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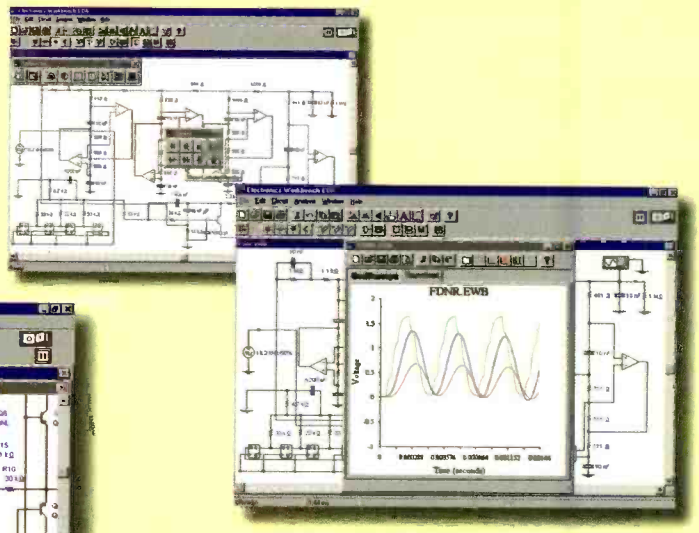

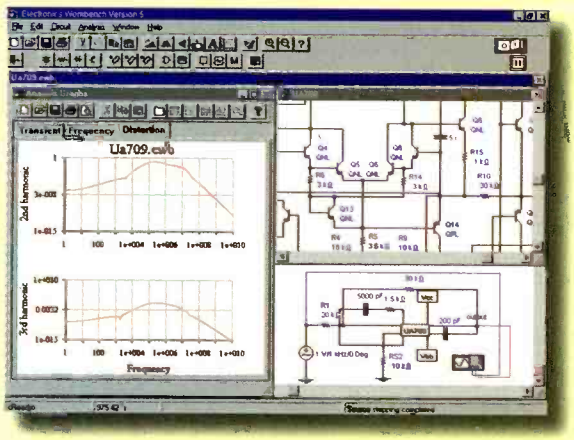

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CIRCLE 13 ON FREE INFORMATION CARD

Popular Electronics®

NOVEMBER 1997
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COVER STORY

CONSTRUCTION

FEATURES

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CIRCLE 14 ON FREE INFORMATION CARD

Editorial

Times Are A'Changin'

As we enter the Fall season we notice changes in the weather, declining daylight hours, and that the gentle lazy days of Summer are fading away. We now look forward to starting new projects, new classes, and meeting new friends. So it is with **Popular Electronics**. Those sharp-eyed readers will notice a new name at the bottom of this editorial column. That's my signature! That's my picture!

Since coming aboard earlier as an Associate Editor, I have been working closely with my mentor, and previous **Popular Electronics** editor, Julian Martin. Julian will be spending the greater part of his time as the "gatekeeper" of our Internet Web site: *www.gernsback.com*, and editing the online edition of Gernsback's venerable publication, *Poptronix*, (and, of course, be my Editorial Advisor).

What do I see in the future for **Popular Electronics**? Drawing upon my own long-term background in electrical engineering, and an even longer time with ham radio as well as being an avid hobbyist-builder, I will continue to guide the magazine into a blend of the latest technological and scientific developments, coupled with the excitement of hands-on project building and techniques. We are planning great construction articles and super features in issues to come, and are committed to bringing you the best of them every month.

Let's try to bring back the excitement of constructing your own project, of first turning it on and, hopefully, achieving the realization that what you built—works! Even if you are the proverbial appliance operator or "couch potato," not knowing which end of the soldering iron you should pick up, or which way to point the remote control, we at **Popular Electronics** will at least attempt to give you an understanding or working knowledge of the latest in the new technologies.

In future issues you may notice subtle changes in the magazine, some of which you may like and, some you may not. But let us know what *you* think—we can be reached by mail, telephone, Fax, and e-mail (sorry you can't get our beeper numbers!). Stop by our Web site, look for new features, get down-loadable software, join our electronics forum, or simply catch up on the latest news in electronics from the editorial departments as well as our reader community.

There was magic to electronics, and there still is!

Ed Whitman
Managing Editor

LETTERS

GOODBYE BBS, HELLO FTP

We have received numerous letters from readers asking why they have been unable to contact our BBS. The Gernsback BBS officially closed on May 1, 1997. Most of its functions have been transferred to our Web site home page: www.gernsback.com *and ftp site:* ftp.gernsback.com *on the Internet. All article-related software files formerly on the BBS as well as all the new files can be found on the ftp site.*

To find the software files for **Popular Electronics**, *bring up the Web site:* http://www.gernsback.com *home page. (Got a problem at this point—see note at end). By the big "Navigation Knob" pointer in the upper right-hand corner of the screen, click on the* **Popular Electronics** *logo and then the DOWNLOADS link. This will connect you to* ftp://ftp.gernsback.com/pub. *Then click on the PE link to view all the current files, their sizes and dates. These article-related software files can now be easily downloaded. If you look at !readme!.txt, you can also get further descriptions on the files in terms of the related construction article and issue.*

(Note: With some Internet servers, a black screen may appear after entering our Web site. At the conclusion of the initial site connections, look for the words on the bottom of the screen "advance the projector". Click on this entry and then on the links to get to our home page. Let us know what technique works best for you!)—Editor

DX NOSTALGIA

I read with great interest the *DX Listening* column in the July issue describing the Hallicrafters S-41W(G) receivers. I can quite directly relate to your nostalgic comments. I also grew up during the 1940s and was an avid DX listener. I built a two-tube regenerative receiver (it even seems that the design came from **Popular Electronics**) at the age of ten. Strangely enough, it worked the first time I turned it on. My projects today should do so well.

Our family receiver was a General Electric table model. If memory serves me correctly, it had eight or nine tubes and was AC powered. Band selection was via a set of pushbuttons on the top of the cabinet. The cabinet was beautifully finished wood. There was no back cover, making it very tempting for a curious young boy to peek in.

The receiver had no BFO, so code transmissions came as a series of thumps. Nonetheless, I still learned to copy those thumps well enough to eavesdrop on CW transmissions. Who could have guessed that this "cast

iron" knowledge of the code would lead many years later to an amateur radio license?

Thank you for bringing back fond memories of a time when everything was simpler, less complicated and more exciting. Sometimes it seems that the challenge is gone with today's technological advances.

G.E.
Branson, MO

CALLING ALL FISH

I have a schematic for a sonic fish caller. I think it could help with my fishing. It asks for a waterproofed speaker. Is there a way to waterproof a speaker so that it will last? If so, what kind of speaker? I was considering a subwoofer so it will cover quite a distance. Thanks in advance for any help.

K.M.
via e-mail

You don't need much sound to catch a fish. Any 2- to 3-inch speaker will do. Even an old ear piece from a cheap headset or an old PC speaker will be fine. Put the speaker in a plastic bag, get most of the air out of the bag, and seal it so it is watertight. The sound from such devices are high-frequency chirps that simulate an insect in distress. No need for a woofer here.—Editor

HAVES & NEEDS

Thank you for printing my request for documentation for the Eico oscilloscope. The response from **Popular Electronics** readers has been without equal. I have been overwhelmed with offers and copies of the documentation. Thanks to all who responded.

John Howell
141 Leonard Lane
Midwest City, OK 73110

I have on my bench an Eico model 565 multimeter, which has a bottom rotary switch that has one set of contacts burned off. Can any of your readers tell me where I can get a replacement switch?

In another vein, I have an old copy of *Mallory Radio Service Encyclopedia, 5th Edition*, which I would be glad to send to any "Antique Buff" who might like it for the cost of postage.

Robert A Bicknell
P.O. Box 231
Cobble Hill, BC
V0R 1L0 Canada

I am in need of a schematic for a Rangaire intercom system installed in the 1961 split-level home that my husband and I recently bought. The system, which consists of the main control board with an AM/FM radio and clock and six speakers (five of which are two-way), doesn't work. After many phone calls, I finally found someone willing to come look at it. He ordered a couple of RCA tubes to see if that would work, but warned me that it might not fix the system.

Any ideas on where I could find a schematic? I'm willing to pay for it if necessary. The system was made by Roberts Manufacturing Company in Cleburne, Texas. The manufacturing code is 120-1, the serial number is 35929, and the model number is WR-770. Thanks for your help.

Sheila Myers
4505 West 82nd Street
Prairie Village, KS 66208

I'm desperate for help. I have put off writing to you for more than a month now, confident that my skills would overcome this problem. I was wrong.

I am looking for a parts reference for a Lowery organ. The part in question is a 14-pin (to 116) IC designated 991-018813-001 or -002. It might have been made by Motorola in the early 1970s. I have searched through all the parts-reference manuals and guidebooks that I could get my hands on, but I came up empty. I'd appreciate any help.

Alex @ Q-TECH
78 Chartier
St-Sauveur, Quebec
J0R 1R4 Canada

I need a manual for Heathkit Model 1044 Battery Charger, or, at least, a circuit description and schematic with X-ray view. Call collect: 787-842-0019 or write to the address below. Thanks.

Ed Ortiz
582 Rambla
Ponce, P.R. 00731

Can anyone suggest where I may purchase the infrared diode and receiver combinations, such as are used in TVs, VHS, or other home appliances? They seem to easily function at considerable distances, which is what I'm trying to do. Thanks for your help.

Anthony Pozzuoli
50 Martindale Road
Clifton, NJ 07013

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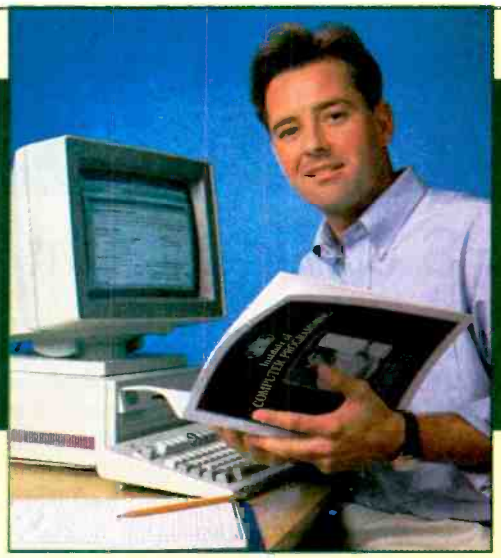

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GPS Navigation at Its Best

Marc Spiwak
Associate Technical Editor
Computer Reseller News

I recently went for a ride in a really cool car. Actually the car was nothing unique, but its voice-prompted Global Positioning System (GPS), or global positional satellite navigation system, was fantastic! The car was fitted with Alpine's new auto navigation system that combines GPS positioning, dead reckoning (using a speed pulse from the vehicle), and built-in piezoelectric gyro sensors for angular velocity to make the system virtually foolproof—to both itself and the driver. The basic system is available from any authorized Alpine dealer for just under $2,000. Alpine insists that the system be installed only by qualified personnel.

Alpine's CVA-1000 in-dash monitor/ receiver combines an Alpine stereo system with an accurate satellite navigation system.

First you need Alpine's *NVA-N751A* navigation system, which has a suggested retail price of $1499. That unit includes a trunk-mounted CD-ROM drive, GPS receiver, and wireless remote control. Then you need either their basic $500 model *TME-M006SA* dedicated 5.6-inch color LCD monitor or the $1300 model *CVA-1000* in-dash system control monitor/receiver. So, for $1999 you get the basic navigation system, and for $2799 you get their really cool in-dash unit that rolls an Alpine stereo system into the package. The combo system has some neat features—including automatic muting of the stereo and others that just wouldn't be possible when integrating the navigation system with existing audio systems.

The Alpine all-in-one system is gadgetry at its best, with a color LCD monitor/stereo receiver that slides in and out of the standard stereo opening in the dashboard. The theft deterrent screen folds down horizontally before sliding into the dashboard and out of sight. The movement of the unit in and out of the dashboard reminds me of the movie *Robocop!*

The proprietary Alpine system is CD-ROM-based with a trunk-mounted disc player. You get one disc included with the navigation system, and you'll need the CD-ROM that covers the part of the country you're interested in. Right now there are six different discs available, with a combined coverage of nearly half of the United States. Each disc contains basic travel information for large areas, including multiple states and detailed information for the major cities contained in those areas. CD-ROMs for the rest of the country are on the way. Additional maps cost $150.

GETTING THERE

Alpine set out to make the navigation system as easy to use as possible. After activating the system with a handheld remote, the screen pops out of the dash and goes through an automatic initialization process. Preferences such as take the shortest route, take the quickest route, avoid expressways, and more can all be set by the user. Next you enter a destination through a series of pop-up menus. Your destination can be a place, a town, an address, an intersection, a gas station, the nearest ATM machine that accepts your particular cash card, and so on. Even the closest Italian restaurant can be found!

Once you start driving, the system displays a series of maps, roads, and pointers, along with a voice prompt that says things like "in a quarter mile, make a slight right turn on 40S South," "make a sharp left here," "get off at the next exit, 33 East," "destination ahead on left," and so on. Only the roads immediately surrounding you are displayed on the screen, with pointers indicating the path you should take.

The system really works, because it directed me and the folks from Alpine to the exact place we specified, indicating all the turns to make along the way. It does have some minor quirks, though. For example, on the way back I asked the system to take us back to my work address. The CD-ROM map knew nothing about the left turn that would take us into my building's parking lot. Instead it took us up to a light and through a congested, construction-filled loop under the Long Island Expressway and back to the building where we could make a right turn into the lot—essentially we made one big U-turn.

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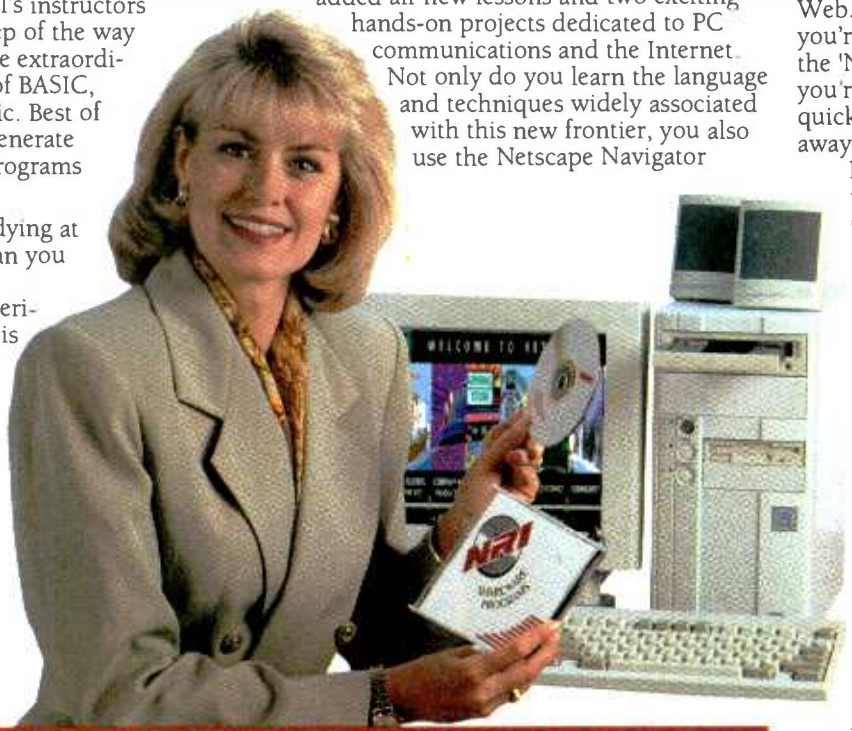

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That's not a big deal though, because I wouldn't even use the system when traveling on familiar roads. But I'd certainly like to have it when traveling through unfamiliar territory. Alpine's system is not cheap, and even though I can't afford one right now, I'm glad that emergency personnel and even servicemen and delivery people can quickly get to my address. I'm sure this stuff will become very popular in the next few years. But it seems as though Alpine has the jump on a lot of the competition today.

THE TOP OF TURTLE BEACH

I've been playing with a sound card that's clearly intended for the audio enthusiast, and not necessarily for the avid game player. I'm talking about Turtle Beach's new high-end sound card, the *MultiSound Pinnacle*. It combines Windows 95 Plug and Play capabilities with very high quality sound. Its signal to noise ratio is greater than 97 dB, total harmonic distortion less than 0.005%, and a flat frequency response from 10 Hz to 22 kHz. The card can accept up to 48 MB of sample RAM, a 4 MB patch set, and a WaveBlaster connector. Hardware wavetable synthesis is provided by a Kurzweil synthesizer engine. I've also got the optional daughtercard with the S/PDIF

Turtle Beach's MultiSound Pinnacle combines Windows 95 Plug and Play capabilities with very high quality sound. It's just what you need for MIDI sequencing and direct-to-disk digital audio recording.

digital I/O connector for linking to DATs, digital mixers, Mini-Discs, DCC, and other digital equipment.

Bundled with the card is Voyetra's Digital Orchestrator Plus SE MIDI/digital audio sequencer software. This lets me record and play digital audio tracks which can be sequenced with MIDI tracks. The card does sound fantastic, with MIDI-sound that's hard to equal. But it's a lot more sound card than I need. With its price of $549 that includes the digital I/O option, the Pinnacle is clearly aimed at the professional, semi-professional, and audiophile markets—and is perfect for MIDI sequencing and direct-to-disk digital audio recording.

NEW SOFTWARE

One of my favorite driving games just got better. *Need For Speed II* from Electronic Arts is here, with new graphics, more detail, new cars, new tracks, new features, and a lot more. In my opinion, driving games have always offered some of the most realistic simulations possible on a PC, and *Need For Speed II* is no exception. This Windows 95 game puts you right in the driver's seat of some of the world's most exotic cars and hands you the keys. If you drive an old clunker to work, you'll really appreciate having the world's finest sports cars available to you in virtual reality. Drive away with this game for only $54.95.

People who like driving games should also take a ride on *Screamer2* from Virgin Interactive Entertainment. It's a sequel to the best-selling game, Screamer. *Screamer2* lets you fly down twisting, turning tracks from icy glacial death traps to treacherous mountain courses and blazing deserts. You feel every inch of road in your customized super-fast high-performance car. The game features six winding tracks with varying levels of difficulty, terrain, and driving conditions. You can take a ride on *Screamer2* for around $20.

Grand Slam is a new, very realistic baseball game for Windows 95 from Virgin Interactive. The disc tracks full stats for 868 players and prospects over the entire season. Pitching and

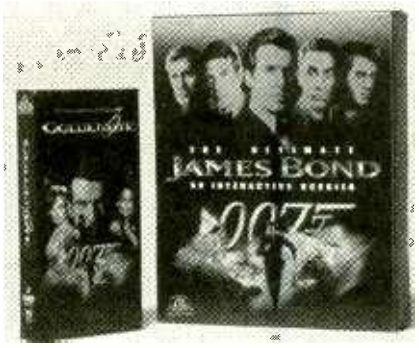
batting meter mechanics offer better control while pitching and batting. The players are video-captured baseball players—real baseball players that were video digitized for the utmost in realism. The 28 stadiums are realistic 3-D ballparks rendered in real-time to allow the camera to be placed in unlimited camera angles. It also contains CD-quality music, real baseball sound effects, and over 2500 play-by-play commentaries. This game really lets you bring the ball game home for only $45.99.

I've been putting Merriam-Webster's *Collegiate Dictionary, Deluxe Electronic Edition on CD-ROM* to good use at work. This valuable reference on CD-ROM contains more than 214,000 definitions; 130,000 synonyms, antonyms, related words and contrasting words, and idiomatic expressions; and over 1,000 illustrations, plus a wealth of other information about language. A sophisticated search engine finds the word you want quickly and easily. This one is well worth its price of $49.95.

The ultimate battle between the Empire and the Rebel Alliance is now being fought with the release of the first Star Wars network game, *X-Wing vs. TIE Fighter.* This multiplayer space combat game from LucasArts Entertainment Company can be configured in single player mode or multiplayer, which allows up to eight players to team up as a squadron or compete against each other using modems or a local area network. The game offers a choice of more than 50 original missions set in familiar Star Wars environments. You can enlist in this space trek for $42.95.

I've always been a fan of James Bond movies, so I really like *The Ultimate James Bond: An Interactive Dossier* from MGM Interactive. This interactive dossier is full of James Bond trivia, and lots more. The two-disc set features video montages for each of the seventeen Bond films plus five new montages capturing the best of Bond. Also included is The Ultimate Bond Trivia Game, news clips, original film credits and posters, plus 55 minutes of video clips, 22 minutes of audio clips, and 1800 still photographs. The game includes a free copy of *GoldenEye* on VHS tape, all for $39.95.

Humongous Entertainment sent me a bunch of new children's titles. In *Putt-Putt Saves The Zoo,* Putt-Putt and his dog Pep help the zoo keeper get ready for the zoo's grand opening. Freddi Fish also makes a return performance in *Freddi Fish 2: The Case of the Haunted Schoolhouse.* Putt-Putt and Freddi Fish are joined by Pajama Sam in *No Need to Hide When It's Dark Outside.* Pajama Sam, the world's youngest superhero, has his superhero gear stolen and scattered. Kids help Pajama Sam recover his gear and find his way. In *Putt-Putt Travels Through Time,* a time machine goes haywire and Putt-Putt's pal Pep and school supplies are lost somewhere in time. Kids help Putt-Putt discover dinosaurs, the medieval times, the old west and the future in search of Pep and the lost items. Puzzles, games and activities throughout all of these games deliver hours of fun. Intended for kids ages three through eight—the Humongous titles are available for $39.95 each.



The Ultimate James Bond: An Interactive Dossier is full of trivia, video montages for each of the seventeen Bond films, news clips, original film credits and posters, and more. You even get a free copy of GoldenEye on VHS tape.

And to round out our review of new software, *Garden Encyclopedia 3.0* from Books That Work offers an extensive photo collection of plants that forms a virtual nursery on your PC. A search capability lets you quickly find plants using either their common or botanical names, or look for particular attributes, such as flower color, climate zone, bloom season, or sun requirements. You're also shown how to take care of the plants you select. There are instructions on selection, planting, and propagation techniques. You can also consult pest and disease control information to keep your plants healthy. Multimedia features include pronunciations of botanical names and instructional videos that show you important plant care tips. Garden Encyclopedia 3.0 sells for around $30.00. ■

New computerized micro-technology regulator...a TV advertiser's nightmare!

Advanced circuitry regulates volume levels during commercials, scene changes and "channel surfing."

by Erika Vanderbilt

Why do television commercials have to be so much louder than the shows? My husband works the night shift and when he's trying to sleep, the house has to be relatively quiet. So when I'm watching TV, I must constantly turn down the volume during commercials and action scenes and then turn it back up when the actors are speaking to each other. It's a real hassle, and changing channels adds a whole new dimension to the problem.

Recently a friend told me about the TV Sound Regulator, a television accessory that is so sophisticated, it actually understands the difference between a whisper and a shout and automatically adjusts your TV's volume accordingly. While controlling volume fluctuation, the TV Sound Regulator maintains the quality of each and every sound. It's the perfect solution to my problem!

Compact and component-compatible. The TV Sound Regulator is a technological state-of-the-art computerized unit that was developed after years of research. The unit is so universal it can be used in conjunction with your VCR, cable box, satellite dish or surround-sound system. It can even work with all four of these systems simultaneously! And the TV Sound Regulator's compact size—small enough to fit in the palm of your hand—keeps it out of sight among your other audio/visual equipment.

Adjusts sound levels instantly. The sound level on your TV can change in a split-second—whether it is due to the beginning of a commercial break or a scene change during regular programming. This unpredictability is a special problem during "channel surfing."

Just as quickly as the volume changes, the TV Sound Regulator will take effect, instantly increasing or decreasing the sound output to whatever level you have chosen. No more scrambling for your remote in a deafening scene-change increase or missing important dialogue in a decrease. And during TV commercials, when the sound would normally rise to an annoying level, the TV Sound Regulator unit adjusts in milliseconds, keeping the volume at just the level you want. Plus, the TV Sound Regulator doesn't alter the nuances found in the sound variations of whispers or shouts.

Easy to install, easy to use. Anyone can install the TV Sound Regulator unit. Simply plug it into the back of your TV set and that's all there is to it. Once you have installed the TV Sound Regulator, just preset the sound level you are most comfortable with by adjusting the volume control button up or down—that's it! The TV Sound Regulator takes it from there. Once you have selected your desired sound level, you don't have to adjust it again. Even after the TV has been turned off, the TV Sound Regulator will "remember" your customized setting. Should you ever want to change your preset sound level, just raise or lower the volume on the remote and the TV Sound Regulator will adjust itself to the new level.

Try it risk-free. With the TV Sound Regulator, you'll never be irritated by volume fluctuations again. Try it yourself! You'll wonder how you ever did without it. Remember, it comes with Comtrad's exclusive risk-free home trial as well as a one-year manufacturer's limited warranty. If you're not satisfied for any reason, simply return it within 90 days for a full "No Questions Asked" refund.

TV Sound Regulator . . . . . $49.95 $6 S&H
Buy two or more . . . . .$44.95 each $6 S&H

Please mention promotional code **2602-11428.**

For fastest service, call toll-free 24 hours a day

800-992-2966

comtrad industries
2820 Waterford Lake Dr., Suite 102
Midlothian, Virginia 23113

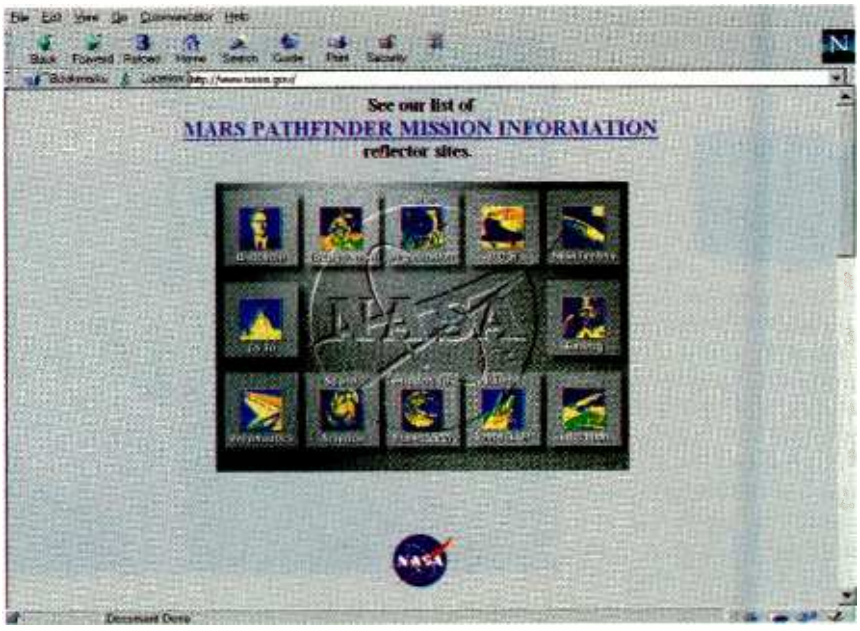
NET WATCH

Are We Alone?

DAN KARAGIANNIS

At the time of this writing, America has gone alien crazy! With NASA's Pathfinder landing on Mars to search for more evidence of life, and the 50th anniversary of the alleged UFO crash at Roswell, New Mexico, people everywhere are looking to the skies and asking the question, "Are we alone?" Then they're turning on their computers, logging on to the Internet, and hoping to get a better answer to that question than the silent night could offer.

Whether the fever is still active by the time you read these words remains to be seen, but regardless, prepare to join us for a look at what the Net has to offer in the realms of life on other worlds. Ranging from scientific to silly and provable to skeptical, these sites all have one thing in common: They show us mankind's fascination with the possibility that life on Earth is not an accident in our universe. Deep down, most of us are captivated by the idea that somewhere out there, somewhere as far as the furthest galaxies that are 15-billion light years away or as close as our red celestial neighbor, other beings are looking up and pondering their place in the universe as well.



If any organization will encounter life in the universe firsthand, it'll be NASA. Visit its home site for megabytes of images and information files on the current state of space exploration

NASA

Since electronics is a scientific field, it only seemed fitting to start our exploration this month with one of the most scientific of sites. Receiving more than 20-million hits a day at the time of this writing, NASA's site has surpassed the traffic of just about every decent and indecent spot on the Web.

That increased traffic is from the Mars Pathfinder Mission, which is why at the top of the NASA page there is a link to Pathfinder mirror sites. When you select one of these, you're brought to the Pathfinder Mission Page, which displays current images and findings from the red planet. They still haven't found any life there, and any data accumulated will be considered old news by the time you read this. However, we can comment on what type of Mars information is available and will still be available.

First you'll have to get used to the way NASA numbers days on the mission. Day one (July 4, 1997) is Sol 1, and they go up from there. There are images and important findings from each day indexed for easy access. Don't miss the 3-D "stereo monster panorama" located under the Sol 8 (July 11, 1997) Images. With red/blue 3-D glasses the rocks and Martian landscape will pop right out at you. NASA has broken the panorama into sections because of its total large size, but each looks great.

Movies and animations abound as well, and most do not require you to download any plug-ins to view them. Sunset on Mars is a short simulation of what its title implies. The live video feed available in NASA Select TV lets you view frames every couple of seconds from NASA's own proprietary channel. It's neat watching the types of content on this "channel" change. We've caught everything from images from space to announcements of lectures! You should also check out the Mars Pathfinder Virtual Reality Complete Guide, which is virtual-reality-like video at its best.

Current Science Results gives you the scoop on NASA's latest deductions obtained from the mission, and Current Weather Conditions lets you know what it's like outside when the little Pathfinder robot goes roaming.

The archive of images is a must-see item as well. Who knows, but by the time you hold this magazine in your hands there could even be pictures of a newly discovered single-cell form of life! I find it hard to believe any green space men will come out in the exposures, though.

The rest of NASA's site has a bunch of great links to explore as well. Though I've covered astronomy on the Web before, I can't reiterate enough how fascinating the Hubble Space Telescope Images are to see at a high- or true-color setting on your computer. The Gallery has video and audio clips, as well as even more still images for the downloading.

If anyone comes across life on other worlds firsthand, it will be

NASA. But when it comes to encountering life through a signal...well, who knows!

SETI INSTITUTE

This next site is the home for "scientific research in the general field of Life in the Universe with an emphasis on the Search for Extraterrestrial Intelligence (SETI)." In other words, the SETI Institute's goal is to answer the question: "Are we alone in the Universe?"

The Institute is a non-profit research organization with more than two dozen projects. Funding for these projects comes from government agencies, private foundations, and individual donors. The world's most comprehensive and sensitive SETI program, Project Phoenix, is funded entirely by private donations. And details about every one of these projects is available online.

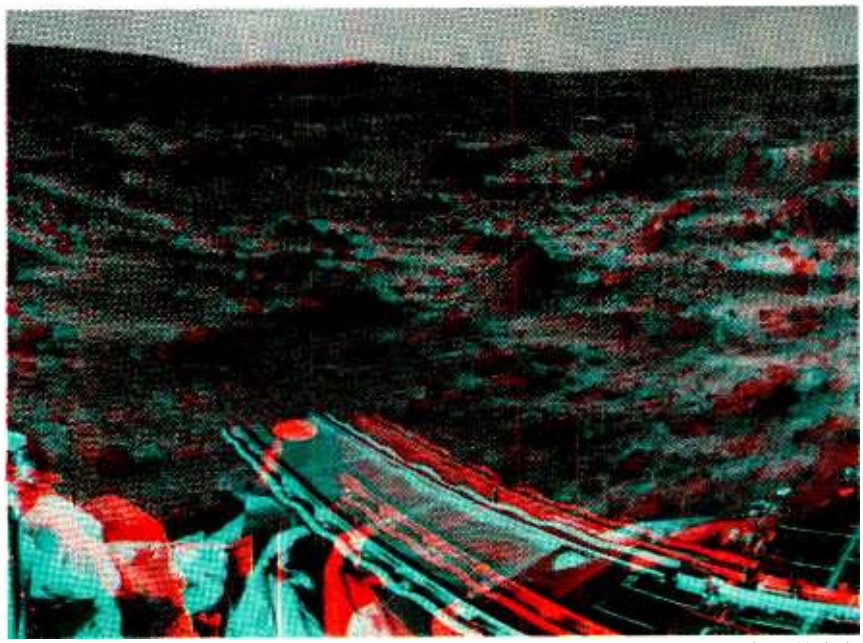
While here you can learn more about the SETI Institute and get some SETI Information. For example, did you know that the Institute began as a NASA program? It only lasted a year, though, because of Congressional pressure (that is, it was costing too much).

The search now continues, however, in Project Phoenix, which uses the largest available radio telescopes (45 to 300 meters) to provide continuous spectrum coverage over a wide range of frequencies, from 1,000 through 3,000 MHz. These telescopes use real-time data processing in an attempt to immediately verify candidate signals. If something is found, it will be posted at this site, though every newspaper and news show will probably broadcast it to the world long before. SETI hasn't "heard" anything coming from space yet. You'll learn all this and more at the Education Dept., and will find out what you can do in the How You Can Help link. There's even a Glossary in the FAQ section, just in case you're relatively new to all of this "out-of-this-world" stuff.

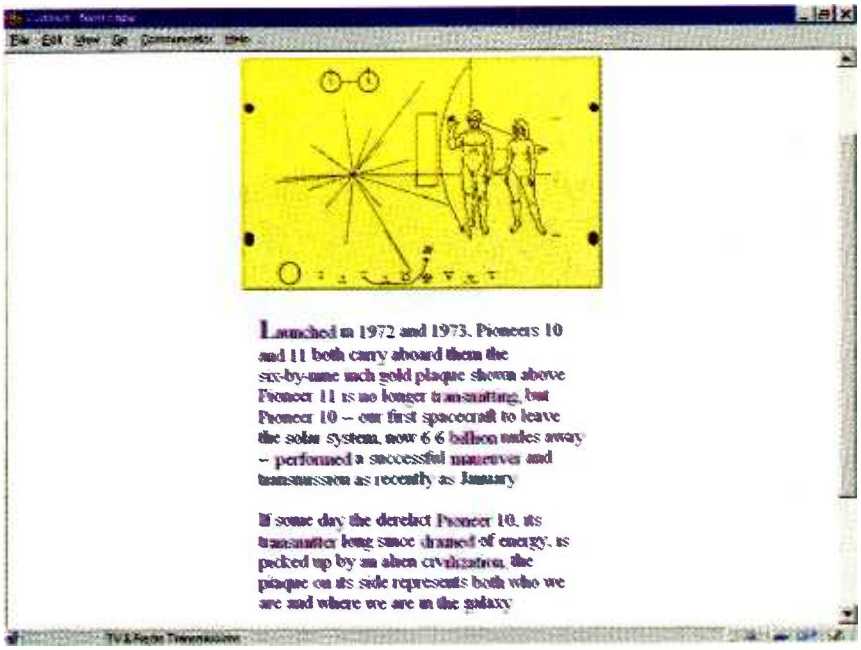
Another interesting feature about this site is that it embraces popular culture and openly expresses how SETI was involved in consultation to make the hit movie *Contact*. And as we'll see, the Web has become a place for promotional movie sites to give more than just hype to the public.

THE MOVIES

As usual, whenever there's a "craze" in the air, Hollywood has a movie or two ready to release to the hungry public. This summer, it was *Contact* and *Men in Black*. While the former was serious and the latter meant to be slapstick, both films spawned Web sites with actual "alien" content.



When viewed onscreen with red/blue 3-D glasses, this and other "stereo" images from NASA's Pathfinder site will pop right out of the screen at you.



This famous Pioneer Plaque which is now 6.6 billion miles away in space is only one of the great images at the Contact movie site.

When you first log onto the Contact The Movie site, you get a blank screen and hear the famous bleeping tones that signal the aliens' attempt to broadcast plans for a spacecraft. Then, you're allowed to access a page that's 75 percent movie information, interviews, and images, and 25 percent scientific information, which is presented in a far more visually pleasing form than at the SETI site. Of particular interest is the wonderful explanation of the Drake Equation, which is the driving force behind SETI. Learn how scientists have deduced that there must be life in the universe, and have each component of this long equation finally make sense.

There's also information on the

(Continued on page 22)

PRODUCT TEST REPORT

Panasonic DVD-A300U Digital Versatile Disc Player

STEPHEN A. BOOTH

This is the first lab-test report of a Digital Versatile Disc (DVD) player to appear in **Popular Electronics**. Lots of subjective appraisals have appeared in a variety of publications. But players of this new format—which compresses entire movies on a CD-size disc—have seldom been examined through the objective lens of the test bench. There's a valid reason for this, and we'll explain why below. It will also explain why this report departs from our usual format. Meanwhile, some background information on DVD, in case you've missed all the hype.

The Panasonic DVD-A300U DVD player.

Unlike 12-inch video laserdiscs, which store images in analog format along with a digital soundtrack, DVD is all digital. The carrier is an optical disc, the same size as a Compact Disc (CD), but capable of compression levels that yield a capacity from 7–to 27–times greater than the roughly 650-megabyte limit of music CDs or computer CD-ROMs. The compression method is MPEG-2, the same method that makes it possible for direct-broadcast satellite (DBS) TV systems, such as DSS and Echostar, to cram so many high-resolution video channels down to a TV-set-top box.

DVD and DBS video have about the same horizontal resolution, some 480 lines, that just about any relatively new TV monitor can display. This compares to about 425 lines for laserdisc, 330 for a live NTSC broadcast and 240 for VHS videotape. As for vertical resolution, DVD (like DBS) is converted in the player from progressive- to interlaced-scanning for display on NTSC monitors (or PAL/SECAM where appropriate).

Like the laserdisc, DVD can carry all manner of supplemental information about the program and is capable of various special effects including freeze-frame, slow-motion, random access to indexed "chapters" and more. It shares with laserdisc the new Dolby Digital AC-3 surround, by which the soundtrack is output as six discrete channels, including a subwoofer channel. For less elaborate home theater systems, DVD also carries analog Dolby Pro Logic surround—whose four channels are matrixed on the digital stereo soundtrack.

Where DVD departs laserdisc audio is in the number of soundtracks it can hold—up to eight in different languages, and as many subtitles for translation. In practice, though, discs now sold in the U.S. usually carry only English, French and Spanish dialogue and subtitles. It can be different elsewhere in the world. We'll explain why shortly.

