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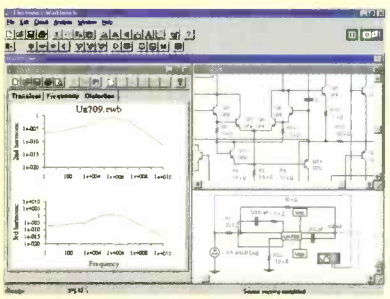

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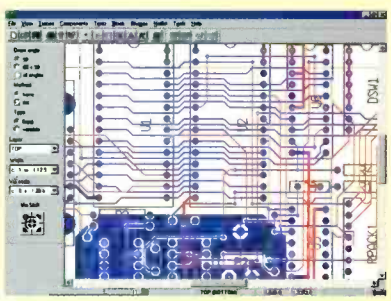

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SEPTEMBER 1998
Vol. 15, No. 9

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POPULAR ELECTRONICS (ISSN 1042-170-X) Published monthly by Gernsback Publications, Inc. 500 Bi-County Boulevard, Farmingdale, NY 11735. Periodicals postage paid at Farmingdale, NY and at additional mailing offices. One-year, twelve issues, subscription rate U.S. and possessions $24.99, Canada $33.15 (includes G.S.T. Canadian Goods and Services Tax Registration No. R125166280), all other countries $33.99. Subscription orders payable in U.S. funds only, International Postal Money Order or check drawn on a U.S. bank. U.S. single copy price $4.99.

Postmaster: Please send address changes to Popular Electronics, Subscription Dept., P.O. Box 338, Mount Morris, IL 61054-9932

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SEPTEMBER 1998

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ABC AUDITED

"Everyone in my bridge club laughed when I said I'd just installed a car alarm"

Bulldog's Car Alarm is the smallest available and features a super-intelligent microprocessor for the ultimate in security.

by Chris Murdock

She's my baby! She's my brand new, beautiful, 4-wheel drive Jeep Grand Cherokee. I've wanted a car like this for a long, long time—big powerplant, cushy seats, high-riding, power everything, with all the extras. Beautiful! But little did I know...

My beautiful Grand Cherokee is a prime target for car thieves! So are all the other SUVs (Sport Utility Vehicles) that are so popular these days. And not just SUVs, but luxury cars, sports cars, pickup trucks, sedans....if your car is expensive, somebody wants to steal it. And what car isn't expensive, these days!

So, my very first purchase for my new vehicle was the best alarm system I could find. What really surprised me was the best alarm on the market was one you install yourself.

Easy installation. I know what you're saying. "I can hardly plug in a light cord, so how am I going to install an alarm system?" I'm the same way. This alarm—the Bulldog Model 1101 Car Alarm—was designed for "no brainer" installation. There's only one wire coming out of the alarm, and it simply attaches to the positive post on the battery of your vehicle. The alligator clip makes this step extremely easy.

Money saver. Because you install it yourself, you avoid shop costs of custom installation. I saved hundreds right off the top. The other BIG saving is I can take the alarm with me when I trade cars. And having an alarm even reduced my insurance rates! The Bulldog Car Alarm offers passive arming which means that if you should ever forget to arm the alarm it will do so automatically. Most insurance companies recognize the benefit of passive arming and offer a discount on their rates.

So advanced, it "thinks." The Bulldog is a "smart" alarm. It has a sophisticated, electronic microprocessor with the ability to differentiate and do the right thing, all by itself.

Here's an example. If your car receives heavy tampering (like a broken window), the Bulldog responds instantly with a full-blown, incredibly loud siren. But if it senses a light touch—like someone trying your door handles—it emits a loud warning "chirp." Like a rattlesnake's rattle, it says, "Back off, Buddy!" If tampering continues, it escalates automatically into full alarm. After splitting eardrums for a good long while, it stops and rearms itself. Like I said: smart!

It senses a change in electrical current. So if someone turns on your dome light, by opening the door, for example, or turns the ignition, it recognizes the threat, and sounds the alarm.

What if, heaven forbid, you're inside your car and someone tries to break in? Press the "panic button" and—you guessed it—the super-loud alarm goes off. A more likely scenario: you can't find your car in the parking lot. Press the remote, and your car calls out to you with "chirps."

You know what I like best? When I leave my car, I press the remote and the alarm "chirps" loudly. It's my not-so-subtle way of telling the whole street, "Don't even think about it."

Risk Free. Your Bulldog Car Alarm comes with Comtrad's 90-day risk free trial offer. Try it, and if you're not satisfied, return it for a full refund. You also get Bulldog's lifetime limited warranty against defects in materials and workmanship. Call today!

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Editorial

The Video Revolution

Back in February, my editorial "Is Big Brother Listening to You?" dealt with the realization that it is relatively easy to listen to any audio that is being broadcast or transmitted, whether it be cellular telephone conversations, wireless microphone transmissions, or just about any two-way radio broadcasts. In this month's issue, we cover hardware and software that go one step further into the stimulation of our senses—wireless video transmission.

I am not just talking about reception of television broadcasts; I am specifically talking about the installation and use of personal video cameras over the Internet. Specifically, in our *Gizmo* column this month, we discuss the new *8×8 ViaTV Phone* that transmits one- or two-way video e-mail over an Internet link; in our *Computer Bits* column, we review the *ViCAM Digital Video Camera* while in our *Multimedia Watch* Column, we highlight all sorts of multimedia video accessories that have just come out on the market. The hardware is available—all you need is a computer with Internet access, the packaged video camera, and software.

Coincidentally or not, the theme is quite apparent—home-video transmissions have found a niche in the consumer market. A few months back I read in *Newsweek* about the extremes to which people have carried this concept. The article mentioned that one woman, Jennifer Ringley, installed a video camera in her room that captures her every domestic activity over her Web site, mundane or not, for the pleasure of "cybervoyeurs" around the world. Like the new movie *The Truman Show*, this illustrates the fascination the public has in viewing all aspects of other peoples' lives on camera. With all the attention Ms. Ringley's Web site has gotten, other similar sites are springing up, such as "AnaCam," "MeganCam," "Peeping Moe," and a host of similar home-based cybervoyeurist home videos.

But watch it! (no pun intended). What works well for the consumer works equally well for the private sector. Although the public decries the video monitoring of traffic at intersections and tollbooths or law-enforcement personnel spying on drug dealers in New York City parks with hidden cameras, this video revolution can be a mixed blessing. Right now the components are in place for Orwell's "Big Brother is Watching You" concept to be a natural by-product of present technology.

Ed Whitman

Ed Whitman
Managing Editor

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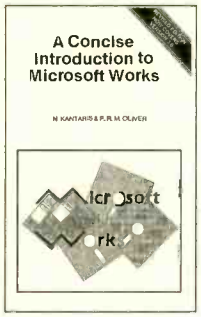

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☐ **BP345–Getting Started In Practical Electronics $8.99.** If you are looking into launching an exciting hobby activity, this text provides basic essentials for the builder and 30 easy-to-build fun projects with which every experimenter should toy. Printed-circuit designs are included to give your project the professional touch.

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The *Hewlett-Packard DeskJet 1120C Professional Series* inkjet printers offers versatile photo-quality printing, exceptional media flexibility, enhanced software features, and network options. These up-graded printers replace the DeskJet 1000C series printers, Hewlett-Packard's (HP) first DeskJet printers to print on 11- by 17-inch (B-size) paper.

Two versions of the printers are available now. The DeskJet 1120 Cse printer is sold in U.S. retail channels and the DeskJet 1120 Cxi printer is available in U.S. commercial channels. Both come with a sample of HP paper and HP PrintKits, which include value-added software.

The DeskJet 1120C printers are ideal for small-business owners and home/office users who need professional-looking black and white and photo-quality full-color printing for their communication and marketing materials. These printers can also be networked for small work groups, by attaching them to networks using HP JetDirect external print servers.

The DeskJet 1120C printers have a one-year, limited manufacturer warranty. The printer is expected to sell for $499 (U.S. street price).

Brilliant Photo-quality Printing. These printers deliver the highest-quality output offered in this series. They include the following features: Smallest ink drops in the desktop-inkjet-printer category to deliver less-visible dots; more shades of color for clear, vibrant, natural-looking results; and sharp, professional-quality black and color printing with HP-developed inks. Premium quality print-out results on all office

standard paper and outstanding results on special (slick) paper are produced.

Software Features. The DeskJet 1120C printers provide support for Microsoft Windows, NT 4.0, Windows 95, Windows 3.1x and DOS. They include 2-MB built-in ROM and 2-MB built-in RAM printer memory. The DeskJet 1120C printers have the following built-in software features: HP ZoomSmart scaling technology that allows users to enlarge or reduce a document to the desired print size, with no loss of resolution; the ability to print catalogs and booklets paginated in the proper order automatically, on any size paper, and with two-sided printing; and the option to make billboard-size posters as large as 54 inches by 40 inches. A print preview feature allows users to preview a true graphical representation of what the printed document will look like—especially effective for billboard layouts.

Performance. The DeskJet 1120C printers produce up to 6.5 pages per minute (ppm) for a black-ink text on 8.5- by 11-inch standard paper and 4.5 ppm for color. In actual print-timing tests conducted, using double-space manuscript copy with narrow margins, the 1120C printed at 5.5 ppm. This performance exceeded repeated tests on comparable laser printers that claim 6 ppm. We are impressed with the printer's speed. Also, the printers can handle documents as small as 4- by 6-inch postcards to 11- by 17-inch posters, with superior results. Because the paper feed bed is large, 3- by 5-inch cards cannot be handled.

Three paper paths permit users to print on a wide variety of media, including greeting-card stock, transparencies, envelopes, labels, plain paper, and specialty papers. The printer was put to immediate use to generate printed-circuit patterns on acetate paper. The clarity of printing on envelopes (including bar codes) far surpasses that of similar-priced laser printers.

The color-alignment process was brief and easy to perform. The Hewlett-Packard process requires a series of black and red lines to be joined for color-dot alignment. The resulting color reproductions from scanned photographs were so excellent that a scanning fault was detected in the flat-bed scanner used to generate the .jpg files.

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How to make your car invisible to radar and laser

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

by Phil Jones

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

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

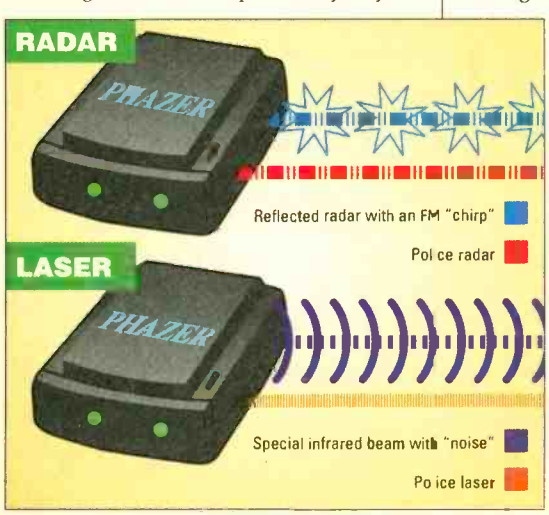
It seems that as speed-detection technology has gotten more and more advanced, speeding tickets have become virtually unavoidable. And although devices exist that enable motorists to detect these speed traps, they are outlawed in many states... including mine.

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

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

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

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



HOW TO MAKE YOUR CAR DISAPPEAR

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

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

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

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

Works with laser, too! The Phazer also protects your vehicle from Lidar guns that use the change in distance over time to detect a vehicle's speed. The Phazer uses light-emitting diodes (LEDs) to fire invisible infrared pulses through the windshield. Laser guns interpret those pulses as a false indication of the car's distance, blocking measurement of your speed.

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

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

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

Risk-free. Speed traps don't make my heart skip a beat anymore. The Phazer and Phantom are both backed by our risk-free trial and three-year manufacturer's warranty. Try them, and if you're not satisfied, return your purchase within 90 days for a "No Questions Asked" refund.

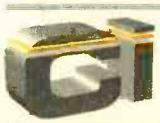
The Phazer:
Three credit-card payments of $66.50 $14 S&H

The Phantom:
Three credit-card payments of $116.50 $18 S&H

Please mention promotional code **2546-13402.**

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

800-399-7863



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

LETTERS

E.Z. SIGNAL GENERATOR CORRECTIONS

There are a few errors in the schematic diagram (Fig. 1) of the "E.Z. Signal Generator" project in the July 1998 issue. Resistor R22 on the schematic should be labeled 12K (12,000 ohms), NOT 1K. Capacitor C15 on the schematic should be a variable 2–25 pF trimmer, NOT 225 pF. Also the polarity orientation of capacitor pair C27 and C35 and pair C26 and C34 should be reversed. The Parts List (page 40) is correct on these components.

Note that the multipurpose board used for the Power Supply portion of this project was obtained as a Radio-Shack *276-150. A separate assembly diagram for the power supply section was omitted due to the simplicity of this portion of the circuit, and the fact that some of the components, such as the transformer, may be mounted on the chassis.—Editor*

ALL ABOUT LEDS

A recent college engineering graduate asked me for a "LED," and I proceeded to ask him: "What size lead does your mechanical pencil take?" He didn't get it, and I think many other people won't get it either!

I believe it's high time that everybody learned the correct pronunciation of the abbreviation, "LED," and what exactly it stands for. A better abbreviation would be "L.E.D," and it's correctly pronounced as: "ell-ee-dee," not a single syllable word such as pencil lead (chemical symbol Pb, Latin *plumbum*) or lead bullets.

The term LED stands for light-emitting diode, and it actually has a junction as in any other semiconductor diode. It has no filament as in an incandescent lamp, and it should never be confused with one! An LED is current-operated rather than voltage-operated as with an incandescent lamp. The reason for this is that the forward current through an LED is an exponential function of its forward voltage. If you take your standard red LED operating on a bias current of 20 mA, it will have a forward drop of about 1.7 volts. The bias current increases about one decade (200 mA) to produce a forward drop increase of only 0.1 volt. As you can see, applying a fixed voltage across an LED is inviting disaster!

The only correct way to operate an LED is with some type of current limiting such as a resistor in series with the supply and LED. Ohm's Law makes this calculation simple. The specs provided with the LED show the maximum current limit of the device. Be kind to your solid-state lamps; they're only diodes after all!

S.C.
So. Bound Brook, NJ

Thanks for the tutorial. It's always good to review some basic concepts. —Editor

SIMPLE COMMERICAL KILLER

In the *Letters* column (**Popular Electronics**, April 1998), it was suggested that you print an article on a rather complex "commercial-killer" circuit involving "voice-print identification," which could eliminate radio advertisements. Something like that did appear in **Radio Electronics** in September 1990, but the job can be done with much simpler circuitry. Since the voice transmissions for ads are almost monophonic, all you have to do is push the *mono* button on your preamp, if you have such an option. I don't have one that I can reach conveniently, so I do most of my listening to radio music through a single loudspeaker hooked up in a special voice-killing monophonic mode. I usually am reading when playing radio music anyhow, so the lack of stereo is not a problem; and my main concern is to prevent distracting speech from getting through.

To avoid possible damage to the radio amplifier's output stage, a simple but safe arrangement is used, as follows. Two 8-ohm, 20-watt resistors are hooked up in series, going from the left stereo radio output wire to the common ground. The point where the two resistors are attached together is then wired to one terminal of my mono loudspeaker. Another pair of resistors are now hooked up to the right stereo output and the same ground, and the point where those two come together is wired to the other terminal of my speaker. Therefore, mono voice signals are canceled, but stereo difference signals get through very nicely, at least for background music listening.

If there is still too much of those pesky commercials, turn down the treble tone control a bit. The lower frequency part of the voice signal is almost entirely mono, even if stereo microphones are being used at the studio, so most of it is squelched quite effectively.

D.S.
via e-mail

COMPUTER HUMOR

TOP 10 WAYS TO TELL IF A HILBILLY HAS BEEN WORKING ON A COMPUTER

1. The mouse is referred to as a "critter."
2. The keyboard is camouflaged.
3. There's a *Bud* can in the CD-ROM drive.
4. There's a gun rack mounted on the CPU.
5. The password is "Bubba."
6. The numeric keyboard only goes up to six.
7. The extra RAM slots have *Dodge* truck parts stored in them.
8. The six front keys have rotted out.
9. Outgoing faxes have tobacco stains on them.
10. The monitor is up on blocks.

J.C.
via e-mail

THE GOOD OLD DAYS ?

Remember when?—

Computer was something on TV
From a science fiction show
A window was something you hated to clean
And ram was the cousin of a goat

Meg was the name of your girlfriend
And gig was your jazz session tonight
Now they all mean different things
And that really mega bytes

An application was for employment
A program was a TV show
A curser used profanity
A keyboard was a piano

Memory was something that you lost
with age
A CD was a bank account
And if you had a 3-1/2-inch floppy
You hoped nobody found out

Compress was something you did to
the garbage
Not something you did to a file
And if you unzipped anything in public
You'd be in jail for a while

Log-on was adding wood to the fire
Hard drive was a long trip on the road
A mouse pad was where a mouse lived
And a backup happened to your
commode

Cut you did with a pocket knife
Paste you did with glue
A web was a spider's home
And a virus was the flu

I guess I'll stick to my pad and paper
And the memory in my head
I hear nobody's been killed in a
computer crash
But when it happens they wish they
were dead.

M.W.
via e-mail

HAVES & NEEDS

Thank you for publishing a superb and interesting magazine. Need operations manual and schematic for a *Heathkit* digital multimeter, Model IM-1202. Any help your readers can give me on this would be appreciated.

Larry Cook
362 East South Street
Richland Center, WI 53581

I am looking for a circuit design for a temperature-measurement device that can measure temperatures from -65 degrees C to 11 degrees C. I need the circuit to transmit temperature data to a digital-memory unit. Readings will be taken every 30 seconds or more. I have a set of thermocouples. I just need a circuit design or a logic design. I can be reached via e-mail at: *cptahab @geocities.com* or at *r_harbert @hotmail. com*. Thank you for your help!

Rashad Harbert ■

"...What seems to be the trouble?..."

NET WATCH

Radio on the Web

KONSTANTINOS KARAGIANNIS

This month we'll be looking at an application of the Internet that's been maturing steadily since its introduction about four years ago. No doubt many of you have downloaded and used the *RealAudio* player with your Web browsers. This clever little application allows Web-content providers to compress and stream audio in real time. As a result, instead of waiting for enormous digital audio files to transfer to their computers, "Netizens" could listen to a file as it was coming in.

The application was so popular that *RealNetworks*, the company that made *RealAudio*, decided to come out with a similar streaming program for video, called, you guessed it—*RealVideo*. Recently, both applications were combined into one *RealPlayer*, and even though our focus this month is on audio, keep in mind that this new combo program is the one you'll need to get to experience the latest in compression technology. It's a free download from the *RealNetworks* site. Now, the audio quality that results from *RealNetworks*' compression schemes has never been much better than what you'd hear if you listened to AM radio; for many *RealAudio* applications that's been just fine, though. All the spoken-word applications such as online news bulletins and broadcasts of baseball games, for example, sound just fine coming through a *RealPlayer*.

What about music? This will be a major part of our focus in this installment of *Net Watch* (though one of our sites does feature talk-type audio, too). Even though everyone prefers CD- or at least FM-radio-quality audio, how many people out there still listen to tunes on AM stations? Quite a lot, actually—when you've got no other option, you make do, right?

You might be wondering why these Net broadcasts aren't CD quality, considering that as computer files they all originate from what must be pure, digital audio. The answer is simple. Digital audio files stored at the sample rate used to make CDs are incredibly large.

At TheDJ, *you can choose from 70 channels of music and listen to them in real-time* RealAudio.

A four-minute song would approach 50 megabytes in size, and transferring this data over a phone line would take forever. *RealAudio* content providers create audio files at much lower sample rates so that the software has less data to compress and send. This is the reason music gets that far-away, slightly hollow quality when played on a *RealPlayer*. There are literally pieces missing from the dynamic structure of the audio. But as mentioned a moment ago, the results are no worse than you'd hear on AM radio, and you should give *RealAudio* files a try.

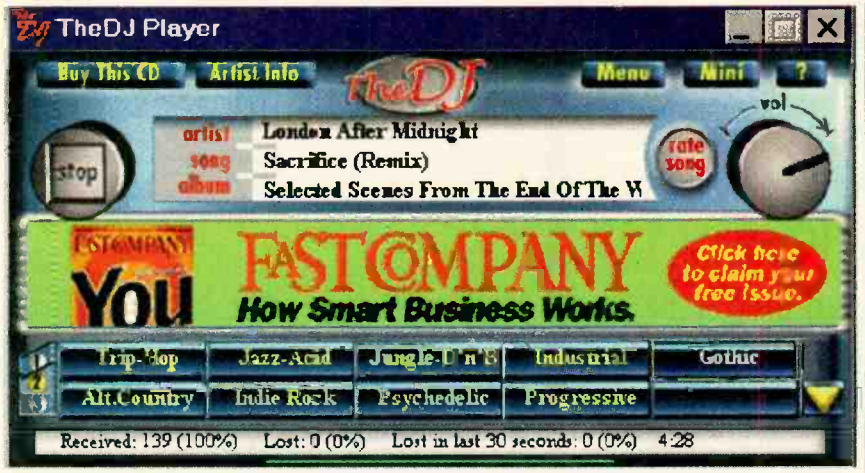
I've found a couple of terrific sites that allow you to use your 28.8 kbps or better connection to the Net to provide you with a constant stream of commercial-free music. As we'll see, some of the types of content on these "stations" are better than what you would hear on the radio, as not everyone likes only what's currently considered popular.

So, if you spend a lot of time connected to the Net, or perhaps work while your computer's online, you might want to take advantage of the fact that your PC probably has a decent set of speakers (a standard item in any modern computer)—so sit back and listen to some of your favorite types of music while clicking away at the keys.

THE DJ OF YOUR CHOICE

Whether you're at a party or listening to the radio, your audio entertainment for the duration is in the hands of a disc jockey or DJ. If this guy or gal doesn't like the bands or artists you like, well, you're in a bit of a bind. This basic fact has been taken a step further into cyberspace, letting you take a bit more control. At the wonderful site called, appropriately, *TheDJ*, you can pick exactly the kind of musical taste you want your DJ to have, and then sit back and let "him" (or "her") do all the work.

When you first access the site, it runs a simple test on your browser to ensure you're capable of receiving the files it transmits. If you've got *RealPlayer* installed, you shouldn't have a problem. Once you hear the audio on the test page, you can enter a wonderful world



TheDJ Player *allows you to program your favorite channels of music and access them without firing up your browser. You do have to put up with live banner ads, though.*

NetRadio Network *offers its listeners over 150 music and talk channels. Those with high-speed connections like ISDN can get linked to better-than-FM-quality audio selections.*

of free choice.

TheDJ provides you with a list of over 70 different channels of audio you can choose from. While real radio stations can be basically divided into those that play one of maybe five different styles of music, *TheDJ* accepts that people have varying tastes.

In addition to what you'd expect to find, like top 40 and country music, *TheDJ's* other channels get pretty specific. The young crowd will love the fact that virtually every type of experimental or underground music is represented, from the trance-inducing sounds of Ambient to the heavy grooves of Electronica and Industrial to my personal favorite—Gothic.

Fans of older, popular music can choose from a particular decade they like or click on a more general grouping like Classic Rock. If you like the true classics, you'll find all sorts of selections sure to please your desire to hear symphonic sounds coming out of your PC.

HOT SITES

RealNetworks
www.realnetworks.com

TheDJ
www.TheDJ.com

NetRadio Network
www.netradio.net

One of the neatest features of the site, particularly if you only have a few channels you like listening to, is the fact that it will allow you to download a proprietary *Player*. This way you don't even need to open your browser. *TheDJ Player* stores your favorite selections as presets on its programmable buttons, and allows you to click on which type of music you're in the mood for. The applet then goes into the Internet, transparently connects with *TheDJ*, and starts the music flowing. While the *Player* is running, the current artist and song name are listed, as is the album title. You can click on a button to be linked to a page with more information about the artist, or if you really like what you hear, clicking on "Buy This CD" will take you directly to the "CDNow" search page so you can find and buy your new favorite.

If you place the mouse pointer over the button of the channel you're listening to, the information bar at the bottom of the *Player* will switch from a countdown of how much time is remaining in the song to a listing of the next two songs coming up. It's nice to know if one of your favorites is on its way, so you can delay getting up for that coffee break.

Like most pages on the Web, the little applet is also subject to advertising. In the center of *TheDJ Player* is a small screen that displays one banner ad at a time (the banners are links to the advertiser's sites).

MORE THAN JUST MUSIC

If you liked the idea of having 70 channels of music to choose from, what would you think about a selection of more than double that number of audio channels? No, they're not all music, but if you like to hear some good talk radio, too, *NetRadio* might be the perfect site to visit.

As you'll see when you first log on to the site, *NetRadio* features plenty of music channels, mixed in with all types of news-related ones. Keep informed and entertained, just by clicking onto different links. The site is based on *RealPlayer*, so once you choose a link you like, you can shut down your browser and leave the *RealPlayer* going. However, you'll lose the ability to interact with the site and choose other channels—this is why *TheDJ* Player is a superior program. But it shouldn't be a major problem to fire up your browser

(Continued on page 14)

Multimedia Video Accessories Galore

MARC SPIWAK
ASSOCIATE TECHNICAL EDITOR
COMPUTER RESELLER NEWS

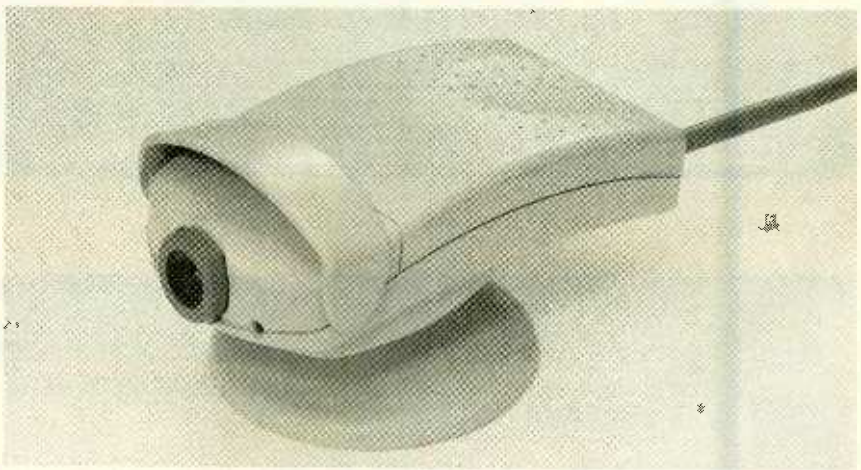
Video on the desktop is pretty much taken for granted these days. Any old PC can do it, just as long as it's not too old. By that I mean a 100-MHz Pentium or faster. If you have anything slower, you really don't want to invest in multimedia hardware for it. I'd actually recommend a 166-MHz or faster Pentium, but 100 MHz will do, at least for the hardware I'm going to talk about.

As I was saying, anyone can play with video on a PC, even those without too much knowledge about how PCs work—it has gotten that simple. People can easily capture still images or full-motion video, edit the material and then post it in Web pages, e-mail it to others, embed it in multimedia presentations, and a lot more. So instead of taking video for granted, this month I thought I'd concentrate on some very affordable, yet quite capable, video hardware I've received in recent months.

VIDEO BLASTER WEBCAM II

Creative Labs recently sent me a sample *Video Blaster WebCam II*, a terrific bargain for only $99. This digital color camera for a PC is great for capturing still and motion video clips. The camera has a focusable lens and can capture true-color (16.7 million colors) motion video up to 30 frames per second at various resolutions with a maximum resolution of 176 × 144 pixels. WebCam can also capture true-color still images with resolutions up to 704 × 576 pixels.

Setting up WebCam is easy, because you don't have to open up the computer's case. The camera stands on top of a monitor and plugs into the PC's parallel port, while power comes from the PC's keyboard port via an included adapter. A one-piece headset and microphone is included with the package to provide full video-conferencing functionality. Drivers and software are loaded from a CD-ROM. The camera provides *Windows 95* and TWAIN support (allowing you to capture high-resolution still images from your favorite photo-editing application)—so it's compatible with a wide variety of applications.



Alaris' QuickVideo DVC1 *color camera can capture full-motion video at 30 frames per second and still images up to 1600 × 1200 pixels.*

Also included in the bundle is all the software programs you need to work with video and still images. *ULead MediaStudio Video Edition* is a video-editing program that lets you capture, modify, and edit still images and AVI files. *ISpy* is a surveillance utility that automatically captures still images and continuously updates a Web page with them. *Creative Video WebPhone* is an Internet video-telephone application that lets you speak to and see anyone in the world for the price of a local Internet connection. *Video Blaster WebCam II* also works with software such as *Microsoft NetMeeting* and *Intel Internet Video Phone*. The camera is H.323 compatible.

Anyone who has been hesitant to try video conferencing because of cost or complexity should really check out WebCam II. It's an easy and inexpensive way to jump into video on the desktop.

QUICKVIDEO TRANSPORT AND QUICKVIDEO DVC1

Alaris sent me samples of some similar video gear for the PC, except that *Alaris* markets two separate products, *QuickVideo Transport* and the *QuickVideo DVC1* color camera. Combined, these two products let you do more than you can with *Creative's WebCam II*.

The *QuickVideo Transport* is a video-capture device that plugs into the parallel port of a PC. Like WebCam, QuickVideo gets its power from the keyboard port using a supplied adapter. QuickVideo captures stills and composite or S-VHS video, but it does not include a camera. But you can connect a camcorder's video output to capture live video, if necessary. QuickVideo lets you capture any video source, as long as it's composite or S-VHS format. This is a great way to get video off a videotape and digitized into a PC. From there the options are endless.

QuickVideo Transport captures true-color full-motion video at up to 30 frames per second and still images up to 1600 × 1200 pixels. An included program, called *Videogram Creator*, lets you create video e-mail in tight little files that contain a built-in player application so that any recipient can play back the video clip. Transport also includes enough software to turn your computer into a complete multimedia

center. *Digital Video Producer* lets you edit, enhance, and add titles to video clips. *Live Pix* lets you enhance, crop, and alter still images. *Gryphon Morph* makes it easy to morph one image into another. The manufacturer's suggested retail price (MSRP) for *QuickVideo Transport* is $119.

If you don't have a camcorder, check out *Alaris' QuickVideo DVC1* color camera. The DVC1 also connects to a PC through the parallel port and pulls power from the keyboard port. DVC1 lets you capture full-motion video at rates from 15 to 30 frames per second and still images at resolutions up to 1600 x 1200.

As with Transport, the DVC1 is also bundled with *Videogram Creator* that lets you preview live video and capture video and stills. You can save video and stills in multiple formats including AVI, BMP, WAV, JPG, and so on, or make Videograms to send to others via e-mail. The DVC1 comes with a TWAIN driver, so it will work with any photo-editing application, and it also works with *Microsoft's NetMeeting*, *VDOPhone* from *VDO*, and *CUSeeMe* from *Whitepine*. The camera is H.323 compatible. *QuickVideo DVC1* has a MSRP of $119.

NITRO DVD

In my opinion, DVD is a must-have in any fast PC. Why not be able to play DVD titles if at all possible? DVD turns your PC into a laser-disc player! Anyway, DVD upgrade kits are common today, selling for between $300 and $400. They include a DVD-ROM drive and MPEG-2 decoder card that works in conjunction with the graphics accelerator card already in a system. You generally need an additional PCI slot to accommodate the MPEG-2 card.

I recently installed one of *STB Systems' NITRO DVD* graphics accelerators in a Pentium II system. With just a bare DVD-ROM drive in the system and no MPEG-2 decoder board, I can still enjoy fast 2D- and 3D-graphics acceleration and play DVD games and movies. You see, *NITRO DVD* provides 2D/3D-hardware, and DVD acceleration all on a single AGP-expansion card. The product sells for under $200, so the MPEG-2 decoding is essentially provided for free. A bare DVD-ROM drive can be had for under $200. Also remember that this solution uses only one slot instead of two.

With The X-Files Unrestricted Access, *you help do the investigative work in Mulder's and Scully's cases.*

NITRO DVD is built around the *Mpact 2 Media Processor* from *Chromatic Research, Inc.*, a rather unique graphics accelerator chip. The Mpact 2 is programmed "on the fly" to perform different tasks requested of it. That also means that future enhancements to NITRO's capabilities can be provided by software upgrades. The card installed easily with no hassles along the way. A software entertainment center is installed that lets you access DVD titles with VCR-like controls. It also provides 3D-hardware acceleration features such as MIP-mapping, perspective correction, texture maps with bilinear or trilinear filtering, double- and Z-buffer support, and video texture mapping. NITRO provides DVD decoding with *Dolby* digital audio decoding using *SRS TruSurround* for virtual surround sound through just a pair of PC speakers.

NITRO DVD is available with 4 Mb or 8 Mb of 600-MHz RAMBUS memory, and it provides full DirectX support and 32-bit Windows 98 support. It has VESA DDC-2B plug-and-play monitor support and is VESA-DPMS compatible for energy conservation. Prices range around $100 MSRP.

NEW SOFTWARE

I just received an assortment of multimedia titles from *Grolier Interactive*. One that's new is the *Grolier Value Pack*, a bundle of four CD-ROMs in one package. Included are the *1998 Grolier Multimedia Encyclopedia*, *Greg Norman Ultimate Challenge Golf*, *Banzai Bug*, and *American Presidency*.

The *Grolier Multimedia Encyclopedia* has been around for many years, and is always being improved—the 1998 edition is no exception. Practically any topic you need to research is on this disc. *Greg Norman Ultimate Challenge Golf* simulates virtually every element of the game including the player's swing, style, preferences, and so on. *Banzai Bug* lets players be flying insects in a fully rendered 360-degree environment. The object is simple—drive the people out of the house. *American Presidency* honors the highest office in the nation, with a multimedia look at the history of this hectic position. The *Grolier Value Pack* includes all four titles for only $29.99.

Another title from Grolier, *Picasso: The Man, His Works, The Legend*, provides a multimedia point of view of Picasso's work. Included are over 600 of his most famous works, in-depth analysis of 100 major works, photos of Picasso, video footage, and more for only $39.99 MSRP. Grolier's *How Would You Survive?* lets you travel back in time and visit the Ancient Egyptians, Aztecs, and Vikings. Learn about everyday life through movies, maps, sound effects, animations, and narration. This survival adventure retails for $24.99.

