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March 1996

# Popular Electronics®

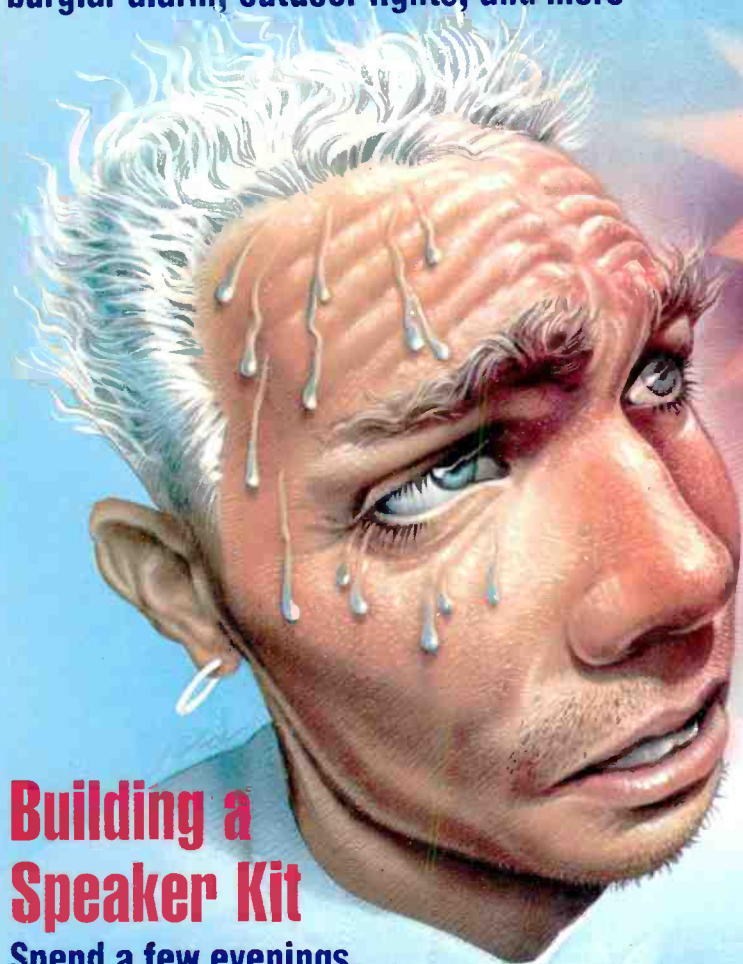
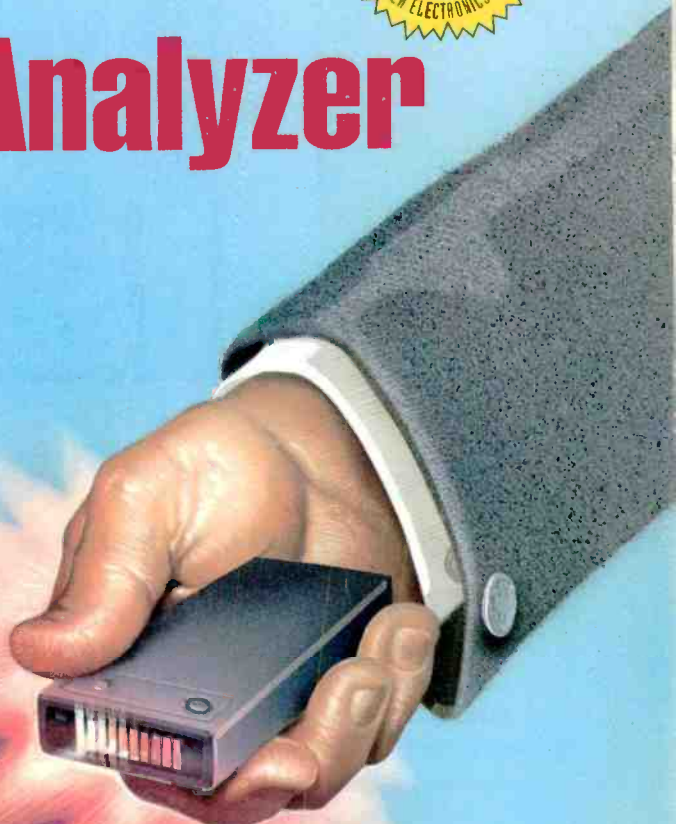


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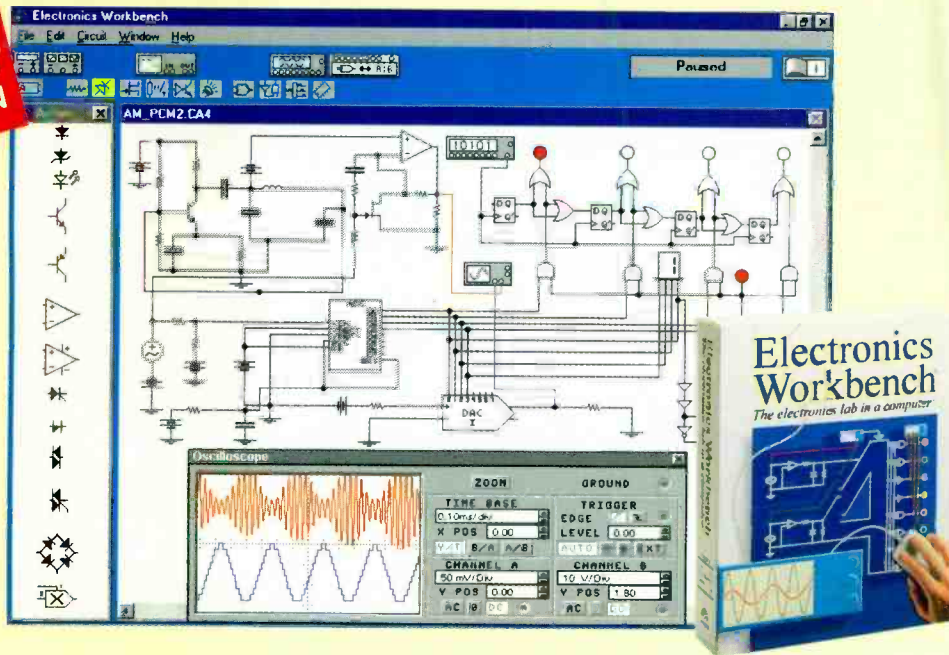


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# Popular Electronics®

MARCH 1996

Vol. 13, No.3



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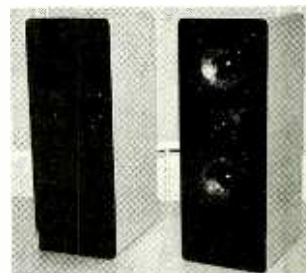
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# EDITORIAL

## TRUE OR FALSE

The search for truth is as old as humankind. In the earliest days of civilization, our ancestors relied on myth and superstition. Later, as our knowledge of science, psychology, and physiology improved, more accurate methods were developed.

We all are familiar with the polygraph, or lie detector. But that device is not the only one that can be used to see if a person is being truthful. Another, more recent device is the vocal-stress analyzer, which detects tiny vocal-cord tremors to indicate if a speaker is under stress, and therefore likely to be lying. In this issue we look at a simple version of that device that any hobbyist can build. Called the "Voice-Stress Analyzer," it takes advantage of a new IC to provide an indication of the stress in a person's voice. It even works with recorded speech and does not depend on language. The story begins on page 41.

Speaking of lies and lying, let's talk about TV commercials. All kidding aside, whether or not you believe what commercials tell you, most people find them to be an annoyance. That's why commercial killers—at least ones that work—have long been a bit of an electronics "holy grail."

The search might be over. A new feature offered in several of this year's RCA VCRs is called Commercial Advance. While it has some flaws, its commercial-killing performance is way beyond anything else available to date.

This month, we look at one of those RCA decks—a four-head, hi-fi unit. We examine Commercial Advance in depth, look at some of the VCR's other features, and put the deck through its paces both on the bench and in the home. Incidentally, first-generation DSS owners will be especially interested in the deck as it can be used to control a DSS receiver, thereby adding a timer-recording capability to that unit.

Bench tests for the deck can be found in Product Test Reports, which begins on page 34. User impressions can be found in Gizmo, which begins on page 5.



Carl Laron  
Editor

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# New breakthrough clones TV signals and sends them to any other TV in your home

Recoton's new development duplicates cable, TV, VCR and satellite signals and transmits them...without any wires!

by Charles Anton

**T**oday, television choices are virtually unlimited. Between cable, satellite TV, videos and network programming, it's almost a full-time job trying to keep up with all the alternatives. And it promises to get more complicated in the future. Breakthroughs in fiber optic technology will bring over 500 channels into your home.

**Home broadcasting breakthrough.** The problem with all this technology is the expense required to maintain your system and keep it up-to-date. Now, a wireless video broadcasting system from Recoton gives you the power to utilize this technology without the hassle and expense of re-wiring your entire home.

Today, Recoton introduces the next generation in wireless broadcasting. The wireless video broadcaster transmits (re-broadcasts) cable, TV, VCR or satellite programs to any other TV in your home...wirelessly!

**Wave of the future.** Never drag your VCR from room to room again: Recoton's wireless video broadcasting system transmits video or TV signals to any other TV in your home.

Because the system is totally wireless, you won't have to worry about running miles of wires. Besides, who wants to install cable in every room of their home? With Recoton's wireless video broadcasting system, you



won't have to. You can even watch one program on your main TV while someone else watches something different on another TV. It's just like having a personal broadcasting system in your home—and it's legal in every state.

**Hi-tech home broadcast.** Recently, the Federal Communications Commission allocated a band of radio frequencies specifically for wireless, in-home product applications. Recoton took advantage of the FCC ruling by creating and introducing wireless equipment that can transmit within the prescribed frequency over distances of up to 150 feet.

**One transmitter, unlimited receivers.** One transmitter will operate an unlimited number of receivers. This means that a transmitter in the den can send signals to a TV in the living room, kitchen, bedroom and anywhere else you may have a TV. Recoton puts your favorite programs where you want them most.

**Unlimited choices.** Since the broadcasting system uses the latest in 900 MHz frequency signals, there is no time-consuming or complicated wiring. The receiver can be easily moved from one television to another.

The transmitter will also broadcast to multiple receivers, so you can watch the same program on multiple TVs simultaneously. The transmitter connects to the source TV; the receivers simply connect to the others.

## Wireless Video Breakthrough...

**Cable** Broadcast cable channels, even premium channels, to other TVs in your home that are not wired for cable.

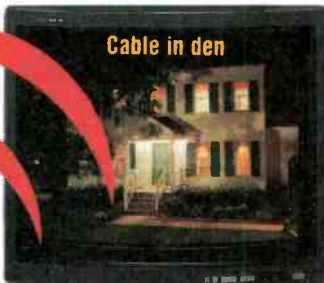
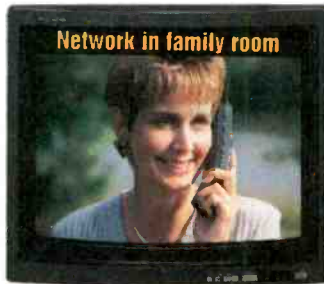
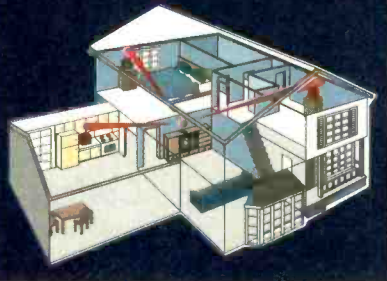
**Videos** Transmit signals from one VCR to any room, even if someone is watching TV in the room that the VCR is in.

**Satellite programs** Watch satellite programs throughout your home without stringing miles of cable everywhere.

**Live video** View home videos as you film them or turn your camcorder into a security camera.

**Network programs** If the main TV is hooked up to an antenna, you can broadcast its clear signal to all the others.

Recoton's video broadcasting system clones the accessories (cable, satellite, VCR, etc.) of one TV and broadcasts it to any other TV in your home...without wires!



**Exclusive factory-direct offer.** With this breakthrough in home video broadcasting technology, you can have the convenience of your own personal wireless broadcasting system for a fraction of the cost of owning your own TV station. For a limited time only, we are offering Recoton's wireless video broadcasting system (one transmitter and one receiver) for the low price of \$99. You can order additional receivers for other TVs for just \$59 each.

**Risk-free offer.** The wireless video broadcasting system by Recoton is backed by Comtrad's exclusive risk-free home trial. Try it, and if you are not completely satisfied, simply return it within 30 days for a full "No Questions Asked" refund. It also comes with a 90-day manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

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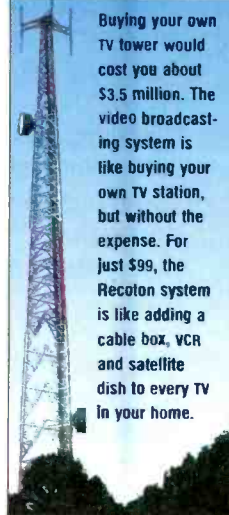


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## ADD A TV TOWER?



Buying your own TV tower would cost you about \$3.5 million. The video broadcasting system is like buying your own TV station, but without the expense. For just \$99, the Recoton system is like adding a cable box, VCR and satellite dish to every TV in your home.



# GIZMO®

## Out, Out, Ad Spots

**RCA COMMERCIAL ADVANCE MODEL VR678HF VCR.** Manufactured by Thomson Consumer Electronics, 10330 North Meridian Street, Indianapolis, IN 46290-1024; Tel. 317-587-4450. Price: \$499.

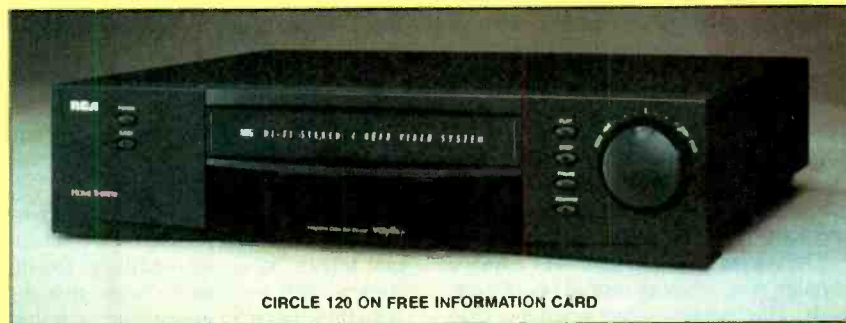
They say that the secret to being happy in life lies not in having all that you want, but in *not wanting* what you don't have. Unfortunately, modern American life conspires against such contentment.

Open a newspaper or magazine, turn on the radio or—worst of all—the TV, and someone will try to sell you something, be it a bigger car, a cleaner floor, a new toy, or sweeter breath. Those insidious messages are bombarding our children as well. In fact, the commercials that interrupt children's programs use much more direct, high-pressure pitches than do ads aimed at adults. After a Saturday morning cartoon marathon, you're more than likely to hear about all the new toys that your kids "need."

It's impossible to avoid all of the advertisements that are thrown your way. You can, however, get rid of the ones on your television. All it takes is the *RCA Commercial-Advance Model VR678HF VCR*. Record a program on the Commercial-Advance, and during playback the VCR will automatically fast forward through the commercial segments. You can watch a taped program virtually commercial-free—without even having to pick up the remote control to skip through the ads.

Three minutes of ads recorded in the SLP mode take about 10 seconds to pass by. You can opt to see a plain blue screen for that period, or to watch the commercials zoom by in forward scan mode.

The VR678HF's on-screen menus are used to activate the Commercial-Advance feature. In the "Preferences" menu, "CF Marking" must be turned on for Commercial-Advance to work. (At the same time,



CIRCLE 120 ON FREE INFORMATION CARD

you can set "CF Playback" to blue or video.) In timer, express, or VCR Plus+ recording modes, Commercial-Advance works automatically, marking the commercials as soon as the recording is finished. In manual recording mode, when you stop recording an on-screen display will ask if you want to mark the commercials right away, later, or not at all.

During recording and playback, the Commercial-Advance technology is invisible to the user. It is only noticeable immediately following recording, when the VR678HF requires a short period of time in which to locate and mark the commercial segments on the tape. You can hear the VCR rewind to the beginning of the recorded portion of the tape, advance until it finds a commercial break, pause to mark it, and then advance again, repeating the process until all commercial breaks have been marked. Marking a 30-minute, prime-time sitcom, for instance, takes about three minutes. As it finds and marks the commercials, "mark" and "comm" appear alternately in the front-panel display panel. When the process is complete, the tape does not rewind; it remains positioned at the end of the recording, ready to tape another program.

Once the commercial breaks have been marked, there are two ways of viewing commercial-free programming. In Auto CF playback, the VCR will automatically advance through the marked blocks of commercials. In manual mode, you must press SEARCH each time you want to skip a batch of commercials.

How does Commercial-Advance tech-

nology track down those nasty commercials? After all, there is no technically discernible difference between commercials and regular programming. Broadcasters don't insert any flags to say "This is a commercial!" However, commercials generally do have many things in common, and those features are what the VCR searches for.

First, virtually all commercials begin and end with a black frame of video and silence. Of course, black frames with silence occur often during normal programming, too, so they can't be used by themselves as a sure indicator of commercials. Commercials have other things in common, however. They usually travel in packs, and they are usually 30, 45, or 60 seconds long.

While the Commercial-Advance VCR is recording, it inserts a timecode on the tape, examines the programming for possible commercial breaks, and stores a map of the programming in memory. After the recording is finished, the map is examined, and the VCR manually marks the commercial breaks with a special code in the tape's control track. On playback, the VCR uses the code to bypass commercials.

The electronic indicators used by the Commercial-Advance VCR are temporary. If you reuse a videotape, recording over previously taped shows, the VCR will ignore the old marks and create new ones for the new programs. A tape recorded on another VCR can be played back on the VR678HF, but the Commercial-Advance feature will not work. Tapes that have been

"marked" by the Commercial-Advance system will play back on any other VCR with no discernible differences.

The Commercial-Advance technology is good, but not perfect. Thomson is candid about its imperfections, listing them in the manual. Several common broadcasting situations cause trouble. For instance, if a commercial break begins during the first or last two minutes of a recording, or the recording starts in the middle of a commercial, it won't be skipped. One isolated commercial, or an ad that runs longer than one minute, won't be skipped either. Commercial-Advance is designed to work with 30-, 45-, and 60-second commercials, and won't mark commercials that run for odd lengths of time. Because local stations use different methods to insert their own commercials than do national networks, the system does not work as accurately with local spots. Station promotions, identifications, and announcements are not considered commercials, so are not skipped.

Occasionally, the system will advance through programming instead of commercials. That usually occurs when less than one minute of programming is shown between commercial breaks, or if a program segment contains a lot of dark, quiet scenes, which could be misconstrued as black frames.

Having read those caveats before testing the Commercial-Advance VCR, we were prepared to be disappointed in its performance. Instead, we were delighted. The instances in which the VCR failed to detect and skip a commercial were few and far between, and those in which it passed over programming even fewer.

We're accustomed to watching taped programming with the remote control in hand, ready to hit FAST FORWARD at the first sign of a commercial. But even with years of practice under our belts, we're no match for the Commercial-Advance. We tend to overshoot the commercial break, and then have to rewind a bit to see the programming we missed. By the time we finish moving forward and back, forward and back, we might just as well have muted the TV during the commercials—we really didn't save much time. The Commercial-Advance, however, fades in and out precisely on cue—almost every time.

It's wonderful to automatically bypass all the commercials. The television viewing experience is enhanced dramatically when it's not interrupted every few minutes by loud, flashy exhortations to spend, spend, spend.

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We also appreciated the savings of time and effort. It's amazing how quickly a half-hour show goes by when the commercials are removed. You can zip through your favorite sit-com in what seems like half the time! Those folks who tape the afternoon soaps for evening or weekend viewing, can watch a full three hour's worth in just over two—and there's no work involved. Couch potatoes are spared even the small effort required to operate the remote.

There are a couple of minor drawbacks to commercial-free viewing. First, there's never a convenient time to grab a snack or take a bathroom break—better take care of those necessities before you start watching! Second, there's the temptation to use the time saved in not watching commercials to keep watching more and more TV—something none of us needs. We actually found ourselves contemplating taping a trashy four-part miniseries before our better judgment kicked in!

People who use their VCRs for more than just taping and playing back commercial television shows—editing, for instance—will be glad to know that the VR678HF has a lot more going for it than just its commercial-advance feature. The four-head, hi-fi, MTS stereo unit offers several different recording and playback modes, and its remote will control several pieces of audio/video gear—including an RCA DSS satellite receiver. The VCR itself can turn on and off and tune a DSS receiver or cable box for time-shifted recordings. Front-panel video and audio inputs, tucked neatly inside a compartment so that they're not visible when not in use, make it easy to connect a camcorder. And the VCR's auto clock-set circuitry puts an end to the flashing "12:00" on the front-panel display.

The Commercial-Advance VCR's playback modes include auto play, auto repeat, slow motion, and variable speed picture search. With the auto play mode selected from the Preferences menu, a tape with the safety tab removed will start playing as soon as it is inserted in the machine. Auto repeat allows you to mark a segment on the tape to be played over and over again. The front-panel shuttle ring is used for variable speed searches; the farther it is turned, the faster the speed, in either forward or reverse direction. The remote control's F.ADV button is used to view a tape one frame at a time, and two slow-motion buttons, marked + and -, are used to increase or decrease the slow-motion playback speed.

There are a few ways to locate a particular show that you've recorded. The VR678HF has a real-time counter, which can be displayed on screen during playback or searches. It also has a "VHS Index Search System" (VISS), that automatically places an index mark on the tape at

the start of each new recording. Pressing the SEARCH button will display an on-screen index search menu, which prompts you to enter the index number and then press FWD or REW. The VCR will search forward or reverse from your present location on the tape to automatically locate the index number you selected. By pressing the SEARCH button twice, you can use the time-search feature, which causes the VCR to move the tape forward or reverse for a specific length of time. The zero-search function, reached by pressing the SEARCH button three times, allows you to quickly return to a counter reading of 0:00:00 from anywhere on the tape. Finally, the blank-search function (four presses of the SEARCH button) locates any blank portions of tape that are more than six seconds long.

The VR678HF also provides a host of recording options. There's basic, manual recording—just hit the REC button on either the front panel or the remote to begin recording and STOP to end it. Express recording eliminates the need to press STOP. Repeatedly pressing the RECORD button on the VCR or the remote increases the record time in half-hour increments, from 30 minutes to four hours. The time selected appears in the front-panel display; recording automatically stops at the end of that time period.

For time-shift recordings, you can use the built-in VCR Plus+ system, or follow the directions provided by standard on-screen recording menus. VCR Plus+ relies on PlusCodes that are printed in most magazine and newspaper TV schedules. Instead of entering the start and stop times, you just enter the numeric code. You still have options as to tape speed and how often to record the program (once, daily, weekly, or weekdays). And the VR678HF's VCR Plus+ includes end-time adjustment, which allows you to adjust the end time of any show you suspect will overrun its allotted time—a football game that goes into overtime, for instance.

Standard timer recording uses easy-to-follow on-screen prompts to request how often to record, the start and stop times, the channel, and the tape speed. With both time-shift methods, on-screen displays verify the times and dates of the programs you've selected and even remind you to turn off the VCR before recording time.

It's easy to record shows from cable or DSS channels using the VR678HF. An infrared transmitter located on top of the VCR will send a signal to the cable box or DSS receiver—which should be positioned directly above the VCR—to turn it on and tune in the correct channel for time-shifted recordings.

The Commercial-Advance VCR's Protect Plus locking feature can be put in  
(Continued on page 9)



# Just Point-and-Shoot

**MODEL VM-PS12 8mm CAMCORDER.**  
From Sanyo, 21350 Lassen Street,  
Chatsworth, CA 91311-2329; Tel.  
818-998-7322. Price: \$499.

People buy camcorders to record the important events in their lives. And topping the list of important events in people's lives is having and raising children.

Unfortunately, camcorders and children are often incompatible. That's because children, by nature, are spontaneous, while most camcorders require quite a bit of fussing and adjusting before they are ready for use. By the time you get all the settings just right, the kids are finished doing whatever it is you wanted to record in the first place.

That goes for kids of all ages, starting right at birth. We're not advocates of camcorders in the delivery room, where there's enough noise and confusion—and way too little privacy—without the addition of extraneous electronic gadgets. But for the expectant father who does opt to play videographer as well as birth coach, point-and-shoot is the way to go. He won't want to miss any of the action while playing around with a sophisticated camcorder.

As the baby grows, videotaping the milestones in his or her life doesn't get much easier. Kids just don't give you any warning when they're about to do something worth videotaping, be it rolling over, taking a step, or saying "Mama." If you want to be sure to capture those moments, it's best to have a camcorder that's as easy to use as an auto-everything still camera.

There are two more reasons for new parents to go with a simple camcorder. All of the other accouterments of babyhood and childhood—and there are many of them—are both complex and expensive. Want to tape baby's ride home from the hospital? You must first figure out how to strap in the (\$60) car seat correctly. First feeding? Expect to spend an afternoon assembling the (\$99) high-chair before you can get started. Taking the little darlin' for a jog in the park? First figure out which button to press to unfold that (\$250) all-terrain stroller. Is he learning to ride a (\$100) bicycle? Better hope the assembly instructions are in English!

You get the picture—or do you?

You do if the camcorder you're using is Sanyo's VM-PS12. Aimed at "customers wary of complex technology and higher prices," the 8mm VM-PS12 delivers the "no-brainer" convenience of popular point-and-shoot still cameras. In fact, there are only three things the vid-



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eographer need remember (besides charging the battery and loading the tape, that is): Remove the lens cap, power up, and press RECORD. And there's only one recording option—a manual 3X zoom lens.

Not surprisingly, there are very few controls on the palm-sized, 1.6-pound camcorder. The POWER and RECORD buttons are positioned side by side within easy reach of your thumb when you're holding the camcorder with your hand in its strap. An LCD display is located just next to the viewfinder. The playback controls—PLAY, STOP, STILL, REW and FF—are hidden beneath a flip-up panel on the top of the camcorder. In the same compartment is a button labeled BLANK, which lets you find the end of the recorded portion of the tape. At the top of the unit, just above the display, are a POWER MODE button, for switching between play and record modes, and the zoom lever.

The manual zoom lever is the only control you'll need to fuss with while recording. It's easy to slide it between wide-angle and telephoto using your index finger. In telephoto mode, the subject should be at least 1.6 meters away from the lens; in wide-angle mode, at least 0.7 meters away.

The 3× zoom range might seem anemic when compared to camcorders that offer zoom ranges of 10× or more. However, it seemed to fit indoor shooting—the most common kind—just perfectly.

The VM-PS12 features a dual-lens system with an optical, as opposed to a video, viewfinder. On the plus side, there's no need to power up to see your subject—just remove the lens cap and take a look. The optical viewfinder also accurately follows the subject as you zoom in and out. On the minus side, you can't use the viewfinder to watch what you've just recorded, so in-camera editing is out of the question. You

must use a TV for playback. That's one reason we're glad that Sanyo included the BLANK button for finding the end of the recording on the tape.

The camcorder's audio and video connectors are located alongside the lens, in a normally covered compartment. In keeping with the minimalist attitude of the VM-PS12, there's no remote control for playback; you must use the controls in the compartment on top of the camcorder.

During recording, the red LED next to the viewfinder and the REC icon on the LCD readout remain steadily lighted; both flash when the camcorder is in pause mode. The display also features warning indicators to let you know if the battery is low, if the tape is nearing or has reached its end, if the video heads are dirty, and if condensation has formed inside the camcorder. An on-screen tape counter lets you know the time remaining on the loaded cassette.

The battery pack installs on the left-hand side of the unit, and the tape compartment is found on the opposite side. With a charged battery and blank cassette loaded, you're ready to roll.

The VM-PS12 manual offers the following instructions for recording: "1. Push the POWER button. 2. Press the RED button to start recording. 3. To stop recording, push the REC button again. When finished recording, turn the power off."

It really is that simple. All necessary adjustments are handled by Sanyo's "Fuzzy Logic" technology, which "automatically adjusts the shutter speed and white balance by imitating human thinking processes for optimal results." For instance, when choosing the shutter speed, the camcorder analyzes six zones of the image and takes into account changing

(Continued on page 9)





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## Creative Camcorder

**ES2000 CAMCORDER.** From Canon U.S.A., Inc., One Canon Plaza, Lake Success, NY 11042; Tel. 516-488-6700. Price: \$1599.

A simple, feature-stripped camcorder can be an excellent choice for home videographers who are more interested in getting something on tape than the process of shooting videos. They want taped mementos, but they don't see videography as a fun hobby. However, videographers who want to make good-looking, interesting, creative videos need the proper tools.

Canon's newest top-of-the-line compact Hi8 camcorder, the *ES2000*, is an ideal tool for the creative videographer. It has a slew of convenience features and an extra helping of quality built in.

The first feature worth noting is the unit's 20× power zoom lens—to date, the industry's longest. True, you might see a camcorder offering a greater zoom range, but it won't be an optical zoom. Instead, many camcorders offer a combination of optical and digital zoom—for example, an optical 10× zoom lens with a 2× digital zoom. Unfortunately, digital zooming inherently reduces the picture's resolution because it works by magnifying the image on the camcorder's CCD image sensor. The result is a picture that is composed of fewer pixels. As the magnification increases, the image's resolution decreases.

The ES2000's zoom lens is controlled by a small lever conveniently located near the index finger. Seven zoom speeds are provided, and depend on how far the zoom

lever is pushed or pulled. The variable speeds allow the full zoom to be traveled in as little as 4, or as much as 20 seconds.

As you might imagine, it is difficult to hold the camera steady enough to get a good picture at maximum zoom. Fortunately, the ES2000 offers an image-stabilization system. Again, Canon chose to go with an optical system, instead of an electronic one, so as not to degrade picture quality.

The image-stabilization system is based on Canon's Vari-Angle Prisma (VAP) technology. The prism is made up of two glass elements that are joined by a flexible plastic material. The space between the elements is filled with a special, transparent, silicon-based oil.

Motion sensors detect horizontal or vertical movement and relay information to a microprocessor that controls prism actuators. The prism, like all other prisms, bends or refracts light. The motion of the prism compensates for camera shake by keeping the image centered on the CCD.

The camcorder is able to compensate for different kinds of motion caused by various shooting situations. For example, a stationary videographer holding the camcorder in his hand will produce completely different motions from one who is walking or riding in a car. The ES2000's system can adapt to them all. The camcorder's image-stabilization system is controlled by several compensation programs, each of which corrects for a certain range of motion frequencies. Canon rates its system as providing a more than 90% uniform compensation between 3 and 17 Hz. It is capable of responding to vibration frequencies as high as 20 Hz. The system is also dependent on the zoom level. It offers

about five times more compensation at the telephoto end than at wide angle.

The image stabilization is not subtle. Without it, the camcorder would be practically unusable at maximum zoom without a tripod. With it, the smooth images it delivers are remarkable—even when tapping from a moving car.

Technically speaking, the lens and optical image-stabilization systems are definitely the most impressive features of the ES2000. From a videographer's creative and convenience standpoint, however, Canon's FlexiZone AF/AE is the camcorder's highlight.

Other camcorders base their auto-focus (AF) and auto-exposure (AE) settings on what is happening in the center of the frame. Although that's sensible, it is rather limiting. What do you do if you want your subject in the lower left corner of the frame, and you want the background to fade away into a soft blur?

With other camcorders, you must enter the manual-focus mode, and then focus on your subject. If the background is much darker or brighter than your subject, you must manually adjust the exposure settings as well. Experienced videographers don't find that too much of a hardship, but beginners or infrequent users do. Plus, there's no denying that adjusting the settings takes time—time that can make you lose the shot that you were looking for.

FlexiZone AF/AE makes it much easier for everyone. With the FlexiZone feature turned on, the viewfinder shows a small frame that indicates the desired area of focus. The default area is the center of the frame. However, the frame can be moved using a joystick-like thumb controller on the back panel of the camcorder.

With the push of a button, the exposure can also be determined by the area inside the frame. The exposure settings remain locked until the button is pushed again, or until the FlexiZone mode is turned off.

One of the things we liked best about FlexiZone was the ability to focus shift. Let's say your family is taking a mule trek down the Grand Canyon. You want to start a scene by focusing on your wife's expression of exhilaration, perched on a mule whose hooves are precariously close to the trail edge. Next you want to change the focus to capture the spectacular canyon view, as the mule train fades into a blur.

Traditional camcorders would require either that you adjust the focus manually, or that you move the camcorder so that the area of interest appeared in the middle of the viewfinder. FlexiZone, however, allows you to hold the camcorder perfectly still—so that the composition of the scene remains constant—and just move the FlexiZone frame over the area of interest. It's not quite automatic, but we can't imagine it being more so.



The advanced features of the ES2000 do not make it a difficult camcorder to use. A full-auto mode lets the camcorder make all of the exposure and focus decisions. Four other auto-exposure modes are available to compensate for special recording environments: Sports, Portrait, Spotlight, and Sand & Snow. An auto-exposure control wheel on the left side of the camcorder is used to select the appropriate setting. In the Sports mode, the camcorder chooses the highest shutter speed possible for the lighting conditions. That produces clearer images that can be analyzed frame-by-frame during slow or still playback—but not on the ES2000, which doesn't support frame-by-frame playback.

The Portrait mode reduces the camcorder's depth of field so that the intended subject stands out from a softened foreground and background. The Spotlight mode is designed for recording scenes in which the subject alone is brightly lit, such as a piano recital. The Sand & Snow mode is intended for recording when the background is so bright that the subject would normally be underexposed, as the sun glares off the snow or water.

A backlight-compensation button is provided to manually brighten the exposure for scenes that have strong backlighting. Shutter speeds can also be set manually. The seven settings range from  $\frac{1}{100}$  second to  $\frac{1}{10,000}$  second.

All of the technology that is crammed into the ES2000 does not make it a large or unwieldy camera. New manufacturing technologies were used to reduce the size and weight of the lens, image-stabilization, and signal-processing sections. The camcorder measures about  $4 \times 4 \times 8$  inches and weighs slightly over two pounds when loaded with a battery and cassette.

The controls are clearly marked and sensibly placed. The right hand controls the record button with the thumb; the index finger operates the zoom and FlexiZone AF controls.

The thumb of the left hand can operate the FlexiZone frame joystick and the manual shutter-speed button. The auto-exposure wheel is on the left side of the camcorder. Above that are two buttons; one is for backlight compensation, the other initiates fade to or from black. Below the exposure wheel is an autofocus on/off button. Behind the button is a wheel for manually changing focus.

The top of the camcorder has a row of buttons for standard VCR playback functions. They do double duty when the camcorder is in the camera mode and become DATE, TITLE, STABILIZATION ON/OFF, and RECORD SEARCH/REVIEW buttons. Also on top of the camcorder are counter-reset and cassette-eject buttons.

There are no buttons located behind hid-

den panels. However, two are located behind the swiveling viewfinder. One changes the video/audio jacks from outputs to inputs for recording. The other turns the tally lamp (a blinking LED that indicates that the camcorder is recording) and the remote sensor on and off. An infrared remote control is supplied with the camcorder.

A small flip-open panel on the back panel covers the audio and video (composite and S-video) connectors as well as the LANC jack that allows the camcorder to be remotely controlled by editing equipment. A microphone input and headphone output are provided on the camcorder's front, right side.

The ES2000's viewfinder provides several important pieces of information and includes a zoom meter as well as icons to indicate the exposure and focusing modes, and whether the high-speed shutter and image-stabilization are on and off. A recording reminder advises users to record each scene for at least 10 seconds for easier editing. The viewfinder is a 0.55-inch color LCD. Normally, we don't like color viewfinders because of their lower resolution. We have no complaints about the ES2000's. It's the first color viewfinder we've used that we prefer over black-and-white.

Titles can be added easily. Up to two lines, each of 16 characters, can be stored in memory. When in the title mode, the FlexiZone is used to scroll through the lines and also through the characters. Either the time, date, or both can also be used as titles.

If you are an experienced videographer looking to move beyond the ordinary, the ES2000 offers the tools to bring out the artistic side of you and uncompromised Hi8 performance. ■

## SANYO CAMCORDER

*(Continued from page 7)*

conditions. The automatic balance corrects color for different lighting situations by analyzing picture information from 64 image areas. The VM-PS12 also features automatic backlight compensation.

There's no doubt about it—the VM-PS12 is quite a departure from any other camcorder we've ever seen. Although it's missing some features that we previously could not have imagined doing without, it made us appreciate that, sometimes, simple can be better. For example, we had come to consider power zoom lenses and automatic focus to be indispensable features. But the VM-PS12's manual zoom lever let us frame the shots quicker than any power zoom we've used. The fixed-focus lens ensured that we got the shots we

wanted and that the camcorder was never fooled by the situations that tend to trip up auto-focus mechanisms.

Lately, we've found ourselves torn between black-and-white and lower-resolution color viewfinders. Without question, the simple optical viewfinder of the VM-PS12 is the sharpest, most realistic that we've ever seen in a camcorder. Of course, it can't do some of the things that conventional camcorder viewfinders do so well—such as showing the length of a scene, or how much tape and battery life is remaining. But people who use their camcorders only on special occasions and tend to get confused with some of the more subtle indicators will probably appreciate that.

The VM-PS12 is not just a special-occasion camcorder. Because it's as easy to use as a point-and-shoot still camera, we found ourselves pulling it out and taping things on a fairly regular basis—our friends' children dressed for Halloween, the roof being torn off our neighbor's house to add a second story, the baby, anytime he did anything remotely cute.

The bottom line? We've never seen a camcorder that was as simple to use or better suited for technophobes. If you want a camcorder that can capture memories without taxing yours, Sanyo's VM-PS12 is it. ■

## RCA VCR

*(Continued from page 6)*

action to ensure that no one messes up your programmed timer recordings. Once the recording is set up, you press and hold the POWER button on the remote for at least six seconds, until "lock" appears in the front-panel display. At that point, the VCR and remote are "locked"—the controls are deactivated. To unlock the unit, you must press and hold the VCR1 (or VCR2.LD) button on the remote control until "hello" appears in the display.

The VR678HF's remote control can operate most major brands of televisions (although not every function on every brand) and cable boxes; a second Thomson (GE, RCA, or ProScan) VCR or laserdisc player; an auxiliary RCA-brand component (radio, CD player, tape player); and an RCA Digital Satellite System receiver. Many of the buttons on the remote play dual roles, depending upon which component has been selected. Despite its multifunctionality, we found ourselves using the remote less often than usual, thanks to the Commercial-Advance feature.

So, have we cut down on our consumer spending since we began using the Commercial-Advance VCR? Definitely not—now we want to go out and buy our own Commercial-Advance VCR! ■



## That's a Wrap!

**VIDEO DIRECTOR SUITE V2.5 and VIDEO DIRECTOR HOME V1.0.** Published by: Gold Disk Inc., 2475 Augustine Drive, Santa Clara, CA 95052. Suggested retail prices: \$199.95 (Suite), and \$99.95 (Home); Estimated street prices: \$99.95 and \$49.95.

Yes, little children can be cute, and everyone deserves a nice vacation once in a while—just don't force us to watch a video of either one.

Of course, like everyone else, we've found ourselves at a friend's or relative's parked in front of a TV with no way out—watching 45 minutes of something such as little Billy's first birthday party. How exciting!

Now we love little Billy, too. And to be honest, there were several truly entertaining scenes in the video—along with the 40 minutes of boring footage. At least our friends recognized that most of the tape was less than stimulating, apologized for that, and even fast-forwarded through some of the duller moments. But there is no excuse for presenting such unexceptional videos when there are easy solutions for editing the tape to remove the bad scenes and leave only the good. Two products from Gold Disk, *VideoDirector Home* and *VideoDirector Suite*, not only make the process easy, but they also make it fun by removing most of the tedium that is usually associated with manual editing.

*VideoDirector Home* is an entry-level home video-editing package. Interestingly, nowhere on the package do the words "edit" or "editor" show up. Perhaps Gold Disk thinks that the idea of video editing would be too scary for consumers. Instead, such phrases as "Now your PC can make highlight videotapes automatically," line the box.

The minimum PC system requirements for running *VideoDirector Home* is a 386-based computer with two megabytes of RAM and Windows 3.1. The package consists of software and a "smart cable" that controls the source camcorder and the recording VCR. Installation is a snap. The software, on two diskettes, installs like any other Windows software. The smart cable plugs into either a 9-pin or 25-pin serial port.

The other end of the smart cable controls the source deck and the record deck that are required for editing. The source deck must be a camcorder that offers either infrared remote control capability or a LANC remote jack. A VCR cannot be used as a source deck. The record deck can be any VCR with infrared remote control.

The control end of the smart cable contains an infrared emitter. It must be placed



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so that the VCR (and, perhaps, the camcorder, if you choose to control it via infrared signals) can "see" it. A LANC (local application control bus) plug is also provided for controlling the source camcorder. It is preferable to use LANC rather than infrared control because it provides two-way communication between the computer and the camcorder for greater accuracy.

The software seems to be designed for people who are not familiar with computers. Although the *VideoDirector* application runs under Microsoft Windows, it doesn't look like a standard Windows application, and, in some cases, it doesn't act like one, either. For example, the program fills the screen when Windows runs in a 640 × 480 graphics mode. It is not resizable, though it can be minimized. There is no title bar, and there is no control button in the upper left corner although there is a minimize button available in the upper right corner.

