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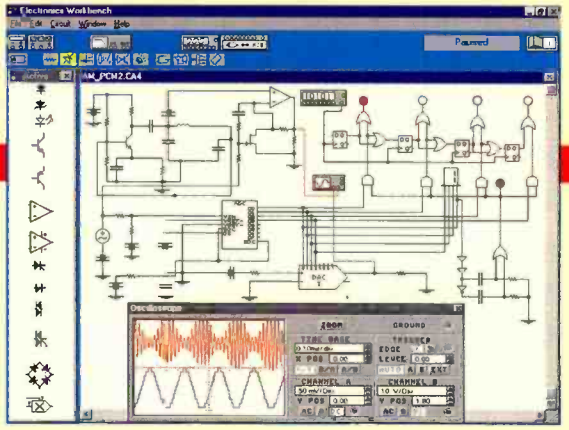

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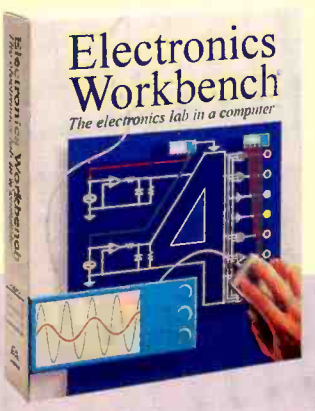

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JULY 1996
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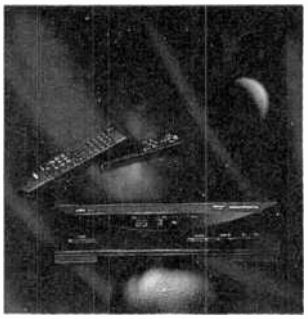

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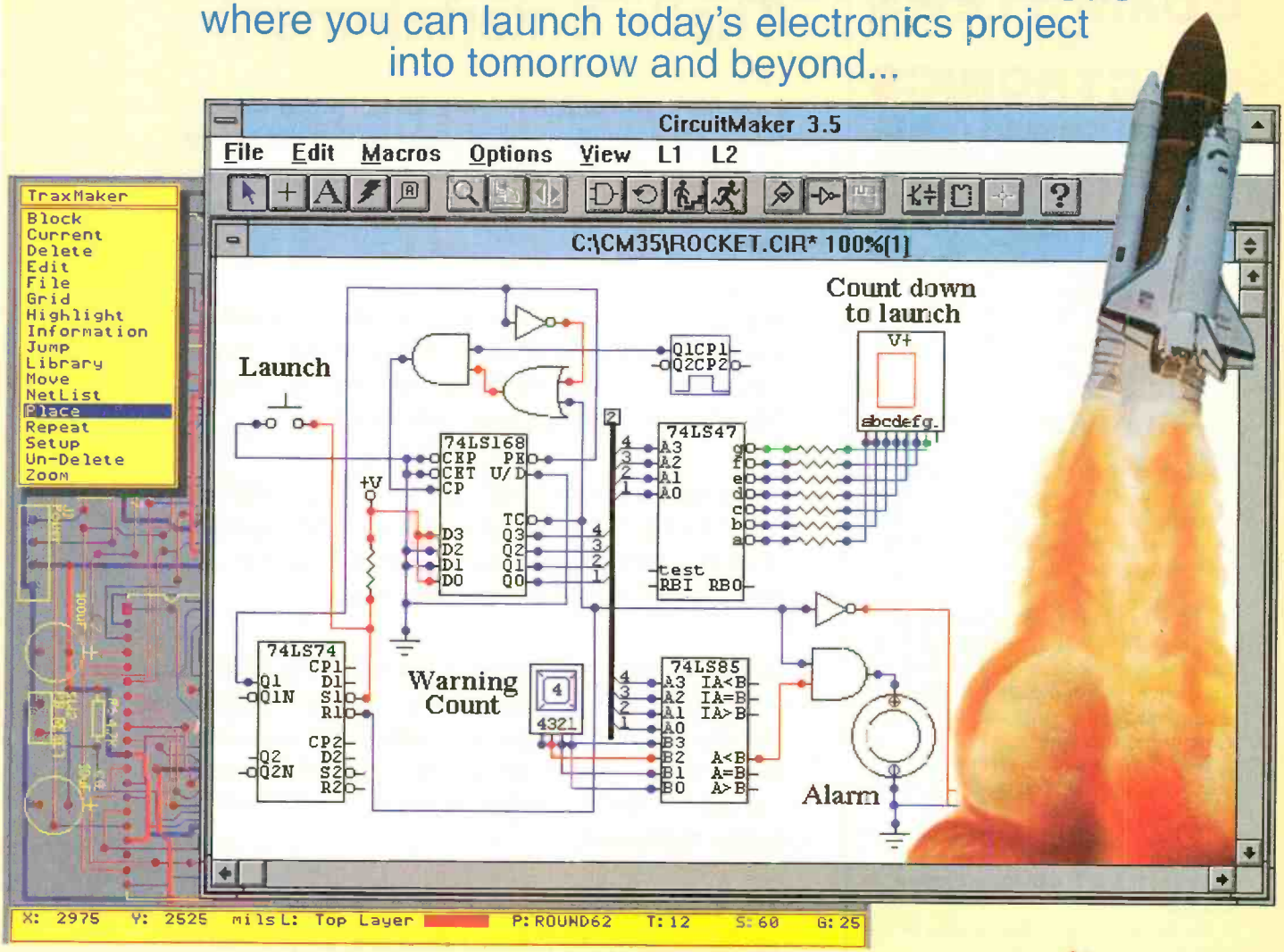

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CIRCLE 157 ON FREE INFORMATION CARD

Editorial

That's Entertainment

From the *House of Wax* to *Jaws 3D*, Hollywood has looked for ways to bring the excitement and realism of 3-D to its film and video entertainment offerings. Unfortunately, for the most part those efforts, if you will pardon the pun, have fallen flat.

Instead, 3-D has come to be associated with promotional gimmicks to spice up films that otherwise would have dubious artistic merit and little commercial success. In video, 3-D's success has been even more limited.

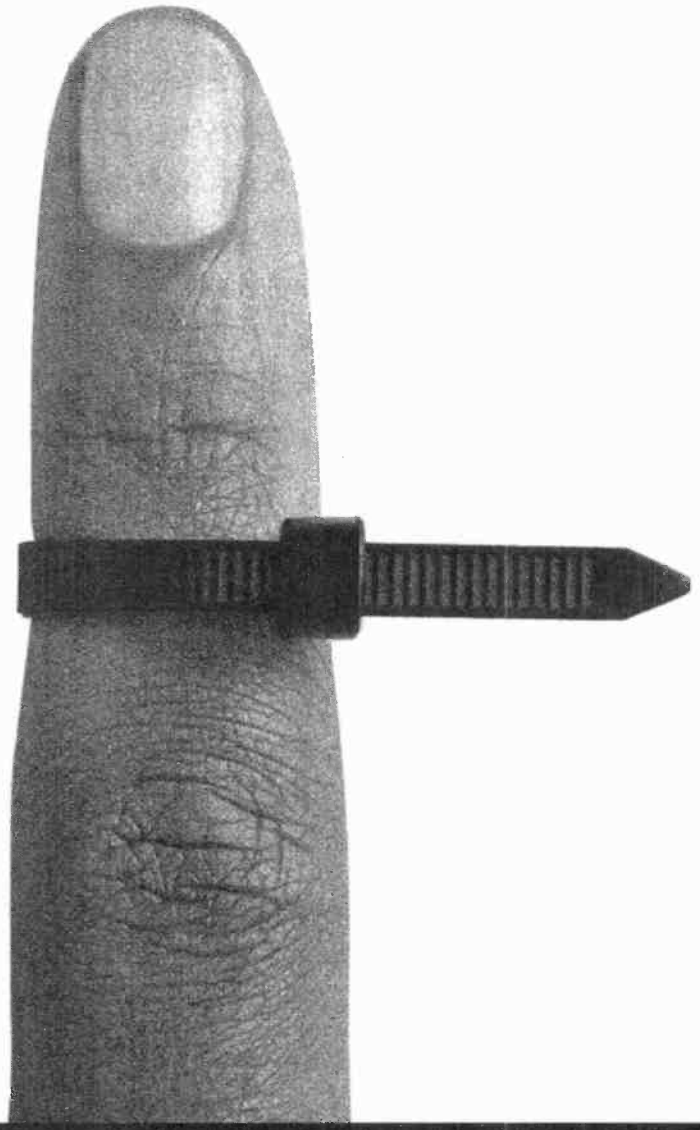
That's not to say that researchers have stopped looking for ways to bring 3-D home. Previously, some fairly good results have been obtained using special electronic glasses. The drawback, of course, is those same glasses.

Now, a promising technique has been developed that has the potential of making 3-D video a reality, at least in arcade video games, and perhaps eventually in the home—and best of all, it works without special glasses. A full report on that system can be found in the article "3-D Video," which begins on page 37.

Also this month is the second half of our **Gizmo** series on big-dish satellite TV. This time we look at some specific pieces of equipment, including a receiver, dish, LNB, actuator, mounting pole, and even cabling—in fact everything you need for your own system. Among other things, we show you how it all goes together, including how to install and align a dish, how to set up and use a receiver, and more. **Gizmo** starts on page 23.

Carl Laron
Editor

Just a reminder.



We even have the bits and pieces to organize your bits and pieces.

Adding a phone? Hooking up a home theater system? Putting up an antenna or satellite dish? You don't need the mess of twisting, trailing wires and cables. When neatness counts, you need flexible split tubing, nylon cord ties, beaded wire ties, wall-feedthrough bushings, adhesive clips or wire staples. And you'll find it all at your nearby RadioShack. We've got the products, the parts and the people to help you put it all together. For a store near you, call 1-800-THE-SHACK.

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CIRCLE 14 ON FREE INFORMATION CARD

LETTERS

Watch Those Connections

MAGNETIC BALL LEVITATOR CORRECTION

I was very glad to see my "Magnetic Ball Levitator" article in the May issue of ***Popular Electronics****.*

Upon reading the article, I noticed I made an error in the schematic. One end of R3 is shown attached to +30V. That is incorrect. It should actually be a connection to +12V.

The error will not damage any components. I suspect that the Levitator might actually still function—but then again, it might not. If it does function when wired incorrectly, the range of the Levitator will probably be limited, and the stability will probably be reduced. I am sorry for any inconvenience that this might have caused.—Jim Cicon

VERSATILE POWER SUPPLY CORRECTION

*It has come to our attention that the author made an error in the schematic in the "Versatile Power Supply" article (***Popular Electronics****, May 1996). There should be no connection between the junction of R1 and S2 and the junction of C3 and the negative output. We're sorry for any inconvenience.—Editor*

THINK TANK CORRECTIONS

Nick Cinquino made us aware of some mistakes that were introduced during the preperation of his schematics for use in the April 1996 installment of Think Tank. *The guitar amp (Fig. 2), stethoscope (Fig. 3), and lightning detector (Fig. 5B) all require split supplies. In the diagrams, pin 4 of each LM741 and LF411 is connected to ground; the circuits will not work that way. Those pins should actually be connected to negative supplies (−12V in Fig. 2 and -9V in Figs. 3 and 5B).*

Sorry about the errors that crept in, Nick. Thanks for doing such great work, we'll be sure to reproduce it better in the future.—Editor

A LONG-LOST FRIEND

I am writing to tell you how surprised and pleased I was to see your April issue on the shelf of my local grocery store—I thought **Popular Electronics** had vanished years ago! And to see the magazine's cover filled with so many projects that are reminiscent of the good old days of the late 1960s and 1970s . . . I can only say that I was swept by a wave of nostalgia as if I had seen a long-lost friend.

My first introduction to **Popular Electronics** was in 1968, when I was a 14-year-old budding guitar player. A friend lent me the April and May 1968 issues, explaining that there was a two-part article about a 60-watt guitar amplifier ("Build the M/M/M Instrument Amplifier"). I stared in wonder at that article and others in those two issues, but it was like reading a foreign language. I was bitten by the electronics bug, and I wanted to become a part of the magic!

After that first fateful meeting with electronics, my course was set. I am now an electronics engineer who has enjoyed working in the electronics industry since 1978.

Thank you for the inspiration 28 years ago. I hope you will continue to inspire others.

G.O.G., Jr.
Bedford, TX

THE RIGHT STUFF

Karl Thurber's article, "Choosing the Right Shortwave Receiver," in the April 1996 issue of **Popular Electronics** is by far the best article I have read on that topic. The article is informative without being too technical. There is just enough technical material to explain the topic to a novice, without being overwhelming.

I plan to buy a used receiver in the near future, and Mr. Thurber's article will be very helpful. Thank you!

H.E.G.
Albuquerque, NM

HAVES & NEEDS

I am in need of a SAM's repair book, #1594, for a Magnavox 3518W081A. Either original schematics or photocopies, for which I will cover the cost, would be appreciated. Thank you.

JIM MONICAL
19016 Highway 169
St. Joseph, MO 64505

I have been getting **Popular Electronics** for years now and really enjoy it. I like the projects, *Ham Radio* and *Antique Radio* columns, *Market Center*, *Letters*, and the many different articles written. Keep up the good work.

Several years ago, you helped me acquire a service manual for an older scope, and I was very grateful for that. I now need the service manuals for a Sanyo VCR Model VHR2251 (serial #59174657), and for a Philips stereo tuner Model FR1410/07 (serial #4XCO40235). I would be happy to pay for postage and copying costs.

DAVID BJORKMAN
Box 308
Elk Point, Alberta
T0A 1A0, Canada

I am a long-time reader of **Popular Electronics** who would appreciate receiving a copy of the schematic and/or manual for a Jackson signal generator Model TVG2 from another reader. I will reimburse any expenses. Thank you.

PATRICK H. LACEY, VE3DIT
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New Products

DSS ACCESSORY KITS

To support the recent GE-brand DSS Digital Satellite System, *Thomson Electronics* has introduced two GE-brand accessory kits: the *Model GED-KIT95 Do-It-Yourself Installation Kit* and the *Model GED940EXP Second Room Kit.*

The installation kit contains everything needed to self-install the GE DSS system. It includes a "how-to" video, an installation guide, a variety of cables, and a hardware bag filled with cable clips, tie wraps, toggles, double expansion anchors, machine screws, a grounding block, washers, silicon sealant, a dish-bolt package, lag screws, a compass, and telephone telco-line cords with modular connectors. The kit also comes with the GE wireless phone-jack system that instantly turns any electrical outlet into a phone jack. That allows consumers to take full advantage of DSS's programming capabilities, some of which require connection to a telephone.

The second room kit is aimed at those who want to watch DSS programming on more than one television set. It contains a remote-control signal sender that sends a signal from the remote to a pre-wired TV located in another room. Other items include a GE DSS universal remote, 100 feet of coaxial cable, two 3-foot coax cables with "F" connectors, and a splitter that can be used to connect the primary and secondary TVs to the DSS receiver. The kit also comes with a surge protector to shield the receiver from potentially damaging power surges. The second room kit can also be used with other audio and video components, including VCRs and cable boxes.

The GE DSS installation kit (pictured) and second room kit have suggested retail prices of $99.95 each. For more information, contact Thomson Consumer Electronics, 2000 Clements Bridge Road, Deptford, NJ 08096.

CIRCLE 80 ON FREE INFORMATION CARD

FULL-RANGE CAPACITANCE/RESISTANCE METER

Wavetek's CR50 measures capacitance in nine ranges—from 200 pF to 20 μF with 0.1-pF resolution—and resistance in seven ranges—from 20 ohms to 20 megohms, with a 0.01-ohm

resolution in the 20-ohm range. The meter features a capacitance zero-adjust button to compensate for test-lead and stray capacitance. The 20-ohm range, typically found only in expensive, bench-quality meters, also features the zero-adjust button to compensate for test-lead resistance. The CR50 also includes a beeper for fast and convenient continuity measurement, and a diode test.

The meter is compact, lightweight, and easy to carry. Its exceptionally large display includes enunciators to echo the specific range selected. The LCD's 0.7-inch high numerals provide quick, easy viewing of all values.

The CR50 has applications in electronic design and testing for design engineers, electronic engineering technicians, and antenna designers and installers. It can be used for capacitor selection, SMD part identification, testing run/start capacitors used with motors, and component tolerance verification. Uses for the resistance ranges include testing ground integrity (below 20-ohm range), resistor value quick checks, and SMD parts selection.

The CR50 capacitance/resistance meter has a list price of $69.95. For more information, contact Wavetek Corporation, 9145 Balboa Avenue, San Diego, CA 92123; Tel. 619-279-2200; Fax: 619-450-0325.

CIRCLE 81 ON FREE INFORMATION CARD

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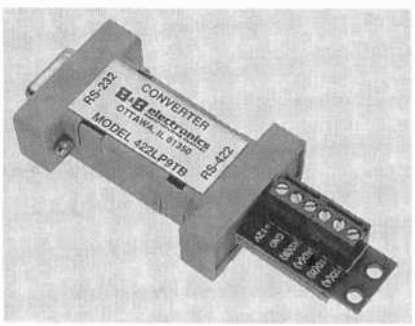

All of the converters are powered from the RS-232 handshake line's DTR and RTS (one must be high). The

continued on page 16

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Multimedia Watch

Full-Length PC Movies

BY MARC SPIWAK
TECHNICAL EDITOR
WINDOWS MAGAZINE

It's the July issue already, and summer soon will be in full swing. Regular activities include more outdoor fun in the warmer months, unless it's just too hot to sit outside. While movies are not usually the first thing on one's mind this time of year, you might be interested to know that today you can buy a single accessory pack for your computer that will allow it to play full-screen, full-length movies, with CD-quality stereo sound. And that one package also includes a bunch of popular movies on CD, so you immediately have something to do with the accessory.

The Ultimate MPEG Video Upgrade Kit allows any computer from a 486 SX and up to play full-length movies on CD, with movies included in the package.

The accessory I'm talking about is the *Ultimate MPEG Video Upgrade Kit* from Vision Interactive Publishing. That MPEG decoder board allows any computer from a 486 SX and up to play movies; it has a list price of $429.

When desktop video first hit the scene, the tiny little video windows were barely worth watching, at least after the initial fascination with them wore off. Remember bunches of people crowding around a monitor to watch Neil Armstrong's famous first step, one of the video clips included in some of the multimedia encyclopedias? You would think that he was taking the step for the first time! Well, just a few years later, nobody would waste their time watching those tiny windows. Why should they when they can watch the whole screen?

The Ultimate MPEG Video Upgrade Kit includes both the Ace Movie Master MPEG decoder card and a bunch of video discs to play on it. You have a choice of either sports titles or movies. I'm not really into sports—if I were, the ESPN Sport Pack includes eight ESPN sports-video CD titles and eight ESPN interactive-CD game titles—so I asked to see the Orion movie pack. That version includes eight full-length movies from Orion and two interactive CD titles. The movies include *Dirty Rotten Scoundrels, The Woman in Red, Force 10 From Navarone, Navy SEALs, FX, Throw Momma From the Train, Cadillac Man,* and *Mermaids.* Each movie comes on a 2-disc set. The video discs conform to the White Book standard for Video Compact Discs and should play on all compatible MPEG-1 decoders. They'll also play on a Philips CDi machine. Vision Interactive has a catalog of other MPEG titles that are currently available, and new ones will be released as time goes on.

I was curious to see how much trouble the Movie Master would present when I went to install it in my computer. I'm very happy to say that it presented no trouble at all, and I had it working in minutes. The Movie Master installs in an empty expansion slot in your computer just like any other card. The card has two video connectors and an audio jack on its back plate; there are no jumpers to set.

A VGA pass-through cable connects the output of your old video card to the input of the Movie Master. Your monitor then connects to the Movie Master output. "Regular" video passes right through the card, but MPEG video is processed and output by the card. The stereo audio jack on the Movie Master's back plate connects directly to amplified speakers or to the input of your sound card. Installation software came on a single diskette and it installed quickly and easily.

So far so good, but being the suspicious type, I thought that maybe some of the movies wouldn't play all the way through, or perhaps that chunks of them were intentionally cut out. I therefore decided to watch some of the movies beginning-to-end just to be sure. I'm happy to report that the movies are intact and do play all the way through.

At the present time I have a beautiful 20-inch Sony monitor connected to the Movie Master PC, and boy is it a great picture. However, any color monitor will do, and the picture looks great

Breakthrough device creates a wall of silent noise that drives away annoying animal pests...

Now you can use ultrasonic power to repel annoying dogs, cats and many wild animals—without harming them.

by Charles Anton

Be honest. Even if you like animals, you don't want strange animals in your yard. You know what I'm talking about: dogs that dig holes and foul your lawn or cats that trample flowers and sleep on your car.

Common problem. If you live in a rural area, you've probably had trouble with raccoons, skunks or possums. If you live in the southwest, you may even have had problems with armadillos.

Until now, there weren't many options. You wouldn't want to harm a stray animal, and an animal control agency may take days to respond, if they do.

Modern solution. Fortunately, modern technology has provided an answer: the new Yard Gard. It uses high-frequency sound waves to force unwanted animals to leave the area. Yard Gard eliminates the need for repellents, trapping or physical attacks. Pests learn to avoid the areas Yard Gard watches over.

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

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

Break their habits. Animals are creatures of habit. They establish a territory and generally follow the same travel routes. Yard Gard forces animals to change their patterns and establish new ones. They soon modify their habitual routes to avoid Yard Gard zones. Once that has happened, they'll no longer be a an irritating problem.

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

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

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

Optional motion sensor. The Yard Gard's optional motion sensor turns the unit on when pests approach, increasing the surprise factor and effectiveness. An optional 50 feet extension cord allows you to place Yard Gard in remote areas that don't have electricity.

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

Mount Yard Gard to a fence or porch railing, or place it on a post.

Try it risk-free. For a limited time, you can get the new Yard Gard at the introductory price of just $99. Call today to take advantage of this special factory-direct pricing. Yard Gard is backed by Comtrad's exclusive risk-free home trial. Try it and if you're not completely satisfied, return it within 90 days for a full "No Questions Asked" refund. Yard Gard is also backed by a two-year manufacturer's warranty. Most orders are processed within 72 hours and shipped UPS.

**People that are more sensitive to high frequency sounds may hear the Yard Gard.*

Yard Gard	**$99** $12 S&H
Motion Sensor	**$39** $4 S&H
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Please mention promotional code 503-PL-6660.

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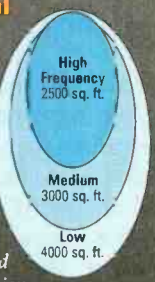
In the past, people relied on traps or poisons to get rid of pests. But environmental awareness has increased the demand for clean, non-lethal pest control methods. Safe and humane, Yard Gard is the perfect solution



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

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

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

Are animals turning your yard into a zoo?

Do cats think your garden is a litter box?

Do you have problems with unusual animals?

on all of them. Some MPEG artifacts are visible in the picture at times, such as small block-like distortion in areas of fast action, but you won't notice that unless you're looking for it. The movies are as entertaining as on a regular television, with better sound and more convenience than a VCR.

NEW STUFF

Reed Reference Publishing continues to send me the latest updates to *Books in Print Plus* on CD-ROM. That database on disc lists all books that are currently in print. The "Plus" version includes 238,000 book reviews, and sells for about 50% more than the regular version. The CD-ROM format makes it very easy to search for what you need. If there's a book in print on a certain subject, by a particular author, or whatever, you can find it with Books in Print.

Olympic Gold presents the complete 100-year history of the modern Summer Olympics.

Hijaak has always been a favorite program of mine, with its ability to let you do nearly anything you want with nearly any type of image on a PC. Unfortunately, the older version of Hijaak was behaving rudely under Windows 95; thankfully, *Hijaak 95* is finally here. That well-behaved 32-bit version of the software is written exclusively for Windows 95, and it does its magic faster than ever. This ultimate graphics viewing and conversion software package lets you view nearly any conceivable file format, capture any screen image, convert any image into any other format, enhance any image, place any image into OLE 2 applications, find and organize images, and more. You can get this excellent software for the bargain price of around $49.

Mentorom Multimedia is producing a new line of high-quality multimedia titles aimed at the educational and research market. The titles combine broadcast-quality audio and video, vast information databases, pictures, tests, games, glossaries, and more. I took a look at three of the Science & Nature titles: *Environment Water, Environment Land & Air,* and *Science Elements*. Water lets the user explore every aspect of that most precious fluid, from its usage throughout history to how it helped shape the elements. Land & Air is the flip side of the coin; it explores the drier parts of the globe. Elements is a multimedia text book filled with chemistry, the periodic table, the structure of atoms, radioactivity, and more.

I've also got a few new titles from Creative Multimedia. *Japanese to Go!* and *Spanish to Go!* are intended to help teach the basics of either language with the power of a multimedia CD-ROM. Master teacher Atsumi Tsukimori teaches the Japanese and Patricia Manzanares-Gonzales teaches the Spanish. The language titles include over an hour of video tutorials, dialog skits, and games. On a less productive, but more entertaining route is *Drivin' Route 66*. That disc takes you to the sights and attractions along this most famous stretch of road that gave it the notoriety it has today. Automobile enthusiasts will like the car photos and trivia.

I've always been a fan of great photography, and I've also been somewhat of an amateur photographer myself for many years. It stands to reason, then, that I've also been a fan of Ansel Adams for nearly as long. Ansel Adams is perhaps the most famous photographer ever to capture the details of the American landscape, in particular the great west and our

VENDOR INFORMATION

Access Software, Inc.
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Activision
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Blizzard Entertainment
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Irvine, CA 92714
CIRCLE 52 ON FREE INFORMATION CARD

Creative Multimedia
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Suite 600
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Electronic Arts Studios
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Inset Systems, Inc.
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New York, NY 10036
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Vision Interactive Publishing
17865 Sky Park Circle, Suite J
Irvine, CA 92714
CIRCLE 63 ON FREE INFORMATION CARD

National Parks. Many of Adams' great black-and-white images are included in the *Ansel Adams Screensaver* from Time Warner Electronic Publishing. The disc includes a series of photographs called the Mural Project, commissioned in 1941 to grace the walls of the Department of the Interior headquarters. It's one of the more interesting things you can do with your computer screen when you're not hard at work.

Two new titles from Viacom New Media this month, *Congo: the Movie—Descent into Zinj*, and *MTV Unplugged*. As you might have guessed, Congo is a thrilling adventure game based on the movie of the same name. Players must venture deep into the Congo in search of rare diamonds hidden in the ancient city of Zinj. Players must also keep in mind that it's a jungle out there. MTV Unplugged is a multimedia tour of the television program that has become a phenomenon. The disc features over 70 unplugged artists, including Aerosmith, Eric Clapton, Bob Dylan, Stone Temple Pilots, and many others. You'll see artist bios, rare footage, photos, special backstage jams, and more.

Another new title from Discovery Channel Multimedia this month is *Olympic Gold*. That one presents the complete 100-year history of the modern Summer Olympics. Olympic fans will have access to a database of 16,000 medal winners, official game rules, and information on the countries that have hosted the games. Users can experience every Summer Olympic Game since 1896. Trivia games let users test their Olympic knowledge.

Earthworm Jim for Windows 95 is a new action game for kids from Activision, but it's one that adults will also enjoy. Players assume the role of Jim the earthworm, who has been given superhuman powers by a high-tech space suit that fell out of the sky. In a quest to save a princess, Jim must cleverly make his way through one obstacle after another in a variety of strange worlds. Also new from Activision is the *MechWarrior 2 Expansion Pack: Ghost Bear's Legacy*. Fans of the original game can pick up where they left off with a new story, new missions, new weapons, and new 'Mechs.

Blizzard Entertainment has released *Warcraft II: Tides of Darkness*. That sequel to the original Warcraft game, Orcs and Humans, offers several enhancements including land, sea, and air combat, head-to-head play against up to eight players, and more. Since the Humans rebuilt their empire across the Great Sea, the Orcish army has been eager to fight again. Players assume the role of the commander of either the Orcs or the Humans, and they must successfully rule their empire and engage in war.

In case you've played out all the add-on golf courses for Access Software's Links game that I've mentioned over the past year or so, there are two new courses for you to follow: the *Cog Hill Golf and Country Club* and *Mauna Kea*. Cog Hill is a course located 30 miles southwest of Chicago, and Mauna Kea is built on a 5000-year-old lava flow in Hawaii.

Sony Interactive has released a new, futuristic racing game called *WipeOut*. Anti-gravity style racing is what separates that game from other racing games. The vehicles hover over a magnetized track that's part road, part rollercoaster. WipeOut features six full-length tracks containing jumps, drops, hairpin twists, and more. There's lots of action in this game.

I recently received the *TIE Fighter Collector's CD-ROM* from LucasArts. The disc includes enhanced versions of the original disk-based games, TIE Fighter and its first add-on campaign, Defender of the Empire. The CD also includes an entirely new campaign. The new campaign features 22 new missions. In case you didn't know it, you get to play the bad guys in the TIE Fighter games!

Last this month is *Desktop Toys* from Electronic Arts. This stuff is similar to screen savers with it's wacky-looking artwork, but it also lets you take out your aggressions on your PC without actually damaging anything. You can blast things with a cannon, torch important documents, break your monitor glass with a hammer, and wreak havoc in other interesting ways. Nine different toys are included. ■

NET WATCH

Two Large Sites

BY DAN KARAGIANNIS

The Internet is growing at quite an impressive rate. While it's difficult to verify the exact monthly percentage of size increase, you can easily see the signs of it. Offline, you'll find more and more providers opening shop, and existing providers constantly adding POP (point of presence) servers to meet the demand for access lines. Online, you'll find increasing numbers of both postings in newsgroups and pages on the web. And the latter themselves are getting larger and more impressive.

This month we'll take a look at two large sites. By large, of course, I'm not referring to the physical size of the servers maintaining them (although they must be pretty impressive as well). I mean the sites allow access to a lot of information and services, and as we'll see, they're both useful to those involved with electronics.

A VILLAGE OF ENGINEERS

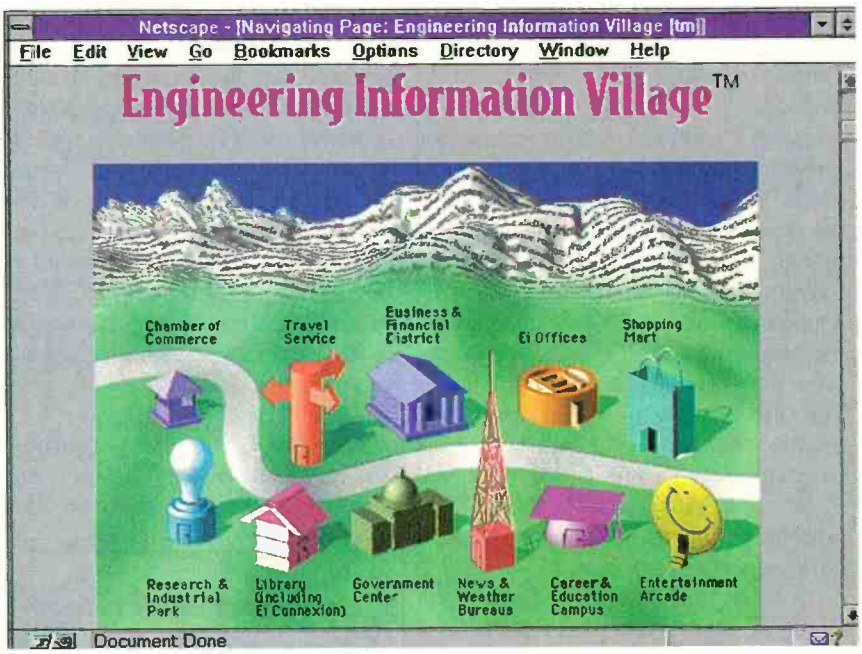
Let's begin with a site of real interest to engineers and students. Called the Engineering Information Village, this resource contains an enormous amount of useful links, information sources, and services.

Before we get into exactly what you'll find at the Ei Village, let me make it clear that the site is not free. Although you can sign on for a 30-day trial membership, after that individuals have to pay $25 a month. There are student discounts and various group rates; see the site for more information.

While the membership costs make the site a little prohibitive to those with simple curiosity in engineering, the benefits of being a "resident" of the Ei Village are well worth it to professional engineers and to those studying to become them. That is especially the case with those who don't have a lot of time to find what they're looking for.

Ei Village previews, selects, organizes, and monitors over 8000 web sites of interest to technical professionals and managers. Think of how long sifting through the web for that much information would take!

As a resident of Ei Village, in addition to the various web links, you'll have access to information and services that are not available elsewhere



With so much to explore at Ei Village, you'll really feel as if you've entered a town for engineers and students.

At Amazon.com, any book in print (and sometimes out of print) is only a few mouse clicks away. You can even have them send a book wrapped as a gift to a friend.

on the Internet. The site has sections called Ei Exclusives, Content Exclusives, Ei Spotlights, Current Trends in Engineering, Ei Tech Alert, and News and Recent Technical Articles, which reflect the Village's weekly engineering-news updates.

Residents also enjoy access to six years of Compendex*Plus, which is the most comprehensive, interdisciplinary engineering database in the world. Another 150 databases are also available through the Ei Village.

Then there are the services. You can use Articles by E-mail and Articles On Call to get a particular current piece of information, check out Editor's Choice and Site Evaluations for great places to visit on the web, ask a Technical Librarian for help, and maybe look through the Library Reference.

In the Community section, you can Ask Your Peers a question, join some Discussion Groups and Forums, or even get Help From a Senior Colleague. The Village is designed so you won't feel alone if you require some assistance.

Before we finish our discussion of the site, and you run off to your browser to set up your free trial account, let me mention that there are also useful links that could help you keep your bookmark file small. In the Village, you'll find links to several sites in each of the following categories: News and Weather, Research and Industrial Park, Library, Business & Financial District, Government Center, Career and Education Campus, Travel Agency, Entertainment Arcade, and Shopping Mart.

AN ONLINE BOOKSHOP

In the past I've covered a few really comprehensive sites where you can buy over 100,000 music CDs. Well, how about a similar site where you can buy over 1,000,000 books? No, that's not an error in comma placement or number of zeros; our next site, Amazon.com, lets you search through and select from one-million titles!

As you can imagine, with that many books available, no matter what your areas of interest are there are plenty of tomes here for you. And yes, there are loads of electronics books from every

publisher you can imagine, including McGraw Hill and Tab Books.

You have several choices when you log onto the site. First, there's a Spotlight section, where different popular books are featured each day. Also, you can select A Personal Notification Service, which will let you know by e-mail when a particular book you want comes out in paperback or when your favorite author releases a new title.

HOT LINKS

Ei Village
http://www.ei.org

Amazon.com
http://www.amazon.com

The main feature of the site is the powerful search engine that you can access by clicking on One Million Titles. You can search the catalog by author, subject, title, or keyword. Partial words can be used as well.

If you're a true bookstore browser, and aren't looking for anything in particular, you could take a look at the books Amazon.com recommends in over 20 categories. If you don't want to trust the site's opinions, you can see lists of books that won the Hugo, Nebula, Pulitzer, and even Nobel awards. Or, just look for the current bestsellers, which are available at 30% off the publisher's list price.

Another neat feature that might help you make your selection is the Customer Review section. Is there a book you have an opinion about? You can easily leave your own review of it there.

You do not need an account with Amazon.com to browse their "shelves." Once you find a book that you would like to order, you will be given the opportunity to create an account. That password-protected account will let you check the status of your orders after they're made.

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When you're setting up your order you will also be presented with the option of sending the book or books as a gift to someone. For two dollars extra, Amazon.com will even wrap it for you in a paper design you can choose right on the screen. There's also a form that lets you enter a message to the gift recipient. For those in a rush, second-day and overnight shipping options are available.

And that about does it for now. Until next time, keep in touch by either sending e-mail to peeditor@aol.com or snail-mail to *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

NEW PRODUCTS

(continued from page 8)

RS-422/485 driver is enabled/disabled with RTS. The receiver is constantly enabled on RS-422 units. On RS-485 units, the receiver is disabled when the driver is enabled, and is enabled when the driver is disabled.

Each of the converters has a female DB-9 connector on the RS-232 side. The 422LP9R and 485LP9R have a female DB-9 connector on the RS-422/485 side. The *422LP9TB* and *485LP9TB* have terminal blocks on the RS-422/485 side and can be externally powered with a 12-volt DC supply.

All four converter models cost $59.95 each. For additional information, contact B&B Electronics Manufacturing Company, 707 Dayton Road, P.O. Box 1040, Ottawa, IL 61350; Tel. 815-433-5100; Fax: 815-434-7094; BBS: 815-434-2927; e-mail: catrqst@bb-elec.com; Home page: http://www.bb-elec.com.

CIRCLE 82 ON FREE INFORMATION CARD

HANDHELD NAVIGATION SYSTEM

Aimed at outdoor enthusiasts including hunters, hikers, fishermen, and ATVers, *Magellan's GPS 4000* is a handheld Global Positioning System (GPS) receiver that offers advanced features such as landmark messaging, the ability to calculate sunrise/sunset times and moon phases for any place in the world on any date, a trip odometer, and a real-time plotter. The 10-ounce positioning and navigation device features six screens: a graphical pointer that steers the user in the direction of the destination; a road screen that illustrates the distance traveled and the orientation to the destination; a position screen with directional arrow; a moving-map track plotter; and two navigation screens, one of which can be customized to display the user's most-often used readouts, such as speed, bearing to destination, and time to go.

With the ease of a push-button phone, a user can call up a variety of position, mapping, and navigation functions. On-screen instructions and a menu-selection format make easy work of saving locations, creating stored landmarks, and setting up navigation routes. The GPS 4000 can store five routes with up to 20 legs, and up to 200 landmarks.

The device's moving-map plotter updates the user's progress in real time, showing the course as he moves, the route he has set, and all landmarks in his field of view.

The GPS 4000 will run continuously for 17 hours, or for weeks if used intermittently, on four AA alkaline batteries. The display is backlit for nighttime use. A carrying case, strap, batteries, and manuals are included. Optional accessories include a swivel mounting bracket; a power/data/antenna kit with remote antenna; and a 10–16-volt DC power/data module that will output GPS position information to other National Marine Electronics Associa-tion standard devices, such as radar, autopilots, and fish finders.

The GPS 4000 handheld navigation device costs $249.99. For further information, contact Magellan Systems, 960 Overland Court, San Dimas, CA 91773; Tel. 800-707-5221. ■

CIRCLE 83 ON FREE INFORMATION CARD

Just like these Fully Trained Electronics Professionals

"Thanks to CIE I have tripled my previous salary, and I am now in a challenging and rewarding new field where only the sky is the limit."
Daniel Wade Reynolds
Industrial Electrician
Ore-Ida Foods

"CIE was recommended to me by my boss. It was appealing since I could study at my own pace at home and during business travel."
Dan Parks
Marketing Manager/Consumer Products
Analog Devices, Inc.

"I loved the flexibility CIE offered. It was the only way I could continue both school and my demanding job."
Britt A. Hanks
Director of Engineering
Petroleum Helicopters, Inc.

"I liked the way the school was set up with laboratory assignments to enforce conceptual learning. The thing which impressed me the most about CIE's curriculum is the way they show application for all the theory that is presented."
Daniel N. Parkman
Missile Electro-Mechanical Technician
U.S. Air Force

"Completing the course gave me the ability to efficiently troubleshoot modern microprocessor based audio and video systems and enjoy a sense of job security."
Tony Reynolds
Service Manager/Technician
Threshold Audio & Video

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CIE is the best educational value you can receive if you want to learn about electronics, and earn a good income with that knowledge. CIE's reputation as the world leader in home study electronics is based solely on the success of our graduates. And we've earned our reputation with an unconditional commitment to provide our students with the very best electronics training.

Just ask any of the 150,000-plus graduates of the Cleveland Institute of Electronics who are working in high-paying positions with aerospace, computer, medical, automotive and communications firms throughout the world. They'll tell you success didn't come easy...but it did come...thanks to their CIE training. And today, a career in electronics offers more rewards than ever before.