The new format is called Digital "Versatile" Disc for good reason. In its current manifestation, it is DVD "video" for pre-recorded movies. Eventually, there will be DVD-Audio, an improvement on CDs by virtue of higher-resolution sampling rates and discrete (rather than multiplexed) multichannel recording. Someday, too, recordable DVD will emerge (DVD-RAM, for Random Access Memory)—as soon as copyright-protection issues are resolved. By the time you read this, the first personal computers with DVD-ROM drives will have appeared—the MPEG-compressed equivalent of today's CD-ROMs. Here's where DVD's roughly 5– to 18–gigabyte capacity can really be exploited.

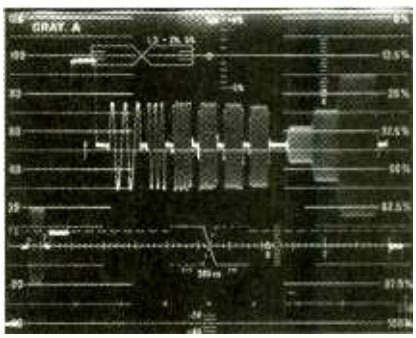


Fig. 1. Sin^2 Pulse and Bar measurements show little overshoot or undershoot in handling the relative timing of chrominance and luminance components.

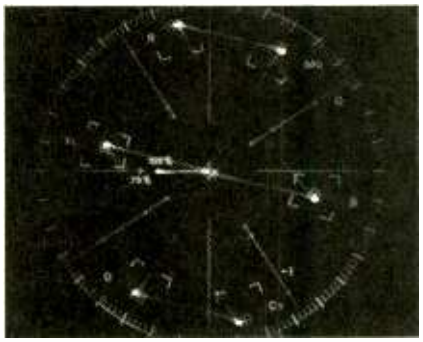


Fig. 2. Color Purity measurements show that every color is right on the mark—there is no phase shift and no under- or oversaturation.

Generically, the DVD format can be single-sided or dual-sided—and dual-layered on either side. The latter feat would be accomplished by a laser pick-up in the player that's is instructed (by coding on the disc) to shift its focus through the topmost layer of bits and bumps (with two-way mirror type reflectivity) to a subterranean level with sufficient reflectivity to bounce the ones and zeroes back. At this writing, for movie DVD players, there are dual-sided and dual-layered discs—but no dual-sided,

TABLE—PANASONIC A300U—TEST RESULTS

Brand: Panasonic
Model: A300U Digital Versatile Disc Player
Price: $649

Features

Multifunction universal remote control
DVD video player (MPEG-2)
Music CD player
Dolby AC-3 digital surround decoder (6 channels)
Video/karaoke CD player (MPEG-1)
Front panel microphone input (for karaoke)
Component- and S-Video outputs
Front panel headphone jack

All electrical measurements were performed by the Advanced Product Evaluation Laboratory, using the Sony HLX-4001 test disc for DVD video performance and the CBS CD-1 standard test disc for digital audio performance.

Digital Video Measurements

Video Frequency Response
(Measured with a multi-burst test signal)

Frequency (MHz)	Video Output (dB)
0.50	0.00
1.00	-0.06
2.00	-0.06
3.00	-0.13
3.58	-0.32
4.20	-0.64

Sin² (sine squared wave) Pulse and Bar
(Used to observe relative chrominance to luminance delay and gain, and consists of equal peak amplitudes of luminance and chrominance—see Fig. 1)

Color Purity
(Signal displayed on vectorscope as phase-angle in saturation level of the colors of a color-bar test signal relative to color reference-burst—see Fig. 2)

Video Signal to Noise Ratio
(Luminance, 10 kHz to 4.2 MHz)

Level (IRE)	Video Output (dB)
100	51.4

Stairstep Linearity
(Measures how well the player resolves different shades of gray)

Step	Video Output (%)
1	-2
2	0
3	-3
4	0
5	-4

Digital Audio Measurements

Reference Level (0 dB, 1 kHz): 2.16 volts

Audio Frequency Response (5 Hz to 20 kHz): +0.05 to -0.15 dB (see Fig. 3)

Signal-to-Noise Ratio ("A" Weighted): 107 dB

Dynamic Range: 100 dB

Total Harmonic Distortion + Noise (@ 0 dB)
1 kHz 0.003%

Channel Separation
(Reference: 0 dB, 1 kHz): 91.3 dB (left channel)
106.0 dB (right channel)

Additional data

Random Access Time (Track 1 to 21):	1.2 seconds
Scan Time (Track 1 to 21):	2.2 seconds
Power Requirements:	19 watts
Dimensions (HxWxD, inches):	$3\text{-}^{7}/_{16}$ x $16\text{-}^{15}/_{16}$ x 12
Weight:	8.25 pounds

FOR MORE INFORMATION

Panasonic
One Panasonic Way
Secaucus, NJ 07094
201-348-7000

dual-layered discs. There's little need for this. Most movies fit well within the 2-hours-15-minutes capacity of a single DVD side.

Meanwhile, most Hollywood studios are issuing their movies on a single DVD in both pan-and-scan (4:3 aspect ratio) and "original widescreen" (read "letterboxed" of whatever ratio—16:9 or 1.85:1 or even wider Panavision) formats. Depending on the disc replicator (at this writing, either Warner or Matsushita, respectively) the DVD comes either as dual-sided or single-side, dual-layer. If it's dual-sided disc, you'll have to flip the disc manually. Unlike the analog laserdisc format, at this time there are no DVD machines that reverse the optical pickup to play the flip side of the disc.

When buying a DVD player or discs, you ought to know that both hardware and software are regionally-coded for use together in different parts of the world. What this means is that a disc meant to be sold in one geographic region won't work on a player designated for use in another area. For example, the U.S. is Region 1, and players and discs sold here are clearly marked so. If you send friends in France a Region 1 DVD, it won't output any video (only audio) on their Region 2 player. Ditto if you bring home some Hong Kong martial-arts movies on that Region 3's DVDs.

The purpose for splitting the world into six regions is to protect the movie industry's distribution schedules. Frequently, a Hollywood film is released later elsewhere in the world—by which time Americans can obtain a videotape (and now DVD) of the movie. By regionally-coding the DVDs, audiences elsewhere won't have access to the movie before it's shown in theaters there. The reason the audio is playable on any region's machines is because the DVD format was designed to be backward-compatible with music compact discs. Yes, your DVD player is also a full-featured CD player—because those older CDs have to be playable on the same machine as forthcoming DVD audio discs.

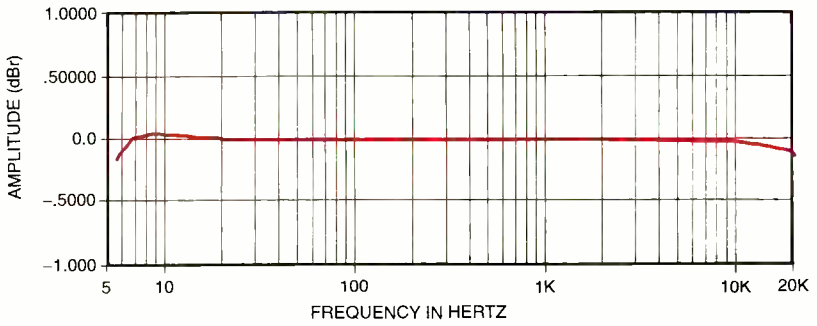


Fig. 3. The frequency response of the DVD-A300U is virtually ruler-flat over the entire audible audio range.

EVALUATION

We have said a great deal about DVD but little so far about Panasonic's DVD-A300U. That's because the player flawlessly executes all the DVD functions described above. Our lab report will be fairly brief too, for reasons beyond our control (at least for the time-being) and which we find annoying. It has to do with a lack of industry-standard test discs for DVD. They just do not exist at this early stage in the product cycle. Various DVD manufacturers have their own test discs, and we acquired Sony's. Unfortunately, it does not offer as many measurements as the industry-standard reference recordings laserdisc ("A Video Standard") that the lab uses to send input to TVs and laserdisc players.

You will notice the lab used the CBS CD-1 test disc to measure this DVD player's digital audio functions. The CBS disc has been the industry standard for testing CD players for many years. We'd rather measure DVD with a test disc prepared by an impartial party—rather than a hardware manufacturer. In the future we hope to use the DVD version of "A Video Standard" now in preparation.

Having said this, let's look at the numbers generated by the Advanced Product Evaluation Laboratory (APEL), the independent testing facility in Bethel, Connecticut that performs measurements for **Popular Electronics**. The test results on this unit are pretty impressive—in some cases, the best video measurements seen to date.

As you see in the accompanying chart and graphs, the player's "Video Frequency Response" output is virtually ruler-flat, maintaining sharpness to the extent of the disc's inherent resolution. Meanwhile, the "SIN² Pulse and Bar" measurements, indicate there is little overshoot or undershoot in the way the DVD-A300U handles the relative timing of chrominance and luminance components.

When it comes to "Color Purity," APEL's President Frank Barr says this is the best he's ever seen! As captured on the vectorscope (Fig. 2) every color is right on the mark: There is no shift in phase, no under- or over-saturation. Barr also notes that Video Signal- to -Noise Ratio is excellent—we cannot recall any analog video source posting a ratio this good."

In all aspects of digital audio performance, the DVD-A300U measured very good to excellent—"Frequency Response" (Fig. 3) is ruler-flat through the audible range from 20 Hz to 20 kHz—off just an inaudible 0.15 dB at the high end, and a barely-measurable 0.05 dB at the sub-audible 5 Hz mark. About the only reason for bringing the bar so low is the Dolby Digital system's provision for a separate subwoofer channel. When somebody builds a subwoofer that can resolve 5 Hz and—better yet—a human auditory system that responds to it (as opposed to a sensory system that feels it), this measurement might become more meaningful.

Channel separation is particularly noteworthy. The high degree of separation here means you will get accurate locational steering from the analog Dolby Pro Logic surround matrixed on the stereo soundtrack. Unfortunately, no lab (except Dolby's) can test Pro Logic surround or the new Dolby Digital. That is because Dolby Laboratories does not release the specifications required of its licensees.

Regarding digital versus analog surround, the DVD-A300 has a built-in decoder for Dolby Digital, so you can send the output directly to a multichan-

It's Not Just Training...

"I needed a refresher in fundamentals and a piece of paper that said I had a degree. CIE gave me both."
Louis P. Briant
Senior Engineer
Sentel Corp.

"CIE allowed me to use my G.I. Bill benefits and independent study allowed me to continue my studies while deployed."
Charles Hopper
Electronics Senior Chief
U.S. Navy

"The fact that I intended to continue pursuing my Associate Degree with CIE was a key factor in being considered for my current position."
Annamarie Webster
Project Engineer - Instrumentation
Ketchikan Pulp

"My associates at work recommended CIE... The lessons were structured so they were easy to comprehend."
Vincent R. Buescher
Communications Technician
AT&T

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NET WATCH

(continued from page 15)

Voyager Recording that was sent into space with instructions for an alien to play it, and the Pioneer Plaque, which shows what we look like and our location in the universe. Basically, if you want a visual companion to the SETI site, you've found it.

And what about the comedy hit of the summer? Does the Men in Black site have anything serious to offer? That depends on how much "paranormal" data you'd like to weed through. Let me explain.

HOT SITES

NASA
http://www.nasa.gov

SETI Institute
http://www.seti.org

Contact
http://www.contact-themovie.com/

Men in Black
http://www.meninblack.com

When you first log on, you're treated to a Neuralizer blast by Mr. Smith. Then you can go to the MiB Training Center for some Shockwave fun stuff. So you want to join the MiB and keep the Earth safe from the scum of the universe? Download the MiB game (2.7 Mb) and listen to Zed invite you to a series of tests to find the best of the best. Four tests will check your motor skills, hand-eye coordination, concentration, and stamina. If you survive this, then click Go Behind the Scenes to learn about the special effects in the film, enter the Men in Black Sweepstakes, and, of course, get a good amount of photos, video clips, and sound bites. Then you might notice there's a section called Men in Black Magazine. Here's where you can read about alleged UFO and alien sightings, as well as a few more terrestrial phenomena such as hauntings and the like. How much of this information can be trusted? Well, it depends on whether you think all those reports of flying saucers and big-headed aliens are true. Do you believe it was only a weather balloon that crashed in Roswell 50 years ago? Some of the information found here might mesh well or clash with your beliefs, but it sure makes you wonder.

And on that mysterious note, I'll be taking my leave of you for now. Please feel free to e-mail me at netwatch@comports.com or snail-mail me at *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. Until next month, stay away from any bright lights in your windows at night! ■

nel amplifier and then on to five speakers and a subwoofer. If your home theater setup is more modest, you would simply take the analog stereo output to a receiver that can decode the multiplexed analog Dolby Pro Logic, or just reproduce a stereo soundtrack.

In hands-on evaluation of the DVD-A300U with a selection of DVD movies, the format and the player delivered on all their promises—almost. One thing we couldn't check out was the option to view a scene from different camera angles—as many as four. The DVD format provides for this—and we even managed to find the "Angle" button on the too-small and cramped Panasonic remote control. But none of the movies we had included multi-angle shots, or even the alternate endings a director can include on the disc.

CONCLUSION

If you're thinking of buying a DVD player, it pays to pay attention to performance—quite literally. This is because your financial investment goes beyond the hardware. Unless a strong rental market develops, you'll be buying DVDs at about $20 a pop. Over time, your software investment will surpass the ante for the hardware. So, study comparative test reports and buy the best-performing DVD player you can afford. Also read competent software reviews to learn if the studio really made a film-to-disc transfer that is worth buying for keeps. As for the multiple angles and alternative endings, you probably won't miss such gimmickry with so much beautiful video to enjoy. ■

GIZMO®

A Digital Revolutionary

MP-EG1A MPEG CAMCORDER KIT. Manufactured by Hitachi Home Electronics, 3890 Steve Reynolds Blvd., Norcross, GA 30093; Tel: 770-279-5600; Web: http://www.hitachi.com. Price: $2500.

Bit by bit, it seems, the analog world is losing itself to the digital realm. The first thing to go was some of our important personal information—paper records replaced by bits in a mammoth mainframe computer. Important as that was, it was something that most people were able to ignore. Digital didn't hit the mainstream until the introduction of the compact disc—which will be two decades old when the next century rolls around.

Digital-phobes need not worry, however. Not every digital format is an instant—or even eventual—success. Consider digital audio tape (DAT), which is loved in the professional audio world but was a consumer flop. And what about MiniDisc, which has found favor with radio broadcasters, but has a small, albeit loyal, following in the consumer world? (On the other hand, MiniDisc *is* doing far better than its once-rival Digital Compact Cassette, or DCC.)

Photography is another application being chased for conquest by digital technology. New digital camera models are being introduced fast and furiously, each generation showing a marked improvement over its predecessor. However, the consumer models that have hit the market so far can be outclassed by a disposable cardboard box equipped with a cheap plastic lens and a roll of 35-mm film. Despite this, digital cameras are selling briskly.

In some parts of the video world—direct broadcast satellite, for instance—the digital revolution is well under way. In other areas, it's just getting under way. DVD, the best consumer video playback format ever introduced, is having trouble convincing a skittish Hollywood that its subscription system is secure. In other words, DVD is apparently too good for Hollywood, which is worried about giving pirates the ability to make high-quality bootleg discs and tapes. Although early sales have been very promising, the

absence of such major studios as Disney could spell doom for the format.

Other new digital video formats include DV and D-VHS, the digital version of the ubiquitous VHS format. While DV remains very expensive, D-VHS is useful only for taping such digital video as that from DSS or EchoStar (Dish Network) satellite broadcasts—and requires a new satellite receiver for playback—so the format is unlikely to generate significant interest until digital TV (DTV) arrives late next year.

DTV, of course, will be the *coup de grace* in the triumph of digital over analog in the world of video, even though the plans for its introduction (and its acceptance) are still a bit nebulous. Who knows how fast digital broadcasts and receivers will penetrate the marketplace? Or how much programming will be high-definition, as opposed to simply digital equivalents of what we watch today?

Can digital video ever hope to match the success that has been achieved by digital audio? When will it hit the living rooms of mainstream America? And why has it taken so long?

MPEG JPEG COMPRESSION

It's true, of course, that nothing stands still for very long in the field of electronics, where technology changes faster than in any other discipline. Digital video is an excellent example.

When the FCC first indicated that it was looking for a next-generation television system, the idea that it could be digital didn't really exist—the bandwidth required for a digital representation of video was just too wide. Enter the new science of digital compression, more accurately called digital data reduction.

The techniques used to reduce the amount of data necessary to accurately render moving and still images digitally were developed during the last decade. The efforts of the Joint Photographic Experts Group and the Moving Pictures Experts Group, led to the JPEG and MPEG compression standards that we now take for granted.

Today, there are two MPEG schemes, MPEG-1 and MPEG-2. MPEG-2 is the compression scheme used on DVD videodiscs and some digital satellite broadcasts such as EchoStar and Primestar. MPEG-1 is the kind of compression used, for example, on Video CDs and many CD-ROM games, and, of course, the Internet. So while digital video has had a hard time getting into our living rooms, it's alive and well on the computer's main street, the Internet.

THE PC CONNECTION

Video is all over the Internet. From kids showing clips of their high videogame scores to street scenes in some remote part of the world, it's all there for the downloading. So how does it get up there?

Getting video into a PC has never been easy. It requires a video camera or camcorder, a video capture board, and, of course, a PC. *Hitachi's MP-EG1A* MPEG camera kit changes all that. You still need the PC, of course, but the camera takes care of everything else because it can shoot MPEG-1 movies directly and store them on its internal hard disk. Just copy the digital video files to your PC, and you're done. (Note that even though the MP-EG1A does shoot moving images, we will refer to it as a "camera" rather than a "camcorder" throughout.)

The kit includes the camera, an ISA interface board, a software bundle, and several accessories, such as a battery charger, remote control, table-top stand, and LCD sun shade. The camera stores its images on an included 260-megabyte PCMCIA Type III PC-card hard disk drive.

The use of a PC-card as a storage medium is a great feature. For one thing, it means that the camera can be used with computers running operating systems other than Windows 95 (for which the MP-EG1A was designed), including Windows NT, Windows 3.1, and Macintosh machines. As long a computer has a PC-card slot (most new laptops do, and add-on slots are available for about $100 for desktops), it can retrieve MPEG movies shot with the camera. However, Hitachi's stated system requirements are for a multimedia PC with a Pentium processor running at 100 MHz or faster, 16 megabytes of RAM, 80 megabytes of available disk space, and a VGA color monitor. (The system should *work* with slower computers, but you'll probably be disappointed with the speed of video playback.)

With the supplied PC card, the camera has a capacity of 20 minutes for video with audio, and a resolution of 352×240. Alternatively, the camera can be used to record 3000 JPEG still images with resolutions of 704×480, or 1000 images, each with 10 seconds of audio. (All of the photos accompanying this piece, with the exception of the opening product shot, were taken using the MP-EG1A.) Recording just audio (with one still image), the 260-megabyte PC card will give you a capacity of four hours. All capacities given here are only approximate—more complex images cannot be compressed as efficiently as simple ones, and quickly moving images cannot be compressed as efficiently as static ones.

It is unclear whether the camera can be used with PC cards other than the 260-megabyte one supplied. We would guess that it can, because the drive seems to have a standard ATA-type interface. But since we didn't have another PC-card disk drive on hand to try out—and because the manual suggests that other cards shouldn't be used—we can't be sure.

BASIC SPECIFICATIONS

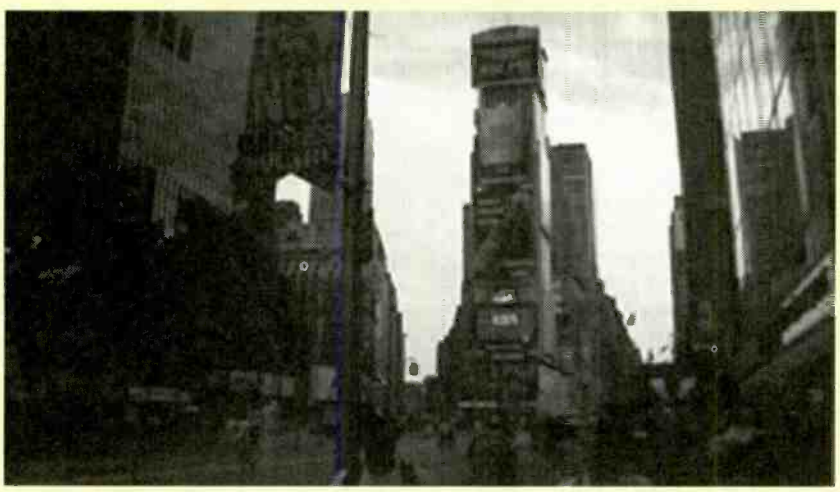
The image sensor in the camera is a ¼-inch CCD with 390,000 pixels. The camera's lens is an f:2.4, 3.6–10.8 mm zoom lens with a 2× digital magnification (for a 6× total). It has automatic exposure control and automatic white balance, a maximum shutter speed of 1/2000 of a second, and is, as far as we can tell, fixed-focus. (Hitachi calls it "pan focus," whatever that means.)

The camera has a square, 20-pin I/O port. Two cables are supplied with the camera. One is used to connect its port to the plug-in ISA card's mini-DIN socket. The other has phono plugs to connect to traditional A/V equipment. Images and photos can also be viewed on the camera's built-in 1.8-inch TFT LCD color viewfinder.

The camera, measuring 3.3×5.6×2.2 inches, is just a little bulkier than a typical 35-mm point-and-shoot camera, and at 19 ounces (including the hard disk and battery), it's only slightly heavier. The MP-EG1A is, however, held vertically in operation, rather than horizontally. Its top is a swivelling head. You can, for example, shoot videos of yourself, something you might want to do in video-conferencing applications. (But because the camera can output only analog data in real time, you'd need a video capture board for that application.)

Why hasn't an easy-to-use MPEG camcorder existed before? Basically, because a single-chip encoder/decoder (CODEC), like Hitachi's MPEG-1, didn't exist. With it, the power consumption is a rather miserly 6½ watts. That means that one of the two included lithium-ion batteries can keep the camera running for up to 40 minutes. That time, of course, will vary depending on such factors as temperature, how often you start and stop recording, and whether you're inclined to use the zoom feature often.

Using the camera is relatively straightforward. Whether you're in the still-camera or camcorder mode, the procedure is the same. Turn the power on, point, using the LCD as a guide, and shoot by pressing the RECORD button. In the camcorder



mode, pressing the RECORD button a second time returns it to the pause mode. The biggest mechanical difference between the MP-EG1A and other camcorders is the delay encountered as you wait for the hard disk to spin up to speed.

The most glaring difference, however, lies in the MP-EG1A's recording and playback *quality*. Just as consumer digital still cameras (including this one) can't come close to matching the quality achievable from the throw-away dime-store 35-mm camcorder, the MP-EG1A can't come close to matching the quality from the cheapest traditional video camcorder.

When viewed on the unit's tiny 1.8-inch screen, the video looks good. Even on a VGA monitor, the quality is acceptable. Throw it up on the TV screen, however, and it begins to fall to pieces. Pixels are not only visible, they're obvious. Motion isn't smooth; it's jerky.

Now, to be fair, Hitachi is not trying to replace traditional camcorders with the MP-EG1A. Rather, the MP-EG1A is intended to bring video directly into cyberspace, or to the corporate intranet, or as e-mail attachments to show Junior's latest antics. (For a digital camcorder that *could* very well replace the camcorder as we know it today, take a look at Sony's DV format. Alas, it can't be used to download video to computers—at least not until copyright issues are settled.)

Unfortunately, the MP-EG1A can't output real-time video to the supplied ISA interface. Instead, it must store files to its internal hard drive, and those files must be transferred manually to another computer, either through the supplied interface card or by swapping the PC card.

The camera offers limited built-in file navigation capabilities. By default, there are a maximum of six "folders" in which you can store videos and pictures. Unfortunately, also by default, all new videos and stills are stored in folder 0. They must be manually moved to other folders after they've been shot. Unfortunately, the folders cannot be renamed.

THE SOFTWARE

The camcorder is supplied with several applications on a single CD-ROM. First, there's Pure Vi, which is the only software you can use to transfer video and audio files into your computer (unless you transfer them through a PC-card slot.) Second is MediaChef/Clipping, which allows you to cut and rearrange video clips "frame by frame." (That's really a misnomer for MPEG video, which doesn't really consist of individual frames, but single frames followed by descriptions of what has changed from one frame to the next.)

The third application provided is MediaChef/Print, which makes it easy to import selected scenes for processing and printing. It also allows you to create thumbnail images for video indexes so that you can identify scenes. The EasyCut application lets you "grab" a selected video clip from an MPEG video file.

Of course, MPEG video is only one of the things that the MP-EG1A can do. JPEG stills are another. So Hitachi picked a "special" (a.k.a. limited) edition of MGI Photo Suite for photo editing and retouching. (See the September 1997 *Gizmo* for a review of the full product.) It also allows you to make "albums" that include both JPEG images and MPEG-1 video files.

AuthoringMaster is an easy-to-use tool for pasting MPEG videos and JPEG stills into business presentations. The final application, SoftPEG, allows MPEG files

to be viewed on computers that don't have hardware or other software MPEG decompression.

All of the software, with the exception of MGI Photo Suite, had the feel of typical Version 1.0 software. We were able to get things done, but not without a few glitches along the way. For example, even basic communication between the camera and its ISA adapter board was kind of iffy. Sometimes just starting the software up again would iron the problem out. (But when the camera enters its 5-minute automatic power-down mode, communications can't be reestablished until both the software and the camera are reinitialized. So don't forget to turn the power savings mode off from the setup menu.)

Tools that are more powerful than the software provided will be required for anyone who wants to do anything at all sophisticated. For example, the supplied applications provide no way to split the picture from the sound. Nor are there capabilities for any special video effects —not even something as simple as a fade to black.

MORE THAN VIDEO

The MP-EG1A has four main recording modes. The two on which we've concentrated most of our discussion so far are MPEG-1 Video and individual JPEG stills. However, there are two additional still-picture recording modes: interval and sequential.

With interval recording, it is possible to take pictures once every 30 seconds, once every minute, or once every five minutes. With sequential recording, it is possible to capture five consecutive still pictures with a speed of about two pictures per second.

Those features are nice—perhaps you could use them to create long-term pseudo security-camera videos, or create some interesting time-lapse sequences.

IS IT WORTH IT?

It is true that we have quite a few complaints about the MP-EG1A. But the MP-EG1A is the first of its kind. We're impressed by it, and we're always appreciative of efforts that advance the state of the art—especially when they risk exposing companies to criticism for taking chances.

No customer considering a traditional camcorder should give Hitachi's MP-EG1A a first, let alone a second, look. Anyone looking for a digital still camera has much cheaper—and equally or more capable—alternatives from which to choose. But the MP-EG1A is a revolutionary product. Hitachi has chosen to tread where no camera, camcorder, or electronics manufacturer has dared tread

(Continued on page 29)

Wave of the Future

GOLDSTAR MODEL MA-1505W MULTIWAVE MICROWAVE OVEN. From LG Electronics U.S.A., Inc., 1000 Sylvan Avenue, Englewood Cliffs, NJ 07632; Web: http://www.lgeus.com. Price: $229.95.

We tend to think of the microwave as a recent innovation. In fact, it's celebrating its golden anniversary.

The idea behind microwave cookery was discovered in one of those "happy accidents" that often precedes a technological breakthrough. Raytheon engineer Percy Spencer realized one day that the electromagnetic waves generated by the radar equipment in the lab had caused a candy bar to melt.

The first commercial microwave oven was the "Radarange," a $3000, refrigerator-sized beast introduced in 1947. It was years before size and price dropped sufficiently for the microwave oven to become a commercial product—longer still before it became a success.

Today, of course, microwave ovens are standard fare in American kitchens. As recently as 20 years ago, however, household penetration was well under 10%.

By the time we began equipping our own kitchen just over a decade ago, a microwave oven was one more must-have appliance (along with the food processor and cappucino maker now permanently residing in the basement). The only thing that saved our original microwave from a similar fate was that it also functioned as a toaster oven, which we use quite frequently.

As a microwave, however, it didn't get much use. True, we softened butter for baking cookies and reheated leftovers occasionally. But when we tried popping popcorn and baking potatoes, we found that the low-powered microwave oven wasn't up to the task. Most of the kernels remained unpopped, and it took almost as long to nuke two large potatoes as it did to set them in the oven next to the roast.

We have to admit, however, that our reluctance to use the microwave stemmed more from snobbery—and, perhaps, ignorance—than its power limitations. Defrosting a container of homemade chicken stock in it was acceptable. Using it to cook coq au vin, however, was another story altogether.

Actually, our feelings reflected those of the general public. A study conducted at the beginning of this decade found that although more than 90% of American kitchens housed a microwave oven, less than 20% of meals were being prepared in them. Instead, 93% of the people surveyed said they used their microwaves to heat leftovers, 79% to warm foods, and 75% to defrost frozen foods. What's more, 13% reported feeling *guilty* for cooking in a microwave, as if the cooking technique somehow rendered the food something less than home-cooked meal.

Back in those care-free (kid-free) days, we thought nothing of preparing veal Sorrentino with homemade pasta, chicken Kiev over wild rice, risotto with shrimp and wild mushrooms, fresh-baked breads, and soups that had simmered for hours as standard dinner fare. We'd dine leisurely, enjoying a bottle of wine with the food.

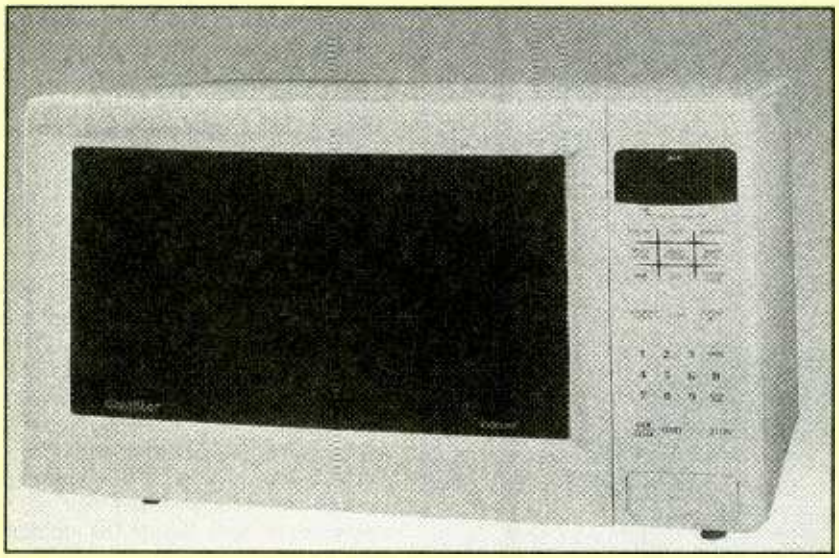
Such meals now require a restaurant—and a babysitter. Dinner hour has become a nightmare of feeding a fussy two-year-old, four finicky cats, and finally, us. We haven't taken to eating hot dogs and macaroni and cheese *every* night, but those items have begun to appear with alarming frequency on our plates as well as the baby's. Why go to the trouble of making fettucini Alfredo when he would much rather eat Spaghetti-O's?

Still, we didn't begin using a microwave for serious cooking until the Goldstar Multiwave MA-1505W arrived for review. Its 1000-watt output and 1.5-cubic-foot capacity afforded us the power and size needed to prepare full meals. Its revolving turntable, one-touch cook buttons, auto-defrosting, and programmable custom cook feature is changing the way we look at microwaves—and the way we prepare our meals.

Microwaves cook from the outside of the dish toward the center, unlike frying in a pan, in which the food in the middle of the pan cooks fastest. The microwaves pass through the surface of the food, penetrating from all sides, to a maximum depth of about 1½ inches. The interior portion is cooked only as the heat generated on the outside travels inward. That's why the center of a microwaved dish is likely to remain cold, and why you wouldn't want to cook a stuffed turkey in a microwave oven. And microwaves cause the liquids in foods to evaporate quickly, so it's important to cover most dishes to prevent them from drying up.

In a conventional oven, it takes no longer to bake eight potatoes than it does to bake one. In a microwave, however, the quantity of food is a determining factor in the cooking time. Because the number of microwaves remains constant, the more food being cooked, the longer it takes.

The MA-1505W is typical of today's crop of high-powered microwaves. It comes in either white or black and measures 22½ × 13½ × 16¾ inches. Its control panel features one-touch buttons for popcorn, pizza, beverage, frozen vegetable,



and baked potato. Rounding out the top of the panel are buttons labeled MORE, LESS, and CUSTOM COOK. Below those are a row of buttons used for automatic defrosting, setting the clock, and creating custom settings. The numeric keypad also includes POWER and COOK TIME buttons. Across the bottom of the control panel are STOP/CLEAR, START, and EZ ON buttons. At the very top of the panel is a display window that shows messages in English, French, or Spanish.

Those scrolling messages walk you through every step, from setting the clock to defrosting a steak. For instance, after a press of the COOK TIME button, the display says, "enter cooking time." When you comply with that direction, a new message appears: "touch start or power." If you opt to change the power setting, the display will prompt you to "enter power level 1 to 10." (Level 10, the highest power level, is the default setting). Then it tells you to press START.

For those who prefer to get more creative, the MA-1505W offers two-stage timed cooking and a custom-cook feature. For two-stage cooking, instead of pressing start at that point, you enter another cook time and power level. You can cook a dish on high for a few minutes, and then "simmer" it on a medium setting, for instance. Two-stage cooking can also be used with the auto-defrost feature.

The MA-1505W will automatically set the amount of time and power level needed to defrost an item when you let it know what type of food it is and how much it weighs. The display prompts you to press 1 for meat, 2 for poultry, or 3 for fish. The weight is entered numerically (press 1 and then 5 to indicate 1.5 pounds). The oven determines the length of time required to defrost the item, and even reminds you with beeps and display prompts to turn, separate, or rearrange the food as needed.

For those of us who prefer to mindlessly zap our food, the Multiwave oven offers a host of convenience features, from the aforementioned one-press cook buttons for popcorn and the like to "EZ ON" cooking.

Each press of the EZ ON button adds 30 seconds of cook time, up to 3 minutes; subsequent presses add one minute each. And if you tend to cook the same thing often (those Spaghetti-O's, for instance, or your morning cup of tea), you can set the custom cook button to remember the one-step cooking instructions needed for that item.

One other very important feature on the oven is a child safety lock. (Curious little hands can get into big trouble around electronics, as we know all too well after our two-year-old recently fed a small pile of paper clips to our floppy drive ... .) When the child lock is activated by holding the 0 button until two beeps are heard and "locked" appears in the display, the oven cannot be turned on. It can be opened however. (You don't have to worry that the kids will zap your toy poodle, just that they'll lock him in the microwave oven.) Holding down the 0 key again will cancel the lock.

The "Multiwave" in the oven's name refers to a patented microwave technology intended to ensure even cooking without cold spots. The revolving turntable furthers that cause. We found that most dishes did heat more evenly than we expected. However, as mentioned previously, microwaves cook food from the edges inward, so the center of a dish will not heat up as fast the rest. There were still a few such cold spots in foods cooked or reheated in the Multiwave oven. Stirring or rearranging the food once or twice during the cooking process alleviated that problem.

Learning to properly use a microwave requires the re-learning of many basic traditional cooking rules and principles. Forget that "20 minutes per pound" for a medium-rare roast beef—it's nine minutes in the microwave. Two potatoes can be baked in 5–8 minutes.

Microwaves, while great for heating up junk foods, are conducive to healthy cooking, because they make it easy to prepare dishes with little or no added fats. Once you understand the principles involved, it's possible to create some elaborate one-dish dinners. Simply arrange the foods that take the longest to heat around the perimeter of the pan, the fastest cookers in the center, and mid-range ones in between, and everything will come out just right. We were skeptical, but we followed the directions in a microwave cookbook, and it actually worked.

Some basic microwave cooking instructions are included in the MA-1505W's manual. There are charts on heating and reheating various items; cooking fresh vegetables; and "roasting" meats, poultry, and fish. Yet another chart explains the different power settings, ranging from 1 (for keeping a dish warm or softening butter) to 10 (for boiling water and cooking poultry, fish, and vegetables). Various in-between settings are recommended for cooking egg or cheese dishes, reheating rice and pasta, baking cakes or breads, cooking different cuts of meat, thawing frozen meat and poultry, and cooking puddings.

Serendipitously, the MA-1505W arrived on the first day of a week-long heat wave when turning on the standard oven, or even a burner on the stove, was unthinkable. Yet, for dinner that night, we ate sauteed spinach with raisins and shredded carrots, a packaged rice dish, and pork chops, all prepared at home.

We used the microwave first to thaw the chops, following the instructions in the display window. Not quite trusting the process (our old microwave tended to scorch the edges while the center remained frozen solid), we kept a close watch. We ended up removing the chops with a couple of minutes left to go, probably because they had begun to defrost a bit in the refrigerator that afternoon. The chops then were marinated in preparation for grilling.

For the next dish, we simply followed the directions on the box of rice. First we cooked the rice with some butter for a couple of minutes, then we added some water and cooked it for 10 minutes more, then added the seasoning mix and finished it off with yet another 15 minutes. There wasn't a significant time savings over cooking it on the stove (perhaps 5 or

(Continued on page 31)

Pint-Sized CB

MODEL HH-45WX CITIZENS BAND RADIO. From Cobra Electronics Corporation, 6500 West Cortland Street, Chicago, IL 60707; Tel: 773-889-8870. Price: $149.

Can you guess to what Time magazine referred in the mid-1970s as "the biggest explosion in communications since the invention of the telephone"? If you guessed Citizens Band, or CB, radio, you're right. Back in those days of oil shortages and the brand new national 55 MPH speed limit, truckers began using CB to apprise their buddies of available fuel and to warn them of speed traps. Burt Reynolds' Smokey and the Bandit films also went a long way toward popularizing CB among regular drivers, who adopted "handles" (nicknames) and picked up the rest of the CB lingo in no time flat.