*VideoDirector Home* doesn't have any menus per se, either. For example, there is no File drop-down menu from which to select to exit the program. Instead, there is an Exit light at the top right of the screen.

The screen is broken into three main areas. The top contains a picture of a camcorder; its controls operate the source camcorder, and let you define and select the video clips that you want to include in your final edited highlight tape. If you have an MCI-compatible video overlay card installed in your computer, a TV will also be displayed at the top of the screen. It can be used to preview the video clips that you mark. If you don't have a video overlay card, you will need a separate composite-video monitor to view the clips that you choose.

The bottom left of the screen contains a catalog of tapes and a script book. The catalog of tapes lets you choose a tape that has scenes you want to include, or to add a new tape to the list. The script book is where you organize the clips in the order

that you want them to appear on the tape. A script can consist of scenes from multiple tapes.

Tucked into the bottom right portion of the screen are tools: a help book, a configuration toolbox, printer configuration, and a trash can.

Editing a tape is an easy process. But before you can get started selecting your clips, you must first tell *VideoDirector* about your camcorder and VCR. If you are using infrared signals to control your camcorder, you must pick the brand and model from a list. If you are using the LANC bus, you must indicate so, but you don't have to worry about the specific brand or model.

You must also select your VCR brand from a list. Of course, there are too many models to list, so just the brand is listed, along with a number if there is more than one set of commands for that brand. For example, if you have a Fisher VCR, you must select one of five command sets and test them to see which works with your specific model.

As we found out, even if your brand is listed, the correct command set might not exist. Fortunately, you can teach *VideoDirector Home* your VCR's commands with your existing remote control. For maximum accuracy in your edits, you can set record-delay and pause-delay times—that is the length of time between when your VCR receives an infrared command and when it actually executes it. The delay can be set either by seconds and tenths of seconds, or by video frames.

When you're confident that *VideoDirector* will control your specific camcorder and VCR, you're ready to start choosing the scenes you want to include in your finished tape. First, click on the New Tape icon, and when prompted, insert the tape into the camcorder. *VideoDirector* then rewinds the tape to the beginning as a calibration aid. Then hit the camcorder's play button (or use the on-screen camcorder's button) and watch the video either on a separate monitor or on the on-screen





VideoDirector Home has an easy-to-use interface that anyone can learn to use.

TV if you have a video overlay card installed. When a scene comes up that you want to save, click the **START OF CLIP** control on the on-screen camcorder. At the end of the scene, click the **END OF CLIP** control. The **PREVIEW** button lets you review your start and end points, which can be easily changed if you want. If your camcorder supports it, you can jog the tape back and forth a frame at a time to get to the right place. When you're finally satisfied that you have the clip you want, you can click on the **SAVE CLIP** button, and assign the clip a name.

It makes sense to mark all of the good scenes in a video tape even if they are ones you don't plan to use immediately. That's because you can't go back later and save additional scenes from a tape without assigning a new name to it.

After you have all of your scenes marked from one or more tapes, you are ready to assemble them into the finished tape. It's a relatively simple process. First choose the tape you want to start with, and double click on the title to obtain a list of clips. Then simply drag the scene you want to include onto the script book. Scenes can come from multiple tapes, and can be placed in any order you want. When you have your script complete, you're ready to record your scenes.

Making the edited tape is simply a matter of clicking the **MAKE TAPE** button. A VCR slides out from the side of the screen to replace the tape list and script book. Most of the process is automatic. VideoDirector rewinds or fast-forwards the camcorder to get to the right scenes, and then starts or pauses recording. VideoDirector prompts you to change tapes in the camcorder if necessary.

#### STEPPING UP

VideoDirector Suite provides the same underlying functionality as VideoDirector Home, but adds a slew of bells and whis-

ties that are lacking from the basic package. It also has the look and feel of traditional Windows programs. To set the software to work with your source and record decks, you must perform essentially the same functions as well. However, the look and feel is much different—easier for Windows users, probably more difficult for computer neophytes.

The Suite software allows you to divide a source tape into chapters, grouping scenes into what it calls "sections." That's far better than the Home software, which only allows scenes to be defined. With experience, we have learned to eliminate most extraneous footage by judicious in-camera editing. That not only makes our final edits easier, but it allows us to fit several events on one tape. After a brief vacation, we might have used some 15 minutes of tape. Of course, we're not going to let the unused tape go to waste, if for no other reason, to conserve space in our tape library. The ability to define sections lets us conveniently find footage from our vacation to Washington and mix it with footage from a family outing in the park.

Another nice feature of the Suite software is the different ways that it displays clip information. One option provides a simple text-only view, another includes full information about the clip along with a "picon"—a picture icon that can be a still frame of video if you have a video-capture board, or any other image you wish to associate with the clip. The third view shows only the picon, creating a storyboard view.

Additional programs are supplied on a CD-ROM, including a title editor, an animation editor, a sound editor, and a lot of images, sounds, and sample animations. However, to incorporate animations or titles requires additional hardware—a device to convert the VGA signals that the computer produces to composite video.

Both VideoDirector Home and Vid-



VideoDirector Suite presents a more traditional Windows interface and added functionality.

eoDirector Suite are ideal solutions for the videographer who wants an easy way to organize and present only the best video that he or she has captured. Although neither offers the frame-by-frame precision that comes only with timecodes, they both do an admirable job. And they make it so easy, that there's no longer any excuse for showing boring videos. ■

## GIZMO NEWS

### Anti-Bacterial Calculator

It's a medical fact that bacteria, and the illnesses they cause, often are passed from hand to hand. Even if you avoid shaking hands all winter long, you are still exposed by touching things that are used by many other people.

Sharp Corporation, responding to "an increased awareness and desire for amenities such as cleanliness, health, safety, and comfort," has introduced two new calculators whose keys and cases are made of a material that contains agents





said to inhibit the growth of bacteria. The inorganic anti-bacterial agents contain antibiotic metals such as silver and zinc intermixed with the material used in the calculators' contact surfaces. The agents remain active and stable even in hot, damp conditions, where bacteria thrives. The Anti-Bacterial Electronic Calculators are intended for use in places where calculators are made available for use by the general public, such as customer-service counters in shops, as well as in businesses where more than one person uses the same calculator. Both modes are currently available in Japan. No U.S. marketing plans have been announced. ■

### CompactFlash Association Formed

Twelve companies prominent in the fields of computing, imaging, communications, and consumer electronics have established the CompactFlash Association (CFA) to promote the adoption of the CompactFlash (CF) storage specification as a new industry storage standard. The CompactFlash storage card is the world's smallest removable data-storage system. First introduced in 1994 by SanDisk, the solid-state CF cartridges, about the size of a matchbook (1.4 × 1.7 × 0.13 inches) are available in 2-, 4-, 10-, and 15-megabyte capacities.

The founding companies are Apple Computer Inc., Canon, Eastman Kodak, Hewlett-Packard, LG Semicon (formerly Goldstar), Matsushita, Motorola, NEC, Polaroid, SanDisk (formerly SunDisk), Seagate, and Seiko Epson. It is expected that the member companies will begin incorporating CF storage cartridges in some of the many different electronic platforms and products that they produce for mass

consumer markets. The CFA is actively recruiting new members, and expects several other companies to join in the near future.

The founding members cite various reasons for backing the CF platform. Canon believes that CF cartridges "will become the film for next-generation digital cameras," while Eastman Kodak considers CompactFlash to be "an excellent solution for Kodak's Digital Imaging products where small-size storage is appropriate." Hewlett-Packard sees CF as "an enabling technology" that could allow the company's handheld products to "seamlessly integrate with numerous mass-market products such as video cameras, pagers, and cellular phones." Motorola "strongly endorses" the establishment of a CF standard, because "a PC Card-compliant storage standard is necessary to encourage the growth of more functionality on smaller, lighter, and less expensive devices."

Another stated goal of the CFA is to encourage other storage or semiconductor manufacturers to develop CF cartridges. SanDisk will transfer the CompactFlash trademark and specifications to the CFA, which will make it available under a royalty license fee to other third-party manufacturers who commit to develop, manufacture, and supply CF products. ■

### Camcorder Low-Lux Standards Adopted

The Electronic Industries Association's Consumer Electronics Group (EIA/CEG)—which has just changed its name to CEMA, for Consumer Electronics Manufacturers Association—has developed a standard that will help camcorder buyers compare the low-light sensitivity (low-lux) of various models.

EIA-639 was developed by a task force created under the direction of the EIA Video Systems Committee and composed of manufacturers, independent test laboratories, technical-media representatives, and consultants. The standard is now in the process of receiving American National Standards Institute (ANSI) certification.

EIA-639 will apply to all types of video cameras and camcorders, including VHS, 8mm, and the new digital products. Those manufacturers who adopt the standard must indicate in their advertisements and literature that the stated low-light performance is as "measured by the EIA standard," and consumers are advised to look for that wording when shopping for a new camcorder or video camera. Previously, each manufacturer used its own methodology to rate camcorder sensitivity.

The task force conducted tests to determine the level of picture performance that camcorder users would consider acceptable when lighting conditions were less than perfect. Those tests revealed the minimum acceptable quality levels for picture brightness, contrast, picture noise, and color. According to the standard, camcorders must equal or exceed the minimum acceptable level for five performance parameters: luminance level, black level, luminance signal-to-noise (S/N) ratio, chroma level, and resolution.

"Camcorder low light sensitivity or lux rating is an advertised feature for camcorders. A low lux rating ... [is a] key feature that influences camcorder sales," said John H. Stevens, task force chairman and manager of camera engineering for Thomson Consumer Electronics. "With this new standard, the industry can provide an accurate guide for consumers interested in buying camcorders." ■

## ELECTRONICS WISH LIST



### Chinese/English Translator

If you're planning a trip to China, consider packing the TR-2000 Chinese/English translator from Seiko Instruments USA (2990 West Lomita Blvd., Torrance, CA 90505; Tel. 310-517-7700). The pocket-sized device translates Mandarin Chinese to English and vice versa, featuring 27,000 Chinese entries and 20,000 English entries with approximately 51,000 translations. The conversion function changes complicated Chinese characters to and from simplified Chinese characters. The TR-2000 features the "EZ-Learn" teaching system, a word quiz that helps you memorize words and phrases. It has a bright display, a QWERTY-style keypad, a bi-directional metric converter and currency converter, and a 10-digit calculator with memory. Operating instructions are printed on the folding lid for quick reference. The translator comes with a carrying case and two lithium batteries. Price: \$49.99.



# ELECTRONICS WISH LIST

## Bad Vibrations

The C-5 and C-10 vibration absorbers from Tekna Sonic, Inc. (442 Houser St., Suite E, Cotati, CA 94931; Tel. 707-794-1512) greatly reduce speaker-enclosure panel vibrations. Attached to the rear panel of a loudspeaker, they function as a selectively tuned energy recovery system, attenuating peak resonances by an average of 15 to 20 dB. Mechanical energy, which causes the destructive vibrations, transfers directly from the enclosure into the vibration absorber. In the process, audible mechanical energy is converted to its inaudible thermal state. According to Tekna Sonic, that produces a dramatic increase in sound clarity not only over the critical mid-range frequencies but in the bass region as well. Prices: C-5: \$40 each; C-10, \$50 each.

CIRCLE 64 ON FREE INFORMATION CARD



Tekna Sonic Vibration Absorbers

## Compact Home-Theater Speakers

For putting big sound into small media rooms, Cerwin-Vega (555 East Easy Street, Simi Valley, CA 93065) offers the Sensurround Home Theater Powered System 6, a compact, six-piece speaker system. Featuring a low-profile center-channel speaker, four small satellites, and a powered subwoofer with remote control, the System 6 uses the same Academy Award-winning Sensurround technology, and delivers the same uncompromising video and audio sound, as Cerwin-Vega's larger seven- and five-piece systems. The modular system allows users to purchase each component separately to configure a system that meets the specific demands and dimensions of almost any room. The magnetically shielded HT-MDC center-channel speaker incorporates dual five-inch high-excursion mid-range drivers with rubber surrounds and a one-inch polycarbonate dome tweeter. It measures 6¾ x 14½ x 6½ inches. The shielded HT-S5 two-way satellite speakers feature a five-inch midrange and a one-inch dome tweeter, and offer power-handling capability of up to 60 watts. They measure 9¼ x 6½ x 6¾ inches. The HT-10PWR 10-inch powered subwoofer features a built-in 100-watt amplifier and comes equipped with its own remote control that targets only subwoofer volume level. Prices: System 6, \$1695; HT-MDC, \$235; HT-S5, \$330/pair; HT-10PWR, \$800.

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Cerwin-Vega Sensurround System 6

## Quake Insurance

According to the experts, if you live in California, particularly near the 800-mile-long San Andreas Fault, you—and your electronic gear—face the threat of a major earthquake in the next five years. TVs, stereos, and other home-electronics are vulnerable to damage from even moderate seismic movement. Treco's (129 East Colorado Blvd., Suite #462, Monrovia, CA 91016; Tel. 818-301-0891) Quake Hold! straps are a line of easy-to-use, adjustable fasteners that keep your electronic equipment safely in place in the event of an earthquake. The straps attach to furniture without damaging the finish, and can be removed quickly for moving or cleaning. The Quake Hold! products are interchangeable and can be mixed and matched to secure top-heavy items such as tall speakers and large monitors. The line includes a VCR/Stereo Strap that can also be used to secure fax machines, computers, microwaves, copiers, and small appliances; TV straps; furniture straps in decorator colors; big screen straps that can also secure large appliances such as refrigerators; and bookcase straps. Now, if they could only do the same for the walls and ceilings .... Prices: N/A.

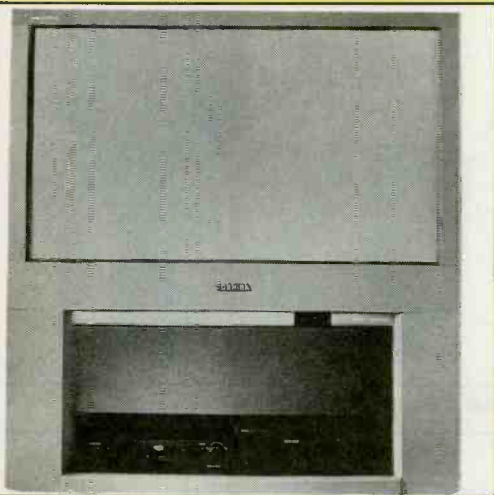
CIRCLE 66 ON FREE INFORMATION CARD



Quake Hold! Straps



# ELECTRONICS WISH LIST

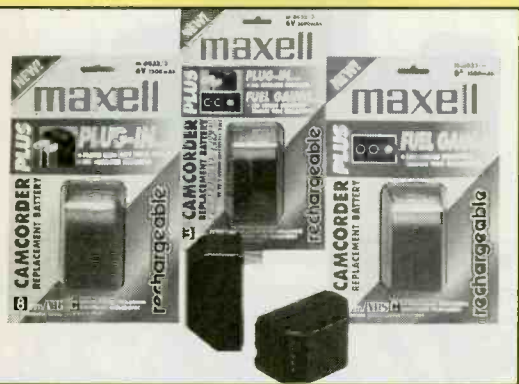


Toshiba TheaterView Widescreen TV

## Widescreen TV

According to *Toshiba America Consumer Products, Inc.* (82 Totowa Road, Wayne, NJ 07470), its TheaterView line, including the widescreen *Model TW56D90*, represents the most advanced rear-screen projection TVs in the industry. The set benefits from I<sup>2</sup>C Digital Chassis technology, which uses micro-processors that continuously monitor and adjust key television functions to provide consistently optimum audio, video, and tuner performance. TheaterView users can adjust the alignment of the set's three image-producing picture tubes without leaving the sofa, via remote control. The TV offers Dolby Pro Logic, a 68-watt audio system, and external rear speakers. Convenience features include favorite-channel selection, two-tuner picture-in-picture, and automatic closed captioning when the MUTE button is pressed on the remote control. Color-temperature control allows the viewer to adjust the overall "warmth" of the image, choosing between three color-temperature selections. The Extended Data Service (EDS) function allows the viewer to access broadcaster-provided information on TV programs, including name, type, length, and network affiliation. Price: \$4999.95.

CIRCLE 67 ON FREE INFORMATION CARD



Maxell Camcorder Plus Battery Packs

## "Self-Charging" Camcorder Batteries

The *Camcorder Plus* battery line from *Maxell Corporation of America* (22-08 Route 208, Fair Lawn, NJ 07410) includes units with built-in self-charging plugs that allow convenient recharging anywhere there's an outlet, whether or not the camcorder's charging unit is present. Recharging begins as soon as the battery is plugged into a standard AC outlet. The *Camcorder Plus* line also includes a *Fuel Gauge* unit that tells the user how much power remains, and the *Combination* battery pack, which combines the built-in charger and the fuel gauge features with high-capacity (2000-mAH) cells. The *Combination* unit delivers two hours of running time, instead of the standard 1.5 hours. The *Camcorder Plus* units are universal batteries that fit most 8mm and VHS-C camcorders, including those manufactured by Sony, Sharp, and JVC. Prices: *Fuel Gauge* (M-6033/1), \$59; *Self-Charging* (M-6033/2), \$69; *Combination* (M/6033/3), \$99.

CIRCLE 68 ON FREE INFORMATION CARD



Carver THX-Certified Amplifier

## THX Amplifier

*Carver Corporation's* (P. O. Box 1237, Lynnwood, WA 98046; Tel. 206-775-1202) *Model A-400x* stereo power amplifier delivers 200 watts (8 ohms) per channel and Home THX certification at a reasonable price. The amp, which is made in the United States, provides more than enough power to drive most loudspeaker systems. If more power is desired, the A-400x can be bridged to deliver 600 watts mono into an 8-ohm load. The amplifier features high-quality components in a simple, rugged chassis. It uses gold-plated RCA input jacks and premium-quality five-way binding posts. Price: \$685.

CIRCLE 69 ON FREE INFORMATION CARD



KAB SpeedStrobe Turntable Timer

## Digital Speed Readout

Aimed at vintage sound enthusiasts as well as dealers and repair technicians, the *SpeedStrobe* digital speed readout from *KAB Electro-Acoustics* (P.O. Box 2922, Plainfield, NJ 07062-0922; Tel. 908-754-1479) uses actual speed numbers, instead of hypnotic bars, to verify turntable speeds at 16, 33, 45, and 70-90 RPM. It includes a handheld, battery-operated strobe light. By using a low-frequency strobe, fewer icons are required around the disc, making it easy to test for jitter and drift. Illuminated with the strobe light, the turntable speed is read directly from the *SpeedStrobe* disc, glowing bright red against a black background. If the readout drifts one position in 60 seconds, it would represent 0.03% accuracy. The digital disc, which was created using sophisticated CAD software, is silk-screened on 20-mil, die-cut plastic and is 10-inches in diameter. Price: \$99.95.

CIRCLE 70 ON FREE INFORMATION CARD

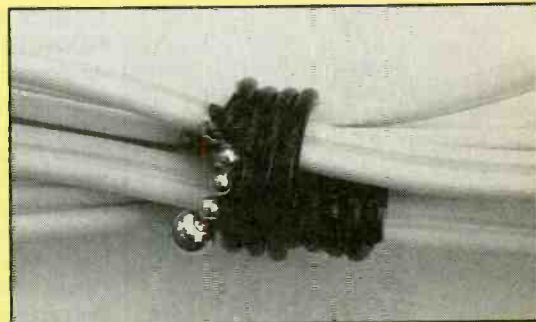


# ELECTRONICS WISH LIST

## Curly Cable Wraps

The *KurlyTie Company* (3382 Border Drive, Stone Mountain, GA 30087) now offers ten different styles of its unique bundling ties. The four reusable *KurlyTie* models, designed for use with audio/video cabling, offer a solid, rubbery grip and adjustable holding force. They lock in position on the cable, fastening in place with a patent-pending base coil design, making it easy to reposition or remove them for use elsewhere. Four *KurlyKwik* models fasten in place on the cable with a standard locking tie. *KurlyTie* and *KurlyKwik* models come in full and small sizes, with or without a convenient pull chain. The full and small sizes of *KurlyKoil* models don't mount on the cable itself, but are intended for tacking up cables or organizing installed cabling. All ten models use an expandable plastic coil to secure cables. Prices: *KurlyTies*, \$7.40 to \$24.95/10-pack; *KurlyKwik*, \$12.40 to \$18.70/10-pack; *KurlyKoil*, \$8.60 to \$22.40/20-pack.

CIRCLE 71 ON FREE INFORMATION CARD



KurlyTie Cable Holders

## CD-ROM-based Video Editor

Borrowing graphics and titling tools from the broadcast TV and magazine production worlds, the *PC Video Studio* from *Sima Products Corporation* (6153 Mulford Street, Niles, IL 60714; Tel. 800-345-7462) allows home videographers to add a vast variety of dazzling typefaces, colors, sizes, backgrounds, clip art, retouching, and other advanced effects to their video productions. The CD-ROM-based device blends analog and digital technologies to offer advanced graphics capabilities at an affordable price. The package includes Corel Draw 3, a feature-rich CD-ROM that contains 14,000 pieces of clip art; 250 PC-compatible type fonts; a drawing program; a photo editor that incorporates Photo CD shots into the video and allows unusual retouching—like putting one person's head on another's body; a photo slide show generator; and tools for retrieving and manipulating libraries of digitally stored information. After the user has created titles and graphic effects on the PC, *PC Video Studio's* VGA-NTSC converter changes the computer's digital video signal into one that can be recorded onto a standard home VCR. The package includes the SED-2 video/audio mixer, which takes video output from the PC and blends the newly created titles, graphics, and pictures into the original video footage. Price: \$199.

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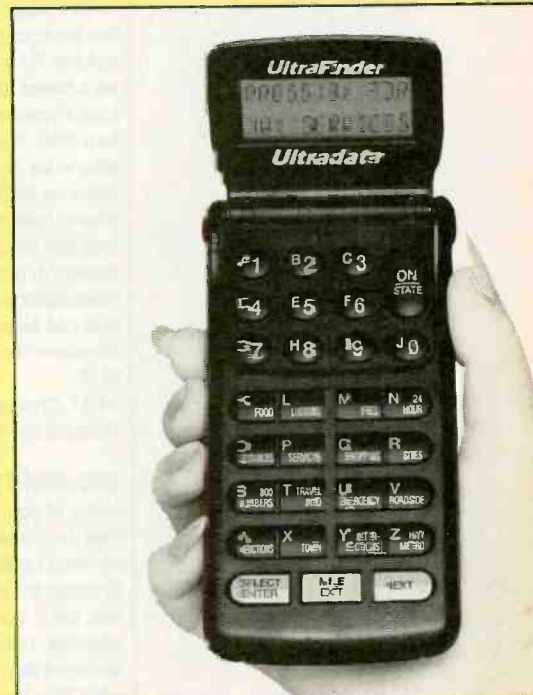


Sima PC Video Studio

## Handheld Travel Guide

Eliminate navigation hassles on your road trips with *Ultradata Systems'* (9375 Dielman Industrial Drive, St. Louis, MO 63132; Tel. 800-747-2605) *UltraFinder*, a handheld computer that provides instant access to more than 100,000 services along the nation's highways and in more than 70 American and Canadian cities. Replacing unwieldy road maps, the *UltraFinder* puts the information you need in your hand with just a few keystrokes. Simply press a button to let it know where you are. In the highway mode, you'll immediately see the distance to the next exit, the exit number, and directions and distance from your exit to your destination. You can also get information regarding gas, lodging, 24-hour food services, rest areas, campgrounds, hospitals, and attractions. *UltraFinder* provides toll-free numbers for motels, and telephone numbers for highway patrol, weather, road conditions, and tourist information. In the city mode, you get immediate access to hotels, restaurants, 24-hour copy centers, 24-hour pharmacies, museums, attractions, car-repair services, and hospitals. You can also get detailed directions from one major location to another. It provides specific directions to large cities across the country and small cities within each of four regions: Northeast, South, Central, and West. Information is kept current via a low-cost, updatable plug-in module. Price: \$129.95.

CIRCLE 73 ON FREE INFORMATION CARD



UltraFinder Navigation Tool

# LETTERS

## Some Corrections, and a Call for Information

### **SORRY, WRONG NUMBER**

An incorrect telephone number was inadvertently listed for the Gernsback BBS in the article "Build an Autoranging Capacitance Meter," which appeared in the January 1996 issue of **Popular Electronics**. The correct number is 516-293-2283. Please do not use the number that appeared in that story. We apologize for any inconvenience. — Editor

### **SORRY, WRONG PRODUCT**

I regret to inform you that an item mentioned in the "Electronics Gift Guide" (*Gizmo*, **Popular Electronics**, December 1995), has been discontinued. The AT&T TV Information Center would have brought information services, telephone answering, and other services to the TV screen. The market response from information service providers and consumers was not strong enough to continue the product offering at this time.

The picture that accompanied the product mention, however, is not the TV Information Center as labeled, but is the AT&T 2-Line Personal Information System 882. The 882 is a screen phone for home offices that can store up to 200 names and phone numbers for easy dialing and can display caller-ID information. It has been in the marketplace for eight months and has been well received by consumers.

M.H.  
AT&T Consumer Products  
Parsippany, NJ

### **TRANSISTOR HISTORY**

Many of your readers will know that the transistor was discovered by Bardeen and Brattain of Bell Laboratories in late 1947. I use the word "discovered" rather than "invented" because they had a good idea what they were looking for, and the device that they accidentally

created, the point-contact transistor, was nothing like it! It was to be four more years before a working junction transistor—which is what Schockley, the Bell Labs theorist, was really seeking—was made.

In the interim, Bell licensed their point-contact technology to many commercial firms, and millions of point-contact transistors were made. That was despite the fact that the operation of the device was very poorly understood in theoretical terms, and its production used a highly empirical technique: so-called "forming." That involved fusing the point contacts to the germanium die using current pulses, and was far more of an art than a science. The resulting structure, usually of PNP polarity, had a common-base current gain ("alpha") considerably greater than one! That shows just how different the device was from the standard transistor that we all know.

About 100 different types of point-contact transistor were made, the majority in the US, a dozen or so in England, and even one or two in France and Germany. Today, the existence of that device type is known only to historians, and very few specimens survive. The early development of the semiconductor industry, from 1947 up to about 1960, is a major interest of mine—particularly the point-contact transistor. If any readers have interesting information or anecdotes from that period, data books or sheets, circuit cards, or early semiconductor devices, I would like to hear from them.

DR. ANDREW WYLIE  
21 Brancaster Lane  
Purley, Surrey CR8 1HJ  
England

### **HAVES & NEEDS**

I am a student in an electronics class and I would be very grateful if any of your readers would send me a schematic diagram of the Sherwood amplifier

model S-9500, serial number T-501859. Thanks.  
CHARLES KWONG WOH  
319-8511 Westminster Highway  
Richmond, B.C.  
Canada, V6X 3H7

I am in need of the schematic for a Panasonic RF 4800 or RF 4900 communications receiver and a schematic for a Bogen LS 330 PA amplifier made by Lear Siegler Inc. I also need a C.R.T. #T52P2 for a Tektronix 532 scope. I need an old VTVM to make into an impedance meter and a bench power supply, about 30 to 50 volts adjustable, single or dual type.

I have the 1804 and 1821 plug-ins for a Hewlett-Packard scope. If anyone needs them, I will sell both for \$120, but they need repairs.  
CRAIG KENDRICK SELLEN  
Box 1038 RR-1 58-B  
Waymart, PA 18472-9712

I have a Hammarlund HQ-170A-VHF, and would appreciate if anyone could send me the manual or schematic. Thank you.  
MICHAEL J. DI STEFANO  
1 Willow Street  
Exeter, NH 03833

I have been reading **Popular Electronics** for more than 40 years, and I've found it to be the leading magazine in its field. I always read the *Letters* column, and I've seen a lot of people who have been helped with electronics problems by other readers. I hope they'll be able to help me, too.

I need schematics for three oscilloscopes. I am trying to repair two of them: a Tektronix model 524-A.D. and an Analab model 1120. The third, a Du-Mont type 304, I now have working. The schematics or other information can be good-quality photocopies, for which I will cover the costs.  
LEWIS E. WILLIAMS  
40 River Road, Apt. 8  
Halifax, NS  
Canada B3R 1V3



# Prepare For a New Future As a LAN Servicing Technician!

Now you can get the equipment, experience, and credentials you need to make money installing, maintaining, and upgrading Local Area Networks!

## Discover what developments in LAN technology can mean for you

Today's LANs are able to transform individual PCs, departments, divisions, and entire corporations into productive information resources. This dynamic, in-demand technology can be your specialization with NRI training, the ticket to a new, secure future.

Now you can be one of the key technicians able to sell, select, install, use, maintain, and manage office networks. And this know-how will earn you top dollar! Only NRI, the leader in at-home training for over 80 years, gives you everything you need to start a new career or business of your own as a sought-after LAN servicing technician.

## Train with and keep the most advanced computer system available in home study today!

NRI knows: To master a revolutionary technology like LAN, you need to train with exceptional equipment. That's why your course includes a 486DX4/100 MHz PC with all these exciting features...

- Space-saving mini-tower design
- 8 meg RAM
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- 14,400 baud fax/modem with 10 free hours of *America Online*
- Quad-speed CD-ROM drive
- 16-bit sound card with stereo speakers
- Windows 95
- Two network interface cards
- Thin, Ethernet cable
- Special coax cable-assembly tools
- And more!

Using LANtastic, award-winning LAN software, you connect this top-of-the-line system to your existing computer (386SX or



## Hands-on training builds confidence

Leaving nothing to chance, NRI's LAN Servicing course goes beyond reading to give you real experience, the kind that makes you proficient on the job.

As an NRI student, you get a chance to build, configure, test, and use your own LAN system! No other school goes the extra mile to make your learning experience so enjoyable and effective.

## Flexible, convenient studying with your own instructor

You study at home, at your own pace. And with NRI's easy new TeleGrading system, you can check your knowledge and progress over the phone - 24 hours a day!

better, with hard drive, 3.5" floppy drive, and at least one meg RAM). Then you're set to explore first-hand the tremendous potential of today's LAN technology.

## Lessons cover entire LAN spectrum

NRI's "bite-sized" lessons explain computer electronics and LAN technology step by step. Even if you have no experience in this field, you'll be able to understand these expertly written texts because they're loaded with diagrams and illustrations. Plus, they present each subject in clear, everyday language so you won't get bogged down in technical jargon.

What's more, you have an expert instructor available throughout your training and career. Offering advice and feedback, your instructor will become a trusted mentor, able to help you move up and make good money as a successful LAN servicing technician.

## FREE catalog gives all the details

If the coupon is missing, write to NRI Schools, 4401 Connecticut Avenue, NW, Washington, DC 20008. Or...

**CALL 1-800-321-4634,  
Ext. 1422**



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# NEW PRODUCTS

## Automotive Navigation System



You can leave the road maps and guidebooks home if your car is equipped with *Pioneer's GPS-X77* satellite-based, in-vehicle navigation system. It uses the Global Positioning System (GPS) along with proprietary CD-ROM technology to create comprehensive digital maps and information listings that provide consumers with directional assistance as they drive. GPS technology uses satellite signals to track the movement of the car. Computer analysis of the signals determines the position and movement of the

vehicle. The vehicle's direction, latitude, longitude, altitude, and speed are instantly relayed. The positioning information is updated approximately every second, providing a real-time display of the vehicle movement on the map. The system also allows the driver to input a destination by either entering a given address or by selecting one of the thousands of information listings contained on the CD-ROM. The software offers more than 90 categories of information listings, including food, lodging, entertainment, shopping, automotive, medical, government, services, and more. The location of a par-

ticular listing can be pinpointed on the map, and its address and phone number displayed on screen. Before beginning a trip, the user can plan out a particular route by placing directional arrows on the map to indicate turns. The GPS-X77 then provides audible instructions, such as "right turn ahead," to prompt the driver along the way. The distance and straight-line direction to the destination is displayed. The system consists of a detachable five-inch color LCD monitor, a combination CD-ROM drive, a GPS receiver and microcomputer in a single DIN-sized chassis, a wireless remote control, and a small-profile GPS antenna. A single CD-ROM disk contains digital maps and information listings for a particular geographic area. The first three discs to be offered cover Southern California, Northern California, and the Pacific Northwest; the fourth is for the Midwest market.

The GPS-X77 navigation system has a suggested retail price of \$2850; each CD-ROM costs \$150. For more information, contact Pioneer Electronics (USA) Inc., 2265 East 220th Street, Long Beach, CA 90810-1639; Tel. 310-952-2286.

**CIRCLE 84 ON FREE INFORMATION CARD**

### CORDLESS MOUSE

*Interlink Electronics' RemotePointPlus* is a handheld, cordless, PC pointing device that offers smooth 360° cursor control and dual mouse-button support. In addition, the device provides four extra programmable buttons that give one-touch access to as many as 15 software programs, presentation tools, media effects, slide shows, and more. Designed for use with today's multimedia software titles with point-and-click interfaces, the RemotePointPlus has a smooth, thumb-driven cursor control and trigger-style click button that make navigation and item assignment



simple. Its four extra buttons allow it to be customized for various applications. Used in multimedia presentations, it allows the speaker to walk around the room and interact naturally with the audience. The RemotePointPlus uses VersaPoint Pressure Pointing technology, in which a force-sensing resistor converts changes in pressure (the touch of a thumb) into changes in resistance, which are translated via firmware into cursor movement. VersaPointPlus software, which is Windows and Windows 95 compatible, provides an intuitive user interface for programming the four extra buttons. Assignable options include highlight text, hide-and-reveal slides, laser-pointer emulation, text underline, draw on the screen, play sounds, launch programs, and more. For instance, one possible edutainment button setting might be: (1) launch game, (2) save game, (3) load game, (4) quit, (11) pause, (22) mute, (33) restart, (44) launch Web browser, etc.

The RemotePointPlus cordless mouse has a suggested list price of \$199.95. For further information, contact Interlink Electronics, 546 Flynn Road, Camarillo, CA 93012; Tel. 800-340-1331 or 805-484-1331; Fax: 805-484-8989; e-mail: support@interlinkelec.com.

**CIRCLE 85 ON FREE INFORMATION CARD**

### TELECOMMUNICATIONS TEST SET

The *Amrel TeleSense 1000* is a handheld transmission-line test



# 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

1 2 3 4 5 6



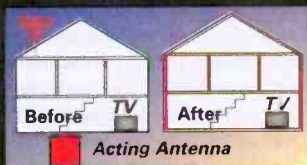
■ When TV signals are tuned at the TV channel's center frequency, optimum tuning has been achieved.

■ 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?



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

### 3. Spectrum antenna features

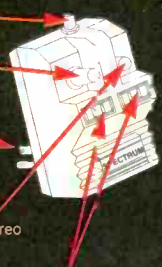
**Parallel 75 ohm resistance**  
For minimum loss of signal

**Signal search control**  
For selecting multiple antenna configurations

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

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

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



**U**ntil 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 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!**

Spectrum Antenna™.....\$39 \$4 S&H  
Additional antennas just.....\$34 S&H free

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For fastest service, call toll-free 24 hours day

**800-992-2966**



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

set designed for troubleshooting, installation, and testing 2-wire/4-wire telecommunication transmission lines. It tests line loss, frequency response, and background noise measurements. A 20-kHz frequency counter is built in. True-RMS level measurements can be constantly monitored on the 3½-digit LCD readout. The TeleSense 1000 can be adapted for many applications that require verifying problems using basic DMM functions such as AC/DC voltage, DC current, and resistance measurements. The device features a precision tone generator with selectable output levels of -13 to 0 dBm for assessment of VF transmission lines.



Packaged in a rugged, bright-yellow ABS plastic case, the TeleSense 1000 can withstand drops of up to 10 feet. It comes with a removable stand, a 9-volt alkaline battery, test leads, and operator's manual, and a hard leather holster for field-service applications.

The Amrei TeleSense 1000 is priced starting at \$495. For additional information, contact American Reliance, Inc., 11801 Goldring Road, Arcadia, CA 91006; Tel. 800-654-9838; Fax: 818-358-3838.

**CIRCLE 86 ON FREE INFORMATION CARD**

### POCKET QUICKEN ON BOOKMAN

Intuit's Pocket Quicken personal financial-tracking system is now available on Franklin Electronics' Bookman electronic book system. Bookman is a line of handheld electronic books that feature a QWERTY keyboard, color-coded keys for



different functions, and a compact LCD screen. The IC-ROM-based Pocket Quicken on Bookman, the first dedicated portable device for the financial software program, also has two cartridge slots on the back that allow instant access to other plug-in reference works. Dictionaries, encyclopedias, and entertainment publications are available in the Bookman format.

Pocket Quicken is specially designed for easy use on the go, allowing users to keep track of cash, check, credit card, and savings transactions as they occur. Users can easily fill out and categorize a simple transaction form as quickly as they would write and record a check in a traditional checkbook register. They can also categorize business expenses by trip, project, or client. At the end of a trip or project, all the related information can be collected to generate an expense report. Pocket Quicken provides up-to-date spending information to help users make financial decisions on-the-spot.

Pocket Quicken on Bookman can be used as a stand-alone personal financial manager, or as a data-capture system that communicates with desktop versions of Quicken. It includes a Mac/IBM-compatible serial port to use with a serial cable and Pocket Quicken Connect for Windows software (Mac software is also available).

Pocket Quicken on Bookman costs \$99. For more information, contact Franklin Electronic Publishers, One Franklin Plaza, Burlington, NJ 08016-4907; Tel. 609-386-2500; Fax: 609-387-7420; or order directly from Intuit at 800-243-4650 ext. 810288.

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### PC-BASED OSCILLOSCOPE

The O-Scope II from Allison

Technology is a compact module that plugs into any printer port, transforming a PC into a dual-trace digital-storage oscilloscope. Applications include testing audio equipment, automobile diagnostics, data logging, field service, noise analysis, and vibration analysis.

Displayed sweeps can be frozen on the screen, printed out, or saved to disk. Operating parameters, such as input range, sweep rate, and trigger level, are displayed and easily adjusted through the computer keyboard. A versatile external trigger is included. In the Frequency Spectrum mode, sweeps of a selected frequency range are presented on a calibrated graph with the option of averaging.



The O-Scope II features simultaneous two-channel data capture for accurate phase measurements in an X-Y presentation. Bandwidth is 250 kHz with sampling rates up to 1,000,000 per second. The minimum PC required is a 286 with 12-MHz speed.

The O-Scope II module costs \$349. For further information, contact Allison Technology Corporation, 8343 Carvel, Houston, TX 77036; Tel. 800-980-9806 or 713-777-0401; Fax: 713-777-4746; BBS: 713-777-4753.

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### REWITABLE OPTICAL DRIVE/CD-ROM PLAYER

The Plasmon PD/CD system is a technically advanced optical drive that provides the capabilities of a removable high-capacity hard drive, a reliable tape backup drive, and a high-speed CD-ROM player in a single, half-height slot. Its micro-optical head assembly offers

unprecedented flexibility. In addition to providing read and direct overwrite capabilities for large-capacity, phase-change optical disks, the PD/CD also reads CD-ROMs, audio CDs, and Photo CDs at a minimum of 600 kilobytes per second (KB/sec). The compact system has an access time of between 100 and 150 milliseconds and, when used with a rewritable phase-change optical disk, transmits data at an average speed of 870 KB/sec.

The PD/CD system was designed for multimedia and desktop publishing/presentation development as well as system backup and secure data storage applications. With the removability of the rugged 650-MB optical disks, the system is also suited for large-scale graphics, engineering, and scientific applications, because work can be organized on a convenient job-by-job, volume-by-volume, or user-by-user basis. Large files can be easily moved from one site to another by shipping or transporting the pocket-sized disks.

The high-speed, random-access system can also be used for PC or network backup, eliminating the need for a separate backup solution. Because the system stores data in the same format as a hard drive, it can be used as a temporary, though slightly slower, replacement for a hard disk until a permanent one is installed. The media is also well suited for downloading and storing highly sensitive information, such as corporate research or government security applications.

Internal and external versions of the PD/CD system are available. Each unit comes with a SCSI-2 interface for fast, easy integration; software drivers for Windows/DOS, Macintosh, and OS/2-based platforms; and one PD650 disk.

The internal PD/CD system has a suggested price of \$895, and the external version is priced at \$975. For more information, contact Plasmon Data Systems, 1654 Centre Pointe Drive, Milpitas, CA 95035; Tel. 800-445-9400 or 408-956-9400; Fax: 408-956-9444.

