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October 1996

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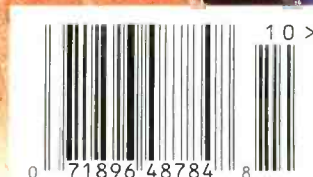
Radio Amateurs

Find out what they do, and how to join the ranks yourself



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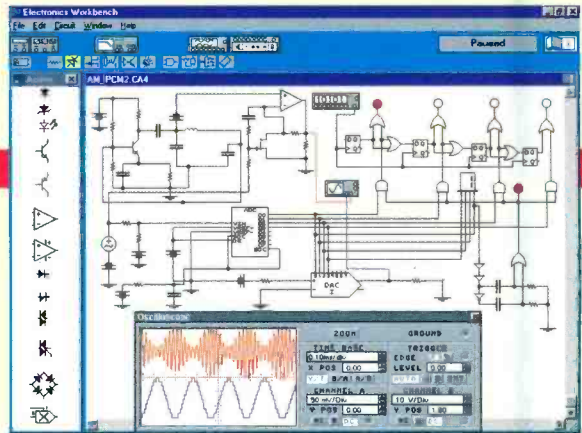
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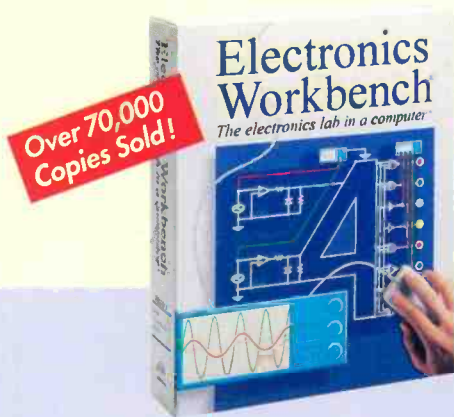
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Popular Electronics®

OCTOBER 1996

Vcl. 13, No. 10



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COVER STORY

31 Build the Goblin Greeter

This Halloween, why not greet trick-or-treaters with a special treat of your own? With the Goblin Greeter installed, every time someone rings your doorbell, he or she will be welcomed to your abode by a spooky, hologram-like phantom and haunting noises. The circuit can also be used indoors to provide your next Halloween party with a frightfully fun host—*D. Derek Verner*

CONSTRUCTION

56 Build a Delayed Sweep Adapter

This simple, plug-in circuit will increase the capabilities and performance of your scope. For less than \$30, the Adapter lets you add a delayed sweep to just about any oscilloscope you choose. That saves you the added cost of buying an oscilloscope with the feature built-in—*Skip Campisi*

FEATURES

39 Using Digital Panel Meters

Here are some great applications for digital panel meters that you can use as stand-alone units or as springboards for your own circuit designs. Once you know how to work with DPMs, you'll be able to increase the accuracy of the next project of yours that requires a display, and give it a more attractive, professional look—*Bill Stiles*

45 Radio Amateurs

Just who are hams and what do they do? There seem to be more than a few misconceptions about the amateur-radio hobby and its practitioners. Learn the truth in this panoramic look at radio amateurs, and see just how easy it is to become a ham yourself—*Karl T. Thurber, Jr.*



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Editorial

A Halloween Treat

As every kid with a sweet tooth knows, Halloween is right around the corner. However, as the little ones suit up in their costumes this year, shouldn't they be able to expect a little more from the holiday than just candy-induced bellyaches?

There's a reason haunted houses are popular attractions at amusement parks like Disney's Magic Kingdom. Children, as well as adults, like to have a little spooky fun every once in a while, and October 31st is the perfect time for it.

This month, **Popular Electronics** brings you a special Halloween treat: the Goblin Greeter. It's a neat circuit that will provide your trick-or-treating visitors with a hauntingly fun show when they ring your doorbell. Imagine their delight when a transparent spook, not unlike one they would see at Disney, appears in the doorway, wishes them a "Happy Halloween," and lets them know candy is on the way. The story begins on page 31.

Also in keeping with the All Hallow's theme, this month's Net Watch focuses on a couple of great Halloween Web sites that you can visit today. Look for it this month on page 16.

Of course, we haven't limited this issue to the spirit of spookiness that fills the month. Those who like to save money on their workbench equipment will love the Delayed Sweep Adapter, which will make an oscilloscope perform like one worth hundreds more. That story begins on page 56, and is only one of the other electronic goodies we have in this issue.

Enjoy!

Dan Karagiannis
Managing Editor

Wireless home video broadcasting breakthrough!

Use 2.4 GHz technology to transmit cable, DSS and VCR signals to any other TV in your home...up to 300 feet away!

WAVECOM Jr., from RF-Link, uses 2.4 GHz technology, circularly polarized transmission, four channels and FM to broadcast stereo audio and video signals with clarity never before available.



You can use WAVECOM Jr. with your:

- ✓ Cable TV
- ✓ Camcorder
- ✓ Computer
- ✓ Digital video disk
- ✓ Laser disc player
- ✓ Network TV
- ✓ Powered speakers
- ✓ Satellite (DSS)
- ✓ Security camera
- ✓ VCR movies
- ✓ Wireless cable

If you are like most people, you probably own more than one television and subscribe to cable or satellite programming. But in order to extend that special programming to your other TVs, you have to run miles of wire and/or pay for the additional connection. Isn't there a better way?

Watch TV on more than one set. New wireless home video broadcasting technology found in WAVECOM Jr. from RF-Link can transmit signals from cable, digital satellite system (DSS), even a VCR, from a video source (your main

TV) to other TVs in your home, office or school without sacrificing picture or sound quality. You can even use it to transmit between your TV and computer, without wires or connection fees!

Introducing WAVECOM Jr. WAVECOM Jr. heralds in the latest in wireless transmission with 2.4 GHz technology. This new frequency is superior to 900 MHz in several ways: the most important benefit of the 2.4 GHz range is that it is totally uncluttered. WAVECOM Jr. is one of the very first products to utilize this frequency, enabling it to deliver consistently sharp stereo audio and video signals, through walls and ceilings, up to 300 feet away.

2.4 GHz circular-polarization technology. For years, the most advanced wireless products have boasted the use of the 900 MHz frequency using linear transmissions. But linear waves can be blocked by studs or other hidden barriers within your walls.

However, WAVECOM Jr.'s 2.4 GHz technology uses a circular polarization signal to give you crystal-clear, powerful re-transmission of audio and video signals throughout your home, unobstructed by walls, ceilings or floors. Even if there is a wall stud in the path of the signal, virtually all of the wave is still free to pass to your television.

In addition, as signals get higher in frequency (from 49 MHz to 900 MHz to 2.4 GHz), the

wavelengths get smaller. So where 900 MHz waves have difficulty passing through certain surfaces (like chicken wire), waves in the 2.4 GHz frequency range can do so easily. In fact, the combination of small wavelength size and circular polarization transmission means that there is virtually no obstacle that WAVECOM Jr. cannot overcome.

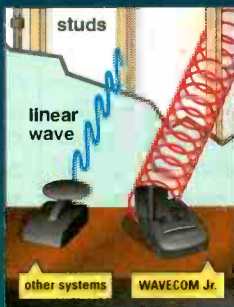
It's FM, not AM. WAVECOM Jr. uses FM to transmit signals, not AM, for the same reasons that FM stations are superior to AM stations. High-gain directional transmitting and receiving antennas are used, instead of omni antennas, to minimize interference from unwanted signals and inherent problems of multipath (a phenomenon where transmitted signals bounce around and create "ghosting").

THE WAVECOM ADVANTAGE

■ **2.4 GHz transmission.** This brand-new, uncluttered frequency provides more clarity than ever thought possible in wireless home broadcasting systems.

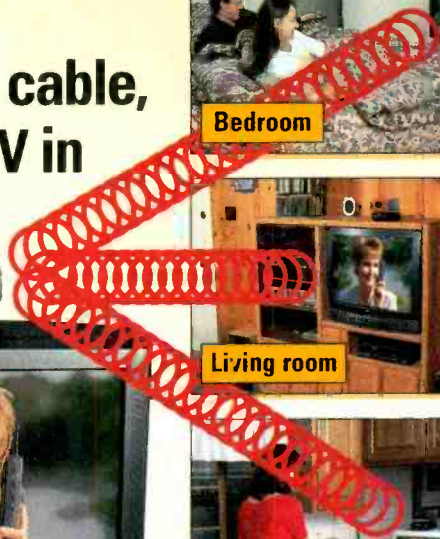
■ **300-foot range.** The WAVECOM Jr. transmitter can broadcast clearly to multiple receivers, through walls, ceiling and floors...up to 300 feet away!

■ **High-gain directional antennas.** The antennas on both the transmitter and receivers are directional—turn them to the left or right, aim them upwards or downwards to create a seamless link.



■ **Circular polarization.** WAVECOM Jr. utilizes circular polarized waves. Unlike linear waves, circular waves can pass through walls—and the hidden obstacles within the walls—unlike any other system.

Not even hidden studs can stop WAVECOM Jr.!



Exclusive features. One of WAVECOM Jr.'s key features is the use of four channels for interference-free channel selection, which makes it arguably the most superior home video broadcasting system available. In many uses, up to four channels can operate simultaneously. This feature can be very useful for private and civil surveillance systems. It also facilitates using your existing camcorder to monitor babies, children and the elderly within your home or yard.

Last but not least, WAVECOM Jr. provides stereo sound with independent left and right audio channels. This enables you to hook up wireless powered speakers to your CD or cassette player. All total, WAVECOM Jr. from RF-Link is the solution to the dilemma posed by modern TV programming options. You can finally reap the benefits of your premium services throughout your entire home...simply, wirelessly and affordably!

Try it risk-free. WAVECOM Jr. is backed by Comtrad's exclusive risk-free trial. Try it in your home! If you're not completely satisfied, simply return it within 90 days for a full refund, "No Questions Asked." WAVECOM Jr. is also covered by a 90-day manufacturer's warranty.

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An LM386 Question

USING THE LM386

I just read "Build the Guitar Track Jammer," by Andrew Singmin in the July 1996 issue of *Popular Electronics*. Having recently built three different circuits using the LM386, I have a couple of suggestions about it.

The circuit (see Fig. 1) might have instability problems, depending on the circuit layout and on varying characteristics of different LM386s. Using C8 in the circuit places the LM386 in its high-gain mode (with a voltage gain of about 200 volts). When C8 is used, a 100- μ F bypass capacitor should be connected from pin 7 to ground, with its positive terminal to pin 7. I also try to place C7 as close as possible to the LM386. That is a good practice with any high-gain IC (as is mentioned by Joseph J. Carr on page 52 of the July 1996 issue).

B.S., CET
Hillsboro, MO

Thank you for your letter—which I actually received before the July issue hit the newsstands over here in Canada!

During a professional career in electronics spanning the better part of 20 years, I have built well over 100 circuits using the LM386 audio power IC. In every case, by the way, I used "real" National Semiconductor devices—never a generic brand—procured through industrial electronics supply houses.

I had noticed over many years of reading articles in *Popular Electronics* that LM386 circuits sometimes feature the additional electrolytic capacitor tied to pin 7. Inclusion of that extra capacitor never made any difference to my own circuits. The variants of the LM386 that I used were the LM386 N-1 (325-mW nominal) and the LM386 N-3 (700-mW nominal). According to National Semiconductor's specifications on the LM386 (Special Purposes

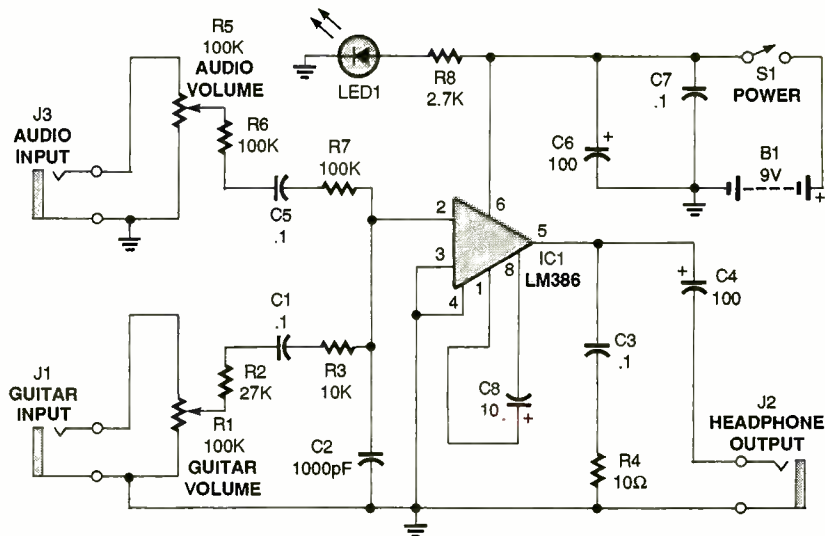


Fig. 1. The Guitar Track Jammer circuit.

Linear Devices Databook, pages 1–29), the optional bypass capacitor was only required for the higher-powered N-4 variant (1000-mW nominal). As I never had a need to use the LM386 N-4, preferring instead to use the LM380 (2.5-watt nominal) for higher-power applications, the extra bypass capacitor was never seen to be needed.

Out of curiosity, I added the extra bypass capacitor to the LM386 N-1 and N-3 designs and found no difference. So, rather than have an extra component that performed no real function, I have always left it out. My circuit board designs with the LM386 have always used 8-pin IC sockets laid out on perforated board and, more recently, on my custom-designed universal PCB ("Singmin PCB"). In both cases, the circuits have always been rock stable. Supply voltages generally run at 9 volts.

The VCC electrolytic bypass capacitor taken to pin 6, however, is a different matter. Severe instability occurs without that component. Yet, to my surprise, I have seen many published circuits in which that capacitor was omitted. As my own circuits critically require that component (it is not an option), I wonder sometimes whether

those circuits had actually been board tested.

Typically, on my board layouts, using the Singmin PCB, the actual positioning of the VCC bypass capacitor (radial type) is no more than one-inch linear distance from pin 6, the VCC terminal. I have also tried locating the bypass capacitor as close to pin 6 as possible, but have found in reality that there is no difference between the two options. For design access, I have thus always "spread out" the layout, where test probing to the IC pins is required.

In the current layout (some one-inch distance), the stability is excellent. Overall space is dictated by the assembly platform size (in this case 2×2 inches), so there is no need to cram all the components into one small area. For hobby projects, ultimate size shrinkage is rarely an issue with simple, one-IC circuits using through-hole technology, as final package size is limited by the relatively huge mechanical components such as the battery, switches, potentiometers, etc.

The design for the "Guitar Track Jammer" came about as a result of a need to pace blues guitar (note-for-note transcriptions) audio tapes (B.B.

King Blues Master I). The unit provided an ambiance that could not be realized by merely running the instructional tape and a guitar amplifier through their own separate speakers. The combined sound presence is quite remarkable to hear.

The high-gain selector capacitor, C8, was included to realize a higher gain in order to mask out (my own) very high ambient noise levels from a nearby furnace/fan. Readers working in a quieter environment could either omit C8 or add a series resistor to reduce the gain if needed. That could work well depending on the type of electric guitar used—i.e., whether the pick-ups have high or low signal outputs. I have found that stock Fender Stratocasters work well even with capacitor C8 left out.

In fact, several local musicians have expressed interest in having the completed unit made available to them and/or just the electronics board pre-built. Any readers interested in the same can write to me at Singmin Enterprises, 9 Milne Crescent, Kanata, Ontario K2K 1H7, Canada or fax 613-592-3058 for details.

—Dr. Andrew Singmin

HAVES & NEEDS

I need a little help identifying a piece of equipment that I recently acquired. The case, made of 3/8-inch aluminum, measures 8.5×3.5×2 inches. On one end is a socket exactly like the plug on the computer end of a printer cable (i.e., IBM XT), pins and all. It also has a socket similar to the threaded type used for cable-TV connections.

The box is labeled "Motorola, Inc. Made in USA. Model #S1895A. Serial #194DPYN357Y. Tx Power Output — 3W. Pri.pwr. 12vdc, NEG gnd. FCC ID: ABZ89FT5725."

Except for capacitors and resistors, I cannot identify any of the components inside.

Any help would be appreciated, even if only an address of the company and branch that could (and would) help.

Thanks.
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Total Recall Voice Recorder

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Back in the Stone Age, the first form of a reminder was probably when a cave dweller placed a pebble on top of a rock, much like tying a ribbon around a finger—except that there were no ribbons. Different pebbles meant different tasks, and many pebbles meant there was a lot of work to be done. But that method had its down sides, and wasn't at all portable.

Next came chiseling messages into stone tablets, but that was time consuming and hardly portable either. It was very difficult to carry stone tablets back and forth from work. The advent of paper and pen was a boon to all, because only lightweight paper scrolls had to be lugged around.

Today, we have endless varieties of gadgets that help us remember. Sure, people still write down messages on paper, but others use tape recorders, digital assistants, pagers, hi-tech watches, and more. Written messages are very useful most of the time, but it's difficult to write and read messages on the go, and nearly impossible to do while driving.

Tape recorders have been used for years to take down messages, and

the smallest recorders today can fit in a shirt pocket. Sometimes a recorder is the only effective method of getting down information. At a lecture or presentation, it can be very difficult to jot down all the significant points while keeping up with all that's being said. But tape recorders have limitations. It's often hard to find the beginning or end of a message, or to find a blank spot in time to record something. And the worst thing that can happen is to have a tape self-destruct at the wrong time.

Total Recall. The Total Recall digital voice recorder and analyzer from Sycom Technologies eliminates all of the hassles of tape recording, retains all of its good points, and adds features that would be impossible with a regular tape recorder. In the past, digital voice recorders couldn't come close to the capacity of magnetic tape recorders. But Total Recall breaks the magnetic tape barrier with models that can record up to 47 minutes of audio without a single moving part.

Four models are available, with internal memory capacity ranging from 1024 kilobytes for the model

VN911 to 4096 kilobytes for the VN947. Four recording modes allow the VN947 to record 23 minutes of audio at the best possible quality level or stretch that memory into 47 minutes at the lowest quality level, with two levels in-between. Recordings are easily understood even at the lowest quality level, and the quality can be set for each message. Messages can also be easily and individually erased or edited. We looked at model VN911, which can record from 6 to 11 minutes of audio, depending on the quality chosen. And the truth is, for just simple message taking, even six minutes is plenty of recording time. Prices start at \$149.95 for the VN911.

Total Recall is a little taller and a little slimmer than a cigarette pack. Two AAA batteries power the unit for up to three months, while an additional lithium button cell maintains clock functions when the AAA cells are dead or removed. Because Total Recall contains a digital clock and calendar, it makes sense that it also has a built-in alarm. But what's really neat is that you can set both the beeper-type alarm and your own custom voice alarms and reminders. Also, all

Revolutionary new product cools, heats and humidifies. Finally—a solution to high fuel bills!

Small company introduces a new evaporative system that cools, heats and humidifies.

by Tyson D. Hindelang

Everyone knows what it is like to be hot or cold. Going outside in the sweltering heat of summer or the dead of winter, you expect it. You should not, however, be uncomfortable in your home. Unfortunately, most people are. You know what I mean—that one room that is never cool enough in the summer or warm enough in the winter.

People have many different ways to remedy the situation. The most common solution is to adjust the thermostat. Unfortunately, this is often the most costly. Today there is a solution that will help cut your fuel bills in the summer as well as the winter—its name is Celsius.

Unlike any other. Celsius is the only device that combines the effects of a portable cooler, heater and humidifier. This three-way climatizer is all you need to supplement your home's



heating and cooling system. It will cool a problem room in the summer, heat it in the winter and humidify it all year round.

Problem rooms. Imagine the benefits of being able to control the climate in different rooms of your home independently. For example, say you have one room that gets the full heat of the sun most of the day. But because the rest of your home is comfortable, you don't want to adjust the thermostat. Now you don't have to! Just put Celsius in that room, and in no time it will be just as comfortable as the rest of your home.

Breakthrough material. The filter pad inside Celsius is unlike any other for several reasons. First, it rotates through the Celsius unit, absorbing water. Made of a washable nylon, the filter is mildew- and rot-resistant because it is always moving; it never sits motionless in a pool of stagnant water.

Another benefit of Celsius' filter pad is that it is pulled through two rollers, creating a self-cleaning effect. Celsius' filter pad can also aid in air filtration; airborne contaminants get trapped in the filter, giving you cleaner air.

Portable. Weighing only 24 pounds, Celsius is both light and portable. Its built-in wheels and side handles enable you to transport it easily from room to room, even when it is full. It is very compact (25" high x 17" wide x 13" deep)—it will fit virtually anywhere.

Health benefits. An environment with the proper level of humidity can alleviate common health problems: chapped lips, sore throats,

cold and allergy problems and even asthma attacks. Physicians frequently recommend humidifiers for patients with upper respiratory problems. And because Celsius is also a humidifier, it is the perfect addition to any home.

The best heater. Celsius' heating system is the most efficient available. The heating process is similar to the cooling process. The ceramic coils of the heater retain their heat for a long time and radiate it very efficiently. The heater warms the air that passes through the moist filter pad and the fan disperses that warm, moist air into your room.

Saves money. Did you know that for every degree you lower your thermostat your fuel bill increases three percent? Celsius eliminates the need to constantly adjust your thermostat. Put Celsius in that one room that's too hot. Or raise your thermostat and keep Celsius in the rooms you occupy the most. It pays for itself by the end of one season! Plus, because it's a three-way climatizer, you don't need a separate heater or humidifier—Celsius does it all!

Factory-direct savings. The combination of a cooler, heater and humidifier makes Celsius the perfect solution to maintaining a healthy, comfortable climate in your home. For a limited time, we're offering it at the introductory price of just \$199. Try it and see what a difference it will make in your home!

Try it risk-free. Celsius is backed by Comtrad's exclusive risk-free home trial. Try it, and if you're not completely satisfied for any reason, simply return it within 90 days for a full refund, "No Questions Asked." Celsius also comes with a five-year manufacturer's warranty. (The first year, Celsius is 100% replaceable; remaining years are prorated.)

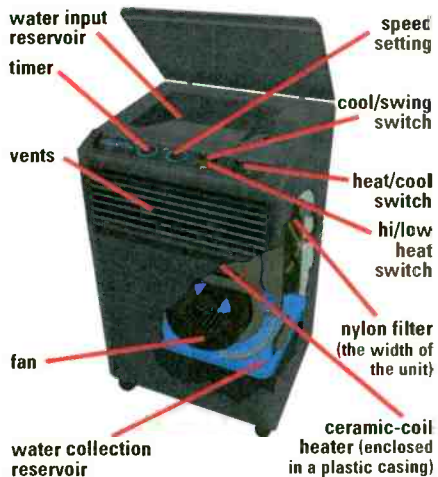


Celsius makes sunny rooms more comfortable without having to adjust your thermostat.

Where can you use Celsius?

- **ATTIC** Most attics don't get cool air because they don't have proper ventilation.
- **BEDROOM** Use it to cool a sunny bedroom.
- **KITCHEN** When cooking, it is difficult to maintain a cool temperature.
- **LIVING ROOM** On hot days, it's hard to keep any high-traffic room comfortable.

HOW CELSIUS WORKS



Celsius is an evaporative room cooler that can also be used as a humidifier and heater. Pour two gallons of water into the reservoir at the top of the unit. As the water is collected in the bottom, a nylon filter pad rotates down into the water, making the pad moist. The pad then rotates upward into the air flow, cooling and adding moisture to the air. Oscillating louvers on the Celsius circulate that chilled, moist air throughout the room.

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recorded messages are time and date stamped!

Controls. Total Recall looks like a cross between a pocket radio and a pager. It's available in black or silver, and the black one we looked at has a slip-resistant rubberized outer surface and fits comfortably in the palm of a hand. The unit's 11 push-buttons and a volume control are easy and fairly intuitive to use. A stiff, laminated wallet information card is included so that you'll always be able to get the most out of the unit. An earphone jack and 3-volt power input jack can be used for various optional accessories.

Play, stop, forward, and reverse controls are laid out in much the same way as a VCR remote control. These same controls also provide pause and skip functions. Three more push-buttons provide access to three different "folders," in which you can store different types of information. You could keep memos in one, phone numbers in another, shopping lists in another, or whatever you want wherever you want. The four remaining buttons are power on/time set, options, erase, and record. An LCD display and two LEDs make up the various indicators. Of course, the unit has a built-in microphone and speaker. There is a reset button on the back of the unit in the rare event it becomes necessary to do so.

Playing a message is as simple as selecting the folder it's in and pressing play. The skip forward and reverse buttons allow you to jump to different messages and parts of messages. An audio scan function, activated by pressing and holding one of the folder buttons, automatically plays the first few seconds of each message in the folder. Recording a message is as simple as selecting a folder and holding down the record button for short messages or pressing and releasing it to record long messages. If no folder is selected, a message will default to folder 1. Erasing or editing a message is as simple as finding the message or part of a message and pressing erase or record.

The options button enables you to select and configure various options. Options include multiple voice alarms, a wake-up alarm, special erase functions, a find-message function, undo erase, set clock, password

enabling, record quality level, a voice-activated recording (VOX) mode, and total clear. The LCD always indicates the selected option and status.

After using Total Recall for a few hours, you'll find that there's almost nothing you can't do when it comes to taking and organizing messages. You can have Total Recall announce when it's time for a business meeting, to take medication, pick someone up, or whatever. You can keep a running shopping or to-do list, while at the same time carrying around hundreds of important telephone numbers. If you hear an interesting commercial on the radio while driving somewhere, you can record the phone number the second it's announced, without taking your eyes off the road. There's no limit to what you can do with Total Recall.

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MULTIMEDIA WATCH

Exploring Outer Space

BY MARC SPIWAK
TECHNICAL EDITOR
WINDOWS MAGAZINE

Recently, I renewed my interest in the American space race, and the Apollo program in particular. I actually watched Neil Armstrong take that first step on the moon, not that I remember any details—I was about 5 years old and my dad woke me to watch it. The recent movie "Apollo 13" is what renewed my interest. It's a fantastic film, and it's a true story, which makes it even more exciting. I think Ron Howard was snubbed for the awards—even if Apollo 13 wasn't the best movie of the year, how could a talking-pig movie win for best visual effects?

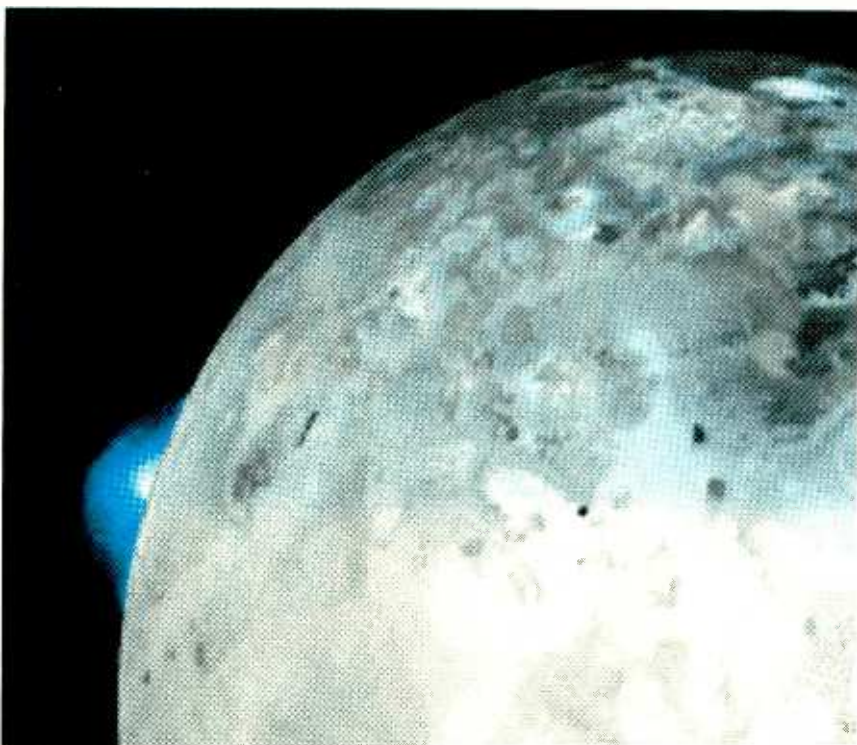
me hungry for more details on the Apollo program; and wouldn't you know it, there's more space information on the Internet than you probably want to know about. Just do a search for NASA or Apollo and you're there.

While searching for information on Apollo 13, I stumbled across a company called Imagination Software that was advertising a CD-ROM called *Giant Leap: The Apollo Chronicles*. This was just what I wanted to see, and I figured that our readers might also be interested. This disc was put together by a very dedicated two-man team. The information content is defi-

disc details each program, the missions, the astronauts, the spacecraft, and more. You will spend hours digging through this disc. You can get your own copy of this great reference source for \$49.95, plus \$6 shipping and handling.

In tracking down the Giant Leap CD-ROM, I learned of other space-related CD-ROM titles and figured I would take a look at them, too. If you would like to learn more about the entire history of manned space flight, and not just about the Apollo missions, check out *Space: A Visual History of Manned Space Flight* from Sumeria. This one contains highlights of the major American programs including Mercury, Gemini, Apollo, and the present-day space shuttles. Over an hour and a half of QuickTime movies from NASA's public-domain footage is included. You'll also find interactive space timelines and textual support for all of the videos and photos. Full search capability lets you find the topics you're interested in. This one sells for \$49.95.

Two more space-related CD-ROMs are available from Lunar Eclipse Software. This division of LunaCorp. is going to use profits from CD-ROM sales to help pay for the first privately funded lunar mission in history some time in 1999. (LunaCorp is actually run by people who were involved in the NASA space programs.) The goal is to land a pair of unmanned rovers on the moon some time in 1999. Much of what we learned from the original moon missions can be found on the *Return to the Moon* CD-ROM, which sells for around \$29.95. This disc lets you rediscover the past missions by viewing over 500 photos, videos, and audio clips. It features a lunar atlas and a vast data bank of lunar information. A Video Show Assistant lets you put together your own lunar multimedia shows with the material included on the disc. You can also try your own



Welcome to the Planets contains this beautiful image of Jupiter's Loki volcano erupting in a burst of blue and white light. (Courtesy of the National Space Science Data Center).

The Apollo program was the United States at its best, and I doubt that we could get there again today—there would just be too many people involved with too much to say about everything. We'd never get it off the ground. Anyway, seeing the movie got

nitely there, and the quality is very good—and content is always more important than presentation glitter.

Giant Leap is chock full of information on the Apollo program, and provides background information on the programs before and after Apollo. The

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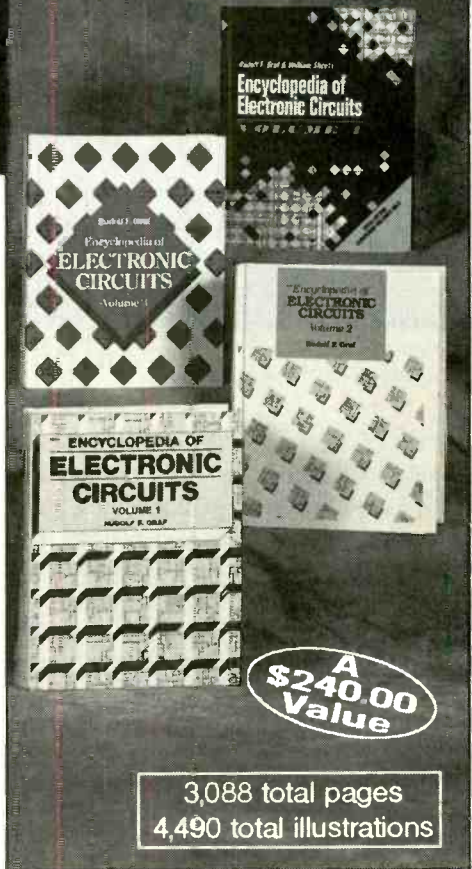
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The Dame Was Loaded is a humorous homage to the 1940's detective movies. You play the role of Scott Anger, wise-cracking private eye.

hand at a lunar landing with the Moonflight simulator.

The lunar missions also taught us a lot about planet Earth. It all depends on how you look at it, and you really do get a completely different view of Earth from space. So, plenty of earthly information is contained on the *Mission: Planet Earth* CD-ROM. This disc lets you examine photographic images of earth taken from space during the lunar missions. Planet Earth also features the first licensed use of the GeoSphere image. This is a single cloud-free view of Earth put together from hundreds of individual satellite images (you've probably already seen it, although not on your computer). These breathtaking images are yours for only \$29.95.

The National Space Science Data Center (NSSDC) houses the greatest collection of space-related data in the world. These documents, photos, tapes, and—you guessed it—CD-ROMs are available to the public. NSSDC has an entire catalog of CD-ROMs, all of them packed with data, documents, images, and more. You have to be an astrophysicist to be interested in a lot of the stuff.

I checked out a CD-ROM entitled *Welcome to the Planets*. This collection of images of the planets within our solar system is available for only \$10.00. The disc first presents a grid of planet photos: Mercury, Venus, Earth, Mars,

Jupiter, Saturn, Uranus, Neptune, Pluto; and a collection of small bodies including comets, asteroids, and meteorites. Clicking on any one of these photos brings up a collection of images of each object. You can zoom into the images, listen to commentary, read the definition of underlined words, and so on. Of the many spectacular images contained on this disc, I particularly like the image of Jupiter's Loki volcano erupting.

RedShift 2 from Maris Multimedia is oriented more around astronomy than space flight. It lets you explore the entire universe from your PC—think of it as a desktop planetarium, but better. You can view the night sky from anywhere in the world, and at any time in history (the sky changes over time). The program is mathematically based, so it can quickly calculate celestial positions; and images are then generated by the program. This disc also allows users to download updates to the program—the appearance of a new comet, for example.

The disc is loaded with real images and video clips of the most spectacular sights in the heavens. You'll find guided tours of the cosmos, interactive tutorials, maps of the planets, 2D and 3D animations (how does an eclipse occur?), and more. There are over 2000 links throughout the disc to Penguin's Dictionary of Astronomy, also included on the disc. A movie

recorder lets you capture your own explorations, and you can print out sky charts to help you in your own stargazing. This jam-packed title sells for around \$59.95.

If you are not sure if you are interested in *RedShift 2*, but would like to view some of its spectacular images and videos, then you should check out *Discover Astronomy*, also from Maris. This one lets you take in many of the sights and sounds from *RedShift*, but without some of the fancier features and at a much lower price of only \$14.95. Supposedly, much of *Discover Astronomy's* content was actually generated using *RedShift 2*. This is a good, inexpensive way to wet your appetite for astronomy.

NEW STUFF

If spy stuff thrills you and you'd like to play the role of a CIA operative trying to protect the cold war peace, then check out Activision's new live-action CD-ROM thriller *Spycraft: The Great Game*. In this game you must unravel an assassination plot that could destroy world peace. First you are sent to a CIA training facility to learn how to manipulate satellite photos, intercept radio communications, trace bullet trajectories, and electronically sketch suspects. These skills and more are necessary to solve the puzzles that will block your path. *Spycraft* has an estimated retail price of \$49.95.

Philips Media is offering another live-action spy game, *The Dame Was Loaded*. This humorous homage to the 1940's detective movies lets the player assume the role of wise-cracking private eye Scott Anger. From classy joints to sleazy dives, the name of the game is to solve the case and stay alive. Thirty characters and a twisting, random story line bring the game to life. A cool jazz sound track and over 40 hours of game play is featured on this 2-disc set. You can bring the '40s alive and hone your detecting skills for only \$39.99.

Golfing enthusiasts might want to check out *Aces, Eagles, & Birdies* from Memorex Software. This Gold Edition set contains three CD titles in one package for \$29.99. The set includes *Picture Perfect Golf*; *ESPN Golf: Lower Your Score With Tom Kite*—

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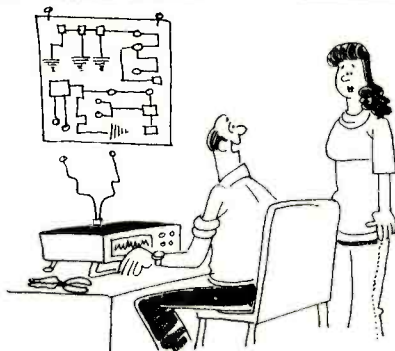
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Shotmaking; and *Golf Digest's Best Places to Play*. This set lets you play golf on your computer, pick up tips for the real game, and plan your next golfing vacation.

New this month from the Creative Wonders division of Electronic Arts is *Madeline: Thinking Games*. This title is intended to teach children ages 5 and up, important thinking skills using memory games, picture-word association, planning, decorating, and so on. This second CD-ROM in the Madeline series features Madeline and her dog, their Parisian home and 11 exciting activities. Kids can navigate through mazes, play songs, add color to pictures, and participate in over 20 minutes of video sing-alongs from the Madeline TV show. The disc will sell for around \$34.95.

French to Go! from Creative Multimedia is the third disc in a series of interactive foreign-language tutorials. Joining Japanese and Spanish, *French to Go!* features master French instructor Dr. Jane Riles as the user's personal tutor. The disc is equivalent to a 12-week curriculum, and it's packed with over 100 instructional videos and 1000 audio files. You can get your *French to Go!* for only \$49.95.

SkyTrip America is a new disc, for kids ages 9 and up, from Discovery Channel Multimedia. *SkyTrip* takes kids on a ride through time and American history in their very own flying machine, whether it be a sleek hoverjet, a homemade clunker, or a hot-air balloon. You make a flight plan, pick any state or region on the map, and take off with the click of a mouse. You'll meet famous pioneers, explore historic places, and learn about it all as you travel. You can even explore a spooky old ghost town out west. With 3-D graphics, narrated stories, games, trivia, and colorful video, the adventures change with every take-off. A *SkyTrip* "ticket" costs \$39.95. ■



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NET WATCH

Halloween on the Web

BY DAN KARAGIANNIS

Well, the ghoulish month has rolled around again, and with it comes my review of some macabre sites that are sure to get you in the spirit of October 31st. Whether you just want some information on appropriate scary movies to rent for a quiet Halloween at home, or would like to order a costume for a fright-filled party, your Net connection can open up a whole new world of festive opportuni-

ties. So, dim the lights, put on some eerie music, and point your Web browser to some of these dark domains on the Web.

the beginnings of Samhain (which the pagan feast Halloween is based on). On October 31st, it was believed that the "veil between the worlds" was lifted, and that those from the other side could come through. People feared such a thing, as you might expect, and for that reason, elements of horror were always associated with the holiday.

In modern times, most of us associ-

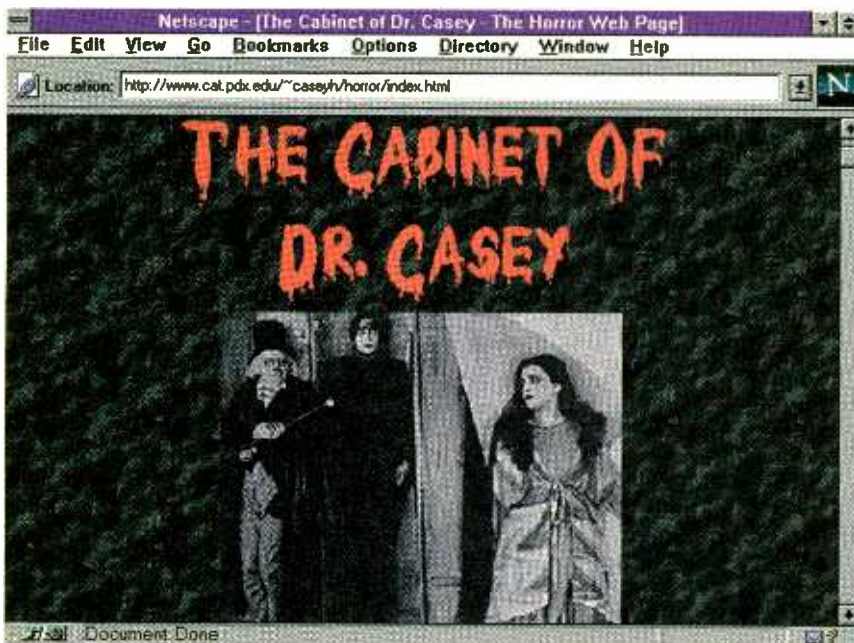
Horror Movie Poster Archive, Horror Reference, Atlas, Timeline, Interviews from the Cabinet, Tales from the Internet, Horror Audio Archive, Horror Graphics Archive, Horror in the Movies, Horror in Literature, Newsgroups, Links Around the Web, and Halloween Sites on the Web. Each deserves at least a brief description here.

The Horror Movie Poster Archive is a large archive of graphics files of (you guessed it) movie posters. What's great about the images here is that they usually are a good size to use as Windows wallpaper (that's convenient because reducing and enlarging images decreases their resolution and makes them less attractive). Not all the images are of "horror" movies, however. Some drama jpegs are here, and I was glad to see a great scan of the *Ghostbusters* poster as well.

