

A SURVIVAL GUIDE FOR PC OWNERS

February 1995

# Popular Electronics

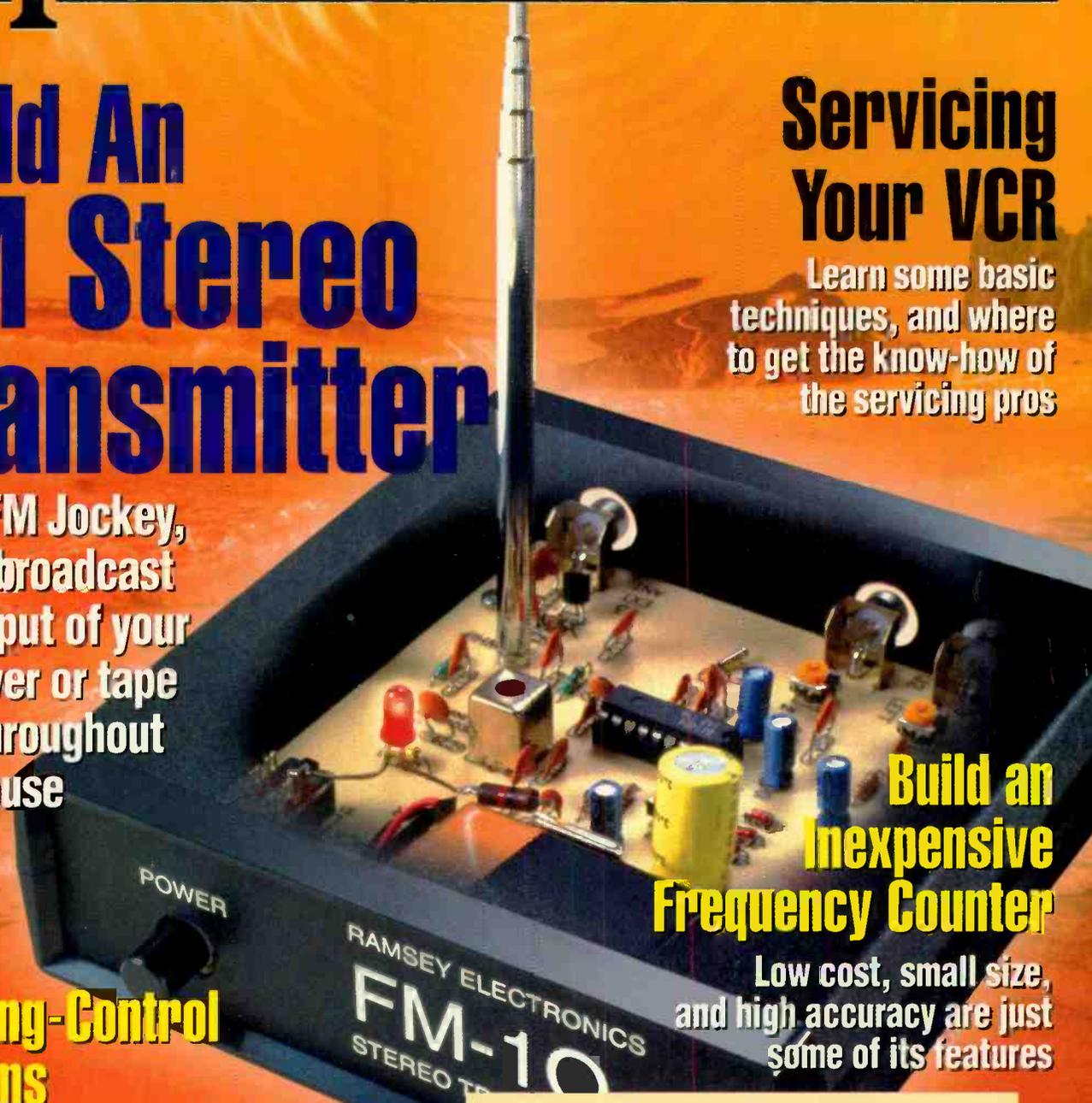


## Build An FM Stereo Transmitter

Be an FM Jockey, or just broadcast the output of your CD player or tape deck throughout your house

## Servicing Your VCR

Learn some basic techniques, and where to get the know-how of the servicing pros



## Build an Inexpensive Frequency Counter

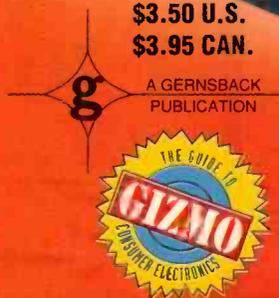
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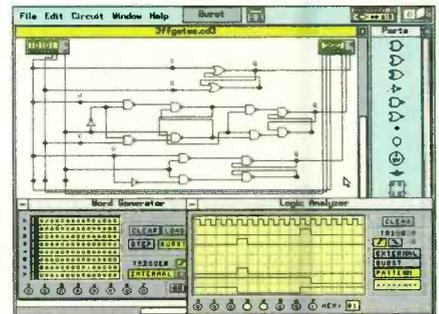


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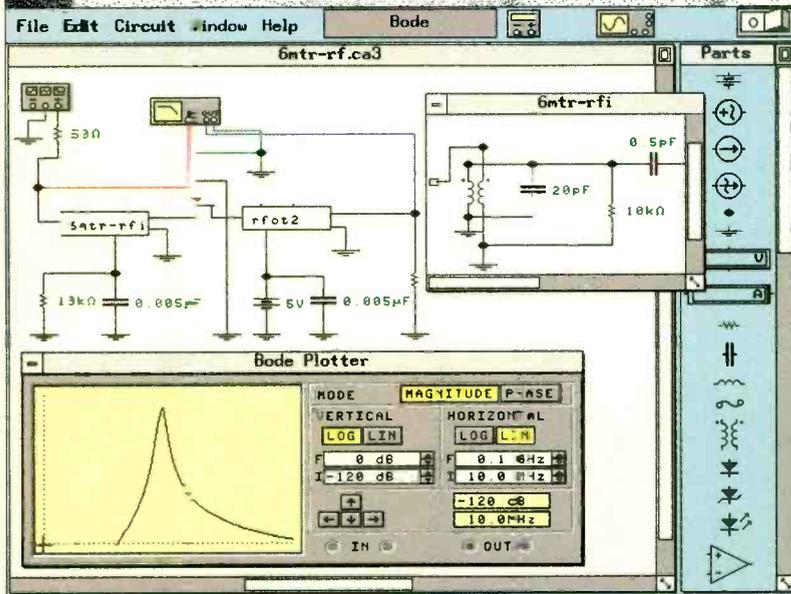
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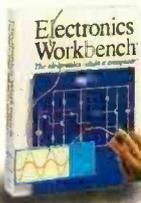
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FEBRUARY 1995

Vol. 12, No. 2



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# EDITORIAL

## BYE-BYE CABLE

Let me say right from the start that I absolutely hate my cable-TV company. Predatory pricing (one of the highest rates in the country), miserable customer service ("If you are unhappy with your service, you can always cancel"), poor selection, a nearly unusable on-screen guide (and no free printed guide)—the list goes on and on.

When the FCC re-regulated cable last year, my initial "reduction" resulted in an *increased* cost of a couple of dollars. Of course, my case was by no means unique; in fact, so many customers around the country received rate increases instead of the intended decrease that the FCC mandated a recalculation of the rate adjustments. That did result in a decrease—of one cent!

Then, to add injury to insult, a couple of months later my cable company raised the price for all of their unregulated programming options, which means everything except broadcast basic. The net result of all of those rate changes was a nearly 10% increase in the cost of my cable service. So much for re-regulation!

But the final straw came when I called to inquire about some programming services that are available as part of the basic package on most other cable services around the country. I'm not talking about anything exotic here, mind you, but rather services like Comedy Central, the Sci-Fi Channel, ESPN2, and so on. I was told that while they were not available in my area at the current time, I would soon have the "opportunity" to purchase them at an added cost.

Enough is enough; I have decided to take my cable company up on their offer—I am canceling my service. What made that decision even easier is that I now have a viable alternative. It is the DSS direct-broadcast satellite service.

I am apparently not the only one that is less than enthusiastic about his or her cable service. Early sales indicate that DSS may become the most quickly accepted consumer-electronics product in history. Is it for you? That depends on your circumstances. I am putting in my system over the weekend, and when we get together next time, I'll tell you more about it.



Carl Laron  
Editor

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## PROJECT PHOTOGRAPHY POINTERS

Fred Blechman's article, "Screen Shots and Project Photography Made Easy" (**Popular Electronics**, December 1994) was interesting and contained some useful information for novice photographers. However, I would like to take exception to some of the recommendations made by Mr. Blechman, and offer one or two of my own.

First, the type of film he suggests is a daylight color-print film. That is a poor choice for use in photographing projects for a number of reasons. Of the eight uses for such photographs listed by the author, almost none can make use of color prints. As far as I am aware, no magazine, book, documentation, or manual will accept color prints. The color-separation process used in printing requires color transparencies or slides. As for illustrating a lecture, that is best done with a slide projector.

Therefore, if the stated objectives are to be met, a slide film such as Ektachrome or Kodachrome (buy American!) is the better choice.

Daylight film, used with tungsten light, requires extensive color correction. Mr. Blechman suggests the use of an 80A filter for that purpose but admits that he has to go to a custom processor and pay extra for further color correction. An 80A filter is ineffective in correcting for the light from a 60-watt household lamp because that type of lamp has a color temperature of about 2600 K, while the filter is designed to correct for 3200 K photographic lights.

Color films are available in Type A (3400 K for photofloods) and Type B (3200 K for studio lamps) as well as Daylight. The

# LETTERS

most useful for our purpose is Type B. I use Ektachrome 160T, which used to be called High-Speed Ektachrome before film speeds became supersonic.

I also use a 60-watt household lamp for the "painted light" technique described in the article, but I use a special transformer to boost the voltage to the point where the color temperature is 3200 K. That occurs at about 170 volts for most household lamps under 100 watts. Since **Popular Electronics** is an electronics magazine, I suspect that many readers will be able to come up with a circuit that will provide the necessary voltage and current. One simple approach would be to operate the lamp on a 220-volt circuit (if available) and use various other lamps or heaters in series with the one used for photography. Juggle the load resistance with various series/parallel combinations and different wattage lamps until the voltage across the photo lamp is 170 volts. That shortens the life of the lamp considerably, so it might be a good idea to add a switching arrangement to lower the voltage to normal during setup. Be sure to shield the light emitted by the load lamps from the scene being photographed. If the lamp is too bright for your required exposure time, simply use a 40- or 25-watt lamp, adjusting the load resistance to maintain the 170 volts required.

A final word about color photography might make the above points moot. It is critical only when there is the necessity for good fidelity between the subject and the picture. Who knows (or cares) what the exact color of an electronic project is supposed to be? As a matter of fact, quality custom color processing requires that a standard color card, or at least a human being, be included on the roll of film to be processed. It is more important in portraits because we all have a pretty good idea of what flesh color is supposed to look like. Think of how hard it is

to adjust the hue and intensity controls on a TV set unless there is a person on the screen to use as a reference.

D.D.V.

*Tuckahoe, NY*

## SMC-SUPPLIER ADDITION

I'd like to make an addition to the list of component suppliers that appeared in the article "A Hobbyist's Guide to Surface-Mount Technology," which appeared in the January 1995 issue of **Popular Electronics**: Garrett IEU, Inc., 3070 Skyway Drive, #104, Santa Maria, CA 93455. Their telephone number is 800-767-0081 or 805-922-0594, and the Fax number is 805-922-3643.

E.C.

*Las Vegas, NV*

## CRASH-PROTECTION UPDATE

The article "All About Crash Protection" (**Popular Electronics**, November 1994) mentioned the SRS-40 Supplemental Restraint system. We appreciate the reference to the system, but would like your readers to note that Applied Safety and Wynn's Climate Systems no longer distribute it. The SRS-40 is now distributed by Breed Technologies, 5300 Old Tampa Highway, P.O. Box 95023, Lakeland, FL 33804-5023; telephone, 1-800-247-6601.

R.L. GREEN

*Director, Aftermarket Sales  
Breed Technologies, Inc.*

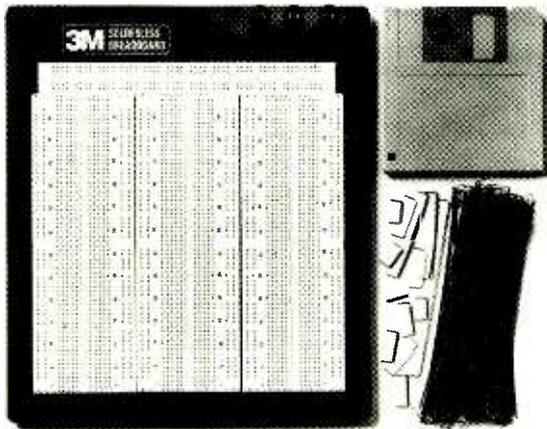
## HAVES & NEEDS

Thank you for publishing a superb and interesting magazine. I need help in locating a Phillips screwdriver, point size "000," that is offset at a 90° angle. Any response will be appreciated.

Thank you.

STEVEN H. SCHROEDER  
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# MULTIMEDIA WATCH

By Marc Spiwak

## Instant Publishing on CD-ROM

The next time you see a major news event begin to unravel, be on the look out for a CD-ROM devoted entirely to the event to hit stores about a week later. That's my prediction if instant publishing continues on its course.

I recently learned of a new CD-ROM title that follows that "premature" release policy of instant publishing. That is *The People vs. O.J. Simpson* from Turner Home Entertainment. Even if you have no interest

in O.J.'s situation, I'm sure this disc is going to be a collector's item, so order now!

How fast was the marketing of the O.J. CD-ROM? Well, the bodies of Nicole Brown and Ronald Goldman were found on June 13, 1994. About two weeks later, Turner Home Entertainment decided to create a CD-ROM, and the product was released on September 14, almost a week before O.J. was first scheduled to go on trial. It seems that the CD-ROM publishers are way ahead of even the TV movie guys!

The disc contains over an hour of CNN video footage of the O.J. Simpson story, and it lets you navigate through all the facts surrounding the case—at least all the facts that were uncovered before the disc was completed. You create your own investigation of the case by selecting from 10 menu choices: the murder, the players, the legal debate, the victims, the suspect, the timeline, the court of public opinion, the evidence, the arrest, and the People vs. O.J.

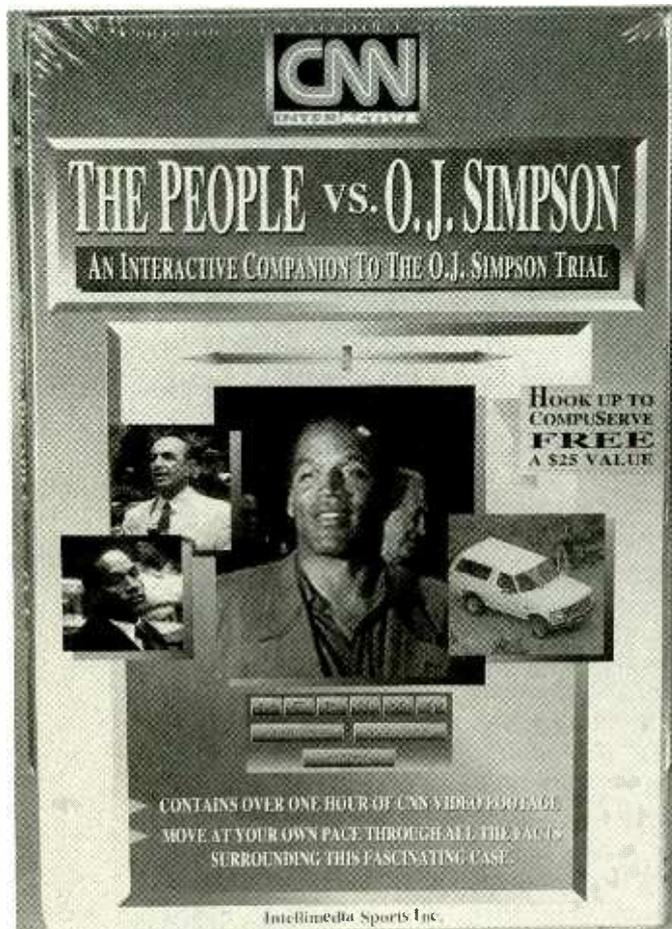
Unfortunately for die-hard Simpson-trial followers, the disc might seem incomplete, as it only features the information uncovered before publishing was completed. And quite possibly, the "real truth" might be told before this column even hits print. Once the fate of O.J. is known, however, I'm sure there will be a follow-up disc that will make for a nice little 2-disc O.J. Sim-

pson set. But for fans of the O.J. Simpson case who need to update their PC database on O.J. faster than the CD-ROM format will allow, the disc also comes with a free sign-up software package (worth \$25) to hook up to CompuServe, where up-to-the-minute O.J. information can be found.

### NEW STUFF

If you want to keep up on news that's slightly less current than the O.J. Simpson case, try *Time Almanac 1990's* and *Time Almanac Reference Edition*, both from Compact Publishing. The 1990's edition contains the complete text of all Time Magazine articles from 1989 through May 2, 1994, and more, including video clips. The Reference Edition is the most in-depth of the Time Almanac series, with over 20,000 articles and 40 minutes of video. The Time Almanac 1990's has a suggested retail price of \$49.95 and the Reference Edition is \$99.95.

This month I've got a couple of CD-ROM's that are helpful in planning family outings. The first one, *AAA Trip Planner*, is the ultimate road-trip resource on CD-ROM from Compton's New Media. The disc is packed with information on hotels, restaurants, and points of interest all across the United States. The database is provided by the American Automobile Association (AAA), so it is highly accurate. The user types in a starting point, a destination,



*The People vs. O.J. Simpson* from Turner Home Entertainment lets you conduct your own investigation of the famous case.

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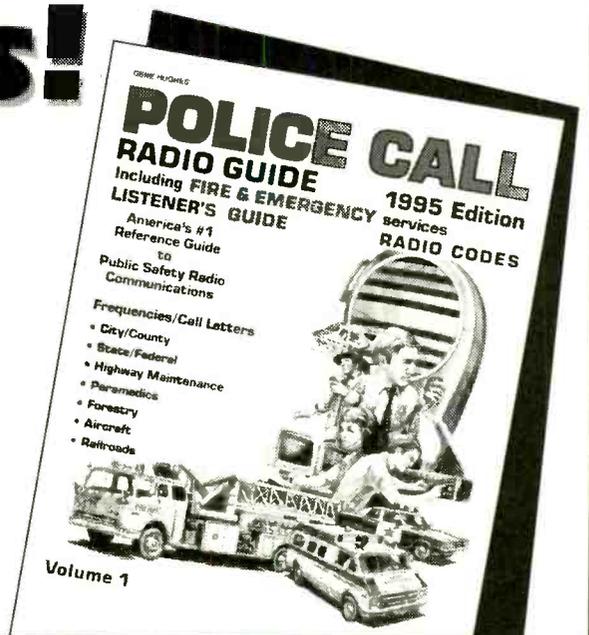
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and any points in between, and the trip planner plots it all out on a map that can be printed. The AAA Trip Planner is \$59.95.

The second disc, *Great Restaurants, Wineries, & Breweries*, is the gourmet guide to eating in America from Deep River Publishing. More than 4000 photographs and menus showcase over 1400 of the best makers of food, wine, and beer in the country. Recipes from many of the restaurants are also included. Eat, drink, and be merry for \$39.95.

*Learn To Speak French 4.0* and *Learn To Speak Spanish 4.0* are the latest ways from Hyperglot Software to learn either language. Learning a foreign language is one exercise that really benefits from multimedia. Hearing how something is pro-

nounced is always better than guessing, and the ability to instantly jump from section to section on CD-ROM beats both audio- and video-tape educational methods hands down. The discs list for \$179.00 each.

I've got two new discs from Microsoft this month, *Ancient Lands* and *Multimedia Strauss*. *Ancient Lands* covers the life and culture of ancient empires and civilizations such as Egypt, Greece, and Rome. *Multimedia Strauss* covers three of Richard Strauss' masterpieces: *Don Juan*, *Death and Transfiguration*, and *Till Eulenspiegel*. Those discs list for \$59.95 each.

For all those amateur detectives out there, *Who Killed Brett Penance* from Creative Multimedia is sure to be of interest. Starring Sheryl Lee from the "Twin



*The Flightstick Pro from CH Products makes piloting any flight game more fun.*

Peaks" TV show, *Who Killed Brett Penance* lets the user interview suspects and witnesses with over 90 minutes of video. The user must collect enough evidence to build a case against a suspect. *Who Killed Brett Penance* sells for \$29.95.

The year is 2012. An alien

invasion has begun. You are a special forces agent who must eliminate the invaders in a high-rise that's 30 floors in a "living hell." *Corridor 7* from Capstone is powered by an enhanced Wolfenstein 3D engine licensed from Id software, so the action and graphics are quite good. You can play *Corridor 7* on CD-ROM for \$49.95.

If you're into adult entertainment on CD-ROM, then you might be interested in a line of products from Pixis Interactive. In particular, check out *Scissors and Stones*, *Virtual Vixens*, and *NeuroDancer*. I can't discuss the details of those discs here, but you might want to check them out for yourself. They list for \$69.95 to \$79.95.