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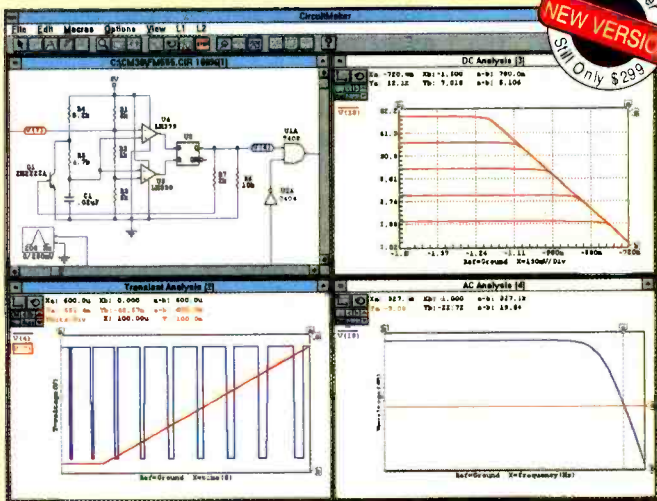


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CircuitMaker's schematic capabilities are unmatched and include many advanced editing features not found in similar programs. These powerful features minimize the time and task associated with drawing a schematic and insure a professional looking final product. Printout and export options are numerous and results are of the highest quality. But that's what people have come to expect from CircuitMaker.



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CircuitMaker's SPICE3 based analog simulation is fast and accurate. SPICE sub circuits for all base level digital devices provides advanced mixed-mode simulation capability. Digital simulation is live and highly interactive. This powerful simulation trio is tightly integrated into one package and will confirm your circuit designs with accuracy and ease.

### Comprehensive Device Library

Version 3 features a state-of-the-art device browser which greatly simplifies the task of organizing and selecting devices. With its newly expanded device library, CircuitMaker now ships with more devices (at no additional cost) than any competing product. If you need a device that isn't provided, CircuitMaker provides industry standard SPICE import and a powerful Macro capability to enable you to create new devices. CircuitMaker provides you with the tools to get the job done right.

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	YES	YES	YES	YES	YES	YES	Retail Price
<b>CircuitMaker</b>	YES	YES	YES	YES	YES	YES	\$299
Electronics Workbench version 4	YES	NO	YES	NO	NO	NO	\$299
Electronics Workbench Engineer's Pack	YES	NO	YES	YES	YES	YES	\$599

**"CircuitMaker Shorts The Competition Out, With An Unbeatable Bottom-line"**

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At MicroCode Engineering we are committed to total customer satisfaction. When you purchase CircuitMaker you have the confidence of knowing that a trained staff of professionals is available to serve you after the sale. Our free unlimited customer service is second to none! Whether you have general or technical questions they will be answered promptly by a knowledgeable representative.

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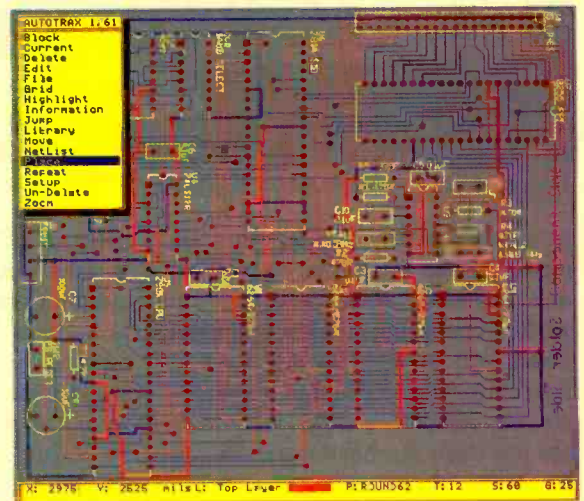
A free functional demo is available on the Internet (<http://www.microcode.com>), on CompuServe (GO MICROCODE) and on America Online (keyword search; CircuitMaker). A demo can be purchased directly from MicroCode Eng. for \$10.

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# MULTIMEDIA WATCH

## Software for Windows 95

BY MARC SPIWAK  
TECHNICAL EDITOR  
WINDOWS MAGAZINE

I've been using Windows 95 a lot lately, and the more I use it, the more I like it. And while it seems a bit slow on a 486 PC, I've been playing with a Pentium 120 desktop and a Pentium 90 laptop, and it flies on those systems. As you can buy a loaded, mid-speed, PCI Pentium system for around \$1500 these days, it might be time for me to finally ditch my old 486.

Anyway, I am getting off the subject. As I started to say, I am beginning

plays, without my computer hanging. While it certainly didn't play the movie with the performance I would have liked, the 486 has never been more stable.

### Win 95 Software

Whenever possible, it's always better to run a Win 95 version of a piece of software than an older version. The newer version will install better, run better, and take advantage of some of Win 95's new features. For example,

Commuter, Crackpots, Fishing Derby, Freeway, Frostbite, Grand Prix, H.E.R.O., Kaboom, Pitfall, River Raid, Seaquest, Sky Jinks, and Spider Fighter. Action Pack 2 includes Atlantis, Barnstorming, Dolphin, Dragster, Enduro, Ice Hockey, Keystone Kapers, Laser Blast, Megamania, Oink!, Plague Attack, River Raid II, Skiing, Stampede, and Tennis.

I recently reported on Activision's new *Pitfall: The Mayan Adventure*, which features Harry Jr., the son of Pitfall Harry from the original game. With the new Pitfall, Harry Jr. is also ready for Windows 95. Also renovated for Win 95 is *Shanghai*, which is four tile-matching games on one disc. You can play The Great Wall where tiles fall as lower ones are removed, Beijing where you match rows of tiles, Action Shanghai where new tiles appear if you aren't fast enough, and Classic Shanghai that can be played with the tiles face up or down.

A new title from Twentieth Century Fox Home Entertainment called *Beyond The Wall* is filled with stories from the Vietnam War in a multimedia presentation. *Beyond The Wall* takes users beyond the front lines through rare home movies, snapshots, letters, songs, and more. The disc is narrated by Adrian Cronauer, the DJ profiled in the film *Good Morning Vietnam*. *Beyond The Wall* sells for \$49.98.

I've got three new titles from Zelos Digital Learning. *Escape From Management Hell* is basically an entertaining game intended to teach management skills to employees at all levels. *Shoot Video Like a Pro* is a multimedia lesson in how to use a video camera to get professional-looking results through the use of virtual cameras, composition, lighting, and sound. *TEAM SAT* lets students choose from eight personal tutors, each with its own personality and style, that then help them achieve higher SAT scores.



*Beyond the Wall*, narrated by Adrian Cronauer is filled with stories about the Vietnam War.

to appreciate Windows 95 more and more. Getting hardware, new or old, and especially multimedia stuff, to work properly in an older computer under Win 95 can be much harder than it ever was in Win 3.11 depending on your computer's BIOS. But I really like the way I can have many different programs running and easily switch between them without Windows crashing or running into memory problems.

At work I might have Word, Excel, Mail, Schedule+, and a few more programs all running at the same time without any trouble. At home, I can run a full-length AVI movie on my 486, and use all the controls while the movie

you'll need the Win 95 version of Word to take advantage of the operating system's ability to use long file names. In addition, the new Word has some neat new features (for example, misspelled words are highlighted as you type). Other companies are also rushing to put out new software versions for Windows 95.

Activision was the first company to send me a bunch of Win 95-updated software. Its *Action Pack* and *Action Pack 2* for Windows 95 are loaded with many of the old Atari 2600 action games you grew up playing, but ready for Windows 95. *Action Pack* includes *Boxing*, *Chopper Command*, *Cosmic*



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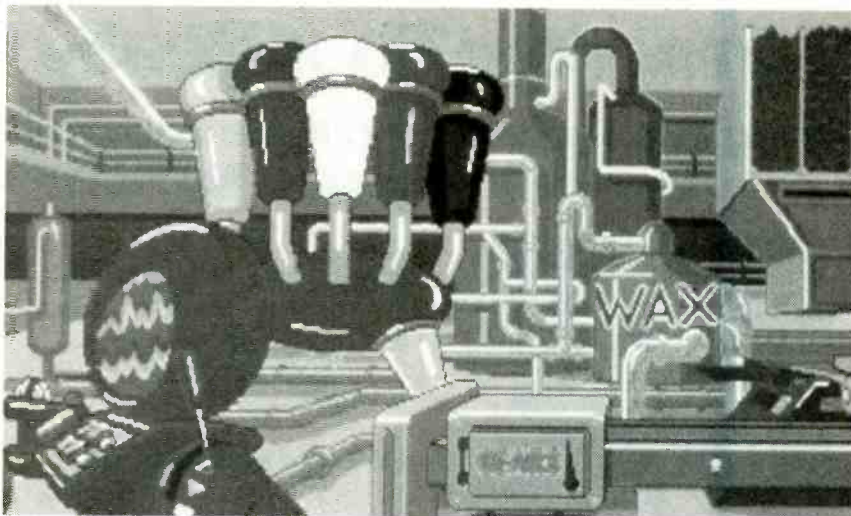
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Photo: Robin Sachs



In *The Crayon Factory*, kids can watch the story or explore the factory, mix and make their own crayons, and more.

For a humorous lesson in how to use Windows 95, check out *The Improv Presents Windows 95 For The Technically Challenged*. That how-to

guide for computers places an emphasis on Windows 95 and lets users select comedy-interlaced lessons from the club's menu. Contact Graphix Zone if you're interested.

### WHERE TO GET IT

#### Activision

11601 Wilshire Boulevard, Suite 1000  
Los Angeles, CA 90025

CIRCLE 50 ON FREE  
INFORMATION CARD

#### Electronic Arts Studios

1450 Fashion Island Blvd.  
San Mateo, CA 94404

CIRCLE 51 ON FREE  
INFORMATION CARD

#### Graphix Zone

42 Corporate Park, Suite 200  
Irvine, CA 92714

CIRCLE 52 ON FREE  
INFORMATION CARD

#### Grolier Electronic Publishing

Sherman Turnpike  
Danbury, CT 06816

CIRCLE 53 ON FREE  
INFORMATION CARD

#### Philips Media

10960 Wilshire Blvd.  
Los Angeles, CA 90024

CIRCLE 54 ON FREE  
INFORMATION CARD

#### Twentieth Century Fox

Home Entertainment  
P.O. Box 900  
Beverly Hills, CA 90213

CIRCLE 55 ON FREE  
INFORMATION CARD

#### Zelos Digital Learning

98 Battery Street, Suite 300  
San Francisco, CA 94111

CIRCLE 56 ON FREE  
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One really neat title this month is *Science Fiction: The Multimedia Encyclopedia of Science Fiction*, from Grolier Electronic Publishing. The disc is based on the Hugo-Award winning book by John Clute and Peter Nicholls (for those readers not familiar with it, the Hugo Award is named after Hugo Gernsback, the founder of the company that publishes this magazine). The disc is filled with photographs, movie clips, and more, from all of your favorite science-fiction sources.

Electronic Arts is offering two new titles, *Fade to Black* and *U.S. Navy Fighters Gold*. *Fade to Black* takes place in the year 2190 when an evil species of master brains have taken over the solar system. In six 3D action levels, you must help the human rebels overthrow the aliens. *U.S. Navy Fighters Gold* is the ultimate in EA's "Air Combat" series of flight simulations. You can fly in many different airplanes and in various missions and scenarios.

Last this month is something for the kids. *The Crayon Factory* from Philips Media tells the story of a crayon factory run by robots. Children can simply watch the story or explore the factory where they can mix and make their own crayons, repair and adjust things, sort colors, and more.



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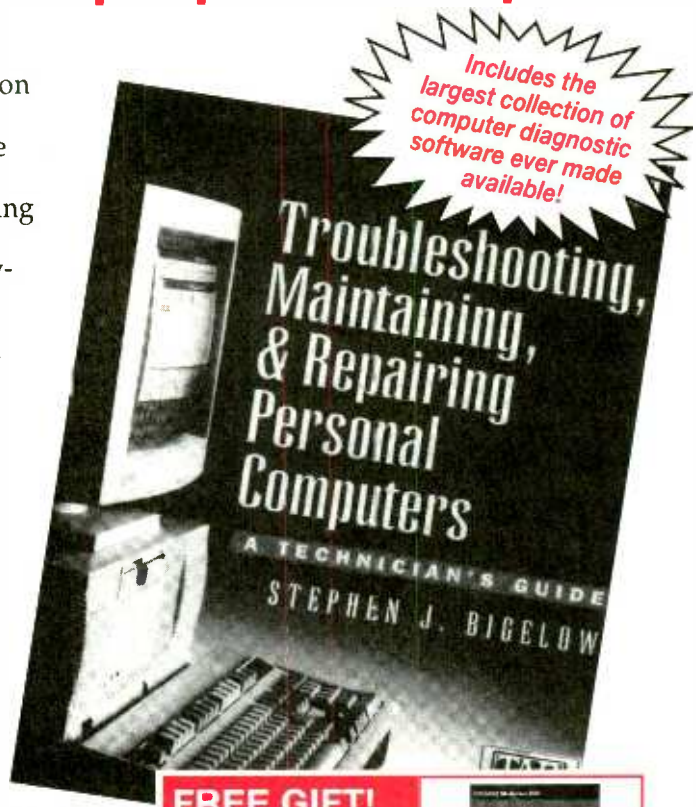
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# NET WATCH

## Shopping for Electronics

BY DAN KARAGIANNIS

Let's face it, electronic components and equipment can get expensive. For that reason, many hobbyists are forced to cannibalize parts from old gear, and use outdated equipment and computers. But that doesn't have to be the case—there are bargains out there. And as you might have guessed (considering which column you're reading), many of those bargains are on the Internet.

One way to buy and sell equipment is directly from Western. If you'd like to buy something, you can check their online searchable list of available equipment, including the following categories: Amplifiers, Analyzers, Antennas, Counters, Generators, Logic Analyzers, Meters, Microwave Components, Oscilloscopes, Power Supplies, Recorders, and Telecommunications.

Swap Meet, which allows users to both post equipment for sale and peruse what others have posted. Judging by some of the posts, you might even be able to work out a trade with someone.

I was impressed with the variety of headings available in the Swap Meet, but even more impressed with the number of postings in some of them. You can choose from Test and Measurement Equipment, Computer Hardware/Software, Radio Equipment For Sale, Radio Equipment Wanted, Consumer Audio, Pro Audio, and Other Misc. Ads. Both Radio sections and the Test and Measurement Equipment section seem to be the most active.

A similar site, but one that is not as well "stocked," is Hi-Tech Surplus. Like Western's site, you can buy items from either the company running the page, or from an Online Swap Meet.

To buy from Hi-Tech directly, you have to first download a DBF III file. The file is zipped (as are many large, downloadable files) and exportable into almost any kind of Database program. In that file you can choose from equipment in the following categories: Audio, Automation, CNC, Components, Computer, Ham, Laser, Manufacturing, Optics, Pneumatics, RF, Robotics, Security, Test Equipment, and Video.

Your other option, the Online Swap Meet, is similar to the one found in Western Electronic's site, except Western's seems to be a lot more active. Again, you can either read the ads or submit one of your own. At this site, submissions are dated and stay online for 30 days; if an item is sold before that time, Hi-Tech asks that you notify them so that they can remove it from the list.

Items found at the Online Swap Meet are grouped under the following categories: Amateur Radio, Components, Laser/Optics, Manufacturing Equipment, Pneumatics/Hydraulics, Robotics/Automation, Service Man-



Looking for a good deal on electronic equipment? The Western Electronic Surplus Online Swap Meet contains lots of bargains.

From online swap meets to storefronts, each of the sites we'll look at this month contains an innovative way of finding just what you're looking for at just the right price. So get out those credit cards and checkbooks; it's time to go shopping!

### SURPLUS AND SWAPPING

Our first site this month is the Western Electronic Surplus page—an easy-to-use, virtual electronic-equipment trader that allows you to both buy and sell equipment. What's great about the site is that it gives two options for doing each.

As far as selling directly to the company goes, they have an e-mail quoting service, where you can send in a description of a piece of equipment and wait for an e-mail price quote. What will Western buy? The company makes the claim that they will buy anything ranging from "a single piece of equipment to an entire business." They go on to add that "any piece is of interest, from an antique scope to a multi-million dollar research facility. We even do trades."

But the neatest feature of the site is one that is only maintained by Western. That's the open, Online



## HOT SITES

**Western Electronic Surplus**  
<http://www.westes.com>

**Hi-Tech Surplus**  
<http://isidaho.com/hitech/hitech.html>

**Internet Shopping Network**  
<http://shop.internet.net>

**Music Boulevard**  
<http://www.musicblvd.com>

uals, Test Equipment, and Misc. Electronics. If you feel that list is not complete, Hi-Tech offers you the option of recommending a new category by e-mail.


## INTERNET SHOPPING NETWORK

First there was the Home Shopping Network, which gave television viewers the ability to shop without the hassles of looking for parking, standing in lines, etc. Of course there were some new hassles. For one, viewers could find themselves waiting for hours until something they liked came on. Then they would have to call HSN to give credit-card and shipping information. Now, there's a subsidiary of the Network that makes shopping even easier.

The Internet Shopping Network speeds up the home-shopping process in two ways: First, it eliminates the problems caused by the linear nature of TV programming. In other words, you can choose from a menu, at any time, what item you'd like to see a description of—no more waiting for it to come on.

Second, there's no need to call up an operator every time you want to place an order. With ISN, you simply set up an account once, giving them your address and credit-card number either by phone or a secure Net transaction. You then receive a membership code that can be used for all future orders. That translates to simple point-and-click buying.

As you can see, there's no doubt about how easy it is to order from ISN. But what is there to order? Well, for starters, there are over 22,000 computer products from more than 600 major companies like Lotus, Symantec, and Microsoft. While I expect that the assorted software and hardware found



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Forget about long lines and looking for parking. The Internet Shopping Network offers some of the best deals on merchandise right over the Net.

at ISN's site will be of greatest interest to **Popular Electronics** readers, there are a lot of other items to order. You can order flowers from FTD, teas from Celestial Seasonings, steak and lobster from Omaha Steaks International, etc.

But the ease of use and great selection of ISN are not the only reasons to visit the site. They also have really incredible prices and specials. At the time of this writing (late October)

specials include a 486-66 Packard Bell computer for \$799 and a 28.8 modem for \$99. From what I've seen, ISN's prices are difficult to beat.

One final note on the site. If you're not sure what computer product to buy, and would rather not rely on a shopping network's advertisement of its products, ISN provides you with another option. You can search online through the past 12 months of *InfoWorld* and *Computer Currents*

magazines for articles and product reviews. Also, technical tips are available from a clickable section of the ISN site called "Ask Dave."

## MUSIC BOULEVARD

In the December issue, I dealt with a few sites that let you order music CDs, cassettes, and videos from your home. Well, only two days after that column went to press, I learned about a new site called Music Boulevard. Since then, I have visited the Web site several times, and am quite impressed with it.

With over 145,000 albums listed, the site claims to be the largest multimedia music store, and they could be right. And best of all, you can get all those albums, which are usually in stock, quickly and at competitive prices. And to help you choose from those items, the site lets you access 30-second sound samples of many popular albums, album art or artist photos, album reviews, and musician biographies.

The appearance of the site can be configured by the user to match his or her own computer's capabilities. If you use a text-based browser, there's a text-only version of the store. If your browser supports graphics, but you have only a moderate-speed connection (9600 to 14,400 bps), there's a slender-graphics mode. And if you have a fast connection (28,800 bps or higher) and a current Netscape browser, a full graphics mode, which is really attractive, can be selected. On anything less than 28,800 bps, downloading pages in the latter mode can be a true test of patience.

In addition to having a great selection, competitive prices, and an attractive interface, the site also provides access to the world of music magazines. You can read articles from and get subscriptions to several music magazines right online. *Billboard* chart listings and a daily online magazine, *Music Wire*, are also available.

Well, that's it for this month. If you have any other sites you'd like to see covered, or perhaps a comment or two, e-mail me at: peeditor@aol.com. You can also snail-mail me at: *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■



With Music Boulevard, you can order any of 145,000 albums, and even listen to 30-second samples of some of them.



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Speed Learning has replaced speed reading. It's a whole new way to read and learn. It's easy to learn...lasts a lifetime... applies to everything you read. It may be the most productive course you've ever taken.

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If you answer "Yes" to any of these questions — then here at last is the practical help you've been waiting for. Whether you read for business or pleasure, school or college, you will build exceptional skills from this major breakthrough in effective reading, created by Dr. Russell Stauffer at the University of Delaware.

**Not just "speed reading" — but speed reading — thinking — understanding — remembering — and — learning**

The new *Speed Learning Program* shows you, step-by-proven step, how to increase your reading skill and speed, so you understand more, remember more and use more of everything you read. The typical remark from over one million people taking the Speed Learning program is, "Why didn't someone teach me this a long time ago." They were no longer held back by their lack of skills and poor reading habits. They could read almost as fast as they could think.

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The new *Speed Learning Program* does not offer you a rehash of the usual eye-exercises, timing devices, and costly gadgets you've probably heard about in connection with speed reading courses, or even tried and found ineffective.

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# Heathkit Individual Learning System For The A+ Certification Program



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**M**uch of the electronics world has shifted toward computers in recent years, and with it, most of the jobs in the electronics field. These days, whether it be in electronics engineering, sales, or servicing, much of the technical work force depends upon computers.

But the electronics field is not alone in that. Computers are everywhere today—at the office, at the library, in schools, auto-repair shops, department stores, and so on.

With more and more computers entering our lives every day, surely more and more of them are going to need servicing. And surely, anyone considering a career in computer servicing is thinking along the right track. But what is it that separates people who think they know computers from those that really do? The answer is knowledge. And how do people and companies know which technicians have the necessary knowledge? The answer to that question is the A+ Certification program.

**A+ Certification.** The A+ Certification testing program is sponsored by the Computing Technology Industry Association (CompTIA). Passing the

program certifies that an individual is a fully competent service technician in the computer industry. And the best thing about the program is that anyone who wants to have a nationally recognized credential as a computer-servicing professional can take the A+ exams.

The A+ Certification program is backed by computer-hardware and software vendors, distributors, resellers, and publications. The Association of Field Service Management, Inc., backs the program as well. Anyone who has earned A+ Certification possesses all the skills necessary to be a successful computer-servicing technician. The exams cover both hardware and software and are not vendor specific. More than 40 organizations have contributed resources to the tests.

One must pass two computer-based test modules—the core and one of two specialties—to become A+ certified. Specialties include a Microsoft Windows/DOS module and a Macintosh module. Candidates can schedule a testing session in any of the 50 states nationwide and in over 150 countries by calling 1-800-776-4276.

**Studying for the Exam.** It costs anywhere from \$90 to \$215 to take the tests, depending on which ones you want to take and whether or not you are employed by a CompTIA member organization. It therefore makes sense to study properly for the test to avoid having to take it over. But what's the best way to study for it?

Heathkit Educational Systems has come to the rescue with a combination book/software-based study course called the *Heathkit Individual Learning System for the A+ Certification Program*. The course prepares you for the exams with reference material and computer-based, timed tests that let you practice answering questions as though you were taking the actual tests. Because the tests themselves are computer-based, it makes sense that the study course is also computer-based. The course sells for \$399.

The study software runs on any 386 or better computer and conveniently prepares the user for the A+ exams at home or in the office. The program computes your answers to determine what topics you've mastered and those you could use a little brushing up on. The program then refers you to



the exact pages in the 9-volume library included with the course that covers everything you need to learn (more on that in a moment). No time is wasted searching through material you already know.

**Practice Makes Perfect.** No matter what the subject, the more you practice, the better you get at it. The same can be said of taking Heathkit's A+ Certification exam training tests. Hundreds of practice questions prepare you for the program's five timed tests. The tests are modeled after the real exams and you can take them over and over again. The only thing is that you don't have to pay the testing fees over and over again! You pay them only once when you are fully prepared to take the real test.

The included 9-volume library contains 4300 pages of the information you must know to pass the A+ Certification program. The books also serve as a good information resource after you pass the exams. A Heathkit study guide and workbook, featuring sample questions and answers, refer-

ences, and more, is contained in a 200-page binder.

**The Course.** The Heathkit course is presented in three steps. Step 1 is where you preview actual test material and isolate areas that require further study. That step tests your knowledge of computers by having you answer up to 500 computerized sample questions. Here you can work at your own pace and run checks on your answers. On-screen explanations to correct answers are offered as well as references to exact book and page numbers in the 9-volume library.

Step 2 is where you study only the topics that need further review. The resource library contains thorough coverage of the core material in the A+ Certification program. The nine titles include: The Complete PC Upgrade and Maintenance Guide, Computers Illustrated, Using MS-DOS, How Windows Work, How Networks Work, Easy Laser Printer Maintenance and Repair, How Macs Work, Danny Goodman's Macintosh Handbook, and more. While the books include

4300 pages, you only read what you have to based on your test results.

Step 3 is where you evaluate your competency and practice taking tests until you're confident. You test yourself against the clock just like the real exams. Once you pass the first test in under an hour, you can take the second, third, fourth, and fifth tests to fine-tune your test-taking skills. Each test presents 100 questions similar to the ones you would face in the real test.

Becoming A+ certified is a terrific way to advance your computer-servicing career, and the Heathkit Individual Learning System for the A+ Certification Program is a terrific way to prepare for the certification exams. For more information on it, contact Heathkit Educational Systems at the address given below, or circle 119 on the Free Information Card.

### FOR MORE INFORMATION

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- No batteries required, powered by phone line.



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**XPS1000 C Kit** ..... \$55.95

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# PRODUCT TEST REPORTS

By Stephen A. Booth

## RCA VR678HF Hi-Fi VCR



CIRCLE 120 ON FREE INFORMATION CARD

*The RCA VR678HF hi-fi VCR has many features that set it apart from the crowd.*

Every now and then a technology comes along whose benefits are so self-evident that the product literally sells itself. The VCR was such an item, because it freed TV viewers from the tyranny of the broadcast timetable. Now RCA has incorporated Commercial-Advance in some of its VCRs, a technology that makes it possible to bypass commercials in time-shift recordings. Odds are the company will find it hard to keep models like the VR678HF in stock.

Basically, Commercial-Advance marks the ad breaks in a recorded program in order to fast-forward them during playback. It's probably the main reason people will buy the VR678HF; and obscures the many additional neat features of this very capable deck.

For example, owners of RCA's first-generation Digital Satellite System receivers (or anyone who buys this now price-reduced, entry-level version) will welcome the DSS time-shift recording function built into the VR678HF. And home-moviemakers looking for a

good editing-VCR will find its shuttle-control, single-frame advance and Dual-VCR AutoEdit features an understated bonus. VCR Plus+ programming with infrared cable-box control is yet another, and now expected, feature.

The VR678HF performs VHS Hi-Fi Stereo recording and playback—a must if you own RCA's DSS system and want to record its near-CD-quality sound intact. Lab tests revealed exceptionally fine audio performance from this VCR, and good if not spectacular video specs. It's not the top-shelf model in RCA's line. That, for the record, is the VR725HF, which is a Super-VHS (S-VHS) deck.

Although the 400 lines of horizontal resolution afforded by S-VHS will preserve more of the near-laserdisc quality of DSS video, we opted to test the VR678HF because of the nearly universal VCR-to-VCR compatibility of the conventional VHS format. Make note, though, that the Commercial-Advance function only operates on similarly-featured VCRs—at this writing, that's available only on the new RCA models.

### FEATURES

While Commercial-Advance (henceforth called CA) might turn up in other VCR brands in the future, RCA is the first licensee for the feature, developed by California inventor Jerry Ig-gulden and licensed by Arthur D. Little Enterprises.

Here's how, and how well, it works.

The feature is activated through the VR678HF's on-screen menu, which is to say you needn't use it if you like to watch the commercials, or use them to signal Pavlovian refrigerator raids or comfort breaks. In any event, CA doesn't eliminate commercials. They're recorded with the rest of the telecast, but coded so that the VCR advances past them to the next program sequence during playback.

While the deck fast-forwards past the commercial, CA normally displays a blue field on your TV screen. As an option, it can maintain a blur of fast-forward video while the commercials advance at 6x normal speed. The math works out like this: A three-minute commercial break scans through in about 30 seconds in SP (Standard Play) mode, or 10 seconds for EP/SLP recordings.

The marking and coding actually takes place after recording (or, after a sequence of closely spaced time-shift recordings). CA rewinds the tape, analyzes it at high-speed for various tell-tale signs of a sponsor's presence, and marks the in- and out-points of those segments. Normally it would blast past the ad-blitz on playback, but if you wish to view the commercials, you'd activate the Manual setting in the on-screen program. You still have the option to skip past the ads by hitting the Search button



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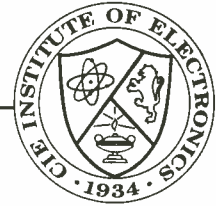
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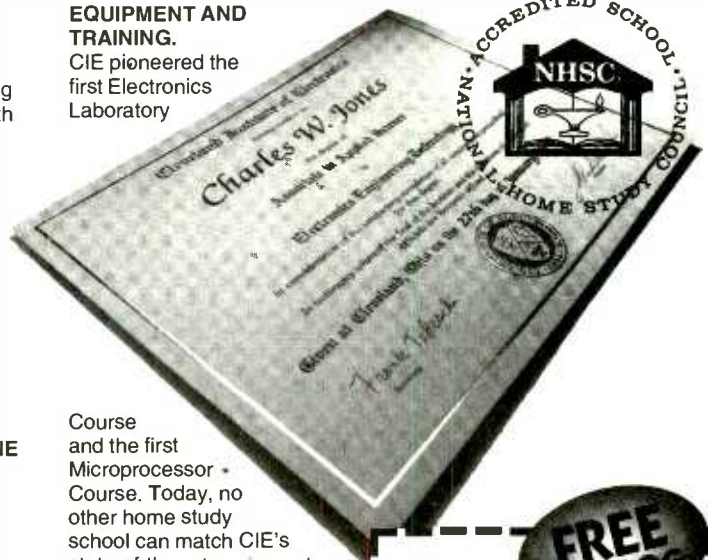
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**TABLE 1—TEST RESULTS**

<b>Brand</b>	RCA
<b>Model</b>	VR678HF VHS Hi-Fi VCR
<b>Price</b>	\$499
<b>Video Measurements (SP Mode)</b>	
Frequency response	-1.34 dB @ 2.0 MHz -19.4 dB @ 3.0 MHz
Signal-to-noise ratios	
Luminance level	
@ 100 IRE	45.2 dB
@ 50 IRE	44.6 dB
@ 10 IRE	43.5 dB
Chroma AM	40.5 dB
Chroma PM	40.4 dB
<b>Audio Measurements (Hi-Fi Recording)</b>	
0-dB reference level (1 kHz)	
Output	2.65 volts
THD	3.0%
Flutter (DIN)	
Average	0.003%
Peak	0.004%
Signal-to-noise ratio	89.6 dB
Frequency response (-3 dB)	20 Hz to 20 kHz
Record/Play THD (@ -10 dB)	
@ 100 Hz	0.19%
@ 1 kHz	0.28%
@ 5 kHz	0.27%
<b>(Conventional Recording)</b>	
0-dB Reference Level (1 kHz)	
Output	0.38 volts
THD	3.00%
Flutter (DIN)	
Average	0.06%
Peak	0.08%
Signal-to-noise ratio	50.3 dB
Frequency response (-3 dB)	200 Hz to 10.0 kHz
Record/Play THD (@ -10 dB)	
@ 100 Hz	0.71%
@ 1 kHz	0.53%
@ 5 kHz	0.25%
<b>MTS Stereo-TV Decoder Measurements (Stereo Mode/Left Channel)</b>	
Signal-to-noise ratio (re 100% modulation)	63.8 dB
THD (@ 1 kHz, -20 dB)	0.36%
Frequency response*	59 Hz to 12.5 kHz
Separation*	26 dB
<b>(Mono Mode)</b>	
Signal-to-noise ratio (re 100% modulation)	64.3 dB
THD (@ 1 kHz, -20 dB)	0.33%
Frequency response (re 100% modulation)	56 Hz to 3.2 kHz
<b>(SAP Mode)</b>	
Signal-to-noise ratio (re 100% modulation)	66.7 dB
THD (@ 1 kHz, -20 dB)	0.84%
Frequency response (re 100% modulation)	60 Hz to 10.1 kHz
<b>Additional Data</b>	
Fast-forward time (T-120 tape)	2 min. 22 sec.
Fast-rewind time (T-120 tape)	2 min. 18 sec.
Power requirements	20 watts
Weight	10 lbs.
Dimensions (HxWxD, inches)	3.5625 x 15.4375 x 12.5

\* Frequency response and stereo separation for Multichannel TV Sound broadcasts are measured using real-world reception conditions of -20dB relative to 100% signal modulation.

on the remote control. (And, if you don't use CA at all, you can still use the VCR's Skip-Search function to fast-forward through the tape in 30-second increments.)

Although our in-use evaluation found CA to be pretty much on-target (and even to work beyond normal, skeptical expectations), both the inventor and RCA concede it isn't perfect. That is due to vagaries in current broadcast practices and, to some extent, sheer flukes of similarity between ad and program appearance.

For the record, CA is one implementation of a technology that has additional features and functions not necessarily incorporated in RCA's VCRs. In this version, RCA notes that it works only with recordings at least 15 minutes long, and that commercial groups within the first and last two minutes of a show won't be skipped. Ditto if recording begins or ends during a commercial break.

"Commercial groups" is a key work—basically CA looks for the telecaster's typical ganging of commercials. RCA says it should work fine with clusters of 30-, 45- and 60-second commercials, but won't skip an isolated ad, or, a single one that runs beyond a minute. Besides skipping commercials, it might zoom past a snippet of program less than a minute-long and jammed between commercials (an unlikely occurrence), or, programming with frequent dark and quiet scenes (not so unlikely).

Again, we put CA through the paces with a wide variety of TV bill-of-fare (children's programming, primetime, live sports, and movies) and it worked just fine. Parents will do hosannas for the way it bumps

those manipulative ads aimed at kids—a tough assignment, because of the way children-targeted commercials mimic program content and come ganged in rapid-fire sequence. For more on the technology behind Commercial Advance, see Gizmo, elsewhere in this issue.

**BEYOND CA**

Among the VR678HF's other features is infrared, cable-box control for unattended recording. That is married to Gemstar's VCR-Plus+ programming system—just punch in the show's numerical ID as found in many printed program guides, and the VCR sets recording time, duration, and channel.

The VR678HF also will initiate unattended recording from an RCA-brand Digital Satellite System receiver. After their initial infatuation, most DSS owners' biggest complaint with the system was that there was no timer-function in the first-generation DSS receivers—and no way for a VCR to tune into its three-digit channels. Some newer DSS receivers have built-in timers so you can record with any VCR, but the DSS timer function makes the HR678HF a convenient update for older RCA satellite receivers. You'll program it like any other VCR but use the three-digit DSS channels. An infrared repeater in the VCR wakes up the DSS receiver and tunes it at the right time.

Although RCA doesn't promote the VR678HF as an editing deck, it can handle most home-movie post-production chores. The front-panel shuttle dial provides variable-speed access in forward or reverse. The

*(Continued on page 71)*

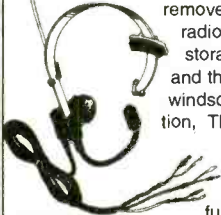


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12vdc, 54 ohm miniature solenoid. Coil mounted on U bracket. Bracket size: 0.36" x 0.43" x 0.81" long. 1.65" long plunger extends from both sides of coil. Spring return. Can be used for both push and pull action.



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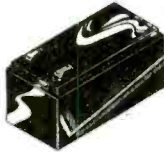
6' 18/2 WHITE

SPT-2 insulation. Polarized 2 prong plug.



2 for \$1<sup>30</sup> CAT # LCAC-18  
100 for \$55.00

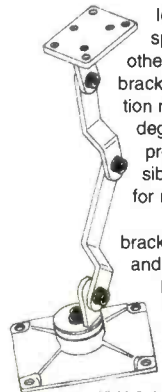
## RECHARGEABLE GEL CELL 12 VOLTS 3 AH



Maintenance free, rechargeable gel cell battery. An excellent back-up power source for alarms, communications equipment, lighting or computers. Can be used in any position and can be trickle charged for long periods of time. 5.3" X 2.63" X 2.39"

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This is a very cool looking microphone, originally designed for use with a "Media-Vision" multi-media package. It has an electret element, so it requires a little voltage to operate. The overall size of the mike is 1.5" high and 0.64" thick including the pocket clip on the back. Also included is a little plastic holder with an adhesive backing which allows the mike to be stored or used while attached to a computer or automobile dashboard. 7' cable with stereo 3.5mm plug. Beige mike, holder and cord.

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LARGE QUANTITY AVAILABLE!

## 9 FOOT DUAL AUDIO CABLE

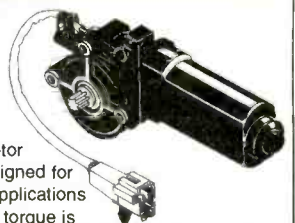


9' shielded dual audio cable with color coded (red and yellow) RCA style pin plugs either end. Black cable.

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# RAINBOW KITS

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Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to

108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your CD's while mowing the lawn, Play music on one channel sing on the other. Clarity is excellent, approx. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls & crystal for stereo separation. 9v battery operation. SIZE: 1.5" x 2.5" x 3"

FMST-100 KIT \$29.95 / Cabinet \$8.95

## PHONE TRANSMITTER

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

TEL-B1 KIT \$12.95 BUILT \$29.95

## SUPERSNOOPER BIG EAR

Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away.

The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to 12v DC. SIZE: 1.75" x 1"

AA-1 KIT \$10.95 BUILT \$29.95

## WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal.

The WM-1 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-1 KIT \$14.95

## DC VOLTAGE MONITOR

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

VM-1 KIT \$7.95

The 10GHz Transmitter is back...

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

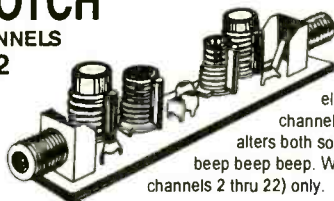
- While your out on American highways personally test yours and your fellow travelers radar detectors.

The "ZAPPER II" is a 10.450 GHz to 10.550 CW oscillator. It has a code key jack installed for those who want to send Morse code.

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FOR CHANNELS 2 thru 22 ONLY



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Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep beep beep. Works on cable channels 2 thru 22) only.

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5K



## STROBE LIGHT

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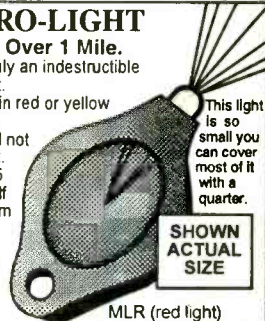
Then this kit is for you. Use it as an emergency light for your auto, radio tower, even use it on your bicycle. Has a variable flash rate. Power requirement 6 or 12v DC. Size 3.5"x1.9"

ST-1 KIT \$9.95

## MICRO-LIGHT

Visible Over 1 Mile. This is truly an indestructible flash light.

- Comes in red or yellow light.
- Bulb will not burn out.
- Uses a 5 year shelf life lithium battery.
- Case made of tough ABS.



This light is so small you can cover most of it with a quarter.

SHOWN ACTUAL SIZE

MLR (red light)

MLY (yellow light) CHOICE \$9.95

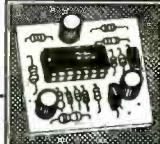


## 4.0 mW Laser Diode

Great for making a gun sight, use as a transit, makes a super experimenters project.

The beam is visible with a wavelength of 670 nm. Size of beam is 6mm at 5 meters. Power requirement 3 volts DC at 85mA. Size: 10.5mm x 18.5mm

LDM-5 New Low Price \$59.95



## VOICE ACTIVATED SWITCH

This VOX circuit can be used to operate a tape recorder, ham radio, CB radio, or turn on an alarm. The VOX-1 kit has 100mA of output that operates a relay, light, motor, ? What could you do with a sound activated switch? Power requirement 7.5 to 18vDC. SIZE: 1.5" x 1.3"

VOX-1 KIT \$6.95



## WIDE BAND PREAMP

The ideal preamp for scanners, hand held radios, frequency counters. Amplifies low level

(weak) signals. If the signal is extremely low 2 amps can be used in series. 1MHz to 2.5GHz @ 2.8dB NF. 1dB compression = +0 dBm. Gain: 1MHz=20dB to 2.5GHz=6dB. Power requirement 12v DC @ 6mA. SIZE: 1.2" x .8"

WBA-6 KIT \$19.95



BY RICHARD PANOSH

**A**re you being lied to? For example, would you like to know if that politician on TV is really planning on lowering taxes? Let's face it, there are countless situations where knowing just who is telling the truth could come in handy. But how do you find out?

We've all heard of galvanic-skin-resistance (GSR) meters that attempt to measure a change in skin resistance that could be caused by nervousness. However, how many people would be willing to get "hooked up" to such a device? And even if they agreed to it, they would surely be insulted.

Now there's a better, less obtrusive method for finding out if you're being lied to. Simply use the *Voice-Stress Analyzer* described in this article. What's best about that device is that the suspected liar doesn't even have to be present—a tape recording of him or her will work just as well!

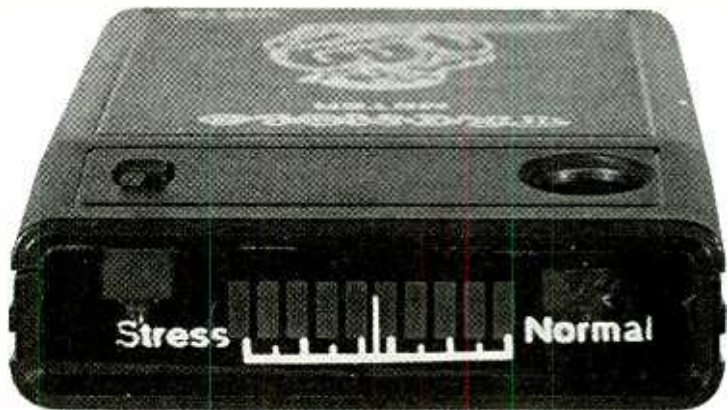
We'll get to how to build the Analyzer in a moment. But first, let's take a look at lie-detection methods of the past, and at how voice-stress analysis came about.