Horror Reference is a neat and searchable link that puts a lot of spooky information at your fingertips. The site claims that the lists are not exhaustive, but rather "a rough guide to the myriad individuals and works that fall within the horror genre." If you know a title of some type of horror, but not its creator, for example, this section of the Cabinet should prove helpful.

The Atlas is an amazing, graphical-based search feature that lets you select a part of the world off a map, or by clicking on a country name. Then, you're presented with folklore and horror-fiction-based information on the area. If the information is of the latter type, the book or movie that is the source is also listed (often with a link for more information).

Now we come to one of the most interesting features of the Cabinet site, the Timeline. Here you'll find a graphic representation of a timeline that spans from the 13th to the 20th century. Just click the century of interest to learn how horror evolved during those years; interestingly, some of the information is on the real-life horror that



Whether you like horror all year long or just during Halloween time, you'll love the ghoulish goodies collected at the Cabinet of Dr. Casey.

ties. So, dim the lights, put on some eerie music, and point your Web browser to some of these dark domains on the Web.

THE CABINET OF DR. CASEY

If you love Halloween, then chances are you at least like (if not love) horror. Like the holiday we're currently focusing on, this dark form of fantasy, which exists because of our enjoyment of a good fright, has been around for quite some time. In fact, the two "H" words have been linked since

ate horror with All Hallows Eve because we *like* to feel scared on that day, not because we have some real supernatural dread. So, whether you like horror for one day a year, or if it happens to be your favorite fictional escape (it's definitely mine), you'll want to check out The Cabinet of Dr. Casey, which carries the appropriate subtitle: The Horror Web Page.

When you first access the site, you will be presented with a classic, black-and-white, horror-movie image. Scrolling down a bit will reveal several excellent links, including the following:

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AH82

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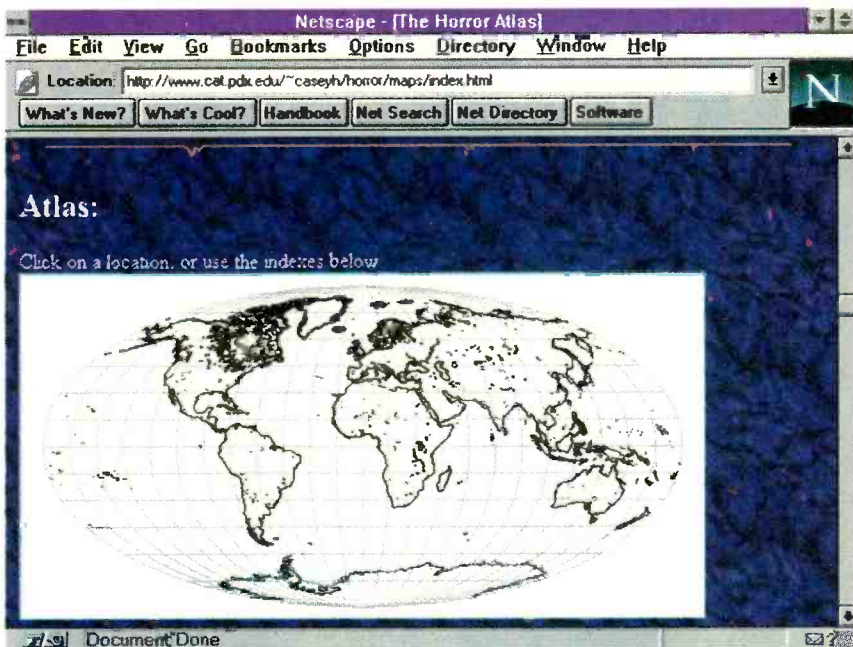
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The Atlas located within the Cabinet of Dr. Casey lets you click on an area of the world to learn what dark fiction and folklore comes from there.

occured, rather than fiction that was created (i.e. the Salem Witch Trials are a good example of that). Within each century heading you can choose from decades of the time period, making it possible to really pinpoint an era you'd like to know about.

The Interviews from the Cabinet link provides you with html-formatted text interviews with famous horror authors. There are also images associated with each.

Tales from the Internet is a collection of horror fiction written by various Netizens. Although the work seems to be from unpublished authors, who knows? The next big talent could be hiding here.

The next two links are similar in structure. The Horror Audio Archive and Horror Graphics Archive contain numerous files in .au and .jpg formats, respectively.

Horror in the Movies is definitely the link to check out if you plan on watching some scary movies this year on Halloween. You're sure to find just the right macabre film here to suit your taste. Hopefully you have a well-stocked video store nearby.

The Horror in Literature link is for those who also enjoy, or perhaps prefer, the theater of the mind's eye. You'll find excerpts from recent horror novels, authors' bibliographies, horror's

100 best books, and more online horror fiction.

Finally, like any good Web site, there are links to other great places. You can go to horror-related newsgroups, visit links around the Web that are of interest to horror fans, and even check out sites pertaining to Halloween in particular.

HALLOWEEN MART

In magazine publishing there's

often a long editorial lead time. That's the reason I'm writing this column towards the end of May 1996 and it's getting published in the middle of August 1996. However, this "August" issue bears the October cover date. That means most of you are now reading about Halloween sites approximately a month or month-and-a-half too early. While that could make it hard to get into the spirit of things, it does have its benefits. An important one of those is that if you order something for Halloween, you can definitely have it before the grim eve.

And just what would you order? Well, Halloween Mart might be able to answer that question for you. They have quite a selection of goodies that you could sure use if you are going to attend or host a costume party, or just need to suit up the kids for their evening of trick or treating. Let's take a look at the links those ghoulish items are organized within:

Clicking on Adult Costumes provides you with an extensive list of costumes, and images of a few of them. You'll find complete outfits of the heroes and villains from the *Batman* movies, monsters of horror fame, and much more. There's something for just about any price range and interest here.

The Children's Costumes link will help you find just the right outfits for



Plan on celebrating Halloween in a visual way? The Halloween Mart can fulfill all your costuming needs.

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Imagine the new freedom you'll have when you learn how to dash through all types of reading material at least twice as fast as you do now, and with greater comprehension. Think of being able to get on top of the avalanche of newspapers, magazines and correspondence you have to read...finishing a stimulating book and retaining facts and details



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more clearly, and with greater accuracy, than ever before.

Listen — and learn — at your own pace

This is a practical, easy-to-learn program that will work for you — no matter how slow a reader you think you are now. The *Speed Learning Program* is scientifically planned to get you started quickly...to help you in spare minutes a day. It brings you a "teacher-on-cassettes" who guides you, instructs, and encourages, explaining material as you read. Interesting items taken from *Time Magazine*, *Business Week*, *Wall Street Journal*, *Money*, *Reader's Digest*, *N.Y. Times* and many others, make the program stimulating, easy and fun...and so much more effective.

Executives, students, professional people, men and women in all walks of life from 15 to 70 have benefitted from this program. *Speed Learning* is a fully accredited course...costing only 1/4 the price of less effective speed reading classroom courses. Now you can examine the same easy, practical and proven methods at home...in your spare time...without risking a penny.

Examine *Speed Learning* RISK FREE for 15 days

You will be thrilled at how quickly this program will begin to develop new thinking and reading skills. After listening to just one cassette and reading the preface, you will quickly see how you can achieve increases in both the speed at which you read, and in the amount you understand and remember.

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able program for 15 days. If, at the end of that time you are not convinced that you would like to master *Speed Learning*, simply return the program for a prompt refund. (See the coupon for low price and convenient credit terms.)

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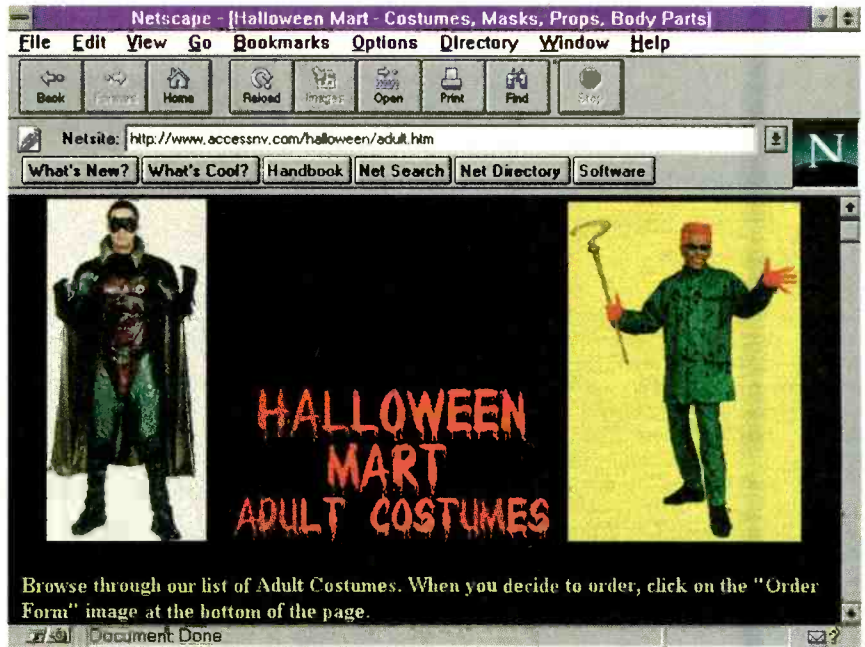
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A public service of this magazine



The adult costumes found at the Halloween Mart are quite impressive looking. Batman fans should especially get a kick out of this year's featured selections.

your little ones to wear while searching for candy. If you think some of the adult costumes are reasonably priced, you'll definitely be pleased with how much (or should I say, how little) the children's versions cost.

Now, I'm sure there are more than a few Star Trek fans who read this magazine. To make shopping easy for individuals such as yourselves, and to accommodate the large variety of merchandise available, the Halloween Mart made a separate section at its Web site called, appropriately enough, Star Trek Costumes. These costumes look very authentic, and shouldn't beam too much cash out of your wallet, either.

If you want a simple and extremely affordable way to dress up, check out the Masks link. Several full-head, high-quality masks are available here. Horror-favorite Pinhead is found here, as well as a President Clinton mask with a moving mouth.

Looking to accent a costume you bought or are putting together yourself? Then you should click on either Props or Body Parts. And, if you are working from scratch, you'll also want to consider getting one of the useful tomes in the Books section. They contain techniques used in Hollywood by makeup and special-effects experts.

And here comes the best part.

When you are ready to order, just click on Order Form. Online ordering couldn't be simpler; you get three options: There's a conventional order form, which would require you to send in your payment; a Netscape-secure credit-card order form, which lets you send your card number and order right

HOT SITES

The Cabinet of Dr. Casey
<http://www.cat.pdx.edu/~caseyh/horror/index.html>

Halloween Mart
<http://www.accessnv.com/halloween>

over the Net; and most innovative of all, a Netscape-secure check order form. I haven't seen the latter anywhere else on the Net yet, but of course, I haven't been *everywhere* on the Net either. Apparently, ordering over the Internet is becoming dangerously convenient. Make sure all your pointing and clicking doesn't leave you hopelessly in debt!

Well, that's all for this month. I hope your Halloween is filled with lots of thrills and chills, both online and off. Until next month, while you're online, you can reach me via e-mail at peeditor@aol.com. If you prefer snail-mail, send it to me at *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735.

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Product Test Report

APC BACK-UPS PRO 650 UNINTERRUPTIBLE POWER SUPPLY

BY STEPHEN A. BOOTH

Much is made of the importance of connecting computers and audio/video gear to surge-suppression devices. Lightning may strike, but it's more likely that any power spikes or surges reaching your equipment will come as a result of quirks in the electrical utility system. Those jolts might not cause instant damage, but take their toll cumulatively.

Because of their sensational, lightning-strikes nature, over-voltage situations get most of the ink. But under-voltage conditions—brown-outs and black-outs—probably cause more trouble with computers. An abrupt power failure will cause you to lose any work-in-progress you haven't saved to the PC's memory, and may damage hard-disk drives or other components. Brown-outs, meanwhile, are treacherous. They stress electronics components, inducing erratic performance in the short-term and reducing longevity overall.

To protect your work and your PC, the machine should be connected to an uninterruptible power supply (UPS), preferably one with a line-conditioner.

The UPS part is literally a battery backup that kicks in immediately to run the PC upon a power failure. How long they back up for depends on the model, but at least long enough for you to save your work and shut off the PC properly. The UPS monitors AC line voltage to determine when to switch to DC. Those with line-conditioners supplement the AC voltage during brown-out periods, thus sparing the PC unwanted stress. They'll act as a surge-suppressors too, buffering any over-voltage.

For this test we selected the BackUPS Pro Model 650 (\$419) from American Power Conversion (APC), because the company's Automatic Voltage Regulation system maintains correct power levels within a given range—before resorting to its batter-

ies. When it does switch to auxiliary power, it can run a substantial multimedia PC for 5 to 20 minutes, depending on the load.

Additionally, APC's PowerChute Pro software for the BackUPS Pro series enables users to program a PC for unattended, safe shutdown and rebooting, among other automated tasks such as performance-logging. The software gives the BackUPS Pro series plug-and-play compatibility with Microsoft's Windows 95 operating system—and also operates with PCs running Microsoft's Windows 3.1 and Windows NT, or IBM's OS/2.

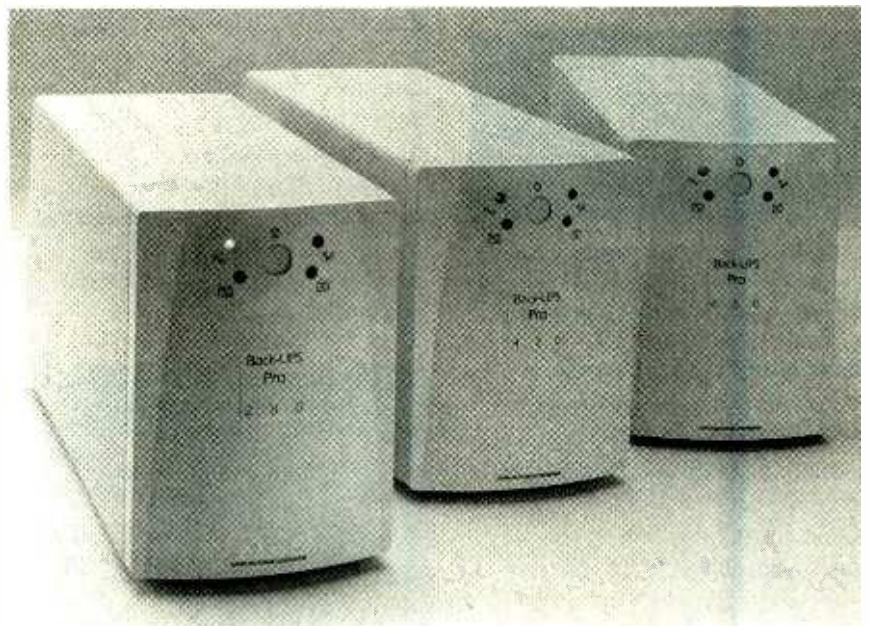
TEST RESULTS

The BackUPS Pro 650 was tested at the Advanced Product Evaluation Laboratory (APEL), an independent testing facility located in Bethel, Connecticut. The unit performed quite well, in some cases exceeding the manufacturer's specs (see Table 1). Meanwhile, in conjunction with the

PowerChute Pro software it worked a bit too well (see Table 2)—a condition APC says it will have remedied by the time you read this.

APEL evaluated the BackUPS Pro 650 on its own merits, and in conjunction with the supplied PowerChute Pro software. This program, formerly an optional purchase, need not be used but is bundled with the UPS.

As an uninterruptible power supply, the BackUPS Pro 650 performed as advertised. Its user-replaceable, hot-swappable batteries delivered 5.5 minutes of power under full-load (410 watts) and 20 minutes at half-load (205 watts). The system's Automatic Voltage Regulation both trimmed overloads as great as 12 percent and boosted under-voltage supplies by the same amount, to keep a computer coasting comfortably. In the under-voltage situation, with line-power as low as 103-VAC, the UPS would run the PC indefinitely without resorting to batteries. The unit's various diagnostic functions worked



The new American Power Conversion Back-UPS Pro Model 650 can possibly save your PC from damage caused by brown-outs.

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

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

by David Evans



Technology corner

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

Bandwidth of TV Signal

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

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

Spectrum system Precision tuning

Other systems Non-precision tuning

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

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

3. Spectrum antenna features

- Parallel 75 ohm resistance**
For minimum loss of signal
- Signal search control**
For selecting multiple antenna configurations
- Polarized three-prong plug for grounding**
For optimum signal grounding to eliminate noise and static
- Resonant line tuner control**
For dialing in crisp, clear TV/stereo reception, eliminates ghosting
- Dual AC outlets with built-in surge protection**
For plugging in additional TV/stereo equipment guarding against damage and electrical surges

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

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

Advanced technology.

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

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

How it works. Broadcast TV signals are sent out from the local broadcast station (ABC, CBS, NBC, etc.). They interface with your home's AC power line system, a huge aerial antenna network of wiring as large as your home itself. When the Spectrum Antenna interfaces with the AC line, the signal is sent to its signal

processing circuit. It then processes and separates the signal into 12 of the best antenna configurations. These specially processed signals route themselves into 12 separate circuits. The Spectrum Antenna includes a 12-position rotary tapping switch, the "Signal Switch" control, which gathers twelve of the best antenna configurations.

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

Risk-free offer. The Spectrum Universal Antenna/Tuner comes with our exclusive 90-day risk-free home trial and a 90-day manufacturer's warranty. Try it, and if you're

not satisfied, return it for a full "No Questions Asked" refund.

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

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fine, including the site-wiring fault indicator (e.g., to detect reversed polarity, or a missing safety ground).

When the AC supply dips below 103 volts, the UPS is supposed to switch to battery power, and it does. At that point, you'd get the requisite warning beeps and should begin to save files, close applications, exit Windows and shut down the PC in the orderly fashion demanded by the Microsoft operating system.

In most cases, PowerChute Pro worked fine, though APEL found "bugs" known to APC. For example, the software would occasionally lose communication with UPS when the drop-down menus were stressed by repeatedly fast mouse-clicks. That isn't normal operating procedure, but it's something a novice or nervous PC user might do. In fact—call it bug number two—the fault was discovered only when a promised feature didn't function

firmware in the BackUPS Pro 650 would "sense" adequate voltage, and signal PowerChute Pro to reboot the PC. Shortly after reboot, and with input unchanged at 90-VAC, the monitoring circuitry in the UPS would sense inadequate power and instruct the software to reinitiate the five-minute shut-down procedure.

That pattern repeated itself time after time, with two test units. Our concern should be obvious: If the cycling were to go on indefinitely, it seemed logical that eventually the UPS battery would lack the juice to run the PC for the five minutes programmed for shut-down—resulting in a hard crash.

As it turns out, that would not happen. According to APC, the unit's "battery depletion protection" would not permit the UPS to start up again once battery voltage dipped below a level needed to shut down the PC correctly (in terms of time, about 1 minute and 45 seconds). Still, APC concedes the flaw is real, and began its own tests to find the cause.

The company informed us that the firmware in the UPS was signaling "all-clear" when line voltage remained constant over a range from 89.3 to 93.3 VAC. The lab was feeding the box a steady 90 volts. According to APC, the fault was that the firmware's threshold was improperly set at 89.3 volts: The unit should not restart until input voltage rises above 93.3 volts. In other words, the shut-off point and turn-on point were virtually the same, so the 650 played yo-yo with PowerChute Pro at 90 VAC.

APC assured us that, as a consequence of APEL's discovery, the firmware in its BackUPS Pro units would be reconfigured immediately to set the turn-on threshold at 93.3 volts. Meanwhile, the company does not plan to recall some 400,000 units already sold.

APC's rationale is that prolonged brown-outs at a constant 90 VAC are unlikely. The company states that, usually, dips so low are variations of brief duration—occurring mostly in summer when the compressors in climate-control equipment induce motor-loads with high inrush currents. We were told that no existing customers had reported problems of the type APEL encountered. Again, the company reiterated

TABLE 1—TEST RESULTS

The following test results were furnished by the Advanced Product Evaluation Laboratory, an independent testing facility located in Bethel, CT. The software provided by the manufacturer was also evaluated.

Brand:	American Power Conversion	
Model:	BackUPS Pro 650	
Price:	\$419	
TEST	APEL DATA	MANUFACTURER'S SPEC
Maximum Capacity	410 watts	410 watts
Phase Synchronization	In phase	In phase
Typical Run-Time (Battery):		
Half Load (205W)	20.0 minutes	19 minutes
Full Load (410W)	5.5 minutes	5 minutes
Voltage Regulation:		
Boost-Input 103 VAC		
Output Voltage	+12% (115 VAC)	+12%
Trim-Input 138 VAC		
Output Voltage	-12% (121 VAC)	-12%
Battery Output (Full Load):		
(Stepped Sine-Wave)	106 VAC	112 VAC
Recharge Time:	4 hours	1-5 hours
Audible Noise:	38 dB	<45 dB
Audible Alarms:		
On Battery	Yes	Yes
Low Battery	Yes	Yes
Overload	Yes	Yes

The PowerChute Pro software won't close files—you'd need other applications that automatically save data. But the APC software will safely shut down the PC's operating system—a great idea for those times when you're not around to do the task.

You could, for example, program the software to commence shut-down within five minutes of battery activation and to automatically power-up and reboot the PC when line voltage returns to the normal operating range. It's here that APEL discovered an interesting "bug" in the system (that discovery was replicated in a second, separate test unit by the lab and, subsequently, by APC's own engineers).

(a sound-effect whereby the software beeps every four seconds to indicate PowerChute Pro is on the job). The software was on the ball, but APC concedes the sound-effect wasn't. The "beep" will be dropped from future software revisions.

On the positive side, PowerChute Pro certainly shut down the PC as programmed. And it automatically rebooted the PC, when informed by the 650's line-monitoring circuitry that adequate AC power had been restored. Here's where APEL discovered a flaw.

When the lab dropped line power to 90 volts, the software shut down the PC as programmed. But within seconds of shutdown, the microprocessor

that the battery-depletion protection in the BackUPS Pro, when used with PowerChute Pro, would not permit a drop-dead situation.

So much for under-voltage problems. Regarding power surges, APC states that clamp-down response is

antee against surge damage to protected equipment.

Considering the fickle nature of utility service, a UPS is a sensible investment for anyone who uses a PC. Given the corrections to the UPS circuitry that APC promises, the BackUPS Pro 650

TABLE 2—SOFTWARE TEST

The APS BackUPS Pro is bundled with PowerChute Pro software, which consists of two software modules. Pwrchute.exe is a monitoring module that communicates to the UPS via the serial port of an IBM-compatible computer running the Microsoft Windows (Windows 95; 3.1; or NT) or IBM OS/2 operating system. Winchute.exe is a user interface module that permits the operator to monitor and control the UPS via drop-down menus and dialogue boxes on the PC display monitor. APEL used an IBM-compatible 486 PC running Windows 3.1 to evaluate the following PowerChute Pro menu selections.

SELECTION	RESULTS
Self Test:	
Green on-line LED (flashes); amber on-battery LED (on)	Yes
Power switches to battery (confirmed by scope)	Yes
Green LED on; amber LED off	Yes
Power switches back on-line	Yes
PowerChute software displays self-test status	Yes
Test UPS Alarm:	
Red overload LED (on); red replace-battery LED (on)	Yes
UPS beeps	Yes
PowerChute software displays alarm-test status	Yes
System:	
(Daily Shutdown Parameters)	
Shutdown at user-programmable time	Yes
Timely shutdown warning message	Yes
Re-boot at user-programmable time (Shutdown Server Now)	Yes
Shutdown at user-programmable time	Yes
Logging:	
Maintains a log of UPS condition	Yes
Erase log and start a new log	Yes
Diagnostics:	
(Simulate Power Failure)	
Green on-line LED (off); amber on-battery LED (on)	Yes
Power switches to battery (confirmed by scope)	Yes
UPS beeps	Yes
Green LED back (on); amber LED extinguished (off)	Yes
Power switches back on-line	Yes
PowerChute software displays power status	Yes
Configuration:	
(UPS Shutdown Parameters)	
Maximum battery run-time programmable by user	Yes*
Interval between warning messages programmable by user (Communications Parameters)	Yes
Sound Effects	No*

* see text

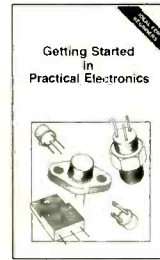
instantaneous when subjected to the 6000-volt surge specified by the IEEE-587 Category-A test, and that its protection circuitry can backstop the approximately 300 volts that might pass through. APEL could not simulate so big a jolt, but consider this: APC puts its money where its mouth is with an impressive \$25,000 lifetime guar-

warrants your consideration.

FOR MORE INFORMATION

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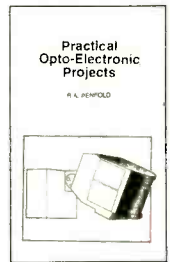


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If you are looking into launching an exciting hobby activity, this text provides minimum essentials for the builder and 30 easy-to-build fun projects every experimenter should toy with. Printed-circuit board designs are included to give your project a professional appearance.

BP349—PRACTICAL OPTO-ELECTRONIC PROJECTS \$5.95

If you shun opto-electronic projects for lack of knowledge, this is the book for you. A bit of introductory theory comes first and then a number of practical projects which utilize a range of opto devices, from a filament bulb to modern infrared sensors and emitters—all are easy to build.



BP363—PRACTICAL ELECTRONIC MUSIC PROJECTS \$5.95

The text contains a goodly number of practical music projects most often requested by musicians. All the projects are relatively low-in-cost to build and all use standard, readily-available components that you can buy. The project categories are guitar, general music and MIDI.



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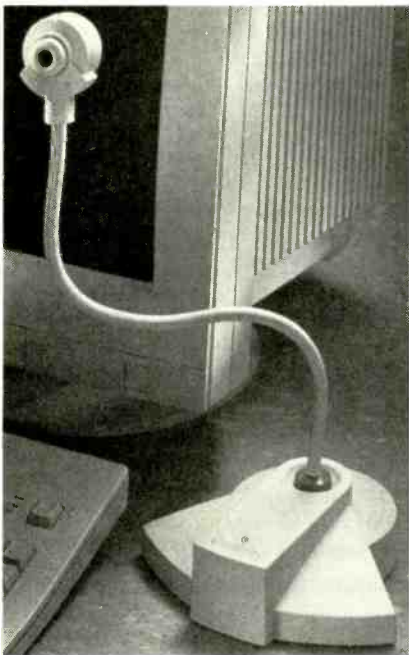
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NEW PRODUCTS

DESKTOP VIDEO CAMERA

In response to the quickly growing video-conferencing market, *VideoLabs' FlexCam*, an integrated color camera and microphone designed for desktop video and communications, now offers S-video output and an attractively lower price.

The $\frac{1}{3}$ -inch, high-resolution CCD S-video camera and the microphone are mounted on a slender, 18-inch flexible wand that can be easily adjusted for precise camera positioning. S-video provides a sharper image with more vivid colors, whether the camera is focused at its closest range of $\frac{1}{4}$ -inch or at a distance. The added detail allows the FlexCam to be used for applications including quality control, presentations, teaching, and video-conferencing.



The FlexCam is available in NTSC or PAL formats and includes industry-standard, line-level audio. The camera is compatible with Apple AV Macintosh computers and all popular digitizing boards for Apple Macintosh and Microsoft Video for Windows.

The FlexCam desktop video camera costs \$395. For more information, contact VideoLabs, 10925 Bren Road 28 East, Minneapolis, MN 55343; Tel.

612-988-0055; Fax: 612-988-0066; e-mail: videolabs@flexcam.com.

CIRCLE 70 ON FREE INFORMATION CARD

MULTIMEDIA MONITOR

The *ViewSonic 17EA* multimedia monitor offers the 17-inch display (16-inch diagonal viewing area) that is now the preferred size for today's varied applications. The flat, square screen delivers a full image display to all four corners. Built-in stereo speakers eliminate the need to add external ones.



The monitor offers resolutions up to 1280x1024 and has an 85-Hz refresh rate at 1024x768. It also features a low 0.28mm dot pitch with a maximum refresh rate of 120 Hz for a crisp, picture-perfect display. An Invar Shadow Mask increases beam alignment for improved image quality with fewer color and focus shifts.

The ViewSonic 17EA has several advanced features, such as OnView™, an on-screen control system for customizing screen images. The OnView menu gives the user the option of adjusting up to 20 different settings including brightness, contrast, size, and positioning. Other features include ViewMatch™ color control and an anti-static/anti-glare screen coating. The monitor is compatible with PCs and Macs and provides Plug & Play + (with a CCD-compatible video card) to support Windows 95.

The ViewSonic 17EA has an esti-

mated street price of \$695. For further information, contact ViewSonic Corporation, 20480 Business Parkway, Walnut, CA 91789; Tel. 909-869-7976 or 800-888-8583; Fax: 909-869-7958.

CIRCLE 71 ON FREE INFORMATION CARD

HAND-HELD ORGANIZERS

Rolodex Electronics' Hand-Held Organizers offer DataGuard™, which uses a Flash ROM memory chip to guarantee against information loss, regardless of battery life. The three palm-sized models in the line each feature an appointment file and a full-view to-do list accessible by date or event, a programmable schedule keeper and daily alarm, a 200-year monthly calendar, a 10-digit calculator, and password protection for confidential data. Rolodex's PC-Link software can be used to transfer data between any of the organizers and an IBM-compatible PC. Infrared transfer is used to upload or download data to any Rolodex electronic desktop or telephone organizers with at least 32K memory.



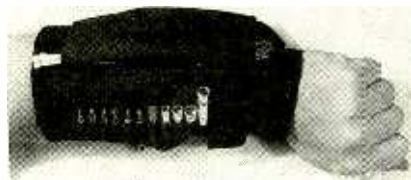
The *Model EL3132*, with 32K DataGuard memory, stores up to 500 records with 30 lines of information per file, has a six-line/24-character LCD, and runs on two AAA batteries. The 64K *Model EL3164* can store up to 1000 records and is powered by a lithium battery. The *Model EL31128* stores as many as 2000 records in its 128K DataGuard memory. All records can be accessed by either name or company.

The EL3132, EL3164, and EL31128 organizers have suggested retail prices of \$59.99, \$79.99, and \$99.99, respectively. For more information, contact Rolodex Corporation, 245 Secaucus Road, Secaucus, NJ 07096-2196; Tel. 201-348-3939.

CIRCLE 72 ON FREE INFORMATION CARD

ARM-BAND TOOL KIT

Paktek's Tool Pak 4RM puts all the tools you need close at hand—just above your hand, in fact. Designed to be worn on your forearm, the toolkit features four expandable Velcro straps that allow it to adjust to a wide range of sizes and fit easily over clothing. You can carry your tools with you, yet have full freedom to use both hands.



The 4RM features two large, flap-covered pockets, each with 20 internal holders to organize small bits and drivers. Convenient for left- and right-handed workers, the 4RM can be worn on either arm. Its two pockets are accessible from both sides.

The 4RM toolkit costs \$21.97. For additional information, contact Paktek, 7307 82nd St. Ct. SW, Tacoma, WA 98498; Tel. 800-258-8458; Fax: 206-589-1091.

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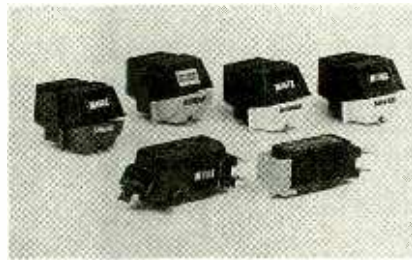
PHONO CARTRIDGES

For audio purists who prefer their music on vinyl, as well as listeners who still enjoy their extensive collections of LPs, *Shure* offers a line of six phono cartridges. Each comes with a diamond-tipped stylus and all necessary mounting hardware for use with most 1/2-inch commercial and consumer tone arms. Two models can also be used on P-mount tone arm systems.

The top-of-the-line *M111E* features a heat-treated stylus and a biradial diamond tip. It is equipped with Shure's

proprietary Dynamic Stabilizer™ shock absorber and the company's Side Guard stylus protection system.

Designed for DJ and broadcast use, the SC35C cartridge is built to work with tone arms requiring a tracking force of four to five grams. Its stylus assembly is rigid enough to withstand the punishment inflicted by back-cueing (or "scratching"), yet compliant enough to provide excellent mid- and high-frequency reproduction.



The rugged and dependable M44GX and M447X cartridges offer value-oriented performance, while the M70BX and M92E provide an economic way to upgrade a turntable. Priced at just \$24.95, the M92E features a biradial diamond tip, a low tracking force range of 0.75 grams to 1.5 grams, and universal mounting capability, fitting both P-mount and 1/2-inch standard tone arm systems.

Suggested retail prices range from the M92E's \$24.95 to \$99.95 for the model M111E. For more information, contact Shure Brothers Inc., 222 Hartrey Avenue, Evanston, IL 60202.

CIRCLE 74 ON FREE INFORMATION CARD

STICK-STYLE DIGITAL MULTIMETER

For about the price of an analog meter, field-service technicians can buy a stick-style digital multimeter with 300-amp AC current clamp, complete with a selection of lead and tip accessories, that comes in a carrying case.

The meter included in the *Model LS33 Fieldpack* from *Fieldpiece* measures voltage up to 600 volts AC/200 volts DC with a resolution of 0.1 mV AC or DC, and resistance up to 20 megohms with a resolution of up to 0.1 ohm. With the AC current clamp attached, currents to 300 amps AC can be measured with a resolution to 0.1 amp. A built-in frequency counter measures up to 40 kHz. The meter

denotes continuity with a loud beep.

The DMM stores measurements in two ways. Its hold button freezes the display. The max button compares the newest reading with prior readings, and then saves only the larger reading.



The lightweight meter has a very narrow housing design, accessory jacks on the top, and a display orientation that allows one-handed operation. It comes in a padded, zippered, mail-pouch-style case.

The LS33 Fieldpack costs \$99. For more information, contact Fieldpiece Instruments, 231 East Imperial Highway, Suite 250, Fullerton, CA 92635; Tel. 714-992-1239; Fax: 714-992-6541.

CIRCLE 75 ON FREE INFORMATION CARD

PROFESSIONAL-CLASS DIGITAL MULTIMETERS

Wavetek's Models 2005 and *2015* autoranging handheld digital multimeters are aimed at engineers, technicians, and plant service personnel responsible for designing, testing, servicing, repairing, maintaining, and measuring electronics or electrical signals. The meters' 4000-count digital display with 42-segment analog bar graph is the largest in their class, with 0.78-inch high numerals. Measuring functions include AC and DC volts and amps, resistance, diode test, and continuity check with beeper. Both models also offer frequency and capacitance measuring functions, and the *Model 2015* measures AC in true-RMS mode as well. Special features include manual-mode range lock; max/min data hold, which freezes the reading on the display for later evaluation; and relative-compare mode.

The compact, lightweight digital

continued on page 73 **29**

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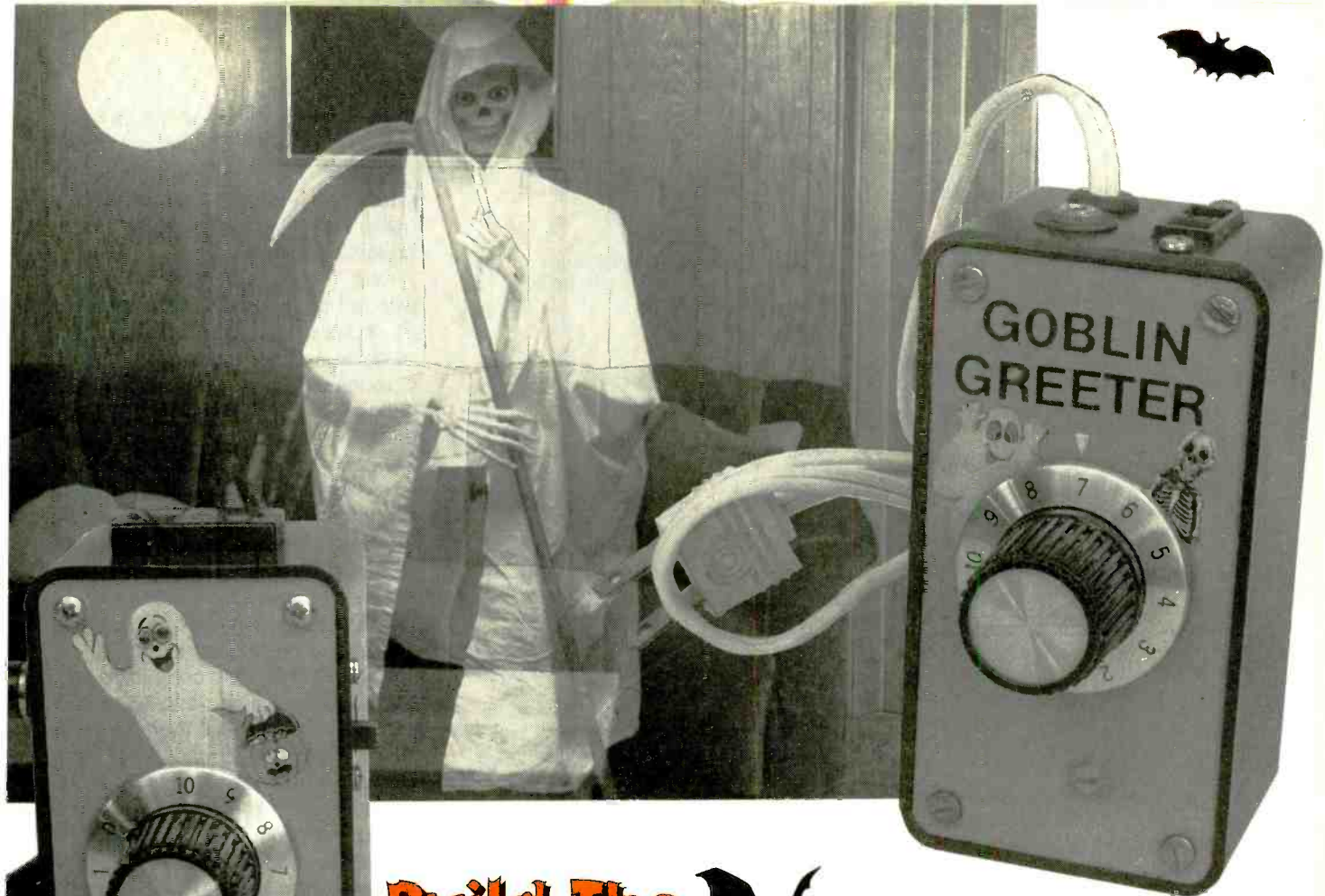
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Build The GOBLIN GREETER

This Halloween greet trick-or-treaters at your front door with a hologram-like ghost and spooky sounds.

BY D. DEREK VERNER

Each Halloween, legions of little witches, devils, goblins, and their ghoul friends arrive at our doors to receive their annual tribute of goodies. Now, while giving candy is great, the last day of October is also about having a little spooky fun. So this year, when your costumed visitors show up with their bags and Jack o'lantern pails, why not treat them to a show that keeps with the "spirit" of the holiday.

Imagine this Halloween scenario: A few seconds after ringing your doorbell, your visitors hear an unearthly shriek, and a life-sized, full-color, 3-D image of a ghost materializes in front of them. The ghost beckons and, in sepulchral tones, bids the visitors enter; then, with a maniacal laugh, and

to the deep reverberating tones of an organ chord, the phantom slowly fades to invisibility.

Does that sound neat? If it does, you'll definitely want to build the *Goblin Greeter* described in this article. It's a starting project that you can whip up in a couple of evenings with parts from your local hardware store and a few simple electronic circuits.

How it Works. By now you might be a bit curious as to how the hologram-like ghost image is generated by the *Goblin Greeter*. As shown in Fig. 1, the optical illusion is created by means of an image reflected from a ghost mannequin hidden from direct view of the visitor. That method is actually one of the oldest illusions used in

stage magic. Called Pepper's Ghost, the technique was made popular in 1863 by Professor Pepper of London when new manufacturing processes made large sheets of plate glass feasible.

Visitors to Disney's Magic Kingdom can see a modern version of Pepper's Ghost in the Haunted Mansion attraction, where ghostly dancers waltz around a ballroom. Our version replaces expensive plate glass with interior storm-window material available from most hardware stores. Such heat-shrinkable plastic film is not only much cheaper than glass, but is also safer to use, easier to store, and lighter than glass. Also, it is so thin that it does not produce the double image that occurs with plate glass.

