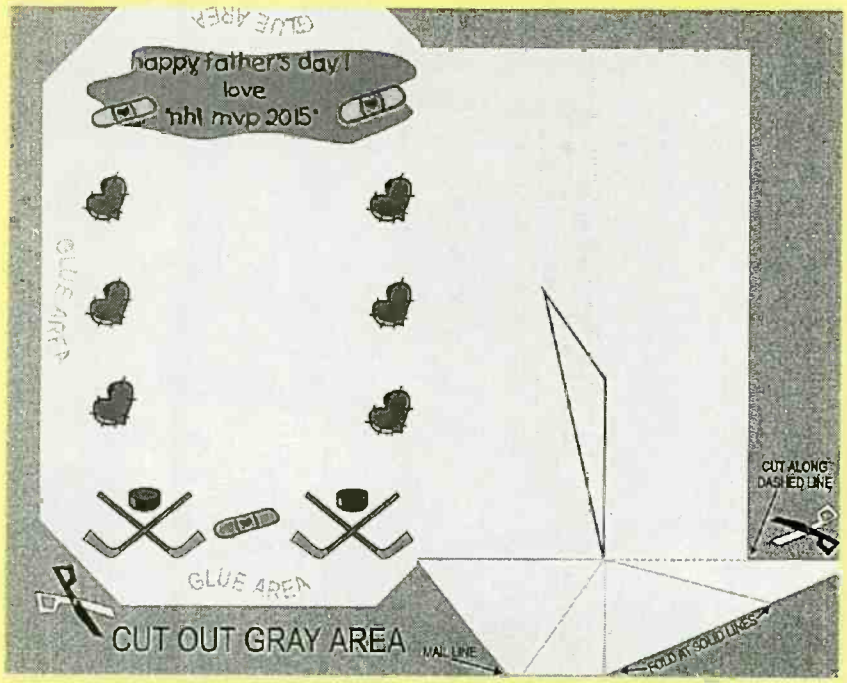


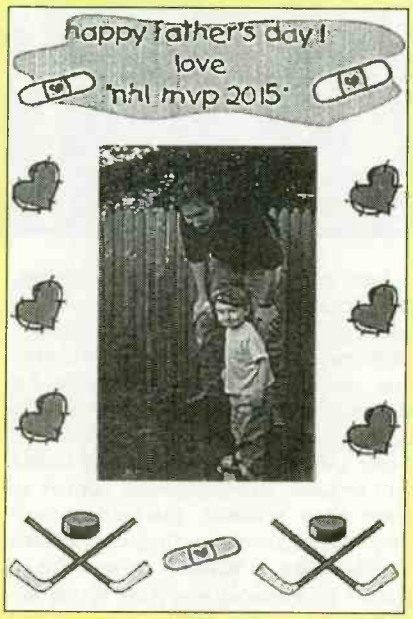
Our Father's Day Frameation, just out of the printer, shows the cut, paste, and fold lines needed to complete the project.

tains four tabbed "folders" representing your design options.

The Project tab is used to select the type of project you'll be designing. Options include portrait and landscape frames in several sizes, a double-sided matte, cards, envelopes, and three sizes of photo album pages. Measurements indicate the size of the photo, not the frame. Select 4×6-inch portrait picture frame, for instance, and your workspace will be bordered by a ruler measuring four inches across the top, and another measuring six inches down the left side. Any borders or artwork you add will fall *inside* that 4×6 boundary, so be prepared to crop your photo, or select the next largest frame size.

Clicking on the Design tab lets you select the design template you'd like to use for your project. A preview window displays the available designs in the category selected. Categories range from animals to wrought iron, and are selected using a scroll bar. Designs are displayed either in small (four at a time) or large (one at a time) size. But either way, it's hard to get an accurate idea from their on-screen representations of what they'll really look like. By selecting a design, you can see it shown somewhat larger in the document page, but we found the printed Frame-It Art Directory to come in really handy at this stage of our projects.

The Stamps tab lets you add more graphics to your project in the form of small pieces of arts or text balloons. Once again, there's a preview window and a list of categories to scroll through. You won't find many of the Stamps shown in the Art Directory, however, so you'll have to spend a bit of time previewing them. Once you've selected a graphic, double-clicking on it moves it to the top left corner of your project. From there, you can move it, resize it, cut and paste it, or copy it. You can even create your own custom borders out of repeated graphic designs—frame a picture of your favorite couch potato, for instance, with a border made up of TVs, remote controls, mugs of beer (all from the TV Party category), and perhaps some junk foods (Foods 1) or sports (Sports 1, 2, or 3) designs.



The completed Father's Day frame, with picture inserted.

The Text Tab allows you to add text to your projects. You might want to use cartoon-style balloons to make your subjects "talk" or simply add a title to your Frameation or album page. Frame-It offers a wide selection of font styles, sizes, and colors, and several types of talk balloons. The program also provides a spell-checker with customizable dictionary. And, for all your home-made Christmas cards, invitations, thank-you notes, and the like, there's also an address-book feature, complete with mail merge for printing those matching envelopes. You can import a mailing list from other databases using a comma-delimited format, export to other databases, and print out your mailing lists for easy reference.

Although there's really no need to bother with digital cameras or scanners—which might scare off some potential Frame-It users—the program does allow you to import such images into your designs. It accepts images in a variety of file formats: .TIF, .EPS, .BMP, .WMF, .PCD, .JPG, and .TGA. Imported images can be cropped, resized, and repositioned.

We started using Frame-It early in June. With Father's Day just around the corner, our first project would be a special frame for a photo of the first time our two-year old skated on his own. We couldn't find a suitable border from the Design categories, so we decided to get creative with the Stamp graphics. For the hockey-loving dad, the frame featured hockey sticks and pucks; in honor of the new skater, we added a few band aids. Some hearts along the sides, and a "Happy Father's Day, Love NHL MVP 2015" message, and our design was complete.

Frame-It does offer several frames that would have been suitable for Father's Day, but they weren't quite as personal. For more traditional occasions—birthdays, weddings, anniversaries—it was

An odd-sized photo is framed effectively with holiday graphics and a frame-within-a-frame.

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easy to find borders to use as is.

We consider ourselves well ahead of the game if we simply get our son's birthday (April 11) photos into an album before we get the following Christmas pictures developed (which usually happens sometime around Valentine's Day). If, however, you are the more organized sort—or if you're creating a small photo album as a gift—you might want to use Frame-It's double-sided matte feature. Once framed and decorated, you fold the matte in half, and insert it into a 4×6-inch plastic photo-album page. If your family has spent a week visiting friends at their beach house, for instance, a seashore-themed photo album would make a nice thank-you gift and memento.

You can get really creative using photos imported from digital cameras or scanners. Here's an album page using three such images.

Or you could make a personalized "brag book" for Grandma, with themed borders around the photos of her little darlings.

Unlike so many software packages that isolate people from each other, Frame-It is a family-oriented program. Get out your box of unframed photos, gather around the PC, and see what fun projects your family can come up with. Hosting Thanksgiving dinner this year? How about making picture-frame place cards. Your kids will be reminded who Great-Aunt Sally is, and all your guests will have a memento to bring home. Take some more pictures that day, and use them to make custom holiday gift tags or ornaments.

The possibilities are limited only by your imagination. If you tire of the borders and graphics that come with the program, just call up Dogbyte to request additional ones. No one will mistake your creations for professional, store-bought frames—but those don't have half the character of homemade Frameations. ■

Got the Picture?

PICTURE IT! 1.0. Published by Microsoft Corp., One Microsoft Way, Redmond WA 98052. Tel: 206-882-8080. Web: http://www.microsoft.com. Price: $54.95.

Microsoft didn't get to be the world's largest software publisher by maintaining a narrow focus. The company likes to keep its fingers in every computer-related pie. So, as you might expect in this age of the Internet and digital cameras, Microsoft has released a software package for manipulating digital images.

Unfortunately, the software isn't up to the company's usual standards. On second thought, it just might be. After all, Microsoft strikes us as being a company that sometimes releases dogs of programs, only to release upgrades that address users' complaints. Those upgrades end up taking over the market. (Can you name any Microsoft version 1.0 software that you are still using?)

Picture It! 1.0, Microsoft's photo-manipulation software, in our opinion, is a program that will need upgrading. That might sound a bit harsh. We're sure that plenty of people will find Picture It! to be picture-perfect—including some of the test subjects we sat down in front of it. But *we* had several complaints.

The program's biggest failing is that it tries to be too user-friendly. One of the main advantages of Microsoft Windows is that it allows software publishers to provide a consistent user interface. Everyone knows—whether you're using Microsoft Word or XyWrite for Windows—that to work on an existing file, you go to the File menu and select Open.

Now it *is* possible to do the same in Picture It!, but other things aren't intuitively obvious. For example, to rotate a picture, you can't go up to the top menu and select something such as Object/Rotate. Instead, you must go to a menu that's always displayed along about ⅓ of the left side of the screen and select

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Prepare It, and then click on Size and Position, and finally, Rotate.

That seemed clumsy to us. But Microsoft appears to have done its homework. The target audience for Picture It! is people who either don't use computers or who use them only infrequently. We introduced the program to a couple of computing neophytes, and they seemed to know—or to be able to figure out with a minimum amount of trouble—exactly what to do.

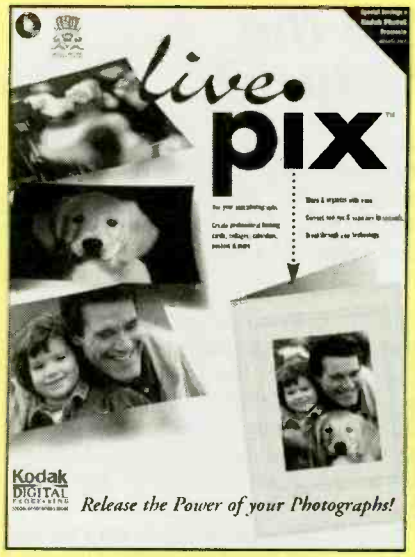
Picture It!'s screen is separated into four discrete areas: a task bar, a "filmstrip," a "stack" and a "picture pane."

Image-manipulation tools allow you to do such things as adding text, moving and resizing selected portions of images, rotating, and moving images. You can sharpen and soften images, and adjust brightness, contrast, and colors.

Picture It! does support FlashPix, a picture-manipulation standard jointly developed by Microsoft, Hewlett-Packard, Live Picture, and Eastman Kodak. The purpose of FlashPix is to allow personal computers to manipulate photographic images with speedy performance. If you've ever used photo-manipulation software in the past, you are well aware of the need for such an apparent power-boost. Consider, for example, the resources required to perform a color or contrast change, or an image resizing. In traditional photo-editing software—regardless of the resolution of the on-screen image—each pixel would be manipulated until the entire photo was transformed.

The FlashPix protocol, in contrast, worries first about speed—displayed speed. A change that you make to an image seems to take place very quickly on screen. The actual change doesn't happen as fast; it's treated as a file that describes the changes between the original and the manipulated image. A great feature of the protocol is seen if you make a change to an image when you've zoomed in on it. FlashPix-compatible software will worry about only what's displayed on the screen. You don't have to wait for all of the pixels at the top left of the image to be manipulated while you're looking at something at the bottom right side of the image.

Despite Microsoft's role in developing the FlashPix standard, we found Picture It! difficult to get the hang of, and—if we had let time pass between sessions—difficult to remember. Inexperienced users seemed to like its interface, so if that is a consideration for you, then Picture It! might be the one to look at. Picture It! Version 2.0, which is scheduled for release in September, may overcome some of this version's shortcomings. ■



Live and Up Close

LIVEPIX VERSION 1.1. Published by Live Picture, 2425 Porter St., Suite 16, Soquel, CA 95073; Tel: 408-464-4200; Web: http://www.livepicture.com. Price: $49.99.

Live Picture, a long-time publisher of high-end professional image-editing software, recently turned its sights on the PC. Along with Kodak, Microsoft, and Hewlett-Packard, it created the FlashPix photo format, which allows PCs to work quickly with large image files. The company's extensive experience shines through in the look and feel of *LivePix*.

LivePix contains a host of ready-made "projects" including signs, greeting cards, and the like. They serve as pretty good starting points for your own projects, but you don't have to use them. We felt comfortable enough starting out with a blank canvas and going from there.

The screen has a standard Windows menu bar that features File, Edit, Gallery, and Help commands if nothing else is open. Open the Gallery—a photo- and project-organization applet—by selecting Gallery/Open Gallery, and an additional Window menu choice shows up. Open an existing image or project and the menu bar changes again, adding Object and Photo choices, as another Project window opens inside the main LivePix window. It contains its own control bar on top, and a tool bar down the side.

The basic tools provided on the toolbar are a Selection tool; a Position tool for rotating, skewing, and perspective changes; a Pan tool; a Zoom tool; a Text tool; a Line and Shape drawing tool; a Filled-Shape drawing tool; a Cutout tool; and a basic Effects tool for removing red eye, distorting the image, and adding drop shadows.

The tools provided are sensible and powerful. Notably missing, unfortunately, is a color-selection tool. However, LivePix does feature "smart" edge-detection that makes cutting items out of images quicker and easier—but still rather tedious. Going back and refining an edge cut is a simple matter, however.

One of the most effective tools for making cut images look better is to soften edges. Any selected image can be softened from the control bar. Another control on that bar lets an image's opacity be adjusted, allowing, for example, the background to show through the type.

The Gallery has two modes of operation: a working mode and an organization mode. In the working mode, you can create or open existing projects, insert and substitute photos, and add projects or photos to the Gallery. In its organize mode, you can create albums, add projects or photos to the Gallery, move between albums, remove projects or photos from the Gallery, and import images from Twain-compliant scanners or cameras.

The Gallery provides a sensible, intuitively understood way to organize all of your images. Images can be easily copied from the Gallery to your current project by clicking on the thumbnail and dragging it to the open "canvas." One of LivePix's nice touches is an information button located on the bottom right corner of each thumbnail. Click it, and you're presented with a drop-down dialog box that tells you the file type, size, location, and creation and modification dates. What's more, if it's a project made up of a composite of images, you get its component files as well.

When a new project is started, you are presented with a blank canvas onto which you add pictures from the Gallery, or pictures acquired from a scanner or camera. You can also open individual images with LivePix, but their canvas size is fixed when they're imported. It's much better to put all of your images in the Gallery, and define your canvas size when you start a new project.

Of the two programs reviewed here, LivePix had the best look and feel. We always felt in control of what we were doing. It was the easiest to learn, as well. It was also subjectively slower than Picture It!, and we missed having color-selection and the ability to flood-fill to replace one color in a photo with another.

We were able to create our best-looking image compositions with LivePix, however, and that is what counts. We especially liked the program's limitless undo ability, and the ability to vary the opacity of images. ■

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Electronics Library

NOW YOU'RE TALKING! ALL YOU NEED TO GET YOUR HAM RADIO TECHNICIAN LICENSE Third Edition

Edited by Larry D. Wolfgang, WR1B and Joel P. Kleinman, N1BKE

It's easy to enter the exciting world of ham radio with the Technician license, which requires no Morse code. (A Novice class license does require that you pass a Morse code test.) This book teaches you all the basic radio theory and FCC rules and regulations needed to pass your Technician Class or Novice Class written exam. Once you have your license, the book is your guide to becoming an effective amateur radio operator.

The book includes everything you need to know to operate a ham station. Intended for either self-study or classroom use, it leads from one subject to the next by building upon the material learned in previous sections. The course work is presented in easily-digestible, "bite-sized" portions, with review questions relating to the material in each section. The book also contains a guide to selecting equipment for your station. Appendixes include helpful data tables, US Amateur frequency and mode allocations, schematic symbols, equations, and a glossary of key terms.

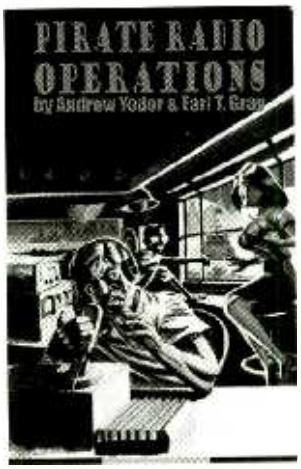
Now You're Talking! costs $19 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111-1494; Tel: 800-32-NEW-HAM; e-mail: newham@arrl.org; Web: http://www.arrl.org.

CIRCLE 91 ON FREE INFORMATION CARD

PIRATE RADIO OPERATIONS

by Andrew Yoder & Earl T. Gray

Clandestine radio broadcasting—commonly known as pirate radio—is one of the most fascinating pastimes available to hobbyists in the Communications Age. This book shows you how to become a pirate radio operator. It includes a complete explanation of private radio, and shows how you can outfit a studio on the cheap. The book covers safety issues, public relations, studio techniques, production practices, and the FCC's stance on pirate radio. It describes how to keep your operations unobtrusive to the authorities, and tells you the best times, places, and frequencies for broadcasts. The book even shows you how to build transmitters and antennas for your own pirate radio station.



Pirate Radio Operations costs $19.95 plus $4.95 shipping and handling and is published by Loompanics Unlimited, P.O. Box 1197, Port Townsend, WA 98368; Tel: 800-380-2230.

CIRCLE 92 ON FREE INFORMATION CARD

ACTIVEX WEB PROGRAMMING: ISAPI, CONTROLS, AND SCRIPTING

by Adam Blum

This book shows Web developers how to use and take full advantage of the ActiveX suite of programming tools and technologies to create dynamic, interactive Web applications. It provides in-depth coverage of ISAPI and ISAPI filters to extend the functionality of your Web site. It tells you everything needed about ActiveX controls, VBScript, and server-side scripting.

The book contains a wealth of sample code, reusable class libraries, and utility programs. Sample programs illustrate how to use each ActiveX technology, and C++ classes help you build your Web applications. The book offers demonstrations of how to integrate Java with ActiveX/COM using the Visual J++ environment. It also includes Denali tutorial and sample scripts for easy-to-build server-side functionality.

At the books's companion Web site, you'll find source code for all the programs described in the book, and working examples of all applications built with ActiveX technologies.

ActiveX Web Programming costs $24.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel: 800-225-5945; Web: http://www/wiley.com.

CIRCLE 93 ON FREE INFORMATION CARD

INSIDE PC CARD: CARDBUS AND PCMCIA DESIGN

by Faisal Haque

PC Card (or PCMCIA) technology, which allows computers to interface with each other using less space than traditional interfaces, is a fast growing area in the electronics market. Once reserved for computing applications such as notebook computers, its size and ruggedness make it appealing for other areas that have not embraced

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peripheral expansion, such as digital cameras and medical instrumentation. Aimed at design engineers who want to take advantage of the latest technology, the book does not just repeat standards or list suppliers. It covers the newest developments in the field, including CardBus, multifunction cards, media-storage formats, and power-management capabilities. It goes on to offer practical design advice on implementation and compatibility, with discussions on interface and configuration issues as well as PC card mechanical issues.

Inside PC Card: CardBus and PCMCIA Design costs $49.95 and is published by Newnes, 313 Washington Street, Newton, MA 02158-1626; Tel: 617-928-2500; Web: http://www.bh.com/el.

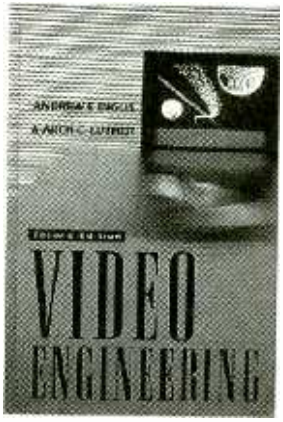
CIRCLE 94 ON FREE INFORMATION CARD

VIDEO ENGINEERING: SECOND EDITION

by Andrew F. Inglis & Arch C. Luther

This leading video-engineering source book has been vastly expanded to provide full coverage of the many growing non-broadcast applications of video, such as computer-display systems and multimedia applications. The book serves as a handy, all-in-one reference for video professionals and a useful textbook for anyone studying video engineering. Particular attention is paid to ground-breaking HDTV technology that will revolutionize television broadcasting, as well as the uses of digital video technology in the generation and display of computer images.

Other key sections address the fundamentals of both analog and digital video systems, the basic criteria for specifying image quality, and the application of colorimetric theory to video systems. The book also presents up-to-the-minute information on home and semi-professional VCRs, video cameras, television receivers and video monitors, CATV systems, satellite video communications, fiber-optic transmission systems, video post-production systems, and video signal formatting for computers.



Video Engineering: Second Edition costs $60 and is published by McGraw-Hill, 11 West 19th Street, New York, NY 10011; Tel. 800-822-8158.

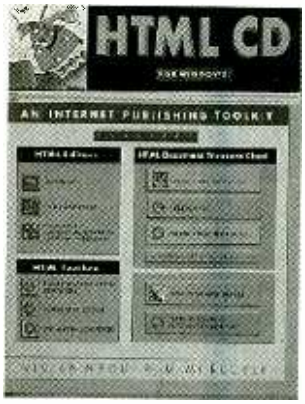
CIRCLE 95 ON FREE INFORMATION CARD

HTML CD FOR WINDOWS: AN INTERNET PUBLISHING TOOLKIT

by Vivian Neou & Mimi Recker

This book and CD-ROM package contains all the information and software you need to transform your Windows PC into a complete World-Wide-Web publishing system. The book teaches anyone who wants to make a splash on the Web how to create Web documents using HTML and build interactive Web sites with forms and other HTML features. Readers learn how to use new HTML 3 and Netscape extensions to build tomorrow's slicker Web pages. The CD-ROM includes software for publishing HTML documents and building your own Web server.

Besides giving you a comprehensive introduction to HTML, the language used by World-Wide-Web documents, the book and CD-ROM provide design tips for building terrific Web pages. The book explains how to jump-start your Web pages with sample templates and demonstration pages, and how to automate Web page construction with Windows software found on the CD-ROM—including HoTMetaL, the most full-featured HTML editor. You can download your favorite Web browser with NetManage's Internet Chameleon and the included Windows Web browser document. A library of Web-compatible icons and clip art is also included.



HTML CD for Windows costs $39.95, including CD-ROM, and is published by Prentice Hall PTR, Upper Saddle River, NJ 07458; Web: http://www.prenhall. com.

CIRCLE 96 ON FREE INFORMATION CARD

ELECTRONIC PUBLISHING CONSTRUCTION KIT: CREATING MULTIMEDIA FOR DISK, CD-ROM, AND THE WORLD WIDE WEB

by Scott Johnson

This book and CD-ROM toolkit enables readers to create a wide range of multimedia applications. Written by one of the creators of the award-winning HyperWriter software, the book reviews the basics of hypertext and multimedia and explains how to quickly master electronic publishing for CD-ROM and the Internet.

The book is divided into three sections. The first covers the basics of digital publishing, explaining when, why, and where it should—and shouldn't—be used. Part I also presents overviews of several popular digital publishing tools, and provides coverage of World-Wide Web basics. Part 2 is dedicated to HyperWriter, leading readers through each step and providing hands-on instruction on every phase of the software and digital publishing. Part 3 covers real-world applications of digital publishing—showing readers how to build an interactive catalog and a Web site.

The text draws heavily on the powerful software included in the CD-ROM. The CD-ROM provides more than $300

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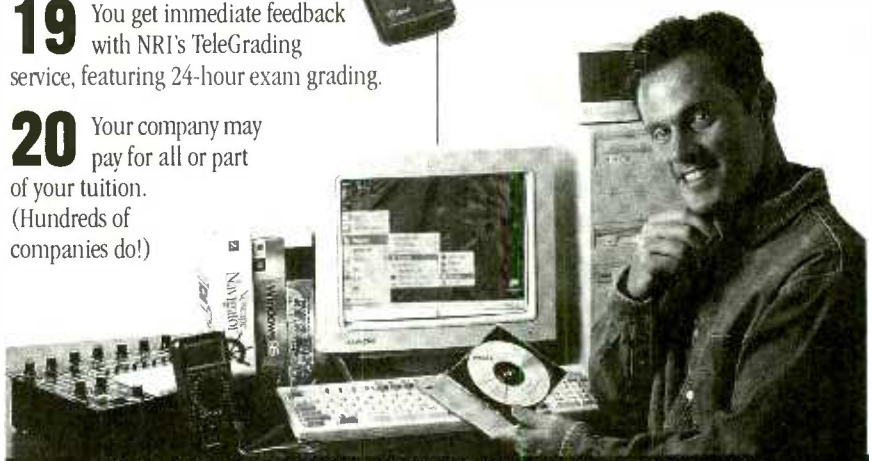

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CIRCLE 97 ON FREE INFORMATION CARD

THE THUNDERBIRD GUIDE TO INTERNATIONAL BUSINESS RESOURCES ON THE WORLD WIDE WEB

by Candace Deans & Shaun Dakin

From a class project at Thunderbird, the American Graduate School of International Management, comes this practical guide to accessing information on the World Wide Web. The text shows readers how to gather the vital information that today's business professional needs to develop an intimate understanding of how business is conducted in different parts of the world.

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Each chapter opens with a short introduction to the region, intended to give readers some insight into the culture, political system and risk, social aspects, and business practices of the area. The introduction is followed by listings of World-Wide Web resources, including URL addresses and brief descriptions of each site. The listings will be updated and expanded on Thunderbird's home page.

The Thunderbird Guide to International Business Resources on the World Wide Web costs $21.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-225-5945; Web: http://www.wileycom/compbooks; Thunderbird Web: http://www.t-bird.edu.

CIRCLE 98 ON FREE INFORMATION CARD

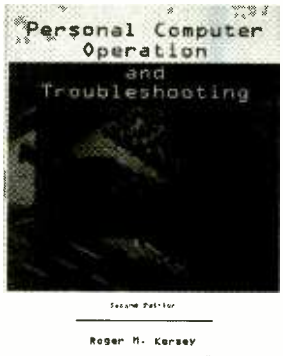
PERSONAL COMPUTER OPERATION AND TROUBLESHOOTING: SECOND EDITION

by Roger M. Kersey

When this book was first released, the field of personal-computer maintenance was just emerging. Since then, it has exploded. From hardware and software to I/O devices and network communications, the PC service expert needs to know much more. The book's second edition has been completely updated and expanded to reflect the massive growth and rapid changes in the field.

Written for the IBM PC, the book features current material on compatible microcomputer systems and I/O systems. An in-depth examination of the component level of the XT is used as a reference point for the rest of the book, which explores the operation and troubleshooting of 286, 386, 486, and Pentium systems. Timely updates on I/O systems include coverage of keyboards, power supplies, monitors, video adapters, floppy and hard drives, printers and the mouse, and parallel and serial I/O systems. Data communications and networking are introduced from a hardware viewpoint. The text ends with an overview of the test equipment and troubleshooting techniques discussed throughout the book.

To make learning easier, each chapter opens with a focused list of learning objectives, then provides working examples and troubleshooting tips. At the end of each chapter is a summary covering the most important information presented within, followed by review questions.



Personal Computer Operation and Troubleshooting, Second Edition, costs $76 and is published by Prentice-Hall, P.O. Box 11071, Des Moines, IA 50336; Tel. 800-947-7700 or 515-284-6751; Fax: 515-284-2607; e-mail: orders @prenhall.com.

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ACTIVE ELECTRONIC COMPONENT HANDBOOK: SECOND EDITION

edited by Charles A. Harper and Harold C. Jones

Engineers involved in electronic design are accustomed to relying upon data sheets from dozens of different sources for current technical information. This book, written by several experts in the field, provides a single source of such data on active electronic components. (A companion volume covers passive components.)

The book is aimed at anyone involved in electronic and electrical design or in any aspect of component specification or use. The comprehensive source book provides property and performance data for all the important component groups and presents comparison data and guidelines for the best component and selection trade-off

(Continued on page 58)

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Low-Power DC UPS

Popular Electronics
October 1997

If you have low-power DC equipment, whose power must be maintained even during power outages, this uninterruptible power supply, which can be operated manually or automatically, is able to handle the job.

PHILIP KANE

Uninterruptible power supplies (UPS) are designed to ensure the continued operation of critical electronic equipment during a power failure. They are manufactured to meet a wide range of power requirements, from backing up your personal computer to keeping your entire home office (or workshop) going. Most are designed to transparently maintain AC power to your equipment by providing for a smooth transition between the main power source and backup power.

There are a number of smaller, less sophisticated devices that have relatively low-power requirements, run on DC rather than AC voltage, but nonetheless must also remain operational in the event of a main power failure. Such devices include fire alarms, small security-system sensor modules, data-acquisition or status-monitoring devices, etc. The obvious choice when it comes to powering said circuits is to use batteries. That isolates them from the main power system; thus, there is no need to be concerned about interruptions in service.

However, batteries will eventually need to be replaced, and therefore require regular monitoring of their condition. A better solution is to use the main power supply in conjunction with batteries as a backup supply, and to provide some means of switching between the two when necessary—in other words, a *Low Power DC UPS*, like the one described in this article.

A Simple UPS. The block diagram in Fig. 1 shows the general organization of a simple UPS. The unit consists of an unregulated DC source, a backup power source, switching logic, and a voltage regulator. The input to the regulator normally comes from the DC source. If the main power is interrupted (causing the DC source to fail), the switching logic toggles, connecting the backup power source to the regulator input. When main power is restored, the switching logic again toggles, reconnecting the main DC source to the regulator. Now that we know a little something

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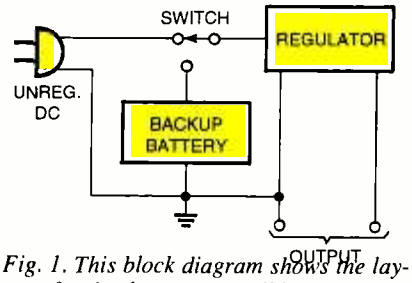

Fig. 1. This block diagram shows the layout of a simple uninterruptible power supply, which is comprised of an unregulated DC source, a backup power source, switching logic, and a voltage regulator.

about UPS operation, let's take a look at the actual circuit.