**The History of Lie Detection.** Since the earliest days of civilization, people have been faced with the problem of figuring out who's lying and who's telling the truth. To help determine that, truth seekers throughout the years have developed many methods to gauge a suspect's guilt or innocence. Most of those methods relied on physiological indicators such as sweating, rapid pulse rates, blushing, rapid breathing, trembling, or shifting gazes.

One of the earliest recorded examples of physiological lie detection is found in the Bible. That was when King Solomon stated he would divide a baby in half to determine by the reactions of two disputing women who the baby's real mother was.

In India, the guilt or innocence of a suspect was determined by forcing him or her to enter a dark room, alone, and grab an asp. Those that grabbed the asp and lived were innocent, while those that were bitten or failed to grab the asp were guilty (whether a suspect grabbed the asp was easy to determine, the snake was coated with a layer of black soot that would mark the suspect's hand).

# BUILD A VOICE- STRESS ANALYZER



*See at a glance if you're being lied to with this innovative, truth-seeking circuit.*

Needless to say, few grabbed the asp and lived.

But in 1927, that all changed. Torturous and inaccurate methods of lie detection were replaced as science was finally applied to the task of gauging a suspect's guilt. The invention that resulted was the polygraph.

The polygraph detects chemical changes that occur in the body under the effects of stress. Stress causes the adrenal glands to increase their output, resulting in increased pulse rate, higher blood pressure, deeper breathing, and GSR changes.

During the 1960s, the American military sponsored research to develop a covert lie detector (a polygraph machine is quite noticeable). Methods ranged from using complex optical scanners to measure pupil dilation, infrared scanners to monitor skin temperature, microwave interferometers to measure breathing, and even odor detectors. Also during that period, some research was directed at detecting stress levels in the voice.

**Voice-Stress Analysis.** It seems that a person's voice changes under stress. In rare instances, a voice can even "crack." Such changes make voice-stress analysis possible. Best of all, as hinted at earlier, a test subject need not be present; conversations taken from a radio, television, telephone, or even tape recording can be used.

Now we'll examine just what causes a stressed individual's voice to change. It has been known for a long time that all working muscles in a relaxed human body produce micro vibrations with approximately 10-Hz cycles. More recently, research has indicated that those micro vibrations might diminish with stress.

Because muscles only exert force by contracting, movement of the body is produced by muscles that work in opposing pairs. In a relaxed state, it is believed that the muscles in the body are similarly relaxed and somewhat sluggish, which results in a dead zone in the control position of a

pair of opposing muscles. The body then alternately tenses opposing muscles to gain a sense of their position. Those vibrations occur at frequencies of 10 Hz.

You might have experienced a good analogy of that concept if you've ever driven an old car with a lot of play in the steering wheel. That play in the steering produces a dead zone around the control position that maintains a straight motion down the road. The dead zone can be handled in one of two ways: You can hold the steering steady, let the car wander off to one side until the error becomes excessive, and then jerk the wheel to correct your course. Or, you can rock the wheel back and forth through the dead zone, sensing the end control points and slowly controlling them to maintain a steady and straight path.

The latter method provides smoother control, and is akin to adding a small oscillation to a servo loop that exactly matches the amplitude of the dead zone. It should be mentioned that the frequency of that oscillation should be greater than the response time of the feedback loop to provide smooth control.

Now back to the muscle-pair example. Under stress and the action of adrenaline, the opposing muscles become more highly tuned and responsive. The dead zone of the muscle pairs is then reduced and the body becomes ready for fight or flight. Consequently, the micro vibrations of muscle pairs diminish with stress.

Because the membranes that form the vocal cord are controlled by three such muscle pairs, it is believed that the pitch of a person's voice will also experience a low-frequency modulation, and the level of that modulation should be inversely related to the level of stress. Those vocal tremors are found in the 7- to 15-Hz range, and are referred to as physiological or micro tremors.

It is believed that micro tremors produce both frequency modulation as well as amplitude modulation. Because micro tremors are small, they are usually inaudible and must be detected electronically. That type of detection is very difficult because human-voice frequencies are by nature quite variable.

In the mid seventies, Alan Bell, Charles McQuiston, and Wilson Ford

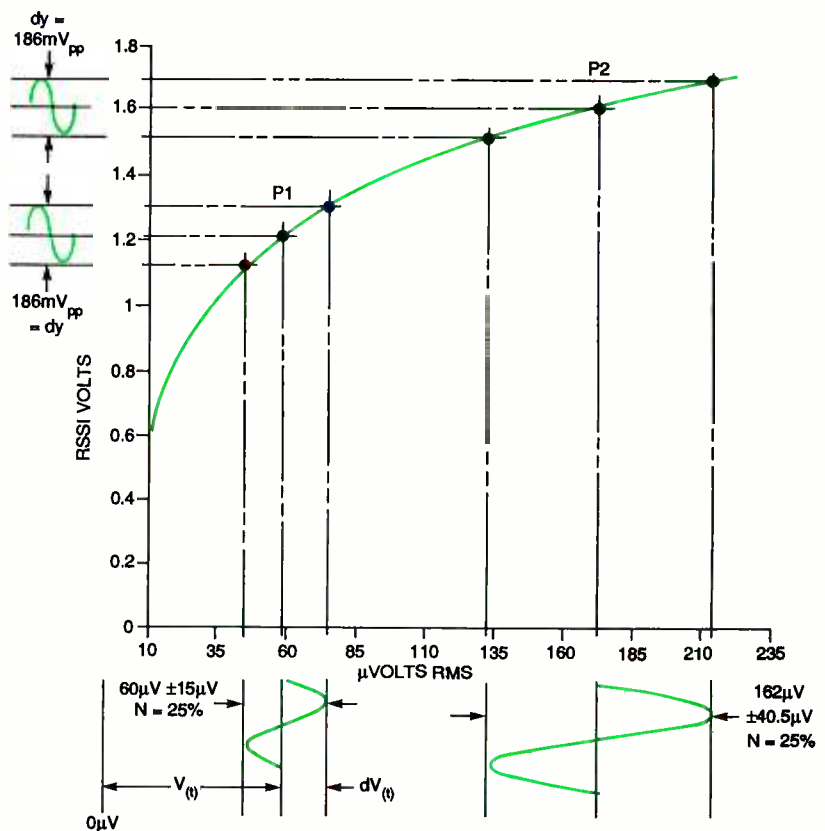


Fig. 1. Shown here is a small portion of a linear plot of Received Signal Strength Indicator (RSSI) response. Note that the slope or gain around small-input-signal-point P1 is high while the gain for a larger signal at a higher point, P2, is smaller.

received a patent on the Psychological Stress Evaluator (PSE). The PSE detects the resulting frequency modulation produced by micro tremors and produces a complicated output signal on a chart recorder. That chart is interpreted by a skilled examiner, as are polygraph results.

A few years after the introduction of the PSE, Fred Fuelleris invented the Vocal Stress Analyzer (VSA). The VSA works by detecting low-frequency amplitude vibrations in the subject's voice. Such amplitude modulation of the voice generates upper and lower sidebands. To determine the degree of stress, the VSA measures the amplitude of those sidebands.

To interpret the results of either a PSE or VSA machine, you must undergo extensive training. Who uses them? Mostly, the machines are bought by investigators, insurance claims adjusters, and law enforcement agencies. The machines are quite expensive, costing a couple-thousand dollars including training.

**A Simpler Approach.** The Voice-

Stress Analyzer described here is based on a new detection scheme that directly measures the percentage of amplitude modulation in a voice. The chip that makes the Analyzer design possible is the Signetics NE614 high-performance FM-IF integrated circuit. While designed for cellular radio service, that 16-pin IC includes a complete successive-detection logarithmic amplifier with a dynamic range of over 90 dB, and a low frequency response due to its DC interstage coupling.

Pin 5 of the NE614 is the detected output and is called the RSSI (Received Signal Strength Indicator) line. The RSSI output level is a full-wave-rectified signal, which we'll refer to as  $y$ , that represents the logarithm of the signal input. That means that the level of amplitude modulation ( $dy$ ) on the RSSI output is a direct measure of the percentage modulation ( $N$ ) of the carrier ( $V_{(t)}$ ) and is independent of its amplitude and frequency. That property of logarithmic response is of significant importance to the Voice-Stress Analyzer because the normal



voice energy during a conversation can vary by as much as 40 dB.

To better understand the logarithmic response just described, see Fig. 1. That figure illustrates a small portion of a linear plot of the RSSI response. Notice that the slope or gain around small-input-signal-point P1 is high while the gain for a larger signal at a higher point, P2, is smaller. The figure illustrates how two different amplitude signals with constant percentage modulation result in a constant output (dy).

**Circuit Description.** The schematic for the Voice-Stress Analyzer is shown in Fig. 2. Power for the circuit is supplied by a 9-volt battery, B1; S1 is the power switch.

Microphone MIC1 is coupled to the NE614 logarithmic amplifier, IC1. The

configuration allows voice frequencies ranging from 500-Hz to 10-kHz, where the human voice exhibits the greatest energy, to pass through. The RSSI output at pin 5 of IC1 is low-pass filtered by R6 and C10.

One section of an LM324M op-amp, IC3-c, buffers the RSSI signal to drive IC3-d, which is configured with a gain of two and a center frequency of  $12 \text{ Hz} \pm 6 \text{ Hz}$ . That results in a low Q value of one. The output at that point is a clean signal of the micro tremor and does not contain artifacts due to signal processing.

Op-amps IC3-a and IC3-b form a full-wave peak detector with an overall gain of 4.2; IC3-a operates on its own as a negative half-wave detector with a gain of 1. Low gain is required at that point because the non-inverting input of IC3-a is biased a bit

higher than +2.5 volts. The high gain occurs in IC3-b because its output swings positive during either cycle of the AC signal (the overall high gain is established by the ratio of R18 to R15, where  $R15 = 2 \times R17$ ).

When the output of IC3-b goes positive it is integrated by R10 and C16 for a fast response. During pauses in speech or under stress, the voltage developed on C16 bleeds off through the longer time constant caused by C16, R18, and R19. That allows the bar-graph-display, DISP1, to show the signal quickly and with a fast attack time, and to hold the value with a slow release time during pauses in the speech process.

The display is controlled by IC4, an LM3914 bar-graph driver. Transistor Q2 is configured as an emitter-follower that buffers the output voltage refer-

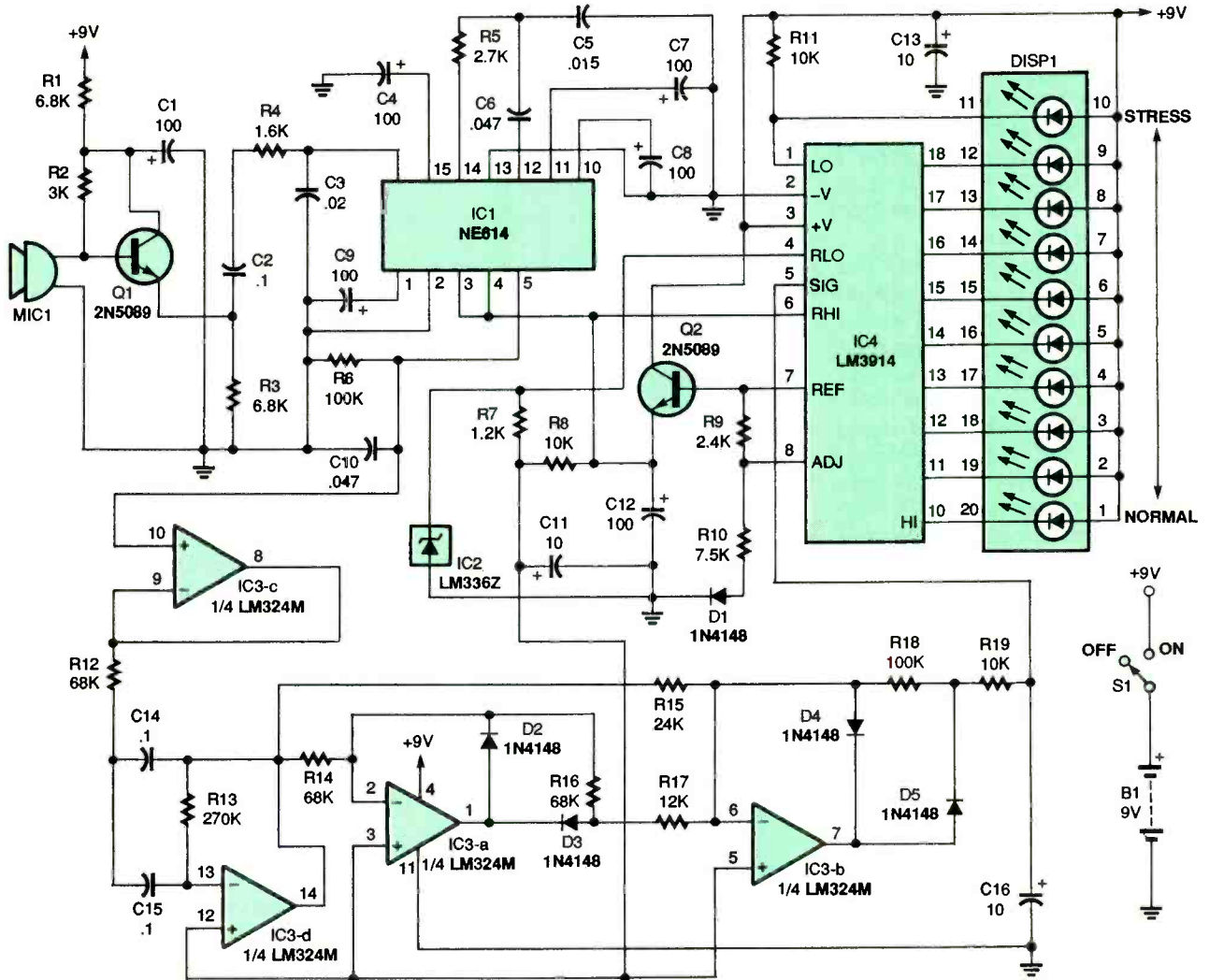


Fig. 2. Here's the schematic for the Voice-Stress Analyzer. At the heart of the circuit is IC1, an NE614 IF logarithmic amplifier, which allows the circuit to "interpret" the human-voice frequencies picked up by MIC1.

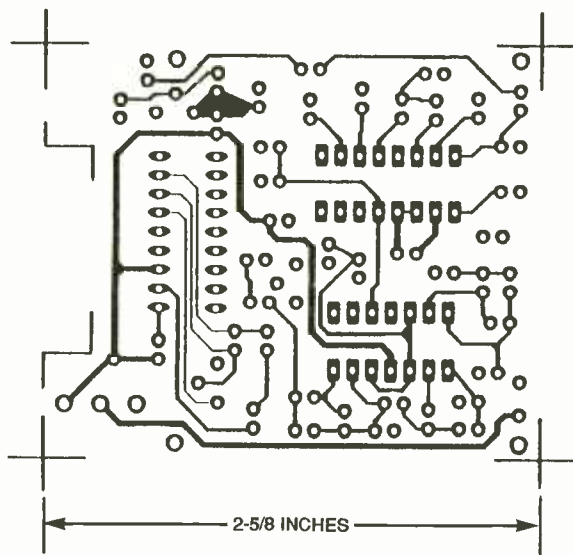


Fig. 3. The solder side of the Analyzer PC board is shown here.

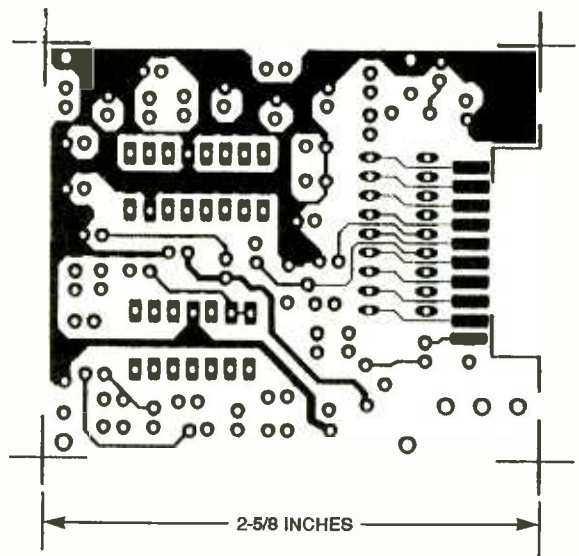


Fig. 4. Here's the component side of the board.

ence of IC4 to reduce power consumption. The transistor supplies a regulated voltage to U1 and the high end of the voltage divider that makes up the internal reference voltages for the comparators inside IC4. The low end of that voltage-divider string is referenced by IC2, an LM336Z, at +2.5 volts. That gives the bar graph a 2.5-volt, full-scale display.

Op-amps IC3-a, IC3-b, and IC3-d are biased from a voltage-divider string made up of R7 and R8. Resistor R7 biases the "quiet" operating point of those op-amps above the voltage level of the first bar-graph comparator so that the first bar will always be lit for a zero input. Because stress is inversely related to the percentage modulation, the first bar must remain lit for zero input to indicate maximum stress state. As stress is reduced and the percentage modulation increases, the signal drives DISP1 into the normal level. Even if the percentage modulation is unusually high, any level above the design value will still only light the tenth bar without going off range.

A swing of 0.3 volt on the RSSI signal will drive DISP1 to full scale. Because the slope of IC1's RSSI line is 0.414-volt/10-dB with a 5-volt supply, the full-scale display requires about a 7-dB swing, which corresponds to a 65% modulation. That value is approximately consistent with the example shown in Fig. 1, where a 25% modulation yields about a 200-mV peak-to-peak swing on the RSSI line. With the

ten-bar display used in the project, each bar represents about 6- or 7-percent AM modulation.

## PARTS LIST FOR THE VOICE-STRESS ANALYZER

### SEMICONDUCTORS

- IC1—NE614 IF amplifier, integrated circuit
- IC2—LM336Z 2.5-volt reference diode, integrated circuit
- IC3—LM324M quad op-amp, integrated circuit
- IC4—LM3914 linear bar-graph driver, integrated circuit
- Q1, Q2—2N5089 NPN transistor
- D1—D5—1N4148 silicon diode
- DISP1—Ten-LED bar-graph display

### RESISTORS

- (All resistors are 1/4-watt, 5% units.)
- R1, R3—6800-ohm
  - R2—3000-ohm
  - R4—1600-ohm
  - R5—2700-ohm
  - R6, R18—100,000-ohm
  - R7—1200-ohm
  - R8, R11, R19—10,000-ohm
  - R9—2400-ohm
  - R10—7500-ohm
  - R12, R14, R16—68,000-ohm
  - R13—270,000-ohm
  - R15—24,000-ohm
  - R17—12,000-ohm

### CAPACITORS

- C1, C4, C7—C9, C12—100- $\mu$ F, 10-WVDC, electrolytic
- C2, C14, C15—0.1- $\mu$ F, polyester
- C3—0.02- $\mu$ F, polyester
- C5—0.015- $\mu$ F, polyester
- C6, C10—0.047- $\mu$ F, polyester
- C11, C13, C16—10- $\mu$ F, 16-WVDC, electrolytic

### ADDITIONAL PARTS AND MATERIALS

- MIC1—Electret condenser element (Digi-Key part no. P9970-ND or equivalent)
- S1—SPDT switch
- B1—9-volt battery
- Printed circuit materials, project enclosure, battery snap with leads, IC sockets, wire, solder, hardware, etc.

**Note:** The following items are available from Vista (P.O. Box 1425, Bolingbrook, IL 60440; Tel. 708-378-5534): NE614 IF amplifier—\$4.50 (plus \$3.00 shipping and handling); pre-etched PC board (TREMOL-BRD)—\$10.00 (plus \$3.00 shipping and handling); kit of all parts including prepunched case with silk screen and battery (TREMOL-KIT)—\$48.00 (plus \$5.00 shipping and handling); fully assembled version is available with battery (TREMOL-ASSEM)—\$59.00 (plus \$5.00 shipping and handling). Illinois residents please add 7.5% sales tax. Check, money order, and credit cards are accepted. For fast check verification, please provide street address (no P.O. boxes), telephone number, and driver's-license number and state of issue.

**Construction.** The author's prototype was built on a double-sided printed-circuit board. If you would like



to build your circuit the same way, you can etch your own board using the solder- and component-side templates shown in Figs. 3 and 4, respectively. Or, you can order a pre-etched board from the source mentioned in the Parts List. It is recommended that you use the PC board because the NE614 is a high-gain, high-frequency IF amplifier, and errors might result from stray capacitances caused by point-to-point wiring.

The PC board is compact and was designed to fit in a pocket-size SerPac M6 case, which is also available from the source mentioned in the Parts List. You can, of course, use any other suitable enclosure.

When building the circuit on the PC board, use the parts-placement diagram shown in Fig. 5 as a guide. Begin assembling the board by mounting DISP1. To do that, first cut the pins on the display to a length of between  $\frac{1}{8}$ - and  $\frac{3}{16}$ -inch. Mount the display with pins 11 through 20 lined up with the pads along the component side of the board. Solder pins 1 through 10 together using a wire; connect that common wire to the pad indicated in Fig. 5.

Mount IC sockets for IC1, IC3, and IC5, making sure they are oriented properly. Install the non-polarized capacitors next. Go on to mount the diodes and transistors and IC2, making sure all are oriented properly. You can then vertically mount all the resistors—that facet of the design helps keep the board compact.

Install the electrolytic capacitors next; note their polarity as indicated in Fig. 5. Then mount switch S1 so that about  $\frac{1}{16}$ -inch of the leads protrude through the PC board. That should ensure the switch clears an opening in the case.

Trim the battery-connector leads to  $2\frac{1}{2}$  inches overall and solder them to the board at the correct points. You might want to apply silicone rubber to the attachment point to reduce the strain at the joint.

At this point, clean the board of residual flux before installing the microphone. The microphone should not come in contact with cleaning solvents. Mount MIC1 with its leads just protruding through the board so that the microphone will have maximum height on the board. You can add a small bead of silicone rubber to the

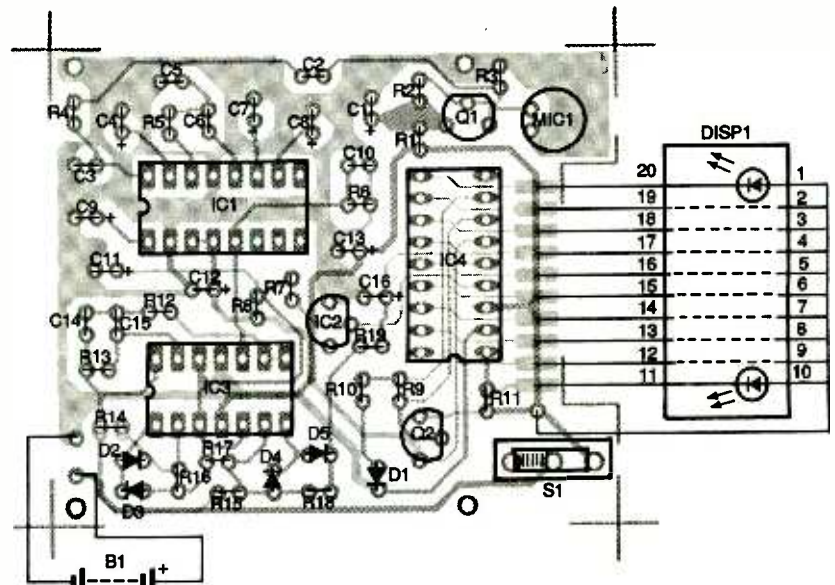


Fig. 5. Use this parts-placement diagram as a guide when assembling the circuit board. Note that pins 1-10 of DISP1 need to be connected together and to the indicated point on the board.

front edge of the microphone to support it more securely. Note: Be sure to use the microphone specified in the Parts List; do not substitute any other electret microphone that might have a different sensitivity, load, or frequency response.

You can now insert the three DIP-package ICs into their respective sockets. Complete the assembly of your Analyzer by mounting the circuit board into a case. If you use the Serpac M6 case mentioned earlier, the four holes at the edges of the board will match the four internal mounting posts of the case. Place a  $\frac{1}{8}$ -inch spacer at the center of the back side of the case to support the board in place when the case is closed. The spacer can be made from foam tape or a rubber pad of suitable thickness.

**Checkout and Use.** When the unit is powered up, the emitter of Q2 should supply a nominal +5 volts. Also, the voltage across IC2 should read about +2.5 volts. At the junction of R7 and R8, the voltage should be larger than that across IC2 to light the first LED bar (in a quiet room). That bar is in the STRESS range, which corresponds to no modulation. It might be necessary to adjust the value of R7, depending upon component tolerances, to obtain that condition.

As you speak, higher LEDs should light in the display area marked NORMAL. Under stress, the modulation

level should fall and a bar in the STRESS half of the display will be lit.

The unit is small enough that you can carry it in a shirt pocket and glance down at the display while someone is speaking. It is best to evaluate a speaker in conversation because the Analyzer takes a moment to acquire the peak level of modulation and display it on the LEDs. If a source of white noise is introduced, such as the noise of running water or the hiss of a blank tape, the Analyzer output will remain in the STRESS region because the mixing of all possible frequencies will produce a zero swing on the RSSI signal. If music is playing, the Analyzer will remain in the STRESS range for the same reason.

You might find it interesting to analyze a taped conversation with the Voice-Stress Analyzer. You'll see that analysis is pretty much independent of the playback volume.

The results of voice-stress analysis are sometimes found in news stories that deal with political scandals and controversies. You can find a good source of stressful situations to evaluate your own Voice-Stress Analyzer by taping direct quotes of suspects from such news stories.

You can also use the Analyzer to measure the degree of stress in the voices of radio announcers or public speakers. As you can see, there are lots of entertaining applications for this fascinating project.

Upon seeing the topic of this article, the first question one might be tempted to ask is: "With all of the great-sounding speakers out there, why would anyone want to build one?" There are several reasons.

One is the joy of building something yourself. Though speaker building might seem intimidating to the uninitiated, if you are good at woodworking, the task is really not that difficult. If you would like to tackle that job from scratch, articles in past issues of **Popular Electronics** (July 1995 and February 1994) serve as good introductions to the topic.

Another reason is the almost legendary fussiness of audiophiles. Not satisfied with even the best high-end speakers, some have turned to building their own speaker systems in a quest to find the perfect "voice" for their sound systems.

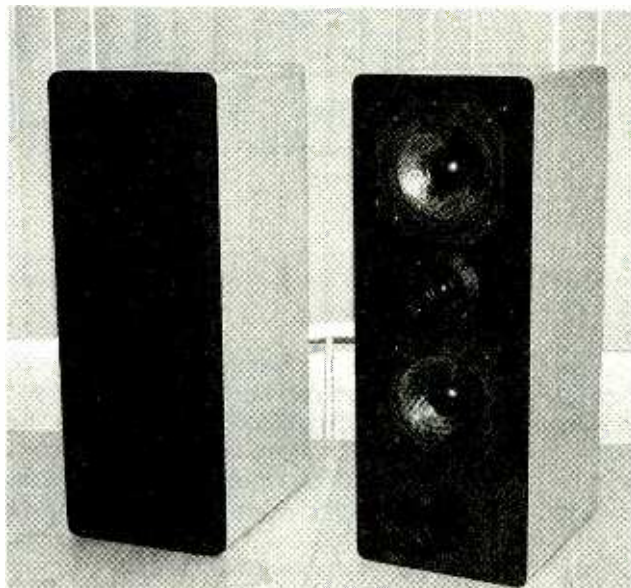
Last, but certainly not least, is economics. Largely thanks to advances in solid-state technology, high-end, feature-packed hi-fi gear has never been less expensive. However, speakers obviously have not benefited from such advances. In fact, building speakers is a labor-intensive process and manufacturing costs have actually risen over the years.

As a result, if you want speakers that are just barely adequate for a middle-of-the-road (\$1000) hi-fi system, you should expect to pay at least \$300 for a pair, and if you want speakers that will do that system justice, you will need to spend at least twice that amount. And, needless to say, better systems will warrant better speakers.

### **What Makes a Good Speaker.**

Aside from the drivers themselves, a good speaker needs a solid, heavy cabinet—one that doesn't vibrate at all when it cranks out sound. A good speaker cabinet is much like the finely

# BUILDING A Loudspeaker KIT



*Have fun for a few evenings  
building your own  
high-end loudspeakers, then  
listen to them for years to come.*

BY MARC SPIWAK

tuned body of a musical string instrument (guitar, violin, etc.). The body must resonate agreeably with the sound it produces or else you've got a "sour" instrument. The same is true of a speaker cabinet; flimsy plastic or plywood just won't do. A speaker cabinet must also be designed specifically for the drivers that will be installed in it.

Speaking of the drivers, today's high technology has greatly extended the realm of what are considered to be high-end speakers. For years and years, speaker cones were made mostly from simple paper products or other materials that didn't age well and couldn't be "rocked" like modern

speakers can. Today, exotic materials, such as gold, platinum, titanium, carbon fiber, and other composites are used to make speakers that can really take a beating while still delivering perfect sound.

### **Build from Scratch or Kit?**

If you are reading this magazine, the odds are good that you like to build things. Speakers should be no exception. If you are good at woodworking, you might want to consider doing the job from scratch. But if you are not, or would like the security of having someone else do the work of selecting drivers and doing the cabinet and crossover design, why not consider going the kit route? In the balance of this article, we'll examine the author's experience in building a speaker kit. After that, you can decide for yourself whether or not it is something you would want to tackle on your own.

### **The A652 Speaker Kit.**

Speaker building is a hobby within itself within the electronics hobby in general. But people who design good-sounding speakers have acquired very special skills that are highly regarded by audio enthusiasts. One such indi-

vidual is Vance Dickason, who was hired by French speaker manufacturer Audax to design a series of speaker kits. The kit we'll be looking at is the *Audax Of America A652* from the Vance Dickason Signature Series, which is distributed by Madisound Speaker Components. The A652 is sort of a "middle of the road" in the high-end arena and, when the complete kit is purchased, costs less than \$650 for a pair. You can pay more and you can pay less for speakers, so we decided to go "halfway" and build a pair of A652s.

The Audax A652s are a hefty pair of speakers for their size, considering that they measure only 25-inches high





*Spongy rubber panels are glued to the inside rear of each speaker.*

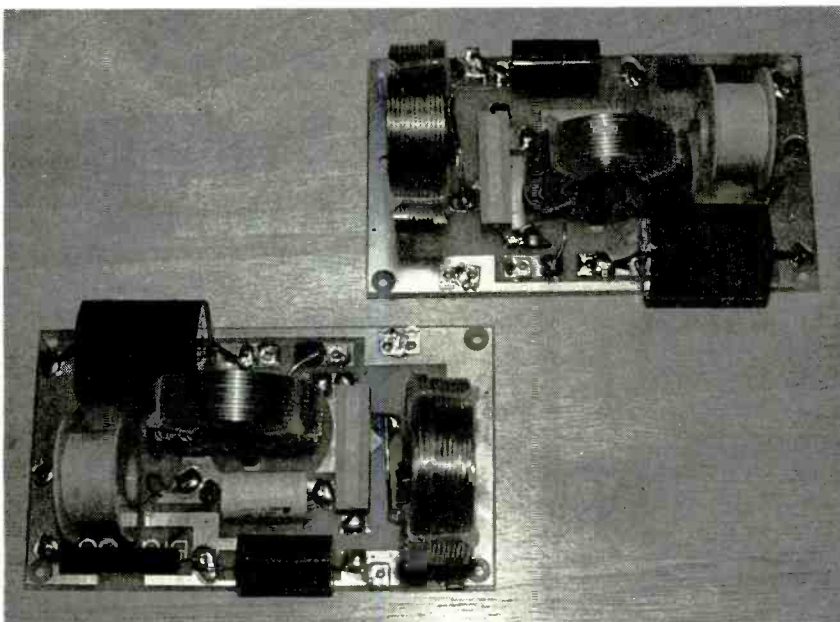
gether, or better, than anything on store shelves.

Part of the attraction in speaker building lies in building beautiful, hand-made cabinets, but you have to be both an artist and a skilled carpenter to do the job right. You can buy the A652 kit without their beautiful cabinets if you want to try to make them yourself. But with the hard part of building the cabinets out of the way, no reader of this magazine should have any trouble building this kit. All it involves is a little gluing (not the cab-

speaker houses two HM170C0 6½-inch woofers with woven carbon fiber cones, a non-resonant die-cast chassis, Kapton voice coil, and more fancy stuff. The tweeters are Audax TWO25M0 1-inch soft-dome units.

The speakers have a nominal impedance of about 4 ohms. That is basically the impedance of any speaker housing two 8-ohm woofers in parallel. No modern amplifier should have any trouble driving 4-ohm speakers. Driving two pairs of them might be another story. The A652s should preferably be powered by at least 50 watts per channel, and they can handle a maximum of about 150 watts apiece.

The crossovers are something special, too, containing huge wire-wound inductors and capacitors. A speaker crossover is basically a series of filters that "steer" different audio frequencies to the proper speakers—woofers should receive low-frequency audio while tweeters should receive the highs. Those large crossover PC boards are pre-assembled by Madi-sound, so all you have to do is wire the boards and mount them in the cabinets. Let's see what's involved in building the A652s.

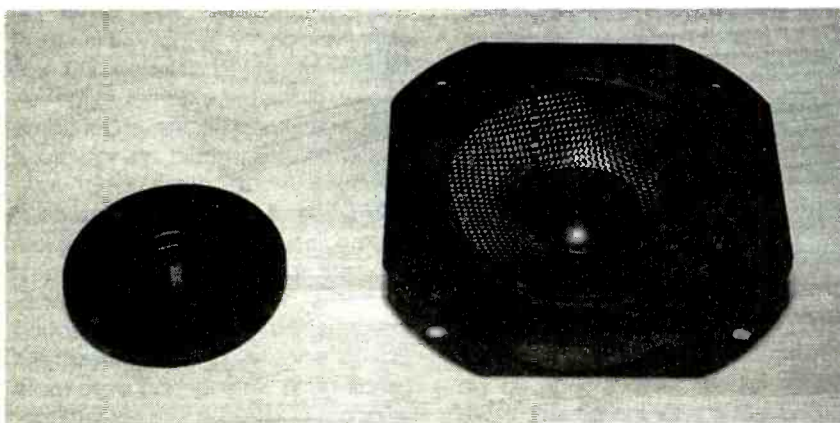


*As you can see, the crossover boards are fairly massive. You do not have to worry about building them as they come pre-assembled.*

**Getting It Together.** The first step in building the A652s is to drill pilot holes in the cabinets for the speaker drivers and rear connector plate using those parts as guides to positioning the holes. We found it best to "punch" the holes first with an awl before drilling.

Next, four lengths of two-conductor wire are soldered to each crossover board that later connects to the three speaker drivers and the input jacks. The wire is included with the kit. The trickiest part is soldering two leads to some of the crossover terminals; you might need a third hand. Certain wire lengths are specified, but we measured before cutting, and there was plenty of extra wire to add a couple of inches to each one. They would be trimmed down later anyway.

The inside of a quality speaker cabinet is not empty as one might imagine. Two panels of a spongy, rubber-like material with concentric ribs molded into them are glued onto the inside surface of the top and bottom rear panels. The glue is included with the kit. The panels are specially designed to absorb shock and vibration

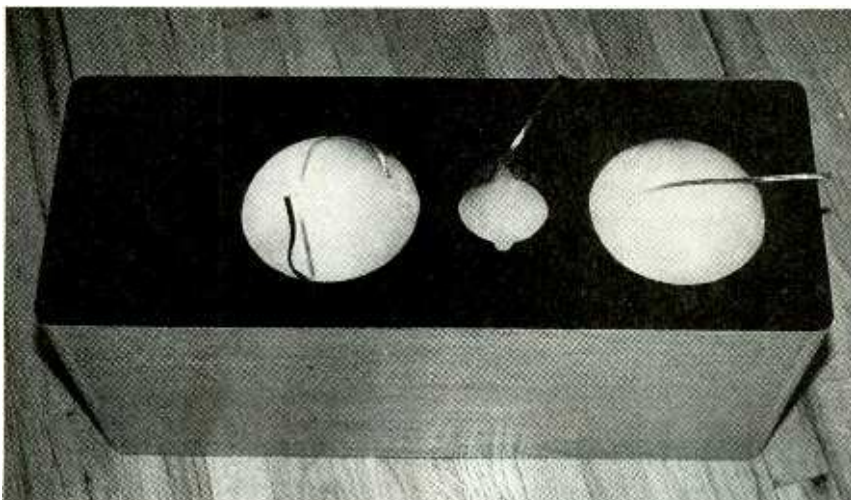


*The drivers are manufactured by French speaker-manufacturer Audax and are of extremely high quality.*

by 9¼-inches wide by 12½-inches deep; however, they weigh about 40 pounds each! That's mostly because of the rigid cabinets made of thick particle board laminated with real oak. The cabinets are as well put to-

gether, some drilling, some wiring, some soldering, etc. It's about three leisurely evenings of work in all.

The speaker drivers themselves, manufactured by Audax, are also works of art—modern art! Each



*We are almost done! Here the cabinets are shown stuffed with wool and waiting for the drivers.*

yet work with the acoustic energy at the same time. If purchased separately, they would sell for \$13 each, and the A652s need four of them.

Next, the crossover boards are mounted with four screws each to the top rear panel of each speaker. This part of the job involves the most work, as making the pilot holes inside the cabinet is difficult (we only had room to work with an awl), and driving screws into the hard particle board would be next to impossible without piloting. But the screws do go in after some fuss.

The next step is to pull the input leads through the hole in the rear of the cabinet and solder the leads to the input jack panel. We trimmed off excess wire leaving us just enough to work with. The input jack panel is then screwed in place.

The interior sides of the cabinets are lined with pieces of a foamy material to further dampen sound. You have to cut the foam to size. The material holds itself in place, and does not have to be glued.

After pulling the speaker wires through the proper driver holes, you must fill the inside of the cabinet with a fluffy wool material, much like pillow stuffing. The instructions call for 12 "fists" of wool in the top and 10 in the bottom. Not knowing how much a "fist" of wool is, but having good common sense, we figured that the inside should be filled with the wool, but not packed tightly. So we packed 12 fluffy "fists" in the top and 10 in the bottom, making the inside of our cabinets look like they were "filled with clouds," hop-

ing that their sound would be the same. We had plenty of wool left over. Depressions should be formed in the wool so that it does not interfere with the movement of the drivers.

Before the speakers can be installed, gaskets must be applied to their rear mounting surfaces. (The input jack panels had gaskets already attached.) The instructions made it sound as though there were supposed to be factory-made speaker

### PRICES

As of this writing, here are Madisound's prices for the various components in the Audax of America A652 speakers.

Set of drivers for two speakers: \$336  
 Cabinets (specify black or clear oak): \$216/pair  
 Pre-assembled crossovers: \$102/pair  
 Miscellaneous parts for two speakers: \$60

There is a 10% discount when the entire kit is purchased. Contact Madisound directly regarding current pricing and shipping and handling costs.

gaskets in the kit but there weren't any. There was a roll of adhesive-backed, sponge-rubber tape, though, so we figured that was for the gaskets. It was no trouble at all applying the tape to the speakers, perhaps even easier than applying actual gaskets would be.

The last step is to trim the speaker leads and solder them to the drivers. That should be done as quickly, and with as little heat as possible to avoid damaging the expensive drivers. We

trimmed off the excess wire, tinned the leads, and soldered. That's all there was to it.

Before testing out the speakers, the instructions say to check each speaker with a D-cell for proper polarity. Connecting a D battery to the speaker terminals should cause all drivers to move in the same direction. It is also suggested to test them in mono with pink noise or FM interstation noise before applying an audio signal.

**Break In.** Those tests out of the way, we were ready to have a listen to the A652s. We won't get into the speaker wire debate, but we will say that you

### ADDRESSES

**Madisound Speaker Components**  
 P.O. Box 44283  
 Madison, WI 53744  
 Tel. 608-831-3433

**Audax of America**  
 10 Upton Drive  
 Wilmington, MA 01887  
 Tel. 508-658-0700

should use a good pair of heavy-gauge speaker cables with the A652s. Cable that's too thin will interfere with the audio signal instead of simply delivering it to the speaker.

We disconnected a pair of Celestion speakers from a Harmon Kardon receiver and connected the A652s to it. The receiver was then turned on with the volume set at minimum. A digitally mastered Classical CD was chosen as the test material. As the volume was turned up, the A652s came to life. Volume should be kept to a minimum in a speaker's early hours.

We are not audio critics, and don't claim to be, so we won't try to explain how the speakers sound with words that have meaning only to us. What we will say is that, at first, the sound lacked what we'll call "richness." But as the hours passed, and even more so as days passed, it was obvious that the speakers were simply breaking in. The speakers eventually sounded wonderful, and they still do.