Spectrum Holobyte just sent me their brand new  
(Continued on page 86)



# Could the latest in wireless speaker technology *outperform* the audio industry's biggest names?

*New technology broadcasts stereo signals on a wide 900 MHz band, giving you crystal-clear sound in any room of your home.*

by Charles Anton

If you're like me, you spend hundreds of dollars a year on the music you listen to. Unfortunately, you're not always in the room where your stereo is. So either you don't listen at all or you turn the volume up so that you can hear your music while you're in other rooms. Sometimes it's so loud you can barely hear the telephone or doorbell.

**Music in every room.** Imagine being able to listen to your stereo or TV in any room of your home without having to run miles of speaker wire. Due to new developments in 900 MHz technology, Recoton was able to introduce a whole new generation of powerful wireless speakers. The transmitter allows stereo signals to travel distances of up to 150 feet (a 70,000 square foot radius) through walls, ceilings and floors without loss of sound quality

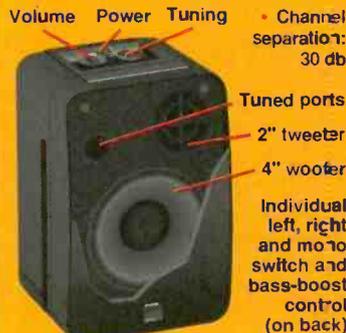
**New breakthrough.** Recently, the FCC designated a 902-928 MHz radio band specifically for wireless in-home applications. The wider frequency band allows clearer, stronger transmission of stereo signals throughout your home. This breakthrough technology allows these wireless speakers to rival the sound of wired speakers.

**Unlimited options.** The powerful transmitter plugs into the headphone, audio-out or tape-out jack on your stereo or TV. The speakers plug into an outlet. One transmitter broadcasts to an unlimited number of speakers and headphones. And since each speaker contains its own built in receiver/amplifier, there are no wires running from the stereo to the speakers.

**Full dynamic range.** The speaker, mounted in a bookshelf-sized acoustically constructed cabinet, provides a two-way

### High-tech wireless sound

Recoton's breakthrough wireless speakers rival the sound of expensive wired speakers. Both the speakers and the headphones contain a built-in receiver and amplifier. Signals are transmitted up to 150 feet through walls without using wires. Their bookshelf-sized (9"H x 6"W x 5.5"L) design provides 10 watts of sound per channel.



bass reflex design for individual bass boost control. Full dynamic range is achieved by the use of a 2" tweeter and 4" woofer. Plus, automatic digital lock-in tuning guarantees optimum reception and eliminates drift.

The new technology provides static-free, interference-free sound in virtually any environment. These speakers are also self-amplified, so they can't be blown out no matter what your stereo's wattage.



.....  
**Add thunderous bass and save \$100.** If you're one of the thousands already enjoying Recoton speakers, or if you order two speakers and a transmitter now, you can save on the bass boost subwoofer. This 10-inch rear-firing subwoofer delivers 50 watts of high-powered stereo sound. It uses the same transmitter as Recoton's stereo speakers. And since bass tones are omni-directional, you can place it inconspicuously in one area of the room and the regular speakers in another. You'll improve the depth of your stereo's sound and save \$100 dollars off the retail price with this special limited-time offer!

**"Dare to Compare" Speaker Challenge.**

Compare Recoton's rich sound quality to that of any \$900 satellite subwoofer speaker system. If you're not completely convinced that this wireless system offers the same outstanding sound quality, simply return it within 90 days for a full "No Questions Asked" refund.



Recoton's wireless bass boost subwoofer adds rich bass tones.

.....  
**Factory direct savings.** Factory direct pricing allows us to offer these speakers far below retail. You get our 90-day "Dare to Compare" money-back guarantee and full one-year manufacturer's warranty. Most orders are processed within 72 hours and shipped via UPS.

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# GIZMO®

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## Dish it Up!

**ZENITH ZS8000LE SATELLITE TV RECEIVER.** From: Zenith Electronics Corporation, 1000 Milwaukee Avenue, Glenview, IL 60025. Price: About \$1200.

Although the excitement surrounding the launch of the RCA DSS digital satellite receiving system is well deserved, traditional C-band satellite reception can't be beat for the variety of programming available. And with the convenience features built into the *Zenith ZS8000LE* receiver, satellite TV can be easy to use.

Because satellite TV is confusing to many people, a brief review of the basics is in order. Satellites are used to distribute television programming across the country. Cable-TV systems, for example, receive satellite-delivered programming from such program providers as HBO, and redistribute the programming to the cable subscribers. Networks also feed most of their programming to their affiliates via satellites.

Satellite-dish owners can tune in to a wide variety of that programming as well. Most satellite-delivered programs are available to individuals by subscription. Virtually all of the major cable networks are scrambled, however, to prevent non-paying dish owners from watching.

Unlike the new direct-broadcast satellite (DBS) system, there is still plenty to watch on satellite TV for free. Un-edited news feeds can be found in abundance, for example. Some cable networks, including the Learning Channel and Fox's FX, can be found "in the clear" along with religious channels, shopping channels, and more. Sports backhauls—transmissions back to the network for redistribution—can also be found (when players aren't on strike, that is). That's no longer true for baseball and football. League rules prohibit the showing of most baseball games outside of the local area, and football—virtually every game—is available for a season subscription priced at \$139.

A wide variety of audio services are also available by satellite, and can be tuned in.



Everything from WCBS, an all-news station from New York, to KLON, a commercial-free jazz station from Long Beach, California is available to dish owners.

Because of the great variety and amount of satellite-delivered programming, a satellite system can be difficult to operate. Unlike DBS systems, which receive programming from one satellite, a home satellite receiver must be able to scan the sky to pick up programming from a variety of satellites. (There are about 19 C-band satellites that can be seen in the continental U.S., and about 14 Ku-band satellites. To the uninitiated, all that can get confusing.)

Zenith, however, built in many convenience features to make the ZS8000LE not only easy to use, but easy to install as well. On-screen menus guide the installer through all of the steps.

The system-setup menu, which can be accessed only by entering the secret code found in the manual, allows the receiver to be configured. The ports for the LNB (low-noise block downconverter, the electronics mounted at the focal point of the dish) can be set for single or dual-LNB systems, or even LNBF (LNB with an integral feedhorn). The east and west limits for dish travel are also set from the menu.

The next step is to program the satellite locations. Assuming that the dish is set up properly and is accurately tracking the arc, you can simply search the sky by pushing the EAST or WEST keys on the remote control until a signal is found. An installer

will be able to recognize many satellites by the programming that is found, but most people will find that a satellite-TV program guide will be a great help in identifying the satellites.

A channel-scan mode, in which the receiver rapidly scans through all channels at both horizontal and vertical polarities, makes it easy to find a satellite. Without such a mode, you might pass a satellite without knowing it because you were tuned to a transponder that wasn't active.

Once a satellite is found, the dish position and the skewing must be peaked for maximum signal. The ZS8000LE makes it easy with a feature called ZAP or Zenith Automatic Peaking. Simply pressing the ZAP key causes the receiver to automatically adjust the dish, the polarity, and the fine tuning to peak the signal—it's a great time saver for installers and it guarantees good results.

Another feature, called Auto Install, makes the installation process a breeze by eliminating the need to manually find all of the satellites in the arc. Only three satellites must be found instead: the eastern-most, the western-most, and a center-located satellite. The receiver then automatically searches the arc, programs the satellite locations in memory, and peaks all settings. As long as the three satellites are identified correctly and their signals are peaked, the auto-install mode works well and allows the entire programming to be completed in about ten minutes.



The remote control is simple thanks to the receiver's extensive menu system.

That auto-install feature can really only be expected to work when the receiver is first installed. Because satellites occasionally move to new locations or are replaced by satellites with different names, the locations stored in memory in the receiver may become inaccurate. Updated software would be required for the auto-install feature to be used for such changes.

The setup menu also has selections that are used after the system is installed. For example, assume that the dish is shifted in high wind. A handy selection allows the satellite locations to be shifted in one direction so that all locations don't have to be shifted manually.

Channels can also be customized in the setup menu. The name, volume, audio frequency, video level, and more can be configured for each channel.

The receiver can be customized in a host of other ways as well. Up to 100 channels can be stored in a favorite-program memory. Up to 100 audio programs can also be stored. The favorite-program memories eliminate the need to remember, for example, that the Sci-Fi channel is on Galaxy 5, transponder 4. Instead, a user could tune to the Sci-Fi channel by punching FAV on the remote control and then punching 49, or whatever number was assigned to it.

It's not even necessary to memorize the

favorite-program number. Instead, the favorite-programs can be stored by the categories of movies, sports, news, superstations, and variety.

Yet another way to categorize programming is by a user list. Up to five different users each can set up a list of personal favorite channels. A sports fanatic might choose to include the dozen or so sports channels on his list, while a cooking enthusiast might include The Learning Channel, the TV Food Network, and PBS. A child might program MTV and Nickelodeon. (Parents who want to ensure that their kids don't watch inappropriate programming can password-protect up to ten channels.)

Satellite audio services are among our favorite programming available with a dish. The ZS8000LE gives three ways to access them. First, from the main menu, you can select Audio Functions, which then provides ways to tune the left- and right-channel frequencies and select the channel bandwidth. You can also choose "other audio programs" from the audio functions menu, which allows you to search common audio-subcarrier frequencies. Finally you can store the audio settings in a favorite-program memory for quick recall.

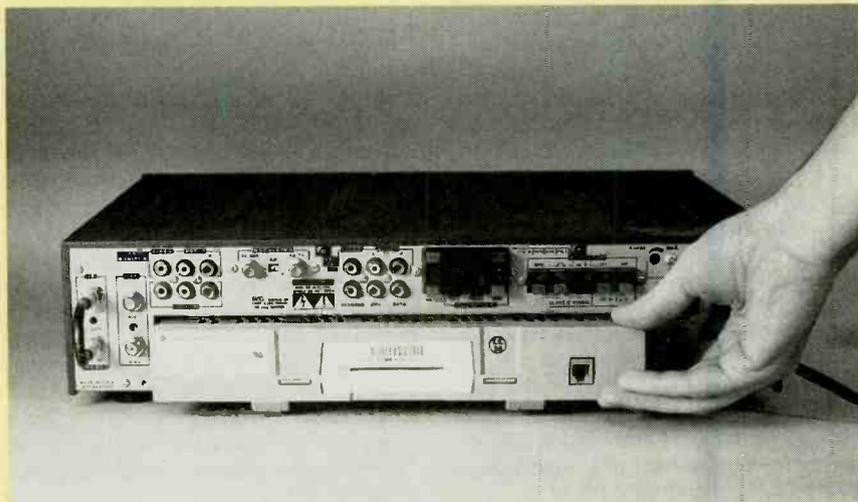
The ZS8000LE receiver contains an internal clock and VCR timer. Actually, the VCR timer is four independent timers, each of which can be set for a single event, for a 5-day (Monday through Friday) daily repeat, a 7-day daily repeat, or a once-per-week recording. This is especially useful for capturing so-called "wild feeds," which often occur during early morning hours. So, for example, if you prefer to watch the ABC soap opera "All My Children" over breakfast instead of waiting for its usual afternoon time slot, you can record the wild feed at 1 AM. Of course, setting the receiver's VCR timer doesn't

set your VCR's timer. The VCR must also be set to record the output of the satellite receiver at the correct time.

If setting multiple timers is too confusing, you might choose to make use of the receiver's VCR Plus+ feature. VCR Plus+ is designed to be used with TV broadcast channels and cable TV. However the ZS8000LE is also compatible because it simulates a cable box. Thus, if you buy a VCR Plus+ stand-alone unit, or a VCR Plus+-equipped VCR, you can perform the "Set Cable" function by using the code number for Zenith cable boxes. The trick is to set the receiver's Favorite Program numbers to correspond to the channel numbers that the VCR Plus+ will output.

Another convenient feature that Zenith included in the receiver is Move Channel. Although many satellite programs remain on the same satellite and on the same transponder for years, others move around occasionally. Changes in the satellites cause programmers to shift from one bird to another as well. For example, during our review of the ZS8000LE, the three major network stations from PrimeTime 24 moved from Satcom F2 to Galaxy 4. Reprogramming the new locations was easy: We first went to the new location of, for example, WABC (G4, transponder 10). We then called up the menu, selected "Program Customizing, and then Move Channel. We then chose the old location where the program was. The new location then acquired the correct name and other settings. Even the favorite-program memories were updated!

Like most satellite receivers today, the ZS8000LE is compatible with Ku-band reception. The Ku band differs from the C-band in a couple of ways. First, none of the major cable-TV programmers are on the Ku band. However, Ku band is where you'll find numerous news feeds and such



The ZS8000LE rear panel. Here a VideoCipher descrambler module is being inserted in its slot.

```

MAIN MENU
→ADD-DELETE FAVORITE
AUDIO FUNCTIONS
VIDEO SETTINGS
PARENTAL CONTROL OFF
VCR TIMER
SLEEP TIMER
SETUP MENU
USE ↑, ENTER
CANCEL TO EXIT MENU

```

```

FAVORITE PROGRAMS
→EXPRESS ---
MOVIES
SPORTS
NEWS-NETWORKS
SUPERSTATIONS-MUSIC
VARIETY
SATELLITE RADIO MENU
USE ↑, ENTER, FAV
CANCEL TO EXIT MENU

```

```

SYSTEM SETUP
SET LNB PORTS
SET E/U LIMITS
SATELLITE LOCATIONS
ADD/DELETE PARENTAL
CLEAR MEMORY
→CHANNEL CUSTOMIZING
USE VCR PLUS [TM]

USE ↑, ENTER
USE ON/OFF TO EXIT

```

```

ADD SATELLITE RADIO
G5/ 2
NAME KLOK-
→OTHER AUDIO PROGRAMS
MODE STEREO
BW NAR
AUDIO L: 5.58 MHZ
AUDIO R: 3.78 MHZ
USE ↑,
<=PRESETS, >= SAT RADIO
CANCEL FOR PREV MENU

```

```

CHANNEL CUSTOMIZING
→ADD/MODIFY CHANNEL
RESET CHANNEL
DELETE CHANNEL
MCUE CHANNEL

YOU'RE ON G4/10 WABC
USE ↑, ENTER
↔ FOR SAT
CANCEL FOR PREV MENU

```

```

VIDEO SETTINGS
→VIEW ALL CHANNELS
SKIP CHANNEL
FORMAT: U
SKEW: -17
VIDEO: NORMAL
VIDEO ON SAT MOVE

USE ↑, ENTER
CANCEL FOR PREV MENU

```

The multiple menus of the ZS8000LE make it easy to control the receiver.

services as the Fire and Emergency Television Network (FETN), most NBC network programming, and ethnic programming. Because there is no threat of interference to terrestrial, telephone microwave transmissions, Ku-band satellites can have higher-power transponders.

However, Ku-band tuning can be frustrating because the dish must track the satellite arc perfectly. A system that has virtually perfect C-band performance might not receive Ku-band satellites at all! Another frustration is that Ku-band doesn't have standard transmitting frequencies like the C-band does. Channel polarities and frequencies vary from satellite to satellite, and channel numbers posted in satellite TV guides might or might not correspond to the receiver's display. Zenith's Ku-seeking, automatic frequency control makes Ku tuning much more user-friendly.

Our only complaints with the receiver are minor. For example, we would prefer separate audio-tuning controls on the unit's remote. Since we often tune through audio subcarriers, we would have found it more convenient than accessing multiple menus. We also would like to see a better front-panel display—something that would allow us to control the receiver without having to turn a video monitor on. Despite those complaints, we thoroughly enjoyed the Zenith ZS8000LE satellite receiver. Its picture performance was outstanding, and its menu system made it easy to use. ■

## GIZMO NEWS

### Sony + General Magic + AT&T

Sony has introduced its Magic Link Personal Intelligent Communicator, the first product based on General Magic's Magic Cap platform and Telescript technology. It is also the first to incorporate AT&T PersonaLink Services.

The Magic Link offers a combination of intelligent messaging capabilities that integrate e-mail, fax, telephone, online services, and nationwide paging. The initial target audience for the product is composed of mobile professionals who need communications to increase their efficiency. The product is primarily a communications tool, not a personal digital assistant or PDA. It does have a pen interface (a keyboard is an add-on accessory) but no handwriting recognition technology is built in.

Telescript technology is a standard for agent-based communications in which electronics agents are created to intel-



Sony's Magic Link Personal Communicator is based on Telescript technology from General Magic.

ligently navigate through a variety of services and across computer systems to perform tasks for their owners. For example, an agent might be programmed to page you when your e-mail account receives an important message from your boss, or when the price on a stock you are interested in drops below a certain level.

AT&T PersonaLink Services, which is based on Telescript technology, offers users a mailbox and a gateway connection to AT&T EasyLink Services. That, in turn, gives users access to public and private messaging systems worldwide, including the Internet and virtually any fax machine. Messages can contain not only text, but voice annotations, electronic ink, and more.

The Magic Link supports wireless messaging through the SkyTel paging network. Customers with a SkyTel alphanumeric pager or an optional Magic Link pager card can receive messages wirelessly through SkyTel.

In the future, an electronic shopping mall called PersonalLink Market Square will be available on-line. There, too, electronic shopping "assistants" will help subscribers browse through, select, and purchase goods.

PersonaLink Services is an open plat-

# World's first wireless home theater system makes professional-quality surround sound affordable...

Now you can add surround sound to your home entertainment lineup with the amazing new Chase Technologies decoder that works with your existing stereo and an assortment of wired and wireless speakers.

by John Lindner

Let's face it. As much fun as renting a video can be, it's just not the same as seeing a movie in a theater. I remember the first time I saw *Jurassic Park*—I nearly jumped out of my seat when the dinosaurs roared. One of the reasons movies seem so real is because surround sound makes it seem

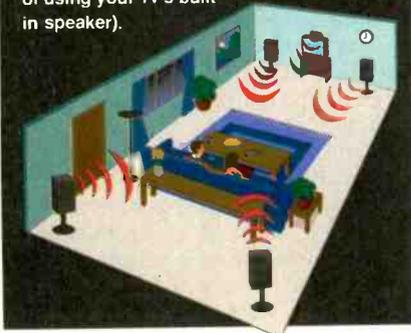
## The secret of surround sound

Surround sound has become the rage of the '90s because it adds depth and realism to stereo sound, giving you the home theater experience. In short, it makes you feel like you are actually at a concert a theater.

To get surround sound, some people have tried simply adding additional speakers to their home entertainment lineup. But it takes more than additional speakers to get surround sound; there needs to be a way of separating the original signal into distinct channels so that you're not just duplicating the same sounds and broadcasting them from different areas of the room.

The new Chase Technologies HTS-1 surround sound decoder does just that, and in a revolutionary way that rivals the best Dolby Pro-Logic and THX systems available. The HTS-1 provides five channels of sound from any two-channel stereo source.

The HTS-1 works with a variety of speakers. In the front, you can use your existing stereo speakers. For the rear, choose from inexpensive wired speakers, high-quality wireless speakers, or even an audiophile-quality wireless satellite subwoofer system. The HTS-1 also gives you the ability to add a powered center channel speaker (instead of using your TV's built-in speaker).



like you're actually there when events are happening. Now there's an incredible new device that lets you use your stereo receiver to get that same surround sound in your home.

**The secret's in the signal.** To get surround sound, you need to do more than simply add extra speakers. There needs to be a way of separating the signal from the musical score or movie soundtrack into distinct channels for each speaker. The new Chase Technologies HTS-1 surround sound decoder does just that, and in a revolutionary way that rivals the best Dolby Pro-Logic and THX systems available today.

**Wins over critics.** In the September 1994 issue of "High Performance Review," noted audio critic Daniel Kumin said "the HTS-1 can do quite a job of recreating a 3D theatrical experience...surround effects emanated with satisfying fullness...sound was clean at any level...with quite involving and natural sound ambience."



**The new HTS-1 decoder won the Design and Engineering Award at the Consumer Electronics Show for being one of the best and most innovative new products.**

Surround™ signals in every stereo, videotape or laserdisc. This passive method is superior to active decoders such as Dolby and THX because it requires no AC current to decode. As a result, you experience more clarity, more detail, and a greater sense of space. Plus, you won't experience the noise or distortion which can occur with active decoding methods. You don't need any extra amps! Just connect the HTS-1 to your stereo, add your speakers, and you'll experience the magic of home theater at a fraction of the cost of other systems.

Plus, John Sunier, a leading authority on surround sound and producer of *Audiophile Audition*, a nationally syndicated radio program for audio enthusiasts, says, "...the new Chase HTS-1, when used to decode the hidden ambience in all musical recordings, definitely outperforms all the Dolby and THX processors (which could cost you up to \$3,000)...I am impressed!"