The Circuit. Figure 2 shows a schematic diagram of the Low-Power UPS, which is intended for low power (200mA or less) applications. It is essentially a switch-mode regulator with battery backup. In normal operation, the circuit provides a regulated 5-volt DC output from an unregulated 12-volt DC source that is connected to PL1. When S1 is closed, the unregulated DC input applied to PL1 divides along two paths. In one path, the source voltage is used to light LED1, indicating that normal power is being supplied to the circuit. In the second path, the source voltage is fed through diode D1 and is filtered by capacitor C1 before traveling on to IC1 (a MAX639 step-down DC-DC converter). That IC steps down the input voltage to provide a regulated output 5-volt DC at 225 mA to whatever device is connected across J1 and J2 (a pair of banana jacks). As long as the circuit is operating normally, a portion of the output voltage is used to light LED2 through a 330-ohm resistor (R4). Taken together LED1 and LED2 indicate the status of the Low-Power DC UPS.

A Closer Look. With both S1 and S2 closed, IC1 (the MAX639) receives input from either the main power source or the backup source. Diode D2 serves as an automatic switch should the main power source fail. That's because as long as the main power is available D2 is reverse biased, so no current flows from the backup battery to the regulator. But if the source voltage drops below the battery (*i.e.* main power failure), D2 becomes forward biased and the battery (B1) supplies power to the regulator. To determine the maximum and minimum values for B1, we must consider the maximum and minimum values for the source voltage, and the forward voltage drop across D1, and D2.

Let's assume that D1 and D2 each have forward voltage drops of 1 volt. The specified input range for the MAX639 is 5.5 to 11.5 volts; therefore, the source voltage (V_S) can range between 7 and 12 volts. If V_S is 9 volts, then the voltage at the cathode of D2 (and also at the input to the regulator) will be 8 volts. Consequently, B1 can not be greater than 9 volts, if D2 is to remain reverse biased. In order to ensure that if V_S fails, the backup voltage will at least equal the MAX639's specified minimum, the backup battery voltage (V_{BB}) can't be less than 7 volts. If V_S were 12 volts, we would have a wider selection range for V_{BB} (7 to 12 volts).

Since the MAX639 will provide regulation down to its minimum input voltage, it is probably a good idea to choose a value for V_{BB} that is towards the low end of its range. That can help to extend battery life in situations where V_S may frequently fall between its normal level and the regulator's minimum input voltage. However, remember that over time battery voltage will fall below its nominal value. If we choose the battery voltage so that V_{BB} is at or near its minimum possible value, the useable life of the battery will be shortened. In our example, we compromise by setting V_{BB} in the middle of the specified range (9 volts).

Two factors to consider when choosing D1 and D2 are the required maximum load current and leakage current. If, as in this case, we are using Alkaline batteries, then we should choose a diode with low leakage current. A 1N4001 was used in the prototype. That diode has a specified maximum reverse (leakage) current of 10 µA at 50 volts DC (reverse voltage). Its forward-current rating is 1 amp, well above the requirements for this application. A better choice would be one of the low leakage Schottky diodes, which have reverse-current ratings in the nanoamp range, as well as low forward-current ratings.

Construction. The prototype was built on a piece of perfboard, using point-to-point wiring techniques. The perfboard assembly was housed in a small plastic storage bowl with a lid. The backup battery configuration (size and number will be determined based on your load requirements) will be a significant factor in your choice of an enclosure. The off-board components (switches, banana jacks, power jack, and LEDs) were mounted to the enclosure. To protect against damage to the circuit due to leakage, a paper barrier (comprised of a piece of cardboard folded

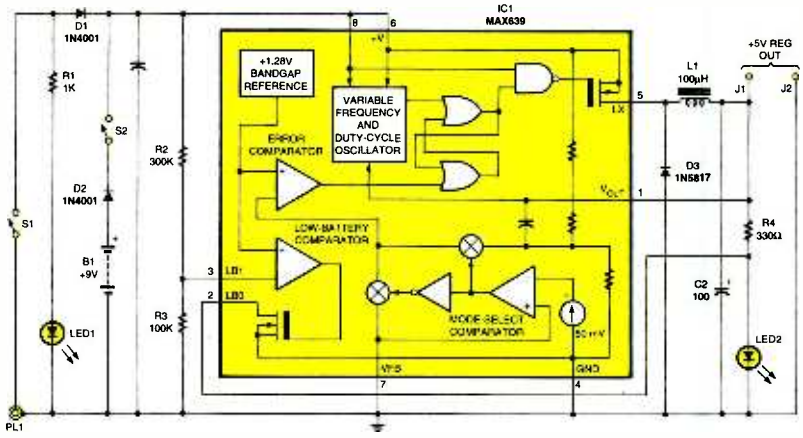

Fig. 2. As shown by this schematic diagram, the Low-Power DC UPS is essentially a switch-mode regulator with battery backup. The circuit is designed to provide a regulated DC output from an unregulated source. Note that if the power fails while both S1 and S2 are closed, battery power is automatically fed to the regulator, which, in turn, maintains power to the circuit.

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PARTS LIST FOR THE LOW-POWER DC UPS

SEMICONDUCTORS

IC1—MAX639 step-down DC-to-DC Converter, integrated circuit
D1, D2—1N4001 1-amp, 50-PIV silicon rectifier diode
D3—1N5817 fast-switching Schottky barrier diode
LED1—Green light-emitting diode, 2.0 volts, 10mA
LED2—Yellow light-emitting diode, 2.0 volts, 10mA

RESISTORS

(All resistors are 1/2-watt, 5% units.)
R1—1000 ohm
R2—300,000-ohm
R3—100,000-ohm
R4—330-ohm

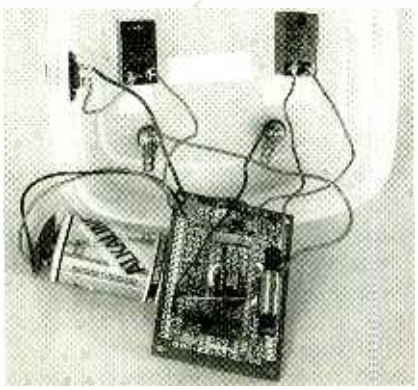
ADDITIONAL PARTS AND MATERIALS

C1—47-μF, 35-WVDC, electrolytic capacitor
C2—100-μF, 35-WVDC, electrolytic capacitor
L1—100-μH, 2-amp inductor
S1, S2—SPST toggle switch
J1, J3,—Banana jack
PL1—Chassis mount power plug
Perfboard materials, enclosure, wire, solder hardware, *etc.*

Note: The MAX639 can be obtained, in small quantities, directly from MAXIM by calling 1-800-998-8800.

around the battery) was used to prevent the battery from shorting to the circuit.

Checkout And Testing. Before powering up the circuit, check all connections. Make sure that you have a DC adapter that can deliver the required maximum current at the required output voltage. Use fresh batteries.



The Low-Power DC UPS was assembled on a small piece of perfboard, using point-to-point wiring technique.

TABLE 1—LED OPERATION

LED1	LED2	CONDITION
Off	Off	Main power off, no backup battery, or low backup battery
Off	On	Main power failure, UPS in backup mode
On	Off	Main power on, however, UPS has failed
On	On	Main power on, UPS operating properly

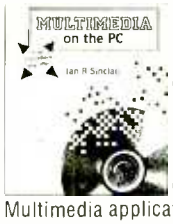
Note: Assume both S1 and S2 are closed

With the backup battery out of the circuit, check the circuit as follows: Set S1 and S2 to their open (off) positions, connect the DC adapter to the UPS, and plug it into a wall outlet. Close S1. Both LED indicators should come on. If neither LED comes on, check the voltage across the input to the UPS. If LED1 is on and LED2 is off, check your wiring, and then the UPS output voltage. If there is no voltage at the output, measure the voltage on the input side of the MAX639. If there is no input voltage, then suspect D1.

If LED1 is off and LED2 is on, check the wiring for LED1 and its limiting resistor. Measure the current between the anode of D2 and ground. It should not exceed the specified leakage current for the diode you have chosen. Verify that the regulator portion of the circuit is operating correctly by varying the load on the UPS (use a potentiometer across the output) and measuring the output voltage. It should be relatively constant (about 5 volts). Be careful not to exceed the specified output current limit (200mA).

With S1 still closed, place a backup battery in the circuit. Close switch S2, and place S1 in the off position. The indicator LED1 should go off. LED2 should remain on. Measure the output voltage. It should still be at the regulated level. Close S1 again and remove the adapter from the wall. LED1 should again go off while LED2 remains on. If you have a variable DC power supply, use it in place of the DC adapter. Using the DC supply, apply power to the circuit, and vary the input voltage between 12 volts and 7 volts, while monitoring the UPS output voltage. It should remain relatively constant. Repeat that step with the UPS under load (up to about 200mA).

UPS Status Indicators. The two LEDs are used to indicate the status of the UPS and the condition of the main power line. Table 1 summarizes the operation of the two LEDs. LED1 lights and remains on as long as the UPS is fed from the main power source. LED2 remains on as long as the voltage at the LBI input (pin 3) is above a value determined by the resistive voltage-divider network, comprised of R2 and R3. The values for R2 and R3 are given by: R2 = R3((VLB/LBI Threshold) -1, where R3 is any resistance in the 10k to 1-megohm ohm range—typically 100k. The LBI Threshold voltage is 1.28V, and VLB is the desired low battery detection voltage, 5 volts for this example. ■



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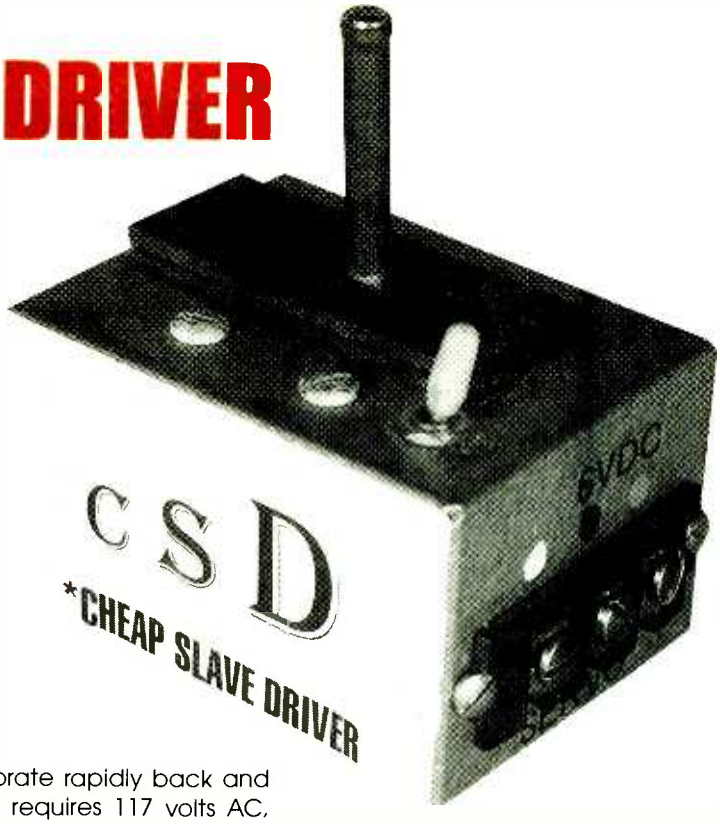
A CHEAP SLAVE DRIVER

Build a simple controller circuit that allows you to remotely operate servo-motors to control surveillance cameras, aim your outdoor antenna, actuate robotic arms, and more!



D. DEREK VERNER

Your first thought may be that you don't need a cheap slave driver, you already have one—at work. The slave driver referred to in this article, however, is not that kind. It is a remote positioner that allows you to control a servomechanism from a distance. It can be used for robotics, remote-controlled toys, positioning a surveillance video camera, and a host of other things. It's cheap, because it can be built with about three dollars worth of components.

There have been a number of systems that perform similar tasks. In the years BC (Before Cable), a TV antenna rotator was familiar to many of us. For our purposes, however, it has a few drawbacks. It's big and clumsy, and its response time is too slow to be considered a true master/slave control system. In addition, it requires 117 volts AC, plus it needs five conductors for its feedback circuit to operate. On the other hand, the synchro or Selsyn system (which dates back to 1943 and was used in WWII military equipment) responds instantly and can be rotated continuously.

Either unit can serve as the slave, since it relies on electrodynamics rather than electronics for its operation. The drawbacks of the Selsyn system is that if it's moved too quickly, it starts to oscillate and vibrate rapidly back and forth. It also requires 117 volts AC, which has to be fed to both units via five conductors that demand adherence to electrical wiring codes.

The *Cheap Slave Driver*, on the other hand, operates on 6 volts, and, after the power is connected, needs only one additional conductor per unit. It will operate servos with up to 33 inch/pounds of torque. The Cheap Slave Driver uses inexpensive servos that are made for the radio control hobby market, which are available from either your local hobby store or from the address shown in the Parts List.

How It Works. The servos are ordinarily connected to a multichannel radio receiver that receives position information from the transmitter's joy stick. The receiver translates the position information into a varying pulse width DC signal. The repetition rate for the pulses can be anything from 20 to 70 Hz. The positive pulse-width can vary from 1 to 2 milliseconds (ms). With a pulse width of 1 ms, the servo travels to one extreme position, and a 2 ms pulse sends it to the other extreme. Servos are available that travel 90° or 180°. Any pulse width between these two limits will send the servo to a corresponding position.

A schematic diagram of the Cheap Slave Driver is shown in Fig. 1. The circuit uses a 555 oscillator/timer, configured for astable operation, to supply the appropriate pulses depending on the position of potentiometer R4. In a regular 555 astable circuit, changing the value of one of the timing resistors would result in a change in the operating frequency as well as in the pulse width. The circuit shown, however, provides independent control of the pulse/space ratio or duty cycle without altering the frequency. That's done by supplying two different paths for the charging and discharging of timing capacitor C1.

When power is applied, capacitor C1 is charged through R1, D2, and half of R4. When the charge on C1 reaches 4 volts (two-thirds of the supply voltage), the IC changes state, causing pin 7 to go low and capacitor C1 to start to discharge through the other half of R4, R3, D1, and R2. When the voltage on C1 falls to 2 volts, the IC's internal flip-flop toggles again (sending pin 7 high), and the capacitor begins to charge once more. Adjusting R4, therefore, changes both the charge

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and discharge rates in a complementary fashion, so that the full cycle length remains constant as does the frequency.

With the value of the components shown, the circuit operates at about 55 Hz and has approximately a 10% duty cycle. Moving R4 over a 60° arc results in a full range of 180° of movement for the servo. The ratio of movement of the potentiometer to movement of the servo is up to the user and can be determined experimentally. The circuit has been designed so that the sum of R2, R3, and R4 is nearly equal to 100k, allowing the value of R4 to be selected for the operating characteristics required. Resistors R2 and R3 provide a minimum resistance in the discharge path, preventing damage to the IC should R4 be set to zero (as seen by the discharge circuit).

PARTS LIST FOR THE CHEAP SLAVE DRIVER

SEMICONDUCTORS

IC1—555 oscillator/timer, integrated circuit
D1, D2—1N4148 general-purpose, small-signal diode

RESISTORS

(All fixed resistors are 1/8-watt, 5% units)
R1, R2—1000-ohm
R3—47,000-ohm
R4—50,000-ohm linear potentiometer

CAPACITORS

C1—0.22-µF, 50-WVDC, electrolytic capacitor
C2—0.01-µF, ceramic disc capacitor

ADDITIONAL PARTS AND MATERIALS

B1—Four D-cell batteries
TS1—3-position terminal strip
Perfboard material, 4 D-cell battery holder, joystick handle, IC socket, solder, wire, hardware, etc.

Note: Servos of various sizes and with many types of mechanical linkages are available from Hobby Lobby, 5614 Franklyn Pike Circle, Brentwood, TN 37027. A catalog outlining their products is available for $2.00.

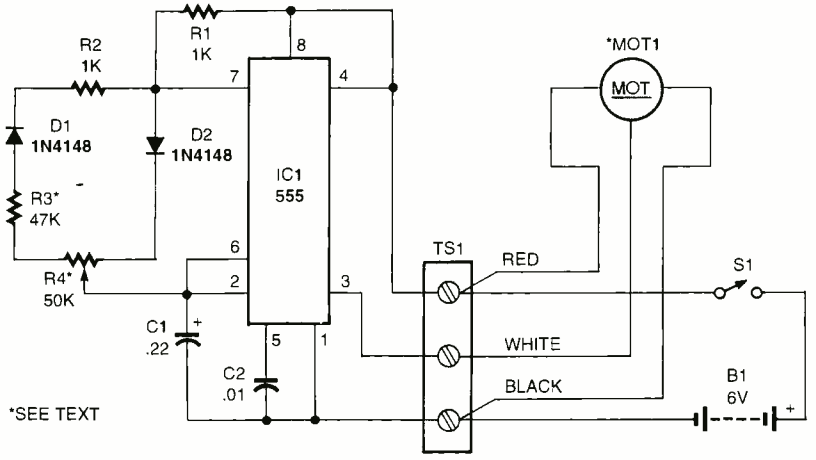


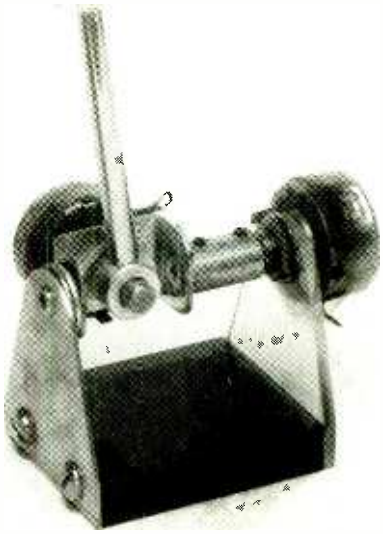
Fig. 1. The Cheap Slave Driver uses a 555 oscillator/timer, configured as a not-so-conventional astable multivibrator, to supply a stream of pulses depending on the position of potentiometer R4. In the circuit, R4 is connected so as to provide separate charge/discharge paths. With D1 and D2 serving as polarized switches, the charging and discharging paths of C1 are kept totally isolated from each other.

Construction. The author's version of the Cheap Slave Driver was built into a Bud type aluminum mini-box, measuring 2-3/4 × 2-1/8 × 1-5/8 inches. Potentiometer R4 was mounted on a small bracket that was attached to the top of the box. A slot in the top of the box allows a joystick type handle to be fastened to R4 and to move over the desired arc. Make the handle by drilling and tapping a shaft collar or small knob, so that a long screw can be installed. Slip the screw into a piece of metal tubing cut to an appropriate length. If you prefer, you can substitute a slide potentiometer for R4.

If you would like to change the ratio of movement between R4 and the servo, you can substitute a different value potentiometer, keeping the total resistance of R4 and R3 at about 100k. A smaller value of R4 will result in less movement of the servo per degree of potentiometer rotation. You can substitute an adjustable 100,000-ohm trimmer potentiometer for R3, so that different values can be substituted for R4. Trimmer potentiometer R3 could then be adjusted to set the desired amount of movement of the joystick to effect a given movement of servo. Some combinations will result in a change of frequency, but since 55 Hz is near the middle of the servo's working range, there should be little effect on operation. Resistor R2 will protect the IC if both adjustments are inadvertently set to zero resistance.

The rest of the components for the Cheap Slave Driver were assembled on a small piece of perfboard—one of the snap-in-half mini IC PC boards sold by RadioShack is ideal—and connected to the control potentiometer through short lengths of insulated hook-up wire. Once the board is assembled and connected to the potentiometer, it's a good idea to

(Continued on page 45)



The simple Cheap Slave Driver outlined in this article is designed to control one remote device, but with a single modification the unit can be made to control two circuits.

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Ham Radio Code Filter

Here's an interesting "first" project for the ham radio operator—an audio filter for making the Morse code station you want to hear stand out from those you don't.

LARRY LISLE, K9ZT

Many early amateur radio enthusiasts first cut their teeth on one of the first modes of radio communications, Morse code on CW—a system by which a continuous wave carrier is interrupted. However, what appears to be simple is confounded by the introduction of atmospheric noise, man-made noise, heterodyning with other radio signals, and even more RF garbage. Here's a simple circuit—the *Ham Radio Code Filter*—that brings the received hash down to a usable signal that can be copied.

About The Circuit. A schematic diagram of the Ham Radio Code Filter is shown in Fig. 1. Looking at the schematic, we see a circuit that's not quite on the cutting-edge of filter technology, but it's easy to build, doesn't require any critical parts or adjustments, and does a good job for its intended purpose! The circuit shows some of the basic principles of operational amplifiers.

The input signal is fed into the op-amp (IC1), where it's amplified and passed on to the earphones. Some of the signal is routed back to IC1's non-inverting (+) input as positive feedback through R1, which boosts the gain. At the same time some of the signal is passed back to the inverting (-) input as negative feedback through a parallel resonant circuit made up of L1 and C1. That cancels the gain of the amplifier, except at the resonant frequency of the tuned circuit, which has a high impedance at resonance.

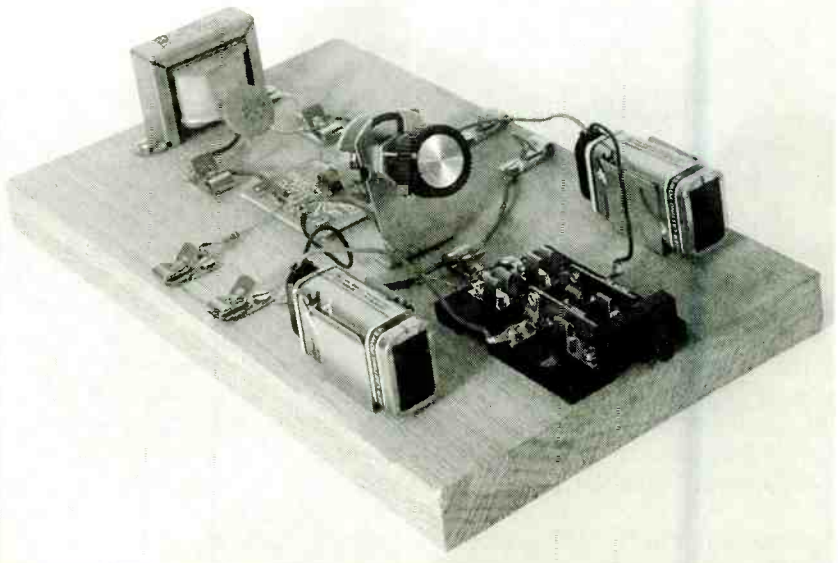
The amount of positive feedback can be varied by adjusting R1. The greater the feedback, the sharper the filter. If the control is advanced too far, the circuit will go into oscillation. The filter is most selective just before that point.

Figure 2 shows the filter's response curve. The curve is razor sharp at the peak but fairly broad 20-dB down, so you can keep track of what's going on around your frequency.

Construction. The Ham Radio Code Filter was assembled on a 5-$^1/_2$ by 10-inch section of board. The circuit layout is non-critical. Fahnestock clips were used for the input and output, but you can use plugs and jacks to match your station. The

PARTS LIST THE HAM RADIO CODE FILTER

IC1—741 op-amp, integrated circuit
R1—1-megohm, potentiometer
R2, R3—10,000-ohm, ¼-watt, 5% resistor
C1—0.01-μF, ceramic-disc capacitor
C2—0.1-μF, Mylar capacitor
L1—5-H choke or equivalent, see text
S1—DPDT knife switch
B1, B2—9-volt alkaline battery
Protoboard, 5-½-inch by 10-inch board, IC socket (optional), battery clips, battery holders, bracket for potentiometer, knob, Fahnestock clips, screws, wire, solder, hardware, etc.



The Code Filter is assembled on a bread board as in the old days of radio.

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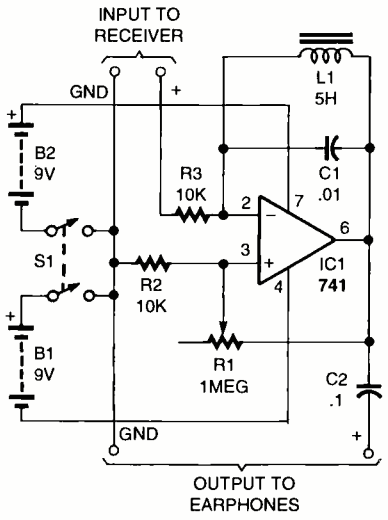

Fig. 1. The filter is not quite on the cutting edge of technology, but it's super easy to build and really cuts the interference and noise on the ham code bands.

integrated circuit is mounted on a small piece of printed-circuit board with the foil side up. Unless you have some soldering experience, you might want to use a socket.

You can mount the small parts on the board too and build the filter much smaller, if you prefer. The Parts List calls for a 5-henry choke for L1, but that isn't critical. Try whatever you have in your junkbox. One winding of an audio transformer might even work—so try it and see! The author used Fahnestock clips for capacitor C1, so you can easily substitute other values to change the frequency of the filter. With those given, it's about 840 Hz.

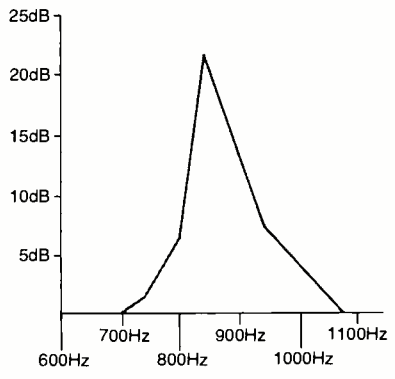

Fig. 2. Here's the filter's selectivity curve. The razor-sharp peak will make the station you want to hear stand out from those that you don't want.

Using the Filter. Connect the input of the filter to the headphone jack of your receiver and connect your earphones to the output. Either high or low impedance phones will work. Close Switch S1 and turn on the radio. Advance the potentiometer until the filter almost breaks into oscillation and then back it off a bit. Tune slowly across a code station, and you'll notice a very sharp peak in the response. If you tune too fast, you can miss some stations! The filter really does cut through the interference and noise! ■

SLAVE DRIVER

Continued from page 43

cover the bottom of the board with tape to insulate it from the metal chassis.

Several servos can be operated by one Cheap Slave Driver, or separate units can be built to operate each servo. Everything is powered by a single battery, so current drain depends on the number of servos used and on the size of each, as well as the amount of force required from them. The one favored by the author draws 25 mA at idle and up to 500 mA when loaded to the stalling point.

One way the author has put a pair of servos to use is in remote aiming of the pump from one of those battery-powered super water guns. That serves to discourage squirrels from feasting at the bird feeder set up in the backyard. Before a legion of rodent lovers deluges the magazine with protests, it should be known that the squirrels have their own feeding station supplied with nuts and grain. Another use you might consider is the positioning of a mirror reflecting a laser or high-powered spotlight for a rock concert type light show. How about animated holiday figures, your own remote-controlled Mars Sojourner rover, or the operation of gates, crossings, cranes and bridges on a model railroad, or a remote-controlled, working, model back hoe? The uses you can put this circuit to are limitless and it will be pleasant to have a Slave Driver do *your* work for a change. ■

HANDS-ON REPORT

Continued from page 12

which blends and layers color hues for vivid output; and HP-developed pigment-based black inks. The results are clear, true colors and black print that's hard to differentiate from that of a laser printer.

To help business users get started using color printing, two programs are included with the DeskJet 1000C: Corel Print House Select 1.1 and MySoftware's MyColorMarketingMaterials 3.1. Both programs are intended to help users create custom brochures, signs, cards, fliers, and other printed materials. They are found on a CD-ROM that also offers HP's own design ideas.

MyColorMarketingMaterials is a bit more business oriented (and also a bit more limited) than Print House Select. The former allows you to create three-fold brochures, letterheads, business cards, certificates, and post cards. In each category, it offers a choice of perhaps a half-dozen different backgrounds, borders, or themes to which you can add your own text or clip art. Print House Select offers more design options and more document categories. For instance, you can create documents from scratch, use the program's clip art and borders, and write your own text or use (or adapt) the samples given. It also lets you create personal items like greeting cards and calendars—which means that if you buy the DeskJet 1000C for your home office, you're likely to get competition from other family members who will want to use it, too.

The DeskJet 1000C professional color printer has a suggested retail price of $569, and is expected to retail for less than $500. For more information, contact Hewlett-Packard Company, Direct Marketing Organization, P. O. Box 58059, MS511L, Santa Clara, CA 95051-8059, Tel: 800-752-0900, Web: *http://www.hp.com.* ■

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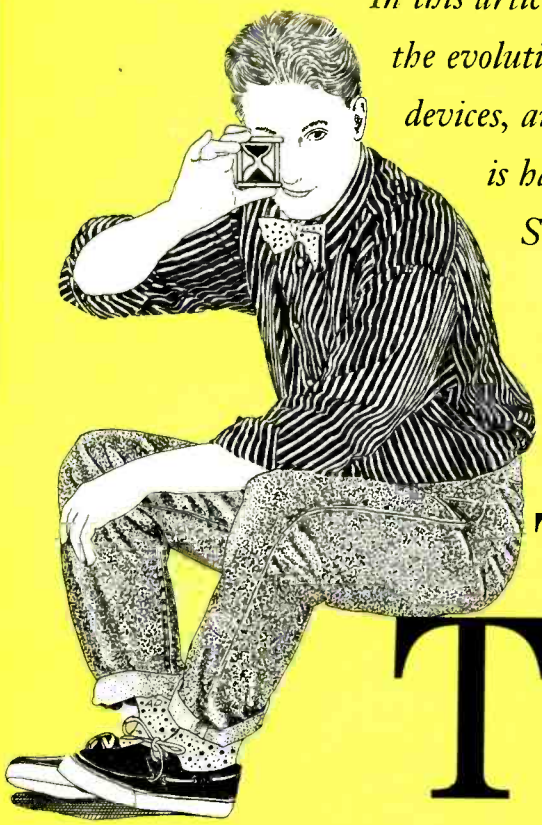
KARL THURBER

A day by any other name would still have only 24 hours. In this article we'll take a look at the evolution of timekeeping devices, and see how that task is handled in the United States and Canada



ALL THE TIME IN THE WORLD

We all know that time is a highly valuable commodity. Each and every one of us observes and uses time, especially those of us with a technical interest—scientists, engineers, air traffic controllers, military personnel, shortwave listeners (SWLs), amateur radio operators, and others. In this article, we'll look at time, see what it is, and describe how to best use it in our day-to-day hobby activities. We'll also discuss ways of accurately keeping and recording time, and how time and frequency are controlled in this country. In addition, we'll describe the current National Institute of Science and Technology (NIST) methods of disseminating time information through a variety of technical services, including HF and LF radio, and several high-tech methods; and present some details of precision timekeeping by our northern neighbor, Canada.