We're happy with our A652s, and we learned a lot about what goes into building a speaker. We hope that our experiences have encouraged you to give speaker building a try. It can be a lot of fun!

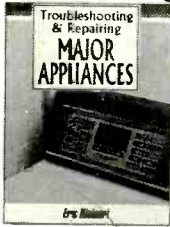


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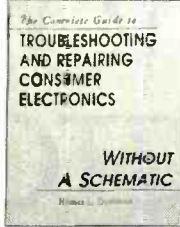
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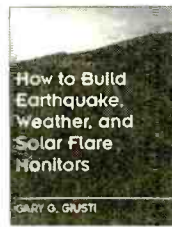
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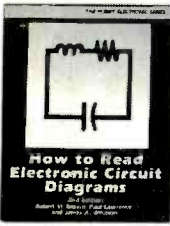
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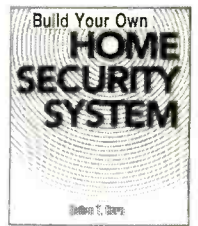
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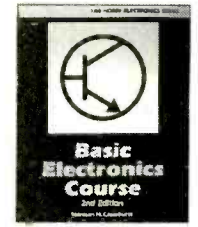
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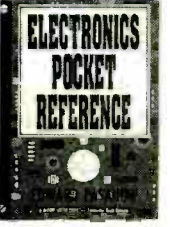
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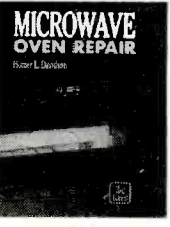
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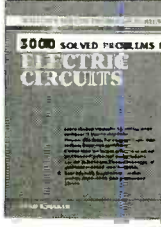
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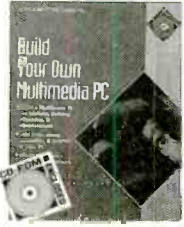
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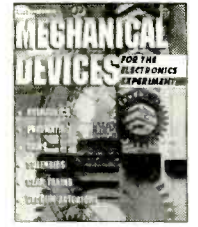
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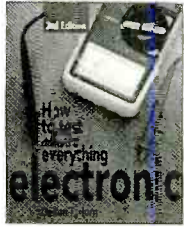
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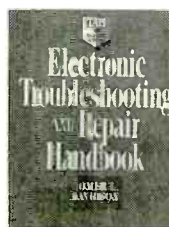
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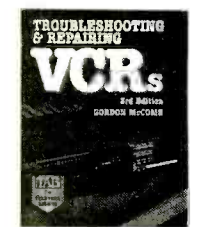
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BY RONALD A. REIS

# BUILD AN ULTRASONIC MOTION DETECTOR

Something's out there—on the porch, in the driveway, or behind the shed. Or maybe it's inside—in the garage, basement, or den. Whatever it is, human or beast, it's moving. Perhaps it's just your teenager sneaking in from a late night out. Possibly it is only the neighborhood cat. Or, more ominously, it could be a prowler bent on theft or physical harm. Whatever is going on, you know something is up because you just installed the *Ultrasonic Motion Detector* described in this article.

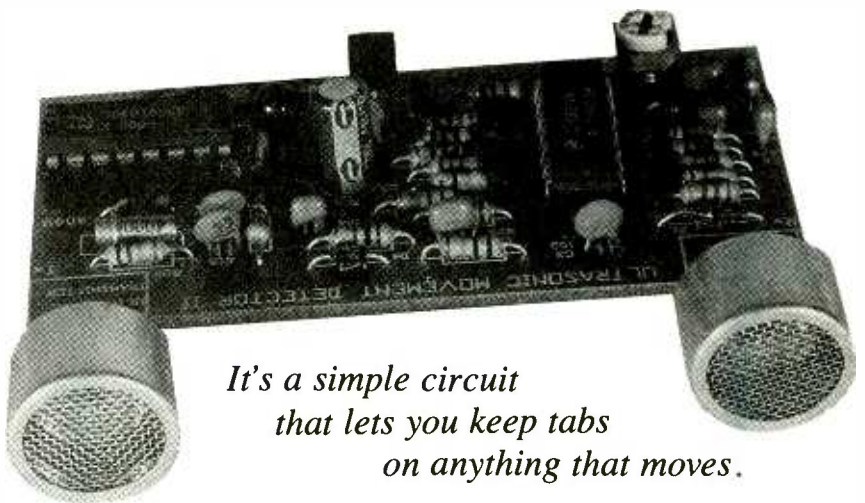
Depending on what parts you have available, or if you buy the complete kit from the source mentioned in the Parts List, the Motion Detector can be built for less than \$30. It contains a complete ultrasonic (40-kHz) crystal-controlled transmitter and a super-sensitive receiver on a printed-circuit board that measures only 1½ × 3 inches.

The project detects motion from 4- to 7-meters away. Once that occurs, a red LED lights. But with additional circuitry attached to the output, the detector can turn on lights, sound buzzers, trip a recording device, or even call the police. Also, the circuit can be made to sound off with a message when anyone moves within its field of detection. Using various voice recording and playback circuits (see "Circuit Circus" in the July and August 1995 issues of this magazine) you might even have the Ultrasonic Motion Detector provide a pleasant greeting or snarl with a barking dog sound when someone approaches the front door.

As you can see, your Ultrasonic Motion Detector project can be put to work in a variety of ways. Let's now look at how it works.

**Circuit Description.** The schematic for the Ultrasonic Motion Detector is shown in Fig. 1. A 9-volt battery, B1, directly provides power for some sections of the circuit. The battery is also connected to a 78L05 regulator, IC3, which provides a 5-volt-DC power source for other sections of the circuit.

The transmitter section of the Detector is basically a crystal-controlled relaxation oscillator built around a 4049 hex inverter, IC2. One of the 4049 sections, IC2-c, along with re-



*It's a simple circuit  
that lets you keep tabs  
on anything that moves.*

sistors R21 and R22, and capacitors C11 and C12, "pings" the 40-kHz crystal into sustained oscillation. The remaining 4049 sections act as linear buffers to drive a 40-kHz, ultrasonic transmitting transducer, BZ2. (For an in-depth review of crystal-oscillator circuits, see Joseph J. Carr's excellent article, "All About Crystal-Oscillator Circuits," in the August 1995 issue of **Popular Electronics**.)

The receiver section of the circuit is made up of four AC-coupled stages, each built around one of four sections of an LM324 op-amp, IC1. In the first stage, the input voltage developed across R1 and R2 is modulated by a 40-kHz, ultrasonic receiving transducer, BZ1, and is then fed to IC1-a, where it is amplified. The receiving transducer detects any reflected sound produced by the transmitting transducer, BZ2. If there is no movement, the resulting envelope signal is just a straight line; diode D1 and resistor R8 operate as a negative peak detector to recover the envelope signal.

In the second stage, which is built around IC1-b, the recovered signal is again amplified. The time constant of IC1-b is quite slow so that the envelope can be followed; the output of the second stage is a DC level that represents the strength of the envelope. If there is movement, the envelope will reflect it in the form of a positive or negative signal.

At the input to the third stage—a differential amplifier built around IC1-c—there are two diodes, D2 and D3. They detect both positive and negative pulses. When there is no movement, the voltage at pin 7 of IC1-b is half the supply voltage and neither D2 or D3 can conduct. The voltage at pin 8 of IC1-c is then low. If the signal rises above +0.7 volt (a silicon diode's breakdown voltage), D3 conducts causing the output on pin 8 to go high. If the signal falls below -0.7 volt, D2 conducts, which also causes the output to go high. Thus we have a window detector. It detects voltages that move both below and above a given range.



The fourth stage, built around IC1-d, is set up as a monostable flip-flop. That stage converts any signal that gets through the filter into a pulse substantial enough to turn on transistor Q1. When Q1 conducts, LED1 turns on and an output signal is provided to drive a separate relay or any other device connected to the circuit (more on that later). The time constant of the monostable flip-flop is about half a second and is set by C8 and R18. Diode D4 is used to separate the charge- and discharge-time constants. It lets the circuit switch on immediately when movement is detected but allows about a half-second delay for the reset.

**Construction.** The author built the Ultrasonic Motion Detector from a complete kit of parts, which includes a pre-etched and drilled PC board. That kit is available from the source mentioned in the Parts List. If you

choose to round up your own components, it is still recommended that you use a PC board. You can use the foil pattern shown in Fig. 2 to make your own.

Refer to the parts-placement diagram shown in Fig. 3 while assembling your circuit. Begin by soldering all resistors flush to the PC board. Then install the five diodes, making sure to orient them properly. Next, install the capacitors. Be sure to double check the polarity of C9

Go on to install crystal XTAL1. Bend the crystal's leads so that the component rests flat on the board. Note the two unused holes next to the two for the crystal. You can bend a resistor lead around the crystal in a "U" shape and solder the lead ends to the unused holes. That should hold the crystal in place.

Install the potentiometer. Then continue by mounting the 78L05 voltage regulator and the BC639 transistor;

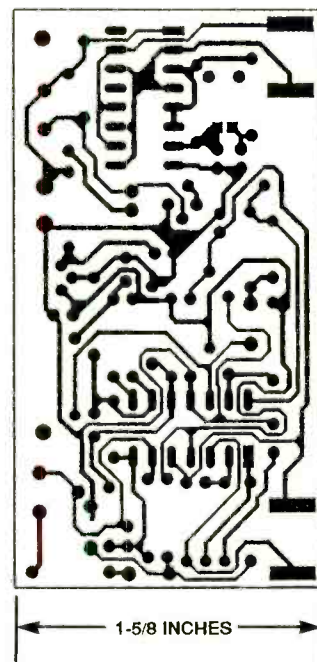


Fig. 2. If you'd like to etch your own board, use this full-size template.

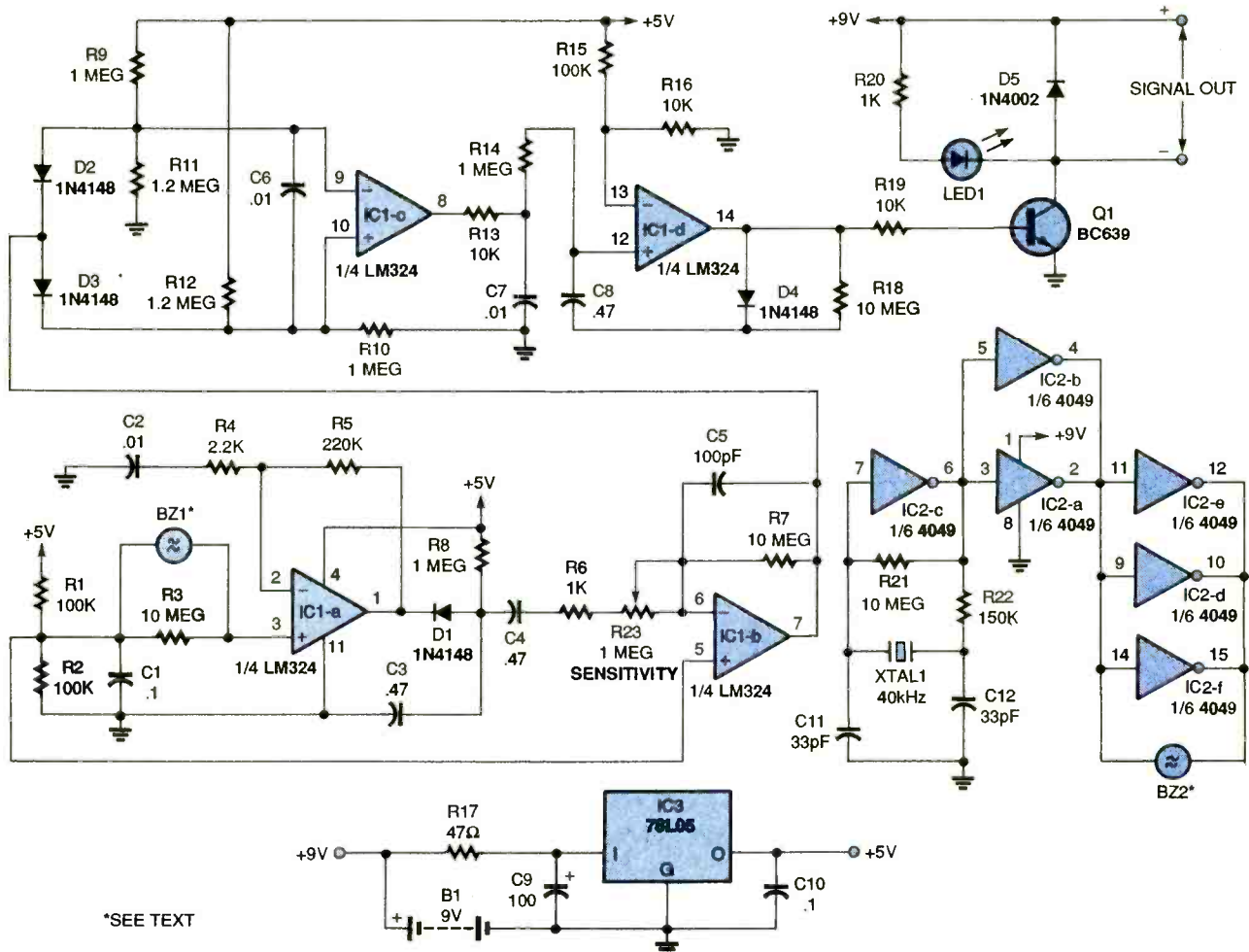


Fig. 1. This is the schematic for the Ultrasonic Motion Detector. When movement is sensed, transistor Q1 switches on, lighting LED1.

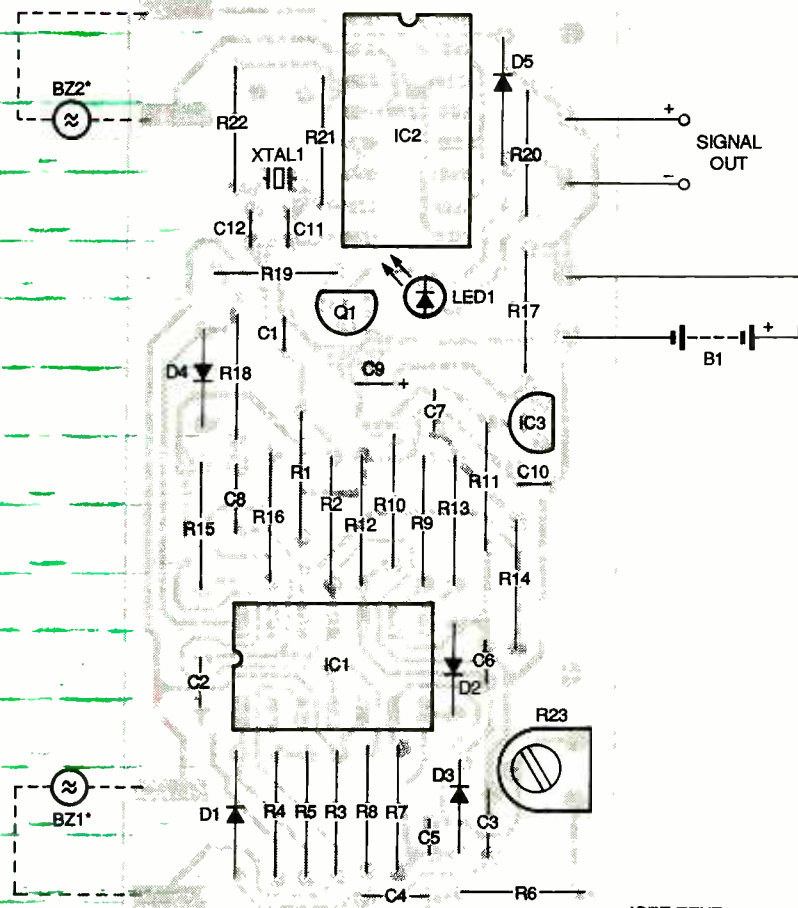


Fig. 3. When assembling the circuit, use this parts-placement diagram as a guide. Note that BZ1 and BZ2 surface-mount on the foil side of the board.

### PARTS LIST FOR THE ALARM CIRCUIT (Fig. 4)

#### SEMICONDUCTORS

- IC1-IC3—555 timer, integrated circuit
- Q1—2N3055 NPN transistor
- D1—1N4148 silicon diode
- D2-D4—1N4001 silicon rectifier diode

#### RESISTORS

- (All resistors are 1/4-watt, 5% units.)
- R1—2.2-megohm
  - R2, R6—10,000-ohm
  - R3—12,000-ohm
  - R4, R7—100,000-ohm
  - R5—1000-ohm
  - R8—120-ohm

#### CAPACITORS

- C1—470- $\mu$ F, 16-WVDC, electrolytic
- C2—47- $\mu$ F, 16-WVDC, electrolytic
- C3, C5-C7—0.01- $\mu$ F, ceramic-disc
- C4—10- $\mu$ F, 16-WVDC, electrolytic

#### ADDITIONAL PARTS AND MATERIALS

- RY1—9-volt relay, normally open contacts
- SPKR1—8-ohm speaker
- Perforated board, IC sockets, wire, solder, hardware, etc.

\*SEE TEXT

ect you have to replace the battery regularly. As the battery voltage decreases, the circuit's sensitivity will change; that is particularly true if the unit is triggered often. To avoid the

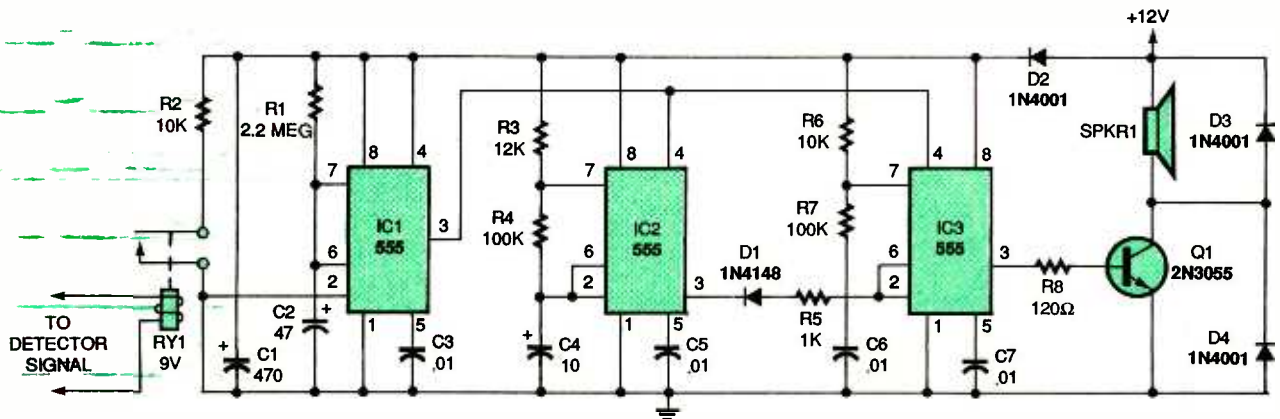


Fig. 4. This simple circuit can be used with the Motion Detector to provide a two-minute alarm tone when motion is detected.

those two parts look alike, so be careful not to confuse them. Also install the LED. Make sure all those parts are oriented as shown in the parts-placement diagram.

Now solder IC sockets for IC1 and IC2 to the board, noting the proper

placement of the notches indicated in Fig. 3. Insert the ICs into their respective sockets.

Connect the leads of the 9-volt battery clip to the board next. Now is a good time to note that if you do plan on using a battery to power the proj-

extra expense of replacing batteries, you might want to replace the battery clip with two wires (red and black can be used to indicate polarity) so that you can hook up a 9-volt power supply.

Now you can install the ultrasonic



transducer pair. If you are not building the project from the kit, you should make sure you are using a matched pair of 40-kHz transducers or the proj-

## PARTS LIST FOR THE ULTRASONIC MOTION DETECTOR (Fig. 1)

### SEMICONDUCTORS

IC1—LM324 quad op-amp, integrated circuit  
IC2—4049 hex inverter, integrated circuit  
IC3—78L05 5-volt regulator, integrated circuit  
Q1—BC639 NPN transistor  
D1—D4—1N4148 silicon diode  
D5—1N4002 silicon rectifier diode  
LED1—Light-emitting diode, red

### RESISTORS

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

R1, R2, R15—100,000-ohm  
R3, R7, R18, R21—10-megohm  
R4—2200-ohm  
R5—220,000-ohm  
R6, R20—1000-ohm  
R8—R10, R14—1-megohm  
R11, R12—1.2-megohm  
R13, R16, R19—10,000-ohm  
R17—47-ohm  
R22—150,000-ohm  
R23—1-megohm potentiometer

### CAPACITORS

C1, C10—0.1- $\mu$ F, ceramic-disc  
C2, C6, C7—0.01- $\mu$ F, ceramic-disc  
C3, C4, C8—0.47- $\mu$ F, ceramic-disc  
C5—100-pF, ceramic-disc  
C9—100- $\mu$ F, 16-WVDC, electrolytic  
C11, C12—33-pF, ceramic-disc

### ADDITIONAL PARTS AND MATERIALS

XTAL1—40-kHz crystal  
BZ1—40-kHz ultrasonic receiving transducer (part of matched pair, see text)  
BZ2—40-kHz ultrasonic transmitting transducer (part of matched pair, see text)  
B1—9-volt battery (see text)  
Printed-circuit materials, IC sockets, battery connector with leads, wire, solder, hardware, etc.

**Note:** The following is available from Marlin P. Jones & Assoc., Inc. (P.O. Box 12685, Lake Park, FL 33403-0685; Tel. 407-848-8236; Fax: 800-4FAXYES); complete kit of parts, including printed-circuit board (6049-KT)—\$27.95 plus \$5.00 shipping and handling. Florida residents please add 6% sales tax.

ect will not work. You can get the "Transmitter/Receiver Pair" from Electronic Goldmine (P.O. Box 5408, Scottsdale, AZ 85261; Tel. 602-451-7454) as part-number G5721. Contact them for more information.

The transmitting transducer, BZ2, has a T suffix on the number stamped underneath it. The receiving transducer, BZ1, has an R suffix. Neither part is polarized. Tag-solder each transducer on its proper pads directly on the foil side of the PC board. The leads should rest flat on the pads and the fronts of the transducers should point away from the PC board.

Finally, install two wires to provide a signal-out connection for attaching various output transducers and circuits. You might want to use one red and one black wire, as the signal is polarized.

**Checkout.** Power up your circuit with either a battery or fixed power source. Set up the Motion Detector in a quiet room with no one moving about. Even air moving (hot air rising, wind blowing, and, believe it or not, someone talking) will trigger the device when set to its greatest sensitivity.

After you connect the power, let the unit stand for at least 20 seconds so the whole circuit will settle down electrically. Set the 1-megohm trimmer potentiometer to about 400,000 ohms by eye (in other words, imagine that the potentiometer has settings for zero through ten, and set it at four). Below about 300,000 ohms, the Detector is often too sensitive and will self-trigger. Trial and error will show the best setting for your particular requirements.

**Some Applications.** Referring back to Fig. 1, note that transistor Q1 turns on and delivers a continuous unregulated 9 volts to a suitable load as long as something is moving within the Detector's range. If the load is a 9-volt relay, virtually any electronic device can be turned on in response to motion. That might be good enough for many applications—lights can be made to flash, horns to blare, etc. (If you have trouble driving the coil of a 9-volt relay, you might need to reduce the value of R19 in Q1's base circuit.)

However, there are times when you will want an output device to remain activated after motion has stopped.

For example, if a prowler quickly crosses the field of "view," you wouldn't want a speaker to sound or a light to flash for just an instant. A continuous signaling, perhaps for many minutes, would be desirable.

The alarm circuit shown in Fig. 4 will provide just such a warning. It consists of three 555 timer ICs, IC1–IC3, where IC1 is operated in a monostable mode, and IC2 and IC3 are in astable configurations.

The trigger input to IC1 (pin 2) is connected to the normally open contacts of a 9-volt relay. The coil of the relay should be connected to the signal output terminals on the PC board. When the Detector senses motion, even for a brief moment, the relay is energized, and pin 2 of IC1 (all part designations given from here on are found in Fig. 4) is brought to ground, thus triggering the monostable circuit, or timer. Pin 3 of IC1 then goes high. The length of time it remains high is determined by the values of R1 and C2. With the components shown, the output pulse is approximately 2 minutes. To increase that time, use a higher-value capacitor for C2, to decrease the time, use a lower-value capacitor.

When the output of IC1 goes high, IC2 and IC3 are activated. The latter timer, IC3, is connected to produce a 500-Hz tone; IC2 is a 1-Hz oscillator. Thus IC2 is used to trigger IC3 on and off once per second, generating a pulse-tone alarm. Note that the alarm circuit is run off a separate power supply from that used by the Detector.

Of course, using an alarm circuit with your Motion Detector is only one application. Let your imagination fly; think of all the devices you can turn on (or off) when movement is sensed. Consider your project as the heart of a wide range of fun and practical applications. ■





# Build a Four-Mode Counter

*It's a great way to measure frequency and time.*

BY CLEMENT S. PEPPER



**M**ost hobbyists would agree that a frequency counter having a range of 2 Hz to 1 MHz would make a useful addition to a collection of gadgets. But that device would be even more useful if it could also: measure the period of cyclic waveforms in the same range to a resolution of one microsecond; total randomly occurring events; and measure the width of singly occurring, positive-going pulses. If you agree that a device with those four modes could really come in handy, then the *Four-Mode Counter* described in this article is for you.

**Circuit Functions.** The circuit diagram for the Counter is shown in Fig. 1. Power for the circuit is supplied by a 9-volt DC source (see the Construction section for more details) to jack J2. An LM7805 regulator, U19, drops the 9 volts to 5 volts for use by the rest of the circuit (current drain is about 150 mA). Capacitors C4–C17 are bypass units.

Switch S1 is used to toggle between a TEST or MEASUREMENT input. When S1 is set to TEST, a timer-circuit test source—made up of U16 (a 7556 timer), R22–R24, and C18—is activated. The output of that test-source section provides a convenient internal means of

verifying frequency count and period operation.

When S1 is switched to MEASUREMENT, a signal input to jack J1 is fed to the buffer section of the circuit. There, an LM339 comparator, U17, provides gain and waveform shaping. Diode D3 clips the negative-going half of sinusoidal inputs, D2 limits the inputs to 5 volts, and D4 provides a small input offset for the operation of U17. The CD4050 chip, U18, provides a buffer for the output of U17.

Rotary-switch S2 is used to select the desired Counter mode. The mode settings are: FREQUENCY, PERIOD, EVENT, and PULSE WIDTH (those settings correspond in order with the four modes introduced earlier). Two CD4503 three-state, non-inverting buffers (U10 and U13) are used to channel the input for the desired operating mode.

The measurements taken in the FREQUENCY and PERIOD modes use the one-second time base and the sequential-latch and sequential-reset pulses generated by it. Those pulses are switched out in the EVENT and PULSE modes where the counter latch input is held high.

When S2 is set to PERIOD, time measurement is limited to a single cycle in the following manner: The initial leading edge from pin 11 of U10 clocks U11-

a. A resulting high on pin 1 of D-type-flip-flop U11-a enables AND-gate U12-a, and 1-MHz clock pulses are then fed to OR-gate U14-a for counting. The next input leading edge toggles U11-b, locking U11-a in the reset mode, and shutting off the flow of clock pulses through U14-a. Gate U12-b inhibits further pulses to U11-b, and U12-d inhibits the period operation when S2 is in the FREQUENCY mode.

In the EVENT and PULSE WIDTH modes, U13 channels the inputs. For inputs in the PULSE WIDTH modes, pin 8 of AND-gate U12-c is held high to enable clock pulses to U13.

Another CD4503, U15, selects between the counter latch and reset functions of the modes. The counter latch is held high when the unit is in the EVENT or PULSE modes; reset is performed manually by pressing switch S3.

Two four-digit counters, U8, a 74C926, and U9, a 74C925, are used in the circuit. Both have internal output latching and multiplexed drivers for seven-segment displays. The multiplexing operations are performed internally, providing a "rotating" pulse sequence that drives switching-transistors Q1–Q6, which allow for the display of each digit in its turn through display-modules DISP1–DISP6. The Counter will display up to 999999. On a following input, the display would roll over to 000000, accompanied by a flash of LED1. Long pulse widths can



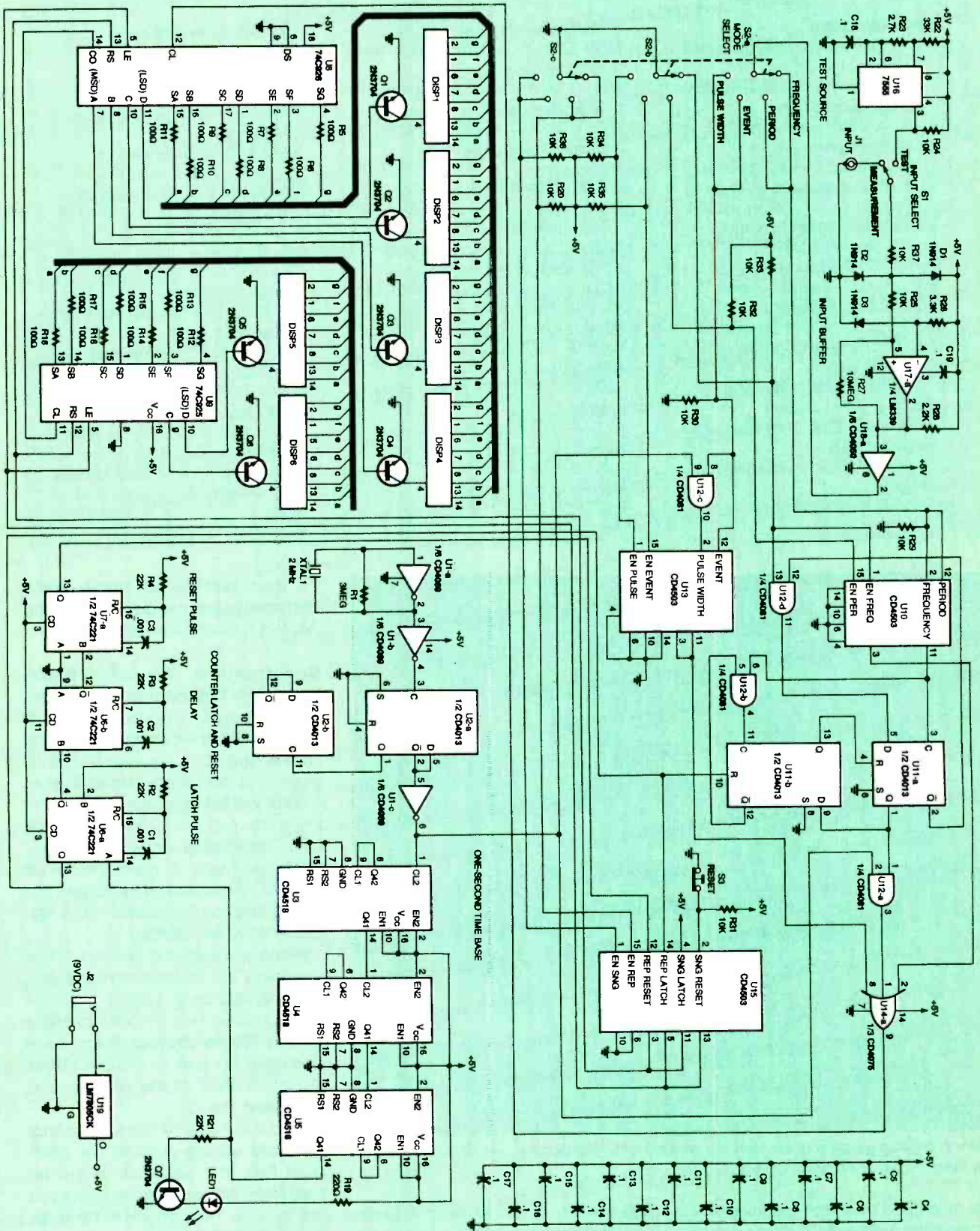


Fig. 1. As this circuit diagram shows, the Counter's display is made up of six individual modules, DISP1-DISP6. The digits are fed to those modules through U8 and U9.



## PARTS LIST FOR THE FOUR-MODE COUNTER

### SEMICONDUCTORS

U1—CD4069 hex inverter, integrated circuit  
 U2, U11—CD4013 dual D-type flip-flop, integrated circuit  
 U3—U5—CD4518 dual decade counter, integrated circuit  
 U6, U7—74C221 dual monostable multivibrator, integrated circuit  
 U8—74C926 4-digit counter with multiplexed 7-segment output driver, integrated circuit  
 U9—74C925 4-digit counter with multiplexed 7-segment output driver, integrated circuit  
 U10, U13, U15—CD4503 hex non-inverting three-state buffer, integrated circuit  
 U12—CD4081 quad 2-input AND gate, integrated circuit  
 U14—CD4075 triple 3-input OR gate, integrated circuit  
 U16—ICM7555 timer, integrated circuit  
 U17—LM339 quad analog

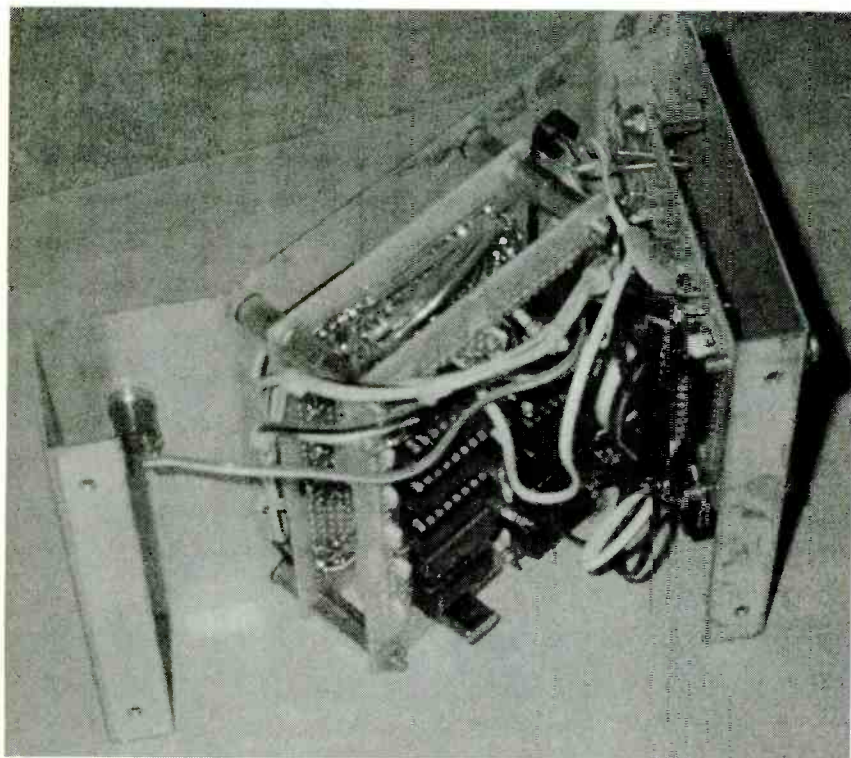
comparator, integrated circuit  
 U18—CD4050 hex buffer, integrated circuit  
 U19—LM7805CK 5-volt regulator, integrated circuit  
 DISP1—DISP6—7-segment display, orange, (MAN3640A or equivalent)  
 Q1—Q7—2N3704 NPN transistor  
 D1—D3—1N914 general-purpose silicon diode  
 LED1—Light-emitting diode, red

### RESISTORS

(All resistors are 1/4-watt, 5% units.)  
 R1—3-megohm  
 R2—R4, R21—22,000-ohm  
 R5—R18—100-ohm  
 R19—220-ohm  
 R20, R24, R25, R29—R37—10,000-ohm  
 R22—33,000-ohm  
 R23—2700-ohm  
 R26—3300-ohm  
 R27—10-megohm  
 R28—2200-ohm

### ADDITIONAL PARTS AND MATERIALS

C1—C3—0.001- $\mu$ F, ceramic-disc capacitor  
 C4—C19—0.1- $\mu$ F, ceramic-disc capacitor  
 XTAL1—2-MHz crystal  
 S1—SPDT switch, mini-toggle  
 S2—Rotary switch, 4-position, 3-pole (Digi-Key EG-1956-ND or equivalent)  
 S3—Pushbutton switch, normally closed  
 J1—Coaxial jack  
 J2—Power jack (should match power plug of adapter)  
 Perforated board, project enclosure, TO-220 heatsink for U19 (Jameco P/N 70771 or equivalent), wall transformer (120-volts AC to 9-volts DC, 1-amp; Jameco P/N 100888 or equivalent), round knob with dial, black transfer lettering, IC sockets, wire, solder, hardware, etc.



Here is an internal view of the author's prototype. As you can see, the circuit was built on three perforated boards.

be measured by keeping track of the flashes; the widths of repeated pulses are summed.

The one-second time base is derived from a 2-MHz crystal oscillator,

XTAL1. A 1-MHz divider input is taken from the first stage of U2-a. The 1-MHz input is further divided by six stages of decade frequency division; three CD4518 decade counters, U3, U4, and

U5, each provide two stages. Latch and reset pulses are derived from the 74C221 monostables, U6 and U7.

**Construction.** The author's prototype was built on three perforated circuit boards, using point-to-point wiring. All the components used in the Four-Mode Counter are standard stock, and are readily available from a variety of hobbyist sources. Some of the parts might even be in your junk box. Depending on what components you have on hand, and what sources you use to get the others, the cost of building the project will be approximately sixty dollars.

When you build the circuit, start by mounting the resistors and capacitors. Then go on to install the diodes and transistors. Next, mount sockets for all the ICs to protect them from damage; be sure to double-check the orientation of the sockets, and then insert the ICs.

Mount the display modules so that the digits will be in order (*i.e.* DISP1 goes first). You will have to cut an opening in whatever project case you use to allow the modules to be seen. You could make some kind of display bezel to cover the modules, if you wish; the author made one using  
 (Continued on page 88)



# BUILD THE SMART STRIP



*It lets you turn on up to three devices just by powering up another one.*

**W**atching TV these days often involves a tiresome routine of flipping on switches, scrambling for remote controls, and turning on accessories. A similar ritual is performed by computer users each time they want to power up their systems and peripherals.

Although most power strips feature a power switch, plugging everything in to an ordinary outlet strip has some unfortunate drawbacks. First of all, placing the strip in a place where the switch can be easily reached usually means that the strip will also be easily seen. And who wants to look at an ugly mess of wires?

Another problem, in the case of connecting all your TV equipment to one strip, is that disconnecting power from a VCR will clear any timer preset programs and reset the clock to that annoying, blinking "12:00." Furthermore, even when remote-control devices are plugged into an outlet strip, the strip must still be turned on manually.

What can you do to avoid all those problems? The answer is simple: Build the *Smart Strip* described in this article. It solves power-control problems by "sensing" when one device is powered on, and automatically turning on the other devices plugged in to it!

For example, a VCR can be plugged into the "sense" outlet of the Smart Strip, and a TV, home-theater system, and cable box can be plugged into the "switched" outlets. The VCR would retain its clock setting and programs, and all of the other plugged-in devices will come on together just by turning on the VCR. Computer equipment can also be easily controlled. A monitor, printer,

BY RODRICK SEELY

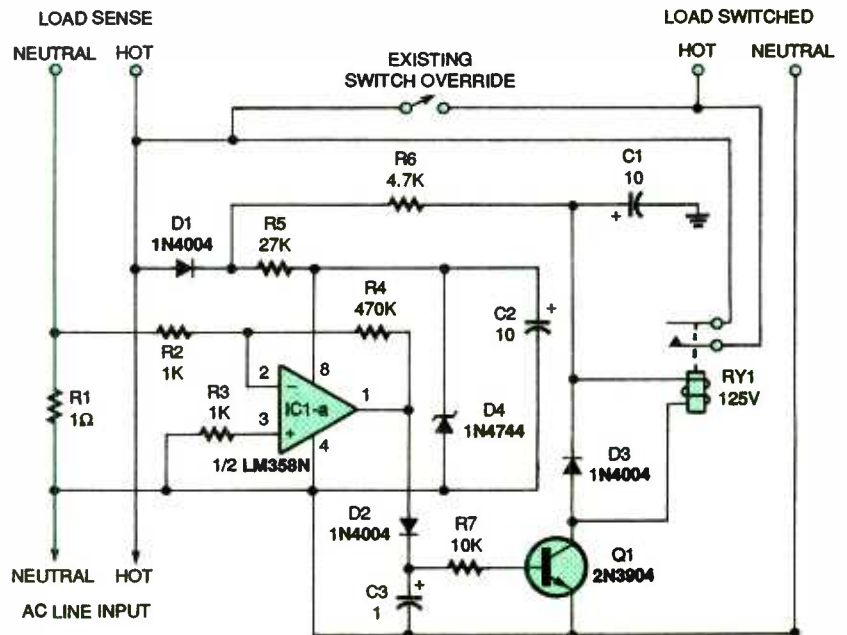
and external modem could all come on just by turning on the computer.

**Circuit Description.** The schematic of the Smart Strip circuit is shown in Fig. 1. The "AC line input" is connected directly to the 117-volt-AC line of a power strip. That voltage is rectified by diode D1 and filtered by capacitor C2.