**Decoding breakthrough.** Last year, audio industry veteran Bob Rapoport invented a new five-channel "passive" circuit for decoding the Dolby

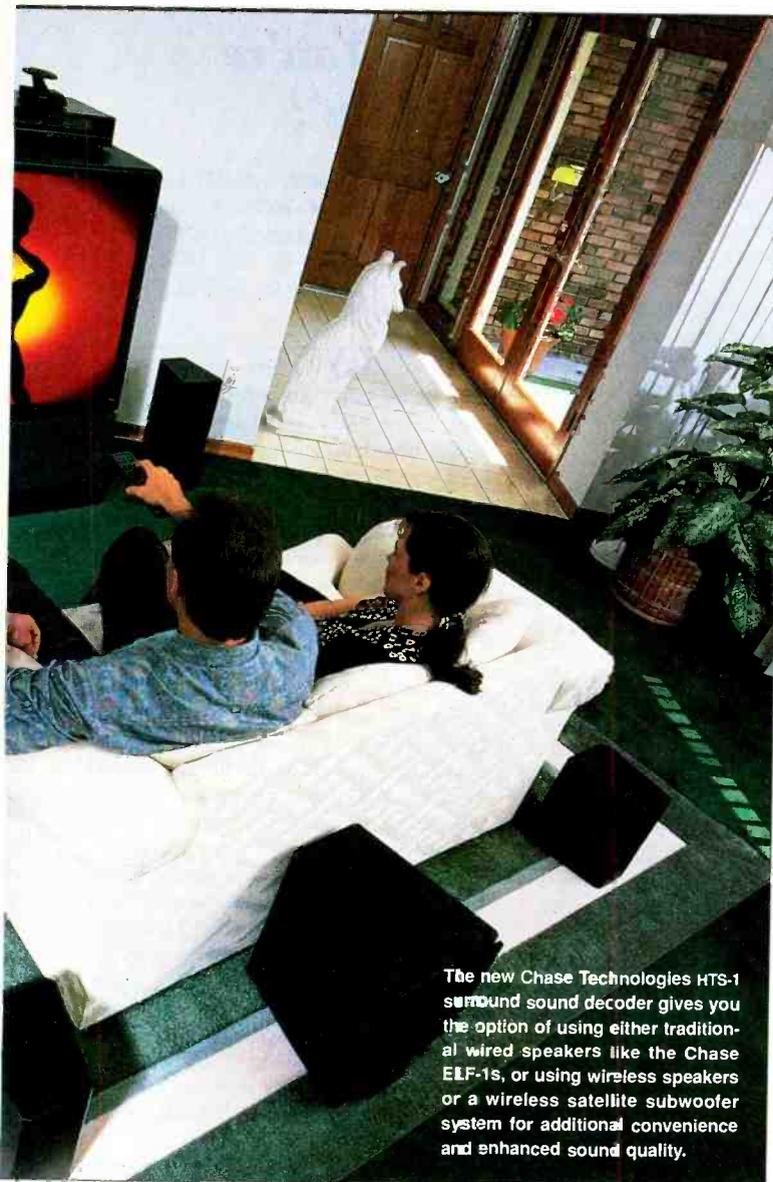


**Five channel options.** The HTS-1 decoder can be used with two, three, four or five channels of amplification, making it the most cost effective method for upgrading your stereo system to full home theater performance on the market. Best of all, the HTS-1 works with a variety of hard wired and wireless speakers.

In the front, most people use wired stereo speakers. Use your existing stereo's speakers or use one of a variety of wired speakers. Comtrad also offers the Chase Dialog center channel speaker. If your front speakers are more than eight feet apart, adding a center channel speaker will help keep voices and sound effects centered on the screen for stunning localization and clarity. The Dialog is self powered and video shielded to prevent interference with your television set.

**The Chase HTS-1 decoder is the most cost-effective method for upgrading an existing stereo system to full home theater performance on the market.**





The new Chase Technologies HTS-1 surround sound decoder gives you the option of using either traditional wired speakers like the Chase ELF-1s, or using wireless speakers or a wireless satellite subwoofer system for additional convenience and enhanced sound quality.

**Wireless freedom.** When it comes to rear speakers, you can again choose standard wired speakers like the Chase ELF-1s. But if you want to avoid the hassle of running speaker wire up and down walls, behind furniture, and under carpet, you can add the freedom and convenience of wireless speakers.

Recoton wireless speakers utilize a transmitter which broadcasts sound signals up to 150 feet through walls, floors and ceilings. The speakers can be placed anywhere; they plug into a standard electric outlet. This eliminates the need to have wires running from the stereo to the speakers, which can be a nuisance with surround sound since the rear speakers are often elevated or wall mounted.

**Affordable option.** Recoton's W440 speakers allow you to add wireless rear channel speakers without compromising the sound quality that wired speakers deliver. Each self-amplified speaker contains a two-inch tweeter and four-inch woofer. They deliver 10 watts per channel for strong, clear fill sound. Their compact design (9" high x 6" wide x 5.5" long), make them the perfect bookshelf-sized companion to your home entertainment set up.

**Audiophile quality.** For the true stereo enthusiast, we offer the Recoton self-amplified wireless satellite subwoofer system. The satellite speakers in the system each bolster 25 watts of clean, distortion-free sound. The subwoofer adds a whole new dimension to your home theater with its 50-watt amplifier that's capable of creating enough rumble to make you feel like you're in the middle of an earthquake.

**The Recoton wireless subwoofer's 50-watt 10-inch speaker delivers thunderous bass that adds depth and realism to the surround sound experience.**



Even the most discriminating surround sound enthusiast will be engulfed by the abundant power and delighted with the full-range, first-rate sound from these black oak vinyl veneer speakers.

**Easy to install.** Every speaker option offered by Comtrad can be easily installed with the HTS-1 in a matter of minutes. Just connect the speaker outputs of your receiver or amp to the HTS-1, then

connect speaker wire to the front and rear speakers. When using wireless speakers, connect the transmitter to the output. One transmitter will broadcast to each wireless speaker.

**Risk-free home trial.** The best way to evaluate surround sound is in your home—not a showroom. That's why we're offering the 30-day risk-free home trial. Try these products in your home and if you're not delighted with the the surround sound experience, return them for a full "No Questions Asked" refund.

HTS-1 surround sound decoder.....\$99 \$10 S&H

Please mention promotional code 711-PL1109.

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## Speaker Options

### Wired Speaker Options

**Front Speakers:** The Chase HTS-1 surround sound decoder can utilize your existing stereo speakers, or any of a variety of wired speakers available through Comtrad or your local electronics dealer.



**Center channel speaker.** If the front speakers are more than eight feet apart, adding a center channel speaker will keep voice cues centered on the screen. We offer the Dialog. It is self-powered and video shielded to prevent interference with TVs. Dialog \$75 \$8 S&H



**Rear channel speakers.** We recommend the quality Chase ELF-1 in either white or black for inexpensive rear channel speakers. Mount them with the enclosed color-matched mounting brackets or flush mount them on the wall. ELF-1 .....\$99/pair \$10 S&H

### Wireless Speaker Options



**Rear channel speakers.** Recoton W440 wireless speakers are the perfect option for people who want quality stereo rear channel speakers without having to run speaker wire. Their two-inch tweeters and four-inch woofers deliver 10 watts per channel—clear, strong stereo fill sound. The speakers work up to 150 feet from the transmitter without loss of sound quality. TX1000 transmitter (works unlimited speakers) .....\$69 \$7 S&H  
W440 wireless speaker (each) ....\$89 \$9 S&H

Get the Chase HTS-1 half off (\$49) when you buy the W440 speaker system!



**Rear channel speakers.** For true audiophile-quality rear channel speakers, we offer the Recoton wireless satellite subwoofer system. This first-of-its-kind system combines a 10-inch rear-firing subwoofer with a pair of 25-watt satellite speakers. The subwoofer provides that distinctive "low-end punch" that you feel in movie theaters, while the satellites are designed to coincide



with surround sound processor specifications balance perfectly with the front speakers. WHT470 transmitter...\$69 \$7 S&H  
WHT421 wireless 50-watt subwoofer .....\$299 \$24 S&H  
WHT462 pair of wireless 25-watt satellite speakers \$329 \$24 S&H

Get the Chase HTS-1 FREE when you buy the satellite subwoofer system!

form, so, according to Gordon Bridge, president of AT&T Consumer Interactive Services. "It will be the creativity of numerous individuals and entrepreneurial companies that will bring the extraordinary power of this platform to its full potential." As other developers become involved, and as the service grows, the Telescript agents are expected to become more intelligent. For example, one envisioned application is a trip planner in which an agent would not only book the right flight and seat assignments, but also monitor the flight and notify you immediately of any delay or schedule changes.

At startup, the monthly subscription fee was set at \$9.95. After the first quarter of this year, subscribers will be billed based on their individual use and will have different pricing options available. Sony's Magic Link communicator carries a suggested retail price of \$995.

### Ground-to-Air Phone Calls

Making telephone calls from airplanes is old hat—it's been possible for ten years. Now, however, it's possible to receive phone calls while in the air! A new service from GTE Airfone is now permitting ground-to-air calls on Delta Shuttle and USAir Shuttle flights between Boston, New York, and Washington, D.C., and on United Airlines transcontinental flights. The service was expected to be available on more than 600 aircraft by the beginning of this year.

In reality, the service is more like ground-to-air paging than ground-to-air calling. It works like this: First, the passenger gets a "personal aircall number" and a personal identification number (PIN) from GTE Airfone. That can be done by calling 1-800-890-3939 on the ground, or \*039 from the plane. A land-bound caller can reach someone on a plane by calling 1-800-AIRPHONE and entering the passenger's aircall number and the caller's phone number. The caller then hangs up.

When the call is made, the phone in the appropriate row in the airplane rings, and the passengers seated in the row simply look on the phone's display screen to see if their seat number is indicated. If it is, the passenger enters his or her PIN and swipes a credit card through the phone. The caller's number is then displayed, and if the passenger wants to talk to that person, he or she then presses "Accept call" and the phone automatically dials the caller back.

The service doesn't come cheap. There is a \$2 activation charge per flight leg. Passengers are charged only for incoming calls they accept. The charge for those calls is the same for standard air-to-ground calls: a \$2.50 set-up charge, and \$2.50 per minute for domestic calls. In the first week of service, more than 40,000 ground-to-

air calling cards were issued. The activation charge was waived at that time.

### NFL on DSS

DirecTV, one of the program suppliers for the RCA DSS digital satellite system, has signed an agreement that gives the service the ability to offer NFL Sunday Ticket to its subscribers. DirecTV customers were scheduled to be able to subscribe to the last five weeks of the season for \$49.95. (The full-year price was \$139 for C-band satellite-dish subscribers, and it is expected that the price will be the same for both C-band and DBS viewers next year.)

NFL Sunday Ticket makes virtually all NFL games—including out-of-town games—available to subscribers for the single fee. Commercial establishments such as sports bars must buy a higher-priced subscription.

At press time, DirecTV was still in negotiations that would allow it to deliver all of the various regional Sports Channels to its subscribers.

### MPEG-2 Encoder

Toshiba Corporation announced that it has developed a video encoder that is compliant with the MPEG-2 (Moving Picture Experts Group) standard. The encoder, according to Toshiba, is the first MPEG-2 encoder to offer both constant and variable bit-rate encoding.

Constant bit-rate encoding compresses images at an unvarying rate, so that the image quality can fluctuate with the complexity of the original image. Variable bit-rate encoding varies the compression ratio of the image to match its complexity.

The Moving Picture Experts Group operates to set standards for the digital compression and decompression of video images. MPEG-2 is the most recent standard, and covers video with the same image quality as TV broadcasts. The standard was scheduled to be adopted by the International Standards Organization (ISO) and the International Electrotechnical Commission (IEC) by the end of 1994.

### Home Theater Winners

The Electronic Industries Association (EIA) has announced four winners of its "National Home Theater Award Search Contest." The entries were based on "more than just equipment," according to Gary Shapiro, who heads the EIA's Consumer Electronics Group. "The judges looked for creativity and for examples of how the home theater improved the quality of the lives of the entrants and their families."

The price of the winning systems systems ranged from under \$1500 to more than \$5000. For example, a machine oper-

(Continued on page 16)

## Now You're Cookin'!

**GE KITCHENVISION MODEL 13TVR40 TV/VCR COMBINATION.** From Thomson Consumer Electronics, 600 North Sherman Drive, P. O. Box 1976, Indianapolis, IN 46206; Tel: 317-267-5000. Price: \$499.

Whoever said that the kitchen is the heart of the home knew his stuff. Americans spend a substantial amount of their leisure time hanging around in the kitchen. Over the past two decades, it has become common to combine the kitchen/breakfast room with an adjoining seating area, to create a "great room" where family and friends can comfortably gather.

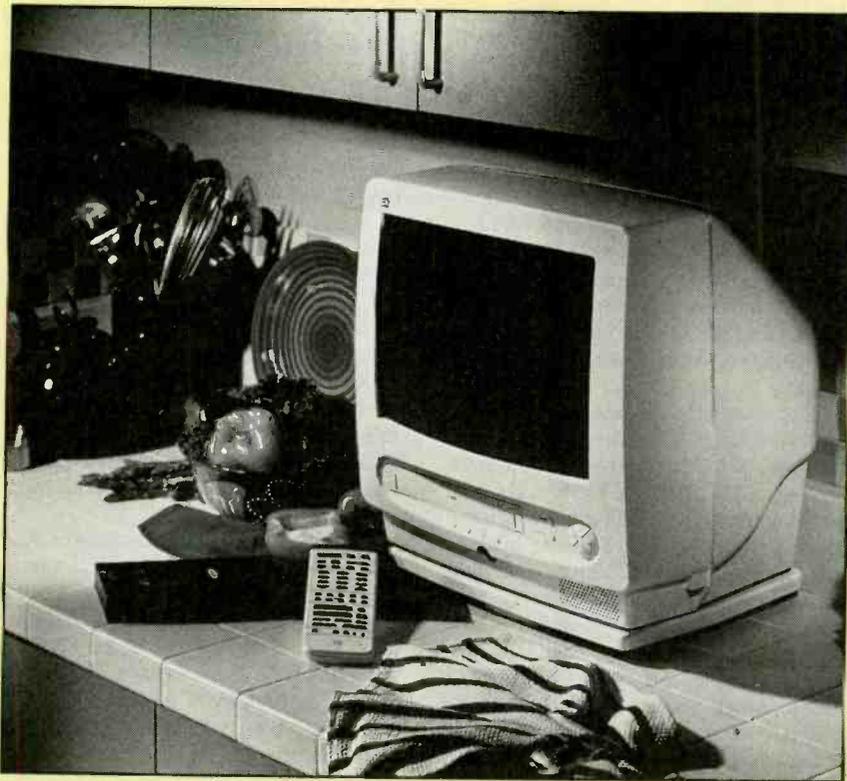
Gone are the days when kitchens were strictly for cooking and eating. Today's kitchens have become the focal point of our homes—the place where kids do homework and school projects, parents pay bills and keep up with correspondence, the family reads the Sunday papers, toddlers play, and everyone relaxes, whether or not food preparation or eating is involved.

Of course, none of those activities top the list of favorite leisure-time activities. Let's face it—most of us spend a good deal of our spare time watching television. So it's not unusual to find a TV in the kitchen. What is unusual, however, is to find a video product that's been designed specifically for use in the kitchen. That's just what Thomson Consumer Electronics had in mind for its combination TV/VCR dubbed the *GE KitchenVision*™.

Actually, the KitchenVision is a fairly standard-issue TVCR, with a few exceptions. First, its cabinet is white, to match today's popular lighter, brighter kitchens. Second, it comes with its own matching lazy Susan, so that the cook can easily spin it toward the food prep area while making dinner, and then point it back toward the table or sofa for more relaxed viewing. It also comes with Velcro mounting strips for its remote control, presumably to help keep the remote out of the soup and in plain sight. Finally, it comes with a cooking video—*The Frugal Gourmet's Fancy Chicken Dishes*—and a catalog containing hundreds of other cooking and entertaining videos, many of which are not available in stores.

So, in reality, it's the packaging that sets the KitchenVision apart from other TVCR's—and let's not downplay packaging. In a crowded market, it can make or break a new product.

The idea is clever: Cooking videos and cooking shows are extremely popular, but their lessons are difficult to put to use



unless you have a VCR in the kitchen. Yet most of us simply don't have the space, or the inclination, to mess with the wires and hookups involved with keeping both a TV and a VCR in the kitchen—not to mention the tangles that can result when you continually turn the video gear to face first the cooking area, then the dining area, and back again. The all-in-one KitchenVision, with its lazy Susan and bonus video, presents a tidy, practical solution to kitchen video.

The smartly packaged KitchenVision fills a niche that most of us didn't realize existed!

The KitchenVision combines a 13-inch color television with a 2-head VCR. As is common in TVCR's, the screen perched atop the VCR portion gives the unit a somewhat ungainly appearance (particularly if it is replacing a more compact, TV-only unit). The tape compartment is located at the lower left of the unit, with VCR controls arrayed below it (REW, PLAY, FFWD, and RECORD, along with LED indicators labeled TIMER and REPEAT) and to its right (STOP/EJECT). Also on the lower right of the unit are the POWER button and, arranged in a circle, the volume- and channel-up and -down buttons. A monaural speaker is found below the volume/channel controls.

Setting up the KitchenVision is a simple matter of connecting it to an antenna or cable system (the manual provides clear, illustrated directions for the technically challenged) and then setting the time and date. On-screen program-

ming makes that process a snap. It's also possible to connect another VCR or a camcorder to the KitchenVision's A/V rear-panel input jacks for copying and editing tapes.

On-screen programming also walks the user through the steps needed to place in AutoProgram memory the channels he or she wants the KitchenVision to stop on when either CHANNEL UP or CHANNEL DOWN is pressed. Selecting channel auto set from the on-screen menu allows the user to, first, select the antenna system (cable or antenna) and, second, to add or delete channels from the AutoProgram memory. (Programs that have been deleted from AutoProgram can still be accessed by pressing in the channel number on the remote control's numeric keypad.)

With front-panel controls limited to the basics, most of the TVCR's functions can be accessed only via the remote control. (It's a good idea to make use of that Velcro mounting strip so that the remote doesn't get lost in the clutter of the kitchen!) The buttons on the remote are grouped according to function, and it's relatively easy to find the button you need among the 50-odd that are found on the remote.

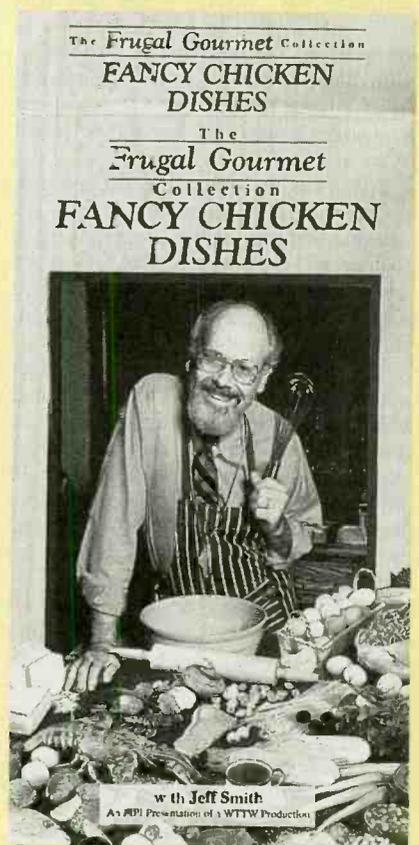
Pressing any function button causes an on-screen display to automatically appear, indicating the function or channel number selected. Pressing RECALL displays the function, time, channel number, time counter, and tape speed when in VCR mode; in TV mode, just the channel is displayed.

Besides the basics, the remote offers

controls for channel search, closed caption, sleep timer, and video adjustments. By pressing CHANNEL SEARCH, the KitchenVision automatically scans through all the channels in AutoProgram, pausing on each one for a few seconds. Closed captioning is accessed through an on-screen menu, which offers the options of turning the captioning on or off, or turning on the text mode. (When a station broadcasts text information such as program listings, it will appear in a block at the bottom of the screen.) The sleep timer allows the viewer to set the TV to turn off automatically after 30, 60, or 90 minutes. Brightness, picture, sharpness, color, and tint can be adjusted using the remote control to manipulate on-screen bar-graphs.

The remote is also used to control the VCR functions, which range from the basics—play, fast forward, rewind, pause, and record—to such special features as monitor, stop action, slow motion, frame advance, commercial scan, double-speed play, repeat tape play, record-end and time search, memory stop, and two different unattended recording options.

Many of those features are used during playback of tapes. Monitor, for instance, allows the user to monitor a TV channel during playback by putting the tape into pause and tuning the TVCR to the desired



The GE KitchenVision comes with an instructional video: The Frugal Gourmet's Fancy Chicken Dishes.

channel. Stop action allows you to stop a tape in mid-action to view a frame more closely without the jitter associated with paused action. The tracking button can be used to obtain a clearer stopped picture. Frame advance lets you view one stop-action after another.

Pressing the SLOW button puts the playback into slow motion. The slow-motion speed can be increased or decreased using the SLOW-UP and SLOW-DOWN buttons.

During playback, the x2 button plays the tape back at double speed. Pressing the F.ADV/CS. button fast-advances the tape in 60-second increments—particularly useful for bypassing commercials.

The KitchenVision offers a few ways to search for a particular tape segment. Time search allows the viewer to search forward or reverse using a specified amount of time. Record-end search automatically locates the point on the tape where a recording ends and a blank portion of tape begins. The memory-stop feature allows the user to quickly return to a timer-counter reading of 0:00:00 (which can be obtained by pressing CLEAR/RESET to reset the timer-counter) The timer is automatically reset to zero whenever the tape is inserted.