Time Calendars of Yore. We don't know much about prehistoric timekeeping, but we do know that in practically every culture some people in the society were preoccupied with measuring and recording time—whether they were ice age hunters, Sumerians, or Stonehenge dwellers. And they all used celestial bodies as references for time frames—ancient civilizations relied heavily upon them to determine the seasons, months, and years.

Over 20,000 years ago, ice age hunters scratched lines in sticks and bones, possibly counting days between phases of the moon. Some 5000 years ago, the Sumerians, in the Tigris-Euphrates valley (an area that is today called Iraq) used a calendar that divided the year into 30-day months. The Sumerians further divided the day into 12 periods (each corresponding to 2 of our hours) and again into 30 parts (each like 4 of our minutes). Today, Muslims use a Babylonian-based 354-day calendar, while most of the world uses a 365-day solar calendar with a leap year every fourth year.

Segmenting the Day Using Sun Clocks. About 5000 years ago people found that they had a need to know the time of day. The advanced civilizations of the Middle East and North Africa stressed making clocks rather than calendars. The Egyptians took an early step in segmenting the day into usable parts something like our hours. As early as 3500 BC, they developed the *obelisk*, a slender, four-sided tapering monument. The obelisk's moving shadow formed a sort of sundial that was capable of determining each day's midday, as well as the year's longest and shortest days. You may be surprised to learn that the Egyptians developed what likely was the world's first portable timepiece—a shadow clock first used in 1500 BC to determine hours. The small device divided the sunlit day into 10 increments, plus two twilight hours, and it also indicated noontime.

The Basic Elements of a Clock. Having described various ancient ways to mark the passage of time, let's define just what a clock is. In essence, a clock is a mechanism that counts and records a series of periodic events. There are two essential components of a clock. The first is a regular, constant, or repetitive process or action to mark off equal time increments. The second is a means of keeping track of the time increments and displaying the result. Timekeeping history is really the continuing search for ever more consistent and precise actions or processes to regulate clock rate.

Early Water Clocks. Water clocks were some of the world's earliest timekeepers. Water clocks differed from previous timekeeping methods in that they didn't depend on celestial bodies. One of the earliest water clocks was developed by the Egyptians as early as 1500 BC; one such device was found in the tomb of Pharaoh Amenhotep I.

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Mechanical Clocks and Pendulums. Despite known deficiencies, fairly simple time-telling systems prevailed during the Middle Ages. In Europe, sundials, hourglasses, marked candles, and oil-burning lamps and wicks were popular. In the Far East, the Chinese even had an incense clock. Large mechanical clocks were first seen in Europe in the 14th century, and they became more prominent in the 16th and 17th centuries. Such clocks were regulated by a so-called *verge and foliot escapement* mechanism, a design advancement that characterized modern clocks and watches for some 300 years. Early mechanical clocks were difficult to regulate, and most did not work well aboard ships in rough seas. It wasn't until the 17th century that the first windup clocks were introduced—the British navy was among the first to use these clocks.

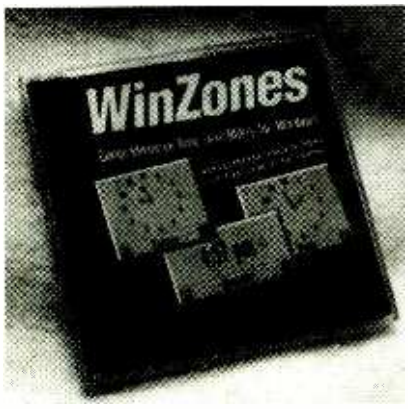
During the early 20th century, the clock (and watch) still were high-priced commodities, which soon became associated with the accuracy of the railroad industry, and later with the radio and TV industries. It took the advent of quartz clocks to make real changes in timekeeping for the public. Today, the clock is a low-cost commodity that's available to practically everyone.

Modern Quartz Clocks. Quartz clocks are based on the piezoelectric (electricity produced by pressure) property of quartz crystals. They are much better than mechanical clocks because they have no gears or escapements to disturb their frequency.

Quartz-based clocks still rely on a mechanical vibration whose frequency depends upon the crystal's size and shape; unfortunately, no two crystals are precisely alike. Therefore, for very precise timekeeping, the quartz clock, in turn, yielded to the *cesium beam* atomic clock in the 1960s as primary laboratory timekeeping devices. The atomic clocks generated very precise frequencies, with time interval accuracies (beyond the reach of mechanical- and quartz-based timepieces) in nano- and picosecond ranges.

Atomic Time and Atomic Clocks. Atomic clock accuracy stems from the very constant resonant frequency of atoms. In 1949, the first atomic clock was based on measurement of a resonant frequency caused by the microwave absorption of the ammonia gas module. But actual performance wasn't much better than existing standards, and so in 1957 National Bureau of Standards or NBS built its first cesium beam atomic clock. In 1960, after the natural resonance frequency of the cesium-133 atom was determined precisely, the cesium atomic clock became the frequency standard maintained by NBS.

However, it wasn't until 1967 that the cesium standard was adopted as the international unit of time, and the second was defined as the microwave resonance frequency (9,192,631,770 cycles per second) of the cesium atom. That made the natural resonance of this element the world standard for atomic time.



WinZones is a Windows utility that displays up to nine active clocks simultaneously on your PC's screen, each showing the correct time for cities in other time zones. It's especially useful for amateur radio enthusiasts; executives; sales people; workers in communications, the media, and transportation; and others who have business across multiple time zones. The program often eliminates the need for multiple desk or wall clocks.

Greenwich and World Time Zones. In the 1840s, the Greenwich time standard was established. Because Great Britain was the major world power at the time, the center of the first time zone was set at the Royal Greenwich Observatory, which was located on the 0-degree longitude meridian. The line was determined by the Astronomer Royal using a transit telescope. The international date line was set to generally follow the 180-degree longitude meridian in the Pacific.

On November 1, 1884, the International Meridian Conference met in Washington DC with delegates from 25 countries. They officially referenced mean solar time to the 24 standard meridians, based 15 degrees east and west of Greenwich, the point from which reckoning for each day should begin. Each time zone represents one hour's time difference between adjacent zones. (See Fig. 1).

Time Zones in the U.S. In this country, time zones didn't become necessary until trains traversed the country. Previously, cities relied on their own local "sun time." The problems associated with tracking hundreds of local times and publishing timetables were overcome only partially by the establishment of some 100 different, but consistent, railroad time zones. In 1883, the government sought to improve the situation by dividing the country into four time zones. At noon on November 18, 1883, the master clock at the United States Naval Observatory (USNO) transmitted the time by telegraph lines to major cities, each of which adjusted their clocks to their time zone's correct time.

Zulu Time. You're probably familiar with the standardized times such as Coordinated Universal Time (UTC). Often, UTC (or Greenwich Mean Time (GMT), as it used to be called) is written with the 24-hour time suffixed with a "Z," for "Zulu" time, using the internationally recognized phonetic for Z, which originated with the military. In that Greenwich is at the "zero meridian," the military began calling GMT "Zero Time," or "Z-Time" for short. The old phonetic alphabet for "Z" was Zebra, but when the international phonetic alphabet changed, the new phonetic became *Zulu*.

Various Time Considerations. In dealing with GMT, UTC, or Zulu time,

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you must be careful about several points. One of the points is the date. In converting times, you must account for the correct date if the time "crosses" midnight or the International Date Line. Having a time chart or world map available helps you picture needed International Date Line time conversions. Daylight Savings Time (DST) also can foul you up, since local standard time is advanced one hour for DST.

UTC doesn't change seasonally, but we have to adjust local timepieces accordingly. In the spring, we set our clocks ahead one hour (spring ahead, as they say) in most places, and in the fall we set them back (fall back). To avoid confusion, international times usually are stated in UTC, and to avoid further confusion between AM and PM, the 24-hour military-style clock usually is used. A very useful software program, WinZones, helps to keep track of the correct times and dates for cities in other time zones.

Time Scales for Everyone. Major users of highly precise time include civilian and military aircraft and ships, commercial radio and TV stations, spacecraft tracking stations, seismographers, astronomers, geologists, electronic power distribution companies, and scientific laboratories. Until 1972, several different time scale families existed. Each time scale was offset from the others for special purposes and users, such as navigators and satellite trackers. That glut of time scales posed a problem because the earth's rotational fluctuations affected UT, but didn't affect atomic time. A compromise time scale, UTC was developed and became effective internationally on January 1, 1972.

Today UTC is considered the modern implementation of GMT, but one that incorporates the accuracy and stability of atomic clocks. Of course, old habits die hard, and people today still refer to UTC as GMT. The UTC time scale, as it's called, that's broadcast by NIST stations WWV and WWVH meets most needs. It runs at a rate that's almost perfectly constant because it's based on atomic standards.

The BIPM. The World's Official

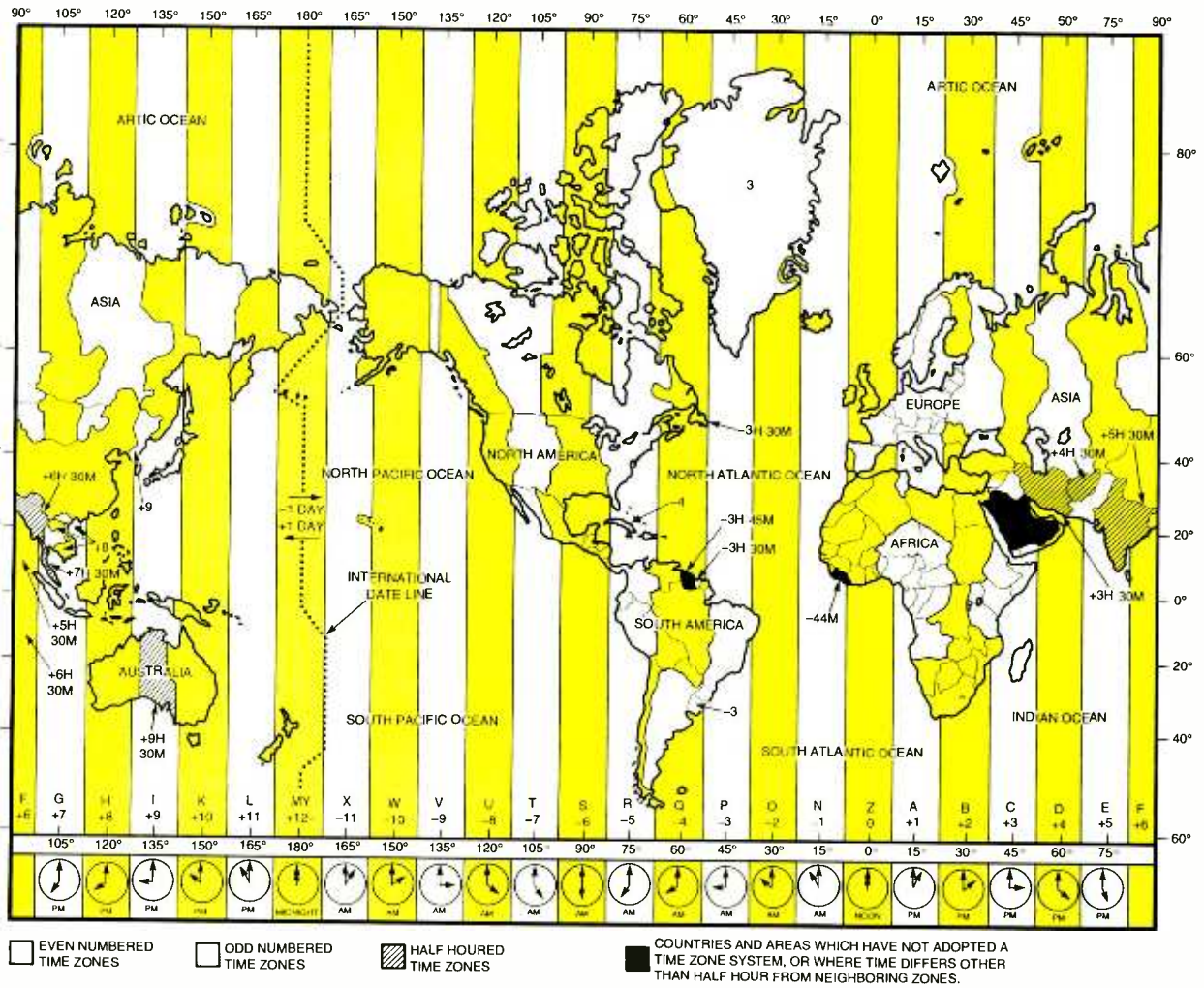

Fig. 1. Shown here are the world's 24 standard time zones and their relationship to the UTC reference zone. Some zones vary in width or are bent, because some countries want to deal with only one standard time. A few countries and areas have not adopted the zone system, and some even have oddball times that differ by only a half-hour or an hour from neighboring zones.

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Timekeeper, the Paris-based *Bureau International Des Poids et Mesures* (BIPM), the International Bureau of Weights and Measures, helps to maintain a single, uniform time system. It's the official custodian of the UTC scale, and it also determines when leap seconds are needed. The BIPM's jobs are many. They involve supervising the International Atomic Time Scale, or TAI; determining and publishing the current values of Universal Time, the angular velocity of the earth's rotation, and the operational coordinates of the poles (which do change); promoting dissemination of the correct UTC by time-signal stations; and refining and improving the time measurement.

Time and Frequency Management in the U.S. The measurement of time and frequency is closely connected. In the U.S., the United States Naval Observatory (USNO) maintains the national time standard and coordinates civil and Department of Defense (DOD) time scales. Thus, USNO serves as the official time reference for timed systems in the United States, such as the OMEGA Navigation system, the Global Positioning Service (GPS), and various Department of Defense communications systems. NIST, while also heavily involved in time determination and dissemination, has primary responsibility for the maintenance of the national standard of frequency. UTC is the basis for the standard frequency and time signals broadcast by the NIST radio stations. Both USNO and NIST maintain practical time scales that are steered to remain within less than one microsecond of UTC.

NIST's Role. As we've seen, accurate time and frequency information is needed by many users. They all need to compare their equipment with a reliable and internationally recognized standard. NIST provides the benchmark for doing this: the primary NIST frequency standard offers a frequency and time interval reference based on the international definition of the second. NIST maintains time and frequency generation and measurement equipment at its Boulder,

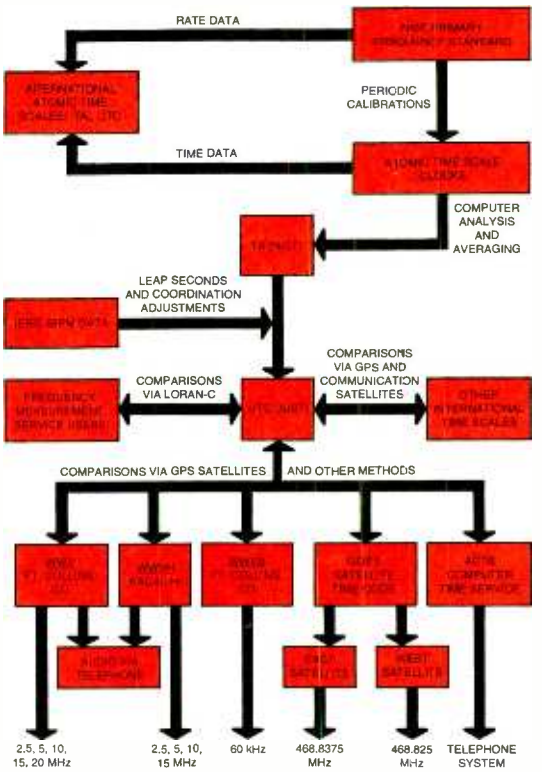

Fig.2. Here's how NIST ties together and controls the various time clocks and frequency standards to ensure accuracy and conformance to international standards. Also depicted is how information is disseminated by radio, satellite, and telephone. Note how atomic-based time and frequency standards are compared, calibrated, and adjusted to ultimately produce UTC, the time scale that's disseminated to users.

CO laboratories. The labs contain the primary NIST frequency standard, the cesium beam atomic clocks, and related equipment. The labs also contain commercial cesium standards, hydrogen maser frequency standards, and other equipment in controlled environments as working standards.

The NIST atomic clock system comprises three main elements. In the first element, there are two primary frequency/time standards, several secondary atomic clocks, and associated computing and measuring equipment (see Fig. 2). A group of smaller commercial atomic clocks forms the second part of the system—the secondary standards—which serve as insurance for continuous timekeeping and adds statistical reliability to the timekeeping process. The use of multiple clocks also permits repairs and modifications without interrupting the time scales.

The third element, computers and measurement equipment, monitors the frequencies or rates of all the clocks against each other, and measures the time differences between the individual clocks. Each clock's performance is evaluated and a weighted average of the inferred atomic time from each is computed. The result provides NIST with a continuous measure of atomic time. The whole system keeps time so precisely that it gains or loses only about one-billionth of a second per day.

USNO's Role. Established in 1830 to cooperate with the Royal Greenwich Observatory and other world observatories, the USNO coordinates with other observatories in determining sidereal (star-related) and universal time (UT), and other important astronomical data. That's done especially for the use of ships (which navigate using celestial bodies) as stellar maps and as references for determining local earth time and position.

Navigators historically have been the largest group of users of precise time information. They must know the time accurately to determine their position from the observation

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Summary of Radio Broadcast Services

Characteristics & Services:	WWV		WWVH		WWVB
Standard Carrier Frequencies	2.5 & 20 MHz	5, 10, & 15 MHz	2.5 MHz	5, 10, & 15 MHz	60 kHz
Power	2500 W	10,000 W	5000 W	10,000 W	13,000 W
Standard Audio Frequencies	440 (A above middle C), 500, & 600 Hz				—
Time Intervals	1 pulse/s; minute mark; hour mark				s; min.
Time Signals: Voice	Once per minute				—
Time Signals: Code	BCD code on 100-Hz subcarrier, 1 pulse/s				BCD code
UT1 Corrections	UT1 corrections are broadcast with an accuracy of ±0.1 s				
Special Announcements	Omega Reports, Geoalerts, Marine Storm Warnings, Global Positioning System Status Reports				—

Fig. 3. Here's a concise summary of the radio broadcast characteristics and services offered by the three NIST standard time and frequency stations—WWV, WWVH, and WWVB. Note the variety of special announcements carried by WWV and WWVH. Telephone service, both voice and modem, also is offered.

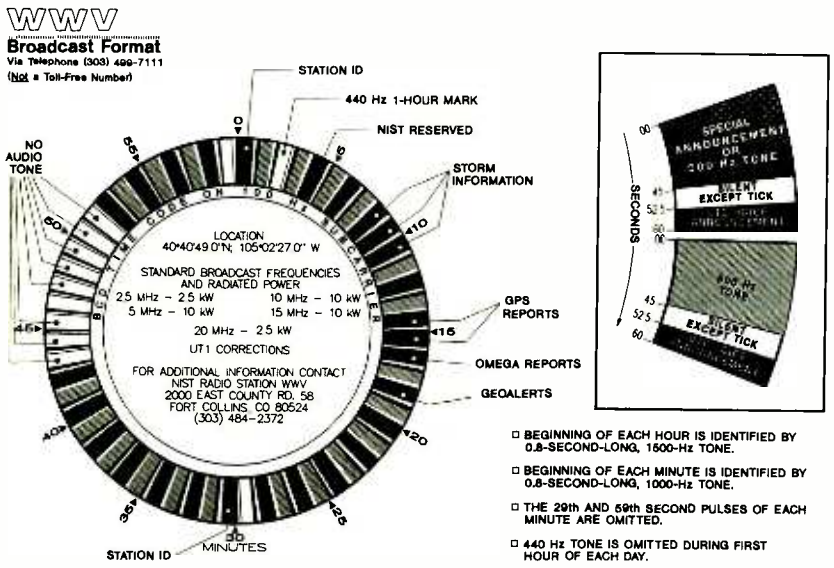

Fig. 4. Here is the hourly broadcast format and schedule of NIST Radio Station WWV, located in Ft. Collins, CO. Note the variety of detailed time and other specialized information presented in the broadcasts. Sister station WWVH in Hawaii broadcasts using a similar, but slightly different, format as well as a female voice for voice IDs to help avoid confusion when both stations may be audible to the user.

of celestial objects or satellites. And today's navigational needs extend from the traditional sea and land uses to air and into space. The USNO determines the positions and motions of the earth, sun, moon, planets, stars, and other celestial objects; provides astronomical data; determines precise time; measures the earth's rotation; and maintains the official master clock for the nation.

As keeper of the master clock, USNO is the source of official time in the United States. The USNO's accurate timekeeping is performed by cesium and hydrogen maser clocks, kept constant to within one nanosecond per day.

The data, which help determine UT based on the rotation of the earth on its axis, are sent to the USNO by magnetic tape. At the USNO, the data are analyzed in a high-speed computing system know as a Very Long Baseline Interferometry (VLBI) correlator. An increasing amount of Observatory data is disseminated over the Internet, which you can find at the USNO home page at *http://www.usno.navy.mil/*. The time also is available by calling 202-762-1401 or 900-410-TIME. You can obtain automated time information at 202-653-0351. For information on USNO tours call 202-762-1467.

Current NIST HF and LF Radio Broadcast Services. Some users bring their own clocks and frequency standards to Boulder for calibration and tests. But most of us simply receive needed signals via the NIST radio stations. NIST uses radio broadcasts to distribute the time and frequency signals because it's not economical to maintain NIST-type standards in laboratories across the country and on every ship and plane. The broadcasts offer practical accuracy of better than one one-hundredth of a second.

Historical Background. The NIST radio stations offer a variety of time, frequency, and other vital technical services. You can "zero in" on the correct time by several means, including telephone company recordings and radio/TV station announcements. But for most of us the most satisfactory and flexible method is to tune our radios to a primary standard provided by the NIST. NIST's predecessor, the NBS, initially set up shop in March, 1923 with radio station WWV, then in Beltsville, MD and, since 1943, in Greenbelt, MD.

In 1966, WWV moved to Fort Collins, CO to increase the accuracy and control of transmissions and to more uniformly cover the U.S. But, in fairness, the Navy gets the honors for transmitting the first time signals. In 1904, a U.S. Navy station broadcast the first worldwide radio time signals, based on a clock provided and controlled by the USNO. NIST's current broadcast services focus on the radio signals from stations WWV, WWVB, and WWVH. You'll find that the time and frequency information sent out by the stations, since it's based on the NIST's atomic clocks, is almost perfectly accurate.

WWV and WWVH. NIST operates two HF radio stations, WWV and WWVH, in Ft. Collins, CO and Kauai, Hawaii, respectively. Both stations continuously broadcast time and frequency signals on 2.5, 5, 10, and 15 MHz, and WWV also broadcasts on 20 MHz.

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You should be able to hear at least one frequency at any time, depending on the time of day and year, radio conditions, and equipment. Frequencies above 10 MHz work best in the daytime, while lower frequencies are best at night. WWV and WWVH offer voice time announcements, standard frequencies and time intervals, digital time code, astronomical time corrections, geophysical alerts, radio propagation information, marine storm warnings, and OMEGA Navigation System and GPS status reports (see Fig. 3 and Fig. 4). The transmitted frequencies are accurate to about 1 part in 100 billion for frequency and 0.01 milliseconds for time. However, received accuracy for WWV and WWVH is less due to propagation effects.

You can hear the WWV and WWVH audio by telephone, with an accuracy of 30 ms or better. To hear the broadcasts, dial 303-499-7111 for WWV or 808-335-4363 for WWVH.

WWVB. The longwaves (LW) are a potential source of standard time and frequency information for serious users. Several stations worldwide broadcast highly accurate LF signals, mostly on frequencies below 100 kHz. As long ago as 1956, the old NBS tested 60 kHz LF transmissions using the experimental callsign KK2XEI. Across the big pond, one of the first broadcast time services, the British station GBR, aired in 1926 on 16 kHz. NIST's WWVB, near the WWV site, broadcasts on 60 kHz with 13 kW to cover the continental U. S.

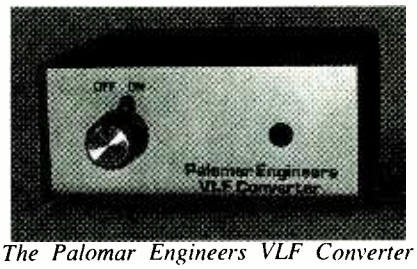
WWVB uses a highly stable crystal oscillator as its frequency generator, referenced to the primary NIST frequency standard. The station is so accurate that it's used by many international standard time-and-frequency stations as a cross-check on their own signals. The station doesn't use voice announcements, but provides continuous digital-based standard time information; time intervals; DST, leap second, and leap year notices; and astronomical time corrections.

A 60-kHz, LF receiver is required to decode the binary coded data sent by WWVB. Why are such low frequencies used for standard time and frequency stations? The low frequencies are favored because of the improvement in received signal accuracy that's possible. At low frequencies, reception doesn't suffer the slight time delays and unpredictable atmospheric variations that distort regular reception of the HF stations WWV and WWVH.

WWVH "aloha" QSL (reception verification) card from the earlier, pre-NIST NBS era indicates that WWVH is located on the island of Kauai. The station commenced broadcasting in November, 1948 from Maui, but it moved to Kauai in July, 1971. The station broadcasts in a format fairly similar to that used by sister station WWV, but it doesn't use the 20 MHz frequency.

You should be able to hear WWVB well anywhere in the country as a result of its central location. To receive WWVB, you can use a surplus VLF/LF receiver, a communications receiver covering the low frequencies, or a converter hooked to your receiver's antenna connection (Palomar Engineers offers a reasonably priced converter for this purpose—call 800-883-7020 for details).

The NIST Automated Computer Time Service (ACTS). Many users require time-of-day to a precision higher than a human operator can achieve, and computer systems of many kinds (including your own PC) can benefit from direct, automated access to a source of official time. In 1988, NIST began the Automated Computer Time Service (ACTS). Using commercial dial-up telephone lines to deliver a digital time code, it lets your PC access the NIST clocks with an accuracy approaching a few milliseconds. Features of the service include compensation for telephone-line delay, advance alert for changes to and from DST, and advance notice of leap second insertion. Since the time code used by ACTS uses the standard ASCII character set, the system works with nearly all computer systems and 300 or 1200 baud modems.



The Palomar Engineers VLF Converter lets you receive the low bands for about $80; all you need to receive WWVB and other low-frequency stations, along with the so-called 1750-meter experimenters' band, is a communications receiver and an antenna. Covering 10–500 kHz, the Model VLF-A converts VLF signals to the 80-meter amateur band, while the Model VLF-S converts signals to 4010–4500 kHz for general coverage SW receivers.

The NIST GOES Satellite Time Code Service. For higher accuracy than that attainable with the radio broadcast services and ACTS, NIST offers the Geostationary Operational Environmental Satellites (GOES) Time Code Service. It's a digital satellite broadcast of time signals from the NOAA GOES weather satellites, orbiting 22,300 miles above the earth's surface. Because they are geostationary, the time code path delay remains relatively constant. NIST uses two GOES satellites to handle the Western Hemisphere and portions of the Atlantic and Pacific, covering at least 40 percent of the earth's surface. Its accuracy, though superb, is limited primarily by knowledge of the exact satellite positions. The broadcast GOES time code includes the current year; day, hour, and minute; astronomical corrections; satellite position information; accuracy indicators; Daylight Savings Time and leap second notices; and system status information.

The NIST Frequency Measurement Service. The NIST Frequency Measurement Service (FMS) lets you make accurate frequency calibrations on-site for a small fee. That's less expensive than sending your equipment to NIST or to a commercial lab for calibration. You can subscribe to FMS by paying a one-time subscription fee and a small monthly fee. NIST loans subscribers a computer-controlled

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There's little to distinguish the nondescript "radio shack" of the NIST Radio Station WWV (located on East County Road 58 in Ft. Collins, CO), except for the station's familiar callsign, which is displayed prominently in the building's entranceway.

"measurement system" centered on a special LORAN-C LF radionavigation receiver. You can connect up to four oscillators to the system; FMS, under computer software control, measures their output constantly and feeds the information back to NIST by modem. NIST compares the measurements with its own standards to certify calibrations as being accurate and traceable to NIST. However, Loran-C doesn't have a time code and is not usually used to obtain time.

NIST Publications. If you're a serious user of time and frequency information, you can obtain a free subscription to the *NIST Time and Frequency Bulletin*. Published monthly, it contains detailed current technical data on WWV, WWVH, WWVB, GOES, and GPS, as well as NIST time scales. Also, NIST Special Publication 432, NIST Time and Frequency Services, tells the whole story of NIST radio broadcast and other services. For additional information, write the NIST Time and Frequency Division at 325 Broadway, Boulder, CO 80303-3328.