The "load-sense" lines are connected to the AC socket in the power strip that will contain the device that will be used to turn the others on. When the load-sense device is turned on, current flows through R1, a 0.1-ohm, 10-watt resistor. The power in R1

is equal to the resistor's value multiplied by the current squared. To limit the power in R1 to 5 watts, therefore, a maximum load of no more than 5 amps should be connected to the load-sense outlet. The resulting voltage drop across R1 is fed to one section of an LM358N op-amp, IC1-a, through resistors R2 and R3. Zener-diode D4 limits the supply for the op-amp to 15-volts DC.

The voltage drop across R1 could be very small if the device plugged into the load-sense socket does not draw much current. To ensure that the circuit is sensitive enough to detect such small-load devices, the gain of IC1-a is set at 470 by resistors R2 and R4. To make the circuit less sensitive, R4 should be a lower value.



*Fig. 1. Here's the schematic diagram for the Smart Strip. When a device connected to the load-sense lines is turned on, the circuit powers up any devices connected to the load-switched lines.*

Because the output of IC1-a is half-wave rectified, diode D2 and capacitor C3 are used to form a peak-hold circuit. As long as C3 is charged to 0.7 volt or more (when a powered-up load-sense device is detected), transistor Q1 will be on, and relay RY1 will close. When those normally open contacts close, the "hot" line is connected to the "load-switched" sockets, effectively turning on any devices that are connected to those outlets. Diode D1, resistor R6, and capacitor C1 provide a DC supply for the 12-volt coil of the relay; diode D3 acts as a clamping diode.

**Construction.** Let's begin our discussion of building the Smart Strip with a **warning:** Because the circuit connects directly to 117-volts AC, extreme care should be taken in its assembly and use. Be sure to observe all safety

### PARTS LIST FOR THE SMART STRIP

#### SEMICONDUCTORS

IC1—LM358N dual op-amp, integrated circuit  
 Q1—2N3904 NPN transistor  
 D1—D3—1N4004 silicon rectifier diode  
 D4—1N4744, 15-volt, 1-watt Zener diode

#### RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise specified.)  
 R1—0.1-ohm, 10-watt  
 R2, R3—1000-ohm  
 R4—470,000-ohm  
 R5—27,000-ohm, 1/2-watt  
 R6—4700-ohm, 2-watt  
 R7—10,000-ohm

#### CAPACITORS

C1—10- $\mu$ F, 100-WVDC, electrolytic  
 C2—10- $\mu$ F, 35-WVDC, electrolytic  
 C3—1- $\mu$ F, 35-WVDC, electrolytic

#### ADDITIONAL PARTS AND MATERIALS

RY1—SPST relay; 12-VDC coil; 10-ampere, 125-VAC contacts (Aromat JS1E-12 or equivalent)

Printed-circuit materials, six-socket power strip, 1/4-inch nylon spacers, wire, solder, hardware, etc.

**Note:** The following is available from Lynn-Eren Electronics (17093 SW Lynnly Way, Sherwood, OR 97140; Tel. 503-625-2205): pre-etched and drilled PC board—\$15. MasterCard, VISA, Check, or Money Order accepted.

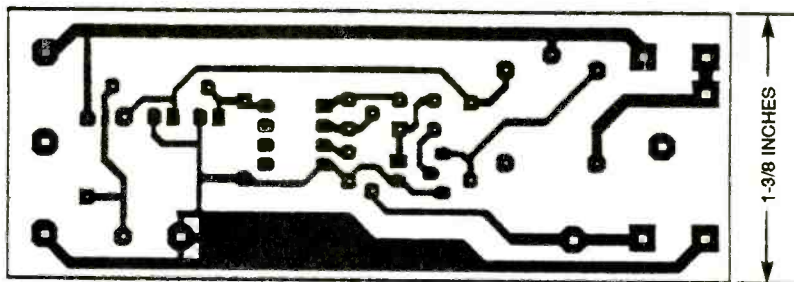


Fig. 2. If you'd like to etch your own PC board, use this full-size foil pattern.

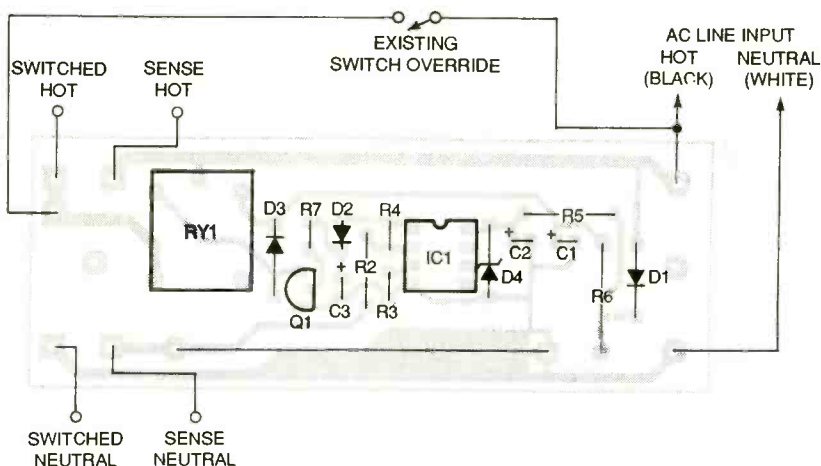


Fig. 3. When installing components onto the PC board, use this parts-placement diagram as a guide.

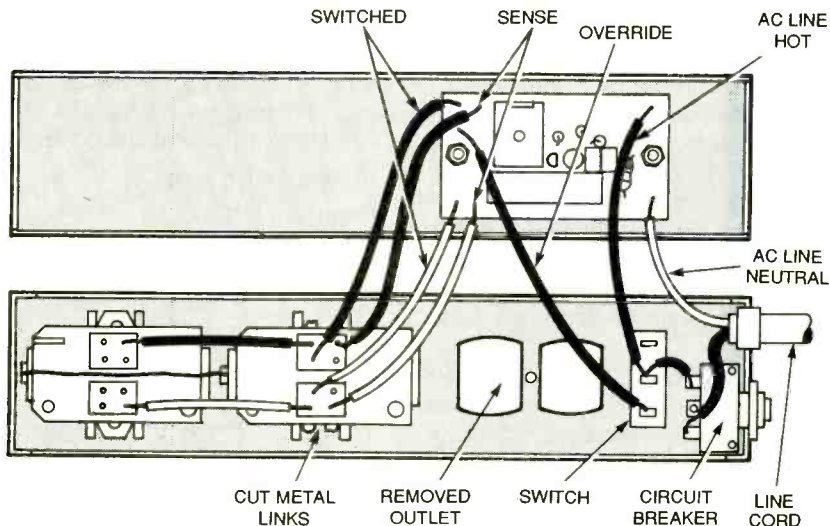


Fig. 4. This diagram shows all the wiring connections you need to make to install the circuit board in a power strip.

precautions that are appropriate when working with 117-volt AC circuits.

The prototype was built on a PC board. That project-building method is recommended to keep the circuit compact enough to fit in a power strip. You can either etch your own board using the pattern shown in Fig. 2, or buy a pre-etched board from the source mentioned in the Parts List.

Use the parts-placement diagram shown in Fig. 3 to make assembling the board easier. Begin by mounting the resistors, then go on to install the capacitors. Be sure to check the polarity of the latter.

Continue by soldering the diodes and transistor to the board, making sure they are oriented properly. Next

(Continued on page 96)



# AN ELECTRO-OPTICAL SHAFT ENCODER

*Here's a way to turn the rotation of a mechanical shaft into a signal that can be used by digital circuits.*

BY PARKER R. COPE

Generating a digital number as an input for a digital system is often a critical problem in the man/machine interface. For example, the digital input for tuning a frequency synthesizer is often generated with thumbwheel switches or a keypad, but they are inconvenient in many applications, such as when you wish to step tune through an entire band. In this article, we will present another solution to that problem, a number generator, based on an electro-optical shaft encoder, that interfaces the familiar control knob to the digital world.

An electro-optical shaft encoder generates a pulse stream whose rate is determined by the speed of rotation of the shaft, and whose sense—that is, whether it is counting up or down—is determined by the direction of rotation of the shaft. The electro-optical encoder described here uses a simple encoding disc and common 4000-series CMOS ICs to generate a binary-coded-decimal (BCD) number. Of course, binary counters could also be used if desired.

**The Shaft Encoder.** The electro-optical shaft encoder is a combination of encoding disc, photosensors, and counters. The encoding disc and photosensors generate a pulse train that can be counted to determine rate, and the disc's direction of rotation can be sensed and used to determine count direction (for example, count up for clockwise and count down for counter-clockwise).

The disc need not be a precision part; it can be made from clear plastic with dark sections or lines painted on it. The number of lines on the disc determines how many pulses are generated per revolution. By using

two photosensors, two signals in quadrature are generated, and from those the direction of rotation can be sensed.

A simple encoding disc is shown in Fig. 1A; note the alternating transparent and opaque sections. A pair of electro-optical photosensors are positioned as shown so that when one is centered over a section the other is positioned over a transition. As the disc is rotated, each photosensor will be alternately illuminated and obscured and produce outputs as shown in Fig. 1B.

From the waveforms it is obvious that the direction of rotation is indicated by the direction of the transitions and the state of the quadrature output. For example, a clockwise rotation is indicated when there is a positive transition (from dark section to light section) at sensor B while sensor A is

low (obscured by a dark section), a positive transition at A while B is high (over a light section), a negative transition of B (going from light to dark) while A is high, and so forth. Likewise a counter-clockwise rotation is indicated when there is a positive transition of B when A is high, a negative transition of A when B is high, and so forth.

**A Pulse Generator.** The circuit shown in Fig. 2 produces one output pulse for every transition of the photosensor outputs or four pulses for every section or line pair. The exclusive nor gates, U1-b and U1-c, produce a pulse on every transition, while U2, a dual four-channel data selector, decodes them into "up" pulses or "down" pulses.

The number of sections or lines that can be accommodated on a disc is determined by its diameter and the width of the sections. As an example, if the sections are made approximately 0.125-inch wide, 25 section pairs can be put on a 2-inch diameter disc and 100 pulses will be generated with every revolution of the disc. The only limiting factor is that the sections must be wider than the photosensor's aperture at the point they pass in front of it. The photosensor used in the circuit has an aperture of only 0.04-inch, so the disc described will work well.

The alignment of the photosensor assembly is not critical. The only concern is that one sensor be over a light area while the other sensor is at a transition from light to dark or dark to light. There are many sensors that could be used, though among the better choices are the Texas Instruments' TIL143 or TIL144 (Digi-Key also has similar devices from Omron). Those are transmissive sensing units that contain a light-emitting diode

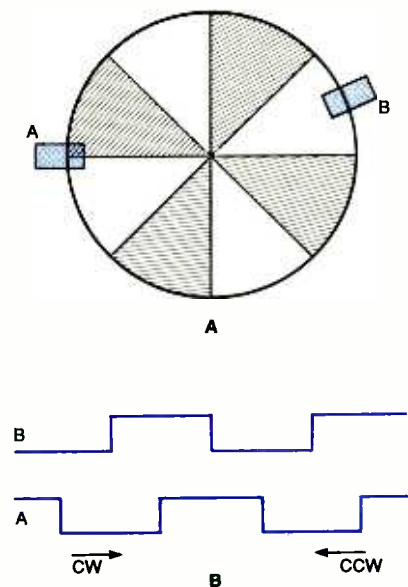


Fig. 1. Sensors should be placed as shown in A to produce the pulse signals shown in B.

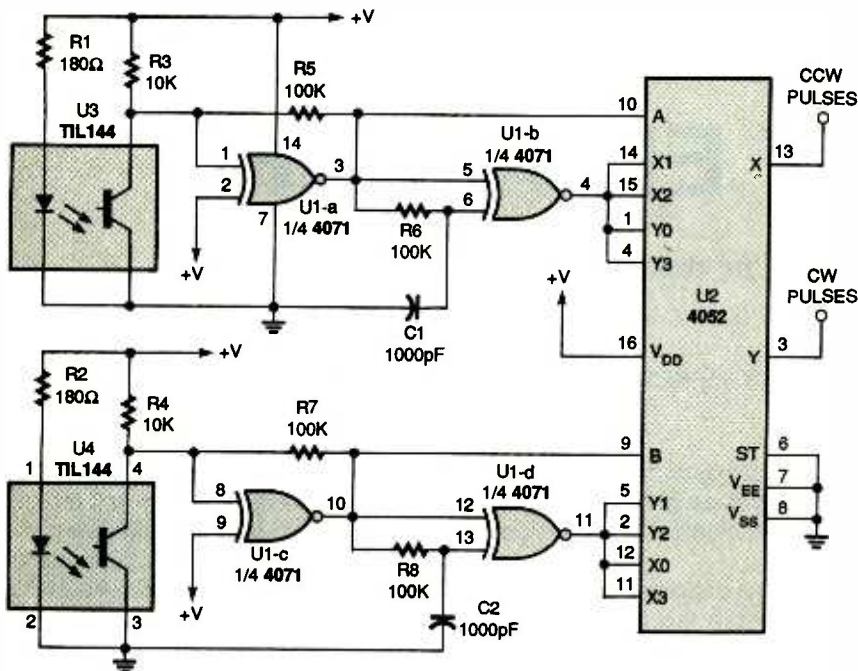


Fig. 2. This circuit reads the alternating clear and dark sections, and the direction of rotation of the disc, and turns it into a string of pulses that indicates rotation rate and direction.

encoding disc, the PT stops conducting and the collector voltage is high.

Two sections of U1 in Fig. 2, U1-a and U1-c, act as buffers and waveshapers for the outputs of the sensor, while U1-b and U1-d generate a pulse at each transition of the sensor's output. The 100K resistors between the output and the input of U1-a and U1-c provide positive feedback to speed up the rise and fall times and also generate hysteresis to eliminate noise during the transitions.

The pulses produced by U1-b and U1-d at the transitions are the result of the delay produced by the R-C circuits located at one input of each gate. For example, U1-b pin 5 follows the transition immediately, while pin 6 slowly follows. With the values shown, the two inputs are different for about 100 μs after every transition, and while the inputs are different, the output is low. Therefore, U1-b generates a negative pulse for every transition of sensor U3, and U1-d generates a negative pulse for every transition of U4. The states of U3 and U4 determine whether the pulse is sent to the X output of the data selector (U2, pin 13) to indicate a CCW pulse or the Y output (pin 3) to indicate a CW pulse.

In Fig. 2, a 4052 data selector is shown for U2, but any dual four-channel data selector such as the Motorola MC14539 or MC14529 will work equally well with the appropriate pin-number changes. The data selector is akin to a two-pole four-position switch with the switch position set by the address inputs (pins 9 and 10).

### Counting Circuits.

The output pulses of the encoding circuit can be counted with any counter. With a BCD up/down counter such as the 40192 shown in Fig. 3, a binary-coded-decimal (BCD) number is produced. Those counters have separate "up" and "down" clock inputs. For example, as long as the "count" input (pin 11) is high, the counter will increment one count for every positive edge at the "clock-up" input (pin 5), and decrement one count for every positive edge at the "clock-down" input (pin 4). Counters can be cascaded by connecting the "borrow" output (pin 13) to the following "clock-down" in-

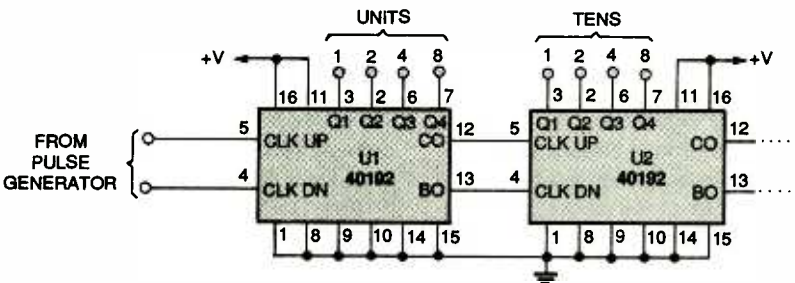


Fig. 3. This circuit takes the output from the pulse generator and produces a BCD count of those pulses.

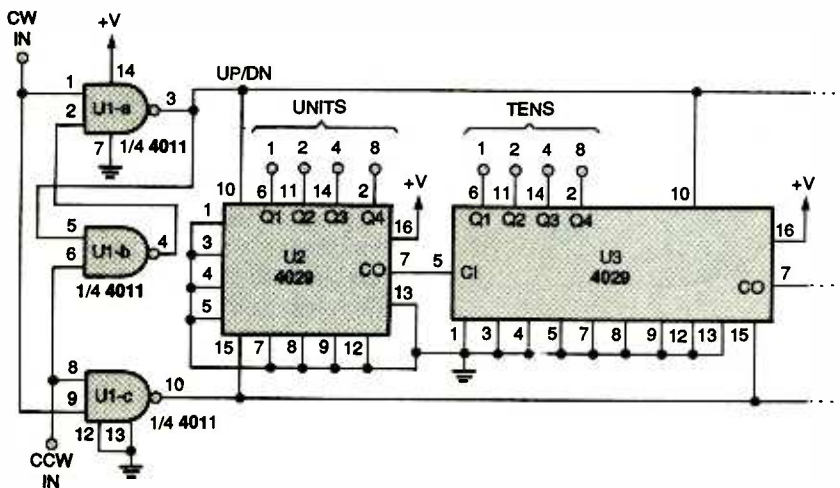


Fig. 4. Here's a different counter based on the 4029. The output is binary or BCD depending on the state of pin 9.

and a phototransistor (PT). When the light from the LED passes through the encoding disc and falls on the PT, the

PT conducts and the collector voltage is low, but when the LED's light is blocked by the opaque section of the

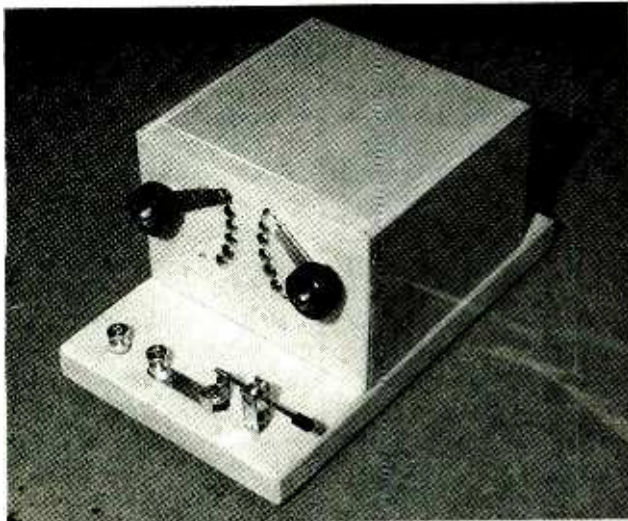
(Continued on page 73)



# ANTIQUE RADIO

By Marc Ellis

## Remember the NBS Set?



Here's Bob's very neat version of the NBS set. The tuning coil, hidden by the cover (a nicety I left off of my version), is directly behind the front panel.

This month, I had intended to bring you a report on the triumphant air test of the 1930's ham receiver. Alas, that project, which has been plagued by delays, is undergoing yet another one. So I thought I'd take the opportunity to tell you about Bob Zinck's version of the NBS (National Bureau of Standards) crystal set, a replica receiver project that

of the wiring, I decided to run all of it beneath the board. In order to accomplish that, I drilled a small "pass-through" hole in the board near each terminal of each of the set's components. The interconnecting wires were then run from point to point under the board, being fed up through the holes to connect with the components.

I used a bare bus-bar wire, similar to that found in early battery radios, to make the connections. Short strips of electrical tape took care of insulating the wires where they crossed each other, and strategically applied staples held the wires in firm contact with the board.

I thought that the result had an interesting period look, something like the underside of an Atwater Kent breadboard set. The top of the set looked great, too, especially after the two 01-A tubes were plugged in.

### WE FAIL THE SMOKE TEST

Wiring completed, I connected a set of phones as well as a couple of surplus 45-volt "B" batteries. To light the tubes, I hooked up a 6-volt-DC wall transformer originally intended to run a Sharp printer. It was rated at a 1.2 amps, more than twice the current drawn by the two 01-A filaments.

I'd always wondered if one of those little power supplies would be suitable for firing up an 01-A. So, without waiting to connect the antenna and ground, I plugged in the wall transformer and advanced the filament rheostat.

One of the two tubes didn't light up, and I soon found out why. It was very loose in its socket. No amount of coaxing and wiggling could make it glow for more than a few seconds. And after it had flickered on and off six or seven times, a tell-tale plume of smoke rising from the floor signaled the sudden death of the Sharp transformer. Perhaps the little semiconductor circuits inside couldn't take the transients created by the flickering tube.

I could kick myself for not examining those sockets more closely before installation. I had been very careful to fix all loose and oxidized connections in the other vintage components used in the set (notably the filament rheostat, which needed a major overhaul), but never thought to check the stiffness of the tube contact springs.

Now I'll have to remove that bum socket (possibly both sockets, because I'm not sure how good the other one—an identical model—really is) and decide on what to substitute for a DC filament supply. I'd really like to try a wall transformer in this application and hope to come across another one of similar wattage. Oh well, maybe next month...

### BOB ZINCK'S COIL DESIGN

When Bob Zinck set out to duplicate the NBS set, he ran into trouble almost at once. The grocery stores at his Canadian location didn't carry Quaker Oats Quick Grits canisters, so he

ran in this column for some months and was completed in the August 1994 issue. Bob was kind enough to send a detailed letter about the construction of his set and some very nice photos. But first, here's the news on the ham set.

### COMPLETING THE WIRING

Readers who have been following the 1930's ham-receiver project know that, at the end of last month's session, the breadboard-style radio was completely assembled and ready for wiring. To make a neat job

had to find a different coil form. At 3.75 inches in diameter, the Ovaltine container he came up with was a bit bigger than the Quick Grits one that I used.

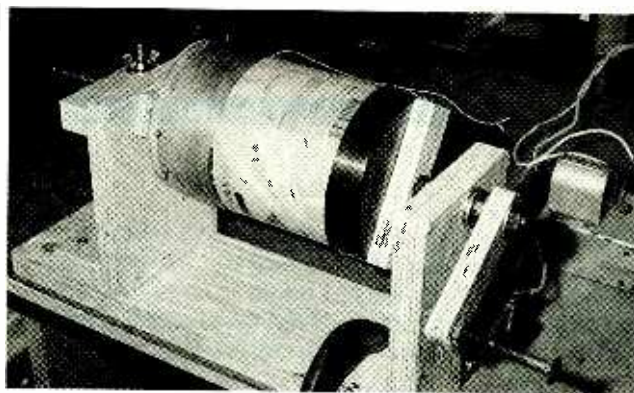
After cleaning off the metal foil glued to the interior of the container (a small wire brush on a drill facilitated what must have been a maddening little task), Bob wound his coil with 24-gauge Celanese-covered wire purchased from Antique Electronic Supply (6221 South Maple Ave., Tempe, AZ 85283). He reports that the wire looks quite similar to the traditional double cotton-covered material—that is until you coat it with lacquer (to bind it to the form), when it turns “a pretty pink.”

Because of the change in form diameter, Bob wound his coil a little differently from mine. Containing 60 turns, it is tapped every ten turns for the first 50, then at turns 55, 56, 57, 58, 59 and 60. To make the turns on his coil nice and neat, he constructed a special winder that worked rather well.

### CRAFTING THE SWITCH PARTS

Not being a wimp like me (I used modern rotary switches from Radio Shack, dressing them up with period fluted knobs), Mr. Zinck crafted his own tap switches along the lines specified in the original NBS article. But, putting himself in the mind set of a 1920's project builder, he didn't hesitate to adapt the plans to take advantage of found materials.

Bob cut the switch contact arms from an old brass mailbox and salvaged the switch tension springs from a scrapped farm generator. Knobs were crafted from hardwood instead of the phenolic rod (now ex-



*This is the jig on which Bob wound his neat Ovaltine canister coil.*

tremely expensive) specified in the article. He did buy new binding-post thumb nuts because “spent” No. 6 dry cells—the original suggested source for those nuts—are no longer part of the American scene (I substituted some Fahnestock clips that I had on hand).

### THE AIR TEST

Like me, Bob quickly lost patience with the touchy Galena and cat's-whisker detector, substituting a more modern crystal diode for the initial testing. As it happens he lives within a mile of three “brute” AM transmitters operating at 780, 920, and 960 kHz. The stations at 780 and 920 come in “clean” on the NBS set; 960 can be heard, but has some crosstalk.

Audio level was good with the galena crystal and excellent with the 1N34. However, Bob's visitors find the cat's whisker and “rock” so entrancing that the 1N34 is now permanently retired.

### CRYSTAL RECEPTION FROM A 1920'S POINT OF VIEW

While we're talking about crystal sets, I thought it might be fun to include a description of crystal detectors—written for beginners—from *Practical Radio* by Moyer and Wostrel (McGraw-Hill, Second Edi-

tion, 1926).

... The crystal mineral that is most used is Galena (lead sulphide). This is a silver-gray mineral, which breaks into squares with mirror-like surfaces.

In its essential parts, a crystal detector consists of a piece of galena crystal mounted in such a way that a fine piece of wire attached to a flexible handle can be made to touch the surface of the mineral. Crystals of that mineral are not uniformly sensitive so that there are some spots that are not as sensitive as others. In the operation of a crystal detector, therefore, the wire must be shifted with its flexible handle on the surface of the galena, until a highly sensitive contact is found. If, however, the surface is jarred, the sensitive contact might be lost, and even with use the sensitiveness of a particular spot is likely to change. No adjustment for receiving radio currents from only one transmitting station (tuning) is possible with a simple receiving set as all near-by stations come in at the same time. There are usually, however, few difficulties in its use because its range is very limited. On the other hand, it is very satisfactory for picking up radio broadcasting from powerful nearby stations.

That about sums up Bob's,

and my own, experience with those cranky little contrivances. However, it's important to note that the Meyer and Wostrel description refers to the simplest possible crystal set—just a crystal detector, set of phones, antenna and ground. With no tuned circuits, then, all radio stations within range would be received at once. It might be interesting to hook up such a circuit today and connect it to a good antenna. With all the AM stations now on the air, there should be quite a cacophony!

Another interesting sidelight on the care and feeding of crystals comes from the construction article on which my NBS series was based: “How to Build an Efficient Crystal Receiver,” from *How to Build your Radio Receiver* (edited by Banning and Cockaday, published by Popular Radio, Inc., 1924).

As the crystal is the life of the set, emphasis is laid upon the importance of securing a good one, which should not only be sensitive to weak signals, but which should give response from local stations at most random positions of the cat whisker. The crystal may be kept covered when the set is not in use, but after a time its surface may become insensitive. It could be cleaned with alcohol or soap and water and a clean brush.

The input terminals of a two-step, audio-frequency amplifier could be connected to the phone binding posts of the set, and good volume of sound will be obtained from local stations. The use of a crystal detector gives signals of maximum clearness.

Many thanks to reader Bob Zinck for sharing the details on his carefully crafted NBS set. ■



# COMPUTER BITS

By Jeff Holtzman

## The SCSI Switch

There are three kinds of people in this crazy world: those who are always organized; those who are (you guessed it) never organized; and those of us in the middle, who oscillate back and forth between the two extremes. For the past few months I've been chronicling some of my efforts to get the pendulum swinging away from never organized and toward always organized.

flow prevented that for now. Originally, I hoped to be able to create this multi-boot system from a single 1-GB hard drive, possibly using disk compression to create multiple virtual drives that could be rearranged to fit the needs of a given computer operating system.

I didn't want to spend any money, because upgrading that particular machine was no longer

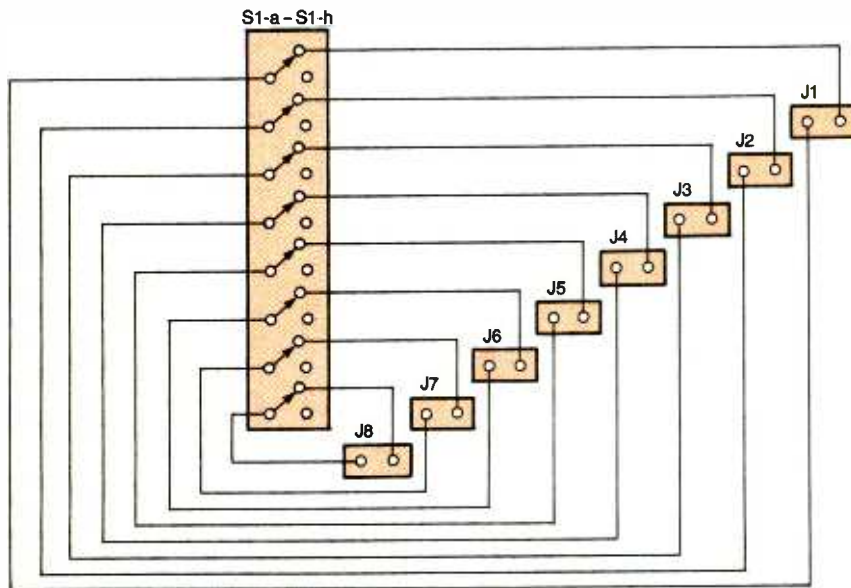
there is some space to play around with.

### THE SWITCH IS ON

The other part of the solution involved a high-tech home-brew device I call the "SCSI Switch," which consists of an 8-position DIP switch, about 24 inches of ribbon cable, and eight female header blocks. A schematic of the switch is shown in Fig. 1. The header blocks plug onto the ID pins of the SCSI hard disks. Through the DIP switch, those IDs can be re-assigned at will. In any given configuration, whichever physical drive has the lowest SCSI ID becomes the boot drive. The others are allocated in order by SCSI ID.

To create your own SCSI Switch, obtain a two-foot-long, 16-conductor ribbon cable terminated on one end with a 16-pin DIP plug. Next, solder each leg of an 8-position DIP switch to the corresponding leg on the DIP plug. Then solder switch-wire pairs to female header blocks. Older drives use 0.1-inch pins; newer ones use 2-mm devices, which require steady hands and patience to work with. I bought all parts from Digi-Key; enough parts to build several SCSI switches cost about \$20.

I filed a slot in an unused plastic drive-bay cover, and hung the DIP-switch end of the device out of that. The other end of the cable snakes through the interior to where the hard disks are mounted. Table 1 shows how I correlated drive ID pins with switch positions. Table 2 shows the corre-  
(Continued on page 77)



You can build your own SCSI switch using a DIP switch, some ribbon cable, and some female header blocks.

One of the biggest problems has involved storage. In short, I wanted my main PC to be able to boot several different operating systems, but run a common set of applications from each. For example, I was hoping to avoid installing separate copies of MS Office (at a space premium of about 100 MB each) to run from each operating system.

The ideal solution would have been simply to buy another machine, but cash

cost effective. But after considering numerous ways of accomplishing my goals, and counting in the expense for possible lost time in trying (and fixing) various solutions, I ended up adding another SCSI drive—a 540-MB beast—at a cost of a little over \$200.

The solution was a compromise, because I still ended up with multiple redundant copies of numerous applications, but at least I can boot multiple operating systems, and

# THINK TANK

By John J. Yacono  
Technical Editor  
Windows Magazine

## Shop Equipment

**A**s part of our contest to award prolific contributors, this month's column will feature the work of one winner: Skip Campisi. If you read this column regularly, you probably recognize his name. His circuits are usually based on sophisticated operating principles, and his text is quite thorough, often including calibration and construction hints. (Although you can't tell from our reproductions of his work, he even color-codes his schematics!)

This round-up of some of

### MEGOHM ADAPTER

Most DMMs measure resistance by applying a constant current to a resistance and measuring the resulting voltage drop. That method is accurate up to the 1- to 10-megohm range, but it's expensive to implement accurately after that. My circuit (see Fig. 1) applies a constant voltage to the resistance under test and measures the resulting current drain with an overall accuracy of  $\pm 0.1\%$  when driving a 4½-digit DVM.

The resulting output volt-

sistors are required: R2 and R10. Use your DMM to select R10 from a 1% lot to be 0.1% accurate. The other resistors are ¼-watt, 5% units. Capacitors C1 and C2 are ceramic and C3 is a tantalum unit. Resistors R3 and R6 are multi-turn, cermet trimmer potentiometers. Batteries B1 and B2 are 3.0-volt, lithium "coin" cells (CR2016/2025/2032). Integrated circuits IC1 and IC2 are TLC271C CMOS op-amps, and D1 is an ICL8069DC 1.2-volt band-gap diode. All parts are available from Mouser Electronics (Tel. 800-346-6873).

Layout of the project is not critical, but due to the low currents involved, pin 2 of IC2 must be isolated from the PC board as follows: Before installing IC2, bend pin 2 away from the package to a horizontal position, letting it float in the air. Connect a short lead between it and a Teflon-insulated stand-off (BP1) mounted on the circuit board. Also, the leads from R8, R9, R10, and J2 go directly to the stand-off without contacting the board. Jacks J1 and J2 should be Teflon-insulated BNC units.

Also, all the hook-up wire used, including input cables, should be Teflon-insulated. That's because currents below about 10 nA leak right through normal insulation, and this circuit dips as low as 10 pA. PC-board material and flux work as pretty-good conductors at those low levels. The only insulating materials to be trusted are air and Teflon, and below about 1 pA, man-made sapphire is

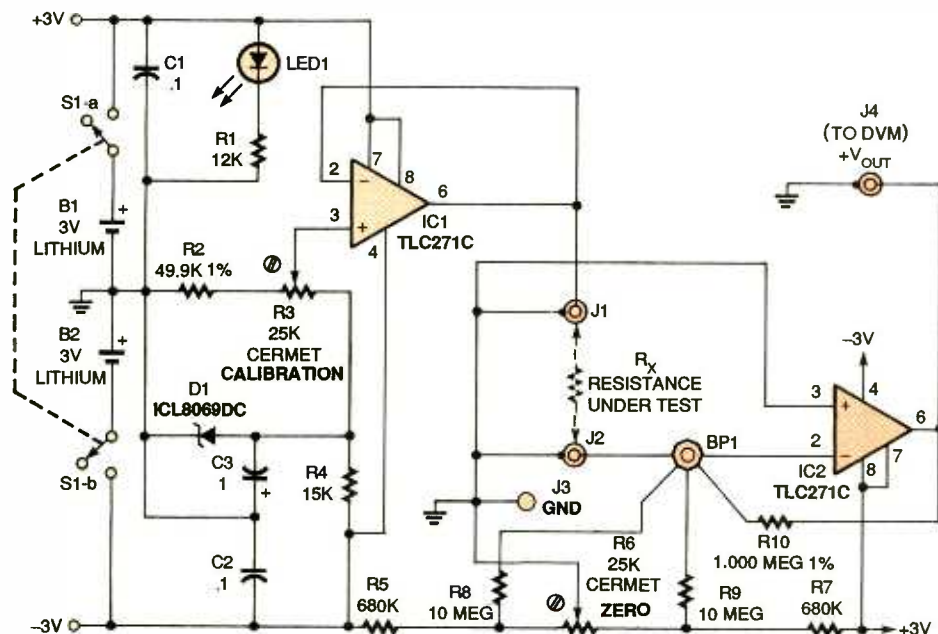


Fig. 1. This extension for your DMM allows it to measure very large resistance values. It's also useful for checking component leakage.

his test equipment continues that tradition, earning him an MCL1010 IC and a free kit, as well as a book. The circuits and explanations of just four of the circuits will take up the space allotted for this column, so I'll postpone our on-going tutorial on capacitors until next month.

age of the device is related to the conductance at the input (the reciprocal of the resistance) at 1.00 nano-ohm-per-millivolt. The maximum output is 2.00 volts—2000 nmhos (representing 500,000 ohms) or 2000 nA—with a resolution of 0.01 nmho (or  $10^{11}$  ohms). Only two precision re-



widely used. For input to J1 and J2, I built a simple plug-in fixture to hold component leads, but you can also use Teflon-insulated plugs and cables, if desired. The output cable to your DMM should be a short (12-inch) twisted-pair, not a piece of shielded cable—coax might cause the output to oscillate.

To calibrate the unit, set R3 for a reading of  $-1.000$  volt at J1, and adjust R6 for a  $0.00$ -mV reading at the output. Besides measuring resistance, this unit can also be used to test semiconductor-junction leakage, either with the internal reference or an external voltage source that is appropriate. Capacitive leakage can also be measured using an external voltage; using the internal reference here could cause the circuit to oscillate. If properly constructed and calibrated, the circuit yields a resolution of 1.0% at 1.00 gigohm (1.00 nanomhos), and 1% at 1.00 nanoamps when driving a 4-1/2-digit DVM. —Skip Campisi, S. Bound Brook, NJ

*Nice work! For the sake of accuracy J1, J2, J3, the wiper of R6, and pin 3 of IC2 should be connected to a single grounding point (a "star" ground). That reduces errors caused by solder-joint resistances.*

### MILLIOHM ADAPTER

The perfect companion to the megohm adapter, this circuit (see Fig. 2) provides a 1.000-ampere constant-current pulse of 100- $\mu$ S duration, at a 100-Hz repetition rate, to the unknown ( $R_x$ ) resistance, and provides an output voltage to your DMM of 1.000-volt per ohm of input resistance. Accuracy is better than  $\pm 1\%$  up to 5.00 ohms, and the resolution using a 3-1/2-digit DMM is 100 micro-

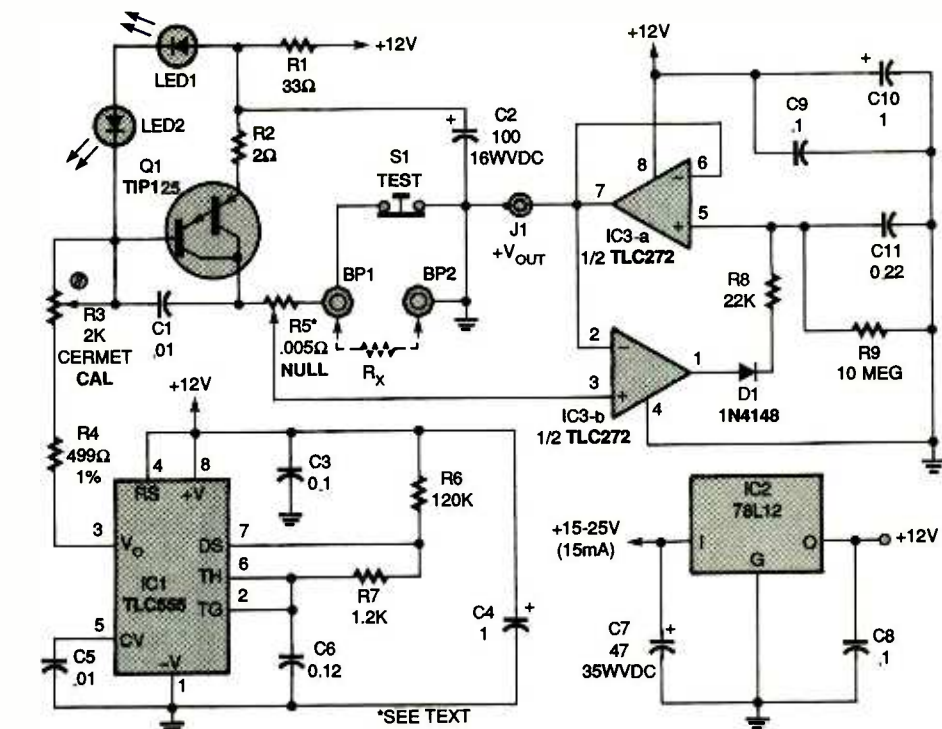


Fig. 2. Need to measure ultra-low resistance? Try adding this milliohm adapter to your DVM.

ohms. Extremely low resistance readings are only limited by the quality of the mechanical connections to  $R_x$  and the accuracy of the NULL setting.

As you can see on the schematic, IC1 (a TLC555) provides the pulse timing to a TIP125 transistor, Q1, which is configured as a capacitive discharge-current source. Capacitor C2 provides the current through R2, a stable metal-film or wire-wound resistor.

Two red LEDs, LED1 and LED2, are selected to have a forward voltage drop of about 1.75 volts each (3.50 volts total) at a current range of 4 to 15 mA, as provided in the circuit. Transistor Q1 has a dynamic  $V_{be}$  of about 1.50 volts, so the LEDs provide a 2.00-volt reference across R2 with some temperature compensation. Integrated-circuit IC3 (a TLC272) is configured as a peak detector (the output to your DMM should be a "twisted-pair" wire not a shielded cable). The 78L12, IC2, which can be powered

by two 9-volt batteries in series, provides a regulated 12 volts to the circuit.

The  $R_x$  terminals, BP1 and BP2, must be heavy-duty binding posts; do not use test leads as that will introduce errors greater than the value of  $R_x$ . Resistor R5, the 0.005-ohm trimmer potentiometer, is simply a 2-1/2-inch length of tinned, 24-gauge bus-bar wire, with the lead from pin 3 of IC3 terminated in a clip that will slide on the bus-bar. The circuit layout is not critical; use short leads, and mount the board in a shielded enclosure.