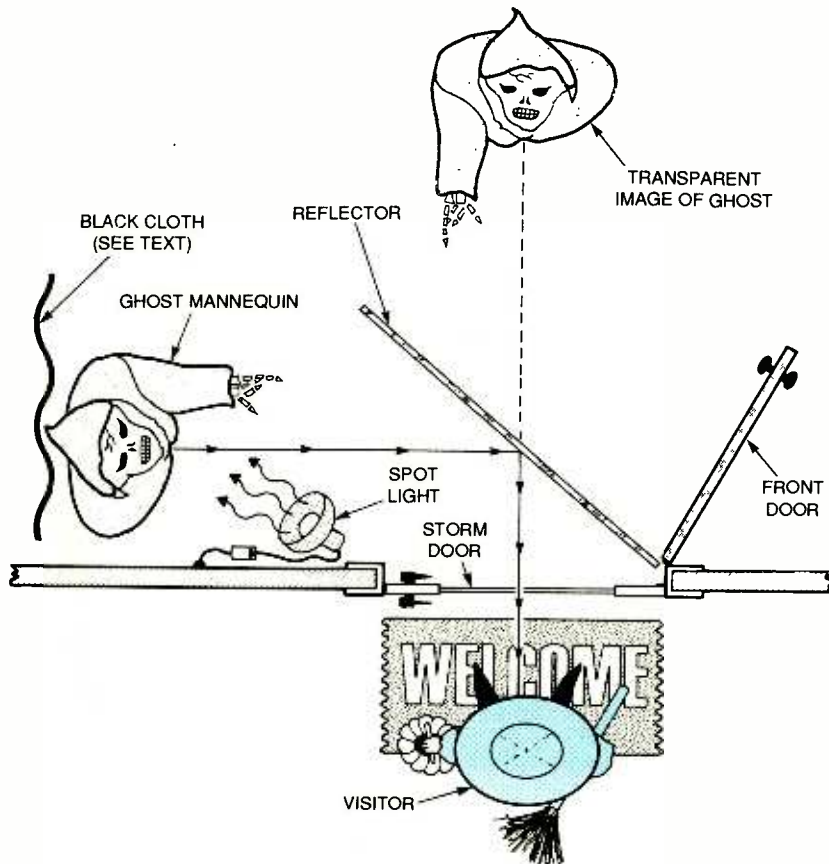


Fig. 1. As the spotlight in the room gets brighter, the ghost mannequin's reflection will gradually appear in the reflector. With proper lighting, the effect can be quite spooky!

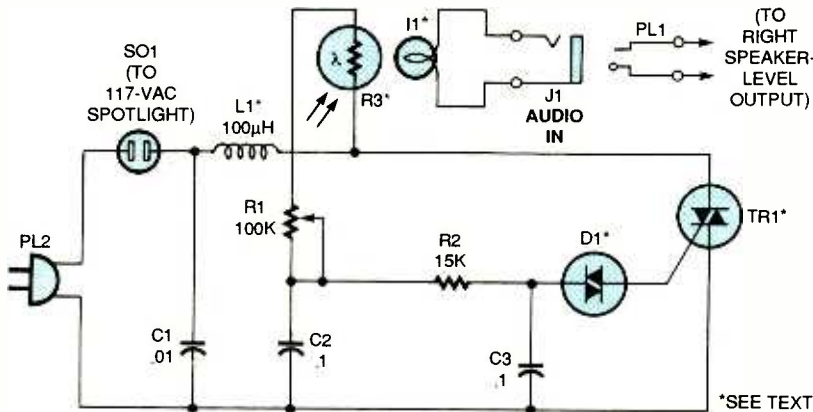


Fig. 2. Here's the schematic for the Goblin Greeter light-controller circuit. As the audio input to J1 becomes louder, a spotlight plugged into SO1 will consequently glow brighter.

When the mannequin is in darkness, the visitor sees through the sheet of plastic into the room beyond. Then, as the lighting on the mannequin is increased by the circuit, the figure becomes more and more visible. The brightness of the lighting is controlled by one track of a stereo tape recorder, while the second track contains appropriate sound effects, such as cackles or howls.

Circuit Description. The Goblin Greeter is made up of two circuits: a light controller and a timer. We'll deal with the timer later on; the light-controller schematic is shown in Fig. 2. Power for the circuit is provided from a standard 117-VAC outlet.

Speaker-level audio from the right channel of a tape recorder is fed to the circuit through jack J1. That audio signal powers a small, low-voltage

lamp, I1, which shines on a CdS light-dependent resistor, R3. Those components form an opto-isolator whose resistance varies with the intensity of the audio signal and, consequently, the brightness of I1.

One "leg" of a phase-shifting network is formed by R3, potentiometer R1, and capacitor C2. The second leg of the network is formed by R2 and C3. Capacitor C2, charged to a higher voltage than C3, replenishes C3's charge each time diac D1 triggers, thereby reducing the circuit's hysteresis or "backlash." Those components determine at what point in each half of the AC cycle D1 will trigger triac TR1 into conduction. The brighter the lamp, the lower the resistance of R3, and the sooner in each half cycle TR1 will conduct.

When TR1 begins to conduct, a 117-VAC spotlight plugged into AC-socket SO1 will be activated. Therefore, the audio signal will control when the spotlight turns on, and the level of the signal will determine the brightness of the spotlight. Inductor L1 and capacitor C1 are used to reduce radio and television interference.



PARTS LIST FOR THE GOBLIN GREETER LIGHT CONTROLLER (Fig. 2)

RESISTORS

- R1—100,000-ohm linear taper potentiometer
- R2—15,000-ohm, 1/4-watt, 5% resistor
- R3—Cadmium-sulfide light-dependent resistor (see text)

ADDITIONAL PARTS AND MATERIALS

- TR1—400-volt, 6-ampere, triac
- D1—Diac (All Electronics type ST2 or equivalent)
- C1—0.01- μ F, ceramic-disc capacitor
- C2, C3—0.1- μ F, metal-film capacitor
- L1—100- μ H, 2-ampere choke coil (see text)
- I1—Miniature lamp, 1.5-volt, 25-mA (see text)
- J1—Phono jack, 1/8-inch
- PL1—Phono plug, 1/8-inch
- PL2—AC plug, 1/8-inch
- SO1—AC socket, 2-terminal
- Perforated board, project enclosure, heat sink (for TR1), AC line cord, knob, small pieces of cork (2), small plastic tube (see text), speaker wire, 117-VAC spotlight (see text), wire, solder, hardware, etc.

The timer circuit shown in Fig. 3 makes the Greeter's operation dependent upon the ringing of a doorbell or actuation of a proximity sensor. It's a straightforward, monostable circuit, centered around IC1, a 555. Power for the circuit is supplied by a 9-volt battery, B1; S1 is the power switch.

Capacitor C1 and the setting of potentiometer R1 establish the length of time RY1 will remain closed when a trigger signal arrives at pin 2 of IC1. That signal, which is input at J1, can be derived from a number of different sources (doorbell, proximity sensor, etc.), as we'll describe later. With the values shown in Fig. 3, the maximum timing period is about 25 seconds. To change the maximum timing period, replace C1 with a capacitor of different value (the value of C1 in microfarads multiplied by 1.1 equals the maximum time interval in seconds).

Diodes D1 and D2 protect IC1 from inductive spikes when RY1 operates. The varistor, MOV1, serves a similar purpose when the unit is connected to a doorbell circuit.

When RY1 is closed, power will be supplied to SO1. Therefore, if the tape recorder used with the Greeter is left in play mode, and is connected to SO1, the timer will cause the recorder to play when the circuit is activated (e.g. when the doorbell is pressed). The recorder will then shut off at the end of the relay timing period. Consequently, after the audio is shut off, the Greeter's light controller also turns off, making your "ghost" and its sound effects vanish.

Circuit Construction. Because layout is not critical, the two circuits are simple enough to build using ordinary perforated board. Before you begin, keep the following in mind:

Warning: Because these are circuits that involve AC electricity, never touch any of the components or connections when the circuits are plugged into an outlet. The jacks on the circuits never connect to AC, and are safe to touch from the outside of the enclosures. However, if you plan on using the circuits while they are open or not enclosed, use an isolation transformer for safety.

The components needed for the circuits are all available from RadioShack and other suppliers, except for the diac. That type-ST2 diac can be

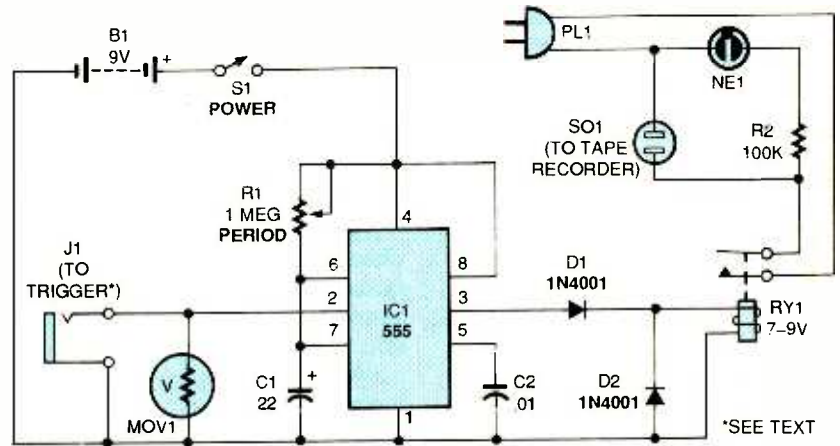



Fig. 3. By setting this timer circuit, you can have the Goblin Greeter illusion last for a predetermined amount of time.



PARTS LIST FOR THE GOBLIN GREETER TIMER (Fig. 3)

- IC1—555 timer, integrated circuit
- D1, D2—1N4001 silicon rectifier diode
- R1—1-megohm linear taper potentiometer
- R2—100,000-ohm, ¼-watt, 5% resistor
- C1—22-μF, 35-WVDC, electrolytic capacitor
- C2—0.01-μF ceramic-disc capacitor
- MOV1—Metal-oxide varistor
- RY1—7-9-volt, 500-ohm relay
- NE1—Neon lamp, type NE-2
- J1—Phono jack, ½-inch
- PL1—AC plug, 2-terminal
- SO1—AC socket, 2-terminal
- S1—SPST switch
- B1—9-volt alkaline battery

Perforated board, project enclosure, AC line cord, knob, fiberoptic fiber (optional, see text), wire, solder, hardware, etc.

obtained from All Electronics Corp. (P.O. Box 567, Van Nuys, CA 91408-0567).

Begin assembling the light controller by mounting the potentiometer, resistor, and capacitors. Then wire the connections from those components to the diac and triac. To use the full current carrying capacity of the triac, it is essential that it be provided with adequate heat sinking. Keep the following in mind, though:

Warning: Many (not all) TO-220-style triacs have the mounting tab common with one of the main terminals. Check with an ohmmeter to see if this is the case, and, if so, use an

insulated mounting system and thermal grease. That precaution is particularly important if the heat sink is mounted on an aluminum project-box cover, as it is in the author's heat-sink. Otherwise the unit will present a shock hazard.

Go on to connect L1 to the circuit. If you're using the 100-μH inductor available from RadioShack, note that it is limited to 2 amperes. Therefore, if you intend to use a spotlight rated higher than 150 watts or so, substitute a choke with a greater current-handling ability.

In the light controller, the lamp chosen for L1 depends on the power output of the recorder's amplifier (remember, the Greeter uses a speaker-level output, not a line-level one). The lowest wattage lamp widely available is the one stocked by RadioShack that matches the specifications in the Parts List. That lamp should be suitable for use with even the ear-phone output of a small cassette recorder; larger stereo systems can drive bigger lamps. Almost any small lamp rated from 1.5 to 6 volts will probably work, but avoid flashlight bulbs because they generally require more current than other small lamps. The lamp selected need not reach full brightness, as long as its intensity varies and it produces enough light to be seen.

Take a small piece of tubing cut from a marking pen. Mount the lamp in a piece of cork and insert it into one side of the tube, as shown in Fig. 4. Insert light-dependent-resistor R3 into the other side of the tube in the same fashion; almost any CdS light-dependent resistor will work in this applica-

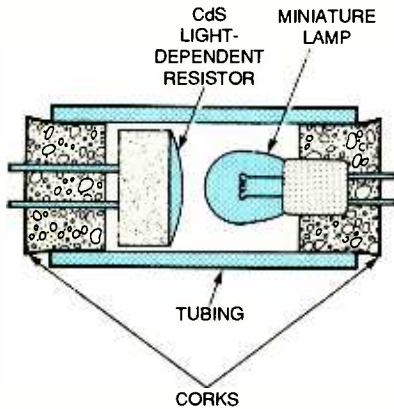


Fig. 4. To create the simple optoisolator used in the light controller, mount the light-dependent resistor (R3) and miniature lamp (I1) in a small tube.

tion. If you have a few to choose from, however, pick one that produces the widest resistance range.

Connect J1 to the lamp in your homemade optoisolator, and then connect the leads of R3 to the circuit. You'll need to manufacture a cable to connect J1 to the tape recorder used. The easiest way to do that is to connect a phono plug, PL1, to some speaker wire. If you're using the unit with a stereo, leave the other ends stripped so they can be inserted into the speaker connector for the right channel. Otherwise, you'll have to splice the leads to the right audio track.

To complete the light-controller circuit, connect AC-socket SO1 and AC-plug PL2 to the board. Use an AC line cord of the desired length for the latter. We'll deal with how to enclose the circuit after we discuss assembling the timer.

To build the timer circuit, begin by mounting an IC socket on a piece of perforated board. Then, make connections from the pins to the potentiometer, capacitors, varistor, jack, switch, and battery. Check the polarity of C1, then go on to mount D1 and D2, also making sure they are oriented properly.

Install the relay next. As shown in Fig. 3, one of the contact connections will be directly to an AC line cord leading to AC-plug PL1. Make the other connection to R2, AC-socket SO1, and neon-lamp NE1 (which is an NE-2 type). When connecting SO1, make sure you leave a little wire so it can be mounted on the enclosure; it obviously needs to be accessible from

outside the circuit. Complete the AC part of the circuit by wiring the shared connection of SO1 and NE1 to the line cord leading to PL1.

Finally, insert IC1 into its socket. You are now ready to mount both circuits in enclosures.

The author's prototypes were enclosed in project boxes with aluminum covers (available from RadioShack). In keeping with the Halloween theme, you should consider painting the covers bright orange and decorating them with cutouts from a gift catalog. In the author's timer circuit, the neon lamp was mounted behind the front cover to illuminate the eyes of a little decorative ghost. You can do the same by drilling two holes behind the eyes and inserting two $\frac{1}{8}$ -inch lengths of fiberoptic fibers. Use a soldering iron to stick the fiber ends to both sides of the cover.

In both circuits, mount the AC sockets on the outside of the enclosures. Make sure you never open one of the cases when the circuits are plugged into an outlet.

Once you have the circuitry completed, it's time to start assembling the larger parts of the Goblin Greeter that make the illusion possible. Let's now turn our attention to the reflector.

Reflector Construction. Although the frame for the reflector can be made from wood, a much better job can be done using electrical metallic tubing (EMT) sold for use as a wiring conduit. The latter was used in the author's prototype, and it worked quite well. The EMT conduit comes in ten-foot lengths and is available from most hardware stores at a nominal cost. Four lengths will be required, and the leftover pieces can be used as described later for the arms of the ghost figure.

The shrinkable plastic should be of the type sold for use with picture windows or sliding glass patio doors. In the author's Greeter, an 84-inch by 25-foot roll was used. That's plenty for several years of use. (To keep things simple, the following assembly details will assume you use a roll of an 84-inch width. If you use a roll of a different width, adjust the dimensions given accordingly.) Also, buy some of the double-sided tape normally used to adhere the plastic to a door or window casement.

You will need four, 2-inch-long pieces of $\frac{1}{2}$ -inch copper tubing and four cast-brass street elbows from the plumbing department as well. Brass elbows are better than copper ones because their thicker walls hold a thread better, and their outside diameter matches that of the conduit, making a smooth frame over which the plastic will shrink with no distortion.

Figure 5 shows how the frame is assembled. Make it as large as possible so that no portion of it will be visible from the visitor's point of view. If you have a roll of plastic of the size described earlier, cut four pieces of EMT conduit to 80 inches in length. A tubing cutter makes quick work of the job, but a hacksaw and file will work as well. The pieces will make up a square frame as tall as a residential doorway and wide enough so that the edges won't be seen.

The inside of the EMT conduit has a weld seam that must be filed away with a rattail file, so that the short lengths of copper tubing can be inserted (as shown in Fig. 5). Using a propane torch, tin the ends of the copper tubing with plumbing solder. Smear a little soldering paste inside the end of a conduit and a brass elbow; assemble the three pieces; and while applying heat with the torch, feed more solder into the joints. While the assembly is still hot, wipe off excess solder with a clean rag.

Repeat that procedure for one end of each EMT conduit. The other ends of the conduits will connect to the narrow parts of the brass elbows. Assemble those pieces on the floor to make sure they form a flat-plane square. Then, drill and tap the holes as shown in Fig. 5. Screw the pieces together using 8-32 screws to complete the frame.

PARTS AND MATERIALS LIST FOR THE REFLECTOR

- Electrical metallic tubing conduit (four 10-foot lengths)
- Shrinkable plastic window insulation, 84-inch-wide roll
- $\frac{1}{2}$ -inch copper tubing (four two-inch pieces)
- Cast-brass street elbow (four)
- Propane torch, plumbing solder, soldering paste, 8-32 screws, double-sided tape, flat-black paint, and assorted hardware.



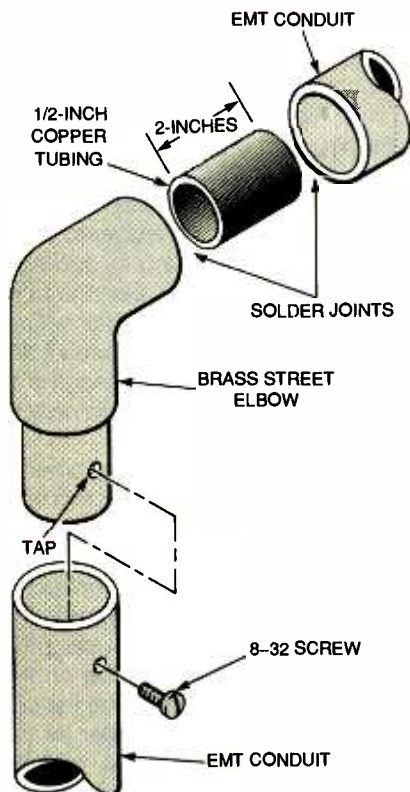


Fig. 5. Only one end of each EMT conduit used in the reflector frame is soldered. The other ends connect with screws to the brass elbows, making the frame easy to disassemble.

When the frame is assembled, give it a coat of flat-black paint and let it dry thoroughly. That will make it almost invisible in dim light.

Apply the double-sided tape around the outside edges of the frame by peeling off the protective backing on one side only. Then, remove the backing facing out on one edge of the frame. Cut an 84-inch square of the shrink film and press one of the factory-cut edges of the film onto the tape; secure the film in one corner first. Then, lifting it off the surface slightly, stretch it taut to the other corner, and press it into place. Repeat with an adjacent factory-cut edge after peeling off more backing paper. Do that two more times to fasten the film to the remaining two edges. Finally, using a hair dryer on its highest setting, shrink the film following the manufacturer's instructions.

Building the Ghost. The completed ghost mannequin used by the author in his prototype is shown in the photo at the beginning of this article. In that photo, the body of the figure is cov-

ered by a sheet to give a more phantom-like appearance. Now, let's look at what holds the ghost together under that covering.

Figure 6 is a photo of the ghost's frame. To assemble the figure's arms, simply use two leftover pieces of conduits. For the hands, attach a pair of rubber skeleton hands that are available from most party-supply stores near Halloween time. Mount both arms to a piece of wood that measures approximately 18 x 3 x 2 inches.

Attach the arm bar to a photographic light stand, camera tripod, or any kind of free-standing, tall, thin object. Then mount a plastic skull (also available from party-supply stores around Halloween) to the top of the assembly. If you are not using a light stand, you might have to make some kind of "neck" for the skull to rest upon.

To complete the ghost, cover the entire figure with a sheet. If you'd like, you can make a scythe out of cardboard, as shown in the photograph at the beginning.

Of course, the aforementioned technique for making a phantom guest greeter is not the only one you can use. There are many other possibilities for creating a ghost of your own design. You can make use of one of the many over-the-head masks available and a dressmaker's dummy, for example. Just be sure to avoid dark colors as they will be hard to light with sufficient intensity. The covering for your phantom (whether it's a sheet or other cloth) should only be white or off-white for best results.

Another option you might want to consider is to have a live person in costume who can move in an appropriate and spooky manner. Lacking a suitable volunteer for this time-consuming activity, try some simple mechanical animation instead. For example, the figure's beckoning hand could be manipulated like a marionette with a black thread run to a motor-driven crank. Similar techniques can be used to operate the skull's jaw or move other portions of the phantom.

Making the Recording. Depending upon the recording equipment you have available, there are many different ways to prepare the all-important tape that provides the appropriate sounds and controls the ghost's

appearance. The simplest way to do it is to use a stereo cassette recorder and a 15-second endless-tape cartridge of the kind sold for use in telephone answering machines.

For the control track you will need a line-level audio source. That can be an FM tuner, which is an excellent source of white noise if it is tuned off-station. Connect the output of the tuner to the right line input of the cassette recorder and connect a microphone to the left microphone input. Set the right level control to minimum and the left one to the appropriate level for your voice. Then, speaking in your ghostliest voice, record your greeting while you adjust the right channel recording level to make the control-track volume increase then decrease (that will make the ghost appear and disappear).

Around Halloween time many stores carry tapes containing all sorts of eerie sound effects such as howling wind, rattling chains, yowling cats, and other spooky sounds. If you can obtain such a recording, play an appropriate section while you are making the voice track.

Whatever technique or sounds you use, make your recording short—seven seconds is about right. After that time, turn both level controls to minimum and shut off the recorder. That will allow an eight-second window so that the timer, set to fifteen seconds, will not get out of sync with the tape (more on the timer in a moment).

If you prefer a different greeting each time the bell is rung, use a longer endless-loop tape and make as many variations as will fit on it. Many readers of this magazine will have more-sophisticated recording equipment and will be able to produce tapes in a more professional manner. For example, a line-level mixer can be used to put together a tape consisting of sound effects, music, and narration. That can be duplicated onto an endless cassette as many times as necessary. A reel-to-reel recorder can also be used for playback by splicing an appropriate length of tape end to end.

If you'd like to make your voice sound more haunting, try using some reverb, echo, or a voice-changing microphone. You can also try recording at one speed and playing back at another.

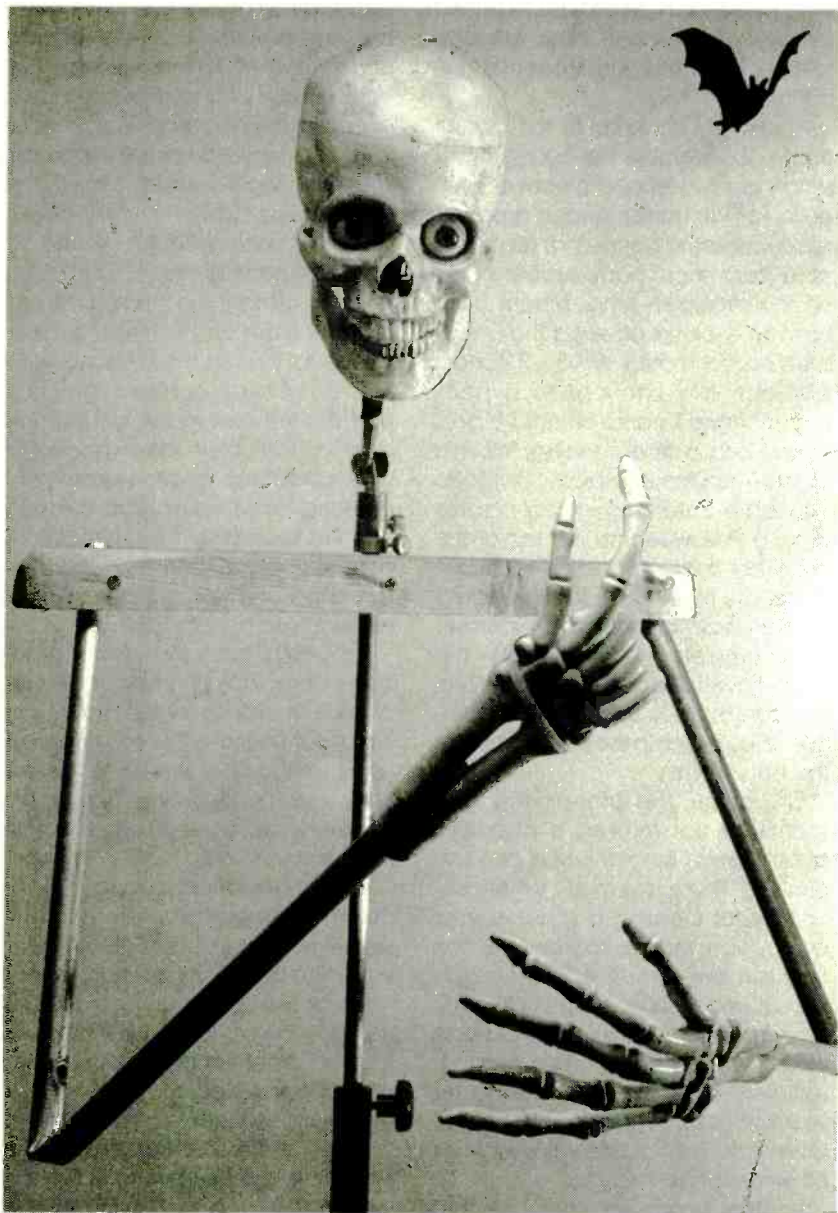


Fig. 6. Here's what the author's prototype ghost mannequin looks like without the sheet that covers it. You can imitate this design using a photographic-light stand, or come up with your own phantom assembly.

Setup and Adjustment. Now you're ready to rig all the Greeter components together and see the rewards of your efforts. Refer back to Fig. 1 for an overhead view of how the illusion is set up. Begin by opening the front door and fastening the reflector frame to the door jamb with duct tape. Set it to an approximate 45-degree angle as shown.

Place the mannequin facing the reflector, and back far enough so that it is not visible from the other side of the storm door. Make sure that easy access can be made to unlatch the

storm door so you can give some soothing treats to the trick-or-treaters who witness the phantom.

Arrange a spotlight so that only the figure is illuminated and no light spills onto the wall behind it. A black cloth hung behind the figure should accomplish that quite nicely. If that is not done, the wall or any furniture behind the figure will also be seen in the reflector. The room lighting should be either completely dark, or dim and shielded from spilling onto the mannequin.

Now for the electrical setup of the

parts: Using shielded audio cable (to prevent false triggering from stray electrical fields), connect the input (J1) of the timer circuit to the doorbell circuit so that when the bell is rung the timer triggers; you might only need to connect the center conductor. If you find that the timer is triggered even when the bell is not rung, try adding a 0.01- μ F capacitor between the center conductor and doorbell wiring. You'll know the timer is triggered if NE1 lights (if you added the fiberoptics as described earlier, that will be easy to determine).

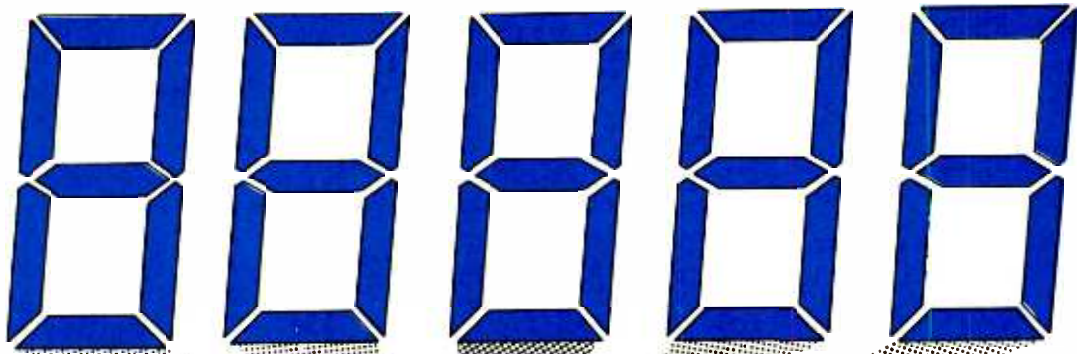
Using a stop watch, set the timer to exactly 15 seconds. Plug the recorder into a wall outlet, press play and allow the recording to finish and run for an additional four seconds. At that point, switch the plug on the recorder to the socket on the timer. Then plug the spotlight into the receptacle on the Greeter light controller. Adjust the potentiometer on the controller for the widest range of brightness, and set the right-channel volume control on the recorder for the highest level of brightness.

The Goblin Greeter is now ready to use under the normal operating conditions we've looked at so far. However, some readers might have to make a few minor modifications to use the Greeter in their homes.

One reason why you might have to modify the unit is if you live in a house or apartment without a storm door. You would then have to set up the Goblin Greeter in a window or, for a Halloween party, in an open doorway to a bedroom. Recall that we mentioned earlier how other triggers to the circuit, besides a doorbell, could be used. They would be necessary if you wanted to use the Greeter in a room indoors. A passive infrared proximity detector, a photocell, or even a mat switch can serve to trigger the unit whenever anyone approaches.

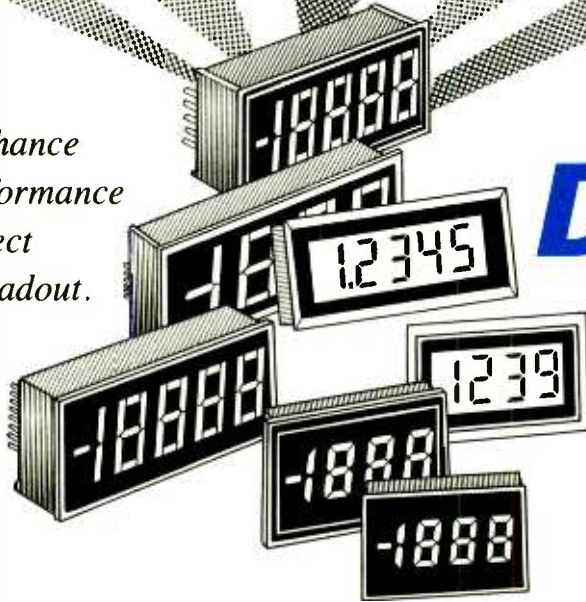
If you want the Greeter to work indoors at a party, the timer portion can be eliminated, and the unit can be controlled by a long tape. Try recording randomly spaced messages that serve to announce various party activities during the evening.

So, whether the Goblin Greeter welcomes trick-or-treaters or serves as a ghost host for your holiday activities, we're sure you'll find it can enhance your Halloween experiences. ■



*Here's how to enhance
the look and performance
of your next project
that requires a readout.*

BY BILL STILES



Using **DIGITAL PANEL METERS**

Several suppliers have recently started selling digital panel meters for a lot less than older DPMs—around ten dollars for 3½-digit meters and twenty dollars for 4½-digit meters. Now that these are available, what can you do with them? An application that might come to mind is to build a multi-range DC voltmeter; but even using a ten-dollar DPM, the total parts cost of such a unit would be about equal to the cost of one of the lower-priced digital multimeters on the market, and those also measure AC, resistance, and current.

So what is a good use for a DPM? One use is as a voltage or current meter for a power supply, battery charger, or other equipment, where better accuracy than an analog meter is desired. Another is as part of equipment that is either not readily available or expensive. We will discuss both ways of using DPMs.

DPM Specifications. In the "DPM Suppliers" box, you'll find a few sources

for DPMs that will work with the circuits described in this article (note that the stock numbers for each DPM are given at the end of each source listing). Just what kind of DPMs would those be? To avoid any confusion, let's give the specifications here of what we'll be working with. Because many of the DPMs available from the sources are similar, we'll look at one common one—a 3½-digit meter available from Marlin P. Jones and Associates (stock number 6929-ME):

The unit's character height is one-half inch. It has a maximum DC readout of 199.9-millivolts DC, with a three position, selectable decimal point. Polarity is automatic, and the input impedance is less than 100 megohms. The DPM will run on a 9- to 12-volt-DC isolated source, and has an accuracy of one-half percent.

Following the usual practice for digital-meter ranges, we will refer to the 199.9-millivolt maximum reading as 200 millivolts. When voltage divider resistors are used for higher ranges, a

1.999-volt range will be called 2-volts, a 19.99-volt range will be called 20-volts, etc.

Power for a DPM. One problem with most or all of the low-priced DPMs is that the 9- to 12-volt DC power supply must be "floating," which means it should be isolated from both input terminals of the DPM. Meters with their negative power supply terminal connected to the common voltage input terminal are available, but are three to five times as expensive (such as Jewell, Martel, and Modutec DPMs).

There are three ways for providing an isolated 9- to 12-volt power supply for DPMs. The simplest power supply is a nine-volt battery. Because the current drain of most DPMs is less than one milliamper, battery life will be long. However, using a battery requires an extra pole on the power switch, and occasional battery replacement.

The simple power source shown in Fig. 1 can be used when the DPM is

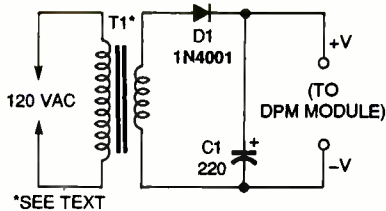


Fig. 1. This simple power source can be used with a DPM that's connected to an AC-powered device.

connected to an AC-powered device. Transformer T1 should be a 6.3-volt power type; the smallest current rating available will be more than adequate. If you can't find a low-current 6.3-volt transformer, use the center tap and one end of the secondary of a small 12.6-volt transformer.

For either AC-powered or battery-powered equipment, the DC-to-DC power supply shown in Fig. 2 can be used. (This circuit is modified from Fig. 6 of "Voltage Converters" by Ray Marston, which appeared in *Electronics Now*, April 1995.) Transformer T1 is a 600-ohm to 600-ohm unit, with one or both windings center-tapped (Hosfelt Electronics number 56-297, Jameco Electronics number 125356 or 105902, or Mouser Electronics number 42TL016 or 42TM016 should all work). Zener diode D2 prevents the output from going over 12 volts at higher input voltages. Because of the high internal impedance of the power supply, a series resistor is not needed before D2.

Values used for R1 and C2 vary, depending on the transformer used and the input voltage. The best values can be determined by building or breadboarding the circuit, using a capacitor substitution box for C2, and a resistor substitution box or a 100,000-ohm potentiometer for R1. (The DPM should be connected to the output.) Values are selected for a minimum output voltage of eight volts (about

the minimum DPM supply for accurate readout) at the lowest possible input voltage, with a reasonable input current. (Using a low value for R1 gives a high output voltage at a low input voltage, but a high input current.) Suitable values of R1 and C2 for use with three transformers are given in Table 1. Note that there are different values depending on the input voltages; both 12 to 14 volts (automotive) and nine volts (battery) are shown. An input current of 15 to 20 mA is assumed. The column for "minimum voltage" is the lowest input voltage for eight volts output. (The Jameco transformers were not tested, but their published specifications are identical to those of the Mouser transformers.)

The waveform produced by this circuit is not symmetrical, and reversing the secondary leads of T1 changes the output voltage. Both connections should be tried, and the one producing the higher voltage should be used. Also, for the 42TL016 and 42TM016 transformers, slightly higher output voltage is produced if the winding marked "P" is used as the secondary in this circuit. Transistor Q1 can be a general-purpose NPN unit. Several 2N3904, 2N4401, and MPSA06 units were tried, and all worked fine. If there is not a bypass or filter capacitor at the DC input source, a 47- μ F or 100- μ F electrolytic capacitor should

be connected in parallel with C1.

Power-Supply Readout. A DPM makes an excellent output meter for a power supply, battery charger, or other similar equipment. The circuit shown in Fig. 1 can be used to power the DPM, or the one in Fig. 2 if a constant 9 or 12 volts is available. A voltage divider (R1 and R2 in Fig. 3) is used at the input of the DPM to give the desired voltage range. Most DPM modules have locations on their circuit board for such voltage-divider resistors, which may be marked R_B and R_A on the board. If those resistors are located off the DPM board, a jumper must be installed, if not already present, at the R_B location on the board.

In the setup in Fig. 3, a ratio of 9 to 1 for R1 and R2 will provide a maximum reading of 2 volts, with 99 to 1 providing a maximum of 20 volts, and 999 to 1 yielding a maximum of 200 volts. Resistors R1 and R2 should be one-percent or closer tolerance. One-percent resistors are available from Digi-Key Corporation (P.O. Box 677, Thief River Falls, MN 56701-0677; Tel. 800-DIGI-KEY), Mouser Electronics (12 Emery Ave., Randolph, NJ 07869-1362; Tel. 800-346-MOUSER), or from many local distributors. (Many "industrial electronics" parts distributors stock one-percent resistors, and will sell them and other parts in small quantities to individuals.) One-half and one-tenth percent resistors are manufactured, but are very expensive and difficult to find in small quantities.

Because most 3-1/2 digit DPMs have a stated accuracy of one-half percent, using one percent resistors will degrade the accuracy slightly. One way to improve the accuracy is to purchase five or ten of each value resistor needed. Then measure each of the resistors, using a digital multimeter, and select the one nearest the center of the range of measurements.

It is usually necessary to connect two resistors in series for use as either R1 or R2 to obtain the exact ratio. For example, for a ratio of nine to one with an input resistance of about one megohm, R1 can be 909,000 ohms, and R2 101,000 ohms (100,000 in series with 1000). For a lower input resistance of 200,000 ohms, R1 can be 180,000 ohms and R2 can be 20,000 ohms, both stock values. If a DPM is being used to measure high voltages, note

PARTS LIST FOR THE AC POWER SUPPLY (Fig. 1)

D1—1N4001 silicon rectifier diode
 C1—220- μ F, 16-WVDC, electrolytic capacitor
 T1—120- to 6.3-volts AC power transformer (see text)
 Perforated board, wire, solder, hardware, etc.

TABLE 1

Transformer	Input Voltage	Minimum Voltage	R1	C2
Hosfelt Electronics 56-297	12 - 14	9	56K	0.01- μ F
	9	7	18K	0.047- μ F
Mouser Electronics 42TL016	12 - 14	9	27K	0.022- μ F
	9	6.5	12K	0.047- μ F
Mouser Electronics 42TM016	12 - 14	9	33K	0.022- μ F
	9	6.5	15K	0.047- μ F

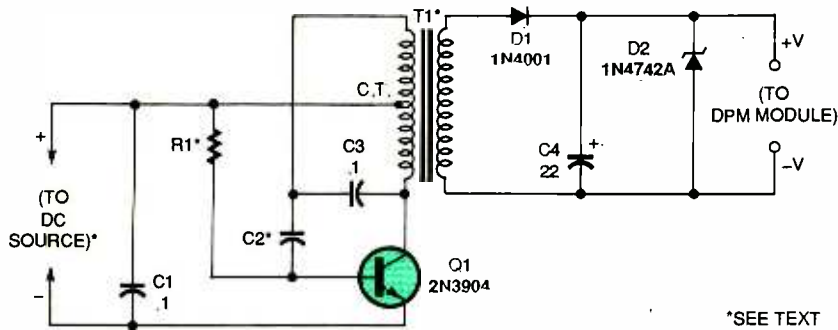


Fig. 2. This DC-to-DC power supply can be used with either AC- or battery-powered DPM modules.

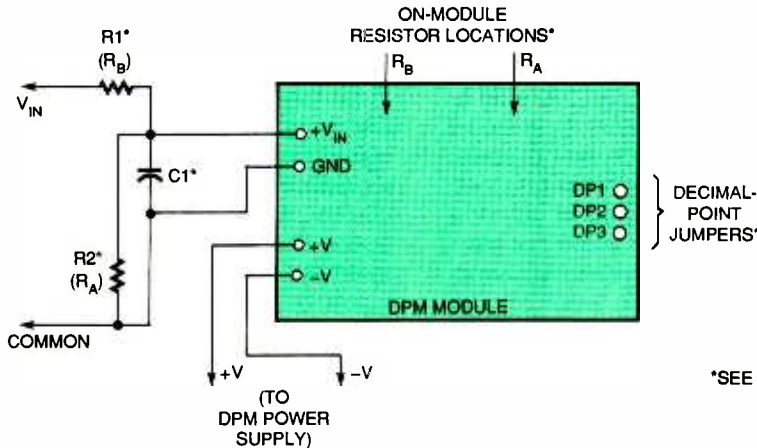


Fig. 3. A voltage divider (shown here as R1 and R2) can be used at the input of a DPM module to provide the desired voltage range. Most DPM modules have locations on their circuit board for such voltage-divider resistors, which may be marked R_B and R_A on the board.