Precision Timekeeping in Canada. If you live overseas, you may want to use standard time and frequency stations located in Buenos Aires, Tokyo, London, Moscow, and several other major cities. The stations are prominently listed in the *World Radio TV Handbook*. Canadians, in particular, find the signals broadcast by the National Research Council's (NRC) Canada time station, CHU, to be very useful since the station provides a service similar to WWV and WWVH.

NRC Canada is the Canadian federal agency responsible for official time, which is handled by its Time Standards Group. NRC time is referenced to its primary cesium beam atomic clocks, located at the NRC time standards laboratory in Ottawa. The clocks are used in conjunction with atomic clocks in the time laboratories of other countries such as the U.S., and, like NIST's clocks, they're coordinated with BIPM.

Among the time services offered by the NRC are Telephone and Radio. Voice announcements of Eastern Time are made over the phone at ten-second intervals, followed by a tone that indicates the exact time. You can get the time announcement in English by dialing 613-745-1576, or in French by calling 613-745-9426. The time signal also ticks each second.

Both the English and French radio networks of the Canadian Broadcasting Corporation (CBC) carry the NRC time signal once per day, at 1300 (on the English network) and at 1200 (on the French), Eastern Time. Note that both the telephone and radio time signals may be routed by one or two communications satellite hops, each hop delaying the signals by 0.25 seconds.

NRC also offers precision telephone digital code time signals for computers and automatic systems. NRC offers two kinds of telephone digital time code. The so-called "old code" system can be used with 300 bps modems; the system offers an accuracy of about .001 seconds. But the precision is degraded by variations in the signal propagation delay through the

(Continued on page 61)

Located on the island of Kauai, Hawaii, NIST Radio Station WWVH's continuous broadcast services supplement those of WWV to provide high-quality signal coverage to the Pacific Basin on all except the 20-MHz frequency. Often you'll hear both WWV and WWVH mixing together. One way to distinguish them quickly is by the voice—WWV's voice is male, while WWVH's voice is female.

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JOSEPH J. CARR

SAFETY FOR ELECTRONIC HOBBYISTS

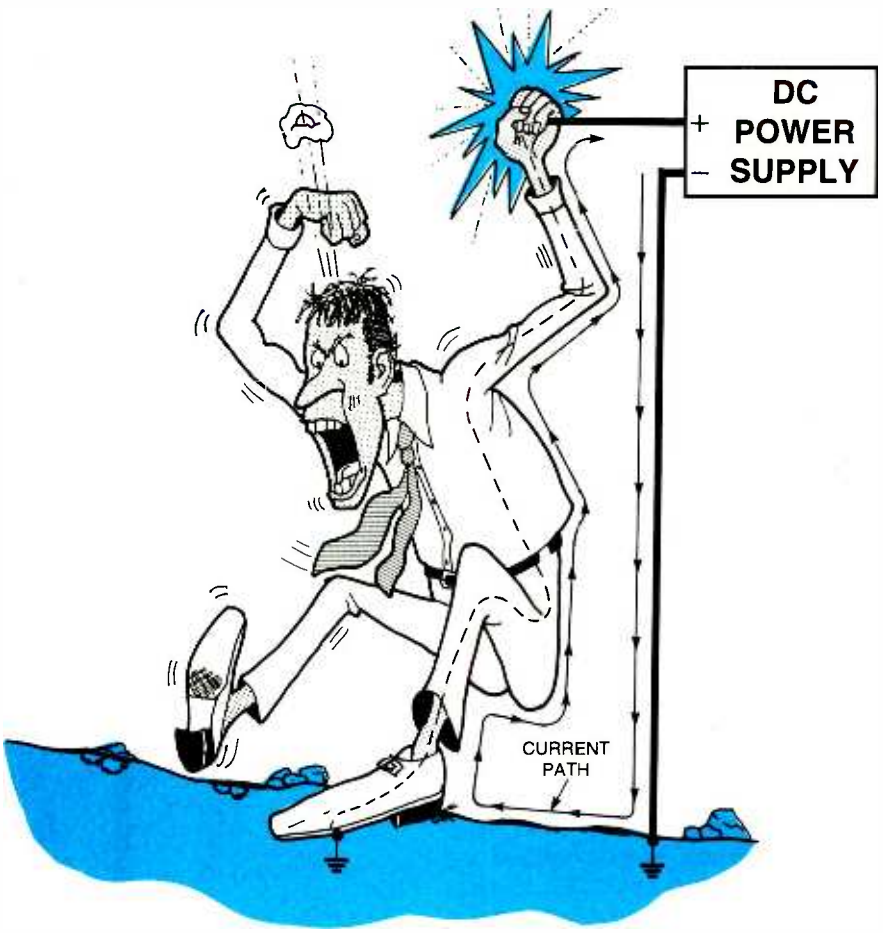
Let's deal with a very uncomfortable, but very necessary, topic: electrical safety. When you work in electronics, you may come into close proximity with voltage and current sources that are high enough to cause some damage... perhaps even death. In this article we will point out the dangers and also give some general advice on how to avoid electrical shock.

How Much Current Is Fatal. Several years ago I worked in a hospital electronics laboratory. One day, while eating lunch in the hospital cafeteria, I overheard an intern claim that 110 volts AC from the wall socket is not dangerous. They had told him in medical school that it's not the voltage that kills, but the current. I leaned back on my chair and asked him: "Doctor, have you ever heard of Ohm's law?" According to Ohm's law, the current is the quotient of voltage and resistance: I = V/R.

Besides that, a little statistic that the doctor apparently didn't know was that 110 volts AC from residential wall sockets is the most common cause of electrocution in the USA. In addition, medical studies reveal that the 50-60-Hz frequency used in power distribution almost worldwide is in the most dangerous range. Higher and lower AC frequencies are less dangerous than good old 60-Hz AC, but still are not safe!

According to medical experts, who have studied electrical shock, the killing factor is current density in the right atrium of the heart. Any flow of current through the body that causes a sufficient level of current to flow in that section of the heart can induce fatal ventricular fibrillation (or ViFib., discussed later in the article). In general, for limb-contact electrical shocks, accepted rules of thumb are: 1-5 mA is the level of perception; 10 mA is the level where pain is sensed; at 100 mA severe muscular contraction occurs, and at 100-300 mA electrocution occurs.

Keep in mind that those figures are approximate, and are not to be taken as guidelines to approximate "assumed risk." Death can occur under certain circumstances with considerably lower levels of current. For example, when you have been sweating or are standing in salt water, all bets are off. In medical situations, the level of current that can kill is considered to be in the 20-150 microampere (μA) level, because the current is induced directly into the body (human skin has a resistance of 500 to 20,000 ohms, and internal tissue has a resistance of 50 ohms or so).



Electrical safety is not just a personal matter. All members of your household should at least be acquainted with some aspects of electrical safety. Your life or that of a family member could depend on it!

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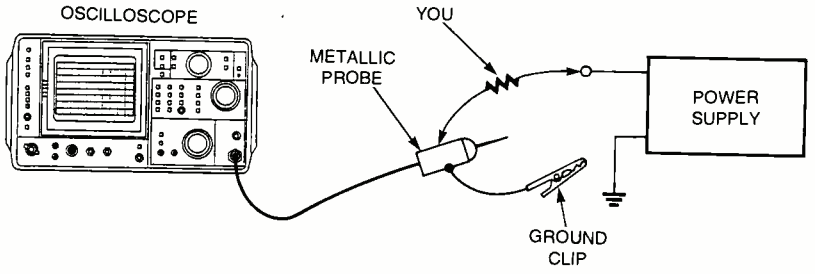

Fig. 1. Indirect electrical shock can occur when you grasp a grounded instrument probe, which, in turn, grounds your body through the instrument's shield and the power cord. Under those conditions, touching a hot point results in a shock.

Is High Current Dangerous? I recently attended a design review meeting in my capacity as an electronics engineer. The customer specification called for insulation of low-voltage (28 volts), high-current (50-amps) DC power-supply terminals. One of the engineers present sneered that this was something like asking him to insulate the battery terminals of his car. The implication of his remark is that low current can never hurt you. But there are two false premises to that opinion.

First, although low-voltage, high-current circuit points rarely cause electrical shock, when the person has a very low electrical skin resistance (very sweaty) or has an open wound, electrical shock is possible. Although most such cases do not result in electrocution, I can recall one electronics technician who injured himself severely when he cut himself on a 5-volt DC, 30-amp computer power supply terminal. Because of the open wound, a large amount of current flowed through his arm and caused physical damage,

Second, high current is extremely dangerous if you happen to be wearing jewelry! About 20 years ago, I worked in a two-way radio shop that used 12-volt batteries and battery chargers for the troubleshooting bench supply for mobile service. A fellow working on the battery rack dropped a wrench, and it fell onto the battery making contact from the positive (+) to the negative (-) terminals through his watchband. The large current flow through the watchband turned it red hot, and gave him second and third degree burns. The moral is don't assume that low-voltage, high-current power supplies are totally benign!

Electrical Shock. In order to raise our consciousness about how shock can occur, let's take a look at a few scenarios in which electrical shock is likely to occur. First, there is the direct approach, which can be, and all too often is, fatal. One main cause of this sort of shock hazard is wearing clothing that is not conducive to workplace safety. For example, if you are wearing conductive shoes, your body is grounded through them. By touching a hot point in a live circuit, thereby completing a circuit though your body, you run the risk of a fatal electrical shock. You don't have to be standing on a damp lawn for that to happen. That scenario can occur whether you are indoors or out. The basement floor is a reasonably good conductor, as are wet leather and some rubber shoes. One of the worst electrical shocks that I ever received was in a car radio shop that had a dry concrete ground-level floor. That was one heck of a gut-wrenching jolt!

Figure 1 illustrates an indirect scenario that especially affects electronics workers. Consider the grounded instrument probe (in this case an oscilloscope). When you grasp that probe, you are grounded through the oscilloscope shield and the power cord ground conductor. If you touch a hot point, then you get zapped. A related scenario is shown in Fig. 2. In this instance, we have an AC/DC appliance, such as some low-cost radio or TV sets. Note that the oscilloscope probe ground is connected to the set ground, which also happens to be one side of the AC line. Everything is fine as long as the AC plug is oriented correctly in the wall, and the wall socket is wired correctly. But if you plug it into the wall backwards, or the socket is wired incorrectly, then the likely outcome will be an explosive short circuit, possibly culminating in the electrocution of the operator.

Another hazardous operation is

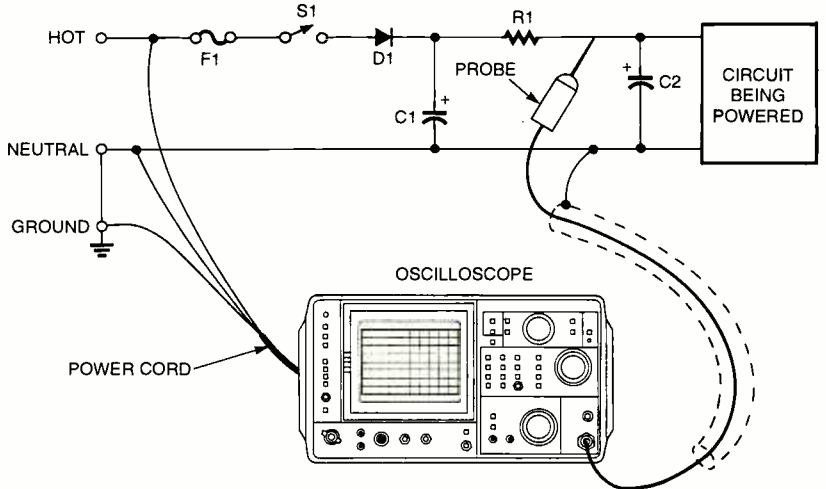

Fig. 2. Another potential shock hazard exists when your test instrument's ground lead is connected to the ground of some AC/DC appliance. Everything is fine as long as the AC plug is oriented correctly in the wall socket and the wall socket is wired correctly. But if either is incorrect, the results could be an explosive short circuit, possibly electrocuting the operator.

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the fatal antenna erection job. It is never good practice to erect an antenna near a power line! **NEVER.** Every year, stories abound of people electrocuted because either an antenna they were working on fell across the power lines, or they tried to toss a wire antenna over the power line in order to raise a long-wire antenna above the lines. Foolish! Those tactics will kill you.

Some Cures For The Problem. Figure 3 shows the schematic representation of the typical USA residential AC electrical system. The power company distributes energy through high voltage AC lines. When it arrives at a point a short distance from your home, it is stepped down via a "pole pig" transformer center-tapped to 220 volts AC. The center-tap of the transformer is grounded (110 volts on either side of the center tap), and therein lies the root of the problem. The two ends of the 220-volt AC secondary are brought into the house as a pair of 110-volt lines. If you connect a socket across the two lines, you get a 220-volt AC outlet. But, if you tap from the ground (center tap) line to either hot lead, you get a 110-volt AC outlet.

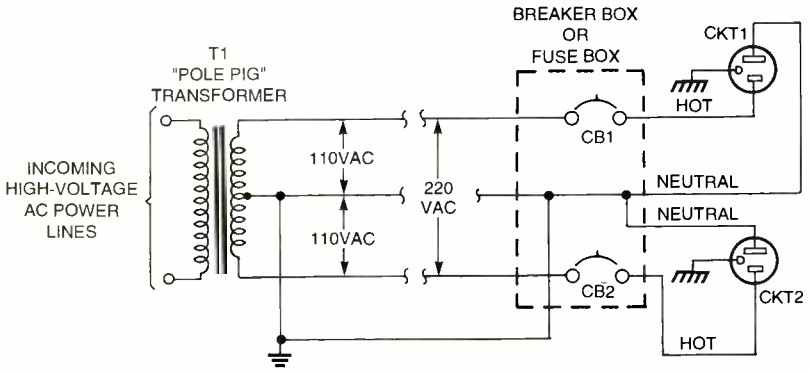

Fig. 3. Shown here is the typical USA residential AC electrical system. Power from the local utility company arrives at your home through a transformer as 220 volts AC that is center-tapped to provide two 110 volt branches. The center-tap of the transformer secondary is grounded, and therein lies the root of the problem.

The problem is that the electrical system in your home or shop is ground referenced. The solution is to make the little local electrical system on your workbench non-ground referenced. Figure 4 shows the wiring on a bench. Transformer T1 can be one of two forms of isolation transformer. A 1:1 transformer produces a 110-volt isolated (non-ground referenced) AC line from a standard 110 volt AC source. A 2:1 transformer does the same thing from a 220-volt AC line.

The second transformer (T2) in Fig. 4 is an autotransformer (commonly called a Variac). Such devices allow you to raise and lower the AC voltage to match equipment being tested. It is usually best to route the autotransformer output to selected outlets only, and monitor the outlet with an AC voltmeter. You can also buy a small isolation transformer, like those used by TV service shops. Such transformers often have built-in AC voltmeters with an expanded scale that reads from 95 to 130 volts AC. In all cases, the power line ground is brought into the outlets, but the neutral line is not connected to the ground at any point.

If you either work on radio transmitters (or other high-power RF producing devices) or work near such generators, then you might want to place an EMI filter in the line at the points marked "X." The EMI filter is a device that is designed to attenuate RF, but not the 60-Hz power. The metal oxide varister (MOV1) is used to clip the amplitude of high-voltage transients (100 microseconds, or so) that could either damage or interfere with the operation of the equipment on the bench.

The fuse (which could be replaced by a circuit breaker) is used to protect equipment on the bench, as well as the transformer. It is always placed in the hot line, or in both lines. Fuses and circuit breakers are never placed in the neutral line only. The switching shown in Fig. 5 breaks both lines. I prefer that approach on the theory that hot and neutral lines can be reversed accidentally, and leave you in the position of breaking a neutral, leaving the hot live as a hissing cobra. The best approach is to place a fuse or breaker in both hot and neutral lines.

It is also a good practice, and may be required by your local electrical code, to use ground fault interrupter (GFI) outlets in your electronics workshop. The GFI outlet has a built-in sensor and circuit-breaker arrangement that cuts off the electricity if more than 5-mA (or some other design value) flows in the ground (not neutral) line. In many jurisdictions, it is mandatory for bathrooms, swimming-pool areas, workshops, outdoor outlets, or any other place where a person is likely to be either grounded or wet to be equipped with GFI outlets.

Some General Advice On Safety. There is only one way to ensure that the AC line won't "bite" you—disconnect it. I make it my practice to *never* work on equipment that has the plug inserted into the power outlet. I don't trust switches, fuses, or circuit breakers. If you were to hand me a shotgun, claiming that it was unloaded, the first thing I'd do is check it myself. The same advice holds true for the electrical connection (which can kill you just as dead as a high-power shotgun blast).

One little bit of advice frequently given to electrical and electronics workers annoys me a lot, because practical experience has shown me that it is fallacious. It is often advised that you work on high-voltage devices with your left hand in your pants pocket. That advice is based on the theory that the left hand to either leg path is supposedly the most deadly. Even if the physiology is correct, which, incidentally, is not a well-established fact, I believe that placing one hand in your pocket puts you in an awkward position, leaving you unable to safely work on a circuit. It

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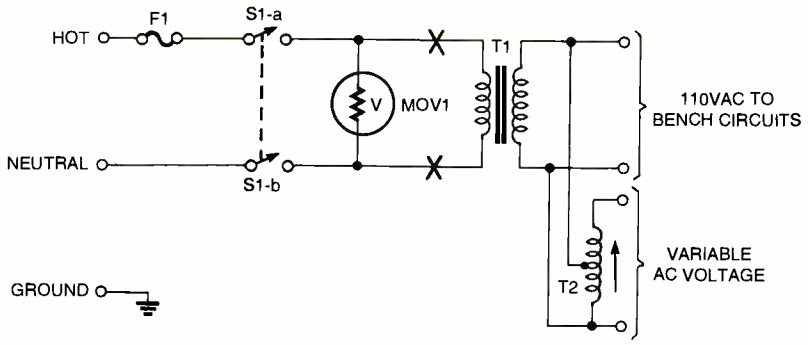

Fig. 4. An autotransformer (T2 in this diagram) can be used to help isolate the operator from the AC ground (or neutral) line, while allowing the circuit-under-test to gradually be brought up to line voltage, thereby reducing the risk of either a fatal shock or irreparable harm to the device being repaired.

is better to use both hands, and arrange the work so that the environment is safe.

What is a safe work environment? The power system should be isolated (as discussed above). The floor should be insulated by a carpet, masonite or plastic cover, a rubber mat, wooden planking, or some other nonconductive material. And the floor should always be dry. When working on high-voltage DC circuits, keep in mind that capacitors store energy. All filter capacitors must be mechanically discharged after the power is turned off. Also, the capacitor must be discharged multiple times, That's because when a short circuit is placed across the capacitor terminals, not all of the energy is removed the first time. Some residual energy is stored in the dielectric even after the main charge is discharged.

On smaller DC filter capacitors, you can short-circuit the capacitor by attaching an alligator clip lead to a probe such as a screw driver, or other device. Be absolutely sure that the shorting device is insulated from the operator. And, be sure to connect the ground lead first, and then hit the positive terminal of the capacitor (or vice versa for positive ground power supplies).

What To Do For A Shock Victim. The mechanism of death from electrical shock is usually a phenomena called ventricular fibrillation. That is an arrhythmic heartbeat in which the heart merely quivers, instead of beating in a normal fashion. Unfortunately, "V.Fib." is incapable of sustaining blood pumping effectiveness, so the victim dies. First, before you can aid the victim of electrical shock, you must be sure that either the victim is away from the current, or the current is turned off! Otherwise, when you touch the victim in order to help, you too will become a victim.

Second, as soon as the victim is clear of the electrical current, initiate cardiopulmonary respiration (CPR), and obtain help. CPR will not bring the victim out of V.Fib—its objective is to provide life support until properly equipped and trained medical personnel can be summoned. They will use an electrical device called (not too cleverly) a "defibrillator" to shock the victim's heart back into correct rhythm. They also use a small collection of drugs and intravenous (IV) solutions in order to re-establish the body's balance.

None of that can or should be performed by an untrained person. In fact, CPR cannot be effectively performed by the untrained person. Anyone who works on or around electrical or electronic equipment should learn CPR. In addition, teenage and adult family members should also learn CPR; after all, who is going to save you when an electrical accident occurs? The local Red Cross, the Heart Association, and most local hospitals can direct you to certified CPR courses. It is impossible for you to learn CPR from watching medical shows on TV. So get trained by a knowledgeable instructor!

Conclusion. Electrical shock can be fatal, and is almost always painful. Even if you aren't killed, substantial injury could occur. But adequate attention to a safe environment and use of safe work practices, will greatly reduce the chances of your encountering what Workman's Compensation instructions call an "untoward event." ■

ELECTRONICS LIBRARY

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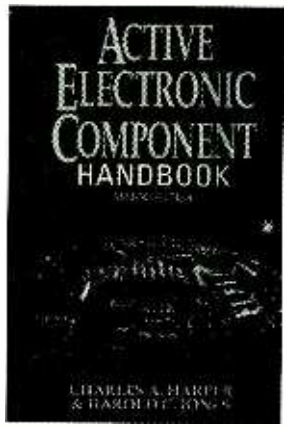
design decisions. The book also offers test and reliability data; listings of specifications and standards; and information on dimensions, configuration, and mechanical and functional performance. More than 700 illustrations accompany the text.



The second edition includes an expert account of the nature and types of active components currently in use, and discusses the importance of developing the right supplier-user team for optimizing the application of those components in electronic systems. There are completely new chapters on microwave and optoelectronic components, and up-to-date coverage of programmable logic and application specific integrated circuits (ASICs), memory devices, microprocessors and microcontrollers, hybrid and multichip module devices, discrete semiconductors, microwave devices, display devices, and photonic components.

Active Electronic Component Handbook: Second Edition costs $79.50 and is published by McGraw-Hill, Inc., 11 West 19th Street, New York, NY 10011; Tel. 800-822-8158. ■

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Radio for the Millions!

MARC ELLIS

Welcome to the October column. Well, for you it might be autumn, but, for me, as I sit down to write, it's the beginning of June. That's the time of year when yard work and other outside projects begin to eat into my soldering-iron time, and this year is no exception. The fact is, I didn't get enough done on the Neutrodyne restoration to talk about. So I had to substitute a piece that didn't require a lot of advance preparation! Nevertheless, I think you're going to enjoy it.

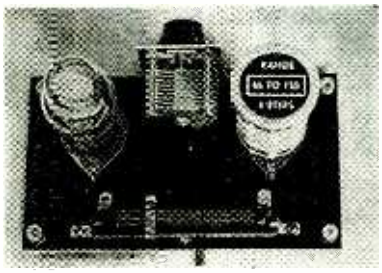
One day, when I was a youngster of about ten, I discovered a slim radio project book on the drugstore magazine rack. It looked like a magazine, but its soft green-and black cover was a little bit different. Obviously intended to last, it seemed to be made of some kind of varnished fabric. The book was the *Popular Science Radio Annual*. In due time, its red-and-gray mate, the *Second Radio Annual*, joined it on the shelves. Both publications were copyrighted 1943 and were from the second printing of May 1944, so I must have acquired them both almost simultaneously.

Those two books were also packaged together in a hard-cover volume with the resounding title *Radio for the Millions*. My dog-eared childhood copy of that version bears a 1943 copyright date, and a copy I picked up later (identical pages, but about one-third the thickness because of war-time paper substitutions) is copyrighted 1945. Original copies of *Radio for the Millions* are seen frequently at radio meets are reasonable prices, and the book can also be found as a reprint.

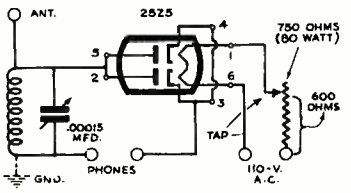
I'm not sure that a more colorful and eccentric array of radio projects has ever been bound between two covers. There were shortwave, AM, and, yes, even FM radios, simple one-tubers and multi-tube superhets, test equipment, public address amps, and disk-recording equipment.

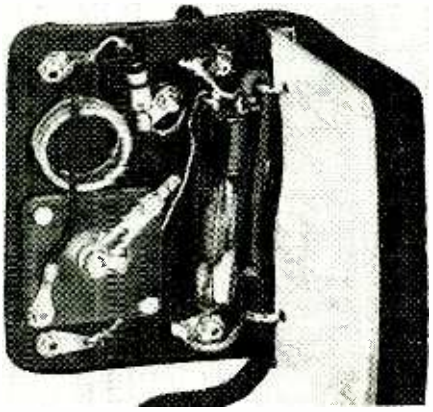
The packaging of these sets showed as much variety as the circuitry. For the bedroom, there was a radio built into a boudoir lamp and a dual-control model for twin beds. For the kitchen, there was a set resembling a flour canister. To take to the football game or out camping, one finds portable sets built into notebooks, Thermos containers, little suitcases, and even a cane seat. There were also a great number of sets, not built into household objects, whose main claim to fame was that they were tiny (or "midget," to use one of the book's favorite adjectives). And that doesn't even scratch the surface!

I thought it would be fun to take a nostalgic tour through the pages of *Radio for the Millions*, but, at first, I was not sure how to pick representatives of such a large and varied body of work. Then it came to me: This time, I'll concentrate on picking from the one-tube

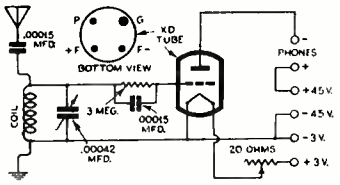


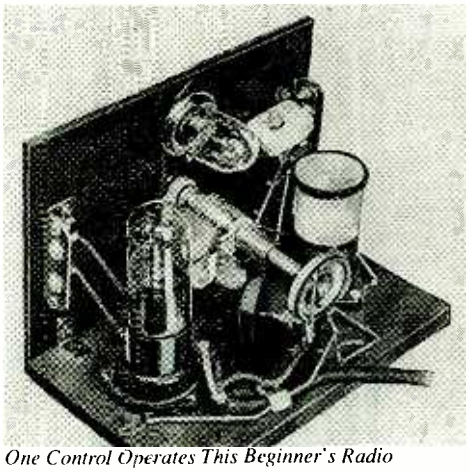
One-Tube Receiver Uses Rectifier as Detector



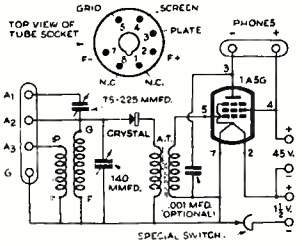


Pocket Radio Built Into a Notebook





One Control Operates This Beginner's Radio



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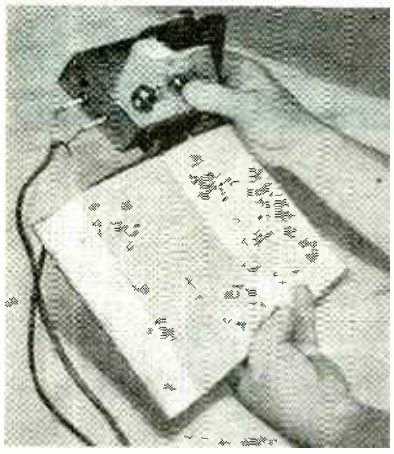
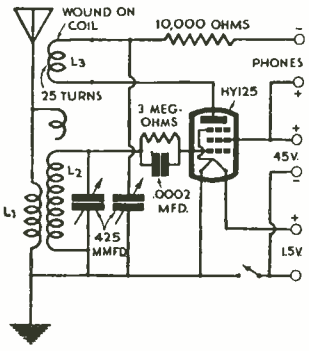
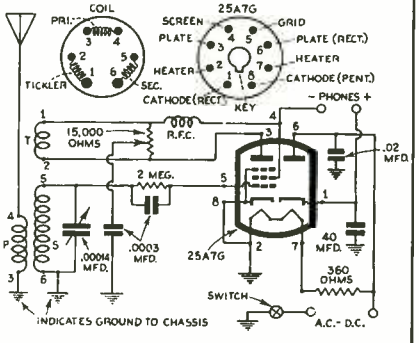


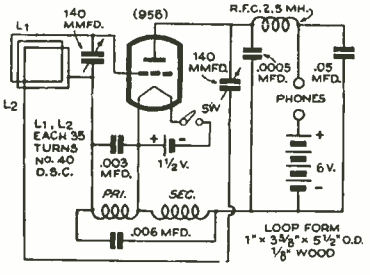
Book-Light Radio



Beginner's One-Tuber



Pocket Receiver for Sports Fans



sets. There are a lot to choose from, and they represent the variety and eccentricity of the projects very well. In future columns, I might review other kinds of projects from the book.

I've selected seven one-tube projects to show you. Each project is represented by a schematic and a photo of the completed unit. These are captioned with their titles as they appeared in *Radio for the Millions*.

THE PROJECTS

One-Tube Receiver Uses Rectifier as Detector is perhaps the simplest of the sets. It uses a 25Z5 rectifier tube, filament powered directly from the AC line via a dropping resistor, as a diode detector. It's really a crystal detector circuit using a tube.

The battery-powered *Pocket Radio Built Into a Notebook* is next up the ladder in complexity. It uses a less than 3-inch-high "XD" tube (perhaps a hearing-aid type?) in a rudimentary grid-leak detector circuit. Just the thing to slip into your pocket for sporting events!

Looking like a refugee from the 1920s, *One Control Operates This Beginner's Radio* nevertheless uses a then-current 1A5 power pentode (designed for battery-powered portable sets) as an audio amplifier. The tube is fed by a crystal detector, making it an interesting hybrid. Why "one-control?" It's turned on and off by a trick switch built onto the tuning capacitor shaft.