The Citizens Band, which was established in 1949, lies between the shortwave broadcast and 10-meter Amateur radio bands. Its 40 channels (expanded from 23 during the height of the CB boom) reside between 26.965 and 27.405 MHz. CB operators do not need an FCC license and are not required to provide station identification, but they must comply with certain FCC rules and regulations. For instance, CB users can "transmit" from one party to another, but "broadcasting" to a wide audience is forbidden. CBs are limited to four watts of output power in AM mode and 12 watts peak envelope power in SSB (single sideband) mode, internal transceiver modifications are not allowed, and (for fixed installations) there are limitations on antenna height.

The CB craze died out in the '80's. While CB radios remained standard gear for truckers, and a few die-hard enthusiasts (many operating at illegally high power over illegally long distances) kept to the air waves, the general public moved on to other fads and fancies.

These days, however, CB is beginning to stage a bit of a comeback that can be attributed, in large part, to the proliferation of another communications technology—the cellular phone.

Cell phones were once used primarily by business people needing to keep in touch with the main office and clients while rushing from appointment to appointment. Sales people, realtors, frequent business travelers all benefit from being accessible wherever they are.

But by the end of last year, close to 35% of American households owned a cellular phone. Like business people, busy family members also need to keep in touch. Yet another factor driving the consumer sales of cellular phones is safety.

What happens when you're alone in the car at night and it breaks down? Is it safer to leave the car and walk along the shoulder in search of an open service station, or to hope that the motorist who stops is a good Samaritan and not a thief (or worse)? If you're carrying a cellular phone, you can call AAA or a friend for help, and sit tight in relative safety until they arrive.

Unfortunately, cellular-phones operating costs are expensive for occasional use. Some people justify the cost by saying it's buying them peace of mind—and the cellular industry has played into their fear, using it as an selling point.

So has the Citizens Band industry, marketing their radios as a less expensive way to call for help when you're stranded on the road. It's an effective marketing strategy, and one that has again raised the public's awareness and acceptance of CB radio—although not nearly to the level reached in the '70s. CB might not let you place a call directly to the Automobile Club, or to your spouse, but you can be fairly certain that someone will be monitoring the emergency channel and will respond to your call for help. That someone might be a member of one of the many police, fire, and emergency service departments that monitor CB emergency channel 9 for distress calls, or a member

of REACT, the Radio Emergency Associated Communications Team. REACT is a nationwide organization of volunteers who use CB radios to provide public-service communications for travelers and their local communities, communications during emergencies and disasters and for community events, and "relentless monitoring of Emergency CB channel 9" in the interest of motorist safety.

The HH-45WX CB radio has the distinction, according to its manufacturer, Cobra Electronics, of being "the world's smallest full-featured hand-held CB radio." It offers 40 CB channels and 10 National Weather Service channels, full channel scan, and instant access to emergency channels. Yet the pocket-sized transceiver stands just 5¼ inches tall, and weighs in at a mere nine ounces, without the six "AA" batteries required for operation.

The bottom half of the radio is actually a battery pack that slides right off for installing batteries. An eight-cell rechargeable NiCd battery cartridge and a 120-volt wall adapter/charger, available as options, make it easy to snap on replacement batteries when needed. A cigarette lighter DC power adapter with five-foot cord is included.

The top half of the unit is the actual radio. It features an LCD display with one row of buttons arrayed horizontally below it, and another vertically on its left side. The buttons below the display each have two labels: M1, M2, M3 and M4 are printed on the keys themselves, and represent stored channel (memory) positions. Just above each of those keys is the label for its other function—CH9/19, DW, SCAN and CB/WX (described below). The speaker and microphone round out the front "panel." The AC power jack is found on the right side of the radio, along with a carrying strap. On the left side are CHANNEL UP and DOWN keys, and a PUSH TO TALK (PTT) button. The top panel contains a BNC connector for the included "rubber duckie" rubberized antenna (an optional long-range antenna is said to double the CB's range), a microphone jack (a microphone/speaker is optional), the squelch control, and the on/off/volume control.

The HH-45WX is easy to use. The LCD readout displays a wealth of information, including your choice of channel or frequency number, signal strength, a low-battery indicator, and which features or modes are active. When you're transmitting, for instance, "TX" is displayed; "RX" means the radio is receiving a signal. The squelch control reduces unwanted "squawky" sounds and other noise between transmissions.

Channels can be selected in several ways. The up and down arrow keys can be pressed repeatedly to move through the channels, or held down to advance more quickly. One press of the CH9/19 button provides instant access to emergency channel 9, while two presses switches to channel 19, the "official" trucker's channel.

Weather channels are accessed using the CB/WX button. The HH-45WX receives eight NOAA (National Oceanic Atmospheric Administration) and two Canadian Weather Radio channels to keep you informed of weather conditions. When the CB/WX button is pressed, the up and down tuning buttons will tune through all weather stations that are in range. The National Weather Service operates a network of almost 400 stations across the country, putting about 90% of the population within range of their broadcasts. NOAA stations broadcast 24 hours a day, seven days a week, providing information on current conditions, short- and long-range forecasts, marine conditions, and warnings of dangerous weather. In southern Canada, a network of 15 stations uses the same frequencies to broadcast continuous weather information.

The HH-45WX allows you to monitor any two preselected channels simultaneously with its Dual Watch feature. Select one channel, and hold down the DW button until you hear a beep, then repeat the process for a second channel. The "DW" icon will be displayed, and the radio will switch back and forth between those two channels.

The radio can also scan all channels with a press of the SCAN button. It pauses at each incoming transmission for five seconds, then proceeds to the next. To stay on one channel, you can press any other key on the unit.

The CH9/19, DW, SCAN, and CB/WX buttons double as memory channels for storing up to eight of the channels you use most often. Tune in a channel, press and release the FUNC (function) key, and then press and hold one of the four memory keys to store that channel. Once the four memory keys are full, the next four channels can be stored (somewhat awkwardly because they are not labeled as memory locations) using the LOCK, LIGHT, CHANNEL UP, and CHANNEL DOWN keys. Stored channels are retrieved by pressing the function key and then the memory location key. It's also possible to scan just through the stored channels, using first the function key and then the M.SC. (memory scan) key.

Citizens Band radios are used not only in emergencies. They are a form of communications enjoyed by truckers and other travelers, and are now being used by families on camping or ski trips, friends out hiking or hunting (or shopping at a crowded mall) to keep in touch and apprise each other of conditions (snow or sales), and chatty teens enamored with wireless communications whose parents cannot afford (or refuse) to pay for hours of cell-phone gossip.

CB operators have developed their own language. The 10-code is used for standard questions and answers. Each phrase is represented by the number 10, followed by another number. Most of us are familiar with "10-4," meaning "message received." The HH-45WX's manual lists dozens of the most commonly used 10-codes and their meanings. The helpful instruction booklet also clues newcomers in on the most effective ways to use emergency channel 9. A "plain-English" interpretation of FCC rules for CB radio is also included with the radio.

The HH-45WX is a compact, convenient CB radio. It's easy to carry along just about anywhere. If, however, you plan to simply stash it in your car for emergency use, you might want to consider having a roof- or hood-mount antenna installed. Otherwise, you might have to step outside the vehicle to make an emergency transmission; the included antenna is not intended for in-vehicle reception or transmission.

10-4. ■

A DIGITAL REVOLUTIONARY

(Continued from page 26)

before, and, for that, it deserves as much praise as we can heap upon it. If you're an early-adopter who's just got the be the first on the block with the newest gizmo, then you'll just have to run out and get one. After all, there's nothing else like it.

Many business people will appreciate the MP-EG1A, too. It's easy enough to set up that almost anyone can be taught to use it to capture video and stills for use elsewhere.

Most important, we hope that other manufacturers—and Hitachi itself, for that matter—get their hands on the MP-EG1A, copy what they like, and improve what they don't.

For example, we would like to see an improved user interface. As it stands, the sole interface is through the small LCD screen on the unit's rear panel. Most of the annunciators are white, and they're readable in many situations. In the sunny outdoors, however, the display usually washes out—even with the sun shield installed—so that the user interface usually disappears. Why not put the important user indicators on an LCD? It might take up some space, but it will consume very little battery power.

Despite our complaints, the MP-EG1A is an amazing product. It's tantalizing to think of what the next generation of disk-based camcorders will bring. ■

File Finder

SMART DISKLABELER SOFTWARE. From Seiko Instruments USA Inc., 1130 Ringwood Court, San Jose, CA 95131; Tel: 408-922-590; Fax: 408-922-5835; Web: http://www.seikos-mart.com. Price: $29.95.

We're the first to admit that we are not well organized. When we attempt a repair job around the house, it often takes longer to locate the necessary tools and hardware than it does to complete the task. And forget about trying to find papers—between professional journals, bills, daily newspapers, bank statements, bills, magazines, books, catalogs, bills, junk mail, press releases, children's artwork, bills, shopping lists and coupons, and yet more bills, it's a chore even finding the right pile to search through. We record television programs on our VCR, but never remember to label the tapes. So, when it's time to watch, we must scan through a half dozen tapes before locating the one we want—if, that is, we haven't accidentally recorded over it already.

We're not much better when it comes to our computer files. More times than we care to remember, we've spent time and effort on the Internet and elsewhere, downloading files, drivers, and patches, only to lose them in one of our stacks of unlabeled (or incorrectly labeled) disks. We always *intend* to label them, but we tend to procrastinate—a major source of our disorganization troubles.

Now that we've discovered the *Smart DiskLabeler* from *Seiko Instruments USA Inc.*, we hope those days have ended. The program provides an easy, convenient way to label and catalog floppies, CD-ROMs, Sysquest and Iomega disks, and other storage media used on business and home PCs. It eliminates the need to insert and read disk after disk in search of a file.

The program maintains a directory of all the files saved on various media, making it easy to locate a particular file. In addition to storing the names and locations of all files, Smart DiskLabeler also lets you add reminders about a file or disk, and prints out labels with a disk name, description, date, and contents for simple identification.

The program requires a 386 or higher PC, Windows 3.1 or 95, a 1.44-MHz 3.5-inch floppy drive, 4 megabytes of RAM, and 2 MB of hard disk space. Seiko recommends using their Smart Label Printer EZ0 or Smart Label Printer Pro; you cannot use the original Smart Label Printer or the Smart Label Printer Plus. You can, however, output the labels to a laser or inkjet desktop printer, using Avery or Maco disk-label sheets. If a disk contains too many files to fit on a label, you can print a complete file listing onto standard paper.

Installation using Windows 95 was a breeze, taking only a minute or two and a few mouse clicks to complete. Using Smart DiskLabeler isn't much more difficult. Stick a disk into the drive, select the proper drive (*not* a hard drive or network drive), click on "read," and enter a name for (and, if desired, a description of) the disk. You'll see all the files displayed in the preview window. Select the label type, click on "print," and your label will be printed.

The left side of the Smart DiskLabeler main screen contains the preview window. Just below it are controls for selecting the drive, and reading, saving, and printing the disk. There's also a box that displays the disk name and the total number of disks catalogued.

The right side of the screen is dedicated to user options: selecting the correct type of printer and label; changing the size (small or large) of the default-window type; and sorting the files by either name, type, or date. Two additional tabs running along the far right side of the screen are labeled "dir" and "notes."

Choosing the directory tab displays a directory all of the disks that have been read by Smart DiskLabeler. Click on one to view its contents. If you're looking for a particular file, and can't remember what disk it is on, you can use the "find" function to locate it. Type in the file name, or part of it (with or without wild cards). Smart DiskLabeler will provide a list of disks on which that name (or partial name) appears. The search results include disk name and description, and file name.

We experienced a glitch using the file-search function. No matter what we searched for—full file names that we knew were on one of the disks, "txt" or "doc" extensions with wild cards and without—we got the same "Files found 0, disks searched 0" message. We closed the program and rebooted the computer, and the glitch disappeared. The file-search function then worked perfectly.

The "notes" tab opens a window with a small box in which to type the disk name, and a much larger box, which we assumed was for typing a descriptive note or reminder to add to a label. We had to make an assumption because "notes" is not mentioned anywhere in the brief user's guide or the on-screen help. We tried attaching a brief note to a label, clicked on save, printed—no note. We recalled that disk—still no note.

We called the technical-support number listed on the back of the user's manual, reached a voice-mail directory with no

option for Smart DiskLabeler, and picked numbers at random until we reached a real, live person. We then remained on hold for more than a half hour while he tried to find an answer to what we considered to be a couple of relatively simple questions: "What is the purpose of the "note" tab?" and "How do we use it?". He offered to call us back when he got some answers. We've yet to hear, but we figure that any notes we need to add could be squeezed into the 45-character space allotted for "disk description."

Other than those two glitches, we experienced no difficulty, even though we used the program with a laser printer instead of a Seiko Smart Labeler. (We do own a Smart Labeler but it turned out to be one of the two models that are incompatible with Smart DiskLabeler.)

In fact, instead of a jumble of floppies strewn in a drawer, we now have a neatly labeled stack. Some are ready to be reused, others have been stored until we might need them. Our backup disks are labeled with dates and descriptions, making it easy to know when we can erase old data.

If only we could figure out how to make Smart DiskLabeler print out reminders such as: "You left the hammer in the pantry closet when you installed shelves in there," or "This videotape contains *Seinfeld* and *ER* episodes recorded on Thursday October 16," or "The overdue MasterCard bill is in the pile on the floor to the left of the couch." Then, we could really get organized! ■

WAVE OF THE FUTURE

(Continued from page 27)

10 minutes), but we didn't heat up the kitchen at all.

As we allowed the rice to "sit covered for five minutes before serving," we "sauteed" the vegetables simply by adding a bit of butter to the dish and zapping it for about two minutes. It came out perfectly. The rice, while still tasty, could have cooked for slightly less time; perhaps the instructions had a less-powerful oven in mind. At least it didn't burn to the bottom of the pan, as our stove top attempts often do while we're tending to child or cats. Microwave ovens turn themselves off; stoves do not.

We grilled the chops for a number of reasons. First, the microwave was already occupied with other dishes. Second, we like the taste of grilled meats. Third, we still haven't overcome our distrust of "nuked" meats—they should be nicely browned, if not charred on the outside, tender and pink on the inside. Microwaves still fall short on browning meats (or anything else).

We found ourselves using the MA-1505W quite a bit, for large and small tasks. The pint of Häagen-Dasz vanilla ice cream that was too frozen to scoop benefited from a brief stint at level 2. It was a pleasure to quickly and thoroughly pop a bag of popcorn to bring to the beach for a snack. We found ourselves reading packages at the supermarket, surprised at how many products include microwave cooking directions, and eying microwave-safe cookware with longing. We even borrowed a couple of "gourmet microwave" books from the library.

We haven't gotten too adventurous yet. The dinner-time "witching hour" still leaves little room for creative cookery. And don't expect to see us roasting our Thanksgiving turkey in the microwave—although we just might cook the broccoli, green beans, and yams in it. But after using the MA-1505W Multiwave, we have a newfound respect for microwave ovens. This is one appliance that's not likely to end up in anyone's basement. ■

Gizmo News

DVD VIDEO GROUP FORMED

To create consumer awareness of the DVD format, executives of the home-video units of prominent film studios and music labels joined with consumer-electronics manufacturers to form the DVD Video Group. The new organization will serve as a central information source and promote the format to consumers, the media, and the retail trade. Founding members include Columbia TriStar Home Video, Image Entertainment, LIVE Entertainment, MGM/UA Home Video, Panasonic Consumer Electronics, Philips Consumer Electronics Company, Pioneer Electronics (USA), PolyGram Video, Samsung Electronics America, Sony Electronics, Sony Wonder/Sony Music Entertainment, Thomson Consumer Electronics, Toshiba America Consumer Products, Warner Home Video, Warner Music Group, and Zenith Electronics Corporation.

The group's mission is to "establish a single, consistent voice to communicate the many benefits of the DVD Video experience," including superior picture and sound quality, compatibility with audio CDs, durability, and special features such as multiple camera angle options and "behind the scenes" commentary.

DVD discs look like audio CDs but hold much more data. It would take seven CDs to hold the 4.7 gigabytes that can be stored on the basic single-layer, single-sided DVD disc. A double-sided, dual-layer disc can hold up to 17 gigabytes. There's enough room on a basic disc for a full-length film, and then some. Producers can choose to add as many as eight different sound tracks, 32 subtitle tracks, various aspect ratios, or even different versions of the film (R- and PG-rated, for instance). Picture quality is better than laserdisc, and Dolby Digital surround sound is used on DVD recordings. (Not all players have Dolby Digital decoding circuitry, however.) Close to 100 titles are currently available, with another 70 or so "soon to be released."

"The DVD Video Group will provide a constant flow of information about DVD Video benefits, as well as updates about hit movies, re-released classics, and innovative music videos from chart-topping artists to consumers, retailers, and the media so they can make informed decisions about this exciting format breakthrough," said Emil Petrone, chairman of the DVD Video Group and of Philips Consumer Electronics. "We hope to welcome many other companies into the DVD Video Group as they solidify their plans and announce their intention to launch DVD products."

MEDIA IN THE MILLENNIUM

According to a study of consumer media consumption, by the turn of the century book-buying will be nudged out of second place by home-video sales and rentals. The number-one category of consumer media spending? The same as now: subscription video services, including pay-per-view, satellite, and cable TV. Usurping recorded music's fourth-place position will be interactive media, which includes video games, online services, and general-interest software.

Those are some of the highlights of the 1997 "Communications Industry Forecast," from Veronis, Suhler & Associates, an investment banking firm that specializes in media transactions. The report also found that American viewers will be spending more time watching subscription TV services than broadcast TV, and that total consumer media spending will increase by almost 40%, to $144.8 billion, by 2001.

The report predicts that the average American will clock an average of 1551 hours a year in front of a television, and 1072 hours listening to radio, slightly less than today's figures. Those favorites will be followed by 336 hours listening to recorded music, 153 hours perusing the daily paper, 99 hours reading books, 79 hours browsing through magazines, 60 hours watching prerecorded videos, 39 hours online, 37 hours playing video games, and 12 hours in movie theaters.

Makes you wonder if you'll have time to sleep, doesn't it?

SMITING CYBERSMUT

The White House and the computer industry have reached an agreement on how to protect children from pornography on the Internet, without requiring government regulation. Such a consensus is important in light of the fact that the 1996 Communications Decency Act—one such government regulation—already has been ruled unconstitutional by the Supreme Court because it restricted freedom of speech. It is hoped that with the Clinton administration and the computer industry working together, it will be possible to avoid the adoption of a "V-chip" for the Internet.

At the mid-summer meeting, computer-industry leaders agreed to police themselves. They offered to make readily available software designed to block material unsuitable for children, and to strive to identify Web sites that are kid-friendly.

President Clinton said that the White House meeting "paved a way to a family-friendly Internet without paving over the constitutional guarantees to free speech and free expression." The government's role will be to strictly enforce existing child-pornography, anti-stalking, and obscenity laws as they apply to the Internet. "We must not allow pornographers and pedophiles to exploit a wonderful medium to abuse our children," the President declared.

Netscape Communications had agreed to add to the next release of its Internet browser controls allowing parents to select which sites their children see. Several search engines, including Yahoo, Lycos, and Excite, have agreed to ask Web sites to rate or label their content when applying for listings in their directories.

Steve Case, chairman of America Online, remarked, "We are—today, right now—delivering tools that empower families, neighbors, and educators to limit and filter what can be seen by, and sent to, our children." He added a note of caution, stating that "tools are a supplement to good parenting, not a replacement for it."

While the government-industry consensus was applauded by several parents' groups, including the National Parent-Teacher's Association, Barbara Ford, president of the American Library Association, supported some of the ideas, but balked at the idea of putting filters on library computers, which are used by adults as well as children.

THE COMPETITION HEATS UP

After a week of intensive negotiations in mid-July, the Federal Communications Commission has tentatively okayed a merger between two communications giants while opening their East-coast monopoly to competition. The $23.7 billion merger of Bell Atlantic and NYNEX is contingent upon a number of provisions, most of them highly technical, that will make it easier for potential rivals such as MCI and AT&T to compete for local customers. Bell Atlantic and NYNEX serve 26 million customers, providing local telephone service to a quarter of the nation.

FCC chairman Reed E. Hundt said of the agreement, "If Bell Atlantic and NYNEX want to be the East Coast phone company, then they must open the whole East Coast to competition."

NYNEX and Bell Atlantic agreed to the terms primarily to hasten the merger, which was proposed last April, but also because the deal might allow them to enter more quickly the lucrative long-distance business. The flip side of opening local markets to competitors would be permitting Bell Atlantic and NYNEX to provide long-distance service.

Thomas Tauke, NYNEX executive vice-president of regulatory affairs, remarked, "Competition will now come more quickly to both the local and the long-distance markets in our 13 states." His company serves all the New England states along with New York, while Bell Atlantic serves six states between New York, North Carolina, and Washington, D.C.

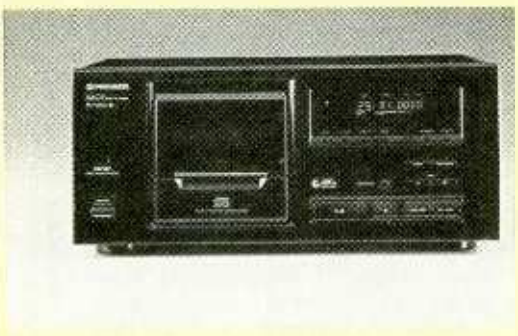
Potential rivals will not have to create their own networks of switches and wires. The agreement mandates that NYNEX and Bell Atlantic lease their wires at wholesale prices to their competitors and set up software systems that would allow their customers to seamlessly switch service to another carrier.

MCI, which now provides local service primarily to businesses, embraced the agreement, which will allow them to reach more residential customers. Headquartered in Washington, D.C., MCI provides a full range of integrated communication services to nearly 21 million customers. With 1996 revenues of $18.5 billion, it is one of the largest and fastest growing telecommunications companies in the world.

Not everyone welcomes the merger, however. Gene Kimmelman, co-director of the Washington office of Consumers Union is opposed to the merger, and believes that the technical provisions are not sufficient to allow the new entrants a fighting chance against the newly merged giant.

And there are some obstacles in the way to final FCC approval, including disagreements over the pricing of local network access and over the scope of the language in the agreement. And the votes of two commissioners other than Mr. Hundt are required. Despite those hurdles, the merger—one of the largest in history—is expected to be approved. ■

ELECTRONICS WISH LIST



Pioneer Multi-Disc CD Changer

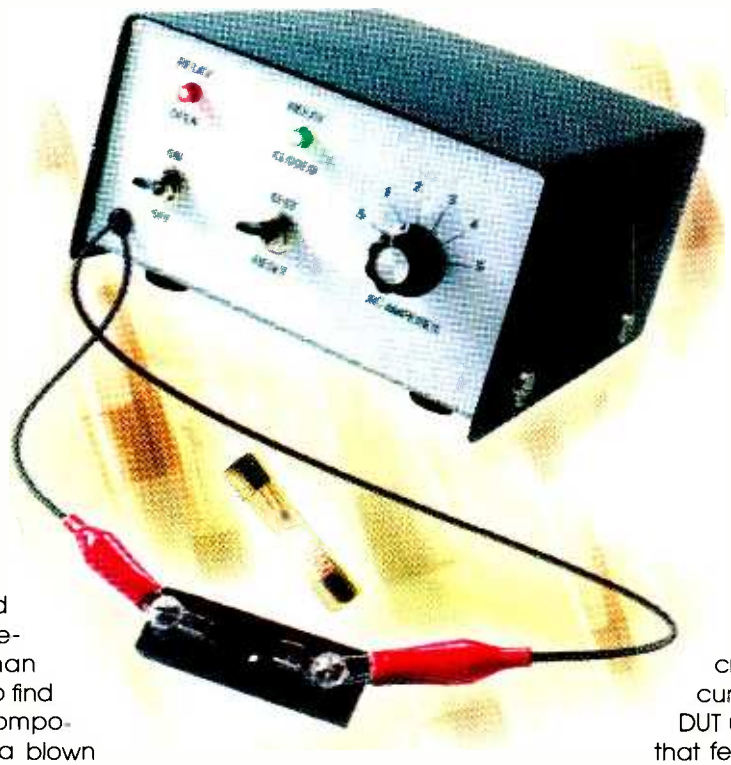
25-Disc CD Changer

Pioneer Electronics' (265 East 220th Street, Long Beach, CA 90810-1639; Web: http://www.pioneerelectronics.com) 25-disc *Model PD-506* CD changer allows you to customize disc selections for a variety of purposes or listening moods. Its mechanical design, which has been improved compared with earlier models, requires substantially fewer moving parts for faster, quieter, smoother operation. The PD-506 offers a number of features for ease of operation. Three custom file groupings let you arrange discs by genre, artist, or style, while best selection memory lets you program up to 15 favorite tracks from among all the loaded discs. Upon power up, last-disc memory recalls the last CD played. The multi-disc changer allows you to play all discs, a single disc, or a programmed selection. It offers seven repeat modes, including single-track and -disc, all discs, custom file disc selection, random, single-disc random, and programmed tracks. Price: $245. ■

Popular Electronics
November 1997

Build the FUSESAVER

When testing electronic equipment, spare yourself some frustration and save the unit's overworked fuses with a simple electronic fuse substitute that can be set to handle operating currents ranging from 0.5 to 5 amps without breaking a sweat.



LARRY BALL

Most technicians won't admit it, but sometimes we take the phrase "smoke test" quite literally. After checking a circuit and replacing the defective components, there comes a moment of truth, which occasionally results in the literal "cloud of smoke." That's because more often than not, we've neglected to find all the defective components, which results in a blown fuse—or sometimes several blown fuses. Wouldn't it be nice to have a fuse that lasts forever, one that can be adjusted to the required current level, and would never have to be replaced? Now you can have just such a fuse, with the *Fusesaver*!

The Fusesaver is a convenient electronic fuse substitute that clips to the fuse connections of the device under test (DUT). With its circuit-breaker-like operation, the Fusesaver replaces the existing (and possibly soon-to-be-blown) fuse. It can save you loads of frustration, not to mention money and wasted time driving around buying fuses. The Fusesaver is simple enough to be built using point-to-point wiring. It was designed around only the most common, readily available parts. In fact, you probably have many of the parts in your junkbox right now. And if you don't have all the parts on hand, everything (except the optional etched and drilled printed circuit board) can be purchased from your local RadioShack outlet.

The Fusesaver places a SPDT relay in series with the DUT to control AC power to the load. At the same time, a monitoring circuit is connected to the DUT to sense the current flowing through the unit. If the current flowing through the DUT rises above a predetermined level, the Fusesaver disconnects the DUT from the AC power source. To accomplish that, the Fusesaver uses the relay's normally-open contacts, which is inherently safer than using the normally-closed contacts. The normally-closed contacts can allow current to flow through the DUT unexpectedly. Because of that feature, you can leave the Fusesaver connected to the DUT even when it is off.

The Fusesaver has six preset current ranges, extending from .5 to 5 amperes, that are made available through a 6-position rotary switch. (Other current ranges can be added to or substituted for those provided with a little experimenting and a switch with more contacts.) The actual current setting can be adjusted to any level within that range.

Since a recent study revealed that over 17% of U.S. fuse sales are electronic fuses, now is a good time to learn how an electronic fuse works by building the Fusesaver for your test bench.

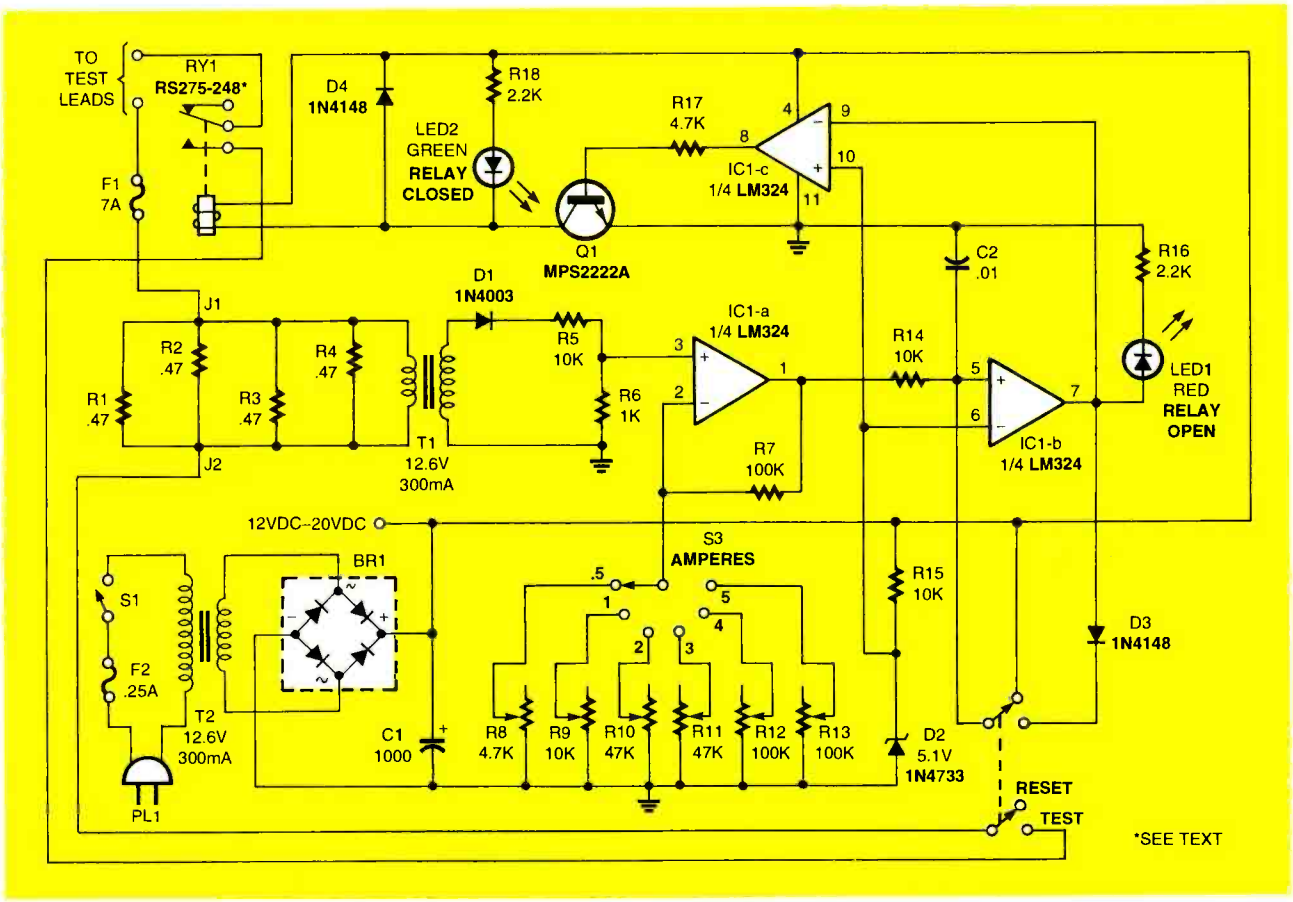


Fig. 1. The Fusesaver—comprised of a quad op-amp, a general-purpose transistor, a pair of step-down transformers, a few diodes, and other support components—is designed to monitor current through the device under test and remove power from the device when its current exceeds a preset level. The Fusesaver has six preset current levels that can be selected via S3.

Circuit Description. Before we get into the nuts and bolts of the circuit, let's take a moment to survey the "lay of the land." Then we'll see what happens as the Fusesaver goes through its paces. A schematic diagram of the Fusesaver is shown in Fig. 1. The circuit is comprised of a quad op-amp, a general-purpose transistor, a pair of step-down transformers, a few diodes, and other support components.

In the circuit, test leads connect the Fusesaver to the fuseholder of the DUT. The test leads allow the Fusesaver to both monitor and turn off the current through the DUT. To determine the proper point at which to shut the DUT down, the Fusesaver samples the voltage drop across four, parallel-connected 0.47-ohm, ceramic, power resistors (R1–R4). As the current through that resistor bank increases, the voltage across the bank increases proportionally. The voltage developed across the resistor bank is coupled through T1 to D1, where it is half-wave rectified. The rectified output of D1 is then reduced by a voltage divider (comprised of R5 and R6).

The voltage appearing at the junction of R5/R6 is applied to the non-inverting input of IC1-a (1/4 of an LM324 quad op-amp) at pin 3. The output gain of IC1-a can be selected via S3 (a SP6P rotary switch). Since the ratio of R7 and the resistor (R8–R13) selected through S3 determines the gain of IC1-a, selecting any of the six available resistances (ranging from 4.7k to 100k) associated with S3 will change the gain, and thus the allowable current range of the circuit. The output of IC1-a is fed, via R14, to the non-inverting input of IC1-b (which is configured for comparator operation and also serves as a latch).

At the same time, a 5.1-volt reference voltage provided by D2 (a 5.1-volt, 1-watt Zener diode) is applied to IC1-b's inverting input at pin 6. The output of IC1-b (pin 7) is fed to the inverting input (pin 10) of IC1-c. The now inverted signal (output at pin 8 of IC1-c) is applied to the base of Q1, which, in turn, controls relay RY1. Energizing the relay causes its normally-open contacts to close, connecting the DUT to the AC power source. When the relay is disengaged, the AC power source is disconnected from the DUT.

Now let's take a look how the circuit works under actual operating conditions. When S2 is placed in the TEST position, the wiper of the switch is connected to the normally-open contact of the relay. Under that condition, no current flows through R1–R4, so the output of IC1-a, which is applied to pin 5 of IC1-b, is below the reference established at pin 6 of IC1-b. Because the inverting input of IC1-b (pin 5) is at a higher potential than its non-inverting input (pin 6), its

PARTS LIST FOR THE FUSESAVER

SEMICONDUCTORS

BR1—1-amp, 200-PIV, full-wave, bridge rectifier (DIP)
D1—1N4003 1-amp, 200-PIV, silicon rectifier diode
D2—1N4733 5.1-volt, 1-watt, Zener diode or equivalent
D3, D4—1N4148 silicon switching diode or equivalent
IC1—LM324 quad op-amp, integrated circuit
LED1—Standard red (Radio Shack 276-041 or equivalent)
LED2—Standard green (Radio Shack 276-022 or equivalent)
Q1— MPS2222A or equivalent NPN silicon transistor

RESISTORS

(All fixed resistors are ¼-watt, 5% units unless otherwise noted.)
R1–R4—0.47-ohm, 5-watt, 10%, ceramic power
R5—10,000-ohm
R6—1000-ohm
R7—100,000-ohm
R8—4700-ohm, miniature trimmer potentiometer
R9—10,000-ohm, miniature trimmer potentiometer
R10, R11—47,000-ohm, miniature trimmer potentiometer
R12, R13—100,000-ohm, miniature trimmer potentiometer
R14, R15—10,000-ohm
R16, R18—2200-ohm
R17—4700-ohm

CAPACITORS

C1—1000-µF, 35-WVDC electrolytic
C2—0.01-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

T1,T2—12.6-volt, 300-mA, miniature, step-down power transformer (RadioShack 273-1385 or equivalent)
RY1—SPDT 12-volt coil, 10-amp contacts relay (Radio Shack 275-248 or equivalent)
S1—SPST toggle switch
S2—SPDT toggle switch (rated 6-amp minimum)
S3—SP6P or DP6P rotary switch
F1—7-amp fuse
F2—0.25-amp fuse
Printed-circuit materials, fuse holders, project enclosure, alligator clips, solder, wire, hardware, *etc.*
Note: The following parts are available from Futuretech (PO Box 6291, Gulf Breeze FL 32561): A printed-circuit board for $12.00 (plus $3 shipping and handling). Florida residents please add 7% sales tax.

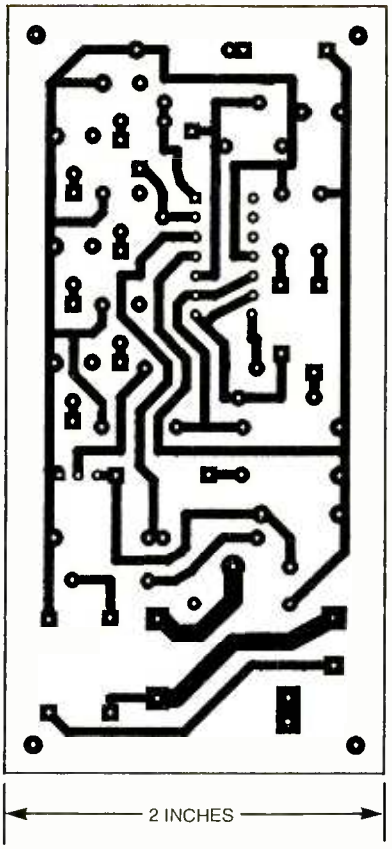


Fig. 2. Although the Fusesaver is simple enough to build using point to point wiring, the bulk of the author's unit was assembled on a printed-circuit board that measures 2 by 4 inches. A template for that printed-circuit pattern is shown here full size.

output is low. That low is applied to the inverting input of IC1-c, forcing the output of IC1-c high. That high is applied to the base of transistor Q1, causing it to turn on.

With Q1 turned on, the coil of the relay is grounded through the transistor, energizing RY1, and allowing current to flow through the DUT. At the same time, the energized transistor (Q1) pulls the cathode of LED2 (the "RELAY CLOSED" indicator) to ground potential, causing it to turn on. Since the DUT current is below the selected level, the output of IC1-b remains low, keeping the output of IC1-c high so RY1 remains in an energized state.

If for some reason the current through the DUT rises above the normal-operation level, the output of IC1-a rises above the reference level established at pin 6 of IC1-b. That causes the output of IC1-b to toggle and latch high (more on the latching function in a moment). The high output of IC1-b, in turn, causes the output of IC1-c to go low. That low turns off Q1, which removes the relay's ground path, de-energizing RY1, thereby disconnecting the AC power source from the DUT. While that's going on, the high output of IC1-b is applied to the anode of LED1 (the "RELAY OPEN" or fuse blown indicator), causing it to light.