One of the few complaints we had about the KitchenVision was that its tape compartment was “sticky”—just the right touch was needed to get the tape to be accepted by the mechanism. Pushing it with too firm or too light a touch resulted in it sticking halfway in. A press of the STOP/EJECT button was needed to release it to try again.

(To be fair, we weren't the first to review this particular KitchenVision unit. It's possible that previous reviewers managed to “gop up” the works, particularly if they were using it in its intended environment—the kitchen—with all its potentially sticky hazards.)

The KitchenVision's two unattended recording options are One Touch Recording (OTR) and timer recording. OTR can be used to begin immediate or delayed recording in recording times ranging for 30 minutes to four hours. The STANDBY button is used to delay the beginning time in half-hour increments to any time up until 11:30 PM of the following day.

Timer recording is more versatile, allowing you to record up to four different programs within a one-month period. Setting a timer recording is done in the standard way, using the numeric keypad on the remote control to “fill in the blanks” for start and end times, channel, speed, etc. in the on-screen menu. You can choose one-time, daily, or weekly recording.

Although there's nothing tricky or difficult about the process, the KitchenVision does have one annoying quirk when it comes to timer recording. After you've set

the proper recording parameters, you must press the TIMER button to actually set the timer. That wouldn't be a problem, except that, with the timer activated, you can't use the VCR portion for anything else—not even to rewind a tape. Pressing TIMER a second time deactivates the timer, allowing the VCR to be used for OTR recording, playback, etc. But there's no reminder to press the button yet again, to reset the timer to record the shows you don't want to miss. (Yes, we missed one or two programs before we got used to the TIMER button!)

That, and the sticky tape well, were our only complaints about the KitchenVision itself. We would have preferred a different cooking video, however. The Frugal Gourmet's tapes don't include printed recipes, making it difficult to follow the instructions without spending \$22 for *The Frugal Gourmet Cookbook* (conveniently sold through the included catalog).

We set the unit up, as intended, in a kitchen. Perched on its lazy Susan on a four-foot-high counter between the cooking and eating areas, the KitchenVision provided clear, unobstructed viewing from anywhere in the room. The lazy Susan is a wonderful add-on; spinning the TVCR to the proper viewing angle couldn't have been easier. And cooking along with an instructional video—using a remote control to pause or rewind whenever necessary—was a vast improvement over trying to keep up with TV chefs in real time (how do they cook so fast?).

Of course, the KitchenVision need not be strictly relegated to the kitchen. A TVCR is a good solution for video in dorm rooms, studio apartments, a teen's room—just about anyplace where a home-theater experience is not a necessity. And, with a few how-to cooking tapes thrown in, the KitchenVision would make an ideal gift for newlyweds or anyone moving away from home (and Mom's cooking) for the first time. ■

## GIZMO NEWS

(Continued from page 14)

ator in House Springs, Missouri spent under \$1500 for a self-installed Zenith projection TV, Pioneer laserdisc player and A/V receiver, an RCA hi-fi VCR, and Infinity and JBL speakers.

A professional home-theater installer spent over \$5000 to install a custom-designed Victorian-style home theater that included a Harman video projector with line doubler, a 100-inch film screen, a Yamaha A/V processor, four Parasound power amplifiers, a Mitsubishi S-VHS hi-fi VCR, a Pioneer laserdisc player, and more. ■

## Write On!

**GRAFFITI HANDWRITING RECOGNITION SOFTWARE.** Published by: Palm Computing, Inc., 4410 El Camino Real, Los Altos, CA 94022. Price: \$79.

When Apple's Newton MessagePad PDA, or personal digital assistant, was first introduced, it was panned almost universally because its most highly touted feature—handwriting recognition—was abysmal. Even though the latest release of the Newton MessagePad has substantially improved recognition (see last month's *Gizmo*), it's still far from perfect. It is not practical, for example, to take quick notes on the MessagePad.

When Tandy and Casio introduced their Zoomer PDA, they chose to recognize printed characters only. Cursive writing was not allowed except as “electronic ink.” The same was true of the Personal Communicator from the now-defunct Eo Corp., a subsidiary of AT&T.

The most recent announcement of a PDA-like device is the Magic Link personal communicator from Sony in cooperation with AT&T and General Magic. Realizing that “handwriting recognition is still a few years off,” no attempt was made to equip the device to recognize handwriting at all. An on-screen keyboard is used to input text. Other messages are stored as electronic ink.

True cursive handwriting recognition might be a few years off, but *Graffiti*, new software from Palm Computing, promises perfect recognition 100 percent of the time. The real surprise is that it delivers.

*Graffiti* is available in versions to support the leading pen-based computing platforms including Apple's Newton, General Magic's Magic Cap, Geoworks' GEOS, Microsoft Windows for Pen Computing, Microsoft Winpad, and PenRight!. We tested a pre-release version for Newton on Apple's MessagePad 110.

*Graffiti*'s virtually perfect recognition capability is possible because it works with a simplified version of the alphabet. Although most letters are written just as they normally are, others are modified slightly. Only one letter, K, is written significantly different; it resembles the lower-case gamma.

Letters are written the same way for upper and lower case. The proper case is handled by shift “keys” or strokes. Learning the letters is easy. According to Palm Computing, most users become competent with *Graffiti* in less than twenty minutes. It didn't take us even that long.

Having to learn a special character set might seem like a major obstacle, but it's not. It's certainly less difficult than learning how to type. People are willing to learn

the QWERTY keyboard layout that was designed specifically to be difficult to use—proficient typists tended to jam the mechanisms of early manual typewriters by typing too fast. The QWERTY layout slowed them down sufficiently.

Although we came up to speed quickly on Graffiti, we did have a couple of trouble spots with it. The letter “N,” for example, was difficult to get used to because of the way the letter must be written. Normally, we write our “N” with a downstroke for the letter’s left vertical edge. We then either retrace the left edge with an upstroke, or lift our pen to create the diagonal and right edge. With graffiti, however, the letter must be written by starting at the bottom of the left edge—sort of like writing the letter “Z” on its side. If we wrote the

letter N the way we would write it on paper, Graffiti translated it as “H,” which is entered as a lower-case h.

We also had a little problem with the letter “U.” We couldn’t seem to resist adding a tail to it. We also had a tendency to write the letter F backward, the way we normally write our capital “F.”

Learning Graffiti’s character set is a relatively small price to pay for the accurate recognition it delivers. The character set works to remove any ambiguity between characters that are written. Traditional recognition schemes, for example, have trouble guessing whether a user has entered an l, an L, or the numeral 1. Graffiti removes the ambiguity by making the l and L distinct characters. Although the numeral 1 is written just like the letter l, it is recognized

as the numeral only when Graffiti’s NumLock is active.

The only numbers that gave us trouble were 4 and 5. The 4 is written just like an L—the downstroke that we normally put in resulted in our 4 being interpreted as 41. Our 5—because we normally put the top stroke on last—was often interpreted as 5 followed by a space, or in some cases, a 5 followed by the numlock shift. The slight changes required for writing numbers in Graffiti’s style were very easy to adapt to. And because the feedback is virtually instantaneous, it’s possible to correct entry errors immediately. A backspace gesture or stroke erases the character. The effect is similar to typing. Often, we realize that we’ve made a typo as we’re typing it and immediately reach for the backspace key.

The response time can be quick because there is no context or multi-stroke ambiguity that Graffiti has to interpret. For example, a traditional recognition system might have trouble determining whether a user has written the letter K or the letters IC, or whether the user has written the letter B or the number 13. Most of the characters in Graffiti are made up of a single stroke.

Graffiti for the Newton MessagePad is supplied on a single high-density floppy disk. The Newton Connection Kit and a Macintosh or IBM-compatible PC are required for installation.

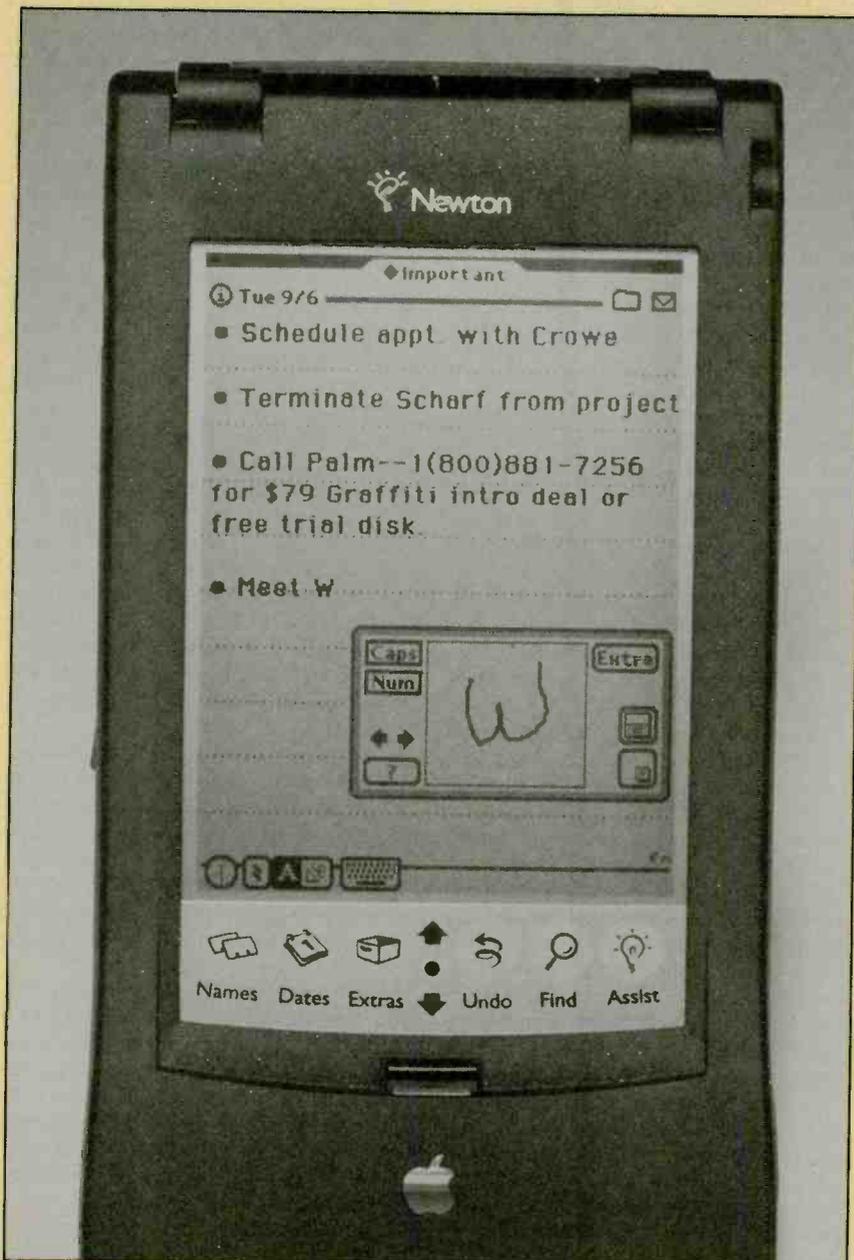
The package consists of four modules: Graffiti itself, a Graffiti tutorial, a help file, and ShortCuts, which allows users to create macros so that complete sentences can be called up with a couple of pen strokes.

A minimum of 83 kilobytes of free memory is required to install the main application on a Newton MessagePad. The help file is about 34 kilobytes, the tutorial about 107 kilobytes, and the ShortCuts application is about 22 kilobytes. Only the main application needs to be installed to use Graffiti. Graffiti is somewhat smaller for the other platforms on which it runs.

Even though we had a pre-release version and did not have a user’s manual, we found Graffiti easy to use. Any questions were answered by the help file and tutorial.

Graffiti has two basic modes of operation. In the first, it runs as a small box that measures about 1×2 inches. The actual text-entry area is an inch square, and is surrounded by several control “buttons.” The box runs in front of all Newton applications. Letters that are entered appear as text at the insertion point in the application. For example, if you bring up the Newton Date Book and set the insertion point at 11:00 by tapping on the screen, then any text entered in Graffiti will appear at the 11:00 entry.

The second way to operate Graffiti is in its Scratchpad mode. Anything entered will be placed on the scratchpad. Then,



### Graffiti Reference Card

**Letters**

A B C D E F G H I J K L M  
 N O P Q R S T U V W X Y Z

Space Back Space Return Caps Shift Caps Lock ShortCuts

**Numbers**

Number Lock = ✓

0 1 2 3 4 5 6 7 8 9

**Common Punctuation**

Punctuation Shift = Tap Once (•)

period comma apostrophe question dash exclamation slash L paren R paren dollar

• Palm Computing, 1994. All rights reserved. Heavy dot indicates starting point.

**More Punctuation**

Punctuation Shift = Tap Once (•)

© # % ^ & \* < > - + = 1

tab

**Extended**

Extended Shift = ✓

• TM ® ©

+ - x ÷ = e v f l i

B A H n Σ O S 8 Q

**International**

To enter these accented letters:  
 á â ã ä å æ ç è é ê ë ì í î ï ð ñ ò ó ô õ ö ÷ ÿ ÿ, draw the letter then the accent stroke below.

Graffiti also supports the characters below without shifting.

ç æ

Part no. 400-0005

The Graffiti character set is easy to learn.

with the Newton Clipboard feature, the text can be moved or copied to any application.

Graffiti also gives easy access to extended characters, for example, signs for the yen or British pound, mathematical symbols, pi, sigma, omega, and more. International accented letters are also available with simple strokes. Although it's easy to forget the proper way to call up characters that you don't use frequently, a quick reference card is provided with the software, and an on-screen reference can be displayed with the tap of the pen.

Palm Computing estimates that users can enter text at speeds up to 30 words per minute. We can't print that fast, but we don't doubt that it's possible because of the speed of the translation. As soon as

you lift the pen to begin the next letter, it is translated to text. Letters can be written right on top of each other—there's no need to move your hand across the page. Best of all, you don't have to look at what you are writing; instead, you can watch the screen where the text is being inserted. That "heads-up" entry is similar to touch-typing.

Graffiti is an elegant solution to the problem of handwriting recognition. We couldn't use it to take notes during, for example, a presentation—we can't print fast enough. But for text entry, it is a good choice. It's far quicker than tapping away on the Newton on-screen keyboard, and it's accurate—100% accuracy isn't an exaggeration. The only mistakes that Graffiti made during our test were due to insufficient pressure on the Newton screen. ■

## Portable Potent Potables

**PARKER'S ELECTRONIC WINE GUIDE and THE ELECTRONIC BARTENDER'S GUIDE.** From: Franklin Electronic Publishers, Inc., 122 Burrs Road, Mt. Holly, NJ 08060; Tel: 609-261-4800; Prices: Wine Guide, \$79.95, Bartender's Guide, \$59.95.

Imagine that you've been "volunteered" to host a dinner party with a guest list that includes your boss, a couple of important out-of-town clients, and their spouses. If you're lucky, your wife will handle the cooking and set the table attractively. But don't think you can get away with just the cleanup at the end of the night. Your position as host demands that you play bartender for the evening.

Again, if you're lucky, your guests will request simple drinks—scotch on the rocks, a screwdriver, a wine spritzer. On the other hand, your boss might be a connoisseur of wine, and his wife's drink of preference could be a Kir Royale. In the worst case scenario, your out-of-town guests might consider any nighttime socializing on their business trip to mean serious partying, along the lines of Long Island Iced Teas or Hurricanes. That leaves you with the daunting tasks of selecting the right wines for pre-dinner sipping and to accompany each course of the meal, and somehow coming up with close approximations of some exotic drinks.

Before you decide to give up and offer only Bud and Bud Lite—or to tell everyone that you and your wife are Pioneers who don't drink or serve alcoholic beverages—take a look at the *Parker's Electronic Wine Guide* and the *Electronic Bartender's Guide*, two pocket-sized ref-

erence devices from *Franklin Electronic Publishers*. Between the two, you'll be able to select the proper wines to serve with every course, and you'll learn not only what goes into a Long Island Iced Tea, but what type of glass to serve it in.

### VERITAS IN VINOS

Let's take a look at the Wine Guide first. According to the manual, the Wine Guide is "intended to make you a more formidable, more confident wine buyer by providing you sufficient insider's information to permit the wisest possible choice when a wine-buying decision must be made." Although the Wine Guide doesn't list every vintage from every winery, it gives a thorough overview of "the best and most consistent" wine producers from around the world. That way, even if the precise bottle of wine on the shelf (or menu) isn't listed, you can take a look at the vineyard's track record and have a pretty good idea of what to expect. (Unless, of course, that particular year was absolutely terrible.)

Based on the book written by Robert Parker, one of the world's foremost authorities on wine, the Wine Guide puts definitive information about more than 6000 wines literally in the palm of your hand. It measures just 4 3/8 x 3 x 1/2 inches and weighs 3.6 ounces, so it's easy to carry in a shirt pocket or a purse when you're shopping for wine or dining out.

Opening the protective cover reveals a screen with a 24 x 127 continuous-pixel display. (The screen is not backlit, so don't plan on using the Wine Guide in a dimly lit restaurant!) Beneath the screen is a QWERTY-style keyboard and several function keys. Like most tiny keypads, this one is not easy to type on. But inputting is generally limited to the type of wine or the vineyard. You don't have to worry about spelling, and in many instances typing the first few letters of your choice will do—Franklin's spell corrector takes care of the rest.

When the Wine Guide is first turned on, a tutorial plays, clueing in the new user to its many features. Pressing the WINES button and then CLEAR stops the tutorial and calls up the main screen, in which you can input the name of the wine (cabernet, chardonnay, etc.) or the winemaker. (Once you become familiar with the Guide, the tutorial can be disabled.)

When you've entered your selection, the top line of the screen changes to a menu bar. At the far left side of the bar it notes the number of matches found for your choice (generally, dozens or even hundreds if you've input a type of wine, and one if you've selected by winery name). The matches appear listed in alphabetical order under the menu bar.

We began by typing in "chardoney." After correcting our spelling to "chardon-

ay," the Wine Guide brought up 245 matches, listed by winery name. You can scroll through the list using the arrow keys or by hitting alpha keys to jump it to a particular label. When you reach a vineyard of interest, pressing ENTER calls up more information. If the winery features more than one chardonnay, you can scroll to the one you want and press ENTER again.

The Wine Guide then lists the name and location of the vineyard, the name of the wine, its vintage, its price range, and its rating. Using the down arrow, you can then scroll through text about the vineyard and its offerings. The coverage of each vineyard is extensive and, unfortunately, its chardonnays might not be the first wines covered. In many cases, you have to keep scrolling, and scrolling, before coming to the description of the wine you're considering buying.

While scrolling, you come across many interesting, entertaining descriptions. "The huge smoky, bacon-fat-scented nose delivered aromas of ground beef, leather, and massive black fruit," read just part of the text on a Syrah from Edmunds St. John's, for instance. The text also generally lets you know whether a wine should be drunk right away or stored for a few years, and what types of food it will complement.

You certainly won't want to go through that scrolling and reading process with all 245 chardonnays before making your purchase selection! Luckily, the search can be limited by opening the pull-down menu found under the "locate" heading on the menu bar. It allows you to limit your current search by inserting parameters in one or more of the following areas: variety name, country, area, growing region, producer rating, vintage, price range, wine color, and rating range.

Robert Parker's wine ratings can be compared to grades in school. A rating of 90-100, "given for outstanding or special effort," is the equivalent of an A. "Many of the wines that fall into the 80-89 range"—equal to a B—"are great values." An average mark is 70-79, the equivalent of a C grade. A rating below 70 represents a D or an F, "the sign of an unbalanced, flawed, or terribly dull or diluted wine."

To limit your search, for instance, you might want to consider only chardonnays from California (214 matches), in the \$10-\$15 price range (71 matches), rated 85+ (34 matches). That is a much easier list to peruse.

Two other headings are found on the menu bar. Under the "Topics" heading are found essays on a wide variety of wine-related topics. Those include Parker's discourses on "Collectors Versus Consumers"; "Destroying the Joy of Wine" (by excessive acidification and filtration;



"Food and Wine Matchups" (no longer red wine with meat, and white with fish and fowl—now it's simple wines with complex dishes, and complex wines with simple dishes); how to buy, serve, and store wine; organic wines; additives; pricing ("The Inflated Wine Pricing of Restaurants" and "Wine Producers' Greed"); "How Much Aging?"; "Unspeakable Practices" (basically, storing and shipping wine under extremely hot or cold conditions); and "The Greatest Wines I Tasted." Quality considerations, buying strategies, and other subjects regarding various wine-producing areas are found under the subhead "Viticultural Information." Other subheads include "Glossary," with definitions of wine terms that might be unfamiliar to neophytes like us; and "Maps" of various growing regions. (The latter two categories can also be accessed via separate function keys labeled GLOSSARY and MAPS, as can information on growing regions using the REGIONS key.)

The final menu bar heading—"Other"—is used largely for "house-keeping." It allows you to enable or disable the opening demonstration, and to select the length of time before the Wine Guide's automatic shutoff kicks in. An on-screen tutorial is also found there.