To calibrate the circuit, first use a heavy shorting-bar between the input terminals, push S1 (TEST), and adjust R5 (NULL) for an output of 1.00 mV or whatever value is convenient for you. (The output can't ever actually reach 0.00 mV.) You'll have to subtract that "null" value from your actual readings. Next, replace the shorting-bar with an accurate resistance, such as two 10.00-ohm, 1% resistors in

parallel, and adjust R3 for the proper output (5.000 volts). All those parts are also available from Mouser Electronics. —Skip Campisi, S. Bound Brook, NJ

*It'd be pretty neat to include this circuit in the same enclosure as the conductance adapter. Jacks J1 and J2 in Fig. 1 could perform the jobs of BP1 and BP2 in Fig. 2, and the circuits could share the same connection to the DVM.*

### FREQUENCY PROBE

This design (see Fig. 3) is a simplified 3-1/2-digit frequency counter having four ranges: 2000 Hz, 20.00 kHz, 200.0 kHz, and 2.000 MHz. An effort was made to miniaturize the circuit to fit in a standard logic-probe-type case; the complete circuit was assembled on a perforated board cut down to 1  $\times$  4-3/4 inches.

As you can see on the schematic, the normal crystal time base with all its dividers was eliminated in favor of one 8-pin DIP: IC1, a TLC555 CMOS oscillator. It

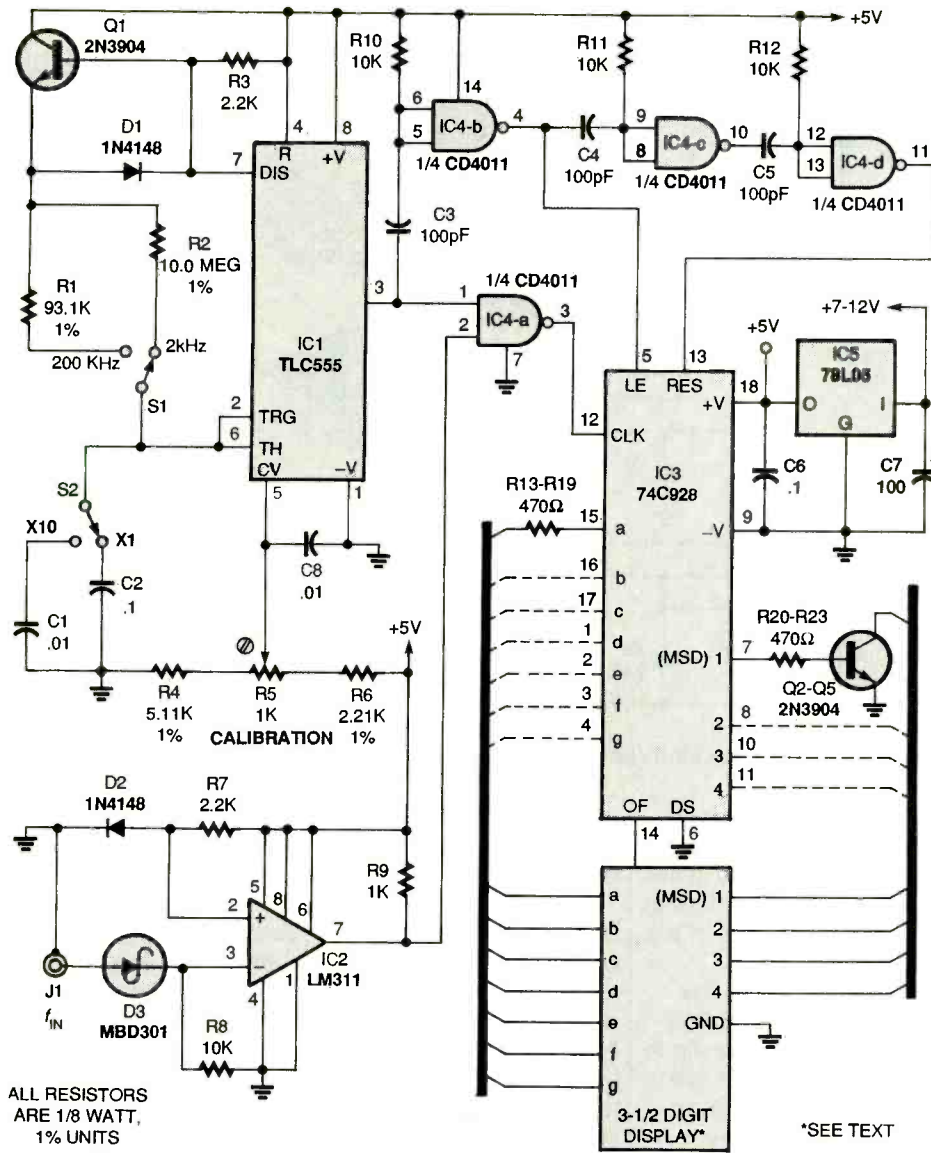


Fig. 3. While this frequency counter is very simple, it has 2000-Hz, 20.00-kHz, 200.0-kHz, and 2.000-MHz ranges, and will work with almost any waveform.

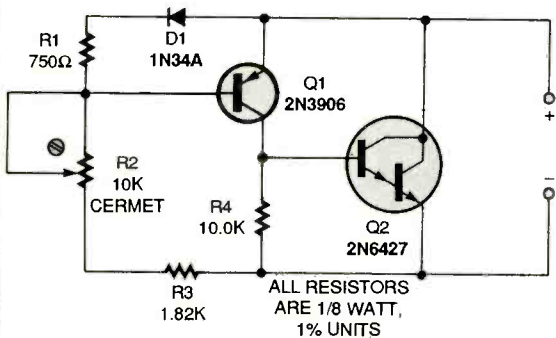


Fig. 4. Zener diodes are great for down-and-dirty regulation, but they can behave unpredictably over a wide temperature range. This circuit acts like a Zener without the drawbacks.

provides gate timings of 1000 ms, 100 ms, 10 ms, and 1 ms using R1, R2, C1, and C2 as the critical timing

components. Select C1 to be exactly 1/10 the value of C2.

Calibration is done with

800-344-4539) carries the 74C928 chip, plus they have a 4-digit display (#P454), which is a multiplexed mini display that should work fine. The digit drivers shown, Q2-Q5, and R20-R23 can be replaced with a single DIP package such as a 75491, 75492, etc. I used a 75491 for simplicity. (Note that in the schematic, only one of each driver circuit is shown; the other, identical, circuits are indicated by dotted lines.)

A 78L05 regulator, IC5, provides the +5 volts for the circuit, and is mounted on board with the other components. It can be driven externally via a standard AC wall adapter of 7 to 12 volts at 30 mA, or from a 9-volt battery. Be sure to bypass the supply pins on each IC with a 0.1-μF monolithic capacitor for noise-free performance! — Skip Campisi, S. Bound Brook, NJ

I don't think you could simplify this circuit any further without sacrificing range. As Skip points out, a 74C00 is an adequate replacement for the CD4011.

## ZENER-DIODE SIMULATOR

Conventional Zener diodes, unless specially compensated, all exhibit a similar problem—as the Zener bias current increases, the temperature coefficient also increases in a positive direction. Also, the temperature compensation can be negative or positive depending on the Zener voltage and the particular bias current used—even for a single diode over its characteristic curve!

Also, Zener diodes available for less than approximately 5.0-volt values also exhibit very weak "knees," where the Zener impedance causes a large voltage

(Continued on page 75)





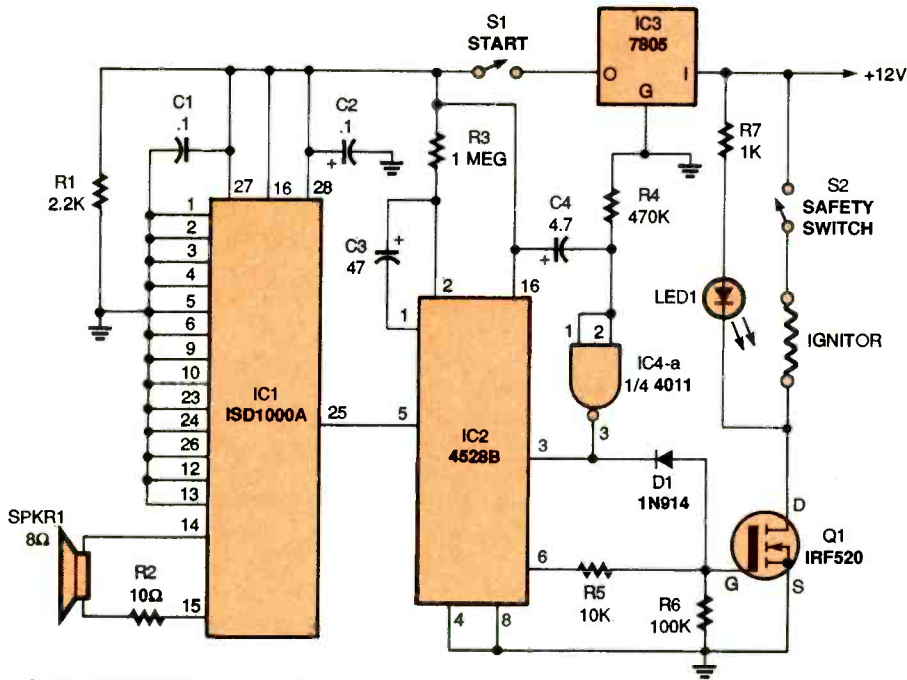


Fig. 2. The ISD1000A you recorded on using the circuit in Fig. 1 forms the heart of this countdown rocket-launcher circuit.

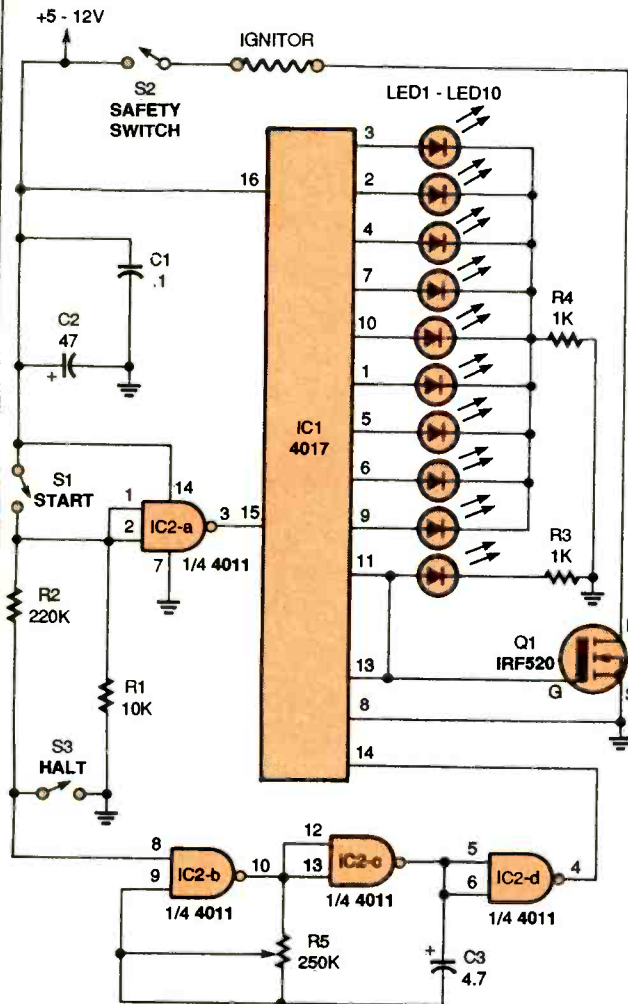


Fig. 3. The ten LEDs provide a 10-to-1 countdown for your model-rocket launches. Don't forget to practice safety first.

(IC4-a) keeps the 4528B monostable multivibrator from misfiring and igniting the rocket motor prematurely. When the start switch is first activated, IC4-a's input goes high while C4 is charging up and its output at pin 3 goes low keeping IC2 from responding to any false input pulse at pin 5. While that's going on, IC4's pin 3 clamps the input of Q1 to ground, through D1, keeping it turned off. After a few seconds C4 is fully charged and IC4-a's output goes positive, enabling IC2 and allowing Q1 to operate. Though not shown in the figure, the inputs of the quad IC's three unused gates (IC-b-IC-d, pins 5, 6, 8, 9, 12, and 13) must be tied to ground.

You could modify the launcher to meet your needs, but in any case use IC sockets and keep all component leads short and neat. And above all, be sure to observe all safety precautions.

firing the rocket engine.

This circuit contains several safety features. Switch S2 is the most direct and obvious safety feature; it removes power to the ignitor fuse. One gate of a 4011 quad two input NAND gate

### PARTS LIST FOR THE COUNTDOWN LAUNCHER (Fig. 2)

#### SEMICONDUCTORS

IC1—ISD1000A voice record/playback chip, integrated circuit  
 IC2—4528B dual monostable multivibrator, integrated circuit  
 IC3—7805 5-volt voltage regulator, integrated circuit  
 IC4—4011 quad two-input NAND gate, integrated circuit  
 Q1—IRF520 hexFET transistor  
 D1—1N914 silicon diode  
 LED1—Light-emitting diode, any color

#### RESISTORS

(All resistors are 1/4-watt 5% units.)  
 R1—2200-ohm  
 R2—10-ohm  
 R3—1-megohm  
 R4—470,000-ohm  
 R5—10,000-ohm  
 R6—100,000-ohm

#### CAPACITORS

C1, C2—0.1- $\mu$ F, ceramic-disc  
 C3—47- $\mu$ F, 16-WVDC, electrolytic  
 C4—4.7- $\mu$ F, 16-WVDC, electrolytic

#### ADDITIONAL PARTS AND MATERIALS

SPKR1—8-ohm speaker  
 S1, S2—SPST toggle switch  
 IC sockets, breadboard, wire, solder, etc.



## PARTS LIST FOR THE LED COUNTDOWN LAUNCHER (Fig. 3)

### SEMICONDUCTORS

IC1—4017 decade-counter/divider, integrated circuit  
IC2—4011 quad two-input NAND gate, integrated circuit  
Q1—IRF520 hexFET transistor  
LED1—LED10—Light-emitting diode, any color

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)  
R1—10,000-ohm  
R2—220,000-ohm  
R3, R4—1000-ohm  
R5—250,000-ohm potentiometer

### CAPACITORS

C1—0.1- $\mu$ F, ceramic-disc  
C2—47- $\mu$ F, 16-WVDC, electrolytic  
C3—4.7- $\mu$ F, 16-WVDC, electrolytic

### ADDITIONAL PARTS AND MATERIALS

S1—S3—SPST toggle switch  
IC socket, perfboard materials, wire, solder, etc.

## LED COUNTDOWN CIRCUIT

Our other rocket-launching circuit, shown in Fig. 3, uses ten LEDs as countdown indicators. This circuit was inspired by a request from Mike from Topsham, ME.

Turning to the circuit, a 4011 quad two-input NAND gate and a 4017 decade-counter/divider IC are the heart of the launcher. Transistor Q1, an IRF520 hexFET sends the current through the ignitor fuse to fire the rocket engine.

Circuit operation goes like this: Two gates of a 4011 NAND gate, IC2-b and IC2-c, are connected in a low-frequency oscillator circuit with R5 and C3 setting the oscillator's frequency. Another gate of that IC, IC2-a, starts the countdown and sets pin 15 of the 4017 to the run condition. The IC's fourth gate, IC2-d, inverts and buffers the oscillator's output and supplies the clock input to pin 14 of the 4017. The ten LEDs indicate the count, and when the last one turns on (LED1) pin 11 goes high, turning Q1 on and firing the ignitor fuse. The last LED, LED1, will remain on until S1 is switched

off. The countdown could be halted by closing S3. Opening S3 continues the countdown.

### A SAFETY NOTE

Never rely on any electronic circuit or mechanical device as a safety measure when you are in harm's way. When working on the rocket always have the battery disconnected and all circuits turned off. Play it safe and have fun. Until our next visit, may all of your rockets go straight up and come down intact. ■

## PRODUCT TEST REPORT (Continued from page 38)

Pause and Frame Advance buttons on the remote let you cue to an exact scene on the master tape. The multifunction remote lets you operate two compatible VCRs (read "RCA") from the one remote with the AutoEdit function. Camcorder-to-VCR editing will be possible with RCA camcorders that have a "Random Assembly Editing" feature.

Finally, an understated

feature called Pro-Tect Plus will be welcome to anyone who's ever gone through the arduous process of programming a VCR for time-shift recording, only to have meddling fingers inadvertently undo the works. Essentially, this locks up the buttons on the VCR and remote control until you unlock it—a deliberate process that takes several seconds.

### PERFORMANCE

Great audio, good video. That's the tale of the tape as measured by the Advanced Product Evaluation Laboratory, an independent testing facility in Bethel, CT. As you'll see from the numbers in Table 1, video frequency response is fine at 2 MHz but sharpness surrenders to noisiness at the 3 MHz point; what that means is that this VCR basically delivers about 220 lines of horizontal resolution out of the possible 240 inherent to the conventional VHS format. Signal-to-noise ratio for luminance is good—44.6 dB at 50 IRE, and adequate but not stellar for color (chroma).

As mentioned earlier, audio performance is the VR678HF's strong suit. At nearly 90 dB, the signal-to-noise ratio is impressive in hi-fi recording—and similarly worthy in conventional (linear track) recording. Distortion (THD) is measurable though not audible in either mode. Frequency response is typical, though the low-end roll-off for linear recordings usually is around 100 Hz compared to the 200 Hz measured here.

The VR678HF really shines in its MTS stereo-broadcast reception performance. Signal-to-noise ratios in all modes put it at the top of its class. But what matters most, to most people, is frequency response and

separation in the stereo mode.

Here, the VR678HF weighs in with 26 dB of separation over a broad range of frequencies—59 Hz to 12.5 kHz. As a consequence, you can expect good results if you're running this VCR's audio through a home-theater system with Dolby Surround decoding.

Bandwidth also is exceptionally wide and flat in the monaural SAP (Second Audio Program) channel. Oddly, frequency response is very limited under normal monaural reception—an anomaly we've noticed with other TVs and VCRs (including RCA's) in the past. Most likely, video makers assign the same low priority to mono reception that hi-fi manufacturers accord to the AM section of their receivers. Probably it matters less with each year, because much as AM went from a music to a talk-show medium as FM became the high-fidelity conduit, more telecast soundtracks now are transmitted in stereo.

In short, the RCA VR678HF is a competent performer with some outstanding features that set it apart from the crowd. For more information, contact the manufacturer (listed below) directly, or circle 120 on the Free Information Card. ■

### FOR MORE INFORMATION

Thomson Consumer Electronics  
600 N. Sherman Dr.  
Indianapolis, IN 46201



# DX LISTENING

## Radio Top of the World

BY DON JENSEN

Among the shortwave-broadcasting countries of Europe, Norway doesn't rank among the biggies. Its national SW voice, *Radio Norway International*, which unofficially calls itself "Radio Top of the World," can't compare with such broadcasters as the British Broadcasting Corporation, Germany's *Deutsche Welle*, *Radio France International*, or even *Radio Nederland*. For one thing, *Radio Norway International* only spends the equivalent of \$1 million a year—small change compared to its big-time neighbors, giving the Nordic nation quite a bang for the . . . er . . . *kroner*, the Norwegian monetary unit.

Even so, shortwave broadcasting in Norway has a long history, although not as long as some other European countries. SW programming began in the late 1930s, from a 5-kilowatt transmitter (modest power even for those early years) at Lambertseter, near the capital, Oslo.

World War II, and the Nazi occupation of Norway, ended those transmissions, although the Norwegian government-in-exile continued to broadcast back to the homeland from BBC transmitters in England and from an American SW outlet, WRUL in Massachusetts.

When the war ended, the Norwegian government built a new and more powerful shortwave transmitter at Fredrikstad in the southeastern part of the country. Its primary purpose then, and still a significant one today, was to reach Norwegian merchant sailors and fishermen in the North Atlantic. Norway always has been a major maritime nation.

Radio Norway's programs, mostly in the Norwegian language, also were, and are, aimed at ex-countrymen, especially those living in North America. A weekly program in English, the only other language used by the station, was soon added.

major European broadcasters, *Radio Norway International* has invested in the high-powered transmitters so necessary to provide solid signals around the globe. Today, it operates a 350-kilowatt transmitter at Fredrikstad. Environmental concerns, however, barred installing newer and even more powerful transmitters there. Instead, a pair of 500-kilowatt transmitters are located at Kvitsoy, and a single 500-kilowatt station is at Sveio.



*Norway's national shortwave broadcaster, Radio Norway International, unofficially calls itself "Radio Top of the World."*

*Radio Norway International*, part of *Norsk Rikskringkasting (NRK)*, the national public-radio and -TV network, itself has only 16 employees. They work from offices and studios in the NRK's Broadcasting House in Oslo. The same small staff also is responsible for the weekly half-hour English program aired Sundays.

RNI's programs are relayed to the main shortwave broadcasting facility at Kvitsoy, and from there, as required, to the Fredrikstad and Sveio transmitter sites.

News broadcasts, especially for Norwegian-speaking listeners abroad,

are an important element in *Radio Norway International's* mission. In the course of a week's programming, those include newscasts that focus heavily on events occurring in the various regions of Norway.

RNI's newsroom is manned from before 6 a.m. local time until well after midnight. But newscasts are aired around the clock. The station's control room and studio are fully automated.

RNI's Sverre Fredheim tells *DX Listening* readers that the station hopes to receive listeners' letters. Accurate reception reports are QSLed with verification cards if sent directly to the station (*Radio Norway International*, N-0340 Oslo 3, Norway) and not to a Norwegian embassy or consulate elsewhere in the world. Recordings of actual off-the-air reception are welcomed, and cassettes will be returned. No return postage is required, and a program schedule is free for the asking, Fredheim says.

*Radio Norway International* beams programming to North America at 0300 UTC on 6,030 kHz, and at 2200 UTC on 6,195 kHz. The half-hour English program, *Norway Now*, featuring news, commentary, and features, is heard only during the Sunday transmissions (Remember, though, that because of the time differences from UTC, the 0300 UTC Sunday transmission is actually heard Saturday night in North America).

The station spokesman reminds SWLs that a good shortwave radio, an antenna, and a measure of patience are necessary prerequisites for shortwave listening. "Since *Radio Norway International* broadcasts in English only once a week, contact with listeners is particularly important. We need to know you are with us!"

### NORDIC NEIGHBOR

Once, quite a few years ago, Norway's neighbor to the south, Denmark, was itself, something of a



major shortwave player. That was back when *Radio Denmark's* 50-kilowatt transmitter could match the SW signals from any European country.

Little Denmark, though, failed to keep up when other international SW broadcasters upped the ante, first to 100-, then to 200-, and, finally, to as much as 500-kilowatt transmitting units. Several years ago, Denmark opted for a different path for its international radio service. It leased airtime for Radio Denmark programs from Radio Norway International.

Once Radio Denmark broadcast widely listened-to English programming. But as its signal gradually was swamped by more powerful international stations, it abandoned those popular English-language programs.

But here's some good news. We have word that Radio Denmark was to resume English programming, albeit on a very limited scale, at the beginning of the year. The programs are supposed to focus on Copenhagen as 1996's "European City of Culture."

The shortwave annual, *Passport To World Band Radio*, reports that if there is sufficient listener response to those 15-minute programs aired, for now, only on the first Sunday of the month, Radio Denmark will consider expanding the English schedule.

Try the Radio Denmark relay on Radio Norway International's lower SW frequencies at 0230 and 0530 UTC. Again, remember that those Sunday UTC times equate to Saturday-night listening; in the United States and Canada, UTC is five hours ahead of EST (EST+5), CST+6, MST+7, and PST+8.

Reports should go to Radio Denmark, Rosenorns Alle 22, DK-1999 Frederiksberg C, Denmark. Correct reports will be verified by mail if an International Reply Coupon (available at your post office) or \$1 bill is enclosed for return postage.

## DOWN THE DIAL

Looking for tuning targets? Try these. What are you hearing on short-

Credits: Don Brewer, KS; Richard Hankinson, KS; Jack Jones, MS; Marie Lamb, NY; Ed Rausch, NJ; George Uhler, CA; North American SW Association, 45 Wildflower Road, Levittown, PA 19057

wave these days? Send me your logging tips for this segment of our monthly column. The address is "DX Listening," **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735.

**ARGENTINA**—6,060 kHz. *Radio Nacional* in Buenos Aires can be heard at 0930 UTC in Spanish with local and world news broadcasts.

**BELGIUM**—13,670 kHz. *Radio Vlaanderen International* was logged on this frequency around 1300 UTC with English news, including announcements of new routes for the Belgian airline, SABENA.

**CANADA**—6,030 kHz. *CFVP* in Calgary, Alberta, is a rarely heard, low-power relay of medium-wave outlet, *CKMX*. Listeners in western Canada and the U.S. might be lucky enough to hear this one around 1300 UTC.

**ISRAEL**—9,435 kHz. *Kol Israel* has English here at 0400 UTC, including world news and a feature program called *Shalom from Jerusalem*.

**LITHUANIA**—9,710 kHz. *Radio Vilnius* was noted signing on at 2130 UTC for a half-hour program in English, announcing that the station intended to shift frequencies to 7,360 kHz. Nice Lithuanian folk music is heard on this one.

**NORTHERN MARIANAS**—9,430 kHz. *KHBI* on the island of Saipan airs some English-language religious programming at 1000 UTC.

**SWEDEN**—9,850 kHz. *Radio Sweden* has English feature programming at 0240 UTC, followed by a newscast.

**THAILAND**—11,850 kHz. *Radio Thailand* is heard with Mandarin Chinese programming, but an English ID and tuning at 1315 UTC. ■



## SHAFT ENCODER

(Continued from page 62)

put and the "carry" output (pin 12) to the following "clock-up" input.

Counters other than the 40192 can also be used. Even single-clocked counters can be used if a latch is used to detect the count direction and the up clock and down clock lines are or'd together to produce a single clock line. Figure 4 shows how that can be done. If you choose to use the 4029 as shown, it can generate either a straight binary number or a BCD decimal number depending on the voltage applied to pin 9. When pin 9 is tied low it generates a BCD number; when pin 9 is tied high it generates a four-bit binary number. In the circuit shown, the chip is set to produce a BCD output.

**Other Considerations.** The mechanics of building the encoder are not critical beyond the mounting of the photosensors. Vinyl sheets are a good choice for the disc material as they can be cut with scissors and are sufficiently rigid for 2-inch diameter discs. The author has used 0.032-inch thick material with good results.

The disc need not be absolutely flat and it can even flex during rotation without seriously affecting operation. About the only thing you have to be concerned about is that if the painted side of the disc rubs against the sensor, the paint will eventually rub off. The author guards against that by gluing a thin piece of clear vinyl over the painted side. The 0.1-inch gap in the photosensors is wide enough to accommodate that set up.

The power supply for the encoder need not be exotic. Anything from 3 to 18 volts will do; just make sure to use appropriate current-limiting resistors for the LEDs in the photosensors. Assuming a 1.3-volt forward drop across the LED (at 25°C), and a current of 20 mA, the value of the limiting resistor is:

$$R = (+V - 1.3)/0.02$$

With a 5-volt supply, R should be 180 ohms, while a 12-volt supply requires an R of 510 ohms.

That's all there is to it. The circuits we've presented here can be used as is, or as a starting point for your own designs. ■

# HAM RADIO

By Joseph J. Carr, K4IPV

## Television and Radio Interference



These two examples of TVI are both caused by a powerful local-signal source such as a ham transmitter, or a broadcast station.

**T**elevision interference (TVI) and radio-broadcast interference (BCI) are among the biggest causes of aggravation for ham-radio operators (or any other operator of radio transmitters). Unfortunately, TVI/BCI is also a fact of life. And like most facts of life, one either deals with it or suffers the consequences. In this month's column we will take a look at TVI/BCI, and what to do about it.

### THE PROBLEM

Any electronic product, whether it's a TV, stereo, radio receiver, or microwave oven, must do two things if it is to work as intended: It must respond correctly to the signals or other stimuli it's intended to respond to, and it must *not* respond to other signals. Unfortunately, most consumer products do poorly in that arena. To be more specific, a profound lack of shielding and filtering in common electronic products means that they often *will* respond to unwanted signals . . . and all-too-often that unwanted signal will emanate from a ham transmitter such as yours!

Although the entire field of electromagnetic interference (EMI) is broader than we can cover here, the basics of television in-

terference and some broadcast interference are easy to deal with. Let's see how that's done.

### FIXING THE TV SET

There are only a few things that can be done to a television receiver, but at least one is real simple. Figure 1 shows the use of a high-pass filter at the antenna input of a TV receiver. Commercial filters can be bought at TV/electronics-parts distributors and ham-radio distributors. Both balanced (300-ohm) and unbalanced (75-ohm) versions are available.

While that is a simple solution, it does not always work. For best results, the filter should be connected directly to the antenna terminals on the back of the TV receiver. Unfortunately, the length of transmission line from the terminals on the TV cabinet and the input of the tuner acts like an antenna and could render the filter useless. The problem is signal being picked up on that piece of antenna lead after the filtering takes place. If the filter fails, then it must be installed inside the TV set as close as possible to the tuner input terminals.

Here's one real-good piece of advice: Don't you do any modifications at all to your neighbor's TV set! Let a professional television-repair technician do the job. The reason is that if you do it yourself, you assume some

liability for the action. Your neighbor will assume that any reception defect thereafter, or any repair that's needed for the next year or two, is your fault. The assumption will be that you either did something wrong, or something is wrong with that darn filter. Be wary, and let a professional do it.

You might wish to pay for the modification to your neighbor's set, if you're a "good guy," but that's not a good idea because all your neighbors will want the same treatment. Besides, the defective design of your neighbor's TV is not your responsibility.

### FIXING THE TRANSMITTER

It might not be your responsibility if your neighbor's set responds inappropriately to large local signals, but it *is* your responsibility to make sure that your signal is clean. A high-frequency (HF) transmitter might have harmonics, *i.e.* spurious signals, that are integer multiples of the main operating frequency ( $2f$ ,  $3f$ , etc.).

One way to make sure your transmitter's output is clean is to connect your HF equipment as shown in Fig. 2. In that figure, the antenna output of the transmitter is connected first to a low-pass filter with a cut-off frequency between 30 and 40 MHz. The TV bands start at 54 MHz in the U.S. and Canada, so a 30- to 40-

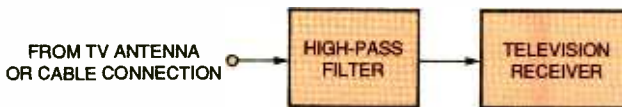


Fig. 1. Here's how a high-pass filter is installed on a TV receiver



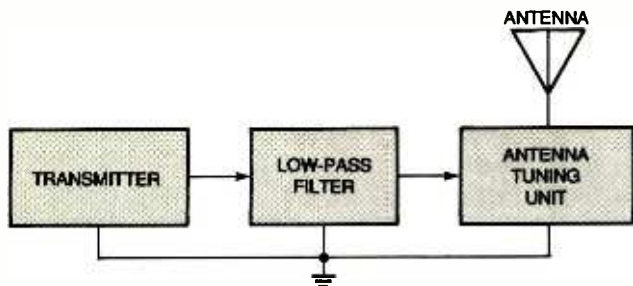


Fig. 2. To help ensure that your transmissions are clean, use this set up.

MHz cut-off on a low-pass filter will give good attenuation of the second harmonic of a ten-meter-band ham signal. The attenuation is even better for lower HF-band signals. Good low-pass filters are readily available through ham-radio distributors.

Be sure to look at the power rating when buying a filter. I've seen 150-, 300-, and 2000-watt models available. If you think you might ever run a linear amplifier, then go ahead and buy the higher-power unit. You can always use a filter rated for a higher power than the transmitter, but if you attempt to run a high power rig into a low-power filter it will become toast in a real-short period of time.

Another way to suppress harmonic energy is to use a proper antenna tuning unit (ATU). By "proper" I mean one that isn't a high-pass filter! A lot of the coax-to-coax ATUs on the market are basically high-pass filters. One common design, shown in Fig. 3, uses a pair of variable capacitors in series with the signal path, separated by a roller or switched inductor across the signal path. Those filters do nothing to eliminate harmonics, even though they will tune-out the effects of VSWR for your transmitter's benefit. A superior tuner will use a circuit similar to the SPC Transmatch shown in Fig. 4.

It's also a good idea to ensure that the rig, filter,

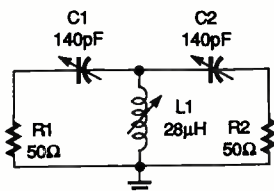


Fig. 3. This basic type of antenna-tuning unit (a line flattener) will correct VSWR problems but do nothing to minimize harmonics.

and ATU are all properly grounded. A good low-resistance path to ground will make all of those components work properly. Failure to provide a good ground will result in poorer performance of the transmitter, might produce little "RF nips" due to RF in the shack (i.e. on the equipment cabinets), and raise the specter of TVI.

### BROADCAST INTERFERENCE

Interference to AM-broadcast receivers is more difficult to snuff out because it requires internal modifications of the receiver. Because of that, the steps are beyond the scope of this column (indeed, the manufacturer

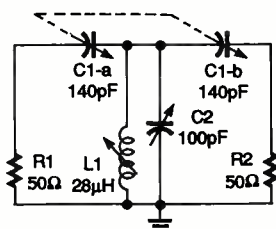


Fig. 4. This improved "SPC" Transmatch will take care of VSWR and help minimize harmonics.

might have to be consulted).

FM-band BCI is another matter, however. The FM receiver might respond to exactly the same kind of filtering as a TV receiver. Indeed, the FM band (88 to 108 MHz) falls between the low-VHF and high-VHF TV channels. If your HF rig is interfering with an FM receiver, then tell the owner to try using a TV-style high-pass filter at the antenna input terminals. If your VHF rig (2-meters and up) is causing the interference, then a low-pass filter centered on some frequency between 108 and 144 MHz is needed.

### ANTENNA POINTING

TV- and FM-band interference can sometimes be minimized by simply turning the receiver's antenna away from the signal

source. Some years ago, when I was troubleshooting TVI on a volunteer basis (a local TVI committee), I found a situation where a complainant's FM yagi antenna was aimed directly at the ham's HF antenna. The short distance between them caused a huge overload situation. When we reoriented the antenna, the BCI disappeared. The pattern of the typical FM/TV antenna is not very narrow, so it can be oriented a little off-axis and still work well.

TVI/BCI can be a perplexing and maddening problem to both the ham and his neighbors. If someone complains, remember your manners in dealing with it.

Until we meet again, I can be reached via snail mail at P.O. Box 1099, Falls Church, VA, 22041, and by e-mail at carrj@aol.com. ■

### THINK TANK

(Continued from page 68)

change over the full bias-current range. This circuit (see Fig. 4) is an attempt to reduce those problems.

As you can see on the schematic diagram, the circuit is quite simple and is biased exactly like a Zener diode. The bias current range is 1 to 20 mA, which can be extended by using a higher-power transistor for Q2. The bonus feature is that this circuit has an adjustable "Zener" voltage of from 1.5 to 6.5 volts. That voltage ( $V_z$ ) can be determined using:

$$V_z = 1.5 + (5R2/10^4)$$

For any setting of R2, the voltage varies less than 1% over the 2- to 20-mA bias current.

The base-emitter voltage of Q1 provides the reference voltage that is

temperature-compensated by D1, a 1N34A germanium diode. A stable voltage of about 375 mV is then present across R1, and a constant current of 0.5 mA flows through the resistor divider. The net temperature coefficient is complex, but remains below  $-2\text{mV}/^\circ\text{C}$ , due to the interaction of the diode and transistors. Darlington-pair Q2 handles all the bias current except for the  $600\ \mu\text{A}$  needed to bias the reference. All parts are available from Electronic Goldmine (P.O. Box 5408, Scottsdale, AZ 85261). —Skip Campisi, S. Bound Brook, NJ

Wow, you put a lot of thought into this relatively simple circuit. As Skip pointed out in his original schematic, the resistors need only be 1/8-watt units.

We're completely out of room for this month. I'll see you all again next time. ■

# SCANNER SCENE

By Marc Saxon

## Scanning the Weather Bands



*Radio Shack's PRO-2042 is designed with the serious scanning enthusiast in mind. Its 1000 memory channels are stored in 10 banks of 100 channels each; an additional 100 memory channels are available for temporarily storing active channels found during searches.*

**A**t first casual glance, the beautiful desktop scanner shown in the photo on this page looks vaguely familiar. And rightly so. Radio Shack's PRO-2042 has replaced the popular PRO-2035, to which it bears a definite family resemblance.

The PRO-2042 is a big, hairy-chested, in-your-face, 1000-channel scanner for the serious enthusiast. The frequency coverage is 25 to 520 MHz, and 760 to 1300 MHz, minus the cellular bands (which cannot be restored, via FCC edict). The

frequencies are set up in 10 banks of 100 memory channels each. Then there are an extra 100 monitor memories for the temporary storage of active channels discovered during searches.

Reception is provided in NFM/WFM/AM modes, with scanning and search at up

to 50 channels per second. The PRO-2042 can scan or search upward or downward. There are 10 different search banks that can be preset and checked out individually or in any combination. You can also enter any frequency manually, then search automatically up or down around it, or tune by hand using the rotary knob.

An interesting addition to the PRO-2042 is the improved lock-out feature, which allows it to skip over specified unwanted channels during searches, as well as locking them out during scanning of programmed memory channels.

Another advanced feature permits you to sort and organize frequencies within a memory bank from the highest to the lowest numbered channel, or vice versa. The auto store feature finds and stores active frequencies in each channel, then looks for additional active frequencies while ignoring previously stored channels.

When any frequency is being monitored, the rotary tuner can be activated to allow adjacent frequencies to be checked for additional activity.

Quite a lot of scanner, we'd say! Check it out at your local Radio Shack store.

### WEATHER TO LISTEN

The usefulness of the VHF weather broadcasts has been heralded by weather forecasters and citizens

alike. For the most part, scanner hobbyists have taken those one-way repeating-tape broadcasts for granted. No doubt about it—they don't offer the interest or excitement of the two-way action communications bands.

But let me speak for a moment, as a scanner hobbyist, on behalf of those stations. There is something to be said for giving them a listen now and again, even when you aren't interested in knowing the weather. Now that many modern scanners have instant one-button access to this band, it's no bother to zero in on them.

Realize that virtually all populated areas of North America can regularly receive local forecasts on at least one of those frequencies. That represents a continuous signal source of a known strength that can be monitored at any time. It's a perfect signal to use for comparison-checking different scanners or antennas. Or you can use the signal to check out possible damage to your antenna system after a storm. If the signal has decayed, then your antenna system has a problem that might not otherwise be readily noticed while scanning two-way communications.

Next, sometimes temperature inversions and other short-term conditions exist that produce unusual reception on those frequencies. For brief periods of time, stations from considerable distances



have been known to blast through at such strengths that they knock out the local service on the same frequency. Keep in mind that not all weather stations are high powered. Many run less than 100 watts. Some do no more than simulcast larger stations in nearby areas.

For the full scope of weather broadcast channels, tune in to 162.40, 162.425, 162.44, 162.45, 162.475, 162.50, 162.525, and 162.55 MHz. In Canada, try 161.44 and 161.775 MHz. Don't write those stations off.

### FROM READERS

Neil Oosten, of Hornby, Ontario, Canada, suggests that Toronto scanner owners punch up 150.67 and 151.79 MHz on their scanners. Those are the CHFI-AM/FM traffic helicopter frequencies, and offer excellent monitoring

fare. They are also used by CHYM-FM in Kitchener, Ontario. Toronto's CHUM-AM/FM runs its traffic helicopter operations on 153.35 MHz, while CFRB does the same on 162.33 MHz.

Neil asks if we can come up with the frequencies used by his favorite IndyCar drivers. No problem—so be sure to take your scanner along next time. Scott Goodyear uses 463.7375 and 468.7375 MHz. Jacques Villeneuve is on 466.5375 MHz. Bobby Rahal holds down 463.8875, 466.3125, 468.2625, and 469.2625 MHz. Paul Tracy takes the high road on UHF with 851.0375, 852.1875, 855.7875, 856.7875, 857.8375, 858.8375, and 859.8375 MHz.

As mentioned here in the November issue, scanners manufactured after April 1994 cannot be user-modified to receive the cellular bands. If you want com-

plete 800–900-MHz coverage, you can get around that regulation by building the *Scanner Converter* described in the November 1995 issue of **Popular Electronics** or by obtaining *GRE SuperConverters*. The SuperConverters are outboard down-converter accessories that bring all 800- to 900-MHz signals through on a scanner's 400- to 500-MHz band. The problem is that the SuperConverters are no longer made either, so the precious supply is quickly drying up.

To the rescue comes The Cellular Security Group. The company has developed a procedure that takes a person's scanner and adds an external switch or internal relay with related wiring along with existing components. That creates a switchable, internal, down-converter that allows full reception of the entire 800-

to 900-MHz band.

Currently, the "Virtual 800-MHz Down Converter" procedure can be performed on the following "unrestorable" newer scanners: Radio Shack PRO-23, PRO-29, PRO-51, and PRO-2035; and Bearcat BC-220, BC-860, BC-3000, BC-8500, and BC-9000. Additional scanners are expected to join the list soon. The down-converter installation costs \$99, including return shipping.

The Cellular Security Group has been flooded with requests, so you'll need to call in advance for a reservation number. For more information, call them at 508-281-8892, or you can hail them on the Internet at [tombornie@msn.com](mailto:tombornie@msn.com) if you prefer e-mail.