The latching action of IC1-b is initiated by feeding its high output back to its non-inverting input via D3 and S2 (when it is in the TEST position), thereby keeping the output of IC1-b high until S2 is placed in the RESET position, which disconnects IC1-b's output from its input. Resistor R14 provides a voltage drop so that the input of IC1-b can be high despite being connected to the low output of IC1-a. Diode D3 prevents IC1-b from becoming latched in the low state.

When S2 is in the RESET position, the non-inverting input of IC1-b is forced high, causing its output to go high. The high output of IC1-b is applied to the anode of the "RELAY OPEN" indicator (LED1), causing it to light. That high is also applied to inverting amplifier IC1-c, forcing its output low. That low, which is then applied to the base of Q1, causes the transistor to cut off, de-energizing RY1, thereby disconnecting the DUT from the AC power source.

Before we even get into the construction of the unit, a warning is in order: Because the Fusesaver operates from an 117-volt AC power source and controls 117-volt AC power sources, all appropriate precautions should be taken in assembling and using the unit.

Construction. The Fusesaver can be built using a variety of construction methods—including point-to-point soldering, wire-wrap techniques, or printed-circuit construction. The author's unit was assembled on a small printed-circuit board, measuring 2 by 4 inches. A template of that printed-circuit layout is shown in Fig. 2. There are two important considerations when building the Fusesaver. Foremost, the 117-volt, AC components *must* be safely isolated from the DC circuitry, and the four 0.47-ohm, 5-watt, power resistors (R1–R4), must be allowed ample airspace so

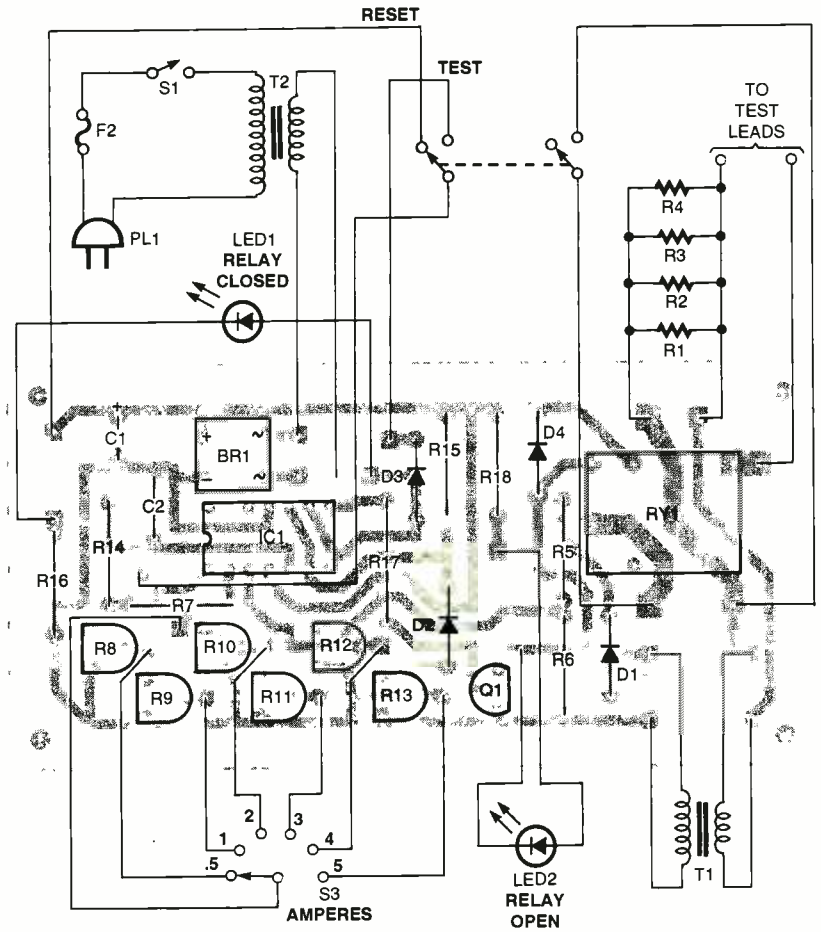
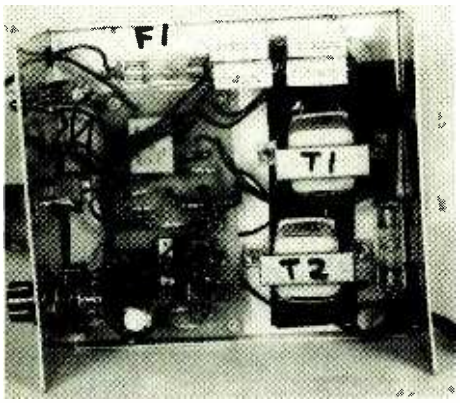


Fig. 3. Assemble the Fusesaver guided by this parts-placement diagram. When assembling the Fusesaver, be certain that the 117-volt, AC components are kept safely isolated from the DC circuitry. Also be sure that the four 0.47-ohm, 5-watt, power resistors (R1–R4) are afforded ample airspace to avoid overheating.



The Fusesaver was mounted in a medium-sized vented metal enclosure. The leads of the two power transformers were bent outward at a 90° angle and then mounted to the bottom of the enclosure. Several layers of electrical tape were positioned directly under the units to prevent them from shorting to the enclosure.

as to provide sufficient ventilation to avoid overheating.

In addition, it is important that the circuit be housed in a vented, metal enclosure like the type used in the author's prototype. The vents allow heat to escape the confines of the enclosure, while the enclosure itself helps to channel additional heat away for the circuitry. Note: The transformers specified in the Parts List have leads that protrude from the bottom the unit. Therefore, when mounting those two units to the enclosure, the leads must be bent 90-degrees outward, and insulation placed between the transformers and the chassis. A pad of several layers of electrical tape should be sufficient.

Once you've obtained all of the components listed in the Parts List, assemble the printed-circuit board guided by the parts-placement diagram shown in Fig. 3. Pay close attention to the placement and orientation of the on-board components. Be especially careful of the orientation of all polarized components (the diodes, IC1, and C1). When wiring the off-board components to the board, take note that T1's normal orientation is flipped; e.g., its low-voltage secondary is used as its primary (input).

When you've finished assembling the printed-circuit board and connecting the off-board components to the circuit, check your work for the usual construction errors—cold solder joints, misoriented or misplaced components.

Calibration and Setup. Once assembly is complete and you are confident that the project contains no construction errors, the Fusesaver should be calibrated. However, if you're willing to accept less accuracy, the current-setting potentiometers (R8–R13) can simply be adjusted as follows: R8 = 500 ohms, R9 = 1.8k, R10 = 4.7k, R11 = 7.9k, R12 = 11.1k, and R12 = 14.4k. Those resistances correspond to 0.5, 1, 2, 3, 4, and 5 amps, respectively. Any resistive AC load—such as large-wattage resistors or even combinations of light bulbs—is acceptable for calibration. If you use light bulbs, don't be fooled by the surge of current as the bulbs turn on. The bulb's cold resistance is less than its hot resistance, so the initial current flow can be surprisingly high. Using R8 as an example, the method of calibration is as follows:

Step 1: Connect a DVM or oscilloscope between IC1 pin 5 and ground.

Step 2: Connect a 0.5-amp resistive load to the test leads of the Fusesaver. With S3 in the 0.5-amp position and S2 in the RESET position, turn on the Fusesaver.

Step 3: Adjust R8 to its maximum value. Turn on the load. Switch S2 from the RESET to the TEST position. With that, current should flow through the load (LED2 will be on).

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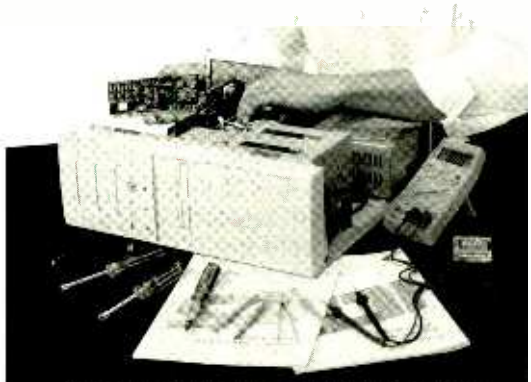

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AV69

While noting the reading on your test instrument, slowly adjust R8 (in effect altering the gain of IC1-a) until RY1 switches the load off. The goal is to determine the exact voltage level at which RY1 is triggered. Repeat this step to be sure that the circuit is properly set. Now, repeat step 3, but this time leave R8 adjusted to a voltage about 20% less than the value needed to trigger the relay. Repeat steps 2 and 3 for each potentiometer, using the appropriate current levels for R9–R13.

Using the Fusesaver. Using the Fusesaver is a lot like calibrating it, except that there are no adjustments to make. Turn on S1 with S2 in the RESET position. Select the desired current level with S3. With the DUT turned off and unplugged from the AC outlet, connect the test clips of the Fusesaver to the fuse holder of the DUT. Plug in and turn on the DUT. Move S2 to the TEST position. If the DUT current is lower than the selected value, RY1 will energize, the DUT will remain connected to the AC power source, and LED2, the (green) RELAY CLOSED indicator, will be on. If the DUT current is higher than the selected value, the Fusesaver will disconnect the DUT from the AC power source, latch in the "fuse blown" state and LED1, the (red) RELAY OPEN indicator will then be on. Once the Fusesaver has been triggered, S2 must be moved to the RESET position to unlatch the unit before retesting the DUT.

You may notice that some devices trigger the Fusesaver's "fuse blown" state at lower current levels than expected. That's normal, and is similar to what happens when you use light bulbs to calibrate the Fusesaver. Many solid-state devices have a higher surge current while turning on than while working. (I wondered how disposable fuses dealt with that problem, and a cursory test found that standard fuses blow at a value up to a 50% higher than their rating. With slow blow, or time delay fuses, much higher peak currents can be accepted). You can compensate for the situation by selecting a higher current level when turning on the DUT, then reducing the level. ■

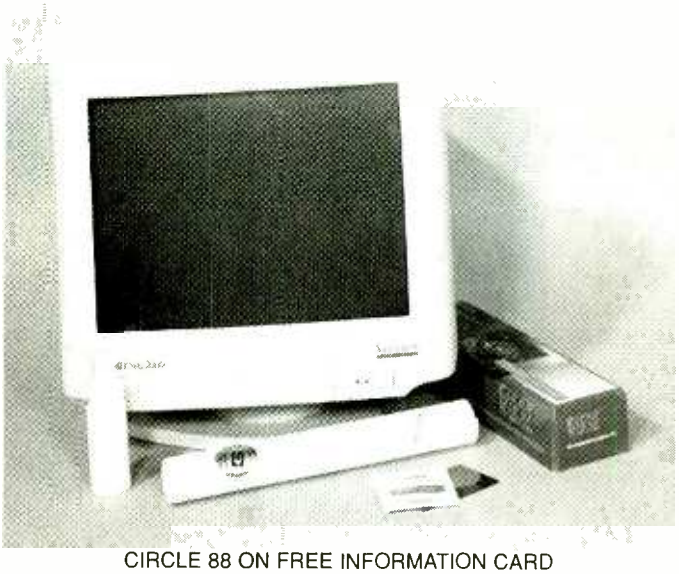
A Hands-on Electronics® REPORT

Clear View TV and PC Softlens Picture Enhancement Filters

Two new products eliminate distracting and annoying glare from your TV screen or sharpen the definition of characters on your monitor screen.

You can go snow blind on a sunny winter day if you are not wearing proper shades (sun glasses). Your TV screen can be almost as bad, with glare and reflection bouncing off the picture tube's polished glass. You could close your shades and put out the lights—thereby eliminating stray light sources. That's tough to do in most homes. One solution to increasing your viewing pleasure is to eliminate reflections by adding a commercial tinted plastic.

Two New Products. The *Clear View TV Softlens Picture Enhancement Filter* from Ergotech International worked well on our TV screen. The tinted plastic fits standard-size picture screens from 14- to 36- inches diagonally. Another product, the *Clear View PC Softlens Monitor Enhancement Filter*, shapes the definition of images on your computer screen. The PC filter adds *pop* to fuzzy characters and details that would ultimately cause eyestrain without the filter.



CIRCLE 88 ON FREE INFORMATION CARD

Installation. Before applying the Clear View TV or PC Softlens tinted plastic sheet to the screen of your monitor, turn off the unit's AC power. Two sheets of plain paper separate the two plastic sheets supplied. Take one sheet of paper for use as a template. Align one corner of the paper with the upper, left-hand corner of the screen. Holding the paper against the screen, score a crease in the paper by pressing your fingernail along all four sides of the screen's edge, creating an outline for the template. Then cut the template just inside the crease mark and recheck the template's size on the screen. Place the tinted plastic (with the uncut plain paper underneath) on a flat, clean surface. Now lay the template on top and cut the plastic to template size.

Thoroughly clean your screen surface with the cleaning pad provided. Check that there is no dust or lint on the tinted plastic. Dust or lint on the plastic or screen will cause bumps or bubbles when the job is done. Fill the plastic bottle with water. Spray a fine mist on the tinted plastic and on the top half of the screen. Do not use excessive water. Catch any water that runs to the bottom of your screen with a paper towel or lint-free cloth.

Place the tinted plastic on the screen with the moistened side against the glass. Take the supplied gold plastic card and, beginning 2 to 3 inches from the top center of the plastic and working upward and outward, gently squeegee the excess water and air from under the plastic. Now continue to squeegee, moving the gold card from the center outward in a downward motion, until all of the excess water and air is removed. Do not press hard with the edge of the gold card while squeegeeing, or you may tear the tinted plastic.

When you are sure the screen is free of all water, turn on the appliance and look at the screen. You may have to goose up the brightness a bit to compensate for some light loss through the plastic, otherwise no other adjustment is required. Now look for those reflections and flares from bright lights that hinder TV viewing. Almost all of them should be gone, and what remains is reduced to below the annoyance level. Also, check out the small print on your computer's screen—suddenly it's sharper!

The TV filters come in seven standard sizes beginning with 14-inch screens (all measurements are made diagonally), and that size sells for $24.99. The largest TV filter is 36 inches and sells for $44.95.

The PC filters come in four standard sizes; the 14-inch filter is $29.99 and the largest (21 inch) sells for $44.99. The filters are available from NESDA Network stores nationally or direct from Ergotech International, Inc. (30 Corporate Park, #300, Irvine, CA 92606; Tel: 714-252-1612; Fax: 714-263-0585;) and e-mail: *ergotech @concentric.net*. Add $5.00 for mail orders. California residents must add applicable sales tax.

Leonid Meteors: Celestial Fireworks, Satellite Killers—or Both?

Kirk A. Kleinschmidt, NTØZ

Will November's Leonid meteor shower—potentially the most powerful of our modern electronic era—destroy Earth's precious satellites and space stations? Much like the plot of a pulp sci-fi novel, comet Tempel-Tuttle will soon pass close to Earth. Sometime during the next four years, the regular November meteor shower—caused by Earth passing through the comet's debris—could become a raging storm the likes of which no orbiting structure has ever encountered.

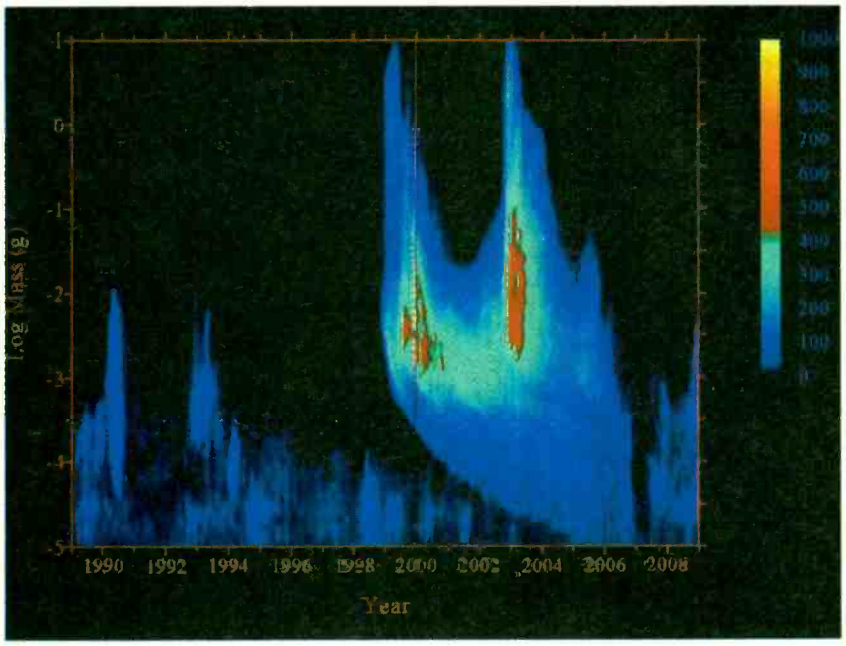
Around 3:30 AM Eastern Time on November 17, 1997, *Galaxy 5*, the venerable cable TV "super satellite," orbiting Earth some 23,500 miles above the equator, was instantly destroyed when a small meteor no bigger than a grain of sand ripped through its innards with seemingly relativistic swiftness. Colliding with a combined velocity of more than 150,000 miles an hour, the grain itself was consumed in the plasma-hot furnace created by the kinetic encounter. A torrent of other nearby micrometeoroids would soon slash brilliant streaks across Earth's nighttime sky as they burned their way into the atmosphere. By the end of this unlikely onslaught, six of Earth's precious geosynchronous satellites would be destroyed or damaged.

On that night, television programs, telephone conversations, computer networks, radio stations and even encrypted images secretly sent from military spy satellites disappeared, as if switched off by some cosmic hand. If the comet, called Tempel-Tuttle in this modern era, had any intelligence as it rounded the sun yet again, perhaps it noticed that Earthlings were now venturing into space—and that they and their constructs seemed quite vulnerable in their new environment.

The Danger is Real. This fictional scenario is a bit dramatic, but as space scientists around the globe are confirming, the potential for destruction or damage to satellites (and other orbiting objects) from meteoroid collisions during this November's upcoming Leonid meteor showers is *very real*.

Satellites have recently been destroyed by micrometeoroids encountered during meteor showers far less active than those predicted for the 1997-2000 Leonids. And *Mir*, the Hubble Space Telescope, and US space shuttles have been visibly damaged by debris and micrometeoroid collisions. What might happen to the more than 500 man-made satellites now in orbit during a meteor storm 10,000 times more intense than normal—with particle impact speeds exceeding 150,000 miles an hour? What indeed! Those conditions were measured during the tremendous 1966 Leonid storm, and scien-

MODELING THE LEONID STREAM



This figure summarizes the early computer modeling results of the Leonid meteor stream as performed by Peter Brown and the University of Western Ontario Meteor Group. The Y axis shows the logarithm of meteoroid mass (10 g at top and 10 micrograms at the bottom) and the X-axis shows the time in years. The diagram in total shows which mass of Leonid meteoroids is predicted to be encountered by the Earth and in what relative numbers according to computer simulations.

This diagram should be interpreted as the relative probability of encountering particles of a given mass in a given year by the Earth—it cannot make absolute predictions of the size or scope of any Leonid storms. The meteoroids shown were ejected from parent comet 55P/Tempel-Tuttle between 1666 and 1965 and are shown at the time they reach the descending node of their orbits (the time when they could encounter the Earth). *Figure courtesy of Peter Brown and the University of Western Ontario.*

tists are worried that we will see a repeat performance (or one or *more* showers of lesser, yet potentially destructive intensity) during the November Leonid showers over the next four years.

Physical collisions alone are cause for concern, but a second threat may be even more ominous. Because of the tremendous impact velocities involved (closing with the Earth at 71 km per second, the Leonids are the fastest-colliding cometary fragments known), the highly charged plasma clouds generated by the impacts of even extremely small Leonid particles may be powerful enough to destroy satellites that would have been minimally affected by the physical collisions. Considering the doubled danger of collisions *and* plasma threats—and the potential for one or more strong Leonid showers from 1997 to 2000—satellite operators are entering a stressful period.

Comets and 55P/Tempel-Tuttle

Most comets encountered by the Earth have relatively stable (although highly elliptical) orbits around the sun. Tempel-Tuttle's orbit traces a very narrow ellipse that rounds the sun and stretches out as far as the orbit of Uranus. The debris left behind by these periodic comets ends up as shooting stars and meteor showers each time the Earth intersects the comet's orbital path.

Several factors allow Tempel-Tuttle to produce periodic spectacles. The comet orbits the sun in nearly the same plane as Earth (inclined only 15 degrees) but *in the opposite orbital direction*, and it has a narrow, dense particle stream (the main stream is estimated to be only 22,000 miles across—consider the popular Hale-Bopp comet with a stream of several million miles long). These factors are exaggerated when the comet passes close to the sun, as it did during the enormous meteor storms observed in 1833 and 1966, and as it will again in 1997-2000.

When the Earth smoves through Tempel-Tuttle's debris stream, the meteors and the planet are moving towards each other with a combined velocity of 71 km per second, or about 158,000 miles per hour. Imagine rear-ending another car on the highway. You're going 70 miles an hour and the car ahead of you is going 50 miles an hour. The difference is a manageable 20 miles an hour. You'll crash, but you'll probably survive. This is somewhat like what happens when we encounter debris orbiting the sun in the *same* direction as Earth motion. With Tempel-Tuttle, the collision is like crashing your car *head-on* into the supersonic *Concorde*—much more violent!

The 1966 Storm and What it Could Mean in the 1990s.

Although the much-heralded Leonids storm of 1833 was spectacular, the November 17, 1966, storm was probably as much as three times as intense, producing up to 150,000 "falling stars" per hour. According to meteorologist and Leonids expert Joe Rao, "In 1965, the year before the big display, Tempel-Tuttle passed very close to the Earth's orbit—little more than the moon's distance away." With Tempel-Tuttle returning to perihelion in late February 1998, the cycle may be starting again.

Peter Brown, a doctoral candidate at the University of Western Ontario (UWO) who specializes in the numerical modeling and analysis of meteor showers, says that during a storm on par with the 1966 spectacular, satellites are exposed in 30 minutes to the number of particles and micrometeoroids normally encountered in a full year.

So, will the killer meteor storm emerge to cripple our precious fleet of satellites, take down the Hubble Space Telescope or cause a tragedy aboard the space station *Freedom*? Or, like some years in the past when conditions should have been "perfect,"—will the storms fizzle and disappoint?

Nicholas Johnson, head of NASA's Orbital Debris Program, still characterizes meteor storm predic-

LDEF—A SPACECRAFT DESIGNER'S BEST FRIEND

Launched in 1984 and recovered by a 1990 shuttle mission, NASA's Long-Duration Exposure Facility (LDEF) gave scientists a lot of information about how materials such as aluminum, fiberglass, composites, glass laminates, ceramic, paints, polymers, thermal insulation, etc., hold up in the harsh "weather" of low-orbit space.

Since LDEF was recovered, scientists and NASA's Langley Research Center have been analyzing the results of the craft's 87 primary experiments. Many of the exposed surfaces, as shown in the accompanying figures, are acned with pits, craters and gashes left by micrometeoroids or other debris.

LDEF was intended to be spaceborne for only a year or so, but the 1984 *Challenger* disaster curtailed shuttle missions for several years, forcing LDEF to live up to the "L" in its name! With no means of relaying sensor data, scientists had to wait patiently to recover the experiments. *Photos courtesy of William Kinard of NASA's Langley Research Center.*

tion as a black art. "We just don't know exactly what's going to happen and when."

Death of a Satellite. Objects in orbit are constantly bombarded by very small particles. Space shuttle windows get "sandblasted" and pitted during missions and are routinely replaced before the craft is relaunched. Long-duration orbiters such as *Mir* have protective window covers to reduce cumulative micrometeoroid damage. The space station *Freedom* will even be armored to withstand the impact of a 1-cm aluminum sphere traveling at 10 km per second.

And while micrometeoroids don't usually destroy satellites on the spot, a large satellite was killed in such an encounter in 1993. The incident spurred Brown and other scientists to study micrometeoroid streams more closely. The casualty was *Olympus*, a large communications platform operated by the European Space Agency. During the 1993 Perseids meteor shower (a minor recurring shower), an outboard solar panel was hit by a meteoroid. According to Brown, scientists think that the kinetic energy transferred during the hit spun the satellite off-axis. Had this been the extent of the damage, *Olympus* probably would have recovered. But as a result of the impact, a highly charged plasma cloud "bathed" the satellite and entered its internal structure, causing gyro errors. Ground-control operators eventually got the satellite stabilized and under control, but all of the satellite's station-keeping fuel had been burned during the recovery. The satellite was effectively dead.

During the same 1993 shower a shuttle mission was delayed and the Hubble Space Telescope was positioned so that its powerful optics were aimed directly away from any incoming meteors. Later shuttle missions would reveal that the Hubble's high-gain dish antenna was cleanly punctured by a meteoroid (or orbiting debris), as were several *Mir* solar modules. Whether the hits took place during the Perseids shower isn't known.

Kinetic Encounters or Plasma Attack? When most of us think about particles hitting satellites we tend to imagine ballistic damage. Much like shooting a bullet at a target, we visualize meteoroids punching into satellites at tremendous speeds. We might even picture the

TABLE 1
STRONGEST OBSERVED LEONID RETURNS SINCE 1799

Year	Period of Occurrence (Activity > 10 times background)	Peak Hourly Rate
1799	Nov 12, 0712 -1200 UTC	> 10,000
1832	Nov 12, 2136 - Nov 13, 0712 UTC	> 20,000
1833	Nov 13, 0712 - 1200 UTC	50,000
1866	Nov 14, 0000 - 0448 UTC	10,000
1867	Nov 15, 0712 - 1200 UTC	>1500
1965	Nov 17, 0224 - 1912 UTC	>5000
1966	Nov 17, 0936 - 1424 UTC	50,000

Note: This information was derived after examining the original sources. In this table, the Peak Hourly Rate is the number of meteors from the shower a standard observer would see under unobstructed skies with the radiant point overhead and the faintest star visible to the unaided eye. *Table courtesy of Peter Brown, UWO.*

TABLE 2
PREDICTED LEONID SHOWER PEAK TIMES

Year	Center of Predicted Peak Periods
1997	Nov 17, 1100 UTC
1998	Nov 17, 1702 UTC
1999	Nov 17, 2302 UTC
2000	Nov 17, 0517 UTC
2001	Nov 17, 1117 UTC
2002	Nov 17, 1731 UTC
2003	Nov 17, 2359 UTC

Note: These times assume that storms in the late 1990s will occur near the same solar longitude as the 1966 storm. The years 1998-2000 are most likely to show storm activity at some level, while 1997 and 2001-2003 are likely to show enhanced activity. *Table courtesy of Peter Brown, UWO.*

satellite breaking up or even exploding—like a scene from a James Bond movie. Ballistic damage is a pressing concern, especially when even a tiny, speck-like particle moving at an incredible velocity can pack as much punch as a tank round or a stick of dynamite. A particle's kinetic energy increases with the square of its velocity, and Leonid particles, with closing velocities much greater than those of typical meteoroids, can pack a tremendous punch.

In the realm of everyday physics this simple model makes sense, especially when a particle hits a thick, solid object such as the main body of a spacecraft or satellite. This allows the tremendous kinetic energy stored in the fast-moving particle to be transferred to the "target." Kinetic damage is bad enough, but Brown and his colleagues are more concerned about the plasma clouds produced when superfast particles hit just about anything (such as those that may have been produced in the *Olympus* incident).

Understanding this mechanism is more difficult and not altogether intuitive. As scientists are discovering, slower, bigger micrometeoroids cause more kinetic damage and produce less "plasma effect" than faster, smaller particles. When particles collide at Leonid velocities, the physical matter simply "falls apart" and disintegrates into a charged plasma cloud before the bulk of its kinetic energy can be transferred to the target. Imagine a super fast ball pitcher throwing a baseball so fast that when the hitter smacked it dead to rights with his bat, instead of the cover being knocked off the ball, as in the old movies, the ball literally "poofed" into nothing (a plasma cloud) while the batter corkscrewed around as if he missed the ball entirely!

The intensity of the plasma field generated on impact varies with the particle's velocity *to the fourth power*. It's amazing to think that a Leonid particle weighing a thousandth of a gram might strike the main structure of a satellite at over 150,000 miles an hour and leave only a microscopic pit in the paint—microseconds before consuming the satellite's electronic systems in a powerful plasma cloud—shocking it as though it had been struck by lightning!

A second effect of plasma clouds may be just as deadly. If the affected satellite survives the direct plasma pulse, it may still be destroyed or damaged by electrostatic discharges between its own components. In orbit, the vacuum of space is an excellent electrical insulator. Insulated spacecraft components such as antennas and solar panels gradually accumulate static charges picked up by "brushing against" the continuous stream of solar emissions, much like an airplane that becomes charged by flying ("frictioning") through the air. Under normal conditions these charges can safely accumulate. But when a satellite is enveloped by a highly conductive plasma cloud, the charged components can "flash over," potentially damaging or knocking out electronic circuits.

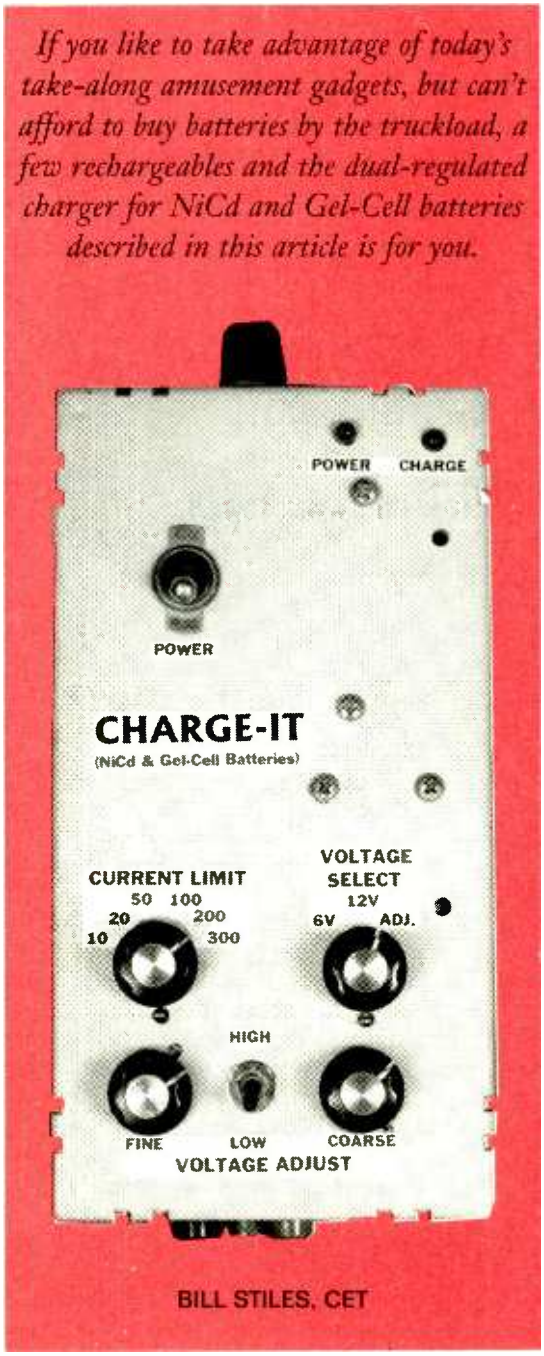
"At Leonid speeds," notes Brown, "meteoroid hits don't have to cause *any* mechanical damage to kill or damage a satellite. In fact, at 71 km per second, plasma damage may be much more of a problem than mechanical damage."

What's NASA Doing? Johnson, Brown and others are sifting through Leonid information on several fronts, and NASA is examining common sense preventive measures. Says Johnson, "Certainly there will be no scheduled shuttle missions or critical launches during the potential storm periods. And if astronauts are aboard the yet-to-be-launched space station, they may be moved into the station's protected internal areas during potential storm periods, or they may even be moved into the emergency crew-recovery

(Continued on page 57)

CHARGE-IT!

If you like to take advantage of today's take-along amusement gadgets, but can't afford to buy batteries by the truckload, a few rechargeables and the dual-regulated charger for NiCd and Gel-Cell batteries described in this article is for you.



BILL STILES, CET

Today NiCd and Gel-Cell rechargeable batteries are found almost everywhere: in tools, computers, telephones, portable radios and TVs, flashlights, emergency lights, camcorders, toys! All those batteries need to be charged. If you bought anything with rechargeable batteries, a charger probably was included in the price of the unit. But if you built a project powered by rechargeable batteries, or replaced non-rechargeable batteries with rechargeable units, or if the original charger is lost or broken, you need a charger.

If your situation fits any of those scenarios, the *Charge-It* is for you. Charge-It will replenish nearly all rechargeable batteries. It has controls that let you set both maximum voltage and maximum current to match the battery being charged. The prototype unit was designed specifically for use with 6-volt NiCd and 12-volt Gel-Cell batteries, so it was originally built with preset charging voltages to accommodate those two types. However, in the present version, a third position on the function switch connects a variable voltage control into the circuit, allowing the circuit to accommodate other battery voltages. If desired, the circuit can be configured to provide additional presets or other voltages.

The maximum current is switch-selected in a 1, 2, 5 sequence from 10 mA to 300 mA, which gives a value near the recommended charging current for most batteries. In addition, Charge-It can be used as a current-limited, variable voltage (1.25 to over 20 volts) power supply. The current limiting ability is useful for testing circuits without overdriving (destroying) the circuit components.

Circuit Description. Figure 1 shows the schematic diagram for Charge-It. AC power is delivered to the circuit through PL1 (AC plug and line cord), S1 (which serves as the main power switch), and F1 (a 1-amp fuse), and applied to T1. The output of T1 (an 18-volt AC, center-tapped, step-down, power transformer) is rectified by BR1 and filtered by capacitor C1. An LM317T adjustustable voltage regulator (IC1) is used as a current limiter. The LM317T limits the voltage between its output and adjust. terminals to 1.25 volts.

When the LM317T is used as a current limiter, a resistor is connected from the output terminal to the adjust. terminal, and the output is taken from the adjust. terminal. A six-position switch, S4, is used to connect the appropriate resistor in the circuit to provide the proper current limit. The resistors for the resistor network (comprised of R5 through R10) is selected by Ohm's Law for a voltage drop of 1.25 at the desired maximum current, using the formula:

$$R = V/I = 1.25 / I$$

In the current-limiting configuration, if the current starts to go over the limit, the LM317T reduces the voltage at its output terminal by reducing the output current, so that the voltage developed across the selected resistor is held to 1.25 volts. Resistors R5–R10 were computed from the above formula. The nearest standard 5% values were used. Components Q1and R2–R4 form a circuit which lights LED2 when the current is at the limit.

A second LM317T, IC2, is used as an adjustable voltage regulator to limit the maximum output voltage to that specified for the battery being charged. It also sets the desired output voltage if Charge-It is used as a power supply. The preset output voltages are set by trimmer potentiometers R14 and R15 for the 12-volt and 6-volt ranges, respectively. A panel-mounted potentiometer, R13 is used to adjust variable output range. Potentiometers R13, R14, or R15 are selected by range switch S3-b. Switch S3-a, when in the 12V position, grounds the negative (–) terminal of BR1, forming a full-wave bridge rectifier - circuit.

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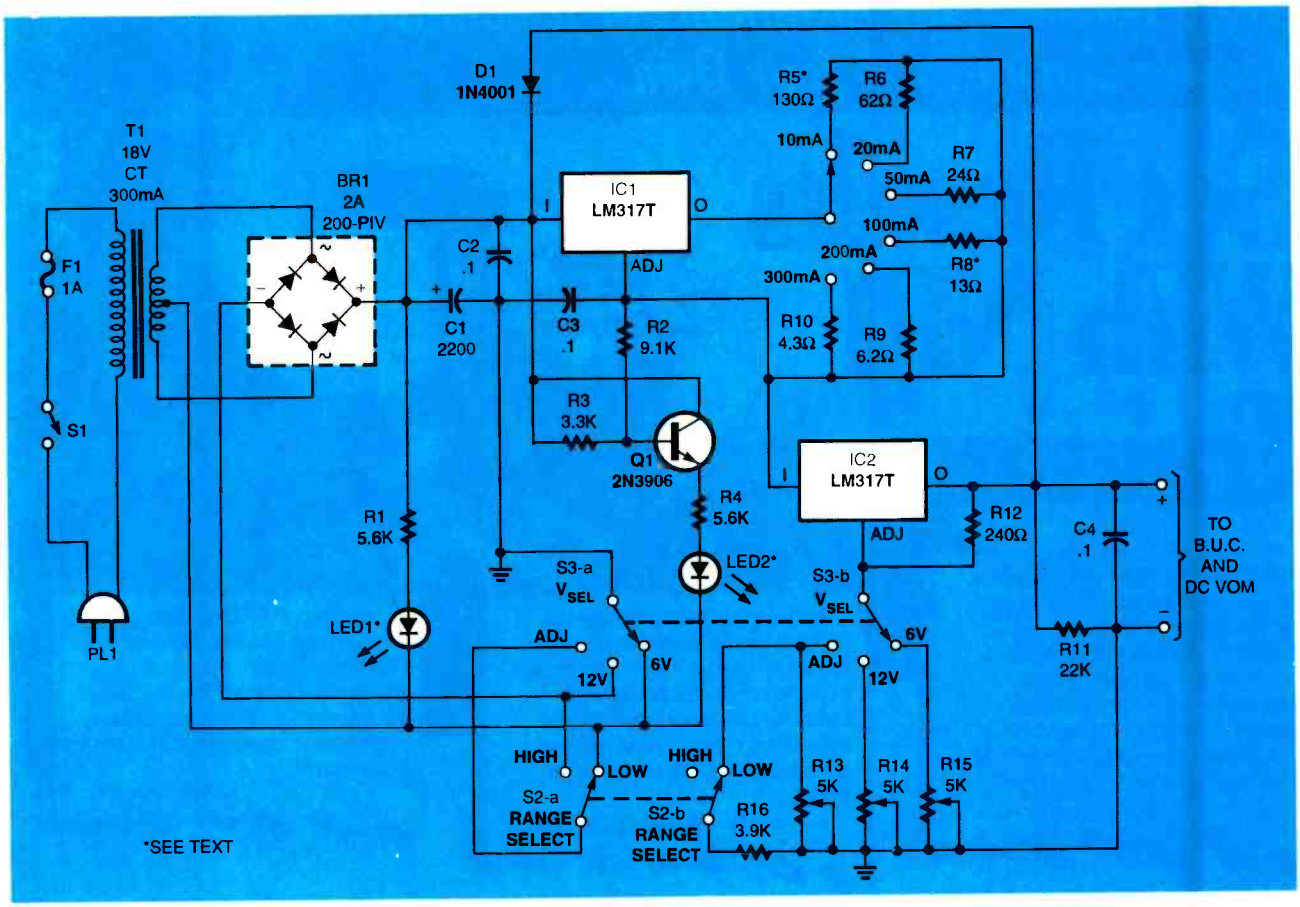


Fig. 1. At the heart of this charger are a pair of LM317T adjustable voltage regulators (IC1 and IC2)—one arranged in a current limiting configuration and the other set up as a simple variable voltage regulator—and fairly a straightforward switching network. Although the circuit is designed as a battery charger, it can also be used as a low-power supply.