#### PORTABLE HAPPY HOUR

We must admit that our familiarity with cocktails is less than our knowledge of wine. We rarely frequent bars, and our drinking usually consists of a bottle of wine with dinner, and beer during football games, casual get-togethers, and summertime chores. We'll order margaritas or sangria when eating Mexican food, a Bloody Mary with brunch, and have ordered tropical concoctions when on vacation, but that's the extent of it.

John J. Poister, author of *The Bartender's Guide* (New American Library, 1989) upon which Franklin's electronic version is based, takes his drinking seriously. He considers bartending, or mixology, an art, and a good bartender the equivalent of a fine chef. The Bartender's Guide can be used casually, to learn how to make exotic drinks, or it can be studied by anyone who wishes to become a "master mixologist."

The Guide provides recipes for more than 2200 drinks, listed alphabetically from Aalborg Sour to Zorro. Each recipe includes ingredients, mixing instructions, and serving tips, including a drawing of the proper glass to use. You can scroll through the list using the arrow keys, or can type in the name of the drink you want. It's not necessary to type the entire name; each press of a letter key brings you closer to the selected drink.

When you first begin to use the Bartender's Guide—after viewing and disabling the opening on-screen demo—you're sure to want to scroll through the drink list just to view some of the more interesting entries. The list can be accessed either from the on-screen menu bar, or from the DRINK function key, located above the QWERTY-style keyboard. We scrolled through 33 cocktails before we came across one we'd heard of (or so we thought): Alabama Slamma. As we continued down the list, however, it turned out that number 34 was the Alabama Slammer, the one we really recognized, which bore no resemblance to the "Slamma."

Unusual drink names included "Death in the Afternoon," which you'd probably want to chase with a "Corpse Reviver." Many were named for famous, or infamous people, including Douglas Fairbanks, Mary Pickford, Martha Washington, Cole Porter, and Al Capone. There

was the Marconi Wireless, and the Lady Lovely's Chatter.

The host at our hypothetical dinner party would have been relieved to learn how to make a Hurricane—assuming, of course, that he had on hand passion-fruit syrup to mix with light rum, gold rum, and lime juice. He probably wouldn't have had to prepare more than one or two Long Island Iced Teas, which include a half-ounce each of gin, vodka, white tequila, and white rum; and a quarter-ounce of white creme de menthe, all mixed with some sour mix and cola.

As entertaining as it is to scroll through the drinks, the rest of the options provide still more information on bartending. Like the Wine Guide, the Bartender's Guide's menu bar offers a host of pull-down menus filled with information and tips. Under the Locate heading are submenus of ingredients and attributes. You can select ingredients to limit your drink search. For instance, tagging gin and lime limits the list of drinks to seven, including the familiar (a Gin Rickey), and the unexpected (a Coco Loco). Gin and Tonic was not included, perhaps because the lime wedge, while a standard ingredient, is just a garnish.

To find Bloody Mary variations, you could tag vodka and tomato juice, or you could select that option from the attributes submenu. Almost all of the 18 selections started with the basic vodka and tomato juice (or V-8) and then added special ingredients. There was the Bloody Blossom (with orange juice), the Bloody Brew (with beer and a dill pickle spear), the Bombay Mary (with curry powder and ground coriander), the Borscht Belt (with beet borscht), the Broody Maly (with sake), Mel Torme's Bloody Mary (mixed in a blender with cucumber, Bermuda onion, and celery), and the Smoky Mary (with barbecue sauce).

Other selections under the attributes subheading included flavored vodkas, hot drinks, martini variations, nonalcoholic drinks, and punches (any of which would surely liven up the typical bridal or baby shower!).

Most of the meaty information about the art of mixology can be found under the menu-bar heading "Topics." Besides a glossary and measurement information (including bottle measurements and old-bottle measurements), subheads include liquors, how-to, and hints.

Each of the spirits listed under liquors is the subject of one or more essays. For instance, for vodka you'll find "The Great White Spirit," "Bloody Mary Lore and Variations," "Martini Variations," "Flavored Vodka," and "The Light Drink Concept." Not to be confused with the martini variations found under the attributes subhead, here you'll find a discussion of the history of, and the proper techniques for mixing and serving, vodka-based martinis.

"How-To" is a bit of a misnomer; the material presented in its essays goes well beyond how to mix, taste, and serve cocktails. In "How to Make a Good Drink," after lamenting the passing of the "golden age of cocktails" (the 1930's and 40's), the author focuses as much on bartending philosophy than technique. Other essays include "When and How to Pour, Stir, Shake, and Whirl!"; "Tools of the Trade (Basic and Optional)"; "What's in a Name"; "A Word About Mixers"; and "The Secret of Every Well-Made Drink (and the Most Often Ignored)"—using the proper amount of good ice.

Finally, there's a list of 39 hints for everything from serving beer to precautions to take when preparing flaming drinks. (Did you know that if you glue swatches of carpeting to your coasters, the coasters won't stick to the bottom of your glasses?)

## LAST CALL

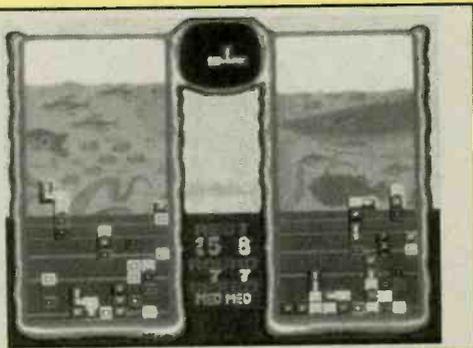
We enjoyed using the Wine Guide, as did the proprietor of our local liquor store, Bill, who tried it out for a week or so. Bill's complaints were similar to ours—the wines included in the guide were often not represented on his stores, (well-stocked) shelves, and vice versa. Locally grown Long Island wines—relative newcomers that are quickly gaining respect among connoisseurs—were mentioned in the Regions section, but no Long Island labels appeared in the search list.

All in all, the Wine Guide is an entertaining Gizmo for those who appreciate, and would like to learn more about, fine wines. We expect it to do well in its ROM card version for Franklin's Digital Book System (which has been selling well with doctors, who generally can afford to buy fine wines). However, it can not replace a knowledgeable wine-shop proprietor, or an experienced restaurant sommelier.

We also had quite a good time with the Bartender's Guide—particularly looking up some of the more unusual drinks. Our favorite (name, not drink): the Canadian Dog's Nose, in which Canadian Whiskey, tomato juice, Worcester and Tabasco sauces are shaken with ice, poured into a large glass, and then topped off with beer. No, we don't intend to try it, or most of the other concoctions listed. But we suppose it can't hurt to know how to make it, should the need ever arise.

Of course, for the professional bartender, the need to mix an unusual drink occurs fairly often. And many so-called "professional" bartenders could benefit from the pointers—and the philosophy—presented in the Guide's Topics section. It would certainly make sense to keep the Electronic Bartender's Guide tucked away safely (in a dry spot; the unit is not spill-resistant) behind the bar at any tavern or restaurant. ■

# ELECTRONICS WISH LIST



Tetris 2

## Return of Tetris

*Tetris 2*, sequel to the popular puzzle video game, is now available for the 16-bit Super NES system from *Nintendo of America Inc.* (4820 150th Ave. N.E., Redmond, WA 98052). With enhanced graphics and sound, the game features four tunes to choose from and amusing game graphics. *Tetris 2* requires players to reposition falling blocks both horizontally and vertically, as well as to match colors, as they drop incessantly from the top of the screen. Pieces of the new blocks are detachable and can be positioned with similar colors anywhere on the screen. The new version also offers players a "puzzle mode" and between-level cartoons. The puzzle mode challenges players to clear all the fixed blocks on screen by placing falling pieces in the correct positions. The cartoons "will keep even the most serious players laughing." Price: \$49.95.

# ELECTRONICS WISH LIST

## Going Up?

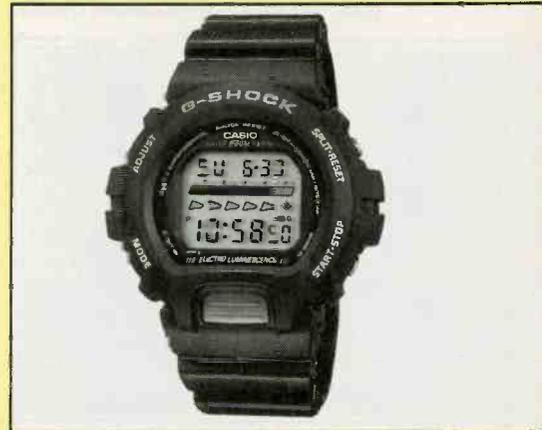
Sanyo's (21350 Lassen Street, Chatsworth, CA 91311-2329) *DC-D16* mini home-music system with six-CD changer features a front-loading elevator for CD storage and playback. The innovative CD changer puts more CD's in a smaller area, without the use of a magazine, using single-drawer loading. The system offers a center section that integrates amplifier, tuner, CD, and cassette functions, all controlled remotely. The digital AM/FM tuner has 36 station presets, a multi-function backlit LCD, and electronic volume control. BassXpander delivers added punch to lower frequencies at all volume levels. Other features include a three-band graphic equalizer, CD-to-tape edit recording system, and powerful three-way bass reflex loudspeakers. Price: \$399.99.



Sanyo Mir System

## Glow-in-the-Dark Watch

You can take the *DW6600* watch to depths of 200 meters and still see the time in total darkness, according to *Casio, Inc.* (570 Mt. Pleasant Avenue, Dover, NJ 07801). Part of Casio's Illuminator Series, the electroluminescence G-shock watch has a display that remains lit for three-plus seconds. The watch also features a countdown target timer. The daily alarm and countdown timer are indicated by the flashing "EL" on the watch crystal. Price: \$99.95.



Casio Illuminator Watch

## Dual-Tuner PIP Television

What to do now that "Home Improvement" and "Frasier" are on in the same time slot? The *NT-339* from *Proton Corporation* (13855 Struikman Road, Cerritos, CA 90703) is a 31-inch stereo monitor/receiver that features two tuners, making it possible to watch two programs simultaneously with no additional equipment required. The set's square, flat tube delivers an exceptionally clear, brilliant picture. The picture is enhanced by Proton's proprietary circuitry, which includes Dynamic Black-Level Extension, Automatic Brightness and Contrast Limiting, and Color Transient Improvement. The *NT-339*, which offers 600 lines of horizontal resolution, also features slow-motion and still-image options. Two full-range speakers and a "Heavy Bass" subwoofer, each with its own dedicated amplifier, assure clear, accurate audio-signal reproduction. The S-VHS-compatible monitor offers multiple rear-panel audio and video inputs and outputs, as well as front-panel inputs for convenient addition of peripheral audio/video equipment. Price: \$2400.



Proton Dual-Tuner PIP Monitor

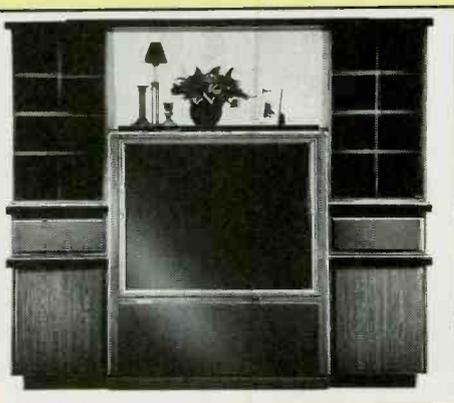
## Easy-Program VCR

With its Program Director remote control, the *VHQ48* VCR from *Quasar Company* (1717 North Randall Road, Elgin, IL 60123-7847) simplifies VCR adjustments and commands—including timer, clock, and date settings—through a series of on-screen instructions. The user is prompted through the entire process for easy, fool-proof operation and programming. After prompts appear on the TV screen, the user can make selections by rotating a dial on the remote control and pressing the PROGRAM button. The four-head, stereo VCR offers built-in MTS circuitry, allowing it to receive and record stereo television and separate audio broadcasts. VCR Plus+ circuitry further simplifies timer recording. A VCR/TV/CATV remote control operates all VCR and three major TV functions. Front-panel A/V input jacks make it easy to hook up a camcorder for playback or editing purposes. Price: \$429.95.



Quasar Easy Program VCR

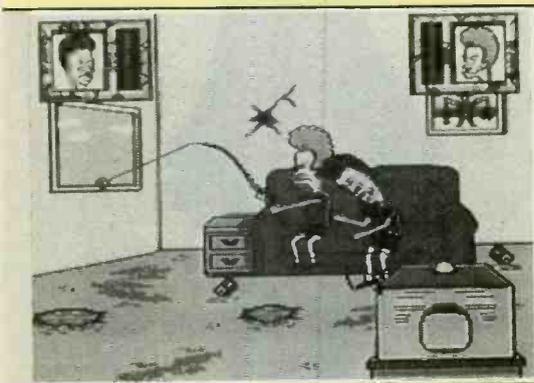
# ELECTRONICS WISH LIST



B-I-C America Home-Theater Center

## Home-Theater Furniture System

You can keep the clutter of all those home-theater components attractively under control with the *Cinema One Series AV-1* integrated home-theater center from *B-I-C America* (883-E Hampshire Road, Stow, OH 44224). The stylish entertainment center provides space for a 40–60-inch rear-projection TV, plus all the necessary components and speakers needed to bring a realistic movie-theater experience into your living room. Two wall units flank the large-screen TV cabinet, and the entire system is topped off with a sturdy horizontal piece that completes the fully integrated look. Two built-in compartments can hold the main speakers, and additional space is offered for a center-channel speaker. Adjustable shelves hold up to eight audio/video components, with ample storage space below for CD's, laserdiscs, or videotapes. The AV-1 is available in black or oak laminate finish. Price: \$899.



Beavis and Butt-Head Video Game

## Heh-heh-heh

If you can't get enough of Beavis and Butt-Head on MTV, you'll be happy to hear that they are now starring in their own video game. Published by *Viacom New Media* (1515 Broadway, New York, NY 10036), *MTV's Beavis and Butt-Head* game is available for Sega Genesis, Super NES, and Sega Game Gear platforms. The goal of each of the three versions is to help Beavis and Butt-Head secure tickets to see Gwar, their favorite heavy-metal band, although the game action varies in each version. Along the way, the two encounter other supporting characters from the TV show, including Daria, Stewart, and Principal McVicker. Prices: N/A.



JVC Easy-One Camcorder

## Point-and-Shoot Camcorder

For people who want to enjoy the benefits of video technology without its complexities, *JVC Company of America* (41 Slater Drive, Elmwood Park, NJ 07407) offers the *GR-EZ1* compact VHS camcorder. The camcorder provides point-and-shoot simplicity, with nothing to intimidate the first-time user. Convenience features include the QwikPix mode, which ensures that each take is five seconds long to create a lively tempo and save on tape and battery usage; Instant ReShoot, which automatically rewinds the tape to the start of the previous, unwanted take; and Seek, which automatically locates the point on a partially recorded tape where the blank tape begins. The LCD status panel atop the GR-EZ1 displays current operational status and a real-time tape counter; date and time can be displayed with the press of a button. The camcorder also offers a 3× power zoom, auto date marking, and VHS compatibility—compact cassettes can be played back on a VHS VCR using a VHS Playpak adapter. Price: \$699.



Sansui VideoSnap Video Printer

## Video Printer

The *VideoSnap* video printer from *Sansui USA Inc.* (1290 Wall Street West, P. O. Box 625, Lyndhurst, NJ 07071) delivers Polaroid Spectra pictures from camcorders, VCR's, television screens, or any other video source. The easy-to-use system makes it possible to take instant pictures from any video source at the touch of two buttons. Press the FREEZE button and, if you like what you see, press the PRINT button. A Polaroid print pops out in a second. VideoSnap is compatible with all NTSC composite video signals and uses standard Polaroid Spectra High-Definition film, which is sold at thousands of retail outlets nationwide. Price: \$600.



## MEI MICRO PREMIUM RMS 150+ REMOVABLE MASS- STORAGE SYSTEM



*Make your next computer upgrade one that will stick; add an infinitely expandable hard drive.*

**W**hen it comes to disk space, too much for today quickly becomes too little for tomorrow. In a multi-user environment, everyone wants their share of disk space, preferring isolation from other users; in a home-office situation, a businessman might compete with a joystick jockey for disk space, even if they're one and the same person. Also, for multimedia applications, disk space vanishes at a dizzying pace. Even though CD-ROM's can hold around 650 MB, their installation routines often dump several megabytes of data onto the hard drive.

Of course, buying multiple hard drives (one per user) is too expensive for most folks. Besides, unless you use portable drives, which are very expensive, that "solution" won't protect your data from other users.

Another solution is to use a removable-media drive. That type of drive remains in the system—only the magnetic media is portable. Because you can always purchase additional media, the "drive" is infinitely upgradeable. Also, because each user can have his or her own cartridge, everyone's data can be kept safe and secure.

Even though the last solution sounds

very promising, removable-media systems have not been cost-effective for most users. However, MEI Micro has changed that by introducing the *Premium RMS 150+ Removable Mass-Storage System*, which they sell directly for \$379.97 + \$3 for shipping and handling.

One thing that makes the RMS 150+ such a good value is an included, pre-formatted 150-megabyte cartridge, which you can boost to over 300 megabytes of storage by using a utility like *Stacker*. Because a comparable, plain hard drive (which runs about \$1 per megabyte) would cost around \$300 anyway, the convenience of having a removable drive only costs an additional \$100.

Furthermore, because 150-MB cartridges cost less than \$100 each, you can purchase additional media for under 66 cents a megabyte uncompressed, and 33 cents a megabyte compressed! With the purchase of one additional cartridge, you can get 600 megabytes of storage and the convenience and security of a removable drive for \$200 less than the cost of a comparable hard drive.

**Features.** The drive requires DOS 4.0 or higher and an external 5¼-inch

drive bay in a 286 or better computer. If you plan to boot the computer from the RMS drive, or if there's no hard drive in the system, the computer should have a user-configurable BIOS. If you run Windows, it should be version 3.0 or higher. Because the drive is IDE-based, it does not have a proprietary adapter card and therefore doesn't use up an adapter-card slot. However, it does use a connector on your computer's existing IDE cable.

In addition to the cartridge mentioned earlier, the RMS 150+ comes with an extra-long IDE cable, in case the one in your computer isn't long enough. It also has memory-resident drivers; software for installation, media maintenance, making back-ups, and caching; mounting screws; and paper-based and hypertext documentation.

The RMS is read/write compatible with Bernoulli 90- and 150-MB cartridges, and read-compatible with 44-MB types. With a mean-time-between-failures rating of 175,000 hours, it is no surprise that the drive carries a 5-year, limited media warranty. The low failure rating might be a result of the drive's automatic self-cleaning-head feature.

Like any hard drive, the RMS can be

configured as a boot drive, so every cartridge you own can boot your machine in its own way. That's great for multi-user (one disk per person) or multi-use (one disk per special application) setups.

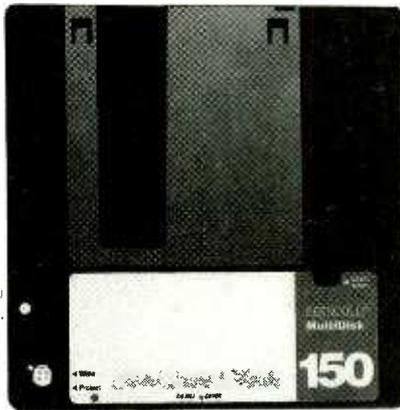
The drive's only disadvantage, when compared to a plain hard drive, is speed. The RMS has an 18-ms effective access time (which can be halved with the caching software), a maximum transfer rate of 15.33 megabits/sec, and a sustained transfer rate of 5.33 megabits/sec. However, the need for the drive can easily outweigh its slightly slower speed. To prove that, we ran some intense real-time graphics off an RMS 150+ with no user-apparent performance impact. That might be due to the unit's built-in 256 KB read/write cache, yet another plus.

In addition to being useful as a hard-drive substitute, the RMS makes a great backup drive. In fact, it can locate information for restoration much faster than a tape backup can. Furthermore, it simplifies making backups of subdirectories or entire volumes; instead of using a special program (as you would need to do for a tape backup drive), you simply issue a DOS "xcopy" command. However, if you like using special software, the included utilities can make backups and disk images.

The software can also spin-down the drive after a user-set period of inactivity. That saves energy, money, and the environment.

**Installation.** An IDE interface can support two IDE devices via a single cable. To keep the drives functionally separate, one is configured as the "master" and the other as the "slave" drive. In systems with only one IDE device, that drive is configured as the master by default. Because only a master drive can be used for automatic booting, there are three possible RMS configurations: the RMS as a non-bootable slave, as a non-bootable master, or as a bootable master.

The drive comes ready for use as a non-bootable slave, so let's discuss that type of installation first. To start, you have to remove the computer's cover and the drive bay's faceplate and shield. Then, slide the drive into the bay and secure it with the included screws. Connect the power



*Although this looks like a microfloppy on steroids, there is nothing "micro" about its storage capacity—300 MB compressed!*

and IDE cables, substituting the supplied IDE cable if needed. Finally, temporarily close-up the computer (put the cover back on, but do not fasten it) and reboot it.

Next, run a utility program to determine if the set-up is okay as is. In our case, the software detected that we had a plain hard drive, so the program automatically interrogated the drive's firmware for its model number and presented us with a drawing of the drive. The drawing indicated an area on the drive to look for jumpers, as well as what their proper settings should be. On checking the old hard drive we found that the diagram was correct and that one jumper needed to be set. We then set the jumper and closed up the computer.