Intended for women, Grolier's *Elle Beauty Guide* is filled with beauty tips gathered from the staff of *Elle* magazine, presented in a multimedia fashion. Topics include skin care, perfume, colors, the sun, and a lot more. For both women and men who like to cook, *Elle Cooking* brings over 2000 recipes from 40 different countries to your kitchen. Each recipe is accompanied by a color photograph, list of ingredients, instructions, and even a wine suggestion. Video clips teach the techniques, and a glossary explains unfamiliar terms. You can even print out recipes if you like. All this for a MSRP of $39.99.

New from *Fox Interactive* comes *The X-Files Unrestricted Access*, a unique look at this hit show and its characters, and the cases they're involved in. In fact, you help do the investigative work. Look through character dossiers from Mulder's and Scully's investigations, examine newspaper clippings and police photographs, and more. Use FBI equipment to analyze fingerprints, voice patterns, and the like. This title is a must-have for any serious X-Files fan. Included are screen savers, sounds, icons, and wallpaper to create a custom X-Files desktop. Unrestricted Access

WHERE TO GET IT

Alaris
47338 Fremont Blvd.
Fremont, CA 94538
800-317-2348
www.alaris.com
CIRCLE 60 ON FREE INFORMATION CARD

Creative Labs
1901 McCarthy Blvd.
Milpitas, CA 95035
800-998-5227
www.creativelabs.com
CIRCLE 61 ON FREE INFORMATION CARD

Expert Software, Inc.
800 Douglas Road, Executive Tower
Coral Gables, FL 33134
800-759-2562
www.expertsoftware.com
CIRCLE 62 ON FREE INFORMATION CARD

Fox Interactive
2121 Avenue of the Stars, Suite 400
Los Angeles, CA 90067
310-369-1000
www.foxinteractive.com
CIRCLE 63 ON FREE INFORMATION CARD

Grolier Interactive, Inc.
90 Sherman Turnpike
Danbury, CT 06816
203-797-3530
www.gi.grolier.com
CIRCLE 64 ON FREE INFORMATION CARD

Humongous Entertainment
13110 N.E. 177th Place
Suite B101, Box 180,
Woodinville, WA 98072
800-499-8386
www.humongous.com
CIRCLE 65 ON FREE INFORMATION CARD

STB Systems, Inc.
1651 North Glenville
Richardson, TX 75081
800-234-4334
www.stb.com
CIRCLE 66 ON FREE INFORMATION CARD

will cost you $34.99.

Freddi Fish is at it again in *Humongous Entertainment's Freddi Fish 3: The Case of the Stolen Conch Shell.* A one-of-a-kind conch shell is missing, and detective Freddi Fish must find it. The annual Founder's Day Festival cannot begin without the Great Conch Shell and its three golden pipes. Kids swim with Freddi and friends through an exotic underwater world to gather clues and find the missing shell. Everything is alive in this multimedia water world, and my 3-½ year old son has really taken a liking to this one. Freddi Fish 3 costs $29.99.

It seems that almost every month I receive a new title from *Expert Software*—not that there's anything wrong with that. So I decided to call *Expert Software* to find out exactly how many titles they have. Now I have more new software titles than I'll ever have time to get to. Unless I mention otherwise, all of the titles below cost only $14.99, which is quite a bargain in my opinion—and these are only a handful of the many titles *Expert Software* offers.

One title, *Astronomer*, features over 40 minutes of video including Neil Armstrong's first moon steps, the Shoemaker-Levy comet collisions with Jupiter, and so on. A night-sky simulation lets you view more than 11,000 celestial objects, and you can just click on an item to learn its name. *100 Amazing Kids Games* includes adventure games, arcade games, mind games, strategy games, and more. For all ages, *24 Games for Windows 95* is filled with board games, card games, cryptograms, and more, all intended specifically for the Windows 95 environment.

Another title, *250 Best Arcade Games* features the more basic shareware-type games you've played over the years. A preview window lets you view game screens instantly without loading the programs. *Bicycle Baccarat* teaches the basics of the popular casino attraction—I think I'll learn how to play it myself. *Bicycle Blackjack* turns you into a Blackjack pro by giving you the inside angles. *Championship Chess* lets you play chess with nine skill levels ranging from beginner to expert. You can play solo or against friends. Play in classic 2D or even 3D if you like.

The *Crayons Coloring Book* is an electronic coloring book and a screen saver. The disc includes more than 100 pictures and a never-ending supply of electronic crayons. *The Multimedia Bug Book*, for ages 5–10, lets youngsters help an absent-minded entomologist find his missing bugs. In *The Multimedia Bird Book*, kids ages 6–12 go bird watching with a lively bird expert. *Trucks & Stuff* for ages 6 and up is loaded with 770 tons of the world's biggest trucks—kids can explore them, load them, drive them, and more.

Evolution of Man lets you trace the footsteps of prehistoric man and introduces you to our earliest ancestors. *Casino CD* is an easy and risk-free way to experience a Las Vegas-style casino. You first register as a guest at a fancy casino hotel and then learn to gamble at craps, slot machines, roulette, blackjack, keno, or video poker without losing any money. You just walk up to any game and start playing. *Casino CD* is for the high rollers, since it costs $19.99. Enjoy! ■

NET WATCH

(continued from page 11)

to make a listening change (many people keep the browser open and minimized, anyway).

Audio quality is basically the same at both sites. One thing we should note, however, is that *NetRadio* does offer a higher-quality option. If your PC has a high-speed link to the Net through ISDN or a local-area network (LAN) linked to a T1 connection, then you can check out the *NetRadio* ISDN link. This is almost CD-quality audio that's better than anything you'd hear on FM radio. Of course, not everyone connects at these speeds, and those of us with modems have to make do with what we have.

An interesting note from your author: Even with 150 channels, *NetRadio* did not have one dedicated to my personal favorite. For the sake of Gothic music, and the neat *Player* application, I'm a frequent user of *TheDJ.*

And that about does it for this month. Until next time, feel free to e-mail me at netwatch@comports.com, or send a good-old USPS letter to *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

DX LISTENING

Broadcast-Band Listening

DON JENSEN

The focus of this column is shortwave, of course, but some readers also do their DX listening on the standard AM broadcast band, 530 to 1700 kHz. This month, let's take a look at broadcast-band (BCB) medium-wave listening. If you haven't tried it yet, you may find a bit of added listening fun.

BCB listening, in fact, is an older hobby than SWLing. It was the 1930s before shortwave broadcasting really took off. By then, radio enthusiasts had been tuning pioneer medium-wave stations like KDKA, Pittsburgh, for nearly a decade. Listening to distant medium-wave (MW) stations was, for a time, a popular craze. But with the advent of coast-to-coast radio networks, the novelty of hearing programs all the way from Schenectady or Los Angeles dimmed for most Americans. However, there always remained a modest hard-core group of BCB DXers.

In many ways, tuning stations in each of the United States is harder than it was a half century ago. The problem is that there are just too many stations, and too much interference on the MW frequencies. In North America, medium-wave stations are spaced at 10 kilohertz intervals in the broadcast band. In Europe, though, spacing between stations is less, so that stations there are assigned odd frequencies "between" those of U.S., Canadian, and Mexican stations. This means that in some parts of eastern North America, under the right situation and conditions it is possible to tune European BCB signals.

Historically, in the U.S., the stations in the BCB were assigned frequencies from 540 to 1600 kHz. Recently, though, the upper end was expanded to include ten more extended band channels from 1610 to 1700 kHz. But these 117 different North American BCB frequencies are not all created equal. Some are so-called clear channel frequencies, meaning that only a few stations, including one or two dominant 50,000-watt outlets in the U.S., Canada, or Mexico operate on each one. Minimal interference usually means these are good spots to look for transcontinental reception of the dominant stations.

BCB station logos and call letters are featured on the cover of a new book detailing how to DX distant broadcast band stations.

The clear channels are: 540 kHz, and every 10 kHz from 640 through 780 kHz; 800 through 900 kHz; 940 kHz; 990 through 1140 kHz; 1160 through 1220 kHz; and 1500 through 1580 kHz. Then there are 41 regional channels, intended to give stations assigned to them regional coverage with minimal interference. These stations are limited to 5000 watts or less. At night, when reception distances increase, they can not run more than 500 watts.

The regional channels are: 550 through 630 kHz, 790 kHz, 910 through 980 kHz, 1150 kHz, 1250 through 1330 kHz, 1350 through 1390 kHz, 1410 through 1440 kHz, 1460 through 1480 kHz, 1590, and 1600 kHz.

There are six local channels—1230 and 1240, 1340, 1400, 1450, and 1490 kHz—designed to cover only a small area. The stations on these frequencies are limited to 1000 watts of power. But each of these frequencies has more than 130 stations assigned! BCB DXers have dubbed them the "graveyard" channels. They are typically crowded and noisy, but can be great fun, since one never knows if and when some distant, very low-powered station might pop in briefly.

The ten extended band frequencies, from 1610 through 1700 kHz, are newly authorized and, as yet, have relatively few stations. Not all AM radios can tune this high. Since there is little co-channel inference so far, this is an interesting range to tune.

HEARING ALL STATES

How difficult is it today to hear all 50 states on the BCB? Today, though theoretically possible, this is unlikely because of crowded band conditions and interference from other stations. From most areas of the U.S., hearing even 30 states is a real challenge.

But, says John Zondlo in his second edition of *Discover DXing! How to Hear Distant AM, FM & TV Stations — see this month's* Electronics Library *for a review of this book*—(Universal Radio Research, 6830 Americana Pkwy., Reynoldsburg, OH 43068, Tel. 800-431-3739, Web: *www.universal-radio.com—Editor*), almost anyone anywhere in the U.S. can log 20 states. Accomplishing that is a good way to get started BCB DXing.

Here are stations Zondlo suggests.

California—Los Angeles, KFI, 640 kHz; or KNX, 1070 kHz; or San Francisco, KNBR, 680 kHz.
Colorado—Denver, KOA, 850 kHz; or KRRF, 1280 kHz.
Georgia—Atlanta, WSB, 750 kHz.
Illinois—Chicago, WMAQ, 670 kHz; WGN, 720 kHz; or WLS, 890 kHz.
Iowa—Des Moines, WHO, 1040 kHz; or Waterloo, KXEL, 1540 kHz.
Louisiana—New Orleans, WWL, 870

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kHz; or Shreveport, KWKH, 1130 kHz.
Massachusetts—Boston, WBZ, 1030 kHz.
Michigan—Detroit, WJR, 760 kHz; or Grand Rapids, WOOD, 1300 kHz.
Minnesota—Minneapolis, WCCO, 830 kHz; or St. Paul, KSTP, 1500 kHz.
Missouri—St. Louis, KMOX, 1120 kHz; or Kansas City, WHB, 810 kHz.
Nebraska—Omaha, KFAB, 1110 kHz; Lexington, KRVN, 880 kHz; or Bellevue, KOIL, 1180 kHz.
New York—New York City, WABC, 770 kHz; WCBS, 880 kHz; or Rochester, WHAM, 1180 kHz.
Ohio—Cincinnati, WLW, 700 kHz; WSAI, 1530 kHz; or Cleveland, WTAM, 1100 kHz.
Oklahoma—Oklahoma City, WKY, 930 kHz; or KOMA, 1520 kHz.
Pennsylvania—Pittsburgh, KDKA, 1020 kHz; KYW, 1060 kHz; or Philadelphia, WPTS, 1210 kHz.
Tennessee—Nashville, WSM, 650 kHz; or WLAC, 1510 kHz.
Texas—San Antonio, WOAI, 1200 kHz; or Fort Worth, WBAP, 820 kHz.
Utah—Salt Lake City, KSL, 1160 kHz.
Virginia—Richmond, WRVA, 1140 kHz; or Norfolk, WTAR, 790 kHz.
West Virginia—Wheeling, WWVA, 1170 kHz.

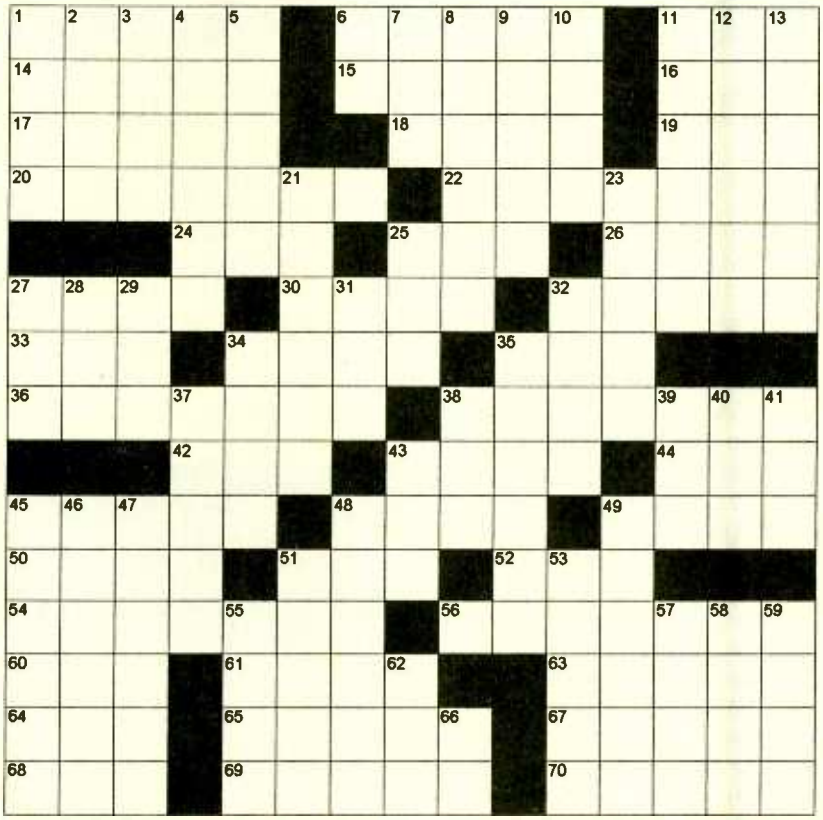
WHEN TO LISTEN?

To begin, check each medium-wave frequency during the daylight hours. On many of the clear channels, you will find one audible 50-kW station, perhaps up to 300 or 400 miles away. On the regional channels, stations 100 to 200 miles away may be audible. On the few local channels, reception under 100 miles is the rule during the day. Log these "regulars" first.

Many, many more options open up during the hours of darkness when long-haul DX is common. The first thing you will note is that reception on the clear channels may extend to stations all across the continent. And the half dozen local channels will become chaotic, with dozens of stations competing. Often nothing is intelligible in the bedlam. But if you listen to one of these graveyard frequencies long enough, first one, then another and another and another local station will briefly pop in with understandable programming, and then fade out.

During the sunset and sunrise periods, BCB stations skip in especially well. Beginning a couple of hours before

Antennas and Transmission Lines



ACROSS
1 Army unit
6 Confess
11 Doctoral degree
14 Screamer's throat dangler
15 Deer-like animal
16 Garden tool
17 Impedance-matching transformer
18 *Ocean Spray's* drink starters
19 Night bird
20 Part of 50 across
22 Consumable
24 Before, poetically
25 Computer key
26 Follow a regimen
27 Square loop-type antenna
30 Air (prefix)
32 Money
33 And so forth
34 Cease
35 U.S. money (abbr.)
36 Items
38 Also known as a "Curtain" antenna
42 Pigpen
43 Tree trunk
44 Dunk
45 Gap
48 Horizontal antenna element support
49 Cut of beef
50 Popular directional antenna
51 Wipe
52 Grow older
54 Struggles
56 Mixed-up letters
60 Fasten
61 Store
63 "_____ Vice" (TV Show)
64 Comp. point
65 Females
67 Customs
68 Angry
69 Thorny flowers
70 Concerning

DOWN
1 Dice
2 President's office
3 Law
4 Adorned, like a hat
5 Not as nuts
6 Morning hour
7 MD
8 Overly (2 words)
9 Abraham's son
10 Camper's dwelling
11 Fearful
12 A wolf or dog
13 Erase
21 Tidily
23 Grown-up
25 Effective increase in transmitter power due to antenna (abbr.)
27 It is proven (abbr.)
28 Southwestern Indian
29 Skit
31 Goddess
32 Ear part
34 Location
35 Turkish overcoat
37 Computer code (abbr.)
38 Ghost's greeting
39 Bother
40 Roman numeral three
41 Lic. pract. nurse
43 Jazz
45 Organization
46 Bronze coating
47 United
48 Chests
49 Horde
51 Ditto (2 words)
53 Antenna-matching network
55 Ratio of max. to min. voltage on a transmission line
57 Seldom
58 Prayer ending
59 Fine spray
62 Teensy
66 Canadian prov.

Answers on page 95

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GLOSSARY

AM—Amplitude Modulation, a broadcasting mode, but often used to refer to regular medium-wave radio broadcasting, *e.g.*, the AM radio band.

BCB—Broadcast Band, another name for the medium-wave frequency range from 530 to 1700 kHz; also called the AM radio band.

DX, DXing—Distant radio signals; listening for distant stations as a hobby.

kHz—kilohertz, 1000 hertz, a station's broadcasting frequency is expressed in kilohertz.

kW—kilowatt, 1000 watts; a station's transmitting power is measured in watts or kilowatts.

MW—Medium wave; frequencies below the shortwave range; see BCB.

SWL, SWLing—Shortwave listener, shortwave listening.

UTC—Universal Coordinated Time, a time reference commonly used in shortwave broadcasting, equivalent to Eastern Daylight Time + 4 hours; CDT + 5 hours; MDT + 6 hours; and PDT + 7 hours.

sunset, look for stations located to the east where it already is getting dark and signal propagation conditions are improving. To the west, stations are still in range-limiting daylight, so they won't cause you interference. From dawn to a couple of hours past sunrise, look for stations to the west, particularly those above 900 kHz.

BCB DXing is a year-round hobby; however, winter provides better reception than summer. There are more hours of darkness during the colder months, and there is more static and nature-made interference during the lightning-prone summertime.

With this introduction to BCB medium-wave DXing—go for it! And if you find you enjoy tuning the regular AM radio band, let me know. I can devote more time and space to the subject in future months if enough of you want it.

DOWN THE DIAL

For dyed-in-the-wool shortwave enthusiasts, though, here are this month's SW stations to tune for:

ALGERIA—15160 kHz, Radio Algiers International is noted at 1200 UTC in English, with identification, news, and commentary, followed by popular music. At the same time, it has been heard, though weaker, on 11715 kHz.

ARMENIA—9965 kHz, The Voice of Armenia is heard here at 2130 UTC with English programming. It also operates on a parallel frequency of 4810 kHz.

COSTA RICA—4832 kHz, Radio Reloj is noted here evenings about 0400 UTC with Spanish programming and Latin pops.

FRENCH GUIANA—17575 kHz, Radio France International, transmitted from its South American relay transmitters, is noted on this frequency, and on parallel 17605 kHz, with French language news announced by a man and woman at 1430 UTC.

MADAGASCAR—9605 kHz, Radio Netherlands relays English programming from this large island nation off the east coast of Africa. You can hear the *Media Network* and *Newsline* programs during the 1800 UTC program hour.

NICARAGUA—5770 kHz, Radio Miskut operates here around 0030 UTC and after, with Spanish language programming including Latin ballads.

PAPUA-NEW GUINEA—4890 kHz, National Broadcasting Corporation, the national station at Port Moresby has popular music programming and time checks from 1215 UTC and a listeners' letters program at 1300 UTC.

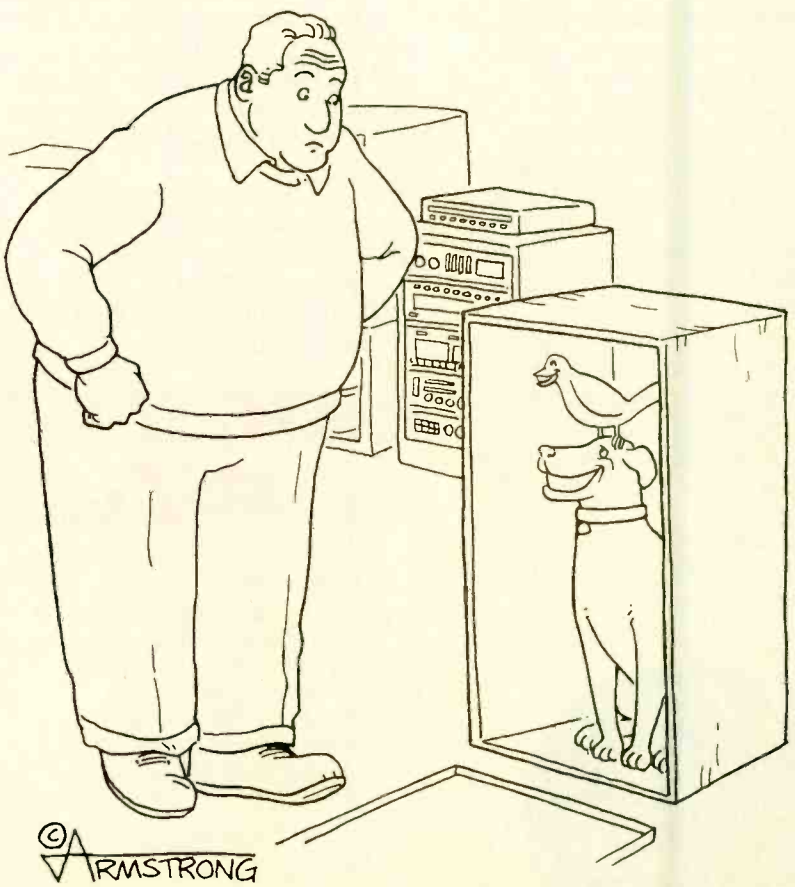
SLOVAKIA—5930 kHz, Radio Slovakia International has an English-language listeners' letters program at 0115 UTC.

TANZANIA—5050 kHz, Radio Tanzania has been observed signing on at 0155 UTC with its tuning signal, sign-on announcement in Swahili, and national anthem, followed by an Islamic prayer.

VANUATU—4960 kHz, Radio Vanuatu, a Pacific region station, has English programming here during our overnight time period, 0700 past 1000 UTC. It has been heard with a mix of island melodies, and country and western music.

VENEZUELA—4940 kHz, Radio Amazonas has Spanish-language programs here during the evening hours. It was logged on one day with Spanish guitar music after 0300 UTC.

ZAMBIA—4910 kHz, Zambia's ZNBC outlet is reported on this frequency during the 0300 to 0430 UTC time slot with programs in an African language, featuring African, U.S. country and western, and pops music. ■



GIZMO®

DVD HITS THE ROAD

DVD-L10 PORTABLE DVD PLAYER. From Panasonic Consumer Electronics Company, One Panasonic Way, Secaucus, NJ 07094. Tel. 800-211-PANA; Web: www.panasonic.com. Suggested retail price: $1299.95.

What electronic gear do you take along on business or pleasure trips? Laptop? Pager? Cell phone? Portable CD player? Microcassette recorder? Electronic organizer? Portable gaming system? GPS route planner?

Just when you thought there was nothing else that could possibly go in your briefcase/overnight bag, *Panasonic* introduces the DVD-L10—the first portable DVD player with built-in LCD screen. Weighing in at less than two pounds and with a two-hour battery life, the portable unit lets you enjoy full-length feature films presented in high-quality digital audio and video anywhere you go. And when you reach your destination, the DVD-L10 can double as a home DVD deck, complete with remote control.

The DVD-L10 is just over 6-inches wide, 6-inches deep, and 1 1/2-inches tall, without its battery pack, which adds another 2 inches to its depth. The unit's "less-than-two-pound" weight is also minus the rather hefty battery pack, which increases the weight by more than 50%.

The DVD player's sloped front panel, accessible even when the unit is closed, features the basic controls—SKIP/SEARCH (forward and back), STOP, STILL/PAUSE, and PLAY—for movie watching and CD listening. (Like all DVD players, the DVD-L10 also plays audio CDs.) At the center of the panel is a display window; beneath that is the sensor for the remote control.

During portable play, the rear panel is completely hidden behind the battery pack. The nickel metal hydride battery takes about two hours to fully charge, after which it will provide about two hours of continuous playback. Remove the battery pack for home use, and you'll find all the necessary inputs to connect the unit to a home-theater system. Those include S-video and optical digital-audio outputs. Plugging the DVD player into a wall outlet requires the use of the battery charger/AC adapter and a special conversion adapter, which means you have to lug along an extra piece if you intend to watch DVD in your hotel room or vacation house.

Along the right side of the unit is the power switch, with on, off, and hold settings. The hold function protects against inadvertent button presses. To the left of the power switch is the DC input connector, for connecting the battery pack or charger/AC adapter for home use, and the headphone/external-speaker jack. A VOLUME-CONTROL knob, which adjusts the volume of either the built-in speakers or the headphones (included) is also found on the side panel.

Flip open the lid, and beneath it you'll find a 5.8-inch (measured diagonally) widescreen color LCD screen. Beneath it are the built-in speakers, brightness and color controls, and a DISPLAY MODE button that allows you to change the aspect ratio (widescreen, 4:3, or letterbox).

The disc compartment, with a small triangular window to show off the spinning DVD, occupies most of the DVD-L10's main body. Arrayed around its lower-left edge are the RETURN button, used to return to the previous menu; the OPEN button; MENU

and TITLE buttons; and a joystick-style SELECT button, ringed by up, down, left, and right arrows. The arrows are used to navigate the on-screen menu; when the desired option is reached, the button is used to select it.

The DVD-L10 is easy to use. Snap on the charged battery pack (or plug in the AC adapter), turn on the power, insert a disc, and press PLAY. That's all there is to it—unless, of course, you want to take advantage of some of DVD's neat advanced features. Depending on the disc you're watching, you might be able to select different languages for the soundtrack or subtitles, for instance. You can use the menu system to access different chapters (tracks) on the disc. Change the aspect ratio. Turn on the Virtual Surround Sound system. Add headphones or speakers. Connect it to a Dolby Digital decoder for full 5.1-channel digital surround sound. Hook it up to a big-screen TV.

We have to admit that we were a bit skeptical about portable DVD watching. Whenever we've used a DVD player, we've made the most of it with the best home-theater accoutrements we could get our hands on. A tiny screen? Two little speakers? Why bother?

Then we tried the DVD-L10—not on an airplane or at a vacation house, as the press kits suggested, but in our daily lives. First, we carried it along on our daily commute on the Long Island Rail Road. The round-trip ride was generally long enough for viewing an entire film (the 3-$^1/_2$-hour director's cut of *Das Boot* was an exception). With headphones on and a gripping story unfolding, we barely noticed the size of the screen. What's immediately apparent, however, is its clarity, brightness, and true colors. A 10-bit video digital-to-analog converter "minimizes digital artifacts resulting in better overall picture quality." The enlarged pixels that can be so obvious on a 100-inch projected image are all but invisible on this small screen, except when zoom mode is engaged. Whatever the mode, the picture is remarkably life-like. We had no cause to tinker with the brightness and color controls; even in bright light, the image didn't wash out. The CD-quality soundtrack, heard through our headphones, was as clear and true as the picture. It was surprisingly easy to become enveloped by a movie, even with such a small screen.

We found ourselves using the DVD-L10 in its portable configuration around the house, too. When a movie ran longer than our train ride, and we had no intention of watching another that evening, it was easier to continue watching the small screen than to connect the player to our home-entertainment system. The portable/headphone mode also enabled us to watch in peace, without disturbing others in the house (whose tastes run more toward *Hercules* and *Peter Pan* than *Fargo* or *Das Boot*). We even carried our portable home theater out to the yard, where we enjoyed the May weather while catching up on our movie-watching. The LCD screen performed admirably outdoors. The image was viewable even in bright sunlight. In dappled sunshine, with a hammock instead of an armchair and headphones to muffle the omnipresent hum of lawn mowers, the DVD-L10 transformed our backyard into an outdoor movie house.

When we did venture indoors to make the connections to our TV and stereo system, the DVD-L10 performed as reliably and conveniently, and with the same high-quality video and audio, as any rack-sized DVD player we've used. We used the supplied optical cable to feed the player's digital output to a Dolby Digital surround receiver, so we could take advantage of some of the 5.1-channel software available. The DVD-L10 reproduced, for example, the 5.1-channel mix of Fleetwood Mac's "The Dance" in all its 3-D mix glory—and left us wondering: "If the U.S.C. Trojan marching band is on stage with Fleetwood Mac, why are all of their horns coming from the rear speakers?"

The remote control lacked backlighting—a feature we look for on home-theater remote controls—but offered logically arranged buttons (which, on our first-production unit, were labeled in Japanese). All of the controls found on the DVD-L10—and then some—also appear on its remote control.

The extra remote-control buttons are provided for the control of advanced DVD operations. The SUBTITLE and AUDIO buttons are used to change the subtitle and soundtrack languages, respectively, when such options are available on a DVD disc. The MARKER button is used to "bookmark" a favorite scene in a film or song on a CD to which you'd like to return. The PLAY MODE button allows you to select normal, random, or programmed play modes. Some DVD discs include scenes that have been shot from different camera angles; pressing the ANGLE button allows you to view the scene from those different angles. DVDs contain their own menus, and the remote's menu button lets you access those. The numeric keypad can be used to select menu options on some discs, while others require you to use the joystick-style arrows and SELECT button to indicate your choices.

The one thing that we found disappointing about the DVD-L10 was the sound quality of the built-in speakers. They sounded tinny—as you'd expect from such tiny drivers—and the volume on many DVD discs was barely loud enough to hear in the quiet of our office, let alone on a train or plane. It wasn't a problem for us—we rarely travel without headphones anyway. If you're on a plane with a companion and want to watch a film together, or if you're relying on the DVD-L10 to keep the kids quiet in the back seat on a long road trip, those speakers will be a problem, however.

As previously mentioned, you can connect external speakers to the DVD-L10—and several companies now make fine compact multimedia speakers. Of course, they're hardly portable. But before you discount their use (you don't want to tote speakers through airports or risk bothering other passengers), consider the added bonus of having a CD player to enjoy when you reach your destination.

With the external speakers in place, you'll also be in a much better position to take advantage of the CD-quality sound produced by the DVD-L10's 96-

Gizmo is published by Gernsback Publications, Inc., 500 Bi-County Blvd., Farmingdale, NY 11735. Senior Writers: Christopher Scott and Teri Scaduto.

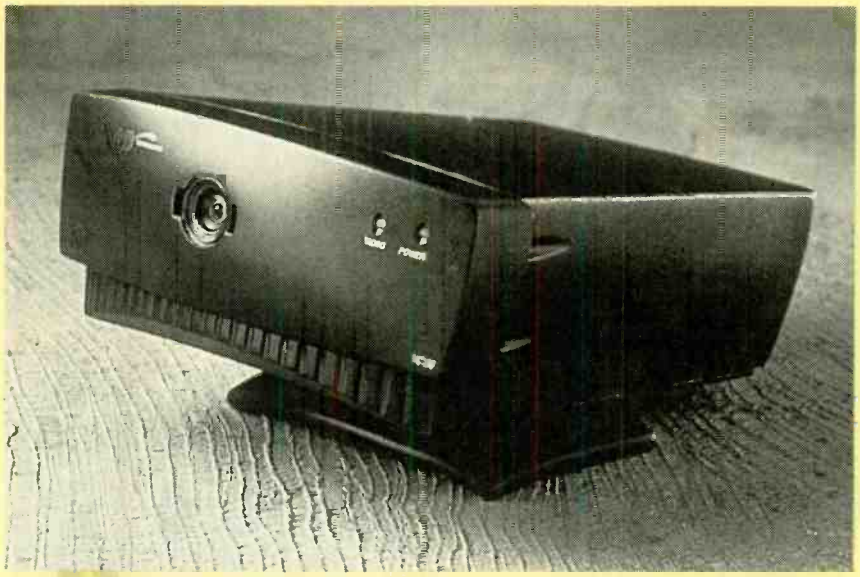
kHz, 24-bit audio DAC—if not quite prepared for true 5.1-channel Digital Dolby (which requires a special decoder and six speakers). However, *Panasonic* offers a Virtual Surround Sound (VSS) mode to simulate a 5.1-channel soundtrack on external speakers (the built-in speakers "are not adequate for reproduction of the virtual surround sound effect," according to the manual). VSS, which allows you to experience surround sound with just two speakers, can't compete with the real thing, but it would certainly come in handy at a vacation house, where you have a TV and stereo in place, but no real home-theater set-up. (It could also work in a hotel room, if you've lugged along those external speakers.)

As fine a piece of technology as it is, we don't envision the DVD-L10 flying off the shelves. Sure, DVD has been making inroads with video aficionados. But as a niche item within a new product category, portable DVD has its work cut out for it. We see it used primarily by frequent travelers with deep pockets; secondarily by video enthusiasts who own vacation homes and would like to enjoy the benefits of DVD at home, in their second home, and while traveling between the two. We truly wish we fit into one of those categories so that we could have a good excuse to buy a DVD-L10 for ourselves—we'd love to own one, if just to enjoy out in that hammock!

THE GRANDMA PHONE

VIATV PHONE MODEL VC105. From 8×8, Inc., 2445 Mission College Blvd., Santa Clara, CA 95054; Tel. 888-VIEW8X8; Fax: 408-980-0432; Web: www.ViaTV.com. Suggested retail price: $449.

The concept of videophones, which has been around for decades, is appealing. How nice to be able to actually see far-flung friends and relatives as you talk to them. What snowbird Grandmother wouldn't love to see her grandchildren proudly display their artwork and class projects? What parent, stuck out of town on business, would not love to say goodnight face-to-face to the kids and spouse?



Those scenarios are not at all far-fetched. Videophones have now reached the real-life stage. In fact, just as we've gotten used to being always accessible via our cell phones and pagers, it's now becoming easy to envision a time when we'll also be reachable via video.

The *ViaTV Phone*, which can be hooked up to any television and touch-tone phone to provide full-color (though not full-motion) video and "telephone-quality" audio over standard phone lines, is a fine example of today's videophone technology. It provides up to 20 frames per second (regular TV is 30 frames per second) and has adjustable resolution and frame rate. It has Caller ID display capability, it's compatible with other brands of video phones based on the H.324 standard or PCs running H.324 videophone software, and it offers both preview mode (where you can see how you'll look to others) and privacy mode (where no one can see you). Its camera has electronic pan/tilt/zoom and snapshot modes, and it allows video calls to be recorded on a VCR. There are no additional phone-company charges for making a video call.