In the 6V position, S3-a removes the ground from BR1, and grounds the center tap of power transformer T1, forming a full-wave rectifier circuit, which has half the output voltage of a bridge rectifier. That lower rectifier output reduces the voltage drop (and power dissipation) in IC1 and IC2 when a lower voltage battery is being charged. When S3 is set to ADJUST, S3-a connects S2-a in the circuit to select either the LOW or HIGH output, by grounding either the center tap of T1 or the negative terminal of BR1, as described earlier.

When set to the LOW position, S2-b also connects R16 in parallel with R13, making setting of low voltages easier. The cathodes of LED1 (a pilot light) and LED2 are connected to the center tap of T1, which reduces the voltage change to them when the rectifier circuit is switched. Diode D1 protects IC1 and IC2 from reverse current, in case a battery is connected when the power is off.

Construction. The original Charge-It was built into a surplus plastic enclosure, measuring 4 × 7.75 × 1.5 inches. Components IC1 and IC2, were mounted to small heat sinks and bolted to the inside of the enclosure. Components Q1 and R2–R4 were mounted on a small section of perfboard. Potentiometers R14 and R15 were glued to the inside of the case with Super-Glue. (They could also be mounted on the perforated board.) Most other parts were connected directly to the switch terminals, the output terminals, or the terminals of IC1 and IC2.

LED2 is a low-current (2 to 2.5 mA) unit. If a conventional LED is used in the circuit (with a smaller value for R4), the turn-on and turn-off of the LED at the current limit is more gradual than with a low-current LED. RadioShack stocks a red low-current LED (part No. 276-044). Another source is Digi-Key Corp. (Tel. 800-344-4539); they have red (stock No. HLMP-4700QT-ND) and yellow (stock No. HLMP-4719QT-ND). Some other manufacturers of low-current LEDs, available from various distributors, are Lumex Optoelectronics Inc., Industrial Devices Inc., Chicago Miniature Lamps, and Linrose Electronics Inc. A low-current LED was also used for LED1.

The output connectors should be selected to match the batteries to be charged. In the prototype unit, two banana jacks were used. Leads terminated in banana plugs at one end and clip leads on the other plug into those jacks, and are used to connect to the battery(s) to be charged, or, if Charge-It is used as a power supply, to the circuit being powered. A two-wire cord was wired in parallel with the banana jacks and the free end terminated with a coaxial DC power

PARTS LIST FOR CHARGE-IT!

SEMICONDUCTORS

IC1, IC2—LM317T adjustable voltage regulator, integrated circuit
Q1—2N3906 general-purpose small-signal PNP transistor
BR1—2-amp, 200-PIV, full-wave, bridge rectifier
D1—1N4001 1-amp, 50-PIV, silicon rectifier diode
LED1, LED2—low-current LED (see text)

RESISTORS

(All fixed resistors are 1/4-watt, 5% units, except where otherwise noted.)
R1, R4—5600-ohm
R2—9100-ohm
R3—3300-ohm
R5—130-ohm
R6—62-ohm
R7—24-ohm
R8—13-ohm, 1/2-watt
R9—6.2-ohm, 1-watt
R10—4.3-ohm, 1-watt
R11—22,000-ohm
R12—240-ohm (see text)
R13—5000-ohm potentiometer (see text)
R14, R15—5000-ohm, multi-turn, trimmer potentiometer
R16—3900-ohm

CAPACITORS

C1—2200-µF, 35-WVDC, electrolytic
C2–C4—0.1-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

F1—1-ampere, 125-VAC fast-blow fuse
PL1—AC plug and line cord
S1—SPST toggle switch
S2—DPDT, miniature toggle or slide switch
S3—DP3P rotary switch, (see text)
S4—DP6P rotary switch (see text)
T1—18-volt CT, 300-mA, step-down, power transformer (see text)
Perfboard (see text), enclosure, fuse holder, TO-220 heat sinks, tip jacks, banana jacks, knobs, wire, solder, hardware, etc.

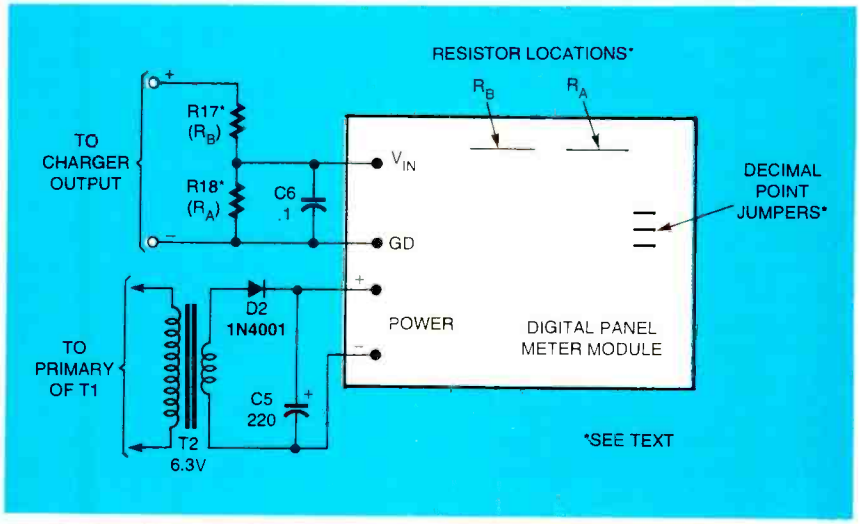


Fig. 2. Although Charge-It is equipped with tip jacks that allow you to plug meter probes into the circuit's output, you may want to go with a permanently connected voltmeter. Here we show you how to connect a low-priced digital panel meter to the circuit.

connector. The connector is used to connect the charger to battery circuits equipped with that type of plug. In addition, tip jacks were also connected in parallel to allow the probes from a digital multimeter to be plugged into the output circuit to measure the output voltage.

Transformer T1 is an 18-volt AC, center-tapped, 300-mA power transformer—available from Mouser Electronics, Tel. (800) 346-6873, as stock number 41FJ300. For higher output current, the Mouser 41FH600 (600 mA) or 41FJO10 (1.0 Amp) can be substituted. Of course, using a larger transformer will, most likely, necessitate the use of a larger enclosure. Larger heatsinks will also be required for IC1 and IC2. If a larger transformer is used, the 300-mA range setting of S4 will need to be changed to reflect the higher current range.

For a 600-mA transformer, replace R10 with a 2-ohm, 2-watt resistor, transforming the 300 mA setting to 600-mA. A 400-mA range could be added by substituting a switch with more positions for S4 and placing a 3-ohm, 2-watt resistor in series with that switch position. For the 1-amp transformer, suggested resistors are 2.4 ohms at 2 watts for a 500-mA range, and 1.2 ohms at 5 watts for a 1-amp range. To increase or decrease the number of preset voltages, a multi-position switch with more contacts than that specified can be substituted for S3.

Because it was difficult to adjust R13 when charging a single NiCd cell, the author modified the circuit by adding a 500-ohm potentiometer (call it R13-b) in series with R13, as a fine adjustment. That gives easy adjustment to the voltage needed, and fast change from a low to a high voltage.

Circuit Add-Ons. Although tip jacks for digital multimeter probes were connected in parallel with the output connectors. If desired, a voltmeter, either analog (such as RadioShack 15-volt meter, part number 270-1754) or digital, could be built into the charger. Doing so would also require that the circuit be housed in a larger enclosure. A circuit for a digital meter, using one of the low-priced digital panel meter (DPM) modules that are currently available from a number of suppliers, is shown in Fig. 2. Unfortunately, most or all of the lower-priced DPMs require a floating power supply, isolated from both input terminals of the DPM. That requires a separate power transformer to supply the DPM. Transformer T2 in Fig. 2 is a 6.3-volt AC transformer. However, the center tap and one end of a small 12.6-volt transformer can also be used. If the DC output voltage is higher than 12 volts, a resistor should be connected in series with D2 to lower the voltage.

One-percent resistors R17 and R18 do not need to be the values specified in the Parts List. Any resistors with

TABLE 1—TYPICAL NICD BATTERY RATINGS

VOLTAGE	AMP-HOURS
9V	65 to 100 mAh
N	150 mAh
AAA	180 to 220 mAh
AA	500 to 650 mAh
Sub-C	600 to 1000 mAh
C	1.6 to 2.4 Ah
D	1.6 to 3 Ah

a ratio of 99:1 can be used, giving a maximum meter reading of 19.99 volts. It is impossible to find any two resistors in standard one-percent values with a 99:1 ratio, so either R17 or R18 will need to be two resistors in series. Many DPM circuits have on-board locations for R17 and R18, often marked R_B and R_A. If R17 and R18 are not mounted on the DPM board, a jumper (if not already present) must be placed in the R_B position. There are usually three locations on the DPM board for decimal point jumpers. Which jumper is used for a 19.99-volt range varies from meter to meter. If the instruction sheet is unclear as to which jumper location is used, it can be determined by experiment. For additional information, see "Using Digital Panel Meters" (which appeared in the October 1996 issue of **Popular Electronics**).

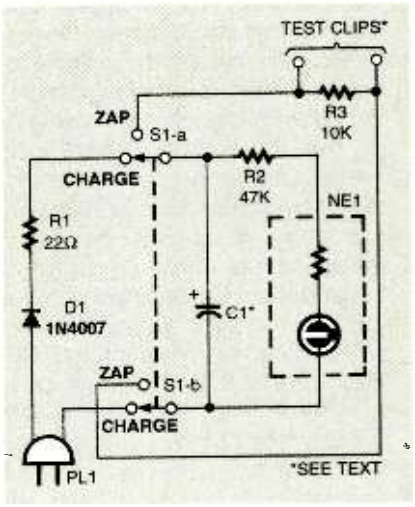


Fig. 3. Anyone who uses NiCd batteries is aware of their tendency to develop internal shorts. But with the circuit shown here, you can apply a high voltage pulse to a shorted battery, zapping the short into oblivion. The Zapper is designed so that the input voltage is never connected to the circuit's output terminals at any time to reduce the risk of electrical shock or damage to the battery.

Calibration And Use. Calibration is simple. Turn on the charger, with no battery connected, and adjust R14 and R15 for the required maximum output voltage. To use Charge-It for other voltage batteries, adjust R13 for the required maximum voltage before connecting the battery. For either preset or adjustable ranges, set S4 to the battery's maximum charging current. (When using Charge-It as a power supply, set R13 for the desired output, and S4 to the maximum current of the circuit being powered.)

The next question is what is the correct voltage and current for battery charging? If available, use the battery manufacturer's specifications. If you don't have them, some data from commonly used batteries is given in Table 1. The usual recommended charging current for both NiCd and Gel-Cell batteries is one-tenth of the amp-hour rating. For example, a battery rated at 1000 mAh (1 Ah) would have a charge current rating of 100 mA. The Ah rating is marked on most Gel-Cell batteries, and many NiCd batteries. For a completely discharged NiCd battery, charge time at one-tenth the Ah rating is usually given as about 14 hours.

Maximum voltages are different if the charger will be left connected to the battery for an indefinite period ("floating charge"), or will be connected only for a limited charging time. The chemistry of Gel-Cells is similar to that of lead-acid automobile batteries, and the voltages are similar as well. For a Gel-Cell left connected to the charger, the usual voltage is 2.3 volts per cell (13.8 volts for a 12-volt battery). For a battery charged for a limited time, the usual voltage is 2.46 volts per cell (14.8 volts for a 12-volt battery).

For most NiCd batteries, the voltage is 1.35 volts per cell for a "floating charge," and 1.45 volts per cell for a limited charging time. "Fast-charge" NiCds use higher charging voltages and currents, but they can also be charged using normal voltages and currents.

Shorted NiCd Cells. One problem with NiCd batteries is the tendency for one cell in an otherwise good battery to develop an internal short. That's more likely to happen when the battery has not been used for some time or hasn't been completely discharged. The short is usually caused by the formation of metallic "whiskers" (dendrites) between the positive and negative electrodes of the cell. A number of circuits have been published to zap the whiskers inside the cell. Some of the circuits are rather complex. Usually, a charged electrolytic capacitor is discharged through the cell to vaporize the short. A rather high voltage is required for best results. The circuit shown in Fig. 3 works very well.

Because the circuit is connected to the power line, it must be well-insulated from the user. The "Zapper" should be built in an all-plastic enclosure. A double-pole, double-throw switch is used for S1 so that output leads are never connected to the power line. It should be a good-quality standard size DPDT toggle switch rated for power line voltages. Although most miniatures are rated for power-line voltages, better safe than sorry.

PARTS LIST FOR THE NiCd CELL "ZAPPER"

RESISTORS
(All resistors are ¼-watt, 5% units.)
R1—22-ohm
R2—47,000-ohm
R3—10,000-ohm

ADDITIONAL PARTS AND MATERIALS
C1—80 to 100-μF, 250-WVDC electrolytic capacitor (see text)
D1—1N4007 1-amp, 1000-PIV, silicon rectifier diode
NE1—120-volt AC neon assembly (RadioShack 272-707 or similar)
PL1—AC plug and line cord
S1—DPDT toggle switch (see text)
Insulated alligator clips, all-plastic enclosure, wire solder, hardware, etc.

Resistor R3 is included in the circuit to discharge C1 if S1 is flipped to the ZAP position with no NiCd cell connected to the circuit. The alligator clips used to connect the circuit to the battery should be insulated. Although there is no voltage across the clips, other than for a few seconds after S1 is moved from CHARGE to ZAP, caution still is needed. Resistor R2 is included in the circuit to reduce the voltage across NE1. If another type of neon assembly is used, it may be necessary to increase the value of R2. A 160-WVDC unit would probably work for C1, but since the charge on C1 will be about 165 volts for an AC line voltage of 120, a 250-WVDC unit is

(Continued on page 55)

Firing Up Those 01-As

MARC ELLIS

For the past few months, I played hooky from the *Freed-Eisemann Neutrodyne Model NR-5* restoration started in the July **Popular Electronics** issue, because I hadn't been able to get in much soldering-iron time. Now I'm back on track, and the concern this month is to work out a way to light the filaments, or "A"-supply of the set's five 01-As. An 01-A tube filament requires five volts at a quarter-amp of *direct* current—one-and-a-quarter amps for the whole set. Alternating current is not acceptable (the result would be a raucous hum in the speaker and not much else). So we can't light the filaments the easy way, from a transformer. In the old days, they used a six-volt car battery.

FILAMENT POWER OPTIONS

The last time I fired up the 01-As in a five-tube, three-dialer was back in the early 1960s. I was just becoming interested in antique sets, and had recently purchased the five-tuber at an antique barn in New England. I was able to purchase a discounted Eico model 1064 "battery eliminator and charger," a hefty hunk of iron weighing in at about 12 pounds.

That Eico DC supply could provide six volts at up to ten amps continuous and, according to catalog descriptions, "delivered the low-ripple DC necessary for servicing transistorized electronic equipment." Of course, it powered my five 01-As without even breaking a sweat, and the radio performed well with hardly a trace of hum audible in the speaker. I still have the Eico, and although it hasn't done much radio work for me in the intervening years, it sure has started a lot of cars!

BUILDING THE DC FILAMENT SUPPLY

Of course, I could also use the Eico for this project with no problems. Another good alternative, I suspect, would be one of the gel-cell rechargeable six-volt batteries (the kind used in emergency lighting systems) commonly available at electronic flea markets. I decided to stick with the battery eliminator concept, but opted for something based on more current technology than the Eico. (Well, maybe it's not that current but, hey, I *am* the *Antique Radio* editor!)

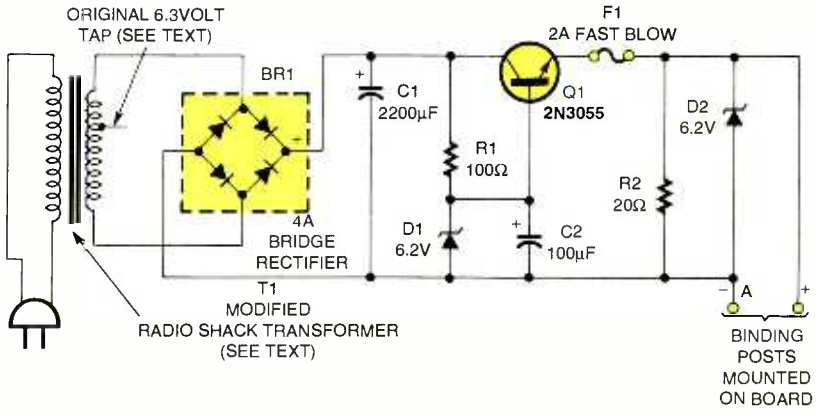


Fig. 1. Schematic of the "A" power unit with parts values noted.

The circuit I chose, shown in Fig. 1, is based on the one described in the article, "An Inexpensive Power Supply for Battery Radios Using Off-the-Shelf Parts," by Dr. Fred Archibald (*The Old-timer's Bulletin* of the Antique Wireless Association, November 1989). All of the parts for the supply were (and are) available off-the-shelf from RadioShack at very low cost. Interested readers should be able to duplicate it without too much trouble. The one small hang-up about this project is the power transformer. The good news is that it's a standard 12-volt, 1.2-amp center-tapped model. Dr. Archibald bought his at RadioShack (273-1352). The bad news is that he had to modify it to produce nine volts.

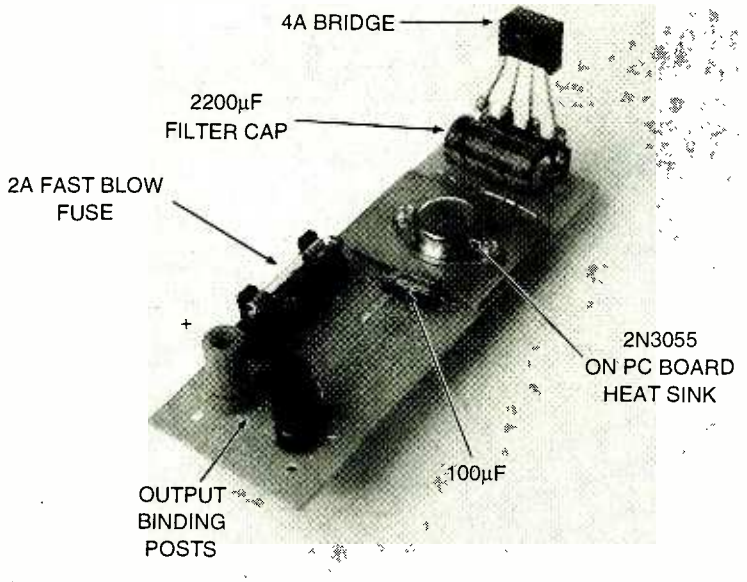
At that time, at least, those transformers had separate primary and secondary windings. It was easy to remove the tape from the secondary and remove 28 of its 116 turns to produce the required voltage (the end result was 9.4 volts.) I don't know if the current generation of RadioShack transformers are as easy to modify. However my junkbox yielded a substantial-looking transformer that had two center-tapped 6.3-volt windings. So I can use one winding and half of the other to deliver the nine-plus volts. The transformer's other 6.3-volt tap was used to power a second, reverse-connected, 6.3-volt transformer for the high-voltage supply (to be discussed in a later issue).

The nine volts is then rectified by a standard bridge unit (I used a RadioShack 276-1173, rated at four amps); filtered by a 2200-µF, 35-volt capacitor (RadioShack 272-1020); and regulated to 6.2-volts by means of a 2N3055 power transistor (RadioShack 276-2041), whose base voltage is controlled by a 6.2-volt Zener diode (RadioShack 276-561) in series with a 100-ohm resistor. The 2N3055 is rated at a whopping 115 watts, amazing considering its diminutive size. Dr. Archibald points out that the rectifier and transistor were deliberately "overrated" to reduce "load-dependent voltage drop" that might make it difficult or impossible to properly adjust the set's filament rheostats.

If the regulating circuit should fail, you won't blow your hard-to-get and expensive 01-As. Another 6.2-volt Zener diode, connected across the output, forms a simple "crowbar" circuit. Should the output voltage rise above 6.2 volts, the diode would conduct heavily and open the two-amp fuse located ahead of it in the circuit before any damage could be done to the tubes.

CONSTRUCTION

I assembled the circuit on a small



Here's the unit as built in my shop. The transformer is not on board, but is mounted separately.

(approximately 7×2-½-inch) RadioShack experimenter's perf board (276-170). The board includes handy foil patterns on the back for making circuit connections. I used the foil for circuit wiring which did not carry appreciable current (such as the components in the base circuit of the 2N3055). All other connections were hard-wired, with the holes in the board used merely as pass-throughs.

The four-amp bridge rectifier was a little large and heavy to mount using the holes on the perf board, so I screw-attached a four-lug terminal strip at the end of the board to hold the component and conveniently make connections to it. Even though the 2N3055 regulator was to be run at a fraction of its current rating, I thought it wise to provide it with some type of heat sink. Here RadioShack let me down; they don't seem to stock a heat sink for that style case. So I installed the regulator through a small square of copper-faced PC-board material prior to mounting it on the perf board. I figured the copper would dissipate at least some of the excess heat.

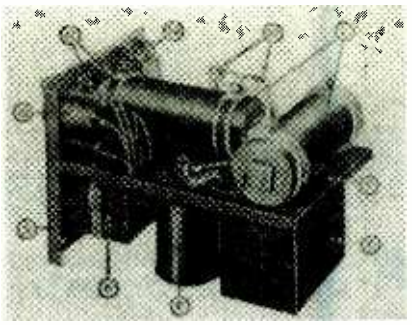
A couple of heavy-duty binding posts, intended for connection to the radio's battery cable, were mounted on the end of the board opposite the bridge rectifier. The holder for the "crowbar-circuit" fuse, also mounted directly on the board, came out of my junkbox but is a standard type.

All components fit comfortably and neatly on this board (except for the power transformer, of course, which was mounted separately), and there is very little more to be said about the wiring of this simple circuit. You'll find all the parts values directly on the accompanying schematic diagram of Fig. 1. The two capacitors are standard RadioShack 35-volt electrolytics. The 100-ohm resistor in the 2N3055 base circuit is the ¼-watt type sold at RadioShack. The 20-ohm load resistor, however, dissipates about two watts of power. I paralleled a couple of 43-ohm, 1-watt resistors from my parts box to achieve the required resistance and power dissipation. They run pretty hot, but they're okay.

I'll decide on the "packaging" for this power supply after I complete the plate-supply board, which I hope to have ready for a later column. Being essentially a lazy type, I probably won't go for a fancy metal enclosure. The two boards and transformer will likely be mounted neatly, "breadboard style," on a piece of pine.

THE SMOKE TEST

With the wiring completed, I hooked up one of the secondaries of my dual-six-volt transformer to half of the other secondary to obtain the required nine volts (closer to 10 volts with no load) for the input of the bridge rectifier. On my first try, as luck would have it, I hooked up the secondaries in "bucking" configuration and ended up with three volts. However, I quickly reversed one of the windings, and that took care of the problem.



Just for fun, here's a look beneath the cover of a Cooper "A" eliminator build in 1927. The large oblong housing on the bottom deck is the power transformer; the filter caps are in the can just ahead of it; the large cylindrical objects on the top deck are filter chokes.

Inserting a two-amp quick-blow fuse in the holder, I checked the output of the supply with my DVM. Eureka! 5.2 volts and no sign of smoke. Looking about for a test resistor that would present the same amp-and-a-quarter load as five 01-As, I came up with a heavy-duty rheostat of about 10 ohms resistance from my junk box. I set the rheostat for full resistance and connected it across the supply in series with a DC ammeter. Then I slowly decreased the resistance until the meter registered an amp-and-a-half. The voltage came down just a very little (perhaps a tenth of a volt). In a few minutes, the case of the 2N3055 and the copper PC board "heat sink" were warm to the touch. In a few more minutes, they were so hot I couldn't touch them at all. I was certainly glad that I had provided a heat sink, even if it is a perfunctory one. I can't imagine how hot this little unit would get when passing the 15 amps it is supposed to be able to handle!

Those who intend to duplicate this circuit should probably try to make a better arrangement for heat dissipation than I did. The original builder of this circuit used a metal enclosure and mounted the 2N3055 on that. However, I did leave the supply on, delivering one-and-a-half amps to the test resistance, for at least an hour. The voltage and current stayed constant, and nothing burned out or smoked.

Curious to get some idea of the "hum content" of the power-supply voltage, I connected a pair of standard 2000-ohm headphones (in series with a 0.1-µF to keep out the DC) across the output and listened intently. There was a very muted hum, but it definitely was not objectionable. Actually, I suspect

that the hum might be even lower under actual receiving conditions because the "heat inertia" of the 01-A filaments will have something of a filtering effect.

"A" ELIMINATORS THE OLD WAY!

Comparing this small circuit board and moderately-priced power transformer with the Eico eliminator/charger that I used for "A"-power 35 years ago, I was quite impressed at the reduction in size, weight, and cost! But, just for fun, let's go back double that number of years and see what an "A" power eliminator looked like 70 years ago. Here's an excerpt from a product description of an "A" battery eliminator offered in 1927 by Cooper Corporation at a cost of $87.50 (pre-inflation dollars):

"This "A" power eliminator really eliminates the "A" battery by converting the alternating house current for direct lighting of standard five-volt radio tubes. The action that takes place in it is purely a transformer-and-rectifying one, wherein the 110-volt AC is stepped down to a lower voltage, rectified, and its pulsations then ironed out by a filtering system of "brute" dimensions ... The use of the unit entails no revision of the filament circuit of the receiver. The containing case is made of 16-gauge steel finished in sagebrush green, and is 9 inches wide, 9-½ inches high, and 13-¾ inches long. It weighs 52 pounds complete."

May the glowing embers of these filaments keep you warm—see you next month! ■

CHARGE IT

(continued from page 52)

listed is specified in the Parts List.

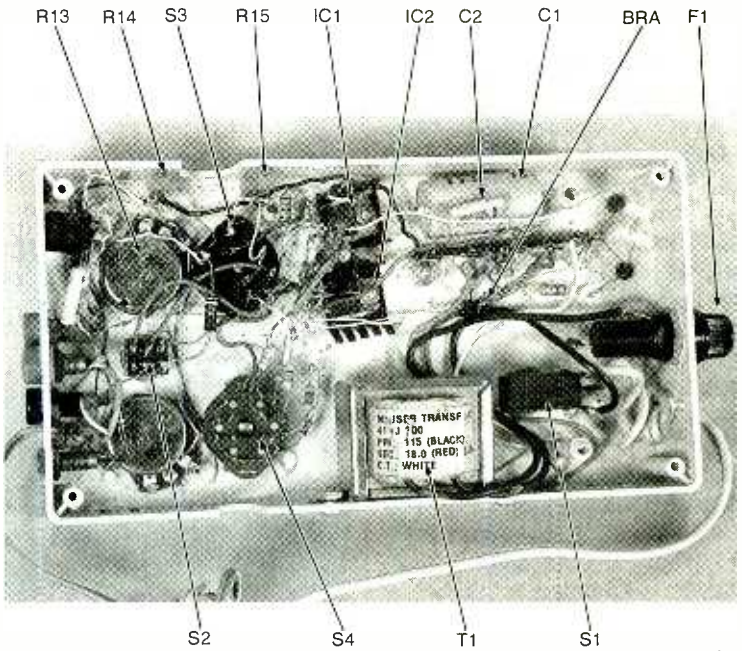
Even if the battery is completely discharged, the voltage of a NiCd battery will usually rise to 1 volt per cell or more after charging for a few minutes. If it does not, there probably is a shorted cell. It is necessary to access the terminals of the cells in the battery to find the shorted cell and to "Zap" it. A shorted cell will have a voltage close to zero. If the battery is shrink-wrapped, small holes can be cut in the wrap to access the outer casing of each cell (usually the negative terminal). If the battery has a hard plastic case, there is usually some way to open it so that it can be reassembled. If you can't, it wasn't useable anyway with a shorted cell, but you may be able to use the cells somewhere else.

The Zapper is connected to only one cell at a time. For a single cell that does not have wire or metal strip connectors, place the cell in a plastic battery holder. For shrink-wrapped batteries, a short bare wire or a safety-pin can be used as a connector for the Zapper. Connect the clips to the bad cell, plug in the Zapper, and flip the switch from CHARGE to ZAP once or twice. There will be a "pop" if the cell is shorted.

When you think the short has been cleared, connect Charge-It to the cell. If the short has, in fact, been cleared the cell voltage will rise to one volt or more. If a cell has been Zapped, or otherwise completely discharged, the initial charging current may be low. Unless the cell is dried out or otherwise ruined, the current will rise after a few hours, and it will charge normally. The charge time can be shortened by using a higher than normal voltage (up to 1.65 volts) to bring the charging current up to normal for that cell. After an hour or two, reduce the voltage setting to normal and continue charging the cell. ■

PARTS LIST FOR THE DIGITAL PANEL METER

C5—220-µF, 25-WVDC, electrolytic capacitor
C6—0.1-µF, ceramic-disc capacitor
D2—1N4001 1-amp, 50-PIV, silicon rectifier diode
R17—1-megohm, ¼-watt, 1% resistor (see text)
R18—10,100-ohm, ¼-watt, 1% resistor (10,000-ohm in series with 100-ohm, see text)
T2—6.3-volt step-down, power transformer (see text)
Digital panel meter module, wire, solder, hardware, etc.



Shown here are the innards of the authors prototype. The unit was hard-wired into its plastic enclosure and the components interconnected with hookup wire. Note that the two trimmer potentiometers (R14 and R15) were glued to the inside wall of the enclosure and connected to the other components using point-to-point wiring techniques.

SCANNER SCENE

Fast-Talking Fast-Food Clerks

MARC SAXON

RadioShack's PRO-2045 desktop unit responds to many scanning needs. It's reasonably priced, feature-rich, and compact—the factors most monitoring fans would agree spell out "desirable." The PRO-2045 offers 200 memory channels set up in 10 banks of 20 channels. Then, there are another 10 monitor memories for temporary storage of newly discovered active channels. Frequency coverage? Oh, yeah! The VHF low band (29–54 MHz), the VHF aeronautic band (108–137 MHz), the VHF high band (137–174 MHz), the UHF military aeronautic band (216–400 MHz), the UHF/UHF-T land-mobile bands (400–512 MHz), and from 806 to 1000 MHz (less the cellular bands, which are factory locked-out, per federal regulations). It scans at 50 or 100 channels per seconds, but it can operate at either 100 or 300 channels per second when in search mode.

An advanced triple-conversion circuit provides fine performance with minimal image interference. Intermediate frequencies are at 380.7 MHz, 10.85 MHz, and 450 kHz. FM sensitivity (with a signal-plus-noise to noise ratio of 20 dB) is 0.5 µV below 54 MHz, 0.6 µV in the high and UHF bands, and 0.8 µV above 800 MHz.

Features? It's got plenty of those, too. There's instant weather-band access, including the ability to sound an alarm if NOAA transmits a severe-weather-alert tone. You get no less than 10 priority channels, a reception counter that lets you know how many hits you've gotten on each programmed channel, a variable signal attenuator, and a lock-out review. The PRO-2045 lets you skip over non-voice data signals and gives you the ability to lock out unwanted frequencies while searching. Frequencies can be selected in several ways, including using the keypad or the rotary tuning knob. An optional extra that RadioShack offers is a Continuous Tone-Controlled Squelch System (CTCSS) board that allows you to set memory channels to activate only when the specified tone appears on those channels.

The PRO-2045 sounds like a lot of receiver, and it is. Yet it carries a catalog price of $349.99. The CTCSS board costs about $40 more. Check it out at any RadioShack.

SCANNING, ON A BUN?

We continue to receive at least a dozen letters each month either contributing fast-food drive-up window information, or else asking if we know why those frequencies continue to attract a cadre of devoted listeners.

Well, they can be rather interesting to monitor at times because the clerks often make rude or off-color remarks about the customers waiting in line or being served. The real fun, we hear, comes when you freak out the clerks by commenting on something they said about the previous customer. That's when they start worrying if they said something that went out over the intercom to the customers. It has a chilling effect, especially if they have also been commenting about the boss!

These are low-powered communications of very short range, so you might not be able to copy them from more than a block or two away. Most scanner directories don't list these stations. The customer's microphone is always open when a car is present. The employee has to push one of two buttons to talk. The use of CTCSS tones permits one button to be used for internal communications while the other puts them through to the customer.

While each fast-food chain has different combinations of customer and clerk frequencies, some chains seem to prefer certain ones. For instance, Arby's often seems to use 30.84 MHz for the customers and 154.57 MHz for the clerks—although you'd really only want to monitor the clerk's channel.

Two popular Burger King channels are 465.8876 and 467.7875 MHz. McDonald's seems to like 151.895, 154.60, 170.245, and 171.105 MHz. Wendy's appears to prefer 465.8875 MHz.

For general searching out of miscellaneous establishments, here are popular channels reported to be used by clerks at various chains: 151.895, 154.515,154.54,154.57,154.60, 169.445, 170.245, 170.305, 171.105, 171.905,461.0875,464.0125, 464.1875,464.925,465.8875, 466.1625,467.1625,467.7375, 467.75, 467.7625, 467.80, 467.8125, 467.825, 467.8375,467.8875,468.2875,and 469.9625 MHz.

NEW PLACES TO MONITOR

The FCC is now processing public-service applications in the 821 to 824 MHz and 866 to 869 MHz bands. Applications were accepted from the

The Pro-2045 is an affordable, full-featured desktop unit from Radio Shack.

western counties of upstate New York and the Philadelphia, Pennsylvania area, but the FCC noted that 800-MHz frequency assignments in some areas around Philadelphia have already been depleted. The agency specifically discouraged applications in the Philadelphia metro area.

Willie D., in the Big Apple, wrote to ask about the frequency to monitor in order to hear the Emergency Medical System (EMS), the NYPD Special Operations Division (SOD), and the highway units. The SOD, which includes the exploits of the Emergency Service units, can be monitored on 470.8375 MHz. The NYPD Traffic division operates highway and traffic units on 470.8625 MHz, with plate checks and related data on 476.7375 and 478.8675 MHz. The New York Fire Department's EMS in Manhattan South operates on 860.7375 MHz, Manhattan North is on 855.4575 MHz, and Brooklyn and Staten Island are on 854.9875 MHz. There are also trunked operations on 854.9875, 857.9875, 858.9875, 859.9875, and 960.9875 MHz.

THUNDERBIRDS

The US Air Force Thunderbirds are almost constantly on tour performing in visiting air shows. These folks make much use of communications, and we frequently hear from readers asking for their latest listings of frequencies. The information we have, which was compiled from various sources, says that they often select from the following frequencies: 66.90 (FM), 120.45, 123.45, 124.25, 134.1, 138.875, 140.40, 141.85, 148.55 (FM), 236.6, 241.4, 241.6, 250.85, 273.5, 283.5, 294.7, 295.7, 322.3, 322.6, 382.9, 394.0, and 413.025 (FM) MHz. With the exception of the three channels indicated as "FM," all are in AM mode. The 148.55 and 413.025 MHz channels are used by maintenance and other ground-support activities.

GIVE US A HAND!

Be a big part of our column by passing along your favorite frequencies, new discoveries, scanning-related information, and suggestions! Your contributions help us keep our column useful and current. Just mail your information to *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. We also invite you to send everything to our column by e-mail at sigintt@aol.com. ■

LEONID METEORS

(continued from page 45)

modules for the relatively short-duration peak periods."

NASA is also carefully analyzing all existing Leonid data to improve its prediction methods and models. A new meteor radar system is also being used to improve the agency's meteor-rate predictions versus actual post-event observations.

Minimizing Threats. When deadly particle streams threaten, turning a satellite's solar arrays parallel to the incoming meteor stream is probably the best action. Measuring 60 feet across or more, solar arrays usually have much more surface area than the satellite's core. This protective measure isn't practical if the satellite's batteries can't tolerate reduced charging current while the array is pointed elsewhere.

Other protective measures include stowing retractable extremities; shutting protective covers, hatches and doors; rotating sensitive instruments and sensors away from the particle stream, and so on. Considering the velocities involved, most satellites are sitting ducks!

The Bottom Line. What are the *real* odds of a spacecraft colliding with a Leonid meteoroid? Hard data is scarce. Orbiting structures vary in size, and satellites over different parts of the globe see widely varying particle rates. We know that if the Leonids storm in at their 1966 level or better, satellites exposed to the stream will encounter meteoroid and impact probability levels some 10,000 times greater than normal. We also know that there is at least a reasonable chance that this may occur during the Leonid showers over the next few years.

Brown, using 1966 rate data, calculates an impact probability of approximately 0.1% per hour for a satellite of "standard area" (10 square meters) exposed to peak-rate particle streams. Many satellites are much larger, especially when their solar arrays are exposed to the stream. An impact probability of 0.1% per hour doesn't sound all that risky, but when you consider that, according to Brown, a satellite of standard area normally has a 0.07% impact probability *per year*, the meteor storm figure stands out.

What about bigger orbiting objects? Brown's analysis of the space station *Freedom*, with an exposed area of almost 500 square meters, suggests a Leonid-storm hit probability of about 0.5%, with a maximum risk of 1%. This figure assumes the station's heavy shielding and estimates the risk associated with a *critical* impact. Its chances of being hit by smaller particles may be greater. And how the station may be affected by potential plasma discharges is unknown.