We found software installation to be even simpler. It is handled by an installation program that prompts the user for some simple input. The program then updates your system files (AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, etc.) and copies drivers and utilities to your system. That completes the process of installing the RMS as a non-bootable slave drive.

The procedure for installing the RMS 150+ as a non-bootable master—which is useful if you don't have another IDE device—is similar. You start by disabling one jumper on the RMS-drive bootable master. Then you follow all the same steps for using the drive as a non-bootable slave. Again, use a utility program that checks for conflicts with an existing hard drive, if any, and tells you what to do.

To set the drive as a bootable mas-

ter, follow the instructions for non-bootable master use, but be prepared to boot your computer by floppy the first time it is powered-up with the RMS in place. Then you must make your computer's CMOS aware of the drive's operating parameters. To do that, you can run the computer's CMOS set-up program and enter the parameters by hand, or request the set-up program to autoconfigure the drive. Next, transfer the operating system to the disk using DOS's SYS command to make it bootable. The one drawback to that set-up is that the boot-cartridge capacity can't be doubled to 300 MB.

**Use.** The RMS 150+ is child's play to operate. Insert a cartridge into the drive as though it were a floppy disk or a backup tape. You should hear a solenoid lock the cartridge in place. That solenoid prevents you from removing a data cartridge while the media is spinning, which would harm the cartridge. As a security precaution, the solenoid also prevents someone from removing a cartridge when the machine is off.

Once a cartridge is inserted, a drive-status LED flashes to indicate that the drive is spinning up. Once spinning at the right speed, the drive is ready for use and the LED glows continuously. A separate LED indicates when the disk is accessed, like on a typical hard drive.

To remove a cartridge, you first press a button on the drive to indicate your intention. The status LED flashes as the drive spins down, letting you know your request is being processed. When the disk stops, the status LED remains off, the solenoid releases, and you can remove the cartridge.

All things considered, the RMS is easy to use, makes sense as an upgrade, and is easy to install. I think it's worth a look if you're in the market for more disk space. For more information on the drive, write to MEI Micro directly (see the "For More Information" box), or circle No. 119 on the Free Information Card. ■



# Be a computer programmer!

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# THINK TANK

By John J. Yacono  
Technical Editor  
Windows Magazine

## Answering Some Questions

In this month's tutorial we'll discuss our first component, the resistor, and its effect on current flow. Also, we'll take a look at how that component is shown in circuit diagrams, and the different types of resistors you're likely to encounter. After that, I'll answer some mail that has piled up.

As you might recall from last month, or already know, a resistor limits current when exposed to a voltage. To show that, let's say that a resistor is connected to a battery of voltage  $V$ . The current-limiting property of resistors is measured in ohms, so let's assume the value of our resistor is " $R$ " ohms. The current that will flow through the resistor, which we'll call " $I$ ," can be calculated from:

$$I = V/R$$

which is a variation of Ohm's Law (mentioned last month).

We can draw a diagram, called a "schematic," to illustrate how the battery and resistor are connected together (see Fig. 1). Although not normally part of

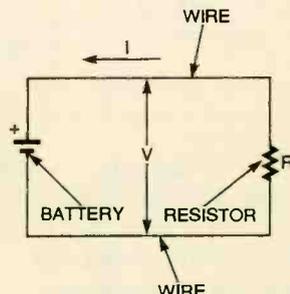


Fig. 1. This simple schematic shows a battery connected by conductors to a resistor. It indicates the voltage ( $V$ ) across the battery and resistor, as well as the current ( $I$ ) flow through both.

a schematic, some descriptive arrows and labels are included in Fig. 1 to help you understand what is going on. Note that the battery has a plus sign to indicate its positive terminal. Lines are drawn between the terminals of the parts to indicate wire connections. An arrow next to the " $I$ " is used to give the impression of electron current flowing through the wire. The arrows pointing away from the  $V$  indicate that there's a difference in voltage at the arrowheads equal to  $V$ . We'll use diagrams like that in the future.

Like the battery, a resistor has two terminals. However, a resistor doesn't have one side that's more positive or negative than the other, so it requires no polarity sign.

The most common types of resistors are shown in Fig. 2. The one in 2A is a low-power unit, the one in 2B is for medium-power use, and the resistor in 2C is used for heavy-duty applications. That raises the question, "How do you know which resistor to use in which application?" Well, a resistor's power rating and power in general is specified in watts. That's a measure of the amount of energy a component or device will dissipate per second. A resistor dissipates energy as heat. If we know how much current ( $I$ ) will flow through a resistor (of value  $R$ ), we can find out how much power it will dissipate as heat per second by using:

$$P = I^2R$$

where  $P$  stands for power in watts.

If we know the voltage across the resistor ( $V$ ) instead of the current through it, we can use:

$$P = V^2/R$$

to find the power dissipated.

Resistors shaped like the one in Fig. 2A typically can handle  $1/8$  or  $1/4$  watt. You can tell the wattage of such resistors by their size,  $1/8$ -watt units being very small in comparison to  $1/4$ -watt units. Sometimes you'll see such low-wattage re-

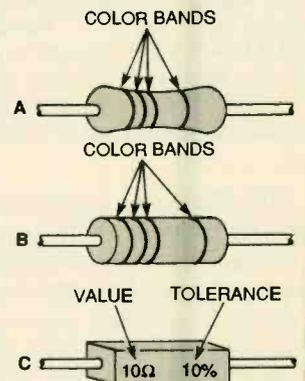


Fig. 2. Resistors come in low-, medium-, and high-wattage types. The difference is in surface area; because high-wattage resistors must dissipate more heat than low-wattage units, they have more surface area.

sistors in cylindrical form (like Fig. 2B), but that is rare, and even so, they are unmistakably small. Resistors like that in Fig. 2B are about the width of a pencil or larger, and can handle  $1/2$ , 1, or 2 watts, differentiated again by size. Resistors like the one in Fig. 2C range from 5 watts and up. Typically their wattages are printed on their bodies.

We'll pick all of that up next time. Now, let's get to some reader mail.

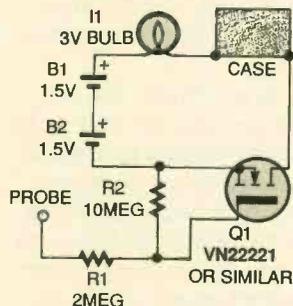
# Measure It All!

## The DMM/LCR Meter/ Frequency Counter. All in One.

### FET WANTED

In the April 1994 issue of **Popular Electronics**, you discussed an Auto-Wiring Tester (see Fig. 3). I want to build one but I cannot find transistor Q1 (a VN22221) anywhere. Can somebody please give me a replacement part number that will match up? Maybe a Radio Shack, SK, or ECG equivalent part is available? — *Walter S. Woodward, Raymore, MO*

*You really don't need a specific part. Almost any p-channel FET will work. I would suggest looking through your junk box for likely candidates and trying them out.*



*Fig. 3. This circuit is very forgiving of values. Almost any P-channel FET will work in place of Q1.*

### LOW-RF SWITCH

I have been receiving **Popular Electronics** for a year now and enjoy it very much. I am looking for an electronic lamp-dimmer circuit with a zero-voltage switching device to avoid producing the radio interference that store-bought dimmers often give off. I would appreciate it very much if you or one of the readers of this great magazine could provide me with a schematic of a suitable circuit. — *Kenneth Nawalkowski, NB, Canada*

*Actually, I wrote about what you need in the May 1994 issue. It appeared on page 53 and was called a "Soldering Iron Controller."*

**T**roubleshoot down to the component level — any component! Verify poorly marked parts, test for tolerances and damage. Wavetek's new DM27XT is not only a full-function DMM, but also includes complete inductance, capacitance, and frequency measurement capabilities.

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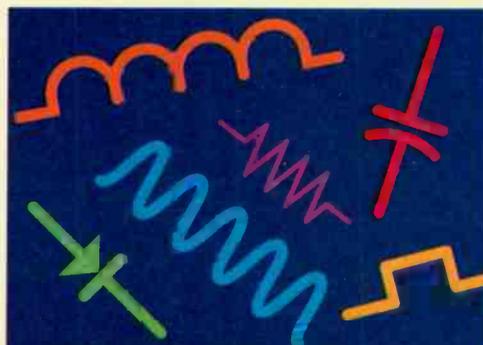
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# WAVETEK

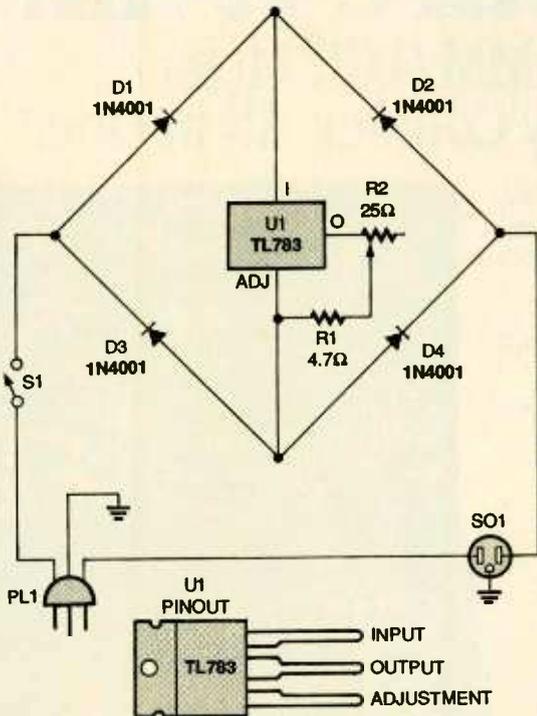


Fig. 4. This circuit uses an adjustable voltage regulator to control current, without producing significant RF interference.

but it will work with any AC device. It does not need a zero-crossing network because it is not based on a Triac. Instead, a current-limiting circuit (see Fig. 4) reduces the peaks of the AC waveforms. That is preferable to the action of a Triac in a light dimmer, which suddenly turns on and generates significant RF harmonics (even with a zero-crossing network) in all but the fully-on state.

### LABEL DILEMMA

For the Tuner Substitute on page 91, in the April 1994 *Popular Electronics*, what is the wattage of the resistors and the value of the capacitors in microfarads and their working voltage? What tuner should I use: UHF or VHF? — A. Burke, Brooklyn, NY

Unless indicated otherwise on a schematic or in a parts list, all the resistors in the magazine are 1/4-watt units. In schematics, the values of capacitors are given in microfarads unless other-

wise noted. The working voltage of capacitors below 1  $\mu\text{F}$  is typically not a concern because most low-value units can withstand at least a couple of hundred volts. For larger capacitors, I usually shoot for a working voltage 50% above the maximum the capacitor will experience under normal conditions in the application. In the case of the Tuner Substitute, that would be 18 volts, so any capacitor rated higher than that would be suitable. As for the tuner, select a tuner to match your needs. The thrust of the article was really the 5-volt power supply for the tuner.

### THE BASICS

I am very interested in building the TTL-based pinewood-derby judge that appears in the September 1993 installment of "Think Tank" (page 74) for our scout pack. Never having built an electronics project from "scratch," (I've always had instructions to follow),

there are a few questions that I need to ask.

The first question is: On the IC's, how do you know which pins are what number? The second question is: Immediately to the right of the component labeled U2-a, there is a capacitor that has no value assigned to it. How would I go about figuring what that value should be? Or was the information accidentally omitted?

Any light you can shed on these questions would be gratefully appreciated. Thank you for such an outstanding column and magazine. Keep up the good work! —Steven Granlund, Middleburg Heights, OH

I'd be glad to help. All chips have either a notch, a dot or both at one end. If you hold that end up, pin one would be the pin to

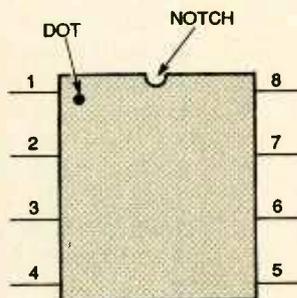


Fig. 5. Pin numbers on IC's start from the left of the notch or dot, and increase in a counter-clockwise direction around the unit.

the left of the dot or notch. The pin numbers advance as you work your way from pin one around the body of the chip in a counter-clockwise direction. (see the example in Fig. 5).

To answer your second question, the capacitor value was mistakenly omitted. The value is 1  $\mu\text{F}$ .

### LIGHT ADD-ON

As a long-time reader of *Popular Electronics*, I con-

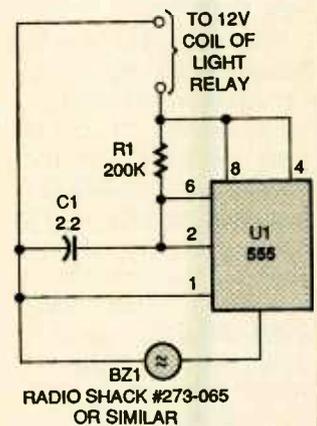


Fig. 6. The entire annunciator circuit shown here can be replaced with a discrete annunciator and resistor in certain circumstances.

tinually find both the "Think Tank" and "Circuit Circus" columns useful and stimulating.

Of particular note was the annunciator add-on for motion sensors submitted by Ron Sharpe of Regina, Saskatchewan appearing in the August 1994 issue on page 24 (see Fig. 6). Most motion-sensor units available in my area do not use a relay to switch the 120 volts for the lights; instead an optoisolator (i.e., a MOC3010) is used.

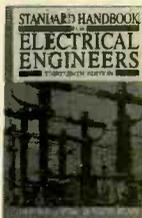
I am very interested in building a similar annunciator add-on for the optoisolator-switched type. Perhaps you or one of your readers could develop an appropriate circuit? Mr. Sharpe's idea is a good one because it doesn't need an external voltage source. Perhaps the solution is to parallel the optocoupler's LED to the input of an appropriate IC that can activate a separately powered buzzer-driver circuit? Any assistance would be appreciated. —Reid Wheeler, Olympia, WA

If the optocoupler's LED is in series with a current-limiting resistor, you could  
(Continued on page 86)

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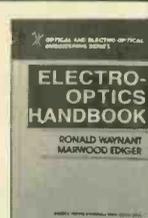
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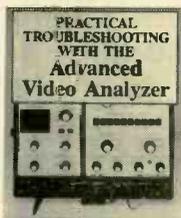
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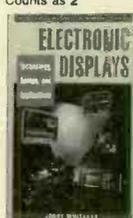
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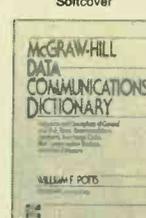
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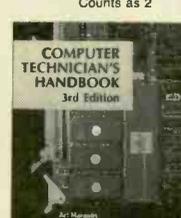
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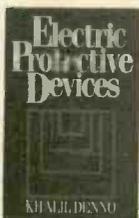
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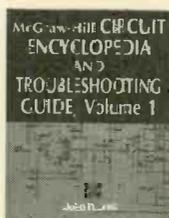
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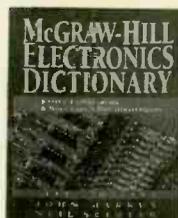
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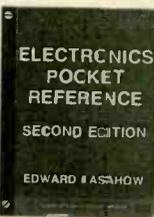
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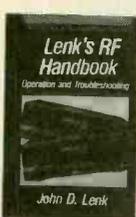
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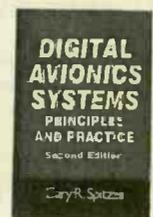
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# BUILD YOUR OWN FM TRANSMITTER

BY  
FRED BLECHMAN



*Build this FM Stereo Transmitter and become a local disc jockey, or just do away with excessive wiring around the house.*

**W**ould you like to be able to send good-audio-quality FM transmissions? Here is a device that will let you do just that. It is called the *FM Stereo Transmitter*, and it is definitely not a toy. With the proper choice of antenna, the Transmitter can broadcast up to a quarter of a mile, or more, with left and right channel separation.

You can use the unit to transmit your tape-deck or CD-player output throughout your house or yard, or even to a nearby car. The transmission can then be received on any broadcast-band FM radio.

Because the Transmitter broadcasts in stereo, it can be used for two-channel experiments and demonstrations. It uses from 3- to 15-volts DC power, has a crystal-controlled subcarrier for frequency stability, and can be built to transmit anywhere in the standard 88–108 MHz, FM-broadcast band.

However, there is one caution you must observe: **You cannot interfere with anyone else's broadcast FM reception.** See the "Frequency Range Selection" box for more on that restriction.

**Circuit Description.** Figure 1 shows the schematic of the FM Stereo Transmitter. The heart of the unit is U1, a BA-1404 FM stereo-transmitter IC. A block diagram of the BA-1404 IC is shown in Fig. 2. Internally, the chip accepts separate left and right audio-

input signals, and contains all the circuitry needed to create and transmit a multiplexed FM-Stereo signal on the FM-broadcast band.

The aforementioned FM signal consists of a main audio channel, which contains the combined left- and right-channel (L + R) audio information; a 19-kHz pilot subcarrier; and the difference-signal (L – R) sidebands, which are centered around a suppressed 38-kHz stereo subcarrier. That complete signal can be processed and demodulated by any FM-broadcast receiver. Monaural FM receivers reproduce left- and right-audio signals together through a single speaker (no stereo). Stereo FM receivers separate left and right audio to individual speakers for the stereo effect, or to provide two "channels" on the same FM carrier.

Now, back to the Fig. 1 schematic. The left and right audio signals are fed

into jacks J1 and J2. Those signal levels can range from the type that feed small speakers or earphones, to the line-level outputs normally fed to amplifiers. If you wish to use a microphone, however, you'll need to boost its output voltage with a pre-amplifier.

Because the input voltages can cover a broad range, potentiometers R1 and R4, together with resistors R3 and R6, and capacitors C1, C2, C4, and C5, are used to control the voltages at pin 18 and pin 1 of U1. That prevents overloading. The pre-emphasis characteristic (U.S. or European) is set by the values of R3 and R6, as described later.

The 3 to 15 volts of required power can be provided by either a battery (B1 shown in Fig. 1 is a 9-volt battery) or a well-filtered power supply. Silicon diodes D1–D3 are forward-biased in series, with a voltage drop of about 0.7 volts each, to provide a stable voltage of about 2.1 volts to power U1.

Potentiometer R7 permits the adjustment of the stereo balance. Crystal XTAL1, together with C7, C10, and U1's internal components, provide the 38-kHz subcarrier oscillator needed to carry the (L – R) sideband signals. Tunable inductor L1 and capacitor C16 form a resonant circuit to determine the operating frequency of U1's oscillator section. The value of C16 determines the frequency adjustment range within the FM-broadcast band, as specified later.

#### WARNING!!

The publisher makes no representations as to the legality of constructing and/or using the FM Stereo Transmitter referred to in this article. The construction and/or use of the transmitter described in this article may violate federal and/or state law. Readers are advised to obtain independent advice as to the propriety of its construction and the use thereof based upon their individual circumstances and jurisdiction.

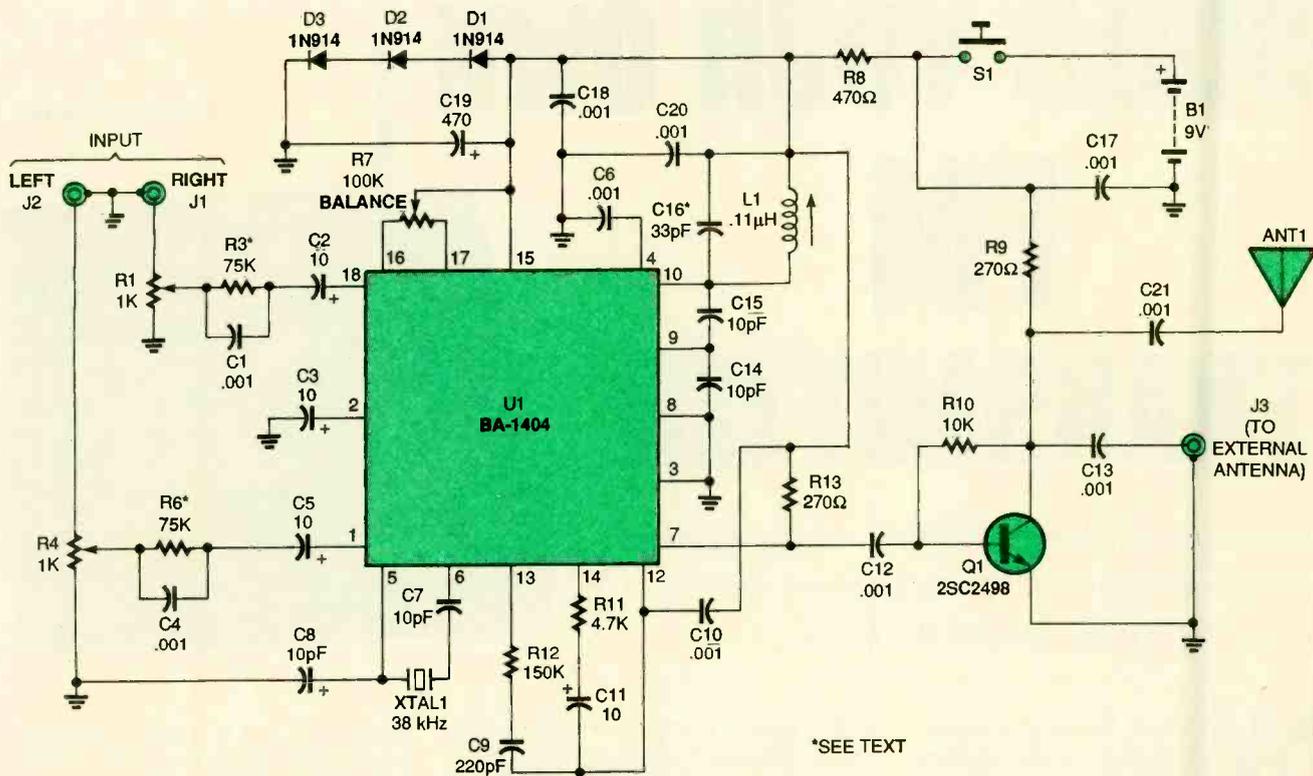


Fig. 1. At the heart of the schematic for the FM Stereo Transmitter is the BA-1404 FM stereo-transmitter IC. Note that there is no R2 or R5 in the circuit.