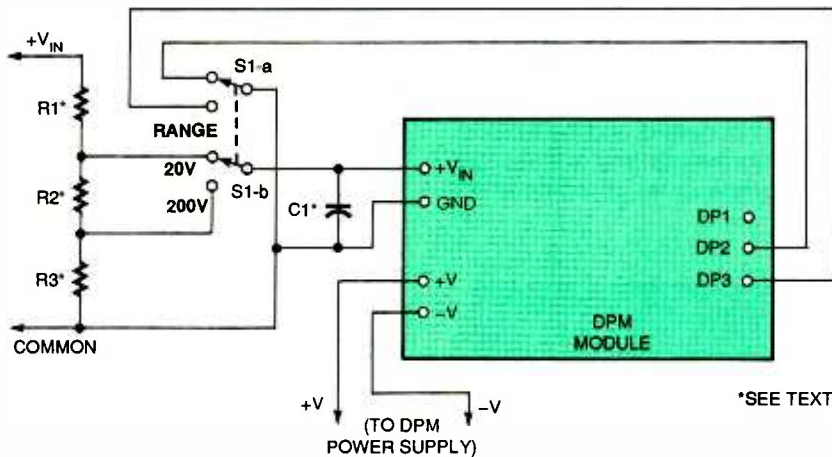


Fig. 4. If more DPM accuracy is needed at low voltages, use a range switch (shown here as S1). The second pole of the switch sets the decimal-point location.

that the maximum voltage with R1 on the DPM circuit board is usually 500 volts. Also, the maximum voltage rating (flash voltage) of 1/4-watt and 1/2-watt resistors is 150 to 250 volts, requiring R1 to be two or three resistors (of approximately equal value) in series for measuring 500 volts. Capacitor C1 is a ceramic-disc or Mylar unit, rang-

ing from 0.01 μ F to 0.1 μ F which bypasses any AC or noise on the input for more stable readings.

Most DPM modules have positions for three jumpers, grounding one of three terminals, which allow the user to select the display of the decimal point. The instruction sheet is often unclear as to which jumper position is

used for each decimal-point location. It might be easier to find the correct jumper location by experiment.

If a DPM output meter is being installed on a variable-voltage power supply with a maximum output over 20 volts, it would be necessary to use a 200-volt range. That would give a least-significant digit of 0.1 volt. If more accuracy is needed at low voltages, there are two solutions: First, use a 4 1/2-digit DPM. Second, use a range switch, which is shown as S1 in Fig. 4. In that circuit, suitable resistor values are 909,000 ohms for R1, 90,900 for R2, and 10,100 (10,000 in series with 100) for R3. The second pole of S1 is used to switch the decimal-point location. (Remember, you might need to experiment to find the correct decimal-point jumpers.)

A DPM can also be used as a DC ammeter (see Fig. 5). The value of shunt-resistor R1 is calculated with Ohm's Law. For a maximum reading of 2 amperes, R1 should be a 0.1-ohm, 1-watt, 1-percent resistor (obtainable from both Digi-Key and Mouser, listed as "silicone-coated wirewound"). For a 200-milliampere range, R1 is 1.0 ohm (available in the same type). For a 20-ampere range, R1 is 0.01 ohm; a wire shunt is probably the best way of getting that value. Components R2 and C1 bypass any AC or noise across R1.

Automobile Voltage Monitor.

Because a DPM's power supply must

PARTS LIST FOR THE DC-TO-DC SUPPLY (Fig. 2)

SEMICONDUCTORS

- Q1—2N3904 or 2N4401 general-purpose NPN transistor
- D1—1N4001 silicon rectifier diode
- D2—1N4742A 12-volt Zener diode

CAPACITORS

- C1, C3—0.1- μ F, Mylar or ceramic-disc
- C2—Mylar or ceramic-disc (see text and Table 1)
- C4—22- μ F, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

- R1—1/4- or 1/2-watt, 5% resistor (see text and Table 1)
 - T1—600- to 600-ohm, center-tapped transformer (see text)
- Perforated board, wire, solder, hardware, etc.

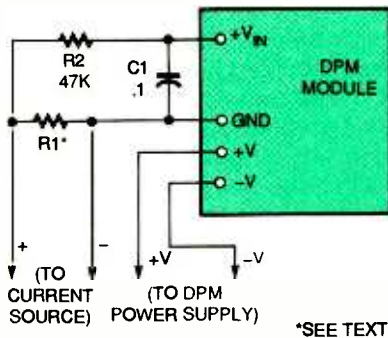


Fig. 5. As shown here, a DPM module can be used as a DC ammeter.

PARTS LIST FOR THE DC AMMETER (Fig. 5)

- R1—1-watt, 1% resistor (see text)
 - R2—47,000-ohm, ¼-watt, 5% resistor
 - C1—0.1-µF, ceramic-disc
- Perforated board, DPM module, wire, solder, hardware, etc.

be isolated from the voltage it's measuring, it becomes difficult to use it to measure a vehicle's battery; in other words, you'd need a separate power source. A 9-volt battery could be used, of course, but that would require a power switch, which isn't very practical if the DPM is installed as a permanent voltage monitor. Another possibility is to use a small 12-volt-coil relay to turn off the DPM battery when the ignition switch is off, but that would still require occasional battery replacement.

The DC-to-DC supply shown in Fig. 6 is a solution to providing power for an

automobile voltage monitor. Cost of the parts is about \$25. A 99-to-1 voltage divider is used at the input of the DPM. Resistors R2 and R3 can be any values with a 99-to-1 ratio. One suitable set of values is 1.0 megohm for R2 and 10,100 ohms for R3 (you'll have to use a 10,000-ohm resistor in series with a 100-ohm one; one million divided by 99 is actually 10101, but 10100 is close enough).

Capacitors C5 and C6 bypass electrical noise, which can cause unstable readings. For portable use in more than one car, an input cord with a lighter plug on one end and a coaxial DC power plug on the other (such as Radio Shack 270-1533, 270-1534, or 270-032) can be used. Jack J1 should be selected to match the DC power plug on the cord. Test leads attached to a plug that matches J1 will allow testing at any point in the car electrical system. If the monitor is permanently installed, the input can be wired directly to a point in the car that is switched on by the ignition switch.

If you are monitoring the voltage of a car's electrical system, what voltages are correct? Many references give a range of 13.8 to 14.8 volts, for a 12-volt system with the alternator charging. Manuals for several GM cars, however, give a range of 13.8 to 15.2 (a Chevrolet mechanic with 25 years experience told us that up to 15.5 volts will not cause any problems). Many voltage regulators are temperature compensated, and the reading will be near the high end of the range at low temperatures, dropping when

the regulator is warmer. There is also a voltage drop in the wires from the battery to the instrument panel. If a high load is turned on (such as the headlights or the heater/AC blower), the voltage at the lighter socket will be reduced slightly.

By adding a few parts to the portable version of the Automobile Voltage Monitor, it can do double duty as a multi-range DC voltmeter (see Fig. 7). The cost of the modification parts is low enough (\$12 to \$15) to make this a practical way of having an extra digital DC voltmeter. Components R9 and C6 bypass any AC or noise on the input.

The use of D3 was suggested by Charles Hansen in a "Letters" column of *Electronics Now* (October, 1995). He suggested a low-leakage Zener diode to protect the DPM in case R8 opens and a high voltage is measured. The author has been unable to locate any Zeners specified as low-leakage. However, many standard Zeners have low enough leakage to be used for D3. Glass-case diodes in ratings of 10 to 15 volts (1N4740 to

PARTS LIST FOR THE AUTOMOBILE VOLTAGE MONITOR (Fig. 6)

SEMICONDUCTORS

- Q1—2N3904 general-purpose NPN transistor
- D1—1N4001 silicon rectifier diode
- D2—1N4742A 12-volt Zener diode

RESISTORS

- R1—¼- or ½-watt, 5% (see text and Table 1)
- R2—1-megohm, ¼-watt, 1% (see text)
- R3—10,100-ohm, ¼-watt, 1% (see text)

CAPACITORS

- C1, C3, C6—0.1-µF, Mylar or ceramic-disc
- C2—Mylar or ceramic-disc (see text and Table 1)
- C4—22-µF, 16-WVDC, electrolytic
- C5—100-µF, 25-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

- T1—600- to 600-ohm, center-tapped transformer (see text)
 - J1—See text
- Perforated board, enclosure (RadioShack number 270-222 or similar), DPM module, input cord (see text), wire, solder, hardware, etc.

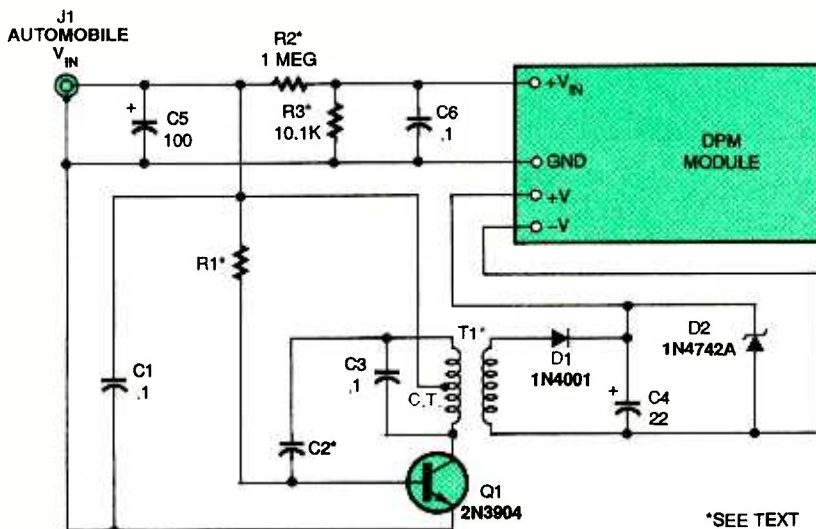


Fig. 6. This DC-to-DC supply solves the problem of providing power for an automobile voltage monitor.

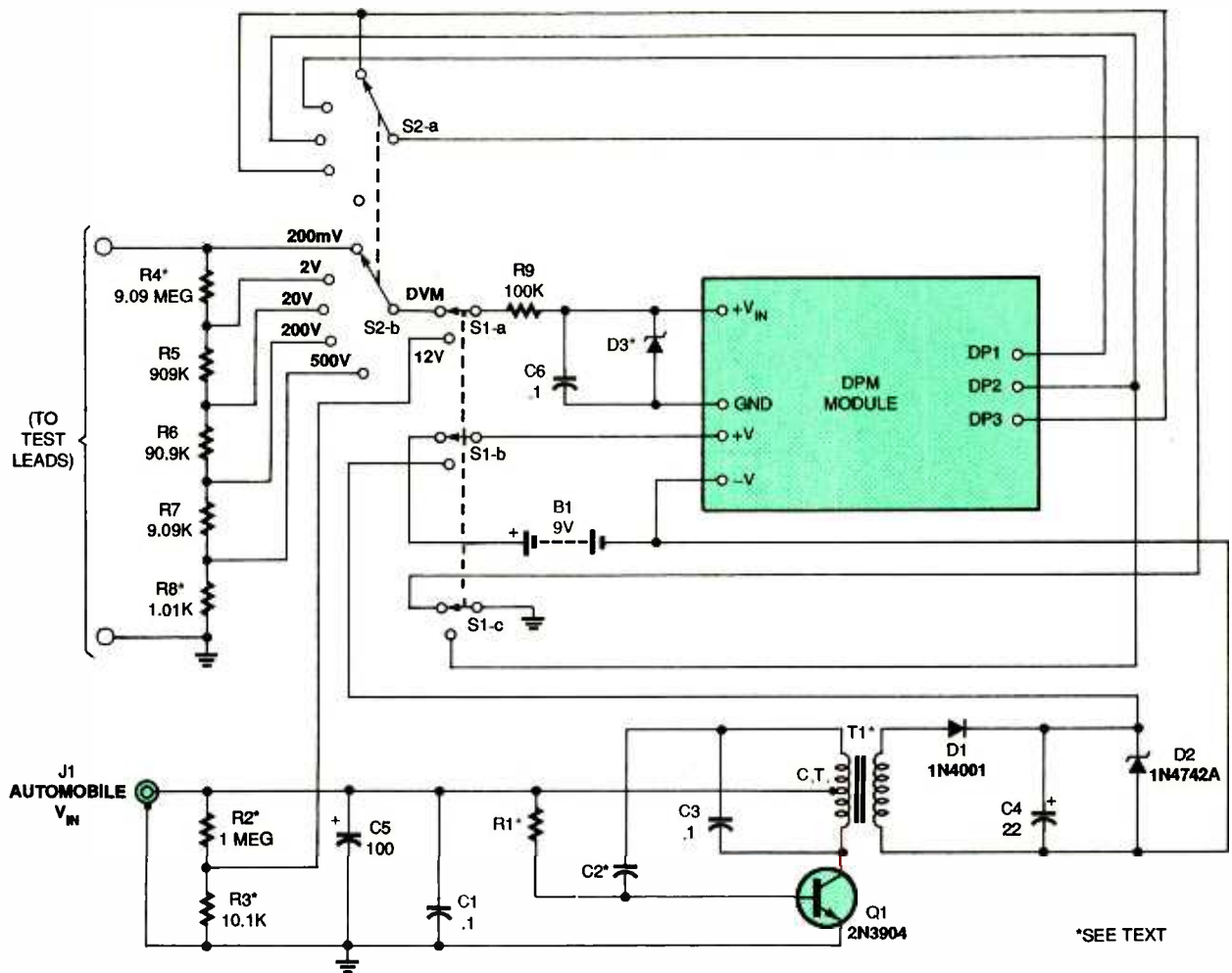


Fig. 7. By adding a few parts to the portable version of the Automobile Voltage Monitor (shown in Fig. 6), it can do double duty as a multi-range DC voltmeter.

1N4744) seem to be best, although a few of them have too much leakage. Several Zeners with black plastic cases all had too much leakage, as well. So what's the best way to select a Zener?

The circuit shown in Fig. 8 can be used to test Zener diodes for leakage. The input voltage is one to five volts. Potentiometer R1 can be a 5000-ohm to 50,000-ohm unit. Capacitor C1 bypasses stray AC pickup, but because of the very high circuit impedance the parts should be kept close together, and the negative input terminal connected to a ground to make the circuit more stable.

Use the circuit with a digital voltmeter that has an input resistance of 10 megohms or higher. Adjust R1 for a reading of about 250 millivolts. A low-leakage Zener will not change the reading when it is connected to or disconnected from the circuit. The diode should be tested with both polar-

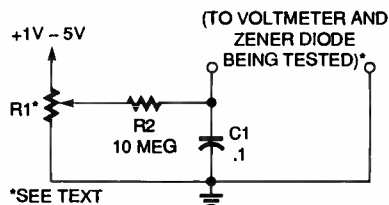


Fig. 8. This circuit can be used to test Zener diodes for leakage. Use it with a digital voltmeter that has an input resistance of 10 megohms or higher.

ities, as some will show leakage at only one polarity, and both are important to allow measurement of positive and negative voltages.

Refer back to Fig. 7. The polarity of D3 is not important; either polarity will protect the DPM. Switch S1 is a 3PDT miniature toggle unit (Circuit Specialists number 8405 or GC Electronics number 35-036). Also, 4PDT switches are available from Hosfelt Electronics, All Electronics, Circuit Specialists, and

GC. A two-position rotary switch could also be used, but it is larger and might require a larger enclosure. (On some DPMs, the common terminal for the decimal point jumpers is not connected to the common input terminal, so S1-c would go to the common terminal for the decimal-point jumpers instead of to ground.)

A 2-pole, 5-position rotary switch is used for S2. It should have a high insulation-voltage rating, because in the higher ranges nearly all the input voltage is across R4 and its terminals on S2. Voltage ratings for the insulation of rotary switches are seldom published, except for switches sold by Mouser Electronics. Their stock number 10WA125 (2-pole, 6-position with an adjustable stop) is rated as having a working voltage of 300VDC, and a breakdown voltage of 1000V RMS. Their lower-priced switches (10YX025 and 10YD025), which are similar in construction and terminal

PARTS LIST FOR THE DIGITAL DC VOLTMETER (Fig. 7)

SEMICONDUCTORS

- Q1—2N3904 general-purpose NPN transistor
 D1—1N4001 silicon rectifier diode
 D2—1N4742A 12-volt Zener diode
 D3—Zener diode (optional, see text)

RESISTORS

- (All resistors are 1/4-watt, 1% units, unless otherwise noted.)
 R1—1/4- or 1/2-watt, 5% (see text and Table 1)
 R2—1-megohm (see text)
 R3—10,100-ohm (see text)
 R4—9.09-megohm (see text)
 R5—909,000-ohm
 R6—90,900-ohm
 R7—9090-ohm
 R8—1010-ohm (1000-ohm in series with 10-ohm)
 R9—100,000-ohm, 1/4- or 1/2-watt, 5%

CAPACITORS

- C1, C3, C6—0.1- μ F, Mylar or ceramic-disc
 C2—Mylar or ceramic-disc (see text and Table 1)
 C4—22- μ F, 16-WVDC, electrolytic
 C5—100- μ F, 25-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

- T1—600- to 600-ohm, center-tapped transformer (see text)
 J1—See text
 S1—3PDT miniature toggle switch (see text)
 S2—2P5T rotary switch (see text)
 B1—9-volt alkaline battery
 Perforated board, enclosure (Radio Shack number 270-222 or similar), DPM Module, input cord (see text), binding posts (2), test leads, battery snap, wire, solder, hardware, etc.

spacing to switches from most other suppliers, are rated as having a breakdown voltage of 500VAC for 60 seconds.

For sufficient voltage rating, R4 (9.09 megohms) must be made up of smaller-value series-connected resistors. In the prototype, four 2.2-megohm, 1/2-watt, 5% units were used, in series with a one-megohm multi-turn trimmer potentiometer, such as a Bourns 3006P or Spectrol 43P. To calibrate R4, measure a voltage just under 200 millivolts, with S2 in the 200-mV position. Then set S2 to the 2-volt range, and adjust the trimmer potentiometer for the same reading.

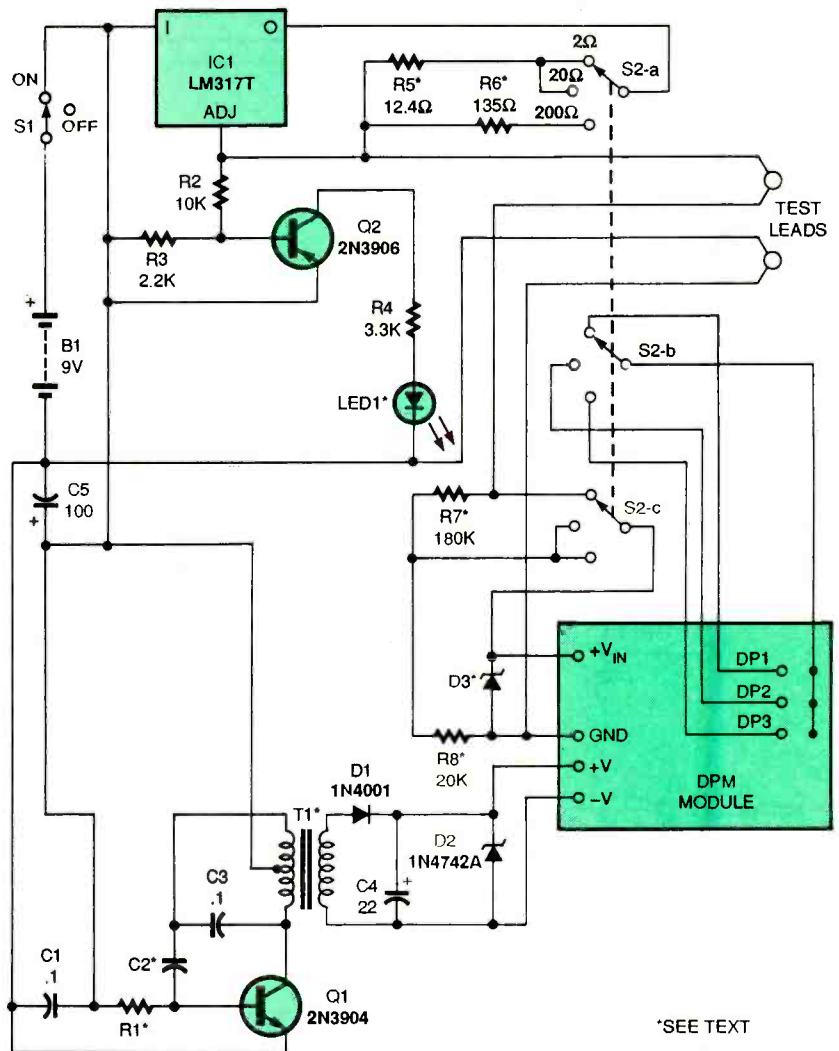


Fig. 9. This direct-reading self-contained Low-Ohms Meter uses the four-wire, constant-current method of resistance measurement. That eliminates any effect of test-lead resistance on measurements.

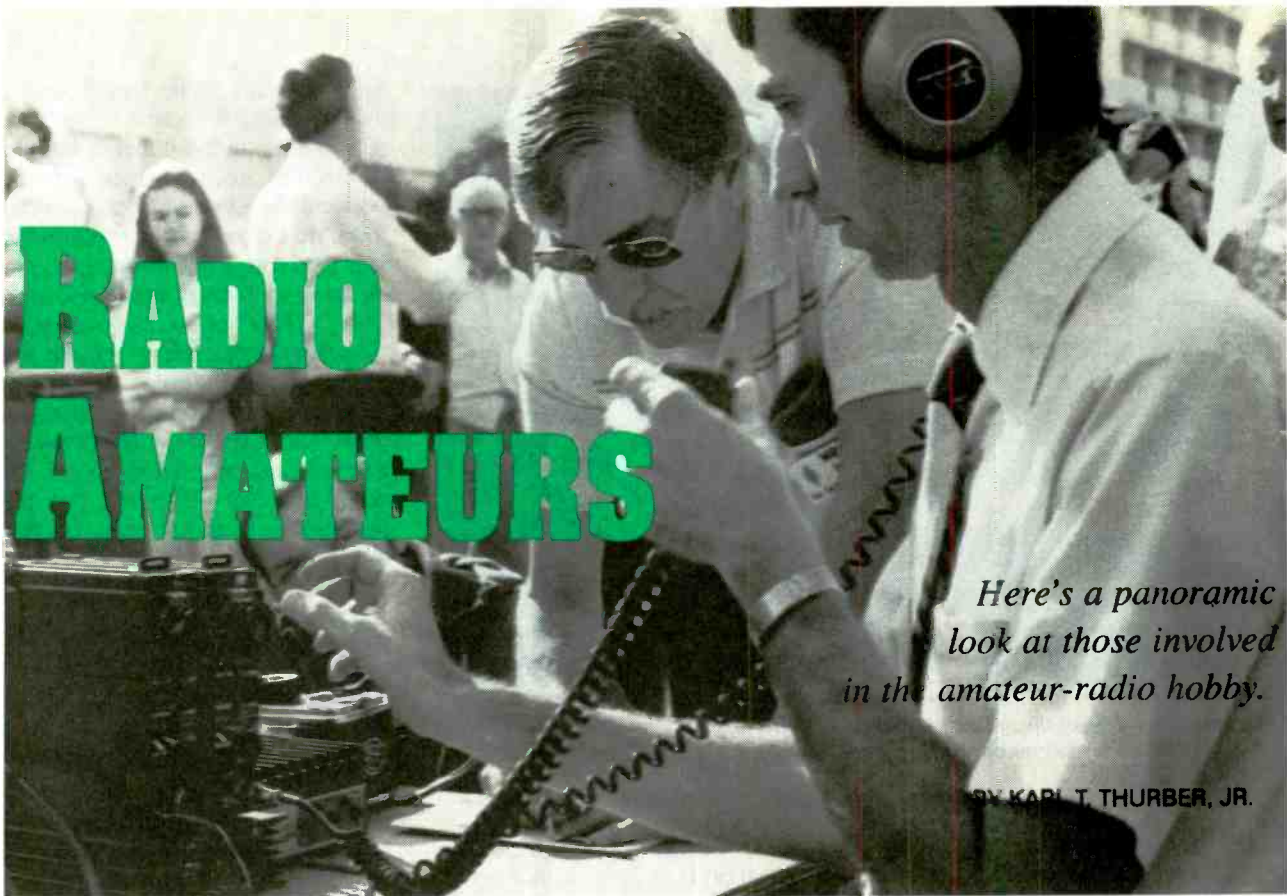
There is no significant change in the input resistance when switching ranges. For that reason, this meter makes a good readout for the author's Megohm Tester described in "Expanded Resistance Ranges for your DMM" (**Popular Electronics**, December 1995).

Low-Ohms Meter. The author's Low-Ohms Tester (also described in the "Expanded Resistance Ranges for your DMM" article) can be converted to a direct-reading self-contained Low-Ohms Meter by adding a DPM and the power supply of Fig. 2. The resulting configuration is shown in Fig. 9.

Using a 3 1/2-digit DPM will give a lowest reading of 1.0 milliohm, while a 4 1/2-digit DPM will provide a reading as low as 0.1 milliohm. The four-wire, constant-current method of resis-

tance measurement is used; each test lead is a two-conductor wire such as zip cord. The two-wire test leads eliminate any effect of test-lead resistance on the measurement. Contact resistance of the test clips must also be eliminated; the contact resistance of ordinary plated-steel alligator clips is too high. Also, their resistance, from the solder lug to the end of the clip, is about one milliohm. For a 4 1/2-digit DPM, the test clips should be Kelvin Clips (such as Mueller 75K, available from Hosfelt Electronics as stock number 52-75K). The jaws of these clips are insulated from each other, and you can connect one wire of a test lead to each jaw. Thus the voltage measured at the jaws of the clip connected to the meter will not include any voltage drop at the contact resis-

(Continued on page 79)



RADIO AMATEURS

Here's a panoramic look at those involved in the amateur-radio hobby.

BY KARL T. THURBER, JR.

Today, with about 650,000 licensed radio amateurs in the United States, amateurs or "hams" are better known than they were years ago. But the public knows little of what hams are all about—even though many well-known personalities are, or were, amateurs (see the "Well-Known Radio Amateurs" box). Fewer still know where the slang term "ham" comes from, are aware of the hobby's traditions and culture, know about some of the neat technologies in which hams are involved, or understand amateur radio's distinctive, even impenetrable lingo. Let's talk about these things, shall we?

Hams? Amateur radio is the practice of communicating using the electromagnetic spectrum. Radio amateurs operate personal two-way radio equipment from various locations, notably from their homes and automobiles. Hams are properly called radio amateurs, and the technically precise name for their hobby is the amateur-radio service.

Amateurs, who come from all walks of life, operate their two-way radio

stations from their homes, cars, boats, airplanes, and the outdoors. In doing so, they make friends around town and around the world. They communicate with each other for fun, in competitive on-the-air contests, and in real-life emergencies.

Having said all that, have you ever wondered why radio amateurs are known informally as "hams," besides the formal term "radio amateur"? Just where does the term come from? Are hams connoisseur pork tasters? Are they folks who live high off the hog, overacting actors and actresses, non-professional dabblers, hobbyist eccentrics, or what?

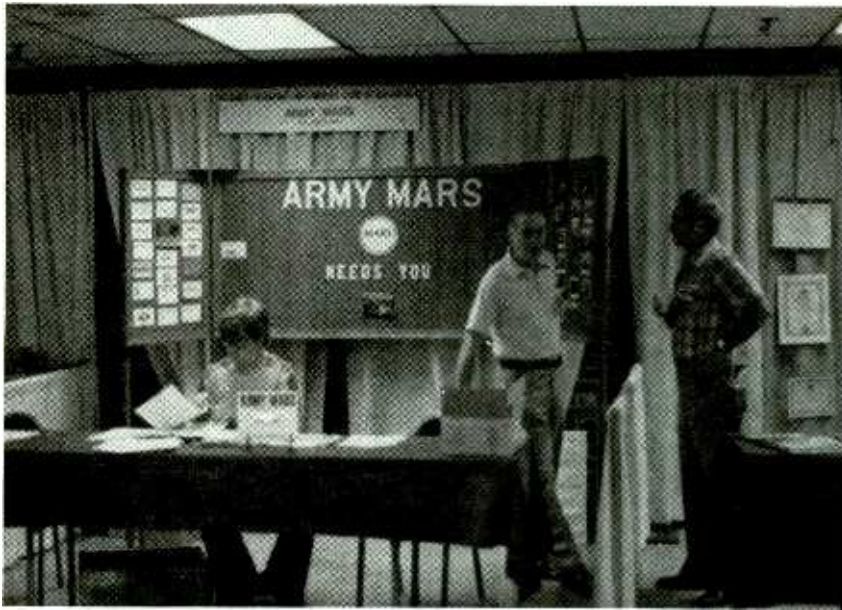
The designation of "ham" never has been satisfactorily explained; history is murky enough that we can't precisely trace the word's origin. But we can at least give some clue as to its historical usage in amateur radio by examining four possibilities for the origin of the term.

Possibility one is that the word "ham" or "HAM" was applied in 1908 as the callsign of one of the first amateur wireless stations, operated by the Harvard Radio Club. The operator-

members were Albert Hyman, Bob Almy, and Peggy Murray. They called their station "Hyman-Almy-Murray." Sending the name in code was tedious, so they contracted it to Hy-Al-Mu, or HYALMU, using the first two letters of each of their last names.

In 1909, confusion resulted between their callsign and signals from the Mexican ship, Myaimo. So they decided to use only the first letter of each name, identifying their station as HAM. That was fine, because in the unregulated, pioneering days of the wireless era, amateur-radio operators picked their own call letters and their operating wavelengths.

There's more to the story, reportedly found in the Congressional Record. The resulting interference between amateur and commercial stations generated heated disputes. The situation came to the attention of Congress, which considered legislation to limit amateur activity. In 1911, Albert Hyman (one of station HAM's operators) chose the controversial Wireless Regulations Bill as a topic of a thesis at Harvard. An instructor insisted that he send a copy of the thesis to Senator



Many amateurs enjoy handling message traffic. One of the major vehicles for supporting members of the military services is the Military Affiliate Radio System (MARS), which operates many networks that encompass separate Army, Navy, and Air Force organizations.

David Walsh, a member of the committee hearing the bill. Walsh was impressed with Hyman, and he asked him to appear before his committee.

Hyman described how station HAM was built, and he decried the fact that if the bill were passed, the operators would have to close down because they couldn't afford the license fees or meet other requirements of the bill. In the debate, station HAM became a rallying symbol of amateurs who hoped to be saved from the "menace" of the big commercial stations that didn't want meddlesome amateurs messing with the increasingly valuable spectrum. When the bill reached the floor of Congress, each speaker talked about "poor little amateur station, HAM." National publicity clearly identified station HAM with radio amateurs. Could that be the explanation?

Well, possibility two is also interesting. Dennis Burgoyne, KE8EY, in a December 1990 letter to the editor of *CompuServe Magazine*, suggested an acronym-based origin. It seems that a popular, early 1900's magazine, *Home Amateur Mechanic*, featured articles on do-it-yourself projects. In one issue, an article described the radio, a newfangled device you could build at home that might enable you to converse with other owners. The home-built radio came to be referred to as the "Home Amateur Mechanic"

Radio, or HAM for short, and people who built and used radios thus came to be known colloquially as HAM radio operators. Does that sound plausible?

Possibility three was suggested by Bill Johnston, WB5CBC. He wrote in November 1976 to *QST* and noted that in the 1800s, "ham" was slang used by railroad telegraphers to describe inexperienced telegraph operators. The definition of a ham as a poor operator probably first appeared in print in G. M. Dodge's classic book, *The Telegraph Instructor*, in 1898. The uncomplimentary term carried over to the spark era, when radio amateurs competed chaotically with a variety of commercial stations for given wavelengths.

Especially before Congress and the Dept. of Commerce (which regulated early radio law under the Radio Act of 1912) relegated hams to below 200 meters (1500 kHz)—wavelengths that then were considered practically worthless—amateurs were notorious for interfering with commercial signals and bringing on complaints about jamming. Radio amateurs, who perhaps were unfamiliar with the uncomplimentary meaning of the term "ham," happily picked it up and applied it to themselves. A reasonable explanation?

Finally, here's possibility four: Several catch-all possible origins are suggested by Steve Mansfield, N1MZA,

the American Radio Relay League (ARRL) Public Information Manager. In a 1993 letter to the editor of **Popular Electronics**, Steve advanced another possible explanation that considers "ham" to be just short for "Hiram," referring to the ARRL's revered founder, Hiram Percy Maxim, who is known as "The Old Man" of amateur radio.

Another explanation suggests that perhaps "ham" is just the shorthand "am," as in amateur. But Steve suggests that, in any case, we apply the science and philosophy rule of Occam's Razor, or parsimony. That rule says that you "do not apply multiple entities without necessity" to conundrums such as these. In other words, always select the simplest of competing explanations for unknown phenomena.

What do you think? While it's a little convoluted, the author leans toward possibility one, even if it doesn't quite meet the test of Occam's Razor. However, surely there are other convincing hypotheses that one might advance. But these hints as to the possible origin of the word are interesting and fascinating to recount.

Amateur Radio's International Basis. Although they're by definition hobbyists, radio amateurs aren't interlopers in the radio spectrum. Embodied in international agreements and the radio rules and regulations of our own government are definitions of the amateur-radio service as a fully authorized user of designated portions of the electromagnetic spectrum.

According to the radio regulations of the International Telecommunication Union (ITU), a United Nations agency headquartered in Switzerland, amateur radio is a bona fide "radiocommunication service." Its purpose is self-training, intercommunication, and technical investigation by persons interested in radio technique solely with a personal aim and without any pecuniary (monetary) interest.

Internationally, various frequency bands are allocated to the amateur-radio service; unlike broadcasting stations, no specific frequencies are assigned to them. This considerable flexibility makes it possible for radio amateurs to communicate with all areas of the world at different times of day and night. Amateurs worldwide

WELL-KNOWN RADIO AMATEURS AND THEIR CALLSIGNS

Amateur radio truly is a hobby that has something for almost everyone, and people of all ages, colors, religions, and economic status are bitten by the "ham radio bug." Radio amateurs include retirees, students, young people, mechanics, technicians, homemakers, doctors, engineers, pilots—just about anyone you can think of, in all walks of life.

Some famous people are radio amateurs, although most are just average people who enjoy making new friends around the world. Listed here, in alphabetical order, are some well-known personalities, past and present, who were, or are, active amateur-radio enthusiasts:

- Guitarist Chet Atkins, WA4CZD
- Astronaut Ken Cameron, KB5AWP
- Broadcast Newsman Walter Cronkite, KB2GSD
- Astronaut Owen Garriott, W5LFL
- Entertainer Arthur Godfrey, K4LIB
- Senator Barry Goldwater, K7UGA
- Air Force General Francis "Butch" Griswold, K0DWC
- Presidential offspring and former ARRL President Herbert Hoover, Jr., W6ZH
- King Hussein of Jordan, JY1
- Air Force General Curtis Le May, W6EZV
- CBS News President Bill Leonard, W2SKE
- Entertainer Ronnie Milsap, WB4KCG
- Husband-and-wife Astronaut team Steve Nagel, N5RAW, and Linda Godwin, N5RAX
- Broadcast Newsman Roy Neal (Hinkel), K6DUE
- Entertainer Donnie Osmond, ex-KA7EVD
- Entertainer Alvino Rey, W6UK
- Astronaut Dick Rutan, KB6LQS

can exchange messages by voice, Morse telegraphy, television, radio-teletype (RTTY), radio facsimile (FAX), satellite, and a bevy of sophisticated digital modes.

Closer to Home. In the United States, the Federal Communications Commission (FCC) regulates the amateur-radio service, and you need a license to operate (we'll deal with how to get a license later on). The service offers a unique opportunity for training, intercommunications, and technical investigation for qualified people interested in radio—once again, to those with a personal aim and without pecuniary interest. Amateurs may design, construct, modify, and repair their own equipment.

The FCC's amateur rules are found in Part 97, Title 47, of the Code of Federal Regulations, referred to simply as the "Part 97 regs." The FCC rules flesh out the details of just why there is an amateur-radio service—one without a strictly economic purpose. The rules emphasize the voluntary, non-commercial nature of the amateur-radio service; the amateur's ability to contribute to the advancement of the radio art in both the communication and the technical phases; the ability to enhance international goodwill; and the expansion of the reservoir of trained operators, technicians, and electronics experts available to the nation.

Some real responsibility is laid on amateurs. By the nature of their free use of the spectrum, radio amateurs generally are expected to serve the public in times of need, such as during natural disasters. In fact, the Part 97 regs state that a primary responsibility of the amateur service is to render public service communications to the general public. Importantly, radio amateurs, being licensed by the government, are expected to be a disciplined and self-regulating service.

Clearing Away Misconceptions. As we've said, the amateur-service rules stress personal aims and non-pecuniary interest. While that means that radio amateurs are hobbyists, they are licensed by their governments and

have to meet internationally agreed-on requirements. Radio amateurs aren't CBers; while both hobbies let their members communicate with other hobbyists, the similarity stops there. CBers (at least in the U.S.) do not have to meet any technical standards and don't have to be licensed personally or have their stations registered with the government.

There also are many misconceptions about hams. Such misconceptions may well discourage potential amateurs from obtaining a license and participating in the hobby. These include the misconceptions that you have to learn Morse code to get any kind of amateur license; you have to be an electronics expert to pass the written exams; ham radio equipment is overly complicated and prohibitively expensive; hams always interfere with their neighbors' radios and TV sets; and hams must keep voluminous records for FCC and various other types of government bureaucrats.

All those statements are misconceptions: they simply are false. You don't need to know Morse for the Technician license, you don't have to be an electronics whiz to pass the tests, ham equipment isn't all that complicated or expensive, few hams interfere with others' electronic equipment, and you don't even have to keep an on-the-air operating log of your contacts.



"Certificate chasers" or "wallpaper collectors" seek awards from a variety of organizations. One is the 10-10 International Net organization, which focuses on 10 meters. A 10-10 hamfest booth is shown here.

What Do Hams Do? Now that we know just what radio amateurs are, we're free to wonder if they really do more than just "talk on their radios." While most amateurs do, in fact, talk a good deal using their radio equipment, there also are many diverse (and fun) "cultural aspects" of amateur radio besides yakking into an open mike.

You'll find the multifaceted aspects of amateur radio include competitive contesting, certificate chasing (earning operating awards), "rag chewing" (engaging in ordinary conversation), experimenting and building equipment, chasing DX (amateurs in distant foreign countries), handling message

traffic, offering public-service communications in emergencies, socializing (with eyeball-to-eyeball contact), and much more. So, then, just what do hams do? Let's take a look at some 17 of those facets in detail. Among other things, radio amateurs:

1. Communicate and Operate: As we will see shortly, there are many things that radio amateurs do. But the most basic activity that almost all hams participate in is ordinary, two-way, on-the-air operating—which isn't broadcasting to the public, but communicating with other radio amateurs.

Most hams like to communicate, to "work" other stations, often exchanging

contact verification cards (QSLs) as the final step in documenting their QSOs or contacts. Consequently, simply getting on the air and communicating with other amateurs by voice, Morse code, and computers is the basic goal of most people who study to obtain an amateur-radio license.

2. Offer Public and Community Service: The concept of service to the public is one of the justifications for amateur radio's existence in a spectrum that's increasingly crowded and valuable. The public has come to expect amateur-radio operators to fill in when the communications chips go down, or when private and governmental communications are overwhelmed, as they often are during natural disasters and other devastating emergencies. The government and the public alike consider amateur-radio operators to be valuable community resources.

Amateurs were early supporters of Civil Defense (CD). CD burst onto the scene around 1950, once the public realized that the Russians had "the bomb." By 1952 amateurs by the thousands had volunteered their stations to emergency communications under the FCC-sanctioned Radio Amateur Civil Emergency Service (RACES). RACES still exists as a special type of volunteer amateur-radio operation. Today it's sponsored by FEMA, the Federal Emergency Management Agency, and it focuses on civil preparedness for local, regional, and national civil emergencies.

Public-service communications take many forms today. Hams often provide communications for accidents and hazards, brush and forest fires, earthquakes and volcanic eruptions, floods, hurricanes, weather spotting and alerts, tornado warnings, winter storm alerts, and more. Amateurs also participate in public-service events such as parades, sports events, festivals, fairs, exhibits, and special local events. Such "non-threatening events" help amateurs build communications skills that may be put to good use when disaster really strikes a blow.