Even with impact probabilities that seem mathematically insignificant, there are hundreds of objects in orbit, each one a potential target for the fast-moving Leonids. Even if every satellite and space station survives this storm period unscathed, the problems produced by debris and micrometeoroid collisions will follow mankind into space. Until we can protect our orbiting structures and space vehicles with certainty, we'll just have to watch the heavens to see what happens! ■

LEARNING ABOUT AND OBSERVING THE LEONIDS

There's a lot of material available to those who want to learn about the Leonids and other comet/meteor shower topics. Those with Internet access can pore through reams of interesting information. To get started, try Gary Kronk's Meteor Links page at *http://medecine.wustl.edu/~kronkg/metlink.html*, the home page for the International Meteor Organization at *http://www.imo.net/*, or the home of the North American Meteor Network at *http://www.medecine.wustl.edu/~kronkg/namn.html*.

Joe Rao's excellent article, "*Leonids: King of the Meteor Showers*," appeared in the November 1995 issue of *Sky & Telescope*. For many readers, Joe's article and "*Planning Your Leonid Watch*," in the same issue, will amount to "one-stop Leonid shopping."

Think Tank

Audio Circuits for the Musician

JOHN J. YACONO
LAB TESTING COORDINATOR
WINDOWS MAGAZINE, IEEE

This month, for the music buffs out there, we have a mixed bag of audio circuits that we will explore. But first let's pick up where we left off on power-supply circuits. So far we have seen how transformers are used to reduce voltages to levels used by low-power circuits (as opposed to major appliances, AC motors, and other heavy-duty devices). We've also shown how diodes rectify (or steer in one direction) current from transformers to convert sinusoidal AC into pulsating direct current. But most devices cannot use a pulsating DC power source—it is an intermittent source of current—and that's where capacitors enter the picture.

Pulsating DC is typically smoothed or filtered by capacitors in order to keep the output voltage of a supply somewhat constant. To see how that works, look at Fig. 1. Both circuits show capacitors being fed pulsating DC. The waveforms on the left of the figures (the inputs to the circuits) show what the input to the circuits would look like if the capacitors were not present to filter the pulses. As you can see, the capacitor in Fig. 1A receives half-wave rectified current, and the capacitor in Fig. 1B receives full-wave rectified current. The capacitors modify the pulses as shown in the outputs of each circuit.

For both circuits, the interaction between the input current/voltage and the capacitor is the same. When the input voltage rises high enough, the rectifier circuit charges the capacitor while supplying current to the load. When the rectifier circuit's voltage drops below that of the voltage stored on the capacitor, the capacitor steps in for the rectifier circuit, and starts discharging current to load. Eventually the rectifier circuit voltage increases again, charging the capacitor and driving the load, and the cycle repeats. Note that while the capacitor helps smooth the output voltage waveform, it does not entirely eliminate the variations in voltage. The remaining undulation, or voltage "droop", is called ripple.

Since a capacitor fed from half-wave rectified DC must wait longer between charges than it would in a full-wave rectified circuit, the output voltage will exhibit more ripple for a given load and input current. So half-wave rectifier circuits should only be used when the load is either very forgiving of changes in the supply voltage or draws very little current between charging cycles. Otherwise the little amount of money you save by avoiding a full-wave rectifier will be spent getting a large enough filter capacitor and a transformer with a high-enough current rating to charge it while powering the load.

The filter capacitor of a full-wave rectifier circuit charges twice as often as in a half-wave circuit, and produces less ripple for the same capacitor value and load current. The capacitor does not discharge as deeply, saving it stress and conserving power that would otherwise be lost in the dielectric. The capacitor requires less charging current, therefore reducing the output current requirements and cost for the supply transformer. Since they can generate the same value of ripple as a half-wave circuit with a smaller value capacitor, the capacitors are smaller and cheaper, too. Full-wave rectified circuits tend to make cost-effective power supplies for circuits that can handle at least small levels of ripple. And there's a simple formula for determining the value of capacitance needed for such full-wave rectified circuits. For a given voltage variation, or ripple, (ΔV) in volts peak-to-peak, the corresponding value of capacitor must be greater than the value shown below:

$$C = (5317 \times I)/(\Delta V)$$

where I is the load current in amperes (at a 60-Hz supply frequency), ΔV the desired ripple voltage (with full-wave rectifying, this is at a frequency of 120 Hz), and C the minimum required filter capacitance value (in μF). For example, to have a 1 volt peak-to-peak ripple when the load current is 2 amperes, you should use a shunt capacitor greater than 10,634 μF. The closest standard value (on the high side) is 12,000 μF.

A better solution to this overall design would be to use a smaller value capacitor, and tolerate a larger amount of ripple, but follow this filter with a linear regulator which would remove the ripple and regulate the output voltage. But let us save this concept for a later date. Now let's get to the mailbag!

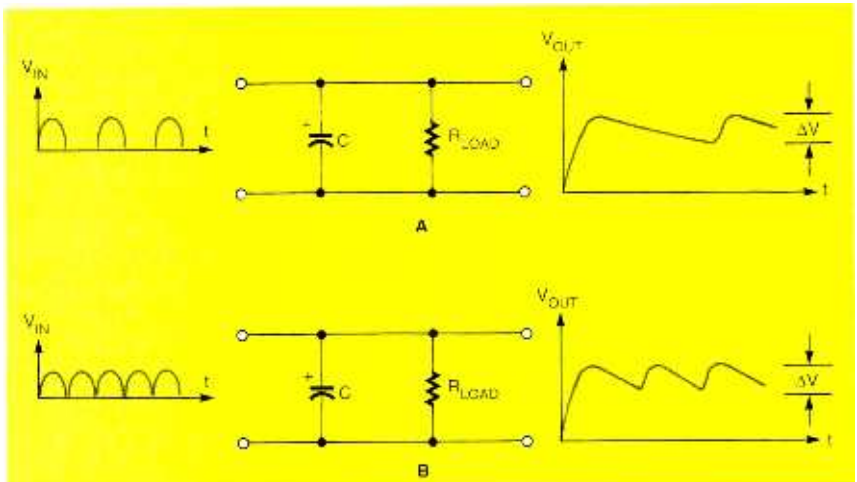


Fig. 1. The capacitor input filter is shown smoothing the input pulsating DC. Output voltage ripple (ΔV) with the half-wave rectified signal in (A) is double that of the full-wave case in (B). Using larger value capacitors will reduce this ripple at the supply output.

REVERB MADE SIMPLE...SIMPLE...SIMPLE

Reverberation, or "reverb" is an echo that mimics the acoustics of an auditorium. Old tube amplifiers used "springline" reverb, which was two electromagnetic transducers separated by springs. One transducer was an "emitter;" the other was a "pickup." The sound was literally bounced back and forth across the spring, creating the echo. Today's solid-state reverb units, used in synthesizers and such, require no wiggling springs, but often need complicated electronic circuitry. The piezo reverberation unit shown in Fig. 2 is an unusual electromechanical blend of both worlds—a spring creates the echo while a solid-state piezo disc picks up the echo!

I got the idea for this weird gadget while toy shopping with my son. The store had these large microphone-like toys that, when spoken into, added an echo. A clandestine shake disclosed the presence of a spring. So I bought two, one for my son to yell into and one for me to disassemble. Inside the unit I discovered that a thin plastic diaphragm coupled the sound waves onto the spring, which in turn resonated and moved the diaphragm to produce the echo.

To build this piezo reverb, you can get one of these toy microphones for just a couple of dollars at a toy store, open it up and remove the spring and two spring hooks. Note the stretched spring length before discarding the diaphragm and enclosure. Next, get two small steel "L" brackets. Attach them to a wood board, spacing them the same distance apart as the spring was stretched inside the toy. Using two-part epoxy, glue the back of a 1-inch piezo disc to the inside of one "L" bracket upright. Glue a hook to the top of the other bracket. When the glue is hardened, suspend the spring between the brackets via the hooks. This whole assembly can be mounted temporarily or permanently outside or inside a speaker enclosure or amplifier with speaker. Next, add shielded wire to the piezo leads, connect these leads to a preamplifier, followed by a mixer to mix this input with the original signal, and apply the composite signal to a power amplifier. During initial tryouts, keep the reverb signal level low to avoid feedback problems.

—Nick Cinquino, Schaumburg, IL

Those who'd like to try this, but can't find the toy, can use any long, very lightweight spring. You might have to spread the windings by clamping one end in a vise and pulling on the loose end. Piezo discs are readily available from All Electronics (800-826-5432). A friend of mine made

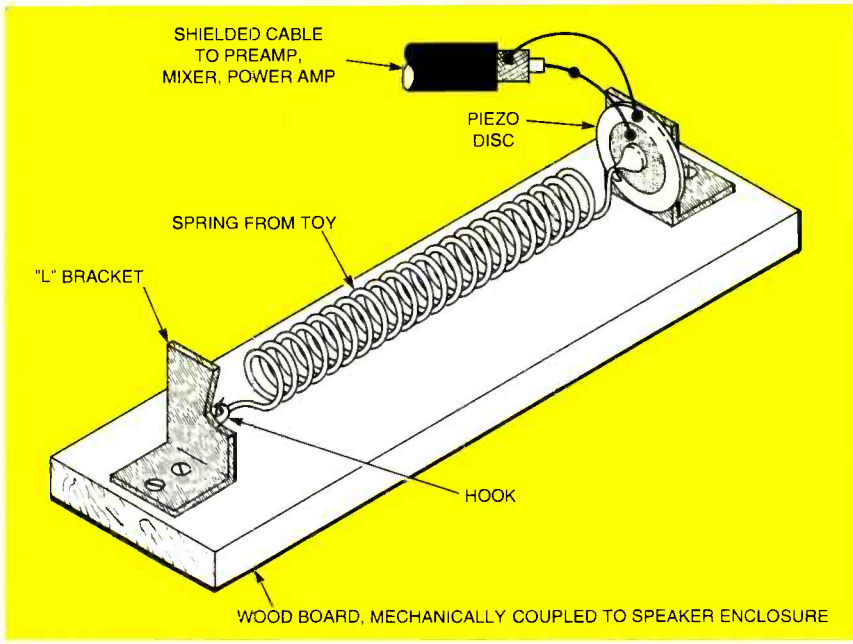


Fig. 2. Although this project is fashioned from a toy, it can add a professional touch to your music system. When the electromechanical assembly is mounted with a speaker or amplifier, listen for the reverberations.

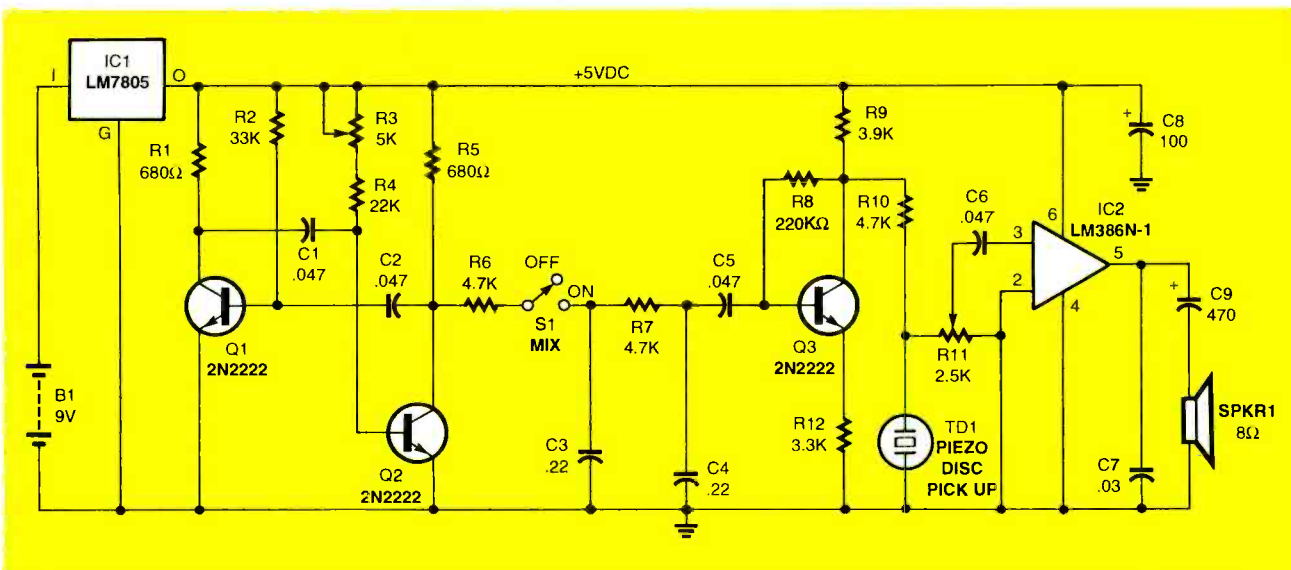


Fig. 3. This neat circuit provides dual functions for the budding musician. The external pickup can be fed directly to a power amplifier or mixed with a precise 440-Hz "A" tone.

something like this and installed it in a long cardboard tube left over from some paper towels. The results are fairly weird and fun.

MIX IT UP

Here's a schematic (see Fig. 3) for a fun little "Swiss-army knife" circuit for musicians. It produces a 440-Hz "A" tone for tuning, with near-sine wave quality. But it can also pick up the vibration of a tuning fork or musical instrument and convert it into sound, or mix it with the 440-Hz tone for comparison by listening to the beat-frequency.

This circuit is handy for several purposes: to directly tune an instrument by ear with the 440-Hz tone, to listen for an obvious beat frequency when electronically mixed with the circuit signal, or to check the accuracy of a tuning fork (I have one that prefers to resonate at 446 Hz!). Also, some weird sounds can be produced by mixing a tuning fork or musical instrument tone other than the oscillator's 440-Hz tone.

Here's how it works. A 9-volt battery is the power source, and a LM7805 IC 5-volt regulator keeps the voltage steady for oscillator accuracy. Transistors Q1 and Q2 form a square wave oscillator. Potentiometer R3 controls the frequency from about 420 to 460 Hz but is carefully adjusted to 440 Hz during construction. The wave is then heavily filtered to near sine-shape by resistors R6, R7 R8 and capacitors C3, C4, C5 at the oscillator-stage output. When mixing is desired, SPST switch S1 passes the 440-Hz sine wave into the preamplifier, Q3. The signal from the piezo disc, which is used as a microphone pickup, is applied at the output of Q3. R11, a 2.5k-ohm potentiometer, is the volume control for the LM386 audio power amplifier. In the mix mode, both the 440 Hz-tone and the piezo disc input combine together and are amplified. When mixing is not desired, then only the piezo disc's input is applied to the power amplifier.

A couple of construction notes. Stick a piece of black vinyl electric tape over the piezo disc to protect the top metal finish. A frequency counter is necessary to adjust the oscillator to exactly 440 Hz. Simply place the counter in parallel with the speaker. Small musical instruments, like a violin or guitar can be rested directly on the piezo disc. Naturally, in the case of pianos and bull-fiddles, you'll want to press the piezo against the instrument. A final note—the circuit is temperature sensitive, so adjust and use it only under room temperature conditions.

—Nick Cinquino, Schaumburg, IL

I haven't seen anything like this circuit before. I suppose NPO capacitors would reduce the circuit's temperature sensitivity a bit, which might be nice. All the semiconductors listed have equivalent substitutes by Thompson. The LM7805 cross-references to a SK3591, while the 2N2222 transistors are SK3444, and the LM386N-1 IC is a SK9210.

ONE-CHIP EQUALIZER

In response to the request for an equalizer in "Music for Pleasure," *Letters*, May 1997, the circuit in Fig. 4 is a pretty straightforward design. The three-band equalizer can be built and operational in about an hour. The circuit uses a single LF347 quad low-noise

PARTS LIST FOR THE ELECTRONIC BONGO (Fig. 5)

SEMICONDUCTORS

IC1-IC3—LF353 dual operational-amplifier JFET input (Thompson SK7641, or equivalent)

RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)

R1, R2, R5, R6, R9, R10, R13, R14, R17, R18—47,000 ohm

R3, R7, R11, R15, R19—10,000 ohm

R4, R8, R12, R16, R20—25,000 ohm linear potentiometer

R21-R25—1800 ohm

R26-R30—15,000 ohm

R31, R33—22,000 ohm

R32—470,000 ohm

R34—220,000 ohm

R35—10,000 ohm panel-mount potentiometer

CAPACITORS

(All capacitors are 50 WVDC or higher, except where noted.)

C1, C5, C6—0.01 μF ceramic disc

C2, C3—0.005 μF ceramic disc

C4—0.02 μF ceramic disc

C7—0.03 μF ceramic disc

C8, C9—0.015 μF mylar

C10—0.04 μF mylar

C11, C12—0.02 μF mylar

C13—0.08 μF mylar

C14, C15—0.04 μF mylar

C16—2.2 μF, 16 WVDC electrolytic

C17—4.7 μF, 16 WVDC electrolytic

C18, C19—100 μF, 16 WVDC electrolytic

ADDITIONAL PARTS AND MATERIALS

S1—DPST switch

B1, B2—9-volt battery

J1—standard audio jack

TP1-TP5—touch pad (see text)

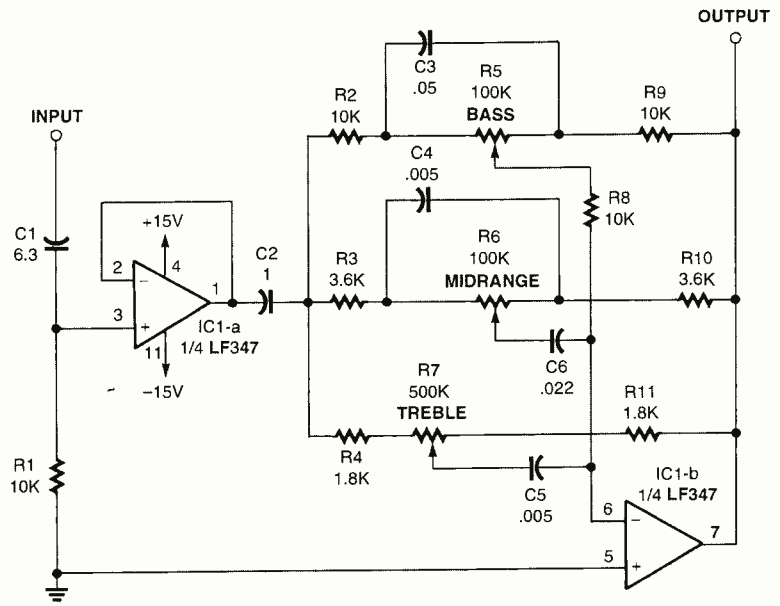


Fig. 4. Here's a simple one-chip equalizer that furnishes bass, midrange, and treble control to an audio input.

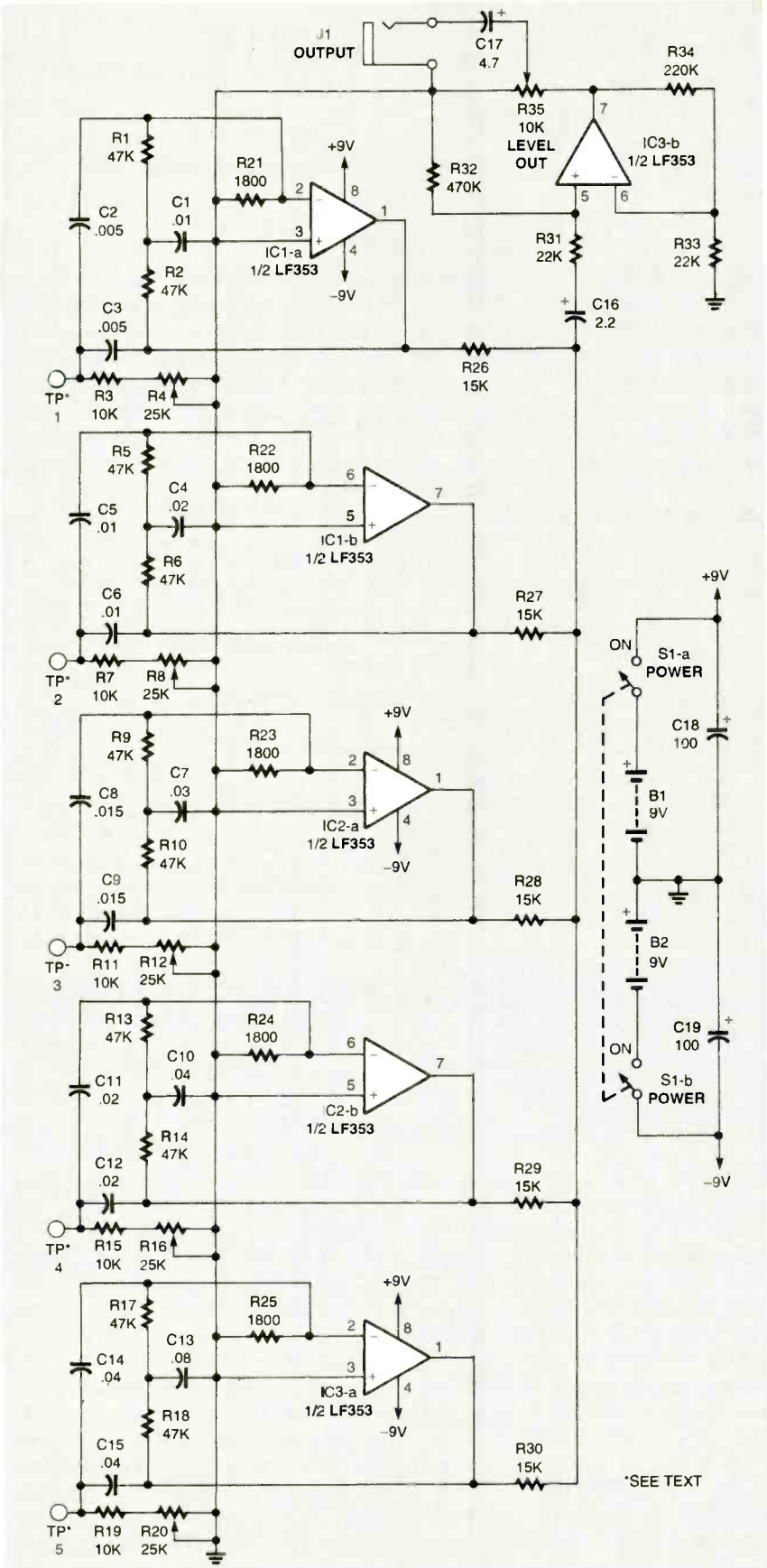


Fig. 5. This electronic bongo produces the sound of practically any percussion instrument. Adding more oscillator circuits will give you the sound of your own orchestra.

JFET input operational amplifier (Thompson equivalent SK4826) and a minimum amount of parts. Building with all new parts would cost about $10.

The audio signal is first conditioned by one quad op-amp IC1-a, and is sent to the three tone-separating networks. Separate potentiometers control bass, mid-range and treble responses. The audio signals are then mixed again by a second quad op-amp IC1-b and applied to the external preamplifier. You can add more control frequencies by adding more networks. The circuit as shown is for monaural operation. For stereo, just duplicate the circuit using the two remaining op-amps in IC1 (not shown), and use stereo potentiometers to control each frequency band.

If you are looking for more bells and whistles for this equalizer, National Semiconductor has the LM1036N—a dual-DC-operated tone/volume/balance control which sells for about $4 (from Digi-Key) and is most worthy of home-audio applications or automobile audio systems. This IC controls bass, treble, volume and balance, and has loudness compensation.

—Damian VanderWilt, Lafayette, CO

I'd be willing to bet your circuit works pretty nicely any way. Using shielded inputs and outputs (especially in a car's electrical environment) is a good idea, as is a metal case.

ELECTRONIC BONGO

Used in conjunction with any amplifier system, the electronic bongo set shown in Fig. 5 will produce the sound of practically any percussive instrument. Each of the five distinct tones produced by this unit is generated by individual twin-T ringing oscillator circuits. A ringing circuit is simply an oscillator adjusted so it does not run continuously. However, when triggered or shocked by a transient, it will break into a short-term oscillation. Since the human body accumulates a definite electric charge picked up from stray AC fields in the room, the oscillators are triggered by merely touching the touch-plates TP1 through TP5 and introducing capacitance into the circuit with your fingers (the touch plates are nothing more than small 1-inch metallic discs soldered into the circuit points with short pieces of shielded wire). If you want additional percussive sounds, simply keep on adding more oscillator circuits.

(Continued on page 76)

Circuit Circus

Simple Applications Of Op-Amps

CHARLES D. RAKES

Last month we were looking over a few basic op-amp circuits, and this visit we're going to continue with more applications. Most of the following will be offered as basic stand-alone circuits that can be used as is or as a part of a more complex circuit or project. Look them over and perhaps you can use at least one of these in an ongoing or future project.

FIXED OUTPUT VOLTAGE REFERENCE

Since many op-amps can be used with a single power source, our first entry, in Fig. 1, uses ¼ of a LM324 quad op-amp in a voltage splitting circuit to supply a bias voltage reference for other op-amps operating in a single supply circuit. In most circuit applications, the op-amp's positive input is biased to one-half of the supply voltage, so its static output is also equal to this voltage. If a different output bias voltage is desired, the voltage divider, made up of R1 and R2, may be adjusted for that output voltage. Since the values of R1 and R2 are equal, the voltage supplied to pin 3 of the op-amp is exactly one-half of the supply voltage. This op-amp circuit is a unity gain follower amplifier with a fixed input voltage. Take a look at Fig. 3 of last month's *Circuit Circus* for additional information on the follower circuit.

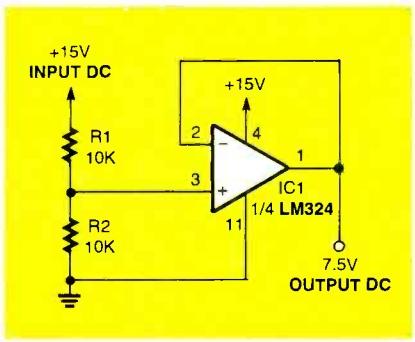


Fig. 1. This handy little circuit forces the op-amp's output at a value to be determined by the voltage divider of R1 and R2 and the supply voltage. Use this feature to supply a fixed bias voltage reference for other devices. In the case shown, the output voltage is one-half the supply voltage.

PARTS LIST FOR FIXED VOLTAGE REFERENCE (FIG. 1)

IC1—LM324 quad op-amp integrated circuit (equivalent part is the SK3643 or NTE987 chip)
R1, R2—10,000-ohm, ¼-watt, 5% resistor

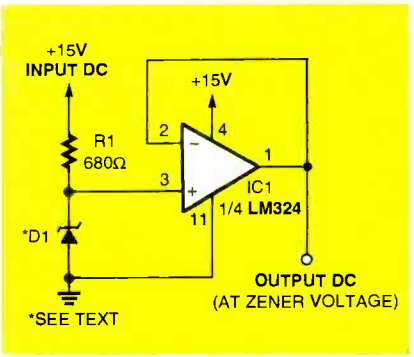


Fig. 2. Similar to the circuit of Fig. 1, but by using the zener diode on the input, the output voltage will be at the zener voltage.

PARTS LIST FOR FIXED VOLTAGE REFERENCE—ZENER-DERIVED (FIG. 2)

D1— Zener diode (see text)
R1—680-ohms, ¼-watt, 5% resistor

Our next design, see Fig. 2, also uses the basic follower circuit, but with a zener-regulated input voltage. This circuit can be used where a specific output voltage is required, and the supply source is not regulated. The follower's output voltage will be the same as the rated zener voltage. For a 15-VDC source, this circuit will work with zener diodes with voltages between 3 to 12 volts.

LIGHT-OPERATED SENSOR

A light-operated sensor, see Fig. 3, is our next op-amp circuit. Here we have the collector of a photo-transistor, Q1, connected to the positive input pin 3 of the op-amp, and the Q1 emitter tied to ground. The op-amp's negative input, pin 2, is connected to a sensitivity potentiometer, R3. As long as the op-amp's negative input is higher than the positive input, the op-amp's output will be negative and LED2 will light. With light hitting the photo-transistor, the op-amp's positive input is near ground level. When the light hitting the photo-transistor is blocked, it turns off, allowing the voltage at pin 3 to rise near the supply level. This switches the op-amp's output to a positive value, lighting LED1. Control R3 sets the circuit's sensitivity. The two LEDs may be replaced with a transistor controlling a relay or other circuitry, similar to the circuits in Figs. 5 and 7.

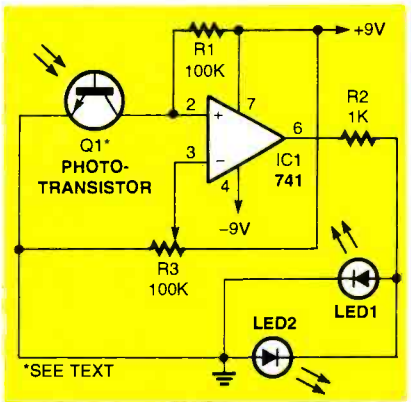


Fig. 3. Here's a neat light-operated sensing circuit. In the absence of light on photo-transistor Q1, LED2 lights. When light impinges on Q1, the op-amp switches current to turn on LED1.

PARTS LIST FOR LIGHT-OPERATED SENSOR (FIG.3)

IC1—741 mini-dip op-amp
LED1—Red LED
LED2—Green LED
Q1—Photo-transistor, RadioShack infrared transistor 276-145
R1—100,000-ohm, ¼-watt, 5% resistor
R2—1000-ohm, ¼-watt, 5% resistor
R3—100,000-ohm potentiometer

ALARM SENSOR

Our next application, in Fig. 4, places an op-amp in a simple closed-circuit alarm sensor and sound-driver circuit. The negative input, pin 2 of a 741 op-amp, is set at one-half of the supply voltage, and the positive input at pin 3 is tied to circuit ground through the normally closed sensor(s). Under these input conditions, the op-amp's output is negative. When the sensor circuit opens, the voltage at pin 3 rises to 9 volts which causes the op-amp's output to go high, turning on Q1 and activating the piezo-sounder BZ1.

Any number of normally closed sensors may be connected in series as long as the total resistance of the sensor circuit is less than 10k ohms. If the sensors cover a large area where 60 Hz might be fed into the sensor circuitry, adding a 0.22 μF across pins 2 and 3 can help keep the AC out.

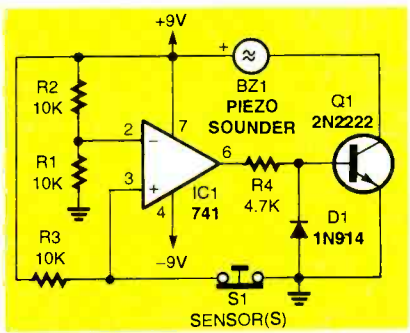


Fig. 4. This voltage-sensing circuit uses a standard op-amp to sound a buzzer when the external sensor(s) path opens up.

PARTS LIST FOR ALARM SENSOR (FIG. 4)

BZ1—Piezo sounder (RadioShack 273-073, or equivalent)
D1—1N914 silicon diode.
IC1—741 mini-dip op-amp
Q1—2N2222 NPN transistor (equivalent part is SK3444 or NTE123A)
R1-R3—10,000-ohm, ¼-watt, 5% resistor
R4—4700-ohm, ¼-watt, 5% resistor
S1—Alarm sensor(s), normally closed (see text)

You will notice that several of these transistor driver circuits have a 1N914 silicon diode connected to the base of the output transistor and ground. This diode clamps the negative output voltage coming from the op-amp when it is in a negative output condition. Without this protection the transistor could be damaged.

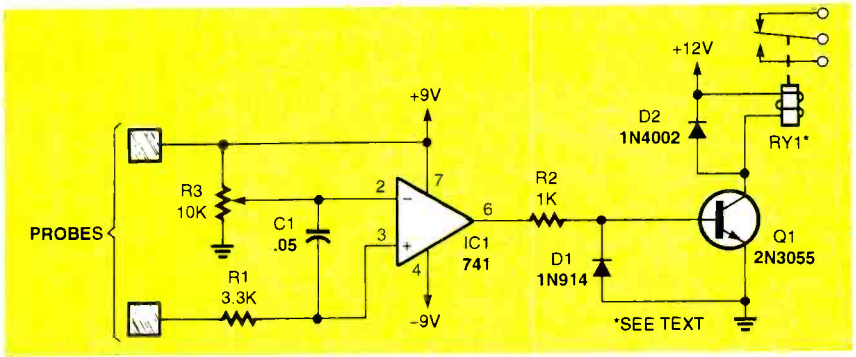


Fig. 5. Need a circuit to sense a voltage change and, in turn, drive a relay? Look no further! When the probes sense a voltage change, such as the presence of water, relay RY1 will be activated and shut down the water valve.

PARTS LIST FOR VOLTAGE-LEVEL SENSOR (FIG. 5)

C1—0.05μF, 100-WVDC, mylar capacitor
D1—1N914 silicon diode
D2—1N4002 silicon diode
IC1—741 mini-dip op-amp integrated circuit, (available from Radio Shack as 276-007, or alternately NTE941M or SK3552, and countless other manufacturers)
Q1—2N3055 power NPN transistor (equivalent part is the RadioShack 276-2041)
R1—3300-ohm, ¼-watt, 5% resistor
R2—1000-ohm, ¼-watt, 5% resistor
R3—10,000-ohm potentiometer
RY1—Water valve or relay-operated valve (see text)
Stainless steel probes (see text)

VOLTAGE-LEVEL SENSOR

If you have a water problem in your basement during the rainy season, then the next circuit can help keep the water level to a minimum. Checkout the circuit out in Fig. 5. A 741 op-amp is connected in a voltage level sensing circuit with the negative input made adjustable for different water conductivity levels. The op-amp's positive input is connected through a resistor to one of two stainless steel probes. The second probe is connected to the positive supply voltage. The probes are set about one-inch apart and are located in the lowest part of the basement. When the water level reaches the two probes, conduction occurs and the op-amp's positive input voltage rises above the negative input setting. This causes the op-amp's output to go positive, turning on Q1 and activating the water valve. Either a 12-volt operated water valve or a relay operating a 110 VAC water valve will work just fine.

PEAK-VOLTAGE DETECTOR AND HOLD

Our next entry is a peak voltage detector and holding circuit shown in Fig. 6. The LM1458, a high-gain dual op-amp—that's actually two 741 op-amps in a single 8-pin mini-package—was used in this circuit. A better choice would be one of the super high input impedance dual JFET op-amps, like National Semiconductor's LF353N or other similar device (such as the Thompson SK7641).

Op-amp IC1-a is connected in a high impedance voltage follower circuit with its positive input, pin 3, connected to the varying input signal. When the input voltage goes up to its peak value, the same voltage appears across C1, charging it to this peak value. Diode D1 only allows the positive peak voltage to pass to C1 and keeps it from discharging back into IC1-a. Op-amp IC1-b is also a voltage follower and produces the peak output at pin 7, which can be read on a digital or analog voltmeter. Once the input level drops below the peak value, C1 slowly begins to discharge. The output meter should be monitored closely for the most accurate peak reading. By just using the LF353N op-amp in place of the LM1458, the discharge time for capacitor C1 will be much slower, and the reading will remain for a longer time period.

DC MOTOR DRIVER AND REVERSER

Our next circuit, see Fig. 7, is a DC motor driver and reversing circuit. Once again the 741 op-amp is operating in the voltage follower configura-

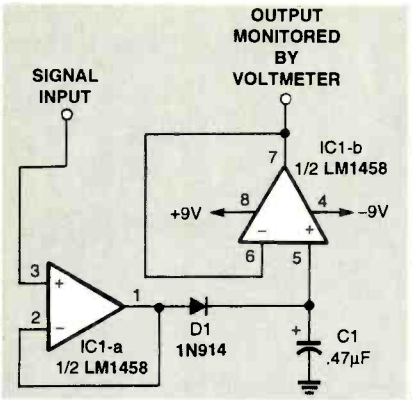


Fig. 6. Here is a simple application of a peak voltage detector and hold circuit using the LM1458 high dual op-amp. As the input changes, the corresponding output voltage at pin 7 is held at its peak value.

PARTS LIST FOR PEAK-VOLTAGE DETECTOR AND HOLD (FIG. 6)

C1—0.47µF, 50-WVDC capacitor
D1—1N914 silicon diode
IC1—LM1458 high-gain dual op-amp (equivalent part is SK3465 or NTE778A)

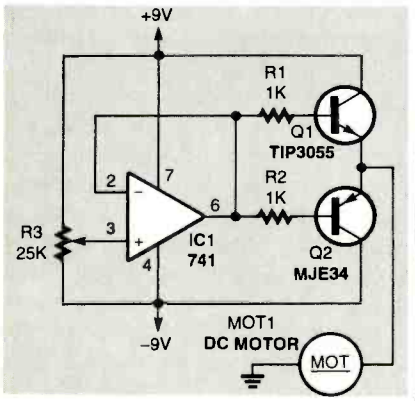


Fig. 7. When you need to provide a driver to a DC motor with reversal capability, this circuit should be utilized. Adjustment of control R3 allows you to control the motor's speed and direction of rotation.

PARTS LIST FOR DC MOTOR DRIVER AND REVERSER (FIG. 7)

IC1—741 mini-dip op-amp
MOT—Small DC motor (see text)
Q1—TIP3055 power NPN transistor (equivalent part is SK3960)
Q2—MJE34 power PNP transistor (equivalent part is SK3274)
R1, R2—1000-ohm, ¼-watt, 5% resistor
R3—25,000-ohm potentiometer

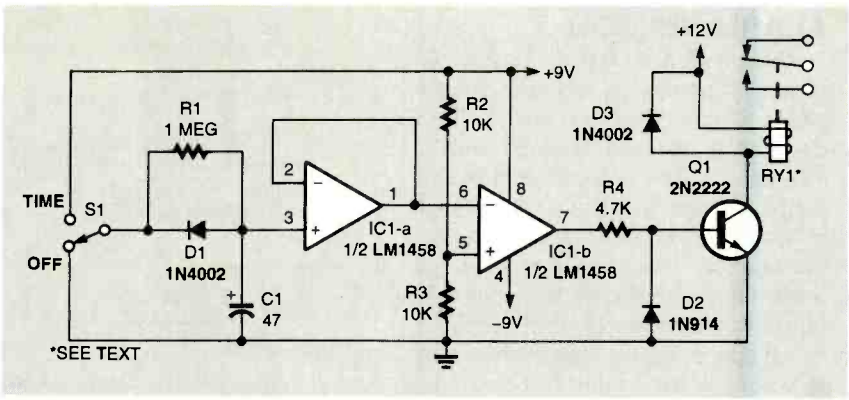


Fig. 8. This simple timer circuit can accurately delay operation of relay RY1 up to 30 seconds.