CIE'S COMMITTED TO BEING THE BEST...IN ONE AREA...ELECTRONICS.
CIE isn't another be-everything-to-everyone school. CIE teaches only one subject and we believe we're the best at what we do. Also, CIE is accredited by the National Home Study Council. And with more than 1,000 graduates each year, we're the largest home study school specializing exclusively in electronics. CIE has been training career-minded students for nearly sixty years and we're the best at our subject...
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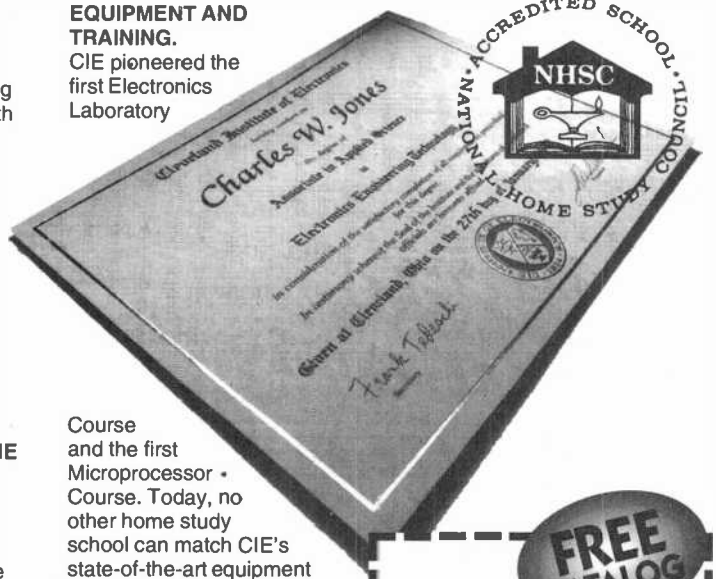
While some of our students have a working knowledge of electronics others are just starting out. That's why CIE has developed twelve career courses and an A.A.S. Degree program to choose from. So, even if you're not sure which electronics career is best for you, CIE can get you started with core lessons applicable to all areas in electronics. And every CIE Course earns credit towards the completion of your Associate in Applied Science Degree. So you can work toward your degree in stages or as fast as you wish. In fact, CIE is the only school that actually rewards you for fast study, which can save you money.



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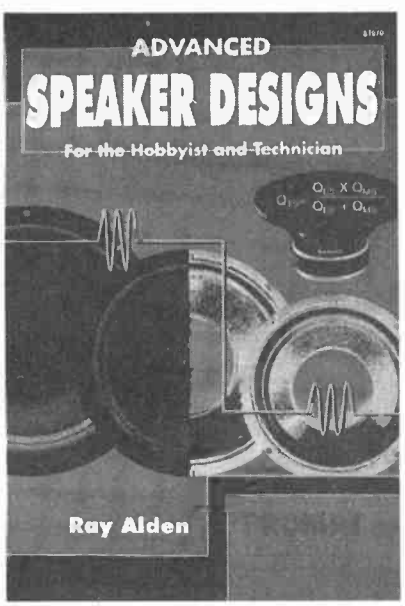
Electronics Library

ADVANCED SPEAKER DESIGNS FOR THE HOBBYIST AND TECHNICIAN

by Ray Alden

This book shows electronic hobbyists and experienced technicians how to create high-quality speaker systems for the home, office, or auditorium. Every part of the system is covered in detail, with chapters on sealed and vented enclosures, and discussions of subwoofers and crossovers. The book also explains how to measure driver parameters and predict system responses for greater precision. Sources for both custom-built and ready-made enclosures are listed in the appendix.



Three speaker-building options are presented to readers. They can build the speaker systems described in the book. Complete plans for seven speaker systems are included. Each features easy-to-understand directions, parts lists, and illustrations. Or they can go a step further, and actually learn to calculate design parameters, system responses, and component values using a scientific calculator. An easier method to creating custom speaker systems is to use a PC and special software to perform the design operations.

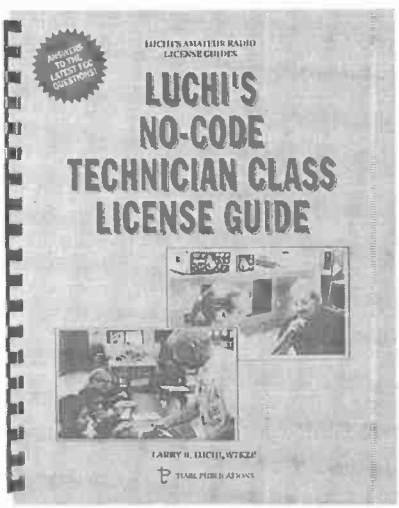
Advanced Speaker Design for the Hobbyist and Technician costs $16.95 and is published by Prompt Publications, 2647 Waterfront Parkway, East Drive, Indianapolis, IN 46214-2012; Tel. 800-428-7267 or 317-298-5710; Fax: 317-298-5604.

CIRCLE 90 ON FREE INFORMATION CARD

LUCHI'S NO-CODE TECHNICIAN CLASS LICENSE GUIDE

by Larry R. Luchi, W7KZE

Written by an electronics teacher who has helped thousands of aspiring hams put an amateur license on their shack walls, this is one of a series that provides all you need to know to pass the licensing exams in each of the amateur-radio classifications. The book takes you through all the latest FCC questions, explaining all the math and theory needed for the no-code technician-class license exam. Each chapter presents the applicable questions and the correct answers, along with the author's explanations and clarifications.



At the end of each chapter is a complete list of FCC questions on that subject, with the multiple-choice answers that you'll have to pick from, so you can test yourself on what you've learned. The guide is set up as a nine-week study course, and stresses keeping a positive attitude. Those who are intimidated by math won't be when reading this book, which guides you step-by-step through each of the formulas.

Luchi's No-Code Technician Class License Guide costs $22.95 and is published by Tiare Publications, P.O. Box 493, Lake Geneva, WI 53147; Tel. 800-420-0579.

CIRCLE 91 ON FREE INFORMATION CARD

1996 ANTENNA PRODUCT GUIDE

from Firestik Antenna Company

This 37-page, full-color catalog features antennas and accessories for CB, scanner, 46/49-MHz, and amateur radio. Highlights include a no-ground-plane CB antenna system that can be

used just about anywhere you might want to have CB communications—with no reflective metal surface (or "ground plane") required. Also featured is the easy-on-the-budget "Road Pal" line of antennas, kits, and acces-

sories. The catalog offers antenna kits specifically designed for installation on motorcycles and all-terrain vehicles, as well as dual- and single-antenna kits, roof and hood-mounting kits, and an indoor CB base antenna system. Accessories include springs, disconnects, brackets, coax cable, adapters, connectors and a wide assortment of mounts.

The catalog also provides an extensive "Technical Support" section, covering the setup and testing of antenna systems. A convenient chart helps you choose the right equipment for your antenna system, and the 15 most common errors that create SWR problems are listed.

The 1996 Antenna Product Guide is available from Firestik Antenna Company, 2614 East Adams Street, Phoenix, AZ 85034-1409; Tel. 602-273-7151; Fax: 602-273-1836.

CIRCLE 92 ON FREE INFORMATION CARD

ELECTRONIC PROJECT BUILDING FOR BEGINNERS

by R.A. Penfold

Written for the complete newcomer to electronic project building, this book provides a thorough introduction to the practical side of the hobby. It covers component identification, including resistor color codes and capacitor value markings, and offers tips on buying the right parts and the right tools for the job. Soldering is covered in detail, with advice on how to produce good joints and avoid "dry" joints.

The book describes various project-building methods, including stripboard, custom printed-circuit boards, plain matrix board, surface-mount boards, and wire-wrapping. It shows readers how to make easy work of the hard wiring, finish a project, and add panel labels. The book also explains how to get "problem" projects to work, including some simple troubleshooting methods.

Electronic Project Building for Beginners is available for $5.95 plus $3 shipping and handling from Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.

CIRCLE 93 ON FREE INFORMATION CARD

COMMUNICATIONS CATALOG 96-01

from Universal Radio

Designed to introduce the radio enthusiast to the newest and best in communications equipment, this catalog features products from such major manufacturers as Sony, Kenwood, Grundig, Drake, Alinco, Panasonic, Japan Radio Company, Icom, and Yaesu. As a direct distributor of all those brands (and more), Universal is in a position to give its customers objective advice on the best equipment for their needs.

The catalog features a full assortment of amateur-radio gear, including HF, UHF/VHF multi, and UHF/VHF FM transceivers; antennas, antenna tuners, and rotors; amplifiers; SWR and power meters; study materials, and Morse-code accessories. In the shortwave category, the catalog offers communications, commercial, wideband, and VHF-UHF receivers; scanners; portable and specialty receivers; antennas; and headphones. Also featured are radioteletype readers and decoders, SWL computer interfaces and radio-related computer accessories, books, and more.

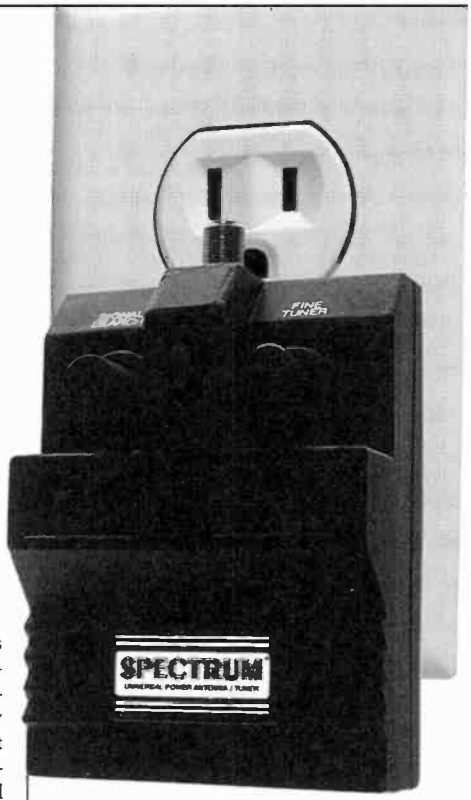
Catalog 96-01 is available for $2 from Universal Radio, 6830 Americana Parkway, Reynoldsburg, OH 43068; Tel. 800-431-3939 for orders, or 614-866-4267. ■

CIRCLE 94 ON FREE INFORMATION CARD

Fifteen years of microelectronic research makes conventional antennas a thing of the past!

This little box uses your home's electrical wiring to give non-subscribers, cable subscribers and satellite users better TV reception!

by David Evans



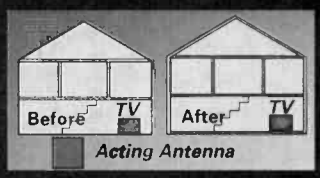
Technology corner

1. Why don't conventional antennas work as well as the Spectrum?

■ When TV signals are tuned at the TV channel's center frequency, optimum tuning has been achieved.

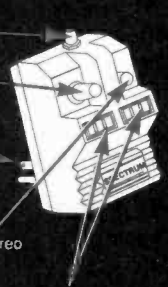
■ Other antennas can't offer center frequency tuning like the Spectrum Antenna can. They only offer such tuning up to the edge of the center frequency. As a result your TV picture remains snowy.

2. How does Spectrum use a home's electrical wiring as an antenna?



Believe it or not, the Spectrum Antenna simply "activates" the giant antenna that already exists in your home. Essentially, it uses all of the wiring throughout your home's walls and ceilings to make an antenna as large as your house for unbelievably clear reception of local broadcasting.

3. Spectrum antenna features



Parallel 75 ohm resistance
For minimum loss of signal

Signal search control
For selecting multiple antenna configurations

Polarized three-prong plug for grounding
For optimum signal grounding to eliminate noise and static

Resonant fine tuner control
For dialing in crisp, clear TV/stereo reception, eliminates ghosting

Dual AC outlets with built-in surge protection
For plugging in additional TV/stereo equipment guarding against damage and electrical surges

Until recently, the only convenient way to guarantee great TV reception was to have cable installed or place an antenna on top of your TV. But who wants to pay a monthly cable fee just to get clear reception, or have rabbit-ear antennas that just don't work on all stations? Some people just aren't interested in subscribing to cable. Or they may live in an area where they can't get cable and TV-top antennas aren't powerful enough. And what about those people who have cable or satellite systems but still can't get certain local stations in clearly?

Now, thanks to fifteen years of microelectronics research, a new device has been developed that is so advanced, it actually makes conventional antennas a thing of the past. It's called the Spectrum Universal Antenna/Tuner.

Advanced technology. Just imagine watching TV and seeing a picture so clear that you'd almost swear you were there live. Just plug the Spectrum Antenna into a standard AC outlet and plug your TV into the Spectrum. You can remove the unsightly clutter of traditional TV-top devices gathering more dust than television signals. Get ready for great reception. Your TV will suddenly display a sharp, focused picture thanks to its advanced design "Signal Search" and "Fine Tuner" controls.

Uses your home's electrical wiring. The Spectrum Antenna is a highly sophisticated electronic device that connects into a standard wall outlet. The outlet interfaces the Spectrum Antenna with the huge antenna that is your home wiring network. It takes the electrical wiring in your house or apartment and turns it into a multi-tunable, giant TV reception station which will improve your TV's overall tuning capability. The results are incredible. Just think how much power runs through your home's AC wiring system—all that power will be used to receive your local broadcasting signals.

How it works. Broadcast TV signals are sent out from the local broadcast station (ABC, CBS, NBC, etc.). They interface with your home's AC power line system, a huge aerial antenna network of wiring as large as your home itself. When the Spectrum Antenna interfaces with the AC line, the signal is sent to its signal processing circuit. It then processes and separates the signal into 12 of the best antenna configurations. These specially processed signals route themselves into 12 separate circuits. The Spectrum Antenna includes a 12-position rotary tapping switch, the "Signal Switch" control, which gathers twelve of the best antenna configurations.

The "Signal Search" offers varying antenna configurations for the user to select from the best signals of all those being sent. The signal then passes through the Spectrum Antenna's special "Fine Tuner" circuit for producing crisp, clear reception.

Risk-free offer. The Spectrum Universal Antenna/Tuner comes with our exclusive 90-day risk-free home trial and a 90-day manufacturer's warranty. Try it, and if you're not satisfied, return it for a full "No Questions Asked" refund.

Who can use Spectrum?

- ***Cable users-You have cable but you can't get certain local stations in clearly.***
- ***Non-cable users-You don't have cable and want the stations to come in more clearly***
- ***Satellite users-You have a digital satellite system but can't get local stations in clearly***

Limited time offer! We realize that most people have more than one TV in their home. We are offering a special discount on additional Spectrum Antennas so you get great reception on all your TVs!

Spectrum Antenna™.....$39 $4 S&H

Additional antennas just.....$34 S&H free

Please mention promotional code 1492-PL-6659.

For fastest service, call toll-free 24 hours day

800-992-2966

COMTRAD INDUSTRIES
2820 Waterford Lake Drive, Suite 106
Midlothian, Virginia 23113

GIZMO®

Ultimate Receiver

SQ590 SATELLITE INTEGRATED RECEIVER/DESCRAMBLER. From: Uniden America Corp., 4700 Amon Carter Blvd., Fort Worth, TX 76155. Price: $599. StarSight module: $199. VideoCipher module: about $400.

For some people, watching satellite TV holds the same appeal as monitoring a scanner or DXing does for radio enthusiasts. There's an element of challenge involved in finding the most interesting programming.

Interesting can have many meanings. Perhaps you enjoy searching out those wild feeds that offer behind-the-scenes glimpses at standard shows. Anyone with a TV can watch *Monday Night Football* or the *Grammy Awards*, but only TVRO owners get to hear the sportscasters chatting during commercial breaks, or watch the stars preparing to be interviewed. Or maybe you enjoy watching your favorite programs a day or two before anyone else does, by catching the network pre-feed. Or you might get a laugh out of some of the off-the-wall programming—the llama auctions, for instance. And if you're the type who prefers channel surfing to actual viewing, you have the satisfaction of knowing that you can flip for hours without landing on the same station twice!

For less adventurous TV viewers, however, the amount of programming available on C-band satellite is a mixed blessing. On the one hand, there's always *something* to watch. On the other hand, there are so many choices that finding what to watch can be a bit overwhelming. Monthly printed program guides list the shows on all the major stations. But those schedules, and the satellite locations of the shows listed, are subject to change. Wading through those lengthy schedules is a challenge in itself.

The *Uniden SQ590* IRD (integrated receiver/descrambler) makes it easy to quickly locate your favorite shows in a couple of ways. You can store up to 160 of your favorite channels in memory for "instant" access. And, with the optional StarSight program-guide module, you have access to an electronic program guide that provides on-screen listings of programming. StarSight is available only by subscription, which typically costs as much as a printed guide would. StarSight, however, can prove to be far more valuable than a printed guide.

StarSight allows you to customize the program schedule to match your viewing preferences. You can have it display only those channels that you receive, and even change the order to have the most frequently watched channels appear at the top of the "page" and your least favorite at the end. You can scroll through the list of programming by time or by channel, or even by category—sports, movies, comedies, drama, and the like. In fact, you can even ask it to display just the baseball schedule, or only action movies. When you find the show you'd like to watch, just highlight it on the menu and press ENTER on the remote control. The IRD will automatically tune to that channel. As an added bonus, StarSight provides one-step VCR recording. Simply highlight on-screen the show you'd like to record, and the StarSight-equipped IRD handles all the technical stuff.

StarSight has been available for a couple of years in TVs, VCRs, cable boxes, and as a stand-alone unit. (See the November 1995 *Gizmo* for complete details on the system.) The Uniden SQ590 is the first C-band satellite receiver to offer the on-screen program guide.

Although we were thrilled at the convenience that StarSight offered, we were initially disappointed at how some of its features were implemented. For example, programming information—or even identification—was not available for all transponders. For example, NewsTalk Television, one of our favorites, wasn't listed. We couldn't use StarSight to record it, or even just to find out what's on.

The problem, it turns out, is that Uniden elected to install a half a megabyte of memory in its receiver. That, of course, leaves only a finite amount of space for program information—enough for a mere 150 channels.

As we were going to press, however, StarSight was working on a new feature called Customized Channel Lineup, which would allow you to pick the 150 channels on which you wanted information. Best of all, those 150 channels could

include the wild feeds that are constantly sought after by many satellite TV watchers.

StarSight is not the only special feature found in the SQ590's relatively small, stream-lined package. Closer in size to a VCR than to most other satellite receivers, the SQ590 measures less than 15 × 15 × 4 inches. Its front panel sports only seven buttons. However, those few controls can be used to operate the most-often-needed functions. The front-panel display is informative, showing the two-character satellite name, the transponder number, and a series of LEDs that indicate where the dish is pointed in the arc. The SQ590 also offers an automatic setup system called "ClarkArk," SCPC (single-carrier per channel) audio reception, and several convenient operation features.

INITIAL SET UP OF THE SYSTEM

Setting up a satellite receiver after the dish is installed is generally a tedious process, requiring the locations of all the satellites in orbit to be programmed manually. Usually, that means moving the dish east or west until a satellite signal is found, and then identifying the satellite by comparing the programming with a satellite TV guide. Once you identify the satellite, you enter its name and its polarity, and you're ready to find the next satellite in the arc. It's really not too difficult, but it is time-consuming and tiresome.

The SQ590 has an automatic programming feature called ClarkArk. (We assume that it's to honor Arthur C. Clarke, who first proposed the idea of geosynchronous communications satellites in the 1940s.) Like other automatic programming features that we've seen, ClarkArk isn't perfect, but it is a help.

To use it, you must first set the east and west dish limits in memory and then find the locations of the first two east or west satellites. Then just tell ClarkArk to do its thing, and it moves throughout the arc finding the satellites, peaking the location, fine-tuning the polarity, and storing the information in memory.

ClarkArk has a major advantage over other auto-programming features we've seen in that it is not limited to knowing the satellites that are programmed in when it was manufactured. That's important because the satellite arc is always changing as new satellites are launched and old satellites are retired. The master list of satellite names, locations, and polarity can be updated before ClarkArk is run.

Satellite dealers and installers will love the ClarkArk feature, because it should save them a lot of time and trouble. Consumers and self-installers might find it somewhat frustrating, however, unless they are familiar with satellite TV and have a list of active satellites and their locations. Even with a list of active satellites, they can run into trouble. For example, they might not know whether they can receive signals from Canada's Anik satellites or Mexico's Solidaridad or Morelos satellites. They might end up confusing ClarkArk, which would mis-program the locations. Fortunately, even if that happens, the fix is easy: Just tune to the mis-programmed satellites and correct the information.

We found that out firsthand. When we first installed our dish, we had it tracking the C-band satellites perfectly, but we were mis-tracking the Ku-band satellites. (Installing a dish for the Ku band is considerably trickier than C-band. If you don't track it perfectly, you will not obtain satisfactory reception.) After tweaking the system and deleting the satellites that we couldn't receive, things worked well. To ensure that the receiver will function well into the next century, its memory can store up to 28 C-band and 28 Ku-band satellites.

Once you've located all the satellites, you can store in memory as many as 160 of your favorite channels for instant access. Well, OK, it's not instant—you still have to wait for the dish to move to the correct satellite. But at least you don't have to remember that the Sci-Fi Channel is on Galaxy 5, transponder 4. You can call up your list and choose the channel from there. Of course, since we had StarSight, we didn't need to use the favorite-channel feature very often.

A built-in timer allows you to program up to seven events over a two-week period. At the specified time, the receiver will automatically move to the desired satellite and channel. That can be used in conjunction with a VCR for unattended recording. Again, since we had StarSight, we didn't have much need for the timer feature. However, the on-screen menus made the process easy.

A Ku-band channel-set feature allows you to reassign channel numbers of Ku-band transponders to correspond to what might be printed in a program guide. That is handy because there is no standard for Ku-band transponder frequencies.

The SQ590 also has a few special-effects features, including the ability to freeze a frame of video, and the ability to scan through a satellite's transponders by displaying four or nine images on the screen at a time.

A PIP or picture-in-picture feature is also provided. The video for the PIP frame, which can be moved to any of the four corners of the screen, must be fed to the receiver's AUX input.

SCPC

Most people who don't have satellite systems are unaware of the wide variety of audio services on satellite subcarriers. More than 100 subcarriers broadcast such programming as FM radio stations including WFMT, a public radio station in Chicago, and WQXR, a commercial classical station in New York. Non-commercial stations include the Voice of America, the BBC World Service, and satellite-delivered in-store background music.

But even those dedicated satellite owners who hunt out the wild feeds and listen to satellite radio might not know that there is another whole world of signals that travel via satellite. Many of the channels that appear blank on the TV screen are actually chock full of such services as telephone communications and data distribution—and a dizzying array of audio channels broadcast in what is known as the SCPC format.

The main reason that most people don't know about SCPC audio is that a special receiver usually is required to hear them. However, SQ590 owners can enjoy the unit's built-in SCPC module.

SCPC stands for Single Carrier Per Channel. Unlike the satellite audio channels that are "piggybacked" as subcarriers of the video signal (making use of the "left-over" bandwidth), each SCPC audio signal has its own carrier. Because audio signals have bandwidths far narrower than video signals, a single satellite transponder (which has a bandwidth of 36 MHz), can support 80 or more SCPC audio signals!

Finding the services that are available on SCPC reminded us a lot of shortwave DXing, the hobby of trying to find distant stations from around the world. Program guides containing SCPC listings are not readily available, and SCPC does not show up on the StarSight guide. *Satellite Orbit*, a monthly guide to satellite TV, occasionally lists a smattering of the SCPC services. An accurate guide is difficult to publish because there are just too many services, and they tend to come and go.

The amount of programming available via SCPC services is astounding. Sports fans will appreciate the ability to pick up what seemed to be almost every professional game being played, as well as quite a bit of minor-league action.

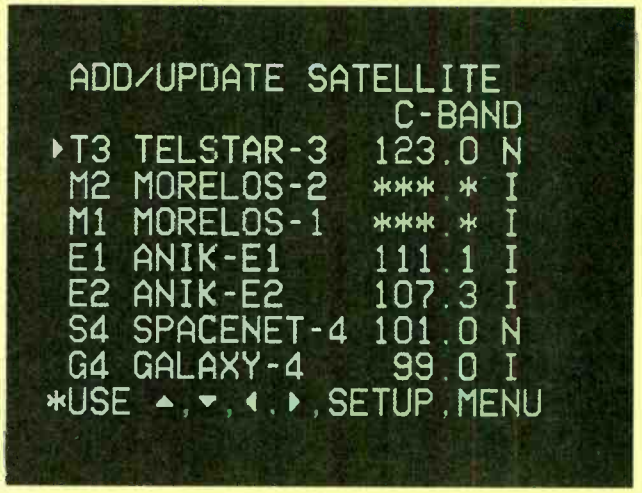
There's also a lot of talk radio, especially telephone call-in shows. Your local broadcast of Larry King's radio show, for example, is likely received by your local affiliates via SCPC.

Other services carried on SCPC include network news. When you hear news at the top of the hour, it's probably coming to

Gizmo is published by Gernsback Publications, Inc., 500 Bi-County Blvd., Farmingdale, NY 11735. Senior Writers: Chris F. O'Brian and Teri Scaduto.

A

B



C

D

E

F

The Uniden SQ590 sports a variety of setup and operational menus. The main menu (A) provides access to basic, everyday functions. However, if you hold the menu button down for about two seconds, you get into the "dealer-only" installation menu (B), which is where the real fun begins. Adding satellites, or changing their locations, is straightforward (C). The ability to program in a new location in longitudinal coordinates is a great convenience, as is the ability to store the satellite's full name. Even if an unsuspecting customer encounters a programming menu, adequate warnings ensure that he or she won't do too much damage (D). Satellite TV is not just video. A plethora of audio programming awaits as well. The SQ-590 offers the most-often needed audio-tuning features (E). Only two audio bandwidths, wide & narrow, are supported. The addition of SCPC capability is unique in the industry. Not all menus feature a solid color background. The video-tuning menu (F) lets you see the results of your adjustments immediately so that you can peak the settings for the best picture.

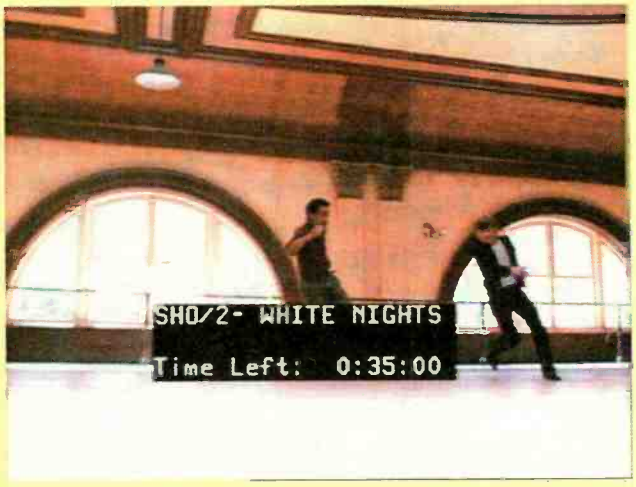
A

B

C

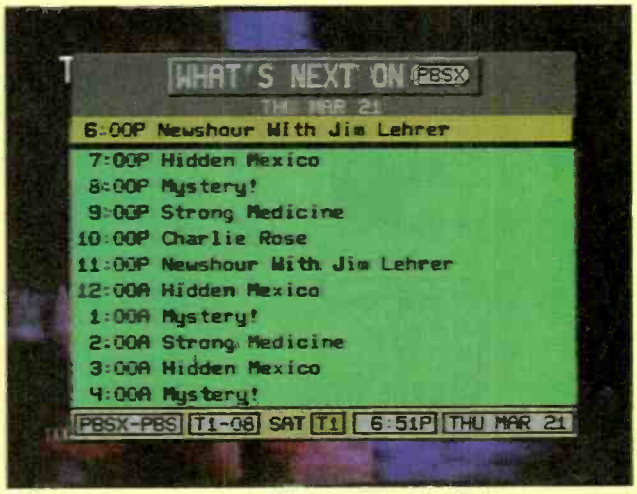
D

E



F

One of the best things about satellite TV is that you can never be sure what you're going to find. The variety of programming available is astounding. Why be limited by the highlight films that your local sportscaster thinks is important? You can catch them all on satellite TV! (A). When Major League Baseball decides to have regular-season inter-league play, you could get the details live and uncut on satellite TV (B). Steve Forbes has long since left the run for the White House, but C-band satellite TV let you see more than what your local broadcaster probably chose to let you see (C). Space Shuttle junkies can keep tabs on all of the latest missions, plus a plethora of science programming on NASA TV (D). Yes, it can get a little boring, but some of the behind-the-scenes action can make for some interesting TV viewing. Here (E), an audio technician adjusts Robert Redford's microphone in preparation for an interview during the Sundance Film Festival. Of course, there's plenty of ordinary programming available on satellite TV, too. Shown in (F) is a scene from the movie White Nights along with a typical VideoCipher display.



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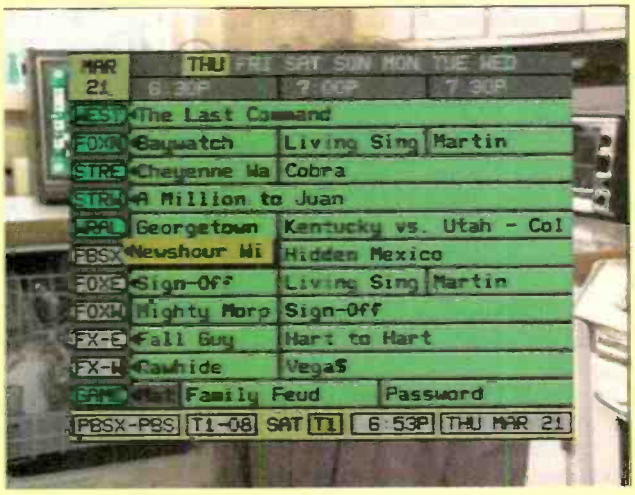

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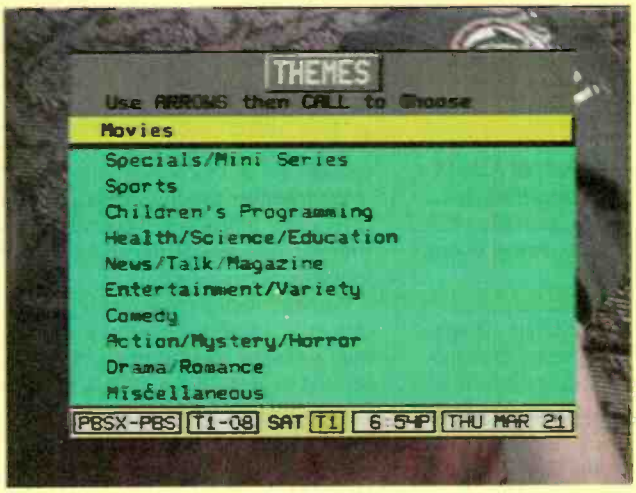

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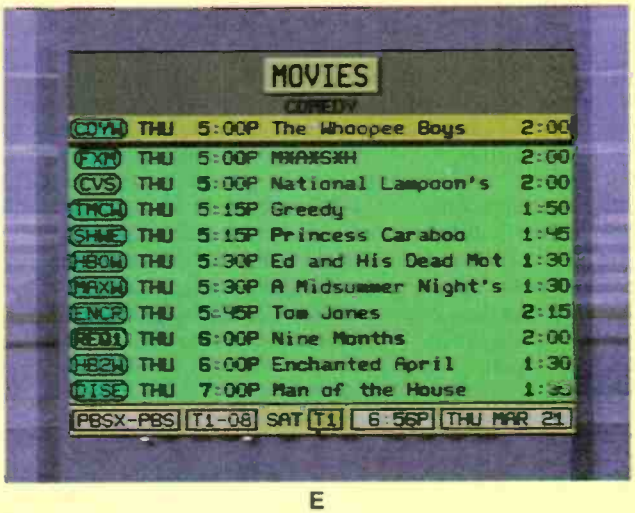

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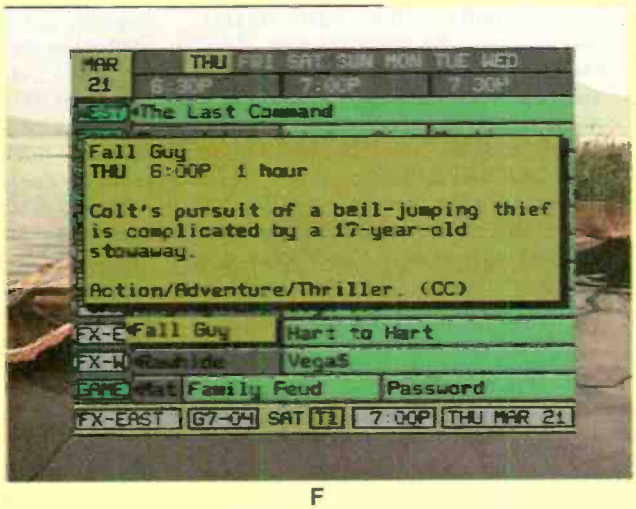


F

StarSight has many display and information options. If you're currently watching one channel, you might choose to display a list of what's on next for several hours (A). Alternatively, you can get a channel guide (B) that shows a grid of about an hour and a half of programming. You can scroll through pages to get a complete list. Channels can be arranged in any order you like—favorite channels could be listed first, for example. For satellite TV, it makes sense to leave them in satellite order—tuning from one end of the arc to the other can take more than a minute. If we listed all movies together, we might be tempted to switch from the Independent Film Channel, in the middle of the arc, to Showtime, closer to one of the edges. If you know what you want to watch—sports, movies, or comedy—you can call up a list by program themes (C). Most themes can be broken out by even finer descriptions (D). You don't necessarily have to tune to a movie to find out what it's all about (E). Hitting the Info key gives you a reasonably good capsule description of its offerings (F). Note that you can still see the current programs at the screen edges.

your local station via satellite. We've heard feeds from CNN Radio, CBS, NPR, Mutual, UPI, and others.

The biggest problem with receiving SCPC services using a home satellite-TV system is that most LNBs are not temperature-stable. Even an LNB that is excellent for wide-bandwidth video might drift too much for narrowband audio. We didn't have problems with drift while we were listening. However, we'd often return to the SCPC receiver only to find that the stations weren't where we expected them to be.

The SCPC module cannot receive stereo. All SCPC carriers are mono; stereo signals are sent as two separate carriers. Stereo SCPC programming is sent in a discrete format—the right and left channels are sent as separate carriers, and there are no real channel-spacing standards. To receive stereo, you need two receivers.

The SCPC module lacks a couple of features that would improve it. One is expansion circuitry, which a commercial SCPC receiver (generally costing many thousands of dollars) requires because SCPC signals are generally compressed. To us, the fidelity of the receiver, when connected to a good amplifier and speakers, was slightly worse than FM broadcasts. More troubling was the lack of a bandwidth adjustment.

Even so, we greatly enjoyed using the SCPC module. We loved having the ability to listen to KIRO-AM in Seattle, Washington, with reception equivalent to local stations. We enjoyed catching feeds from everything from the Soldier's Radio Network to radio station WHO in Des Moines, Iowa. We marveled at the sheer overload of sports programming on the satellites. With the SCPC module, who needs video?

BLOCK THAT SHOW!

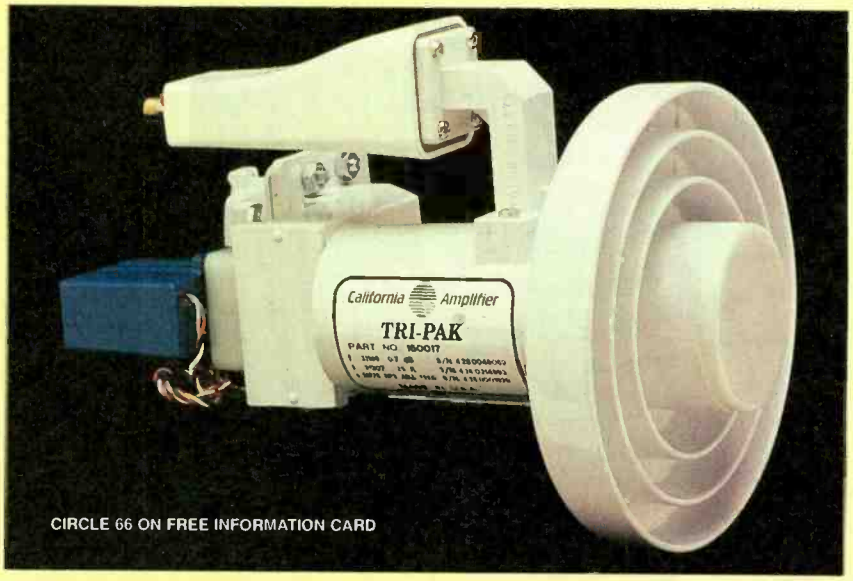
Like all other consumer satellite receivers, the SQ590 has a slot in the back for the insertion of a VideoCipher descrambler module. This module is required to watch any of the scrambled cable TV services.

While politicians are now hot on the topic of the so-called V-chip, it's interesting to note that C-band VideoCipher owners have always had the ability to block access to movies according to their MPAA ratings. Of course, those ratings apply only to movies, and not all movies are rated. It is not possible for the module to lock out movies that are rated G (general audiences) or NR (not rated).

The SQ590 does, however, allow you to block access to individual channels, including those that are in the clear. So, for example, if you wanted to protect your children from the sex-channel promotional pitches—or if you didn't want to be bothered by them yourself as you were flipping, you can block out that channel.

The menu system of the SQ590 makes using the unit easy. For example, let's assume that you are trying to find a new satellite, and you move your dish east to where you think it should be. When you find it, you don't have to go through the sometimes tedious process of fine-tuning its position and adjusting the skew. Instead, simply hit MENU, QUICKTUNE. The SQ590 will peak the signal automatically.

The SQ590 represents the best of both—no, several—worlds. Its ClarkArk system makes it easy to get up and running so that video DXers can start searching out programming right away. Its StarSight option makes it easy for more traditional viewers to find the shows they want to watch. The SCPC module adds scores of audio feeds to scan and enjoy. And its convenient on-screen menu system makes everyday and advanced operations a breeze. ■



Feed Me!

C/Ku TRI-PAK FEEDHORN/LNB ASSEMBLY. From: California Amplifier, Inc., 460 Calle San Pablo, Camirillo, CA 93012. Tel. 805-987-9000. Price: about $399.

Although one of the smallest components of a satellite-TV system, the electronic components mounted at the dish are some of the most important factors affecting picture quality.

The parabolic satellite dish itself, of course, is just a huge reflector. At its focal point is a *feedhorn* and *LNB* or low-noise amplifier and block downconverter. The LNB takes the microwave signals that it receives (3.7–4.2 GHz for the C band, and 11.7–12.2 GHz for the Ku band), amplifies them, and then converts them to a lower frequency that is sent to the satellite receiver for display.

The job of the feedhorn is to collect the microwave signals reflected from the dish's surface and feed them to the LNB. Of course, anything mounted at the dish's focal point will be illuminated by the signals reflected from the dish. But it will also see noise and other off-axis signals. The feedhorn must ignore such noise, without adding any of its own.

At the bottom of the throat of the feedhorn is a small probe that can be thought of as the actual antenna. That probe transfers the collected signal to the LNB. The probe is connected to a servomotor that rotates the probe to correspond to the signal's polarity.

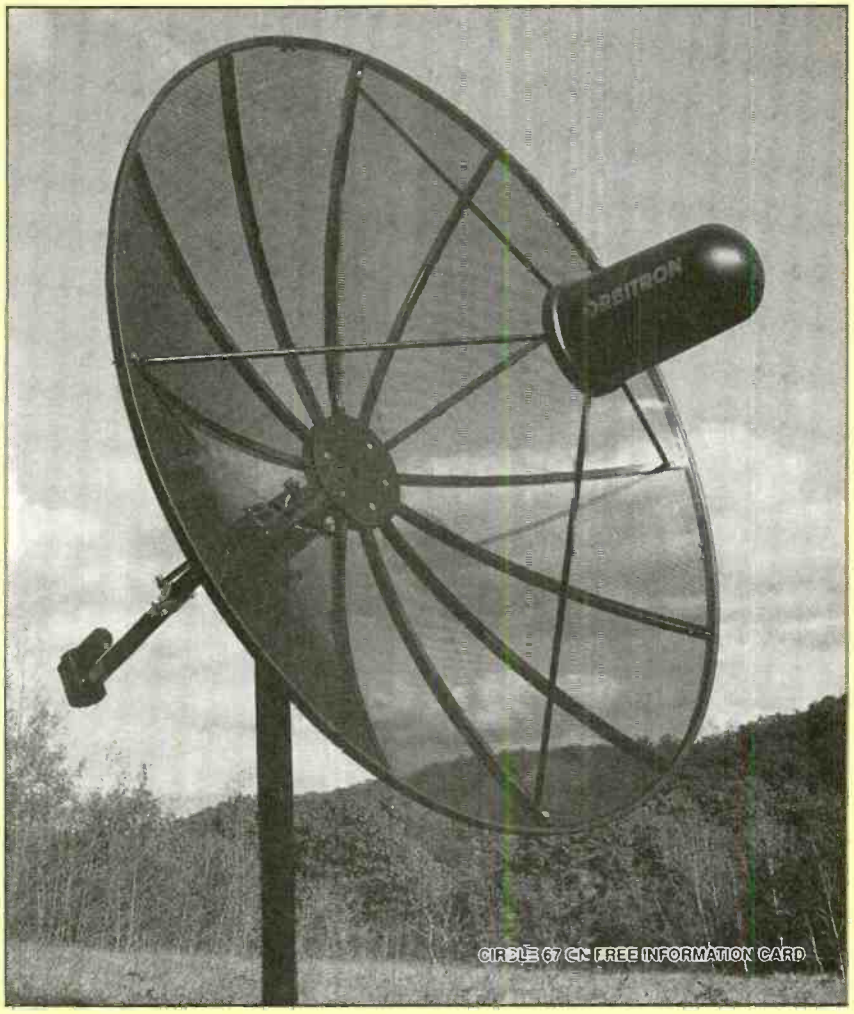
For our installation, we could have chosen to go with a feedhorn and LNBs from different manufacturers. Instead we decided to go with the *Tri-Pak* from *California Amplifier (Cal-Amp)*. Because we were installing the feed on a small dish, we wanted to be sure that the components would be designed to work together optimally.