3. Handle Message Traffic: Closely related to emergency communications is another aspect of public service. It's message or traffic handling—developing expertise in han-

VOLUNTEER EXAMINER COORDINATORS

There are 16 volunteer examiner coordinator (VEC) groups authorized by the Federal Communications Commission (FCC), although some of these groups are small and offer only infrequent examination opportunities. The two main VEC groups operating nationally are the

American Radio Relay League and VEC

225 Main Street
Newington, CT 06111
Tel. 860-594-0300

Anchorage Amateur Radio Club

2628 Turnagain Parkway
Anchorage, AK 99517
Tel. 907-786-8121 (D),
907-243-2221 (N),
907-276-5121, or
907-274-5546

Central Alabama VEC, Inc.

1215 Dale Dr. S.E.
Huntsville, AL 35801
Tel. 205-536-3904

Golden Empire Amateur Radio Society

P.O. Box 508
Chico, CA 95927

Greater Los Angeles Amateur Radio Group

9737 Noble Ave.
Sepulveda, CA 91343
Tel. 818-992-2068 or
805-822-1473

Jefferson Amateur Radio Club

P.O. Box 24368
New Orleans, LA 70184-4368
Tel. 504-737-2315

Koolau Amateur Radio Club

45-529 Nakuluai St.
Kaneohe, HI 96744
Tel. 808-235-4132

Laurel Amateur Radio Club, Inc.

P.O. Box 3039
Laurel, MD 20709-0039
Tel. 301-572-5124 (D),
301-317-7819 (N), or 301-588-3924

ARRL/VEC and the W5YI-VEC, included in the listing, below. Note the multiple day (D) and night (N) telephone numbers listed for some VECs; many of them are individual volunteer members' home telephone numbers.

The Milwaukee Radio Amateurs Club, Inc.

P.O. Box 25707
Milwaukee, WI 53225
Tel. 414-466-4267

Mountain Amateur Radio Club

P.O. Box 10
Burlington, WV 26710
Tel. 304-289-3576 or
301-724-0674

PHD Amateur Radio Association, Inc.

P.O. Box 11
Liberty, MO 64068-0011
Tel. 816-781-7313

Sandarc-VEC

P.O. Box 2446
La Mesa, CA 91943-2446
Tel. 619-465-3926

Sunnyvale VEC Amateur Radio Club

P.O. Box 60307
Sunnyvale, CA 94088-0307
Tel. 408-255-9000

Triad Emergency Amateur Radio Club

3504 Stonehurst Pl.
High Point, NC 27265
Tel. 910-841-7576

Western Carolinas Amateur Radio Society VEC

5833 Clinton Hwy.
Suite 203
Knoxville, TN 37912-2500
Tel. 615-688-7771

W5YI-VEC

P.O. Box 565101
Dallas, TX 75356-5101
Tel. 817-461-6443

dling routine messages. While on the surface "third party" traffic handling for others may not seem glamorous or important, it's good experience for handling serious, life-and-death messages during disasters and other emergencies.

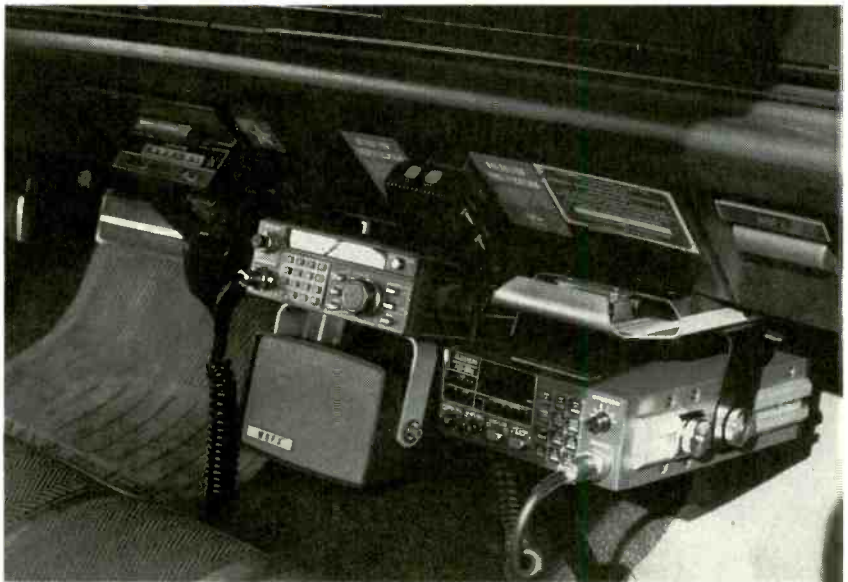
While real-time digital communications, especially packet radio and AMTOR (AMateur Teleprinting Over Radio), have changed somewhat the nature of traffic handling, much message traffic still is passed using traditional modes, Morse code, and voice. Most amateur messages are handled through formally organized traffic networks, such as the ARRL's National Traffic System (NTS), which consists of over 500 amateur nets.

Messages are handled by net members checking in to place messages into the system, or to take out messages for delivery in one's local area. Such messages directed to members of the general public usually are delivered by telephone.

4. Chew the Rag: It's no sin for you to be a rag chewer—to talk at length about the ordinary things non-amateurs talk about, such as the weather, sports, politics, and other "in good taste" topics. While extended rag chewing is considered by some amateurs to be "yakking" that wastes valuable spectrum space, "chewing the rag" is a valid technique in the use of amateur radio in the hobbyist sense: It encourages friendly QSOs of more substance than today's all-too-frequent "hello-good-bye" type of contact.

Rag chewing is such a sufficiently valid purpose that the ARRL even offers an operating award, the Rag Chewers' Club (RCC). Because of its ease of attainment, it's often the first operating award new operators seek. To obtain the RCC award, all you have to do is rag chew on-the-air for at least a half-hour, and request the award from the ARRL (you don't have to be a member).

5. Work DX: Working DX, contacting other amateurs in distant (or rarely contacted) foreign countries, is one of the oldest ham pursuits. Even in these days of easy worldwide Internet, satellite, and telephone communications, there still is something magical and thrilling about communicating with stations halfway around the earth, using your own radio equip-



If you find it difficult or impossible to operate ham gear effectively from a crowded apartment or condo location, you may want to seriously consider equipping a vehicle with a radio setup.



Hamfests and radio flea markets are popular amateur activities. The core activity of many hamfests is their flea market or swap meet area where amateurs buy, sell, and swap old and new equipment and parts.

ment, and exchanging QSL cards with those stations. Most hams agree that DXing, especially on the long-haul HF bands, is one of the most satisfying and rewarding aspects of amateur radio—and it's also one of the most avidly pursued aspects of the hobby.

If you want to successfully work DX on HF, precision techniques are involved, especially when running QRP (low power) with simple antennas and no-frills, basic equipment. There's also a premium on good DX etiquette that should always be exercised in pursuing DX QSOs, so as not to cause other operators undue frustration and inter-

ference—often very tricky and difficult when a truly "rare one" suddenly emerges on a crowded ham band.

Many DXers get the ultimate thrill out of becoming DX themselves: participating in a "DXpedition" to some remote, rarely worked, highly desirable location. Actually being the much-sought-after foreign DX strikes the fancy of many, although planning and preparing DXpeditions is difficult, time-consuming, and expensive. Too, many of the "choice" (read "remote and rare") locations are dangerous to visit and operate from, either due to physical conditions (rocky reefs,



Communicating through amateur-radio satellites, which are akin to orbiting signal repeaters, is one of the "hot" areas in amateur radio, one that holds much promise for the future. Here amateurs at a hamfest demonstrate operating techniques and procedures.

storms, lack of water, etc.) or unstable political realities (banditry, insurrection, and the like). But, as many DX hounds will tell you, these obstacles are just part of the challenge of being a true DXer.

6. Seek Operating Awards: The pursuit of amateur operating awards is a major part of what many hams do. To them, just working or communicating with certain stations or classes of stations isn't sufficiently satisfying. They're motivated to document their operating skills in various categories by seeking paper awards, trophies, and plaques.

If you're a "certificate chaser" or "wallpaper collector," you seek a variety of awards from American, foreign, and international organizations, clubs, and publishers. Probably the most sought-after award in amateur radio is that of the ARRL's DX Century Club (DXCC), essentially for documented communication with radio amateurs in at least 100 different countries. Many special classifications, variants, and "endorsements" are available for this highly coveted and respected DX award.

There also are awards for such diverse activities as code proficiency, working all states (WAS) and continents (WAC), VHF/UHF operating (VHF/UHF Century Club, or VUCC), working all radio zones (WAZ) and call-sign prefixes (WPX), and many spe-

cialized awards, issued by the ARRL and other organizations. These awards cover an amazing variety of feats and accomplishments, such as contacting a given number of U.S. counties, Swiss cantons, Russian oblasts, or members of the award's sponsoring organization.

7. Compete in Contests: Many radio amateurs are very competitive individuals who simply like to win at whatever they do, hobbies included; they're referred to as contesters. An amateur radio contest is a competitive operating event—much like a sporting event—held between rivals over a predetermined operating period. For a hobby, however, the main goal of contests is (or at least should be) that the participants enjoy themselves, and at the same time help to advance the radio art and increase their expertise.

There are countless contest classifications. You'll find domestic contests, in which the objective is to work as many stations as possible, such as the ARRL's Sweepstakes (SS); VHF/UHF contests, focusing on the bands above 50 MHz, such as the ARRL's VHF QSO Parties and the CQ Magazine VHF WPX Contest; beginner-oriented contests, such as the ARRL's Novice Roundup; and numerous specialized or localized competitions, most of which require you to work members of a particular group.

8. Tinker and Experiment: Once you overcome the hurdle of obtaining your amateur-radio license, you can elect to be an "appliance operator" if you so choose. Although historically radio amateurs have been known for their technical skills, often building at least some of their equipment, there's nothing that says that you must do so—the choice is yours. But many amateurs, even those who don't have any special electronics skills, enjoy tinkering and experimenting with their antennas, equipment, and ham-shack accessories—anything but leaving well enough alone.

With today's technologically sophisticated radio equipment, it may no longer be practical for you to build major pieces of gear, such as a receiver, transmitter, or transceiver. But you can build smaller items (such as accessories of various kinds). Most major amateur journals are chock full of realistic construction projects, many of them geared to the electronics beginner using simple tools.

9. Operate Using Low Power (QRP): Why operate QRP that is, use low power, especially if you don't have to do so? Isn't it something like competing in the prize ring with one hand tied behind your back? Possibly so, but many hams enjoy the added challenge. Some of the advantages "flea-power" operators find, in addition to the basic challenge factor, include minimum expense, small equipment size and weight, easier emergency and portable operation, practical long-term battery life, and—not the least—a significant scoring advantage in many radio contests.

On the flip side, you may find that commercial QRP equipment selection is limited, and available equipment often is not only low in power but also is primitive in terms of features. Too, voice communications are more difficult using QRP, meaning that CW (Morse code) and some digital modes are the more practical modes.

QRPers are a hardy band, and to cater to them there's a special interest group, the QRP Amateur Radio Club International, Inc. (QRP ARC), whose motto is "power is no substitute for skill." The club, founded in 1961, has as its purpose the joining together of those amateurs who enjoy running low power. The organization encour-

ages QRP by means of various awards programs, activities, and contests. The QRP ARCI also publishes The QRP Quarterly newsletter and holds regular on-the-air QSO parties.

10. Enjoy their Hamshacks: All amateurs, regardless of how elaborate their radio stations may be, have their gear located in their "radio hamshack." Early shipboard installations and shore stations tended to be located in isolated radio rooms or buildings, and for good reason. That was because the noisy spark transmitters produced an ear-shattering crash every time the key was depressed, disturbing all within earshot.

If the early spark-rig amateur wasn't banished to a distant outbuilding, cabin, or detached structure, he was at least relegated to space behind the basement furnace or to an attic enclave where he wouldn't disturb the family. Today, however, you'll find modern, silently efficient amateur stations housed in almost every conceivable spot in the home. But, even if that spot is the most luxurious and comfortable part of your home, it's still called the hamshack—and that holds true even if the spot is really in your boat, airplane, or automobile.

11. Talk a Funny Language: Just about every profession (and most hobbies) has its own distinctive and sometimes impenetrable jargon. Amateur radio is no exception: There's no end to "hamspeak" buzzwords. Most of those have their origin in the need to create a shorthand to simplify Morse transmissions, one that could have the same meaning regardless of operators' languages. The genesis and usage of this vernacular is interesting, so let's unscramble some of the lingo.

The popular general call or attention signal made by amateurs, CQ, originated with 19th century telegraph systems. It originally meant that all telegraph offices should be ready to receive a message. Today, CQ means that you're inviting anyone who hears you to reply to your call.

The term 73 "ties the ribbons on" or ends a contact, or QSO. It still is a popular, all-purpose amateur salutation, in particular meaning best regards or good-bye. A 73-like feminine variation is 88. The term means "love and kisses" and is used between amateurs of the opposite sex.

Prosigns are special telegraphic expression and procedure symbols, such as SK (end of transmission) and K (go ahead) that have been word-saving shortcuts at least since the earliest days of wireless. The voice-equivalent prowords clear, break, over, affirmative, negative, and roger are self-explanatory. However, contrary to popular belief and classic war movie usage, "roger" simply means "I have received your last transmission correctly," but doesn't mean "yes" or "affirmative."

The Q-Code is a three-letter series of shortcut codes that has been in use at least since 1912. The Q-code was designed to overcome language barriers by ship operators as they communicated among themselves and with shore stations. Most of the original codes still are in use today. Some of the more popular Q-codes favored by hams include QTH (location), QRM (interference), QSL (acknowledgment of receipt), QSO (contact), and QST (calling all radio amateurs).

12. Socialize at Hamfests and Swap Meets: A hamfest is a grand meeting of radio amateurs, ranging from small get-togethers to major radio conventions. But the term covers a lot of ground. Some are small, attracting only a few hundred visitors. Others attract tens of thousands of attendees, such as the Dayton Hamvention, which really is a hamfest event that's in a class all by itself. The largest U.S. amateur radio convention by far is a

three-day affair held in the spring, one that draws some 30,000 attendees each year.

You'll find that hamfests indeed are popular eyeball-to-eyeball activities. The main activity at most is the radio flea market or swap meet area where people buy, sell, and swap radio equipment, parts, and components. They also include a variety of educational activities with beginner sessions, technical seminars, and operating presentations being featured.

Best of all, many hamfests feature supervised on-site amateur radio examinations. Volunteer Examiners (VEs)—amateurs who volunteer their services as test-givers—are certified by the Federal Communications Commission (FCC) to administer all classes of amateur radio licensing exams (more on testing later).

13. Act as "Elmers": Beginning radio amateurs always have looked to more experienced operators, or "Elmers" (as we call them today), to provide guidance and help. In the early days of amateur radio, most grizzled "old timers" gladly accepted that responsibility, helping youngsters eager to get their licenses by setting good examples of proper operating practice and providing Morse-code and technical assistance. The beginner usually was able to get help with a low-budget project when it was needed.

In those days, if you were an amateur or prospective amateur, you experienced a special bonding and

Greetings From One of the CQ Gang!



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CONFIRMING 2-WAY QSO

PSE QSL TNX

CALL	DATE			UTC	BAND	MODE	RST	RIG, PWR., ANT.
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A W4MPY QSL

For many radio amateurs, exchanging a QSL (verification) card is the final courtesy of a two-way contact. Shown here is the author's personal QSL card,

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were treated fraternally. Unfortunately, as the hobby has grown much larger and become "more professional" over the years, at least some of this camaraderie has evaporated. But there still are Elmers out there to help you get started; you just have to look harder to find them at radio clubs, at hamfests, and on the air. You can continue the tradition: If someone mentors you as an Elmer, when you become experienced, you should become an Elmer for others.

14. Radio Direction-Find: A rather

specialized amateur radiosport for VHF and UHF operators is radio direction finding, or RDFing (sometimes known as hidden-transmitter hunting, fox hunting, or bunny hunting). In RDFing, someone hides a radio transmitter in an inconspicuous place and the radiosport participants each try to be the first to find the hidden transmitter. Such contests can be very competitive and popular group events at radio club outings and at hamfests.

You'll find RDFing to be both an art and a science. There's a serious side to RDFing that relates to improving your skill at finding transmitters that are engaged in illegal practices, such as jamming repeaters or unlicensed intruders (often using stolen transceivers) on the ham bands.

15. Communicate via Satellites:

So far, we've mostly covered activities hams traditionally have enjoyed. Now, it's time to look to the future. Communicating through amateur-radio satellites, which are akin to orbiting signal repeaters, is one of the current "hot," growing high-tech areas in amateur radio.

Since 1961, when the first Orbiting Satellite Carrying Amateur Radio (OSCAR) was launched, amateurs have communicated via satellite over thousands of miles using very high frequencies (VHF) and ultra high frequencies (UHF), wavelengths traditionally used for short distances. Today you can make international QSOs via satellites, using relatively simple equipment.

A new era in long-distance amateur communications dawned in 1983, when the first Phase 3 satellite, OSCAR 10, was launched. But today there is only one major amateur-radio satellite, OSCAR 13, that's capable of providing consistently reliable intercontinental amateur communications. Unfortunately, it soon will plunge into the atmosphere and be destroyed.

The under-construction Phase 3D satellite, a replacement for OSCAR 13, is the largest and most advanced amateur satellite ever built. It's aimed squarely at reducing the cost and complexity of satellite-capable amateur stations, plus adding new frequency and data choices. The launch of Phase 3D is to be aboard the European Space Agency's (ESA's) Ariane 5 vehicle from the ESA complex in

French Guiana, set for September 1996. More information is available from the Radio Amateur Satellite Corporation (AMSAT).

16. Communicate Digitally: Amateur radio is more exciting than ever, due mostly to the effects of digital-based operating modes. Today's hamshack typically is equipped with a PC and takes advantage of several state-of-the-art communications techniques.

Indeed, a host of digital-based technologies has caused amateur-radio hamshacks to change tremendously, and the pace is accelerating. We're now halfway through the decade in which digitized, computerized amateur-radio communications takes off and positions the hobby to thrive and grow in the next century.

Packet radio took amateur radio by storm in the 1980s. It's a high-speed, frequency-space efficient mode that lets you digitally send, receive, store, and forward messages. It's similar to RTTY, but packet data is sent at a much higher speed, and in a "connected" (telephone-like), nearly interference-free, error-checking, and networked fashion, especially on VHF/UHF.

But digital radio is more than just packet. Several related ARQ (automatic repeat request) modes are popular on HF where packet reliability leaves something to be desired. AMATEUR Teleprinting Over Radio (AMTOR) is an error-checking mode that minimizes interference (QRM), fading (QSB), and static (QRN).

The German-developed Packet Teleprinting Over Radio fills a void in digital communications; PACTOR has been likened to an enhanced AMTOR that combines the best features of AMTOR with HF packet radio. And then there's the highly efficient CLOVER mode, named after its clover-like wave pattern; popularized by HAL Communications, it's becoming a popular mode on HF. Ditto for G-TOR, a high-throughput HF system developed by Kantronics.

Today, the heart of many digitally equipped hamshacks has evolved from the relatively simple TNC (terminal node controller) required by packet to a new-generation multi-mode data controller that lets you use up to a dozen or so digital modes of

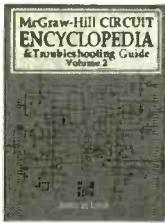
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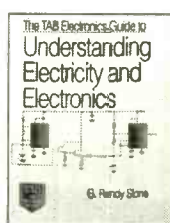
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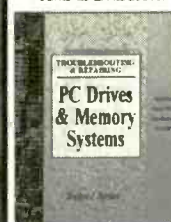
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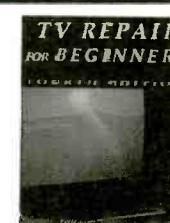
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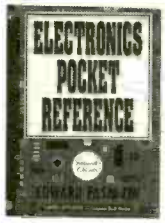
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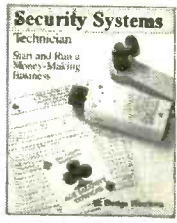
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BUILD A DELAYED SWEEP ADAPTER



Add more versatility to your oscilloscope with this simple and inexpensive plug-in adapter.

BY SKIP CAMPISI

If you're like a lot of other hobbyists out there, chances are you have a limited budget for test equipment. Therefore, if you recently bought an oscilloscope you probably couldn't justify that extra two- or three-hundred dollars for a unit with built-in delayed sweep. But how often since that purchase have you needed to look at the leading edge of a narrow, low duty-cycle pulse, at high sweep rates? Or perhaps you have needed to expand a waveform to look for a "suspected" oscillation, but just couldn't stabilize the trace.

Thanks to the current trend in oscilloscope designs, most scopes are now equipped with a channel-1 output jack, which provides a "sample" of the channel-1 input waveform. The jack is normally a BNC connector located on the rear scope panel, and is designed to drive a standard 50-ohm cable. Because the input signal is attenuated via the scope controls, no other attenuators are necessary for external instruments. That makes designing add-on instruments much simpler.

One such add-on, which will solve the problems just presented, is the *Delayed Sweep Adapter* described in this article. It is essentially a monostable multivibrator that is triggered via the "sample" at the channel-1 output. The Adapter output is then fed to your

oscilloscope's trigger input jack in the external trigger mode.

With the delay set on the Adapter for slightly less than the waveform's time period, the sweep will trigger before the next cycle, thus allowing you to see the leading edge of a pulse waveform. The leading edge area may then be expanded by increasing the scope's sweep speed, while adjusting the delay on the Adapter to maintain the position of the trace. Of course, any part of any waveform can be viewed and expanded in a similar fashion.

Built as described, the Delayed Sweep Adapter will perform as well as if you had spent two- to three-hundred extra on your scope. However, it will only cost you twenty to thirty dollars to build!

Circuit Description. The schematic for the Delayed Sweep Adapter is shown in Fig. 1. Power for the circuit is provided by a dual-polarity, 5-volt supply, which we'll deal with a little later on.

An LM360 high-speed comparator (IC1) with complementary TTL outputs is at the heart of the circuit. A trigger-level control, potentiometer R2, allows the Adapter to trigger on any part of the waveform being displayed.

With the values shown, the circuit functions well with a Hitachi V-212 os-

cilloscope, whose channel-1 output is about 25 millivolts per vertical division of the signal display. Assuming a normal display of about six divisions, the level control provides a range of ± 150 millivolts. You can easily change that range to suit your scope output by adjusting the ratio of R3 (15,000 ohms) to R4 (470 ohms); however, maintain the ratio of R5 (100,000 ohms) to R4 (470 ohms) for proper hysteresis. Resistor R1 (51 ohms) "terminates" the 50-ohm cable from the channel-1 output jack.

A 7473 TTL dual J/K flip-flop, IC2, is configured in its toggle mode to divide the input frequency by two. That ensures that IC3, a 74121 TTL monostable multivibrator, will function accurately over the input waveform's full time period. The pulse output from IC3 is coupled to the trigger-input jack of your oscilloscope, and the "slope" is selected via S2 to match the slope selected on your oscilloscope.

Potentiometer R9 allows fine positioning of the trace, and potentiometer R7 allows the output pulse width selected to be multiplied by a factor of "x 1" to over "x 2.5." Switch S1 lets you select the desired pulse width by switching in C8 through C13, in a 1-2-5 sequence. Although the schematic only indicates six switch positions for clarity, more can be added if desired.

The Adapter circuit was designed to

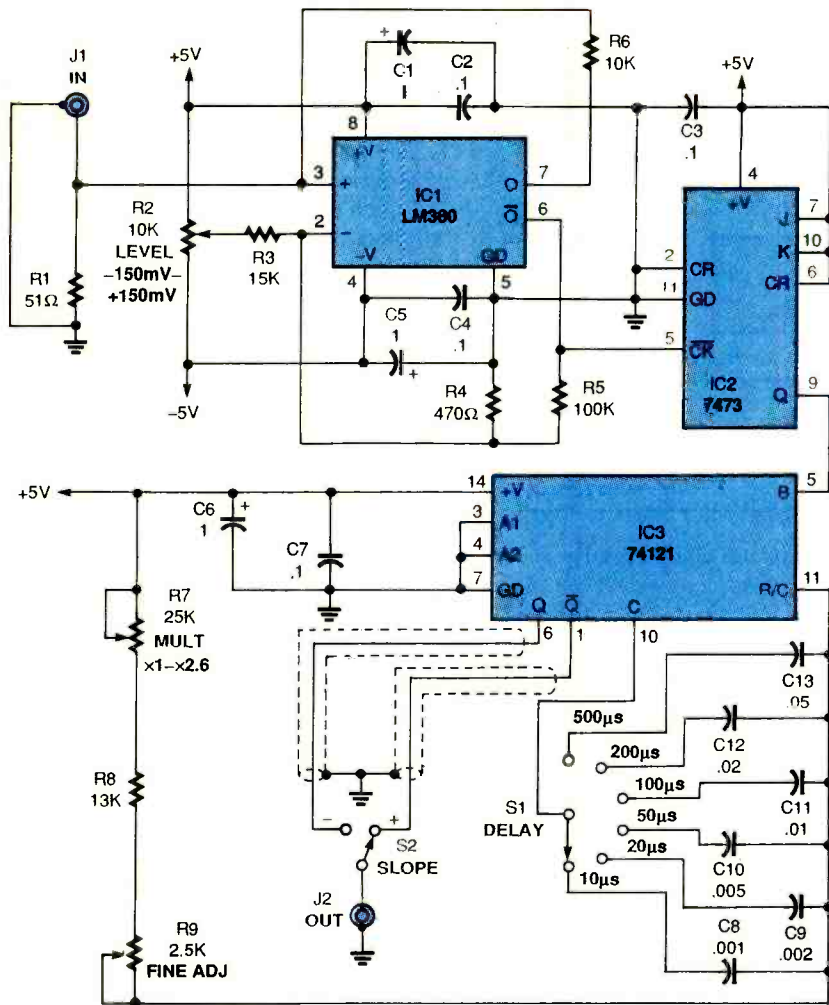


Fig. 1. Here's the schematic for the Delayed Sweep Adapter. With the values shown for C8-C13, the delay range is 10- μ s to 500- μ s, but that can be changed or expanded quite easily.

operate on an external ± 5 -volt, 100-milliamp power supply, to avoid 60-Hz pickup in the unit. A schematic diagram of the supply is shown in Fig. 2.

Transformer T1 steps down the voltage from an AC outlet to about 12 volts. That AC is then rectified by BR1 and fed to a +5-volt regulator (IC1) and a -5-volt regulator (IC2) to provide a true bipolar supply.

Construction. The author's prototype for the Delayed Sweep Adapter was built on perforated board using point-to-point wiring, but you can use any suitable method of project building that you prefer. Begin assembly by mounting sockets for the three ICs.

Wire the fixed resistors (except for R1) and capacitors (except for C8-C13) to the IC sockets, using short leads for their connections. Be sure

that the polarized capacitors are oriented properly. Next, solder short, insulated wire leads to accommodate connections to the potentiometers, switch S1, and jacks, which will be mounted to the enclosure. (Switch S2 will also be mounted to the cabinet, but shielded cable must be used to connect it, as we'll mention in a moment).

The enclosure used for the author's prototype was an aluminum cabinet measuring $1\frac{1}{8} \times 2\frac{1}{8} \times 8\frac{1}{2}$ inches, but you can use any suitable shielded case. Mount J1 on one end and J2 at the other end. The potentiometers and switches can be arranged on the face of the cabinet; make sure S2 is located close to J2.

If you plan on building the power supply for use only with the Adapter, you can leave an opening to run power leads through. However, if

PARTS LIST FOR THE DELAYED SWEEP ADAPTER (Fig. 1)

SEMICONDUCTORS

- IC1—LM390 high-speed comparator, integrated circuit
- IC2—7473 TTL dual J/K flip-flop, integrated circuit
- IC3—74121 TTL monostable multivibrator, integrated circuit

RESISTORS

(All fixed resistors are $\frac{1}{4}$ -watt, 5% units.)

- R1—51-ohm
- R2—10,000-ohm linear taper potentiometer, panel-mount
- R3—15,000-ohm
- R4—470-ohm
- R5—100,000-ohm
- R6—10,000-ohm
- R7—25,000-ohm linear taper potentiometer, panel-mount
- R8—13,000-ohm
- R9—2500-ohm linear taper potentiometer, panel-mount

CAPACITORS

- C1, C5, C6—1- μ F, solid tantalum
- C2-C4, C7—0.1- μ F, ceramic-disc
- C8—0.001- μ F, ceramic-disc (see text)
- C9—0.002- μ F, ceramic-disc (see text)
- C10—0.005- μ F, ceramic-disc (see text)
- C11—0.01- μ F, ceramic-disc (see text)
- C12—0.02- μ F, ceramic-disc (see text)
- C13—0.05- μ F, ceramic-disc (see text)

ADDITIONAL PARTS AND MATERIALS

- J1, J2—BNC jack, panel mount
- S1—1P12T rotary switch
- S2—SPDT miniature toggle switch
- Perforated board, aluminum enclosure, BNC IC sockets, control knobs, coaxial cable, wire, solder, hardware, etc.

you'd like to be able to disconnect the Adapter, you might want to consider adding a power jack to the Adapter at this time. Make sure it's a 3-contact jack to accommodate the +5-volt, -5-volt, and ground connections.

Mount the circuit board inside the enclosure, near S1, and make the connections from the wire leads to the panel-mounted components. Solder resistor R1 directly onto J1. Connect J2 to S2, then use two coaxial cables (with one end of each shield grounded) to connect the switch terminals to pins 1 and 6 on IC3.

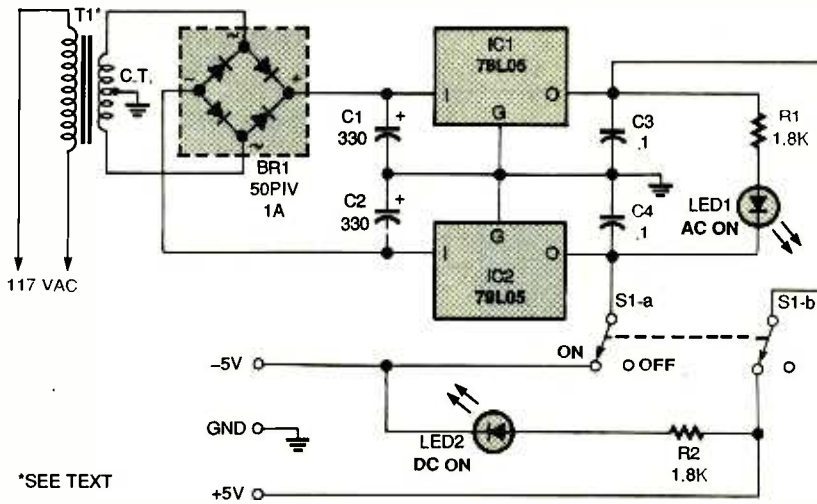


Fig. 2. If you don't have a bipolar 5-volt supply, build this simple circuit to power-up your Adapter.

Mount C8 through C13 (and any other range capacitors you plan on using) directly from the appropriate terminals on S1 to a bit of stiff wire, which should connect to R9 and pin 11 of IC3, keeping those leads as short as possible. When choosing capacitors for C8–C13, keep in mind that the circuit shows a range of 10 microseconds through 50 microseconds of delay. However, you may select any range you desire or expand the range. It's possible to expand the range because the switch used for S1 is a 12-position unit, and only six positions are used as shown in Fig. 1.

Here's how to choose appropriate range capacitors: As the range progresses in a 1-2-5 fashion, so do the capacitor values. As indicated on the schematic, C8 (0.001 μF) equals 10 μs, C9 (0.002 μF) equals 20 μs, C10 (0.005 μF) equals 50 μs, C11 (0.01 μF) equals 100 μs, and so on. If, for instance, you desire ranges of 1, 2, and 5 microseconds, the values to use would be 100 pF, 200 pF, and 500 pF. If you desire ranges of 1, 2, and 5 milliseconds, the values would be 0.1 μF, 0.2 μF, and 0.5 μF. (The capacitance is equal to the delay divided by 10,000.) Use high-quality capacitors for timing stability.

To complete assembly, insert the ICs into their sockets. Before you close up the enclosure, calibrate R7 as follows: The ×1 position should be equal to 0 ohms, ×1.5 should equal 7150 ohms, ×2 should be 14,300 ohms, and so on. Mark and label your cabinet appropriately. Double-check all of your wiring and interconnects, install control

**PARTS LIST FOR THE
±5-VOLT POWER SUPPLY
(Fig. 2)**

SEMICONDUCTORS
 IC1—78L05 +5-volt regulator, integrated circuit
 IC2—79L05 -5-volt regulator, integrated circuit
 BR1—1-ampere, 50-PIV bridge rectifier
 LED1—Light-emitting diode, red
 LED2—Light-emitting diode, yellow

ADDITIONAL PARTS AND MATERIALS
 R1, R2—1800-ohm, ¼-watt, 5% resistor
 C1, C2—330-μF, 16-WVDC, electrolytic capacitor
 C3, C4—0.1-μF ceramic-disc capacitor
 T1—120- to 12.6-VAC, 0.2-ampere, center-tapped transformer
 S1—DPDT miniature toggle switch
 Perforated board, enclosure, wire, solder, hardware, etc.

knobs on the control shafts, and close up the cabinet.

Build the power supply on a piece of perforated board as well. Connect the components as shown in the schematic, making sure to match all the indicated polarities. Mount the transformer in an enclosure, and then connect the board to it. Be sure to close the supply case before you plug the circuit in.

The supply can be connected to the Adapter with a 2-conductor shielded cable. If you mounted a jack to the Adapter, make sure the

shielded cable is connected to a matching 3-contact plug.

Operation. Using standard BNC-terminated cables (RG-174 or RG-58), connect J1 to the channel-1 output jack on your oscilloscope, and J2 to the trigger-input jack on your scope. Then power up the Adapter.

With your scope set up for internal triggering, apply the signal-to-be-tested to your scope's channel-1 input, displaying one cycle at about six vertical divisions of height. Note the approximate time period of the signal. Set up the Adapter in the following manner:

Find the position of R9 that yields accurate time-delay indications (that will most likely be the center of rotation) and leave it set there. Set S1 and R7 to the approximate signal time period you would like. Then set S2 to match the slope setting on your oscilloscope. (Note: Reversing the setting of S2 will give you a normal, non-delayed display.)

Now switch the oscilloscope's trigger source to the external setting, and adjust R2 on the Adapter for a stable trace. Rotate R7 back and forth; note how the waveform trigger point can be moved to any location on the trace. Select the section of the trace to be expanded, and move it to the left side of the CRT screen by adjusting R9. Reset S1 if needed. You may now increase the scope's sweep speed to expand the section desired, adjusting R9 as needed to maintain position on the screen.

That method can be used on any type of waveform: pulse, sine, square, triangle, etc., whether unipolar or bipolar. The only limits to the expansion of the trace are the scope's available trace intensity, and the "jitters" in the display caused by unequal cycle times in the signal itself. ■



ANTIQUE Radio

Looks Like It's Mailbag Time!

BY MARC ELLIS

My plans for this month were to move right along with the *Star Roamer* restoration—until I took a look at my rather full “in” box. It seems like (where does the time go?) we haven’t published any reader mail for about four months. There are many rather interesting letters, so let’s dive right in!

HAVES AND NEEDS

Robert D. Laszlo (11287 Wildwood Dr., Osceola, IN 46561-9371) would like construction information and a parts source for a simple “cat’s whisker” crystal set. His wife is a first-grade teacher, and he’d like to build one for her class.



Larry Scalph's beautiful Zenith 8S463 is shown installed in its cabinet.

In addition to the Webster-Chicago wire recorder (Model 180-1) and 10-inch Sentinel black-and-white TV (Model IU-415-CV) mentioned in our May issue, *Craig Sellen* (RR-1 58-B Box 1038, Waymart, PA 18472-1038) is now offering a 3KP4 CRT as used in Pilot pre-war and wartime experimental TV sets. Interested? Make an offer! Craig is also looking for schematics for the Panasonic RF-4800 or RF-4900

communications receivers and the Bogen LS-330 PA amplifier.

Joseph R. Veltri (249 Kingwood Street, Morgantown, WV 26505) is looking for information on a one-tube RCA Radiola. He can't read the model number. Anyone want to correspond with Joe about this rare set?

Dr. S. Sadik (7321 Harps Mill Road, Raleigh, NC 27615-5418) needs a schematic and service information for a circa-1929 Thomas Edison, Inc. (Orange, NJ) Receiver Unit Type 7R and its accompanying power unit (Type 7P). *John H. Rodriguez* (123 Colonel's Lane, Weymouth, MA 02189 or call collect at 617-331-4874) would like a repair source for a two-speed hysteresis motor.

Dave Eley (17294 58th Avenue, Surrey, BC, Canada V3S 1K8) is still looking for a Miller coil to complete his Theremin (see the May 1996 column). I didn't help him much by getting the number of the coil wrong. What he needs is a Miller #695, *not* a #6905. Dave also, quite reasonably, blames me for misprinting the Theremin Enthusiasts Club International's e-mail address. However, just to make sure I'm not getting soft in my old age, I checked his original letter. Sorry, Dave, that last boo-boo is yours! Anyway, you can e-mail the Theremin Enthusiasts (c/o Barry Eso) at beso@cln.etc.bc.ca.

SUBSTITUTE OUTPUT TRANSFORMER

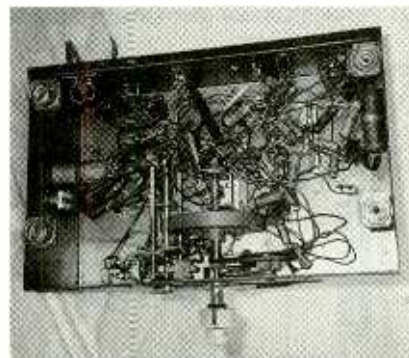
Needing a 2500-ohm primary/8-ohm secondary output transformer in a hurry, reader *Bill Stiles'* (Hillsboro, MO) gaze fell upon a 6.3-volt 1.2-amp filament transformer in his junk box. Calculating the impedance ratio of the required transformer (312:1), he took square roots to determine the needed turns ratio (17.7:1). In a power transformer, turns ratio is equal to voltage ratio, so the 117-volt to 6.3-volt filament transformer had a turns ratio of

8.6:1—close enough!

Filament transformers aren't exactly designed for hi-fi response, but then neither are small audio transformers. And the filament transformer's power rating ($6.3 \times 1.2 = 7.56$ watts) was more than enough to handle the audio power developed by the little set. Bill says that the substitute transformer worked out quite well.

KEEPING CAPS AUTHENTIC LOOKING

Larry Scalph (Tacoma, WA) won't turn on a long-unused vintage radio without replacing all electrolytic and paper capacitors. But he likes to keep the caps looking authentic, so he mounts the replacements inside the shells of the originals. After removing each old capacitor and cleaning it with alcohol, he slits the shell lengthwise with a razor blade and removes it from around the “insides.” Using wire ties, he fastens the shell into its original cylindrical shape and coats the inside with fast-set epoxy.



Here's the under-chassis view of Larry's restored Zenith 8S463. The capacitor shells are original but they have new capacitors inside.

Next, he removes the ties, inserts the new capacitor (metallized-film caps are used for their small physical size) and seals the ends with hot glue. “Off-white” glue sticks are best because their color is similar to that of the original wax. Larry finishes the job by running the hot end of his glue gun over

the slit in the shell—camouflaging the slit by melting some of the original wax over it. Capacitors are removed, rebuilt, and replaced one at a time to avoid confusion and wiring errors. Replaced capacitors are positioned so that their slits are out of sight.

Larry also fuses the primary of each set's power transformer before returning the chassis to its cabinet. The added fuse might not be an authentic touch, but someday it may well save an expensive and difficult-to-replace transformer!

CRYSTAL SET HAS FULL-WAVE RECTIFICATION

Gus Linja (Lake Linden, MI) tells us that he's been building crystal sets since the early 1940s, and even back then was intrigued by the extra power that might be available if a full-wave rectifier was substituted for the half-wave circuit that was typically used. The scheme wasn't practical then, because it would have required four separate galena crystals with four separate cat's whisker adjustments. Once semiconductor diodes became available, however, he tried it (see Fig. 1). Antenna Coil L1 and capacitors C1 and C2 were salvaged from an Atwater-Kent battery-operated TRF; capacitor C3 is 0.05-mF; and diodes D1 through D4 are germanium diodes.

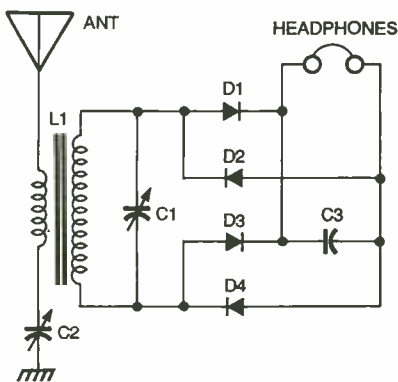


Fig. 1. This is the schematic for Gus Linja's "full-wave" crystal set. See the text for a description of the components.