The *ViaTV Phone* consists of an unobtrusive set-top box that contains a digital video camera, a video-processing system, and a 33.6-kbsp analog modem. The unit is approximately 3½ inches tall, 6¼ inches wide, and 7½ inches deep. Basically rectangular in shape, though its front panel is gently curved, the box sits atop a tilt-and-swivel base that allows you to properly position the camera. Centered on the front panel is the camera lens. In the upper-right corner are two LEDs—a green one indicates that the power is on, and a yellow one lets you know that the camera is transmitting video.

The rear panel offers inputs for two modular phone cords (one connects to the phone line and the other to a phone), the power adapter, an antenna adapter, and an accessory port that is presently unused. There are also video-out and audio-out jacks, as well as the power switch.

Connection is relatively straightforward, although we wouldn't recommend using the Quick Start Guide, which needlessly causes confusion with instructions like "Place the ViaTV base, with the *8×8* logo facing forward, on top of your TV. Set the *ViaTV Phone* on the base." Perhaps there's another model that comes in two pieces, but the Model VC105 is a one-piece unit.

Basically, you can simply route the video and audio outputs to your TV or VCR, or use the supplied antenna adapter to let the videophone share your TV's antenna input. A touch-tone telephone is connected to the base unit, and then a phone line is run from the ViaTV to the phone jack on the wall. The adapter must be set to use either channel 3 or channel 4. Both the TV and the telephone will continue to work as usual when not used to make video phone calls.

Dubbed "The Grandma Phone," the ViaTV Phone allows you to see your loved ones as you carry on a phone conversation.

Installation requires a phone and a television located in the same room—and, in looking for a second party to do an initial test of the units, we were surprised to find out just how many people do not have such an arrangement. Most of our friends and neighbors have the TV in the living room or family room, and phones in kitchens and bedrooms. Even though the 15- and 25-foot phone cords that 8×8 thoughtfully includes might be long enough to span the distance between two rooms, the camera won't be able to see you unless you're sitting more or less in front of the base unit.

Because we're always testing video and telephony products, we have TVs and phone jacks just about everywhere. In our office, installation was by the book—so we thought. However, the ViaTV box does not support the use of a two-line phone—an inexcusable oversight in our opinion. So, in routing our office phone through the ViaTV, we disabled one line. For the duration of our temporary test setup, we had to use a cordless handset to replace the disabled line.

That gave us an idea. Instead of running a phone wire across the living room, why not connect the set-top box to a cordless phone located just a few feet away from our TV's back panel—but in a different room. That setup works fine as long as the handset has a working touch-tone keypad, which is needed to operate the *ViaTV Phone* by selecting options from an on-screen menu.

There's one more thing to take into consideration when setting up the *ViaTV Phone*, and that's the room's lighting. The camera performs best in a bright, evenly lit room. It's not a good idea to sit in front of a window or bright light, because the back-lighting will throw your face into shadow.

To make a video call, turn on the TV and tune it to channel 3 (or 4), switch on the ViaTV unit, pick up the phone, and press the # key. At this point, you'll be able to see a "preview" of what the person on the other end will see. This allows you to adjust the camera angle or the room lighting, if necessary (and to see if your hair is combed properly or any dust-bunnies are showing). Dial normally, and when both of you are ready to start the video call, press the # key again to call up the "Start Video" menu on the TV. Pressing 1 activates the camera (the yellow light will come on) and initializes the video call. The process takes between 15 and 45 seconds, during which time the audio is muted. When the other party's image appears on your TV screen, the video-call connection is complete.

In our first test—with the highly unlikely scenario of using a videophone to talk to a person in the same house—we were amazed by the "preview," which appeared to be full-motion video. That's because it *was* full-motion; we were seeing ourselves exactly as the camera viewed us, with no processing. Even on a cloudy afternoon, we experienced problems with backlighting from two shuttered windows opposite the television. We were able to counter the effect somewhat by turning on bright lights elsewhere in the room, but our faces were still shadowed.

We placed our call to the second *ViaTV Phone*, located in the office on the opposite side of the house. That camera was not plagued by afternoon sun (although curtainless windows precluded morning video calls from that east-facing location), and the subject came in quite clearly. The 20-frames-per-minute speed seemed slow and awkward at first (especially after that full-motion preview), but once we began talking, we quickly got accustomed to it. It didn't take long to get used to hearing the other party's voice come through our TV speakers, instead of the phone, either.

Of course, a video phone call loses all its novelty when the person you're talking to is just a few yards away. For test purposes, however, we had to make sure that both phones were working properly before sending one unit out to a second party. We also needed to ascertain whether that second party (Grandma) would be able to install the unit on her end, or if our help would be needed. Although the installation is relatively straightforward, unless Grandma is accustomed to connecting electronics, it's probably best to plan on helping with the hookup. In our case, with her TV and phone located in a small study, installation and setup were quite simple.

The first video call was a treat for both Grandma and her three-year-old grandson. It's hard to say who got a bigger kick out of the experience of seeing each other while chatting on the phone. In this instance, the call was between New York City and Long Island. There was no difference in video quality. And, because the video is transmitted over phone lines, it doesn't matter how far apart the callers are; the quality remains the same—unless you're stuck with a bad connection and the modems can't connect at 33.6 kbps.

Although Grandma's study did not receive any morning sun, we still wanted to make some minor adjustments to the picture. One really cool feature of the *ViaTV Phone* is that if the other party is also using a recent model *8×8* videophone, your Model VC105 can remotely adjust their camera features as well! That would have come in handy in the movie *Mother*, in which Debbie Reynolds (playing the technophobic mother) could not manage to get herself into the picture when using the videophone that her son had given her and insisted she use.

Actually, it came in handy for us, too. Video adjustments are made using the phone keypad and the on-screen menu. Its options are view, size, quality, camera, and end (to end a video call). View allows you to choose the source of the picture you're watching: Remote for the other party, local for you, or both, to see the two views together on the screen. Selecting remote also gives you control over size, quality, and camera adjustments at the other end of the call.

The Size menu lets you determine the best size for the image (small, medium, or large), depending on your distance from the TV and the size of the TV monitor. The Quality control is used to choose which is more important on a particular call—frame rate or resolution. (This control works only if the videophone on the other end also supports variable frame rates and resolutions.) The faster the frame rate, the lower the resolution. In some cases, you might want speed (if you're watching your granddaughter's new dance steps); in others, you might prefer to see a more detailed image (a quiet conversation with a loved one). We found the sharp setting to be best suited for most video calls.

The Camera menu allows you to make adjustments on camera features including pan/tilt, zoom, and snapshot, as well as to set the video source and to activate the privacy mode. The pan/tilt option lets you move the camera up and down and right and left. The zoom option offers three modes: wide, normal, and telephoto. The snapshot option allows you to "capture" the current image so that it remains on screen for the rest of the call—in which case, you'd certainly want to be in sharp quality mode—or until you release it.

In our case, Grandma would rather not be bothered making adjustments and was all too happy to either leave all the settings the same at all times, or to let us handle any necessary changes—and we'd imagine that our situation is fairly typical. In fact, today's consumer videophones have been dubbed "Grandma phones," reflecting their primary target market. If you're thinking of buying a videophone at this early stage, it's quite likely that you will have the same model as the person on the other end. You'll probably either purchase your phone and a second one as a gift for a relative, or make the buying decision jointly with the other person to ensure that your phones will have the highest possible level of compatibility.

The *ViaTV Phone* offers a few other nice options and features. It allows you to use a speakerphone, so that you can be free to gesture with both hands and move around the room while talking. The VC105 uses echo suppression that's designed for normal phones, however; and that can conflict with the acoustic echo cancellation that most speakerphones incorporate. The *ViaTV Phone's* echo cancellation must be turned off (using the on-screen menus) when you plan to use a speakerphone.

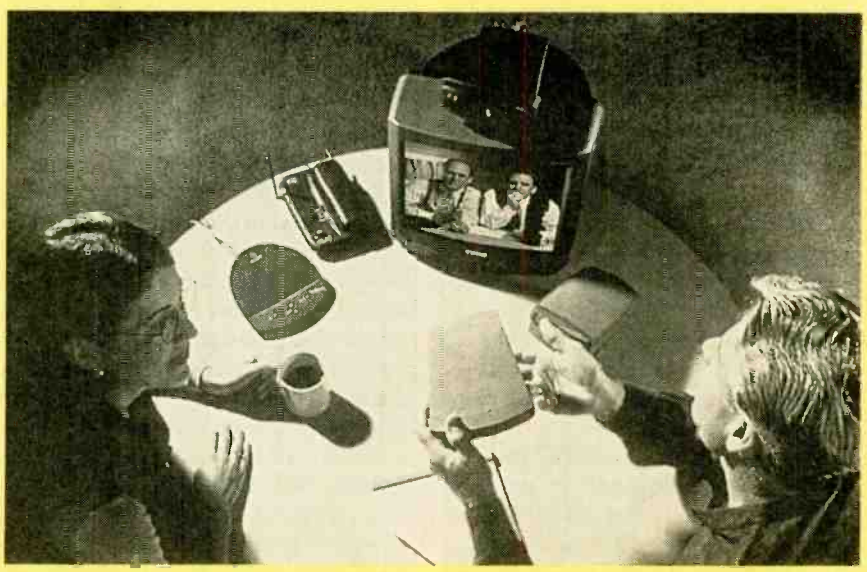
The videophone is compatible with Caller ID. If you subscribe to the service, the time, date, and phone number are displayed on screen between the first and second rings. If you aren't there to pick up the call, the *ViaTV Phone* remembers the number of the last call received and automatically displays it when you next pick up the phone. It's also possible to retrieve the same information about the last four callers identified by Caller ID.

The *ViaTV Phone's* auto-answer feature allows it to be used as a security monitor. Going to visit Grandma in Florida? While you're there, you can phone home and pan around the room in which the phone is located, to be sure that nothing's been disturbed.

Although it really is delightful to be able to see a loved one while talking long distance, there are a few downsides to the videophone concept in general, and to the *ViaTV Phone* in particular. The most obvious objection to the concept of video telephony, of course, is the fear of being caught barely dressed, with the house a mess, or in some other embarrassingly candid situation. Thanks to privacy mode, that fear is totally unfounded. Even if you had the ViaTV unit powered up and your TV on and tuned to the appropriate channel, the time it takes for the cameras to come on and the video to be initialized gives you plenty of time to select privacy mode (or just turn off the unit).

Another "problem" is more of an inconvenience: You must turn off Call Waiting if you have it. Come to think of it, that might be a benefit in disguise.

The real drawback to video phone



The ViaTV phone can be used for videoconfernce calls.

calls, in our opinion, is the need to stay put. We use cordless phones almost exclusively, and have become dependent on the freedom they offer. While we can remember the days when getting a phone call meant finding a comfortable seat and relaxing while focusing on a conversation with a friend, today's phone time is also used to feed the cats, empty the dishwasher, get dressed, clean up, put in a load of laundry, iron clothes, work at the computer, cook dinner, and do a hundred other mundane tasks. Maybe what we're calling a drawback is really a blessing—forcing us to take some down time—but we found it difficult to stay still for an entire call. Luckily, Grandma was more interested in talking to her grandson, whose phone-call attention span was greatly increased by the addition of video.

Perhaps videophones can do the opposite of what so many other technologies have done. Perhaps they can make us take the time to have a real, uninterrupted, face-to-face conversation with an important person in our lives.

By the way, now that computer superstore retailers, such as *CompUSA*, *CompuSmart* and *Data Vision Computer Video*, along with catalog retailers, have started to carry *ViaTV Phone*, the street price for the Model VC105 has dropped to around $349.

FOR THE RECORD

RECORD-A-CALL TELEPHONE HANDSET MODEL HR100. From Record-A-Phone Corporation, P.O. Box 220709, Great Neck, NY 11021; Tel. 800-521-8150. Suggested retail price: $79.95.

Recently, before driving to a not-very-local museum to see a special exhibit, we called to find out how late it was open and how to get there. The recorded directions were recited so quickly that we had to call back two additional times in order to get them all down on paper.

Today, we called an HMO for a list of member doctors whose practices are located in our area. This time, we didn't even bother with pen and paper. Instead, we replaced our telephone's handset with the *Record-A-Call*, a unique handset with its own built-in tape recorder. We simply recorded the list, then pulled out the local phone book and played back the recording, highlighting the names and numbers of the doctors on our plan.

The *Record-A-Call* is somewhat wider and deeper than a typical handset. Although its is the standard 8-inches long (allowing it to fit into most phone cradles and replace most handsets—except those that contain the phone's sole dial, since the Model HR100 has no keypad), it is about $2^1/_2$-inches wide and $2^1/_4$-inches deep (measured from the front of the speaker and microphone to the back of the handset). Other handsets might have similar overall dimensions, but they are generally sculpted to feel more compact. Of course, they don't have tape compartments built in or tape-recorder controls projecting from their sides.

The *Record-A-Call's* tape recorder controls are positioned for fingertip access when you're holding the phone in your right hand. The stop/eject, play, and record functions are controlled by a row of buttons; fast-forward and rewind are selected via a slide switch found below those buttons. Two dials on the opposite side of the handset are used to adjust volume and playback speed, and a slide switch is used to select the recording speed (SP or LP).

On top of the handset is a speaker, the tape well, and the battery compartment. Two AA batteries (included) are required. Inside the battery compartment is a microphone-match switch, labeled A and B.

The handset is designed to work with all brands of telephones, but different brands require different microphone settings. If you're using an *AT&T* phone, for instance, the mic-match switch should be set to the A position. *Panasonic* phones require the B position. For other brands, you can determine the correct setting by blowing or speaking into the handset, after it's been installed.

Installation is a simple matter of inserting the batteries, unplugging the old handset from its coiled cord, and replacing it with the *Record-A-Call*. Heavy-duty batteries will provide about five hours of recording/playback time, while alkaline batteries will extend it to about 12 hours. The battery LED, located next to the FF/REW slide switch, dims when batteries need replacing, but you're more likely to notice distortion during playback before then.

With the *Record-A-Call* handset in place, there's no difference at all in placing or receiving phone calls—except that the handset looks and feels a bit awkward at first, especially if it has replaced one of today's ultra-slim models. To make the replacement handset blend in as well as possible, the company offers it in black, white, or gray. As long as it matches the base, it doesn't look bad, even if it doesn't fit exactly.

To use the *Record-A-Call* for its intended function, a standard microcassette is required. They are available in 30-, 60-, or 90-minute lengths; a 60-minute *TDK* tape is included with the

handset. The tape speed can be set to standard play or long-play mode, which doubles the tape capacity to a maximum of 180 minutes. When you want to record a conversation, press REC and PLAY; that's all there is to it—from a technical standpoint, at least.

Legally, matters can be a bit more complex. A bright red warning is included with the user instructions: "In some states, taping a telephone conversation without the consent of all parties to the conversation may be a criminal offense. It is strongly recommended that you do not tape any telephone conversation without the consent of all parties to the conversation, unless you have consulted with an attorney as to any laws applicable to taping conversations in the relevant states or jurisdictions."

Of course, if you're using the *Record-A-Call* to record your mom's pot roast recipe, or the coach's directions to this week's soccer game, you're not likely to run into any legal dilemmas. If you're recording the confessions of someone who had an affair with a highly-placed political figure, on the other hand, you'd better get her okay before taping the calls. There are several situations that fall somewhere between the mundane and the sensational in which the *Record-A-Call* could come in handy—and in which the recordings made may or may not be legal, or admissible in a court of law, or publishable.

We asked a lawyer friend about the legalities of taping calls in those situations in New York, and learned that, unless the other party is told beforehand that you are going to tape the conversation, the recording would not be admissible here.

In our line of work—and in many others, we're sure—the *Record-A-Call* can simplify a number of tasks, none of which need involve lawyers. The *Record-A-Call* doubles as a "dictation machine," so that we could record spoken reminders to ourselves, or dictate a letter to be typed later. The built-in recorder would make easy work of telephone interviews with company executives or engineers, for instance, and would provide a good way to keep track of article assignments (number of words/pages, due dates, payments, *etc.*) from various editors and publications. We might not even have to divulge that the interview was being taped, as long as the subject knew that his comments were "for the record." If a dispute arose over article length, subject, or payment, we'd hope having a tape of the conversation would help settle any differences amicably.

We wouldn't even have to bring the tape into the editorial offices. The *Record-A-Call* allows you to play back a tape over the phone, allowing both parties to hear the original recording and to continue a normal conversation while it is playing. Another convenient playback feature allows you to adjust the playback speed so that when it comes time to write down directions to the museum, or that pot roast recipe, or the letter you dictated, you can keep up with the spoken words.

There is one drawback to actually using the *Record-A-Call*. By placing the tape mechanism so close to the handset's earpiece, the noise made by the turning motor is quite obvious.

In fact, in our tests, the person on the other end of the line could hear a tape being played back much more clearly than the we could via the *Record-A-Call* handset. Even using the loudest volume setting, the recorded conversations were barely audible at our end.

We suspected that our test unit was suffering from a glitch. When we tried unplugging the phone cord and using the speaker on the back of the handset, the recordings played back perfectly, allowing us to experience the convenience of phone recording, albeit one step removed. Every word was clearly heard, and the ability to slow the recordings to make notes was a big plus.

With a deadline looming, we were not able to try out a second *Record-A-Call* unit to experience what we hope will be glitch-free operation. Tune in next month for an update.

GIZMO NEWS

On-Line Shoppers

Think of men and shopping, and the typical image is a poor guy left sitting on a bench at the mall for hours, holding an ever-growing pile of packages accumulated by his wife (and possibly his kids). Men, for the most part, don't like shopping for the sake of shopping. If they need something, they'll go into a store and buy it, but they won't be tempted to cruise through the rest of the store just to see what's available.

Of course, that assumes that the store is a building, with display racks, mannequins, cash registers, *etc.*—and not an on-line marketplace. Internet shopping seems to appeal to men the way malls appeal to women.

According to a Connecticut-based market-research firm called *Plan*, men enjoy the process of Web browsing so much that they find themselves also browsing through merchandise. A person who might have made a quick foray into a record store to pick up a specific CD finds himself perusing all the available selections in an on-line music shop—and often ends up buying more than just the one disc he intended to purchase. And someone who becomes accustomed to using his credit card to make small purchases (books, CDs, flowers) over the Internet is more likely to feel comfortable with on-line orders of big-ticket items, from plane tickets to stocks and mutual funds.

Internet purchasing is definitely on the rise. About 7 million on-line households made electronic purchases in the second half of 1997. *Plan* found that on-line plane ticket reservations increased 300 percent in 1997, stock and mutual fund purchases jumped almost that much (291 percent), computer hardware sales grew 111 percent, and car rentals rose 105 percent.

White House Approves Enhanced GPS

The Global Positioning System (GPS) has always been, first and foremost, a defense system, designed to enhance the effectiveness of U.S. military forces. GPS also plays an important role in the emerging Global Information Infrastructure, used for mapping and surveying, international air-traffic management, and global change research. And it is gaining in popularity among civilian users, with the growing availability of vehicle and hand-held personal navigation systems.

There is an inherent conflict, however, between the need of consumer, scientific, civil, and commercial GPS users for accurate tracking, and nation-

al security—the Pentagon would prefer that potential enemies not be able to use our own tracking system against us. Orbiting GPS satellites send signals that give their location and the time of transmission. Earth-based receivers use that information to determine their own positions, based on how far away the satellites are and the time difference among arriving signals. The Pentagon, which has spent $10 billion on the GPS system, actually inserts errors into the GPS timing signal. Military GPS receivers filter out the errors, which make non-military receivers less accurate. This is known as Selective Availability (SA).

The White House recently approved the addition of two new civilian GPS signals (one located near the frequency of the current GPS L2 signal, the other frequency not yet defined) that will significantly enhance the effectiveness of civilian GPS systems. When the new satellites are launched (about five years from now), even the least expensive GPS receivers will be able to pinpoint a location to within 33 feet — almost ten times better than the within-325-feet accuracy promised by today's inexpensive units (actual accuracy usually ranges from about 1150 to 160 feet). The White House Plan calls for Selective Availability to be phased out within the next ten years. Instead, in the event of war or other disaster, the new system would be able to eliminate service in specific areas as needed.

Although today's GPS receivers will be able to handle the new signals, the enhanced GPS system will compensate for the distortion of radio signals in the ionosphere by sending signals on two radio frequencies. Because each of the frequencies would be affected differently by the distortion, a new GPS receiver would be able to compare the two, calculate the extent of the distortion based on the differences between the two signals, and make the necessary corrections.

The White House announcement was greeted with enthusiasm by the United States Global Positioning System Industry Council (USGIC). "We believe that this decision sets the stage for continued technical evolution of GPS, and its augmentations, to meet the dynamic needs of users worldwide," said Charles R. Trimble, Chairman of the USGIC and president and CEO of *Trimble*, a GPS manufacturing firm.

Charles Boesenberg, UGSIC director and president and CEO of another GPS company, *Magellan, Inc.*, noted, "Today information technologies arrive at a rapid rate. Sustaining long-term growth is the real challenge. This decision demonstrates that a stable policy-making process exists and is one that can handle future challenges."

According to Paul A. Rauschelback, VP of Technology, Space, and Aviation Control for *Honeywell, Inc.*, and a USGIC director, "Immediate beneficiaries will be public safety of the international aviation and maritime user communities. The real significance is that users worldwide can be confident that GPS will continue to grow and evolve to meet their needs as a global information utility."

Cable TV Meets DTV

The National Cable Television Association's (NCTA) Cable '98 conference, held this spring in Atlanta, Georgia, was marked by discord sparked by the industry's imminent conversion to digital television (DTV). The night before the conference's opening, the NCTA and the Consumer Electronics Manufacturers Association (CEMA) released a list of eight specifications with which all cable-ready DTVs must comply. To ensure compatibility, cable-TV multi-system operators (MSOs) also will have to abide by the standards.

The specifications require compliance with the ATSC Digital TV Standard A/53, which describes end-to-end system characteristics and EIA-23 RF performance recommendations. Systems must also tune channels according to EIA-542 specifications; support MPEG-2 packetization, use in-band Program and System information Protocol for definition of V-chip information and on-screen program guides; use only the transmission video display formats from ATSC A/53 Table 3; support emergency messaging services; and use only 64/256 Quadrature Amplitude Modulation or 8 Vestigial Sideband Modulation (VSB), although 16 VSB might be an option.

The cable industry, while resigned to the coming of digital broadcasts this November, is not pleased with the prospect of mandatory implementation of the specifications. The "must-carry" issue focuses on whether cable operators will be required to pass all DTV formats through to viewers. Broadcasters want their digital signals to be relayed with no loss of resolution. Cable operators are concerned that, faced with limited capacity, they will be forced to drop channels to comply with the regulations.

FCC Chairman William Kennard advised the industry that if it isn't ready to roll with DTV in November, it will face regulatory action. Speaking at the NCTA conference, Kennard said, "My preference is to allow the market to work these resolutions out, but fundamentally my job is to do everything I can to promote choice and competition. If the industries don't move quickly to reach solutions, then government must step in." Under the 1996 Telecommunications Act, the FCC is required to ensure that digital set-top boxes are commercially available in a timely manner. At press time, Kennard planned to propose an order that implements the DTV requirements at the FCC's June meeting.

John Malone, chairman of *Tele-Communications Inc.*, threw a wrench into the proceedings by announcing that TCI will not support the interlaced-scanning formats that CBS and NBC plan to use. Malone, along with TCI president Leo Hindery, said that TCI, Fox, and ABC "encourage progressive scan as the transmission format of HDTV, for reasons of bandwidth and spectrum efficiency, customer economics, and picture quality." TCI plans to use a *General Instrument* digital set-top box that has the ability to pass through to HDTV receivers all DTV formats.

CEMA president Gary Shapiro responded to Malone's comments with a call for the FCC "to enforce the must-carry laws for HDTV to succeed."

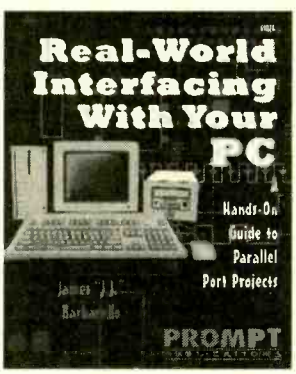
For now, the FCC is willing to let the industries work out their differences on the must-carry issue, and let the cable industry decide upon an open architecture for the set-top boxes—although they must do so quickly. "The clock is ticking," Kennard warned at Cable '98. ■

Electronics Library

REAL-WORLD INTERFACING WITH YOUR PC: A HANDS-ON GUIDE TO PARALLEL PORT PROJECTS

by James J. Barbarello

The uses and applications of personal computers continue to grow. Interfacing is the next wave for those who want to use their computers for things other than manipulating text, data, and graphics; and the parallel port is the key. Although the parallel-port is a general-purpose input/output device, it can be used for things like operating an analog-to-digital converter or for building a swipe-card system that provides entry via an electronic door lock.



Written by frequent **Popular Electronics** contributor J.J. Barbarello, this book is a hands-on guide to parallel-port projects. Geared to electronics hobbyists, this book provides a basic understanding of writing software that controls the parallel port hardware. It walks the reader through an entire analog-to-digital converter project, from design to construction to checkout.

A chapter on project construction techniques, a checklist for easy reference, as well as a recommended inventory of starter electronic parts helps less-experienced readers get started. *Real-World Interfacing With Your PC: A Hands-On Guide To Parallel Port Projects costs $16.95, and is published by Prompt Publications, 2647 Waterfront Parkway, East Drive, Suite 300, Indianapolis, IN 46214-2041; Tel. 800-428-7267; Web: www.hwsams.com.*

CIRCLE 90 ON FREE INFORMATION CARD

DISCOVER DXing! HOW TO HEAR DISTANT AM, FM & TV STATIONS: SECOND EDITION

by John Zondlo

By way of a non-technical introduction, *Discover DXing!* will help you hear more far-away stations on the AM, FM, and TV bands, using equipment you already own. DX, as most of our readers know, is a ham-radio term that means distance, and DXing is the challenging hobby of listening to distant stations.

The expanded second edition is written in a conversational style that makes this book as easy to read as it is informative. Topics covered in this concise book include propagation, seasonal conditions, equipment, antennas, and reference materials. Obtaining verifications (QSLs), keeping a log, and finding radio clubs are among the other subjects discussed. It also includes a list of AM clear channel stations, as well as a list of VHF TV stations

The author suggests best bets for hearing all fifty states on the AM band. (See mention of this book in the *DX Listening* column in this issue.) In addition, in another chapter, he gives tips on hearing your first ten foreign countries on AM.

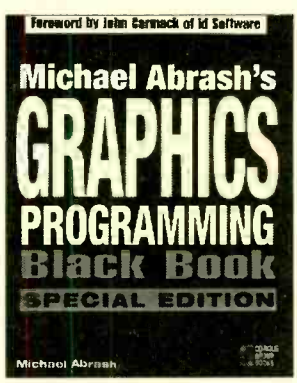
Discover DXing! How To Hear Distant AM, FM & TV Stations: Second Edition costs $5.95, and is published by Universal Radio Research, 6830 Americana Parkway, Reynoldsburg, OH 43068, Tel. 800-431-3939 or 614-866-4267; Web: www.universal-radio.com.

CIRCLE 91 ON FREE INFORMATION CARD

MICHAEL ABRASH'S GRAPHICS PROGRAMMING BLACK BOOK, SPECIAL EDITION

by Michael Abrash

The Black Book series offers high-level answers for advanced problems. They are not intended as project books or beginning-level tutorials. The author is considered a leading graphics guru who has done more than anyone else to conquer the performance limitations of the PC. This special edition contains virtually everything he has ever written about performance coding and real-time graphics. His Zen books are included in their entirety (*Zen of Assembly Language, Zen of Code Optimization,* and *Zen of Graphics Programming*). New material on the graphics technology behind Quake is included as well. The 1342-page book is organized by topic and has an excellent index.



Readers will gain insight on *Intel* code performance tuning, from registers and pipelining to branch prediction. Also covered is the theory and practice of seamless, flicker-free, real-time 2D- and 3D- animation, using state-of-the-

(Continued on page 68)

New Products

WORLD-BAND COMMUNICATIONS RECEIVER

The *R. L. Drake Company* recently announced their latest product in world-band communications technology—the *R8B World-Band Communications Receiver*. Designed and engineered to meet the highest expectations of SW enthusiasts, the R8B is simple enough in operation for the beginner, yet equipped with high-powered features for the hobbyist and the expert.

The receiver's selectable sideband synchronous detection ensures that signals are received loud and clear. In AM mode, the synchronous detector enhances reception by eliminating or reducing distortion. In cooperation with multiple filters and passband offset, this feature gives the listener superior audio quality.

The R8B has 1000 memory positions for conveniently storing frequency, bandwidth, and mode data. Multiple scan functions allow the user to easily scan frequencies or selected memories by carrier, time, or seek modes. Memories are stored on an electronically erasable memory chip that does not require battery backup and retains information in the event of a power loss.

Coverage of all world bands is provided by the receiver's wide frequency range—100 to 30,000 kHz. (Additional VHF bands—35–55 MHz and 108–174 MHz, including marine and aircraft bands—are also available with an optional VHF converter.) The receiver's five built-in filter bandwidths ensure reception of most signals under virtually any conditions, eliminating having to purchase more equipment or extras.

The R8B offers a complete package that includes sequential tuning through all memory preset channels; and several built-in features, among which are a noise blanker to minimize electrical interference and a pre-amp and attenuator that improves reception of both very weak and very strong signals. Other features that improve performance are the passband offset—particularly useful for clarifying reception of distant signals—and a selectable AGC delay to receive weak or fading signals.

Sensible front-panel ergonomics are found in the R8B, such as keypad entry of all functions, including mode and bandwidth. Large, legible controls and selectable kHz and MHz display modes are provided on the receiver. An alphanumeric LCD can be customized for a seven-character display of broadcast station names, in addition to displaying frequency.

A built-in multi-voltage power supply permits operation virtually anywhere. A RS232C serial interface, a tone control, a removable power cord, two clock timers, a built-in speaker, dual antenna inputs, a mute switch for use with a transmitter, and a headphone jack are included with the receiver.

The *R8B World-Band Communications Receiver*, which weighs 13 pounds and measures approximately 5- by 13- by 13-inches, costs $1199. For more information, contact *R. L. Drake Company*, 230 Industrial Drive, Franklin, OH 45005; Tel. 513-746-4556; Fax: 513-743-4510; Web: *www.rldrake.com*.

CIRCLE 80 ON FREE INFORMATION CARD

ISOLATED AC POWER SUPPLY

Meant for circuit design and development, the *Global Specialties* Model 1505 is a continuously variable, triple-isolated dual-output AC power source. It features two outputs of 0–150 VAC @ 4 amps and 0–260 VAC @ 2 amps. The *Isolated Variable AC Line Supply Model 1505* is intended to be used with a 115–120 VAC @ 60 Hz input. The 1505's circuit design allows for cleaner, more efficient operation, which significantly reduces the amount of heat generated by the power supplies, even under full load.

The instrument has applications in electronic laboratories, as well as in production-line testing and repair facilities, hospitals, schools, and universities. The isolation transformer's output voltage is continuously adjustable throughout its entire range, and it is triple isolated from the input line to protect against shock hazard.

The digital-output panel meter provides a 3-digit reading. Power-line leakage up to 9.99 mA can be measured by means of a selectable range probe that can be plugged into a convenient front-panel outlet, and the resulting reading is displayed on the meter.

Features of the Model 1505, which weighs 30 pounds and measures approximately 11- by 5- by $10^1/_2$-inches, include capacitive coupling less than 0.0005 pF, galvanic leakage less than 10 μA, and 120 dB noise attenuation. The unit is fully protected by fuses in the primary and secondary windings.

The *Model 1505 Isolated Variable AC Line Supply* has a list price of $610. (Other models in the series, the 1504 and 1506 have list prices of $425 and $635, respectively). For more information, contact *Global Specialties*, 70 Fulton Terrace, New Haven, CT 06512; Tel. 800-572-1028; Fax: 203-468-0060; Web: *www.globalspecialties.com*.

CIRCLE 81 ON FREE INFORMATION CARD ■

"If you are so worried about computer security, why don't you try using a password other than 'Open Sesame'!"

AUTOMATIC BLOWER CONTROL

Modernize your warm-air furnace with this easy-to-build circuit, which allows maximum heat to be extracted from your heating unit.

ANTHONY J. CARISTI

Imagine getting heat from your furnace less than one minute after you get up on those cold winter mornings! Of course, modern state-of-the-art, warm-air furnaces use electronic-timing circuitry to control the operation of the unit's blower motor. Those who are fortunate enough to live in homes heated by such furnaces know what a *blessing* they can be—they can be set so that the furnace warms the house just prior to your family's wake up time. But for those whose warm-air furnace is more than just a few years old, it is necessary to make their way to the thermostat to crank up the heat. (Older furnaces rely on a thermostatic switch to turn the blower on and off.)

If your home is heated by one of the older furnaces, why not modernize it with the *Automatic Blower Control* described in this article. The Automatic Blower Control uses a preprogrammed timer to control blower operation. Not only does the circuit enhance creature comforts, but it saves fuel as well.