The C-band LNB has a noise temperature of 20 K (kelvins) and a gain of 65 dB. The Ku-band LNB is rated with a noise figure of 0.7 dB and a gain of 59 dB. All ratings are excellent. Again, because we were going with a smaller dish, we had to be sure to get the highest performance LNBs we could. Because a small dish just can't collect as much signal as a larger one, we had to be sure to keep internally generated noise to a minimum.

The results? Our system generated sparklie-free pictures on some of the weaker satellites and transponders. We were pleasantly surprised. ■

Dishing It Up

ORBITRON SX6 SATELLITE TV ANTENNA. From Orbitron, 352 S. Peterson St., Spring Green, WI 53588. Tel. 608-588-2923. Price: about $200.



New, higher-powered satellites are allowing smaller dishes to be used successfully in many parts of the country. We decided to see whether a smaller dish would perform well enough in suburban New York.

Now, small is relative. Orbitron's SX6 has a diameter of only 69 inches—just under six feet. That's tiny when compared to the Orbitron SST10 that functions as our main dish. But it dwarfs our 18-inch RCA DSS dish and three-foot dish for DMX Music Express.

The real question we had was whether a dish with only about one third of the collection area of our big dish could perform adequately in the northeastern U.S. We didn't really expect stellar performance on the C-band, but we decided that even that would be OK. We really needed it just in the summertime, when the trees in a neighbor's yard form a pretty effective shield against satellite signals in the middle of the arc.

The SX6's focal length (the distance between the face of the dish and its focal point at the feedhorn) is 31¾ inches. Its F/D ratio (the ratio of the focal length to diameter) is 0.46, which makes it a fairly shallow dish.

The SX6 calls for a 3½-inch (outside diameter) schedule-40 pipe. That's not something that's available at your local hardware store—look in the yellow pages under "Pipe." After the pole is installed, the mount head is put in place on top of the pole. Then we attached the mount beam, which contains the spider arms to which the dish is attached, to the mount head.

Our next step was to join the four petals that make up the dish by bolting the section together snugly. Then we lifted the reflector and put it on the mount, making sure that the ribs where the panels are joined were secure in the spider arms of the mount. We inserted bolts loosely to hold the reflector to the mount. Then we temporarily attached the actuator to hold the dish in place.

The next step was to attach the front plate, and then to tighten all the bolts, working from the outside in, making sure that the sections were aligned properly, and that the dish surface was smooth.

Then it was time to mount the four legs that support the feedhorn. We much prefer the quad-leg support over the so-called "button-hook" support—it's just a more stable configuration that doesn't give in to the wind. When we installed the feedhorn, only minor adjustments were required to get the feed to the 31¾-inch focal point of the dish.

All that was left to do was to hook up the electronics, set the polar-axis and declination-offset angles, and then align and track the antenna so that it was precisely aimed at the satellite arc.

Aligning an antenna to reliably track the satellite arc can be an art in itself. The basic procedure is a three-step process. First, you must find the satellite that is closest to due south of the installation location. For us, that satellite is Galaxy 6, which we then used to peak the dish's azimuth. Then you track the arc as far as you can toward the horizon. When you reach the last viewable satellite, you use it to peak the dish's elevation.

Once everything was peaked, we got to see just how well a six-foot dish could perform. The results? Well, we're not ready to give up our ten-footer yet.

On most of the newer, more powerful C-band satellites, the signals were strong and free of sparklies. The problem that we ran into was interference from adjacent satellites. Satellites are separated by only two degrees. Unfortunately, a six-foot dish has a broader view than that. Still, for the most part, the SX-6 provided a very watchable picture.

On Ku band, the SX-6 really performed well. The dish has a higher gain at the higher Ku-band frequencies. The SX-6 actually outperformed our 10-foot Orbitron SST-10—but only because our ten-footer is out of alignment, waiting for warmer weather when we can get up on the roof and give it the tuneup that it needs.

The bottom line is that for our northeastern location, the SX-6 is a compromise for C-band satellite TV reception. It probably performs excellently in the middle of the country. Here at the edges, however, it doesn't deliver the quality that satellite TV is capable of providing, and should be considered only if there is absolutely no way to install a lager dish.

As a secondary antenna, the SX-6 performs marvelously. Now, if one of us wants to watch some video programming and the other wants to listen to some satellite audio, there's no more arguing. The big dish can be used for Showtime, and the six-footer can hunt out for strange feeds on Ku band. ■

Installing the Orbitron SX-6 is not difficult if you take it one step at a time. We started by installing the mount head on the pole, and then attaching the spider bracket to the mount head. We then temporarily attached the actuator to hold the spider bracket steady. The next step was to assemble the four petals of the reflector on the ground, and then to hoist the antenna onto the spider bracket. Although it's undoubtedly easier with two people, we didn't have any trouble getting around the back side of the antenna to install a bolt through the spider bracket and reflector to hold it in place. We next attached the center hub, and then made sure that the sections are aligned properly before we tightened all the bolts, starting from the outside and working in toward the center. We then fastened the LNB support brackets, and measured to make sure that the feed was positioned at the center of the dish, and at the right distance from the surface. After we set the elevation and declination angles with a protractor, we were ready to track the arc by hooking up a receiver right at the dish site.

Home Base

QIK-BASE ANTENNA-POLE BASE. Manufactured by: Paullin Industries, Inc., 1446 State Route 60, Ashland, OH 44805. Tel. 800-821-7384. Price: about $90.

Installing a C-band satellite-TV antenna isn't difficult if you understand how it must be aimed at the satellite arc. However, one task that is difficult—back-breaking, even—is planting the pole that holds the dish.

Traditionally, it requires a shovel and post-hole digger, a wheelbarrow to cart away the dirt, and to use when you mix the concrete. Mixing the concrete often seems like an art in itself. We always seem to go back and forth between a mix that's too soupy or too firm.

For this installation, we wanted to try something different: The *Qik-Base* (pronounced "quick base") from *Paullin Industries*. The Qik-Base doesn't' rely on a mass of concrete to hold the pole in place. Instead, it holds the pole with a combination of tightly tamped dry concrete in a narrow hole, a collar that clamps onto the pole, and four steel angle-iron "roots."

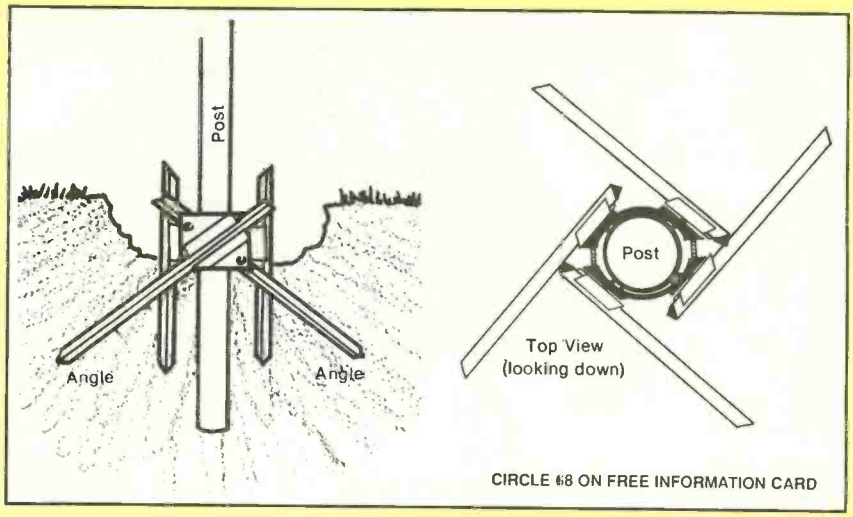
We couldn't complete our installation in the hour suggested by Paullin's literature, but installing the Qik-Base is clearly a one-person job. To start, you must dig a 16-inch diameter hole about ten inches deep. Then you have to create a narrow-diameter hole down another three to five feet.

Unlike traditional installations, the Qik-Base relies on having a narrow hole. The narrow hole in combination with the tamped dry concrete is what keeps the pole steady. For a three-inch pipe, you'd want a four-inch hole; for a four-inch pipe, you'd want a five-inch hole, and so on. No shovel that we know of could create so narrow a hole. The answer is to use an earth auger. Fortunately for us, our sandy soil was easy to bore with the auger, and rocks weren't a problem.

After setting the pole in the hole, you must add a dry mix of dry sand and cement. A mix of one part dry cement to three parts sand is fine. We took the easier way of just buying a bag of ready-mixed Quickcrete mortar mix.

The dry mix is added to the hole, about four inches at a time. Then a narrow wood tamp is used to solidify the mix. As always, it's important to make sure that the pole is perfectly plumb.

When the hole is full, it's time to install the Qik-Base itself. The two halves of the clamp are bolted loosely together and slid over and down the pole until it rests at the bottom of the 16-inch hole. Then the clamp is tightened as tightly as possible to



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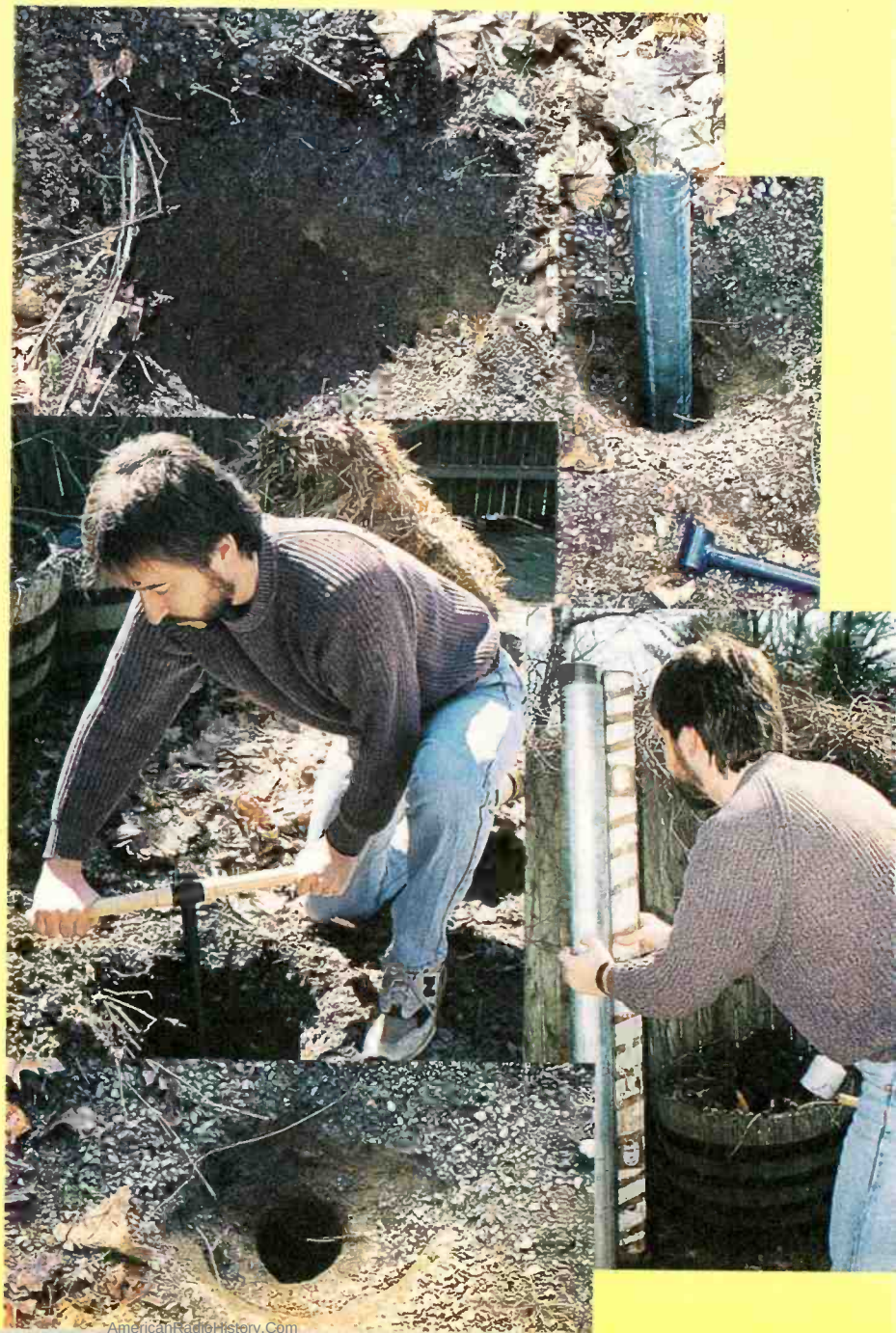
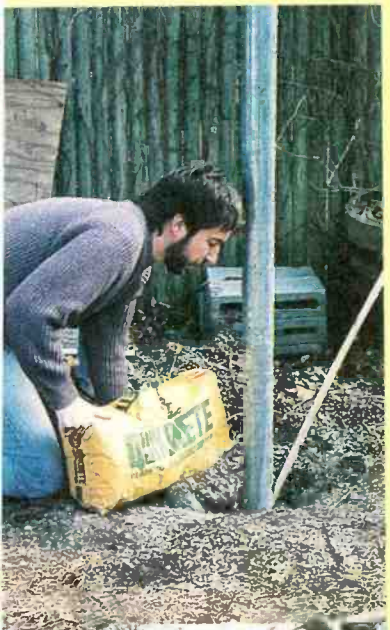
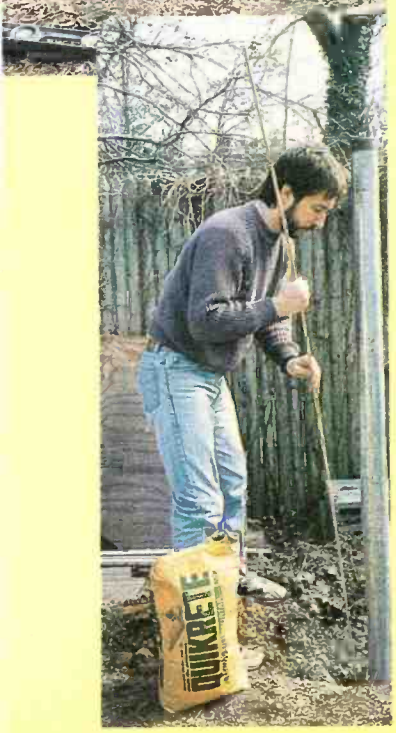
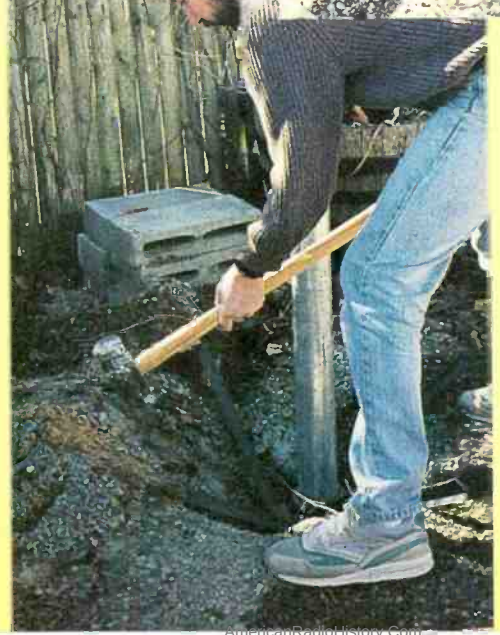


prevent the post from turning. Four additional metal pieces are attached to the clamps to act as guides for the Qik-Base's angle-iron "roots." Then the roots are pounded into the earth, the hole is filled, the sod is replaced, and you've got one sturdily mounted pole!

Not only was the Qik-Base easier to install than a traditionally mounted pole, it might have another major advantage a few years down the road. If our neighbor's young tree grows high enough to block our view of the arc, we can simply pull up our dish's "roots," and take our Qik-Base to a better location. Try doing that with a concrete-mounted pole! ■







Installing the pole for the dish was made easy thanks to the Qik-Base. We started with a rather ordinary hole about ten inches deep an about a foot and a half in diameter. Then we used an earth auger to drill a narrow hole about three and a half feet further down. The earth auger is the key — you can't dig such a narrow hole with either a shovel or a post-hole digger! Next, we placed the post in the hole and made sure that it was plumb by using the longest level we had, and by checking in multiple locations around the pole to ensure that it was true. You can't track the satellites with a pole that's not plumb! We then took a bag of dry mortar mix and poured it slowly into the gap between the pole and the walls of the hole. We poured just four inches at a time, and tamped the mortar mix with a thin, narrow tamp, being sure that the pole remained plumb. When the hole was filled, the pole already seemed sturdy. But now we had to make sure it stayed there. We slipped the Qik-Base collar over the pole, and tightened it at the bottom of the hole. Then we attached brackets to hold the angle irons. We inserted the angle iron "roots," and then, working around the base, we pounded them evenly into the earth. Again, we made sure that the pole remained plumb. This being the first time we used the Qik-Base, we weren't able to complete the job in the hour that Paullin Industries estimated. Next time, the job would go much faster. However, there's no doubt that we got it done a lot faster than if we had used a concrete base! Something to remember. The Qik-Base works very well for satellite TV installations, but it should work equally as well for lamp poles, flag poles, basketball backboards, or any number of other projects that traditionally require a concrete base.

Moving the Dish

SKYLIGHTER DISH ACTUATOR. From: Venture Manufacturing Co., 3636 Dayton Park Dr., Dayton, OH 45414. Tel. 513-233-8792. Price: N/A.

A dish that can't move is a pretty boring dish. An actuator arm is what gives a satellite dish the ability to find all of the satellites in the Clarke Belt.

With our six-foot dish, we didn't need the world's largest actuator. We could get by easily with an 18-inch unit. There was one main requirement that we had for our actuator arm: It had to be reliable.

That's why we went with the *Skylighter* from *Venture Manufacturing*. What sets the Skylighter apart from most other actuator arms is its ball-screw mechanism.

Most actuators are acme types. They consist basically of a threaded rod and a nut. A motor turns the rod, and it moves toward or backs away from the nut, which is held in place. Attach the nut to a tube, and attach the tube to a dish, and you can move the dish by turning the threaded rod.

It's a simple machine. Usually, we feel that the simpler, the better. But not with actuators. If you've ever tightened a recalcitrant nut or screw, you probably felt the heat that is generated because of the inefficiencies. Add in some wind load on a dish, and you can imagine how hard an actuator has to work.

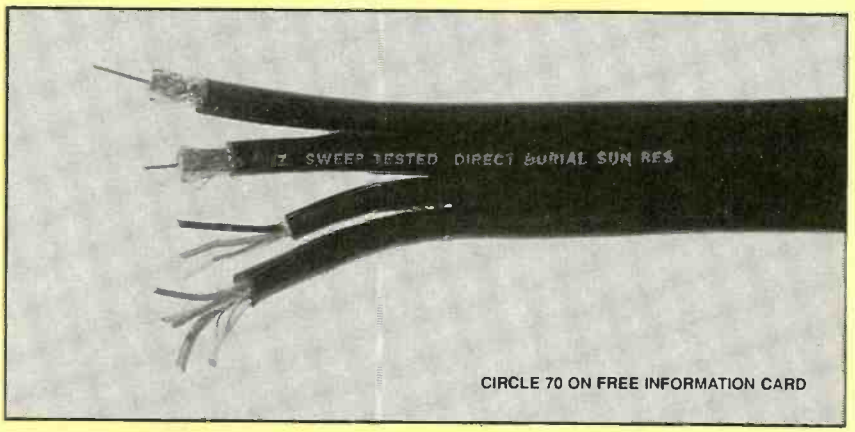
The Skylighter's operating principle is much the same as an acme actuator, but instead of a nut, the threaded rod rides in ball bearings. The threaded rod forms the inner race for the ball bearings, and the nut forms the outer race.

The increased efficiency allows more of the power to be used for the useful work of moving the dish, not heating up a nut and screw. That's a good thing, and is the reason that ball-screws are used to move airplane wing flaps and landing gears. We were able to move the dish by hand-tuning the actuator gears with our fingers.

OK. Our application isn't nearly as critical. But an actuator arm is something that you want to think about only once—when you install it. Hopefully, we'll forget completely about the Skylighter—until we put up yet another dish. ■

It's not Cable TV!

Earth-Pruf II Satellite Combination Cable. From: International Electronic Wire and Cable Co., 89-1/2 O'Leary Drive, Bensenville, IL 60106. Tel. 708-860-2210. Price: N/A.



Once you have your dish—complete with actuator, feedhorn, and LNBs—erected, and your integrated receiver/descrambler set up on a shelf in your entertainment center, you have to supply a means of communications between the two. The signals from both feedhorns must be sent to the receiver, and the receiver must send control signals to the servo motor in the feedhorn. Depending on the distance between your dish and your receiver, that can require hundreds of feet of cable. You need two coaxial cables to carry the signals in from the C-band and Ku-band feedhorns; three-conductor, 20-gauge stranded cable to link the IRD and the feedhorn motor; 16-gauge stranded cable to power the actuator; and three-conductor, 22-gauge stranded plus bare wire for the actuator sensor.

In the old days, you had to run each of those cables separately. Today, however, it's easy to find all-in-one ribbon cable specially made for satellite-TV installations. We used *Earth-Pruf II* flat satellite combination cable from *International Electronic Wire and Cable Co.*

The Earth-Pruf cable allowed us to keep our cable runs neat and orderly, and its double-shielded RG-6 coaxial cable ensured that our dish delivered the full output of our LNB to our satellite receiver. Without instruments, we could detect no loss even with a cable run of more than 100 feet.

Unless your dish is mounted on the roof of your house and the cable runs directly down through the roof to your living room, all of those cables are going to be subjected to the rigors of outdoor use. The ribbon cable we used is intended for direct burial. However, it's safer to run it through PVC conduit for added protection against gnawing rodents or mishaps with a shovel or weed-whacker. ■

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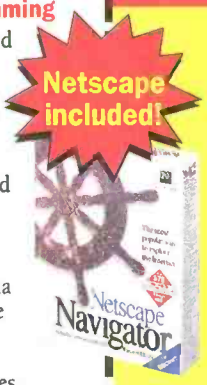

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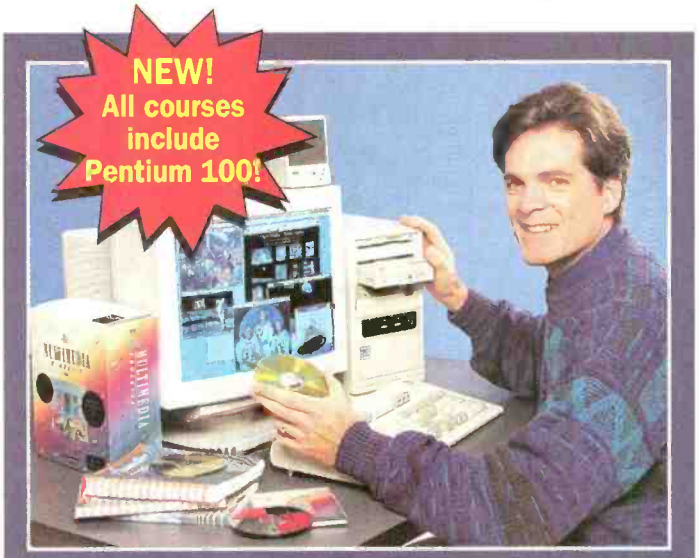

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3-D VIDEO

Has the search finally ended for a practical way to display 3-D images on your TV set?

BY MARVIN MALLON

Since the early days of TV, achieving a true stereoscopic—or 3D—image has been an elusive goal. Electronics pioneers such as Lee DeForest (vacuum-tube and radio inventor), and Vladimir Zworykin (inventor of the camera-pickup tube) described 3-D TV devices in their early patents. Attempts at stereo broadcasting using anaglyphs (a pair of red and blue images) were made as early as 1953. That technique has been used several times in the last decade, but due to poor resolution and color accuracy, it leads to mediocre results at best.

Well, while you should not expect to see "Baywatch" beauties jump off the screen and parade around your living room any time soon, the prospects for seeing true 3-D TV in your home have recently improved thanks to the development of a new technique. But before we get into that, let's get a little background on the development (or lack thereof) of 3-D video to the present time.

Some Background. The most promising systems in use today for displaying stereo images require the viewer to wear some kind of special apparatus. Those "glasses" contain either two separate video displays, or a pair of LCD shutters that are synchronized to a single external display. In both cases, the hardware required is relatively expensive, and the bulky headgear is not conducive to long periods of viewing. That kind of setup might be fine for delicate microsurgery, but probably will not be used to view your favorite soap opera of the future.

There are, of course, other techniques, such as polarized projection and prism glasses, which work very well in film and print media, but are not feasible using standard video equipment. Yet another technique makes use of the Pulfrich phenomenon, which translates horizontal motion into apparent depth. At least one attempt to exploit that phenomenon for 3-D was undertaken by a major advertiser. Despite a huge campaign to promote the broadcast of a 3-D commercial during a past Super Bowl game, the results left most viewers overwhelmingly unimpressed.

3-D TV Without Glasses. Several technologies exist for creating autostereoscopic images, that is, images that appear three dimensional without the use of special glasses. Holography can create truly amazing displays, such as the holographic image of a microscope where the viewer can actually look through the eyepiece and see a magnified object. Unfortunately, the creation and transmission of an electronic hologram is presently not practical.

Another scheme for autostereoscopic viewing is based on the segmented or lenticular screen. Recent 3-D still photography is based on that approach. Baseball cards and book covers have drawn on this technique for its curiosity value. While suitable for family snapshots that show Fido's tongue seemingly licking your face, that concept is not immediately adaptable for television.

Yet another means for displaying 3-D images on an ordinary TV receiver has been developed. The technique involves alternating pairs of images or parallax scanning. In essence, the binocular views are presented to the eyes sequentially over time. Although both eyes see the exact same image, the brain interprets the changing parallax information as depth cues. While that adds a slight amount of artificial motion to the scene, the brain can be fooled to ignore it.

For example, consider the actual image focused on your retina at any given moment. Normal "saccadic" eye movements and the motion of the head and body cause that image to change radically. Yet as you walk down the street, the trees appear to

remain stationary (that certainly makes the brain a far superior image stabilizer than that found in any camcorder!).

That technique has been used by one manufacturer, Vision III Imaging, Inc., for their *Vision III* system for parallax scanning using a single camera. In that system, a moving optical element within the camera lens provides the various views of the scene. By scanning the scene in a complete circle at approximately 4 Hz, the system creates a strong sense of dimension, sharpness, and overall realism. While certainly not as dramatic as a 3-D movie viewed through polarized glasses, there definitely is an improvement in perceived depth over that provided by ordinary film or television.

The technique seems to exploit certain depth-mapping psycho-physical mechanisms in the human visual system. Therefore, it is similar to other monocular depth cues such as relative size, depth-of-field, linear perspective, interposition, and light and shadow. Indeed, in images created by the system, the 3-D effect is significantly stronger when viewed with only one eye open!

The major drawback to the system is that visual perception varies greatly between individuals, so not everyone gets the full impact of the Vision III images. Some report a tremendous sense of depth, while others report no difference at all when compared to normal two-dimensional images. Some merely perceive the Vision III images as being sharper. Whatever the improvement, the main advantage of this system is that it is compatible with all present film and television equipment, and does not require the use of special screens or glasses for viewing.

A New Technique. A novel technique for achieving 3-D television is in development by a Los Angeles organization, INFINITY Multimedia of Sherman Oaks, California. Best of all, you needn't wear any red-blue, polarized, or liquid-crystal display (LCD) shutter-glasses to view the astounding effect of their projected three-dimensional images.

INFINITY has assembled a "proof-of-concept" TV monitor based on the 1993 patented design of Dr. Adrian Travis, of Cambridge University, England. The unit does not require the viewer to wear any distracting glasses or headgear, yet provides stunning results—from the soft-drink commercial witnessed only by wearing cardboard red-blue glasses, to the more sophisticated "electronic-shutter" headpiece, all suffer by comparison to this revolutionary glasses-free technique.

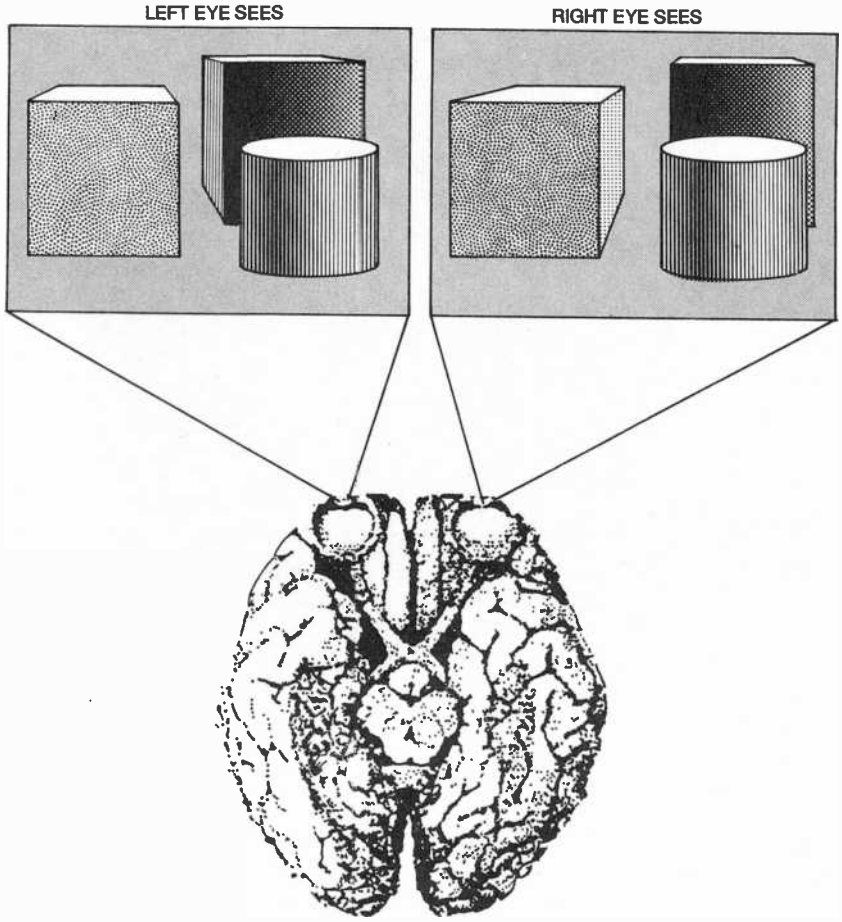

Fig. 1. We see in 3-D because the brain fuses the images seen by the left and right eyes and extracts various depth cues from them.

How It Works. Autostereo vision (the ability to perceive depth) is the result of two phenomena, "stereo parallax" and "movement parallax." As Fig. 1 shows, each eye sees a slightly different view of the world. Our brain receives two distinct images and fuses them, resulting in 3-D depth perception. That results in "stereo (or binocular) parallax." Additional 3-D information is generated when we move our heads from side to side. That enhances the effect and is the result of "movement parallax."

In the Cambridge autostereo system, the lack of special glasses doesn't diminish the three-dimensional effect obtained by stereo parallax. Additionally, the presentation takes advantage of the movement parallax phenomenon as well. Both are achieved by dividing the displayed image into a large number of segments, with each slice containing a view of the image taken from a slightly different, adjacent position.

As Fig. 2 shows, this multi-view autostereoscopic display requires multiple, distinct pictures of an object taken from numerous adjacent viewing positions. Those multiple pictures are flashed up a television CRT (while an LCD screen could also be used, for simplicity, we'll only deal with a CRT-based system for the balance of this

ACKNOWLEDGMENTS

This article was prepared based on a witnessed demonstration of equipment described, plus background information supplied by Peter M. Canepa, Vice President of Technology and Brian H. Ton, Chief Operating Officer, INFINITY Multimedia. Additional technical information was submitted by Jeff Mazur, Director of Technology, ABC Television.

discussion) very quickly, in sequence. At the same time as one of the pictures is being displayed, one of a set of liquid-crystal shutters in front of the CRT is opened. That makes the picture visible to only a part of the area in front of the display. The shutters determine where the observer can see each of the pictures. The whole process is repeated very rapidly, sixty times a second. Each of the observer's eyes thus sees a series of very-short, very-bright images of one of the pictures. The eyes integrate those short picture bursts to give the effect of a continuously displayed picture.

Because each eye sees a different picture, the observer gets one of the important 3-D depth cues; stereo parallax. Because he sees different pictures when he moves his head, he gets another important 3-D depth cue; movement parallax. Those two effects combine to produce an illusion of real depth in the 3-D image.

The heart of the system is the special lens-shutter combination that is mounted directly between the CRT and the front viewing element, which, in the case of the demonstration unit only, is a Fresnel lens. See Fig. 3. At any instant in time, the CRT is displaying a full-screen image taken from one distinct vantage point. However, the rear-lens element of the shutter assembly, through a complex design, creates a Fourier transform of the image and presents it to the LCD high-speed electronic shutter.

The shutter, in turn, allows the image to be seen only from the same vantage point as the original image was captured. If the observer moves his head to either side, the opaque portion of the shutter (at that instant of time) blocks out any view. The front element of the lens steers the viewable image to the observer.

As the numerous views of the photographed object are sequentially displayed on the CRT, the shutter stays in synchronization, and the end result is a sweeping display to the observer. Appropriately, the entire device is identified as a "time multiplexed, multi-view system."

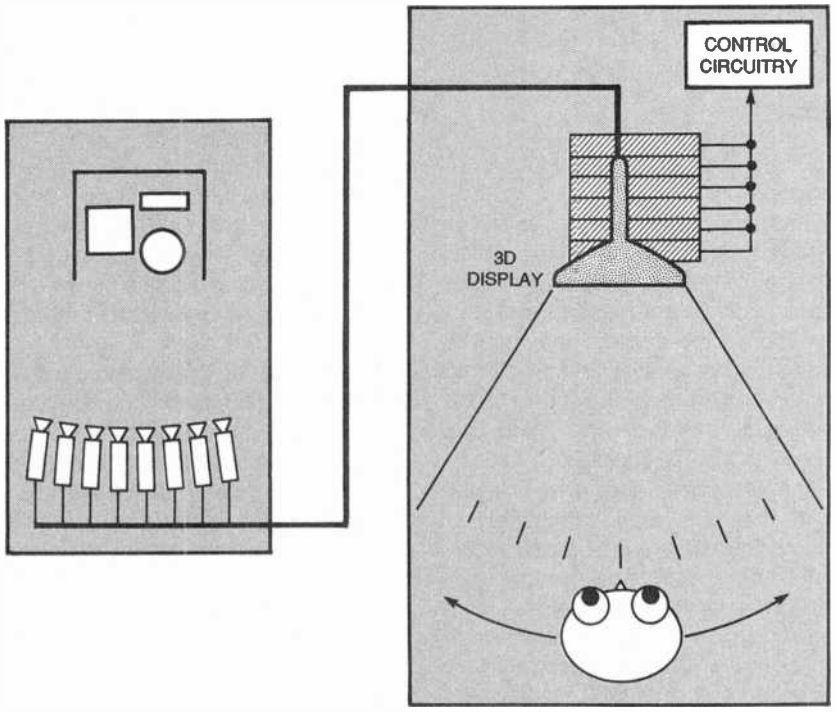

Fig. 2. In the multi-view stereoscopic system, multiple distinct views of an image are flashed onto a display screen in sequence, with an electronic shutter controlling which of the images a viewer can see at a time.

The Display Architecture. The Cambridge display consists of two major electro-optical components and the associated drive electronics (see Fig. 4). The electro-optics consist of a high-brightness, high-speed CRT, designed for use in projection televisions and the lens-shutter system previously discussed. The electronics to drive those are custom circuits designed at Cambridge. The whole system has been assembled and tested at Cambridge.

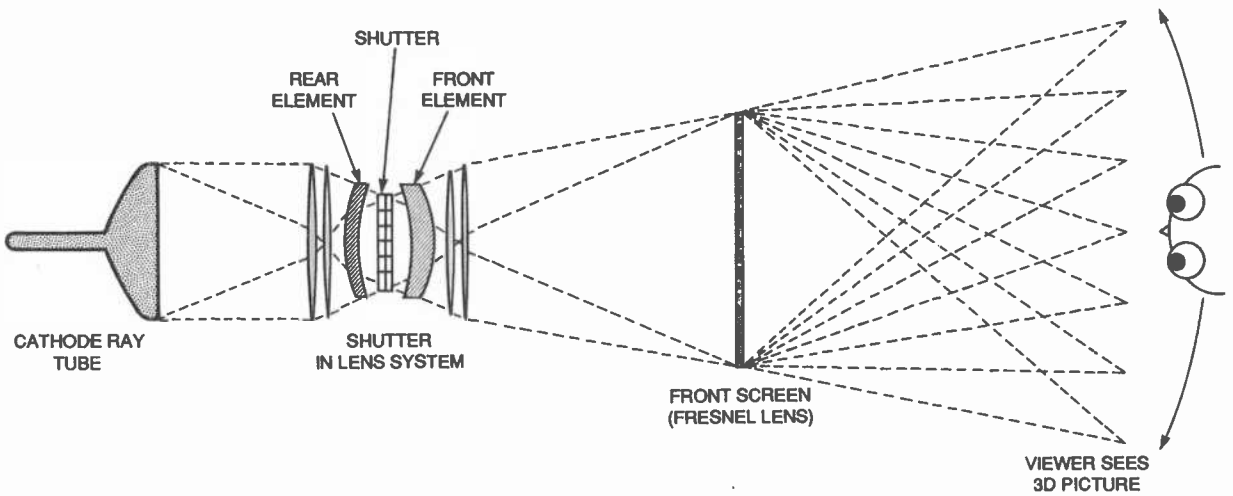

Fig. 3. The heart of the system is the special lens-shutter combination that is mounted directly between the CRT and the front viewing element.

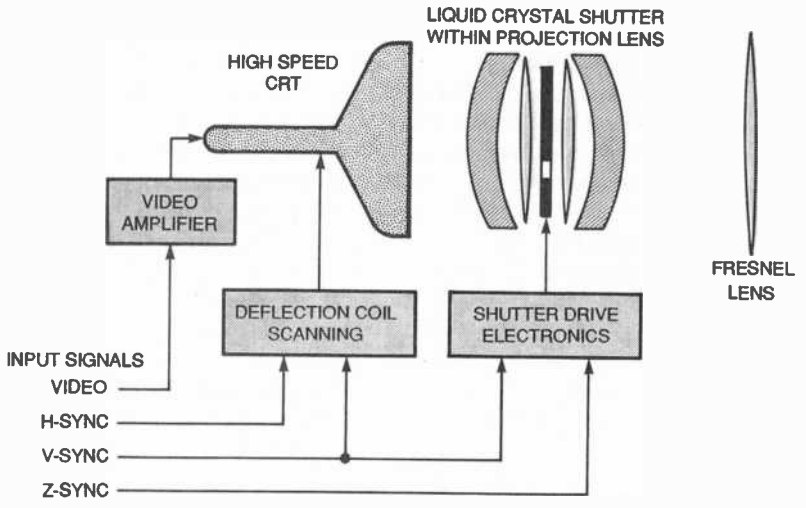

Fig. 4. The display device consists of a high-speed, high-brightness CRT, the lens/shutter assembly, and the controlling electronics.

The CRT is a 9-inch projection tube, with a usable picture area of 160 mm by 120 mm (8-inch diagonal). That CRT is the largest high-brightness CRT that was readily available. The phosphor is a Zn/CdS P4 white phosphor, chosen for its high sensitivity and fast decay time of approximately 60 microseconds to 10% of peak light output. It is a combination of yellow and blue phosphors, both with similar decay times.

The lens-shutter system was built around a 5-inch projection lens, the largest readily obtainable. It is made of multiple plastic and glass elements. Those were calibrated and their mount was then re-machined to allow for insertion of the liquid-crystal shutter.

The shutter, made by British manufacturer Thorn EMI, is a ferroelectric liquid-crystal element. It consists of a linear array of 16 segments, each forming a vertical slot. The active area is 100 mm by 100 mm. Each segment is 6.25-mm wide by 100-mm high, and switches in less than 100 microseconds.

The front Fresnel lens is a commercially available plastic lens. The image of the CRT forms on a 200-mm by 160-mm area of the lens (10-inch diagonal).