Capacitor C1 is for main tuning, while C2 tunes the antenna circuit. With the set connected to a 100-foot wire antenna (50-feet up at the highest point), enough power was generated

The G. M. R. Super-Heterodyne Converter with Remote Control



The G. M. R. Super-Heterodyne Converter, newest achievement in radio, has a two-fold purpose. 1. It converts tuned radio frequency models into highly selective, fine-performing super-heterodynes. 2. It provides remote control over all stations in the full broadcast range—a thirty-foot extension cord makes it possible to place the converter wherever it is most convenient. Here is a sensational new profit maker in radio that every present owner will want.

List Price **\$49⁷⁵**
complete

A contemporary trade magazine ad for the G.M.R. Superheterodyne Converter (courtesy Alan Douglas).

so that Gus could operate a speaker (through an output transformer). When

the house was quiet, he could listen to the programs from across the room. Sensitivity and selectivity were quite good. At night, he could hear several clear-channel stations (KXEL, KOIL, WLW, and others). With the ground disconnected, he could receive some of the major shortwave broadcasters, such as Voice of America, Radio Moscow, Radio Havana, and Voice of the Andes.

READERS' PUZZLES SOLVED

Radio historian Alan Douglas (Pocasset, MA) identified Loren Perkins' "ashtray radio," featured in the May issue, as a General Motors "G.M.R. Super-Heterodyne Converter." The dual-function G.M.R. converted TRF radios into "highly selective, fine-performing superheterodynes" and provided "remote control over all stations in the full broadcast range."

Alan also ID'd Curt Wagner's "What is it?" (also in the May issue) as some form of laboratory potentiometer—possibly a pH meter. Taking it a step further, retired instrument technician/field engineer Don Waltenberger (Garrettsville, OH) is reasonably certain that the instrument is a millivolt potentiometer used to measure the output of thermocouples employed for precise temperature measurements.

THE BOAKE CARTER PHILCO

Speaking of solutions to reader puzzles, we've had a very big response to reader Ray Shetrone's (Ft. Meyers, FL) query regarding the flamboyant signature on the dial of his Philco 38-7 console. As was announced in an earlier column (thanks to information provided by Popular Electronics' art director Andy Duzant), the signature belongs to Boake Carter, a well-known newscaster of the 1930s whose broadcasts were as flamboyant as his calligraphy. At one point in his career, Carter was sponsored by Philco, and the following passage (courtesy of Philco historian Ron Ramirez) is taken from the 1937 Philco dealer catalog—which was quoting Time magazine of April 13, 1936:

"Not only is Boake Carter currently the most popular of Radio's news com

continued on page 62

DX LISTENING

Slovak Radio On the Air

BY DON JENSEN

Slovakia is one of Europe's newest countries, born on January 1, 1993, with the dissolution of what was Czechoslovakia. The split, peaceful and democratic, brought many changes to the two new countries, Slovakia and the Czech Republic. For many years, a single shortwave entity known as Radio Prague was the voice of a federated Czechoslovakia. Suddenly, Slovakia was unrepresented on the shortwave bands. And so a new SW voice, the international service of Slovak Radio, came into being.

Today, Radio Slovakia International broadcasts in five languages, English, French, German, and Russian, in addition to the native Slovak. The station's staff produces eight-and-a-half hours of shortwave programming, including a half hour of English, seven days a week.

Programming begins with about five minutes of news. The rest of the half hour is a radio magazine, whose highlights vary day by day. Some highlights from RSI's schedule include:

Monday: sports, history, cultural, and foreign-relations segments.

programs are aired to other parts of the world at 0830 UTC, on 11,990, 15,460 and 17,550 kHz; at 1630 UTC, and again at 1830 UTC, on 5,915 and 6,055 kHz. Some of these may be audible in the US and Canada, although they are specifically directed elsewhere.

RSI's English programming to North America is aired at 0100 UTC on 5,930, 7,300, and 9,440 kHz. Send reception reports to Radio Slovakia International, Mytna 1, 812-90, Bratislava, Slovak Republic. If you want to ring them up instead, the phone number for the English service is 011-42-7-498-075.

WHAT IN THE WORLD

Radio Netherlands' The Research File is an award-winning science and technology program now in its ninth year. The show, hosted by Anne Blair Gould, covers developments in space science, medicine, psychology, environmental research, science, and technology from Holland, across Europe and the world.

Each week, Gould picks stories and answers to questions. What's interesting about this scientific development? What does it mean? And do these things really apply to us? Anyone interested in the "cutting edge" of science is bound to be intrigued. And its Futures segments reveal technological developments so new that they haven't even happened yet!

The Research File can be heard during Radio Netherland's Monday shortwave transmissions. This includes broadcasts beamed to North America during the 0030 and 0430 UTC scheduled transmission periods. Frequencies used during the former period are 6,020, 6,165, and 9,845 kHz; and at 6,165 and 9,590 kHz during the latter period.

Send both comments on the programs and reception reports to Radio Netherlands, English Section, PO Box 222, 1200 JG Hilversum, Holland. Or send e-mail to letters@rnw.nl.



Anne Blair Gould, host of Radio Netherlands' science program, The Research File.

As with most assets of the former Czechoslovakia, the existing shortwave facilities were divided among new Slovakia and the Czech Republic. They consisted of a single 100-kilowatt and two powerful 250-kilowatt transmitters at Rimavska Soboto and Velke Kostolany within Slovakia.

CREDITS: Brian Alexander, PA; Bruce Conti, NH; Robert Hill, MA; Harold Levison, PA; Ed Newbury, NE; Benton Owsley, CA; George Poppin, CA; Ed Rausch, NJ; World DX Club, c/o Richard D'Angelo, 2216 Burkey Drive, Wyomissing PA 19610; North American SW Association, 45 Wildflower Road, Levittown PA 19067.

Tuesday: tourism or Slovakian personalities.

Wednesday: business and economic news.

Thursday: domestic politics, science, and education.

Friday: a cultural spotlight, including Slovakian cooking or language lessons.

Saturday: a rebroadcast of the best feature segments of the week.

Sunday: a mailbag program of listeners' letters, and Slovakian music.

Radio Slovakia International English

PROGRAM GUIDE

This month, I'm offering a taste of some of the most interesting programming available on shortwave radio.

One source for information on SW programs, says Richard Cuff, writing in his Easy Listening column in the monthly *Journal of the North American SW Association*, is *The International Directory of Shortwave Radio Programs*. The data is compiled by John Figliozzi and, says Cuff, "the book is available through RadioShack stores throughout North America." The price is \$10.95.

NEW GUY IN CHARGE

Regular readers of this column know of ANARC, the Association of North Radio Clubs, the umbrella organization that provides links between the important radio listening clubs in the US and Canada. Promoting the hobby is an important function of ANARC. Not so well known to North American listeners, though, is its counterpart across the Atlantic, the European DX Council.

For the past 16 years, EDXC's secretary general has been Michael Murray of the United Kingdom. During that period, the organization has held successful annual conferences and publicized the listening hobby at telecommunications and electronic exhibitions from London to Geneva.

In May, Murray stepped down from his longtime post. Elected to replace

him as the head of EDXC is Risto Vahakainu of Finland. The new address of the EDXC is P.O. Box 214, FIN-00101, Helsinki, Finland. Success and good luck to you, Risto!

DOWN THE DIAL

Here are some shortwave listening targets to try for.

ALBANIA—7,270 kHz. Radio Tirana's English programming probably isn't quite as awful as it once was, but.... Still, it does have some interesting Albanian music programming that's worthwhile. Try around 0345 UTC.

BANGLADESH—9,548 kHz. Radio Bangladesh has English until 1300 UTC sign off. Look for news, Bangladeshi music, and commentary before it leaves the air.

BRAZIL—4,875 kHz. Radio Roraima has been heard on this frequency around 0230 UTC with Portuguese-language programming, including popular music and commercials.

CZECH REPUBLIC—7,345 kHz. Radio Prague, an old familiar identification from the days before Czechoslovakia split into this republic and Slovakia, is widely heard with English-language programs at 0000 UTC and again at 0100 UTC. You may also find it on 5,930 kHz during the first half hour of transmission, and on 6,200 kHz during the latter period.

HONG KONG—7,180 kHz. British Broadcasting Corporation's Hong Kong relay on shortwave won't be around too

much longer, so log it while you can. This bit of Britain in the Far East is scheduled to revert to China and the BBC will remove its powerful SW transmitters. It is heard in mid-America around 0950 UTC.

MALAWI—3,380 kHz. MBC, the shortwave outlet of this southern African nation has been logged at 0248 UTC sign on, with a rooster crowing interval signal, and opening announcements. A strong signal suggests a more powerful transmitter.

MEXICO—5,985 kHz. Radio Mexico International has a new English program schedule. For an excellent segment of Mexican music, try tuning in from 0330 to 0400 UTC, Monday through Saturday. You can also find music at 1430 to 1500 UTC on 9,705 kHz.

UNITED STATES—9,815 kHz. Radio Marti, America's Spanish language anti-Castro broadcaster, is beamed to Cuba by Voice of America transmitters at Delano, CA. Listen around 0030 UTC for Radio Marti identifications and a Spanish newscast. There is interference from a Cuban "bubble machine" jammer.

VENEZUELA—4,940 kHz. Radio Amazonas in Puerto Ayacucho was heard in February on the station's first day of operation. Reportedly it uses the former Radio Continental transmitter. Listen for this one in Spanish during the evening hours until sign off, shortly after 0400 UTC. ■

ANTIQUE RADIO

(continued from page 60)

mentators, with a rating of 12.6 by the Crossley Survey, he is also far and away the most daring. His freedom to express any partisan opinion that pops into his curly head is the wonder of a notoriously timid industry. However, while Carter's crusty editorializing delights thousands of listeners, it chagrins thousands more, keeps him in a perpetual conversational stew."

"He must have been the Limbaugh of his day," ventures Ron—and drawing on what I've since read about Carter, I can vouch for the fact that such was indeed the case. Ron is checking with set owner Shetrone to see if it can be determined whether the

Boake Carter signature was inscribed on the dial or printed on it. That might shed some light on whether the set was a one-of-a-kind model made for Boake or part of a special limited-edition promotional run. I'll let you know if there is more news on this.

Thanks to the following readers for writing or calling in and sharing their memories of Carter: *Lloyd Zimmerman* (Skokie, IL), *Raymond F. Elsner* (Littleton, CO), *Stan Niedermeier* (Newport, MI), and *William Barriger* (Greenville, SC). *Jim Ferris* (Coos Bay, OR) believes that Paul Douglas, later a well-known actor, was the announcer for the Carter program. He remembers listening to the show on a 1930 Philco cathedral set. *Thomas S. Ely, M.D.* (Bloomfield, NY) noted that Shetrone's

Philco must have been used at night for long-distance listening because the call letters displayed on it belonged to stations in Washington, DC; New York City, Baltimore, and Philadelphia. *Joe Watkins* (Boulder, CO) remembers listening to Carter on either KSD or KMOX in St. Louis. *W. R. Cobb* (Laguna Hills, CA) is amused at my ignorance in not immediately recognizing Boake Carter's name. He adds that it was not unusual for Philco, during that era, to inscribe owner's names on radio dials—which makes it plausible that the set might either have belonged to Boake or been signed by him personally.

Thanks also to *Alan Douglas* (Pocasset, MA) and *Tony Jacobi* (Ralston, NE) for historical information relating to Boake. ■

SCANNER SCENE

Entering the Computer Age

BY MARC SAXON

Thus far, we have not mentioned aspects of computer-aided scanning. You might not even be aware that many high-end scanners come already equipped for computer control via a simple RS-232 serial port.

The ability to control a scanner with a computer is similar to using a remote control to operate a TV—no more getting up and down to change channels. Many TV remotes are equipped with VCR Plus+, providing simple time-shift recording by inputting a digital code.

times 1000 characteristics. The computer can do the job in about three minutes! You can also get CD-ROM databases showing FCC licensees.

Scancat-Gold (Version 6.0) software offers computer control of major brands of scanners, including AOR, Icom, and RadioShack's PRO-2005/6 and PRO-2042 (with additional interface, not supplied), and others. The software restores cellular frequencies in the AR-800. With a simple menu choice, you can select from several

great job. It can run on virtually any DOS-based PC with at least 640 kilobytes of RAM, and also runs as a DOS application under Windows or Windows 95. A Windows 95 version should be available by the time you read this. A fully operational demo disk is available for \$5, or you can request more information, from Computer Aided Technologies, P.O. Box 18285, Shreveport, LA 71138. You can call them at 318-687-2555, send e-mail to scancat@bcrr.secret.com, or check out their Web site at <http://www.scancat.com>.

READERS WRITE

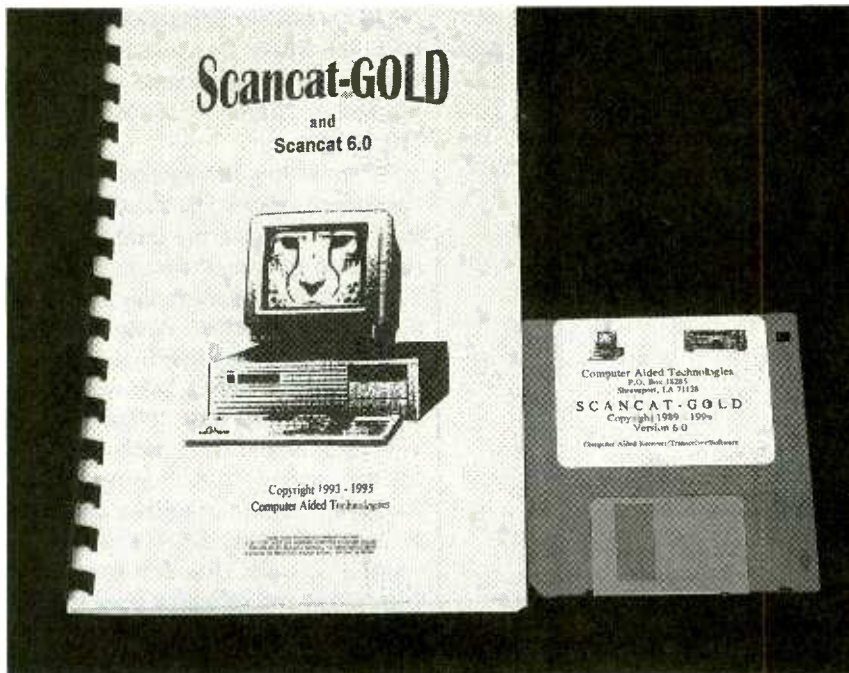
Rick Montero, of Las Vegas, Nevada, writes to mention that he often sees Federal Express (FedEx) cargo aircraft in that company's TV commercials. He has also seen the planes at airports in Las Vegas, Los Angeles, and Dallas. Rick wonders if FedEx has a nationwide frequency for communicating with its fleet of aircraft. He hasn't been able to locate it yet by searching 128.825 to 132.0 MHz, which is where he thinks it probably is.

That would be the first place we'd check, too, Rick, because all the airlines have "company" frequencies there. I have monitored FedEx in that band on 131.925 MHz. But my own search efforts have also detected quite a bit of FedEx activity on 122.875 MHz. So it looks as if they are using one of the two distant and inconspicuous channels reserved for small cargo aircraft and commuter airlines. The other similar channel is 122.825 MHz.

For the record, the United Parcel Service (UPS) fleet of planes has been monitored on 129.425 MHz, while the DL air cargo operations seem to occur on 131.625 MHz.

Here are some other aeronautical tidbits. Pilots like to chat amongst themselves while flying. Those conversations often range from raucous to raw. Regulations designate 122.75Mhz

continued on page 67



Scancat-Gold software offers computer control of major brands of scanners, including AOR, Icom, and RadioShack's PRO-2005/6 and PRO-2042. It lets you scan between two frequencies, create and scan disk files, search for new frequencies, log to files, and more.

Computer control of a scanner not only provides "remote control," but also unattended logging of everything that is transmitted. Newer scanners such as AOR's AR-8000 have 1000 programmable channels, each of which can contain seven characteristic descriptions. Because the basic "stand-alone" scanner enables input only by setting an individual adjustment for each characteristic, the scanner would have to program seven

radios to be used; scan between two frequencies; create and scan disk files, search for new frequencies, and log to files. With some radios, you can do spectrum analysis while you are scanning and listening. The program has D-Base import ability and 15 scanning bands. With an added Optoelectronics OS456 board, a PRO-2006 will also decode PL and DCS codes.

Scancat-Gold costs less than \$100, is easy to install and use, and does a

Think Tank

Jose Wins Again

JOHN YACONO
TECHNICAL EDITOR
WINDOWS MAGAZINE

This month we'll showcase the work of Jose Ignatius A. Alea, who has submitted another month's worth of quality circuits. Before we get to them, however, I'll continue our discussion of inductors.

Last time we discussed how the geometry of a coil helps concentrate the magnetic field generated by the current flowing within its turns. That configuration enables us to take advantage of the relationship between electricity and magnetism, because it makes it possible to generate significant magnetic fields with reasonable

increases; as current decreases the magnetic-field strength decreases. Well, a reciprocal rule holds, too: If you were to introduce a coil into a varying magnetic field, a potential would develop at its ends.

That brings us to an interesting property of inductors called "electromagnetic kickback." Say we establish a constant flow of current through an inductor. Of course, a steady magnetic field forms around and within the inductor. What happens if you disconnect the power supply? Well, current in the inductor halts, but the magnetic

ated the field in the first place.

This property can be useful, like for generating high voltages, or it can be destructive, harming delicate components if left unchecked. We'll explore some of the possibilities next month; but now, let's get to the letters.

LIGHT-ACTIVATED SWITCH

One evening while standing on the street, I was looking at the street lights and thought it would be nice if I could make my outdoor lights switch on and off automatically. So I built the circuit in Fig. 1, which is simple and only requires parts available at RadioShack.

When even a little light hits the light-dependent resistor, R5, transistor Q1 is turned off because the base has less resistance to ground than to the positive rail. In that situation, the base is at a negative potential. When the sun sets, R5 is no longer illuminated, giving the transistor's base a high resistance to ground—higher than 100,000 ohms. With less resistance to positive potential, the base is biased, turning on Q1. Relay RY1 is then energized and pulls in, connecting the SCR1's anode to positive potential. The 555 timer, IC1, powers up, and its output goes high to approximately 10.67 volts, which is sufficient to energize RY2. Relay RY2 then pulls in, keeping the AC bulb on the whole night, and turning it off again at sunrise.

Make sure the project is out in the open, say on a roof, so R5 will respond to even the slightest rays of the sun. Cover the R5 with a transparent material shaped like a converging meniscus lens, and glue the sides of the transparent material to the enclosure, to protect the light-dependent resistor from rain. A 12-volt power supply completes the circuit.

—Jose Ignatius A. Alea, Cebu, Philippines

Interesting use of the 555. Since it's

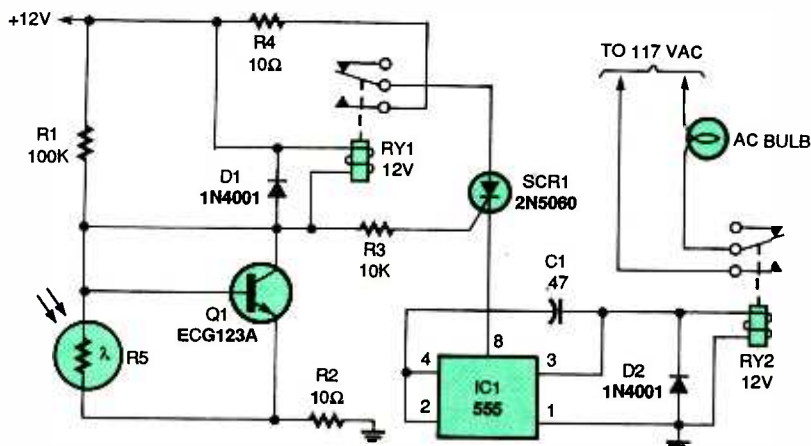


Fig. 1. This circuit will make your outdoor lights switch on and off automatically with the setting and rising of the sun.

levels of current. As experimenters, the configuration also allows us to experience the relationship through simple experiments like last month's electromagnet.

The relationship between electricity and magnetism, as we've explored it thus far, is that "a steady current creates a steady magnetic field." What sort of magnetic field does a varying current produce? Well, the magnetic-field strength is proportional to the current, so a varying current creates a varying magnetic field. As current increases, the magnetic-field strength

field doesn't simply vanish; there's a certain amount of energy invested in the magnetic field and that cannot simply disappear. (The current helped generate and maintain the magnetic field, but once started, the field is like a separate entity or force to be reckoned with.) Instead the magnetic field begins to collapse. That's analogous to placing the coil in a varying magnetic field. The result is a very high voltage generated at the leads of the coil—the kickback—which if connected to a load, would generate current that would oppose the current that cre-

an outdoor project, I'd seal the case with silicon caulk. Also be sure not to work on the circuit while it's connected to AC.

TOUCH/INFRARED SWITCHES

This touch switch (see Fig. 2A) controls an AC-powered bulb, and requires only a few parts. Touching the touch plate triggers the SCR's gate, turning it on and allowing current to flow from the cathode to the anode of SCR1, thereby activating the relay.

ing the relay. Releasing S1 places the circuit back in standby mode.

The light-dependent resistor, R2, is used if you want to turn on the circuit via infrared. Just make sure to cover R2 with an IR filter, to protect it from unwanted light rays, which result in false triggering.

Using a battery as a supply is not advisable. As the battery's energy decreases, the touch switch would no longer function. Use a 9-volt regulated power supply instead.

The circuit in Fig. 2B operates in

turning off the SCR. Or you can press S1 to turn the circuitry off.

—Jose Ignatius A. Alea, Cebu, Philippines

Exposed Kodachrome film works great as an IR filter. The remote control can be made from a normally open pushbutton, a resistor, a high-intensity IR LED, and a battery—all in series. A simple flashlight with an IR filter will also work. Either way, I'd use a lens to make the range practical.

ALTERNATE TOUCH SWITCHES

John, this switching device (see Fig. 3A) can be used for AC-switching or any other application whenever a switching device is needed. It is built around an oscillator/timer IC configured in a way that makes it function as a one-shot monostable device. When S1 is closed, the circuitry is on in standby mode. When the touch plate is touched, the output of 555-timer IC1 goes high, supplying a positive potential to the base of transistor Q2, aiding its bias. The transistor is then on, allowing current to flow through pins 4, 5, and 6 of IC2. The gate of the SCR is then triggered, the relay is energized, and its contacts turn the AC bulb on. To turn the bulb off, just press S2 (reset), which disconnects the anode of the SCR from the positive supply, turning it off, and de-energizing the relay.

The light-dependent resistor (R7) is used if you want to turn on the circuit remotely. Just point a flashlight at R7 to decrease its resistance, therefore leaving only the 1,000-ohm resistor as the base resistance. That resistance gives the base a positive potential, forward biasing the emitter-base junction of transistor Q1. Transistor Q2 is also turned on, as its base is made positive by Q1, which triggers SCR1, energizing the relay.

Just be sure that R7's sensing portion is covered with an infrared filter; you can use a developed color film for that. Use a flashlight with an adjustable beam lens, so the light rays are narrower and more concentrated at the center. The touch plate is very sensitive, so be sure to install it on a plastic material to prevent unwanted triggering. The touch plate can be made of any electrical conductor.

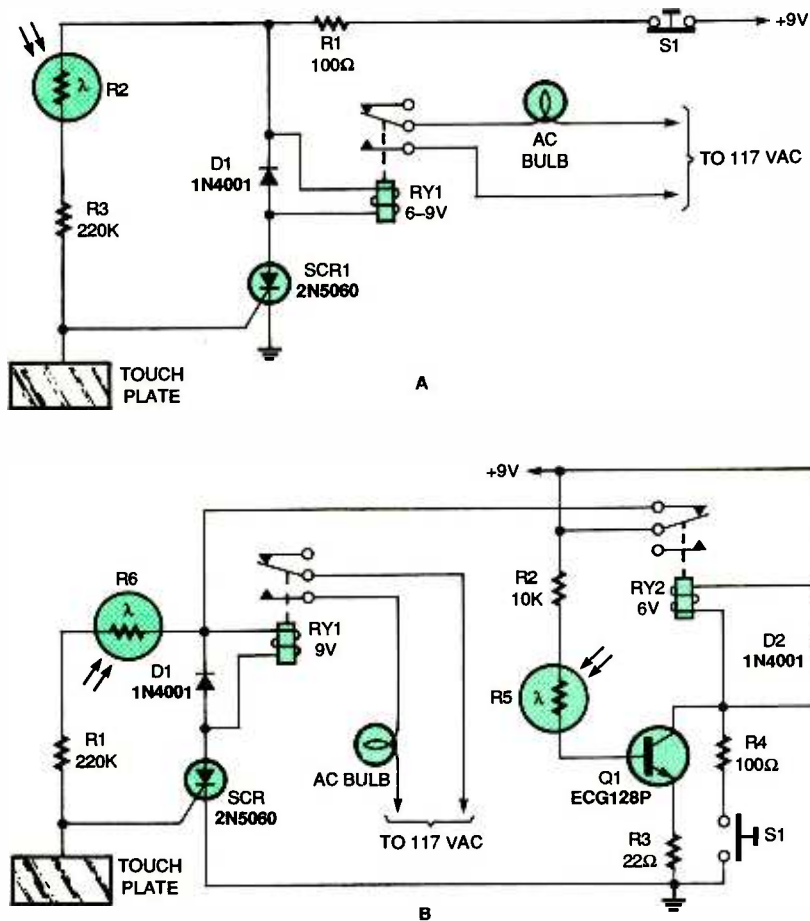


Fig. 2. Turn on an AC bulb by touch or with IR light using this circuit (A). Another circuit (B) lets you also turn off the bulb by touch or a pushbutton switch.

When that happens, the relay's contacts pull in and turn on the bulb or whatever you connect to the circuit. Just be sure that the relay contacts can withstand the high-voltage AC. To turn off the circuit, just press S1 (a normally closed pushbutton switch) to disconnect the anode of the SCR from the positive supply, thereby de-activat-

the same way, but it is equipped with a light-dependent-resistor switch for turning the circuit off. When R5 is illuminated by a flashlight, its resistance lowers, leaving only 10,000 ohms as the minimum base resistance. That process gives a positive potential to the base of Q1, therefore turning on the transistor, activating RY2, and

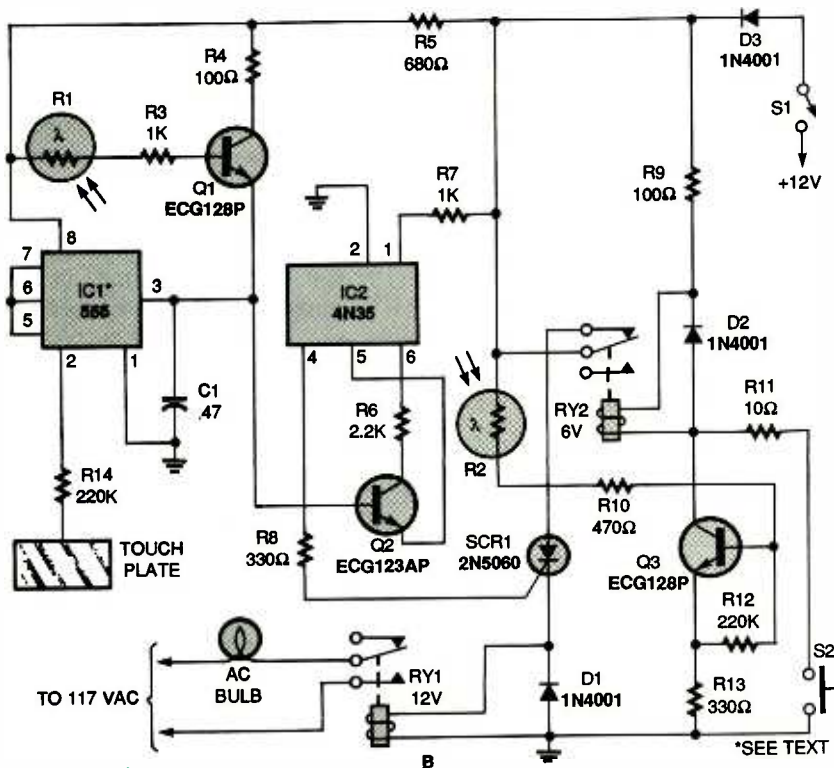
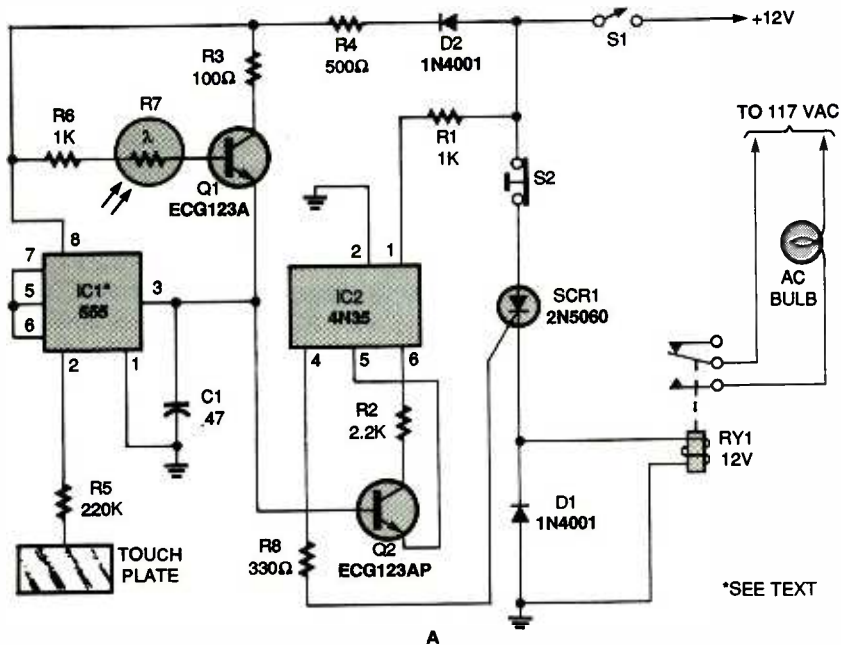


Fig. 3. This alternate touch- and light-controlled switch is built around a 4N35 optocoupler (A). A variation (B) allows for remote shut-off of the circuit, using a strong flashlight.

The switching device in Fig. 3B is similar to the one in Fig. 3A, but more convenient because it has a remote off switch. When the touch plate is touched, it turns the output of IC1 on, giving a positive potential to the base of Q2. In turn, that turns on pins 4, 5, and 6 of IC2, therefore triggering the

SCR's gate and energizing RY1. With RY1 energized, its contacts pull in, turning on the AC bulb. When R1 is hit by strong light, it turns on the SCR and energizes RY1. To turn the AC bulb off, just point a strong flashlight at R2, decreasing the base resistance of Q3, making its base positive, and therefore

energizing RY2. When the contact of RY2 pulls in, it disconnects the anode of the SCR from the positive supply, therefore turning it off. Or you can press S2 to energize RY2 and turn off the AC bulb.

—Jose Ignatius A. Alea, Cebu, Philippines

Jose also advises us to use either an NE555P or NE555N, as not all 555s will work as touch-activated monostables. If you wish to experiment with various 555s, say from your junk box, then use a socket to accommodate the IC.

LIGHT FLASHER

The circuit in Fig. 4 is an AC light flasher. It's built around a 555 oscillator/timer IC in an unusual configuration. Pins 5 and 6 are shorted together, so that both comparators in the 555 will have the same potential, keeping the output low. If both are disconnected, output-pin 3 always goes high. With both pins shorted, the 555 uses only its other comparator to turn the output high and low.

When there is no light detected by light-dependent resistor R1, pin 2 is at negative potential because the resistance of R1 plus R4 is higher than 100,000 ohms. The 555 (IC1) is thus triggered, thereby driving pin 3 high, and energizing the relay at the same time. The contacts pull in, turning on the lamp. When R1 senses the light, it pulls pin 2 positive through R4, bringing IC1's output low, and de-energizing the relay.

The output of IC1 is approximately 9.57 volts and its current is 20 mA in a 12-volt/500-mA circuit, which is sufficient to drive the relay. The 270-ohm resistor acts as a current-limiter for IC1.

The light-dependent resistor will suffer memory effect if exposed directly to sunlight. If possible, use an IR filter if you use the circuit in direct sunlight.

—Jose Ignatius A. Alea, Cebu, Philippines

Running the power supply off the AC line seems natural enough, so bring both lines into the project box and run two wires to the AC load, rather than placing the project in series with the load and AC source.

Be sure to insulate all the AC connections thoroughly.

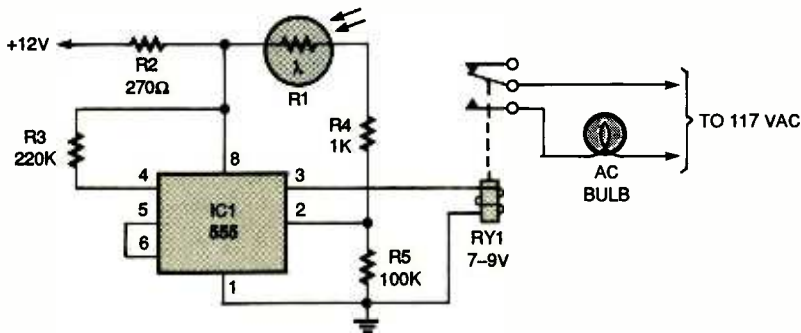


Fig. 4. This AC light flasher is built around a 555 oscillator/timer IC that is configured in an unusual way.

CONTINUITY CHECKER

John, while working on some electronic equipment, I came to the point when I wanted to make a continuity test. My DMM is equipped with a check-

er, but I was determined to design one that is smaller and more handy. So I threw some parts together and it worked just as I wanted it to; it's useful and fits comfortably into my pocket.

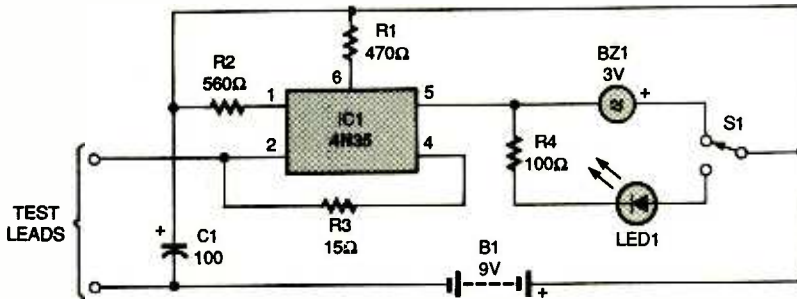


Fig. 5. Switch S1 in this continuity checker lets you decide whether you want an audible or visible indication of continuity.

SCANNER SCENE

(continued from page 63)

as the yak channel for private fixed-wing aircraft, and 123.025 MHz for choppers. Sometimes private pilots also chat on 122.9 MHz, and airline pilots have unofficially appropriated 123.45 MHz for exchanging chit chat. Within the past year, several additional, totally unauthorized pilot-to-pilot channels have been reported, by our readers. They are 122.775, 122.85, 122.925, 126.125, and 136.975 MHz.

WHAT'S IN THE TRUNK?

In response to many inquiries, there isn't any (legally) available software to permit standard scanners to follow 800-MHz trunked communications systems. There are several different types of trunking systems in use, but the software that controls frequency movement is copyrighted and pirates have been

prosecuted. While scanners can't actually track a specific channel sequence, they can monitor system groups.

Most systems use groups of five frequencies, or multiples of five, taking the total number up to 20 or 25. Each group of five will have the same kHz extension, for example, XXX.0125 (851.0125, 852.0125, 853.0125 MHz, etc.). Many of those systems change frequencies in descending frequency order; consider that when programming a scanner.

One way to approach the situation would be to monitor late at night, preferably on a week night, when the traffic is light. It's easier then to follow how that particular trunking system is shifting from channel to channel.

A scanner owner reports that he had been able to track his local police and fire departments' trunked repeater system by knowing the order of frequencies the repeater worked, which was

You can see from Fig. 5 it's built around a 4N35 optocoupler. When the test leads are shorted by a resistance, it turns IC1 on by pulling pins 2 and 4 low, allowing current to flow through pins 6 and 5. Current to pin 5 flows through either the buzzer or the LED, depending upon the position of S1. To test continuity of 50 ohms or less, use the buzzer as the indicator. For continuity of up to 1000 ohms, use the LED.

The circuit can also be used to check PN junctions of transistors and diodes, with less possibility of damaging such sensitive components. For that, use the LED, and connect the lead from pin 2 of IC1 to the P side. The supply can be from 7.5 to 9 volts. —Jose Ignatius A. Alea, Cebu, Philippines

To catch fast pulses, folks might want to trigger a monostable with pin 5, and use it to drive the LED and the buzzer. The monostable will act like a pulse stretcher.

Another column's come and gone. Remember, if you've got some interesting circuits for me, send them to *Think Tank*, Popular Electronics, 500 Bi-County Blvd., Farmingdale, NY 11735. If they appear here, you'll receive a book from our library. Send enough to fill a whole column, and you'll get a kit and MCL1010 chip, ■

descending. First he entered the frequencies in descending order, five times. The radio then only scanned that bank of 20 frequencies. When the scanner stopped because of a transmission, he pressed MANUAL to kill the scanning action. When he heard the tone, he could press MANUAL and there they were! The drawback was that if the fire department was on the next channel, he had to press MANUAL again. That method worked fine until the system began randomizing the data channel every hour. One observer notes that this concept won't work with any of the Uniden models that will scan only in ascending frequency order within a given bank, regardless of channel assignment. Such is life.

If you can offer insight into scanning trunked systems, or just want to keep in touch, write to *Scanner Scene*, Popular Electronics, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

Circuit Circus

Op-Amp Applications

BY CHARLES D. RAKES

Lately it seems like more questions are being asked about op-amps than any other active electronic component. How do they work? What can they do for me? How do I hook them up? Those are all common queries hobbyists make and, this month, we'll try to address a few of those concerns.

When the first integrated-circuit operational amplifier hit the market, it gave the world a magic analog device that changed electronics forever. The generic op-amp is a two-input, differential, high-gain DC amplifier. Being very versatile, op-amps are used in AC and DC amplifiers, active filters, comparators, integration and summing circuits, and in many other analog circuit functions.

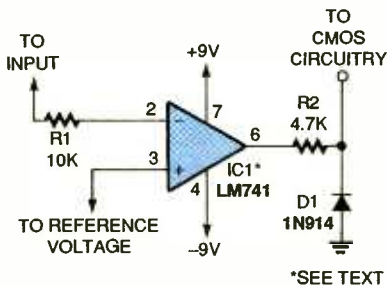


Fig. 1. This CMOS interface makes it possible for a simple or complex analog circuit to input data into a digital system.

PARTS LIST FOR THE CMOS-INTERFACE DRIVER (Fig. 1)

IC1—LM741 op-amp, integrated circuit
D1—1N914 silicon diode
R1—10,000-ohm, $\frac{1}{4}$ -watt, 5% resistor
R2—4700-ohm, $\frac{1}{4}$ -watt, 5% resistor
Wire, solder, etc.

An ideal op-amp would have infinite open loop gain and input impedance, as well as an output impedance of zero. In the real world of op-amps, however, those characteristics don't exist and probably never will. The available op-amps are still very useful, though.

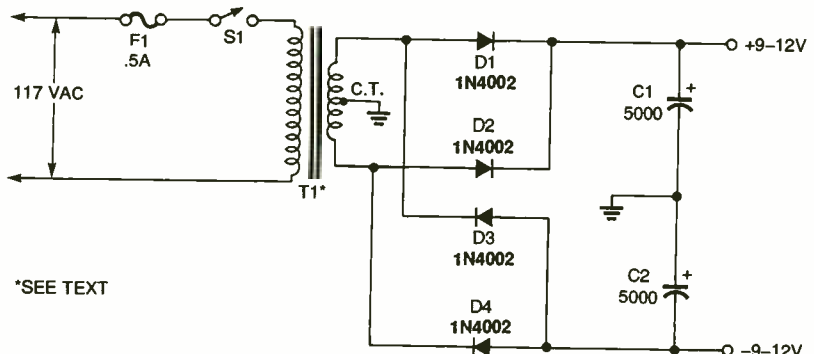


Fig. 2. Here's a simple dual-voltage power-supply that can be used to power the op-amp circuits in this month's column.

CMOS-INTERFACE DRIVER

Our first op-amp circuit application, see Fig. 1, places IC1, a general-purpose LM741 op-amp, in an interface-driver circuit for operating with CMOS digital circuitry. The op-amp is connected in a comparator circuit with its output tailored to safely connect to the input of a CMOS integrated circuit. Diode D1 clamps any negative voltage that could damage the CMOS device.