In older furnaces, a bonnet or plenum must be heated to well over 100 degrees Fahrenheit before the blower is allowed to operate. During that time, no heat is delivered to the living spaces of the home, as precious energy ($$$) goes up the chimney. The solid-state control described herein is designed to simulate the operation of the newest warm-air furnaces available. Its dual timing circuit provides almost instant blower operation, and that operation is sustained

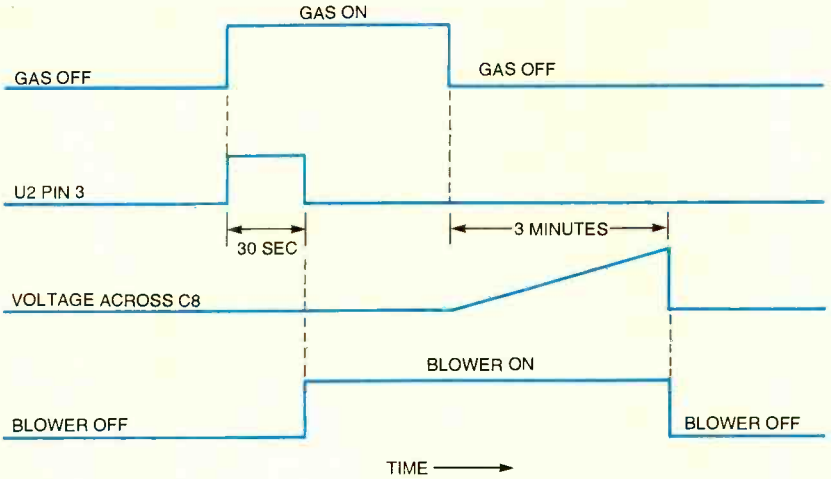


Fig. 1. This timing diagram illustrates the operation of the circuit. When the furnace is activated in response to the thermostat, a 30-second delay is initiated. At the end of that delay, the blower is energized, sending warm air to the living areas of your home.

as long as the burner is going.

When the thermostat setting is reached, the burner extinguishes, but the blower continues to operate for three minutes or more to extract as many BTUs (British Thermal Units) from the heat exchanger as possible. In addition, the circuit provides continuous air circulation, which is the recommended type of operation for warm-air furnaces.

How It Works. The operation of the circuit is straightforward. The timing diagram in Fig. 1 illustrates the operation of the circuit. When the furnace's gas valve is activated in response to a command from the thermostat, a 30-second delay is started. At the end of that time, the

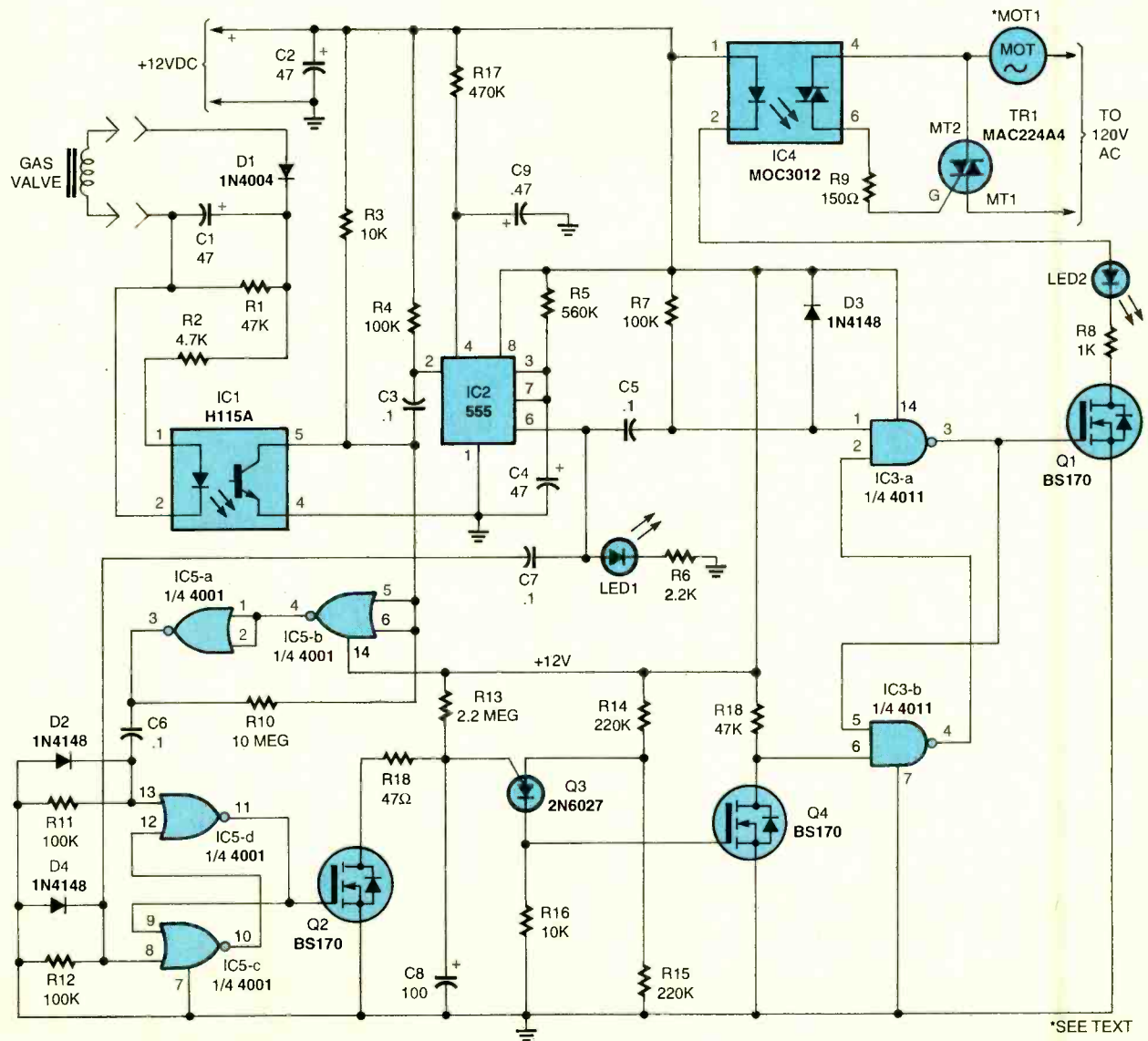


Fig. 2. The Automatic Blower Control is comprised of five ICs, three TMOS FETs, a PUT, a Triac, a pair of LEDs, several diodes, and assorted support components.

blower is energized, sending warm air to the living areas of your home.

When the gas valve turns off, a second timing cycle is initiated. At the end of the second cycle, the blower is turned off unless the gas valve has been re-energized in response to the thermostat setting. The circuit, which contains a pair of LEDs for self-diagnostics, is totally isolated from the furnace wiring by a pair of optoisolator/couplers. The circuit's solid-state construction precludes the need for relays.

About The Circuit. A schematic diagram of the Automatic Blower Control is shown in Fig. 2. In that circuit, D1, C1, and R1 form a half-wave rectifier circuit that is fed from voltage (24 volts AC) present across the gas valve when the burner is operating. When the gas valve opens, C1 charges to about 35 volts DC, and when it closes, that voltage falls to zero.

The voltage across the gas valve is fed to an optoisolator/coupler (IC1), which has a phototransistor output. During burner operation (gas valve open), IC1's internal LED is illuminated, causing its phototransistor output to be switched on. That pulls the voltage at pin 5 of IC1 to zero. At all other times, the transistor is at cutoff, and the output of IC1 at pin 5 remains at V_{DD} (12 volts DC).

A 555 oscillator/timer (IC2) configured as a one-shot or monostable multivibrator provides a timed pulse output of about 30 seconds, as determined by an RC network, consisting of R5 and C4. When the gas valve is first powered, the negative-going wavefront appearing at pin 5 of IC1 is coupled to the trigger input of IC2 through C3. That causes the output of IC2 at pin 3 to rise to V_{DD} for about 30 seconds. At the same time, LED1 is activated, indicating that IC2 has been triggered.

Half of a 4011 quad 2-input NAND gate (IC3-a and IC3-b) are wired as a bistable multivibrator. The logic levels at the outputs of the two gates (pin 3 of IC3-a and pin 4 of IC3-b) are always opposite to each other. Under normal operating conditions when the circuit is powered and the gas valve is off, the output of IC3-a at pin 3 is low.

When the 30-second delay provided by IC2 has elapsed, its pin 3 output goes low, causing the output of the bistable circuit to toggle to its opposite state. At that point, pin 3 of IC3-a goes high. That high is fed to the gate of a BS170 TMOS FET (Q1), causing it to turn on. With Q1 turned on, LED2 lights, providing a visual indication that IC4 has been energized. At the same time, the Triac-driver output of IC4 turns on, applying a voltage to the gate of Triac TR1, causing it to turn on.

The furnace's blower motor is connected in series with the AC power line and the main terminals (MT1 and MT2) of TR1, so that when TR1 is activated, the blower motor turns on. The blower motor remains in operation until a shut-down command is received.

Two sections of a 4001 quad 2-input NOR gate (IC5-c and IC5-d) are connected in a bistable circuit, similar to that formed by IC3-a and IC3-b. In this case, however, a positive-going pulse applied to pin 13 or pin 8 of IC5 toggles the bistable circuit from one state to the other. Each time IC2 is activated by the opening of the gas valve, the rising wavefront of the 30-second timer causes the bistable circuit to be placed in the reset condition, with pin 11 of IC5-d at logic one (high). That high is applied to the gate of TMOS FET Q2, forward biasing it and pulling its drain voltage to zero.

When the thermostat setting is satisfied, the gas valve closes, producing a positive-going wavefront at pin 5 of IC1, which is coupled to pin 13 of IC5-d—causing pin 11 of IC5-d to go to zero. That, in turn, deactivates Q2.

Components R13–R16, C8, and Q3 (a programmable unijunction transistor or PUT) form a relaxation oscillator, which has a period of about 3 minutes, as determined by R13 and C8. When Q2 is cut off, C8 is allowed to charge through R13. Resistors R14 and R15 form a voltage-divider network, which provides a bias voltage of about $^1/_2V_{DD}$ to the gate of Q3.

When the voltage across C8 exceeds the gate voltage, Q3 fires and the charge stored in the capacitor is suddenly dumped to R16. The resulting voltage spike across the resistor forward biases Q4, causing its drain voltage to fall to zero. The negative-going trigger pulse generated at the drain of Q4 is fed to pin 6 of IC3-b, setting the bistable latch to the off condition. That, in turn, shuts down Q1, IC4, and the blower motor. The dual-timing cycle repeats when the thermostat again calls for heat.

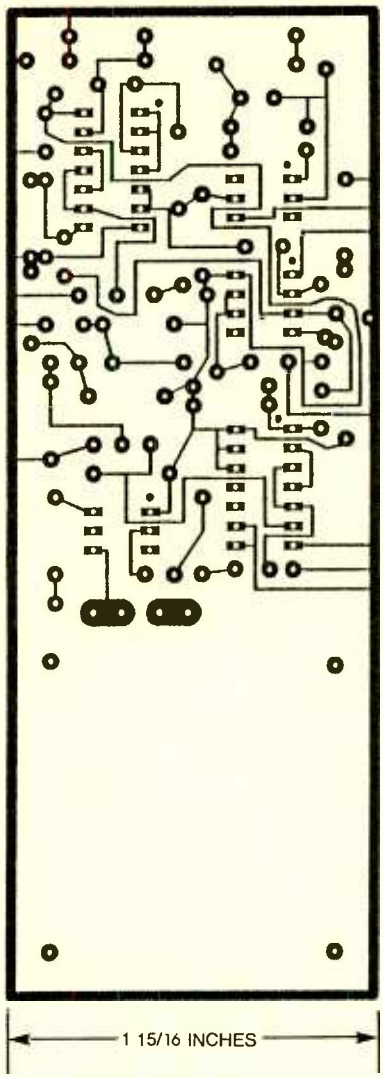


Fig. 3. The author's prototype of the Automatic Blower Control was assembled on a printed-circuit board, measuring $1^{15}/_{16}$ by $5^1/_8$ inches, a full-size template of which is shown here.

Power to operate the circuit—which draws less than 25 mA of current—is provided by a standard 12-volt DC wall transformer.

Construction. The author's prototype of the Automatic Blower Control was assembled on a printed-circuit board, measuring $1^{15}/_{16}$ by $5^1/_8$ inches. A full-size template of

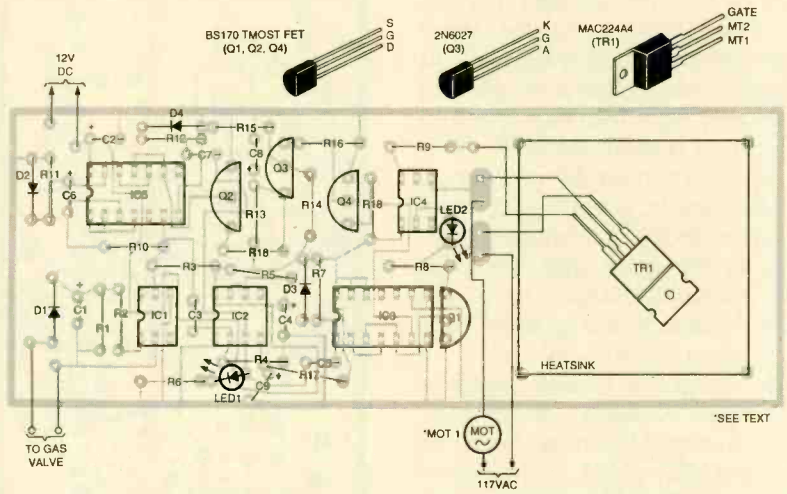


Fig. 4. Once you've gathered all the parts listed in the Parts List, assemble the printed-circuit board guided by the parts-placement diagram shown here.

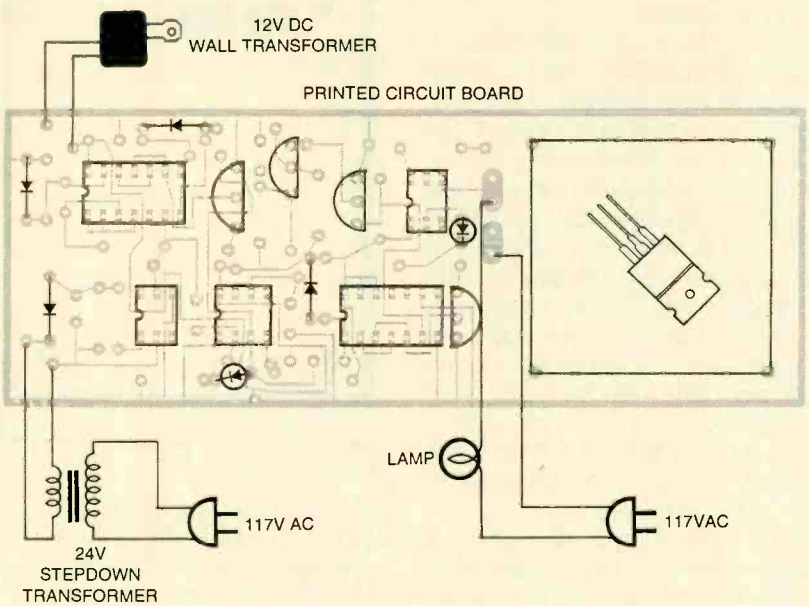


Fig. 5. The circuit can be bench tested using an ordinary 100-watt incandescent lamp in the arrangement shown here.

the printed-circuit layout is shown in Fig. 3, for those who prefer to etch their own board. For those who'd rather not etch their own board, a drilled and etched board is available from the source given in the Parts List.

Once you've gathered all the parts listed in the Parts List, assemble the printed-circuit board guided by the parts-placement diagram shown in Fig. 4. Since the Triac will be called upon to dissipate several watts (depending upon the size of the blower motor), the Triac requires a heatsink. Although the builder has the option of using any heatsink capable of dissipating the heat generated, a suitable one is suggested in the Parts List. Bear in mind that the metal tab of the Triac is electrically hot, so it and the heatsink must not be shorted to any part of the circuit or furnace.

Note: All polarized components such as semiconductor devices and electrolytic capacitors must be properly oriented. Just one part placed backwards in the board will render the circuit inoperative and may cause damage to one or more components. The integrated circuits should be soldered directly to the printed-circuit board for reliable

PARTS LIST FOR THE AUTOMATIC BLOWER CONTROL

SEMICONDUCTORS

D1—1N4004 1-amp, 400-PIV silicon rectifier diode
D2, D3, D4—1N4148 or similar, general-purpose silicon diode
IC1—H11A5 transistor-output, optoisolator/coupler, integrated circuit
IC2—LMC555CN CMOS oscillator/timer, integrated circuit
IC3—CD4011BE CMOS quad 2-input, NAND-gate, integrated circuit
IC4—MOC3011 zero-crossing, Triac-out put, optoisolator/coupler, integrated circuit
IC5—CD4001BE CMOS quad 2-input, NOR-gate, integrated circuit
LED1, LED2—General-purpose, light-emitting diode
Q1, Q2, Q4—BS170 N-channel enhancement TMOS FET
Q3—2N6027 programmable unijunction transistor
TR1—MAC224A4 400VDRM, 40-amp Triac

RESISTORS

(All fixed resistors are 1/4-watt, 5%, carbon units, unless otherwise noted.)
R1—47,000-ohm
R2—4700-ohm
R3, R16—10,000-ohm
R4, R7, R11, R12—100,000-ohm
R5—560,000-ohm
R6—2200-ohm
R8—1000-ohm
R9—150-ohm
R10—10-megohm
R13—2.2-megohm
R14, R15—220,000-ohm
R17—470,000-ohm
R18—47-ohm

CAPACITORS

C1, C2, C4—47-µF, 50-WVDC electrolytic
C3, C5, C6, C7—0.1-µF, ceramic-disc
C8—100-µF, 16-WVDC, low-leakage electrolytic
C9—0.47-µF, 50-WVDC electrolytic

ADDITIONAL PARTS AND MATERIALS

Printed-circuit materials, 12-volt DC, 200-mA wall transformer (Digi-Key T509 or similar), heatsink (Mouser 532-500403B00 or similar), heatsink compound, optional enclosure, hookup wire, solder, hardware, *etc.*

Note: The following parts are available from A. Caristi, 69 White Pond Road, Waldwick, NJ 07463: An etched and drilled printed-circuit board for $12.75; IC1, IC2, IC3, IC4, IC5 for $2.50 each: Q1, Q2, Q3, Q4 for $2.00 each; and TR1 for $6.75. Please add $5.00 postage/handling.

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bility, since the circuit will be subjected to any possible vibration of the furnace while the blower is operating. Before soldering, be absolutely sure that each IC is properly oriented as illustrated in Fig. 3. Be careful; it is difficult to remove an IC from the board once it has been soldered in place.

Capacitor C8 should be a low-leakage electrolytic type. Ordinary electrolytics may have too much leakage current to permit the capacitor to charge during the 3-minute time frame. **Note:** The timing of Q3 can be increased or decreased as desired by using a larger or smaller capacitance value for C8. Timed cycles over 6 minutes are not recommended.

Be very careful when handling the Triac. If the leads need to be bent slightly, be sure that the bends take place away from the plastic body of the part. That helps to avoid any possible damage due to stress. To perform the bending operation, it is best if two long-nose pliers are used. Use #18 gauge wire for the power connections (MT1 and MT2) and be absolutely certain that the wiring to the Triac is correct: Follow the pinout diagrams in Fig. 4 to ensure that the Triac is properly connected to the circuit.

The Triac should be mounted to the heatsink using suitable hardware and heatsink compound. No insulator is required, but bear in mind that the heatsink will be electrically hot. It therefore must not touch any other component or metal part of the furnace.

When the printed-circuit board is completed and the Triac securely mounted to its heatsink, examine the assembly very carefully for opens, short circuits, and bad solder connections—which may appear as dull blobs of solder. Any solder joint that is suspect should be redone by removing the old solder with desoldering braid, cleaning the joint, and carefully applying new solder. It is far easier to correct problems at this stage rather than later on if you discover that the circuit does not work.

If desired, the circuit board may be housed in a small covered plastic enclosure to protect it from dirt and inadvertent short circuits. Remember, the heatsink will need some air flow to keep the Triac from overheating. Drill holes in the sides of the enclosure for air flow, and for the power input and output leads. Using 105°C insulated stranded wire for these connections is recommended. Remember the blower draws several amperes from the power line; do not use wire smaller than #16 to wire the Triac. If possible use different color wires to help avoid mistakes.

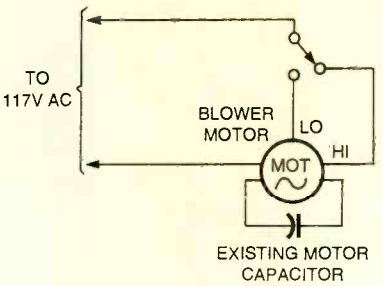


Fig. 6. There are hundreds of models of warm-air furnaces in use today, most of which have either a single-speed or multi-speed permanent split-capacitor blower motor. A typical permanent split-capacitor setup is shown here.

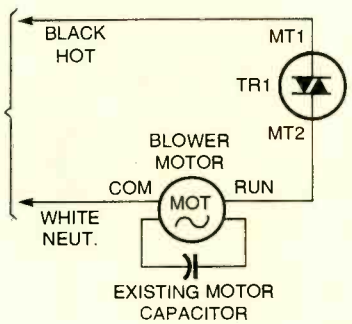


Fig. 7. In this single-speed-motor blower circuit, wires to the existing plenum thermostatic switch are rewired to the MT1 and MT2 terminals of TR1 in the Automatic Blower Control.

Do not connect the circuit to the furnace at this time. The assembly must first be checked to ensure that it is operating properly.

Preliminary Test. The circuit can be bench tested prior to being connected to your furnace using an ordinary 100-watt incandescent lamp to simulate the blower motor. To test the circuit, you'll need (in addition to the 100-watt incandescent lamp) a 24-volt step-down transformer to simulate the 24-volt gas-valve power, and a DVM or VOM to measure voltages. To set up the test, wire the circuit as shown in Fig. 5.

CAUTION: The circuit is powered directly from the AC line. Be very careful not to touch any of the power Triac wiring while AC voltage is coursing through the circuit.

Apply 12 volts DC to the power input of the circuit, using a wall transformer. Be sure to observe proper polarity when connecting the power source to the circuit. If LED1 and/or LED2 comes on when power is first applied, allow a few minutes for the circuit to complete its cycle, and for both LEDs to extinguish.

Apply 117 volts AC to the Triac and lamp circuit. The lamp should be off. Then apply 24 volts AC to the gas-valve terminals of the board. Note that LED1 comes on for about 30 seconds. When LED1 goes out, LED2 should come on and the 100-watt lamp should light to full brilliance.

After a minute or two, remove the 24-volt AC source from the gas-valve terminals of the board, while glancing at your watch. After about 3 minutes, LED2 and the lamp should go out.

If the board is operating as described, it is ready to be connected to the furnace. If not, take the following steps to locate and correct the fault. First check the 117-volt AC, 24-volt AC, and 12-volt DC sources to ensure that they are delivering power to the circuit. If LED1 does not light, check the orientation of LED1, D1, C1, IC1, and IC2. Verify that IC1 pin 5 is at +12 volts without 24 volts AC applied to the gas-valve inputs of the circuit board, and that it goes to zero when it is. Check all components associated with IC1 and IC2, and try new chips if all else fails. Do not proceed until LED1 is operating properly.

If LED2 does not light when LED1 goes out, check IC3, IC4, D3, Q1 and the orientation of LED2. Try replacing the chips. If LED2 operates properly, but the lamp does not light, check the bulb to be sure it is not burned out. Check TR1 and verify that its three wire leads are properly connected to the circuit and not shorted to each other. Check IC4 for the proper part number. Try replacing TR1 and IC4.

If the lamp comes on properly, but does not shut off at the end of

the second timed cycle, check IC5, Q2–Q4, D2, D4, and all associated components. Be sure that C8 is oriented properly in the circuit and does not have excessive leakage current. Monitor the voltage across C8 to verify that it charges to about $7\frac{1}{2}$ volts when the 24-volt AC source is removed from the circuit, then falls to zero when Q3 fires. Try replacing IC3, IC5, Q2–Q4. Check the Triac's wiring.

When the fault has been located and corrected, the circuit is ready for installation into the furnace.

Gas-Valve Connection. Before connecting the Automatic Blower Control to the furnace, turn off power to the furnace system at the emergency switch and locate the two wires that feed 24 volts AC to the gas valve. Those wires are energized only when the thermostat calls for heat.

After locating the wires, turn furnace power on, and using a DVM or VOM set to AC volts, verify that there is 24 volts AC across them when the thermostat is set as high as it will go. Then set the thermostat as low as it will go and check that the voltage falls to zero.

The two existing wires on the gas valve are left in place, and a second pair is attached. Using flexible insulated wire rated at 105°C, connect the GV terminals of the printed-circuit board to the gas valve's power source.

Installation. First, disconnect power from the furnace by placing the emergency switch and circuit breaker in the off position. Then locate the two blower control wires that are connected to the existing plenum thermostatic switch. Disconnect those two wires from the switch.

There may be literally hundreds of models of warm-air furnaces in use today, so it is not possible to address each and every one. However, most furnaces have either a single-speed or multi-speed permanent split capacitor (PSC) blower motor. A typical permanent split capacitor setup is shown in Fig. 6. Units that are designed to handle air conditioning as well as heating usually have a two-, three-, or four-speed motor that is automatically set to high speed for cooling and low speed for heating via a switching relay.

Figures 7 and 8 illustrate two typical blower motor wiring diagrams,

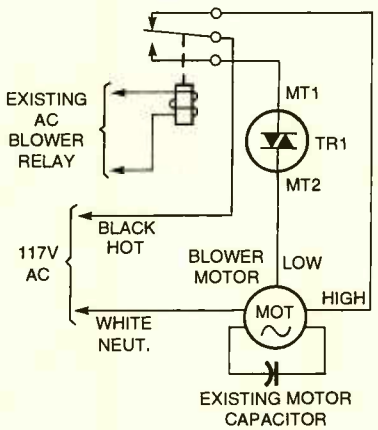


Fig. 8. Furnaces that are equipped for central air conditioning should be wired as shown here. Note that in this arrangement the high-speed terminal of the motor is energized by a relay, while low speed is operated by TR1 for heating only.

using TR1 as the off/on switch. In the single-speed motor circuit shown in Fig. 7, wires to the existing plenum thermostatic switch are disconnected and then wired to the MT1 and MT2 terminals of TR1. Since the control circuit is optically isolated, the polarity of the wires is inconsequential.

Furnaces that are equipped for central air conditioning should be wired as shown in Fig. 8. In that illustration, the high-speed terminal of the motor is automatically energized by a relay when the compressor is powered. Low speed is operated by TR1 only for heating. The high-speed circuit should not be changed when wiring the blower control into the furnace.

The builder has the option of mounting the printed-circuit assembly inside the cabinet of the furnace, or mounting it externally. If external mounting is selected, the assembly must be placed in a small enclosure to prevent electrical shock and short circuits.

When the wiring is completed, check it thoroughly to be sure it is 100% correct as shown in Fig. 7 or 8.

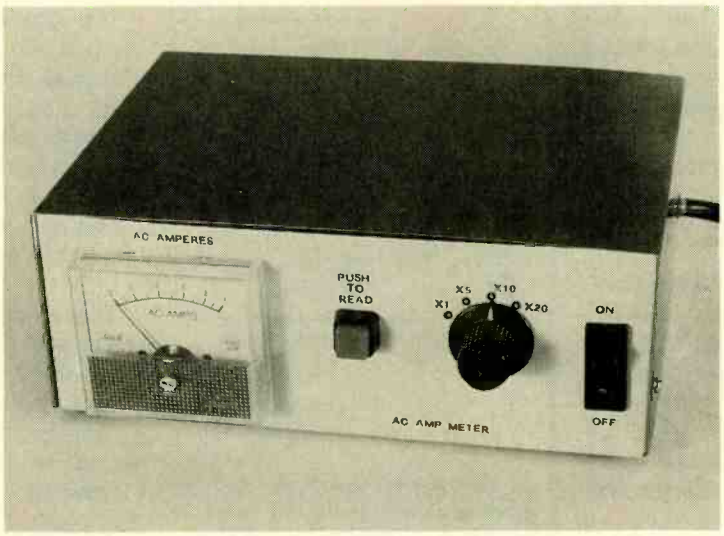
Final Test. Set the room thermostat down as far as it will go. Apply 12 volts DC to the board. If LED1 and/or LED2 light, allow a couple of minutes for the timed cycles to finish. Turn furnace power on. Initially, the blower should be off. Then set the thermostat as high as it will go. The gas burner should come on. About 30 seconds later the blower should come on. Wait a couple of minutes, and then turn the thermostat as low as it will go to extinguish the gas burner. The blower should continue to operate for about three minutes, and then shut off. That completes the final test.

Thermostat Heat Anticipator. To further enhance your comfort, it would be desirable to attain continuous air circulation—the recommended mode of operation during cold weather conditions. The most desirable type of furnace operation is to allow the burner to operate in short cycles (a minute or two at a time) as opposed to long ones. In that way, the gas burner cycles off and on during the three-minute, blower-delay cycle, keeping the motor in operation until the shut-off command is generated by the second timing circuit.

Continuous air circulation can be accomplished using the adjustable heat anticipator feature of most thermostats. The heat anticipator is a small rheostat that is connected in series with the contact wiring of the thermostat. When the gas valve is energized, the I_R drop across the rheostat causes it to heat up, fooling the thermostat into thinking that the room is warmer than it really is. As a result, the gas is turned off before the furnace can overshoot and make the room too warm.

Set the rheostat for more resistance (a lower current setting) than the original setting. That causes the burner to cycle as desired. The adjustment should be done under cold-weather conditions, and may require a little tweaking for optimum results. After operating the system through several variations in weather conditions, you may wish to fine tune the heat anticipator setting to suit your individual preference. In any event, this project is sure to be a hit next winter when the "hawk" tries to invade your home. ■

Build an AC AMP METER



In your quest to conserve energy and save money, you can take the guesswork out of how much current your electrical appliances use by building this AC amp meter.

WALTER W. SCHOPP

Have your monthly electric bills become outrageously high? Do you try in vain to find out where the "energy hog" is hiding? With energy cost skyrocketing, the trend in modern appliances is toward lower power. Unfortunately, as appliance power requirements decrease, the cost of energy increases at a rate three to four times your energy savings. And since few households replace major appliances frequently, even the most energy conscious get socked with higher energy costs.

Large electrical appliances—such as refrigerators, freezers, washing machines, dishwashers, *etc.*—contribute the most to high monthly bills. And as they age, what were once state-of-the-art, energy-saving appliances, begin to consume more and more energy. One way to minimize energy costs is to use large appliances less often. But such items—as refrigerators and freezers are simply impractical to operate sporadically.

So you set out on a futile quest to determine which appliances are causing your electric bill to soar. Of course, not knowing any better, you first grab your trusty multimeter only to find that the unit's AC current range is limited to a few milliamps—assuming that it can measure AC amps at all. The reason small meters are not designed to measure large amounts of current is that high-wattage resistors are required to accomplish the task. Such resistors can not easily be tucked into the tiny cases that make multimeters such a convenience. But armed with the *AC Amp Meter* described in this article, you can locate and replace or repair those power-hungry appliances. Before we get into the specifics of our "current-counting" circuit, let's discuss some ammeter basics.

Ammeter Basics. A basic ammeter circuit is shown in Fig. 1. In that circuit, a resistor (R) is placed in series with the load. All of the current applied to the load must also pass through the series resistor. By Ohm's law, we know that current passing through a resistance produces a voltage drop, and that the voltage drop developed across the resistance is directly proportional to the current through it. Next consider that all voltmeters, including AC units, read DC. Therefore, in order for an AC ammeter to operate, the input AC signal must be converted (rectified) before it can be applied to the DC meter. The series resistor must drop enough voltage to produce a representative sample of the current going through it. At the same time, it must offer a small enough resistance so that the majority of the voltage applied to the circuit is dropped across the load, while keeping the power rating of the series resistance as small as possible.

For example, let's assume that the series resistance (R) in our circuit is 1 ohm and that the current (I) through the load is 1 amp. By Ohm's law, the voltage (E) drop across the resistance is:

$$E = I \times R = 1 \text{ (amp)} \times 1 \text{ (ohm)} = 1 \text{ (volt)}$$

Using Ohm's power law ($P = I \times E$), we get:

$$P = 1 \times 1 = 1 \text{ watt}$$

So far so good—one-watt resistors are relatively small. Now let's see what happens if the current is increased to 20 amps, but the resistance remains the same. Again resorting to Ohm's voltage law, we get:

$$E = 20 \times 1 = 20 \text{ volts}$$

By Ohm's power law:

$$P = 20 \times 20 = 400 \text{ watts}$$

That is a pretty hefty size resistor. Obviously, you are not going to get a 400-watt resistor to fit into that small multimeter enclosure. As can be seen from our example, a 1-ohm series resistor works fine when reading low-current levels, but it is impractical for reading higher currents.

And let us not forget about the diodes that are used to rectify the AC input. They present another problem. Since all diodes have an internal resistance that causes them to have a voltage drop of 0.6 volts each, the scale of an AC meter is distorted (most of the dial markings are scrunched together at the lower end of the scale). Distorting the scale allows the meter to give a

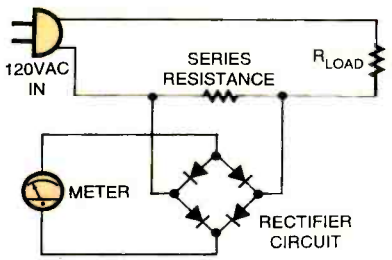


Fig. 1. In the simplest form of AC ammeter, a resistor (R) is placed in series with the load. The voltage drop across the series resistor is applied to a rectifier circuit, and the resulting signal is then fed to a DC meter.

more accurate indication of current levels. Altering the scale in that manner works fine, except that it makes the meter very hard to accurately read on the low end. That's why, when using such meters, the range is normally selected to provide a mid-scale deflection.

Since our basic circuit uses a full-wave bridge rectifier, there are always two diodes in series with the meter current during either half of the AC cycle. With each diode dropping 0.6 volt, the total drop across the diodes will always be 1.2 volts—that's a very large percentage of the small voltage dropped across the series resistor. Because of that, care must be taken when choosing the series resistance. If the series resistance is too large, the wattage of the resistor must be very high. That translates into an extremely large resistor. On the other hand, if it is too low, the internal resistance of the diodes will represent too great an error on the small voltage drop and will produce erroneous readings.

On a final note, whenever any device is inserted into a circuit to measure some quantity, the circuit will be disturbed. So one of the main tenets of any good measuring device is to disturb the circuit as little as possible.