PARTS LIST FOR TIMER (FIG. 8)

C1—47µF, 25-WVDC, electrolytic capacitor
D1, D3—1N4002 silicon diode
D2—1N914 silicon diode
IC1—LM1458 high-gain dual op-amp
Q1—2N2222 NPN transistor
R1—1-megohm, ¼-watt, 5% resistor
R2, R3—10,000-ohm, ¼-watt, 5% resistor
R4—4,700 ohm ¼-watt, 5% resistor
RY1—12-volt mini-relay
S1—SPDT toggle switch

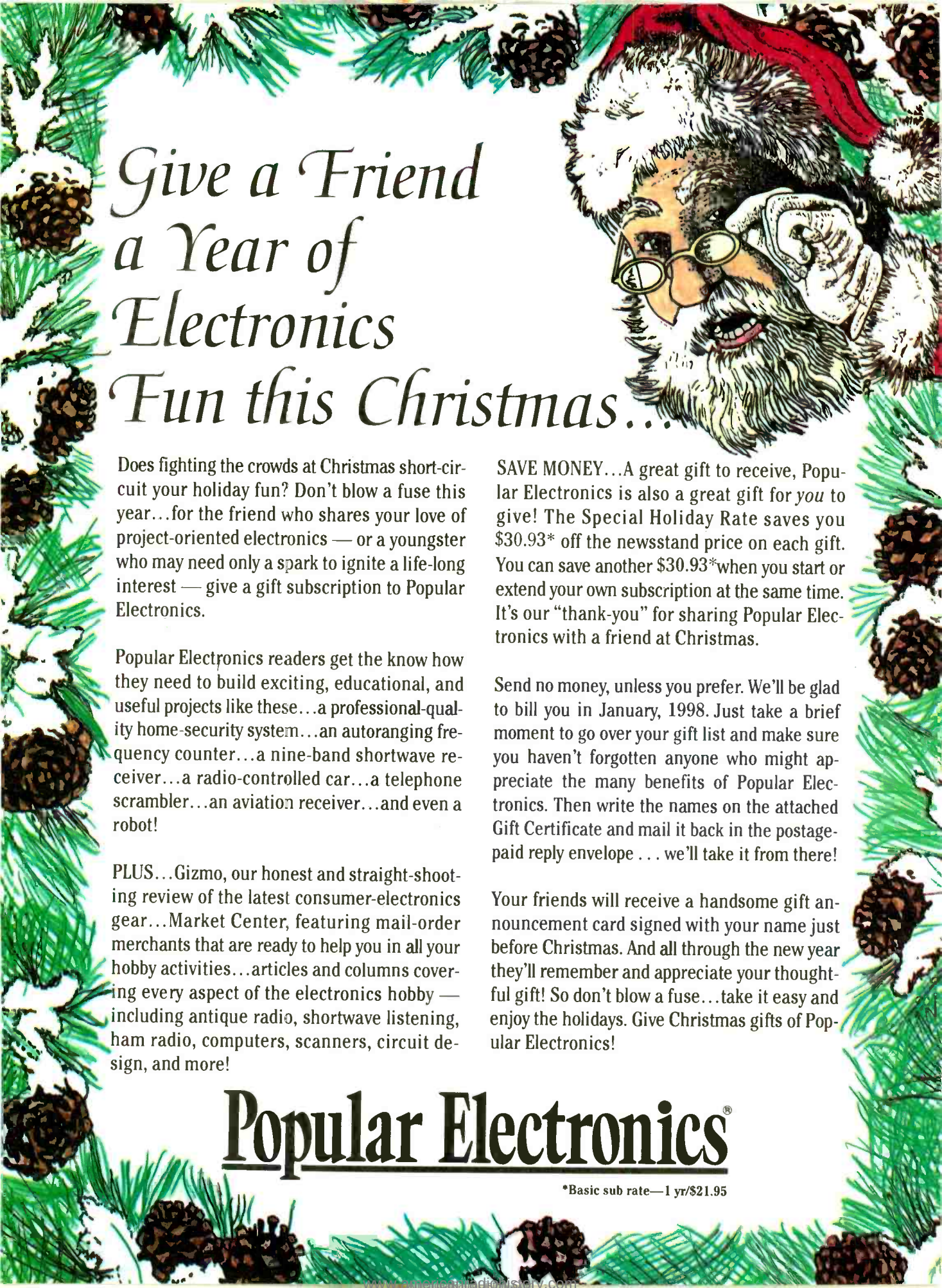
tion with its positive input at pin 3, connected to the speed and rotation direction potentiometer, R3. When the wiper of R3 is at its mid-position, the op-amp's output will be near zero and neither Q1 or Q2 will be turned on. When the wiper is turned up toward the positive side, the output will go positive and Q1 will supply current to the motor. When the potentiometer is turned toward the negative supply, the op-amp's output switches to a negative voltage, turning Q1 off and Q2 on, which reverses the motor's direction of rotation. As the potentiometer's wiper is moved toward either end, the speed increases in whichever direction it is turning. Measure the voltage swing on the emitters of Q1 and Q2 to determine the DC voltage range allowable for the chosen motor.

Looks like it's time to go for now. See you here at the Circus next month, have fun working with op-amps, and good circuitry always!

TIMER

Our last circuit uses a 1458 dual op-amp in a timer circuit as shown in Fig. 8. With S1 in the OFF position shown, wiper to ground, C1, is discharged through diode D1, and the voltage at pin 3 of op-amp IC-1a is near zero. IC1-a's output at pin 1 is also near zero. Op-amp IC-1b's positive input at pin 5 is set to one-half of the supply voltage. With the positive input at a higher voltage than the negative input, the op-amp's output is positive, turning on Q1 and operating the relay. Switching S1 to the TIME position supplies current through the timing resistor R1 to begin charging C1. When the voltage at pin 6 of IC1b rises slightly above the voltage at pin 5, its output voltage changes from positive to negative, turning Q1 off and dropping out the relay.

The opposite output condition can be obtained by reversing the leads to the inputs of op-amp IC1-b. With this change the relay will not operate until S1 is switched to the TIME position. The relay will remain in this state until the circuit times out, closing the relay. The approximate time delay with the values shown is about 30 seconds. To lengthen the time period, increase either or both of the timing components, C1 and R1. Use the best quality low-leakage capacitor for C1 for long timing periods. The capacitor's internal leakage current will be the limiting factor on long timing cycles. ■



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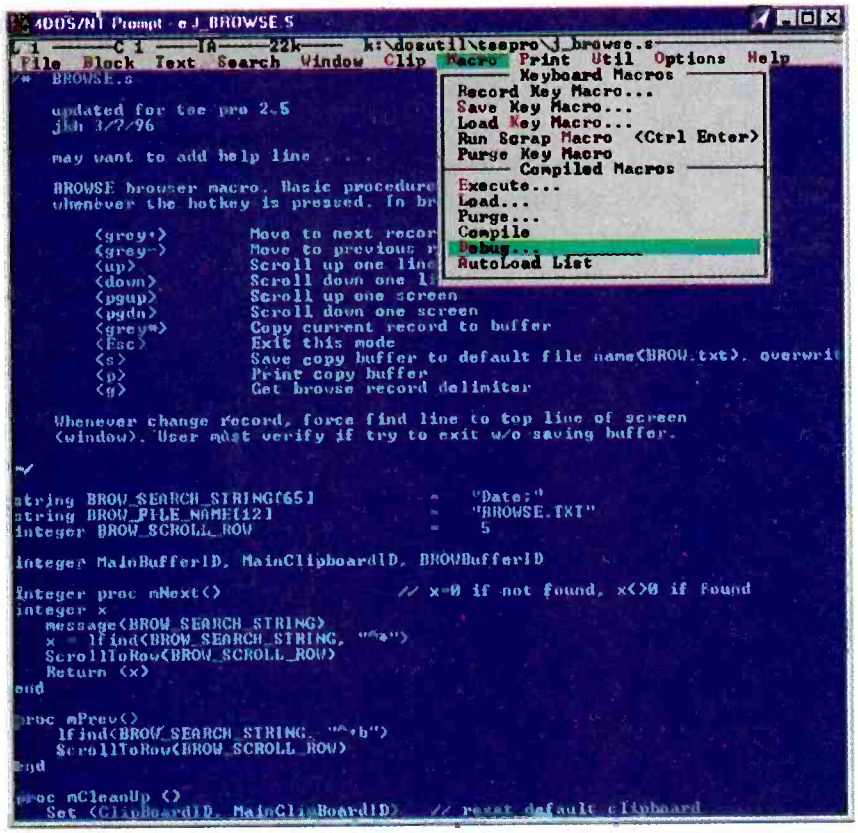
COMPUTER BITS

The SemWare Editor

JEFF HOLTZMAN

The text editor you use can dramatically affect how you work and how well. If you use one of the editors that come with DOS or Windows (Edlin, Edit, Notepad), you are probably cheating yourself. There are many, many much more powerful editors for both DOS and Windows, and many are available as low-cost shareware products. Although I've tried many text editors over the years, the one I keep coming back to is *The SemWare Editor* (TSE for short).



The SemWare Editor (TSE) is a character-mode text editor that runs under DOS and Windows. It is small, fast, and extremely customizable. Use it as is, or build your own text editor using TSE's compiled macros.

TSE is a character-mode beast that runs under plain DOS or in a DOS box under any version of Windows. (It also runs under OS/2, if anyone still cares.) I'll discuss version 2.5 here; a new version (2.6) that provides long filename and huge memory support under Win95/NT is also available. There is also a "junior" version with reduced capabilities. Demos of all versions are available from the company's Web site.

WHAT'S SO GOOD ABOUT TSE?

I like TSE for three reasons—it is small, it is fast, and it is ultra-configurable. The basic executable weighs in at about 144K. (The junior version is about half that.) In this day of cheap gigabyte drives, size may seem a moot point, but it's not really. For one, smaller size translates to faster load times. For another, its small size makes TSE easily portable. I've written here in the past about the "emergency" floppy I keep handy, particularly when visiting client sites. In addition to critical DOS programs like FDISK, FORMAT, and XCOPY, that floppy also contains my collection of indispensable utilities, including TSE.

TSE is fast. It loads fast, and it runs fast. That doesn't mean it's not full-featured, however. It does mean that the program is built from tight, efficient code, hand-crafted in a way rarely seen these days. Outside of the productivity advantages TSE provides, I like using it just because it is so well crafted.

There are numerous ways to configure TSE, covering hundreds and hundreds of canned options. And with its built-in Pascal-like macro language (which can call assembly routines), you can build powerful extensions of your own. There is an active community of TSE users that has developed an extensive library of macro add-ons. See SemWare's Web site for details.

Other features include extensive online and printed documentation; a spell checker; language sensitivity; standard and regular-expression style search/replace functions; a nicely implemented incremental search function; ability to use extended VGA modes; smart indentation, and a variety of smart tab modes. TSE also utilizes a (somewhat awkward) hexadecimal editing mode; templates for inserting boilerplate text; keyboard macros that can be recorded, saved, and played back; line and box drawing using DOS characters; multi-file and multi-window editing; several word-wrapping options; many column-mode operations; internal clipboards; Windows clipboard interaction—the list goes on and on.

CUSTOMIZING AND CODING

The grossest level of customization occurs via what SemWare calls UI (for user interface) files. When you install TSE, you can choose among several user-interface emulations: WordPerfect, WordStar, Brief, and several others. Corresponding to each is a UI file that binds internal editor commands and macros to specific keystrokes, keystroke combinations, and menu structures. You are free to use any UI file as

(continued on page 92)

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DX LISTENING

Radio Netherlands—A Golden Anniversary

DON JENSEN

A good argument can be made that international shortwave programming began with the Dutch, about 70 years ago, with the pioneer broadcasts of PCJJ, a transmitter operated by the Philips Laboratories in Eindhoven, Holland. Until World War II, and the Nazi invasion of the Netherlands, the privately owned Dutch station served as its country's English language radio voice to the world. But at war's end, the Philips operation was absorbed into what has become today's Radio Nederland Wereldomroep or Radio Netherlands, now celebrating its 50th anniversary. As their program guide says "1997 means 70 years of international broadcasting, 50 years of Radio Netherlands."

Like its predecessor, PCJJ, Radio Netherlands (RN) has been something of a pioneer during the past five decades. In 1947, RN English offerings were brief, 20 minutes daily—10 minutes of news and 10 minutes of commentary. On weekends there was Eddie Startz' "Happy Station," a popular variety radio show that dated back to PCJJ and the late 1920s.

In the '50s, the station introduced a more eclectic broadcast schedule. A program guide from that era lists programs about Great Dutchmen, a Farmers' Corner, Sports Pastimes and a weekly feature "Views of An American Correspondent," hosted by Daniel Schor—still a fixture on American public radio broadcasts. "DX Juke Box," with the voices of Derek Jordan, Harry van Gelder and Jim Vastenhous, began in the late 1950s, helping listeners understand the mysteries of shortwave listening.

(CREDITS: Brian Alexander, PA; Bob Fraser, MA; Harold Levison, PA; William McGuire, MD; Kevin Murray, MA; Ed Newbury, NE; Ed Rausch, NJ; Christos Rigas, IL; Chuck Rippel, VA; Betsy Robinson, TN; Henry Weissborn, TX; Dan Ziolkowski, NY; North American SW Association, 45 Wildflower Road, Levittown, PA 19057).

During the '60s, Amsterdam was a focal point for the youthful flower-power movement. And Radio Netherlands gave the rest of the world a hesitant introduction to that sometimes radical scene, mostly through music. The station built a musical library of some of the "hip" bands of the day.

Until the 1960s, Radio Netherlands broadcast only from Dutch soil, with a transmitter complex at Lopik, in west-central Holland. This single site served reasonably well for many years, but, as shortwave broadcasters used progressively more powerful transmitters and increasingly attempted to outshout each other, reception of RN in some parts of the world became difficult. Director Lieuwe Tijmstra was instrumental in deciding that Radio Netherlands should improve its signal by using overseas relay stations. This was then a relatively new concept in shortwave broadcasting, and, for RN, led to new relay transmitters on the islands of Bonaire in the West Indies and Madagascar off Africa's east coast. Regional African and Asian services were then begun. In the late 1960s, programming concepts broadened. No longer did RN English broadcasts focus mostly on Dutch events—tulips and windmills—but began taking on a more international flavor. A noticeably lighter touch was introduced, a distinctly laid-back Dutch approach. A popular feature of the period was "His and Hers," with Jerry Cowan and his wife, Dody. This program continued into the early 1980s.

The mid-1970s saw something of an ideological split among the station's programming staff, with more radical elements pushing to expand the traditional, conservative program lineup. This led to controversial documentaries on topics such as trans-sexualism and a more outspoken, tolerant attitude in RN programming, reflecting what many listeners already associated with the Dutch society. Still the schedule carried old familiar shows like "His and Hers" and "The Happy Station."

Diana Janssen and Jonathan Marks, the crew of Radio Netherlands' Media Network program.

For shortwave listeners, the DX programming was shaped by presenters Dick Speekman, the late Frits Greveling and Wim van Amstel. Jonathan Marks reworked the format and name in the 1980s, with "Media Network" emerging as a features-oriented communications magazine. Later "Media Network" add-

(Continued on page 102)

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Antenna Scaling

JOSEPH J. CARR, K4IPV

Anyone who reads my columns, articles or books knows that I am an antenna enthusiast. There are a lot of antenna articles published every year; sometimes very clever designs are seen. One thing that is missing from many articles are the assumptions and decisions made by the designer, as well as (in some cases) the particular equations used to derive the various lengths and spacings seen on the antenna.

The published design is fine so long as you want to operate on the same frequency. But what if you want to move the resonant frequency to a different part of the band, or build the antenna for a different band altogether? You see antenna handbooks, for example, that give designs for 2-meter beams at 144.1 MHz. Why build the antenna for the lower edge of the band—and how would the dimensions change for the high end of the band at 147.9 MHz?

Also, I've seen a lot of 20-meter quads and beams designed for either the phone or CW portions of the band. What if you are a phone operator and the published design was for the CW portion? You would want to move the resonant frequency a couple hundred kilohertz.

The problem for shortwave listeners (SWLs) is even greater. Most of the published antenna designs are for amateur radio bands, and not the bands normally used by SWLs. I suspect one reason my book *Joe Carr's Receiving Antenna Handbook* is a bestseller is that this very issue is addressed.

MODELING TECHNIQUES

What we need is a method for converting antenna dimensions and element spacing from one frequency to another. Fortunately, the answer is as simple as junior high school arithmetic (unless, of course, you found ratio and proportion intellectually daunting). Let's take a look at a sample problem.

Suppose that Fig. 1A is a 40-meter dipole cut for 7.150 MHz. The textbook tells us that the overall length A = 468/7.15 = 65.5 feet. That makes the two elements, each half the overall length, B = 32.75 feet. Now, suppose we want to cut a dipole for 10.125 MHz, center frequency for the 30-meter band (Fig. 1B). What do we do? Well, here's where we do a little ratio 'rithmetic:

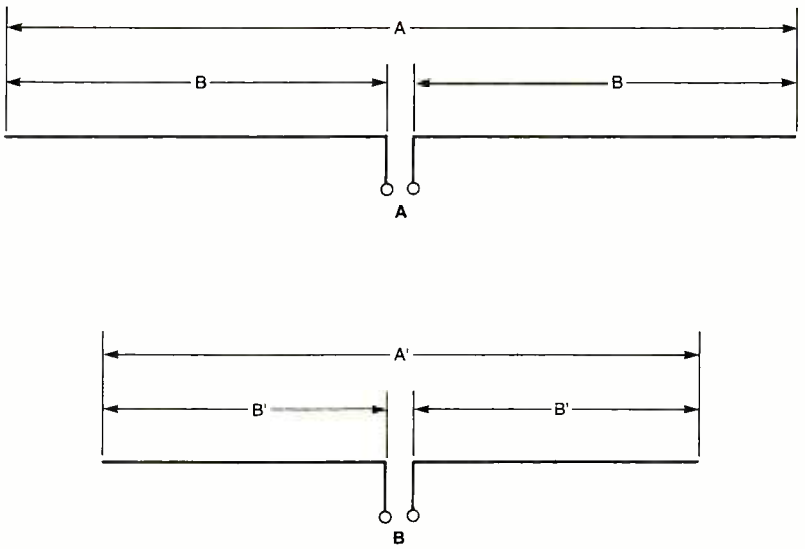


Fig. 1A. 40-meter dipole, Fig. 1B. Scaled-down 30-meter dipole.

$$A/A' = f'/f$$

where: A is the initial overall design length at frequency f, and A′ is the desired length at new frequency f′.

$$65.5/A' = 10.125/7.15$$

Solving for A′, we find A′ = [(65.5)(7.15)/10.125] = 46.25 feet, which is the needed length for operation in the 30-meter band.

We can simplify the problem a little bit. If we divide f by f′, we get a scaling proportion. In our case, f/f′ = 7.15/10.125 = 0.706. We can then multiply this scaler by the existing lengths to find the new lengths; namely, 0.706×65.5 feet = 46.25 feet. If you actually do these operations, you will find a slight error due to the fact that I rounded off the numbers for the sake of simplicity—besides how many 1/10-inch cuts do you want to try making on a 46-foot wire?

To be strictly correct, *all* physical dimensions of this dipole must be scaled, including dipole wire diameter (more details on these effects can be found in *The ARRL Antenna Handbook*). Antenna scaling or antenna modeling techniques are widely used in antenna measurements to obtain improved control over the test conditions or antenna costs. Antennas for ships, aircraft and space vehicles often fall into this category. Physically large antennas are often modeled to dimensions that are readily obtainable on the antenna test range.

YAGI ANTENNA

The case of the dipole antenna in Fig. 1 is a trivial example selected for ease of illustrating the principle. But the method becomes a lot more useful when dealing with more complex antennas such as the Yagi beam in Fig. 2. There are three elements: a *driven element*, a *reflector* and a *director*. The driven element is a half wavelength dipole, and is the only element connected to the transmitter or receiver. The reflector and directors are "parasitic" elements, and help in beam forming. The spacings between the elements (S1 and S2) are also critical. Sometimes they are the same, but in other

designs they may be different. Designing your own Yagi is daunting to some, but if you use the frequency scaling method discussed here, then you will be able to successfully replicate an antenna on a different frequency or band. Just follow one rule:

Scale all dimensions and spacings by the same scaling factor.

It will not work if you scale the element lengths but not the spacings, or if you scale the driven element and not the parasitic elements. *Apply the same factor to all dimensions.*

The downside is that you are stuck with the assumptions and choices made by the original designer. If you want to vary any parameters, then you will have to obtain a mathematically heavy professional antenna book to do the job. At one time I wondered why the professional engineering books used much more complicated equations than the amateur radio press. One reason is that the amateur radio press makes certain assumptions for you. For example, the dipole equation is based on a very high length/diameter ratio for the antenna conductor. Wire always fits this description in the HF bands. Scaling assumes the assumptions are still assumed. The fly in the ointment is seen when you attempt to scale too far. For example, trying to scale a 20-meter Yagi to work at 220 MHz might produce problems because even wire can have a significantly lower length/diameter ratio at those frequencies. In that case, try to find a VHF or UHF beam design that you can frequency scale. For most practical situations, however, frequency scaling works wonders—especially for those who are either mathematically challenged or are like me (lazy).

A LITTLE PERSONAL ADVICE (A CAUTIONARY TALE)

I never have a quiet day. Why? Because my right ear has a constant, never-ending ringing that sounds about like a 4-kHz sine wave. The ringing started about a year ago. It wasn't constant at first, but over several weeks it got real darn annoying. So I went to the doctor, who in turn referred me to an ENT ("ear nose and throat", a.k.a "oto-laryngologist"—when he wants to impress himself) doctor.

The ENT doc sent me to an audiologist who ran a simple audiogram and found rather bad high frequency hearing loss in that ear. She next ran an evoked potentials test. In this test they measure the patient's EEG (brain waves), while repetitively providing the same tone to each ear in turn for several minutes. When the EEG waves are signal averaged, the component due to the sound emerges and the rest is filtered out. My results were abnormal.

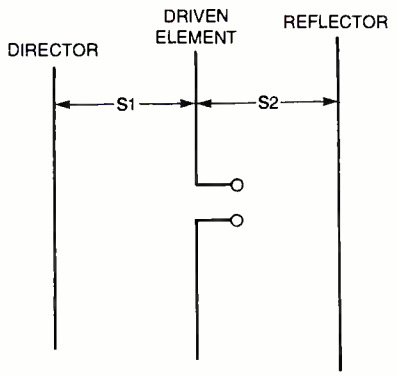


Fig. 2. Three-element Yagi beam antenna

The ENT doc next sent me to have a magnetic resonance imaging (MRI) scan of the brain to rule out an acoustic neuroma tumor. The test came back normal. "That's too bad," said the ENT doctor, "If there was a tumor, then there's something I could do for you."

We discussed my audio history. In many people my age the cause of ear ringing is 1960's vintage rock music, which we heard live. After further questioning, the doctor believes that my problem is due to ham radio!

Yep! Ham radio! The problem stems from the late 1950s and early 1960s when I was operating every day for several hours instead of doing homework (which explains my high school record!). With the gain up high, listening for a weak signal *through earphones*, I would frequently tune across some guy who was about a gozillion decibels stronger than signal I was copying. Either that, or the clown across town running a 2,000-watt "loudenboomer" linear amplifier into a high gain band-buster antenna settled right on my frequency without listening first (rude!). I can remember those events causing an (almost pleasurable) buzz in my right ear. Those experiences caused damage to the cochlea of my inner ear.

I normally don't like to share personal things with you, but this story is a "lessons learned" tale that hopefully prevents you from having similar problems. Earphones put a high audio power density into your ear. Even though communications receiver audio output stages tend to be low power (less than 1 watt in many cases), the power density is high because of the confined area provided by earphones. Avoid using the earphones in a manner that assaults your ears!

I asked the ENT doc how this problem could be prevented. His advice was three-fold:

1. Wear "shooter's ear plugs" under the earphones. These ear plugs are used by target shooters to prevent ear damage. They have a little piston plunger inside. The plunger stays open at normal sound levels, so you can hear what's going on around you, but snap shut when a high amplitude sound (like a pistol shot or loudenboomer signal) is received.

2. Ride the volume control so you can instantly knock down the signal level if it suddenly gets louder.

3. Wear the earphones a little forward of the ears, so that the ear is not fully covered.

The latter piece of advice struck me hard. My ham radio mentor, the late Mac Parker (W4II), told me exactly the same thing when I was 14 years old. In addition, a number of professional merchant marine radiotelegraphy operators, and a former boss (who was a Chief Radioman in the World War II U.S. Navy) gave me the same advice. But, dumb kid, I didn't follow it.

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. ■

SUGGESTED READING

Joe Carr's Receiving Antenna Handbook
Joseph J. Carr
ISBN: 1-878707-07-8
Universal Radio
6830 American Parkway
Reynoldsburg, OH 43068
Tel: 800-431-3939
Web: *http://www.universal-radio.com*
Price: $19.95 plus $2 (shipping/handling)

The ARRL Antenna Handbook, 18th Edition
ISBN: 0-87259-473-4
American Radio Relay League
225 Main Street
Newington, CT 06111
Tel: 888-277-5289
Web: *http://www.arrl.org/*
Price: $30 plus $5 (shipping/handling)

Electronics Library

MICROSOFT INTERNET EXPLORER ASSISTANT

by Ian Sinclair

Written for novice Internet users as well as those who are accustomed to other software, this book helps you get the most out of Microsoft Internet Explorer, as well as its Mail and News sections. The book is logically organized and easy to use. The main text consists of the most frequently used aspects of the program, all in alphabetical order. A short index of actions that are not listed in the main section allows you to look up their use in the longer references.

Even the main menu items (like File) are included, so that you can remind yourself of the most elementary points as well as learn the details of actions that are new to you. Along with concise descriptions, the book adds advice and information to answer questions that you may not have even thought to ask. In addition, there are explanations and comments illustrating why one method might be preferable to another, or why you might want to use an unfamiliar Internet Explorer command. The book provides a cross-reference index, a list of newsgroups, and tables of items (such as key shortcuts) that are not easy to find.

Microsoft Internet Explorer (order number BP425) is available for $6.95 plus $3 shipping and handling from Electronics Technology Today, P.O. Box 240, Massapequa, NY 11762-0240.

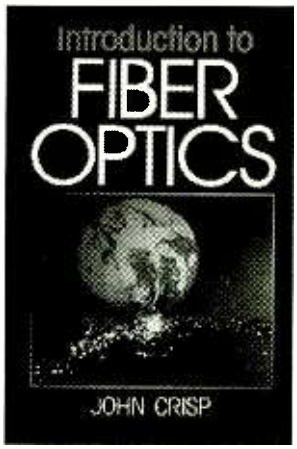
CIRCLE 90 ON FREE INFORMATION CARD

INTRODUCTION TO FIBER OPTICS

by John Crisp

This introduction to fiber optics neither assumes previous knowledge of the subject, nor requires a technical or mathematical background. It is suitable for anyone from engineers, technicians and installers to students and hobbyists—anyone who will be using optical fibers or needs to understand how they work.

After a broad introduction to the subject, ideas are developed clearly to ensure that new material is built upon firm foundations. Emphasis is given to areas that present the most problems. New terms are always explained, the main terms used in specifications and catalogs are described, and typical values are quoted. Representative examples of equipment such as cleavers, splicers, and optical time-domain reflectometers (OTDRs) are given, concentrating on the principles involved, which can then be transferred to other appropriate models.



Each chapter ends with multiple-choice questions, the answers to which are at the back of the book, along with a glossary and index.

Introduction to Fiber Optics costs $28.95 and is published by Newnes, Butterworth-Heinemann, 225 Wildwood Avenue, Unit B, P.O. Box 4500, Woburn, MA 01801-2041; Tel. 617-928-2500; Fax: 617-933-6333.

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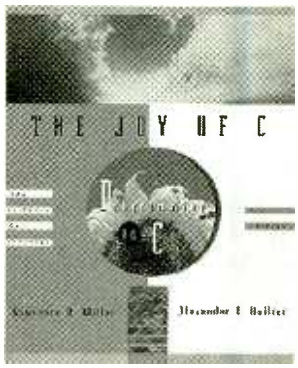
THE JOY OF C: Programming in C, Third Edition

by Lawrence H. Miller and Alexander E. Quilici

This book provide step-by-step instructions to take you from novice to expert C programmer. It shows exactly how to write clear, concise C programs that are portable, efficient, and easy to maintain. The book also offers hands-on, detailed coverage of C++, one of the most popular and flexible programming languages in use today.



Avoiding contrived program fragments or incomplete coverage that leaves you confused and frustrated, the book presents instead a collection of useful programs intended to illustrate the features of C in a realistic way. A DOS-based companion disk contains all the programs in the text, so you can get immediate feedback on the programs you write. A checklist of potential trouble spots and likely errors helps you avoid mistakes and debug programs.

The book shows multiple versions of example programs. It starts out with simple ones and gradually expands as you learn to use various language features to make the program more efficient. Case studies are included that show how to build big programs from small pieces.

The Joy of C: Programming in C costs $58.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel: 1-800-225-5945; Web: http://www/wiley. com.

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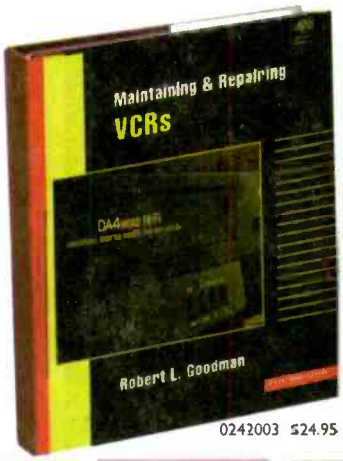

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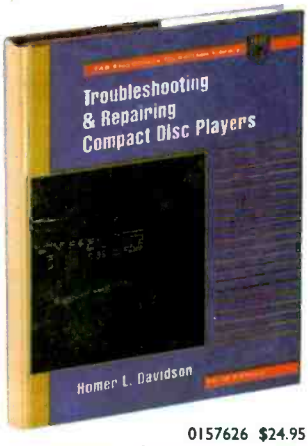

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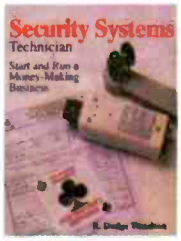

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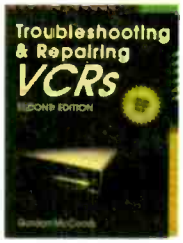

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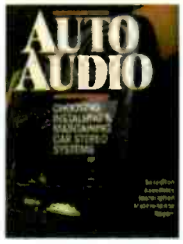

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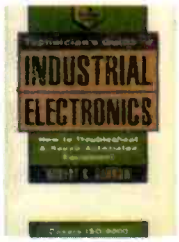

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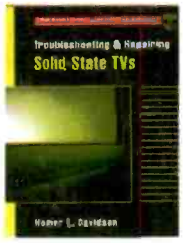

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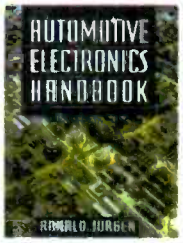

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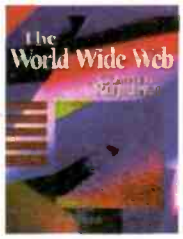

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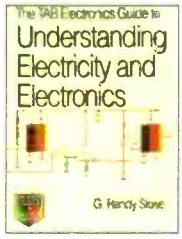

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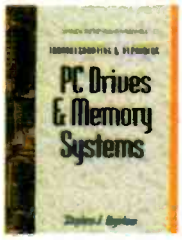

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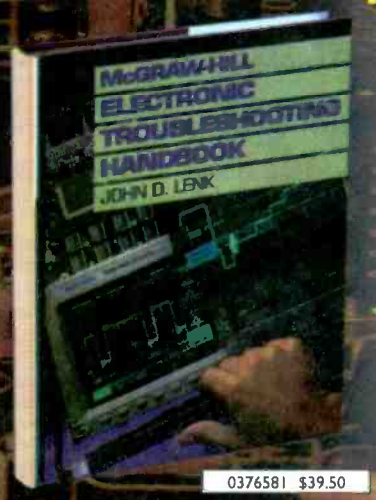

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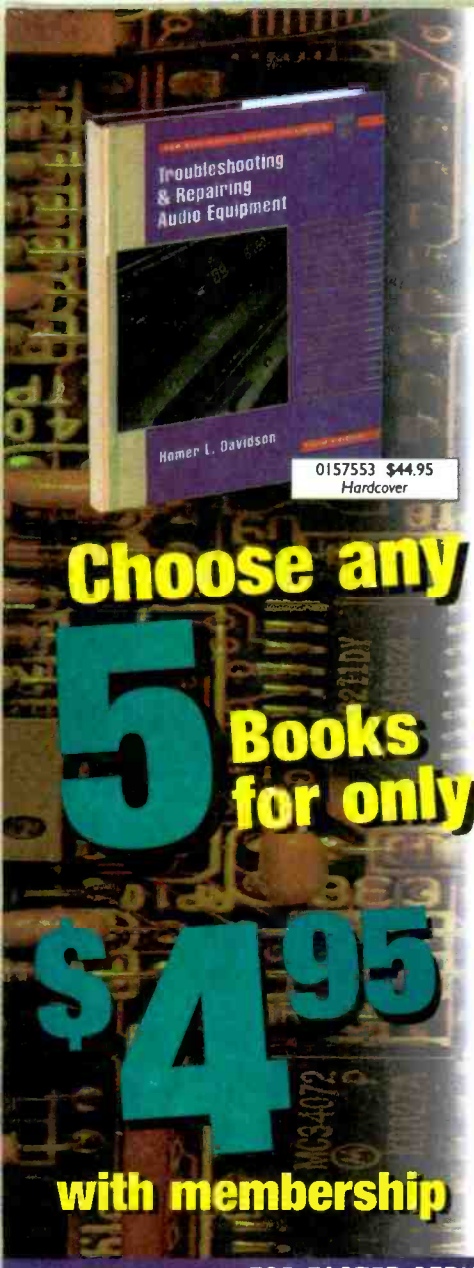

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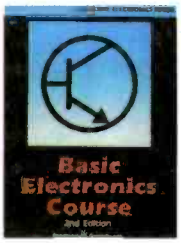

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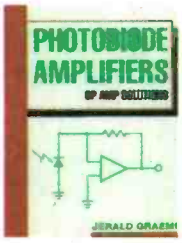

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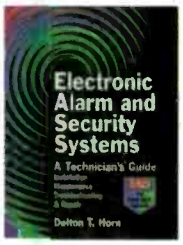

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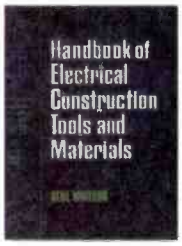

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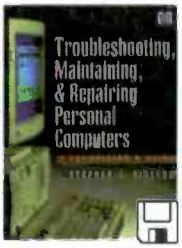

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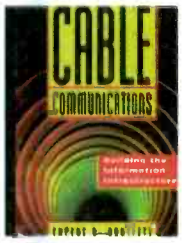

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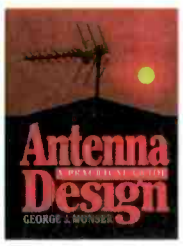

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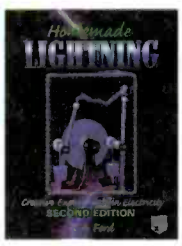

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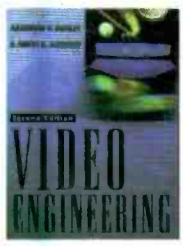

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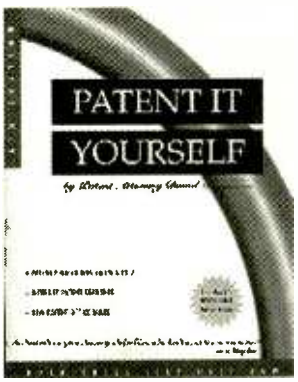

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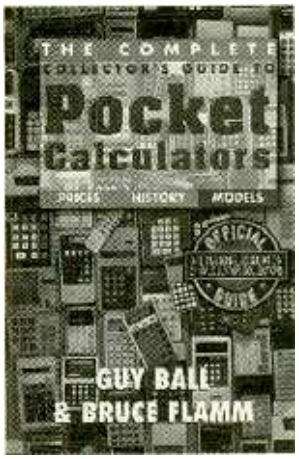
As leading authorities on early electronic calculators, and the organizers of the International Association of Calculator Collectors, the authors have a combined experience of 25 years of calculator collecting. They have extensively researched the birth and explosive growth of electronic calculators in the late 1960s and early 1970s, and have interviewed some of the top engineers and merchandisers of that era.

In this book, they offer a wealth of information on that "Golden Age" of calculators. Besides a master list of more than 1500 different models from over 220 companies, the book provides a comprehensive pricing guide, and it offers pointers on how to find desirable calculators at the best prices. There's a concise historical summary of calculator developments in the 1960s and 1970s, descriptions of the



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by Ronald K. Jurgen, Editor-in-Chief

This comprehensive guide to today's fast-changing world of digital consumer electronics provides a wealth of engineering information, covering every major area of digital electronics today as well as future projections. The reader will find complete details on enabling technologies; the latest standards; delivery and reception systems; imaging, audio, and information and communication products; appliances; and residential automation. Each section is edited by experts in the field.

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Digital Consumer Electronics Handbook costs $99.50 and is published by McGraw-Hill, Inc. 11 West 19th Street, New York, NY 10011; Tel. 212-337-5951; Fax: 212-337-4092; Web: www.ee.mcgraw-hill.com.

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THINK TANK

(continued from page 61)

Each oscillator can easily be adjusted for best sound with a potentiometer.