When IC1's input voltage goes below the reference voltage at pin 3, the output at pin 6 goes high; when the input voltage goes above the reference voltage, the output goes low. The low or negative clamped output of IC1 pulls the CMOS input low for a "0" logic input. When IC1's output is high, a "1" logic output is then fed to the CMOS device.

The main advantage of the CMOS interface is that it makes it possible for a simple or complex analog circuit to input data into a digital system. A good example of its use would be with an analog sensor that has a slow-changing output. The sensor might not necessarily produce a good input signal for digital processing, but when the sensor's output is fed through the op-amp the output level changes very fast, which produces a good logic input to the CMOS circuitry.

PARTS LIST FOR THE DUAL-VOLTAGE SUPPLY (Fig. 2)

D1-D4—1N4002 silicon rectifier diode
C1, C2—5000- μ F, 25-WVDC, electrolytic capacitor
T1—117- to 12-volt center-tap transformer (see text)
S1—SPST switch
F1—0.5-ampere fuse
Wire, solder, etc.

DUAL-VOLTAGE SUPPLY

Our next entry, shown in Fig. 2, is a simple dual-voltage power-supply circuit that can be used with our op-amp circuits. Transformer T1 can be any low-cost, low-current, 12-volt, center-tap unit you have kicking around in your parts box, or one purchased from a local parts house. In any case, the output current isn't critical and can be anything from 50 mA to 1 A. The filter capacitors, C1 and C2, should be as large in value as possible for a clean, ripple-free output.

AC AMPLIFIER

The circuit shown in Fig. 3 takes a not-so-well-known type of op-amp and places it in an AC amplifier circuit with a pre-set gain of 50. The LM3900 Norton or current-difference amplifier (IC1) really isn't a true op-amp at all, but does simulate an op-amp in its performance. One important feature that

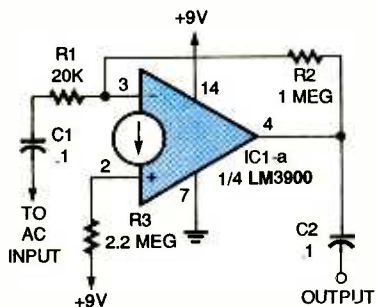


Fig. 3. While the LM3900 current-difference amplifier (IC1) used in this AC amplifier really isn't a true op-amp, it does simulate one in its performance; however, the IC requires only a one-polarity power source.

PARTS LIST FOR THE AC AMPLIFIER (Fig. 3)

RESISTORS

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

R1—20,000-ohm

R2—1-megohm

R3—2.2-megohm

ADDITIONAL PARTS AND MATERIALS

IC1—LM3900 quad op-amp, integrated circuit

C1, C2—0.1-μF, ceramic-disc capacitor
Wire, solder, etc.

the LM3900 offers is that it requires only a one-polarity power source (that is, one power pin connects to a positive supply and the other connects to ground).

The amplifier's gain is set by selecting the values of R1 and R2 as in a standard op-amp circuit. Gain is equal to

$$R2 / R1$$

The IC's positive input current at pin 2 is set by selecting the value of resistor R3.

The current at pin 2 should be the same as the feedback current for the input at pin 3. The voltage at the output is about half of the supply voltage, or in this case 4.5-volts DC. Because the current source for the positive input is taken from the full supply voltage, the resistor value would be about twice the size of the feedback resistor, R2. The nearest available value is 2.2 megohms.

The AC gain may be varied by changing the R2/R1 ratio. A 10,000-ohm resistor used for R1 increases the amplifier's gain from 50 to 100. If R2 is

changed, be sure to adjust R3 accordingly.

ADJUSTABLE COMPARATOR

Our next circuit, see Fig. 4, contains an LM741 op-amp in an adjustable comparator configuration, with an LED

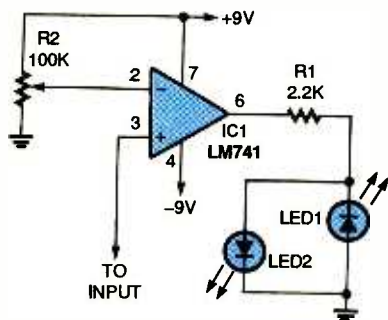


Fig. 4. This adjustable comparator may be used to drive devices such as an opto-coupler controlling an AC circuit, or a transistor-driven relay.

PARTS LIST FOR THE ADJUSTABLE COMPARATOR (Fig. 4)

IC1—LM741 op-amp, integrated circuit

LED1, LED2—Light-emitting diode, any color

R1—2200-ohm, 1/4-watt, 5% resistor

R2—100,000-ohm potentiometer

Wire, solder, etc.

indicator. With R2 set for a positive 1-volt level at pin 2, and the input voltage at pin 3 below 1-volt, the output will be negative, turning on LED1. When the voltage level at the input goes above the 1-volt level, the output switches positive, turning LED2 on and LED1 off.

The op-amp's output at pin 6 may be used to drive other devices such as an opto-coupler controlling an AC circuit or a transistor-driven relay. Another option is to use this comparator in a similar fashion as the circuit in Fig. 1—that is, to couple an analog circuit to the "digital world."

DUAL-VOLTAGE COMPARATOR

The circuit in Fig. 5 contains two 741 op-amps (IC1 and IC2) in a dual-voltage comparator circuit. Potentiometer R3 may be adjusted for one input-voltage level and R4 for another level. One

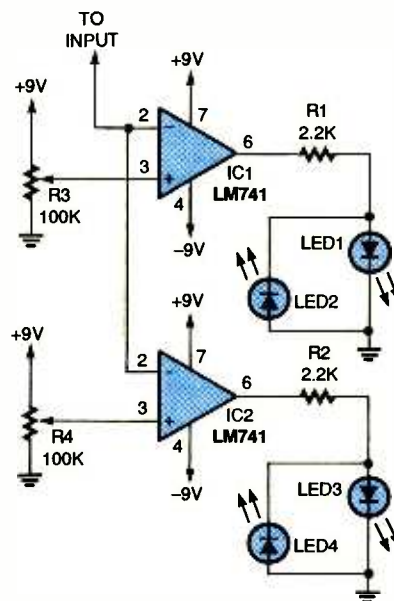


Fig. 5. Use this dual comparator to monitor a battery while it's charging; the circuit will let you check for under- and over-voltage conditions.

PARTS LIST FOR THE DUAL-VOLTAGE COMPARATOR (Fig. 5)

IC1, IC2—LM741 op-amp, integrated circuit

LED1-LED4—Light-emitting diode, any color

R1, R2—2200-ohm, 1/4-watt, 5% resistor

R3, R4—100,000-ohm potentiometer

Wire, solder, etc.

use for this dual comparator would be to monitor a battery under charge to check for under- and over-voltage conditions.

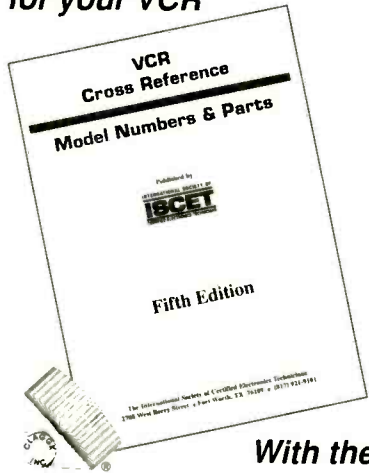
Also in this circuit, the LEDs may be replaced with other devices to control external circuitry. An opto-coupler could be used in a battery-charging circuit to shut the charger down in case of an over-voltage charge condition.

FOUR-LEVEL VOLTAGE DETECTOR

In the circuit shown in Fig. 6, an LM339 quad comparator, IC1, operates as a four-level voltage detector. Four 100,000-ohm potentiometers, R5-R8, allow for individual voltage settings for each section of the comparator. To provide status indication, four LEDs are connected to the output of the comparator sections.

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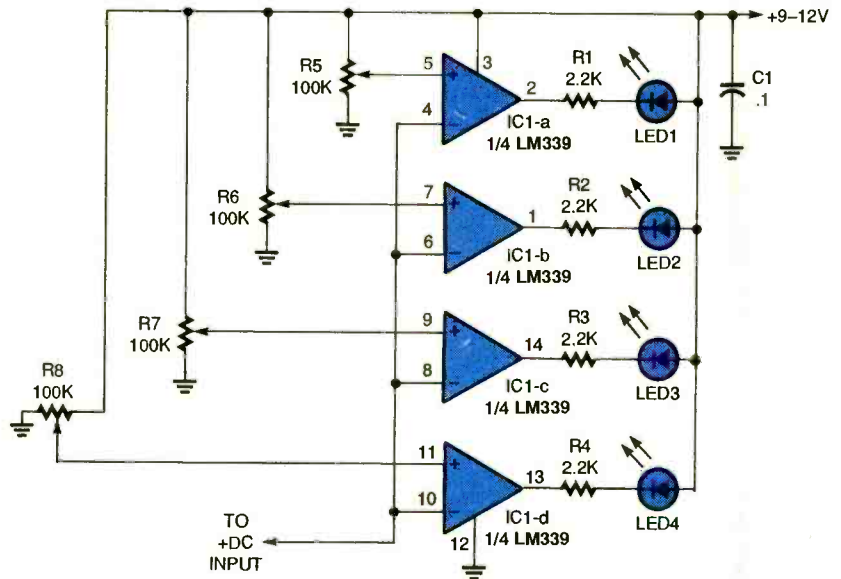


Fig. 6. This four-level voltage detector can be used as a bargraph voltmeter. Simply set each potentiometer (R5-R8) for a specific voltage.

PARTS LIST FOR THE FOUR-LEVEL VOLTAGE DETECTOR (Fig. 6)

IC1—LM339 quad comparator, integrated circuit
LED1-LED4—Light-emitting diode, any color
R1-R4—2200-ohm, 1/4-watt, 5% resistor
R5-R8—100,000-ohm potentiometer
C1—0.1-μF, ceramic-disc
Wire, solder, etc.

The circuit may be used as a bargraph voltmeter with each potentiometer set for a specific voltage. If you build two of the quad comparator circuits and connect the inputs together, you can create a voltmeter with double the read-out resolution.

VOLTAGE WINDOW

Our last entry, see Fig. 7, uses two sections of a quad LM339 comparator in a voltage-window circuit. The positive input of one comparator and the negative input of the other are tied together and serve as the input circuit. The remaining two inputs are connected to two ten-turn potentiometers, R1 and R2. The comparator's outputs, which are both tied together, operate LED1.

The easiest way to set the window circuit up is to use a digital voltmeter and set the reference voltages to the same voltage, and then vary one to set the width of the window. When the input voltage is within the window area, LED1

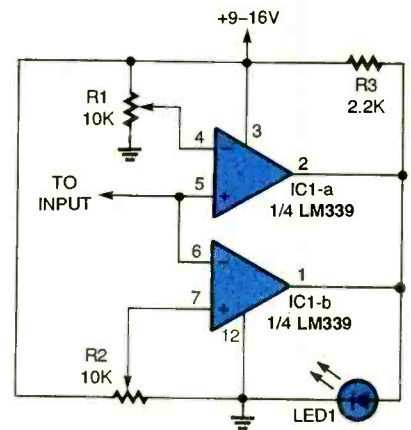


Fig. 7. Using a digital voltmeter, set the reference voltages in this voltage window to the same values. Then vary one to set the width of the window; when the input voltage is within the window area, LED1 will light.

PARTS LIST FOR THE VOLTAGE WINDOW (Fig. 7)

IC1—LM339 quad comparator, integrated circuit
LED1—Light-emitting diode, any color
R1, R2—10,000-ohm ten-turn potentiometer
R3—2200-ohm, 1/4-watt, 5% resistor
Wire, solder, etc.

will light. The circuit is very sensitive, allowing the window opening to be set to only a few millivolts, or, if you prefer, wide open for several volts.

Now that we've looked at six simple op-amp circuits, see if one can find a place in one of your projects. ■



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COMPUTER BITS

Help Tools

BY JEFF HOLTZMAN

Last month we talked about hypertext, and particularly about how to create Windows help files from scratch. This time, I want to take a brief look at three tools that help automate help-file creation.

Incidentally, I should point out that a help file doesn't necessarily have to be a help file. You can publish any text and graphics in a help file. Some people create on-line résumés. Some companies use WinHelp to publish corporate information. Others use it for on-line catalogs. The nice thing about help files is that you have a guaranteed compatible audience of every Windows desktop on the planet. The Web and browser technology is cutting in to that type of use, but it's still viable as a publishing medium.

Many tools, both shareware and commercial, are available for helping to create help files. All of them fall into one of three categories: coding helpers, WYSIWYG designers, and document converters

I'll talk about one example from each: RoboHelp, The Hypertext Suite, and Doc-To-Help. But first let's talk about some of the coding that is required to build a help file.

When creating a Windows help file, you have to be concerned with two kinds of text formatting and three footnote codes. (There are other coding styles and footnote codes, but these are the most commonly used.) The two types of formatting are hidden text and underlining. The footnote codes are the pound sign, the dollar sign, and capital K.

In a help file, the unit of information is a topic. A topic may be one screen full of information, or more information, in which case, scroll bars appear. In the source code for a help file, a hard page break separates topics. Typically following the page break is a topic title, such as "C/C++ Elements." The footnote codes precede the title.

The topic. Both the help system and the help author use the Topic ID as the target of a hypertext jump.

The dollar sign specifies the title of the topic. The title is what the help system displays as the result of an end-user search or find operation. The Topic ID and the title may be identical. Neither is required, and there are legitimate reasons for excluding them. Normally, however, both are used.

Capital K is the third footnote code. It allows the help author to specify keywords by which the help file may be searched. The list of words you see under the Index tab of the Win95 help system is simply a sorted list of all the words specified in all the K footnotes in all the topics of all the help files in the help system. K keywords are equivalent to index entries in a print manual.

Then there are the two kinds of formatting: underline and hidden text. You underline a word or phrase (or graphic) that you want to use as a hot spot. Immediately following it, you

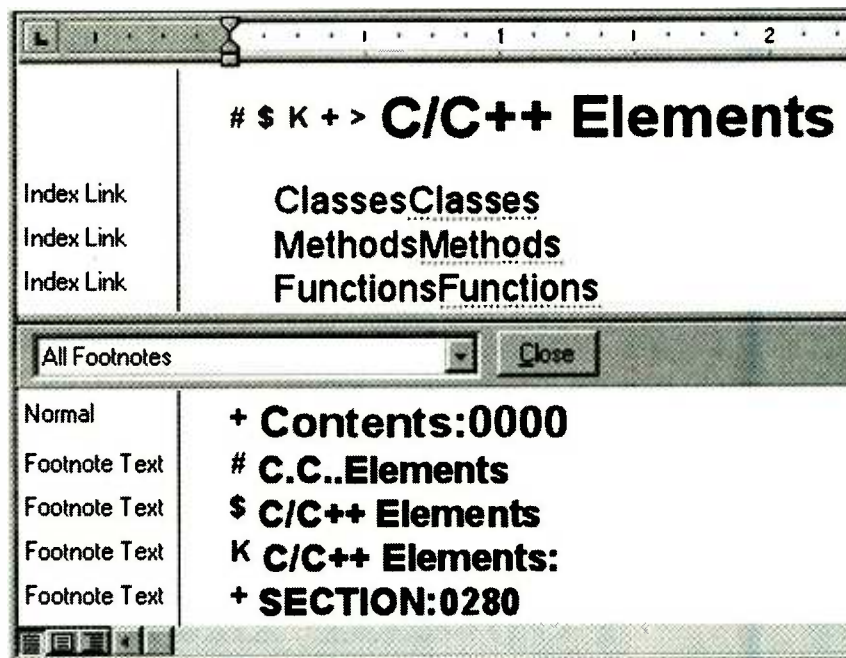
insert the Topic ID of the topic to which you want to jump. Then you format the Topic ID as hidden text.

If that process sounds convoluted, complicated, unintuitive, and so on—it is. But that's what help authors have been struggling with for years. So now let's look at the tools and see how they can help.

THE TOOLS

RoboHelp is published by Blue Sky Software and sells for \$599. It is a coding automator. That is, it helps automate the process of inserting footnote codes, underlining, hidden text, and all the others. The software thoroughly integrates itself into Microsoft Word, which is required to run the program. The RoboHelp helps you keep track of Topic IDs (jump targets), but only by means of lists, not graphically.

Doc-To-Help 2.0 by Wextech Systems goes for \$395. It also integrates itself thoroughly with MS Word. However, it attempts to shield the help



Creating Windows help files is a lot like programming in assembly language. There are lots of down-and-dirty details that make it hard to focus on more important details—like helping your users get help!

author from the nitty gritty details by having the author work in what is essentially a paper-based paradigm. In other words, you write as if for a paper manual. Then you run a conversion process, in which D2H creates separate RTF files with all the appropriate coding. The downside is that the conversion process is slower by orders of magnitude than the help compiler. For example, in one project I recently oversaw, the D2H conversion took about 20 minutes, while the help compiler took about 8 seconds.

HyperAct Inc, delivers The HyperText Suite which includes the Help Writer's Assistant 2.1 Professional for \$375. If all you need is the Help Writer's Assistant, it costs \$199. The system dispenses with Word and the paper-based paradigm altogether. Instead, HTS goes for a WYSIWYG authoring environment, in which a multi-pane window lets you view your hypertext structure as an outline, and individual topics in a word-processing pane. Actually, HTS consists of several components, of which

VENDOR INFORMATION

Blue Sky Software
7777 Fay Ave., Suite 201
La Jolla, CA 92037

HyperAct Inc.
3437 335th Street
West Des Moines, IA 50266

Wextech Systems
310 Madison Avenue, Suite 905
New York, NY 10017

the Help Writer's Assistant, HWA, is the help-authoring tool. The suite also includes a scripting language that adds a degree of interactivity to WinHelp files. HWA is available separately at lower cost, and is downloadable shareware.

Doc-To-Help is the easiest way to create a help file. It also allows you to concern yourself with higher-level issues than document formatting. But on a project of any size, it is slow. RoboHelp depends on a much deeper understanding of WinHelp coding conventions, but provides much more precise control over the finished product.

RH is also much speedier than D2H. HWA makes an admirable stab at surpassing the WinHelp coding paradigm. Its limitations are weak paper-document support, slow performance, and user-interface quirks.

Ironically enough, all three products are poorly documented. But any of them is better than working with just Word (or God forbid, raw RTF files) and the help compiler.

It's also worth noting that both RH and HWA have export-to-HTML options, which allows fairly straightforward conversion of help-system documents to Web-browser format. However, don't get your hopes up too high; the conversion is not exactly foolproof.

There is a small but active international community of Windows help developers on the Internet. You can get more information in the Help section of the Windows SDK forum on CompuServe (Go WINS SDK). There are also news net and mailing list groups on the Internet that serve the WinHelp community. ■

NEW PRODUCTS

(continued from page 29)

multimeters each come with a protective holster, operator's manual, test leads, battery, and extra fuse. The test leads are over-shrouded to eliminate the possibility of shock in dense mea-



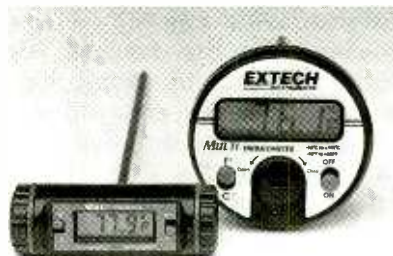
suring areas. A warning beeper sounds when the test leads are placed incorrectly.

Models 2005 and 2015 digital multimeters cost \$159.95 and \$179.95, respectively. For more information, contact Wavetek Corporation, Instruments Division, 9045 Balboa Avenue, San Diego, CA 92123; Tel. 619-279-2200; Fax: 619-565-9558.

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STEM THERMOMETERS

Two stem thermometers from Extech are designed for use in liquids and semi-solids. Both can be switched between Celsius and Fahrenheit and



offer high resolution of 0.1° to 199.9° and 1° over 200°. They are accurate to less than 2°F and 1°C.

Both models feature a five-inch

stainless-steel thermistor probe. Model 392050 has a two-inch diameter, round dial head with a 0.4-inch LCD readout. Model 392065 has a T-bar head with a 0.19-inch LCD. Both come with a plastic protective sheath with a pocket clip, and a 1.5-volt button battery.

The Models 392050 and 392065 stem thermometers each cost \$25. For additional information, contact Extech Instruments Corporation, 335 Bear Hill Road, Waltham, MA 02154; Tel. 617-890-7440; Fax: 617-890-7864; e-mail: extech@extech.com; Web site: <http://www.extech.com>.

CIRCLE 77 ON FREE INFORMATION CARD

SOLDERING IRONS

Antex soldering irons from M.M. Newman Corporation heat up rapidly, provide quick recovery times, and are comfortable to hold because their heating elements are located directly under the tips. The soldering irons accommodate a wide variety of slide-on tips for specialized applications.

Placing the heating element under
continued on page 75

HAM Radio

The Folded Dipole

BY JOSEPH J. CARR, K4IPV

Antennas are one of my passions. Many of the antennas that I have covered in these pages and elsewhere have been a bit esoteric. And although they all provide some advantages to the builder and user, they are not always simple to build and erect. From time to time, I like to cover one of the fundamental antennas.

The feedpoint is formed by breaking one of the two conductors at its midpoint. The feedpoint impedance of this antenna is just under 300 ohms, so it makes a good match to another piece of 300-ohm twin-lead used as a transmission line.

The overall length of the folded dipole is found from the same equation

amounts of RF power in transmitting stations, and in all receiving stations, but one has to be a bit careful as power levels increase. I recall one 40-meter folded dipole fed with around 400 watts of RF that got uncomfortably hot to the touch after just a few minutes of CW operation.

Folded dipole construction always looks easier in magazine articles than it is in real life. The problem is that the conductors used in 300-ohm twin-lead are small, and not intended to support any weight or stand up under wind forces (that can be larger than most of us imagine because the antenna has a large "sail area" in wind). As a result, folded dipoles usually break and come down either at the feedpoint or one of the two ends. The solution is to make fittings such as the ones shown in Fig. 2 for the center and Fig. 3 for the ends.

The folded dipole fittings in Fig. 2 must be made from an insulating material. I've seen similar devices made of hardwood salvaged from flooring, and then coated in polyurethane or varnish to protect against rain. Others use Plexiglas, Lexan, or other materials. I've even seen one commercial folded-dipole center insulator made of high-impact nylon, but it seems to have disappeared from the marketplace. In Fig. 2, the wire connections are soldered to solder lugs attached to brass machine screws. All other screws and

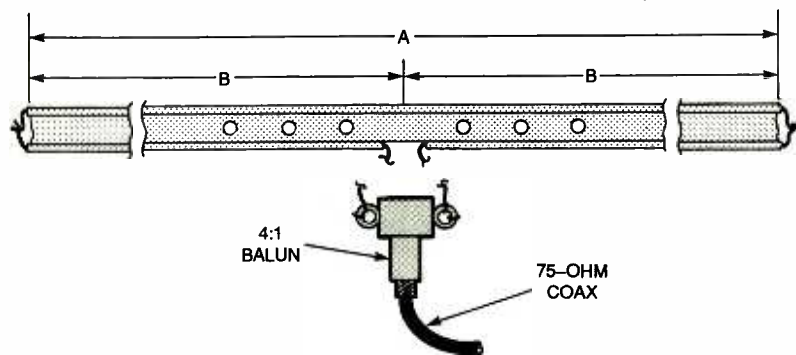


Fig. 1. The basic folded dipole. The letters are used in the formula to determine length of the element for specific frequencies. Note the holes for mounting the antenna on an insulated support.

In the past several months I have received several questions about folded-dipole antennas in my e-mail box. One was of the "what are these things" variety, but others dealt with the practical aspects of actually building a folded dipole. Building folded dipoles is not all that hard, but building one that stays up can be more than a little problematical.

The half-wave folded dipole antenna (see Fig. 1) has a wider bandwidth than the common half-wave dipole. But the improved bandwidth comes at the expense of more complex construction. The folded dipole consists of a loop of wire made from a half-wave section of twin-lead or parallel transmission line. The most common form of folded dipole uses 300-ohm television antenna twin-lead for the radiator element. Note that the two conductors of the twin-lead are shorted together at both ends of the radiator.

as a regular half wavelength dipole:

$$L = 468/f$$

where L is the length in feet and f is the frequency in MHz.

There may be a small amount of additional foreshortening due to the velocity factor of the twin-lead, so this length may be a bit long for the desired frequency. You can adjust to the desired frequency by trimming the same amount off each end while monitoring the VSWR to determine the resonant frequency.

If you want to use coaxial cable to feed the folded dipole, insert a 4:1 balun transformer at the feedpoint. It reduces the feedpoint impedance from near 300 ohms to near 75 ohms to make a good match to 75-ohm coaxial cable (e.g. RG-59 or RG-11).

A folded dipole made of 300-ohm twin-lead can be used with moderate

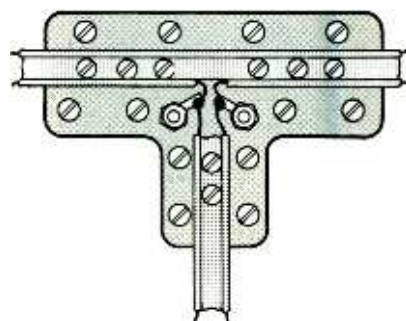


Fig. 2. Here's a detailed look at a home-brew center insulator.

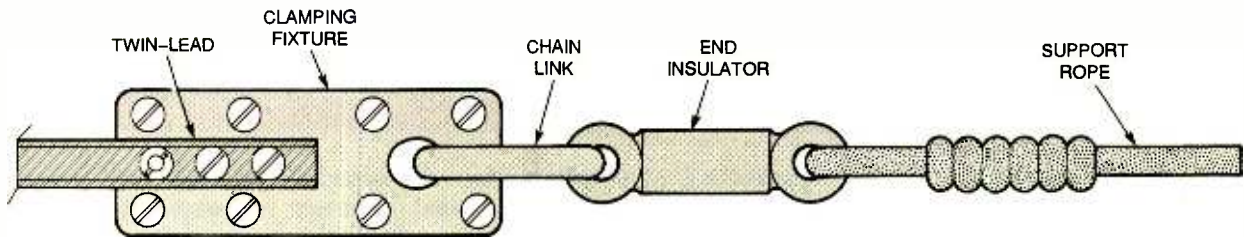


Fig. 3. An end insulator for a twin-lead dipole is easy to make if you follow this diagram.

nuts are made of nylon to minimize interaction with the antenna.

Note in Figs. 1 through 3 that holes are cut into the insulation of the twin-lead, and nylon machine screws are passed through both these holes and mating holes cut into the mounting device. Matching hex nuts on the other side secure the screw (see side view in Fig. 4). This keeps the twin-lead from slipping out of the block, or at least delays the day when it might fail.

The preparation of the twin-lead is shown in Fig. 4. Cut the length of the twin-lead radiator element according to the equation mentioned earlier to match the intended frequency for the antenna. At the exact mid-point of the twin-lead, cut one of the conductors and strip it back a bit on both sides. This is the feedpoint for the antenna's transmission line.

Also strip the wires at both ends of the dipole so the two conductors of the twin-lead can be connected together (the folded dipole forms a complete loop with a very low—near zero—resistance at DC, (but not at RF). Cut the holes in the twin-lead with a paper hole punch. Alternatively, you can use a leather hole punch.

Solder all connections with either 50/50 or 60/40 resin core solder (**never use acid core solder in electronics!**). You are not soldering to provide strength, but rather to protect the electrical integrity of the joint.

SAFETY WARNING

Erecting antennas can be dangerous. Do not assume that the twin-lead insulation will protect you if it contacts the electrical power lines. **Never attempt to throw an antenna wire or transmission line across power lines!** The two insulations can cut into each other, and if you touch such a

connection you'll become a big smoking hole in the ground. Mixing antennas and AC power lines is a lethal stupidity.

WARC-99 WARNING

Every ten to twenty years the nations of the world convene in Geneva, Switzerland to haggle about the allocation of the radio-frequency spectrum. This is called the World Administrative Radio Conference (WARC), and since the next one is in 1999, it is being called WARC-99. It was during WARC-79 that ham operators won the use of the 30-meter, 17-meter, and 13-meter bands. But that doesn't mean we will win anything the next time. Indeed, there is a strong danger that we will lose spectrum space.

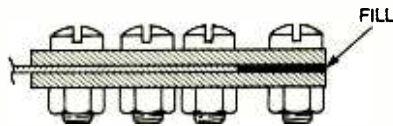


Fig. 4. This side view of the center insulator shows how it protects the twin-lead antenna wire.

The financial value of spectrum space has never been greater because of the proliferation of wireless technologies. One package-delivery service has already attacked the 220-MHz ham band, and that's only the start. Look for attempts to take over many of our bands, especially in the VHF, UHF, and microwave regions. If we are not using them a lot, then we can expect no assistance from the FCC.

If you want to keep up with WARC-99 preparations, then let me recommend that you join the American Radio Relay League (ARRL), 225 Main

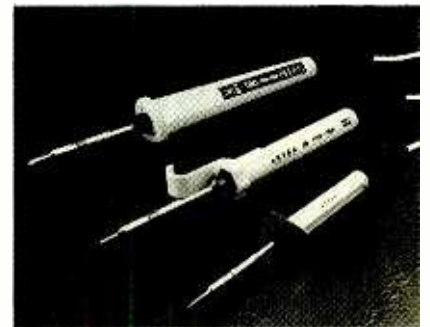
Street, Newington, CT 06111. Some people feel a little antipathy for the ARRL, for real or imagined grievances, but there is one thing that is for certain: with regard to WARC-99 they are basically the only game in town.

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

NEW PRODUCTS

(continued from page 73)

the tips provides optimum thermal efficiency. The Antex line includes the G/3U 18-watt miniature iron, which heats up to 750°F; the standard Model XS 25-watt iron, which reaches 800°F; and the temperature-controlled Model TCS, whose in-handle controls allow the temperature to be adjusted from



390°F to 850°F with $\pm 1\%$ stability during use. All three models are ready to solder in just 45 seconds. The lightweight soldering irons feature plastic handles that stay cool, making work more comfortable.

Prices for the Antex soldering irons start at \$19. For additional information, contact M.M. Newman Corporation, 24 Tioga Way, P.O. Box 615, Marblehead, MA 01945; Tel. 617-631-7100; Fax: 617-631-8887. ■

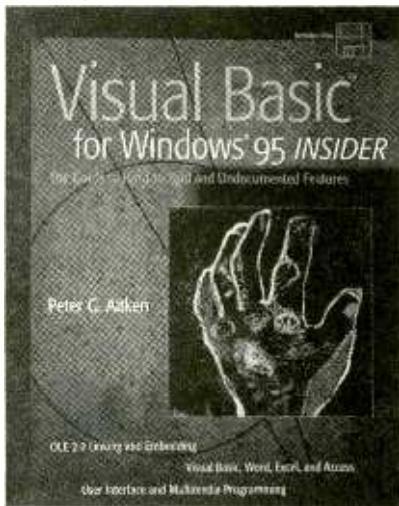
Circle 78 on FREE INFORMATION CARD

ELECTRONICS LIBRARY

VISUAL BASIC FOR WINDOWS 95 INSIDER: The Guide to Hard-to-Find and Undocumented Features

by Peter G. Aitken

Visual Basic for Windows 95 is the programming language used by serious programmers who want shortcuts when developing Windows applications. This book teaches users the latest undocumented capabilities of Visual Basic for Windows 95, so that they can accomplish their everyday programming tasks more quickly and easily.



Readers learn how to master the new Windows Applications Program Interface (API), and how to link Windows 95 applications using OLE 2.0. The book shows how to use Visual Basic for Windows 95 to create multimedia applications and prototype applications, write database programs for Microsoft's Access, and create graphical front-ends for other programs.

The book explains how to get more out of Visual Basic for Windows 95 by customizing the program to match the reader's style of working and individual goals. It provides many innovative shortcuts, tricks, and techniques that aren't documented anywhere else.

The included diskette contains drop-in code, including interface design components and tools; component applications,

including OLE 2.0 programs; advanced graphics routines; and system management programs.

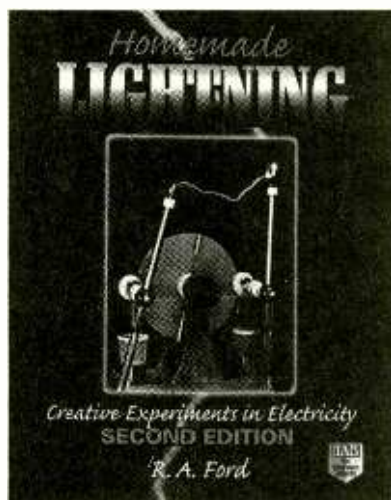
Visual Basic for Windows 95 Insider: The Guide to Hard-to-Find and Undocumented Features costs \$44.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-CALL-WILEY.

CIRCLE 80 ON FREE INFORMATION CARD

HOMEMADE LIGHTNING: CREATIVE EXPERIMENTS IN ELECTRICITY Second Edition

by R.A. Ford

Striking a delicate balance between challenging readers and confusing them, this book is filled with useful projects for serious hobbyists, students, inventors, and experimenters. The updated and expanded second edition provides newly discovered information on electrostatic generators and complete, step-by-step directions for building different types of generators; including Wimshurst and Van de Graaff.



The book thoroughly covers the theory of electrostatic generator operation to give readers a solid foundation for the projects. Experiments include electrostatic construction, electrohor-

iculture, gravitation and electricity, cold light, and electric tornadoes. The text also discusses Victorian-era electrostatic generator design, contains accompanying illustrations from turn-of-the-century patent applications, and provides hard-to-find information on electrical anomalies.

Homemade Lightning: Creative Experiments in Electricity, Second Edition costs \$19.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 800-233-11286.

CIRCLE 81 ON FREE INFORMATION CARD

WORLD TREASURE NEWS

from Fisher Research Laboratory

If you haven't yet been bitten by the treasure-hunting bug, this newsletter should do the trick. The 28-page, magazine-style newsletter documents valuable discoveries made around the world by people using Fisher metal detectors. The unburied treasures include a Confederate battle medal that fetched



\$11,000 at auction, a forgotten 19th-Century cemetery, gold nuggets, the wreck of a Civil War submarine that sank in 1867, a variety of weapons used in crimes ranging from robbery to murder, and solid gold Celtic coins dating from the 1st Century B.C.

The newsletter contains articles on archaeology, gold prospecting, underwater treasure hunting, new products, and treasure-hunting clubs. Excerpts of an article that originally appeared in the February 1939 issue of *Science and Mechanics Magazine* describes how to make your own two-box metal detector.

The World Treasure News is free upon request from Fisher Research Laboratory, Dept. P-E, 200 West Wilmott Road, Los Banos, CA 93635; Tel. 800-M-SCOPE-1 or 209-826-3292; Fax: 209-826-0416.

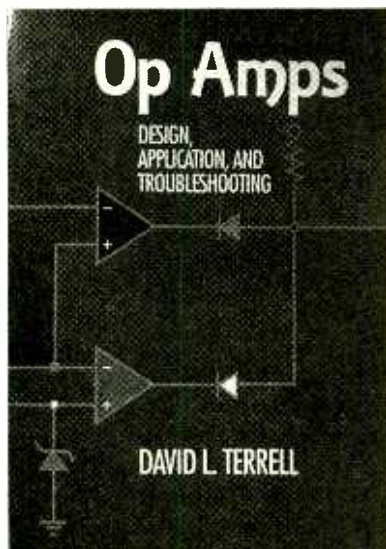
CIRCLE 82 ON FREE INFORMATION CARD

OP AMPS: DESIGN, APPLICATION, AND TROUBLESHOOTING Second Edition

by David L. Terrell

This easy-to-read book deliberately straddles the imaginary line between the technical and engineering worlds. Technical details of operational amplifiers are explained in clear and understandable language without sacrificing technical depth.

Topics are carefully addressed on three levels. The operational overview describes the purpose and explains the



operation of each op-amp circuit from an intuitive and non-mathematical point of view. The numerical analysis shows how to calculate important circuit para-

meters such as AC and DC voltages, amplification, frequency response, switching speeds, and input and output impedances. The design procedures discussion presents step-by-step design techniques for a wide range of op-amp circuits, including basic amplifiers, comparators, oscillators, active filters, signal-processing circuits, and more.

The book also presents troubleshooting techniques that rely on the application of fundamental electronics principles, and it describes systematic methods that can be used to diagnose defects in many kinds of circuits that use op amps.

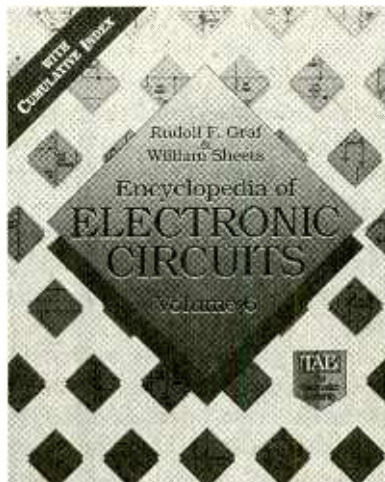
Op Amps: Design, Application, and Troubleshooting, Second Edition costs \$49.95 and is published by Butterworth-Heinemann, 313 Washington Street, Newton, MA 02158-1626; Tel. 617-928-2500; Fax: 617-928-2620.

CIRCLE 83 ON FREE INFORMATION CARD

ENCYCLOPEDIA OF ELECTRONICS CIRCUITS Volume 6

by Rudolf F. Graf & William Sheets

Like each of its five predecessors, Volume 6 of this popular series contains more than 1000 state-of-the-art electronics circuits, most direct from the manufacturers, some designed by the authors, and others collected from books and magazines. To make it easy for readers to find what they need, the circuits are arranged alphabetically by type. The book's index is cumulative,



listing the more than 6000 circuits that have been published to date in the six-volume series. Together, those six books form a comprehensive reference that will allow readers to quickly and easily find the types of circuits they need.

The book is divided into more than 100 circuit categories, including amateur TV, amplifiers, battery chargers, clocks, computers, fiber-optics, games, lasers, light-control, Morse Code, oscillators, power supplies, radar detectors, scanners, timers, transmitters, and white-noise generators.

Encyclopedia of Electronics Circuits, Volume 6, costs \$34.95 and is published by McGraw-Hill Book Company, 11 West 19th Street, New York, NY 10011; Tel. 800-2-MCGRAW.

CIRCLE 84 ON FREE INFORMATION CARD

TOOL & EQUIPMENT CATALOG #55

from Techni-Tool

This 254-page, full-color catalog features hundreds of products for electronics professionals and hobbyists. Product categories include cases and tool kits, cleaning and safety supplies, test instruments, soldering and desoldering gear, telecommunications and fiber optics, pliers and cutters, strippers and crimpers, production tools, ESD control, workstations and chairs, and magnifiers and lights. The catalog provides a photograph and full description of each item offered. Also featured is Techni-Tools "Design-A-Kit"



service, which allows you to specify precisely which tools you want—and don't want—in a tool kit.

Catalog #55 is free upon request from Techni-Tool, 5 Apollo Road, Box 368, Plymouth Meeting, PA 19462; Tel. 610-941-2400; Fax: 610-828-5623.

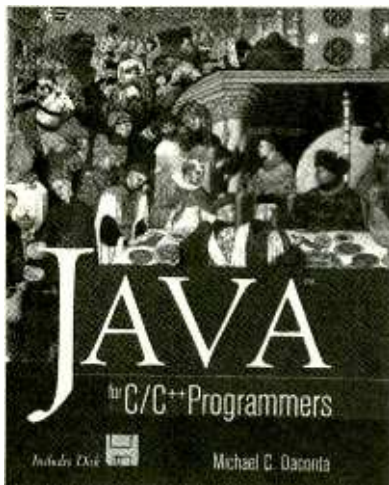
CIRCLE 85 ON FREE INFORMATION CARD

JAVA FOR C/C++ PROGRAMMERS

by Michael C. Daconta

Most C and C++ programmers already have some of the skills needed to write simple Java applets. This book helps them take the next step to become proficient in Java.

The book teaches Java by building on C and C++ concepts. Taking readers beyond applet development, it trains them on how to exploit the languages' similarities. The book explains how to program proficiently using Java, the Java Abstract Window Toolkit, and applets. It teaches readers how to develop large-scale, multi-platform, networked Java applications in days. It also presents the basics of JavaScript programming and shows readers how to incorporate JavaScript code into Web pages.



The book comes with a disk that includes more than 100 complete Java and JavaScript source code examples from the text; useful Java applications such as a database management system, a graphical reminder application, and a multi-threaded simulation; and

time-saving programmer utilities including a Line Number filter, a Comment filter, and an API extractor.