Let us hear from you. Write to us at *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

### COMPUTER BITS

(Continued from page 6)

sponding switch settings and drive-letter specifications for booting various operating systems.

One concern I had in building the SCSI Switch was whether running the ID lines through the RF-noisy environment of the computer would cause trouble. I've experienced none, but caution is advised. Another concern is that the 2-mm pins are very short, so the connection is not rock-stable. As long as the PC remains stationary, problems are unlikely, but jostling the computer could dislodge a jumper.

Using the device is simple; just set the DIP switch to the desired operating-system configuration and reboot. Apparently the jum-

SWrCh Position	Header Block	Hard Disk	ID pin
1	J1	H1	0
2	J2	H1	1
3	J3	H1	2
4	J4	H2	0
5	J5	H2	1
6	J6	H2	2
7	J7	H3	0
8	J8	H3	1

Configuration	Switch Positions								Drive		
	H1			H2			H3		H1	H2	H3
	1	2	3	4	5	6	7	8			
Windows 3.1	0	0	0	0	1	0	1	0	C	E	D
Windows 95	1	0	0	0	1	0	0	0	D	E	C
OS/2 Warp	1	0	0	0	0	0	0	1	D	C	E

pers are read only at boot, so you can safely change IDs without removing power.

In case you're wondering why I bother using SCSI when IDE drives are cheap-

er, there are several reasons. SCSI is much more flexible than IDE in its ability to handle different kinds of devices. SCSI is more mature than IDE, and standards

are better evolved, so conflicts are fewer. SCSI provides better performance than IDE in a multitasking environment. There is better operating-system support for SCSI.

IDE's chief advantages are cost and simplicity of setup and configuration. But to me, those points are moot, because once you learn the simple rules of SCSI configuration, it's easy. Also, I've got seven-year-old SCSI drives still in service that work with the latest and greatest cards, and I hear nothing but woe from IDE users about backward compatibility.

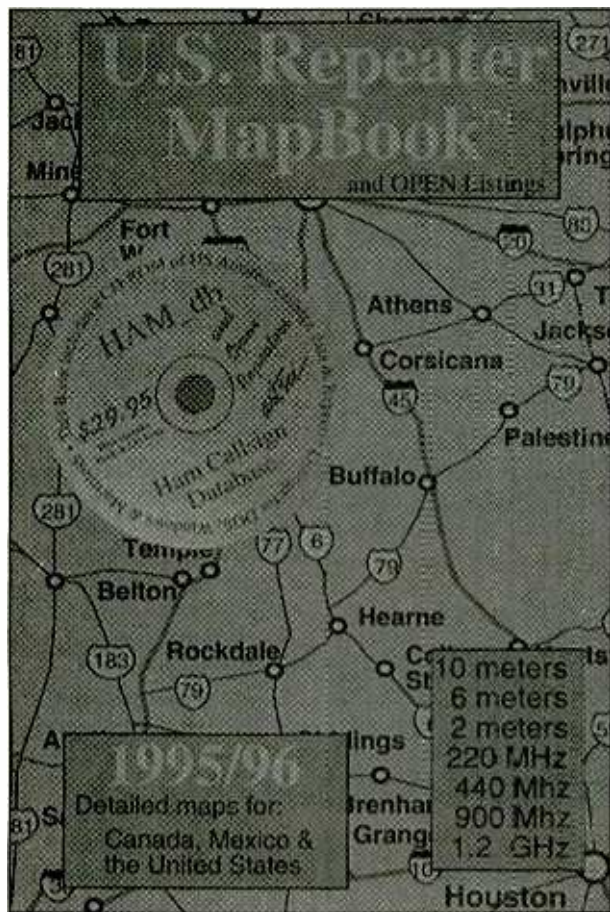
In conclusion, the PC architecture has its faults (such as the way it wastes disk-sector storage space), but its openness and flexibility allow creativity in finding solutions to unusual problems. ■

# ELECTRONICS LIBRARY

## U.S. Repeater MapBook

by Bill Smith, N6MQS & John Mitchell

This book-and-CD-ROM package contains a wealth of information for the modern amateur radio operator. PerCon Incorporated's CD-ROM, which will operate on DOS, Windows, and Macintosh systems, contains the complete FCC Amateur Radio Callsign database, enhanced with additional information not available from any other source. The book shows open repeaters across the United States, Canada, and Mexico. The set forms a comprehensive reference for hams at home or on the road.



The book contains detailed maps of all 50 states and the Canadian provinces; one map serves all of Mexico. New to this

fifth edition are state-by-state frequency lists, which appear on the pages facing the maps. The frequency lists are organized alphabetically by city for ease of use.

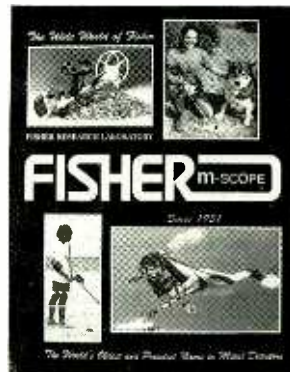
*The U.S. Repeater MapBook with CD-ROM costs \$29.95 and is published by Artsci, P.O. Box 1428, Burbank, CA 91507; Tel. 818-843-4080; Fax: 818-846-2298; Internet: <http://www.earthlink.net/~artsci>.*

**CIRCLE 80 ON FREE INFORMATION CARD**

## METAL-DETECTOR CATALOG

from Fisher Research Laboratory

Fisher's latest catalog features metal detectors for treasure hunting, underwater searching, gold prospecting, relic hunting, and competition treasure hunting. The 15-page, full-color brochure describes 12 different metal detectors that are available from the company in detail. A full-page "Fisher Details" chart compares the important features of each detector, from optional search coils to push-



button pin-point controls.

Four new models are highlighted in the catalog. The Gold Bug-2 is a 71-kHz gold-hunting detector. The Impulse pulse-indication detector is designed for underwater metal detection.

The CZ-20 QuickSilver is an underwater version of Fisher's popular QuickSilver target-ID detector. The CZ-6a is hailed as the next-generation QuickSilver metal detector.

*The Metal-Detector Catalog is free upon request from Fisher Research Laboratory, Dept. PE, 200 West Wilmott Road, Los Banos, CA 93635; Tel. 800-M-SCOPE-1; Fax: 209-826-0416.*

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by Jim Sterne

Businesses are rushing to jump onto the World-Wide Web, but not all of them know what they're doing. An electronic presence is a valuable tool for conducting business, and the right marketing message can improve a business' chance for success. This book helps marketing professionals create an intelligent, attractive Web presence. It introduces executives to the Internet and the World-Wide Web, and helps them set realistic goals for online marketing. The book explains how to create user-friendly, interactive, interesting Web pages. It teaches how to get useful feedback and provide customer service. Internet security, international issues, and other thorny issues are discussed. Finally, the book examines the future of online marketing.

*World Wide Web Marketing costs \$24.95. The book is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-225-5945.*

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Keep track of all numbers dialed or entered from any phone on your line. Connects to your telephone wall jack. Decodes all 16 touch-tones 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. \$54.50



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This is our finest piece of detection equipment! The CSD-18 quickly locates electronic eavesdropping devices in telephones, homes, offices, vehicles, boats, or concealed on the body. It will actually pick up many eavesdropping transmitters at ranges up to 25 ft! Extreme sensitivity is obtained via ultra-efficient amplification circuitry directly following the RF detection stages. Excellent quality dynamic headphones exclude all external sounds to further enhance detector output.



FULL RANGE DYNAMIC HEADPHONES

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

#### "FLASHING" LED Warns You Instantly!



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

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

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



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

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

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

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

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

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##### 100% POSITIVE INDICATION

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##### EXCLUSIVE "LISTEN-IN" FEATURE!

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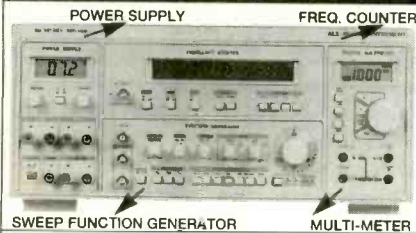
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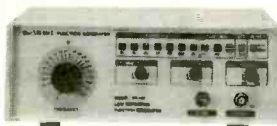


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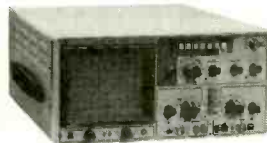


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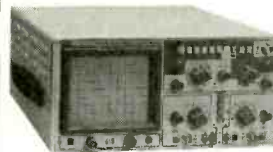
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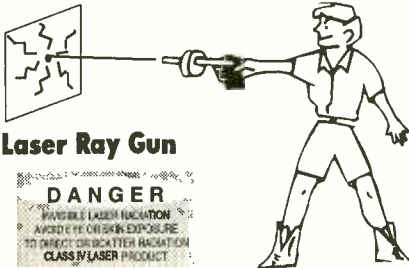
# AMAZING Electronic and Scientific Products

## Mystery Levitating Device!



Remember War of the Worlds? Objects float in air and move to the touch. Defies gravity, amazing gift, conversation piece, magic trick or great science project.

ANT1K Easy to Assemble Kit / Plans ..... \$19.50



## Laser Ray Gun

**DANGER**

WARNING: LASER IRRADIATION  
AVOID EYE CONTACT. EXPOSURE  
TO DIRECT BEAM AFTER RADIATION  
CLASS IV LASER PRODUCT.

Advanced project produces a burst of light energy capable of burning holes in most materials. Hand-held device uses rechargeable batteries. 500 joules of flash energy excite either a neodymium glass, yag or other suitable 3" laser rod. This is a dangerous CLASS IV project (individual parts/assemblies available). LAGUN1 Plans ..... \$20.00  
LAGUN1K Kit / Plans ..... Price on Request

## Extended Play Telephone Recording System



## Telephone Recording System

READY TO USE! Automatically controls and records on our X-4 extended play recorder, taping both sides of a telephone conversation. Intended for order entry verification. Check your local laws as some states may require an alerting beeper. TAP20X Ready to Use System ..... \$129.50



## Shocker Force Field / Vehicle Electrifier

Neat little device allows you to make hand and shock balls, shock wands and electrify objects, charge capacitors. Great payback for those wise guys who have wronged you! SHK1K Easy to Assemble Electronic Kit ..... \$29.50



## Electric Charge Gun

All New Technology!

Stuns/immobilizes attackers up to 15 feet away!  
\*Legal in most state (not in NY, NJ, MA, WI) • More knock-down power than most handguns • No permanent injury • ID coded • Free 80KV stun gun with every purchase.  
ECG1 Data Packet, Creditable toward purchase ..... \$10.00  
ECG10 Charge Gun, Ready to Use, w/Free 80KV Gun \$249.50

## Homing / Tracking Transmitter

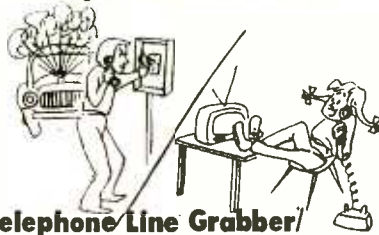
Beeper device, 3 mile range.  
HOD1 Plans ..... \$10.00 HOD1K Kit / Plans ..... \$49.50

## Listen Through Walls, Floors

Highly sensitive stethoscope mike.  
STETH1 Plans ..... \$8.00 STETH1K Kit/Plans ..... \$44.50



## Infinity Transmitter ++



## Telephone Line Grabber / Room Monitor / Controller

All New - The Ultimate in Home/Office Security & Safety!  
Simple to use! Call your home or office, push a secret tone on your telephone keypad to access: • On premises sounds and voices • Ongoing phone conversation w/break-in capability • Up to 10 external electrical functions, lights, TV, alarms, coffee pots, heater, etc. CAUTION! Check legality with your state's attorney general's office before use for monitoring of voices.  
TELECON1K Kit, includes PC board ..... \$149.50  
TELECON10 Ready to Use ..... \$199.50

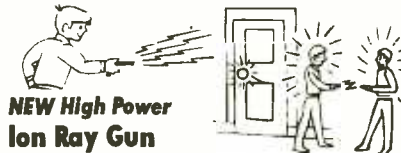
## Visible Beam Laser

Easy to build, RED Beam, visible for miles. Use for light shows, window bounce holography, cloud illumination and much more!  
LAS1KM Kit w/1mw Laser Tube, Class II ..... \$69.50  
LAS3KM Kit w/2.5mw Laser Tube, Class IIIA ..... \$99.50

## Life is Precious - PROTECT IT!



Hard hitting, crackling, sizzling HIGH VOLTAGE plasma! Stuns and immobilizes most attackers  
STUN200 Ready to Use, 200,000V ..... \$69.50  
STUN120 Smaller Unit, 120,000V ..... \$39.50



## NEW High Power Ion Ray Gun

Projects charged ions that induce shocks in people and objects without any connection! Great science project as well as a high tech party prank. IOG7 Plans ..... \$15.00  
IOG7K Kit/Plans ..... \$99.50

## Invisible Pain Field Generator



Shirt pocket size electronic device produces time variant complex shock waves of intense directional acoustic energy, capable of warding off aggressive animals, etc.  
IPG7 Plans ..... \$8.00 IPG7K Kit/Plans ..... \$49.50  
IPG70 Assembled ..... \$74.50

## 1000 Ft++ Potato Cannon

NOT A TOY. Uses electronic or piezo ignition. CAUTION REQUIRED!  
POT1 Plans ..... (Dangerous Product) ..... \$10.00

## FireBall Gun

Shoots flaming ball - two shot capacity  
Great for SPECIAL effects and remote fire starting. CAUTION REQUIRED!  
FIREBALL Plans (Dangerous Product) ..... \$10.00

## TV & FM Joker / Jammer



Shirt pocket device allows you to totally control and remotely disrupt TV or radio reception. Great gag to play on family or friends. Discretion required.  
EJK1KM Easy to Assemble Electronic Kit ..... \$24.50

## ATTENTION: High Voltage Fans!

4,000 volts in the palm of your hand! Experiment with anti-gravity, hovercraft, ion guns, force fields, plasma guns, shock devices, wireless energy and electrical pyrotechnics. Input: 9-14VDC.  
MINIMAX4 Ready to Use ..... \$19.50



## "Laser Bounce" Listener System

NEW - Latest Technology! Allows you to hear sounds from a premises without gaining access. Aim at room window and listen to sounds from within via reflected laser light. Not for illegal use. Requires video tripods.  
LWB3K 5mw Laser and Receiver Kit ..... \$149.50  
LWB30 Ready to Use ..... \$199.50

## 5mw Visible Red Pocket Laser

Utilizes our touch power control!  
VRL5KM Kit / Plans ..... \$74.50

## Electronic Hypnotism

Puts subjects under control using highly effective electronic stimuli. Intended for parties and entertainment but must be used with caution. Includes valuable text book reference and plans.  
EH2 Plans and Text Book ..... \$19.50

## Automotive

## NEON



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RG4K (Specify Color) ..... \$129.50  
Flash-To-Music Option for above kit FMU1 ..... \$29.50



License Frame Kit (Specify Color) LIC1K ..... \$24.50

## 3 Mi FM Wireless Microphone

Subminiature! Crystal clear, ultra sensitive pickup transmits voices and sounds to FM radio. Excellent for security, monitoring of children or invalids. Become the neighborhood disk jockey!  
FMV1 Plans ..... \$7.00 FMV1K Kit and Plans ..... \$39.50

## Telephone Transmitter - 3 Mi

Automatically transmits both sides of a telephone conversation to an FM radio. • Tunable Frequency • Undetectable on Phone • Easy to Build and Use • Up to 3 Mile Range • Only transmits during phone use. VVPM7 Plans ..... \$7.00  
VVPM7K Kit/Plans ..... \$39.50

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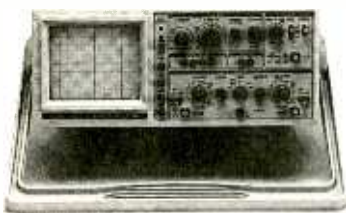
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Model	OS-3020	OS-3040	OS-3060
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Tektronix 465B	100 MHz	\$689.00
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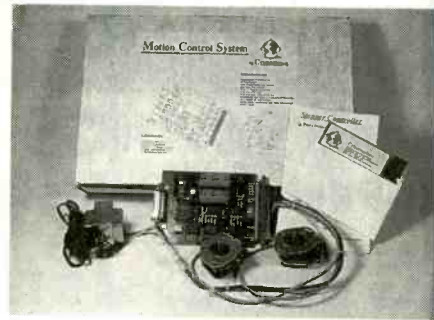
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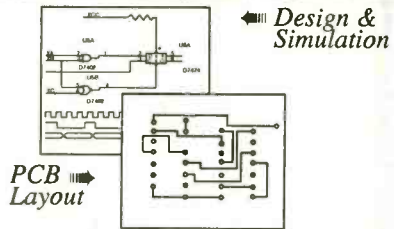
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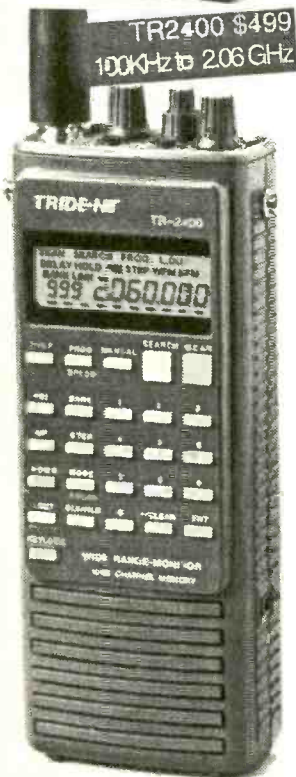
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  - Trigger Mode: Software trigger only
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  - Output Range: 0 to +5V or 0 to +10V
- **16 Digital Inputs**
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**ACL-711S \$199**

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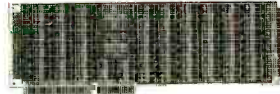
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		1	10	25	100	250
PM-128	3-1/2 Digit LCD Panel Meter	\$ 9.90	\$ 7.09	\$ 6.40	\$ 5.86	\$ 5.25
PM-129	3-1/2 Digit LED Panel Meter	11.49	9.54	8.67	7.95	6.95
PM-328	4-1/2 Digit LCD Panel Meter	19.88	16.40	14.90	13.66	11.93

This very easy to use tool is a "must have" if you need to straighten the pins on your IC's. Made from anti-static material, this tool is suitable for IC's from 8 to 20 pins (narrow side) and 24-48 pins (wide side). A grounding terminal is also built-in to the tool allowing for easy grounding when using this tool at a fixed location.



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ICS-01	\$7.18	\$6.44	\$4.89

**PC218902 (AT-BUS)**



- Board Length: 13-1/8" (333mm)
- Board Width: 4-5/16" (110mm)
- Double Sided, 3-Hole Solder Pads and Power Buses
- Space Reserved for: Header, 32x2, 0.1" Spacing and Pin Grid Array

CAT NO	PRICE EACH	
	1	5
PC218902	\$25.66	\$20.25

**PC218904 (AT-BUS)**



- Board Length: 13-1/8" (333mm)
- Board Width: 4-5/16" (110mm)
- Double Sided, Pad-Per-Hole and Power Buses
- Space Reserved for: 1 D-Type Connector, 25-pin

CAT NO	PRICE EACH	
	1	5
PC218904	\$25.42	\$20.06

**PC218903 (XT-BUS)**



- Board Length: 13-1/8" (333mm)
- Board Width: 4-5/16" (110mm)
- Double Sided, Pad-Per-Hole and Power Buses
- Space Reserved for 1 D-Type Connector, 25-Pin

CAT NO	PRICE EACH	
	1	5
PC218903	\$23.51	\$18.63

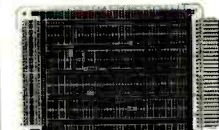
**PC232904 (Multi-BUS)**



- Board Length: 12" (305mm)
- Board Width: 6-3/4" (171mm)
- Double Sided, Pad-Per-Hole and Power Buses
- Space Reserved for 1 Header, 100x2, 0.1" Spacing

CAT NO	PRICE EACH	
	1	5
PC232904	\$38.40	\$29.80

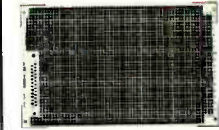
**PC207905 (STD-BUS)**



- Board Length: 6-1/2" (165mm)
- Board Width: 4-7/16" (113mm)
- Double Sided, 3-hole Solder Pads, Ground Plane and Power Bus
- Space Reserved for 1 Header, 34x3, 0.1" Spacing

CAT NO	PRICE EACH	
	1	5
PC207905	\$13.66	\$11.25

**PC412902 (VME-BUS)**

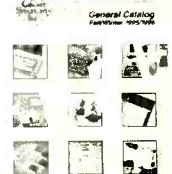


- Board Length: 6-5/16" (160mm)
- Board Width: 3-15/16" (100mm)
- Single Sided, Pad-Per-Hole and Power Buses
- Space Reserved for 1 D-Type Connector, 25-Pin

CAT NO	PRICE EACH	
	1	5
PC412902	\$7.06	\$6.00

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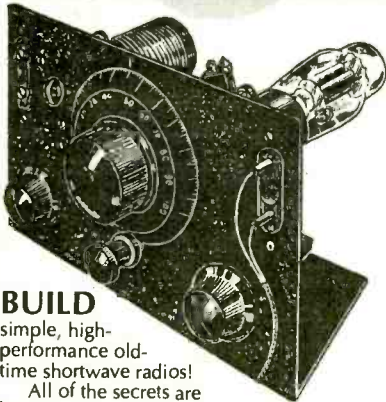
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This is a compilation of shortwave construction articles from "Short Wave Craft" magazines published in the 20's & 30's. It's wall-to-wall "how-to."

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Also included is a new chapter showing how you can use transistors to replace hard-to-find vacuum tubes. You'll even see the circuit that was lashed together on a table top one night using junk box parts, a hair curler and alligator clips. Attached to an antenna strung across the basement ceiling and a 9 volt battery, signals started **POPPING** in like crazy. In a couple of minutes an urgent message from a ship's captain off Seattle over 1500 miles away was heard asking for a navigator to help him through shallow water!

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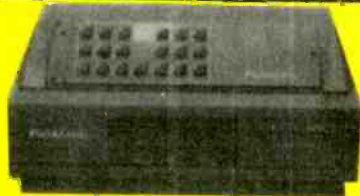
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## 4-MODE COUNTER

(Continued from page 58)

smoked Mylar, pasteboard, and black vinyl tape.

The three switches and the LED mount to the project enclosure. When the components are secured in their positions, attach leads to them and connect those wires to the correct points in the board. Check to see that all parts have been connected properly before applying power.

**Checkout and Use.** Apply power to the unit, and set S2 to FREQUENCY. The display should read 000000. If some of the segments are not lit up, go back and check your wiring again.

Connect the Counter to a signal source with a known frequency, using jack J1. The displayed number should match the frequency value. If it doesn't, then you have to make sure the connections on the board are all correct and solid (make sure there are no cold joints).

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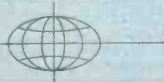
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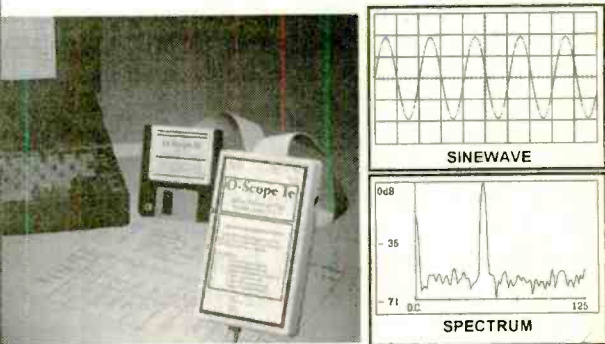
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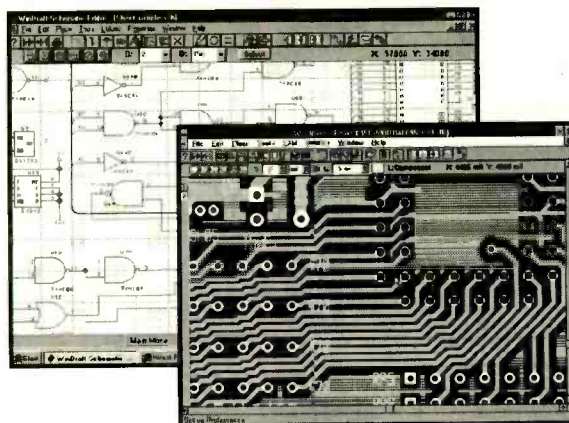
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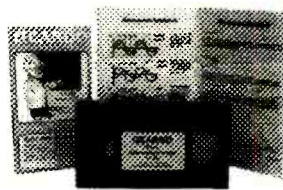
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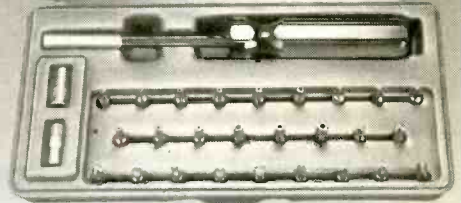
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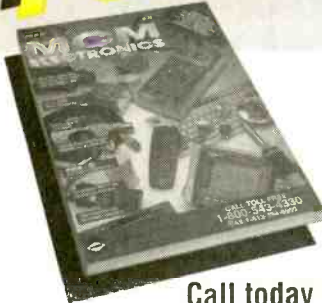
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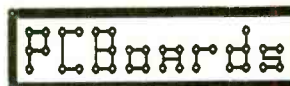
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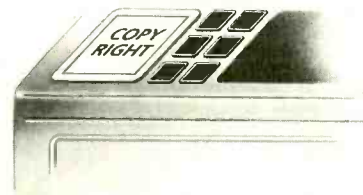
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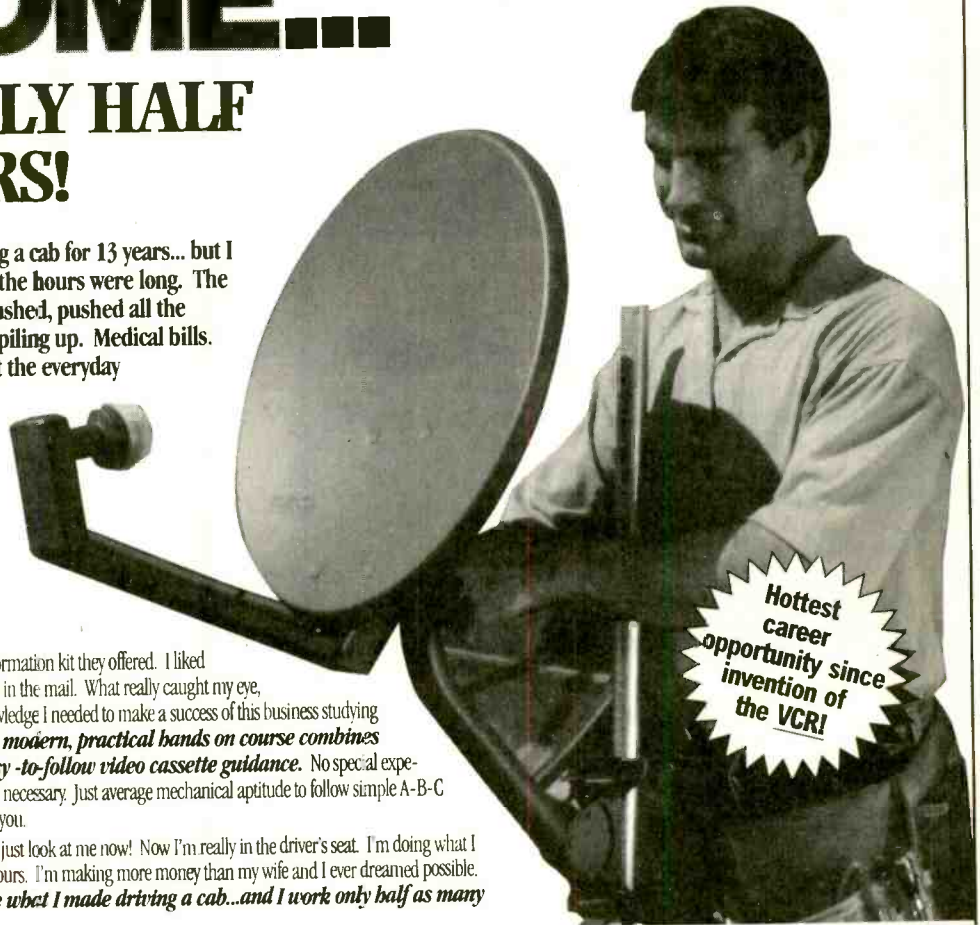
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### SMART STRIP

(Continued from page 60)

install the relay (check to see if the relay you use has a polarity-sensitive coil). To complete the on-board assembly, mount an IC socket for IC1 (checking its orientation as well) and insert the chip.

The next step is to install the Smart Strip circuit into a power strip. Just about any six-socket strip that can be disassembled will work with a few modifications. Whatever strip you use, however, make sure it is **unplugged** before you begin. To make room for the circuit board, one of the three duplex-style outlets should be removed (a duplex-style outlet has two AC sockets on it). It is best to remove the double outlet closest to the line cord to simplify wiring to the circuit board. The opening left by the removed outlet should be covered to prevent any shock hazard.

On the remaining duplex-style outlet that is closest to the location of the removed outlet, cut the metal links

that electrically connect the two AC sockets of the outlet (see Fig. 4). You can then make the off-board connections shown electrically in Fig. 3, and mechanically in Fig. 4; use 18-gauge, stranded, insulated wire for those connections.

Mount the circuit board inside the outlet strip near the line cord. You can use two screws and 1/4-inch nylon spacers to do that. Make absolutely sure that everything is wired correctly before closing up the strip. If any part of the circuit is not connected properly, or if it makes contact with the metal housing or the outlets, serious damage could result. When you're sure the wiring is okay, reassemble the outlet strip with the circuit board installed.

**Checkout and Use.** Once the circuit board is safely installed, the Smart Strip is ready for testing. To test the circuit, you will need two appliances such as lamps or other small, inexpensive AC-line-powered devices. (It's always a good idea to check AC-power-source projects with cheap

devices just in case you made a wiring error; you wouldn't want to damage a computer or TV as a result of a wiring mistake!)

Plug one device into one of the switched sockets and turn the device's power switch on. Connect the other device into the load-sense socket, but leave its power switch off. Next, plug the Smart Strip into an electrical outlet. If your strip has a power switch, it should be turned on as well. Now, turn on the device plugged into the sense socket and make sure the device plugged into the switched outlet also comes on. If that doesn't happen, unplug the strip and check your wiring to find the source of your problem.

The Smart Strip can be used with virtually any combination of electrical appliances as long as the sense device draws 5 amps or less, and the switched devices draw less than 10 amps combined. Keep those guidelines in mind, and you can use the Smart Strip in your home, workshop, or office to make running several appliances or pieces of equipment a lot easier.



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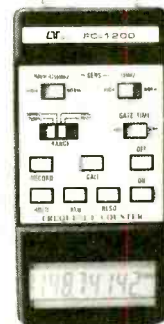


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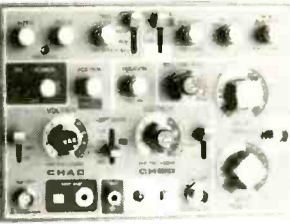
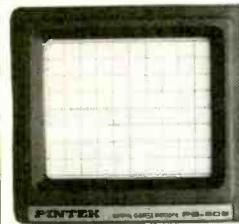
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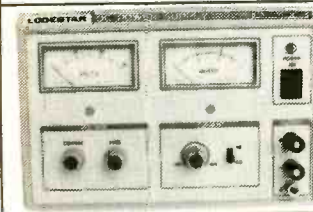
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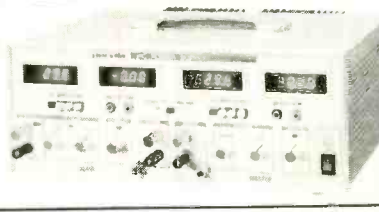
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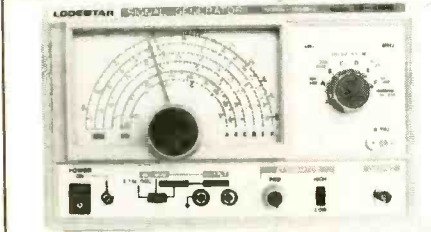
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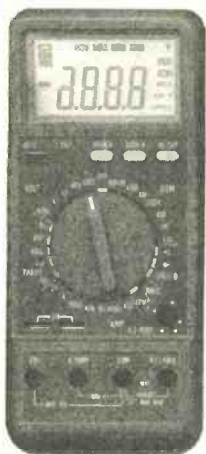
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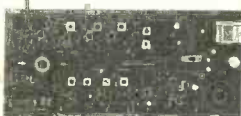


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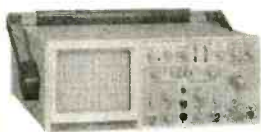
ANALOG		Sensitivity (max)	No. of Channels	Sweep Rate Max ns/div	Delayed Sweep	Video Sync	Component Tester	Beam Find	Time Base
Model	Bandwidth MHz								
S-1385	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1380	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1345	40	1mV/div	2	10ns/div	No	Yes	No	No	1
S-1340	40	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
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
DS-803	60	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232

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Dual Time Base • Delayed Sweep

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

**Model 2190A**  
**100MHz 3 Channel**  
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91 ..... **\$1225**  
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97A ..... **\$2945**  
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### HOW TO WRITE YOUR AD

**TYPE** or **PRINT** your classified ad copy **CLEARLY** (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but, in all cases, full payment must accompany your order.

### WHAT WE DO

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

### RATES

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

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

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Boldface (not available as all caps),** add .40 per word additional. **Entire ad in boldface,** add 20%. **Tint screen behind entire ad,** add 25%. **Tint screen plus all boldface ad,** add 45%. **Expanded type ad,** add \$2.25 per word.

**General Information:** A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

### DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. **POPULAR ELECTRONICS** is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. **NO REFUNDS,** advertising credit only. No phone orders.

### CONTENT

All classified advertising in **POPULAR ELECTRONICS** is limited to electronics items only. All ads are subject to the publishers approval. **WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.**

**AD RATES:** \$1.75 per word, Minimum \$26.25

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130 -- Audio-Video Lasers	300 -- Computer Hardware	480 -- Miscellaneous Electronics For Sale	660 -- Satellite Equipment
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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5 - \$26.25	6 - \$26.25	7 - \$26.25	8 - \$26.25	33 - \$57.75	34 - \$59.50	35 - \$61.25	36 - \$63.00
9 - \$26.25	10 - \$26.25	11 - \$26.25	12 - \$26.25	37 - \$64.75	38 - \$66.50	39 - \$68.25	40 - \$70.00
13 - \$26.25	14 - \$26.25	15 - \$26.25	16 - \$28.00	Total words _____ \$1.75 per word = \$ _____			
17 - \$29.75	18 - \$31.50	19 - \$33.25	20 - \$35.00	Bold Face _____ \$0.40 per word = \$ _____			
21 - \$36.75	22 - \$38.50	23 - \$40.25	24 - \$42.00	Special Heading _____ \$20.00 = \$ _____			
25 - \$43.75	26 - \$45.50	27 - \$47.25	28 - \$49.00	Other _____ = \$ _____			

Total classified ad payment \$ \_\_\_\_\_ enclosed

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Card # \_\_\_\_\_ Expiration Date \_\_\_\_/\_\_\_\_

Signature \_\_\_\_\_

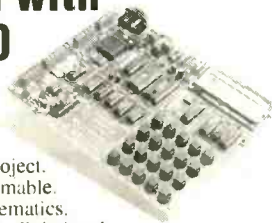
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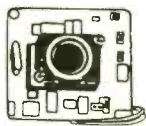
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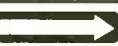
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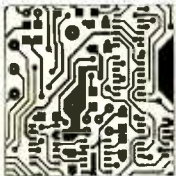
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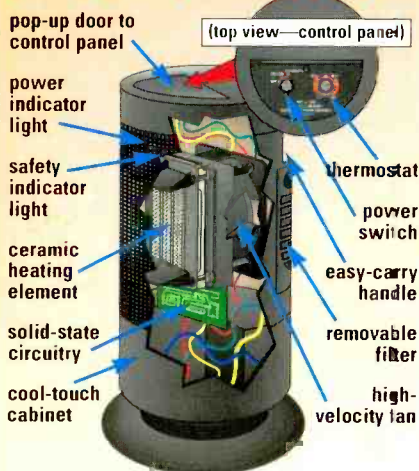
# The efficiency of ceramic warmth combines with oscillation to create the perfect heater...

*This compact heater uses a genuine ceramic heating element and an oscillating fan to eliminate cold spots and provide intense warmth throughout an entire room!*

by Irma J. Westburg

If you could build the perfect heater, what features would it have? A safe, yet effective, heating element? A thermostat that would let you select a desired comfort level? An effective way to disperse the heat throughout an entire room? Safety features like automatic tip-over and overheat protection?

## EXTENSIVE FEATURES



*The RST-1200 is the only heater that combines the intense warmth of a ceramic heating element with a solid-state thermostat and an oscillating fan. The result? An energy-efficient space heater that will consistently heat an entire room to your desired temperature.*



*The RST-1200 oscillates 70°, distributing warmth throughout an entire room.*

**The oscillating difference.** The RST-1200 is unlike ordinary space heaters because it oscillates

over a range of 70°, the RST-1200 spreads the warmth created by its genuine ceramic heating element evenly throughout your room, eliminating cold spots. And with its solid-state thermostat, you can set a specific temperature, and the RST-1200 will maintain it effectively and efficiently.

If you're like me, you're thinking "Sure, that sounds like the perfect heater, but there's nothing like that available." Guess again. Royal Sovereign recently unveiled a remarkable new heater that combines a ceramic heating element with a solid-state thermostat and an oscillating fan—its called the RST-1200 Oscillating heater.

**The ceramic advantage.** Many space heaters use a nickel coil which burns oxygen—a process which can produce odors and even cause headaches. Plus, the heaters often get hot to the touch, creating a possible fire hazard. And because they don't have a thermostat, you must constantly turn them on and off to stay comfortable.

The RST-1200, on the other hand, utilizes a genuine ceramic heating element. Ceramic elements are known to be a very efficient and effective heating method. Ceramic heaters do not burn air—therefore, they do not cause any odors or produce any unwanted side effects. Even more important is the fact that the RST-1200 does not get hot to the touch—that means it is not a fire hazard.

**Control your climate.** The RST-1200 has an electronic thermostat that lets you choose your own comfort level. Simply set the dial to the appropriate temperature, and the RST-1200 will automatically maintain that comfort level. It provides even, uniform heat—without irritating hot/cold cycles.

**Spread warmth throughout a room.** One of the best features about this amazing new heater is its oscillation—the RST-1200 oscillates over a range of 70°. A high-velocity fan disperses the intense warmth produced by the ceramic heating element, resulting in even distribution of the heat. The RST-1200 will eliminate cold spots, even in those rooms with poor ventilation!

**Safety features.** The RST-1200 may be the safest space heater you can buy. Its cool-touch cabinet prevents the RST-1200 from being a fire hazard, even when in close proximity to drapery, quilts and paper tissue! The RST-1200 also



has built-in, automatic overheat and tip-over protection. The unit will shut off if tipped over, airflow is blocked or anything is spilled on it. A red safety light indicates that the unit has shut itself off for some reason. The RST-1200 is so safe you can let it run 24 hours a day, worry-free!

### RST-1200 FEATURES:

- Genuine ceramic heating element
- 70° oscillation
- Solid-state electronic thermostat
- Automatic tip-over and overheat protector
- High-velocity fan
- Cool-touch cabinet
- Compact size
- Maximum 1500 watts, 5200 btu

**Designed to fit in any environment.** The RST-1200 is very compact, measuring a mere 13" tall and weighing just under two-and-a-half pounds! With a diameter of 8.3", you can put the RST-1200 virtually anywhere in your home! In addition, its sleek design makes it a welcome addition to any decor—most people won't even know it's a heater!

**Try it risk-free.** The RST-1200 Oscillating heater is backed by Comtrad's exclusive risk-free home trial. Try it, and if you are not completely satisfied, simply return it within 90 days for a full "No Questions Asked" refund. It also comes with a one-year manufacturer's limited warranty.

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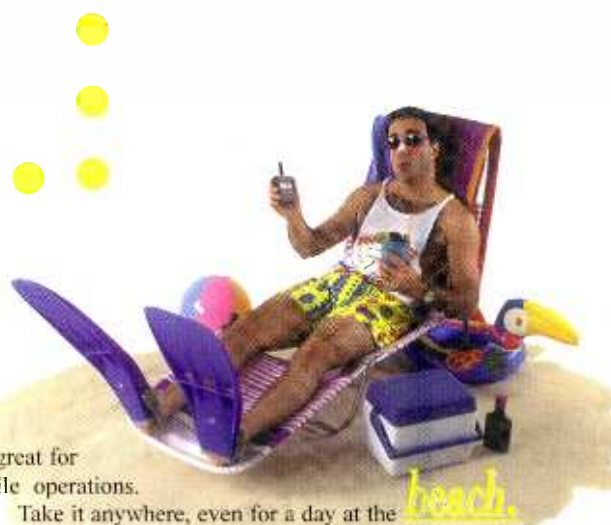
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