The AC Amp Meter meets that criteria. The AC Amp Meter has four ranges: ×1, ×5, ×10, and ×20. The series resistance for each range is comprised of a network of low-wattage power resistors. The network approach allows each setting to far exceed the minimum wattage required, thus minimal heat is generated. In order to use small-value series resistances and still overcome the scale distortion caused by the diodes, the voltage drop across the selected resistance branch is ampli-

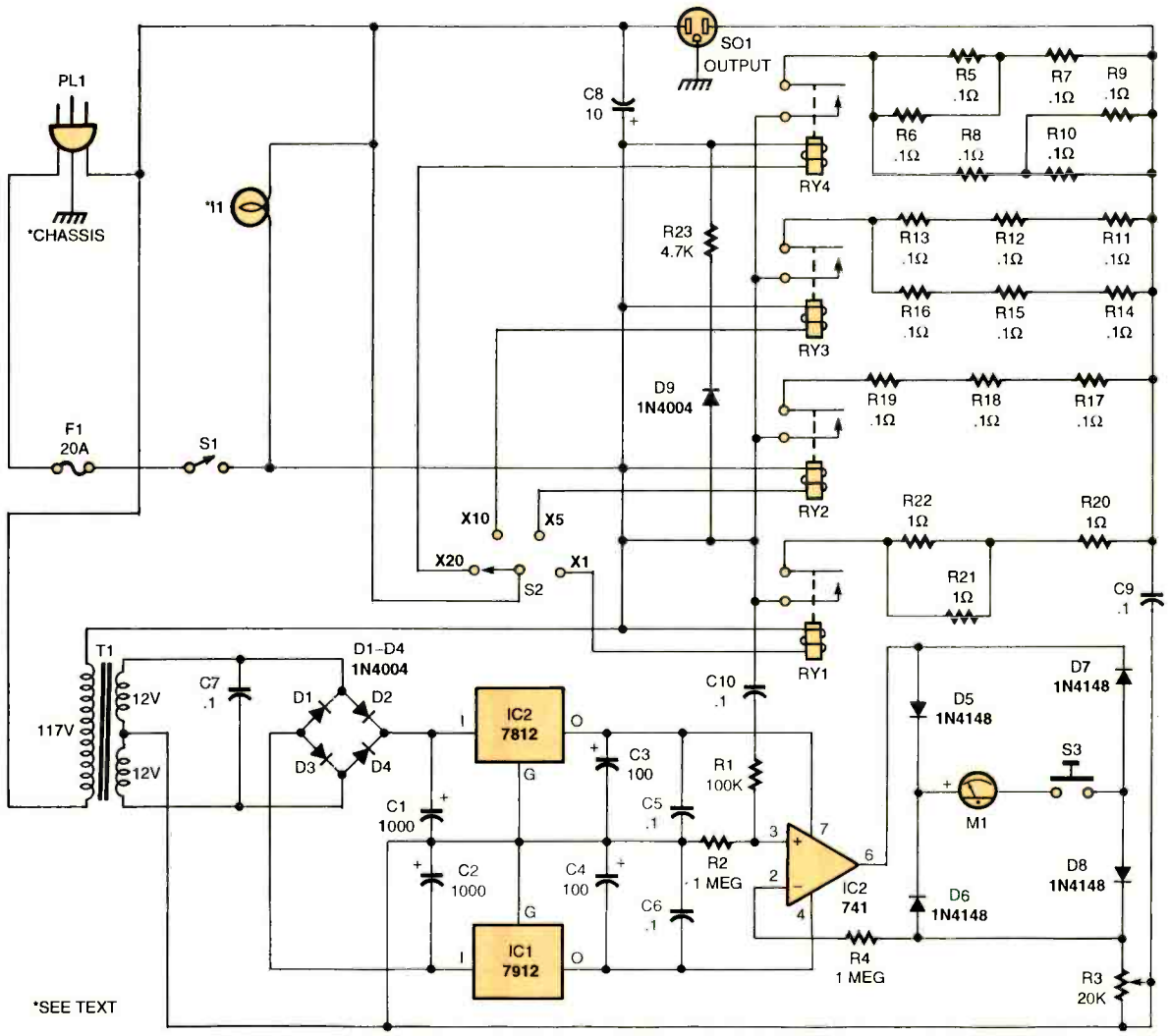


Fig. 2. The AC Amp Meter—which can be broken down into two sections: the attenuator and metering sections—is comprised of four 48-volt relays, several resistance networks, a dual (±) 12-volt power supply, an op-amp, a 1-mA D'Arsonval panel meter, and a few additional components.

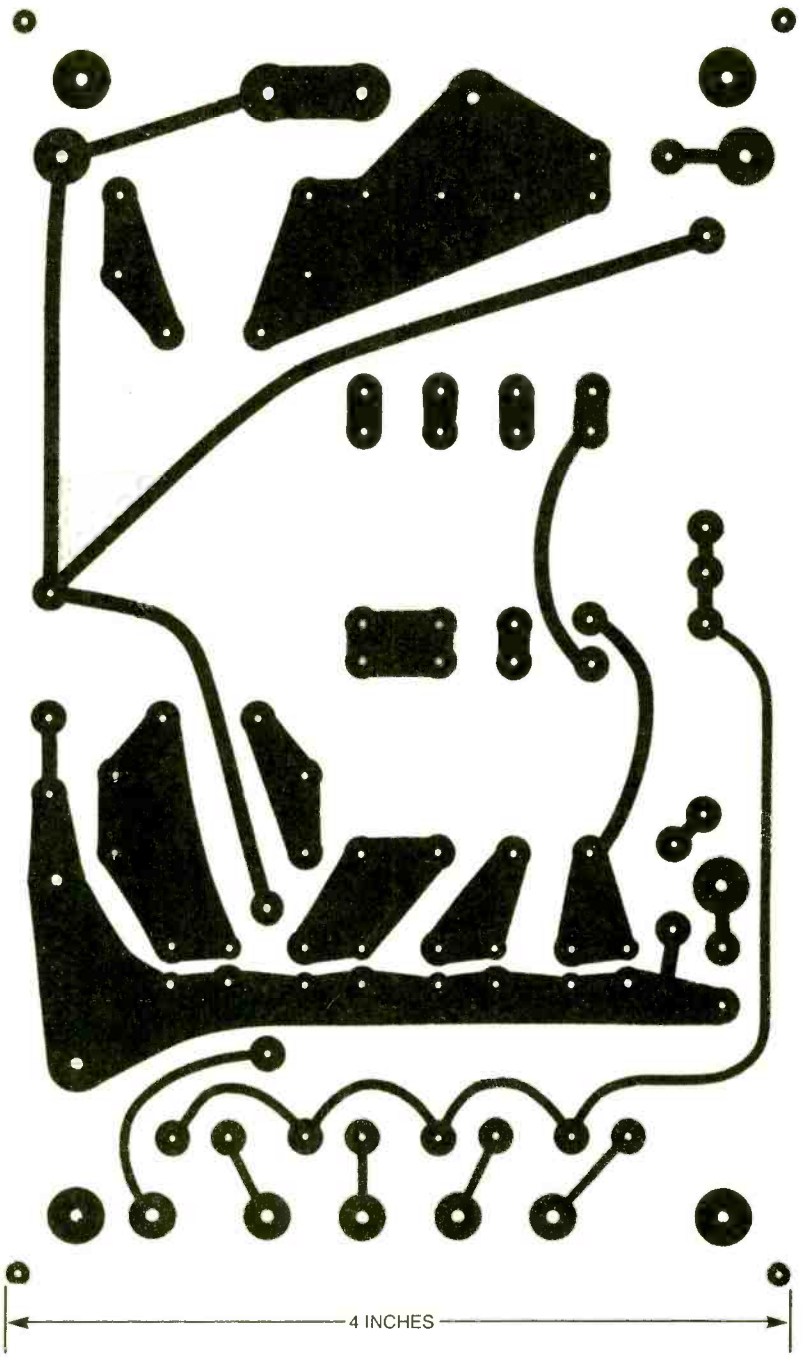


Fig. 3. The AC Amp Meter was assembled on a pair of printed-circuit boards; an attenuator section and the metering section. A template of the printed-circuit pattern for the attenuator board is shown here at full size.

fied, rectified, and read as DC on a milliamp meter. Since rectification takes place after amplification, the distortion caused by the diodes is minimal.

About The Circuit. A schematic diagram of the AC Amp Meter—which can be broken down into two sections: the attenuator and metering sections—is shown in Fig. 2. The attenuator section is comprised of four 48-volt relays, several resistance networks, and a few additional components. The relays were chosen for their high current contacts. The DC voltage for the relay coils is derived from the AC line. Diode D9, functioning as a half-wave rectifier, converts the AC line voltage to DC. The resulting DC voltage is reduced by R23 to 48 volts and is then filtered by capacitor C8. Rotary switch, S2 is used to select the meter's current range by energizing one of the four relays, RY1–RY4. When a relay is energized, its contacts close, inserting one of the resistance networks into the line. The AC voltage drop across the selected resistance branch is coupled through capacitors C9 and C10 to an amplifier in the metering section of the circuit.

The metering section is comprised of a dual (±) 12-volt power supply—built around T1 (a dual 12-volt secondary transformer); a full-wave bridge rectifier comprised of four 1N4004 1-amp, 400-PIV, rectifier diodes; a pair of 12-volt, 1-amp regulators (IC1, a 7912 negative unit, and IC2, a 7812 positive unit); and assorted filtering capacitors—an op-amp, and a 1-mA D'Arsonval, panel meter.

The AC line voltage is fed to the primary of T1. The transformer, along with diodes D1–D4, the two 12-volt regulators (IC1 and IC2), and capacitors C1–C6, is used to produce a relatively ripple-free voltage with which to power IC3. Capacitors C1 to C4 are used as filters, and C5 and C6 function as bypass capacitors.

The voltage drop across the selected resistance network in the attenuator section is coupled through R1 to the non-inverting input of IC3—an amplifier that has a gain of about 10—at pin 3. The AC output of IC3 at pin 6 is applied to a second full-wave rectifier (this one comprised of D5 through D8) at the D5/D7 junction. The resulting DC output, taken from the D5/D6 and D7/D8 junctions, is applied to meter M1, and causes its needle to deflect. Potentiometer R3 is used to adjust the meter gain so that an accurate reading can be obtained.

Construction. The AC Amp Meter was assembled on a pair of printed-circuit boards; one board for the attenuator section and the other containing the metering circuitry. A template of the author's printed-circuit pattern for the attenuator board, which measures 4 by 6 inches, is shown in Fig. 3. The pattern can be copied from the page and used

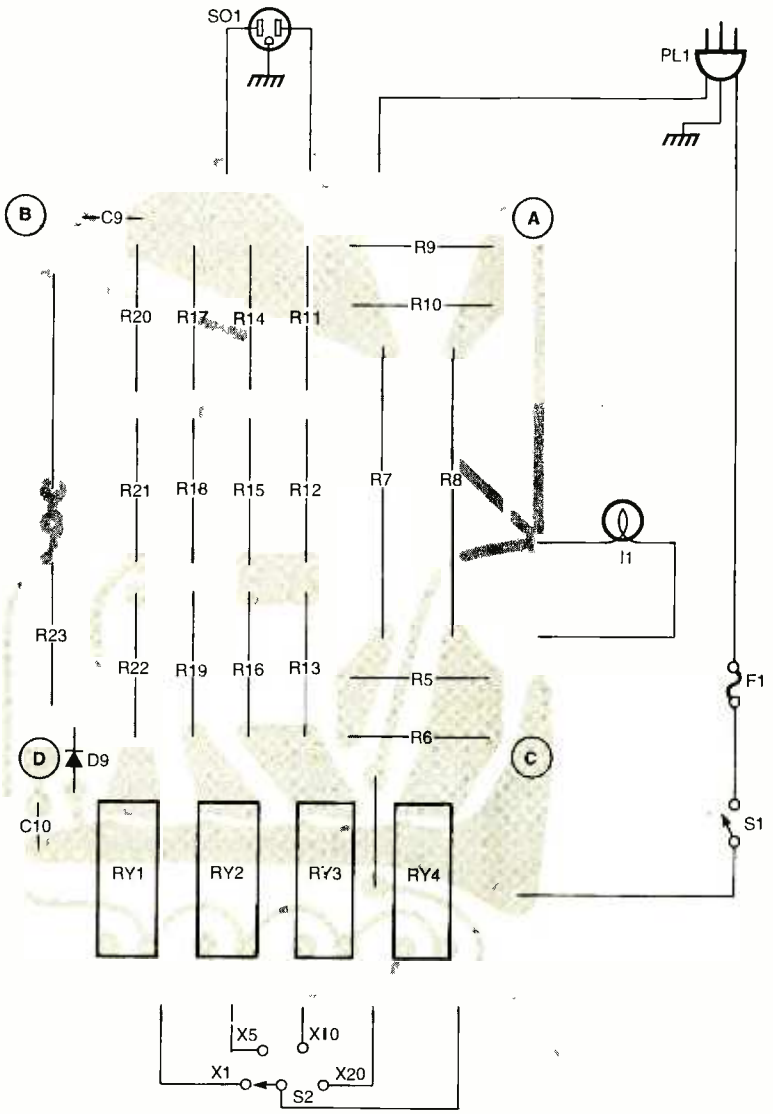


Fig. 4. Assemble the attenuator board guided by this parts-placement diagram. Start by installing a jumper wire between RY3 and RY4, followed by the four banks of high-powered resistors (R5–R22) and the capacitors (C8–C10), and the lone diode (D9). Once those components are in place, mount four 3/4-inch threaded spacers at the points labeled A, B, C, and D using appropriate hardware.

PARTS LIST FOR THE AC AMP METER

SEMICONDUCTORS

D1, D2, D3, D4, D9—1N4004 1-amp, 400-PIV, rectifier diode
D5, D6, D7, D8—1N4148 general-purpose, small-signal diode
IC1—7912 fixed, 12-volt, 1-amp, negative, voltage regulator, integrated circuit
IC2—7812 fixed, 12-volt, 1-amp, positive, voltage regulator, integrated circuit
IC3—741 op-amp, integrated circuit

RESISTORS

(All fixed resistors are 5% units unless otherwise noted.)
R1—100,000-ohm, 1/4-watt
R2, R4—1-megohm, 1/4-watt
R3—20,000-ohm, miniature, trimmer potentiometer
R5, R6, R9, R10–R19—0.1-ohm, 5-watt, 10%
R7, R8—0.1-ohm, 10-watt, 10%
R20–R22—1-ohm, 5-watt
R23—4700-ohm, 5-watt

CAPACITORS

C1, C2—1000-µF, 25-WVDC, electrolytic
C3, C4—100-µF, 25-WVDC, electrolytic
C5, C6, C7—0.1-µF, 50-WVDC, ceramic-disc
C8—10-µF, 250-WVDC, electrolytic
C9, C10—0.1-µF, 250-WVDC, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

F1—20-amp glass fuse
I1—117-volt AC, panel-mounted pilot lamp (optional, see text)
M1—1-mA D'Arsonval meter (Shure Model 8336 or 01MAMO-1; Electronic Express; Tel. 800-972-2225)
PL1—AC line cord with molded plug
RY1–RY4—117-volt AC coil, 48-volt DC contact relay (see text)
S1—30-amp rocker switch (see text)
S2—SP4P rotary switch
S3—Normally-open pushbutton switch
T1—Dual 12-volt secondary step-down transformer (Newark Electronics #44F2123)
Printed-circuit materials, enclosure (RadioShack #270-274), spacers (see text), panel-mounted fuse holder, solder, wire, hardware, *etc.*

to etch your own printed-circuit board. Once you've obtained all of the parts listed in the Parts List, assemble the attenuator board guided by the parts-placement diagram shown in Fig. 4. Start by installing a jumper wire in the pads indicated in the parts-placement diagram between RY3 and RY4.

The attenuator board contains four banks of high-powered resistors that serve as the series-dropping resistances for the unit's four ranges. Install the high-powered resistors, R5–R22, followed by the capacitors (C8–C10) and the lone diode (D9). When populating the attenuator board, be sure that the electrolytic capacitor (C8) and the diode are properly oriented. Next install the four relays (available from Hosfelt Electronics, Inc., 2700 Sunset Blvd., Steubenville, OH 43952-1158; Tel. 888-264-6464 or 800-524-6464, as part #45-432), and then wire the off-board components to the board as shown. **Note:** Although S1 and I1 are shown as separate units, the switch used in the author's prototype has the lamp built into it. (The switch used in the author's prototype is part #51-330 and is available from Hosfelt Electronics.) If you choose to use separate parts, wire them into the circuit as shown. If, on the other hand, you decide to use the same switch as the author did, omit the lamp. However, it will be necessary to bring both the hot and neutral lines of the AC source out to the switch in order for its internal lamp to work. Once that is done, all that's left to do is to insert screws through

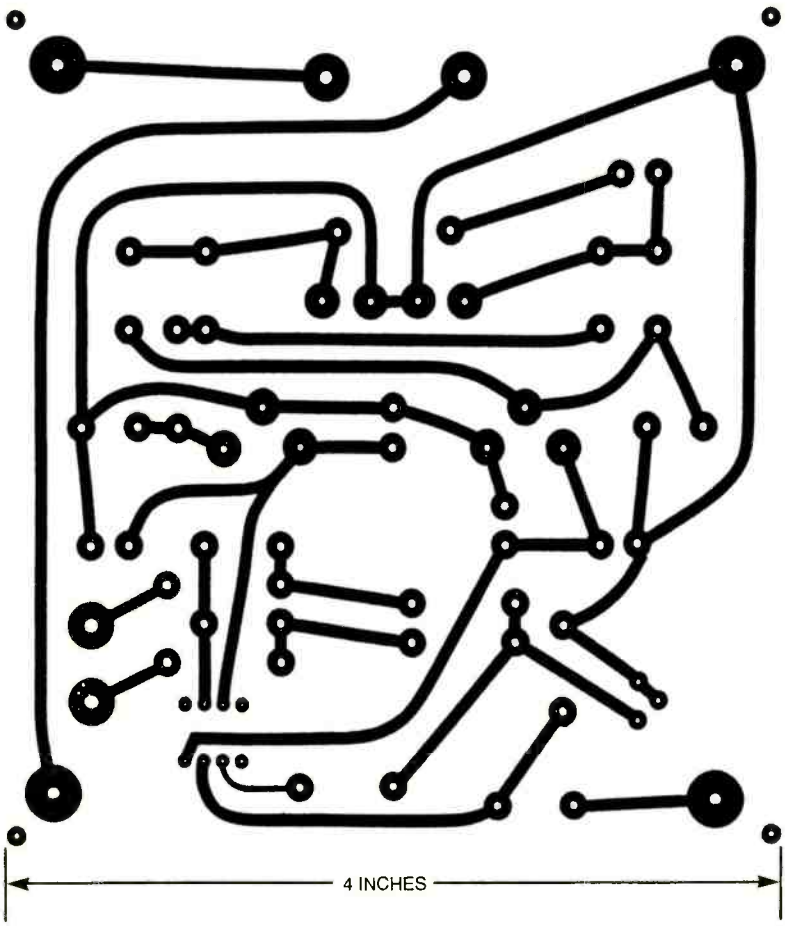


Fig. 5. The template for the metering board is shown here full size. Note that the four large pads located in the corners of the board correspond to four similar pads on the attenuator board.

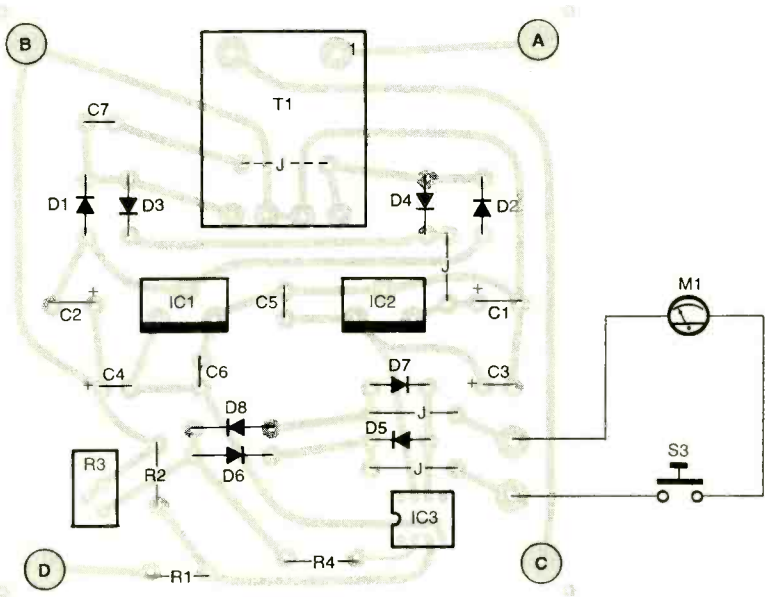


Fig. 6. The metering board—whose parts-placement diagram is shown here—contains several polarized components (D1–D8, IC1–IC3, and C1–C4). Although the trimmer potentiometer (R3) is not polarized, it nonetheless must be properly oriented.

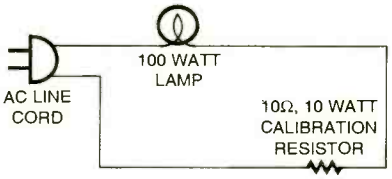
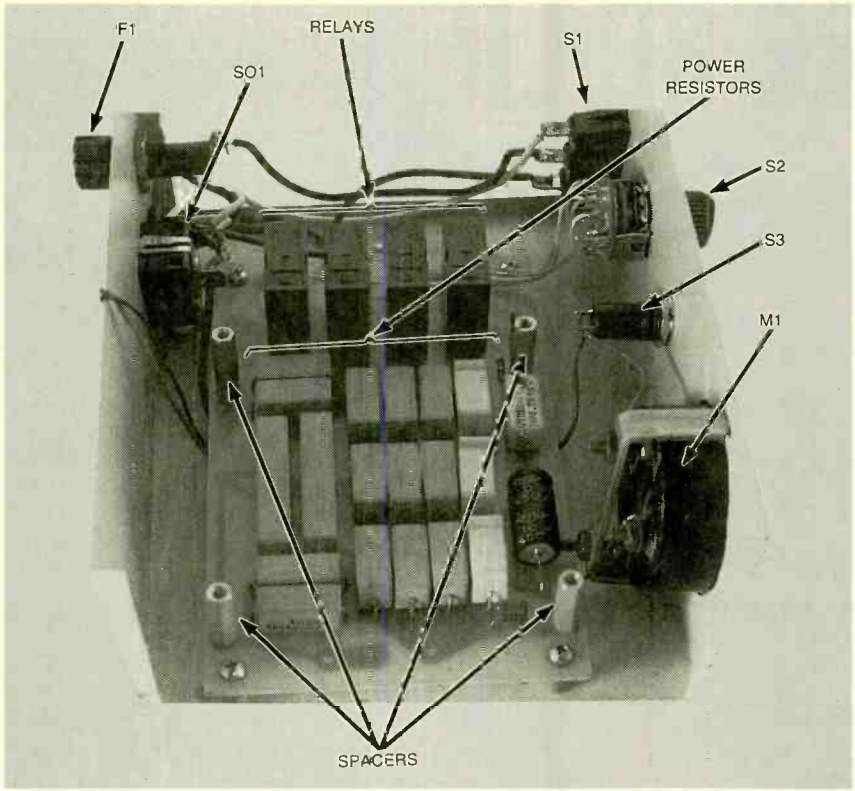


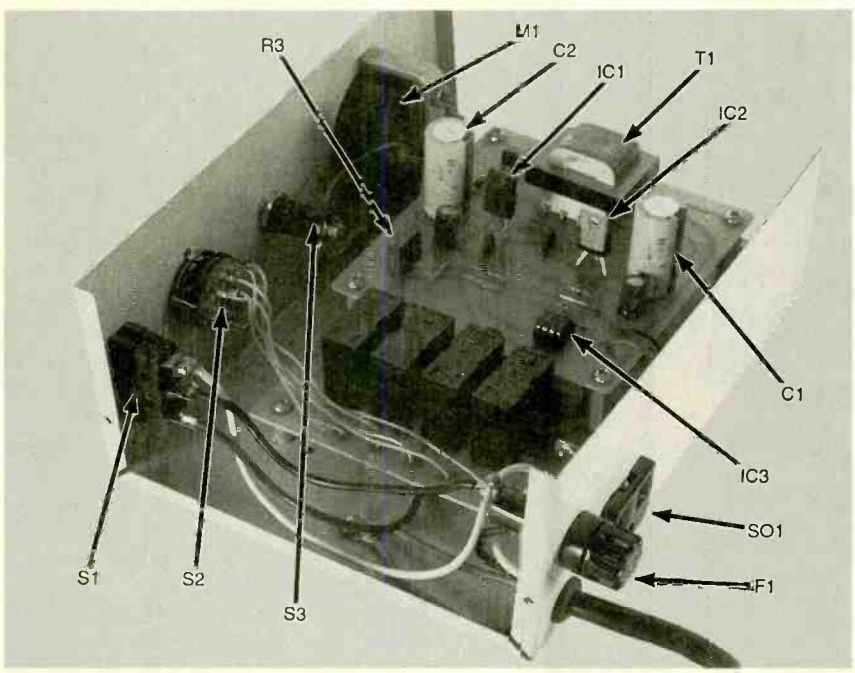
Fig. 7. To calibrate the circuit, place a 10-ohm, 10-watt resistor in series with a 100-watt lamp and connect the assembly to an AC line cord with plug.

the board from the foil side at the points labeled A, B, C, and D; screw four $^3/_4$-inch threaded metal spacers on to the screws from the component side of the board; and solder the heads of the screws to the foil side of the board. The metering board mounts to those spacers, so that points A, B, C, and D on the attenuator board align with like identified points on the metering board. Line voltage, as well as the voltage across the series resistance, is delivered to the metering board through those spacer/screw combinations. Corner holes in the attenuator board are used for mounting the board in its enclosure.

Once the attenuator board is completed, turn your attention to the metering board. A template for the metering board is shown in Fig. 5, while its parts-placement diagram is shown in Fig. 6. Note that the metering board contains several polarized components—eight diodes (D1–D8), three ICs (IC1–IC3), and four electrolytic capacitors (C1–C4)—plus a trimmer potentiometer (which is not polarized, but nonetheless must be properly oriented), and three jumper connections. Start by installing the jumper connections first, followed by transformer T1 (available from Hosfelt Electronics). The transformer's terminals are numbered: Be sure that pin 1 is situated as shown in Fig. 6. Once all of the jumper connections and components have been installed, connect the ends of a pair of wires to the points indicated, and solder the free ends to the meter and push-button switch as shown. Before you go any further, inspect the two circuit boards for the usual construction errors: cold solder joints, misconnected or misoriented components, solder bridges, *etc.* When you are sure that the two boards contain no construction errors, mount the metering



The AC Amp Meter was assembled on a pair of printed-circuit boards. The larger of the two, the attenuator board, is shown here mounted at the bottom of its enclosure. Four threaded spacers have already been secured in place to accept the second board.



The second board, containing the meter circuitry (but not the meter itself), is shown here mounted over the attenuator board on four spacers. The spacers also couple AC voltage and signals from the attenuator board to the metering circuitry.

board on top of the attenuator board, separated by the four $^3/_4$-inch spacers as described earlier, and secure them together with matching hardware.

Next prepare the enclosure that is to house the finished unit. Make cutouts and drill holes in the front panel to accommodate the D'Arsonval meter (M1) and switches (S1–S3). The rear panel requires two holes (for the line cord and panel-mounted fuse holder) and a cutout for the AC receptacle (SO1). Mount the off-board components in their respective holes or cutouts.

Calibration. In order to be useful, a standard must be set for the AC Amp Meter. In order to do that, we'll need to feed a known current through the unit. That is accomplished by first measuring the resistance of a power resistor rated for 10 ohms, 10 watts using a DVM and recording its measured value. Then wire the resistor in series with a 100-watt lamp and connect a line cord to that assembly as shown in Fig. 7. Plug the line cord into the AC Amp Meter, turn on the power, and measure the voltage drop across the resistor. Then using the measured value of the resistor and the measured voltage drop, calculate the current (which should be less than 1 amp or about 800 milliamps) flowing to the lamp using Ohm's law. Turn the AC Amp Meter off and set its range switch to the ×1 scale. Then turn the AC Amp Meter on and adjust R3 until the meter gives a reading equal to the calculated current level.

Essentially, what you are doing is connecting two resistors in series with each other, then reading the AC voltage dropped across the calibration resistor, and calculating the current using Ohm's law—while reading the voltage dropped on the resistance branch in the AC Amp Meter. Since both resistances are in series with each other, it is assumed that the current flowing through one unit is present in both. Reading the voltage and calculating the current in one resistance gives the current in the other.

Once you've built the AC Amp Meter, you'll find that you may have misjudged the current used in many of your appliances. Over the last few years, many appliance makers have been striving to reduce the power needed to operate their units. As the wattage is reduced, so is the current. Many claims are made, and a lot of them are not exactly factual. With this unit on your side, it is easy to find out the truth. ■

LET THERE BE LIGHT—
THE STORY OF THOMAS ALVA EDISON

Thomas Alva Edison—arguably America's most famous inventor—developed the first electric light bulb. He is also credited with inventing or improving other devices, like the telephone, the movie projector, and the phonograph.

VICTOR PARACHIN

On the evening of Wednesday, October 21, 1931, cities, towns, and villages all over the United States joined together, dimming their lights for one minute. Even the light on the Statue of Liberty was turned off. The extinguishing of light was America's way of paying a final tribute to Thomas Alva Edison, who died three days earlier on October 18th at 84 years of age.

When his death was first announced, suggestions were sent to Congress that the nation could best honor this remarkable man by shutting off all electric power for a few solemn minutes. However, Congress determined that the loss of electricity on so large a scale, even briefly, could create a national disaster and pose a major security risk. That decision revealed the inventor's enormous contribution to life in the twentieth century. Not only did Edison usher in the technological age, but the inventions that he developed made the country and the world dependent upon them.

The Early Years. The world into which Thomas Alva Edison was born in 1847 was extremely different from the world in which he died—1847 was a world without radios and televisions, automobiles and airplanes, telephones and electricity. There were no motion pictures, neon lights, phonographs, or records. It was a world where a twenty-mile trip was a great distance and where a trip from one side of the United States to the other was a grueling journey that took many months.

However, the world in which Edison died 84 years later had become much like the world we know today. Airplanes flew daily across the country, automobiles were beginning to clog the streets, movies were big business, radio carried news instantly into the most remote corners of the planet, and television was being developed.

The man frequently cited as the world's greatest inventor was born in Milan, Ohio on February 11, 1847 to Samuel Edison, Jr. and Nancy Elliot Edison. Thomas was their seventh and last child. In 1854, when Edison was 7, the family moved to Port Huron, Michigan, where the youth entered grade school. The only formal education Thomas Alva Edison would receive lasted a mere three months.

His mother, trained as a school teacher herself, became alarmed by the rigidity and negative attitudes of Edison's teacher. The teacher labeled Edison "slow" because he asked many questions. However, his mother recognized her son's creative and curious mind so she resolved to home-school the boy.

His mother helped the young Edison set up a small laboratory in the basement of his home. There Edison conducted various experiments based on ideas he gleaned from reading science and reference books in the library. In later years, Edison would say: "I didn't read a few books, I read the library."

In order to generate an income so he could continue buying chemicals and other supplies for his experiments, Edison, at age 12, took on a job selling newspapers on a train route that went from Port Huron to Detroit daily. While that job did provide Edison with the funds necessary for his childhood experiments, it may also have been the source of his hearing impairment, which would plague Edison in adult life. One morning Edison was late getting to the train. The car was already moving when he leaped for the steps, his arms full of newspapers. He barely made the last step and might have fallen under the train if a man had not reached out and grabbed Edison by the ears to pull him safely on board.

By the time Thomas Alva Edison (born to Samuel Edison, Jr. and Nancy Elliot Edison in Milan, Ohio on February 11, 1847) was 12, he had read most of the works of Shakespeare and Dickens, as well as Edward Gibbon's Decline and Fall Of The Roman Empire *and Thomas Paine's* Age of Reason.

Edison recalled that incident quite vividly: "I ran after it (the train) and caught the rear step nearly out of wind and hardly able to lift myself up, for the steps in those days were high. A trainman reached and grabbed me by the ears, and as he pulled me up, I felt something in my ears crack; right after that I began to get deaf . . . If it was that man who injured my hearing, he did it while saving my life."

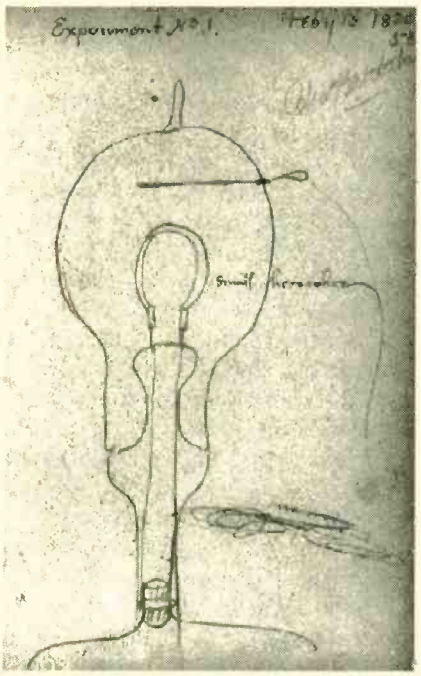
In 1863, at 16, Edison learned telegraphy and spent the next four years as an itinerant telegrapher, working in the midwest, the South, New England, and Canada. It was while engaged in telegraphy that Edison's career as an inventor emerged. Edison was challenged by a problem that needed to be solved: how to send two messages at the same time on a single telegraph wire. Because there were no telephones or radios, telegraph wires crackled constantly with messages. During peak hours of the day, people were turned away because the telegraph wires were too busy to accept additional messages for transmission. Edison began working on a "duplex" telegraph system, whereby two messages could be sent simultaneously on the same wire. Edison theorized if one message could travel in one direction and another in the opposite direction, twice as many messages could be sent and telegraph companies could double their income. After several failures, Edison's experiments worked, and he took out seven patents on a new and improved telegraph system.

That success further motivated Edison to change careers from being a telegrapher to becoming an inventor. In 1869, at the age of 21, Edison moved to New York City, where he began working on improving the stock ticker. When he succeeded, General Marshall Lefferts, an executive with Western Union, offered Edison an astonishing $40,000 for his new machine. With cash in hand, Edison used that money to set up his own company in Newark, New Jersey, which manufactured the new stock tickers. In 1871, at this plant, Edison took notice of an employee, Mary Stilwell. By Christmas of that year, she became Mary Edison and they started a family. They had three children—Marion, Tom, Jr., and Will.