As you can see, the circuit consists of five identical twin-T oscillators associated with op-amps in IC1-a through IC3-a, while IC3-b serves as a preamplifier mixer whose output is coupled by C17 to output jack J1. Look at the circuit associated with IC1. Resistors R1, R2, and capacitor C1 constitute one leg of the twin-T network branches. Components C2, C3, R3, and R4 constitute another twin-T network branch in parallel with the first branch. When the values of the resistors and capacitors in the twin-T network are proportioned properly, the circuit will operate as a free-running oscillator or as a ringing circuit, depending on the resistance set by potentiometer R4. Each oscillator's output, taken from the op-amp output side of the twin-T network, is fed to a common line through resistors R26 through R30, then through C16, and R31 to op-amp IC3-b. That last op-amp amplifies the signal and feeds it to output jack J1.

Resistor values are the same from one oscillator to the next. Different frequencies are obtained by using different value capacitors. Although some of the capacitor values listed are nonstandard values, they can easily be obtained by paralleling available standard capacitors—and recalling that paralleled capacitors add in value. For example, capacitor C2, at 0.02 μF, was obtained by paralleling two 0.01 μF capacitors. Capacitor C8 was found by shunting 0.01 μF with a 0.005 μF capacitor. Use standard values found in your electronics junk-box and a little arithmetic! The capacitor values shown will produce tones for a tom-tom, low-pitched bongo and high-pitched bongo. Other tones can be obtained. For example, for bass drums, use larger capacitor values, and for higher-pitched bongos, wood blocks and claves, etc., use smaller value capacitors. When you add on another oscillator circuit, using oscillator IC1-a as an example, remember that C2 and C3 must always be equal, and C1 must always be twice the value of either. If the capacitor values are cut in half, the frequency increases approximately one octave and vice-versa.

Adjustment of potentiometers R4, R8, R12, R16, and R20 are very simple and should be made from time to time because of drift due to voltage and/or temperature changes. Connect the output of the electronic bongo to an amplifier or earphones. Turn all the potentiometers to their maximum resistance position (full counterclockwise). Turn each potentiometer, one at a time, clockwise, until oscillation starts. Then turn them each counterclockwise until the oscillation just stops. Tap a touch plate quickly, and you'll hear a percussion-like sound.

—Craig Kendrick Sellen, Waymart, PA

Wow, that's really unusual! This is one project worthy of a nicely crafted wooden case.

Well, that's another month's worth of soldering-iron fodder. Please send diagrams and full explanations of your best working circuits to Think Tank, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. You'll receive a book for each one that appears here, or if you fill a whole column you'll get a free kit, a book, and an individually packaged Motorola MC1010L chip from 1967. Keep those ideas coming! ■

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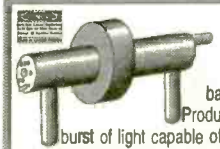

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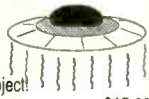

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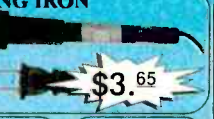

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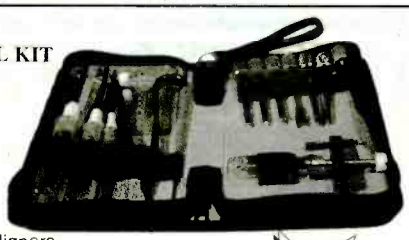

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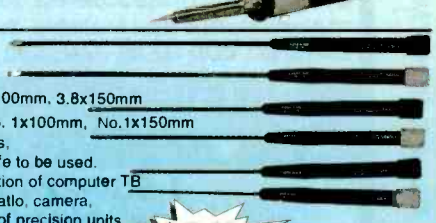

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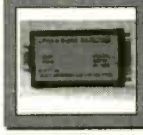

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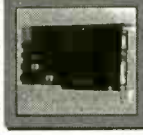

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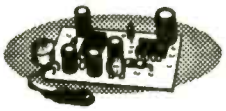
SUPER SNOOPER BIG EAR



Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to12v DC. SIZE:1.75"x 1"

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

STROBE LIGHT

Do you need an attention getter, warning light,or flashing light for model airplanes? Then this kit is for you. Use it as an emergency light for your auto, radio tower, even use it on your bicycle. Has a variable flash rate.Power requirement 6 or 12v DC. Size 3.5"x1.9"

ST-1 KIT **$11.95**

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**

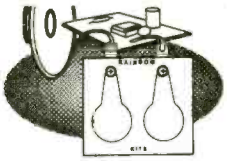
AUDIO PREAMP

Boost your microphones output 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"

AP-1 KIT **$9.95**

LIE DETECTOR



This kit can be great fun at parties. Lie and an audible tone will change, the more you lie the louder the tone. When you lie, your hands sweat. This kit allows you to measure these changes, only a very slight amount of change will cause the tone to increase in frequency. Power requirement 6 to 12v DC. SIZE: .8" x 1.2"

LD-1 KIT **$9.95**

WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-2 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. 6 to 12v DC. SIZE: 1.25" x 1"

WM-2 KIT **$14.95**

DC VOLTAGE MONITOR

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".

VM-1 KIT **$7.95**

FM STEREO TRANSMITTER

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

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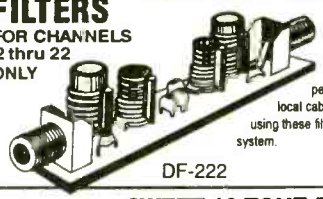
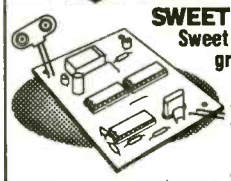


NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

DF-222 KIT **$14.95**

SWEET 16 TONE DECODER

Sweet 16 tone decoder operates great over phone lines, radios or scanners.



- 16 TTL Level Outputs
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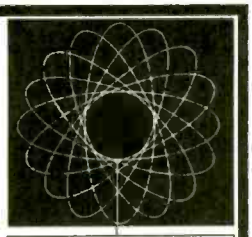
- 9v battery powered. Size: 2 3/4" x 2 1/8"

TT-16 KIT **$34.95**

He-Ne Laser Kit.



A Laser switching power supply kit

Input 12v Dc 1A, Output 2 to 12 KV at 3 to ma. Trigger voltage aprox. 8 to 10KV Complete with PC Board 6.25" x 2.25", schematic and all parts

LPS-1 KIT **$69.95**

B He-Ne Laser Tube

L1MW-1 KIT **$49.95**

C Mirror motor kit

Project Lissajous patterns on walls. Comes complete with 2 Motors, 2 Front Surface Mirrors, Mounting Brackets, and Speed Control.

MM-2 KIT **$34.95**

D Deluxe Case

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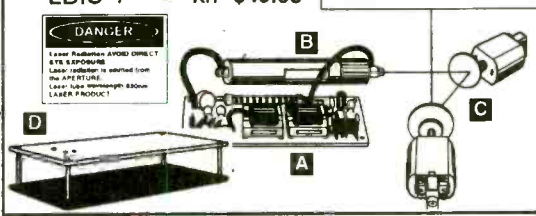

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Control 4 separate devices with DTMF tones from anywhere in the world!

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- **Turn a device ON or OFF, from anywhere in the world.**
- **Listen for any sounds in your house using the AA-1 Big Ear kit.**
- **Connect the Phone Tone Genie to the speaker of your scanner or ham radio to listen for a special tone code that can turn on an emergency radio for fireman or police.**

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

PTG-C Case **$12.95**

MICRO-MINIATURE PHONE TRANSMITTER

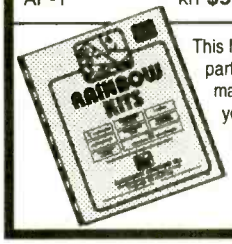
We haven't seen a smaller phone transmitter than the MMPT2 kit. Powered by the phone, it requires no battery. Transmits both sides of a phone conversation to an FM radio up to a 1/4 mile away.Tunable from 88 to 108MHz FM. Attach it to one phone or add it to the line to pick up all incoming calls. The MMPT2 is undetectable if properly installed. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. SIZE: .45" x .6"

MMPT2 KIT **$29.95**

MICRO-MINIATURE WIRELESS MIKE

So small you could hide this one on some real bugs! It's the smallest we've ever seen. With it's super sensitive mike it transmits a whisper or a room of conversation to an FM radio, tunable from 88 to 108MHz FM. With a proper antenna 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**



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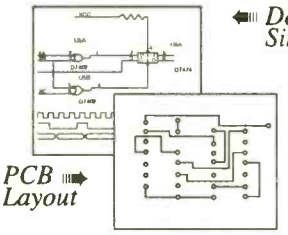

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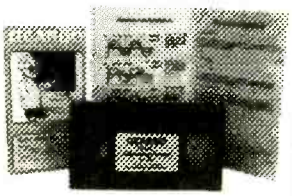

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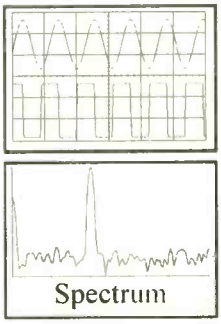

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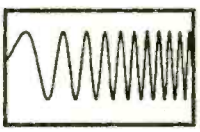
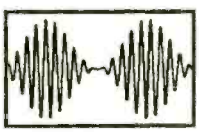
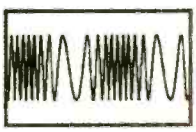
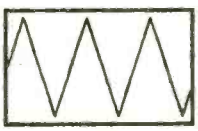
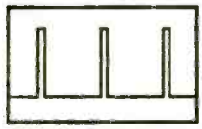

DC to 20 MHz linear and log sweeps

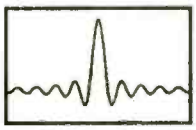

Int/Ext AM, SSB, Dualtone Gen.

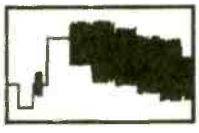

Int/Ext FM, PM, BPSK, Burst


Ramps, Triangles, Exponentials


Pulse Generator


Noise


Arbitrary Waveforms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Temperature Ranges:
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Dimensions: 188mm long x 87mm wide x 33mm thick
Net Weight: 400g

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Range:	Resolution:	Accuracy:
200mV	100µV	
2000mV	1mV	±(1%rdg+2dgts)
20V	10mV	
200V	100mV	
1000V	1V	

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

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

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

AC Voltage (ACV)

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

$19.00 any qty

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 150MHz (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 SetDC~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

SEE OUR ON-LINE CATALOG AT www.cir.com

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.

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)

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)

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

• SOLDER • SOLDER • SOLDER •
• SOLDER • SOLDER • SOLDER •

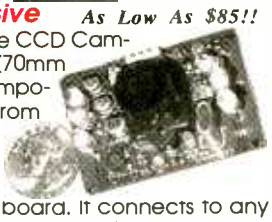
We stock high quality 60/40(Sn%/Pb%), .031" and 63/37, .031" diameter. This is prime JIS certified solder that we maintain as a regular stock item (It is not "Left-overs, Rejects or Surplus") and you can buy it from us at a fraction of the price that you are used to.

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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YOUR MANUFACTURER OF HIGH QUALITY KITS!

143.775 MHz CRYSTAL CONTROLLED TRANSMITTER KITS

XTR300EZ $79.95 | XTL3000EZ $99.95 | XTL1000EZ $69.95

CRYSTAL TRANSMITTER KITS
- Ultra-miniature surface mount construction.
- E-Z kit approach makes assembly a snap.
- Miniature battery and holder will mount directly to the circuit board.
- Transmit to any scanner type receiver

XTR300
TRACKING TRANSMITTER KIT
Transmits continuous beep-beep-beep
Ideal for locating lost or stolen items
Range up to 1 mile

XTL3000
LONG RANGE TRANSMITTER KIT
Sensitive built in microphone
Range up to 1 mile
Custom frequencies available

XTL1000
TRANSMITTER KIT
Sensitive built in microphone
Range up to 1/2 mile
Custom frequencies available

BUG DETECTOR

XBD500 $129.95

- Professional quality.
- Assembly is a snap.
- Covers 1 to 2,000MHz.
- Uses new Microwave Integrated Circuit amplifier.
- Adjustable sensitivity.
- Audio jack for privacy ear phone.

Any intercepted signal causes an audio tone that increases from a low pitched growl to a high pitched squeal as the signal strength increases.

88-108 MHz FM RECEIVER

XMR2000 $29.95

- Worlds smallest FM radio.
- As small as a hearing aid.
- Weighs less than 1/4 oz.
- Digital touch tuning.
- Ideal for use with our 88-108MHz FM transmitters

88-108 MHz FM TRANSMITTER KITS

XST 500EZ $49.95 | XWB 1000EZ $46.95 | XFM 100C $21.95

XSP 250EZ $34.95 | XTR 100C $29.95 | XTT 100C $19.95

XST 500 Voice transmitter. Range up to 1 mile. Supersensitive mic. Uses 9 volt battery. Uses surface mount components.

XWB 1000 Voice transmitter. Range up to 1/2 mile. Includes mic and battery on circuit board. Uses surface mount components.

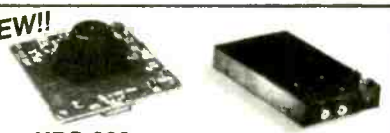
XFM 100 Voice transmitter. Range up to 1 mile. 9 v battery and leaded components.

XSP 250 Super-miniature telephone transmitter. Range 1/4 mile. Powered by phone line. Uses surface mount component.

XTR 100 Tracking transmitter. Range up to 1 mile. Uses 9 volt battery. Transmits a BEEP - BEEP - BEEP tone

XTT 100 Telephone transmitter. Range up to 1 mile. Uses 9 volt battery.

NEW!!



XPC 200
PIN HOLE CAMERA
400 LINE RESOLUTION
- Audio and Video outputs.
- See entire room through pin sized hole.
- Use with any TV or VCR with audio & video input connectors.
- Other models available.

Assembled $169.95

XVS100
TV TRANSMITTER
- Use with XVC200, VCR, Camcorder, etc.
- Power cube included.
- Uses UHF TV Band.
- Transmits video & audio.
- Up to 100 foot range.

E-Z Kit $39.95

"THE ENFORCER"!

NEW!

XXE-1000
EZ Kit $49.95

10.450 TO 10.550 GHz hand held transmitter. Extra high output level. Includes an input connector for keyed amateur band operation. May be used to test your own radar detector.

PHONE VOICE CHANGER KIT

16 levels of digital voice changing. Sound tougher, older or younger, female or male.

NEW!!

Works with regular or multi-line phones. Connects between handset and phone. Note: will not work with cordless or cellular type telephones.

XVC-2005C $59.95

XANDI ADVANCED HOBBY KITS

XPS 1000C $55.95

TELEPHONE SNOOP KIT
- Dial home from anywhere and hear inside your home.
- TouchTone coded for secure operation.
- Stop burglars and intruders.
- Reliable 24 hour protection.

XLC 900C $49.95

SCANNER CONVERTER KIT(800-950MHZ)
- Uninterrupted coverage of the 800 to 950 MHz band!.
- Works with any 400-550MHz scanner.
- Gain: 6 dB typical.
- Noise figure: 3 dB typical.

XVA 250C $49.95

VOICE-STRESS ANALYZER KIT
- See at a glance if your being lied to!
- Subject need not be present. Works with voices from recordings, TV or radio.
- Has built-in microphone.
- Easy to use LED display output.

XFS 108C $39.95

88-108 MHz FM STEREO TRANSMITTER KIT
- Separate level control for both left and right channels.
- Output level circuit with test points for quick and easy tuning.
- Transmit from any stereo audio source to most any FM stereo receiver.

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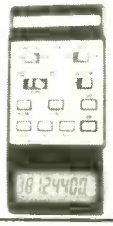
DMM

DMM-10 ($19.95): 3½ digit, DC/AC V, Ω, hFE, diode, signal output+3V,-0.5Vsq.,50%duty)
DMM-17B ($39.95): 3½ digit,DC/ACV, contin., DC/ACA, Ω, Capacitance,hFE, diode, Freq
DMM-20 ($74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω, hFE, diode, duty cycle
DMM-22 ($89.95): 4000counts, bar graph, Freq, AC/DC(V,A), Ω, Capacitance, diode, contin.
DMM-23T ($99.95): 4½ digit, high resol. (10uV, 10nA, 10mΩ), hFE, diode, contin., true rms
DMM-89S ($179.00): true rms, AC/DC (V,A), Ω, bar graph, freq, capac., dBm, logic, diode
DMM-113 ($24.95): Pocket Size, DC/ACV, Ω, diode, Continuity beeper
DMM-120 ($24.95): economy type, DCV,ACV, DCA, Ω,hFE, diode
DMM-122 ($59.95): DC/AC(V,A), Ω, hFE, diode, capacitance, freq, logic, continuity
DMM-123 ($44.95): DMM + capacitance, DC/AC(V,A), Ω, hFE, diode, continuity
DMM-124 ($69.95): Electrical+Temp,DC/ACV, , capacitance, freq, 3 phase, diode, contin.
DMM-125C ($54.95): Autorange + bar graph, DC/ACV, Cap,Ω, diode, continuity beeper



LCR METER

CAP-15 *($49.95)*: 3½ digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution zero adjustment.
LCR-195 *($89.95)*: 1uH-200H (induct.), 0.1pF-200uF(Capac.), 0.01Ω-20M Ω(resistance)
LCR-814 *($189.95)*: 0.1uH-200H, 0.1pF-20mF, 0.1Ω-20MΩ, Q Factor, dissipation, zero adjust
LCR-131D *($229.95)*: autorange, 0.1uH-10kH, 0.1pF-10mF, 1mΩ-10MΩ, Q Factor, serial/parallel, 120Hz/1kHz testing mode

FREQ. COUNTER

FC-1200 *($129.95)*: 1.25GHz Handheld, 8 digits display, 10ppm accurary, sensitivity 5mV (130-350MHz), 30mV (440MHz), 22m (800MHz), batteries or 9V adapter.
FC-2500 *($179.95)*: 2.5GHz Handheld, 8 digits display, 4ppm accurary, sensitivity <50mV, batteries or 9V adapter.
FC-5270A *($349.95)* 1.2 Ghz bench type, 8 digit, 10 ppm, 35mV sensitivity, 10Vp-p max. input, power by 9V adapter.
FC-5700 *($329.95)* 1.3GHz bench type, 8 digit, 1 ppm accuracy, 20mV sensitivity, period 0.1us to 100ms. Ideal for test & repair of audio instrument.

FLUKE DMM

HandHeld		*Scope Meter*	
12	$ 84.95	92B	$1,399
70-II	$ 75.95	96B	$1,699
73-II	$ 97.95	99B	$1,999
75-II	$129.00	105B	$2,499
76-II	$175.00	863E	$469
77-II	$155.00	867E	$659
79/29-II	$175.00		
87	$287.00		

SPECIALTY

- Sound meter $169.95
- EMF Tester $69.95
- Conductivity $169.95
- Thermometer $69.95-$89.95
- Humid./Temp meter $169.95
- Press. meter $299.95
- Electr. scale $89.95
- Watt Meter $129.95
- High Voltgae Probe $59.95
- pH Meter $79.95
- Light Meter $80-$90
- Light Adapter $49.95
- Anemometer $179.95
- Anemometer adapter (And More) $89.95

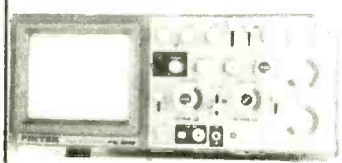
OSCILLOSCOPE

Dual Trace, Component Test, 6" CRT, X-Y Operation, TV Sync, CH2 Output, Graticule Illum, 2 Probes(x1;x10)

- PS-200 20 MHz Dual Trace $339.95
- PS-205 20 MHz Dual w/ Delay Sweep $429.95
- PS-400 40 MHz Dual Trace $494.95
- PS-405 40 MHz Dual w/ Delay Sweep $569.95
- PS-605 60 MHz Dual w/ Delay Sweep $769.95
- PS-1000 100MHz Dual Trace $999.95

Digital Scope:
- DS-303 30MHz Digital, 20 Samples/sec $849.95
- DS-303P RS-232 interface, 30Mhz $1,049.95

Scope Probe:
HP-9060 (60MHz) $15, HP-9150 (150MHz) $22, HP-9250 (250MHz)$29, HP-9258 (250MHz,100:1)$39



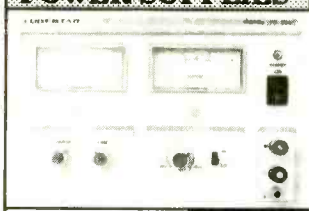
AUDIO/RF/FUNCT. GENERATOR

RF Generator
- **SG-4160** ($124.95) 100kHz-150MHz sinewaves in 8 ranges, 100mV at 35MHz
- **SG-4162** ($229.95): Generate same signal as SG-4160, but with int. counter (150MHz).

Audio Generator
- **AG-2601** ($124.95)10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave
- **AG-2603** ($229.95): Same as AG-2601, but with additional counter and digital display.

Function Generator
- **FG-2100A**($169.95).2Hz-2MHz,5mV-20Vpp
- **FG-2102AD** ($229.95) same as FG-2100A, but with int. counter and TTL, CMOS output.
- **FG-2103** ($329.95) *Sweep* 0.5Hz-5MHz, linear/log, VCG, GCV, and int. counter

POWER SUPPLIES



Single Output DC Power Supplies

- Short Circuit and overload protected
- Constant current, constant voltage mode
- 0.02%+2mV line regulation; 0.02%+2mV load regulate

Analog Meters Display
PS-303 ($159.00) 30V/3A
PS-305 ($219.95) 30V/5A
PS-8110 ($289.95) 60V/5A
PS-8112 ($399.95) 60V/5A
PS-1610 ($289.00) 16V/10A
PS-8107 ($399.95) 30V/10A

Digital Voltage, Analog Current
PS-8200 ($179.95) 30V/3A
PS-8201 ($239.95) 30V/5A

Digital Volt & Current Display
PS-8300 ($199.95) 30V/3A
PS-8301 ($259.95) 30V/5A

Dual Tracking

- Short Circuit & overload protected
- Constant current & constant mode
- Independent or Tracking

Dual Tracking (Analog V & I Displays)
PS-303D ($314.95) 30V/3A/30V/3A
PS-305D ($399.95) 30V/5A/30V/5A
PS-8108 ($549.95) 60V/3A/60V/3A
PS-8109 ($699.95) 60V/5A/60V/5A

Triple Output

- One fixed 5VDC, 3 Amp output
- Parallel to double current output (PS-8102 & PS-8103 only)

Triple Output (Analog displays)
PS-8102 ($399.95) 30V/3A/30V/3A
PS-8103 ($489.95) 30V/5A/30V/5A

Digital Displays
PS-8202 ($499.95) 30V/3A/30V/3A
PS-8203 ($549.95) 30V/5A/30V/5A

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COMPUTER BITS

(continued from page 66)

a base, then customize it to your taste. TSE includes many more commands (some 350) than it actually binds to UI elements, so if you find a must-have command you can either substitute it for something else, or bind it to a new key or menu item.

You can also write macros to add more extensive functionality, and there are multiple ways to access add-on macros. You can "burn them in" to the base executable. You can compile them, leave them stored on disk, and access them via a menu item. You can dynamically load and unload macros while running the editor. You can execute a macro specified via the command line.

VENDOR INFORMATION

The SemWare Editor Professional 2.5 ($109.00).
SemWare Corporation
4343 Shallowford Road, Suite C3A,
Marietta, GA 30062-5022
800-467-3692, 770-641-9002
Web: *http://www.semware.com*

TSE includes its own extensive "potpourri" of macros accessible via a menu entry. Example macros include an ASCII chart, an extensive file manager, a word counter, a file "diff" utility, colored syntax highlighting, and many more. All of the potpourri macros are stored externally, but can be extracted and burned in to the executable for portability if desired.

MY GAL SAL

You use TSE itself to write, compile, and debug macros. The language is called SAL, for SemWare Application Language. The overall system provides pretty much all the capabilities you would expect to see in any modern high-level language development environment. The compiler is an external executable that produces dynamically loadable *.MAC files. The debugger provides single stepping, breakpoints, watch variables, animated execution, and more.

The compiler provides C-like preprocessor directives like #include, which makes it easy to organize your files. Actually, I wish SemWare itself had made better use of #include for organizing the UI files. The reason is that they typically contain not only keystroke bindings, but also utility routines written in SAL. Upgrades would be easier if the company kept customization items separate from those unlikely to be customized.

LISTING 1

```
/*****************************************/
proc mEditSystemFiles()
    EditFile("C:\AUTOEXEC.BAT")
    EditFile("C:\CONFIG.SYS")
    EditFile("C:\WINDOWS\WIN.INI")
    EditFile("C:\WINDOWS\SYS
    TEM.INI")

/*****************************************/
proc mRestoreCursorLine()
    RestoreCursorLine()
    BegLine()

/*****************************************/
proc mDoublePrint()
    if isChanged()
    SaveFile()
    endif
    Dos("lj2 " + CurrFileName(),
    _DONT_CLEAR_)
```

Listing 1 shows three simple macros that are permanent fixtures in my copy of TSE. The first makes TSE load the critical system boot files for editing, much like the SysEdit utility of Windows. The second macro simply alters the behavior of the built-in system function that allows you to undo changes to the current line. My version places the cursor at the beginning of the line after performing the undo. The third macro launches an external DOS program that prints the specified file in small type using two columns across a landscape-oriented sheet of paper. My macro saves the current file, and then runs the print utility on the current file.

I integrate these macros into my copy of TSE by adding the print macro to the print menu, binding the EditSystemFiles macro to an unused keystroke combination (Ctrl+Shift+S), and substituting my RestoreCursorLine for the standard version where it is called in the UI file. Those macros are very simple, but should give you some idea of how easy it is to add useful functionality to TSE.

Straight out of the box, TSE is a wonderful product. By adding your own templates and macros, you can evolve it into a unique tool that exactly meets your needs. TSE gets my highest recommendation. ■

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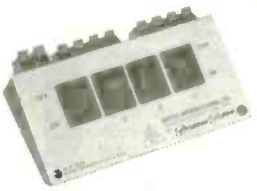

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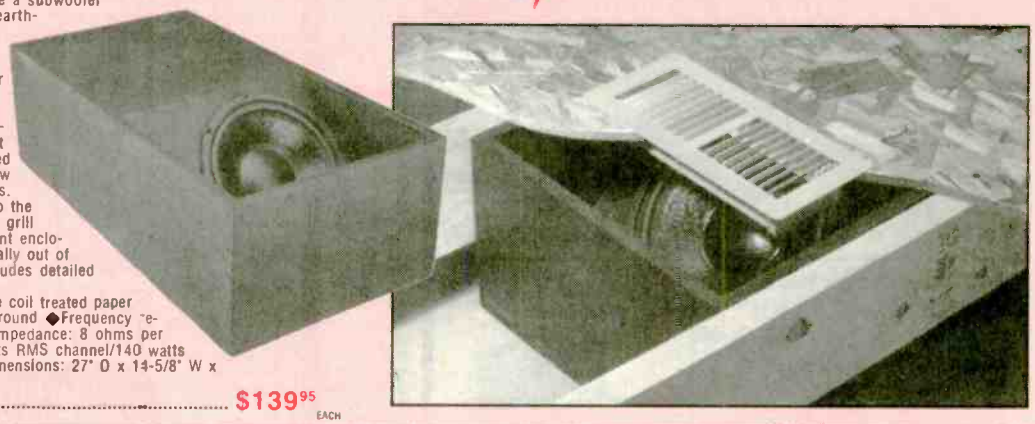

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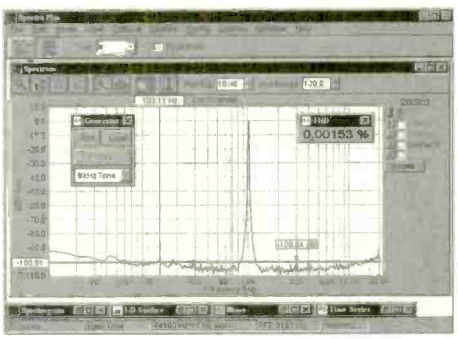

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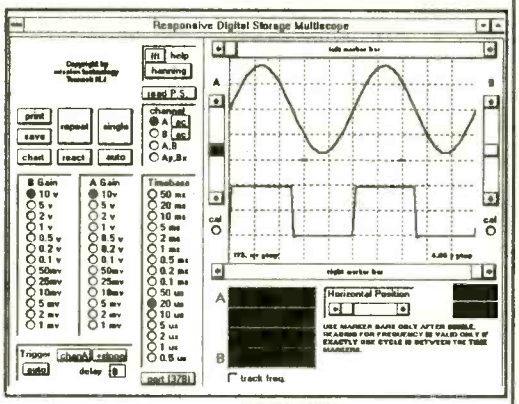

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DX LISTENING

(continued from page 68)

ed co-host Diana Janssen.

The '80s also ushered in the use of state-of-the-art satellites to beam programming to its overseas relay stations. Radio Netherlands wrestled free from the 10-day delay required when feature program tapes had to be shipped out to the remote relays. News programming was also strengthened to keep listeners abreast of current events.

Today Radio Netherlands broadcasts on shortwave to the American continent in English, Spanish and Dutch every day of the year. Broadcasting in English can be found on 6,165 kHz and 9,845 kHz from 2330 to 0125 UTC for the east and central North American continent, and on 6,165 kHz and 9,590 kHz from 0430 to 0525 UTC for the western Americas. These transmissions are relayed from their Bonaire site in the Caribbean. Special 50th anniversary documentaries are scheduled throughout the year. Program details can be accessed on their Web page at: *http://www.rnw.nl.*, or write them at Postbus 222, NL-1200 JG Hilversum, Holland.

Radio Netherlands feels it is not just another international shortwave broadcaster, but an English language service clearly identifiable and different from the other guys. Many of its SWL fans agree.

FLORIDA SHORTWAVER

Radio Miami International, with call letters, WRMI, is one of a number of privately operated commercial US shortwave broadcasters. The station sells airtime to a variety of religious, political and commercial organizations. All programs except "Viva Miami" are produced by outside organizations.

WRMI began broadcasting from Miami with its own 50,000 watt transmitter in 1994, after having purchased air-time from other western hemisphere shortwave outlets since 1989. It operates on a rather easy-to-tune frequency of 9,955 kHz in the 31 meter band.

Until recently, a single transmitting antenna directed signals southward to the Caribbean, Central and South America, although good signals were noted in North America. The station now has a second antenna, which provides even better signals in the eastern part of the US, and the Federal Communications Commission has granted Radio Miami International permission to add a second 50 kilowatt transmitter.

General Manager Jeff White says the station is always happy to hear from SWLs. Reports may be sent to him at WRMI, P.O. Box 526852, Miami, FL 33152, or, via e-mail at 71163.1735 @compuserve.com. You can even phone the station at 305-267-1728, or fax them at 305-267-9253.

DOWN THE DIAL

Heard anything new? Let us know at the *DX Listening* desk. In the meantime, looking for some tempting tuning targets? Try these.

ALBANIA—7,260 kHz, Radio Tirana was off the air for a few days during the worst of that country's international crisis earlier this year. Broadcasting in English now seems back to normal on this frequency from 0145 to 0200 UTC, on 6,115 kHz, and from 0230 to 0300 UTC, on 6,140 kHz.

ANGUILLA—11,775 kHz, Caribbean Beacon from this West Indian island has been heard around 1225 UTC with a program featuring evangelist Dr. Gene Scott requesting donations.

BOLIVIA—4,845 kHz, Radio Fides has been reported on this channel and parallel frequencies early mornings before 1100 UTC, and also during the evening until 0505 UTC sign off—all in Spanish.

BRAZIL—15,445 kHz, Radio Nacional Brasilia has English programming at 1200 UTC. Noted with music and news, including an item reporting that there are 5 million to 10 million crocodiles in Brazil!

CANADA—6,130 kHz, CHNX, a regional station at Halifax, has been noted at 2254 UTC with Golden Oldies music, weather and ads, relaying programming from CHNS on 960 kHz, medium wave AM radio.

JORDAN—11,690 kHz, Radio Jordan has been heard here in English at 1650 UTC, with pop music, identification, news and weather information, followed by Islamic programming.

SPAIN—9,690 kHz, China Radio International, relayed from a Spanish transmitter, has been noted in English at 0320 UTC with a program called "China Snapshots," followed by a Speaking Chinese lesson. ■

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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

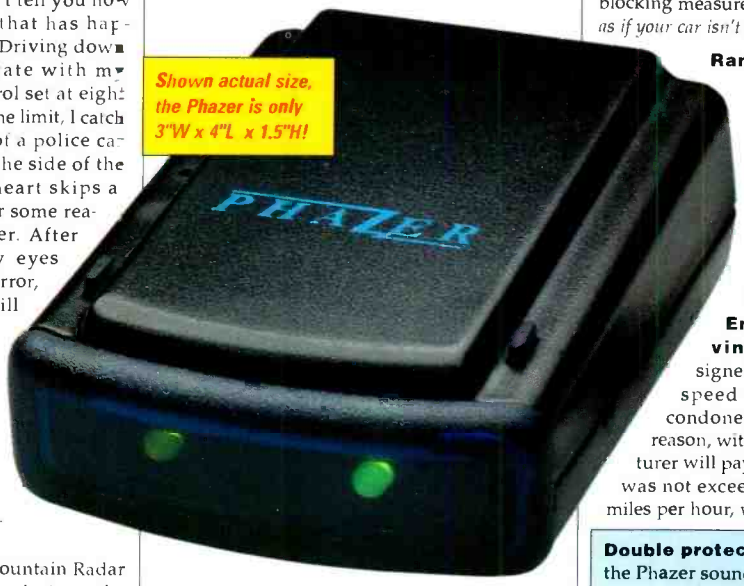
If your heart doesn't skip a beat when you drive past a speed trap—even if you aren't speeding—don't bother reading this. I can't tell you how many times that has happened to me. Driving down the interstate with my cruise control set at eight miles over the limit, I catch a glimpse of a police car parked 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.

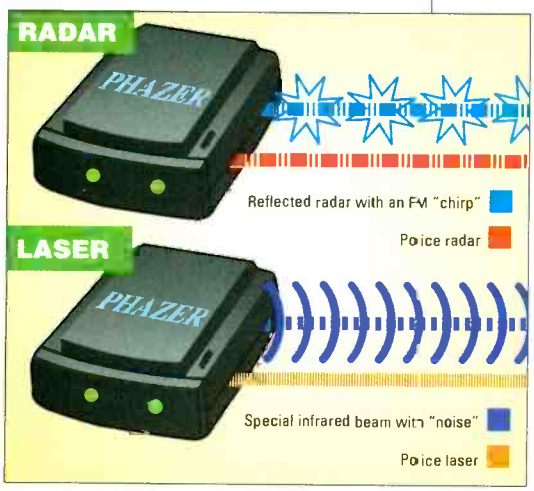
The radar component works by mixing an X, K or Ka radar signal with an FM "chirp" and bouncing it back at the squad car by way of a waveguide antenna, effectively confusing the computer inside the radar gun. The laser component transmits an infrared beam that has the same effect on laser Lidar units.



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!

4"W x 4"L x 1.5"H

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.

The Phazer . . . . . $199 $14 S&H
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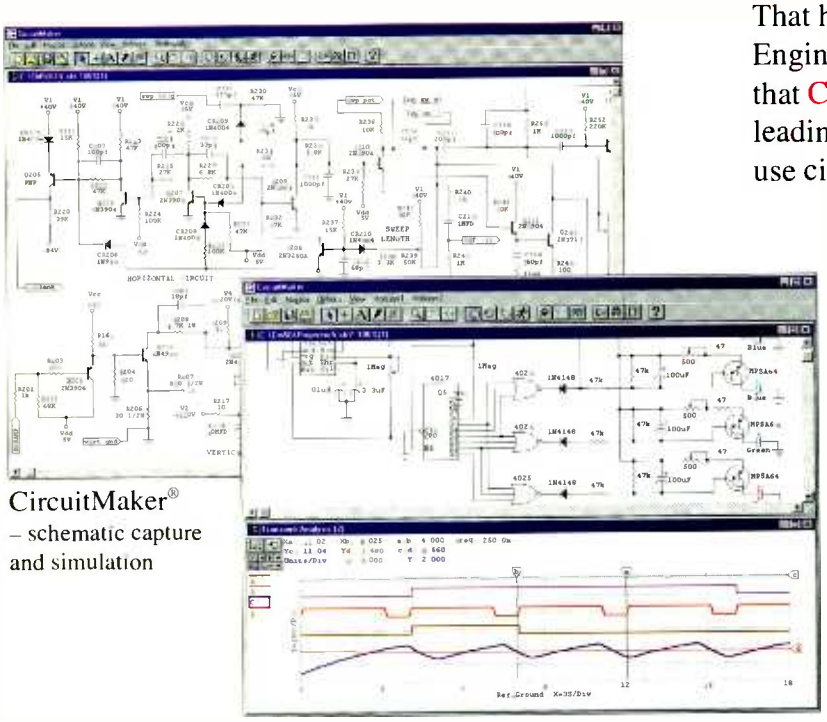

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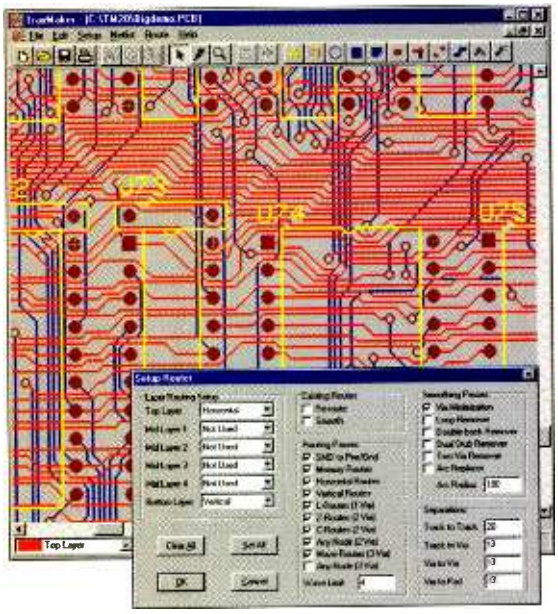

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