Book-Light Radio, a simple regenerative battery set, is—as its name implies—built into a little book-light stand.

The *Beginner's One-Tuber* is a straightforward, line-powered regenerative circuit. It makes use of a dual-purpose (diode-pentode) tube with the diode acting as a rectifier. Notice that one side of the line is firmly grounded to the metal chassis, as was often the case in those carefree, safety-unconscious days. I wonder how many people got knocked on their keisters by that little feature?

Another "go-anywhere" portable is *Pocket Receiver for Sports Fans*, which is a regenerative using a then-high-tech type 958 acorn tube and boasting a loop antenna wound around its cigar-box wood case. The set manages to do its thing with a mere six volts on the 958's plate!

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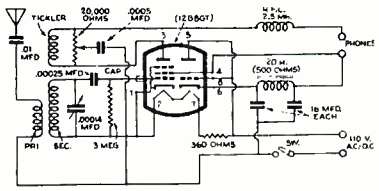


Schematic of One Tube radio

Europe on One Tube

Saving perhaps the most romantic for last, we have *Europe on One Tube.* Also a simple regenerative, the shortwave set is AC-DC powered, using the triode section of a dual-purpose 12B8GT (grid and plate tied together) as the rectifier. Note that the designer prudently used a ground bus, so there is no dangerous grounding of the AC/DC line to the chassis.

I hope you had fun with this little tour through *Radio for the Millions.* We'll do it again sometime, and I might even tell you about my long-ago adventures with *Four Dollars Builds This Loudspeaker Set!* ■

That's not our ship you idiot - that's a smoke detector!

ALL THE TIME

(continued from page 54)

THE WORLDRADIO "CONTACT ALL TIME ZONES" AWARD

The structure of the world's time zones is important to radio amateurs. Worldradio, a major monthly amateur radio news publication, recently set up a new award—Contact All Time Zones (CATZ)—for amateurs to achieve. The award is based on the division of the world into 24 time zones, each 15 degrees wide. For the sake of the award, half-hour and other artificial time zones are ignored.

If you're applying for the award, you must have a two-way contact on amateur radio frequencies with a station in each of the 24 time zones; contacts with one's own nation don't count. You must have made all contacts from a location within the same country, and you must have QSL (verification) cards from each of the time zones. To obtain the award (an attractive 8- x 10-inch certificate), you must submit a list showing each contact's details along with a nominal fee to the award's sponsor. For more information, contact Worldradio, Worldradio CATZ Award Manager, 2120 8th St., Sacramento, CA 95818; Tel: 916-457-3655.

telephone lines, including the delay of up to 0.25 seconds per communications satellite hop. An improved code system using an interactive ASCII-based protocol supports correction for signal propagation through the telephone link; an overall accuracy of a few milliseconds is possible.

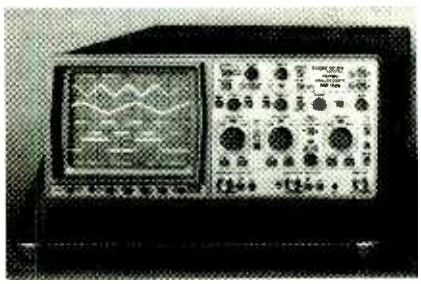
You can obtain time accuracy superior to telephone time accuracy by means of NRC's radio time signals, broadcast continuously from shortwave radio station CHU. If you make corrections for the propagation delay from CHU to you, and for delays in your receiver, you can attain an accuracy of better than 1 millisecond. CHU also broadcasts a time code that can be decoded with common computers and modems. While the NIST stations operate on round frequencies such as 2.5, 5, 10, 15, and 20 MHz, CHU transmits on oddball frequencies—3330, 7335, and 14,670 kHz—using up to 10 kW of power. The CHU frequencies are derived from one of a trio of closely synchronized atomic clocks located at the transmitter site, three clocks being used to allow majority logic checking.

Summary. The measurement of time has become more sophisticated with each year. And time measurements will become more complex in the future, as new techniques in several scientific fields afford even more progress in defining just what time is and how best to measure and disseminate it. ■

NEW PRODUCTS

(continued from page 22)

The HM1505 features two vertical input channels and a second time base. The second time base—with the ability to magnify, over 1000 times, extremely small portions of the input signal—has its own triggering controls, including level and slope selection, to allow a stable and precisely referenced display of asynchronous or jittery signal segments. The trigger circuit is designed to provide reliable triggering to over 250-MHz at signal levels as low as 0.5 division. An active TV Sync Separator for TV-signal tracing ensures accurate triggering even with noisy signals.



To ensure accuracy, a built-in switchable calibrator checks the instrument's transient response characteristics—from probe tip to CRT screen. The essential high-frequency compensation of wide-band probes can be performed with the calibrator, which features a rise time of less than 4 ns.

The HM1505 oscilloscope costs $1480. For information, contact Hameg Instruments, 266 East Meadow Avenue, East Meadow, NY 11554; Tel: 800-247-1241 or 516-794-4080; Fax: 516-794-1855; e-mail: *hameg @aol.com.*

CIRCLE 83 ON FREE INFORMATION CARD

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Big Loop Antennas

JOSEPH J. CARR, K4IPV

The topic this month is the large loop antenna, of which there are several varieties for both transmitting and receiving. A large loop is one that is made of wire that is at least one-half wavelength long at the desired center frequency of operation. Small loops, on the other hand, are made of wire that is less than 0.2 wavelengths long (some sources say less than 0.15 wavelength).

The large loop antennas are bi-directional, and radiate primarily in the two directions that are perpendicular to the plane of the loop. They are relatively easy to build, and usually perform better in electrically noisy areas than dipoles. Also, close to the ground, the large loop often has a more predictable pattern than the dipole.

QUAD LOOPS

The quad loop antenna (see Fig. 1) is perhaps the most effective and efficient of the large loop antennas, and it is certainly the most popular. The quad loop consists of a one wavelength loop of wire formed into a square shape. It provides about 2 dB gain over a dipole. The two views in Fig. 1 are from the horizontal perspective looking at the broad side of the loop. The azimuthal radiation pattern is a figure-8, like a dipole, with the directivity in-and-out of the page.

The quad loop can be fed in either of two ways. Figure 1A shows the feed attached to the bottom wire segment, and this produces horizontal polarization. The same polarization occurs if the feedpoint is in the top horizontal segment. If the feed is in either vertical segment (Fig. 1B), then the polarization will be vertical.

The overall length of the wire used to make the loop is found from the formula:

$$L_{Feet} = 1005/F_{MHz} \qquad \text{(Eq. 1)}$$

The total length of the wire, L_{Feet}, is in feet, while the desired frequency, F_{MHz}, is in MHz. Each side of the loop is one-fourth of the total wire length.

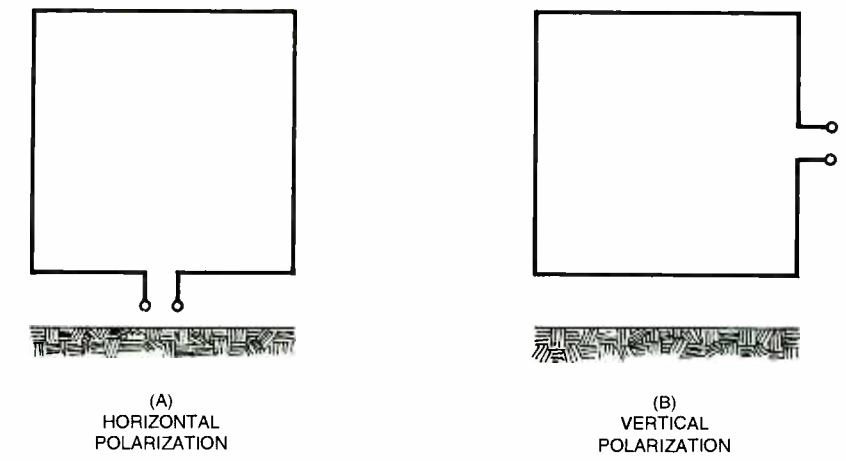

Fig. 1. Quad loop antenna.

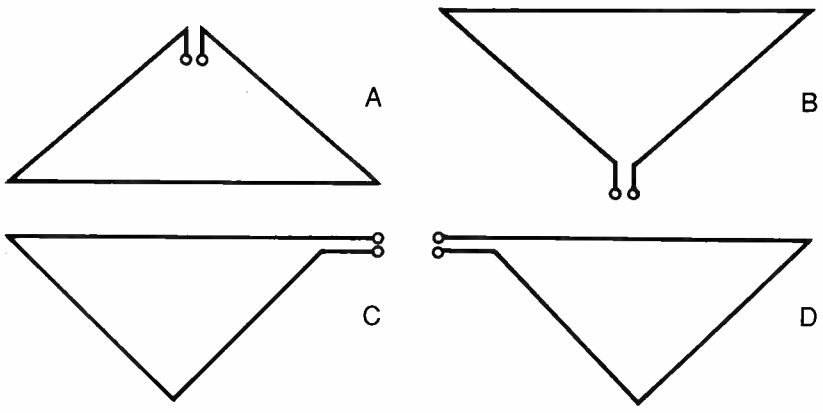

Fig. 2. Delta loop antennas: A) top feed; B) bottom feed; C) right side feed; D) left side feed.

Examples of overall wire lengths for loops of various frequencies are shown in Table 1.

There are several methods for constructing the quad loop. In general, the wire used is insulated copper no. 12 to no. 18 gauge. If you want a fixed loop, then it can be suspended from insulators and ropes from convenient support structures (tree, mast, or roof of a building). Alternatively, you can buy a quad beam kit from a manufacturer and only use the spreaders (this only works at the higher frequencies).

The quad loop can be fed with coaxial cable transmission line, and it is a good idea to use a 1:1 balun transformer at the feedpoint if only coax is used. The impedance match is not exact, and some VSWR will be found. The feedpoint impedance is on the order of 100-ohms, so the VSWR when 75-ohm coaxial cable is used is only 100/75 or 1.33:1.

Some people use a coaxial cable impedance matching stub between the quad loop feedpoint and the coaxial cable to the rig or receiver. Such a stub, called a *Q-section*, is made of 75-ohm coax, and is one-quarter wavelength long. The coax to the rig or the receiver in that case is 52-ohms. To make an electrical quarter wavelength matching stub, you must shorten the physical length by the value of the velocity factor (VF) of the coaxial cable used for the matching section. For example, suppose we are building a

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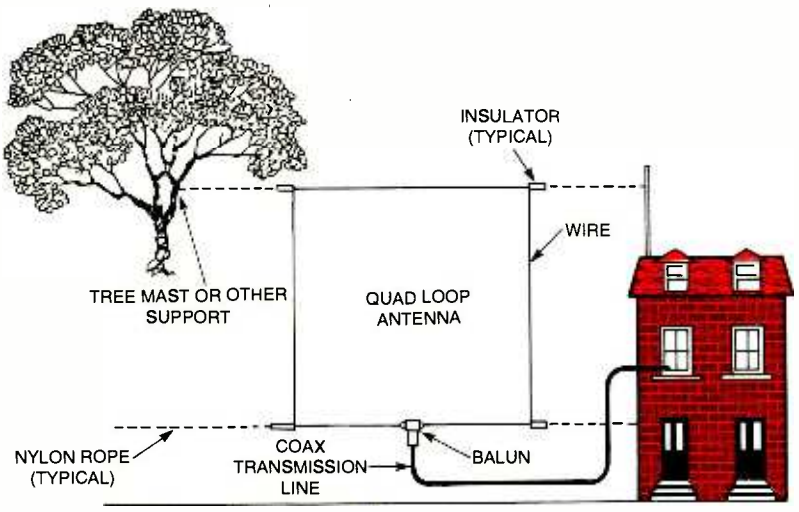

Fig. 3. Typical loop antenna installation.

TABLE 1 — Quad Loop Antenna Lengths

Band Center Frequency (MHz)	Overall Loop Length (Feet)	(Meters)
3.75	268.0	81.7
7.2	140.0	42.7
10.1	99.5	30.3
14.2	71.0	21.6
18.1	55.5	16.9
21.3	47.2	14.4
24.9	40.4	12.3
28.5	35.3	10.7

quad loop for 14.25 MHz. A quarter wavelength in free space is 246/14.25 = 17.26 feet (recall that the length in feet of a half-wave in free space is $492/F_{MHz}$). But if polyethylene dielectric coaxial cable (VF = 0.66) is used, the physical length required to make an electrical quarter wavelength is 17.26 feet x 0.66 = 11.4 feet. If polyfoam dielectric coax (VF = 0.82) is used for the matching section, then the required physical length is 14.1 feet.

You can make a quad beam by using two quad loop elements, parallel to each other and spaced between 0.15 and 0.25 wavelengths apart. The driven element is as shown in Fig. 1, while the reflector (which is behind the driven element) is a continuous loop without coax feed. It is also a few percent longer than the driven element—so use 1030 as the numerator for the length constant in the formula.

The quad loop beam has a tradition that goes back to just before World War II. Missionary shortwave radio station HCJB in Quito, Ecuador was experiencing problems with its Yagi beam antennas at this high elevation. There was a constant corona discharge off the ends of the elements, because the tips are high voltage points. At lower altitudes than Quito's Andes location, these antennas do not exhibit the problem, but at that altitude the arcing was severe enough to create a constant (and expensive) maintenance problem for the engineers. They invented the quad beam to solve the problem. The reason is that the feed method puts the high voltage nodes in the middle of the vertical segments. It takes a much higher voltage to cause corona arcing from the middle of a cylindrical conductor than off the ends, so the problem was eliminated.

Ham operators and some commercial stations quickly picked up on the quad beam, because it offered a relatively low cost method for obtaining directivity and gain. In addition, the quad beam is believed to work better than the Yagi beam in installations that are close to the Earth's surface (under one-half wavelength above ground).

DELTA LOOPS

The delta loop (see Fig. 2) gets its name from the fact that its triangular shape resembles the upper-case Greek letter *delta* Δ. These three-sided loops are made with a full wavelength piece of wire, each side of the equilateral triangle being one-third wavelength long. The overall length of the wire used to make the delta loop is also found from the equation, only if the antenna is mounted far enough from the ground and surrounding objects to simulate the elusive "free space" ideal. Usually this means about two or more wavelengths. But for practical delta loops closer to the Earth's surface a nearer approximation is found from the formula $(935/F_{MHz})$. Each side of the delta is one-third of the computed total wire length. The actual size for minimum VSWR will be between the two formula values (total length constants of 1005 or 935). If you use an antenna tuner, either size will produce at least decent (if not spectacular) results—the actual total lengths are not critical. That's one of the problems with any antenna work—final lengths cannot easily be predicted before testing, except in free space.

Three different feed schemes are shown in Fig. 2, but all three of them attach the feedline at an apex of the triangle. The antenna in Fig. 2A is fed at the top apex, the one in Fig. 2B is fed at the bottom apex, while the ones in Figs. 2C and 2D are fed at the right and left side apexes, respectively.

INSTALLATION OF LOOPS

Although it is impossible for me to recommend a specific installation scheme (it depends on the local situation), it is possible to offer some general guidelines. In Fig. 3, the assumption is that there are two mounts from which to mount a quad or delta loop antenna. In this case, the two mounts are a mast on the roof of a house and a nearby tree. Similarly, two masts could also be used. One of my ham buddies, now living in Ireland, uses the 100-foot tower containing his beam antenna for the middle support of a delta loop antenna.

The loop is suspended from end insulators and ropes. Use high strength nylon rope for best results (cotton rope stretches and breaks in only a few weeks in some areas, especially wet areas). The balun transformer that

(Continued on page 76)

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SCANNER SCENE

Cordless Phone Monitoring: A Legal Question

MARC SAXON

Cordless telephones, often referred to by the general public as "portable telephones," became an instant success. The original 10-channel versions came out in the late 1970s, with the handsets transmitting between 49.67 and 49.99 MHz and the bases on about 1700 kHz. By 1984, the FCC had paired the 10 handset frequencies to 10 discrete base channels that they had newly established between 46.61 and 46.97 MHz. The 46-MHz bases, which transmit both sides of conversations, boast an average base/handset two-way communications range of up to 1,500 feet using their built-in short whip antennas. That's better than a third of a mile!

It didn't take much calculating to realize that an outside-mounted rooftop antenna connected to a scanner might receive such signals from a mile or two away, maybe more. Thus was born the popular pastime of using scanners for recreational eavesdropping on cordless phone calls. Fans reported the calls funnier, juicier, and far more lurid than any TV program, be it sitcom or soap opera.

When the Electronic Communications Privacy Act (ECPA) was passed in 1986, it sought to make it illegal to monitor 800-MHz cellular calls. ECPA specifically *excluded* "transmissions between a cordless phone and a base unit."

In 1995, the cordless phone channels had become so crowded that the FCC added 15 more base frequencies between 43.72 and 44.46 MHz, plus 15 new handset channels between 48.76 and 49.50 MHz. Many scanner owners rejoiced at the prospect of 25 channels of eavesdropping potential unencumbered by federal restrictions. But soon after, as supposed privacy protection, the government quietly slipped through Public Law 103-414, eliminating the ECPA's reference to cordless phones. That has caused some confusion and concern to scanner owners because some hobbyists felt it made cordless-phone monitoring a violation of federal laws. Perhaps the intent was to make it a violation, but does it really do anything? We wonder.

A number of unusual factors bear upon the popular hobby of monitoring cordless phones.

The original ECPA exclusion mentioned solely transmissions between the handset and the base, but strangely didn't cover transmissions between the base and the handset. Therefore, base-to-handset transmissions don't appear to be part of the new restriction. Scanner monitoring involves only the frequencies of the base units!

Remember this, too. Those now-illegal-to-monitor cordless-handset frequencies established within the 49.60-50.00-MHz band are also allocated for federal station use. In addition, they are used by FM baby monitors and Part 15 license-free walkie-talkies. Those channels are shared with channels allocated to forest product companies, industrial users, highway-maintenance agencies, and power utilities. Notwithstanding ECPA restrictions on monitoring cordless handsets, there are no restrictions to monitoring the other stations using the very same frequencies!

(Continued on page 66)

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COMPUTER BITS

Adios ISA

JEFF HOLTZMAN

You may as well trash all your PC expansion cards; they're about to become obsolete! The draft version of Microsoft's hardware specification for PC '98, issued in April 1997, requires that the industry standard architecture (ISA) bus not be used in all PCs built hereafter. (See Table 1 for an overview of PC '98 system requirements). *[Editor's note: As this issue goes to press, the hardware spec for PC '98 is intended to be finalized in July 1997.]*

Spring 1997 was a historic time for this announcement. It was ten years ago when IBM tried a similar maneuver. Ever hear of the PS/2? It had an expansion bus called the microchannel architecture, or MCA for short. One salient and ultimately deadly feature of the MCA bus was its incompatibility with the reigning standard of the day, venerable old ISA. What makes Microsoft think it can succeed where IBM failed?—Timing.

IN THIS BUSINESS, TIMING IS EVERYTHING

In 1987 we needed the ISA bus. Do we today? On the negative side, ISA's inherent lack of intelligence makes system configuration difficult to manage manually, and impossible automatically. (Can you say IRQ conflict?) Besides, there's not much left on the ISA bus anyway. Memory interfaces moved to the motherboard years ago. The PCI bus arose to provide a 32-bit path for graphics and network adapters, and, not coincidentally, software manageability. So what does that leave? Serial and parallel ports, game controllers, slow-speed SCSI cards for things like scanners and Zip drives. None of which are exactly compelling. Most new motherboards come with on-board ports, and the SCSI situation can be handled via peripheral component interconnect (PCI), or, longer term, incorporated into IEEE-1394.

There is a small but significant market in industrial sensing and control devices that for the most part are married to ISA. Manufacturers of those boards will simply have to retool, and without mass market volume, that will be expensive, both for vendors and users.

TABLE 1—BASIC PC '98 SYSTEM REQUIREMENTS

PC '98 Reference	Required	Recommended
System requirements "Basic PC '98"	Basic PC '98 minimum, including complete OnNow support	
System buses "USB;" "IEEE-1394;" "PCI"	Basic PC '98 minimum (USB and PCI) ISA expansion bus not used	IEEE-1394; Device Bay; CardBus for mobile PCs
I/O devices "Input Components"	Basic PC '98 minimum	USB game pad; I/O devices use external bus; Remote control
Graphics and video components "Graphics Adapters" and "Video Components"	VPE-enabled and DVD-ready; Driver support for 3-D software acceleration	3-D hardware acceleration; Advanced Graphics Port; Video port; Analog cable TV tuner; TV output
Audio Components "Audio Components"	Consumer PC audio	Digital ready; Support of music synthesis
Communications "Modems"	Internal 33.6 kBps V.36 -1996 modem; Windows driver module support, where relevant	High-speed dial-up link with NDIS 5 support
Storage capabilities "Storage and Related Peripherals"	Bus mastering; 6X CD-ROM; DVD-ready	DVD-ROM, with DVD-Video capabilities

TABLE 2—FOR MORE INFORMATION

Topic	Source(s)
PC '98	*http://microsoft.com/hwdev/pc97.htm*
Plug and play	*http://www.microsoft.com/hwdev/pnpspecs.htm*
Video specs	*http://www.vesa.org*
USB	*http://www.usb.org* *http://developer.intel.com/design/litcentr/litweb/usb.htm* *http://developer.intel.com/design/usb*
IEEE-1394	*http://www.sel.sony.com/sel/consumer/camcorder/home.cgi* *http://www.ti.com/sc/ieee1394* *http://developer.intel.com*
Color	*http://www.color.org*
SCSI and IDE	Global Engineering Documents, 800-854-7179, 303-792-2181

ENTER THE NEW BUS SPECIFICATIONS

To provide a bit of context, USB (Universal Serial Bus) is a medium-bandwidth serial bus supporting data transfer rates of 1 to 12 MBps. By contrast, IEEE-1394 is a high-speed serial bus that runs at 100 to 400 MBps, eventually, perhaps, as fast as 1600 MBps. USB is being touted as the easy-use plug-and-play way of attaching mice, modems, printers, digital cameras, IR and RF interfaces, joysticks, game pads, and virtual reality helmets via simple, low-cost connectors and hubs. IEEE-1394 is intended to provide high-density peripheral storage and

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real-time playback of audio and video data.

Both USB and IEEE-1394 may be used for connecting devices, via the new Device Bay requirement—also part of PC '98. The device bay is intended to provide a more black-box means of installing peripherals. For example, you could use a single device bay to house, at various times, a CD-ROM reader, a CD-ROM writer, a DVD drive, and a hard drive, all without reconfiguring the system.

GOOD RIDDANCE?

I have no love affair with ISA. It has served well, but if its time is up, so be it. The question is this: during the transition, how will we handle maintenance and support? For example, now, if a serial port goes bad, either on the motherboard or an expansion card, it's simple and inexpensive to replace it. But without an ISA bus, that won't be the case. Eventually, of course, we'll be using USB for those purposes, but currently USB is barely more than vapor. I agree that ISA needs to go. I would just like to have something in place to help ease the transition. USB sounds good in theory, but it won't be a panacea. Currently you can't stop by the local computer store on a Saturday afternoon to pick up a spare USB I/O interface.

All of this makes me think there's more to this than meets the eye. Corporations are clamoring for manageability of computing resources. ISA is unmanageable. USB is manageable. But there is almost no USB hardware, because there is no market. Of course, there's no market because there's no hardware.

So I think Microsoft is saying adios ISA in PC '98 as a way of breaking out of the loop, as a way of jump-starting the USB market. Devious? Only moderately. Obviously Microsoft can't force hardware vendors not to put in ISA buses. But it could withhold Windows-related logos and licensing, thereby potentially damaging a vendor's market image and credibility.

Actually, I'm pretty excited about USB. I think it's going to open up lots of new and interesting computer interfacing opportunities for **Popular Electronics** readers. Check out the sources listed in Table 2 to be informed on the latest changes taking place in this fast-moving industry! Stay tuned... ■

SCANNER SCENE

(continued from page 64)

Okay, suppose the ECPA *might* actually cover 43.72-46.97-MHz base channels. All 15 of the newly assigned channels between 43.72 and 44.46 MHz are intended for and actively used by a myriad of land-mobile services, especially buses, trucks, and forest-conservation activities. Those channels lying between 46.61 and 46.97 MHz are in yet another band shared with federal stations. It's quite legal to monitor federal stations, trucks, buses, and forest-conservation communications.

Is there any logical reason to assume that scanners being legally used to monitor those frequencies can selectively filter out those certain signals that were legislated into a "restricted" status? Unless they can come around and install "V Chips" on scanners, it certainly seems that a cordless-telephone-monitoring restriction couldn't work, regardless of how the law was worded.

And what about cordless-phone owners who complain of interference from their neighbors' phones? They say that their phones allow them to overhear the calls of others. Wouldn't they be guilty of violating monitoring restrictions?

Normally, it would be virtually impossible to prove violations of monitoring restrictions. Some localities and states have anti-wiretap laws that have been turned against those who have tape-recorded phone calls and then turned the tapes over to others or to the news media. We know of no instances whereby scanner owners, in the privacy of their own homes, monitoring for their sole personal enlightenment have ever been accused or hassled for violating the ECPA or anti-wiretap laws. From the number of inquiries received here, it appears that there is a large audience out there listening in, just as there is a lot of concern about the meaning of Public Law 103-414.

OUR MAILBAG

We recently received an announcement introducing a newsletter that will be of interest to scanner owners. It's called *Scanning USA*, and we are told it's a monthly covering breaking news; technical topics; product information; railroad, aviation, and public-safety communications; and more. Its staff includes some people who previously worked on the now-defunct *Scanner Journal*. Twelve issues are $19, and a sample issue costs $3. Make checks payable to Alex Blaha, 2054 Hawthorne, Joliet, IL 60435. For more information, call 815-722-0717, or e-mail 105626.1406@compuserve.com.

L. Santos, of California, writes to ask if we can provide any frequency information for the Los Angeles City Fire Department. The most active frequencies are Channels 4, 7, 8, and 9, as they are used for dispatching. They are on 857.9375, 859.4375, 858.4375, and 857.2375 MHz, respectively. The LAFD welcomes listeners to its frequencies. The official list of all 18 repeated and six simplex LAFD frequencies, as well as other information about the agency, can be accessed by visiting the agency's Web site at *http://www.ci.la.ca.us/dept/LAFD*.

FAREWELL, FULL FREQUENCY

Here's an update on the popular AOR AR8000 scanner. Because it had full frequency coverage, the FCC pulled the plug on its certification. A version with the cellular frequencies blocked out will take its place. We understand that there are no more full-frequency coverage models left unsold.

KEEP US POSTED

Let's hear from you with frequencies, loggings, ideas, and questions. Write to us at *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. Our e-mail address is Sigintt@aol.com. ■

THE COLLECTED WORKS OF MOHAMMED ULLYSES FIPS

#166—By Hugo Gernsback. Here is a collection of 21 April Fools Articles, reprinted from the pages of the magazines they appeared in, as a 74-page, 8½ × 11-inch book. The stories were written between 1933 and 1964. Some of the devices actually exist today. Others are just around the corner. All are fun and almost possible. Stories include the Cordless Radio Iron, The Visi-Talkie, Electronic Razor, 30-Day LP Record, Teleyeglasses and even Electronic Brain Servicing. Get your copy today. Ask for book **#166** and include **$16.00 (includes shipping and handling)** in the US and Canada, and order from **CLAGGK Inc., P.O. Box 4099, Farmingdale, NY 11735-0793.** Payment in US funds by US bank check or International Money Order. Allow 6-8 weeks for delivery.

MA05

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

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CIRCUIT CIRCUS

Op-Amps

CHARLES D. RAKES

Op-amps! That's what we're going to look at this visit. You'll find them working tirelessly just about everywhere there is electronic equipment being used. And if you are just getting into circuit and project building, the following basic op-amp circuit configurations could be helpful in your future designs.

We will start out with the inverting amplifier circuit of Fig. 1, using one of the most popular and often used op-amp ICs around, the 741. The 741 general-purpose operational amplifier is almost bullet-proof, with several built-in protection features to help keep our electronic nemesis "Murphy" at bay. The op-amp's input and output circuits are protected from overload and output latch-up. That means that you can short the output or input for an indefinite period of time without harm or smoke. Self-oscillation is squelched by an internal frequency compensation circuitry. This op-amp normally operates from a dual or bipolar power source but can be made to operate from a single power source as we'll see later on.

INVERTING AMPLIFIER

The 741 op-amp is available in several different packages. Our choice of the day is the popular 8-lead mini-DIP package. The circuit of Fig. 1 has the 741 operating in a standard voltage amplifier configuration for DC amplification with a gain of 100. If you were to take a voltmeter and check the voltage at pins 2, 3, and 6 (negative voltmeter lead to circuit common), they all would measure near zero. If you apply a 0.01 volts positive to the input, the output would drop to a minus 1-volt level—that's what an inverting amplifier does.

Determining the op-amp's input impedance and voltage gain figure goes like this. The voltage gain of the circuit, G, is expressed as the ratio of resistors R2 divided by R1 (G = R2/R1). That's how we set up the component values for a voltage gain of

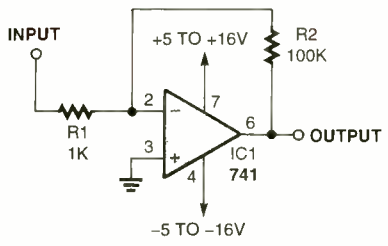

Fig. 1. This is about the simplest op-amp circuit around. The inverting amplifier gives you an output that is 100 times the input—but out-of-phase.