Although married, Edison continued to work long, hard hours at his plant. By 1876 Edison's reputation as an innovative inventor was established, and he found himself a member of a new breed: free-lance inventor selling his new inventions to the highest bidder. That year he also concluded that his Newark facility was too small, so he decided to build a new plant in nearby Menlo Park. There, he established the world's first "invention factory."

On this site about 20 miles from New York, Edison erected an ordi-

Photos are provided by the United States Department of the Interior, National Park Service, and Edison National Historic Site; and appear here by permission.



In 1878, Edison took on the challenge of creating the world's first long-working, inexpensive electric light. Edison began experimenting with filaments—platinum, chromium, molybdenum, osmium, boron, silicon, nickel, and platinum again—that would burn inside a vacuum. Nothing worked properly, so Edison turned to a carbonized thread.

nary white building measuring 100 feet long by 30 feet wide. Then he assembled a dozen men, some with unique scientific skills and others with special technical expertise. Edison also provided all the necessary equipment, supplies, and materials.

Today "invention factories" are quite common. They are referred to as "research and development" departments and are operated under the auspices of a major corporation. However, in Edison's day, his "invention factory" was a first and provided him with a unique opportunity to create. Of his "invention factory" Edison said: "I think . . . there is where I can beat other inventors, as I have so many facilities here for trying experiments."

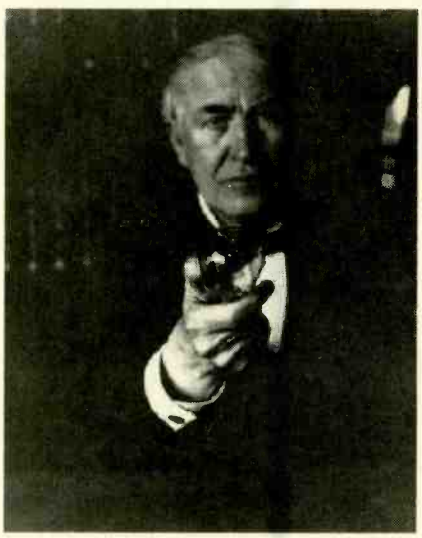
The Birth of the Electric Light. It was there in 1878 that Edison took on the challenge of creating the world's first long-working, inexpensive electric light. The concept of electric lighting was not new. The arc lamp, which produced light by jumping a bright arc of electricity between two electrically charged rods, had been around for several decades. But it was too bright to be used and far too expensive. Edison envisioned a light bulb that could illuminate a small room as well as a massive auditorium and be inexpensive enough that the average person could afford to make several purchases for a home. At that time, homes and buildings were illuminated either by candlelight or gaslight.

Edison began experimenting with a filament that would burn inside a vacuum. He tried platinum, chromium, molybenum, osmium, boron, silicon, nickel, and platinum again. Nothing worked properly, so Edison turned to a carbonized thread. Edison described his early success with light: "We built the lamp and turned on the current. It lit up, and in the first breathless minutes we measured its resistance quickly and found it was 275 ohms—all we wanted. Then we sat down and looked at that lamp. We wanted to see how long it would burn. The problem was solved—if the filament would last. The day was—let me see—October 21, 1879. We sat and looked and the lamp continued to burn, and the longer it burned the more fascinated we were. None of us could go to bed, and there was no sleep for any of us for forty hours. We sat and just watched it with anxiety growing into elation. It lasted about forty-five hours, and then I said, 'If it will burn that number of hours now, I know I can make it burn a hundred.'"

A part of Edison's genius was his ability to see an entire system. In many ways, Edison was the world's first systems analyst. He produced and patented not only the light bulb but the entire electrical system needed to maintain it: bulbs, switches, dynamos, and other parts. Edison's development of the electric light transformed the history of civilization. Because of his light bulb, daytime was lengthened—making it possible for people to enjoy evening leisure hours and to conduct business for more hours in a day. Electric light freed factories to operate two or more shifts, producing more goods. Edison's electric light bulb made the lives of people far more comfortable than those of previous generations.

Of course, Edison was also the key figure in perfecting the phonograph and the motion picture camera, both of which have spawned enormous entertainment industries in music, film, and television. Edison holds more patents than any other individual in US history, an astonishing 1093 for such diverse technologies as the improved telegraph, mimeograph, improved telephone, phonograph, electric light, improved electric generator, electric-power train, improved motion picture camera, and the alkaline storage battery. By the late 1870s, Edison was becoming world renowned and increasingly described in this country's newspapers with great awe and admiration. The *Cincinnati Commercial* called him "Edison the Magician." The *New York Daily Graphic* headlined Edison as "The Wizard of Menlo Park." The *Boston Herald* referred to him as "A Wonderful Genius."

Although lauded world-wide, Edison was primarily a loner. While he had many colleagues and acquaintances, Edison had few close friends. The companion he



Because of Edison's light bulb, daytime was lengthened—allowing factories to operate two or more shifts—making people's lives far more comfortable than those of previous generations.

enjoyed most was the younger Henry Ford. "As to Henry Ford," Edison once said, "words are inadequate to express my feel-ings. I can only say to you, that in the fullest and richest meaning of the terms—he is my best friend." The two spent much time together and for many

(Continued on page 54)

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ANTIQUE RADIO

Radio Repair For Dummies-1

MARC ELLIS

No, I'm not trying to insult the **Popular Electronics'** readership! This just seemed to be a good time to take a look at some simple radio repair techniques for newcomers to our hobby—something I haven't addressed in several years. And I couldn't resist borrowing the title idea from that popular series of "how to" computer books. In this month's column we'll talk about basic equipment for the workbench.

Actually, it is possible to equip yourself with some pretty good test gear at very small expense. Even such things as sophisticated scopes, sweep generators, *etc.* can be obtained for little outlay if you have sharp eyes at the swap meets and are not averse to doing a little negotiating. But if you are new to the hobby, it will take some time to decide what you need, locate it, and learn to restore and use it.

Does this mean you can't immediately take some steps towards repairing some of the radio "finds" that are beginning to grace your shelves? Absolutely not! It is amazing how many problems can be dealt with by using just the test instruments that nature has equipped you with: especially your nose, eyes, and—that most sophisticated instrument of all—the gray matter residing within your skull.

Even if you don't actually uncover the problem, you can at least rule out the obvious and easy-to-fix difficulties. If you reach a dead end, write up your findings-to-date and store them inside the radio, awaiting the day when your knowledge is greater and your bench better equipped.

BASIC TOOLKIT

Even though I've just finished making a strong case for how much can be accomplished with very little, there are a few things I'd like you to have among the resources on your bench. You should have some basic tools, of course, including a couple of screwdrivers of different sizes (make sure you have one small enough to fit the set screws on control knobs). You'll also need needle-nose pliers, a soldering iron, and a nutdriver set. Aerosol cans of control cleaner/lubricant and dust remover should also be on your shelf.

An RCA VoltOhmyst Junior *like this one (or its "Senior" big brother), if in good shape, will serve well as your basic multimeter.*

Also, please get yourself a multimeter—an instrument for measuring voltage, resistance and, sometimes, current. At the swap meets, you can find classic top-quality vacuum tube voltmeters (VTVMs), such as the *RCA VoltOhmyst*, at very good prices. These have the sensitivity required to carry out almost any test without disturbing the normal (or abnormal, as the case may be) operation of the receiver.

But hold out for one that's in excellent cosmetic condition (which is at least some indication that it had good treatment). And make sure you get the manual and probes. Even so, don't pay too much because you won't really know how well it works until you can get it home and try it out on some known voltages and resistances. If you'd rather buy new, avoid inexpensive utility meters of the "2000-ohms-per-volt" variety. A 20,000 ohms-per-volt model (25 bucks at *RadioShack*) is quite usable, but you'll eventually want a decent digital model or an analog model with solid-state "innards." The latter two are in the sensitivity class of a vacuum tube voltmeter and in the $60 price range. All of these meters will do something the vintage VTVMs generally do not do—measure current (not necessary for most diagnostic testing).

TUBE MANUALS

You'll need tube manuals, too. They will give you pinout diagrams of the various tube elements so you'll know where to put your test probes (or your fingers, for some of the simpler tests). They'll also give you an idea of the voltages, or at least voltage ranges, to be encountered at the various tube pins. This is obviously very helpful when you are trying to pinpoint trouble. Tube manuals are very common and inexpensive at radio swap meets.

Get yourself a couple of manuals: one from about the early 1940s and one from about the early 1960s. The early ones provide more information on the earlier tubes (which are usually relegated to a "seldom-used" section in the later books). If you don't want to wait for the swap meets, reprints are available. When I last looked, *Lindsay Publications* (P.O. Box 538, Bradley, IL 60915) carried a 1959 *RCA* receiving tube manual and a 1937 *Sylvania* book. *Antique Electronic Supply* (AES) (6221 South Maple Ave., Tempe, AZ 85283; Tel. 602-820-5411; Web: *www.tubesandmore.com*), also carries a 1959 *RCA* manual reprint. Either of these excellent sources will send you a free catalog. And in the AES catalog, you'll also find many tools, parts, and supplies to help you in your restorations.

A SAFETY MUST

The final item that should be on every radio workbench, even a newbie's workbench, is an isolation transformer. This advice is often given and just as often ignored. Don't ignore this advice and imperil your safety. What's an isolation transformer? It is a transformer designed not to step voltage up or down (which is the usual job assigned to a transformer), but to isolate the equipment plugged into it from the killer current available at your household wall outlet. The one you want has a primary that plugs into the 115–120 volt line and delivers the same voltage at its sec-

ondary. But it can deliver only an amp or two at best, not the 15 or 20 amps, or more, that can be pulled from the wall plug.

This is something of a safety factor in itself, but—more importantly—a set powered by an isolation transformer no longer has any points that are "hot-to-ground." As most of you know, I'm sure, one side of the AC line that comes to your house is normally connected to ground. So if you accidentally touch the ungrounded side of the line while probing a radio chassis, and at the same time are standing on a damp basement floor with damp shoes (for example) or are somehow in contact with a metal plumbing pipe, you could light up like a Christmas tree.

Particularly hazardous are sets of the AC-DC type, many of which have one side of the line grounded directly to the chassis. Put the plug in the wrong way, and it could easily be the *hot* side. Even transformer-powered sets, which don't have this wiring configuration, often have a noise-reduction capacitor connected from one side of the line to the chassis. If the capacitor becomes leaky (often happens in old sets), the chassis could easily become hot to ground. A hot chassis is a hazard for two reasons; it can zap you directly—and it can also cause unexpected and dangerous pyrotechnics when you connect to it the ground lead from a piece of test equipment that has a grounded chassis.

A transformer rated at 150 watts will handle most sets. You might get away with a lesser rating if you work only on small table models. The transformer might come already set up for radio work, with a cord to plug into the wall and an outlet to receive the plug of the ailing set.

The units tend to be costly new, but frequently turn up in surplus sources and radio meets at affordable prices. Surplus transformers, usually the most economical, will probably need to have sockets and line cords attached. As long as you are adding this wiring, it would be a good idea to put a fuse appropriate for the transformer's wattage rating in series with the secondary. It will protect the transformer from an overload caused by a shorted power supply in the test radio.

EYEBALLING YOUR SET

Once you have the tools and other items, you'll probably want to power up one of your radios and see if you can make it go. But resist the urge! There's a lot to be done before you should consider applying power. At this point you could easily damage the set or make existing damage worse. And the more work you can do up front, the easier your troubleshooting job will be after you turn the radio on. In fact, you might not even have any troubleshooting to do at all!

First, carefully remove the radio from its cabinet. If there is a lot of dust, clear it with the blower function of your vacuum cleaner or use that brand-new spray

1940 RCA *tube manual from the author's collection. Pair up one from this era with one from the early 1960s to take care of most of your reference needs.*

can of dust remover on your bench. Pay particular attention to the plates of the tuning capacitor, which are prime dust magnets.

Now begin a searching physical inspection of your acquisition. A good place to start is the line cord. If it's an original rubber-covered job, the cord will no doubt be brittle and starting to crack. Make a note to replace it. If it is fabric covered, look for wear around the plug and around the grommet where the cord enters the set. Check the wires coming out of the cord inside the set for brittleness or cracking. And, especially if the set is a small table model, see if it has three wires instead of the usual two. The extra wire is a line-cord resistor for the set's series heater string.

Look at all of the paper capacitors in the set. If they are the waxed type, has wax pooled and melted out? What about the resistors? Do any of them seem discolored by heat, or are they possibly even charred? What about burned or charred wire insulation? You won't be thinking about replacing any of these parts now. Just noting facts that will help you with your diagnosis.

Examine the chassis for places where ground lugs are attached. These may be riveted, fastened under the nuts holding other components in place, or attached by dedicated screws and nuts. Check for looseness or corrosion at these locations and note your results. It's also a good idea to check for signs of amateur "repairs." Are there chewed-up screw heads? Cold solder joints? Crudely installed parts or wiring? Add all such suspicious items to your notes.

Make a chart of the set's tube socket layout and, one by one, remove the tubes and note the tube numbers on the chart. If a number is not legible (it happens!), don't try cleaning it off. It is probably not etched into the glass, as you might think, but stamped or stenciled in some manner. You may very well wipe it off with the overlying dirt. For now, just write a code number on a bit of masking tape and stick it to the tube (avoid any printed areas). Write the code number on the chart.

Tubes should be removed using a gentle rocking-and-pulling motion. If a tube has a base (Bakelite, metal, ceramic, *etc.*), grasp the tube by the base during removal rather than by the glass. The old glue is dried out and brittle, and the bond between base and glass could be very fragile.

Loctal tubes are particularly hard to remove after they have been sitting in their sockets for many years. And their metal bases are particularly apt to come loose. You might try turning the chassis on its side and holding the retaining spring away from the tube's locating pin (where it protrudes from the bottom of the tube socket) as you patiently rock and pull from above.

Use the same care when removing clips from grid caps. The caps are often "glued" in place by minute amounts of corrosion. On no account try to remove the clip by twisting it hard. There's a much better than even chance you'll end up breaking the cap away from the glass tip. You may even wrench the cap off its connecting wire, perhaps shatter-

ing the tip and ruining the tube.

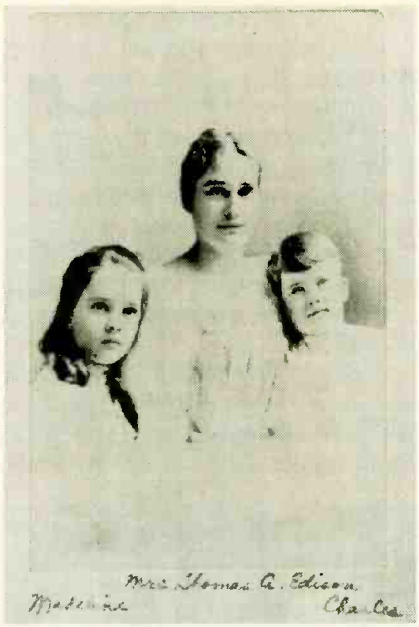
If there is a way to mechanically "spread" the clip and release the tension, go that route. Otherwise, lay on some *WD40* (being sure to keep it off any tube markings) and let it work in overnight before trying another gentle twist. See you next month, when we'll discuss the rest of the things that should be done before your initial "smoke test." ■

LET THERE BE LIGHT

(continued from page 48)

years took an annual vacation together.

Success and fame did not spare Edison from tragedy. In 1884, Mary Edison, then only twenty-nine years old, caught typhoid fever. Sick for several weeks, she died on August 9, 1884. When Edison's daughter Marion awoke that morning she "found him shaking with grief, weeping and sobbing so he could hardly tell me that Mother had died in the night." Edison was a widower at thirty-seven years of age. Concerned friends immediately began introducing Edison to a number of young women and within six months of Mary's death, Edison met Mina Miller, who became his second wife. They had three children, Charles (who later became Governor of New Jersey), Theodore, and Madeline.



After the death of his first wife Mary, Edison met Mina Miller (center), who became his second wife. Together, they had three children. Charles (right), who later became Governor of New Jersey; Theodore (not shown); and Madeline (left).

Edison Honored. In October of 1929, Henry Ford honored the aging Edison on the fiftieth anniversary of the invention of the light bulb. Captioned, "Light's Golden Jubilee," the celebration was attended by dignitaries from around the world, including President and Mrs. Herbert Hoover; Marie Curie, the famous physicist; and Orville Wright, the airplane pioneer. For the event, Ford rebuilt Edison's entire Menlo Park laboratory at the Ford factory in Dearborn, Michigan. Edison was deeply touched when he saw the reconstruction.

This moving account was recorded in the *Detroit Free Press*: "As he walked to a chair and sat down, his companions in the party remained where they stood, apart from him a dozen feet. No word was spoken; it was as if by common consent the spectators instinctively felt awe here, in the presence of an old man upon whom the memories of eighty-two years were flooding back. He sat there, silent, his arms folded, an indescribably lonely figure, lonely in the loneliness of genius, of one who somehow had passed the others, who no longer has equals to share the world, his thoughts, his feelings. For five, perhaps ten, minutes, the scene was unmarred by a word or a gesture, except that now and then Edison looked about him and his eyes dimmed. Suddenly he cleared his throat and the spell was broken."

Edison then complimented Ford on the reconstruction saying it was "ninety-nine and one half percent perfect!" Concerned, Ford immediately asked: "What is the matter with the other one-half percent?" With a sly grin on his face, Edison said: "Well, we never kept it as clean as this."

Two years later, in August of 1931, Edison began to grow steadily weaker from uremic poisoning and collapsed in his living room. In the days that followed, it became clear to doctors that Edison would not recover. President Herbert Hoover was left with the responsibility of telling an anxious nation that the country would soon lose the man who helped usher America into the technological age. On October 14, Edison lapsed into a coma and lay near death for two days. Reporters waited on the lawn for a sign, which came at 3:24 AM, on October 18th. All the lights in his bedroom were turned on signifying his death. Just a few hours earlier, Edison emerged briefly from the coma and uttered these final words to his wife, Mina: "It is very beautiful over there." ■

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CIRCUIT CIRCUS

Monitors and Magic

CHARLES D. RAKES

Hello Circuiteers! This time we're going to try to help out a reader with his circuit request, and then stir the old circuit-pot and see what floats to the top.

MAIL-MONITOR CIRCUIT— USING A MAILBOX SWITCH

I received a circuit request from Daniel, who wants a mailbox monitor that will let him know when Uncle Sam makes a mail delivery. Daniel has already installed a wire-pair running from his house to his mailbox and would like to use them in his monitoring system.

Our first circuit suggestion for Daniel is shown in Fig. 1. A pushbutton switch is mounted to the inside of the mailbox in a manner that when the mailbox door is closed, the switch is in the normally-open condition. When the door is opened to insert or remove mail, the switch closes, completing the current path back to the monitoring circuitry.

When the circuit is in operation, the 2N3906 transistor, Q1, looks across resistor R5 for any indication of current flow through the wire-pair coming from the mailbox. As long as the door on the mailbox is closed, Q1 is like an open switch drawing zero current from the power source. Therefore no voltage is dropped across R5. The voltage at the top of R2 is also zero, letting the 2N5061 SCR remain cut off. The total circuit current under these conditions is nearly zero. After the mailbox door is opened, the normally-open switch, S1, now closes, which forces the junction of resistors R3 and R5 to circuit ground—turning on Q1. This transistor now supplies gate current to SCR1, turning it on and lighting indicator LED1. Closing the mailbox door turns off Q1, but the SCR remains on until the reset switch, S2, is operated.

Capacitor C1 is connected across the incoming wire pair to help filter out undesired signals that could cause the circuit to misfire, turning on the LED and sending Daniel outdoors for an unnecessary trip to the mailbox. Capacitor C2

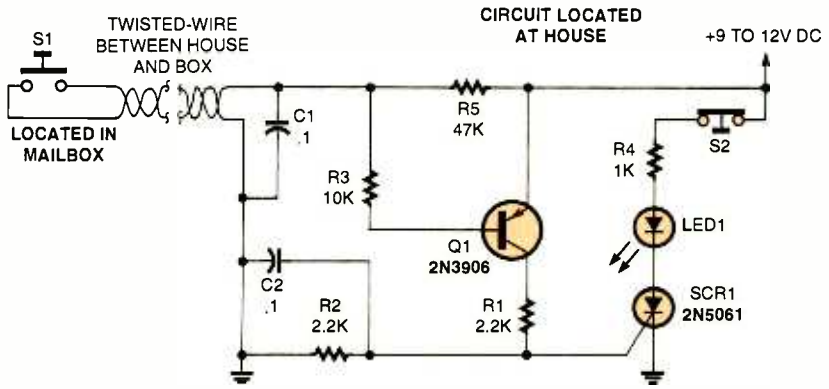


Fig. 1. Install this mail-monitor circuit into the mailbox for your house to alert you when mail arrives.

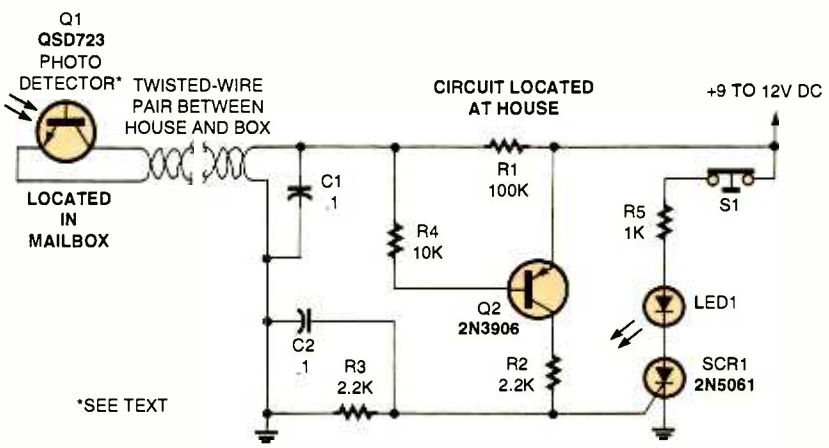


Fig. 2. In this mail-monitor circuit, the mailbox's mechanical switch is replaced by a photodetector for improved reliability.

PARTS LIST FOR MAIL-MONITOR CIRCUIT—USING A MAILBOX SWITCH (FIG. 1)

C1, C2—0.1-µF, ceramic-disc capacitor
LED1—Light-emitting diode, any color
Q1—2N3906 PNP transistor (NTE159, SK3466, or equivalent)
R1, R2—2200-ohm, 1/4-watt, 5% resistor
R3—10,000-ohm, 1/4-watt, 5% resistor
R4—1000-ohm, 1/4-watt, 5% resistor
R5—47,000-ohm, 1/4-watt, 5% resistor
S1—Normally open SPST leaf-operated switch (*Mouser Electronics* part 101-1201; Tel. 800-346-6873, or similar type)
S2—Normally-closed SPST pushbutton switch
SCR1—2N5061 silicon-controlled rectifier (NTE5401, SK3638, or equivalent

PARTS LIST FOR MAIL-MONITOR CIRCUIT—USING A MAILBOX PHOTODECTECTOR (FIG. 2)

C1, C2—0.1-µF, ceramic-disc capacitor
LED1—Light-emitting diode, any color
Q1—Photodetector, (*Mouser Electronics* part 512-QSD723; Tel. 800-346-6873, or similar type)
Q2—2N3906 PNP transistor (NTE159, SK3466, or equivalent)
R1—100,000-ohm, 1/4-watt, 5% resistor
R2, R3—2200-ohm, 1/4-watt, 5% resistor
R4—10,000-ohm, 1/4-watt, 5% resistor
R5—1000-ohm, 1/4-watt, 5% resistor
S1—Normally-closed SPST pushbutton switch
SCR1—2N5061 silicon-controlled rectifier (NTE5401, SK3638, or equivalent)

is added insurance to remove any RF or noise that might get past Q1.

MAIL-MONITOR CIRCUIT—USING A PHOTODETECTOR

Our second mailbox circuit, see Fig. 2, uses a photodetector as the open door sensor. The photodetector is located inside the mailbox near the door and positioned to look out the door. A closed mailbox allows very little outside light to enter, and under these conditions Q1 is like an open switch, allowing little or no current to flow through R1.

When the mailbox door is open, light activates the photodetector, turning on transistor Q2 and the SCR in the same manner as our first circuit. As before, opening the mailbox door takes the junction of resistors R1 and R4 to circuit ground—turning on Q2. This transistor supplies gate current to SCR1, turning it on and lighting LED1. Closing the mailbox door turns off Q1, but the SCR remains on until the reset switch, S1, is operated. Now we have replaced the mechanical switch with the solid-state photodetector for improved reliability.

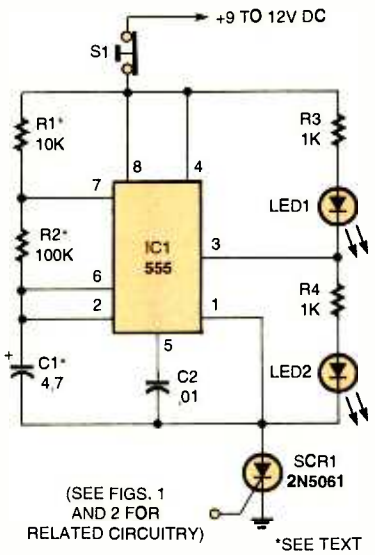


Fig. 3. Add this flasher circuit to the previous mail-monitor circuits to see a flashing pattern when the mail arrives.

PARTS LIST FOR MONITOR FLASHER ADD-ON CIRCUIT (FIG. 3)

C1—4.7-μF, 25-WVDC, electrolytic capacitor
C2—0.01-μF, ceramic-disc capacitor
IC1—555 oscillator/timer integrated circuit, (NTE955M, SK3564, or equivalent)
LED1, LED2—Light-emitting diode, any color
R1—10,000-ohm, 1/4-watt, 5% resistor
R2—100,000-ohm, 1/4-watt, 5% resistor
R3, R4—1000-ohm, 1/4-watt, 5% resistor
S1—Normally-closed SPST pushbutton switch
SCR1—2N5061 silicon-controlled rectifier (NTE5401, SK3638, or equivalent)
(See Parts List for Figs. 1 and 2 for other components.)

MONITOR FLASHER ADD-ON CIRCUIT

The single LED indicator used in both mailbox monitors may be replaced with the dual-flashing LED circuit shown in Fig. 3. Here we have a 555 oscillator/timer IC connected in a dual-output low-frequency oscillator that alternately turns LED1 and LED2 on and off at a rate of about one-per-second. The flashing rate may be altered by varying the values of C1 and R2. Increasing either or both component values will lower the rate, and decreasing their values will increase the rate. Resistor R1 can be varied to equalize the on time of each LED.

MAGIC ELECTRONICS BOX

Our next circuit, see Fig. 4A, is a magic electronics box that only (you) the master can control! Pick the magic box up and look it over, then say a few chosen words. When you set it down, it begins to sound off with an ear-piercing annoying tone. Allow anyone to pick the box up and try to silence the tone without destroying the box. Casually take the box back, repeat a few magic words, set it down again, and the tone ceases. The secret to becoming the master of the magic box is in knowing how to position the box and where to set it.

Here's how the magic box works. The circuit is housed in a small wood or plastic case with the two magnetically-activated SPST reed switches attached to the inside surface of the cabinet, preferably either adjacent or on opposite sides (illustrated in Fig. 4B). The medium for the magic box can be any table or surface where a permanent magnet can be hidden under the surface that will still operate the reed switches when the box is positioned on the table above the magnet. Placing the box with switch S1 over the magnet will trigger transistor Q1 on and turn on the piezo sounder. The piezo oscillator will continue to sound off until the box is positioned with S2 over the magnet. Closing S2 places a short across the SCR, turning it off and silencing the piezo oscillator. Placing additional magnets at different locations will add to the mystery of magic box.

WHISTLE-ACTIVATED SWITCH CIRCUIT

Jay, a local electronic hobbyist, dropped by the other day looking for a whistle-activated switch circuit that could be used to operate a relay and drive an external load. Jay only wanted

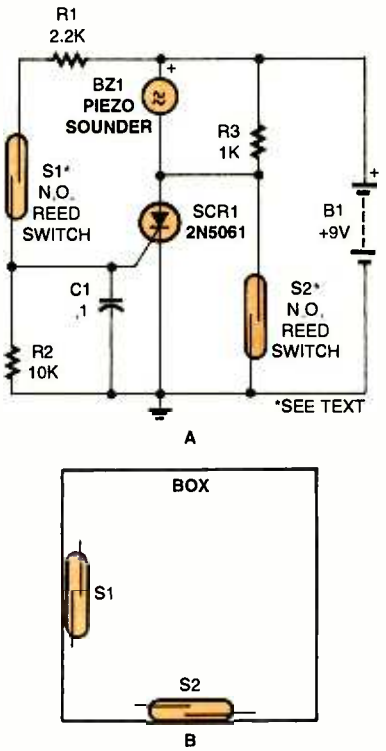


Fig. 4. Build this circuit, and be the magician in your neighborhood! When this box is moved, only you will know how to silence the piercing buzzer sound.

PARTS LIST FOR MAGIC ELECTRONICS BOX (FIG. 4)

B1—9-volt transistor battery
BZ1—Piezo sounder (*RadioShack* part 273-059, or equivalent)
C1—0.1-μF, ceramic-disc capacitor
R1—2200-ohm, 1/4-watt, 5% resistor
R2—10,000-ohm, 1/4-watt, 5% resistor
R3—1000-ohm, 1/4-watt, 5% resistor
S1, S2—Normally-open SPST magnetically-actuated reed switch (*Hosfelt Electronics* part 51-144; Tel. 888-0524-6464, or equivalent)
SCR1—2N5061 silicon-controlled rectifier (NTE5401, SK3638, or equivalent)
Miscellaneous parts—Box, battery holder, magnets, *etc.*

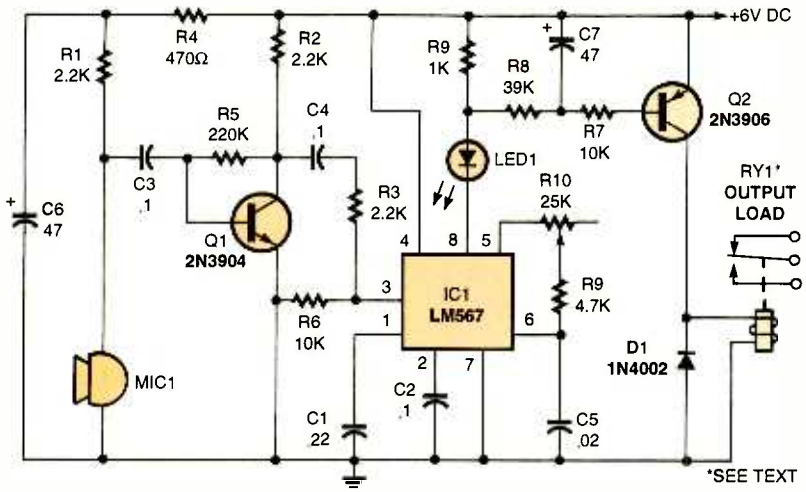


Fig. 5. Whistle a happy tune, and this circuit will close the relay and activate the external load.

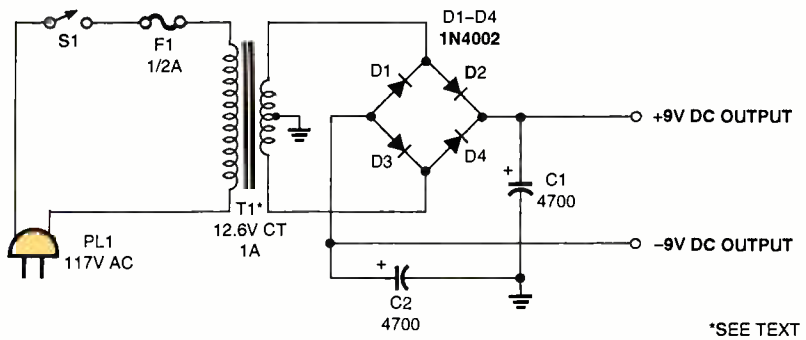


Fig. 6. Here's a real handy 9-volt, dual-polarity, unregulated DC supply, which can easily drive most low-current devices.

PARTS LIST FOR WHISTLE-ACTIVATED SWITCH CIRCUIT (FIG. 5)

SEMICONDUCTORS

D1—1N4002, 1-amp, 100-PIV, general-purpose rectifier diode
IC1—LM567 PLL tone-decoder integrated circuit (NTE832, SK9089, or equivalent)
LED1—Light-emitting diode, any color
Q1—2N3904 NPN transistor (NTE123AP, SK3854, or equivalent)
Q2—2N3906 PNP transistor (NTE159, SK3466, or equivalent)

RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)
R1, R2, R3—2200-ohm
R4—470-ohm
R5—220,000-ohm
R6, R7—10,000-ohm
R8—39,000-ohm
R9—4700-ohm
R10—25,000-ohm potentiometer

CAPACITORS

C1—0.22-μF, ceramic-disc capacitor
C2–C4—0.1-μF, ceramic-disc capacitor
C5—0.02-μF, mylar, or similar capacitor
C6, C7—47-μF, 25-WVDC, electrolytic capacitor

ADDITIONAL PARTS AND MATERIALS

MIC1—Electret-type microphone (*RadioShack* part 270-092, or equivalent)
RY1—5-volt relay, (see text) Whistle, cabinet, power source, *etc.*

PARTS LIST FOR 9-VOLT, DUAL-POLARITY, UNREGULATED DC SUPPLY (FIG. 6)

C1, C2—4700-μF, 25-WVDC, electrolytic capacitor
D1–D4—1N4002, 1-amp, 100-PIV, general-purpose rectifier diode
F1—1/2-amp fuse
S1—SPST toggle switch
T1—12.6-volt, 1-amp step-down power transformer with center tap, (*Mouser Electronics* part 41FG010; Tel. 800-346-6873, or equivalent)

the relay to remain closed during the time the whistle was being blown. I sent him home with the circuit shown in Fig. 5 and explained the circuit's operation in the following manner. MIC1, an electret-type microphone, picks up the sound energy and sends it to transistor Q1 for amplification. The amplified signal is coupled to the input of IC1, an LM567 PLL (phase-locked-loop) tone-decoder integrated circuit that detects the whistle tone and sets its output at pin 8 to low, lighting LED1 and pulling resistor R8 to near ground level. Timing components C7 and R8 make up a simple time-delay circuit that keeps the relay from chattering due to voice and noise signals that fall within the bandwidth of the PLL. The delay may be varied by changing the value of capacitor C7 to a larger value for added delay and reduced in value for less delay. Just about any 5-volt SPDT relay will do for RY1, as long as the coil resistance falls within the 200– to 500-ohm range. The relay's contact ratings should be selected for the end-use application.