That optical system was relatively simple to build. There are no critical optical dimensions, apart from the fabrication of the liquid-crystal shutter. Even in the shutter, the critical dimensions are well within commercial liquid-crystal manufacturing parameters, so that it can be made by a commercial LCD supplier.

The electronics that drive the CRT and the LCD were designed at Cambridge. The CRT electronics consist of horizontal- and vertical-scan circuitry, a video amplifier, and power-supply and CRT-protection circuitry (not shown). The frame rate is between 450 and 1050 Hz, depending on the number of views. The line rate is 150 kHz. The video amplifier has a bandwidth of 150 MHz.

Those frame and line rates are substantially higher than used in conventional CRT displays. For example, a 1280 × 1024 computer-video display would typically have a frame rate of 60 Hz and a line rate of 64 kHz. The video-amplifier bandwidth of 150 MHz is within the performance ability of conventional high-specification CRTs. However, to drive the CRT at a high level of brightness requires a 130-volt peak-to-peak video signal, leading to peak screen loading of 70 watts. As a result, the CRT face plate is liquid cooled. Peak image luminance at the face plate is 34,000 cd/m² (10,000 foot-lamberts). Compare that with around 150 foot-lambert for typical standard television displays.

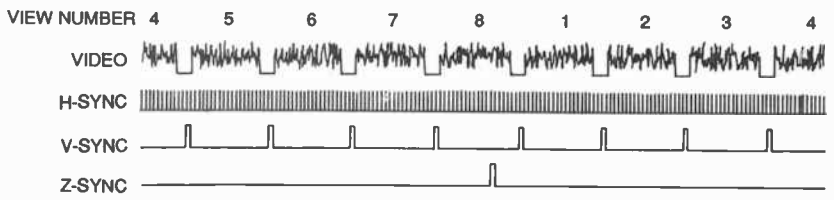

Fig. 5. Here are the drive signals for an eight-view, non-interlaced autostereo image. The entire cycle repeats at 60 Hz.

The electronics for the liquid-crystal shutter are relatively straightforward, producing a series of plus-or-minus 40-volt and plus-or-minus 5-volt pulses to turn the appropriate liquid-crystal segments on and off in synchronization with the CRT image. Ferroelectric liquid crystals are, however, still in their infancy, and much experimentation was required to determine the voltage pulse timings.

The liquid-crystal shutter has to be synchronized with the image on the CRT. The shutter is stepped during each vertical retrace of the CRT. It is reset to its initial position by an external "Z-sync" synchronization pulse.

Color. Thus far, the system discussed has been monochromatic (black-and-white). The obvious way to extend the system to color would be to use a three-gun shadow mask CRT. That, unfortunately, is not presently possible because the high beam current required would destroy the shadow mask. That leaves two options: either three separate red, green, and blue display devices, combined with some mirror arrangement, or a color sequential system using a fast-switching color filter and the fast black-and-white CRT already used in the monochrome display.

The first option requires precise alignment of the three display devices and complex combining optics. Neither of those is an insurmountable problem and that approach might be used in the future. In the short term, however, due to cost considerations, the switching color-filter approach is the one being pursued. The sole disadvantage of that approach is that each view direction must be displayed three times: once for red, once for green, and once for blue. That reduces the maximum possible view directions from sixteen to six, and decreases the light transmission.

Initial experiments in sequential color were made using a rotating six-segment color filter (two segments of

each primary color), reminiscent of the early experiments in color TV. Rotating at 1500 rpm, that filter provided the first 24-bit full-color autostereoscopic images on the display. However, that mechanical device is unsuitable as a commercial solution; for one thing, the outer rim of the rotating filter spins at a speed of 55 mph!

A more suitable mechanism was found in the form of a Tektronix liquid-crystal color shutter. That commercially available shutter consists of two consecutive switched liquid-crystal color filters, one switching between red and cyan, the other between blue and yellow.

How well does that display reproduce colors? Observations reveal that the system gives at least adequate renditions of all three primary colors. Although the pure red is unsaturated, flesh tones are acceptable, and color gray-scaling is very good. At peak brightness, the display produces 100 cd/m^2 (30 foot-lambert). The maximum resolution of the color display is 640 × 240 pixels, 6 views, 24-bit color at a 50-Hz refresh rate when driven from a computer. A live video system developed at Cambridge can provide six views of full color video at a resolution of 384 × 288 (half PAL).

Work on the display system is continuing. Already a prototype 25-inch diagonal display has been created by rearranging the projection lens, and installing a 500-mm by 380-mm Fresnel lens. The next step in the development phase is to produce a color display with higher resolution and more views.

Image Sources and Examples. Images can be sent to the autostereo display from two sources at present: a computer or a live video system. The display takes a standard video signal as input. That signal, see Fig. 5, consists of a single monochrome video channel and separate horizontal and vertical synchronization channels. All channels are running at the appropriate fast field rate. Each view is sent to the display in a separate field with the views being sent sequentially left to right. One extra synchronizing signal is required on a separate channel. This azimuth-sync or Z-sync signal tells the display which field represents the left-most view. Z-sync consists of a pulse that occurs during the field immediately prior to the left-most view.

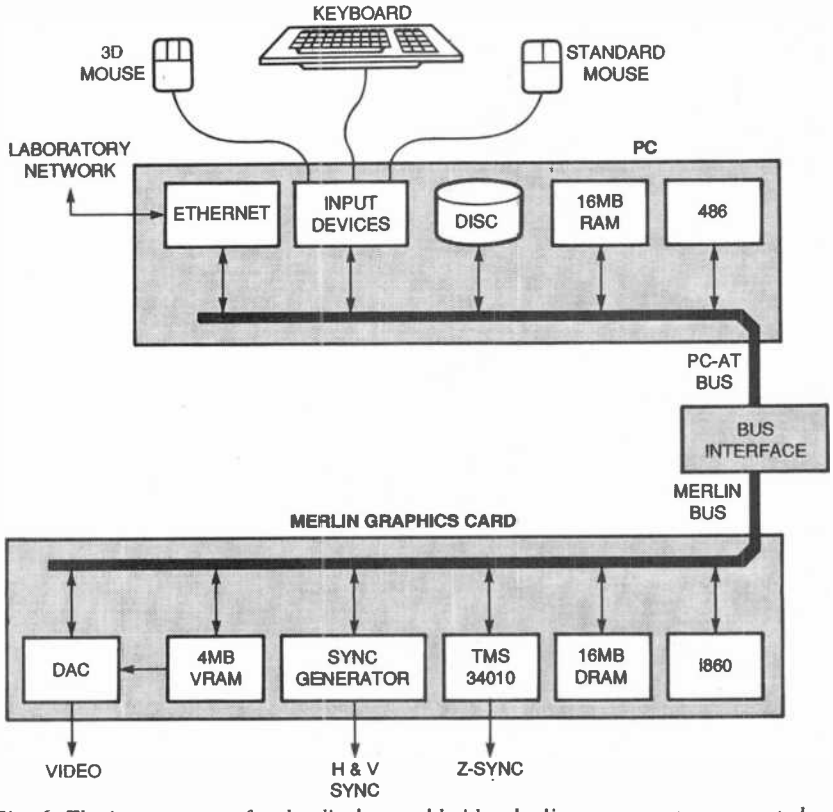

Fig. 6. The image source for the display could either be live or computer-generated video. Here's the architecture of the system used to generate computer images for the demonstration display.

Using more-or-less conventional video allows any flexible video-output system to be used to generate signals for the display. The Cambridge group uses an off-the-shelf Merlin graphics card, produced by Datapath, installed in a PC. A variety of interactive software has been written for that card to demonstrate the capabilities of the display. The majority of the software is built on top of a graphics-programming library (written at Cambridge) that handles all of the autostereo-image generation, leaving the programmer free to concentrate on the application.

Software has also been written for displaying pre-rendered autostereo images and animated image sequences. A variety of interested parties have provided sets of such images; those range from scientific images to video-game scenes.

The autostereoscopic camera system, also developed at Cambridge, produces live autostereo video for the display. The system multiplexes input from six (color) or eight (monochrome) cameras and produces a video stream and synchronization signals for the display.

Figure 6 shows the architecture of the current computer system used to drive the display. The host PC acts as a server for access to disk, input devices, and the network. The i860 on the graphics card is the main processor and performs all of the rendering. The TMS 34010 generates the Z-sync and ensures that the correct field is being output by the DAC at all times.

(Continued on page 74)

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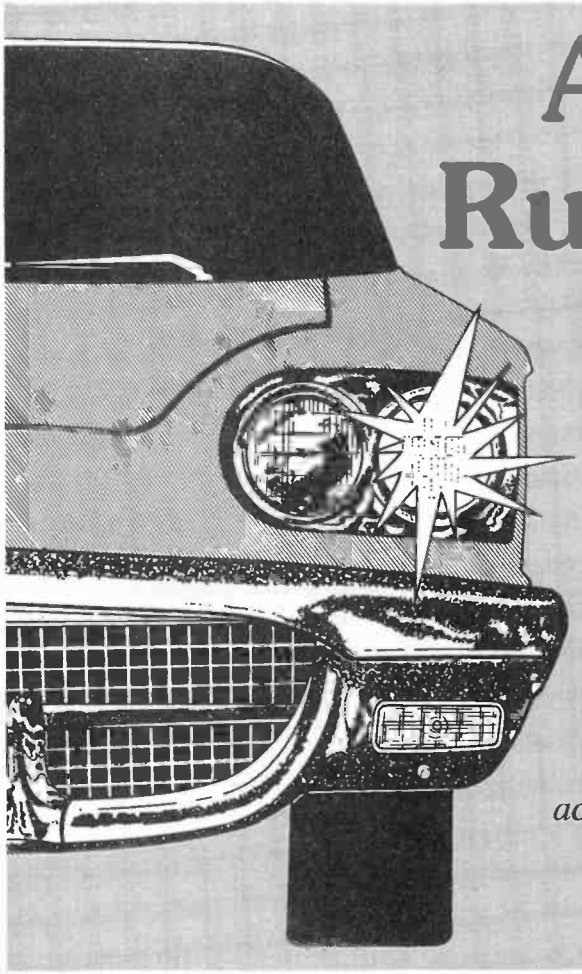
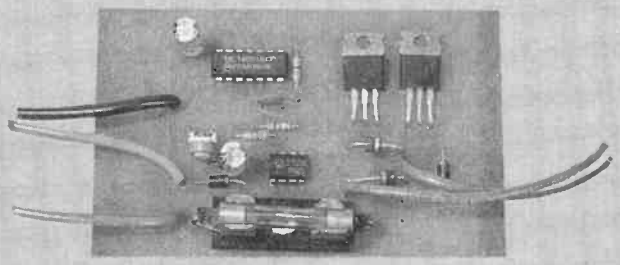
Add Daytime Running Lights To Your Car





This circuit could keep you out of a few accidents, and could possibly even save your life.

BY ANTHONY J. CARISTI

You will be hearing a lot about daytime running lights in the near future. Actually, you have probably seen some vehicles that have that feature, which maintains automotive headlamp illumination whenever the vehicle is in operation. Studies have shown that when vehicular lights are operated during daylight hours, there is a significant decrease in accidents. That makes a lot of sense—it's easier to see a lighted vehicle.

Furthermore, the use of daytime running lights is important because many drivers neglect to turn on headlights when poor visibility conditions exist during rain, snow, fog, and twilight hours. Driver apathy is so bad that some states have been forced to enact laws to force all drivers to turn on their headlights when the windshield wipers are operating. Eventually, when all vehicles on the road are equipped with daytime running lights, accidents are sure to decrease. As a result, many 1996-model vehicles will be supplied with the feature as standard equipment. (Incidentally, daytime running lights have been mandatory in new cars in Canada for many years.)

However, there is no need for you to wait until you purchase a new car or truck to benefit from the new safety advantage. You can equip your vehicle right now with the *Daytime Running Lights* described in this article. Our DRL add-on is a simple circuit that is completely automatic in operation and will not interfere with normal operation of the headlight system of the vehicle.

When most people hear about daytime running lights, they wonder why you can't just turn on a vehicle's headlights during the day. What they don't know is that there is no need to have full headlight intensity to achieve the desired effect. Additionally, it would not be a good idea to expose all oncoming traffic to the full glare of headlights. For those reasons, a diminished amount of brightness is produced by the DRL circuit.

Circuit Description. The DRL circuit is shown in Fig. 1. It is a variable-duty-cycle power oscillator that allows pulses of current to be applied to the headlights whenever the ignition of the vehicle is turned on. Because of the variable-duty-cycle system, there is no need for high-wattage current-limiting resistors that are expensive and bulky, and which would generate undesirable heat.

The 12-volt DC power that drives the circuit is taken from two sources in the vehicle. Power for the headlights is provided by the vehicular battery and generator system, and is input through fuse F1 to the circuit. The power source for the digital or logic part of the circuit is the +12-volt line that feeds the ignition system of the vehicle. When the ignition is turned on, the circuit is on, and when the ignition is turned off, so is the circuit.

When the ignition is on, power is applied through D1 to operate IC1, a 555 timer that is connected as a free-running multivibrator. The frequency of operation of IC1 is determined by potentiometer R1, resistors R2 and R3, and capacitor C2. Pin 3 of IC1 provides the output of the oscillator; the

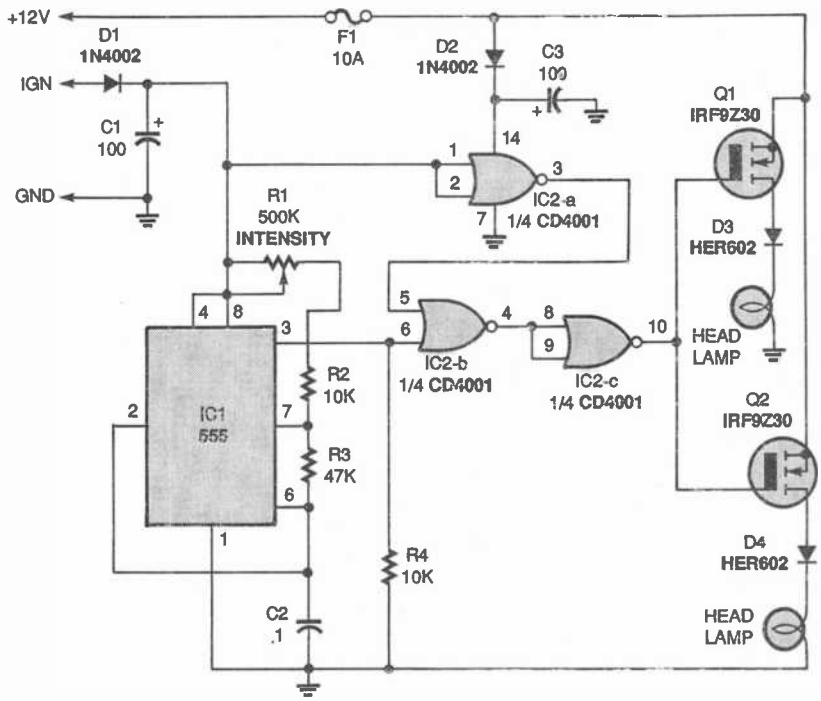


Fig. 1. This is the schematic for the Daytime Running Lights circuit. Potentiometer R1 can be used to adjust the intensity of the headlamps.

duty cycle is determined by the following ratio:

(R1 + R2)/R3

Potentiometer R1 allows the duty cycle of the negative part of the waveform to be adjusted from about 10% to almost 50%. That adjustment capability is provided so that the intensity of illumination can be set as desired. Note that the maximum intensity of the lights is held to less than 50%, as determined by the output at pin 3 of IC1.

A set of logic gates (IC2), powered by the battery and generator, is used to control the operation of the circuit. When the ignition is off, the logic output of pin 3 of IC2-a is high because the input voltage to pins 1 and 2 is zero. That output voltage is inverted by IC2-b and again by IC2-c, resulting in a high logic level fed to the gate of hexFET transistors Q1 and Q2. Under that high-logic condition, the transistors are not forward-biased and the headlights remain off.

When the ignition is on, the oscillator is powered through D1. The pulse train output of IC1 is inverted twice, by IC2-b and IC2-c, and ultimately appears simultaneously at the gates of Q1 and Q2. Those two transistors then feed +12-volt pulses through their respective diodes, D3 and D4, to each of the low-beam headlights of the vehicle. The diodes provide isolation between the DRL circuit and the electrical system of the vehicle.

The design of the circuit makes it possible to add second pairs of hexFET transistors and corresponding diodes to the circuit and have them driven by IC2-c. Thus, if desired, the taillights of the vehicle may also be used for DRL operation.

Construction. The author's prototype for the DRL circuit was built on a printed-circuit board. That method of assembly is recommended because the rattling environment of a moving vehicle could damage and weaken other forms of electrical connections, such as point-to-point wiring. If you would like to etch your own PC board, a full-size template is provided in Fig. 2. Or, you can order a drilled and etched board from the source given in the Parts List.

To make assembly easier, use the parts-placement diagram shown in Fig. 3. Begin by installing a fuse mount for F1; however, do not insert the fuse yet. Then go on to mount the resistors and capacitors, being sure to orient the polarized capacitors properly. Also install the potentiometer at this point.

Solder five 16-gauge, insulated stranded wires to the board to allow for the ground, power, and headlamp

PARTS LIST FOR THE DAYTIME RUNNING LIGHTS

SEMICONDUCTORS

IC1—555 timer, integrated circuit
IC2—CD4001 quad 2-input NOR gate, integrated circuit
Q1, Q2—IRF9Z30 hexFET transistor
D1, D2—1N4002 silicon diode
D3, D4—HER602 silicon diode

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—500,000-ohm potentiometer, PC-mount
R2, R4—10,000-ohm
R3—47,000-ohm

ADDITIONAL PARTS AND MATERIALS

C1, C3—100-µF, 25-WVDC, electrolytic capacitor
C2—0.1-µF, ceramic-disc capacitor
F1—10-ampere fuse, 3AG or similar
Printed-circuit materials, enclosure, fuse holder, 16-gauge stranded wire, 12-volt test lamps (2), SPST test switches (2), electrical tape, wire, solder, hardware, etc.

Note: The following parts are available from A. Caristi (69 White Pond Road, Waldwick, NJ 07363): etched and drilled PC board—$14.95; IC1—$2.50; IC2—$2.50. Please add $4.00 postage and handling; NJ residents also add appropriate sales tax.

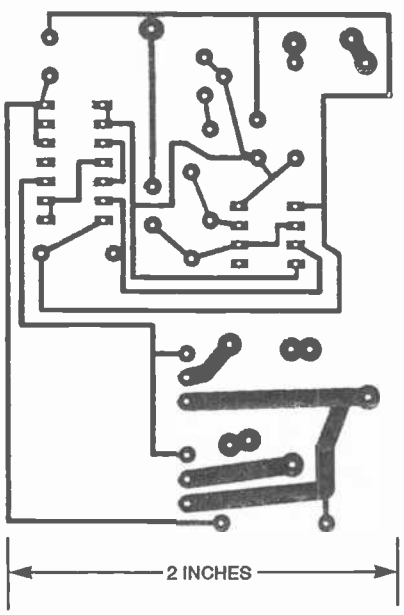


Fig. 2. If you'd like to etch your own PC board, use this full-size template.

connections shown. The wires should each be as long as necessary to reach all the appropriate points in your car's electrical system (that will depend on where you plan on mounting the circuit; more on that later). If possible, four or five different colors should be used to help avoid mistakes in wiring.

Use two pairs of long-nose pliers to bend the leads of the transistors at right angles as far from their cases as possible. Then mount the two transistors flat against the board. Because the transistors normally run hot, you might want to also install a small, insulated heat sink for each. Secure each transistor to the PC board using suitable hardware.

Next, mount the diodes, followed by the two integrated circuits. Make sure all those components are oriented properly. To complete assembly, insert a fuse into the holder.

Double-check the board at this time for any mistakes you might have made. When you're satisfied with the board, place it into a small, covered, plastic enclosure to protect it from dirt and inadvertent short circuits. Drill holes in the sides of the enclosure for the two input power leads, ground connection, and two output wires.

Your DRL circuit is now ready, but don't attempt to install it in the vehicle at this time. It must first be tested to ensure that it is working properly.

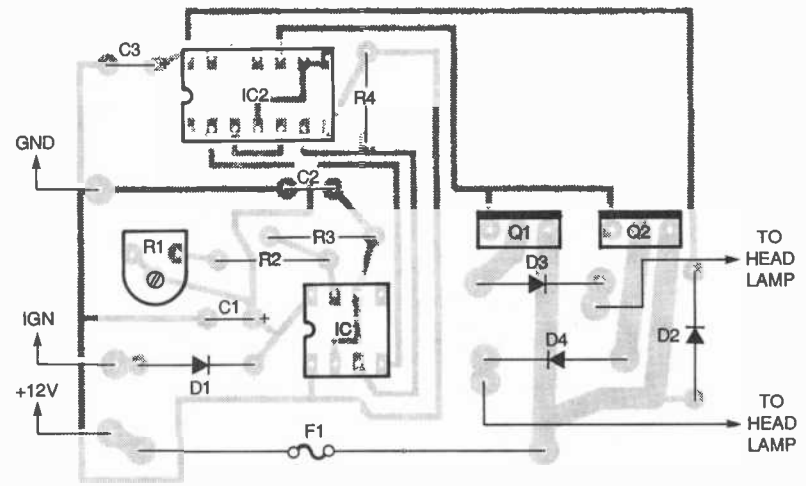


Fig. 3. Use this parts-placement diagram as a guide when assembling the PC board, and when connecting it to your vehicle.

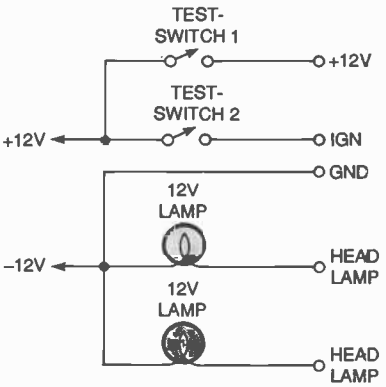


Fig. 4. This simple test setup will let you determine if your DRL circuit is working before you install the latter in your vehicle.

Preliminary Test. To perform the initial test of the circuit, a source of 12-volts DC is required. You will also need a voltmeter, and an oscilloscope to observe circuit waveforms. You will also need two SPST switches and two small, 12-volt lamps; the latter will be used as test loads to simulate the headlamps. Be sure the power source is capable of driving both lamps simultaneously.

Figure 4 shows how to wire the test setup. The small-circle connection points correspond to the points on the DRL circuit board. When the test circuit is connected, turn the power supply on, close test-switch 1, and leave test-switch 2 open. Both lamps should be extinguished as a result.

If one or both of the lamps light, troubleshoot the circuit before proceeding with the checkout. Measure the voltage at the gate of Q1 and Q2. Normal indication is about +12 volts. If the gate voltage of Q1 and Q2 is not +12 volts, check IC2 and its associated wiring. Also check the orientation of the other parts again; if one or more is positioned incorrectly, it is possible some of the parts are now damaged and new ones might be required.

Once the first test is complete, close test-switch 2. Both test lamps should glow. Adjust R1 over its range and note that it is possible to vary the brightness of the lamps. Then set R1 to mid position.

If the lamps do not light, and you already checked the orientation of all the parts, connect an oscilloscope to pin 3 of IC1 to ascertain that the chip is oscillating. If the waveform is absent, check R1–R3, and C2. If they're okay, try a new chip for IC1.

With the preceding tests completed, the DRL circuit is operational. It is now ready to be installed.

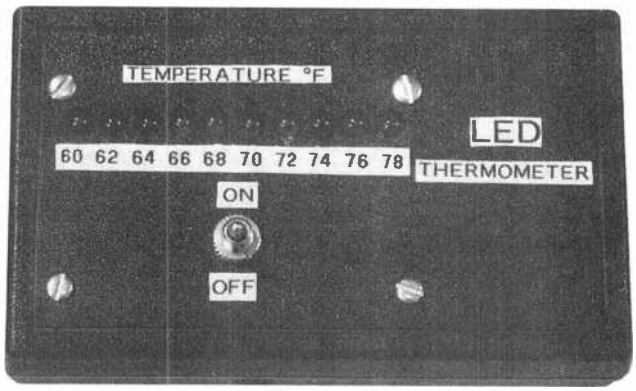
Installation and Adjustment. There are literally thousands of vehicle models in use today, so it is not possible to address the particular DRL installation details for each and every one here. However, most vehicles have a simple power on/off switch and a high-beam/low-beam switch that operates the headlamps. The following instructions were written with that in mind.

Before starting, for safety, disconnect the ground (chassis) wire from the vehicle's battery. Then mount the DRL enclosure near the front of the vehicle where it is close to the headlamps. Be sure to choose a location that is protected against engine heat, rain, snow, and road hazards (pebbles, etc.).

See Fig. 3 again before making the following connections. Splice one of the wires labeled "To Headlamp" to the low-beam wire of the left headlamp. In other words, remove a small amount of insulation from the low-beam wire and wrap the wire from the DRL circuit around it. Solder the connection and then insulate thoroughly with plastic electrical tape. Because the lamp has three wires—high beam, low beam, and ground—be sure to properly identify the low-beam wire. If in doubt, use a voltmeter to check which wire is hot when the low beams are operated by the instrument panel switch. Repeat the operation for the right headlamp.

Splice the wire labeled "+12V" to the heavy-duty lead that comes off the positive side of the battery. Many

(Continued on page 68)



BUILD AN LED Thermometer

See at a glance what a room's temperature is within two degrees.

BY WILLIAM SHEETS AND RUDOLF F. GRAF

Most homes have several rooms that are not equipped with thermostats. As a result, it's often difficult to determine how the heating or air-conditioning system is working in such rooms. A simple way to overcome that problem is to install a room thermometer, and if you're like most hobbyists you'll probably want to build your own.

The *LED Thermometer* described in this article is perfect for room-temperature applications. It displays the temperature within a range of 60 to 78 degrees Fahrenheit, using ten LEDs as a readout; each LED represents a two-degree step. The unit can be set to indicate temperature by either lighting just the appropriate LED, or all the LEDs up to and including the correct LED, forming a kind of bargraph display.

In addition to being useful, the project is also a good introduction to working with bar- and dot-graph displays and drivers, and temperature sensors and their applications. And depending on the LED colors and type of enclosure you use, the project could make an interesting conversation piece as well.

Circuit Description. The schematic for the LED Thermometer is shown in Fig. 1. As shown, the circuit is powered by a 9-volt battery, B1, but can easily run off any 7- to 10-volt DC power supply.

At the heart of the Thermometer is IC1, an LM34 temperature sensor. That device produces a voltage between the V_{out} and GND terminals that is linearly proportional to temperature. Although the output is usually 10 millivolts per degree Fahrenheit, IC1 is connected in a resistor network (made up of R1–R3) with a gain that provides an output of 40 mV/°F. Capacitor C1 is used as a noise bypass across R1 and R2. Because the voltage output by IC1 will be used by the rest of the circuit to "determine" what the temperature in the room is, potentiometer R1 will have to be calibrated exactly (but more on that later).

The output of IC1 is fed to pin 5 of IC2, an LM3914 LED bar- or dot-graph driver, which is where the actual temperature-determining process occurs. Here's how that works: IC2 has ten internal comparators, the output pins of which are connected to LED1–LED10. The voltage input to pin 5 is compared by IC2 to the voltages at pins 4 and 6 (more on those reference voltages in a moment); that process determines which LED or LEDs light. The LEDs can be set to light either one at a time (dot mode) or progressively (bar mode). When jumper JU1 is not installed, dot mode is enabled, and

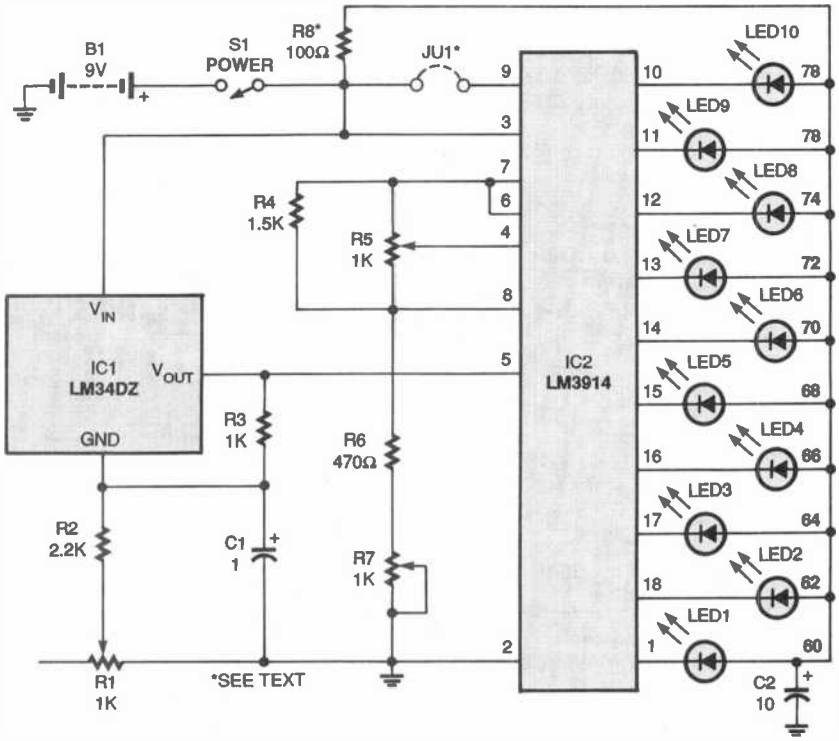


Fig. 1. Here's the schematic for the LED Thermometer. An LM34DZ temperature sensor, IC1, outputs a voltage that changes with temperature. The circuit interprets that output and displays the temperature in two-degree steps using LED1 through LED10.

when the jumper is installed, the chip is in bar mode.

In dot mode, the LED that corresponds to the correct input voltage (in other words, temperature) lights by itself. That way, when the input voltage increases, an LED representing a higher temperature will light, and the LED previously lit will extinguish. In bar mode, the LED representing the temperature and all the lower LEDs stay lit. Each mode has its advantages—the dot mode uses less current because only one LED is lit at a time, but the bar mode is easier to read at a glance. Resistor R8 and capacitor C2 provide decoupling for the LED-supply circuit. If bar-mode operation is desired, it is recommended that you reduce the value of R8 to 15 ohms.

In order to display a range of 60°F to 78°F, pin 6 must have a reference of 3.345 volts and pin 4 should have a reference of 2.545 volts. Those values are obtained through adjustments of potentiometers R5 and R7 (we'll deal with calibration later on).

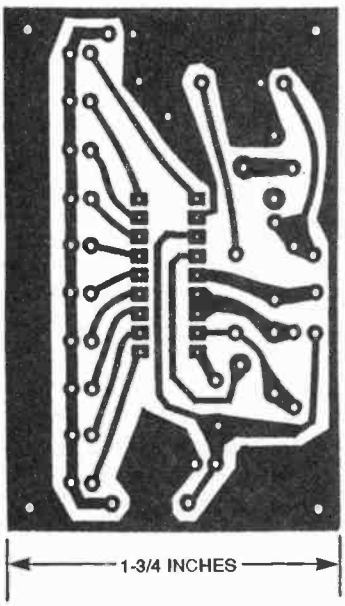


Fig. 2. You can use this full-size template to etch your own PC board for the Thermometer.

Construction. The authors' prototype for the LED Thermometer was built on a printed-circuit board. If you'd like to do the same, you can either use the template shown in Fig. 2 to etch your own board, or buy a pre-etched and drilled board as part of a kit of parts available from the source mentioned in the Parts List. Another option is to build the circuit on a perforated board; however, you will have to make some consideration for IC1's placement (more on that in a moment).

If you decide to use a PC board, refer to the parts-placement diagram shown in Fig. 3 when assembling the circuit. You should decide which mode (bar or dot) you want the circuit to work in before you begin. For bar mode, install jumper JU1 and a 15-ohm resistor for R8. For dot mode, omit that jumper and use a 100-ohm unit for R8.

PARTS LIST FOR THE LED THERMOMETER

SEMICONDUCTORS

IC1—LM34DZ temperature sensor, integrated circuit
IC2—LM3914 LED bar- or dot-graph driver, integrated circuit
LED1–LED10—Light-emitting diode, any color

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1, R5, R7—1000-ohm trimmer potentiometer
R2—2200-ohm
R3—1000-ohm
R4—1500-ohm
R6—470-ohm
R8—100-ohm (or 15-ohm, see text)

ADDITIONAL PARTS AND MATERIALS

C1—1-μF, 50-WVDC, electrolytic capacitor
C2—10-μF, 16-WVDC, electrolytic capacitor
S1—SPST switch
B1—9-volt alkaline battery
Printed-circuit materials, suitable enclosure, 18-pin IC socket, wire, solder, hardware, etc.

Note: The following is available from North Country Radio (P.O. Box 53, Wykagyl Station, New Rochelle, NY 10804): complete kit of parts including an etched and drilled PC board and power connector (but no enclosure)—$23.00. Please add $4.50 for shipping and handling; NY residents please also add 8.25% sales tax.

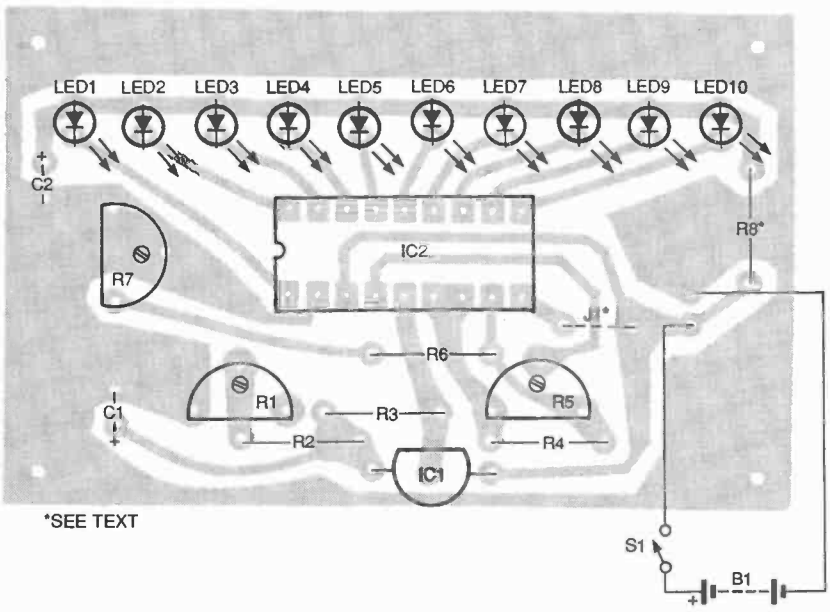


Fig. 3. If you're building the Thermometer circuit on a PC board, use this parts-placement diagram as a guide.

Mount a socket for IC2, but don't install it yet. Then solder the resistors and potentiometers to the board.

Install the two electrolytic capacitors to the board and double-check their polarity against the parts-placement diagram. Continue assembly by soldering to the board two wires for connections to the battery snap and switch S1.

Mount the LEDs next, making certain that they are oriented properly. You can use any combination of LED colors you like, but remember that all LEDs are supplied the same drive current. If you find later that an individual LED is too bright, you can use a shunting resistor across it to reduce its drive current.

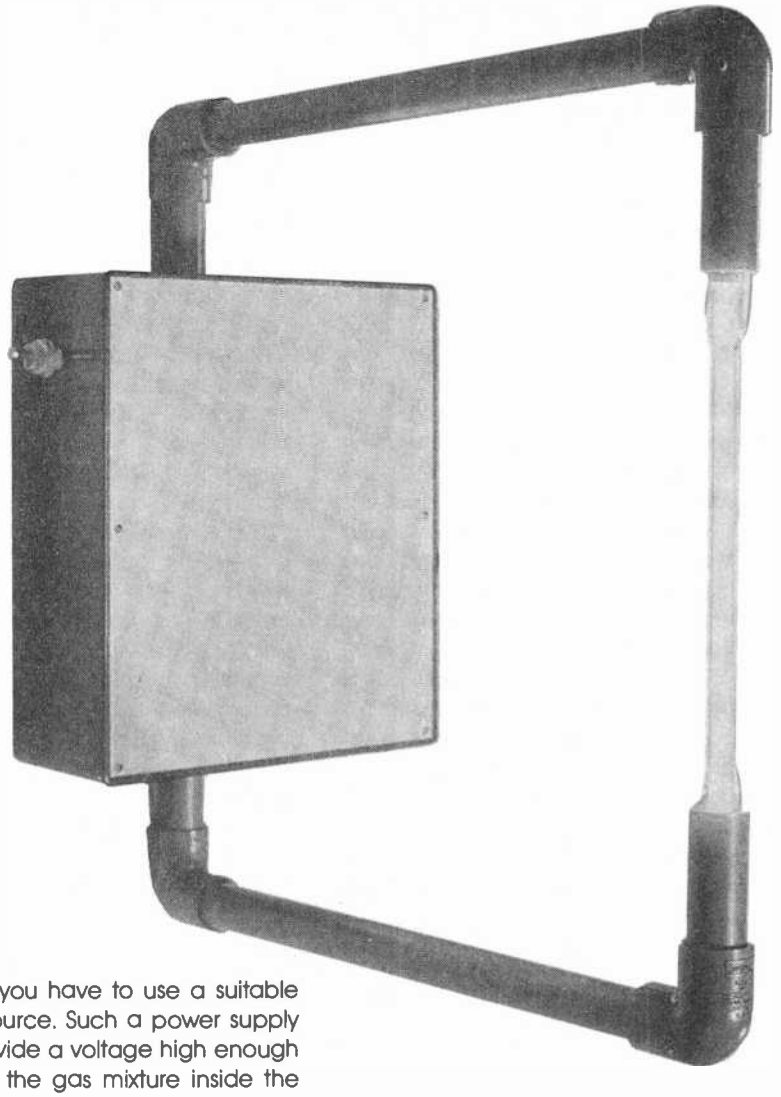
Next mount IC1. If you're building

(Continued on page 74)

BUILD A HIGH-VOLTAGE POWER SUPPLY

Use it to light a neon tube or in any other high-voltage application.

BY VINCENT VOLLONO



Anyone who has experimented with high-voltage power supplies knows that they can be used in a lot of projects. Take a look at the photo on this page, for example, and you'll see an obvious one—lighting a neon tube. The *High-Voltage Power Supply* described in this article delivers 500 volts of high-frequency AC (15 kHz) that can be used for that very application, or for some others we'll look at briefly later on.

Why Neon? When it comes to impressive, eye-catching lighting displays, neon has to rate among the top. Neon is used by almost all kinds of business from pizza shops to clothing stores to attract their potential customers, but it can also be used as a neat decoration in the home as well. Let's look at how the neon-tube application for the high-voltage supply works.

A neon tube is made as follows: A glass tube is emptied with a vacuum pump to a pressure well below atmospheric. Then, a very small amount of neon gas is inserted into the glass tube, which is sealed airtight after that.

To make a neon tube actually give off light, you have to use a suitable power source. Such a power supply must provide a voltage high enough to ionize the gas mixture inside the tube, causing an excitation of the neon gas atoms that results in a bright discharge. The High-Voltage Power Supply can easily power a six-inch neon tube.

Circuit Description. The schematic for the Power Supply is shown in Fig. 1. Power for the circuit is supplied by a step-down transformer, T2, and full-wave bridge rectifier, BR1, which convert 117-volts AC to 12-volts DC. Capacitor C3 acts as a filter.

The heart of the circuit is a Schmitt-trigger hex inverter, U1. Capacitor C1, resistor R1, and potentiometer R2 are connected to one section of the inverter, U1-a, to form an oscillator that runs at approximately 15 kHz (because U1 is a Schmitt trigger, the output squarewave is very clean). Adjusting R2 varies the frequency.

The output of the oscillator is fed into the remaining five inverters (U1-b through U1-f), which are connected in parallel to create a buffer that is capable of increasing the drive current of the oscillator. The squarewave output is used to drive the switching transistor, Q1, which in turn switches the primary windings of the ferrite-core transformer, T1. Approximately 500-volts AC at 15 kHz are output from the secondary of that transformer.

Construction. The author's prototype was built on two separate perforated boards, using point-to-point wiring, and was mounted inside a plastic project box. Two boards were used to separate the power-supply section of the circuit from the oscillator. Try to keep all the wiring in this project as short as possible, especially the high-voltage wire from the ferrite transformer.

Begin assembly by mounting iron-core transformer T2 on a perforated board. Then mount the bridge rectifier and capacitor C3 to the board as well. Connect all the components and then attach the power cord, plug, and switch to the primary of T2.

Wire the components for the oscillator onto another board. Start with

the resistors, capacitors, and potentiometer. Then attach the fuse and the ferrite transformer, T1.