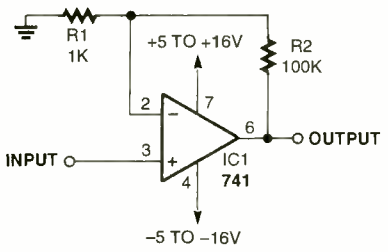

Fig. 2. Here's the same circuit in a noninverting configuration with a gain of 100 times the input—and in-phase.

100. R1 is a 1000-ohm resistor, R2 is 100k-ohm and the amplifier's gain figure calculates to be 100. The circuit's input resistance is approximately the value of R1, or 1000-ohms, but the output impedance is a little more complicated to figure out due to the effects of feedback; however it is very low, generally under a few ohms.

To operate the amplifier in the AC mode just add coupling capacitors in series with the input and output circuit. These capacitor values will depend on the amplifier's frequency range and should be no greater in reactance than one-tenth of the input and output impedance. The formula for capacitive reactance, X_C in ohms is $X_C = 1/(2\pi \times F \times C)$, or approximately $X_C \approx 1/(6.28 \times F \times C)$, where F = frequency in Hertz, and C = capacitance in farads. The 741's maximum operating frequency is about 1-MHz at unity gain. The 741 is not designed for RF applications and will perform its best at audio frequencies.

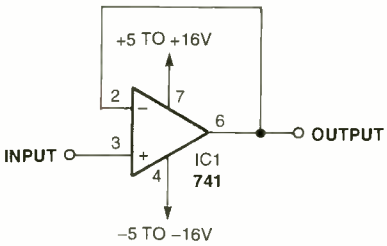

Fig. 3. This unity gain amplifier features very low output resistance and very high output resistance. A great little circuit to use when you need to isolate parts of a circuit from each other.

PARTS LIST FOR SIMPLE VOLTAGE AMPLIFIER CIRCUITS (FIGS. 1, 2, AND 3)

IC1—741 mini-dip op-amp integrated circuit, (available from RadioShack as 276-007, or alternately NTE941M or SK3552, and countless other manufacturers)
R1—1000-ohm, ¼-watt, 5% resistor
R2—100,000-ohm, ¼-watt, 5% resistor

NONINVERTING AMPLIFIER

Our second 741 circuit is a noninverting amplifier shown in Fig. 2. The resistance values for R1 and R2 are the same as those used in our first circuit, but the gain is higher by a factor of 1. The extra gain occurs because the input signal is added to the amplifier's output signal and G = 1 + (R2/R1). In this circuit the output voltage is 1.01-volt positive for a 0.01-volt input. Unless a precision gain figure is required, the formula for voltage gain in the inverting amplifier may also be used here. Since we normally use 5% resistors, the small difference in the two formulas won't matter much unless the chosen gain figure is low.

Another important feature the noninverting amplifier offers is its very high input impedance (in most cases several thousand megohms). This is an ideal amplifier circuit to use when working with high impedance signal sources.

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Once again, its output impedance is very low.

UNITY GAIN AMPLIFIER

Our next version of the noninverting op-amp, shown in Fig. 3, is designed as a unity gain (G = 1) follower amplifier. This is an ideal buffer amplifier that can be used to isolate sensitive circuits such as oscillators, high impedance transducers, and any critical circuit that is sensitive to loading or frequency pulling. Several unity gain follower amplifiers may be used with their inputs tied together, with each buffer output used to drive a different circuit and maintain isolation from the signal source to the final outputs.

DC DIFFERENTIAL AMPLIFIER

A DC differential amplifier circuit is shown in Fig. 4. This amplifier has two inputs and a common output. If each input is of equal value but of opposite polarity, the amplifier's output at pin 6 is zero. But if one of the inputs is slightly higher or lower than the other, the output will be the voltage difference between inputs times the gain of the amplifier, which in this case is 100. The output voltage may be determined by the formula: $V_{out} = (V_{input\ "B"} - V_{input\ "A"}) \times G$.

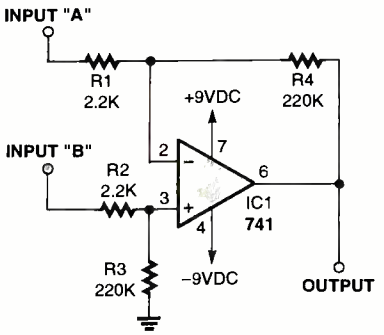

Fig. 4. This DC difference amplifier performs subtraction with the two input signals. With equal inputs at "A" and "B", this circuit ideally produces zero voltage at the output. You can find this configuration of the op-amp in many instrumentation circuits.

PARTS LIST FOR DC DIFFERENTIAL AMPLIFIER (FIG. 4)

IC1—741 mini-dip op-amp integrated circuit
R1, R2—2200-ohm, ¼-watt, 5% resistor
R3, R4—220,000-ohm, ¼-watt, 5% resistor

The DC differential amplifier may also be used as an AC differential amplifier by coupling the two input circuits with capacitors. Use the same capacitor reactance formula as suggested for Figure 1. If both inputs receive the same AC signal and the signals are the same in amplitude and phase, the amplifier's output will be zero. But if either input varies in level or phase, the amplifier will produce a differential output in response to the input change.

The differential amplifier cancels common-mode signals and is often used when 60-Hz hum pickup is a problem. Since both inputs are affected equally, the 60-Hz signal will be canceled out in the differential amplifier and will not be present in the output signal.

SINGLE-SUPPLY INVERTING AMPLIFIER

Our next entry in Fig. 5 has the 741 connected in an inverting AC amplifier circuit with a gain of 47 (G = 470k/10k) and operating from a *single* DC supply. The op-amp's positive input at pin 3 is connected to a voltage divider, R3 and R4, setting it to one-half of the supply voltage, or, in this case, 6 volts. Here the negative power source (at pin 4) is returned to ground, and the positive DC source is connected to the +12-volt supply. Expect to see a large AC signal at pin 6, out-of-phase with the input, and offset by about 6 volts DC.

Take your DC voltmeter and measure the voltage at pins 2, 3, and 6, and you should read approximately 6 volts at each location. These measurements can be helpful when troubleshooting this type of circuit. If any of the voltages are off by very much and all resistors and capacitors are good, it is a fair assumption that the op-amp has gone south!

The following capacitor values and reactance figures will help in selecting capacitors for audio op-amp applications. A 0.1-μF capacitor operating at 100 Hz has a capacitance reactance of about 16,000 ohms, at 1 kHz about 1600 ohms, and at 10 kHz about 160 ohms. A 0.01-μF capacitor will have ten times the capacitance reactance, and a 1.0-μF will only have one-tenth the reactance of a 0.1-μF capacitor. Capacitor C1 provides DC isolation between the AC signal input and the DC voltage at pin 2. Similarly capacitor C2 isolates the DC offset from appearing at the output of the circuit. Capacitor C3 ensures that the positive input is at an AC ground potential, and the value of C3 should be selected to have a low reactance at the lowest input frequency of operation. Resistors R1 and R2 serve their usual function of establishing input resistance and circuit gain.

MICROPHONE AMPLIFIER CIRCUIT

An electret condenser microphone amplifier circuit is our next design shown in Fig. 6. Here we have the 741 operating in an inverting variable gain amplifier circuit with the input being driven by a low-level electret microphone. Also notice that this amplifier circuit is operating from a single 9-volt supply (which also places a required amount of DC through the microphone). The circuit's gain may be varied with potentiometer R4, from a low gain of 10 to a maximum of 110 (when R4 is set at its maximum value of 100k-ohm).

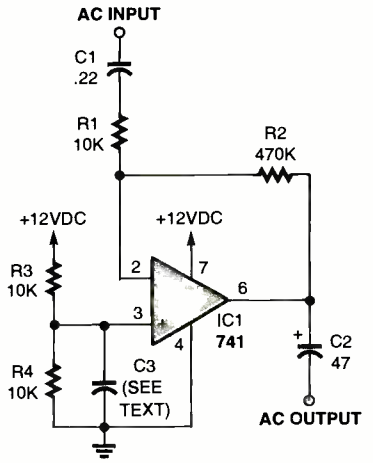

Fig. 5. The 741 is configured as an AC inverting amplifier with a gain of 47. The main feature in this circuit is the use of a single polarity DC power source.

PARTS LIST FOR AC AMPLIFIER OPERATING FROM SINGLE SUPPLY (FIG. 5)

IC1—741 mini-dip op-amp integrated circuit
C1—0.22-μF, 50-WVDC, mylar or similar capacitor
C2—47-μF, 25-WVDC, electrolytic capacitor
C3—(see text)
R1, R3, R4—10,000-ohm, ¼-watt, 5% resistor
R2—470,000-ohm, ¼-watt, 5% resistor

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LOW VOLTAGE AUDIO AMPLIFIER—FIXED GAIN

In the circuits shown above, the op-amp has been shown as a voltage amplifier with limited output current capability. This means that loads, such as speakers, requiring substantial currents cannot be driven directly by the outputs of these general-purpose op-amps. Devices that can be used in this application are specialized ICs designed as power amplifiers.

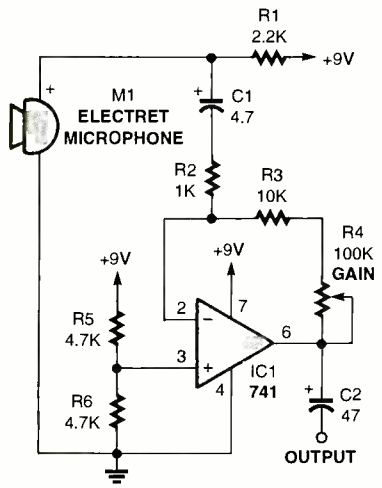

Fig. 6. Want a simple and cheap circuit for amplifying output from an electret condenser microphone—then use the op-amp in this manner.

The popular National Semiconductor LM386N-1 voltage audio power amplifier is the star of our last two amplifier circuits. If you haven't been exposed to this mini-dip power amplifier IC, here's a general description. The LM386 requires a minimum of external parts and will operate from a supply voltage of 5 to 15 volts. The amplifier's gain may be set by selecting a few external components, and the quiescent current drain is minimal, making it a good choice for battery-operated circuits.

Our first LM386 audio amplifier circuit, shown in Fig. 7, has a fixed voltage gain of 20 and sufficient output to drive a 4-ohm speaker with about ¼-watt output power. Potentiometer R1 varies the signal gain.

PARTS LIST FOR MICROPHONE AMPLIFIER (FIG. 6)

IC1—741 mini-dip op-amp integrated circuit
C1—4.7-μF, 25-WVDC, electrolytic capacitor
C2—47-μF, 25-WVDC, electrolytic capacitor
M1—electret microphone element, RadioShack 270-090
(All resistors are ¼-watt, 5% units, unless otherwise noted.)
R1—2200-ohm
R2—1000-ohm
R3—10,000-ohm
R4—100,000-ohm potentiometer, ½-watt
R5, R6—4700-ohm

LOW VOLTAGE AUDIO AMPLIFIER—ADJUSTABLE GAIN

Our second LM386 audio power amplifier circuit takes advantage of the IC's internal gain tailoring circuitry, and offers a two-position switch, providing a gain of 50 or 200. Fine control of the signal gain is available with potentiometer R1.

Only four additional external components were needed to raise the IC's gain from the fixed configuration. Bypass capacitor C3 is added, while C2, R2, and S1 complete the components required for the gain change. This is one great little amplifier! Try one; you'll like it I'm sure.

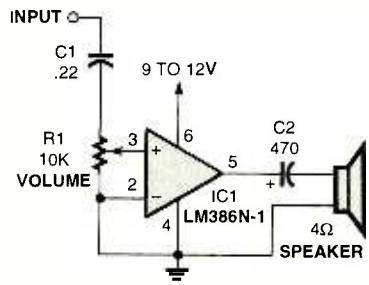

Fig. 7. Here's the popular LM386N-1 low voltage power amplifier designed with a fixed gain of about 20. Maximum power output is around ¼-watt. Use a heatsink with IC1 if high power usage is expected. This application of the LM386N-1 is used in many small computer multi-media amplifiers with adjustable volume control.

PARTS LIST FOR FIXED GAIN AUDIO AMPLIFIER (FIG. 7)

IC1—LM386N-1 audio power IC (equivalent part is the SK9210 chip)
C1—0.22-μF, 50-WVDC, mylar or similar capacitor
C2—470-μF, 25-WVDC, electrolytic capacitor
R1—10,000-ohm potentiometer, ½-watt
4-ohm speaker

PARTS LIST FOR ADJUSTABLE GAIN AUDIO AMPLIFIER (FIG. 8)

IC1—LM386N-1 audio power IC
C1—0.22-μF, 50-WVDC, mylar or similar capacitor
C2—10-μF, 25-WVDC, electrolytic capacitor
C3—100-μF, 25-WVDC, electrolytic capacitor
C4—470-μF, 25-WVDC, electrolytic capacitor
R1—10,000-ohm potentiometer, ½-watt
R2—1200-ohm, ¼-watt, 5% resistor
S1—SPDT toggle or slide switch
4-ohm speaker

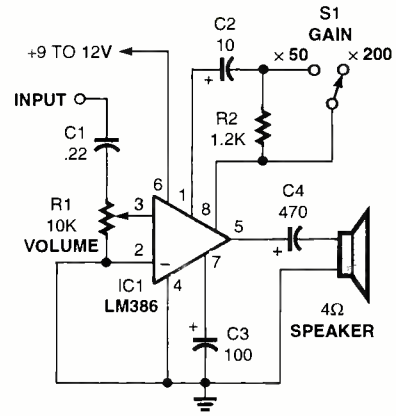

Fig. 8. The LM386 in this circuit features two-position selectable gain and adjustable volume. This is a great circuit to use for amplifying low-level input signals with wide dynamic ranges.

FOR MORE INFORMATION

Interested in learning more about operational amplifiers? Here are two recommended books that cover both the theoretical and practical side of these useful solid-state devices:

Gayakwad, Ramakant A. *Op-Amps and Linear Integrated Circuits, Second Edition*, Prentice Hall, 1988. ISBN 0-13-637174-4.

Terrell, David L. *Op-Amps, Design, Application, and Troubleshooting, Second Edition*, Butterworth-Heinemann, 1996. ISBN 0-7506-9702-4. (Reviewed in **Popular Electronics**, "Electronics Library", October 1996).

Once again it is time to leave, so until we meet here next month may all of your circuits be "Murphy"-free and all of your operational amplifier circuits be operational! ■

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Think Tank

Craig Revisited

JOHN J. YACONO
LAB TESTING COORDINATOR
COMPUTER RESELLER NEWS

Craig Sellen of Waymart, PA has sent us another batch of great circuits. Next month, I promise to pick up our discussion where we left off and explore some applications for the diode circuits we have covered. Here's Craig!

TEST GENERATOR

With the introduction of the LM566 Voltage Controlled Oscillator (VCO) IC from National Semiconductor, a number of new circuit ideas came to my mind. Among the many uses for this VCO IC is the function test generator shown in Fig. 1. Good substitutes for LM566CN IC are NTE994M or SK9224 or the RadioShack RSU 11392529. Powered by a conventional 9-volt battery, the circuit can be used in a number of testing applications since it delivers square waves (5 V_{p-p}), triangle waves (1.5 V_{p-p}), and positive and negative going spikes (both at 1.5 V_{p-p}). The fact that it has separate outputs for these four waveforms increases its versatility. Although it is not designed to operate into low impedance loads, a transistor or op-amp buffer can be used as an interface for such loads.

I like the way you used the diodes on the square wave output to obtain the spike pulses. Note that since the triangle waves are AC-coupled, they should be symmetrical around zero volts.

VARIABLE-PULSE GENERATOR

The circuit in Fig. 2 generates single-shot pulses in the manual mode with variable attack (rise) and decay (fall) rates up to 20 milliseconds. In the repeat mode, repetition rates of approximately 1 Hz to 25 Hz are available. With S1 placed in the repeat position, C2 charges at a rate determined by the (RC) time constant of R1 and R2, and then discharges through R3, R4 and R5. When the emitter of the uni-junction transistor Q1 conducts, the cycle repeats and transistor Q2 is switched off to a non-conducting state during the discharge of the capacitor C2. When S1 is moved to the manual position, one-shot pulses can be initiated by depressing the normally open pushbutton switch S2, and they will be sustained as long as the switch is in the closed position. The decay of the pulse occurs upon the release of the key. The 2N2646 UJT can be replaced with a NTE6401 or SK9123 or the RadioShack RSU 11415502. The 2N3904 transistor can be replaced with a NTE123AP or SK3854 device.

Definitely a nice start to a signal injector or a sound-effects generator. Sending the output to an audio modulator should produce some unusual effects that could be quite useful in signal tracing.

TREMOLO OSCILLATOR

A simple tremolo oscillator (which generates a trembling or vibrating effect) is shown in Fig. 3. The oscillator circuit is designed around a 741 op-amp employing a "Wein-bridge" oscillator network consisting of C1, C2, R1, R2 and potentiometer R3. The potentiometer controls the frequency rate of the tremolo oscillator. Amplitude limiting is introduced into the oscillator by diodes D1, D2, and resistor R5, and the negative feedback to the op-amp via resistor R4. The dual-potentiometer, R1, controls the frequency rate, while R3 adjusts the tremolo depth.

A foot pedal switch (normally closed) in the circuit activates/deactivates the tremolo effect. When the foot pedal switch is closed, the oscillator ceases sending a signal to the modulator. Whenever the foot pedal is open, a signal is produced adding tremolo to the modulator's output.

Wow, add this to a modulator and you're all set. Anyone out there with some electric organ circuits that might be good mates for this application—send them in!

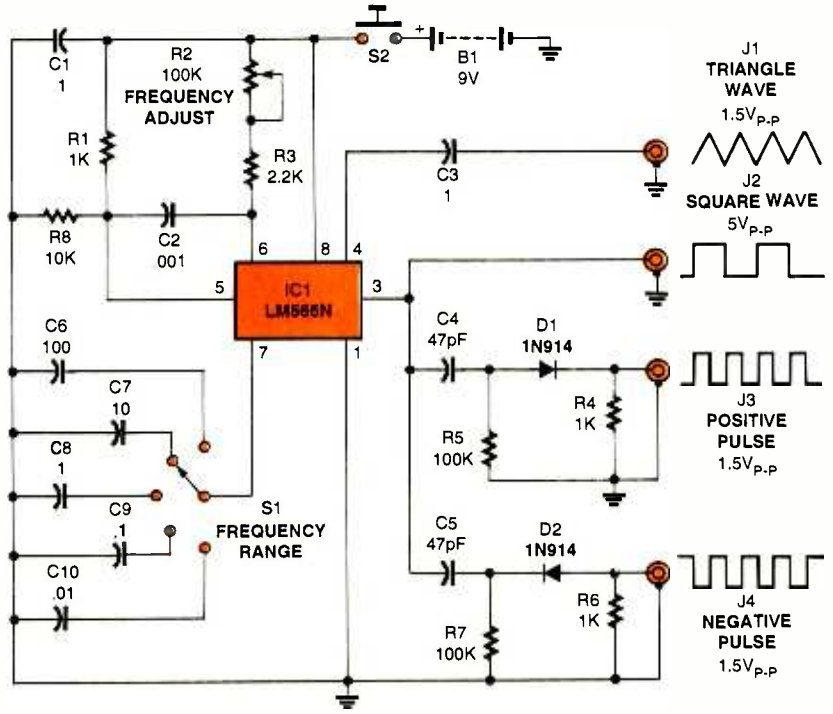

Fig. 1. This generator furnishes several test waveforms over a frequency range controlled by resistor R2 and capacitors C6 through C10.

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LABORATORY PULSE GENERATOR

Most simple pulse generators have several drawbacks—their frequency range is limited, transition times may be sluggish, and the output waveshape may not be symmetrical. The pulse generator in Fig. 4 overcomes these deficiencies by using a novel design to produce perfectly symmetrical pulses with fast rise and fall times covering the range from 40 Hz to 40 kHz.

The first objection can be overcome by using a wide-range relaxation oscillator with a fixed capacitor and a variable resistor. Such an oscillator can easily be adjusted through a 1000-to-1 range with a single-turn potentiometer. The components associated with Q1 and Q2 form such a relaxation oscillator and pulse generator. Equivalent transistors for the 2N3906 and 2N3904 are the complementary pair NTE153 and NTE-123AP, respectively. The series combination of R1 and R2 charges C1 to the trigger voltage of Q1. Resistor R3 forms a voltage divider with the series combination of R1 and R2 to set a threshold point for Q1. Transistor Q1 draws current through R5, which turns on Q2. Regenerative action causes Q2 to hold Q1 on until C1 is completely discharged—then the cycle starts over again. The combination of L1 and R4 limits the peak discharge currents to protect Q1 from damage. The upper frequency limit is set by the timer constant given by 1/(R1 x C1) and the lower limit by 1/[(R1 + R2) x (C1)]. The ratio of R2 to R1 is 1000:1, which represents the approximate frequency range of the generator. The selected value of C1 places the generator frequency in the desired audio to ultrasonic part of the spectrum.

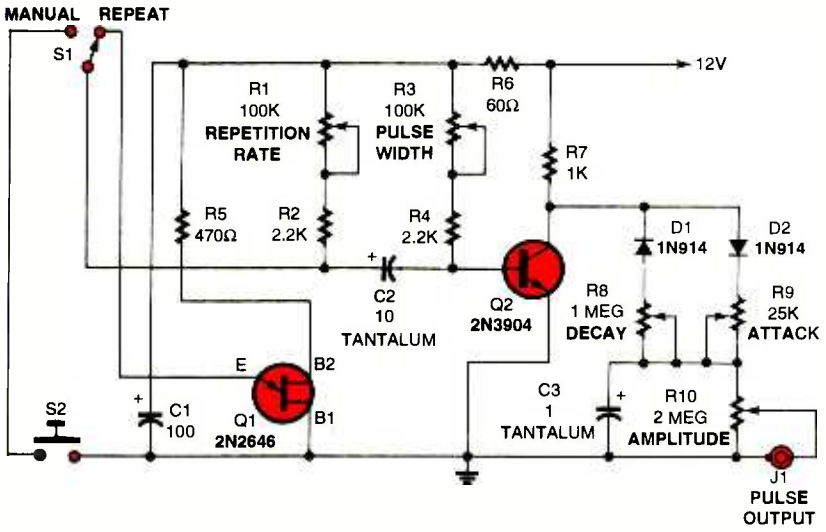

Fig. 2. This handy little pulse generator can be used for testing purposes and having a little audio fun.

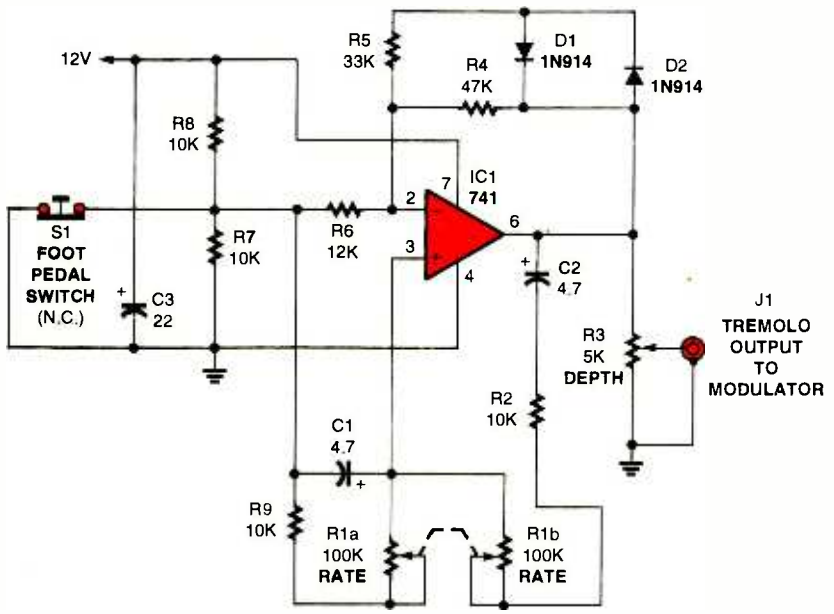

Fig. 3. Just hook up this tremolo oscillator circuit to your audio modulator, and the shaking will begin!

In adjusting circuit operation, the first step is to check the pulse generator frequency. At point "A" in the circuit, narrow negative-going pulses should occur. If frequency control R2 is set at minimum resistance, these pulses will be at the highest frequency and more easily observed. Once they are acquired, rotate R2 to its maximum resistance to make sure the frequency is variable. If no pulses are apparent, then adjust bias-level control R7 to obtain an output pulse. Trimmer potentiometer R7 should be adjusted so that R2 has complete control over output frequency.

The output terminal at J1 is isolated by a complementary emitter-follower pair formed by Q3 and Q4. This circuit is fairly novel in that the output is DC coupled yet referenced to ground; that is, the pulse output will always rise from the ground to some positive level. This level is set by R11, which places a clamp voltage on the collector of Q3. Using this scheme, the generator displays a constant output impedance below 200-ohms—besides the DC coupling and zero reference features. Maximum output voltage is about 5 volts peak-to-peak. If a flip-flop chip is placed at point "X," this circuit can be converted into a square wave generator, but the flip-flop will divide the pulse generator frequency in half.

Naturally, Craig means a toggle flip-flop. Those three-series connected batteries should produce some hefty current, so heatsinks for the output transistors would be a good idea. For fixed usage the batteries can be replaced by a 28 volt DC regulated power supply.

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SIGNAL TRACER

This pocket-size probe (see Fig. 5) locates and detects defective stages in any radio or amplifier, be it AM or FM, tube or transistor-based. The tracer also proves useful for tracking down sources of hum, noise and distortion. Because the tracer has a standard phone plug for its input, you can connect audio cables to it to check signals, cables such as those from your stereo system's record player, tuner, or tape deck.

The tracer is basically a high-gain audio amplifier. To trace audio signals, you set input selector switch S1 to the AF (audio frequency) position and place the test probe to the circuit point where audio is expected. The test signal at J1 then goes into the 741 op-amp's input via C1 and volume control R4. To trace RF signals, you set S1 to the RF (radio frequency) position. The signal detected is converted to audio by diodes D1 and D2 and routed to the input of IC1 by way of resistor R4. You listen for the detected signal with a miniature crystal earphone at J2. An 8.4-volt mercury battery supplies operating power for the signal tracer.

For economy, convenient handling and small size, I placed my model in a plastic toothbrush case. The volume control, conveniently mounted on the cover of the case, varies the signal level to the amplifier. Such a control is necessary to prevent high-level signals from overloading the amplifier. The test probe, J1, is made from a RCA plug with a short piece of no. 18 gauge solid wire soldered to the center of the plug. The ground lead is soldered to the shield of the plug and terminated in an alligator clip. The earphone jack is a standard $^1/_8$-inch (3.5 mm) configuration. The tracer is built on a piece of perfboard. First, temporarily position the volume control, R4, and associated SPDT switch S1, along with the battery, B1, inside the plastic toothbrush case. Then check to make sure the board fits before you install parts on it.

I used standard components for my tracer, but space can be saved by using $^1/_4$-watt resistors and low-voltage capacitors (such as 16-WVDC) for all the capacitors except for the two input capacitors, C1 and C2. To save even more space, use $^1/_8$-watt resistors and surface-mounted components wherever possible. An 8.4-volt mercury battery is used in my device. I selected this non-conventional battery, since I found its cylindrical size fit nicely into my toothbrush holder. Since this voltage is not critical, a more readily available 12-volt battery obtained from RadioShack (23-144) could be used, but then you might have to get their "type N" holder (270-405).

Wire the tracer using solder clips to mount all the parts, except diodes D1 and D2. Also, when bending the leads of D1 and D2, hold each lead with a pair of needle-nose pliers at the end of the diode's body. Make the connections as short as possible and watch the heat when soldering, since too much heat will destroy the diodes. Cut off the ends of the solder clips sticking through the board so the board fits low in the case.

The holes in the case for J1, J2 and S1 can be made with a single-edged razor blade. Cut the front of the case's cover so it fits snugly around J1. Position J2 in the cover so that it will not touch components on the board when the cover is closed. Plug a crystal earphone into J2, set switch S1 to the AF position, turn the volume control full clockwise, and touch the probe tip. You should hear a loud buzz. Try the tracer on a working radio. Connect the probe's center wire to the center lug on a radio's volume control and turn the radio's volume full up. With S1 in the AF position, you should hear the signal. Move the probe to the plate or collector of the first audio stage, and you should also hear the signal. Set S1 to

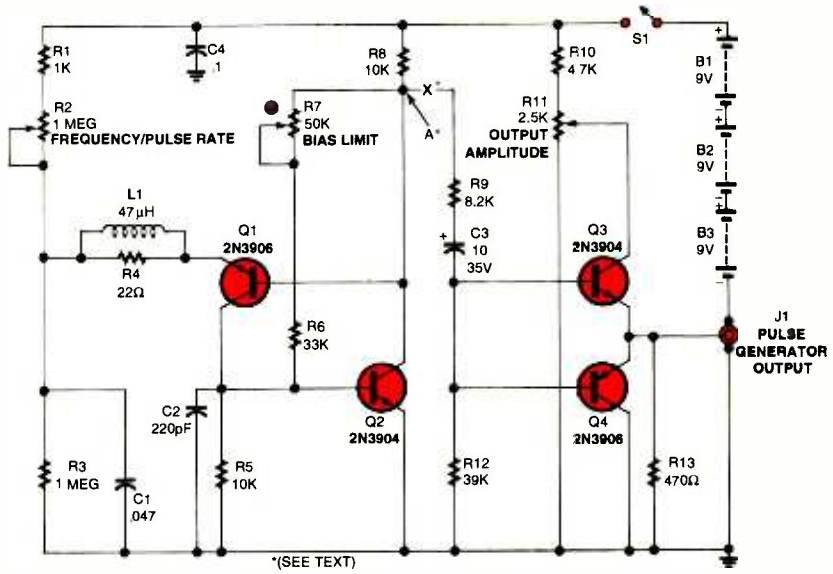

Fig. 4. Here's a general purpose pulse generator which produces 5 V_{p-p} pulses over the 40 Hz to 40 kHz repetition frequency range.