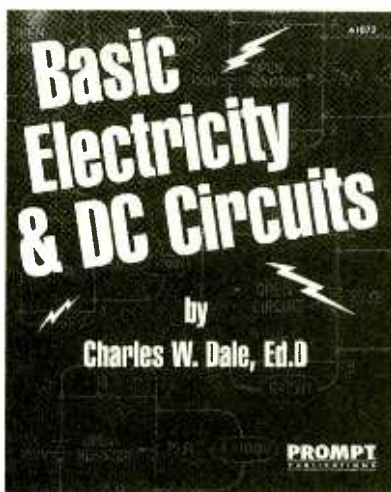
Java for C/C++ Programmers costs \$39.95, including disk, and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-CALL-WILEY.

CIRCLE 86 ON FREE INFORMATION CARD

BASIC ELECTRICITY & DC CIRCUITS

by Charles W. Dale, Ed.D.

This book requires no previous knowledge of electricity or sophisticated mathematics. It allows readers to learn about electricity from the ground up, at their own pace. Concepts and terms are introduced as they are needed, with many detailed examples and explanations.



Each topic is presented as a complete lesson, with its objectives stated up front and with three different types of examples to wrap up. Worked-through example problems apply the theory taught in each lesson to real-life situations involving DC electricity. Next, readers can test their new skills by trying to solve a set of practice problems. Finally, a two-page quiz serves as an indicator of areas requiring further study.

Lesson topics include an introduction to electricity; voltage, current, and resistance; scientific notation and metric prefixes; Ohm's Law and power; series circuits; parallel circuits; parallel-series circuits; series-parallel cir-

cuits; voltage dividers and power; Kirchoff's Laws; advanced methods of DC circuit analysis; capacitors and the RC time constant; and inductors and the L/R time constant.

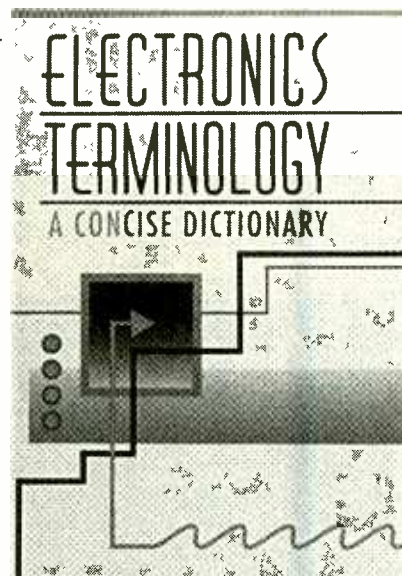
Basic Electricity & DC Circuits costs \$34.95 and is published by Prompt Publications, 2647 Waterfront Parkway, East Drive, Indianapolis, IN 46214-2012; Tel. 800-428-7267 or 317-298-5710; Fax: 317-298-5604.

CIRCLE 87 ON FREE INFORMATION CARD

ELECTRONICS TERMINOLOGY: A Concise Dictionary

compiled by Informatik Rezurch

This pocket-sized book provides up-to-date, succinct definitions of electronics jargon for technicians and engineers on the move. The book's first section contains translations of acronyms ranging from "A" (angstrom unit) to "ZnO" (zinc oxide). The second section offers many



straight forward definitions of electronics, packaging and production, computer, and semiconductor terms. Many acronyms and definitions are cross-referenced to provide complete coverage.

Electronics Terminology: A Concise Dictionary costs \$12.95 and is published by Butterworth-Heinemann, 313 Washington Street, Newton, MA 02158-1626; Tel. 617-928-2500; Fax: 617-928-2620.

CIRCLE 88 ON FREE INFORMATION CARD

DIGITAL PANEL METERS

(Continued from page 44)

tance or along the length of the current-carrying jaws.

For a 3½-digit DPM, Kelvin Clips can also be used, but heavy solid-copper clips (also made by Mueller and available from Mouser Electronics and Hosfelt Electronics) will also work and are much cheaper. For copper clips, you have to move them slightly, after clipping them on the object to be measured, to get the lowest resistance. (The resistance along the

length of copper clips is about 0.1 milliohm.)

An LM317T adjustable voltage regulator, IC1, is used as a current limiter; IC1 limits the voltage between its output and adjustment terminals to 1.25 volts, and R5 and R6 are chosen to have that voltage drop at the desired current. At low currents, the resistance must be slightly higher than the calculated value; for 10 mA, R6 should be about 135 ohms, but this might vary slightly for different LM317Ts. In the prototype, a 200-ohm multi-turn trimmer potentiometer was used for R6, and was calibrated by measuring several precision resistors. An alternate calibration method is to connect a milliammeter to the test leads and adjust R6 for a reading of 10 mA. The calculated value for R5 is 12.5 ohms; the nearest standard 1% resistor value is 12.4 ohms. Because there is a slight variation in LM317Ts from the specified 1.25 volts, measure a few units to find one having the closest output to that value. An alternative would be to use a 20-ohm trimmer potentiometer for R5.

When the current is at the limit of 10 mA or 100 mA, LED1 lights. If LED1 is dim, the battery is getting weak. Components Q2, R2, R3, and R4 make up the control circuit for LED1. The LED is a low-current type, needing only 2 mA to 2.5 mA, which extends the life of B1 and also gives a better indication (than a standard LED) if the current is below the limit. RadioShack offers a red, low-current LED (number 276-044). Another source is Digi-Key Corp.; they have red (number HLMP-4719QT-ND) and yellow (number HLMP-4710QT-ND). Linrose Electronics Inc. has three case styles, each in three colors (red, yellow, or green, series 4300F, 4300H, and 4300T), which are sold by local parts distributors.

Zener-diode D3 can be used if desired to protect the DPM from high voltage accidentally applied to the test leads. It is selected in the same manner as was D3 in Fig. 7. On the 4½-digit DPM used in the prototype, the common point for the decimal-point jumpers was not connected to the common point for voltage input, and S2-b was wired as shown in Fig. 9. Again, the order of the decimal-point jumpers varies on different DPMs. In the prototype, a 4-pole, 3-position ro-

DPM SUPPLIERS

All Electronics Corp.

P.O. Box 567
Van Nuys, CA 91408-0567
Tel. 800-826-5432
Fax: 818-781-2653
Stock-number PM-128 (3½-digit)

B.G. Micro, Inc.

P.O. Box 280298
Dallas, TX 75228
Tel. 800-276-2206
Fax: 214-271-2462
Stock-number PM-128 (3½-digit)

Black Feather Electronics

645 Temple Avenue #7
Long Beach, CA 90814
Tel. 800-526-3717
Stock-number PM-1 (3½-digit)

Circuit Specialists, Inc.

P.O. Box 3047
Scottsdale, AZ 85271-3047
Tel. 800-528-1417
Fax: 602-464-5824
Stock-numbers PM-128 (3½-digit) and PM-328 (4½-digit)

Hosfelt Electronics, Inc.

2700 Sunset Blvd.
Steubenville, OH 43952-1158
Tel. 800-524-6464
Fax: 800-524-5414
Stock-numbers 39-165 and 39-177 (3½-digit) and 39-176 (4½-digit)

Jameco Electronics

1355 Shoreway Rd.
Belmont, CA 94002-4100
Tel. 800-831-4242
Fax: 415-592-2503
Stock-numbers 108388 or DPM128 (3½-digit) and 123140 or DPM328 (4½-digit)

Marlin P. Jones & Assoc. Inc.

P.O. Box 12685
Lake Park, FL 33403-0685
Tel. 800-OK-2-ORDER
Fax: 800-4-FAX-YES
Stock-numbers 6929-ME (3½-digit) and 7160-ME (4½-digit)

tary switch was used for S2, with one pole not used.

In building the prototype, the regulator was mounted to the case, and its terminals were used as tie points. Components Q2, R2, R3, and R4 were mounted on the extra pads of the DC-to-DC power supply board. No pilot light is used; if one is desired, another 3300-ohm resistor and low-current LED could be used, connected from the input terminal of IC1 to the negative terminal of B1. Total parts cost is about \$35 if a 3½-digit DPM and copper test clips are used. For a 4½-digit DPM and Kelvin clips, the total parts cost of the unit is about \$60. ■

PARTS LIST FOR THE LOW-OHMS METER (Fig. 9)

SEMICONDUCTORS

IC1—LM317T adjustable-voltage regulator, integrated circuit
Q1—2N3904 general-purpose NPN transistor
Q2—2N3906 PNP transistor
D1—1N4001 silicon rectifier diode
D2—1N4742A 12-volt Zener diode
D3—Zener diode (optional, see text)
LED1—Low-current light-emitting diode (see text)

RESISTORS

(All resistors are ¼-watt, 5% units, unless otherwise noted.)

R1—See text and Table 1
R2—10,000-ohm
R3—2200-ohm
R4—3300-ohm
R5—12.4-ohm, 1%
R6—135-ohm (see text)
R7—180,000-ohm, 1%
R8—20,000-ohm, 1%

CAPACITORS

C1, C3—0.1-μF, Mylar or ceramic-disc
C2—Mylar or ceramic-disc (see text and Table 1)
C4—22-μF, 16-WVDC, electrolytic
C5—100-μF, 25-WVDC, electrolytic

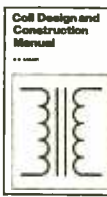
ADDITIONAL PARTS AND MATERIALS

T1—600- to 600-ohm, center-tapped transformer (see text)
S1—SPDT miniature slide or toggle switch
S2—3P3T rotary switch (see text)
B1—9-volt alkaline battery
Perforated board, enclosure (RadioShack number 270-222 or similar), DPM module, battery snap, zip cord (18- or 20-gauge), test clips (see text), wire, solder, hardware, etc.

Hobbyist's Paperback Budget Books



□ BP80/98—Popular Electronic Circuits—Books 1 and 2...\$11.90. Contains a wide range of circuits which are accompanied by text giving a brief introduction, circuit description and special notes on construction and setting-up that may be necessary.



□ #160—Coil Design and Construction Manual...\$5.95. A complete book for the home builder on how to make RF, IF, audio and power chokes and transformers. Practically every possible type is discussed and calculations are explained in detail.



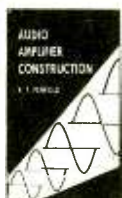
□ BP271—How to Expand, Modernize and Repair PC's and Compatibles...\$7.75. All the practical information you are likely to need to upgrade your PC and compatible. Also contains useful information and illustrations to help you with repairs.



□ BP276—Shortwave Superhet Receiver Construction...\$6.95. Provides construction details, including coil winding, of a number of advanced-design receivers which should have performance levels at least equal to commercial sets of similar complexity.



□ #223—50 Projects Using IC CA3130...\$5.00. One of the more practical and useful operational amplifiers (opamp), the CA3130 integrated circuit chip is the heart of several easy-to-assemble projects covered in the book. The projects are divided into five categories: audio projects, RF projects, test equipment, household projects and a catch-all miscellaneous group. Ideal for all skill levels.



□ BP122—Audio Amplifier Construction...\$5.75. Practical designs are featured and include circuit diagram and description, Veroboard or printed-circuit board layout and construction notes. The text is divided into two parts. The first deals with many types of preamplifiers. The second covers power amplifiers from a simple low-power battery type to a 100-watt DC-coupled amplifier using four MOSFETs in the output stage.



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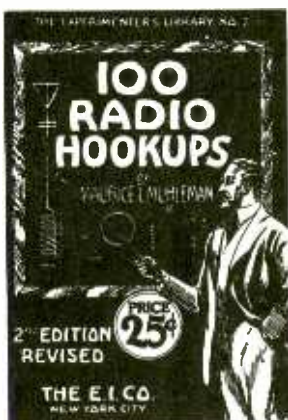
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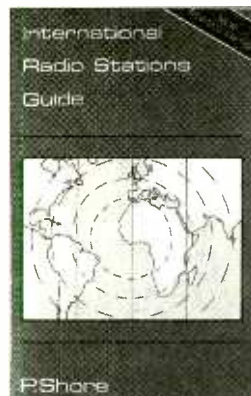
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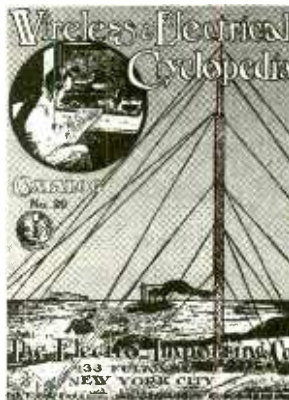
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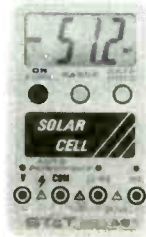
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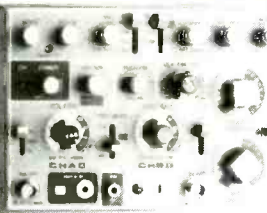
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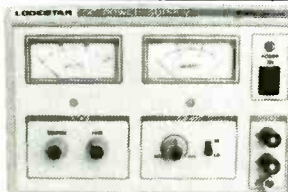


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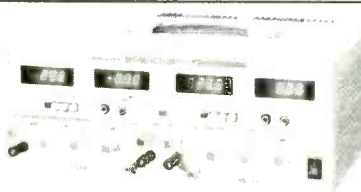
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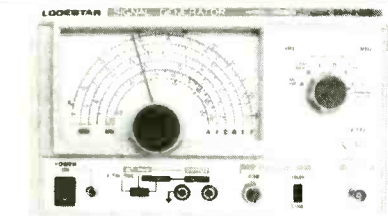
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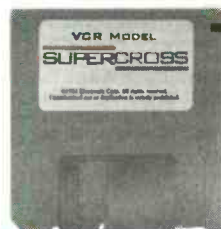
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MV-3100A \$159.95 wide band 5Hz-1MHz, 3 scales, mV, dB & dBm; 300 μ V-100V in 12 ranges, 10 μ V resolution, -70-40dB in 12 ranges, 0dB=1Vrms, 0dBm=0.755V; $\pm 3\%$ accuracy; Input impedance 10M Ω ; Noise <2% **MV-3201B \$309.95** dual Display 3 digit LED channels, simultaneous measurement.

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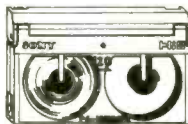
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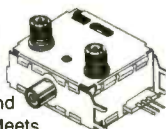
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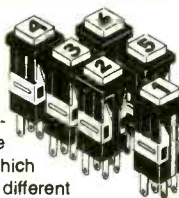


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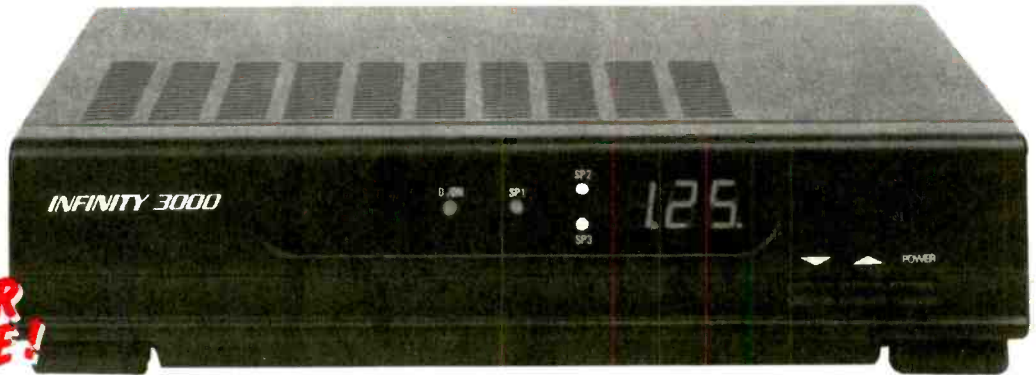
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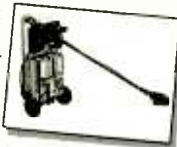
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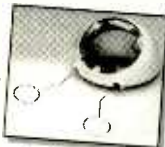


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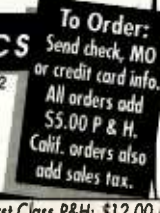
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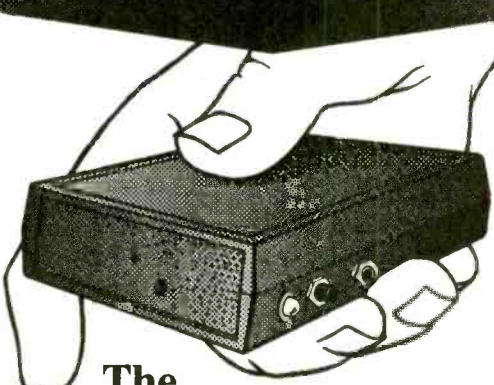


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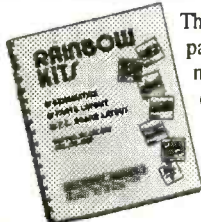
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WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-2 kit is a buffered wireless mike that operates from 80MHz to 120MHz

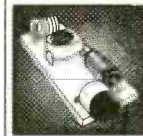
FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. 6 to 12v DC. SIZE: 1.25" x 1"
WM-2 KIT \$14.95



MICRO-MINIATURE PHONE TRANSMITTER

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

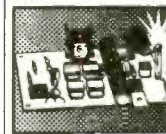
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MICRO-MINIATURE WIRELESS MIKE

So small you could hide this one on some real bugs! It's the smallest we've ever seen. With it's super sensitive mike it transmits a whisper or a room of conversation to an FM radio, tunable from 88 to 108MHz FM. With a proper antenna it transmits about 1/2 mile. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. Power requirement 6 to 12v DC. Size .35" x .9"

MMWM5 KIT \$34.95



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Press a button and learn every number dialed on your phone

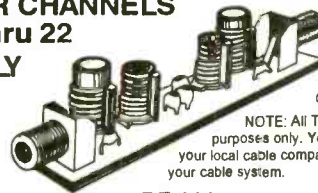
Okay. Caller ID's tell you what number is calling you. But what about the calls made from your phone? Now, return from work or vacation and know the answer. The new DTMF Recorder electronically logs and saves every number dialed. This is the same high-tech magic used by detectives and government spies. Now yours. Does your wife or husband make expensive long-distance calls and then deny it? Does your son or daughter call that low-life you forbade them to talk to? Now know.

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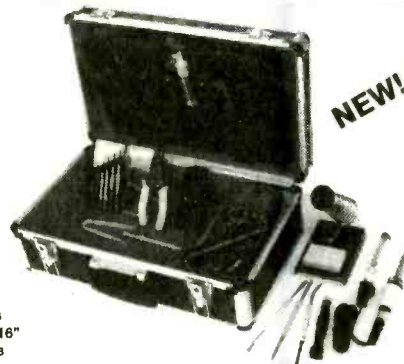
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- TL-8 - Precision Screw Drivers
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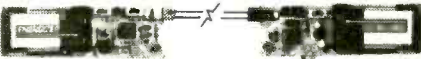
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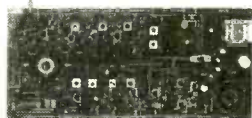
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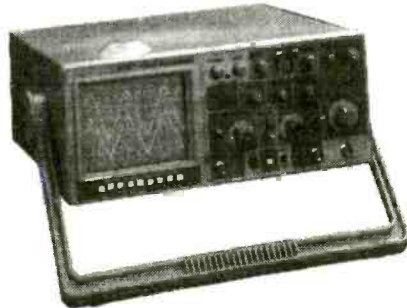
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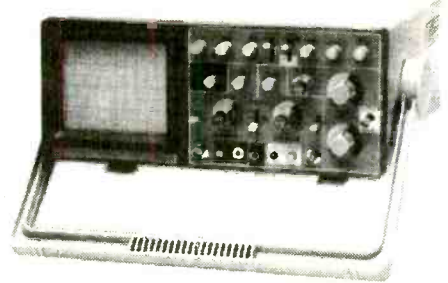
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ANALOG		Sensitivity (max)	No. of Channels	Sweep Rate Max ns/div	Delayed Sweep	Video Sync	Component Tester	Beam Find	Time Base
Model	Bandwidth MHz								
S-1385	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1360	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1345	40	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1340	40	1mV/div	2	10ns/div	No	Yes	No	No	1
S-1330	25	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1325	25	1mV/div	2	10ns/div	No	Yes	No	No	1

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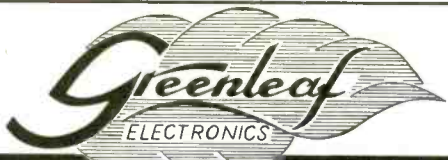
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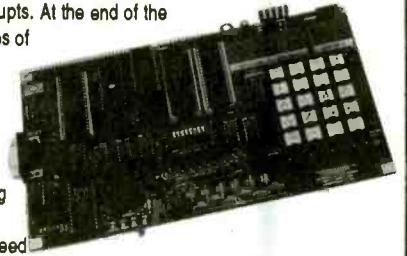
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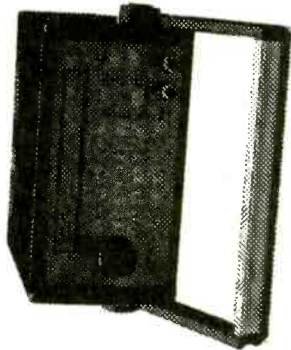
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Rubber Boot Included

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+2dgt)
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+2dgt)
20mA 10µA
200mA 100µA
10A 10mA ±(1.2%rdg+2dgt)

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

AC Voltage (ACV)

Range; Resolution: Accuracy:

200V 100mV ±(1.2%rdg+10dgt)
750V 1V

Frequency Range: 45Hz-450Hz

Maximum Allowable Input: 750V rms

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



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Range; Resolution: Accuracy:

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2000Ω 1Ω
20KΩ 10Ω ±(1.2%rdg+2dgt)
200KΩ 100Ω
2000KΩ 1KΩ
20MΩ 10KΩ ±(2%rdg+10dgt)
Maximum Open Circuit Voltage: 2.8V

Diode Test

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

hFE Test

Measures transistor hFE.

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

Switchable Scope Probe Sets

(Selectable X1/Ref/X10) These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 150MHz (model HP 9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

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



Positive Photo Resist Pre-Sensitized Printed Circuit Boards

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

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

CAT NO	DESCRIPTION	PRICE EACH		
		1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	\$2.55	\$1.90	\$1.70
PP114	114mm x 185mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10

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

CAT NO	DESCRIPTION	PRICE EACH		
		1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	\$ 3.90	\$2.98	\$2.60
GS114	114mm x 185mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80

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

CAT NO	DESCRIPTION	PRICE EACH		
		1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	\$ 5.07	\$3.68	\$3.38
GD114	114mm x 185mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30

Etching Chemicals/Ferri Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	PRICE EACH	
		1	5
ER-3	Makes 1 pint	\$3.50	\$2.75



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

CAT NO	DESCRIPTION	PRICE EACH		
		1	10	25
POSDEV	Positive Developer	\$.95	\$.80	\$5.50



Etching Tank This handy etching system will handle PC boards up to 8"x9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!

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

Desoldering Pumps

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



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

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Electronic Soldering System Here's the ideal solution

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

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



Electronic Soldering System with LED Display

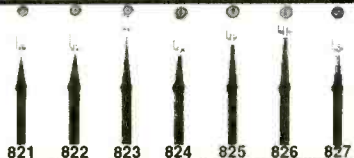
Deluxe temperature controlled system with LED display for maximum accuracy. Temperature is adjustable from 160°-480°C (320°-900°F). Iron heating power is 48 Watts. Runs on 24V from controller unit. Replacement irons and tips are available. Tip size is 5.3mm.

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



Replacement Tips for SL10/SL30

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



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

Ball Bearing 12V DC Fans



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

INDUSTRY BEST PRICING!

Specifications

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

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

CCD Camera - IR Responsive As Low As \$109!!

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



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

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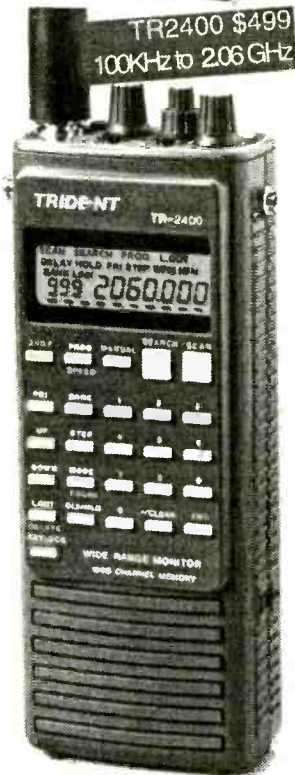
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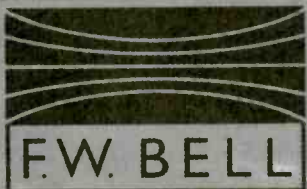
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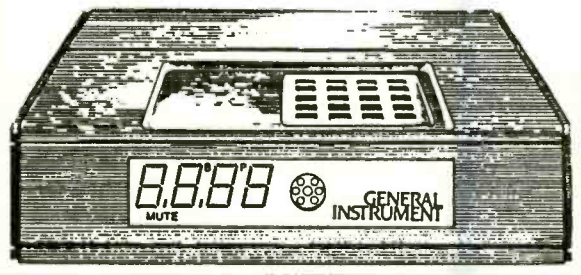
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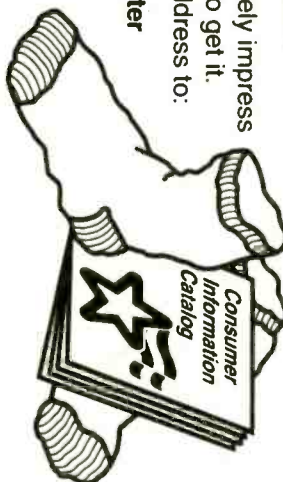


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RADIO AMATEURS

(Continued from page 52)

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17. Use their PCs: Do you own or use a PC? If so, that's great, since few activities go together as well as personal computing and amateur radio. Today's technology lets amateurs link their PCs to their radio equipment, to perform many tasks in the hamshack that make an already enjoyable hobby much more fun. And, best of all, you don't have to be a computer whiz to take advantage of the technology.

However, one hang-up has been software. Until just a few years ago, hamshack PC software was quite limited, and it focused mainly on QSO and contest logging. Today, software has emerged that lets you use your PC for much more, including a dozen-and-a-half distinct classes of software applications, such as: Morse Code and radio theory practice, instruction, and testing; computer-based radio and station control; logging, contesting, and awards tracking; automated QSL card processing; directional antenna aiming; radio propagation prediction; antenna design and modeling; satellite tracking and antenna control; CW and RTTY reception and transmission; and packet radio and other digital communications.

Other computer applications include graphical (image) communications such as FAX, SSTV, WeFAX, and FSTV (fast-scan TV); electronic circuit design and performance calculation; CD-ROM based callsign lookup; and various forms of online communication, including the Internet. You could also add a "miscellaneous" classification to include multipurpose hamshack software to logically integrate a variety of functions for maximum efficiency and convenience. Indeed, as we transition to Windows 95, OS/2, and other graphical, multitasking environments, traditional software classifications will blur as hamshack tasks become more demanding and programs multifunctional and better integrated.

Putting it all Together. From the foregoing, you can see that there are many diverse aspects of amateur radio—so many that hams can easily pursue the hobby too intensely, to the exclusion of friends, family, and the "real world" community around them. After all, even in this high-tech, digital world, amateurs still are real people, not virtual ones.

There's a long-standing Amateur's Code that helps puts those things together. Originally written by Paul M. Segal, W9EEA, in 1928, the Code has been adopted by the ARRL, and it's still meaningful today. While perhaps a bit idealistic in its "mom and apple pie" approach, it properly stresses that the radio amateur is balanced, never interfering with the pleasure of others; loyal to other amateurs; progressive, with his operations above reproach; friendly, offering advice and counsel to beginners; balanced, with amateur radio an avocation that shouldn't interfere with duties to family, job, school, or community; and patriotic, with station and skills made available for service to country and community. Very good advice for yesterday, the present, and especially the future.

A good way to keep up with the hobby and its practitioners is to go online, either with one of the online communications utilities such as America Online and CompuServe, or on the Internet (especially the World-Wide Web). Be sure to check out the Ham Radio Club (Keyword: HAM or HAM RADIO) and ARRL areas (found in the Ham Radio Club) on America Online, and the HamNet Forum (GO HAMNET) on CompuServe. The CompuServe HamNet Forum is especially useful in that it has a number of areas in which you can exchange messages and download software files relating to most of the activities and interests we discussed. There also is the related HamNet Companion Internet Web page, found at <http://www.webcom.com/~sj/HamNet—Companion/>.

As we've seen, amateur radio definitely isn't a trifling hobby despite its rather obscure origins, its sometimes unusual pursuits, and its strange jargon. And, since it is one of the few hobbies for which you have to be licensed to participate, hams appreciate the hobby even more for its strict entry requirements. Maybe you'll give

this fascinating and rewarding avocation a try—if you do, you won't be sorry.

Becoming a Ham. Anyone can become a radio amateur, regardless of age, gender, or physical ability. Hams include students, retirees, young people, old people, clergymen, mechanics, technicians, homemakers, doctors, engineers, pilots—just about anyone, including yourself. People from all walks of life and of all ages can and do pass the amateur exams.

Best of all, getting an amateur-radio license is easier than you might think, especially since 1991, in that you no longer have to learn Morse code. And even entry-level (Novice, Technician, and Technician Plus) licenses let you use voice and the latest digital and computer-based technologies on the air.

Of course, to obtain a license, you must pass an exam. In 1985, the FCC set up a program whereby licensed radio amateurs called Volunteer Examiners (VEs)—amateurs in the community who volunteered their services as test-givers—were organized into testing teams by several (now 16) FCC-authorized Volunteer Examiner Coordinator (VEC) groups.

The VECs are certified by the FCC to administer exams; questions are drawn from a regularly updated question pool developed by the FCC and the VECs. The VECs conduct exam sessions, often held at hamfests. Although the FCC doesn't charge to issue or renew licenses, the VECs may charge nominal fees.

The VECs administer the exams for the Novice, Technician, Technician Plus, General, Advanced, and Extra "tickets." Although you can initially qualify for any of the operator classes, most people find the Novice and Technician/Technician Plus licenses are ideal entry points. They give you, as a newcomer, access to a considerable number of frequency bands without a too-difficult examination. Let's look at each:

Technician: The Technician class license is aimed at folks with a technical bent, though you don't have to be an electrical engineer to qualify. The "no-code" Technician Class doesn't require that you know Morse code—you must just pass a relatively easy exam on radio operating prac-

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Vocal Filter
 An audio device which can be used with a home component stereo system to filter out the main vocal sound track from standard stereo recordings (CD, tape, record or FM), leaving the background music to sing along with. Produce your own karaoke tapes from your personal library.

DTMF Decoder/Logger
 Keep track of all numbers dialed or entered from any phone on your line. Connects to your telephone wall jack. Decodes all 16 touch-tone and displays them on an LCD display. Holds the last 240 digits in a nonvolatile memory. Scroll through and view all telephone numbers dialed, credit card numbers entered, etc.

October 1996, Popular Electronics

tices, FCC rules, and basic electrical theory. It offers all amateur privileges in the 6-meter (50 MHz) and higher (VHF/UHF) bands. Technician Class operating privileges include FM voice, digital packet, satellite, television, single-sideband voice, and several other modes.

Technician Plus: The Technician Class operator who has successfully completed the Morse code requirement is known as a "Technician Plus." The frequency bands for the Technician license give you access to "local" communications. But you also can use the Morse test to gain access to the long-haul bands, the same as the Novice class. Thus, as a Technician Plus, you're also allowed Novice-type operating privileges in the popular 10, 15, 40, and 80-meter high frequency (HF) shortwave bands (see below).

Novice: The Novice Class license is for beginners who don't have the technical knowledge to pass the Technician-level theory and regulations exam, but who can pass the relatively simple Novice-level FCC theory and regulations exam and the 5-WPM Morse code test. Privileges include voice operation in the 10-meter band and Morse in the 10, 15, 40, and 80-meter shortwave bands, as well as operation on some "local" VHF/UHF bands. Since the Novice class gives a range of HF privileges, it's attractive to those with a desire to talk to those far-away places.

The three top license classes are General, Advanced, and Extra. If you're a licensee of one of these three classes, you have access to portions of all amateur bands, but you have to contend with progressively more difficult exams, and requirements for copying faster Morse code (13, 13, and 20 WPM, respectively). Bear in mind that, as you progress up the licensing ladder, you're given credit for all exams or parts of the exams, such as a code test, that you've previously passed. Here are some more details of each license:

General: If there ever was such a thing as a "standard-class" amateur license, it's the General Class license. The popular, middle-of-the-road license has as its key features a 13-WPM Morse code requirement and privileges in at least a portion of every amateur band. If you're a General, you have all amateur operating priv-

ileges across most parts of all bands, except for the relatively few sub-band privileges that are reserved for the Advanced and Extra Classes.

Advanced: A somewhat tougher written theory examination characterizes the Advanced Class license. Roughly descended from the old "Class A" amateur license, it gives all privileges of General Class licensees, plus some additional frequency-of-operation privileges in portions of the HF bands. Like the General, the Advanced Class exam requires a 13-WPM Morse test.

Extra: At the pinnacle of the amateur-radio licensing structure is the Amateur Extra Class license, with a still-stricter exam and a somewhat daunting Morse code requirement of 20 WPM. The license authorizes unrestricted, full-privilege operation on all amateur bands as an incentive for amateurs to pursue the Extra ticket. Relatively few amateurs go all the way to the Extra, however, perhaps believing that the few additional privileges don't justify the effort required to achieve it.

Getting Exam Information. To prepare for the exams, you'll need study materials and more information about classes, examination points, and clubs in your area. For details on getting started in amateur radio, contact your local amateur radio club or one of the Volunteer Examiner Coordinators (VECs). There are 16 VECs (see the "Volunteer Examiner Coordinators" box).

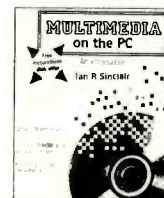
A number of organizations are more than willing to help. One of these is the American Radio Relay League (ARRL), the national organization of amateur-radio operators. The ARRL distributes a free "Getting Started in Ham Radio" information package that you can obtain as a first step. Ask for it by calling the New Ham Hotline at 800-326-3942. The material describes amateur-radio and popular ARRL study guides. It also includes a customized list of local amateur-radio clubs, ham-radio classes, and volunteer examiners in your area.

Various amateur-radio-license study packages, books and software, as well as Morse code study materials, also are available from a variety of publishers. RadioShack stores, for example, sell a variety of ARRL and other

study guides, including the ARRL book, *Now You're Talking! All You Need to Get Your First Ham Radio License* (see the "Bibliography" for more information). ■

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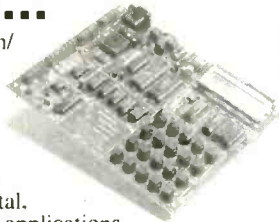
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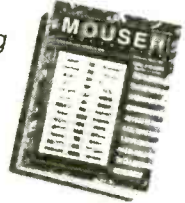
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The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

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

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

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General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. **POPULAR ELECTRONICS** is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. **NO REFUNDS**, advertising credit only. No phone orders.

CONTENT

All classified advertising in **POPULAR ELECTRONICS** is limited to electronics items only. All ads are subject to the publishers approval. **WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.**

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Send you ad payments to:

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160 - Business Opportunities	330 - Computer Software	510 - Miscellaneous Electronics Wanted	690 - Security
190 - Cable TV	360 - Education	540 - Music & Accessories	710 - Telephone
210 - CB-Scanners	390 - FAX	570 - Plans-Kits-Schematics	720 - Test Equipment

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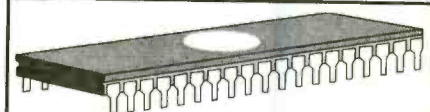
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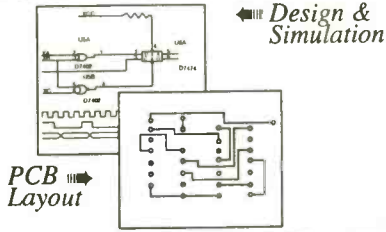
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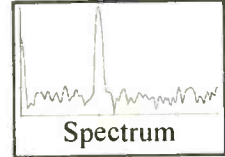
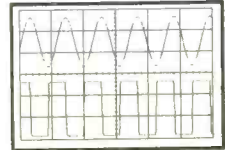


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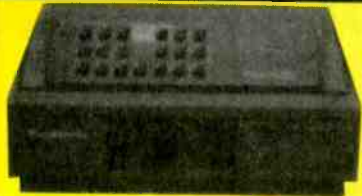
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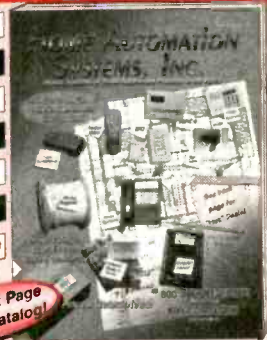
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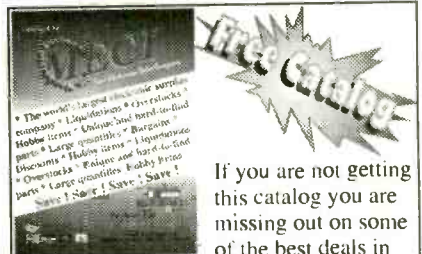


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BASIC Stamps are component-sized computers that run BASIC programs. They have 8 or 16 I/O lines, which can be used for a variety of digital and analog purposes. And their BASIC language is both familiar and extensive; the language includes FOR...NEXT, IF...THEN, and GOTO, as well as XOUT, SHIFTOUT, DTMFOUT, and other special commands.

We've been making BASIC Stamps for several years, and we've accumulated some interesting photos along the way. In this ad, we thought it might be fun to show some of these photos.



Marvin Green and his students in Hillsboro, Oregon, use BASIC Stamps to make small robots.



John McLean uses BASIC Stamps to gather data in Lechuguilla Cave (America's deepest cave, located in Carlsbad Caverns National Park).



Charles Walsh and his students in Great Falls, Montana, use BASIC Stamps in robotics projects.



Barry Jones of Tech-Warrior, Inc. (Lanham, Maryland) uses BASIC Stamps to add auto-repeat, LCD readouts, and other features to his paintball rifles.

BS1-IC Module **\$34**

8 I/O lines
80 instructions max.
2000 instructions/sec.
2400 baud serial I/O
14-pin SIP module

I/O instructions for pushbuttons, potentiometers, pulse measurement, PWM, serial I/O, sound, etc.



FaxBack
#6002

Programming Package **\$99**

Contains programming materials needed to program BASIC Stamps; includes cables, PC software, manuals, and free tech. support.

Carrier Boards **\$15-\$20**

Provide small prototyping area, 9-volt battery clips, and programming connector. Not absolutely necessary, but recommended to make programming easy.

BS2-IC Module **\$49**

16 I/O lines
500 instructions max.
4000 instructions/sec.
50k baud serial I/O
24-pin DIP module

Same I/O instructions as BS1, plus touch-tones, frequency generation, pulse counting, serial shift registers, X-10 powerline control, etc. I/O functions common to both modules have a higher resolution on the BS2-IC, due to its faster clock speed.

Data Collection Board **\$179**

This nifty board from Scott Edwards Electronics provides everything you need to use the BS2-IC as a data logger. Includes ample prototyping area, two 12-bit analog inputs, a real-time clock, and 32K bytes of EEPROM storage. BS2-IC module not included.



PARALLAX 

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Prices do not include shipping and applicable sales tax • Features and prices subject to change without notice. • Prices are U.S. prices only; prices in other countries may vary

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- NMEA-0183 GPS Interface provides tagging data with location for mapping applications*
- CI-V compliant Serial Data Interface with both TTL and RS232C levels
- Frequency Recording Memory Register logs 500 frequencies with Time, Date, Latitude, and Longitude information
- Real-Time Clock/Calendar with battery back-up
- Frequency Lock Out, Manual Skip, and Auto or Manual Hold capability
- Tape Control Output with Tape Recorder Pause control relay and DTMF Encoder for audio data recording
- Rotary Encoder for easy selection of menus for setup
- Internal Speaker, Audio earphone/headphone jack
- Miniature 8-pin DIN Serial Interface port for PC connection
- Relative ten segment Signal Strength Bargraph Mode
- Numerical Deviation Mode with 1-10kHz and 10-100kHz ranges
- Includes Built-in Rapid Charge NiCad Batteries with 8 hour discharge time and a Universal Power Supply

*Software for mapping applications is planned by third party Software Design Companies. Inquire about the availability and specific Companies to contact.



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CTCSS Mode

461.725 MHz
 DTMF: 8003275912

DTMF Mode

DCS Mode also available

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- Signal Strength Mode
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