Transformer T1 in the author's prototype was made using a pot core and magnet wire. To make your own transformer, take a pot core and begin by winding 500 turns of 30-gauge magnet wire for the secondary. Wind the layers in even, straight turns to ensure space economy and improvement in efficiency. When you're done winding the secondary, spray it with an insulating product such as NO-ARC. Then cover the secondary with an insulating layer or two of scotch tape before winding the primary over it. The primary is made by winding 20 turns of 22-gauge magnet wire over the insulated secondary.

The last on-board component to mount is U1. Then mount switching-transistor Q1 (which handles a fair amount of current) off-board and adequately heatsink it for proper operation—it should only run slightly warm.

When the unit is completed as described, it is capable of delivering up to four watts of power, in a relatively small package. By using a higher-rated switching transistor and increasing the current flow, you can boost the output power. If you do that, though, make sure that all the components used are properly rated to handle the increased current flow.

Checkout. Before plugging the unit in, and turning it on, keep the following in mind: The output of the High-Voltage Power Supply will cause you to receive quite a shock if you come in contact with the output terminals of T1. Be *extremely* careful when you are close to that transformer, and never touch any component of the circuit when the unit is plugged in.

Turn on the Supply and, depending on what application you use it for, you should know pretty quickly if it's working properly or not. In case of a problem, first check to make sure that the power-supply board of the circuit is supplying 12-volts DC to the oscillator board. If it's not, then check your wiring to make sure it is correct.

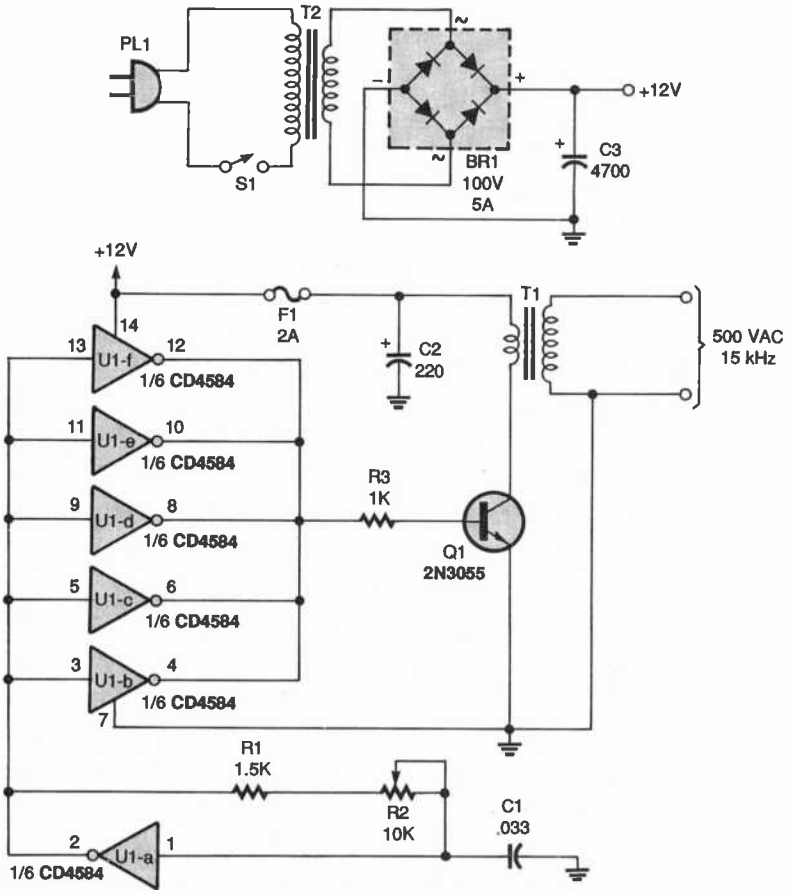


Fig. 1. Here's the schematic for the High-Voltage Power Supply. A 15-kHz pulse, generated by U1, drives switching-transformer Q1. Transformer T1 then steps up the generated AC to 500 volts.

PARTS LIST FOR THE HIGH-VOLTAGE POWER SUPPLY

SEMICONDUCTORS

U1—CD4584 Schmitt trigger hex inverter, integrated circuit
Q1—2N3055 NPN switching transistor
BR1—Full-wave bridge rectifier, 100-volt, 5-ampere

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—1500-ohm
R2—10,000-ohm potentiometer
R3—1000-ohm

CAPACITORS

C1—0.033-μF, Mylar
C2—220-μF, 16-WVDC, electrolytic
C3—4700-μF, 35-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

T1—Ferrite-core transformer, 500-volt output (see text)
T2—Iron-core transformer, 120- to 12-volts AC, 1 ampere
F1—2-ampere fuse
PL1—Two-terminal AC plug
S1—SPST toggle switch
Perforated board, project enclosure, two-lead power cord, wire, solder, hardware, etc.

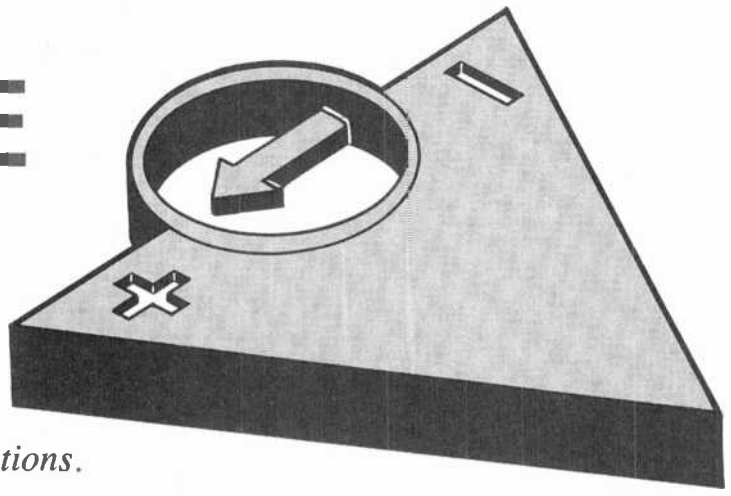
If 12 volts are supplied, then check pin 8 of U1 with a scope. You should find a 15-kHz squarewave present there. If there is no wave at all, then you might have a defective IC.

Applications. So what are you going to do with the 500 volts of high-frequency AC your Supply is producing? Well, as we mentioned earlier, a primary application for the Supply is as a power source to light a neon tube. The unit should easily light a 6-inch neon tube if built according to the specifications given. In the author's prototype, ½-inch-diameter PVC tubing was used as a support for the neon tube as well as a way to hide the wiring.

Of course, you can also use the High-Voltage Power Supply on your workbench to experiment with high-voltage, high-frequency AC. Or, by adding a bridge rectifier at the output of transformer T1, you can convert the unit into a high-voltage DC power supply. Just remember that no matter what application you find, high voltages are dangerous. *So be careful!* ■

BY JOSEPH J. CARR

Using the CURRENT DIFFERENCE AMPLIFIER



The current-difference amplifier is as easy to use as an op-amp, and is better suited to certain applications.

The operational amplifier is familiar to most readers because it has a long and popular history in electronics. One of the problems with such widespread popularity of one device, however, is that it tempts us to overlook perfectly good solutions to problems that can be offered by other linear, integrated-circuit designs. One such linear IC amplifier is the current-difference amplifier (CDA), also called the Norton Amplifier. That is a non-operational, linear, IC amplifier that performs similarly to the op-amp, but not exactly the same. The CDA has certain features that make it uniquely useful for certain applications.

One place where the CDA is more useful than the operational amplifier is in circuits that process AC signals, but are limited to a single-polarity, DC power supply. For example, in automotive-electronics equipment limited to a single 12- (actually +12 to +14.4) volt DC battery power supply (and uses the car chassis for negative common return).

There are other cases where the majority of the circuit operates from a single, DC power supply, but a linear IC amp is also required. In those situations, we would either have to bias the operational amplifier with an external resistor network, provide a second DC power supply, or use a CDA.

The normal circuit symbol for the CDA is shown in Fig. 1. That symbol looks much like the regular op-amp symbol, except that a "current source" is placed between the two inputs. The symbol is typically used for several products such as the LM3900, which is a quad Norton/CDA amplifier. You might sometimes find schematics where the op-amp symbol is used for the CDA, but the symbol shown in Fig. 1 is technically more accurate.

CDA Circuit Configurations. The input circuit of a CDA differs radically from the operational amplifier. Recall that op-amps use a differential-input, common-emitter amplifier that is driven from a constant-current source supplying the collector-emitter current.

The CDA is quite different, however, as can be seen in Fig. 2. The overall circuit of a typical CDA is shown in Fig. 2A, while an alternate form of the input circuit is shown in Fig. 2B. Transistor Q7 in Fig. 2A forms the output transistor, while Q5 is the driver. Both the NPN output transistor and the PNP driver transistor operate in the emitter-follower configuration. Transistors Q4–Q6 and Q8 are connected to serve as current sources. The input transistor is Q3, and it operates in the common emitter configuration. The base of Q3 forms the inverting (−IN) input for the CDA.

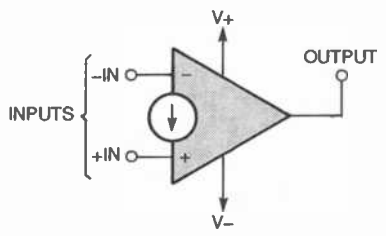


Fig. 1. Here's the schematic symbol for the current-difference amplifier. It resembles an op-amp with the exception of a current source between the inverting and noninverting inputs.

The noninverting input of the CDA (+IN) is formed with a "current-mirror" transistor, Q1 (transistor Q1 in Fig. 2A is "diode connected" and serves exactly the same function as diode D1 in Fig. 2B). The dynamic resistance offered by the current mirror transistor (Q2) is given by:

$$R = 26/I_B \text{ [Eq. 1]}$$

Where: R is the dynamic resistance of Q2 in ohms and I_B is the base bias current of Q3 in milliamperes

Equation 1 is used only at or near normal room temperature (25°C to 30°C) because I_B will vary with wide temperature excursions. For most common applications, however, the room-temperature version of the equation will suffice. Data sheets for specific current-difference amplifiers give additional details for amplifiers that must operate outside of the relatively narrow temperature range for the simplified room-temperature equation.

Figure 3 shows the pin-out for the LM3900, which is among the most popular CDA devices. That chip is a 14-pin DIP that contains four CDA de-

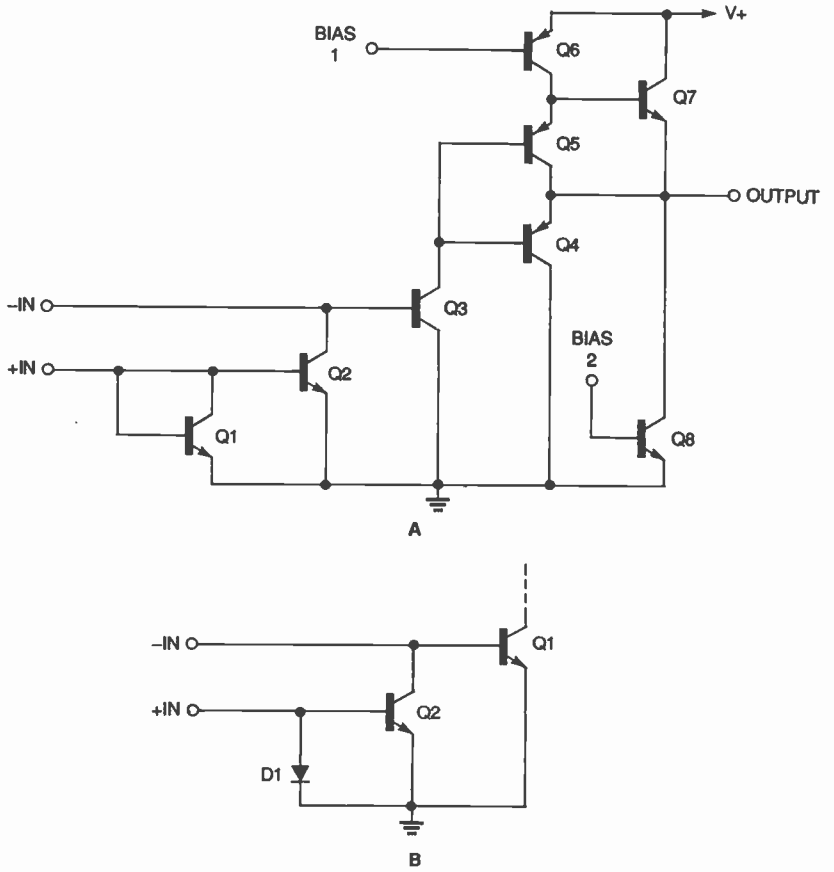


Fig. 2. The internal circuitry of a typical current-difference amplifier integrated circuit is shown in A; an alternate form of the input circuit (a current mirror) is shown in B.

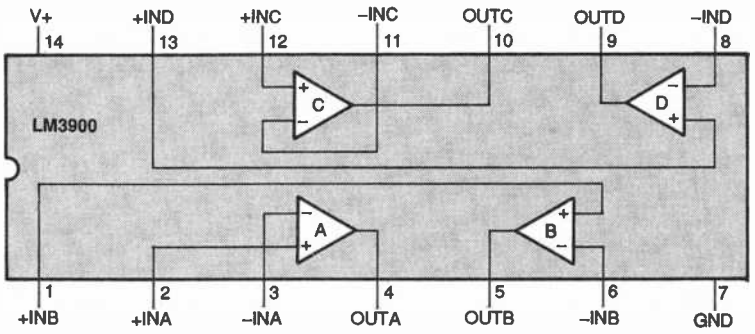


Fig. 3. Here's the pin out of a common current-difference amplifier IC, the LM3900.

vices operating from a single ground and DC power terminal. Other than the power lines, however, the four devices (A, B, C, and D) are completely independent.

CDA Inverting-Follower Circuits. Like operational amplifiers, the CDA can be configured in either inverting- or noninverting-follower configurations. The inverting follower is shown in Fig. 4. In many respects, that circuit is very similar to operational amplifiers. The voltage gain of the circuit is set approximately by the ratio of the feedback to the input resistor:

$$A_V = -(R2/R1) \text{ [Eq. 2]}$$

Where: A_V is the voltage gain, R2 is the feedback resistance, and R1 is the input resistance. The minus sign indicates that a 180-degree phase reversal occurs between input and output signals.

We must provide a bias to the current-mirror transistor (Q2 in Fig. 2A), so resistor R_{REF} is connected in series with the noninverting input of the CDA and a reference-voltage source, V_{REF}. In many practical circuits the reference voltage source is merely the V+ supply used for the CDA. In other cases, however, some other potential might be required, or alternatively the reference current is required to be regulated more tightly (or with less noise) than the DC power-supply voltage. Ordinarily the reference current is set to some convenient value between 5 μA and 100 μA. For V+ power-supply values of +12 VDC, for example, it is common to find a 1-megohm resistor used for R_{REF}. In that case, the input reference current is: I_{REF} = (12 volts)/(1,000,000 ohms) = 12 μA.

A constraint placed on CDAs is that the input resistor (R1) used to set gain must be high compared with the value of the current-mirror dynamic resistance. The CDA becomes nonlinear (*i.e.* distorts the input signal) if the input-resistor value approaches the current-mirror resistance, R. In that case, the voltage gain is not – (R2/R1), but rather:

$$A_V = R2/(R1 + R) \text{ [Eq 3]}$$

Where: A_V is the voltage gain, R2 is the feedback resistance, R1 is the input resistance, and R is the current-mirror resistance.

Equation 3 essentially reduces to equation 2 when we can force R1 to be much larger than R. That goal is easily achieved in most circuits be-

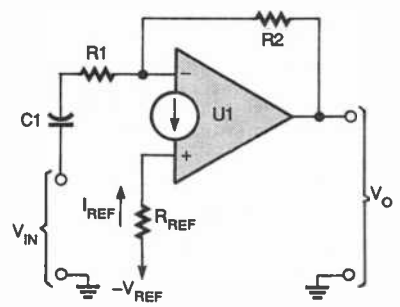


Fig. 4. Here a CDA is used much like an op-amp in an inverting follower circuit.

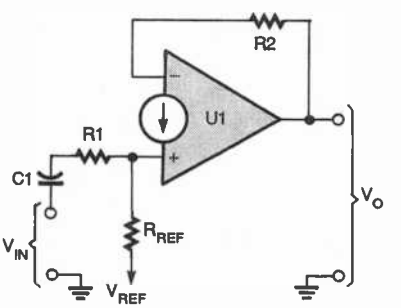


Fig. 5. Here is a noninverting follower built around a current-difference amplifier.

cause R is typically very small.

The output voltage of the CDA will have a DC-offset potential even when the AC input signal is zero. That potential is given by:

$$V_O = ((V_{REF} \times R2/R_{REF}) + 1) - (R2/R_{REF})\phi \text{ [Eq. 4]}$$

Where: V_O is the output in volts, V_{REF} is the reference potential in volts (usually V+), R2 is the feedback resistance in ohms, R_{REF} is the current-mirror bias resistance in ohms, and ϕ is a temperature-dependent factor (0.70 volts for room temperature).

The capacitor in series with the input circuitry has the effect of limiting the low-end frequency response. The −3-dB cutoff frequency is a function of the value of that capacitor and the input resistance, R1. That cutoff frequency, *f*, is given by:

$$f = 1{,}000{,}000/(2\pi R1C1) \text{ [Eq. 5]}$$

Where: *f* is the lower end −3-dB frequency in hertz (Hz), R1 is in ohms, and C1 is in microfarads.

In some CDA circuits there is also a capacitor in series with the output terminal. The purpose of that capacitor is to prevent the DC offset that is inherent in this type of circuit from affecting following circuits. The output capacitor will also limit the low-end frequency response. The same form of equation 5 is used to determine that frequency, but the input resistance of the load is used in place of R1.

As is often the case with equations presented in electronics books, equation 5 is not necessarily in the most useful form. In most cases, you will know the input resistance (R1) from the application. It is typically not less than ten times the source impedance, and forms part of the gain equation. In general, the driving source impedance and voltage gain tends to determine the value of R1. The required low-end frequency response is usually determined from the application. You generally know (or can find out) the frequency range of the intended input signals. From the lower limit of that frequency range you can determine the value of *f*. In short, the values of *f* and R1 are usually set by considerations other than the circuit itself. Therefore, to be truly useful, you need a version of equation 5 that assumes knowledge of R1 and *f* and instead calculates the value of C1. Using elementary arithmetic:

$$C1 = 1{,}000{,}000/(2\pi R1f) \text{ [Eq. 6]}$$

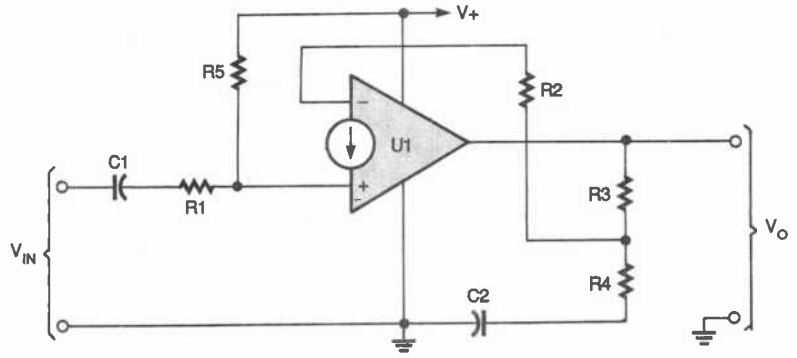


Fig. 6. In applications where larger than normal voltage gains are needed, this super gain CDA-based amplifier can be used.

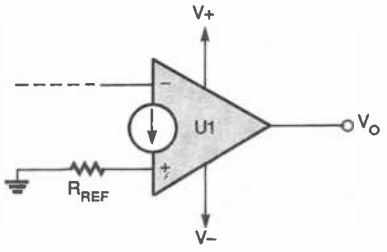


Fig. 7. Though intended for use in single-ended-supply applications, the CDA can be configured for use with a bipolar supply.

Where: A_V is the voltage gain, R1 and R2 are in ohms, and $I_{REF(mA)}$ is the bias current in milliamperes (mA).

The reference current, I_{REF}, is set to a value between 5 μA and 100 μA. Unlike the situation in the inverting amplifier, the value of that current is partially responsible for setting the gain of the circuit. Some clever designers have even used that current as a limited gain control for some CDA stages. The value of the resistor that provides the reference current (R_{REF}) is set by Ohms law, considering the required value of reference current and the reference voltage, V_{REF}. In most common applications, the reference voltage is merely one of the supply voltages. The value of R_{REF} is determined from:

$$R_{REF} = V_{REF}/I_{REF} \text{ [Eq. 8]}$$

Where: R_{REF} is the reference resistor in ohms, V_{REF} is the reference potential in volts, and I_{REF} is the reference current in amperes.

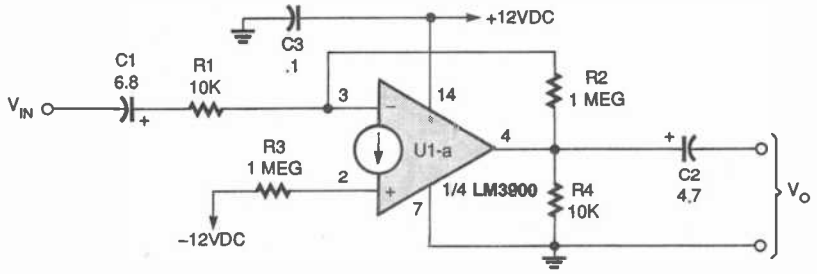


Fig. 8. Here is a practical 20-dB gain AC amplifier built using the LM3900 CDA.

Noninverting Amplifier Circuits. The noninverting amplifier CDA configuration is shown in Fig. 5. That circuit retains the reference-current bias applied to the noninverting input, but rearranges some of the other components. As in the case of the inverting-amplifier configuration, the noninverting amplifier uses R2 to provide negative feedback between the output terminal and the inverting input. Unlike the inverting-CDA circuit, however, input-resistor R1 is connected in series with the noninverting input. The gain of the noninverting CDA amplifier is given by:

$$A_V = R2/((26R1)/I_{REF(mA)}) \text{ [Eq. 7]}$$

The value of input impedance is approximately equal to R1, provided that R1 is much higher than the dynamic resistance of the current mirror inside the CDA (which is typically the case). As was true in the inverting follower case, the input capacitor (C1) sets the low-end frequency response of the amplifier. The −3-dB frequency is given by exactly the same equation

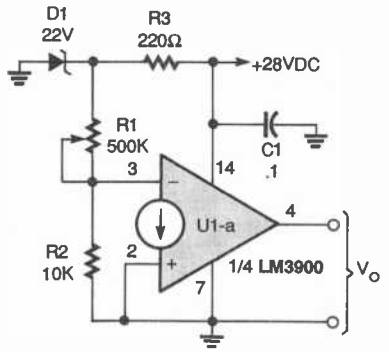


Fig. 9. This variable-voltage source can provide between 0.6 to 20 volts, depending on the setting of R1.

as for the inverting case (see equations 5 and 6).

Super-Gain Amplifier. There is a practical limit to voltage gain using standard resistor values and standard circuit configurations (a similar problem also exists for operational amplifiers). In Figure 6 we see a means for overcoming the limitations. That supergain amplifier circuit forms a noninverting follower in a manner similar to the earlier circuit, except that feedback-resistor R2 is driven from an output voltage-divider network rather than directly from the output terminal of the CDA. The voltage gain of the circuit of Fig. 6 is given by:

$$A_V = (R2/R1)((R3 + R4)/R3) \text{ [Eq. 9]}$$

Capacitor C1 is set using the same equation (equation 6) that was used previously, while C2 is set to have a capacitive reactance of R4/10 at the lowest frequency of operation (in other words, the low end −3-dB point).

Using Bipolar DC Power Supplies. The current-difference amplifier is designed primarily for single-polarity power-supply circuits. In most cases, the CDA will operate with a V+ DC power supply in which one side is grounded. We can, however, operate the CDA in a circuit with a bipolar DC power supply using a circuit such as the one in Fig. 7. The reference resistor, R_{REF} is connected from the noninverting input to ground. The V− and V+ power supplies are each ground referenced and of equal potential. Thus, the 5- to 100-μA bias current is found from $(V+)/R_{REF}$.

Applications Projects. The CDA device is very useful, and has almost as many applications as the operational amplifier. Unlike the op-amp, however, the CDA is happy operating from a single, DC power supply. Thus, it is popular in automotive and portable equipment designs. In this section, we will take a look at some representative application circuits in the form of some small projects.

20-dB Gain CDA AC Amplifier. This project is an inverting amplifier with an AC gain of 100 (*i.e.* 20 dB) and an input impedance of at least 10,000 ohms. An appropriate circuit built around the LM3900 CDA is shown in Fig. 8.

The reference resistor is set to 1 megohm. The gain (A_V) is set by the ratio of the feedback and input resistors: R2/R1. Because the input impedance needs to be at least 10,000 ohms, we set R1 = 10,000 ohms. The gain is 100, so the feedback resistor must be:

$$R2 = A_V R1$$

The DC power supplies are set to ±12 volts, a common value that is easily obtained. The input and output terminals are capacitor coupled. Those capacitors, and their associated resistors, form high-pass filters that set the lower-end −6-dB points in the frequency-response characteristic. In each case, the frequency is:

$$f = 1/(2\pi RC)$$

The last capacitor in the circuit (C3) is used to decouple the DC power-supply line. As shown in Fig. 9, that capacitor is a 0.1-μF unit, and must be mounted as close as possible to the body of the LM3900.

CDA-based Variable-Voltage Source. Figure 9 shows the circuit of a variable voltage source that produces outputs of 0.6 to 20 volts, depending on the setting of potentiometer R1. That circuit can also be used as a fixed-voltage source by replacing the potentiometer with a fixed resistor of appropriate value. Like the other circuits discussed thus far, it is based on the LM3900.

The maximum voltage that is produced depends on the Zener voltage of the Zener reference diode (D1). In the case shown here, the Zener is a 22-volt unit, so the maximum output voltage will be something between 20 and 22 volts. Lower values of maximum output voltage can be accommodated by using a diode with a lower Zener voltage for D1.

CDA-Based Audio Mixer. An audio mixer is a handy circuit that will combine two or more audio signal sources into one signal channel. Figure 10 shows an audio mixer that is built around the LM3900 CDA. The crux of this circuit is the three input networks, principally R3, R4, and R5. Those resistors are connected to different input sources (labeled $V_{IN}1$, $V_{IN}2$, and $V_{IN}3$). Those three resistors all connect to the inverting input of the CDA. The gain is approximately:

$$A_V = R2/R_X$$

Where R_X is the value of any one input resistor. The output voltage is:

$$V_O = R2((V_{IN}1/R3) + (V_{IN}2/R4) + (V_{IN}3/R5))$$

If resistor R2 is made variable, then the potentiometer used for R2 will serve as a master gain control for the audio mixer. ■

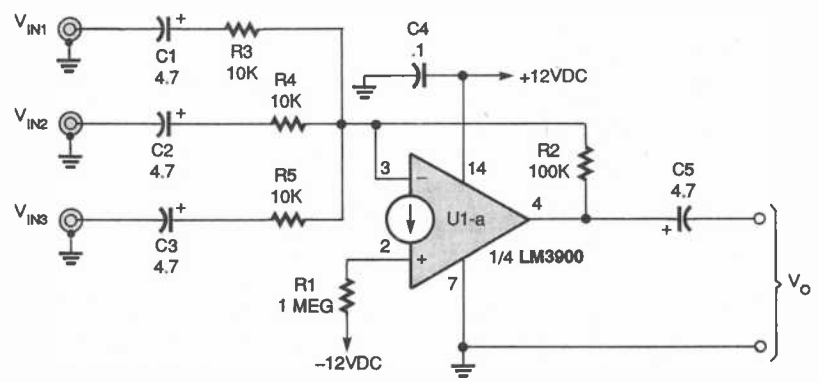


Fig. 10. This CDA-based audio mixer will take the signals from up to three channels and combine them into one channel. Once again, it is built around the LM3900.

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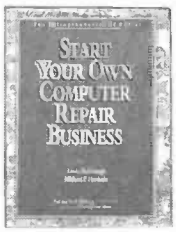

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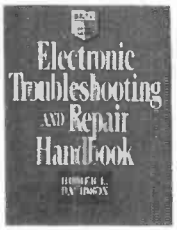

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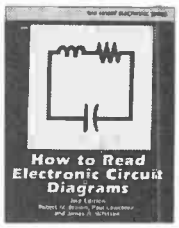

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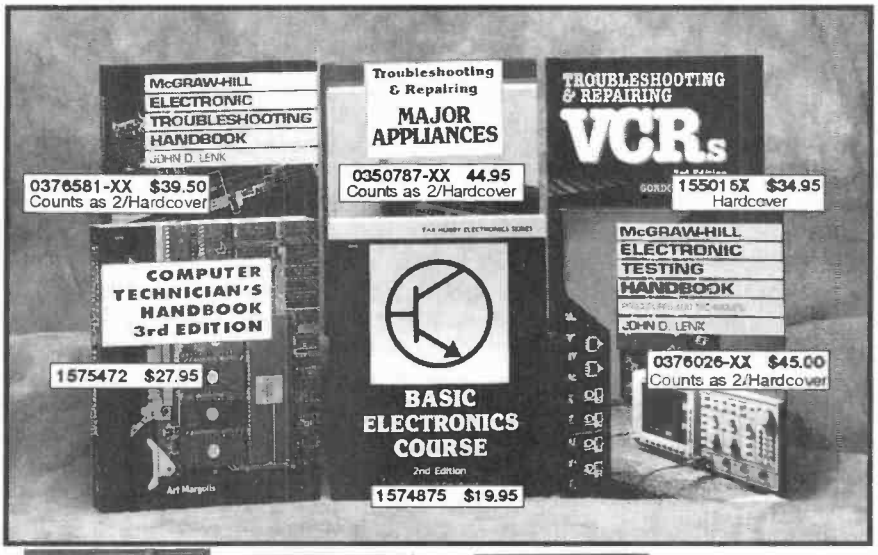

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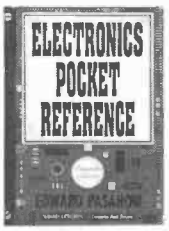

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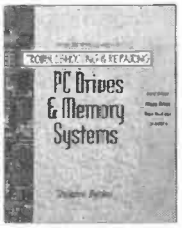

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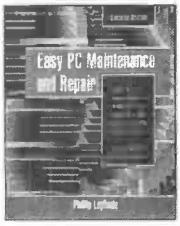

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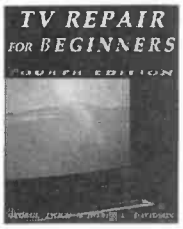

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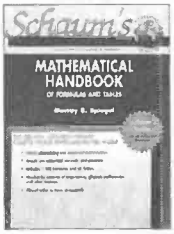

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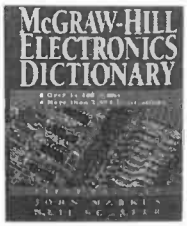

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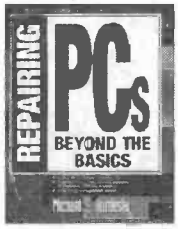

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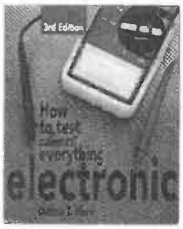

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BUILD THE GUITAR TRACK JAMMER

Play guitar along with your favorite music, and listen to the mix on headphones.

BY ANDREW SINGMIN

All budding guitarists want to emulate their heroes. It's a fact that we all learn from imitation; therefore, playing along with your favorite guitarists is an excellent way to improve your "chops." However, let's face it, turning up your stereo and cranking up your guitar amp could bother more than a few of those around you!

The *Guitar Track Jammer* described in this article lets you play along with tapes or CDs of your favorites, mix the volumes of your guitar and the music, and listen to the output on headphones. Imagine copying the riffs of guitar legends, note-for-note, and trading searing pentatonics, "hammer-ons," and "pull-offs" with the pros.

Once you've fired up the Jammer and heard the sound, you won't believe the "presence" that can be obtained from such a simple design. Part of the reason for that is that extraneous room sounds are blocked out by the headphones. The mixed output therefore surrounds you with sound; you'll feel as if what you're playing really is another guitar track on one of your favorite albums.

Circuit Description. The schematic for the Jammer is shown in Fig. 1. Power for the circuit is provided by a 9-volt battery, B1; S1 is the power switch. Resistor R8 limits current to LED1, which is a power-on indicator.

Capacitors C6 and C7 provide decoupling for IC1, an LM386 audio amplifier. As configured here, with bypass-capacitor C8 between pins 1 and 8, IC1 has a gain of 200, which is sufficient for this application, and safe for your hearing!

The guitar input is fed into J1, a standard ¼-inch jack; the signal is then coupled to potentiometer R1 for volume control. From R1's wiper, the guitar signal passes through capacitor C1 and resistors R2 and R3. Those resistors provide an optimized isolation between the guitar's volume control and the other audio input (which we'll look at in a moment), so there is minimum loading by the guitar's controls. The guitar signal then ties to shunt-capacitor C2 to prevent RF breakthrough at the input, and is input to pin 2 of IC1.

The audio input (which can be any mono, line-level signal) is fed to jack J3. Potentiometer R5 is used to control the volume, and capacitor C5 provides coupling. Resistors R6 and R7 prevent the guitar input feed at pin 2 from being shunted to ground.

The resulting mixed audio that is output at pin 5 of IC1 is fed to a conventional Zobel shunt network, composed of R4 and C3. That network stabilizes the audio output at higher levels. The final mono signal is then fed through capacitor C4 to headphone-jack J2.

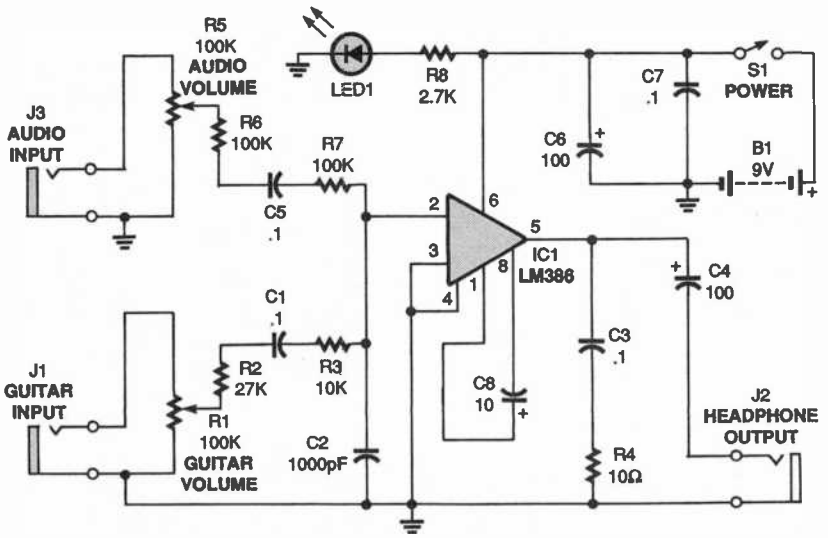
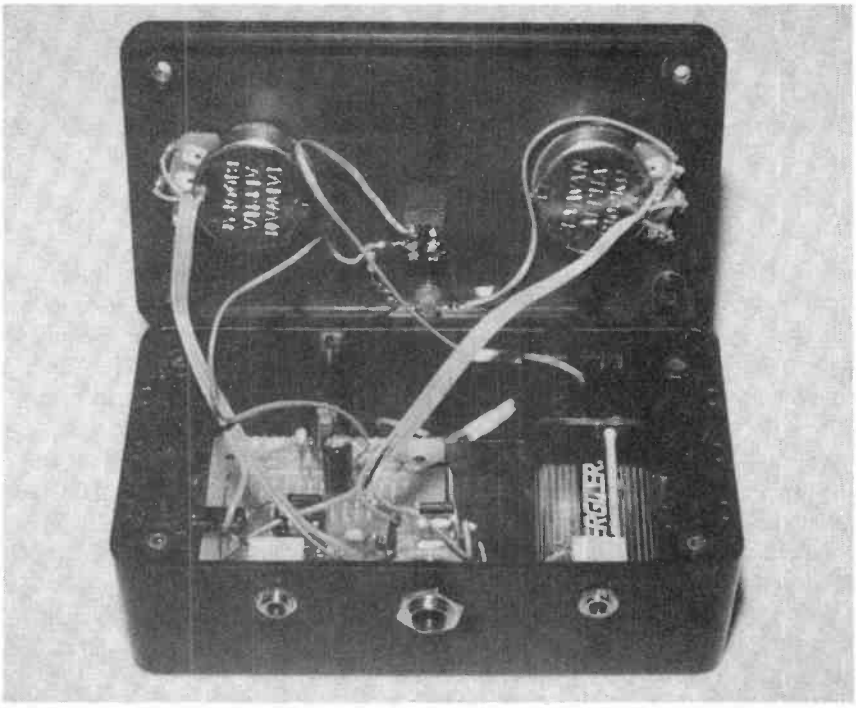


Fig. 1. To use the Guitar Track Jammer, plug your guitar into J1 and an audio source into J3, mix the two volumes using R1 and R5, and listen to the output using headphones plugged into J2.



This internal view of the author's prototype shows how it was built on a universal assembly board.

Construction. The author's prototype for the Guitar Track Jammer was built on a universal prototyping board (available from the source mentioned in the Parts List). However, the Jammer can be built using standard perforated board and point-to-point wiring, or any other standard project-building method. Due to its low parts count, the project can be easily completed in one evening.

While deciding on a layout for the project, keep the following in mind: All leads should be as short as possible, and input wires and jacks should be placed away from the output wires and jack.

Begin by mounting an IC socket to your board. Then, following the schematic, wire together the resistors and capacitors working your way away from the IC socket. Leave short leads for connections to the LED, potentiometers (which will connect to the input jacks), output jack, power switch (which will connect to the positive battery terminal), and the negative battery terminal. Twist together the audio leads into pairs for the best noise immunity; shielded wire can also be used for those connections, but is not necessary. When all those on-board connections have been made, insert IC1 into the socket.

Next, mount the jacks, switch, and potentiometers to a suitable-size enclosure. Make the connections from those components to the appropriate leads. Then, wire a battery snap to the switch and the negative power lead you already wired to the board.

Connection Modifications. If you want to use the Jammer with any stereo equipment you will have to make some modifications to the latter. That is because the inputs and outputs of the Jammer are mono; therefore, any plugs connected to the unit must also be mono types.

For starters, there's your audio source. If you are using a CD player or tape deck, you will most likely have a stereo output. A trip to a store like Radio Shack will solve that problem; you can easily find a stereo-to-mono adapter. Or, you could cut a stereo cable and make one end of it mono by connecting the two signal wires to one terminal of a mono jack, and the ground wire or wires to the other terminal.

You will have to make a similar modification to the headphones you use with the unit—low-cost types are fine for this application. Either get an adapter or cut the cable and add a mono jack.

Checkout and Use. Examine the wiring of the circuit, comparing it to the schematic. If it looks okay, attach a battery to the snap. Use a standard guitar cable to connect your electric guitar to J1. Then, connect an audio source to J3 (using the cable you either made or bought), and connect your modified headphones to J2.

Turn on the Jammer and turn up the guitar's own volume control. Starting with R1 at its lowest setting, strum a chord and adjust the potentiometer until you reach a comfortable volume in the headphones. Then, turn your audio source on and, starting with R5 at its lowest setting, adjust that potentiometer. You will probably not have to turn that volume up too loud, as it should be a louder signal than the guitar. ■

PARTS LIST FOR THE GUITAR TRACK JAMMER

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1, R5—100,000-ohm potentiometer
R2—27,000-ohm
R3—10,000-ohm
R4—10-ohm
R6, R7—100,000-ohm
R8—2700-ohm

CAPACITORS
C1, C3, C5, C7—0.1-µF, ceramic-disc
C2—1000-pF, ceramic-disc
C4, C6—100-µF, 25-WVDC, electrolytic
C8—10-µF, 25-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS
IC1—LM386 audio amp, integrated circuit
LED1—Light-emitting diode, any color
J1—¼-inch phono jack
J2, J3—⅛-inch phono jack
S1—SPST switch
B1—9-volt alkaline battery
Perforated board, enclosure, IC socket, battery snap, knobs (for R1 and R5), wire, solder, hardware, etc.

Note: The following is available from Singmin Enterprises (9 Milne Crescent, Kanata, Ontario K2K 1H7, Canada): Singmin PCB assembly board (which breaks down to four 2- by 2¼-inch boards)—$25.00. Price includes shipping; check or money order accepted.

DX LISTENING

It's Time Time!

BY DON JENSEN

Late one Saturday afternoon, not long ago, I was surprised to receive a trans-Pacific phone call from an old friend and longtime DXer I'd not heard from in quite a while. During our chat, he happened to mention what a fine Sunday morning it was in Hong Kong.