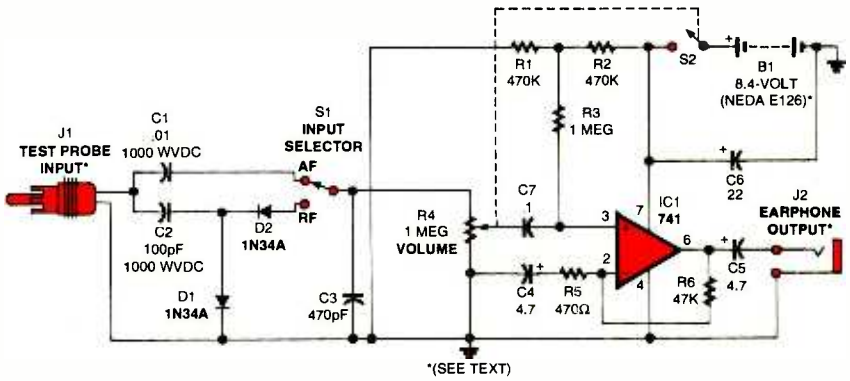

Fig. 5. Use this compact signal tracer to troubleshoot the defective stages in any radio or amplifier. Just listen to the point at which the signal first disappears or becomes distorted, and you will know where to look for the problem.

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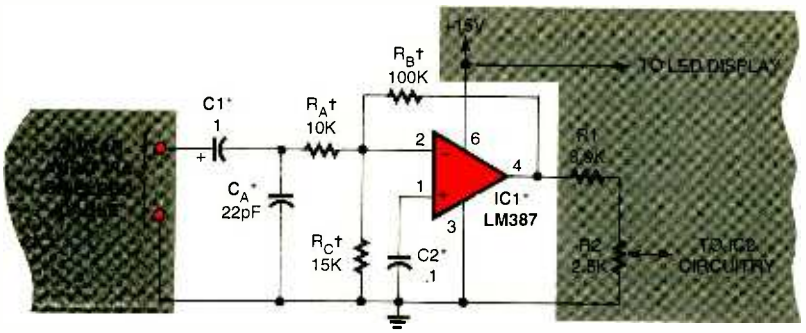

Fig. 6 The LM387 IC can be substituted for the obsoleted LM382, providing these changes are made to the "Guitar Practice Amplifier" circuit shown in the July "Think Tank" (page 66).

the RF position and touch the probe to the plate or collector of an IF stage. Again you should hear a signal (in both cases make sure the ground lead on the probe connects to the chassis).

The tracer can be used to check any portion of a radio circuit where a signal normally would be present. You also can connect an AF or RF signal generator to the receiver if strong signals are not available in your area. Generally speaking, you start troubleshooting at the output of a receiver or amplifier, and work your way back to the input. Always feed the injector's signal to the grid or of a tube or the base of a transistor. Touch the tracer's probe to the plate of the tube or the collector of a transistor. When you pick up the signal, you've found the defective stage!

Heads up—this is a great companion to the signal injector Craig provided last month.

THINK TANK RE-THINK

Nick Cinquino reports that the LM382 dual pre-amplifier IC used in his "Guitar Practice Amplifier" circuit, in the July "Think Tank" (page 66) has been obsoleted by National Semiconductor and may be difficult to obtain from standard suppliers. Nick recommends substituting the readily available LM387 IC, and making the modifications to the existing circuit shown in Fig. 6. The shaded lines show where the original connections are located. Should you have difficulty locating a LM387, substitute a NTE824 or SK9013 IC.

By the way—check our Web page: www.gernsback.com, for any corrections, modifications, or suggestions, in construction of these circuits. We try to keep you posted by putting out this information as soon as it is obtained. Drop by our site—you're always welcome and you might be pleasantly surprised by what you find!—Editor

That's another month's worth of circuit fun. If you'd like to receive a book from our library and see your work in print, just send in a quality working-circuit schematic and explanation to me here at *Think Tank*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. Send in enough to fill up a column, and you'll receive a kit and 1967 MCL1010 chip as well. ■

MULTIMEDIA WATCH

(continued from page 16)

jumping, acceleration, braking, and collisions, all based on real vehicle physics. Car damage accumulates, including dents and bullet holes. This one's $49.95. One last title from Activision is the *MechWarrior 2 BattlePack*, which includes a free copy of the official MechWarrior 2 Battle Guide from Brady Books. The BattlePack loads the MechWarrior 2 trilogy into one value-packed set. You get the original MechWarrior 2, Ghost Bear's Legacy expansion pack, NetMech, and the book for $49.99.

New this month from Access Software is an add-on golf course, *Oakland Hills*, for its premier golfing software, Links LS. This is computer golfing at its best, where authentic scenery and textures combine with life-like shadows and fog to make the simulation so realistic you can practically smell the wet grass. Since the early 1920s, Oakland Hills has made its mark in golfing history. Thanks to Access Software, this is one more golf course that virtual golfers can bring home. Greens fee for Oakland Hills will run you $29.95.

Body Voyage, from Time Warner Electronic Publishing, is a three-dimensional tour of a real human body. It brings to life the beauty and complexity of the human body through a virtual voyage into human tissue, muscle, bone, and organs. There are 3-D muscular and skeletal fly-throughs, 15 dissolving views showing layers of the body, and 400 labels of body parts including a description. The disc features high-end graphics of 100 percent real data from the Visible Human Project by the National Library of Medicine. With an estimated street price of $39.95, Body Voyage is one fantastic voyage.

Cloud 9 Interactive lets kids ages five to eight dig for fossils in locations around the world and learn math, science, and geography at the same time. The title of this disc is *I Can Be A Dinosaur Finder*. Kids can go back in time to play with dinosaurs and see how they roamed the earth. Or they can help Doc Rock complete his dinosaur exhibits. Kids can even print out reward certificates to share with family and friends. If you ever wanted to draw comics like Marvel Comics legend Stan Lee, here's your chance. In Cloud 9's *Marvel Creativity Center*, Stan Lee needs your help to complete his latest comic book and discover the villain-at-large. Each of the 90 drawing lessons brings you closer to finding the villain. You learn the basics of drawing comics, from working with shapes to creating final characters. You also learn the tricks that bring Spider Man, The X-Men and all the other Marvel characters to life. The Cloud 9 discs sell for $29.95 each.

Tonka Construction from Hasbro Interactive is for kids ages four and up. Kids take charge of a fleet of virtual Tonka trucks and construction projects. They can excavate, build roads, design a city park, and more. There are 14 Tonka trucks to play with, and kids can access information on all of them—they will need that information because the trucks are always in need of maintenance, paint, and repairs. This is the easiest way to let kids run rampant at a construction site without getting hurt or having to wear a hard hat. Hop aboard your Tonka truck for only $19. ■

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DX LISTENING

Solomon Islands Calling

DON JENSEN

During World War II, a Navy landing ship visited the Great Lakes port town where I grew up. Its mission was to promote the sale of war bonds and to illustrate the hardships and dangers our boys were experiencing in the Pacific Theater. Visitors to the ship could walk through a realistic display that had been constructed in the ship's spacious hold. It was a dank, dark, noisy and—to an impressionable boy—a thoroughly frightening replica of the jungle battlefield of Guadalcanal in the Solomon Islands.

That mental picture came back to me not long ago when I received a letter from Frank Charles, a *DX* reader from Tucson, Arizona.

"US Army Radio Station WVTQ began broadcasting in the Solomon Islands in 1942," Frank wrote. "It broadcast to the Armed Forces in the South Pacific."

He should know, of course, because he was there, listening to the Armed Forces Radio broadcasts on shortwave.

"I used a GI version of a Majestic AM-SW radio, with a metal cabinet painted GI olive drab. The station broadcast on shortwave around 20 MHz, from 6:30 in the morning to midnight, with the best selection of stateside programming, including news and sports."

During the occupation of Japan immediately after the war ended, Frank says, the station moved to Osaka, Japan.

"I wonder if this station is still in operation? If so, what is the frequency and can it be heard here in the U.S?"

Frank's letter sent me scurrying to my reference files, because WVTQ predates my own introduction to shortwave listening by a few years. Unfortunately, I could not locate any information about this SW broadcaster. There were, however, a number of such Armed Forces radios that operated from the islands of the Pacific Theater during the later years of WWII. Most of them, and surely WVTQ, had closed down by the time I began my SWLing at age 11 in 1947.

Sorry to disappoint you, Frank, but your station hasn't been on the air for more than a half century! Still, for you, and other sharp-eared SWLs, it's still possible to hear SW broadcasts from the Solomon Islands.

This vintage QSL dates to pre-independence days when the Solomon Islands were a British protectorate, and the shortwave station was known as the Solomon Islands Broadcasting Service.

For those who know their WWII history, or in Frank's case, lived through it, there are two of the islands in this chain whose names were written in blood during the war: Guadalcanal and Bougainville.

The six-month battle for the Solomons in 1942 and 1943 took some 3,600 American and 20,000 Japanese lives. Even today, scars remain—rusted war machines overgrown by jungle and sunken hulks off shore.

Independence from a British protectorate came in 1978 to the six main islands and hundreds of tiny atolls that make up today's nation of the Solomon Islands. Bougainville, the northern link in this island chain is geographically one of the Solomons, but politically is part of Papua New Guinea.

The Solomon's present capital, Honiara on Guadalcanal Island, didn't even exist when the Marine Raiders stormed ashore in 1942. A post-WWII town, it is the only urban area on the island, with local stores, branches of Australian and Japanese companies, and a few tourist hotels. Overlooking the town, amid the tropical fauna, are attractive homes. Here, at Honiara, is the shortwave station of the Solomon Islands Broadcasting Corporation (or SIBC), which operates a pair of modestly powered 10-kilowatt transmitters on 5,020 and 9,545 kHz. Programming is mostly in English, though some broadcasts in the local pidgin language also are aired.

RELAYED NEWSCASTS

A typical identification is: "This is the Solomon Islands Broadcasting Corporation, the Happy Islands." Newscasts are aired on the hour, most of them relays from Radio Australia, Radio New Zealand and the BBC World Service, but a local news broadcast is presented at 0730 UTC. The current shortwave schedule is 24 hours on 5,020 kHz, and 2000 to 0730 UTC on 9,545 kHz. Your local midnight to dawn

(CREDITS: Brian Alexander, PA; Erik Bueneman, MO; William McGuire, MD; Kevin Murray, MA; Ed Rausch, NJ; Jim Renfrew, NY; Chuck Rippel, VA; Betsy Robinson, TN; Allan Rosewarne, IL; Dan Ziolkowski, NY; North American SW Association, 45 Wildflower Road, Levittown PA 19057)

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hours probably will offer the best chance to hear this station.

On Bougainville island, the National Broadcasting Corporation of Papua New Guinea has its own shortwave outlet, Radio North Solomons at Kieta. Its programs are mostly in the local pidgin, in which it identifies as "Maus Bilong Sunkamap" (Mouth Belong Sun-come-up, or Voice of the Sunrise).

Like the Solomon Islands Broadcasting Corporation, Radio North Solomons uses a 10-kilowatt shortwave transmitter. The station is a good bit more difficult to hear in North America on its frequency of 3,325 kHz in the 90-meter band. Its scheduled North America broadcasts are at 0700 to 1300 UTC, but probably the best opportunity to log this one would he toward the latter part of that time slot, around your local dawn.

THE LONG, LONG LETTER

Perhaps the longest running program on shortwave is "Letter from America", the personalized commentary of Alistair Cooke, now nearing the end of its 51st year on the British Broadcasting Corporation's World Service. Not long ago, there was a rumor circulating that the venerable Cooke was about to hang it up after more than a half-century. This proved not to be the case, though who knows just how much longer the erudite broadcaster will continue his string of weekly BBC broadcasts which began March 23, 1946.

Letter from America can be heard several times during the BBC's World Service schedule Saturdays and Sundays. Currently the schedule is being revised so you may have to hunt around a bit, or you might wish to check Auntie Beeb's website: *http://www.bbc.co.uk/worldservice*. E-mail inquiries can be sent to *worldservice.letters@bbc.co.uk*.

DOWN THE DIAL

There's a world of listening just waiting to be heard! Here are some listening targets you may want to try:

Bulgaria—9,485 kHz, Radio Bulgaria in Sofia has English programming at 0000 UTC. It has been heard here with tuning signal, identification and a report on Bulgaria's role in NATO.

Colombia—6,115 kHz, La Voz del Llano-Llano translates, roughly, as the cattle-raising grasslands-is noted in Spanish around 1000 UTC with advertisements, identification and frequency announcement.

Croatia—5,895 kHz, Croatian Radio broadcasts in English at 2300 UTC with identification and news, followed by programming in Croatian.

Cuba—3,550 kHz, Radio Rebelde. This unintended transmission is actually the fifth harmonic of the medium wave outlet on 710 kHz. You can also find this one, in Spanish, of course, on its intended shortwave frequency of 5,025 kHz about 0900 UTC.

Cyprus—6,180 kHz, British Broadcasting Service English programming is relayed from this eastern Mediterranean island at 2130 UTC.

Czech Republic—5,930 kHz, Radio Prague operates on this frequency at 0005 UTC, with English programming, including interval signal, identification, program schedule and news broadcast.

Germany—7,265 kHz, Sudwestfunk, one of a handful of small German domestic broadcasters on shortwave, is reported here from 2338 UTC with pop music, then German identification and news.

Ivory Coast—7,215 kHz, Radio Cote d'Ivoire, a west African SW voice, has been heard around 0630 UTC with African music and French announcements,

Laos—6,130 kHz, Lao National Radio is not an easy catch, but try for this one, broadcasting in an Asian language around 1135 UTC. Listen for seven gongs on the hour.

Solomon Islands—5,020 kHz, Solomon Islands Broadcasting Corp. was heard here from 1115 UTC, with popular music and a local weather forecast, reporting a tropical disturbance expected for Guadalcanal province.

Sudan—9,200 kHz, Voice of Sudan, Radio Omdurman was logged at 0320 UTC, with a talk in Arabic and station identification.

Venezuela—4,980 kHz, Ecos del Torbes has a fine musical program, La Musica de Venezuela, at a not so fine time—0950 UTC. Early bird SWLs will find this one in Spanish shortly before 1000 UTC.

Remember I'm always interested in hearing from you with your logging information and questions or comments about SWLing. Address them to me, Don Jensen, c/o DX LISTENING, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

HAM RADIO

(continued from page 63)

feeds the antenna (producing in this case horizontal polarization) is attached to the center of the bottom run of wire. Larger loops of the sort shown in Fig. 3 may tend to flop about in the wind, and thus could sustain damage. As a result, it is also wise to use rope lines from the balun and both lower end insulators to wooden stakes in the ground.

SAFETY NOTE: Large wire antennas may break in the wind, and then whip around. Be sure to install the antenna so that a whipping end, or a length that drops, can never—that is NEVER—come in contact with power lines. Also, do not toss a wire over a power line to install it...you can be killed!

Comments?—I can be reached by snail mail at P.O. Box 1099, Falls Church, VA, 22041, or by e-mail at CARRJJ@AOL.COM. ■

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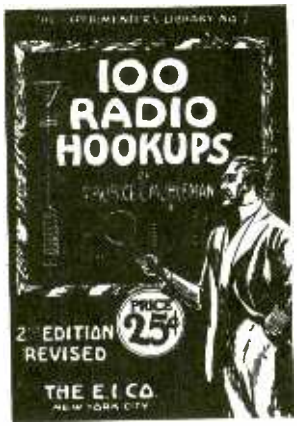

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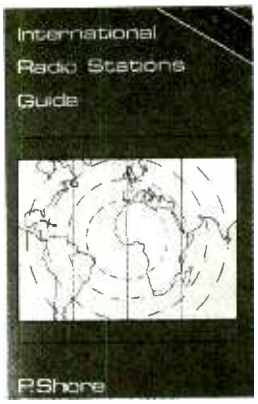

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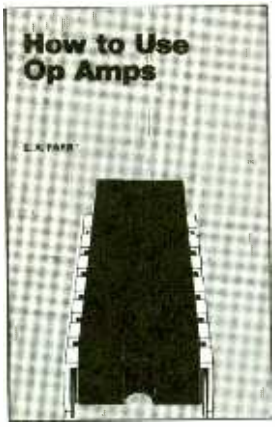

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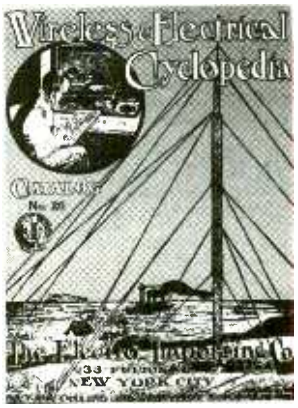

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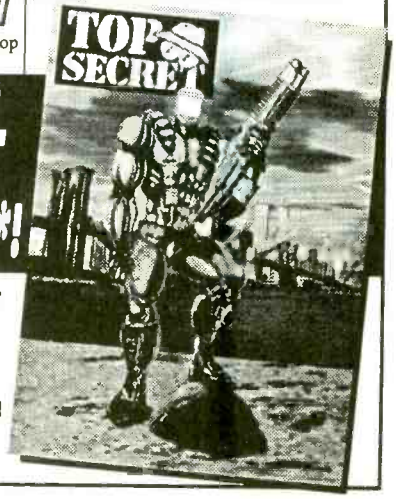

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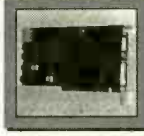
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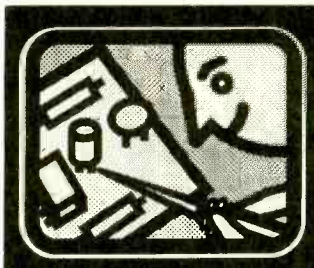

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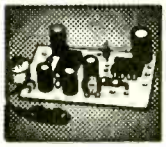
WM-2 KIT **$14.95**



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AA-1 BUILT $29.95 KIT **$10.95**

PHONE TRANSMITTER

Small but mighty,it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz to 130MHz FM. You can also use it as a speaker phone. SIZE:1.25" x .6".

TEL-B1 KIT **$12.95**

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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.Power requirement 6 or 12v DC. Size 3.5"x1.9"

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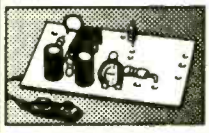

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Boost your microphones output up to line level!

Plug your mic into our AP-1 and drive your amp. to full capacity. Connect an AP-1 to a pair of amplified speakers, plug your mic in and you have an instant PA system. Requires 6 to 12v DC Size: 1.75" X 1"

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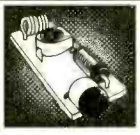


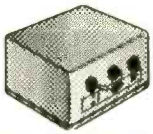
MICRO-MINIATURE WIRELESS MIKE

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 it transmits about 1/2 mile. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. Power requirement 6 to 12v DC. Size .35"x.9"

MMWM5 KIT **$34.95**

PHONE SLEUTH

Ever want to know every number dialed on your phones while you were away?



Here is the solution! Just hook up the Phone Sleuth to your phone line, then at your leisure, down load the numbers called on your phones to your computer using the RS-232 Serial Interface Module unit. Keep track of the calls and no one but you will know the phone numbers are being monitored and stored. The Phone Sleuth saves every number dialed, even all local calls. Works great with scanners, voice mailbox, answering machines, modem access numbers and decodes tones stored on a tape recorder. It even records credit card numbers entered through your phone key pad. The Phone Sleuth can be used to record cellular or repeater phone numbers heard over your phone. Size: 1.6" H x 2.5" W x 3" D

• Decodes all DTMF Tones from 0 thru 9, #, *, A, B, C. • Stores the last 490 Digits it receives. • Information stored by the Phone Sleuth can be displayed on your computer, saved to a disk or sent to your printer, using our RS-232 Serial Interface unit. Power by 9v battery.

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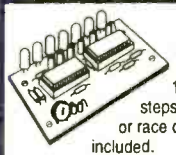

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If battery status is important, you need this kit. This kit uses 7 LEDs to monitor 12v DC in 1v, 1/2v, or 1/4v steps. Monitor 8v or 5v in 1/4v steps. Great for boats, motor homes, model planes or race car ni-cads. All parts and instructions are included. SIZE: 1.3" x 2.7".

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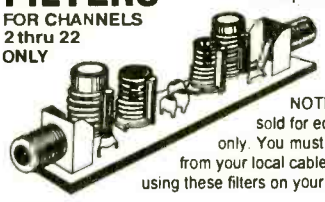
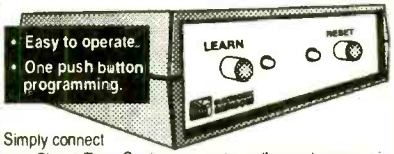


NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

DF-222 KIT **$14.95**

PHONE TONE GENIE

Control 4 separate devices with DTMF tones from anywhere in the world!



Simply connect your Phone Tone Genie to your phone line and program in a security code using DTMF tones up to 16 digits in length with your telephone. Any device connected to the Phone Tone Genie can then be turned on or off by entering your security code. Each device may operate off of 120 VAC and up to 2 Amps.

Operates from 12 VDC Wall transformer which is included.

- **Turn a device ON or OFF, from across town or anywhere in the world.**
- **Perhaps you need to Listen for any sounds in your house with the AA-1 Super Snooper Big Ear.**
- **Connect the Phone Tone Genie to the speaker of your scanner or ham radio.**

Size: 1.5"H x 5"W x 5.3"D

PTG-1 BUILT **$139.95** KIT **$99.95**

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Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your CD's while mowing the lawn, Play music on one channel sing on the other. Clarity is excellent, aprox. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls & crystal for stereo separation. 9v battery operation. SIZE: 1.5" x 2.5" x 3"

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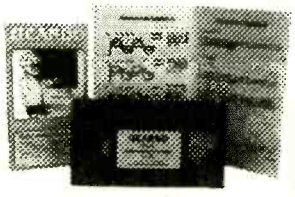

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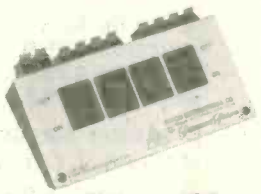

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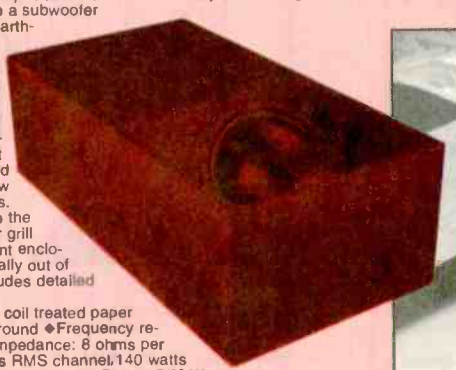

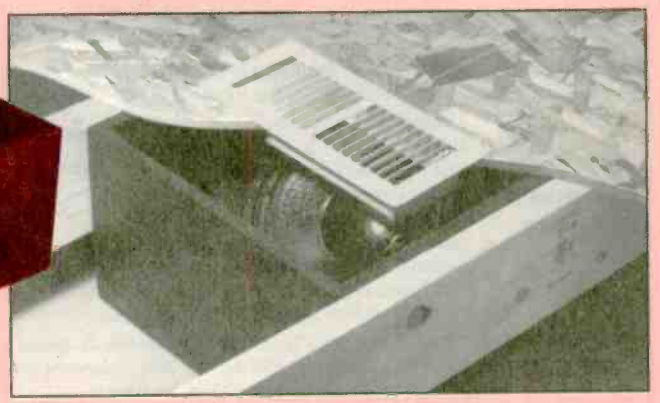

Specifications: 10" dual voice coil treated paper cone woofer with poly foam surround ◆Frequency response: 30-100 Hz ◆Nominal impedance: 8 ohms per coil ◆Power handling: 100 watts RMS channel, 140 watts max ◆SPL: 89 dB 1W/1m ◆Dimensions: 27" D x 14-5/8" W x 9" H ◆Net weight: 29 lbs.

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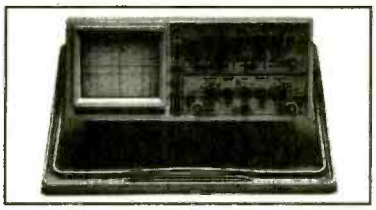

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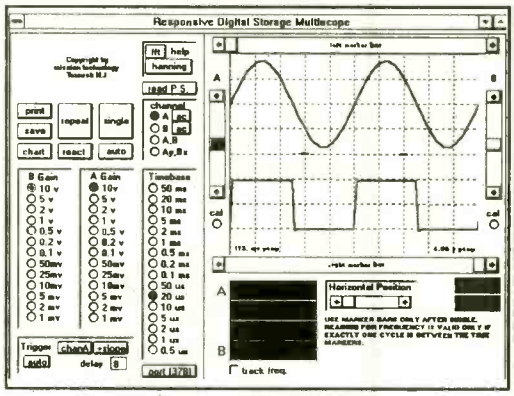

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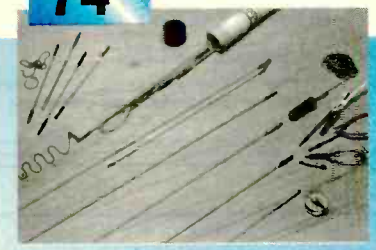

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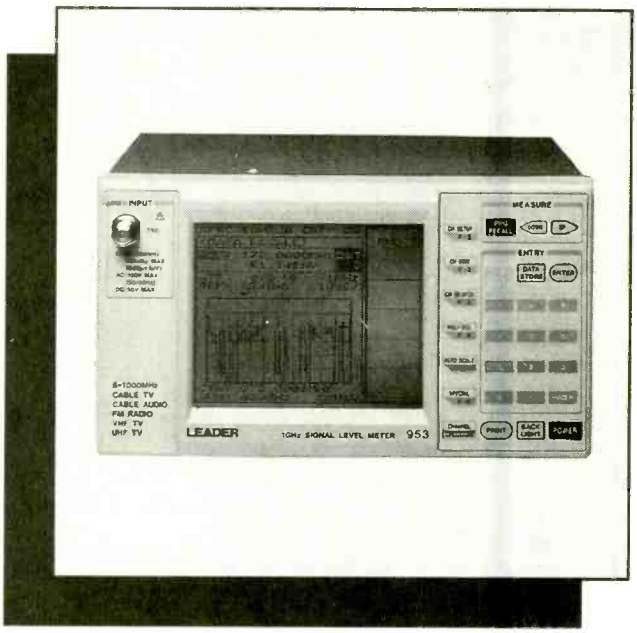

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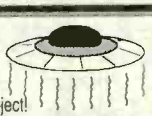

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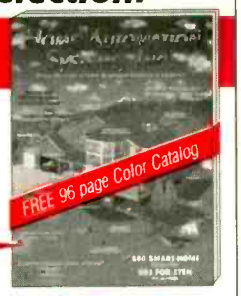

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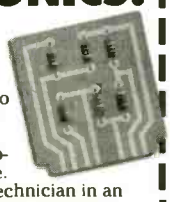

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20V	10mV	
200V	100mV	
1000V	1V	

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

Range:	Resolution:	Accuracy:
200µA	100nA	±(1.2%rdg+2dgts)
2000µA	1µA	
20mA	10µA	
200mA	100µA	
10A	10mA	±(1.2%rdg+2dgts)

Overload Protection: mA Input, 2A/250V fuse.

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Range:	Resolution:	Accuracy:
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750V	1V	

Frequency Range: 45Hz-450Hz
Maximum Allowable Input: 750V rms
Response: Average Responding. Calibrated in rms of a Sine Wave.

Resistance (Ω)

Range:	Resolution:	Accuracy:
200Ω	100mΩ	±(1.2%rdg+2dgts)
2000Ω	1Ω	
20KΩ	10Ω	
200KΩ	100Ω	
2000KΩ	1KΩ	
20MΩ	10KΩ	±(2%rdg+10dgts)

Maximum Open Circuit Voltage: 2.8V

Diode Test
Measures forward voltage drop of a semiconductor junction in mV test current of 1.5mA Max.

ohFE Test
Measures transistor hFE.

CAT NO	DESCRIPTION	PRICE
9300G	Rugged High Quality DMM with Rubber Boot	$19.00

Switchable Scope Probe Sets

(Selectable X1/Ref/X10) These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 50MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

CAT NO	DESCRIPTION	PRICE EACH 1	10	100
HP-9060	Scope Probe Set DC~60MHz	$16.49	$14.49	$11.58
HP-9150	Scope Probe Set DC~150MHz	24.95	21.95	18.62

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-3	Makes 1 pint	$3.50	$2.75

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

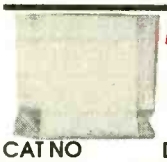
CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 165mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10
PP1212	305mm x 305mm/12" x 12" *NEW!*	12.78	10.65	8.52

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
GS114	114mm x 165mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80
GS1212	305mm x 305mm/12" x 12" *NEW!*	18.88	15.73	12.59

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114	114mm x 165mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30
GD1212	305mm x 305mm/12" x 12" *NEW!*	22.09	18.35	14.68



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
POSDEV	Positive Developer	$ .95	$ .80	$ .50

Etching Tank

This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	$37.95

Removeable Hard Drive Racks

The ideal solution for protecting highly sensitive data. Or, buy one computer and allow individual users to keep their hard drive with their own applications and set-ups. Just turn the system off, lift the handle and the hard drive pops right out. Key lock included to avoid accidental or unauthorized removal. Includes hard drive activity LED's. Rack includes mounting hardware, keylock, front panel LED, convenient pull out handle. Made from high impact ABS plastic. Fits in 5.25" bay.