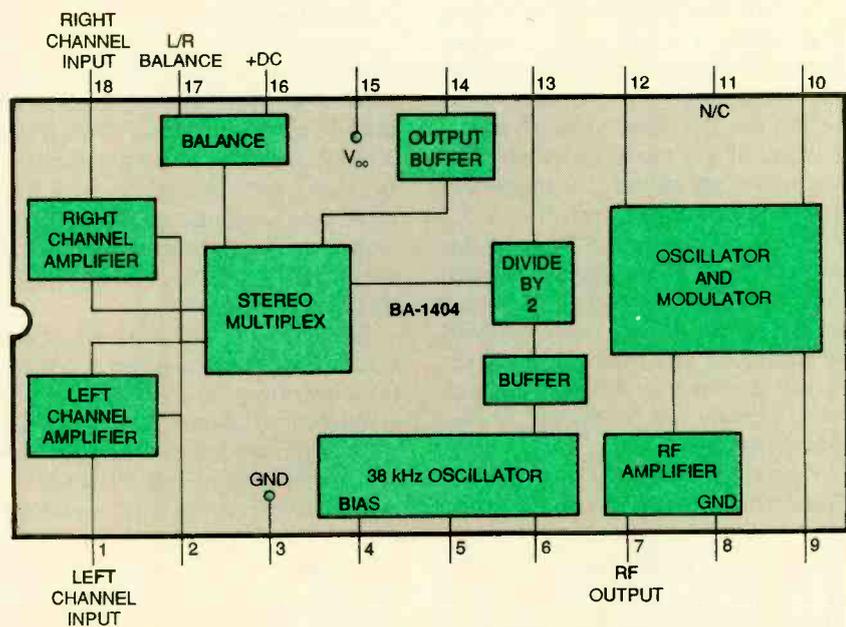


Fig. 2. The overall simplicity of the FM Stereo Transmitter is made possible by the many internal functions performed by the BA-1404 IC, which are shown in this block diagram.

VHF transistor Q1 and its associated components amplify the RF output at pin 7 of U1, feeding either telescoping antenna ANT1, or an external antenna jack at J3. That RF signal is modulated by three signals from U1: the stereo-

multiplex signal at pin 14, the 19-kHz pilot tone at pin 13, and the oscillator and modulator signal at pin 12.

**Construction.** Portions of the Transmitter circuit operate at a relatively

high frequency. Therefore, if you hand-wire the circuit, you could run into trouble with stray inductance and capacitance. To avoid that, use the printed-circuit template shown in Fig. 3 to etch your own board.

If you don't feel like making your own printed-circuit board, you could order an etched, drilled, and silk-screened PC-board from the source given in the Parts List. Other parts kits available for the Transmitter are also available from the same source, as detailed in the parts list.

The parts layout is shown in Fig. 4. Be careful to orient the diodes, transistor, and electrolytic capacitors as shown. The use of a socket for U1 is recommended.

You must make two choices along the way regarding certain capacitors and resistors. First, you must decide what portion of the FM-broadcast band you wish to use; that's because the Transmitter is only tunable over about one-third of the entire band. See the "Frequency Range Selection" box for help in making the proper selection.

Capacitor C16 sets the frequency range of the FM Stereo Transmitter. To transmit at approximately 88–95 MHz,

use a 33-pF capacitor for C16; for 95–102-MHz transmission, use a 27-pF capacitor; and for 102–108 MHz, use a 22-pF capacitor. If you are not sure in which part of the FM band to transmit, solder a “trial” C16 with some lead length to spare. That way you can desolder the capacitor and replace it with one of another appropriate value.

The second choice you need to make is to decide what pre-emphasis value you want. Pre-emphasis is a technique used in FM transmitters to increase the high-frequency signal-to-noise ratio. If you want the pre-emphasis to be 75 microseconds (as used in North America and Japan), use 75K resistors for R3 and R6. If you want the pre-emphasis to be 50 microseconds (as used in Europe, Russia, and in some other countries), use 47K resistors for R3 and R6.

**Some Options.** Because the Transmitter consumes power and emits RF whenever it is on, a visual “on the air” indicator is a useful addition. Simply connect an LED in series with a 1K resistor between one of the positive DC terminals of the switch and a ground point in the circuit; the cathode of the LED should be connected to the latter. When power switch S1 is on, the LED should light. If it doesn’t, you either

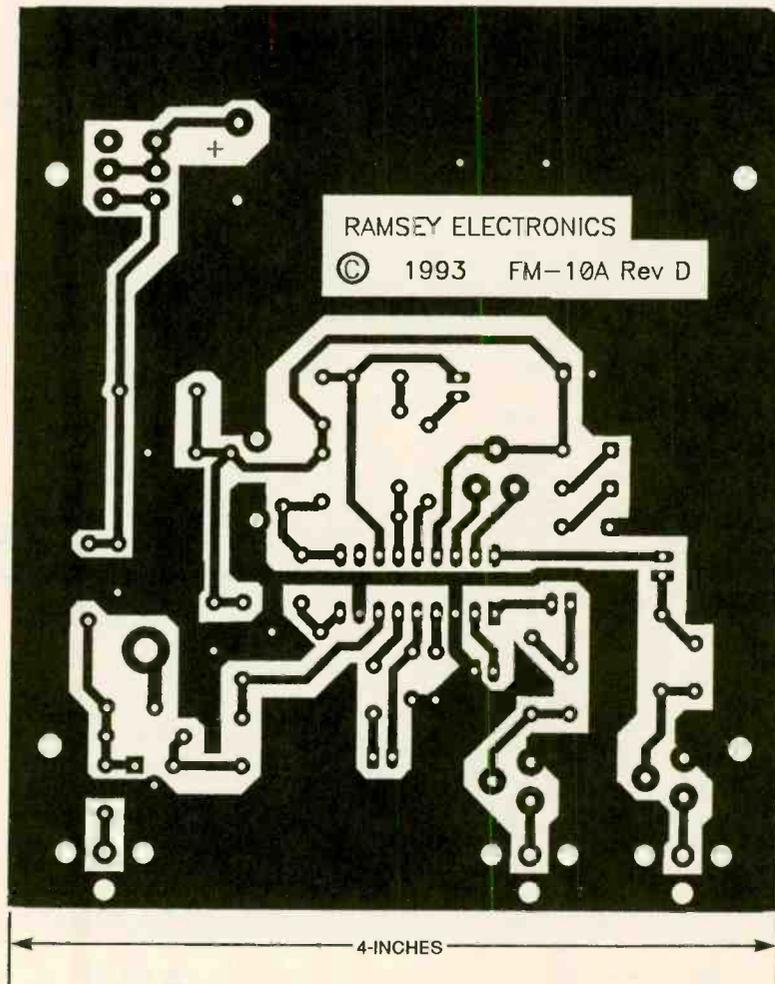


Fig. 3. The foil pattern for the Transmitter’s PC-board is shown here.

### PARTS LIST FOR THE FM STEREO TRANSMITTER

#### SEMICONDUCTORS

- U1—BA-1404 FM stereo transmitter, integrated circuit\*
- Q1—2SC2498, 2SC2570, or 2N5179 low-noise VHF/UHF NPN transistor\*
- D1, D2, D3—1N914 or 1N4148 silicon diode

#### RESISTORS

- (All fixed resistors are ¼-watt, 5% units.)
- R1, R4—1000-ohm trimmer potentiometer\*
  - R2, R5—not used
  - R3, R6—75,000-ohm or 47,000-ohm (see text)
  - R7—100,000-ohm trimmer potentiometer\*
  - R8—470-ohm
  - R9, R13—270-ohm
  - R10—10,000-ohm
  - R11—4700-ohm
  - R12—150,000-ohm

#### CAPACITORS

- C1, C4, C6, C10, C12, C13, C17,

- C18, C20, C21—0.001-μF, ceramic-disc
- C2, C3, C5, C11—10-μF, 16-WVDC, electrolytic
- C7, C8, C14, C15—10-pF, ceramic-disc
- C9—220-pF, ceramic-disc
- C16—22-, 27-, or 33-pF, ceramic-disc (see text)
- C19—470-μF, 16-WVDC, electrolytic

#### ADDITIONAL PARTS AND MATERIALS

- ANT1—4- to 19-inch telescoping antenna
- L1—0.11-μH, shielded adjustable inductor\*
- XTAL1—38-kHz crystal, watch crystal package\*
- J1, J2, J3—RCA-type PC-mounted jacks\*
- B1—9-volt alkaline battery (or other 3–15-volt DC power source)
- S1—SPST pushbutton switch, normally open, PC-mounted\*
- Printed-circuit materials, enclosure,

18-pin socket for U1\*, solder, hardware, etc.

**Note:** The following items are available from Ramsey Electronics, Inc. (793 Canning Parkway, Victor, NY 14564, Order Tel. 800-446-2295, Information Tel. 716-924-4560, Fax: 716-924-4555): A complete kit for the FM Stereo Transmitter (FM-10ABP), including the printed-circuit board (but not the custom case or antenna)—\$34.95; an etched and drilled, silk-screened printed-circuit board (FM-10APCBP)—\$10.00; a “Special Parts Kit” (FM-10ASPKBP) containing all parts marked \* above—\$24.95; a custom case complete with knob and antenna (CFM-BP)—\$14.95; a 110VAC power adapter (FMAC-BP)—\$9.95. Postage/handling/insurance per order is \$4.95. Please add an additional \$3 for orders under \$20. New York residents please add 7% sales tax.

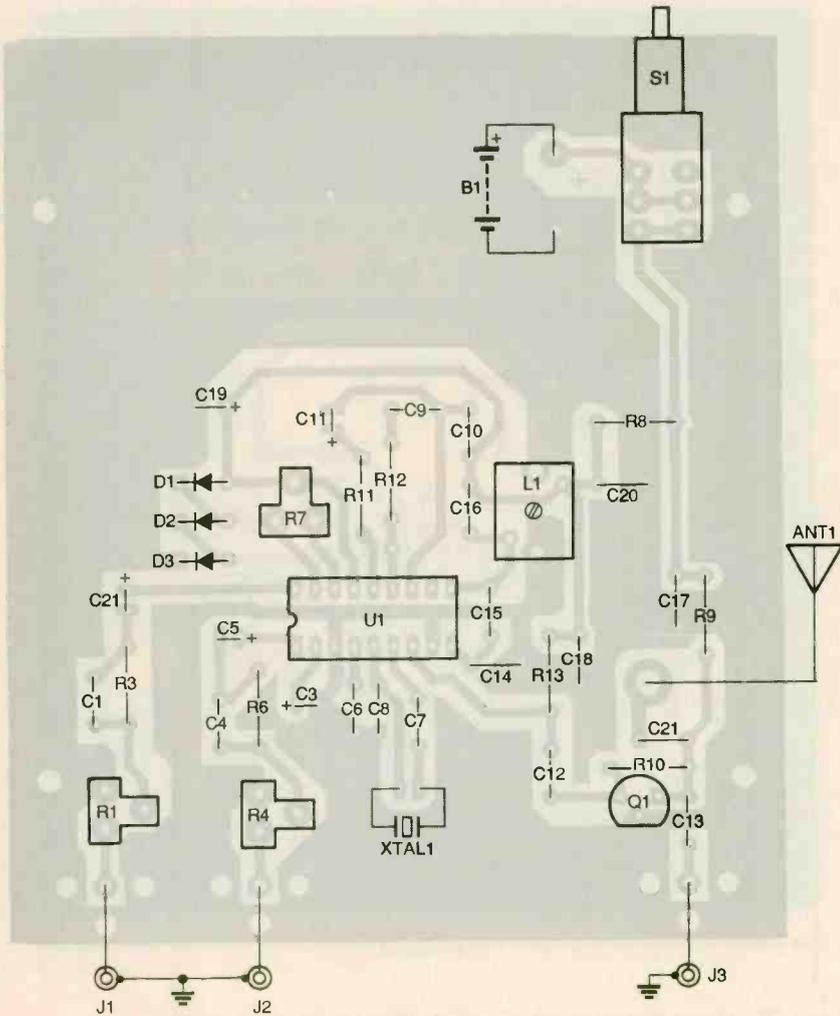


Fig. 4. Use this parts-placement diagram as a guide when mounting components on the board. Before soldering the polarized components, check to make sure their orientations match the ones shown here.



The assembled circuit board is shown here. Note the addition of an LED and a 1K resistor in series, which act as a power indicator (see text).

### ANTENNA CONSIDERATIONS

FCC Part-15 Rules specify a maximum field strength for an unlicensed, FM-broadcast device—250 microvolts at a one-meter-long receiving antenna located 3 meters (9.94 feet) from the transmitter. That field strength is inversely proportional to distance (at twice the distance, the field strength is halved). Therefore, at 384 meters (1260 feet—almost a quarter of a mile), the allowable signal is 1.95 microvolts, which is still strong enough to be picked up by an average stereo FM receiver. A "sensitive" receiver responds to a signal as small as 0.5 microvolts!

Note that the FCC Rules do not specify the power output of the transmitter—only the field strength at the receiving antenna. Because it is possible to couple an amplifier and high-gain antenna to your FM Stereo Transmitter, you could inadvertently exceed FCC limitations.

Unless you have a means of measuring field strength at those low levels, the best way to stay within the FCC-allowed field strength is to use the 19-inch telescoping antenna provided with the custom cabinet kit, or one like it. That antenna will give you a horizontally non-directional signal.

For a more directional signal, use a horizontally mounted dipole antenna (each half of the antenna should be about 30 inches), plugged into J3, instead of using a telescoping antenna. When mounted horizontally, the maximum radiated signal of a dipole is perpendicular to the direction of the wire; a north-south antenna will have maximum radiation to the east and west. ■

have the LED connected backwards, or to the wrong points in the circuit.

A custom, two-part plastic case, with front and back panels and a knob for the switch, is available from the source in the Parts List. Use of the custom cabinet enhances the appearance of your Transmitter, while protecting its circuitry.

The custom cabinet also comes with a telescoping "whip" antenna that opens to a length of 19 inches. Except for the antenna hole (and LED hole, if you use one), all other holes in the cabinet are drilled, and silk-screened with the appropriate legends. If you do not use the custom cabinet, you will still need to get some kind of antenna. See the "Antenna Considerations" box for suggestions.

**Audio Sources.** The FM Stereo Transmitter can accommodate a fairly broad range of audio sources at its J1  
(Continued on page 91)

**A**nti-lock braking systems (ABS) are now available as standard or optional equipment on most cars and light trucks sold in the United States and Canada. Traction-control systems (TCS) are also now becoming commonplace. But the quest for accident-avoidance systems is far from over. The next step, at least according to German automakers BMW and Mercedes-Benz, and electronics

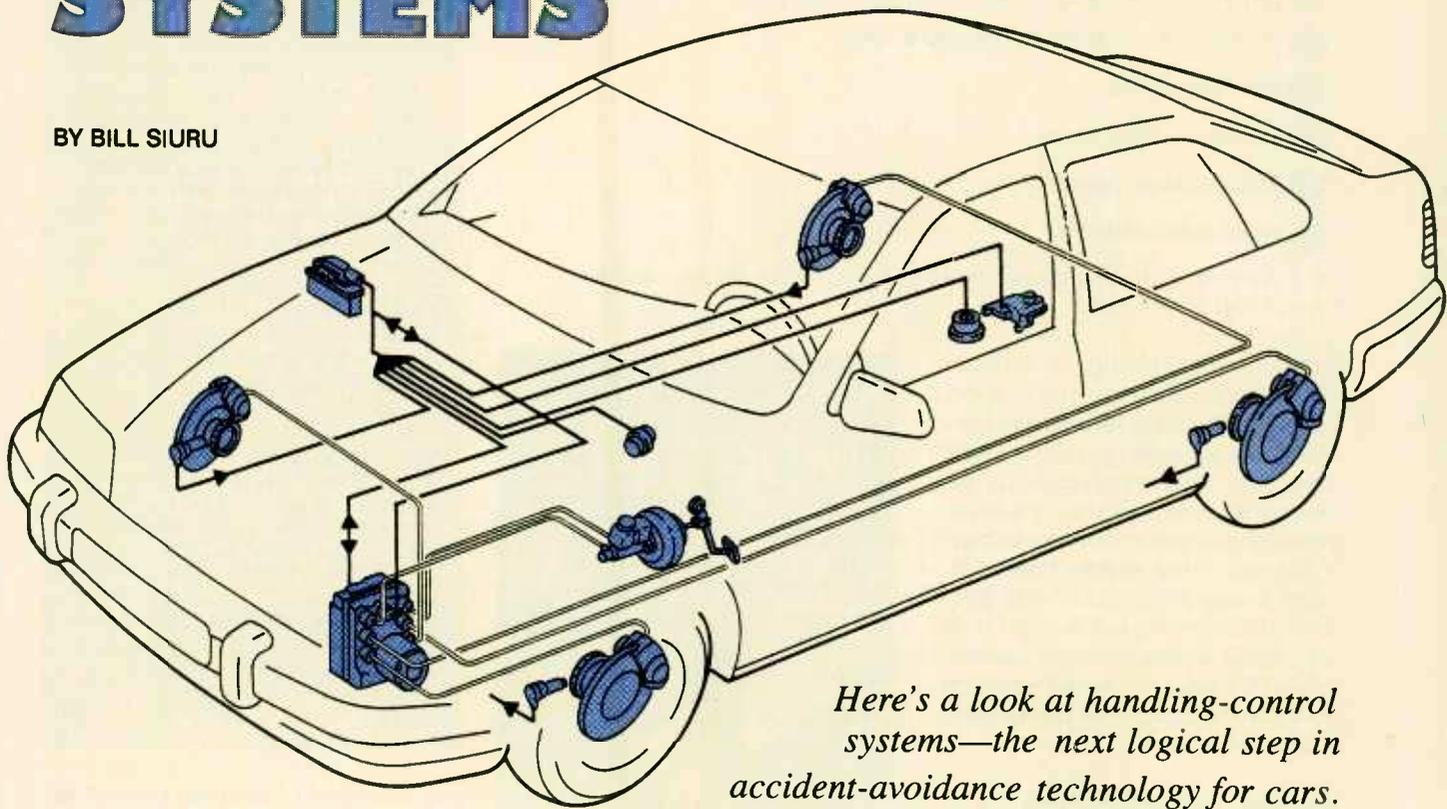
control system is Vehicle-Dynamics Control (VDC) or *FDR Fahr-dynamik-kegelung* (road-handling control) developed jointly by Mercedes-Benz and Bosch AG. Vehicle-Dynamics Control will first appear on some mid-1995 European Mercedes-Benz S-Class models and should reach the U.S. market during the 1996 model year. Rival BMW has a very similar system under development. That system

coming handling-control systems use the sensors, electronic controls, microprocessors, and software logic already on-board for anti-lock braking and traction control. In addition, the more demanding handling-control function requires additional sensors and microprocessor capability.

**ABS and TCS.** Anti-lock braking operates during braking on slippery sur-

# HANDLING - CONTROL SYSTEMS

BY BILL SIURU



*Here's a look at handling-control systems—the next logical step in accident-avoidance technology for cars.*

supplier Robert Bosch, will be handling-control systems. That makes sense, since such systems are a logical extension of ABS and TCS technologies.

Anti-lock braking avoids skidding when stopping on slippery surfaces, and traction control allows you to get going again, especially on ice and snow. Handling-control systems would do their job by maintaining control and preventing an uncontrolled skid when taking a curve or in other driving situations.

A prime example of a handling-

is called DCS3; it is the third-generation of their Dynamic Stability-Control System. In fact an earlier, somewhat more elementary DCS capability is already available on some BMW models (see the "Dynamic Stability Control" box for more on that system).

Anti-lock-braking, traction-control, and handling-control systems like VDC all work on the same basic principles. They go into action when one or more wheels are locking up or slipping to the point where it starts affecting the ability to steer and control the vehicle's direction. Indeed, the up-

faces when brake lockup is imminent. It reduces stopping distances to a minimum while allowing the driver to steer the vehicle even in adverse driving situations. In contrast, traction control operates when accelerating on slippery surfaces when one of the driving wheels loses traction and starts slipping. Traction control allows a vehicle to maintain traction under icy or snowy road conditions and is a modern-day equivalent of a limited-slip differential.