I was momentarily taken aback. Despite years of listening to shortwave stations all over the world, it still gave me pause, realizing that at the very instant my watch showed 5 p.m., his indicated 7 the next morning. Time, of course. is relative. It depends on where in the world you are. When it's day here, it's night somewhere else; today in the U.S., tomorrow in Hong Kong. We know it's true, but still, some part of our mind finds this concept of multiple time zones unreal. Perhaps that's why many SWLs still have trouble with worldwide broadcasting schedules.

I thought about my wonderment when I received a letter recently from reader Joseph Lerma, of Blue Island, IL. "Would you explain the hours," he asks. "I'm new at using the UTC time and how it relates to the time here in the U.S. Could you print a chart or table showing our time and their time? Your help would be very much appreciated."

OK, Joe, here goes. Each day is 24 hours long. The earth is divided into 360 degrees of longitude. To make that fit, time changes one hour, plus or minus, for each 15 degrees of longitude we travel, east or west. We are most familiar with the four time zones in the 48 contiguous United States—Eastern, Central, Mountain, and Pacific—but there are 20 more time zones around the world.

A European SW station whose programs go out to an audience in several time zones has a problem. What does it mean to listeners in London, Louisville, or Los Angeles when the station announces that its next English-language programming will begin at 10 p.m. Whose 10 p.m. is it, anyway?

That's why international broadcasters tend to announce schedules using a standard world-time reference. Once that was called Greenwich Mean Time, the time at the 0 meridian of longitude, which happens to run through Greenwich, England. More recently, this standard has been called Universal Coordinated Time, abbreviated, from the French translation of that term, as UTC.

To convert UTC to your local-time equivalent, you must add or subtract a certain number of hours. For example, a SW broadcaster in Finland (UTC+2), where the local time is 2 a.m., may announce the time as midnight UTC. Listeners in Manhattan and Montreal, in the Eastern Standard Time (UTC-5) zone, will hear that same time announcement and note their local clock time is 7 p.m. the previous evening. Note that when your calculations take you across midnight UTC, the day changes.

As noted, Eastern Standard Time is equal to UTC minus 5 hours. Or, put another way, UTC is equivalent to EST plus 5 hours. As I frequently note in

TABLE 1

UTC to LOCAL TIME conversion chart

UTC	EDT	CDT EST	MDT CST	PDT MST	PST
0000	8 p.m.	7 p.m.	6 p.m.	5 p.m.	4 p.m.
0100	9 p.m.	8 p.m.	7 p.m.	6 p.m.	5 p.m.
0200	10 p.m.	9 p.m.	8 p.m.	7 p.m.	6 p.m.
0300	11 p.m.	10 p.m.	9 p.m.	8 p.m.	7 p.m.
0400	12 Mid	11 p.m.	10 p.m.	9 p.m.	8 p.m.
0500	1 a.m.	12 Mid	11 p.m.	10 p.m.	9 p.m.
0600	2 a.m.	1 a.m.	12 Mid	11 p.m.	10 p.m.
0700	3 a.m.	2 a.m.	1 a.m.	12 Mid	11 p.m.
0800	4 a.m.	3 a.m.	2 a.m.	1 a.m.	12 Mid
0900	5 a.m.	4 a.m.	3 a.m.	2 a.m.	1 a.m.
1000	6 a.m.	5 a.m.	4 a.m.	3 a.m.	2 a.m.
1100	7 a.m.	6 a.m.	5 a.m.	4 a.m.	3 a.m.
1200	8 a.m.	7 a.m.	6 a.m.	5 a.m.	4 a.m.
1300	9 a.m.	8 a.m.	7 a.m.	6 a.m.	5 a.m.
1400	10 a.m.	9 a.m.	8 a.m.	7 a.m.	6 a.m.
1500	11 a.m.	10 a.m.	9 a.m.	8 a.m.	7 a.m.
1600	12 Noon	11 a.m.	10 a.m.	9 a.m.	8 a.m.
1700	1 p.m.	12 Noon	11 a.m.	10 a.m.	9 a.m.
1800	2 p.m.	1 p.m.	12 Noon	11 a.m.	10 a.m.
1900	3 p.m.	2 p.m.	1 p.m.	12 Noon	11 a.m.
2000	4 p.m.	3 p.m.	2 p.m.	1 p.m.	12 Noon
2100	5 p.m.	4 p.m.	3 p.m.	2 p.m.	1 p.m.
2200	6 p.m.	5 p.m.	4 p.m.	3 p.m.	2 p.m.
2300	7 p.m.	6 p.m.	5 p.m.	4 p.m.	3 p.m.

CREDITS: Brian Alexander, PA; Ross Comeau, MA; Bill Flynn, OR; William McGuire, MD; Ed Newbury, NE; Denis Pasquale, PA; John Rogers, MA; North American SW Association, 45 Wildflower Road, Levittown PA 19057

this column as a reminder, UTC also is equal to Central Standard Time plus 6 hours, Mountain Standard Time plus 7 hours, and Pacific Standard Time plus 8 hours. But during the months of Daylight Savings Time, those are shifted one hour. Therefore, currently, in most of the U.S. where summer time applies, UTC equals EDT+4, CDT+5, MDT+6, and PDT+7.

Now let's add one more complication: The a.m. and p.m. designators often cause problems. Does 10 o'clock mean morning or night? The military, long ago, solved this by using 24-hour clock references, and so does UTC. In the 24-hour clock, 1 a.m. is 0100; 6 a.m. is 0600; 12 noon is 1200; 1 p.m. is 1300; 6 p.m. is 1800 and 12 midnight is 2400 (or 0000). Note the use of four digits and the elimination of the usual colon. Some examples: 11:55 a.m. EDT Saturday is the same time as 1555 UTC (because UTC EDT+4) Saturday. And 12:05 p.m. EDT Saturday equals 1605 UTC Saturday. 7:55 p.m. EDT Saturday is equivalent to 2355 UTC Saturday. But 8:05 p.m. EDT Saturday, only 10-minutes later, equals 0005 UTC Sunday. As Joe requested.

To help with all of that, I've included a time-conversion chart, Table 1, in this month's column. Again, note that when using the UTC date, the shaded times represent the previous evening. I suggest you photocopy that chart and post it near your SW receiver for quick reference. Or, as some DXers do, get a digital clock that displays time in the 24-hour format (or paste appropriate stickers on your regular clock face to remind you that 1 p.m. = 1300; 2 p.m. = 1400; 3 p.m. = 1500, etc.) and set it for UTC.

I hope that this has helped you, Joe, and any other readers who've had problems doping out UTC time references.

MORE MAIL

Back in February's installment of *DX Listening*, a North Carolina reader, B.C. Eckert, asked for suggestions on SWLing from his auto while commuting to and from work. He said he used his SW portable with its whip antenna but that inside the car, it didn't bring in many signals. I suggested using an add-on device such as MFJ Enterprises' MFJ-306 World Band Mobile Shortwave Converter with the car's regular AM-band radio. Now a reader, Theo Turk, Euclid, OH, offers another approach to on-the-road DXing.

Reader Turk, a ham and an electronics experimenter, says he had the same problem. "Only the stronger megawatt SW stations could be heard in the car, using my small solid-state shortwave receiver." To get around that, he uses his four-foot stainless 2-meter, ham-band, magnetic-mount antenna, though he suggests a more inexpensive approach would be to use an old CB magnetic-mount antenna, which might be found for a few dollars at a garage sale. A short length of RG58 50-ohm coax, with a UG88 BNC connector at the end, brings the "signal" into the car through a window.

Theo then soldered the connector to a small coil, about a half inch in diameter and one-inch long, salvaged from the loop antenna of an old AM transistor radio. He drilled a half-inch-diameter hole in one end of a small plastic box and, with Super Glue, mounted the coil/connector inside the box, the coil over the hole. To receive SW signals, he inserts the receiver's unextended whip antenna through the hole in the plastic box and through the coil.

"Now I am able to receive the other 99 percent of the shortwave broadcasts I had been missing previously, thanks to inductive pickup," Theo says.

Thanks for the suggestion. Others might wish to experiment with different arrangements to inductively couple the portable receiver's monopole whip to a CB or VHF ham-band antenna mounted outside the vehicle to improve mobile SWLing.

DOWN THE DIAL

What are you hearing on SW these days? Why not drop me a line listing some of your favorite recent catches on the bands. Be sure to include times and frequency, and a bit of information on the programming you heard. Here are some of the loggings others have reported:

BRAZIL—4,885 kHz. *Radio Clube do Para* is logged on this frequency at 0350 UTC with Brazilian pops and talk in Portuguese.

CANADA—6,160 kHz. *CKZN*, St. Johns, is heard here, signing on at 0957 UTC, with the Canadian national anthem, identification, and "Labrador Morning" program.

FRENCH GUIANA—5,920 kHz. *Radio France International's* South American SW relay is noted at around 0400 UTC with French-language news, political commentary, and popular music.

GUATEMALA—3,300 kHz. *TGNA, Radio Cultural,* a Guatemala City SW station, has English-language religious programs beginning at 0300 UTC. Sometimes it has a good signal.

LIBERIA—4,760 kHz. *ELWA* in this troubled West African nation is noted again at 2100 UTC with English-language messages from station staff and religious programming.

NEW IRELAND—3,905 kHz. Look for drumming and chants from *Radio New Ireland* on this Pacific island at around 1000 UTC.

SICILY—6,060 kHz. *Radio TV Italiana*, Sicily, is the only SW station on this Mediterranean island province of Italy. It is heard at around 0500 UTC in Italian, with music, identification, and frequent mention of Sicily.

TAJIKISTAN—4,635 kHz. *Tajik Radio* is likely the one heard here about 0100 UTC with news in the local language and ethnic music.

UGANDA—4,976 kHz. *Radio Uganda* is heard at about 2030 UTC with continuous African music.

ZIMBABWE—3,306 kHz. *Radio 2* is noted signing on at 0302 UTC with the national anthem, a religious program, and African pop music. It has been noted past 0345 UTC. ■

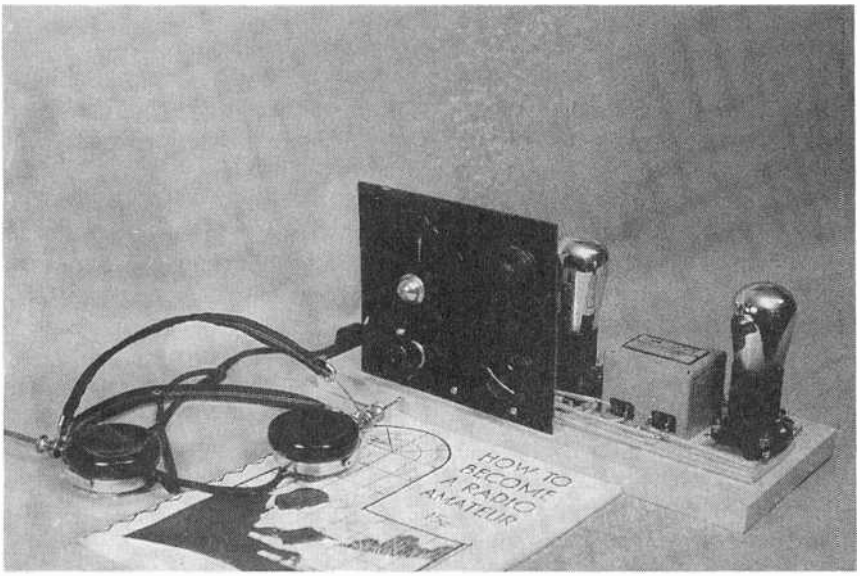
"Harry's hobby is blowing fuses"

ANTIQUE RADIO

1930's Ham Receiver Revisited

BY MARC ELLIS

Regular readers of this column know that we have just completed a recreation of the "starter" ham receiver described in the 1930 edition of the Amateur Radio Relay League's "How to Become a Radio Amateur." That project was discussed in the following columns: October and November 1995, and January through April 1996. The simple, but effective, circuit used an 01-A tube as a regenerative detector and a second 01-A as an audio amplifier.



Here John Haught gives us a still life of his elegantly built "1930's Ham Receiver" posed with the Lindsay reprint of the ARRL publication containing the original construction article.

As described in the ARRL publication, the receiver tuned the 160- and 80-meter amateur bands. The set did not employ plug-in coils, but was equipped with a fixed coil designed for 160 meters. A tap on the coil, used in conjunction with an alligator clip on a wire lead, permitted shorting out about half of the turns in order to access the 80-meter band. My own version of the set worked admirably on 160 meters, but stubbornly refused to regenerate on 80 meters.

I was delighted recently to receive a letter from reader John Haught (Aliquippa, PA). Intrigued by the coverage in this column, John decided to build his own version of the set. The result was so elegant compared with my own comparatively slapdash version of the radio that I thought I'd share it with the readership at large.

Almost in the same mail, I received review copies of a couple of new Lindsay Publications books of great interest to those who like to experiment with old-time receiver circuits. We'll also be talking about them this month.

JOHN'S SET

John built his set on a 6×14×¾-inch maple baseboard finished with polyurethane varnish. The 7-inch-wide, 6-inch-high front panel was made from a vintage ¾-inch hard-rubber blank. All major components are from the 1930's era. The dial and variable capacitor are by National, and the tube sockets are "Benjamin" brand. The audio transformer is a Silver Marshall 255.

An outstanding feature of John's set is the painstaking wiring job. In my version of the radio, the bare bus-bar wires were run point-to-point under the baseboard, being insulated only where they crossed. But John wired in true 1920's fashion—making all connections on the component side of the board and using spaghetti-covered bus bar. All wiring was parallel to the edges of the board and all changes in direction were 90-degree bends.

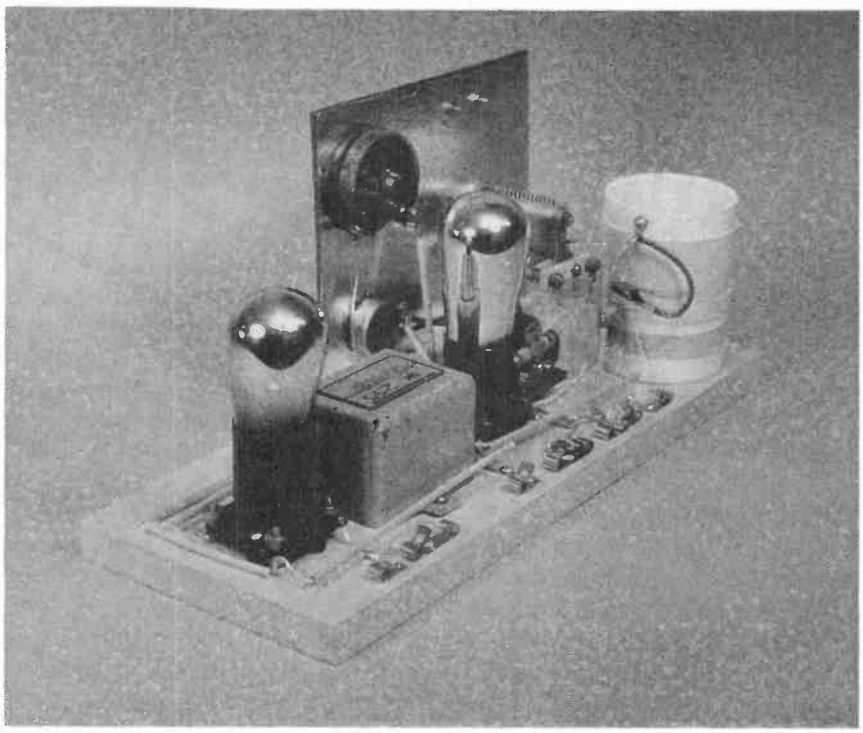
John's radio tunes the broadcast band and 160 meters instead of 160 and 80. And, he reports, it works well on both bands. He even picked up a bit of BCB DX, pulling in stations from Ohio and Tennessee at his Pennsylvania location. Unfortunately, John didn't include coil and capacitor data in his letter. All we know is that the coil form was cut from a section of PVC waste pipe and that the wire is vintage double-cotton-covered.

Maybe we can prevail upon John to let us in on the coil and capacitor specifications so that readers who want to duplicate his version of this minimal 1930's radio will be able to do so.

THE NEW LINDSAY BOOKS

As many readers know, Lindsay Publications (P.O. Box 53, Bradley, IL 60915-0538) specializes in high-quality reprints of interesting and arcane technical books from the past. In the May 1996 column we discussed the Lindsay catalog and some typical examples of the many radio-related books listed found there. Even so, as long as we are still on the subject of 1930's regenerative receivers, I couldn't resist reviewing the following two newly released Lindsay books.

Those Great Old Handbook Receivers (subtitled *Techniques of Early Vacuum Tube Shortwave Receiver Construction*—158 pages, softcover) is an extremely interesting publishing idea. Within its covers, Lindsay has reproduced the sections dealing with receiver building (and related subjects) from the 1929 and 1934 editions of the *ARRL Radio Amateur's Handbook*. The *Handbook*,



The rear view of John's set provides a glimpse of the meticulous 1920's-style wiring and PVC waste-pipe coil form.

which is still being published in yearly editions by the Amateur Radio Relay League, was generally accepted then—as now—as the radio amateur's bible of cutting-edge communications circuitry.

The two editions selected are excellent choices. The 1929 edition features regenerative circuits using battery-operated triodes (generally 01-A's and 99's)—though there are circuits incorporating the then-newly introduced, but short-lived, type-22 battery-operated screen grid tube. (The type 22 was released just as "plug-in" radios were beginning to dominate the market, so it was soon supplanted by its AC-operated counterpart, the type 24.)

Regenerative receivers, a perennial ham favorite, were also well-represented in the 1934 edition. But the variety of tube types available had mushroomed to include AC-operated triodes, tetrodes (or screen-grid tubes), and even pentodes. Accordingly, the receivers illustrated were much more sophisticated, and generally operated from AC power supplies rather than batteries. By then, the superheterodyne circuit had found widespread acceptance in ham-radio circles, and both simple and very complex designs are illustrated.(Would you believe homemade IF transformers?) Lindsay Publications is to be congratulated for making key sections of these rare handbooks accessible to today's experimenters.

I really enjoyed browsing through *Secrets of Homebuilt Regenerative Receivers*, by C.F. Rockey (127 pages, soft cover). This is a new book, not a reprint, and I'm going to recommend it highly to anyone interested in recreating early regenerative sets.

Rockey began building sets as a schoolboy in 1930—the height of the regenerative era. He received his ham license (W9CSH) in 1934, served as an aviation electronics technician during World War II, and later taught electronics and science courses at the high-school and technical-school levels.

Now retired, "Rock" is sharing his lore with the new generation of electronic experimenters. According to the publisher's blurb, "What you don't get is detailed information on building a particular set. That can be found in other books ... What you get here are all the little things that have been left out of other books, little things that can mean the difference between mediocrity and eye-popping success, especially if you're just starting out."

Why is it that building coils from vintage published data can be disappointing? What is the purpose of that mysterious RF choke in series with the headphones? What do you do if your set won't go into regeneration smoothly, but instead emits a disquieting raspy "brrrrrp"? How do you calculate the size of the tickler coil for a short-wave coil of a given frequency range? Questions like those are rarely covered in the vintage manuals and construction articles. But Rockey answers them all and more.

As an added bonus, the book also shows how many of the old circuits can be duplicated using junction field-effect transistors (JFETS) instead of tubes. Thanks for taking the time to share your considerable expertise with us, Mr. Rockey!

Current prices (subject to change) of these books are: *Great Old Handbook Receivers, $8.95*; *Secrets of Homebuilt Regenerative Receivers*, $9.95. Shipping and handling is $1.00 for the first book ordered, and $0.50 for each additional book. By the way, it should be mentioned that a reprint of

Here, reprinted from the May column, is another look at Ray Shetrone's Philco dial with the Boak Carter "signature" (see text).

the 1930 edition of the ARRL's *How to Become a Radio Amateur* (which contains the construction article on which our 1930 Ham Receiver was based) is also available from Lindsay. The current price is $3.95 plus shipping and handling (as just explained).

I GET A NEW JOB

Readers of this column might be interested to know that I've just become editor of *The Old-Timer's Bulletin* (familiarly known as the *OTB*),

continued on page 73

Radio Potpourri

BY JOSEPH J. CARR, K4IPV

Between letters forwarded by the editors of **Popular Electronics**, direct letters, and Internet e-mail (Carrjj@aol.com), I get quite a few letters. And, although some might legitimately complain that I take too long, I at least attempt to get everyone an answer. This month, I'll address some letters that I think are of general interest right here in this column.

AUDIO-FREQUENCY ANTENNA

One reader wanted to know how long a "transmitting" antenna is for audio frequencies. I presume that he meant the VLF and ELF frequencies below 20 kHz. The answer is two-fold. First, why in the world would one want to transmit on those frequencies? It's illegal, after all, except possibly for very, very low power devices that don't interfere with any established radio service. And even for that purpose the rules are pretty specific about antenna lengths . . . and they are all way, way too short for resonant operation.

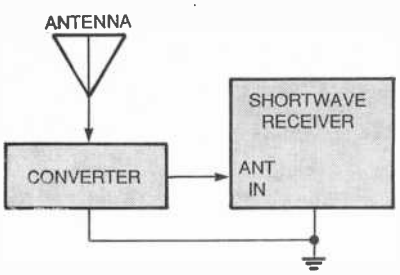


Fig. 1. Here's how an external frequency converter is hooked up to a typical communications receiver.

What is "resonant operation?" The antenna is cut for a specific frequency, *i.e.* a quarter-wavelength or half-wavelength long (certain other lengths are also resonant, but we can make the point with just those lengths). At 10 kHz, for example, a quarter-wavelength, end-fed Marconi antenna is 24,600-feet long; a center-fed, half-wavelength antenna is twice as long. In other words, the simple Marconi-style antenna is about 4.7-miles long at 10 kHz!

Some people have legitimately used such antennas, by the way. One of my novice-era "Elmers" was the late Vic Clark, W4KFC, past president of the American Radio Relay League (ARRL). Vic was also Director of the Coast Guard Electronics Engineering Laboratory in Alexandria, VA. He took a business trip for the USCG down to Peru. He was riding a train to a remote 19-kHz VLF radio station and noted a single conductor wire tacked to poles along the track. At first, he thought it was an antiquated telegraph wire, but on arriving at the station discovered that it was one section of a 19-kHz rhombic antenna that was 24-miles long on each of its four sides!

FREQUENCY CONVERTERS

Frequency-converter circuits can be used either in receivers to down-convert or upconvert RF signals to an intermediate frequency (IF), or can be used external to the receiver to provide a frequency band that isn't normally available. Figure 1 shows how the basic external converter is used with a high-frequency shortwave receiver. The antenna picks up RF frequency $f1$, and feeds it to the converter. The converter contains an oscillator (usually crystal controlled) operating at $f2$. The two frequencies heterodyne together and produce sum ($f1 + f2$) and difference ($f1 - f2$) signals. Either of those two frequencies can be used as the intermediate frequency, and tuned by the HF receiver.

I received two mail items that requested information on converters. One reader wanted to receive WWV on a ham-band receiver, while another reader, possibly responding to some of my articles on VLF radio, wanted to convert 10- to 100-kHz signals to either a ham band or to one of the other HF bands close to the ham bands. Fortunately, both of those requests can be filled with similar circuits based on the NE-602 device.

The NE-602 is an 8-pin miniDIP converter chip that contains a transconductance-cell double-balanced modulator (DBM) and an oscillator stage. It is capable of producing oscillator signals up to 200 MHz, and receives RF signals up to 500 MHz.

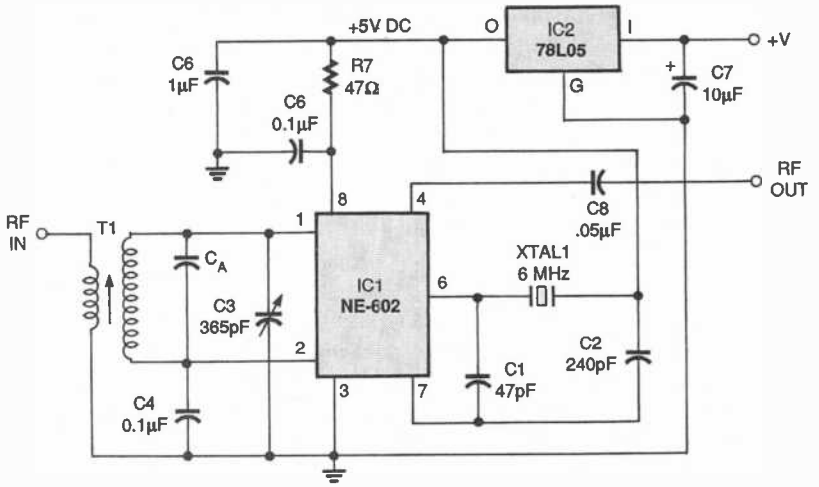


Fig. 2. This converter circuit, built around an NE-602, will translate WWV's 10-MHz signal to the 75-meter ham band.

The NE-602 can be bought from mail-order sources such as Digi-Key (P.O. Box 677, Thief River Falls, MN, 56701-0677).

Figure 2 shows the circuit for an HF-band converter that will accomplish the job of converting the 10-MHz WWV signal to the 75-meter ham band. The local oscillator section of an NE-602 is available on pins 6 (base) and 7 (emitter). In this circuit, a 6.00-MHz crystal oscillator is provided by the NE-602. Capacitors C1 and C2 form the feedback network. The junction of C2 and XTAL1 can be connected to either the +5-VDC line or ground (the former is shown here).

The frequency, 6.00 MHz, was chosen for two reasons. First, 6.00-MHz

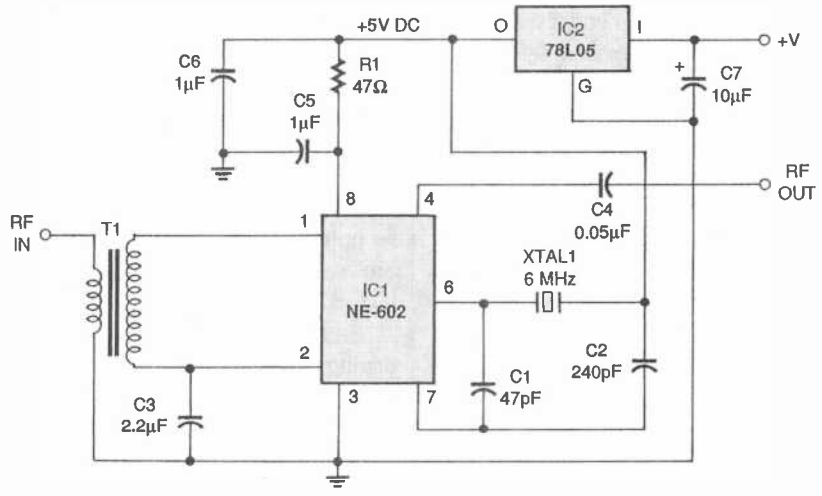


Fig. 3. This circuit is similar to the WWV converter shown in Fig. 2, except that it is used to translate VLF signals to the 6000-kHz region.

crystals are easily available. The second reason is that the difference frequency between WWV's 10 MHz and the 6.00-MHz crystal frequency is 4.00 MHz, which is found at the top end of the 75-meter ham band. Other-frequency crystals will produce other output sum or difference frequencies, so tune the receiver appropriately if something other than 6.00 MHz is used.

The output of the NE-602 is available on two complementary outputs, pins 4 and 5. In this circuit, a single DC-blocking capacitor (C8) is used as the output from either pin 4 or 5 to the receiver antenna input.

The RF input signal is applied across pins 1 and 2. In this version of the circuit, a tuned RF transformer is used as the input frequency selector. For 10 MHz, a standard 10.7-MHz, transistor-radio, FM-broadcast IF transformer is sufficient. Capacitor C_A is normally inside the transformer, and is not provided by the circuit builder. It tends to be 68 to 180 pF, depending on the inductance of the secondary winding in the particular transformer.

Normally, the secondary winding's slug-tuned core can be adjusted from 10.7 MHz down to 10 MHz without any extra work. If it doesn't tune that low, then add a few picofarads of capacitance at a time until resonance is reached (start with 22 pF in parallel with the transformer secondary, *i.e.* across pins 1 and 2 of the NE-602; more or less might be actually needed).

The NE-602 runs from a +5-VDC power source. To supply that, +9 to +15 VDC is passed through a low-power, three-terminal, IC voltage-regulator device (U2, 78L05) to produce the needed voltage.

The VLF version of the converter is shown in Fig. 3. For the sake of convenience, the circuit is the same as the previous one, except in the input section. The 6.00-MHz crystal is selected for the same reason as above, but the receiver must be tuned from 6,010 kHz to 6,100 kHz to receive the desired band.

The input circuit is a little different from what you might expect. Transformer T1 is an audio-coupling transformer. You can use a 600:600-ohm "line" transformer, or one with a step-up turns ratio. Two popular transformers for this purpose are the standard 8Ω/1000Ω transistor-radio audio-output transformer (I used a $2 cheapie from Radio Shack) and the 50Ω/600Ω or 50Ω/1,000Ω microphone transformers.

Why audio transformers in an RF project? Well, they have "good enough" response out to more than 100 kHz. Above that frequency, the response falls off very rapidly, so the transformer also serves to filter out strong local signals such as from AM broadcast-band stations nearby.

One possible problem with the circuits shown here is the fact that the 6.00-MHz local-oscillator frequency is close to the RF frequency. After all, the desired reception band goes down to 10 kHz. Most of the time, on a DBM such as the NE-602, the LO and RF frequencies are suppressed in the output, so that will not affect the receiver. But if the receiver is desensitized a little bit from the 6.00-MHz oscillator (as seen by a drop of sensitivity as you tune the receiver closer to 6.010 MHz),

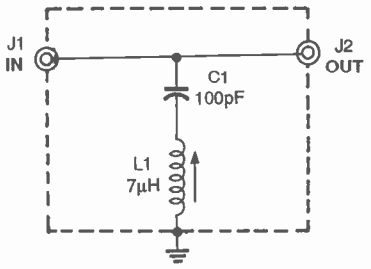


Fig. 4. If your receiver is "desensitized" by the converter's local oscillator, this 6.000-MHz wavetrap could help minimize the problem.

then you might want to try a series-tuned wavetrap such as the one shown in Fig. 4. The capacitor is any 100-pF ceramic-disc or silvered-mica unit. The inductor is a slug-tuned coil such as the 6.8-µH Toko coil sold under Digi-Key part number TK-1205-ND. The 6.8-µH inductance can easily be retuned to null the LO frequency. Some performance near 10 kHz (*i.e.* when the receiver is tuned to 6.010 MHz) will suffer, because the wavetrap doesn't have zero bandwidth, but it may well be less than the desensitization of the receiver. ■

Think Tank

And Another Winner

JOHN YACONO
TECHNICAL EDITOR
WINDOWS MAGAZINE

Well, we've got another winner, Jose Ignatius A. Alea, who's supplied lots of good circuits. (Congratulations, Jose!) He'll receive a kit, MCL1010 chip (which I covered in my first column), and book (the premium for a single submission). Before we get to his stuff, let's continue with our tutorial on capacitors, which will soon come to a close.

One capacitor that's worthy of note is the glass monolithic type. Those units are interesting because of their high reliability, low tolerance, great simplicity, fixed temperature coefficient, high-voltage capability (up to 500 volts), and low-power dissipation. They're composed of alternating layers of metal (the plates) and glass (the dielectric). That club sandwich is squeezed together under high pressure and high temperature, and then sealed in enamel or glass.

The glass monolithic units are fairly impervious to the frailties of most capacitors. Their value is stable even with age, and they can handle significant RF-current levels with little dielectric loss. All that makes them suitable for RF oscillators, filters, and linear amplifiers (up to 500 MHz). Their primary limitation is, unfortunately, capacitance range. They are typically built with values of only up to 10,000 pF.

Similar characteristics can be found in the mica family. Some mica capacitors, with mica sheets sandwiched between lead-tin plates, are similar to glass units in structure. Silvered-mica capacitors, on the other hand, are made of silver-coated mica sheets layered together. Like glass units, they can also handle high voltages, absorb little power, have excellent tolerance over changes in frequency and temperature, and do not suffer from the ravages of time. Their accuracy makes them suitable for use in RF filtering, bypassing, coupling, and delay lines. They too can operate up to 500 MHz, but, unlike glass units, mica capacitors can be made up to 0.1°F, with voltage ratings up to 2500 volts.

The only drawback of mica capacitors is something called "ion migration." Under a combination of high temperature, high humidity, and high DC voltage, the silver can move around, changing the value or even causing complete failure.

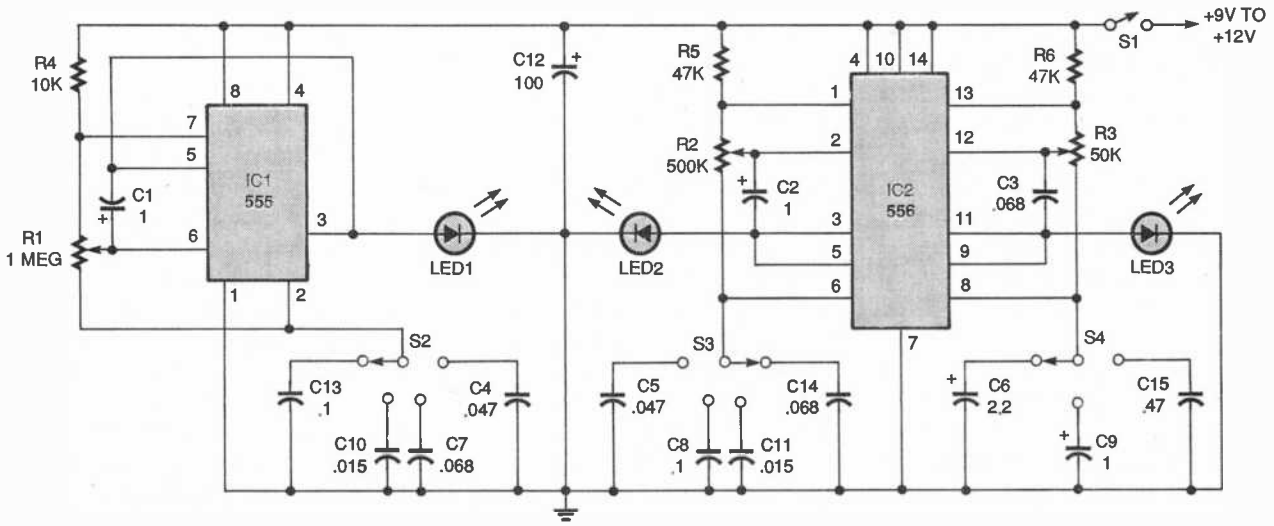
Now, let's get to those winning circuits.

LED FLASHER

While listening to music I thought to myself: "Music is composed of different frequencies blended to make pleasant sounds, why not have lights blink at different rates to entertain, too." So I decided to design a circuit to entertain my eyes while listening to music. To understand how it works, see Fig. 1.

The circuit contains 3 oscillators, one based on a 555 (IC1) and the others centered around a 556 (IC2). When S1 is on, each oscillator's LED (LED1, LED2, or LED3) will flash rhythmically according to the setting of its potentiometer (R1, R2, or R3), and the capacitor selected by its switch (S2, S3, or S4).

Each oscillator output is capable of driving up to 20 jumbo LEDs connected in parallel. Arrange the LEDs artistically to suit your taste. The circuit will operate on a battery or any 9- to 12-volt DC source. If using a 12-volt wall adapter be sure that the supply current is below 1 ampere. The 556 tends to



64 *Fig. 1. This LED Flasher lets you choose between different flashing rates, using potentiometers R1-R3 and switches S2-S4.*

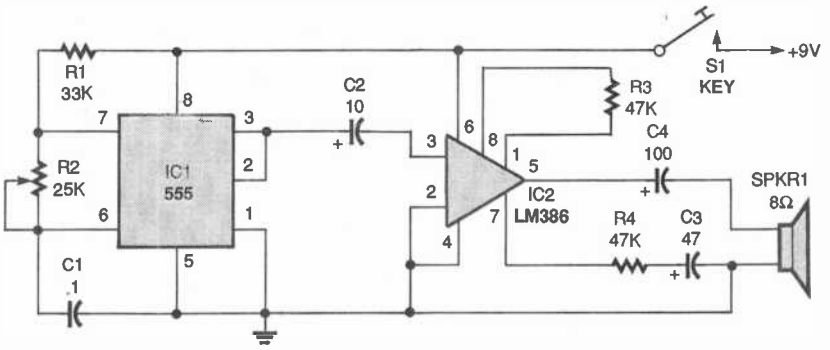


Fig. 2. Building this Morse-code oscillator will give you an inexpensive way to practice copying.

heat a little bit, but that's nothing to worry about. If you operate it for hours, use a 9-volt supply. All parts are available at Radio Shack and many other sources. Is this worth a book, John?

—Jose Ignatius A. Alea, Cebu, Phillipines

inexpensive alternative. Its parts are not expensive or numerous, but it sounds like a real Morse-code oscillator—and it's loud!

The circuit (see Fig. 2) is built around a 555 oscillator (IC1) and an LM386 audio amplifier (IC2). The 555

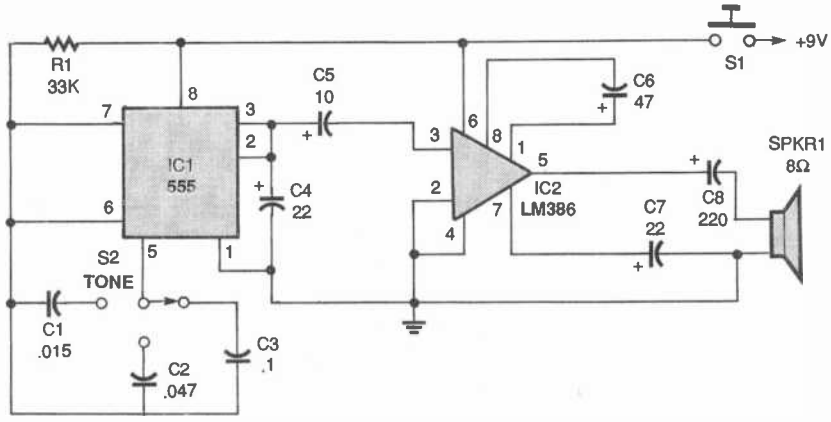


Fig. 3. Here's a three-tone generator that, depending on the switch used for S1, can be used as a burglar alarm. Switch S2 lets you select between the three tones.

It certainly is. Years ago, folks used to make a similar device by taking a bunch of neon bulbs, each in series with its own capacitor, and connecting the bulb/capacitor pairs in parallel to an AC source. The differences in the bulbs and capacitors caused the bulbs to reach ignition potential at different times, so they flashed at different rates.

MORSE-CODE OSCILLATOR

I didn't like the tone (or buzz) produced by most Morse-code practice oscillators. They seldom produce a tone like a real Morse-code oscillator, compromising the quality of the practice sessions.

Using an actual Morse-code oscillator just for copying practice is expensive, so I decided to design an

circuit is an astable oscillator, although it's wired in an unorthodox way, with the chip output retriggering the circuit.

When the key (S1) is pressed, it activates the circuit. The 555 oscillates at a frequency determined by R1, R2, and C1. Potentiometer R2 is used to adjust the tone frequency of the oscillator. Some of the output current of IC1 is coupled to IC2 via a 10°F capacitor, C2, so that it will be sufficient to drive a loudspeaker.

Because the circuit has no gain control, the volume depends on the size and wattage of the speaker. I experimented with a 230-mm, 50-watt woofer and it sent out a loud tone. For my permanent speaker, however, I use an 8-ohm, 5-watt speaker that is best for low-volume tones, but of course you can use any low-wattage speaker you have.

I'm using the circuit to prepare for the Radiotelephony license exams. The components used in the oscillator are readily available.

More power to the magazine and to you, too.

—Jose Ignatius A. Alea, Cebu, Phillipines

I remember the sound of an old practice oscillator I had as a kid. It was just like a door buzzer in an old tenement building. I'm sure what you've done is a lot nicer.

THREE-TONE GENERATOR

The three-tone generator in Fig. 3 makes a great warning device. It has a lot of uses; for example, if the appropriate switch is used for S1, the circuit can be used as a burglar alarm.

When S1 is pressed it turns on the circuit. The tone frequencies depend on resistor R1 and capacitors C1 through C3. Switch S2 lets you select between those capacitors. Capacitor C1 produces the highest frequency because it has the lowest capacitance, while C3 generates the lowest frequency.

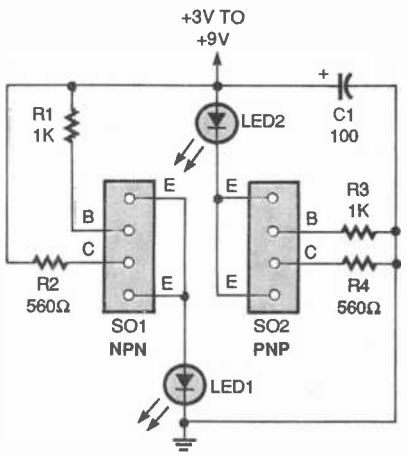


Fig. 4. When a good T092 transistor is placed in the carrect socket of this tester, the circuit turns on according to the kind of transistor being tested.