The circuit's tuning range with the component values given should cover frequencies between 1 kHz and 15 kHz. If a lower or higher frequency tuning range is desired, just change the value of capacitor C5. Make C5 larger for a lower frequency range and smaller for a higher tuning range. If you can't whistle or repeat the same tone—use a toy whistle!

9-VOLT, DUAL-POLARITY, UNREGULATED DC SUPPLY

No matter how many DC power supplies my workbench has available, it is always short one dual-polarity supply. I rectified the shortage by building up a couple of the 9-volt, dual-polarity, unregulated supplies shown in Fig. 6. Granted they are not high-tech or fancy in appearance, but when I need to check out an op-amp circuit requiring a dual supply—they get the job done. The supply will produce ±9-volts at current levels up to 100 mA, and up to 1 amp at a reduced output voltage. At the higher current levels the ripple increases accordingly, but when used at lower current levels, the large filter capacitors do a good job.

That's about it for now, so circuiteers send me your circuit ideas and requests. I'll do my best to air them here at the circus for everyone's benefit. See you here next issue! ■

COMPUTER BITS

The *ViCAM Digital Video Camera*

JEFF HOLTZMAN

For this month's issue, we will let our readers take a breather from their microcontroller education to look at a lighter, consumer or user-level topic. This time, for example, we'll talk about a new miniature digital video camera, the *ViCAM Digital Video Camera* by *Vista Imaging Inc.* Next time, we'll continue our examination of *Atmel's* AVR series of microcontrollers.

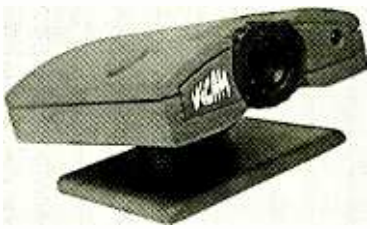
THE ViCAM

The *ViCAM Digital Video Camera* by *Vista Imaging* is not a portable snapshot camera. It is a tethered model intended for stationary applications, such as video-conferencing, security, Web broadcasting, and the like. I tested it on a 180-MHz Pentium Pro system with 64 Mb running under Windows 95 OSR2. The ViCAM has a suggested retail price of $199.95.

The camera installs easily. Plug one connector into a parallel port, the other into a keyboard port (for power), load the software from the included CD, and go. Both port connectors are pass-through types, and the kit includes a PS/2 to DIN keyboard adapter. The installation program is really a shell for several sub-installation programs; it would be clearer and more convenient to integrate all setup options into a single program. By the time you read this, Vista will be coming out with a USB-version.

The ViCAM comes with three main applications: A bitmap editor, a movie editor, and a trial copy of a face-recognition engine. The bitmap editor, *PhotoSuite SE* allows you to take snapshots, touch them up, add special effects, and so forth. It also provides some capabilities for creating greeting cards, sports cards, *etc.* The movie editor, *VideoWave*, allows you to record videos from the ViCAM and add sound annotation and text overlays, while the program *Video Control* permits transmission of high-quality e-mail and video mail.

For many people, the biggest question for this type of device is image quality. I found that it's highly sensitive to several aspects of computer configuration, namely parallel-port type and mode, and video-driver mode. My test machine has one of the modern multimode parallel ports. BIOS setup features allow the user to specify Compatible, ECP, and EPP modes. The machine was initially set up in Compatible mode. Further, the video driver was set to a 256-color mode. Also, ViCAM lens focus is set by turning the lens, mounted in a very finely threaded cylinder, that was tightened down all the way—presumably to prevent it from coming loose during shipping. The combination of those three variables produced a post-installation image that was totally unrecognizable—just floating blobs of incandescence. The effect was sort of interesting, like something from a sci-fi movie, but not exactly what I expected.



The ViCAM by Vista Imaging *provides easy connections, portability, and a CCD sensor in the camera which results in good image quality for the price.*

The ViCAM package comes complete with video camera, parallel-port cable assembly, PS/2 to DIN adapter, and software.

After adjusting the focus, I got a clear, though extremely jerky, image. Normally, with this type of device, you measure frame rate in frames per second; the initial mode was more like seconds per frame. You can adjust several parameters within the image capture program to improve image quality. In particular, by reducing image size and changing (from the default 24-bit color mode) to a 256-grayscale mode, I got a pretty steady image, but still not of the expected quality. Actually, I found the overall quality of the grayscale mode superior to even the optimized color modes.

Next I changed video mode. Fortunately, my video card, a *Matrox Millennium*, comes with a utility that allows quick mode changes, although an intervening reboot was required. I changed it from 8-bit (256 colors) to 32-bit (true color) mode. Jerkiness definitely improved.

Next I changed the parallel-port mode from default (compatible) to EPP. At that point I could run the ViCAM at its largest image size in full-color mode, without serious image motion degradation. It's not something you'd want to film *Titanic* in, but for home-movie, real-estate, or Web-site usage, it's adequate. Stills captured into the image-editing program were pretty good. Picture edges tended to be somewhat washed out and blurry. And there were some rainbow-like artifacts in central portions of the picture.

All in all, the device performs as advertised, and it is quite fun to use. The fact that it doesn't require a proprietary installation card is nice, which simplifies installation. However, it took a fair amount of system-level tweaking to maximize image quality, and I doubt many nontechnical users would have a clue about how to proceed. The documentation, which consists of a single-sheet *Quick Start* guide, is no help. There is additional on-line help and tutorials for the edit packages. The company also sells an auxiliary lens pack for about $50, which includes one close-up and two wide-angle lenses.

I think the ViCAM would be much more successful if it provided some sort of configuration/optimization wizard that could sense current and available system capabilities, and help the

(Continued on page 68)

Using the General Coverage Portion of Your Receiver

JOSEPH J. CARR, K4IPV

When I first got into ham radio, one of the really prized possessions a ham could own was a ham-band only high-frequency receiver. With a few exceptions (like my old *Hallicrafters* SX-28A), general-coverage receivers did not work as well for ham purposes as ham-band only models. The general-coverage receiver was designed for wide-frequency coverage, with a special "bandspread" dial calibrated for the ham bands. The neat trick that one learned early on was to calibrate the band edges by lining up the main tuning dial and the bandspread dial with a 100-kHz crystal calibrator.

But today the situation is different. First off, we don't usually see separate receivers and transmitters in ham stations. The "rig" these days is a transceiver; *i.e.*, transmitter-receiver combination unit. The modern transceiver is ham-band only in the transmit mode, but usually is a general coverage for the receive modes. Some of them even have a separate receive-antenna input connector if you care to use it. It is quite common to find receivers on ham rigs that operate from 100 kHz in the low-frequency spectrum all the way up to 30 MHz in the HF bands.

Although HF ham operators usually spend most of their time listening to the standard ham bands, there is a lot of other stuff to be heard. This month let's take a look at the general picture outside of the ham bands.

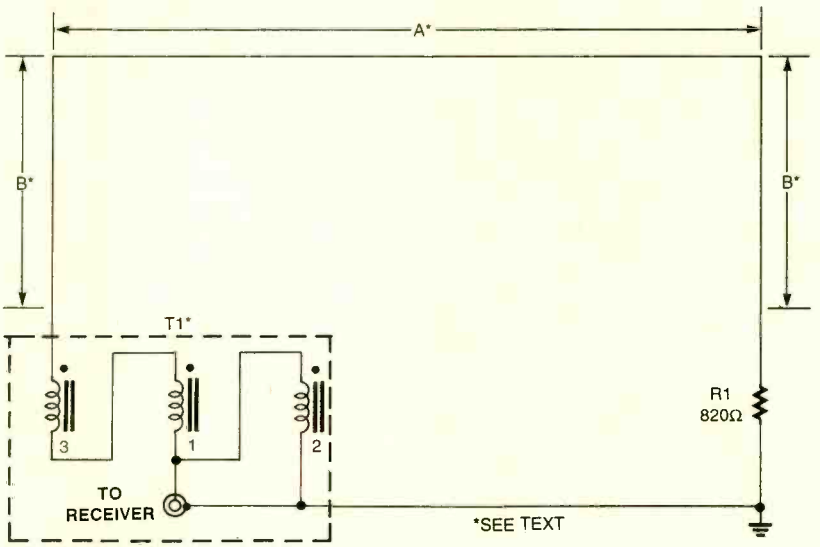


Fig. 1. The EWE low-noise, low-frequency, receiving antenna.

WHAT'S OUTSIDE THE HAM BANDS?

100–540 kHz. These are the long-wave bands. Some CW (Morse code) activity is found in this region. You will also find some beacons using CW to identify their call signs. Some beacons transmit using AM and provide weather forecasts. European broadcasters use a portion of the long-wave bands as a second AM broadcast band. The European low-frequency AM broadcast band (BCB) is from 145 kHz to 280 kHz. Signals in this band are often difficult to receive due to high noise levels, but are not impossible especially on the east coast of the U.S.

540–1700 kHz. AM BCB formerly ended at 1600 kHz. A large number of AM BCB stations will be heard, especially after dark. North American stations are spaced every 10 kHz (*e.g.*, 780 kHz and 790 kHz). Other nations use frequencies between the North American frequencies (*e.g.*, 785 kHz and 795 kHz). A few stations are found on odd frequencies such as 783 kHz.

2000–2850 kHz. Maritime SSB, CW, and RTTY. The International voice emergency and distress channel is 2182 kHz. Also check out 2082, 2638, and 2782 kHz. Coast Guard marine weather broadcasts at 2670 kHz. At times you may hear South American, African, and Pacific-rim domestic AM broadcast services, especially between 2300 and 2500 kHz (2500 kHz is used by WWV/WWVH).

2850–3150 kHz. Some CW and USB SSB voice communications and weather broadcasts (primarily airlines).

3150–3400 kHz. Fixed station and mobile stations. Some Federal Emergency Management Agency stations. Time and frequency station CHU (Canada) on 3330 kHz. Portion of the band used for tropical broadcasting.

3400–3500 kHz. Similar in use to 2850–3105 kHz.

4000–4065 kHz. Fixed station and Military Affiliate Radio System (MARS) stations.

4065–4438 kHz. Maritime CW, RTTY, and USB SSB signals. Check 4125 (international calling channel).

4440–4650 kHz. Fixed and mobile allocations. Check out 4449 kHz for USAF USB voice activity.

4750–4995 kHz. 60-meter tropical broadcast band. African stations will begin to appear right after local sunset, and continue until late evening. Also look for South and Central American stations and Pacific-rim (notably Indonesia) stations.

5730–5950 kHz. Numerous stations using CW, RTTY, and SSB. U.S. Weather Bureau operates a network on 5923 using USB SSB voice. Also found are Department of Energy, NASA, and USAF. The NASA frequency (5810 kHz) is used in support of space-shuttle launches.

5950–6200 kHz. 49-meter interna-

tional broadcast band. AM signals from Europe, South America, Asia, Eurasia, and Pacific areas.

6200–6525 kHz. Maritime communications. CW, RTTY, and USB SSB voice. Often used for inland waterway communications.

7300–8195 kHz. CHU (Canada) time and frequency station on 7335 kHz in French and English. U.S. Customs Service and Interpol (international police agency) use this band on occasion. Also, some international broadcasters are found here.

8195–9040 kHz. Aeronautical communications, especially trans-Atlantic. Long Island, NY and Gander, Newfoundland stations handle in-bound aircraft from Europe. SSB commonly used. I used to listen to this band quite a bit on the old SX-28A. It was interesting to eavesdrop on the airliners approaching North America after flying over the Atlantic Ocean.

9500–9900 kHz. 31-meter international broadcast band. One of the most popular listening bands.

10,005–10,100 kHz. USB SSB. Airline corporate communications..

10,150–11,175 kHz. Feeder signals for international broadcasters to overseas relay stations. Carry the same content as the AM signals in the regulator international broadcast bands, but use SSB instead.

11,650–11,975 kHz. 25-meter international broadcast band. Active during day and at night, but evening is by far the most active. Broadcasters from around the world are heard in this band.

13,600–13,800 kHz. 22-meter international broadcast band (new). Active during the day, especially in the early afternoon.

15,010–15,100 kHz. Aeronautical band using USB SSB. Military airborne stations are found in this band.

15,100–15,600 kHz. 19-meter international broadcast band. Band is quite active during daylight and evening hours. Especially during the day, signals from Australia, Japan, and other Far East countries are heard.

17,550–17,900 kHz. 16-meter international broadcasting band. Active during most of the day, into the early evening.

17,900–18,030 kHz. Aeronautical signals using USB SSB.

20,010–21,000 kHz. Aeronautical and fixed stations. USAF and NASA use this band on occasion. The USAF uses USB SSB, while NASA uses LSB SSB.

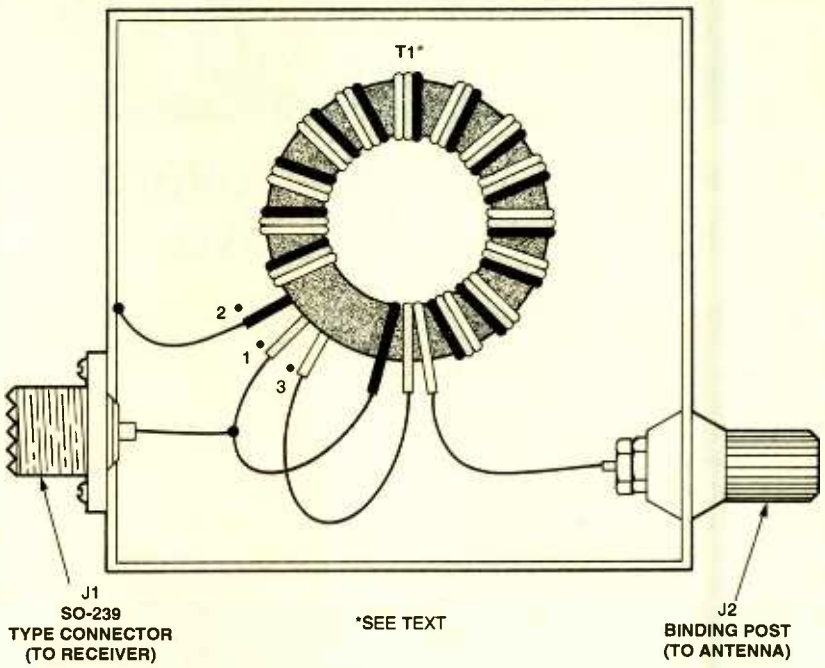


Fig. 2. Transformer enclosure for the EWE antenna.

21,450–21,850 kHz. 13-meter international broadcast band. Not used during low solar activity, but now that the solar cycle is on the way up, more activity is expected.

21,870–22,000 kHz. Aeronautical and fixed stations.

22,000–22,855 kHz. Maritime stations using USB SSB.

25,670–26,100 kHz. 11-meter international broadcasting band. Not very well used.

26,100–28,000 kHz. Fixed and mobile communications. This frequency range includes the Citizen's Band (26,965–27,405 kHz). A number of illegal CB operators can be found in the space above the Citizen's Band, 27,500–28,000 kHz.

LOW-NOISE RECEIVING ANTENNA FOR THE LOWER BANDS

There is a lot of neat activity in the medium wave and "tropical" shortwave bands, *i.e.* those between 160 meters and 40 meters. A problem with reception in those bands, including the ham bands, is that there is a great deal of noise! Both natural and man-made sources ruin reception for many people. Keep in mind that receiving radio signals is basically an exercise in signal-to-noise ratio (SNR). If we can build an antenna that is less sensitive to local noise signals than sky-wave radio signals, then we are ahead of the game. Figure 1 shows such an antenna.

This antenna is called the "EWE" or "Ewe" (not an acronym or farm animal; rumor has it that when the antenna was first mentioned in *QST* magazine in February 1995, and later in *QST*, January 1996, this name developed as a cute way of saying "U"—which is the upside-down shape of the antenna over ground), and vaguely resembles the Beverage antenna (described in **Popular Electronics**, January 1998), but it isn't the same. It consists of two vertical sections of length "B," and a horizontal section of length "A." For operation around 80 meters or 3.5 MHz, A = 21 feet, and B = 10 feet. The antenna is 10 feet off the ground.

For this design, the far end of the EWE antenna (which is the theoretical "back-end" of the antenna, since it produces a cardioid-type pattern, with the main lobe towards the receiver feed) is terminated in an 820-ohm resistor. This resistor must be non-inductive, so use a carbon composition or metal-film resistor. The power level is not important, because for our purposes we are not using this antenna for transmitting—just receiving.

The receiver end is connected to a 52-ohm coaxial cable through a broadband impedance transformer. Details of

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SCANNER SCENE

Most Talked-About Scanner?

MARC SAXON

Every now and again, a piece of scanner hardware comes down the pike that captures the imagination of radio monitors and creates a lot of word-of-mouth. In short, before you know it, the unit has become somewhat of an instant legend. *Uniden*'s *Bearcat BC-9000XLT* is just such a scanner. Features and performance, Bunky, those are the keywords.

With the exception of some UHF-TV channels (550-760 MHz) and the now-off-limits (by FCC decree) cellular bands, the BC-9000XLT provides copious frequency coverage straight through from 25–1300 MHz, NFM, WFM, and AM (user-selectable modes). Store it all in 500 memory channels, which are set up in 20 banks of 25 channels each. You can scan up to 100 channels per second; when searching for frequencies in the VHF band, you get to select a rate of either 100 or 300 steps-per-second. You can skip over unwanted data signals and birdies (see below), and an optional CTCSS (PL, if you prefer that term) tone board allows you to add selective station reception when monitoring those networks equipped with this feature.

Frequencies may be accessed by the keypad, by manually stepping through bands, or by the large rotary control knob. A frequency transfer button allows you to reassign a stored frequency to another bank's open channel. A STORE feature searches out and stores frequencies in an available channel location in any band(s) and then returns to SEARCH/SCAN function—all automatically. Programmed frequencies are sorted within each bank for faster scanning, also automatically.

Another feature is the auxiliary terminal that allows the user to control tape On/Off when transmissions are received. Don't forget the display feature that allows the counting and recording of each channel's activity while scanning. Round it all off with instant Weather-Band access and good looks. Is the BC-9000XLT a scanner and a half, or what? Look for it at any *Uniden* Bearcat dealer.

Note that the BC-9000XLT's cellular frequencies had to be permanently blocked out at the factory during the manufacturing process. A number of owners have reported, however, that cellular images still come in very well on this scanner in the 360–385-MHz range. In addition, on the BC-9000XLT, it's reported that you can use the SND button during a search in a manner similar to the MON button on *RadioShack* scanners, transferring a frequency to any bank you've selected to be your *Monitor* bank. With *RadioShack* scanners, you need to go through extra steps to transfer the memories from Monitor channels to permanent memory locations.

The BC-9000XLT provides frequency coverage from 25–1300 MHz, NFM, WFM, and AM. The frequencies can be stored in 500 memory channels, which are set up in 20 banks of 25 channels each.

SITES FOR SCANNING

The many monitor enthusiasts who are into VHF aeronautical monitoring will be interested to learn they can use a PC to track any commercial airline flight that is in progress, getting the current position, altitude, speed, type of aircraft, departure time, estimated arrival time, and lots more. You can check random flights, or the one flight or airport that interests you the most. Check out this Web site: *www.thetrip.com*.

Some rather quirky communications are often encountered on airline company frequencies, including pilot reports of their aircraft's mechanical problems, complaints about unruly passengers, complaints by passengers about bad service or lost items, requests for police to meet the aircraft upon landing, *etc.* These communications are in the 128.825–132-MHz band.

Specific airline frequencies that have produced good results include: *American Airlines* 129.2, 129.35, 131.4; *Carnival* 129.8; *Continental* 130.9; *Delta* 129.9, 129.55, 130.1, 131.45; *FedEx* 131.925; *Kiwi* 129.9; *Tower Air* 130.55; *United* 129.3, 129.53 129.85; and *UPS* 129.425, 129.475 MHz.

Recent monitoring during Presidential visits indicates that 162.6875, 164.8875, 165.375, 165.7875, 166.5125, 171.2875, and 408.50 MHz are reported to be the most frequently used by the Secret Service, White House Communications Agency (WHCA), and related support staffs. Note that while 165.375 and 408.50 MHz have many transmissions in the clear, the other frequencies are often scrambled. WHCA's digital paging is on 167.025 MHz.

A correspondent reports that U.S. Marshals use: 163.20, 163.8125, 164.60, 162.7125, 162.7875, 170.75, and 170.75 MHz.

DRIVE-THROUGH TALK

Pete Yellin, of Kentucky, writes to say that several area *McDonald's* are reportedly using 900-MHz communications systems for their drive-through operations instead of their older 154-MHz radios. He asks if these new frequencies are known. Several fast-food chains seem to be switching to 900 MHz, with headsets operating in WFM mode on frequencies between 903.0–905 MHz (12.5-kHz steps), and the customer's outside speakers between 920.0–922.0 MHz (12.5-kHz steps).

Some reported in use (customer/clerk) are: *Arby's* 920.75/903.725; *Burger King* 920.2625/903.2625; *Coffee Time* 920.7375/903.7375; *Dairy Queen* 920.2626/903.2625; *Dunkin' Donuts* 920.2625/903.2625; *Kenny Roger's Roasters* 920.2875/ 903.2875; *McDonald's* 920.20/903.20, 920.2625/ 903.2625, 920.50/903.50, 920.9625/ 903.9625 MHz.

MAILBAG

Nicky, a reader in western New York

(Continued on page 68)

Think Tank

Varactors, Photoresistors, and All Sorts of Circuits

ALEX BIE

Apart from being used purely for rectification, semiconductor diodes have a number of other properties which can be put to good use in a variety of applications. One such property is that they exhibit a change in capacitance when a variable reverse bias is applied. As a result of this phenomenon, diodes designed and used for this application are called varactor (variable reactance), or varicap (variable capacitance) diodes, or simply, tuning diodes.

The capacitance change can be used in a variety of ways. One of the most obvious is for applying frequency modulation to a signal from a varying audio voltage in an oscillator or in a phase-reactance modulator. Frequency synthesizers make widespread use of varactors.

Varactor diodes are also used in voltage-controlled filters. Often these filters are controlled by microprocessors where the tuning data is sent to a digital-to-analog converter, and the resulting analog voltage output controls the varactor diodes used in the filter.

HOW THEY WORK

We have already seen that the electron activity for semiconductor diodes occurs in the junction between the N-type and P-type semiconductor material. The same is true for varactor diodes. Here the area, called the depletion layer, does not allow current to flow and acts as if it is a plate capacitor (illustrated in Fig. 1).

When a reverse bias is applied, the depletion layer widens, effectively increasing the gap between the plates; and the capacitance becomes less, as shown in the curve of Fig. 2. In this way, a varactor becomes a voltage-controlled capacitor. Varactor diodes are always run with a reverse bias. A forward bias is avoided because the diode starts to conduct, which has the effect of reducing the "Q-factor" or selectivity of the tuned circuit.

The actual capacitance range that is obtained depends upon a number of factors. One is the area of the junction. Another factor is the width of the depletion region for a given voltage. This is governed by the doping concentration, and it is normally adjusted to give a relatively abrupt junction, which results in a greater capacitance change.

Diodes typically operate with reverse bias ranging from around a couple of volts up to 20 volts and higher. Some may even operate up to as much as 60 volts, although at the top end of the range comparatively little change in capacitance is seen.

TUNING RANGE

Obviously the most important characteristic of a varactor diode is its tuning range. Normally two voltage points are specified, one at the top of the range and the other near the bottom at the minimum usable voltage. It's obviously important to select a diode that combines the correct capacitance range for the available tuning voltage range. The higher voltage specified is normally the maximum reverse bias, and this should not be exceeded—otherwise breakdown may occur. For example, the 1N5441 varactor diode (similar to an NTE 610, SK3323, *Motorola* MV2101, *etc.*), is used frequently in RF design. This device has a nominal diode capacitance of 6.8 pF at a reverse voltage of 4 volts at 1 MHz, with a typical capacitance tuning ratio of 2.5 between reverse voltages of 4 to 60 volts (maximum reverse breakdown voltage is 60 volts).

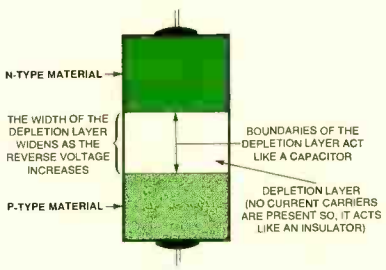

Fig. 1. The physics of a varactor diode.

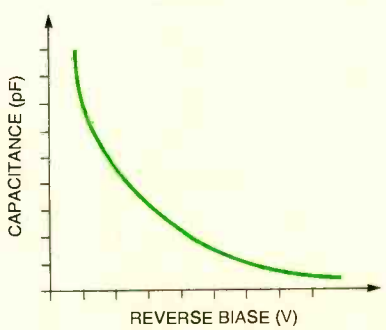

Fig. 2. Relationship between voltage and capacitance for a varactor diode.

An important characteristic of any varactor diode is its "Q." This is particularly important in a number of applications including radio tuning, UHF/TV tuners, telecommunications, *etc.* For oscillators used in frequency synthesizers, this quality affects the noise performance. High-Q diodes enable a very narrow tuned circuit to be achieved, and in turn this reduces the phase noise produced by the circuit. For the 1N5441, the specified Q is 450 at a reverse voltage of 4 volts and at a frequency of 50 MHz.

For filter applications, the Q is again very important. A high-Q diode will enable the filter to give a sharper response, whereas a low-Q diode will increase the losses. The Q of a diode is simply the ratio of the capacitive reactance and the bulk resistance; *i.e.*, $Q = X_C/R_S$ at a specified frequency.

Reference may also be made to abrupt- and hyper-abrupt diodes. These diodes have a very sharp junction, and small changes in voltage give a relatively large percentage change in capacitance (a tuning ratio greater than 10-to-1). These diodes are particularly useful when oscillators or filters need to be "swept" over large frequency ranges.

("What is A...?" series by Ian Poole, G3YWX, reprinted by permission from *Practical Wireless*, Arrowsmith Court, Station Approach, Broadstone, Dorset BH18 8PW, England.)

BACK-TO-BACK ARRANGEMENT

Varactor diodes can be used in a variety of ways. However, one of the most common, is in a back-to-back arrangement in a tuned circuit like that shown in the schematic of Fig. 3. The use of the varactor diodes, D1 and D2, prevents the alternating RF voltage in the circuit from driving the diodes into forward conduction; however, it does mean that the total capacitance of the diode combination is only half that of each diode, assuming they have the same capacitance. The control voltage is applied through the resistor, R1, in the control voltage line and the capacitor, C1, to ground to act as a filter. High-value resistors, approximately 10k are generally used since the feed impedance to the diodes is high. The frequency of the tuned circuit is determined by the values of inductor L1, the fixed capacitor, C2, and the shunt capacitance combination of the tuning diodes.

Next month, we will continue our "What is a ...?" series with PIN Diodes. Now here are some novel circuits that have come to this column from our readers.

RECHARGEABLE FLASHLIGHT

I put together this battery pack inside a flashlight (see Fig. 4A), which I've used for many years. Not only did I save on C-cell batteries, but this unit is dependable and long lasting when the batteries are recharged in an AC outlet.

The four rechargeable C-cells were obtained from *RadioShack* as "Sub C"-type nickel-cadmium batteries, part 23-190 (solder tabs, and rated at 1.25 volts each with 1400 mAh capacity). The schematic of the hookup (shown in Fig. 4B) was designed with on-hand components. The DC modular adapter is a *Hosfelt* part 56-185 (Tel. 800-524-6464) which is rated at 6 VDC at 2A, and its adapter plug has a 5.5 mm outer diameter, 2.15 mm inner diameter, center negative. So the compatible mating connector, which was mounted near the front of the flashlight, is a *Hosfelt* jack, part 60-35.—*Frank Barone, New Haven, CT*

Very useful project, Frank. This design can be easily changed to accommodate other components. Just make sure the NiCd batteries chosen will fit into your flashlight! Once the batteries are picked, the recharger or DC modular adapter must be selected. With the adapter specs known, work towards selecting a mechanically and electrically compatible mating socket to be mounted somewhere on the body of the flashlight. That's about it—hope you see the light—and just make sure you observe the necessary precautions about recharging NiCd cells.

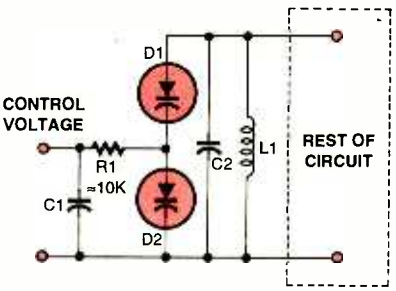

Fig. 3. A tuned circuit using back-to-back varactor diodes.

REMOTE-CONTROL TESTER

My next door neighbor asked me to check his TV infrared remote control (IRC) unit. The TV set seemed OK, the batteries in the IRC were good, but the unit would not operate any of the TV's functions. I needed a way to functionally check this remote. Later that evening, I came up with the circuit, shown in Fig. 5, which not only eventually helped me check their remote, but also proved to be an invaluable tester for other types of IRC devices.

The description of the circuit is pretty simple. A general-purpose cadmium sulfide (CdS) photoresistor (available in a package of five from *RadioShack*, part 276-1657) was used as the input to the circuit. The electrical output from the cell is proportional to the infrared energy impinging upon it from the remote-under-test. The 10k potentiometer is used to adjust the signal level. This electrical signal is then applied to an external detector for analysis. The detector that was used in my case, was a *RadioShack* mini-audio amplifier, part 277-1008—but any general-purpose audio amplifier will work for the detector in this circuit.

I then brought my circuit and external amplifier into my neighbor's house. I first tried out several known-working IRCs, by aiming them directly at the CdS cell in my circuit. This check produced various tones from the amplifier when the different buttons were pressed on the remotes. My neighbor's remote produced similar tones—so I assumed that the remote was also good. On a hunch, I closed the drapes and moved a decorative vase off the coffee table adjacent to the TV set. Guess what—that did it! The remote now controlled the TV—the vase was blocking the energy from reaching the sensor in the set.

This circuit has proved very useful for checking out other types of remotes—for lamps, stereo components, and even garage-door openers. I am sure that the innovative readers at **Popular Electronics** can find other uses for this tester.—*Craig Fawcett CET, Downers Grove, IL*

Nice job, Craig. Now if one of our readers can set up a technique that would calibrate some standard detector with the tones produced from various remotes—then we would really have developed a precise general-purpose IRC tester.

MOTOR CONTROLLER–2

Although there are numerous schematics out there of devices that will drive a small DC motor either clockwise or counter-clockwise (depending on which sensor is sensing), I thought them more complex than they need to be—for my needs anyway. So I put together this little design shown in Fig. 6. I call this circuit the "MotorController–2" ("MotorController–1" was a commercial kit which contained two 741 operational-amplifier ICs, four CdS photoresistive cells, two transistors, and two diodes. Besides not working as advertised, it was a soldering nightmare; and I wouldn't wish that task on my worst enemy!). My circuit on the other hand contains only two PNP transistors, two NPN transistors, two CdS cells, and two resistors. Besides being easier to put together, it doesn't contain any ICs, so it isn't as sensitive to static electricity.

It may make it easier to understand my circuit if you forget that the transistors are transistors, but instead are acting like relays. You'll probably appreciate that both halves of this circuit are identical (the battery path separates the two). Basically what separates each half are the CdS cells (*RadioShack* part 276-1657); therefore, this circuit works best when one CdS cell is in the dark and the other is not. If both photoresistive cells, R2 and R3, are in the dark—the motor does not turn; likewise, if both

R2 and R3 are equally illuminated, and if their resistance values are the same, the motor again does not turn. If the resistance values are not the same, then when R2 and R3 are equally illuminated, the current will flow through the path of least resistance.

When cell R2 receives light, Q2, a 2N3904 NPN transistor, is activated. Its collector voltage provides current to the motor's negative terminal and activates Q1, which provides current to the motor's positive terminal. The other half of the circuit operates in the same way. The only difference is that collector voltages of transistors Q3 and Q4 are directed so that the motor receives reversed polarity.

When assembling the circuit, try to make sure that the resistance values of photocells R1 and R2 are the same, or close to each other in value—this can easily be done with the use of an ohmmeter. The two CdS cells I selected had a low resistance of 11k ohm (as measured when illuminated with a 60–75 watt light bulb), and a high resistance of 1.5 Megohms when in the dark.—*Curt Donofrio, Shelton, CT*

Curt, this certainly looks like a novel use of CdS cells. You can substitute an NTE 123AP or SK3854 for the 2N3904 transistors and NTE159 or SK3466 units for the 2N3906 transistors.

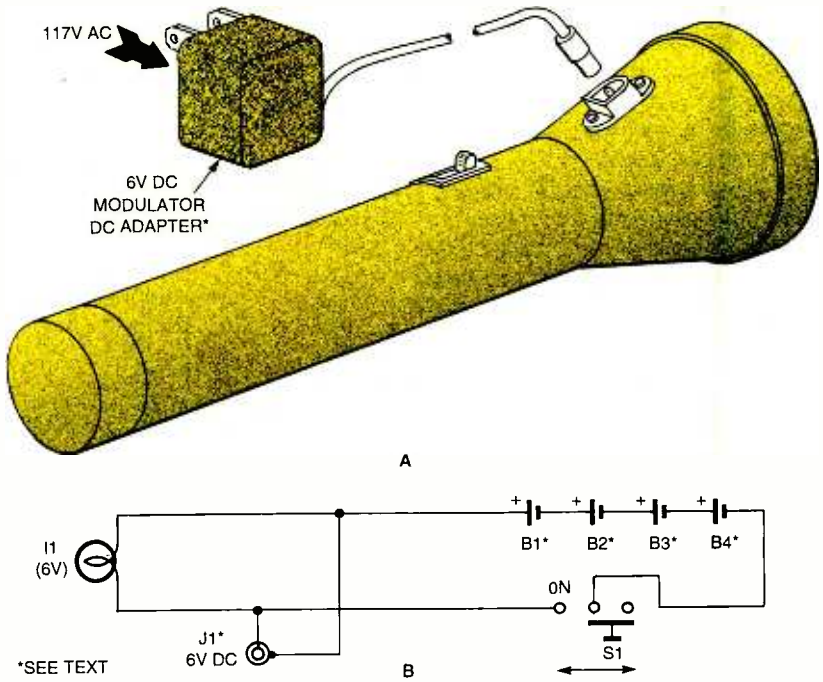

Fig. 4. Here's a handy rechargeable flashlight circuit, which will never leave you in the dark.