Features: • Ideal for Hard Drive Portability • Solve Software Data Security Issues • Carry Your Hard Drive Between Home and Office • Each User Can Have His or Her Personal Hard Drive

CAT NO	DESCRIPTION	PRICE
SpecialHDRACK-IDE	For IDE Hard Drive	$14.95

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Digital Panel Meters (LCD & LED)

Don't let the prices fool you. These digital panel meters are not surplus, so even if you design them into an ongoing manufactured product, you can be assured of continued availability. These high quality digital panel meters are decimal point selectable with guaranteed zero reading at zero volts input.

Applications Include:

- Voltmeter
- Thermometer
- pH Meter
- dB Meter
- Watt Meter
- Current Meter
- Capacitance Meter
- LUX Meter
- LCR Meter
- Other Industrial & Domestic Uses

PM-128: 3-1/2D LCD Digital Panel Meter

PM-129: 3-1/2D LED Digital Panel Meter

Features

- 200mV Full Scale Input Sensitivity
- PM-128 - Single 9VDC Operation
- PM-129 - Single 9VDC Operation
- Decimal Point Selectable
- PM-128 - 13mm Figure Height
- Automatic Polarity Indication
- Guaranteed Zero Reading for 0 Volt Input
- High Input Impedance (>100Mohm)

3-1/2 Digit LCD 3-1/2 Digit LED 4-1/2 Digit LCD

PM-328: 4-1/2D LCD Digital Panel Meter

Features

- 200.00mV Full Scale Input Sensitivity
- Single 9V DC Operation
- Decimal Point Selectable
- 11mm LCD Figure Height
- Automatic Polarity Indication
- Low Battery Detection and Indication
- High Input Impedance (>100 Mohm)

Specifications - PM-128/PM-129

Maximum Input	: 199.9mV DC
Maximum Display	: 1999 counts (3-1/2 Digits) w/Automatic Polarity Indication
Indication Method	: PM-128 - LCD Display PM-129 - LED Display
Measuring Method	: Dual-Slope Integration A/D Converter System
Overrange Indication	: "1" Shown In the Display
Reading Rate Time	: 2-3 Readings per sec.
Input Impedance	: >100 Mohm
Accuracy	: +-0.5% (23+-5°C, <80% RH)
Power Dissipation	: PM-128 - 1mA DC PM-129 - 60mA DC
Decimal Point	: Selectable w/Wire Jumper
Supply Voltage	: PM-128 - 9V DC PM-129 - 9V DC
Size	: 67mm x 44mm

Specifications - PM-328

Maximum Input	: 199.99mV DC
Maximum Display	: 19999 counts (4-1/2 Digits) w/Automatic Polarity Indication
Indication Method	: LCD Display
Overrange Indication	: "1" Shown In the Display
Input Impedance	: >100 Mohm
Accuracy	: +-0.05% (23+-5°C, <80% RH)
Power Dissipation	: 1mA DC
Decimal Point	: Selectable w/Wire Jumper
Supply Voltage	: 9V DC
Size	: 67mm x 44mm

AS LOW AS $5.25 ea.

CAT NO	DESCRIPTION	PRICE EACH 1	10	25	100	250
PM-128	3-1/2 Digit LCD Panel Meter	$ 9.90	$ 7.09	$ 6.40	$ 5.86	$ 5.25
PM-129	3-1/2 Digit LED Panel Meter	11.49	9.54	8.67	7.95	6.95
PM-328	4-1/2 Digit LCD Panel Meter	19.88	16.40	14.90	13.66	11.93

Ball Bearing 12V DC Fans

These High Quality Fans feature Ball Bearings and Brushless DC Motors. All of them are designed to meet UL, CSA & VDE Standards. Design these fans into power supplies, computers or other equipment requiring additional air flows for heat removal. These fans are regular Circuit Specialists stock items — they are not surplus.

INDUSTRY BEST PRICING!

CAT NO	PRICE EACH 1	10	25	100
CSD 4010-12	$ 9.88	$ 6.38	$5.48	$4.87
CSD 6025-12	9.38	5.91	5.41	4.71
CSD 8025-12	8.88	5.85	5.19	4.49
CSD 9225-12	8.95	6.14	5.29	4.59
CSD 1225-12	11.45	8.96	7.82	6.85

Specifications

CAT NO	DIMENSIONS (MM)	RATED VOLTAGE (V)	START VOLTAGE (V)	INPUT CURRENT (A)	AIR FLOW (CFM)	STATIC PRESSURE (INCH-H_2O)	SPEED (RPM)	NOISE LEVEL (dB)	WEIGHT (g)
CSD 4010-12	40x40x10mm	12	7	0.06	5.1	0.19	5,500	26	20
CSD 6025-12	60x60x25mm	12	5	0.13	13.7	0.165	4,500	28	65
CSD 8025-12	80x80x25mm	12	5	0.16	37.8	0.177	3,000	31	80
CSD 9225-12	92x92x25mm	12	5	0.32	42	0.18	2,800	37	95
CSD 1225-12	120x120x25mm	12	5	0.35	62	0.180	2,500	42	135

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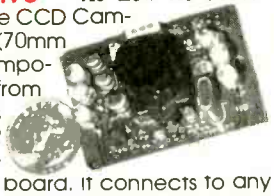
We stock high quality 60/40(Sn%/Pb%), .031" and 63/37, .031" diameter. This is prime JIS certified solder that we maintain as a regular stock item (It is not "Left-overs, Rejects or Surplus") and you can buy it from us at a fraction of the price that you are used to.

Tired of Paying Inflated Prices for Solder?

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
RH60-1	1-lb. Spool, .031", 60/40	$ 6.90	$ 5.96	$ 5.30
RH63-1	1-lb. Spool, .031", 63/37	6.95	6.10	5.41
RH60-4	4.4-lb. Spool, .031", 60/40	24.00	21.90	17.92
RH60-TUBE	6-oz. Tube, .031", 60/40	.99	.89	.79

CCD Camera - IR Responsive

As Low As $85!!



This black and white monochrome CCD Camera is totally contained on a PCB (70mm x 46mm). The lens is the tallest component on the board (27mm high from the back of the PCB) and it works with light as low as 0.1 lux. It is IR Responsive for use in total darkness. It comes with six IR LED's on board. It connects to any standard monitor, AUX or video input on a VCR or through a video modulator to a TV. Works with a REGULATED 12V power supply (11V-13V). Hooks up by connectiong three wires: red to 12V, black to ground (power & video) and brown to video signal output.

Power Supply Regulating Kit for CA-H34

This simple kit is designed to fit onto the back of the CA-H34 CCD camera. It resolves the problem of hooking up the camera to an UNREGULATED supply (which damages the camera) by providing safe regulated power from any 12V-14V DC supply. It also provides regulated 12V DC from a 12V AC source.

CAT NO	DESCRIPTION	PRICE EACH 1	5
CA-H34A	PCB Mounted IRCCD Camera	$99.00	$85.00
A34	Power Supply Regulating Kit	$6.95	-----

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TZPC1003	**$49-**	**$44-**	**$42-**

One of our best selling converters featuring sleep timer, parental lock, last channel recall, favorite channel memory, and 80 channel capability.

TZPC175DG2	**$89-**	**$85-**	**$82-**

Our "Top of the line" converter with volume control. Featuring sleep timer standard/HRC switchable, parental lock, last channel recall, favorite channel memory, and 83 channel capable.

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FAX (810) 566-7253

PC-based Front Panel Access Computer

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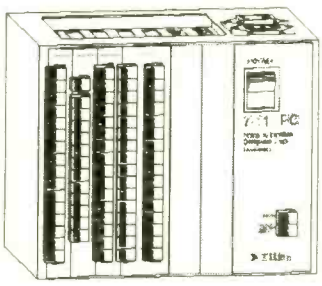

For Computer Telephony Server or Home Automation or Network Computer
Fanless, compact size
9.0"W 7.5"H 6.5"D

Handy PC **--- Field Computer** from $700
In between of Laptop & Desktop for the size,
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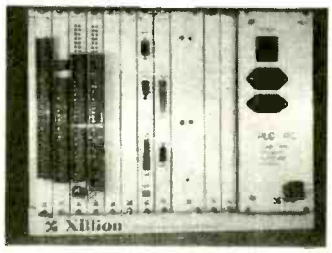
Easy to carry around, 10.5"W 11"H 6.5"D

PLC PC **--- Industrial Computer** from $900
Accessibility like PLC (Programmable Logic Controller)
Euro Bus and PCI Bus for higher reliability & better performance.
17"W 11"H 6.5"D



All above 3 models accept ISA or PCI interface cards, and proprietary front panel connecting cards: I/O, A/D, D/A, X-10, up to 10A/220V

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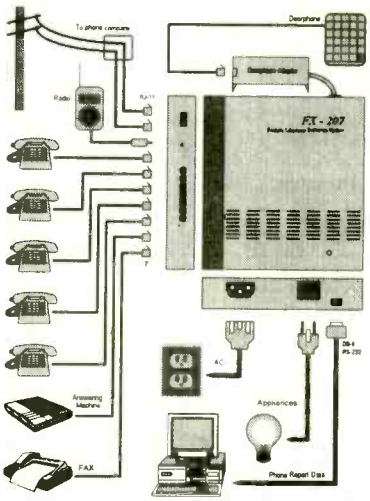

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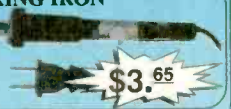

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2SD-1650	SANYO	5	0.99
STR-30130	SANKEN	1	2.66
TA-7777N	TOSHIBA	1	5.25
TDA-2005	SGS	5	1.49

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Features: • Wider than specified frequency response • High deflection factor of 1mV/div. • Wide dynamic range up to 30MHz without waveform distortion • Algebraic sum of CH1 and CH2 • Low drift with compensation circuit • Superb trigger sensitivity • Maximum sweep rate of video signals with internal TV sync. separator • Jittless trigger circuitry • CH1 signal output terminal available • Variable trigger hold-off • High precision X-Y phase difference measurement up to 50kHz • Built-in function generator with BNC output of 50Ω and TTL • Three kinds of waveform are available with 50Ω output • Flat output waveform frequency up to 1MHz

Specifications: Vertical deflection: • Bandwidth: DC coupled (DC to 20MHz normal), AC coupled: (10Hz to 20MHz normal) • Deflection factor: 5mV/div to 5V/div in 10 calibrated steps of 1-2-5 sequence • Rise time: 17,5ns or less

Horizontal deflection: • Time Base A: 0.2µs to 0.2S/div in 19 calibrated steps. 1-2-5 sequence • Uncalibrated continuous control between steps of at least 1: 2.5.

20 MHZ

Manuf # OS-9020G

$450.00

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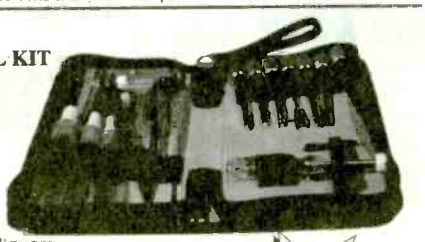

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- Cleans in one step, no rinsing required • Contains no ozone depleting compounds HCFC free • Not for use on energized equipment • CFC and

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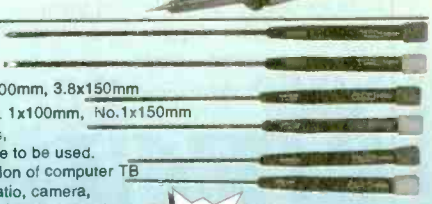

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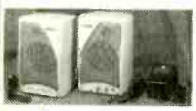

50 Watt Multimedia Speakers

Amplified speaker system features 50 watt max. power output, 80Hz-20KHz frequency response, 3" magnetically shielded full range speaker. Separate controls for power, volume and tone. Includes LED power indicator and front headphone jack. Includes cables and wall transformer. Size: 5-1/8" (D) x 4-1/2" (W) x 7" (H).

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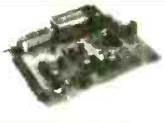

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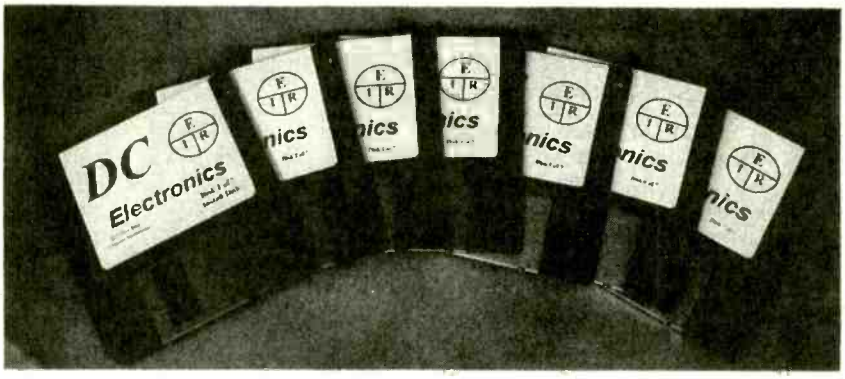

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9. Parallel Circuits
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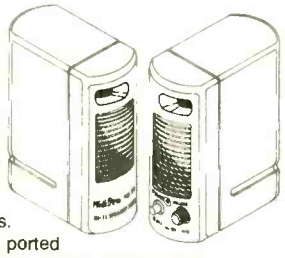

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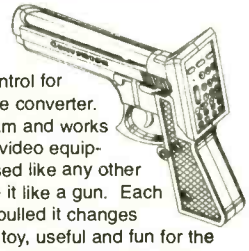

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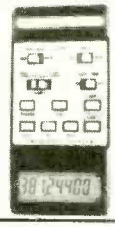

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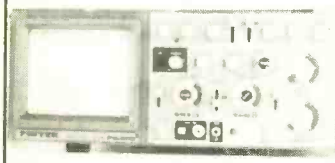

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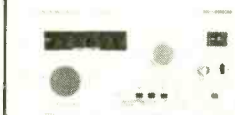

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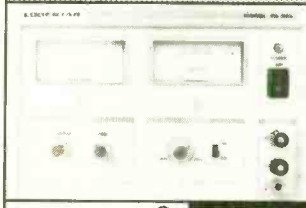

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- Dual CH/X-Y operation
- 1 mV/div sensitivity
- Z-axis input,CH1 output
- TV syn., trigger level lock
- 2 probes (x1, x10)

OS-305 ($209.95) - 5 MHz One Channel
OS-310 ($324.95) - 10 MHz One channel

DC POWER SUPPLIES

Triple Output

- 2 variable out 0-30V,0-3A
- One fixed 5V,3A output
- Auto track, serial, parallel
- Const. volt, current mode
- 4 analog or 2 digital display

PC-3030 ($499.95)
PC-3030D ($549.95)

Single Output

- Const voltage, current mod
- Voltage regulation ≤0.01%
- Current regulation ≤0.2%
- PS: 2 analog or 1 digital dis
- PR: 2 analog or 2 digital dis

Analog Meters Display

PS-1830 ($209.95) 18V/3A
PS-1850 ($219.95) 18V/5A

PS-3030 ($224.95) 30V/3A
PS-6010 ($209.95)60V/10A

PR-3060 ($314.95)30V/6A
PR-6030 ($314.95)60V/3A

Digital Meters Display

PS-1830D($219.95)18V/3A
PS-1850D($244.95)18V/5A
PS-3030D($254.95)30V/3A
PR-6030D($399.95)60V/3A

Programmable

- High stability, low drift
- One fixed 5V,3A output
- 100point program(PPS ser)
- 50point program(PPT ser.)
- Auto serial/parall.(PPT ser)
- Auto track (PPT series), IEEE-488.2 and SCPI compatible command set (optional)

PPS-1860G ($1,099.95)
PPS-3635G ($1,099.95)

PPS-6020G ($1,099.95)
PPT-1830G ($1,399.95)
PPT-3615G ($1,399.95)

FG-830 ($1,499.95) 30MHz Synthesized Function Gen.
- Output: sine, tri., square, sync out, arb. waveform
- 20mHz Freq. resolution
- Linear/log sweep
- Arbitrary modulation
- RS232; IEEE-488(option)

FUNCTION GENERATOR

FG-8015G($189.95)Sweep
- 0.02Hz-2Mhz,no counter
- Sine/Squ/Tri/pulse/Ramp

FG-8016G ($239.95)
- 0.02Hz-2MHz w/ counter
- Pulse, function generator

FG-8017G($249.95)Sweep
- Sine/Tri/Squ/TTL/CMOS
- 0.02Hz-2Mhz, FM mod.

FG-8019 ($399.95) Sweep
- 0.02Hz-2MHz w/counter
- INT/EXT AM/FM mod

FG-8019 ($209.95)
- 0.02Hz-2MHz w/counter

FG-8050 ($499.95) Sweep
- 0.05Hz-5MHz w/counter
- INT/EXT AM/FM mod

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DM-8034($179.95) 3½ dgt
- AC/DV(V,A),C,Ω,diode
- 1000V, 20A, 0.5% accu.

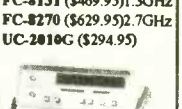
DM-8040($339.95) 3½ dgt
- ACV to 50kHz, true rms

DM-8055($649.95) 5½ dgt
- 0.006% basic accuracy
- 1uV,1mΩ,1nA resolution
- dBm,auto,REL, min/max

DM-8055G($889.95)GPIB
- Same funct. as DM-8055

Frequency Counters

FC-8131 ($469.95)1.3GHz
FC-8270 ($629.95)2.7GHz
UC-2010G ($294.95)



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(Patent No: 81011/81324)

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- **Pulse Generator**
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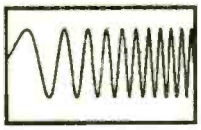
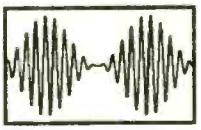
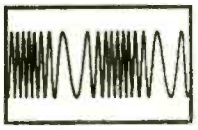


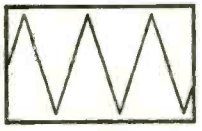
DC to 20 MHz linear and log sweeps



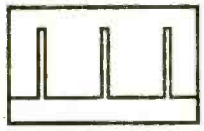
Int/Ext AM, SSB, Dualtone Gen.



Int/Ext FM, PM, BPSK, Burst

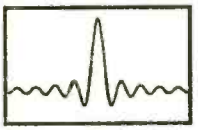


Ramps, Triangles, Exponentials

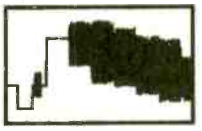


Pulse Generator

Noise



Arbitrary Waveforms



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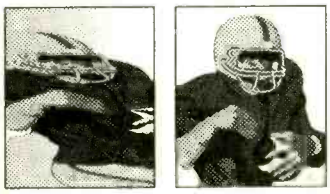

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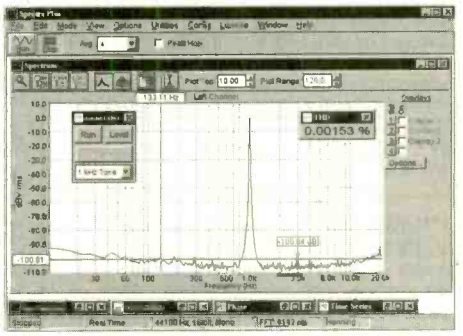

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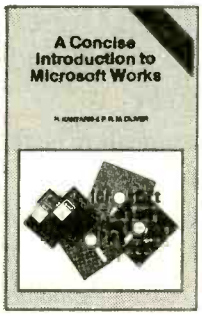

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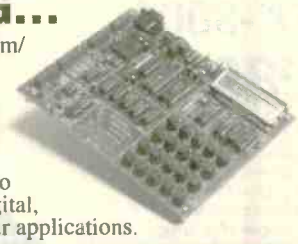

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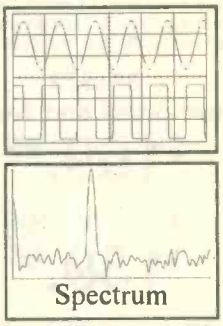

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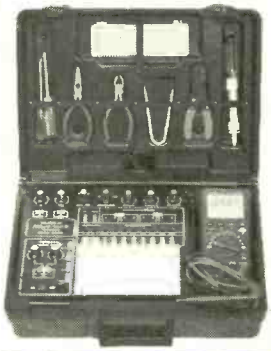

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- ST-2 - Long Nose Pliers
- ST-30 - Deluxe Wire Stripper
- SE-1 - Solder Ease Kit
- ND-3 - 3 pc. Nut Driver Set
- TL-8 - Precision Screw Drivers
- ST-5 - Screw Driver Slotted 3/16"
- ST-6 - Screw Driver #1 Phillips
- ET-10 - IC Puller
- SP-2 - Solder Pump
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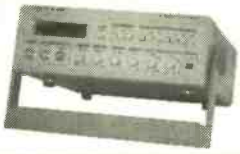

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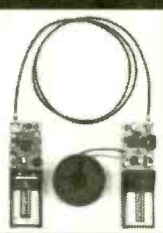

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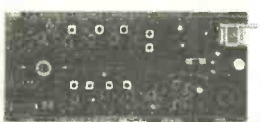
with training course



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- V mode-displays two signals unrelated in frequency
- Component tester

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- Z-axis input
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- V mode displays two signals unrelated in frequency
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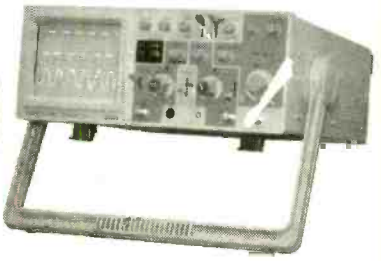

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DS-603 $1350
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S-1360 $749
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S-1330 $439
- 25MHz Analog
- Delayed Sweep

S-1325 $325
- 25MHz Analog

OSCILLOSCOPE SELECTION CHART

ANALOG

Model	Bandwidth MHz	Sensitivity (max)	No. of Channels	Sweep Rate Max ns/div	Delayed Sweep	Video Sync	Component Tester	Beam Find	Time Base
S-1360	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1345	40	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1340	40	1mV/div	2	10ns/div	No	Yes	No	No	1
S-1330	25	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1325	25	1mV/div	2	10ns/div	No	Yes	No	No	1

DIGITAL STORAGE

Model	Bandwidth MHz	Analog Sen (max)	No. of Channels	Sampling Rate	Memory Channel	Internally Backed Up	Pretrigger %	Output
DS-303	30	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232
DS-603	60	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232

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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 each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). 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 ads or multiple ads in the same issue, but, in all cases, full payment must accompany your order.

WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.75 per word. Minimum charge is $26.25 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a Box number you must include your permanent address and phone number for our files. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Sorry, no discounts on credit-card orders. Boldface (not available as all caps),** add .40 per word additional. **Entire ad in boldface,** add 20%. **Tint screen behind entire ad,** add 25%. **Tint screen plus all boldface ad,** add 45%. **Expanded type ad,** add $2.25 per word.

General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. POPULAR ELECTRONICS is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

CONTENT

All classified advertising in POPULAR ELECTRONICS is limited to electronics items only. All ads are subject to the publishers approval. WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.

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Send you ad payments to:
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100 – Antique Electronics	270 – Computer Equipment Wanted	450 – Ham Gear Wanted	630 – Repairs-Services
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160 – Business Opportunities	330 – Computer Software	510 – Miscellaneous Electronics Wanted	690 – Security
190 – Cable TV	360 – Education	540 – Music & Accessories	710 – Telephone
210 – CB-Scanners	390 – FAX	570 – Plans-Kits-Schematics	720 – Test Equipment

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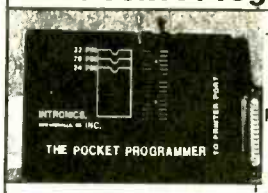

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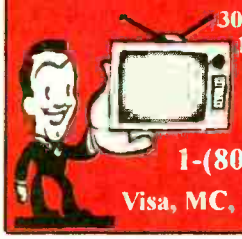

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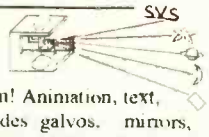

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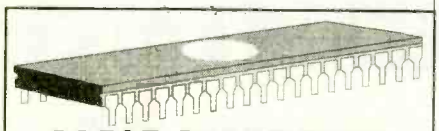

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Free Information Number		Page
—	Aegis Research, Canada	80
—	AES	101
26	Alfa Electronics	98
28	All Electronics	97
137	Allison Technology	101
—	Allstar Electronics	108
—	Amaze Electronics	84
—	American Innovations	107
—	Andromeda Research	89
—	Basic Electrical Supply	88
32	C&S Sales, Inc.	102
—	CD Electronics	82
—	Circuit Specialists	90
—	Cleveland Institute of Electronics	19
—	Command Productions	82
—	Comtrad Industries	11, 15
—	Consumertronics	78
48	Dalbani	93
—	DC Electronics	96
—	EDE Spy Outlet	109
148	Electronic Rainbow	81
—	Electronic Tech. Today	77, 100
—	EMAC	84
—	Foley-Belsaw	105
—	Forest Electronics	80
—	Fotronic Corporation	84
—	General Device Instruments	106
—	Greenleaf Electronics Inc.	86
—	Home Automation Systems	89
—	Information Unlimited	87
13	Interactive Image Technologies	CV2
—	Intronics, Inc.	106
—	Kableworks	92
—	KDE Electronics	86
149	MCM Electronics	85
—	Mega Electronics	94
150	Mendelson's	94
151	Mendelson's	89
174	Mental Automation	5
171	MicroCode Engineering	CV4
—	Millennium Enterprises	109
—	Mo-Tech Distributors	92
—	Modern Electronics	94
—	Mondo-tronics	94
—	NRI Schools	37
—	NS International	106
156	Parallax	CV3
146	Parts Express	83
—	Pioneer Hill Software	99
45	Prairie Digital Inc.	80
47	Print	86
46	Print	101
14	Radio Shack	3
—	School of Electronics	89
—	Silicon Valley Surplus	108
—	Sirius MicroSystems	88
—	Smithy Company	107
—	Tab Books	49, 79
—	Tech Services & Solutions	88
142	Telulex	99
—	Transtronics	109
136	UCANDO Videos	82
—	US Cyberlab	107
—	Vision Electronics	99
—	Visual Communications	108
172	Windjammer Barefoot Cruises	4
—	WPT Publications	89
134	Xandi Electronics	95
—	Xillion	92

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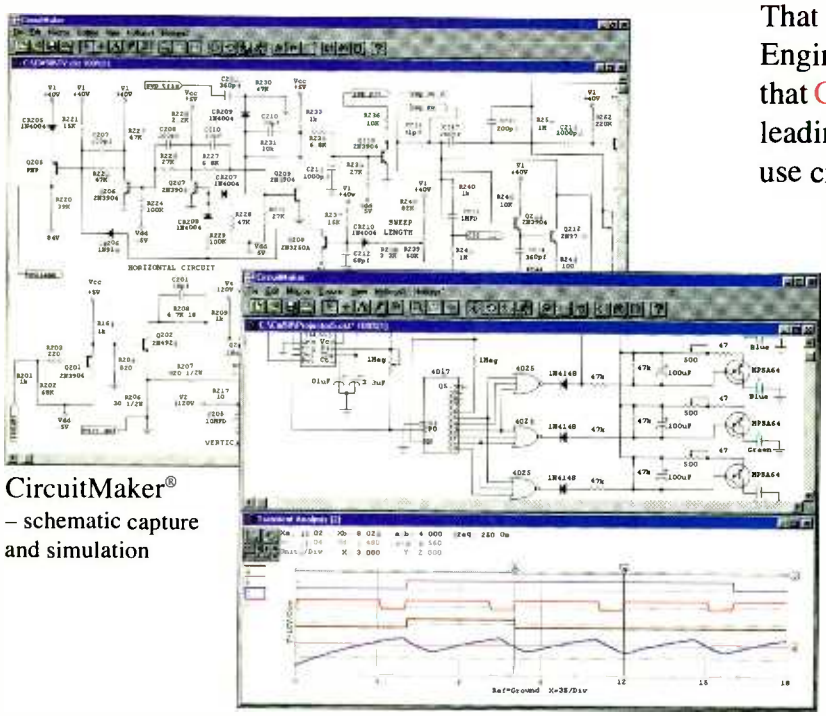

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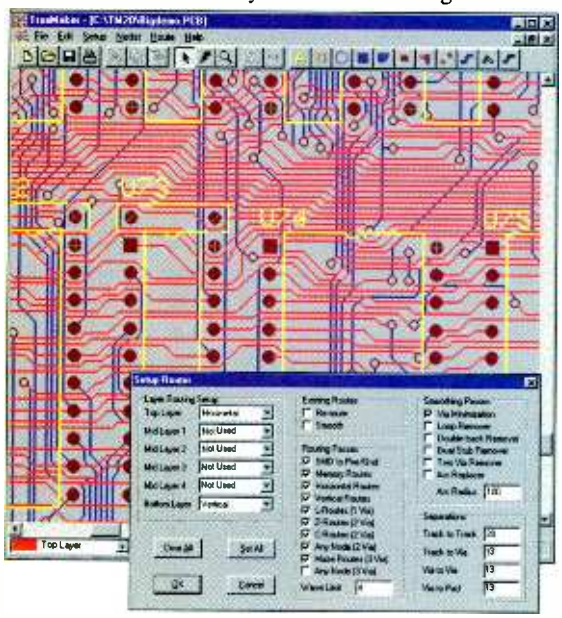

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