Output-pin 3 of IC1 (a 555) charges C4. That capacitor determines how long it will take before the oscillator is retriggered via pin 2. Increasing the value of C4 will decrease the frequency of the generator, and decreasing the value will increase the frequency.

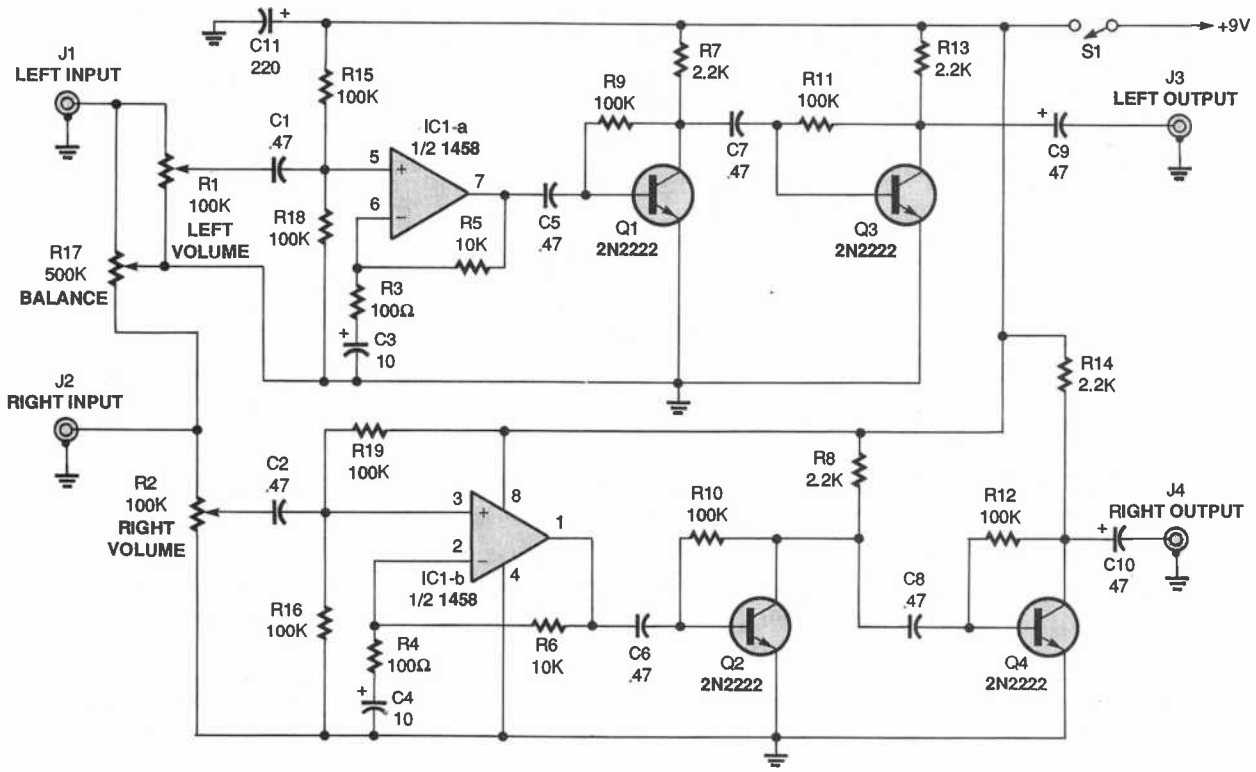


Fig. 5. This stereo amp can be used with a Walkman or portable CD player, and a pair of speakers, to provide a room-full of sound.

An LM386 (IC2) is used to increase the gain of the generator.

—Jose Ignatius A. Alea, Cebu, Phillipines

This has real potential. If S1 is replaced by three switching devices, maybe 3 door-mat switches, each located at a different entrance, it'd make an interesting door alert for a noisy workshop.

JUNKBOX TRANSISTOR CHECKER

Checking transistors in T092 packages with a DVM is cumbersome. So, to make things easier, I designed a simple transistor checker (see Fig. 4) from parts in my electronics junkbox.

When a T092-type transistor is placed in the correct socket, if the transistor is good, the circuit turns on according to the kind of transistor being tested. For example, if a good NPN unit is tested, LED1 turns on.

Note that there are 2 emitter positions in each socket. That is because there are some transistors that have different pin configurations. Some are EBC and some are ECB. If you don't know the configuration, you can test all the possible pin positions until an LED turns on. You'll need to know if the transistor is an NPN or a PNP type, however.

The supply voltage can be 3 to 9 volts. There's no power switch because, without a socketed transistor, capacitor C1 is the only load on the battery.

For the sockets, I used an 8-pin, mini-dip socket. The circuit is super useful and super simple too, that's why I thought of sending it to you. I have one of these on my workbench. I hope this circuit will satisfy you.

—Jose Ignatius A. Alea, Cebu, Phillipines

The circuit is definitely useful and inexpensive. I would recommend adding a switch, though. Electrolytic capacitors are pretty leaky.

STEREO AMP

The mini-stereo amp in Fig. 5 is a circuit for a Walkman, Discman, or other low-power, audio-output device. The amp can also be used as a preamp for 2 microphones if standard phono jacks are used for J1 and J2.

The output of the audio source is fed to the left and right inputs of the circuit (J1 and J2). Potentiometers R1 and R2 control the volumes of the input signals, while potentiometer R17 is a balance control. The incoming signals are coupled through capacitors C1 and C2 to the non-inverting inputs of op-amps IC1-a and IC1-b. Because IC1 operates as a single-supply amplifier, its output signal fluctuates above and below half of the supply voltage.

The output signals of the op-amps are coupled to the bases of two 2N2222 transistors (Q1 and Q2), which further amplify the left and right signals. Then, the outputs of the transistors are coupled to the bases of two more 2N2222 transistors (Q3 and Q4), further boosting the left and right signals. The transistor pairs also act as buffers.

—Jose Ignatius A. Alea, Cebu, Phillipines

Great. I'd recommend heatsinking the transistors, especially if you plan on having the circuit output significant volume levels.

Well, that's all the room we have for this month. If you'd like to submit one circuit or even a column-full, write to *Think Tank*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

COMPUTER BITS

PC Cards

BY JEFF HOLTZMAN

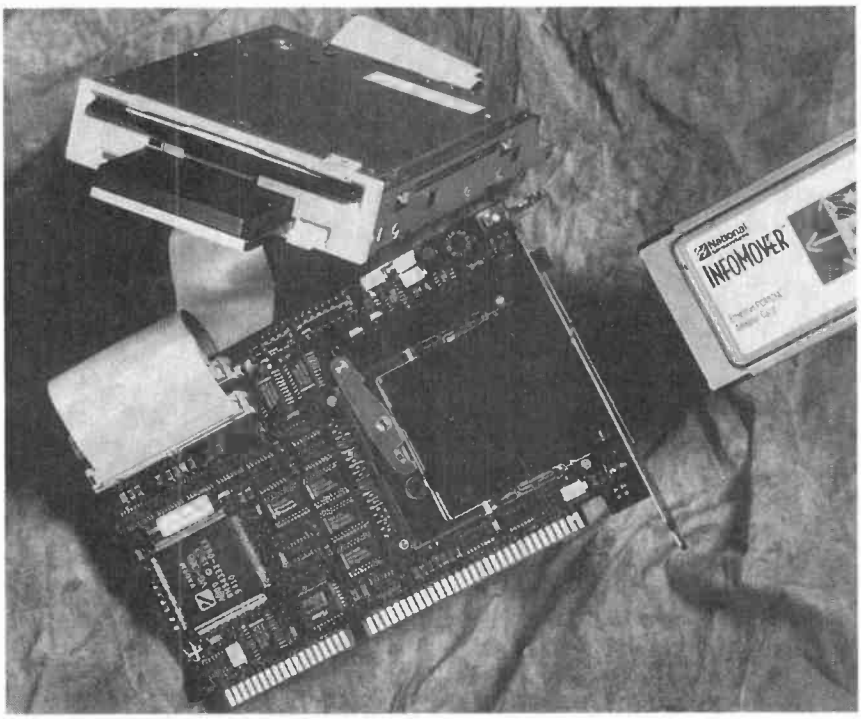
PC Cards, formerly known as PCMCIA cards, are sexy. They're about the size of a business card, and only a few millimeters thick. Compared with traditional peripheral-interface cards, they have many advantages.

The connectors are keyed, so you can't insert them upside down or backward and accidentally reverse the power connections. You'd have to work hard to hurt the connectors, as the card contains the female end, and the male end is recessed deep in the slot of the receptacle.

PC Cards were designed from the beginning to be plug-and-play. Early models had lots of compatibility problems, but those problems are decreasing, especially with the multitude of drivers and the Plug-And-Play support available in Windows 95.

There is an incredible variety of PC Cards available now. Common ones provide memory, hard-disk, Fax/modem, and network interfaces. But there are lots of special-purpose cards as well. For example, I've recently seen network routers (devices that direct network traffic) built in PC-Card format. You can buy SCSI interfaces in PC-Card size for connecting CD-ROM drives to laptops. Industrial data-collection modules are available in PC-Card format. The list goes on and on.

Running modern PC Cards on modern laptops is more likely to produce success than any combination of older cards and older laptops. I tested several modern modem and network interface cards in an old HP OmniBook 300. It's a 386-based machine with built-in DOS 5.0, Windows 3.1, Word for Windows, Excel, and some proprietary HP applications (a calculator, a planner, etc.). The version I have has a 10-MB PC Card, which it uses to emulate a hard disk. The machine also has a whopping 2 MB of RAM, an unusual built-in mouse, and a monochrome non-backlit VGA-resolution LCD screen. It was pretty hot stuff in 1992, but it's still serviceable now. I'm not about to retire it, not with current notebooks costing 50—100% more than comparable desktop units.



The SwapBox Combo from SCM Microsystems is one of a variety of devices for using PC-Card (formerly PCMCIA) devices in desktop PCs.

But getting it to do what I wanted has been painful. All I wanted was a working network connection when I was in the office, and a working modem connection while on the road. I also needed the computer to work from within the office for testing various telephone, network, and online services.

NETWORK-CARD NIRVANA

First I tried using a fancy new 3Com card with the company's "parallel tasking" architecture that is supposed to improve performance over standard cards. Unfortunately the OmniBook absolutely refused to recognize that card. Then I went to a non-PC-Card solution, a Xircom parallel-port adapter. It worked very nicely, but I wanted a cleaner solution. Eventually I learned from HP that several network cards were certified to work in the OmniBook 300.

So I purchased a card made by Socket Communications for about $200. The purchase price was painful, but the card did plug right in and work. One thing I really like is that the card comes with a cable adapter that accepts both 10-Base-2 (coax) and 10-Base-T (twisted-pair) cabling. Currently I use coax, but I plan to upgrade to twisted pair soon.

One thing I dislike is that if the OmniBook powers itself down with the network card and software installed, the machine must be rebooted the next time you power it up. Oh well, what's another <Ctrl-Alt-Delete> among friends?

MODEM MANIA

Things went much smoother with modem cards. I tried two, both of

which worked right out of the box. One is the Optima 288 V.34 Fax/modem with EZjack, made by Hayes; the other is the ProClass 288 V.34 Data/Fax Modem with EZ-Port, made by Practical Peripherals. Both devices worked fine with both DOS and Windows communications programs, connecting to a variety of public and private online systems.

The EZjack and EZ-Port connectors are interesting. With older PCMCIA modems, a special cable plugged into the card, and the telephone cable plugged into the special cable. The EZ port models have a push-in/push-out mechanism that allows you to insert a modular phone cable into the EZ "doohickey" without the special cable. Warning: the pins on those EZ ports are very fragile. One pin got caught in the end of a faulty telephone cable, which bent the pin, which eventually weakened and broke off. That was unpleasant. (By the way, there is no comparable EZ port for network interface PC Cards. They always seem to have special interface cables.)

DESKTOP INTERFACE

People traditionally think of PC Cards as being used in laptops, but there is also reason to use them in desktops. Consequently, several companies have released PC-Card adapters for desktop PCs.

I investigated several such devices. One is the CardDock, made by Greystone Peripherals. CardDock is a plastic carrier that fits in a 5.25-inch drive bay. It has two PC-Card slots mounted side-by-side. Each slot uses two pair of wide (40-pin) ribbon cables, which run back to an ISA interface card. An LED mounted by each slot indicates card activity. Each slot can accommodate a PC Card as thick as 15 mm.

CardDock also has an RJ-11 phone jack for simplifying modem connections. To use the phone jack, you connect a short jumper (not included) between your PC-Card modem and the front-panel phone jack. Then you can connect the phone cord to an RJ-11 connector on the mounting bracket of the interface card. That arrangement helps reduce cable clutter around the front of the machine.

Incidentally, an illustration in the manual suggests that you can use the phone jack for a 10-Base-T network connection, but that is not the case. That type of network connector has more pins (8) than the RJ-11 (4), and the connector is wider to accommodate the extra pins. CardDock comes with a set of drivers for use under Windows 3.1, but I just plugged and played it under Win95.

I also looked at a pair of devices from SCM Microsystems. The SwapBox Combo integrates a PC-Card slot with a 3.5-inch floppy-disk drive. The SwapBox Plug 'n Play resembles CardDock. It contains two stacked PC-Card slots. The lower slot accepts a 5-mm card; the upper slot (as well as the slot in the SwapBox Combo) accepts 10-mm cards. Installation of both devices was completely plug-and-play under Win95 running on a custom-built clone. Both devices interface via an ISA card to which one 50-conductor ribbon-cable per slot runs. Cabling is tight, but it works.

SCM has a wide variety of configurations, whereas Greystone has but a few. The SCM units I examined had more solid mechanical construction than the Greystone, but the Greystone unit is less expensive. The rear-panel modem connector of the Greystone unit is a nice feature, unmatched by anything currently in SCM's line.

The bottom line is that if you need to share mass storage or peripherals between a desktop and a laptop, a unit from either company can fill the bill, especially if you're running under Win95. NT and OS/2 users should also experience no trouble. ■

VENDOR INFORMATION

Greystone Peripherals Inc.
130-A Knowles Drive
Los Gatos, CA 95030

Hayes Microcomputer Products, Inc.
P.O. Box 105203
Atlanta, GA 30348

Practical Peripherals
375 Conejo Ridge Ave.
Thousand Oaks, CA 91361

SCM Microsystems
131 Albright Way
Los Gatos, CA 95030

Xircom
2300 Corporate Center Drive
Thousand Oaks, CA 91320-1420

RUNNING LIGHTS

(Continued from page 44)

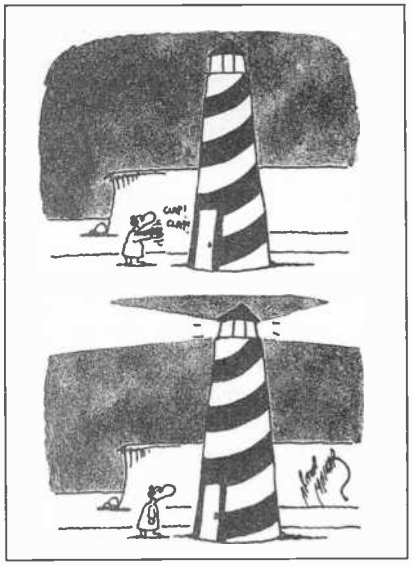
vehicles have two wires, one for the starter and the other for the electrical system. Choose the smaller of the two wires to make the connection. Solder the splice and insulate it with electrical tape.

Next locate any wire in the vehicle's engine compartment that is energized with +12 volts *only* when the ignition switch is on. That can easily be determined with a voltmeter. Splice the wire labeled "IGN" to that wire you just located. Solder the connection and then insulate it with electrical tape, as before.

Finally, connect the wire labeled "GND" to any metal part of the vehicle, such as under the head of a screw that threads into metal. Make sure when you tighten such a screw that you don't strip the threads. Add a blob of solder to secure the connection.

With your DRL circuit installed, reconnect the ground lead of the battery. Then start the vehicle and note that the headlamps are partially illuminated. Adjust R1 for the desired amount of brightness. Remember, there should be sufficient illumination so that the lamps will be visible in full sunlight. Turn the engine off; the lights should extinguish.

With that test and adjustment completed, your vehicle is now equipped with Daytime Running Lights. But don't forget the number-one accident precaution in any car or truck—the driver. Be sure to drive safely! ■



Circuits for Gardeners

BY CHARLES D. RAKES

Joe, a local college student, came by a short time ago looking for some help in building an automatic watering system for a small-scale hothouse operation he was putting together. He needed a circuit that could sense the moisture content in the soil and one that automatically adds water when the moisture level drops below a preset value. I thought that our readers—especially those who like to do a touch of gardening—might also find the circuits I came up with useful, so I decided to share them with everyone.

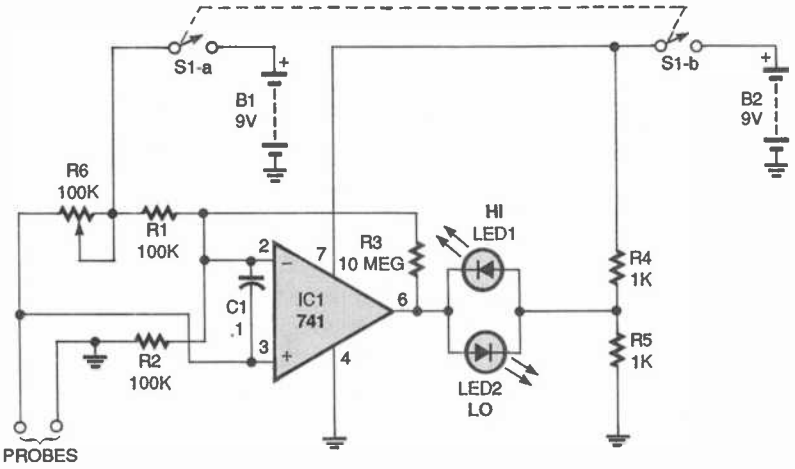


Fig. 1. The state of the two LEDs in this soil-monitoring circuit tells us the relative moisture of the soil.

MOISTURE MONITOR

The first thing Joe needed was a simple method to monitor the soil's moisture content. Take a look at Fig. 1 and you'll see a bridge circuit that's designed to measure resistance that's been adapted to perfectly fit this application.

In the circuit, when the value of R6 equals the value of the resistance of the soil between the two probes, the bridge circuit is in balance. To set up the circuit, bring the soil you wish to monitor to the proper moisture level and insert the two probes into that soil. Then adjust R6 until the two LEDs are both off, or at least dim to the same level.

When wired as shown, the two LEDs serve as a null indicator. That is, LED2 is on when the ground resistance is higher than the preset resistance value of R6, and LED1 is on when the ground resistance is lower than the preset value. When both LEDs go dark or dim to the same brilliance the bridge circuit is in balance. At balance, the setting of R6 equals the ground resistance.

The probes, see Fig. 2, are two 6-inch by $^1/_{16}$-inch, round, stainless-steel rods mounted about 1-inch apart in an insulated handle. A wire is attached to each rod, and each wire connects to the circuit, as shown in Fig. 1. The length and diameter of the rods are really not critical, so use what you have available.

VALVE CONTROL

Our first moisture-detection and control circuit, shown in Fig. 3, turns an electric water valve off when the soil's moisture content reaches a preset level. A positive 12-volt source is connected to one of the probes and the other probe is tied to the base of Q1. Resistor R4 is used to set the sensitivity.

When the moisture is below the preset level, Q1 is off and Q2 is on, pulling the relay in, which in turn supplies power to the water valve. As the moisture around the probes increases, the ground resistance between the two probes decreases until enough current flows into the base of Q1, turning it on and Q2 off. The relay then drops out, power is cut to the valve, and the water flow ceases.

The probes for the control circuit can be assembled like those in Fig. 2, or you can use two stainless-steel rods without the insulated holder. One advantage of using separate rods is that the location of each probe could be better positioned for a desired moisture-coverage pattern. Also, for moisture sampling at a given depth the probes can be insulated with shrink tubing down to within about one inch of the end.

AC VALVE CONTROL

If the probes are not made of good-quality material, electrolysis can occur, which over time can affect the circuit's operation. One way to overcome that problem is to clean the probes often or

PARTS LIST FOR THE MOISTURE MONITOR (Fig. 1)

SEMICONDUCTORS
U1—741 op-amp, integrated circuit
LED1, LED2—Light-emitting diode, any type or color

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1, R2—100,000-ohm
R3—10-megohm
R4, R5—1000-ohm
R6—100,000-ohm, potentiometer

ADDITIONAL PARTS AND MATERIALS
C1—0.1-μF, ceramic-disc capacitor
S1—DPDT switch
B1, B2—9-volt battery
Probes (see text), IC socket, wire, solder, etc.

use a circuit that operates with an AC voltage on the probes.

An AC-probe moisture detector and water-valve control circuit is shown in Fig. 4. A 24-volt center-tapped transformer is connected in an AC bridge circuit. Each half of the transformer's secondary operates as one of the two fixed elements of the bridge, with the ground resistance between the probes and R2 as the two variable elements.

The normal operation of an AC bridge circuit that's used to determine a component's value—be it resistance, inductance, or capacitance—is to balance the bridge with the variable element and read the component's value at balance on the dial. On either side of balance, the output is an AC signal that's equal in amplitude but 180-degrees out of phase.

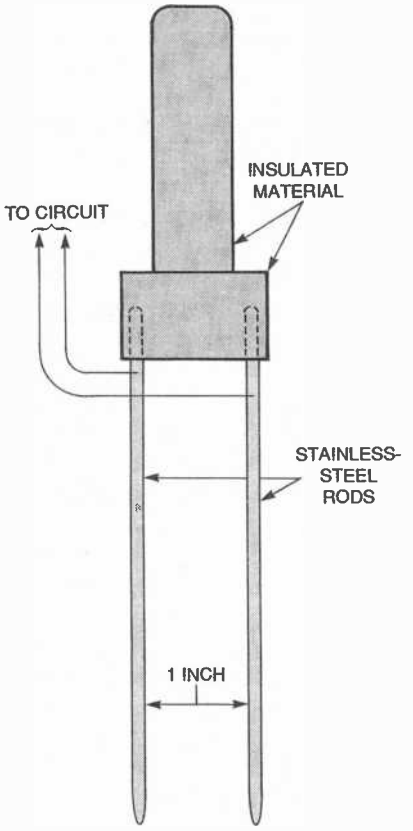


Fig. 2. This probe assembly can be used with the circuit in Fig.1, as well as other circuits in this month's column. While some dimensions are specified, they are not critical so feel free to use whatever is handy.

If a standard AC bridge circuit was used for the moisture sensor, it could only indicate when the ground resistance was equal to the preset value of R4. As the bridge became balanced, the water valve would turn off, but the water would continue to soak into the ground, lowering the resistance between the probes. That would cause the bridge to unbalance, turning the water valve back on and flooding the area. Not so good.

The circuit in Fig. 4 overcomes the problem by comparing the output phase of the bridge to the output phase of the "A" side of T1's secondary. Starting out with the probes in dry soil with a resistance much higher than the preset resistance value of R4, the relay would be operated and water would flow. Here's why. When T1's "A" secondary winding goes positive the voltage is fed to the relay through a 1N4002 diode and the LED. At the same time the output at "C" also is going positive, because the resistance value of R4 is much lower than the ground resistance, supplying current through R3 and D1 to the base of Q1, turning it on. In turn, Q2 turns on, pulling in the relay and activating the water valve.

When the resistance across the probes equals R4's preset value, the bridge is balanced and the output voltage at "C" is zero. Transistors Q1 and Q2 turn off, dropping out the relay and stopping the water flow.

As the water soaks into the soil the bridge becomes unbalanced in the other direction but the relay does not pull in. Here's why: When T1's "B" secondary winding goes positive, current can flow into the base of Q1 but no collector current can flow because the voltage at the "A" secondary winding is 180-degrees out of phase and negative. That negative voltage is blocked from passing to the relay and transistor circuitry by D2. As long as the resistance across the probes is lower in value than R4's setting, the water valve will remain off. Capacitor C1 smoothes out the pulsating DC that feeds the relay to keep it from chattering. The LED indicates when the water valve is turned on.

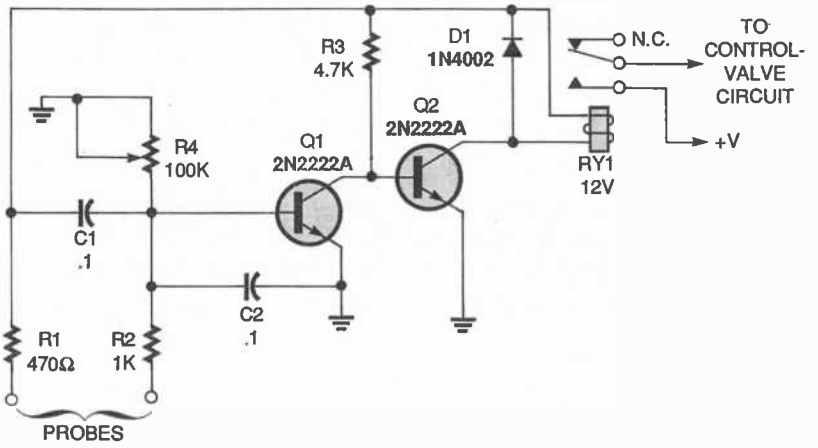


Fig. 3. This circuit builds upon the principles used in the circuit of Fig. 1 to provide automatic operation of a watering system when a dry-soil condition is detected.

EXPERIMENTER'S VALVE CONTROL

Our last entry for this visit is especially presented for all of our experimenting friends. The moisture sensor in Fig. 5 does not depend on the ohmic resistance of the soil to activate the water valve. Instead, a VLF oscillator circuit with its tuned inductor buried in

PARTS LIST FOR THE VALVE CONTROL (Fig. 3)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—470-ohm
R2—1000-ohm
R3—4700-ohm
R4—100,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS
Q1 ,Q2—2N2222A NPN transistor
D1—1N4002 silicon diode
C1, C2—0.1-μF, ceramic-disc capacitor
RY1—12-volt DC relay, normally open
Probe materials (see text), power source, wire, solder etc.

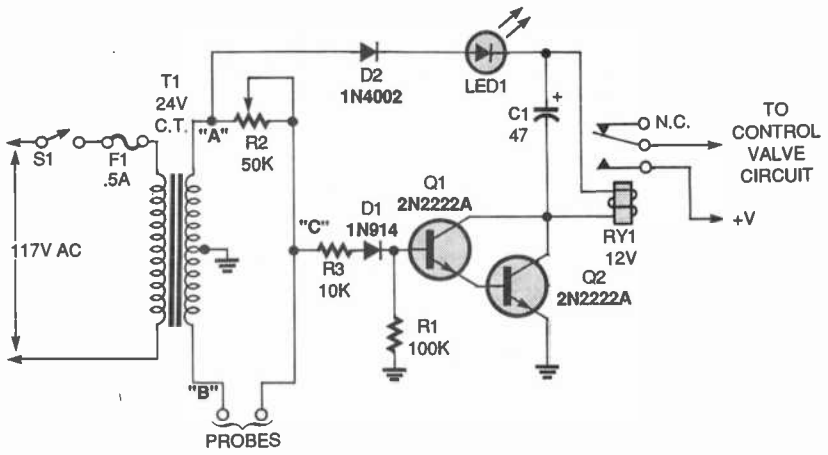


Fig. 4. To prevent the effects of electrolysis from affecting the operation of the monitor/control circuit over time, it can be modified to operate using an AC voltage.

the soil senses the moisture content by absorption.

Here's how the circuit operates: Transistor Q2, along with L1, C3, and C4, make up a simple Hartley oscillator. The circuit oscillates at about 16 kHz. Transistor Q1, in an emitter-follower configuration, isolates the output circuit from loading or influencing the oscillator circuit. Diodes D1 and D2 convert the RF signal to DC to supply bias current for Q3, which operates the water-valve relay as long as the oscillator's output signal is sufficient to turn that transistor on. The oscillator's sensitivity to varying soil conditions is set by R6, a 10-turn trimmer potentiometer.

The inductor, L1, consists of a 100-foot length of #26 plastic-covered wire wound in a 4-inch loop and kept together with electrical tape. The loop is one area where much can be gained by experimenting. A pancake loop might be more sensitive, or a different-shaped loop might work better. Also try different oscillator frequencies. Remember, the key thing here is to experiment and have fun.

Locate the loop about 3- to 6-inches deep in dry soil and adjust R6 until the relay just pulls in. Slowly add water to the soil and watch for the relay to fall out. The circuit operates just fine in some soils and not at all in some other soil mixtures. If you don't like to experiment pass this one by, but if you do and discover ways to improve the circuit's operation let me know. You can write to *Circuit Circus,* **Popular Electronics,** 500 Bi-County Blvd., Farmingdale, NY 11735.

Well, it looks like the clock has just stoped ticking for this month. So, good circuitry for now, and we'll see you back here next time. ■

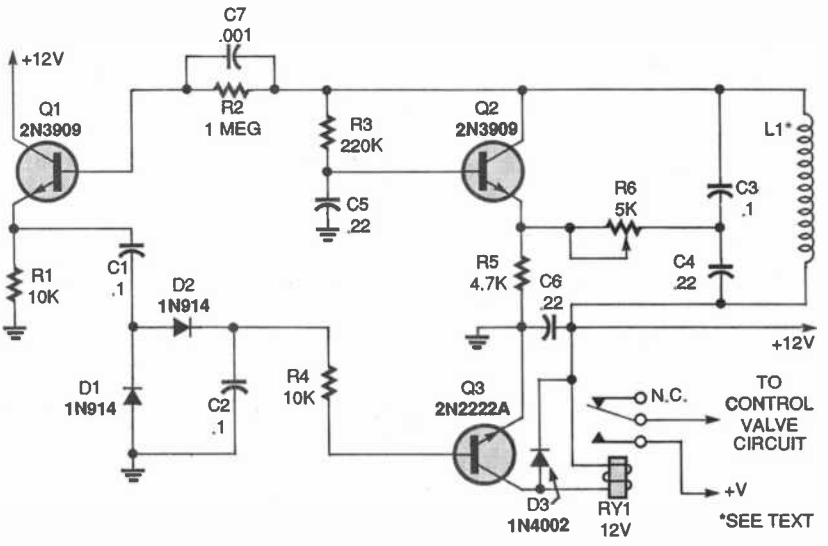


Fig. 5. If you're the type that likes to experiment, this circuit might be for you. Instead of probes, it uses a homemade inductor (see text) to sense soil moisture.

PARTS LISTFOR THE AC VALVE CONTROL (Fig. 4)

SEMICONDUCTORS
Q1, Q2—2N2222A NPN transistor
D1—1N914 silicon diode
D2—1N4002 silicon diode
LED1—Light-emitting diode, any color or type

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—100,000-ohm
R2—50,000-ohm, potentiometer
R3—10,000-ohm

ADDITIONAL PARTS AND MATERIALS
T1—24-volt , 100-mA, transformer, center-tapped
S1—SPST switch
RY1—12-volt DC relay, normally open
F1—0.5-amp fuse
Probes (see text), wire solder, etc.

PARTS LIST FOR THE EXPERIMENTER'S VALVE CONTROL (Fig. 5)

SEMICONDUCTORS
Q1, Q2— 2N3904 NPN transistor
Q3—2N2222A NPN transistor
D1, D2—1N914 silicon diode
D3—1N4002 silicon diode

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1, R4—10,000-ohm
R2—1-megohm
R3—220,000-ohm
R5—4700-ohm
R6—5000-ohm, 10-turn trimmer potentiometer

CAPACITORS
C1-C3—0.1-µF, Mylar
C4-C6—0.22-µF, Mylar
C7—0.001-µF, Mylar

ADDITIONAL PARTS AND MATERIALS
L1—see text
RY1—12-volt DC relay, normally open
Wire, solder, etc.

SCANNER SCENE

U.S. Coast Guard Communications

BY MARC SAXON

Take one look at *Uniden's BC-9000XLT* and you'll know it is intended for the more advanced scannist. Not that the BC-9000XLT is difficult to operate, but it has sophisticated features that beginners and casual listeners would never use. Basically, the set has 500 memory channels set up in 20 banks of 25 channels each. It can receive practically every frequency between 25 MHz and 1300 MHz. The gaps are 550 to 760 MHz (the UHF-TV channels) and the two cellular bands (which cannot be user-restored).

The classy Uniden BC-9000XLT offers such sophisticated provisions as 500 memory channels, 20 priority channels, and auto-store, and data-skip features.

The BC-9000XLT has a keypad for entering frequencies, but also offers a rotary tuning knob that permits manual exploration of bands. The set scans at up to 100 channels per second, and when searching the VHF band, the operator can select either 100 or 300 frequencies per second. The unit receives NFM, WFM, and AM, with provisions for the operator to modify the default setting.

Getting into the unit's more exotic features, we find no less than 20 available priority channels. An auto-store provision searches out and stores frequencies to available memory slots, then returns to search for more active frequencies. Stored frequencies can be moved to open channels in other banks. Programmed frequencies are automatically stored within each bank to allow the fastest scanning. A "data skip" feature can be switched on to let the unit skip over unwanted data transmissions (it also cuts down on birdies). The BC-9000XLT has a nice LCD readout with large alphanumeric characters.

Add to those features the optional CTCSS tone board, and you end up with a serious and impressive piece of intercept hardware. It's easy on the eyeballs, too.

COAST-TO-COAST

Scanner owners within range of coastal areas, inland waterways, and larger lakes are usually familiar with U.S. Coast Guard communications. This time of year, when recreational boating is in full swing, the USCG is probably well known to you from its activities on 156.30, 156.80, and 157.10 MHz. Maybe you also have tuned in on USCG stations contacting their own vessels on 157.05. 157.075, and 157.15 MHz, or USCG Auxiliary vessels on 157.175 MHz. Those are the most popular channels known to scanner owners. There are many other, less-well-known, usually interesting, and even more action-filled channels!

The USCG becomes involved in instances when the safety and integrity of navigable waterways could be threatened by the presence of hazardous items or substances, ranging from accidental fuel spills to the transportation of explosives. When such an incident occurs, the Coast Guard swings into action. Monitor for their *Hazmat* (Hazardous Materials) operations on 162.025, 162.125, and 162.175 MHz.

U.S. Coast Guard helicopters and fixed-wing aircraft perform many search-and-rescue missions that you can easily monitor on the usual 157-MHz marine-band channels. Those communications are only half of the story, because the missions also use UHF aeronautic-band frequencies. Monitor 164.30, 164.55, 282.8, 381.7, 381.8, and 393.9 MHz for a fuller picture of USCG search-and-rescue activities.

One of the Coast Guard's most important roles is in the area of law enforcement. Besides enforcing numerous laws relating to maritime safety, the USCG is actively engaged in patrolling coastal waters, especially to intercept narcotics traffickers, and also to help enforce immigration laws.

The USCG can operate within U.S. Customs Service networks while engaged in narcotics interdiction activities. Nevertheless, the USCG also

has many of its own frequencies for use during investigative, intelligence, and enforcement activities. Those include 162.05, 162.125, 162.25, 162.325, 163.05, 163.175, 164.30, 164.55, 164.775, 165.2625, 165.3125, 165.3375, 167.90, 168.50, 171.15, and 171.3375 MHz. At times, voice scramblers are used.

Note that only a couple of those frequencies might be expected to be assigned and in use in any given area. Your best bet would be to enter all of them in your scanner and let them perk for a month or more to see which show signs of activity in your area. In any event, 282.8 and 381.8 MHz are in very wide use, and you should at least be able to count on those during SAR missions, regardless of your location.

Canadian Coast Guard? Give a listen on 157.175, 161.65, 161.825, 161.90, and 162.475 MHz.

FROM OUR READERS

Roger Vogt, of Cleveland, Ohio, writes that he has copied NFM-mode military transmissions on 262.15 MHz. He thought it was odd because he understood 225 to 400 MHz to be the AM-mode UHF military aeronautics band. Well, it is, but it's also *more* than that. From roughly 243.8 to 270.0 MHz (in 25-kHz steps), there are countless downlink frequencies from military communications satellites intermixed with the AM aeronautics communications.

Military satellites use data and voice, although they are usually sent encrypted. Still, once in a while, transmissions come through in the clear. Those are in NFM mode. It appears that Roger's intercept was from one of the U.S. Navy's FLTSATCOM birds. Nice catch!

From San Jose, California, comes a note from J.H., who mentions that the best summertime gathering in the Bay Area is the Gilroy Garlic Festival. It draws huge crowds and plenty of security personnel to keep things under control. J.H. would like to find out the best frequencies to monitor during that breathtaking event.

For starters, the best law-enforcement channel is probably 154.92 MHz because all the local agencies share it. The Festival personnel operate on 464.325, 464.575, 464.775, 464.825, and 464.975 MHz.

Paul Girard is a reader heading from Maine to the Big Apple for a visit this summer. He plans to try to find out how far he can receive when he takes his handheld scanner atop the city's tallest structures. Paul asks if the Empire State Building and the World Trade Center use frequencies that he can monitor.

The Empire State Building has personnel on 463.45 MHz, while the World Trade Center is reported to use 453.475 MHz for security, 470.5625 MHz for operations, and 470.5875 MHz for maintenance. It's anyone's guess about the reaction when Paul shows up demanding to use a scanner from those security-conscious buildings. We hope his next postcard to us isn't sent from Leavenworth!

Why not send in your scanner-related frequencies, loggings, discoveries, shack photos, and questions? Help keep us tops! Write to *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

ANTIQUE RADIO

(continued from page 61)

which is the official journal of The Antique Wireless Association (AWA). For those who might not be familiar with it, The Antique Wireless Association is a national organization whose members include a large percentage of hard-core and highly experienced hobbyists.

With this new job and my ongoing publication of *The Radio Collector*, a bimonthly journal for newcomers to our hobby, I've gotten rather deeper into the antique-radio scene than I'd anticipated when I began this column for **Popular Electronics** some ten years ago. But I love every moment of it!

Those who might be interested in joining the AWA and receiving the quarterly *Old-Timer's Bulletin* should contact Joyce Peckham, Box E, Breesport, NY 14816. Dues are $15 (1 year); $27 (2 years); $18 (1 year overseas airmail). Anyone interested in receiving a free information sheet on *The Radio Collector* may write me at P.O. Box 1306, Evanston, IL 60204-1306. But please don't use that address for correspondence relating to my articles in **Popular Electronics**! Write me c/o *Antique Radio* as indicated at the conclusion of this column.

DIAL MYSTERY EXPLAINED

Back in the May column, I mentioned that reader Raymond Shetrone (Ft. Meyers, FL) was looking for somebody to shed some light on an odd inscription found on the dial of his Philco 38-7 console. It appeared to be a very flamboyant cursive signature, and certainly didn't look like the original Philco issue.

The day before I sat to write this, an explanation was offered from a surprising source. I got a phone call from Andre Duzant, Art Director of this magazine. Andy and I were co-workers on the original **Popular Electronics** over thirty years ago. It was fun to chat with him because we don't have much opportunity to talk anymore. (I work out of my home, about a thousand miles away from the business offices of **Popular Electronics**.)

But the main reason for the call was Ray Shetrone's "mystery dial." Andy had recognized the flamboyantly inscribed name as that of Boak Carter, a well-known news analyst on New York City's station WJZ during the late 30s and/or early 40s.

Boak's program was apparently local to NYC and not carried on national network. So while he was well-known, Carter was never a really prominent radio figure. Andy's feeling is that the newscaster's career fell into decline during World War II, when the news was being delivered by such towering figures as Edward R. Murrow, Eric Sevareid, and Gabriel Heatter.

How did Boak's name get on that radio dial? We can only guess. It seems quite possible that set had actually belonged to Carter—perhaps customized for him and presented to him by Philco. Does anybody have any other ideas or information about this intriguing little mystery? Please write and let me know. As always, I can be reached c/o *Antique Radio*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

3-D VIDEO

(Continued from page 41)

What You'll See. The 10-inch, conventional, phosphor-coated, CRT that is at the heart of the prototype CRT delivers a small, but impressive demonstration consisting of about 20 different images. For example, one image is of an electron-microscope blow-up of a common light-bulb filament. Its coils seem to project two to three inches in front of the screen and, hologram-like, you can move your head and see to either side of the protruding picture.

Other computer-generated images currently available consist of rotating balls, cubes, and a mini-demo of a future arcade game. Interestingly, that demo features joystick input that moves a cross-hair from side to side among an array of colored objects. But unlike what you'll find at your local arcade, the joystick can be picked up, rotated, and moved forward and backward, causing the darting cross-hair to follow on the screen. Realistically, the cross-hair is masked whenever it passes behind any of the screen objects. "Flight Simulator" fans, hold on to your hats!