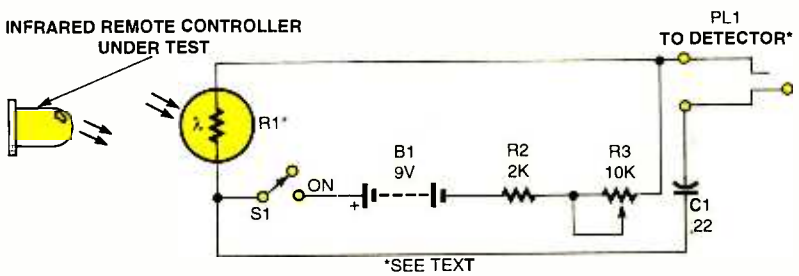

Fig. 5. This simple circuit, when connected to an external detector, can be used to test all types of infrared remote controls.

EASY-TO-BUILD PH METER

If you've ever wondered what the pH is of the acid-rain landing on your car or wanted to double check the pH of your pool water, garden soil, or beer-batch, then you need an accurate pH meter. The pH meter circuit, shown in Fig. 7, is a simple circuit, since it is the probe that really does all the work.

A pH probe is essentially a battery; it generates a weak voltage dependent on the pH—which gives you a quantitative measure of the acidity or alkalinity of a solution-under-test. (The normal pH scale ranges from zero to 14, with neutral represented by 7. Values less than 7 are acid; greater than 7 indicates alkalinity). The probe's impedance is very high, so if you directly attach an analog millivoltmeter you'll read a big fat zero. To remedy this, the probe output is fed to IC1, a *National Semiconductor* LF411 low-offset, low-drift JFET input op-amp, configured as a buffer amplifier. The LF411 has a very high input impedance, which is ideal to buffer the probe output. The buffered output is then fed to IC2, an LM741 op-amp configured as a gain amplifier but with zeroing capability too. The amplified, zeroed output is then applied to M1, a zero-center, ±400 microamp meter, through the adjustable resistor, R7. The circuit is powered by two 9-volt batteries in a split supply—so the unit is portable. Keep probe inputs shielded and as short as possible; other than this, the construction/layout is not critical.

To calibrate the circuit for operation, connect a pH probe through a BNC connector, P1, to the input BNC jack, J1. Prepare three buffer solutions (see vendor information at end), which are standards of pH 4.0, 7.0, and 10.0. Dip the probe into the pH 7 buffer (neutral) and wait a minute for the reading to stabilize; then adjust potentiometer R1 until the meter is exactly centered. Next, rinse the probe in water and immerse it in the pH 4 buffer solution. The meter will deflect negative; adjust potentiometer R2 until the meter needle is halfway between center and its pegged position. Rinse the probe again and insert it in the pH 10 solution; the meter should deflect positive to the same degree that the pH 4 drove it negative. Rinse the probe again, double check pH 7, rinse, and then measure the pH of your sample. That should calibrate the meter for operation.

Keep your water, buffers, and sample at room temperature when reading since the probe is temperature sensitive. When not in use, store the probe tip immersed in a little clean water.

Many types of pH probes exist and will work with this circuit. In selecting a probe on the basis of low price, high durability, ease of use and low maintenance, the best choice is a combination pH/reference electrode in an epoxy body with sealed gel-filled reference. Most scientific supply companies carry this type. One type I have had success with is manufactured by *Davis Instruments*, Tel. 800-368-2516, model no. S200C, which currently costs $47. They also have the buffer solution standards (4.0, 7.0, 10.0, respectively) at around $8 each, corresponding to catalog numbers: HI7004, HI7007, and HI7010.—*Nick Cinquino, Schaumburg IL*

Nick also suggests that to avoid nosy onlookers while checking out polluted river water, wear a white lab coat, and look worried—onlookers will keep their distance! By the way, the LM741 op-amp can be replaced by an NTE941 or SK3514; however, there does not appear to be a similar equivalent for the LF411 op-amp, due to its unique low-offset, low-drift characteristics. The LM741 is pin-compatible with the LF411, but it does not have the same JFET characteristics.

MAILBAG

In the *Think Tank* circuit for May 1998, "Automated Motor Pump Switch," I noticed a poor choice of material for the electrodes. I don't believe you'll find any aluminum used in a water-level detection system as it would soon corrode and quit working reliably, and then not at all. Even if there were no current flowing, it would corrode, but with a current flow it will happen faster. The copper material alternative suggested by the author could wind up just about as bad, depending on what chemicals are in the water. I would suggest using stainless steel for reliability, (*i.e.* welding rods), and revising the circuit to use 12-volts AC across the electrodes, if possible, instead of the 12-volts DC. The alternating current flow will help to keep down mineral deposits on the electrodes. Connections to the stainless steel rods can be mechanically made above the water level, since stainless steel is rather difficult to solder to this material.

I wouldn't trust the aluminum or copper in a sump-pump arrangement. Just when needed, it would most likely fail.—*Donald K. Belmont, Snohomish, WA*

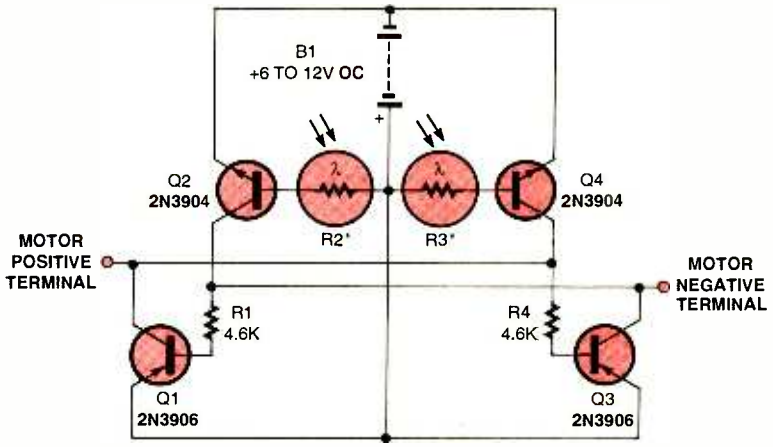

Fig. 6. This unusual circuit is able to drive a small DC motor clockwise or counter-clockwise through a unique use of photoresistive components.

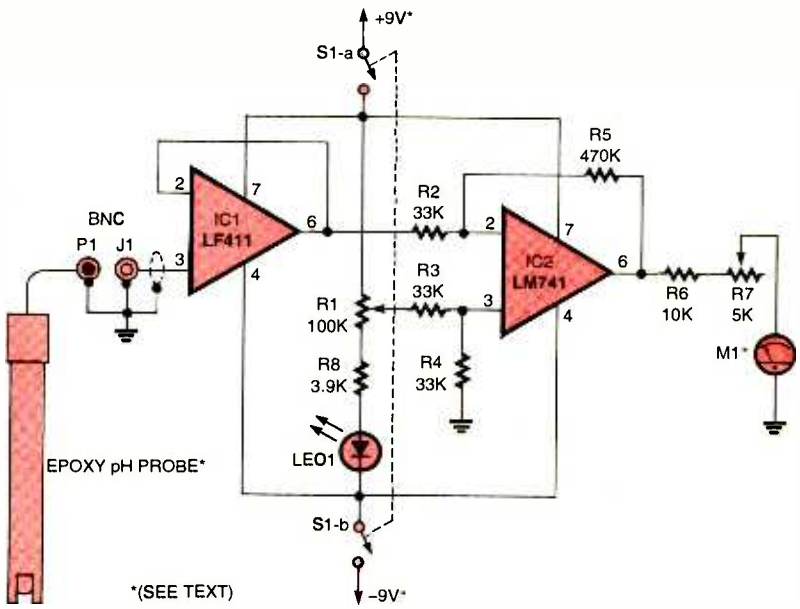

Fig. 7. Here's a very easy-to-build accurate pH meter circuit that can be used to test the acidity or alkalinity of pool water, garden soil, or many other items around your home.

With a DC voltage applied to the electrodes of the "Automated Motor Pump Switch" circuit, one has to be very careful of the choice of materials used for the electrodes. Some years ago, I addressed the same problem with a sump-pump control, and I found that few metals could resist electrolysis. Stainless steel electrodes might work. However, if you could find one of the old type dry-cell batteries with a solid carbon rod for the positive post, that rod would probably be best. I solved the problem by applying AC voltage to the electrodes and designing the circuit around that approach. This way I was able to use the end of a copper wire to do the job.—*Dwight Eggleston, Union City, IN*

I'm writing to inform you that the circuit, "Vacuum-Tube Audio Amplifier," in the June 1998 *Think Tank* column appears to be a close copy of the circuit in my article "Build a Vacuum-Tube Audio Amplifier," which was published as a full construction article in the June 1995 **Popular Electronics**, and also reprinted in the Fall 1995 **Electronics Hobbyists Handbook**. Would you please print a correction about the

authorship of this material?—*Larry Lisle, Rockford, IL*

Thanks for bringing this to our attention, Larry. Unfortunately, no searchable database exists—on the Internet or elsewhere—of published circuits. They do say imitation is the sincerest form of flattery!

That's about it for this month's column. Remember—this is **your** column—keep those circuits, solutions and ideas coming in. For each of your circuits that appear, you'll receive a book from our library. Send in enough circuits to fill a whole column and you will get a nifty kit or electronics tool to make your construction easier. Write me—Alex Bie, *Think Tank*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

HAM RADIO

(continued from page 60)

the transformer winding are shown in Fig. 2. The transformer should be built on a toroidal powdered iron core made of type-2, type-6 or, preferably, type-15 (red/white color code) material. The type-15 powdered iron is optimized for use into the tropical bands, but not much higher. The transformer should be wound with 18 turns of any size enameled wire from no. 22 AWG to no. 26 AWG. This amount of wire suggests a T-68 or T-82 size core. A suitable core would be the T-68-15 or T-82-15, for example. In the figure, note where points 1, 2, and 3 go to in the antenna system. For best results, build the transformer into a weather-tight aluminum-shielded box.

Reports indicate that the EWE antenna works better than an equivalent dipole antenna, but worse than a Beverage antenna. However, if you have limited real estate for the low-frequency bands, then this is the way to go—especially if you have a good ground system or are near salt water.

A NEW WEB SITE TO CHECK OUT

There is a new hobby electronics Web site that you might want to check out. It is operated by ham/SWL author Harry Helms and his company *LLH Publications*. It deals with general electronics topics of interest to both electronics hobbyists and the ham/SWL community. The Web address is *www.hobby-electronics.com.*

PERSONAL NOTE

One of my "sub-hobbies" is collecting antique radio receivers. Because of my fond memories of the *Hallicrafter's* SX-28A, I would like to obtain one. It should be in good condition, but need not be perfect. I can perform repairs, but a non-working receiver is worth less to me than a working model. I am particularly interested in either a post-World War II civilian model, or a World War II military model. The pre-war SX-28 is not desirable (Note: not all SX-28A's have the "A" on the model number, but are SX-28A's nonetheless if they are post-war production). If you have a lead on where I might find one, contact me at the address below. I am willing to drive up to, oh, 200 miles from Washington, DC to get it.

Questions or comments? I can be reached by snail mail at P.O. Box 1099, Falls Church, VA, 22041, or by e-mail at carrjj@aol.com. ■

COMPUTER BITS

(continued from page 58)

user maximize image quality. The included software packages are no match for stand-alone specialty programs, but they're certainly enough to wet your whistle and see whether a more capable package would be appropriate.

One thing I like is that the ViCAM conforms to the TWAIN specification. This allows it to be used as a capture engine for just about any modern image processing program, such as the Wang image editor included with *Win95*, *Paint Shop Pro 4.x*, and so forth. Another plus about the parallel-port connection is the unit's usability with laptops. For portable image acquisition, it's great. Just make sure you have at least a 200-MHz CPU, and an auxiliary keyboard port. For more information, contact the ViCAM people at *Vista Imaging Inc.*, 521 Taylor Way, San Carlos, CA 94070; Tel. 650-802-9685; Web: *www.vistaimaging.com.*

See you next time, when we'll discuss *AVR* timing loops—coming up will be a field-tested science-fair project that uses the *AVR* microcontroller development board to host a number-guessing game. In the meantime, happy imaging and contact me at jeff@ingeninc.com. ■

SCANNER SCENE

(continued from page 61)

State, wonders if we can provide the frequencies by the U.S. Border Patrol in his area. Try the following (repeater out/in): Channel 1, 163.625/162.825; Channel 2, 163.625/162.925; Channel 3, 163.625/163.625; Channel 4, 163.675/163.675; Channel 5, 163.675/162.825; Channel 6, 163.675/162.925; Channel 7, 163.725/162.825; Channel 8, 163.625/162.825; and Channel 9, 165.2375/166.4365 MHz. The CTCSS tones are 100 Hz on Channels 1, 2, 3, and 9; 123.0 Hz on Channels 4, 5, and 6; and 151.4 Hz on Channels 7 and 8. The agency's units can also operate on other law enforcement channels, such as those of local sheriffs, state police, *etc.*

A steady trickle of mail arrives from readers who ask us to explain what birdies are, inasmuch as the term is used within the scanner community quite often. In a nutshell, scanners are highly complex devices that require the use of any number of internal oscillator circuits that generate low-level signals at various frequencies. Those phantom internally generated signals that fall within the tuning range of the scanner may appear to the listener as if an unmodulated (open) carrier was present. These unwanted signals are known as birdies.

Write to us! Our e-mail address is: Sigintt@aol.com, Our postal address is: Scanner Scene, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

ELECTRONICS LIBRARY

(continued from page 29)

art mechanisms like Binary Space Partitioning (BSP) trees.

The included CD-ROM features Abrash's *Zen of Assembly Language*. All projects discussed in the book, including executable files and the Zen Timer, the author's code profiling tool, are on the CD-ROM, as are several essays from his ongoing work on game development.

Michael Abrash's Graphics Programming Black Book, Special Edition costs $59.99 and is published by The Coriolis Group, 14455 North Hayden, Suite 220, Scottsdale, AZ 85260; Tel. 800-410-0192 or 602-483-0192; Fax: 602-483-0193: Web: www.coriolis.com.

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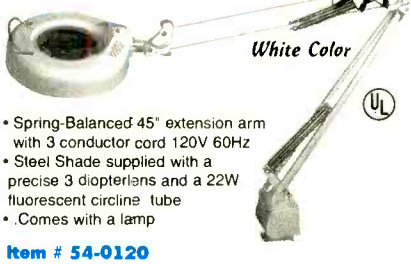

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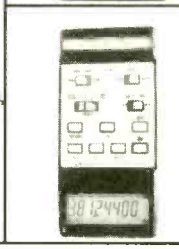
DMM-125C ($54.95): Autorange + bar graph, DC/ACV, Cap,Ω, diode, continuity beeper



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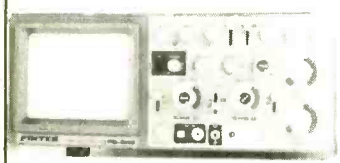
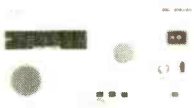


- PS-200 20 MHz Dual Trace $339.95
- PS-205 20 MHz Dual w/ Delay Sweep $429.95
- PS-400 40 MHz Dual Trace $494.95
- PS-405 40 MHz Dual w/ Delay Sweep $569.95
- PS-605 60 MHz Dual w/ Delay Sweep $769.95
- PS-1000 100MHz Dual Trace $999.95

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

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

AUDIO/RF/FUNCT. GENERATOR

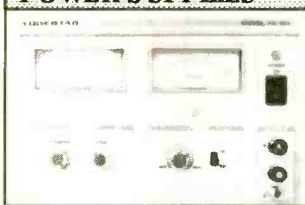


RF Generator
- **SG-4160** ($124.95) 100kHz-150MHz sinewaves in 8 ranges, 100mV at 35MHz
- **SG-4162** ($229.95): same as SG-4160, plus 6 digits int/ext freq. counter (150MHz).

Audio Generator
- **AG-2601** ($124.95)10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave
- **AG-2603** ($229.95): same as AG-2601, plus 6 digits int/ext freq. counter (150MHz).

Function Generator
- **FG-2100A**($169.95).2Hz-2MHz,5mV-20V$_{pp}$
- **FG-2102AD** ($229.95) same as FG-2100A, plus int. counter and TTL, CMOS output.
- **FG-2103** ($329.95) *Sweep* 0.5Hz-5MHz, linear/log, VCG, GCV, 6 dig. int/ext counter

POWER SUPPLIES



Single Output DC Power Supplies

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

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

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

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

Dual Tracking

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

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

Triple Output

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

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

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

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OS-622G $369.95 20 MHz Oscilloscope

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- **Readout & Cursor meas**
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- Z-axis input,CH1 output
- TV syn., trigger level lock
- 2 probes (x1, x10)

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

OS-305 ($229.95) - 5 MHz One Channel
OS-310 ($324.95) - 10 MHz One Channel

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DC POWER SUPPLIES

Triple Output

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

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

Single Output

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

Analog Meters Display
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PS-1850 ($229.95) 18V/5A

PS-3030 ($219.95) 30V/3A
PS-6010 ($209.95)60V/10A

PR-3060 ($329.95)30V/6A
PR-6030 ($329.95)60V/3A
PR-1810H($349.95)18V/10A

Digital Meters Display
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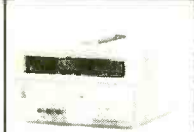
PS-1850D($254.95)18V/5A
PS-3030D($254.95)30V/3A
PR-6030D($399.95)60V/3A

Programmable



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PPS-6020G ($1,149.95)
PPT-1830G ($1,499.95)
PPT-3615G ($1,499.95)

FG-830G ($1,799.95) 30MHz Synthesized Function Gen.
- Output: sine, tri., square, sync out, arb. waveform
- 20mHz Freq. resolution
- Linear/log sweep
- Arbitrary modulation
- RS232, IEEE-488(option)

FUNCTION GENERATOR

FG-8015G($179.95)Sweep
- 0.02Hz-2MHz,no counter
- Sine/Squ/Tri/pulse/Ramp

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

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

FG-8020G ($209.95)
- 0.02Hz-2MHz

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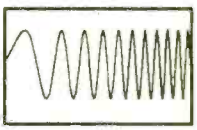
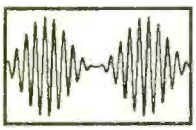
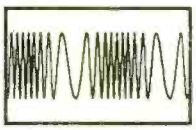


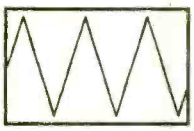
DC to 20 MHz linear and log sweeps



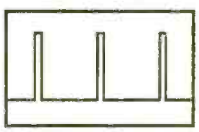
Int/Ext AM, SSB, Dualtone Gen.



Int/Ext FM, PM, BPSK, Burst

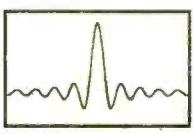


Ramps, Triangles, Exponentials

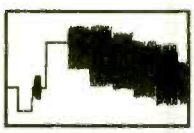


Pulse Generator

Noise



Arbitrary Waveforms



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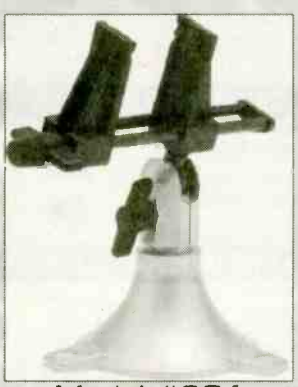

Model #201
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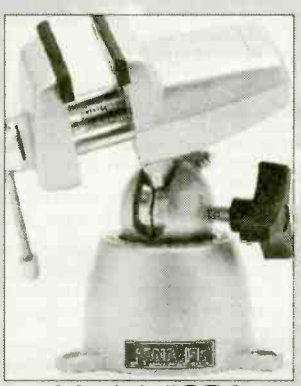

Model #301
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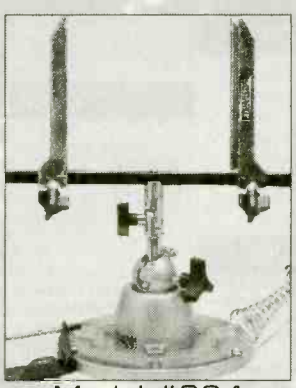

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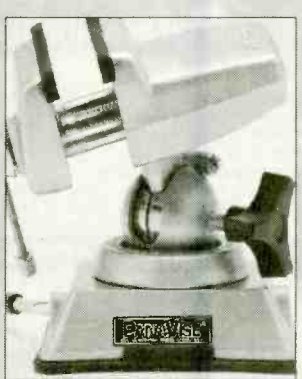

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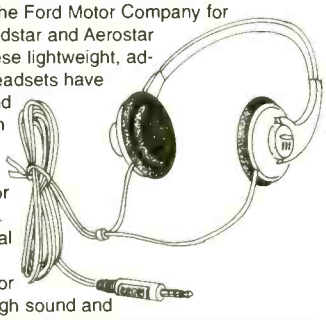

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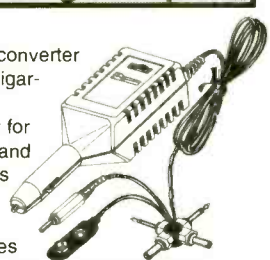

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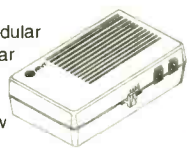

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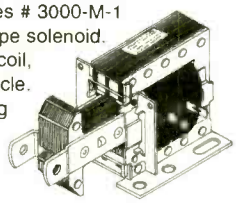

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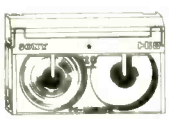

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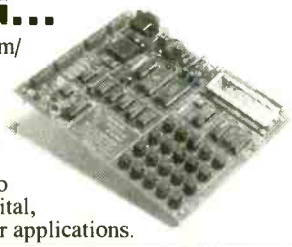

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- Great for use with any power supply • Provides eight pairs of RF bypassed binding posts • Handles 15A total

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Micro Board CCD Camera

- ½" CCD image device • 330 lines of resolution • 3.6mm lens • 92° viewing angle • Requires 12VDC, 330mA • 75ohm NTSC composite video output
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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	±(1.2%rdg+2dgts)
10A	10mA	

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

Resistance (Ω)

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

Maximum Open Circuit Voltage: 2.8V

Diode Test

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

ohFE Test

Measures transistor hFE.

Frequency Range: 45Hz-450Hz

Maximum Allowable Input: 750V rms

Response: Average Responding. Calibrated in rms of a Sine Wave.

AC Voltage (ACV)

Range:	Resolution:	Accuracy:
200V	100mV	±(1.2%rdg+10dgts)
750V	1V	

$19.00 any qty

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

Positive Photofabrication Kit

Make your own PCB's

Kit includes the basic items needed to fabricate pre-sensitized printed circuit boards (does not include artwork). Also included is a basic process guide to assist the user in the basics of exposing, developing and etching a PCB. All items fit conveniently in the plastic development tray, and a tight fitting lid is included for handy storage. Additional recommended supplies for fabricating PCB's are: exposure bulb, etchant tank, eye protection, art-work, paper towels.

Kit Includes

- 1 each 3"x5" pre-sensitized single sided PCB
- 1 each 4"x6" pre-sensitized single sided PCB
- 1 each 6"x6" pre-sensitized single sided PCB
- 1 each 500ml developer liquid
- 1 each 500ml ferric chloride etching liquid
- 2 each foam brushes
- 1 each plastic development tray
- 1 each rubber gloves
- 1 each instruction sheet

new!

CAT NO	DESCRIPTION	PRICE
416-K	Photofabrication Kit	$27.95

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	1	PRICE EACH 10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 165mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10
PP1212	305mm x 305mm/12" x 12"	12.78	10.65	8.52

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

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

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

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

Exposure System

Just place your presensitized board and artwork centered under the exposure fixture. Place the convenient acrylic sheet over the board and artwork to hold everything in place. Turn on light. Voila! Exposure takes about 5 minutes. Kit includes one fluorescent tube, stand and acrylic weight.

new!

Features

- Exposes boards in about 5 minutes!
- Convenient acrylic sheet to hold board in place during exposure (12.5" x 8.5")
- Fluorescent light fixture with plastic cover designed to aid in proper light refractions for even exposure

CAT NO	DESCRIPTION	PRICE
416-X	Fluorescent Exposure System	$31.95
416-B	Extra Replacement Fluorescent Tube	16.95

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

Developer

This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
POSDEV	Positive Developer	$ .95	$ .80	$ .50

Etching 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

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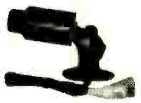
Color Weather Proof Bullet Camera

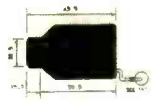
1/3" CCD with removeable rotation capable mounting bracket

new!



Specifications

Image Sensor:	Interline transfer CCD 1/3" format
Effective Pixel:	512(H)x492(V) pixels/NTSC 512(H)x582(V) pixels/PAL
Scanning System:	2 : 1 interlaced
Sync System:	Internal sync
Sync Pulse:	15.734KHz +1%(H)/15.625KHz +1%(H) 59.94Hz +1%(V)/ 50Hz +1%(V) Sub-Carrier 3.57 MHz +30ppm
Resolution:	400 TV lines (H)
S/N Ratio:	More than 46dB (typ)
Gamma Characteristics:	0.45
Min. Illumination:	1 LUX (F1.2 10 IRE)
Video Out:	Composite video signal : 1.0Vp-p
White Balance:	Auto white balance
Electronic Shutter:	1/60 - 1/100,000 SEC(N) 1/50 - 1/100,000 SEC (P)
Power Supply:	DC 12V + 10%
Power Consumption:	240mA (typ)
Lens:	4mm (78 or 92 degree) F : 2.0
Ambient Operating Temp:	-5 deg. C +40 Deg. C
Ambient Storage Temp:	-10 Deg. C+50 Deg. C RH 95% MAX
Dimension:	2 1/8" (L) x 1 1/4" (D)
Weight:	3 oz.



CAT NO	DESCRIPTION	PRICE EACH 1	5
WDB-5407S	Color Water Tight Bullet Camera	$299.00	$269.00

(water tight for outdoor use, not suitable for sustained underwater use)

CCD Bullet Cameras

new!

Available with standard or pinhole lens. Virtually indestructible bullet shaped casing. This sleek B&W camera can be mounted on walls or ceilings along narrow corridors or virtually any location for virtually any surveillance application. 0.5 lux minimum illumination with 380 lines of resolution. Even includes a built-in electronic iris for automatic light compensation.

Features

- Extremely low power consumption
- No blooming, no burning
- 0.5 LUX minimum illumination
- CCD area image sensor for long camera life
- Ultra small size allows for simple application and installation
- Built-in electronic auto iris for automatic light compensation
- Ultra compact camera

Specifications

Image Pick-Up Device:	1/3" CCD area sensor
No. of Pixels:	EIA = 512(H) x 492(V)
Pixel Pitch:	EIA = 9.6uM(H) x 7.5uM
Scanning System:	EIA=525 lines, 60 field/sec
Sync System:	Internal sync
H. Resolution:	430 TU line
V. Resolution:	400 TU line
Usable Illumination:	0.5 Lux F1.6
S/N Ratio:	More than 48dB
Gamma Characteristic:	0.45
Video Output:	1.0 - 1.1 up-p 75 Ohm
Electronic Shutter Time:	EIA=1/60 - 1/50,000 sec
Lens F No. Focal Length:	STD : 1.6 Open / 4.3mm(78 deg) Pinhole: 4.3 fixed/ 2.8mm(91.4 deg)
Power Consumption:	DC 9V (8-10V), 110mA
Operational Temp.:	-10 deg - +50 deg C RH95% max
Storage Temp:	-20 deg - +60 deg C RH95% max
Dimensions:	STD : 22mm(W) x 22mm(H) x 38mm(D) Pinhole: 22mm(W) x 22mm(H) x 30mm(D)
Weight:	35g max

CAT NO	DESCRIPTION	PRICE EACH 1	5
WDB-07S	Standard Lens Version	$144.00	$129.00
WDB-07P	Pinhole Lens Version	144.00	129.00
WDP-07S/water	Standard Lens Weather Proof	169.00	152.00

CCD Dome Camera with Audio

B&W DOME camera with integrated microphone. Ideal security system application. 12 VDC operation.

new!

Specifications

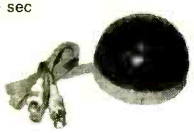


Image Device:	1/3" interline transfer CCD
Picture Elements:	EIA=542(H)x492(V)
Scanning System:	2:1 Interlace
Synchronization System:	Internal
Horizontal Resolution:	380 TV Lines
Sensitivity:	Under 0.3 LUX
Electronic Iris (linear):	EIA = 1/60~1/100,000 sec
Video Output:	1.0vp-p, 75 ohm
S/N Ratio:	More than 50dB
Power Supply:	12V DC (±20%)
Gamma:	r=1
Power Consumption:	110 mA max
Operating Temp.:	-10°C ~ +50° C
Operating Humidity:	RH 95% Max
Weight:	100g
Applied Lens:	3.6mm -92°, 4.3mm -78°
AI/EE/Flicker Less/Mirror Image:	Jump soldering selection
Audio Pick-up Sensitivity:	-60dB (0dB=1V/ubar)
Audio Frequency Range:	20 Hz ~ 20 kHz
Audio S/N Ratio:	More than 40dB
Audio Output Level:	1Vp-p/600 ohm
Dimensions:	87 x 55.5mm

CAT NO	DESCRIPTION	PRICE EACH 1	5
WDDB-6500	B&W Dome Camera	$144.00	$129.00

1/3" CCD Board Cameras

Available with **PINHOLE LENS** with **AUDIO**; **STANDARD LENS** with **AUDIO**; and **STANDARD LENS** with **INFRA-RED and AUDIO**. These are the world's smallest commercially available CCD board cameras!

World's Smallest B&W Board Cameras

Specifications

WDP-2000

WDS-2005

WDI-4000

Image Pick-Up Device	1/3" CCD area Sensor
Picture Elements	EIA=512(H) x 492(V)
Pixel Pitch	EIA=9.6UM (H) x 7.5UM (V)
Scanning System	2 : 1 Interlace
Scanning Frequency	EIA=525 lines, 60 field/sec (II) 15.750 KHz x 60 HK
Resolution	430 Lines
Minimum Illumination	0.03 LUX
S/N Ratio	45DB
Lens Mounting	4.3mm standard, 5mm pinhole
Video Output	1.0 VP-P/750OHM composite signal
Power Requirement	8-12 VDC (9VDC standard)
Power Consumption	100mA
Operating Temperature	-20C -+ 70 C RH 95% Max
Storage Temperature	-40C -= 85 C RH 95% Max
Audio Pick-Up Sensitivity	-60 DB (0DB = 1B/UBAR. 1KNZ)
Audio Frequency Range	20 Hz to 20KHz
Audio S/N Ratio	More than 35DB
Audio Output Level	1VP-P/600 OHM

Dimensions

WDP-2000	30mm (H) x 30mm (W)
WDS-2005	30mm (H) x 30mm (W)
WDI-4000	44mm (H) x 30mm (W)

CAT NO	DESCRIPTION	PRICE EACH 1	5
WDP-2000	1/3" B&W Pinhole Lens with Audio	$89.00	$77.00
WDS-2005	1/3" B&W Standard Lens with Audio	89.00	77.00
WDI-4000	1/3" B&W Infra-RED with Audio	89.00	77.00
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Standard Tip

Features

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Fast Heat Up & Recovery. A long life Japanese made ceramic heating element facilitates fast heat up, fast recovery and exacting temperature control with minimal overshoot. Heat-up time to working temperature is attained in about 45 seconds. **Spike Free Circuit.** "Zero voltage" switching and fully grounded design meets military application standards for protection of electrosensitive devices against line transience and voltage spikes. Tip leakage is less than 0.4 mv or 0.5 ohm resistance. **External Calibration Port.** A calibration port is located on the face of the unit thus temperature adjustments are quick and convenient.

Lightweight Soldering Iron. Ergonomic mini handle that stays "cool". Handle assembly cord is made from silicone rubber that won't be damaged when coming into contact with high temperature irons.

Isolated Power Unit. The power unit is isolated from the AC line by a high quality transformer and only 24 Vac voltage is used to drive the heating element. **ESD Safe.** Exceeds all soldering equipment military specifications regarding electro static sensitive devices for critical applications. **Lock-Out Feature:** Constructed with a lock-out feature to allow supervisors only to set and lock specific soldering temperatures. Accomplished via a special sized allen head screw located on the front panel. **Superior High Insulation** ceramic heater provides insulation rated over 100Mohms at 750° F. **Optional SMD Tip Series** for re-work applications. **Range of Interchangeable Tips Available** for maximum system flexibility.

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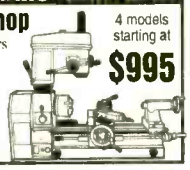

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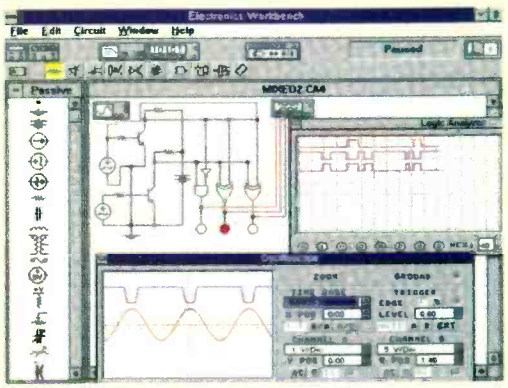

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