What Happens Next? It is expected that the first appearance of this equipment will be in the video arcades. With the impact that virtual reality has made in the arcades, there is a likelihood that autostereo will reap even larger profits for the game manufacturers. Even considering the remaining technical problems and the necessary manufacturing startup, these fancy new arcade machines could become available before the end of this year. Most of the major players in the video-game field have already been given a demonstration of this new approach to 3-D display.

The next likely step would be for home versions of the arcade games. While the required outlay for the new display devices would represent a significant investment for the average family, the producers of autostereo hope to ride into your house on the coattails of High-Definition Television (HDTV), taking advantage of the large-scale turnover in home TVs that HDTV could cause.

The prospects for broadcast use are the final, and most remote step. For one thing, there are still technical problems that must be overcome. What's more, broadcasters will need to invest in the multiple-view cameras necessary to transmit autostereoscopic images. Even so, if the system proves to be successful, that last step could take place sometime early in the new millennium. ■

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LED THERMOMETER

(Continued from page 46)

the circuit on a perforated board, make sure you position IC1 away from any heat source such as IC2 or the LEDs, and be sure to use thin wire (28-gauge or finer) to reduce heat conduction into the sensor. Also, make sure the IC is placed at the edge of the board. That way, a hole in whatever enclosure you use will allow it to detect air temperature in the room, and not in the unit. Finally, insert IC2 into its socket to complete on-board assembly.

Choose an enclosure for the board next. Drill holes for IC1, the ten LEDs, and S1 in that case. Mount S1 and connect it electrically to the wires you soldered to the board earlier. Connect the battery snap, as shown in the parts-placement diagram, and mount the board in the enclosure.

Calibration. Thoroughly check the wiring on your circuit board. Make sure polarity is not reversed anywhere on the board, as that could damage IC1 and IC2. If the connections look correct, set the three potentiometers at approximately the middle of their ranges. Then connect B1 to the circuit and turn the unit on.

After a few minutes of warm-up time, use a DVM, or a 1% or better analog VOM, to take the following readings. Attach the negative meter lead to ground on the board, then connect the positive lead to pins 6 and 7 of IC2. Set potentiometer R7 so the voltage reads 3.345 volts, or as close to that value as possible. That done, connect the positive lead to pin 4 of IC2 and adjust potentiometer R5 for a reading of 2.545 volts; try to make your adjustment of R5 as accurate as possible.

Next, using a standard thermometer that is known to be reasonably correct, measure the air temperature as close to IC1 as possible. (Photo thermometers for darkroom use are good for that purpose as they are usually calibrated at 68°F.) Using the temperature reading as a guide, adjust potentiometer R1 so that the proper LED for that temperature lights (if you're using bar mode, all the LEDs ranging up to the correct one should light as well).

Next, measure the voltage between pin 5 of IC2 and ground. It should read close to the value calculated in the following equation:

$$V = 0.225 + (0.04 \times T)$$

where V is the DC voltage at pin 5 of IC2, and T is the temperature in degrees Fahrenheit.

If you have no thermometer, use the following procedure to calibrate R1: Disconnect power from the circuit and remove IC1 and IC2. Then, using an accurate ohmmeter, measure the value of R3 in ohms; record that value. Connect the ohmmeter across R1 next. Set R1 so that a reading of exactly 3 times that of R3 is obtained. Reinstall IC1 and IC2, and you're done.

Here's a final thing to keep in mind: When using high-efficiency LEDs, due to leakage current a faint glow might be seen in LED1 even when it is not supposed to be lit. However, that glow should only be visible in a darkened room. If that phantom illumination is bothersome, a 10,000-ohm resistor can be connected across LED1. Incidentally, the authors find the dim glow of LED1 to be a useful "power-on" indicator. ■

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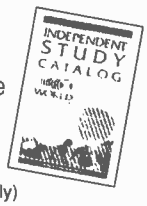

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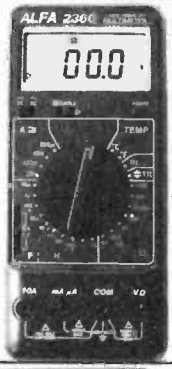

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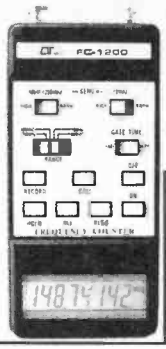

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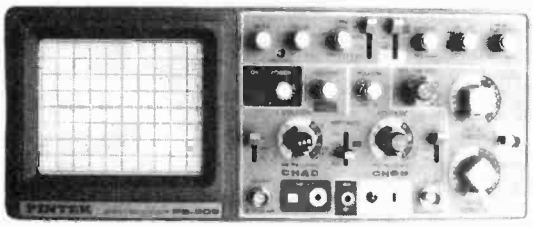

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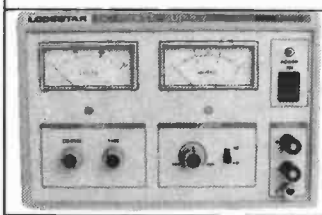

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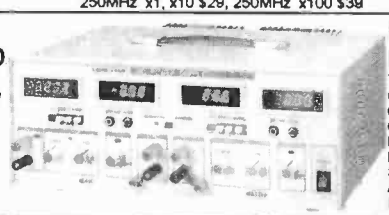

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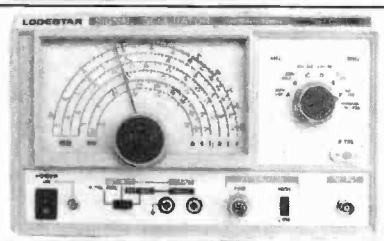

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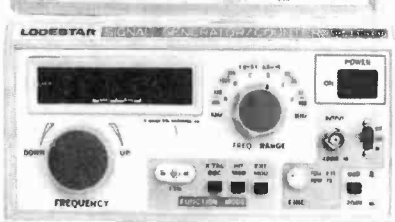

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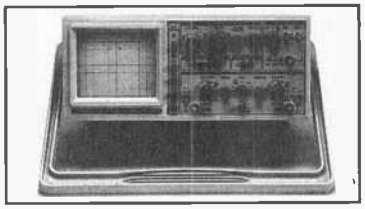

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Encompassing an extremely wide-band frequency coverage of under 1 Mhz to over 3 Ghz, the CSD-18 quickly "homes-in" on any eavesdropping transmitter and immediately pinpoints its location. The closer you get to the "bug", the further the needle moves to the right. It's as simple as that.

FULL RANGE DYNAMIC HEADPHONES

"FLASHING" LED WARNS YOU INSTANTLY!

And, for maximum telephone security, the CSD-18 automatically analyzes a pre-programmed series of electronic measurements along the telephone line and converts the analysis into an easy to follow, step by step, test procedure. No technical knowledge is required or necessary. A visual indication (via a flashing LED) immediately reveals the presence of the various types of telephone "taps" and the flashing sequence identifies the actual type of eavesdropping device.

DETECTS THE LATEST "SUPER-BUGS"

Exclusive GSS proprietary circuitry assures the utmost privacy protection possible today. The CSD-18 detects even the very latest ultra-sophisticated eavesdropping devices specifically designed to defeat detection, including sophisticated "Frequency Hoppers" and "Burst Bugs". Also includes multi-line option for testing business phones.

CONDUCT A PROFESSIONAL SEARCH...ANYTIME...ANYWHERE!

Every newspaper and magazine article and every radio and TV story discussing some new episode involving "Bugging" devices, continues to increase the ever growing demand for electronic Counter-Surveillance "sweeps" and equipment. The very limited supply of competently trained and equipped Counter-Surveillance specialists has created a situation where "sweep" rates exceeding $250 per hour are now considered reasonable and appropriate.

This is an exciting, immensely interesting and profitable field that you can enter with a minimum investment. Two hours actual practice with the CSD-18 will have you "reading" and "clearing" telephones and rooms with professional ease and competence. The average fee for "debugging" a single telephone is over $200.00 It requires about 45 minutes to complete the job and once it gets around that YOU can provide this service, you'll quickly have more clients than you can handle.
Even if you choose to provide "sweeps" for only a small number of friends and associates, your initial investment will quickly be returned many times over.

FREE WITH ORDER!

SUBMINIATURE "BODY WIRE" DETECTOR!

If you fear the possibility of being overheard and/or recorded during private conversations and require "silent" notification, we've also included our SBD-5 (regularly $225) as a FREE GIFT! Only 3" x 2" x 1", this exciting new development in micro-miniaturization will instantly detect hidden body wires at ranges up to 10 ft and alert you via a silent vibration.

BIG MONEY OPPORTUNITIES!

Also, complete information describing the fantastic opportunities now open to trained Counter-Surveillance technicians and how a number of individuals are reaping a Bonanza in this booming business! You'll learn exactly how the ever increasing use of Electronic Listening Devices by investigative agencies, government agencies, jealous suitors and unscrupulous business competitors, etc. has created huge demand for this service.

FASCINATING HI-TECH INFORMATION PACKAGE!

A detailed analysis of a variety of extremely fascinating hi-tech devices and procedures used for ultra-sophisticated audio and video eavesdropping including micro-wave and laser device monitoring; new methods for listening thru walls; all about scramblers, voice changers and exactly how neighbors eavesdrop. How missing persons are found, confidential data banks are broken into, lie detectors deceived and much more!

A comprehensive information package JAM-PACKED FULL of some of the most exciting and fascinating reading imaginable. Reads like a James Bond novel, with one important exception...IT'S NOT FICTION!

THE ONE "BUG" TO FEAR MOST!

While most individuals are now somewhat guarded in their telephone conversations, they still rather naively feel secure in the "privacy" of their own home or office. However, the most common type of "tap" presently used by eavesdroppers now picks up ALL SOUNDS AND CONVERSATION WITHIN A ROOM ... WITH THE TELEPHONE STILL ON THE HOOK!

Due to this devastating capability, this "Infinity" tap (variously referred to as Infinity Transmitter, Hookswitch Bypass, 3rd Wire, Harmonica Bug, etc.) has become the "bug of choice".

In flagrant violation of federal law prohibiting their use and sale, these devices in various forms are openly advertised in many technical publications for as little as $30. Literally thousands of these devices are now in the hands of unscrupulous individuals all over the country!

In response to this ever-growing threat, a uniquely engineered feature of the CSD-18 now also detects Infinity type devices anywhere "down the line".

In other words, if ANYONE ... ANYWHERE ... is utilizing the telephone tip and/or ring wires to monitor your private room conversations while your telephone is on the hook, you'll immediately be made aware of it via a flashing LED!

100% POSITIVE INDICATION

The CSD-18 also flawlessly detects "Series" and "Parallel" telephone transmitters and "Telephone Recording Devices". And, a separate feature silently indicates when extension phones are picked up or being used. The CSD-18 completely eliminates all doubt and guesswork.

EXCLUSIVE "LISTEN-IN" FEATURE!

The CSD-18 will even allow you to "listen-in" to exactly what the eavesdropper is surreptitiously monitoring. And, without the eavesdropper ever becoming aware that he has been detected! We are unaware of ANY other detection equipment having this combined capability AT ANY PRICE!

MAXIMUM PROTECTION

The CSD-18 detects and locates ALL major categories of surveillance equipment including:
BUMPER BEEPERS,
"BODY" TRANSMITTERS
TELEPHONE RECORDING DEVICES
SERIES & PARALLEL PHONE TRANSMITTERS
"INFINITY", MICRO-WAVE AND "LASER" BUGS
& ALL TYPES OF CONCEALED TRANSMITTERS
Including Video, Computer and Fax Transmitters

CSD-18 **$495** Complete

Includes headphones, antenna/probe, all plugs and adapters, batteries, the Free SBD-5 & Info Packages.

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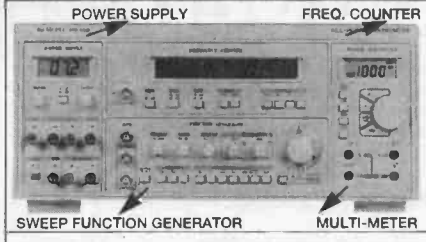


MT-100

Reg. $599.

$419.00

Four Instruments in One Instrument

1 Function Generator
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- 0.2 Hz ~ 2MHz

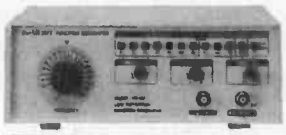
2 Frequency Counter
- 8 Digit LED
- 1 Hz ~ 100MHz
- ± (1 Hz + 1 dgt. + Time Base Error)

3 Power Supply
- 3-1/2 Digit LCD
- Triple output: #1. 0~50V, 0.5A MAX #2. 15V, 1A #3. 5V, 2A

4 Digital Multimeter
- 3-1/2 Digit LCD
- DCV, ACV, Ω, DCA, ACA
- ± (0.5% + 2 dgts)

FG-140 2MHz Function Generator

Reg. $249. **$149.00**



- 0.2 Hz ~ 2.0 MHz, 7 Decades
- Sine, Square, Triangle, Pulse, Ramp, Skewed Sine
- VCF, Symmetry
- Variable DC Offset Control

2MHz Sweep Function Gen. w/Freq. Counter

FG-150

Reg. $399. **$229.00**

- 4 Digit LED Display
- Sine, Square, Triangle, TTL, Pulse, Ramp, Skewed Sine
- Linear/Logarithmic Sweep
- 10 MHz Freq. Counter

1.0GHz Frequency Counter, High Resolution

FC-200

Reg. $399. **$219.00**

- 1.0 Hz ~ 1.0 GHz
- 8 Digit LED Display
- Auto & Manual Range
- 4 Selectable Gate Times
- 1MΩ & 50Ω Input Impedance

Oscilloscope Probe Set

Switch Selectable X1/X10

HP-9060, 60MHz Reg. $29. **$17.00**
HP-9150, 150MHz Reg. $49. **$27.00**
HP-9250, 250MHz Reg. $59. **$37.00**

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Reg. $249. **$159.00**

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- 0.1 ~ 3A
- Short & Overload Protection

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Reg. $399. **$249.00**

- 0-16 VDC
- 0.1 ~ 10A
- Short & Overload Protection

Deluxe O'scopes w/Phillips CRT. "BEST BUY!"

OS-3304 Reg. $499. $349.00

OS-3324 Reg. $599. $429.00

OS-3344 Reg. $899. $649.00

OS-3304 25MHz, Dual Trace

1 • DC to 25 MHz. Dual Channel
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 14n Sec. or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 2kV
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

OS-3324, 3 Function

1 • OS-3304

2 • Dual Component Tester/Comparator

3 • Triple DC Power Supply 5VDC, +12 VDC, -12VDC

OS-3344, 5 Function

1 + 2 + 3 • OS-3324

4 • Frequency Counter 100MHz, 7 Digit LED Display

5 • Function Generator 0.02 Hz to 2.0 MHz

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Reg. $799. **$549.00**

- DC to 40 MHz. Dual Channel
- Delayed Sweep 100nS to 1.OS 7 decade
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 8.5nS or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 12kV
- Variable Hold Off
- 16ns ~ 1.0s Time Base
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

Bel MERIT

DM5050C DM5100

Reg. $149.

$89.00

Including Deluxe Holster

Features (DM5050C/DM5100)

- Basic DCV Accuracy: ± 0.25%
- AC/DC Volt & Amp, Ohm
- Diode, Continuity Beeper
- Alligator Clip Test-Leads
- Lead Holders/Velcro Strap Holster

DM5050C, DMM + Capacitance

- 9 Function / 42 Range
- Multimeter
  - Ohm: Up to 2000MΩ
  - Amp: AC/DC 2 Amp
- Extended Capacitance Meter (9 Range)
  - 0.1pF - 20,000µF
  - Zero Adjust Knob
- Trig Lamp

DM5100, Wide Range w/Logic

- 11 Function / 45 Range
- Auto Power Off
- Data Hold & Peak Hold
- Freq: Up to 20MHz
- Amp: Up to 20A AC/DC
- Ohm: Up to 200MΩ
- Capacitance: 1p - 200µF
- Logic: TTL, TR hFE

Digital Engine Analyzer

Reg. $119. **$69.00**

DM230

- 3 1/2 Digit LCD
- Engine Analyzer Taco, Dwell, Duty Cycle
- DMM DCV, DCA, Ω
- Temperature 0 ~ 1.999°F
- Diode
- Continuity
- Holster, Temp. Probe, Clip Leads

Capacitance Meter

Reg. $79. **$49.00**

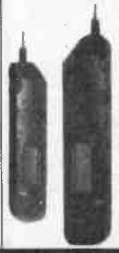
CM210

- 3 1/2 Digit LCD
- 0.1p-20,000µF 9 Ranges
- 0.5% basic Accu.
- Zero Adjust Knob
- Test Leads & Built In Socket

Pen-Type DMM w/Logic

Reg. $79. **$59.00**

DM150



- 3 1/2 Digit
- Dual Display
- Auto & Manual
- DCV, ACV, ACA, DCA, Ω
- Logic CMOS/TTL
- Data Hold
- Diode
- Continuity

Multifunction DMM

Reg. $99. **$64.00**

DM4050

- 3 1/2 Digit
- Basic Accuracy: 0.25%
- Heavy Duty, 20A AC/DC Resistance 20MΩ
- Capacitance
- Freq. up to 20MHz
- TR-hFE
- Diode
- Continuity
- Deluxe Holster

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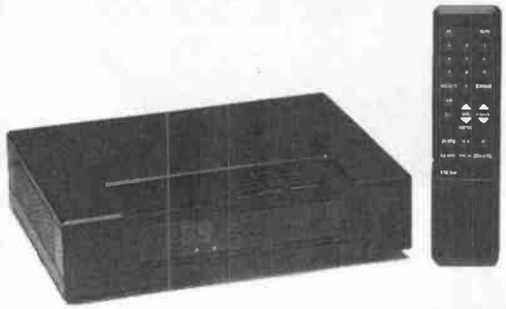

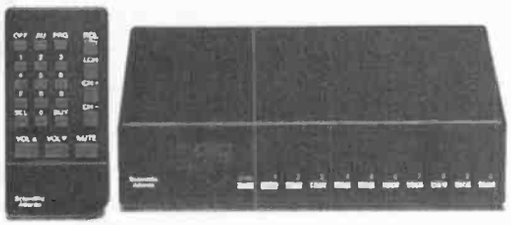

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20MHz 2-CH DUAL TRACE

$498.00

1 MHZ FUNCTION GENERATOR

Features

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

Specifications:

Vertical deflection: • Bandwidth :DC coupled (DC to 20MHz normal), AC coupled :(10Hz to 20MHz normal) • Deflection factor: 5mV/div to 5V/div in 10 calibrated steps of 1-2-5 sequence • Rise time: 17.5nS or less

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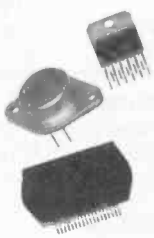
2SD-1650	SANYO	5	1.69
STRD-1005	SANKEN	1	4.15
STR-30130	SANKEN	1	2.66
STRS-6301	SANKEN	1	8.50
TA-7777N	TOSHIBA	1	6.96
TDA-2005	SGS	5	1.49



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• Designed for cleaning and degreasing consumer electronics • Cleans in one step, no rinsing required • Contains no ozone depleting compounds • CFC and HCFC free
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• 11" Long Wire Lead
• Insulated 1 1/2" Alligator Clips
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SOLDER WICK

• Solder Remover
• Length 5 Feet

85¢ Min. 2 pcs.

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The most popular

• VCR Head puller
• Retaining ring remover
• Spring hook
• Micro screwdriver
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• Dimensions: 91/2"(W) X 121/4"(L)
• 7 Assorted head & guide aligners
• 3 Reverseable screwdrivers (Small-Flat-Philips)

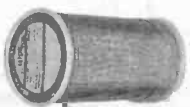
LOGIC Probe

ORDER Nº 51-1015

$8.99

• Length: 8 inches
• Range: 4.5 To 15 VDC
• Includes Test Leads • Compatible With TTL,DTL,RTL,HTL,CMOS, NMOS Logic

SOLDER ROLL



• 1 LB Spool
• 370 deg F melting point
• Fastest solder
• Alloy 60/40, tin lead, non corrosive flux, Diam. 1.2mm

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TEMPERATURE CONTROLLED SOLDERING STATION

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• Adjustable Temp.: 300°F - 790°F - 150°C - 480°C
• Grounded Tip for Soldering : Static Sensitive Devices, Heater Aid.
• Led Power Temperature Indicator
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• Auxiliary Grounded Terminal
• Comes in digital LED display
• 48 Watts soldering Iron

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• Controls basic functions of TV, VCR, cable box, and CD or laser player • Ergonomic design! Main buttons are in line with natural thumb motion • Two-minute memory allows time to replasce batteries without reprogramming • Programming reminder sticker inside battery compartment • Sleep time for 60, 30, or 15 minutes(according to your TV) • Set key recessed to prevent accidental deprogramming • Spanish instruction included. • Requires four AAA Batteries (not included)

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General

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%
Temperature Ranges:
Operating: 0°C to 40°C (32°F to 104°F)
Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery(NEDA1604)
Low Battery Indication: BAT on Left of LCD Display
Dimensions: 188mm long x 87mm wide x 33mm thick
Net Weight: 400g

DC Voltage (DCV)

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.

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Resistance (Ω)

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

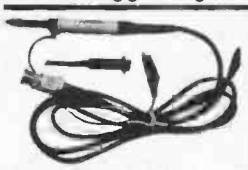
Maximum Open Circuit Voltage: 2.8V

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

Continuity
The beeper will sound when the resistance of circuit under measurement is less than 30Ω.

hFE Test
Measures transistor hFE.

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



Switchable Scope Probe Sets

(Selectable X1/Ref/X10) These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP9060) 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 Set DC~150MHz	24.95	21.95	18.62

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 185mm/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

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 185mm/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

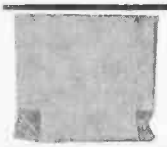
Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

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 185mm/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

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



Developer This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water.

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

Desoldering Pumps

These powerful plastic body desoldering pumps are designed for easy one hand operation for fast, efficient desoldering. Double O-ring piston seals for maximum suction.

CAT NO	DESCRIPTION	PRICE EACH 1	5	10
08-366S	Large Desoldering Pump	$15.89	$13.49	$11.95
08-366E	Regular Desoldering Pump	10.89	8.59	7.39
08-366TIP	Replacement Tip	1.95	1.95	1.95

!!!!!!! SEE OUR ON-LINE CATALOG AT http://www.cir.com !!!!!!!

Electronic Soldering System

Here's the ideal solution when **Temperature Control** is required. Easy to use slide control allows user to set system from 300°F to 840°F. Voltage to Iron from control unit is 24V Iron heating power is 48W. Replaceable 5.3mm tip is standard. Replacement irons and tips are available.

AS LOW AS $50.00

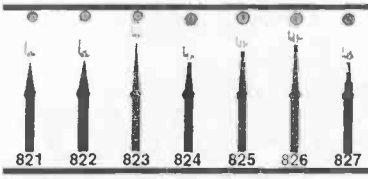
CAT NO	DESCRIPTION	PRICE EACH 1	5
SL10	Temp Controlled Soldering Iron	$56.00	$50.00
SL24V	Spare 24V Soldering Iron	10.50	7.50

Electronic Soldering System with LED Display

Deluxe temperature controlled system with LED display for maximum accuracy. Temperature is adjustable from 160°-480°C (320°-900°F). Iron heating power is 48 Watts. Runs on 24V from controller unit. Replacement irons and tips are available. Tip size is 5.3mm.

AS LOW AS $75

CAT NO	DESCRIPTION	PRICE EACH 1	5
SL30	Deluxe Soldering System w/LED	$86.00	$75.00
SL24V	Spare 24V Soldering Iron for SL10 or SL30	10.50	7.50

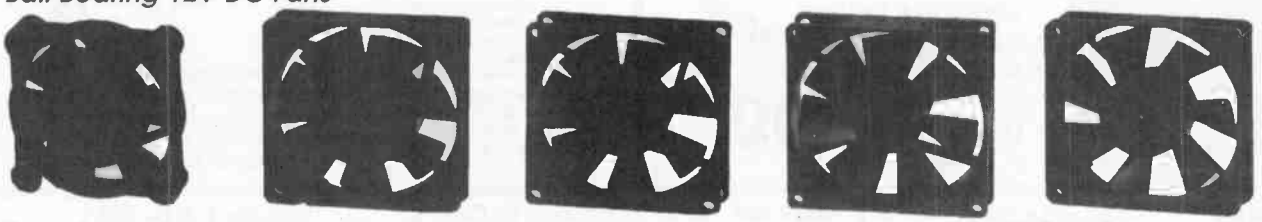


Replacement Tips for SL10/SL30

We now offer a variety of replacement tips for the SL10/SL30 soldering stations.

CAT NO	DESCRIPTION	PRICE EACH 1	5
821	1/32" Pencil Tip	$1.39	$1.19
822	1/32" Pencil Tip	1.39	1.19
823	1/64" Pencil Tip	1.39	1.19
824	1/16" Chisel Tip	1.49	1.29
825	1/8" Chisel Tip	$1.49	$1.29
826	3/64" Chisel Tip	1.49	1.29
827	3/64" Pencil Tip	1.59	1.39

Ball Bearing 12V DC Fans



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

INDUSTRY BEST PRICING!

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

Specifications

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

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

Tired of Paying Inflated Prices for Solder?

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
RH60-1	1-lb. Spool, .031", 60/40	$ 6.90	$ 5.96	$ 5.30
RH63-1	1-lb. Spool, .031", 60/40	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 $109!!***

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.

CAT NO	DESCRIPTION	PRICE EACH 1	5
CA-H34A	PCB Mounted IRCCD Camera	$125.00	$109.00

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V-1585 - 4 Channel $2095
V-1565 w/ Cursors $1795
V-1560 . . . . . $1595

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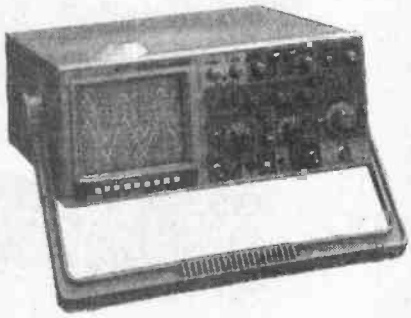
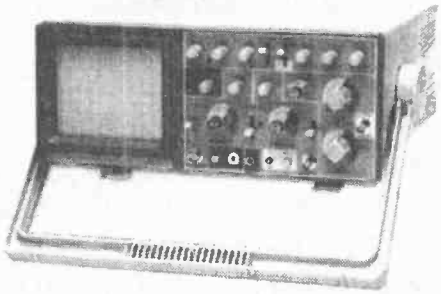
VC-6524 - Storage 20MS/s $2295
V-695 - 60MHz w/ Cursors $1549
V-555 - w/ Cursors $1095
V-552 . . . . . $949
V-509 - Battery Operated . $1795

20MHz

VC-5025A - 20MS/s DSO w/ DMM **$1160**
VC-5025 - 20MS/s DSO w/ DMM **$935**
VC-6523 - Storage 20MS/s $1995
V-252 . . . . . $449
V-209 - Battery Operated . $1425

Quality Scopes by Elenco





60MHz

DS-603 $1350
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- 20MS/s Sampling Rate

S-1365 $795
- Analog w/ Cursors

S-1360 $759
- Analog with Delayed Sweep

40MHz

S-1345 $569
- Analog with Delayed Sweep

S-1340 $489
- Analog

2 Year Warranty

25/30MHz

DS-303 $1095
- Analog / Digital Storage

S-1330 $439
- 25MHz Analog
- Delayed Sweep

S-1325 $335
- 25MHz Analog

OSCILLOSCOPE SELECTION CHART

ANALOG

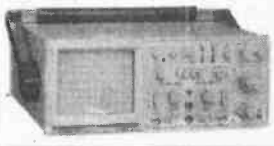
Model	Bandwidth MHz	Sensitivity (max)	No. of Channels	Sweep Rate Max ns/div	Delayed Sweep	Video Sync	Component Tester	Beam Find	Time Base
S-1365	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1360	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1345	40	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1340	40	1mV/div	2	10ns/div	No	Yes	No	No	1
S-1330	25	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1325	25	1mV/div	2	10ns/div	No	Yes	No	No	1

DIGITAL STORAGE

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

B&K Precision at Discount Prices

20MHz Analog
2120 - $389.95
2125 - $539.95
Delayed Sweep



Model 1541C
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Dual Trace

60MHz with Cursors readouts and Dual Time Base
Model 2260
$1225

Model 2160
60MHz Dual Trace
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Dual Time Base • Delayed Sweep

Model 2190A
100MHz 3 Channel
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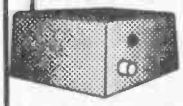
RAINBOW KITS

Many of our kits are available completely built



FM STEREO TRANSMITTER

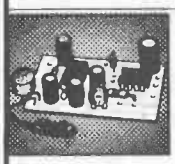
Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your CD's while mowing the lawn, Play music on one channel sing on the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

FMST-100 Cabinet $8.95 KIT $29.95

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 BUILT $29.95 KIT $12.95



SUPER SNOOPER BIG EAR

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

AA-1 BUILT $29.95 KIT $10.95

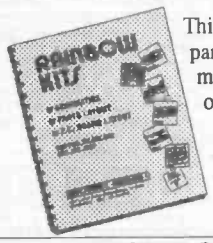
The "ZAPPER II"

With it's new and improved design it will not only test your radar detector... BUT it's tuned to the amateur radio band .

- While your out on American highways personally test yours and your fellow travelers radar detectors.

The "ZAPPER II" is a 10.450 GHz to 10.550 Transmitter

KIT $39.95 BUILT $49.95



This Manual contains schematics, parts lists & P.C. board layouts for many of the Rainbow Kits. Use your own parts to construct our kits.

KIT BOOK $14.95

$9.95 with the purchase of any kit.

WIRELESS FM MICROPHONE

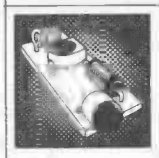
Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-2 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. includes a mini-electret mike. 6 to 12v DC.

SIZE: 1.25" x 1" WM-2 KIT $14.95

MICRO-MINIATURE PHONE TRANSMITTER

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

MMPT2 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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INCLUDES 2 AAA Batteries
PEN SIZE: Aprox. 5.5" x .5"

10 times brighter than the 670nm model!

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- Hear mere whispers at incredible distances.
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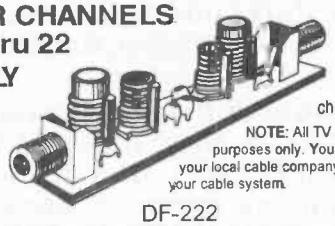
BE-1 BUILT $149.95

TV NOTCH FILTERS

FOR CHANNELS 2 thru 22 ONLY



Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep beep beep. Works on cable channels 2 thru 22) only.

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

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See our Catalog for our infamous cellphone modification guide ($69) - detailed, comprehensive, covers all makes - 10 times more info than competitor's "guide"). (Do Special Projects above to get up-to-date hardware/software).

Free Data Search: As a special **FREE** service to our C&CP customers, we will perform one **FREE** search of our massive cellphone database if requested within 30 days of your purchase of C&CP. Data now on cellphones is so great, we can fit in C&CP only that in greatest demand. Search results not guaranteed. Request by mail (don't fax); include a #10 SASE.

VOICE MAIL HACKING

How Voice Mail Box (VMB) systems are used and the specific ways they are hacked. Includes **ASPEN, MESSAGE CENTER, BIX, GENESIS, EZ, SYDNEY, PHONE MAIL, AUDIX, CINDY, CENTAGRAM, SPERRY LINK, RSVP,** etc. Absolutely required for all users, sysops and security personnel! $29.

PBX HACKING

1,000s of PBXs are hacked to the tune of $ Billions/yr! While "VOICE MAIL HACKING" details how VMSs are hacked for "phun" and profit - including VMS methods for hacking PBXs themselves - "PBX HACKING" addresses ALL issues relating to PBX hacking, including countermeasures! Can your business or agency afford a $90,000 phone fraud loss (the average loss due to hacked PBXs)? As described in Forbes Magazine. $29

PHREAKING CALLER ID & ANI

Details on how they work and dozens of effective ways of defeating Caller ID, ANI, *69, *57, and Call Blocking and *67. Also describes Caller ID, Orange, Beige, Cheese and CF Boxes, ESS, SS7, E-911, various CLASS services, CNA, NON PUB DA, CAMA, DNR, 800-ECR, Diverters, Extenders, Centrex - more. $29.

Beyond PHONE COLOR BOXES

Dozens phone color boxes described - many circuits. Plus Call Forwarding, Conferencing, Phreak History, Glossary, Diverters, Extenders, Loops, REMOBS, Bridging Heads & Cans, Optocom, 3rd Party and many other non-box methods - more. $39.

HACKING ANSWERING MACHINES

How answering machines are hacked to listen to - even erase - messages, and to convert them into mini-VMBs. And countermeasures - protect yourself from snoops, stalkers, burglars and pranksters! $29.

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Cardholders, merchants, banks suffer $ Billions in losses annually because of credit card fraud. Describes every known means of credit card fraud and scams. Protect yourself! $29.

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ATM crimes, abuses, vulnerabilities and defeats exposed! 100+ methods detailed, include: Physical, Reg. E, cipher, PIN compromise, card counterfeiting, magnetic stripe, false front, TEMPEST, Van Eck, tapping, spoofing, inside job, super-cool, vibration, pulse, high voltage - others. Case histories, law, countermeasures, detailed security checklist, labeled internal photos, figures. ATMs contain up to $250,000 in cash! Recent $350,000 ATM crime spree still unsolved! $39.

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Cons & scams and related swindles fleece Americans of $100+ Billion per year! The most comprehensive survival manual on cons & scams of all kinds - from the classic to hi-tech. Details on 100s and many variations. And countermeasures. Protect yourself! $39.

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Describes in detail how computers penetrate each other, and how **VIRUSES, TROJAN HORSES, WORMS,** etc are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary **FLUSHOT+** protection system (**Ed. Choice, PC Magazine**). BBS advice, password defeats, glossary - much more! **Manual + Disks* $39.**

Beyond VAN ECK PHREAKING

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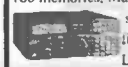

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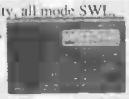

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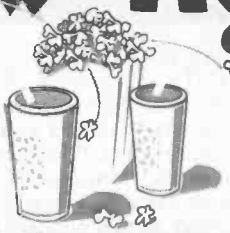

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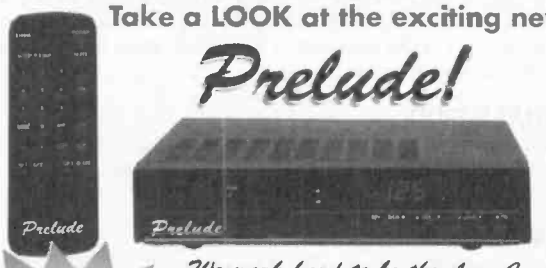

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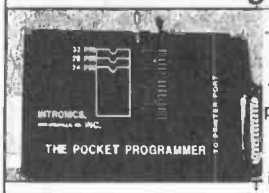

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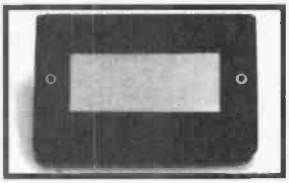

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We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but, in all cases, full payment must accompany your order.

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

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

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

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Boldface (not available as all caps),** add .40 per word additional. **Entire ad in boldface,** add 20%. **Tint screen behind entire ad,** add 25%. **Tint screen plus all boldface ad,** add 45%. **Expanded type ad,** add $2.25 per word.

General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. POPULAR ELECTRONICS is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

CONTENT

All classified advertising in POPULAR ELECTRONICS is limited to electronics items only. All ads are subject to the publishers approval. WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.

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160 – Business Opportunities	330 – Computer Software	510 – Miscellaneous Electronics Wanted	690 – Security
190 – Cable TV	360 – Education	540 – Music & Accessories	710 – Telephone
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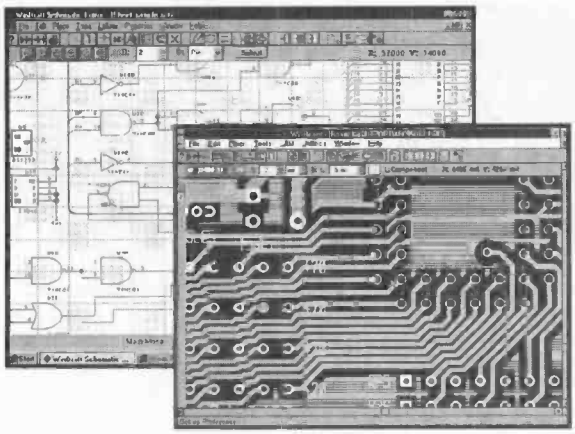

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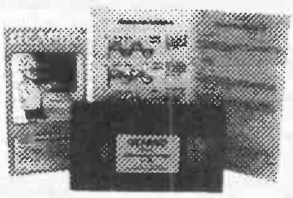

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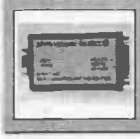

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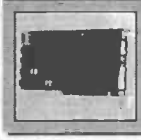

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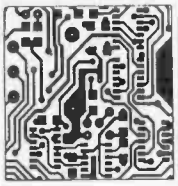

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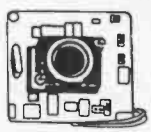

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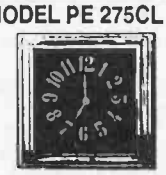

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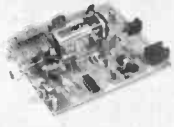

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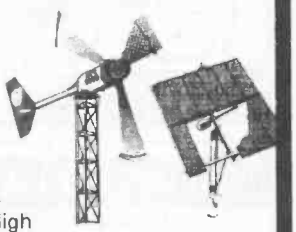

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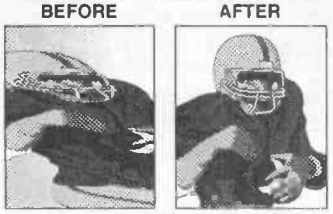

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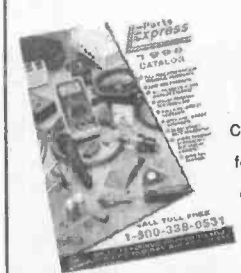

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18" satellite dish attracts thousands of cable subscribers—only $34.95 a month for access to 175 channels!

The RCA digital satellite system gives you access to over 175 channels, has crystal-clear picture quality, is compact in size, easy to install and easy to use—all at about the same cost as cable!

by Charles Anton

DSS® DIGITAL SATELLITE SYSTEM

Just about everyone has heard of satellite dishes. You can get amazing picture quality and a lot more channels. Until now, the satellite dishes were big and expensive! You wanted the great features, but not an eyesore satellite dish in your backyard and the expense involved in getting one.

Introducing the RCA satellite system, RCA realized this dilemma and created the DSS system. It features a satellite dish just 18" wide, costs about the same as cable, gives you extraordinary picture quality, access to over 175 channels and exclusive movie and sports channels options!

Three satellites. There are three satellites located 22,300 miles above Texas. The satellites receive program information from two uplink centers that then beam the signals down to your RCA DSS dish!

The 18" dish. The RCA DSS system comes with a compact 18" wide satellite dish—about the size of a large pizza—that picks up digital signals. Once installed, it never needs to move. The dish is easily connected to the side of a house, deck or balcony. Unlike larger motor-driven satellite dishes which need to rotate in order to receive satellite signals, the DSS is a fixed-dish system that gains information from the three DIRECTV satellites.

Satellite receiver. The receiver also has a compact design that blends with your other electronic devices. It receives the satellite digital information that gives you great programming.

Remote control. The remote control operates the satellite receiver, as well as RCA and most other brands of televisions. It makes finding programs an interactive experience. Locating a show will be as easy as pointing the remote and selecting a channel!

Extraordinary picture quality. It's hard to say what the best feature is about the DSS system, but the picture quality is one that is amazing. You will receive an outstanding crystal-clear picture. Your programs and shows will have a picture quality not available before. You'll never look at TV the same way again!

YOU CAN USE THE DSS SYSTEM IF...

1. You can position the 18" dish to face a southwesterly direction where the three satellites are located
2. You live in a single-family dwelling or have landlord approval
3. You live within the continental United States
4. You don't have any neighborhood zoning restrictions

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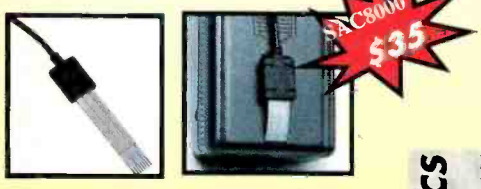

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