Traction control uses the ABS wheel-speed sensors, which sense wheel

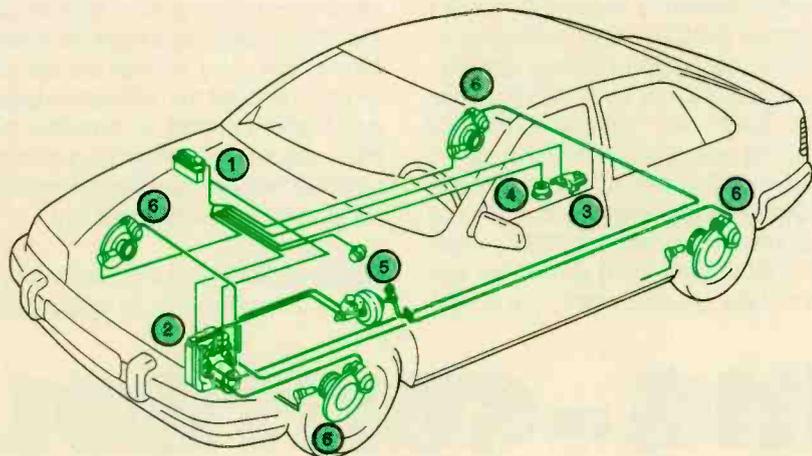
## Dynamic Stability Control

BMW introduced its first-generation Dynamic Stability Control (DCS) on its 850 Ci flagship coupe sold in markets other than the U.S. in late 1992. DCS augments anti-lock braking available on all BMW's and ASC (Automatic Stability Control) traction-control system available on many of its models. With ASC not only are brakes applied, but the engine output is also modified through such actions as adjusting the throttle butterfly and ignition timing as well as cut-off of the fuel injection and ignition. If the car has an automatic transmission, the shift-control program is also modified.

Like the Mercedes-Benz VDC, a steering-angle sensor has been added for the DCS system to provide additional information to the ABS/ASC wheel-slip algorithm. That additional measurement provides greater refinement in stability and traction because lateral dynamics are included, though lateral slip is not measured.

By comparing the difference between the actual handling and the desired nominal handling calculated from computer models, the microprocessor calculates an error signal. That signal controls brake intervention and cuts back engine torque even more smoothly and precisely than with ASC traction control alone, where only longitudinal slip on the rear drive wheels is controlled.

DCS is designed to operate during steering maneuvers, allowing the driver to take curves without losing any of the car's traction. While the initial DCS system featured a separate control unit for the handling-control function, the second-generation DCS has the ASC traction-control and DCS handling-control functions integrated in the same control unit. That second-generation version of DCS will be offered on 1995 V-12 7-series sedans in addition to the 850 Ci coupe.

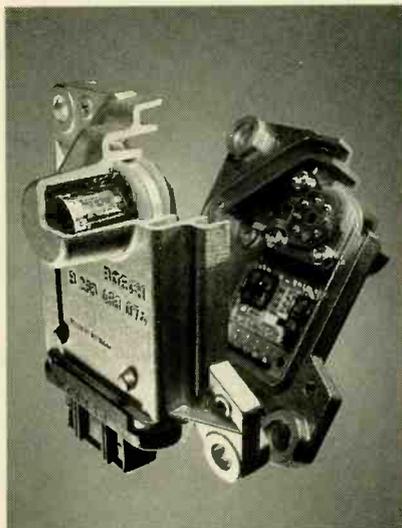


- 1 ELECTRONIC CONTROL UNIT (ABS/ASR/VDC) WITH CAN LINK TO VEHICLE POWERTRAIN CONTROL MODULE
- 2 HYDRAULIC MODULATOR WITH PRESSURE SENSOR
- 3 YAW-RATE SENSOR
- 4 LATERAL ACCELEROMETER
- 5 STEERING-ANGLE SENSOR
- 6 WHEEL-SPEED SENSORS

Fig. 1. Here are the various sensors and control units used in the Mercedes-Benz/Bosch vehicle-control system.

lockup when braking, to monitor wheel speed during acceleration. Whereas ABS rapidly releases and applies brake pressure to prevent wheel lock up, traction control applies brake pressure to individual driving wheels, preventing wheel spin when traction is reduced or lost entirely. Unlike ABS, which is used on all four wheels, traction-control braking is only applied on the driving wheels. In more sophisticated TCS, the engine may also be controlled to reduce the power delivered to the wheels.

**Handling-Control Systems.** In contrast to the above, a handling-control system such as VDC operates while the car is rolling along at a constant speed, accelerating, or braking. Using electronic sensors and computer logic, the new system enhances steering performance by determining every microsecond whether or not the car is going exactly in the direction that the driver is steering. The slightest difference between what the driver is "asking" via steering-wheel inputs and what the vehicle is actually doing identifies a condition where directional stability could be lost. If such a condition is identified, the system's microprocessor corrects for it almost in-



The yaw-rate sensor, the heart of the VDC system, measures the rotation of the car around its vertical axis. (Photo courtesy of Robert Bosch Corp.)

stantly by applying appropriate braking. The system works so fast and so unobtrusively that the correction is usually applied before the driver even senses any changes in directional stability.

In addition to the ABS/TCS components, VDC requires sensors for steering angle, braking pressure, lateral acceleration, and yaw rate (see Fig.

1). Complete handling control requires detection of lateral slippage, that is a loss of traction in a direction other than that in which the car is supposed to be traveling. If the lateral traction between the tires and the road is no longer adequate for one or more wheels, directional instability may result, particularly in curves. One example is "fishtailing" when the car is turning about its vertical axis. Actual lateral movement of the car cannot be calculated from the wheel-speed sensors used with ABS and TCS.

For handling control, the computer logic has to calculate the difference between the instantaneous desired and actual directions. If there is a dif-

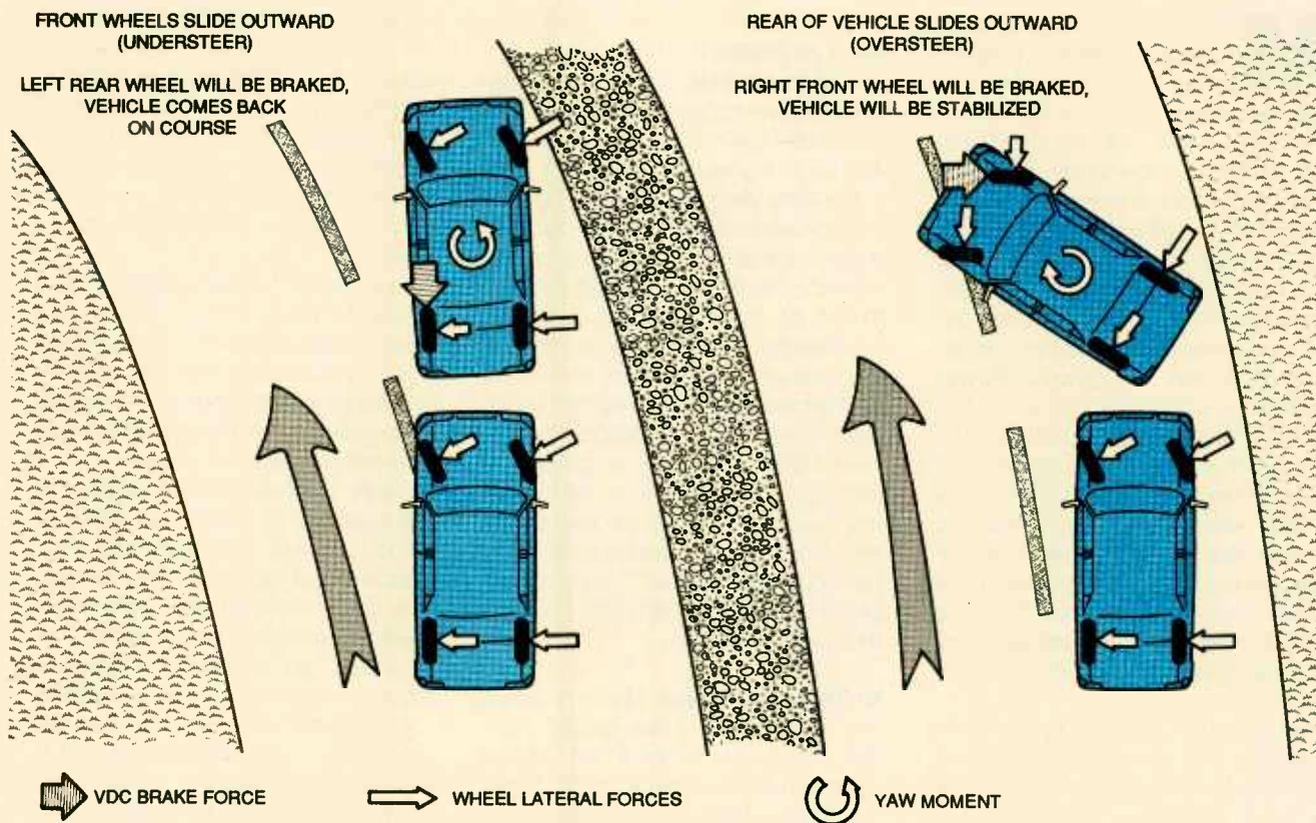


Fig. 2. In an understeer condition, the left-rear wheel is braked, bringing the car back on course. During oversteer (fishtailing), the right-front wheel is braked.

ference, a correction command is sent to the braking system. If the car understeers and swerves off course when driven in a curve, the system corrects by braking the inner rear wheel with respect to the curve to turn the car into the corner, bringing it back on course (see Fig. 2). If brakes are already on, the outside front-wheel brake is released.

On the other hand, oversteer occurs when the rear end attempts to swing around, resulting in fishtailing. That instability is corrected by applying the appropriate outside front brake, or alternatively, releasing the opposite rear brake. As with ABS, braking can approach the locking limit of the road and tire interface if required. While braking, vehicle momentum can be further reduced by throttling the engine and/or applying the other individual brakes.

The Mercedes-Benz/Bosch VDC system operates under all driving conditions including when driving straight-ahead, accelerating, braking, and even coasting. It can handle all road surface conditions including uneven surfaces, snow, ice and gravel.

**How it Works.** A block diagram of the Mercedes Benz/Bosch system is shown in Fig. 3. Driver intent, that is the "desired driving course," is calculated from wheel speed and steering-wheel-angle information. Wheel speeds are measured by the same speed sensors used for the anti-lock and traction-control systems. An additional sensor is added to measure the instantaneous angle of the steering wheel. The intended-direction calculation also uses information on current engine load, and the braking pressure supplied by the master cylinder is also sensed.

Determining the actual course of the vehicle is a more complicated task. That is the job of two sensors: a lateral accelerometer and a yaw-rate sensor.

The lateral accelerometer measures the lateral "g" forces while the vehicle is turning in a curve. That analog sensor operates on a spring-mass principle. A "Hall-effect" generator translates the spring displacement into an electrical signal. The sensor must be very sensitive with an operating range of  $\pm 1.4$  g.

The yaw-rate sensor measures the speed at which the car rotates around its vertical axis. That sensor has a small, hollow steel cylinder that serves as the measuring element. The thin wall of the cylinder is excited with piezo elements to vibrate at a frequency of 15 kHz. Two pairs of those piezo elements (four elements in total) are arranged on the cylinder with paired elements opposite each other. One of those pairs brings the cylinder into resonance. The other pair, displaced by 90 degrees, stabilizes the vibration. When the vehicle rotates about its vertical axis, the vibration nodes shift slightly in proportion to the rate of rotation. Instantaneous yaw rates can be sensed by measuring that slight shift.

In developing the yaw-rate sensor, Bosch started with a measuring technique from the aviation industry. The technique has now been adapted for large-scale automotive production. A large investment was made in developing the sensor so that it can withstand the extreme environmental conditions found in automobiles, (Continued on page 93)

**M**ost readers of this magazine probably tinkered with all kinds of unusual hardware—both electrical and mechanical—when they were kids. I'm assuming that because I certainly did, and we're all birds of the same feather—or at least we are all similarly feathered.

I've made robots out of clocks; strobe lights out of record-player motors and coffee cans; go-karts out of wood, wheels, and vacuum-cleaner motors; very dangerous "power saws" out of X-Acto blades and a DC motor; and a "wired" remote-control car out of various motors, gears, and other hardware. A motor—any motor—was always a good find. Any broken item that contained a motor was immediately ripped apart for its motor and anything else that was useful—switches, lights, and gearboxes were all pretty valuable (to me, at least).

Even though I'm over 30 years old now, I still find sometimes that I can't resist slapping together various items to make something unusual, or just plain fun. I can't help it—if I see some parts that beg to be assembled into one unit, I do just that. And believe me, since I started working for this magazine, mountains of assorted electronic parts have piled up.

One day, I was staring at some solar panels wondering if they could power a motor I had. To find out, I connected the panels to the motor and took the assembly out into bright sunlight. It worked well, and I soon after thought up the concept of the *Solar-Powered Airplane*—a toy that could perpetually fly in circles as long as bright light is available.

**The Airplane Concept.** Out of all the applications that a solar-powered motor could have, why did I decide to build a toy airplane? Well, for starters, the two solar panels I had looked like they would make perfect wings. Also, my low-voltage DC motor ran perfectly well from the low power produced by the solar panels (at least

well enough for an attached propeller to produce a little force). Let's just say that the two solar wing panels and the low-voltage motor screamed out to be assembled as an airplane. And so, to my workbench I went.

The only design problems I could think of were how to make a pivoting stand assembly and how to properly balance the plane. I realized that low friction on the pivoting stand would be essential for the plane to be able to move with the little force produced by the propeller. I decided that a ball bearing would be necessary to minimize friction as much as possible—nothing fancy, just any old ball bearing I could find. As for my other problem, balancing the plane could only be accomplished with the finished plane and stand assembly in hand, so that was left for later.

**Building the Plane.** Figure 1 shows the "schematic" of the airplane circuit, if you want to call it that. Do two solar panels plus one DC motor make a circuit?—technically I guess they do, albeit a very simple one!

Getting the solar panels is the easy part. The rest of the airplane and the

stand, however, have to be fabricated out of some kind of material, and wood is the best alternative. Wood is easy to come by—anyone can get it from a nearby source—and is probably the easiest material to work with. I also like the irony of a solar-powered, electric airplane that's made out of wood.

I had thought about using an actual airplane model—either a plastic or a tissue-paper-covered, balsa-wood type—and adding the solar panels and motor to it, but that would require extra work, extra money, and extra time to complete the project.

Figure 2 shows how the airplane is put together. To fasten everything in place, you will need hot-melt glue, double-sided tape, and a few screws. Due to the differences in weight between woods of various type and thickness, I will provide only approximate dimensions to follow in building your airplane. Also included are the procedures necessary to arrive at a well-balanced airplane, since an airplane that is poorly balanced will fly slow, wobble, or even topple over.

The solar panels specified in the Parts and Materials List come with a

## Build a Solar-Powered Model Airplane



BY  
MARC SPIWAK

*Build this inexpensive toy airplane that flies nonstop and never needs batteries.*

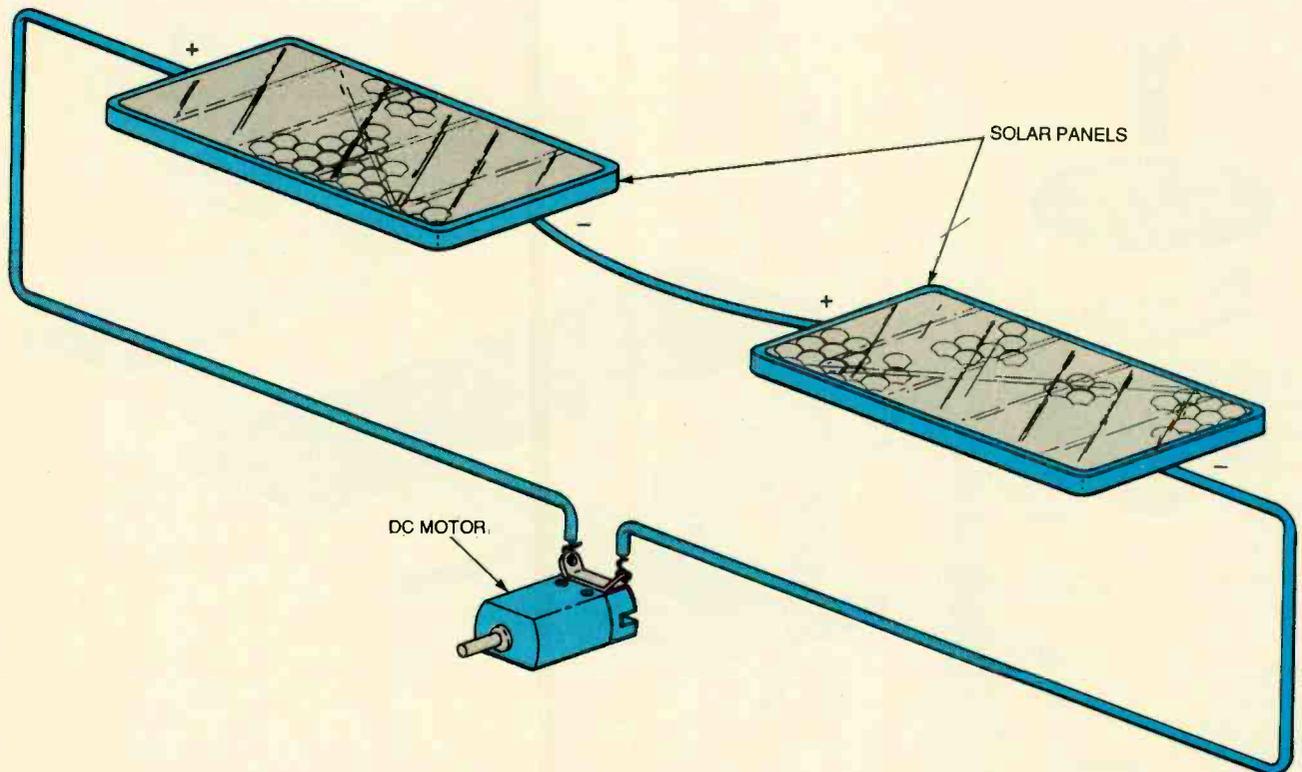


Fig. 1. As this "schematic" shows, two solar panels and one DC motor are the only components that make up the airplane's circuit.

metal strap, probably intended for connecting multiple panels together. On each panel, the positive and negative terminals on the bottom are threaded and come with a nut and lockwasher. Simply connect the two panels together—from the positive terminal of one to the negative of the other—with the metal strap and some hot-melt glue.

Next, cut a length of wood about 5½-inches long for the airplane fuselage. Also cut three pieces of wood for the tail, each approximately 2-inches long by 1½-inches wide, and secure them to the fuselage with hot-melt glue. Attach a small "shelf" for the motor, of the same width as the fuselage (probably about 2-inches long, and ¼ of an inch thick), to the underside of the fuselage at the front of the plane using hot-melt glue. Stick the motor to the top of the shelf with a piece of double-sided tape. The tape will hold because the weight of the motor presses down on it.

Make the pivot arm from another piece of wood about 13-inches long. Drill a hole vertically in the approximate center of the pivot arm to accept the bearing you will use. Make sure the hole provides a snug fit around the outside diameter of the bearing.

### PARTS AND MATERIALS LIST FOR THE SOLAR-POWERED AIRPLANE

- Solar panels (2), 0.45-volt, 1000-milliamp (Kelvin Electronics No. 260099 or equivalent)
  - DC motor, low-voltage (Kelvin Electronics No. 852211 or equivalent)
  - Plastic propeller, 3-blade (Kelvin Electronics No. 850590 or equivalent)
  - Ball bearing, ½-inch outside-diameter, or similar unit
  - Wood, screws, spacer, hot-melt glue, double-sided tape, paint, and assorted hardware.
- Note:** The solar panels (\$5.95 each), low-voltage motor (60 cents), and propeller (\$1.20) are available from Kelvin Electronics, 10 Hub Drive, Melville, NY 11747. Tel. 516-756-1750 or 800-645-9212.

Use another piece of wood, about 9-inches long, to form a support column. Then attach the base, a 7-inch square piece of plywood, to the column with a screw through the underside of the base and into the column. Countersink the hole in the plywood so that the head of the screw does not interfere with the base.

Mount the bearing on top of the column with a screw and a spacer. Make sure that the bearing rests on its inner race and that its outer race can spin freely (see Fig. 2). If you can't find a suitable spacer, one can be made from a piece of a ball-point pen's case.

At this point, the plane must be temporarily assembled so that it can be balanced. Everything must be in place to balance the plane—the motor, the propeller, the wings, and any hardware.

Place the pivot arm so that when it is connected the plane is balanced front-to-back (see Fig. 3). Then, attach the solar wings to the fuselage and to the pivot arm with double-sided tape, and fasten the plane in place with a screw going through the side of the fuselage and into the pivot arm. The pivot arm looks best if it's hidden under the wing of the plane. If you find that you can't balance your plane that way, simply add weight (or remove it if possible) to the front or back of the plane to balance the load.

Next, add a counterweight to the other end of the pivot arm to balance the entire assembly for rotational motion. Use something that closely matches the weight of your finished plane. I used a large bolt and two

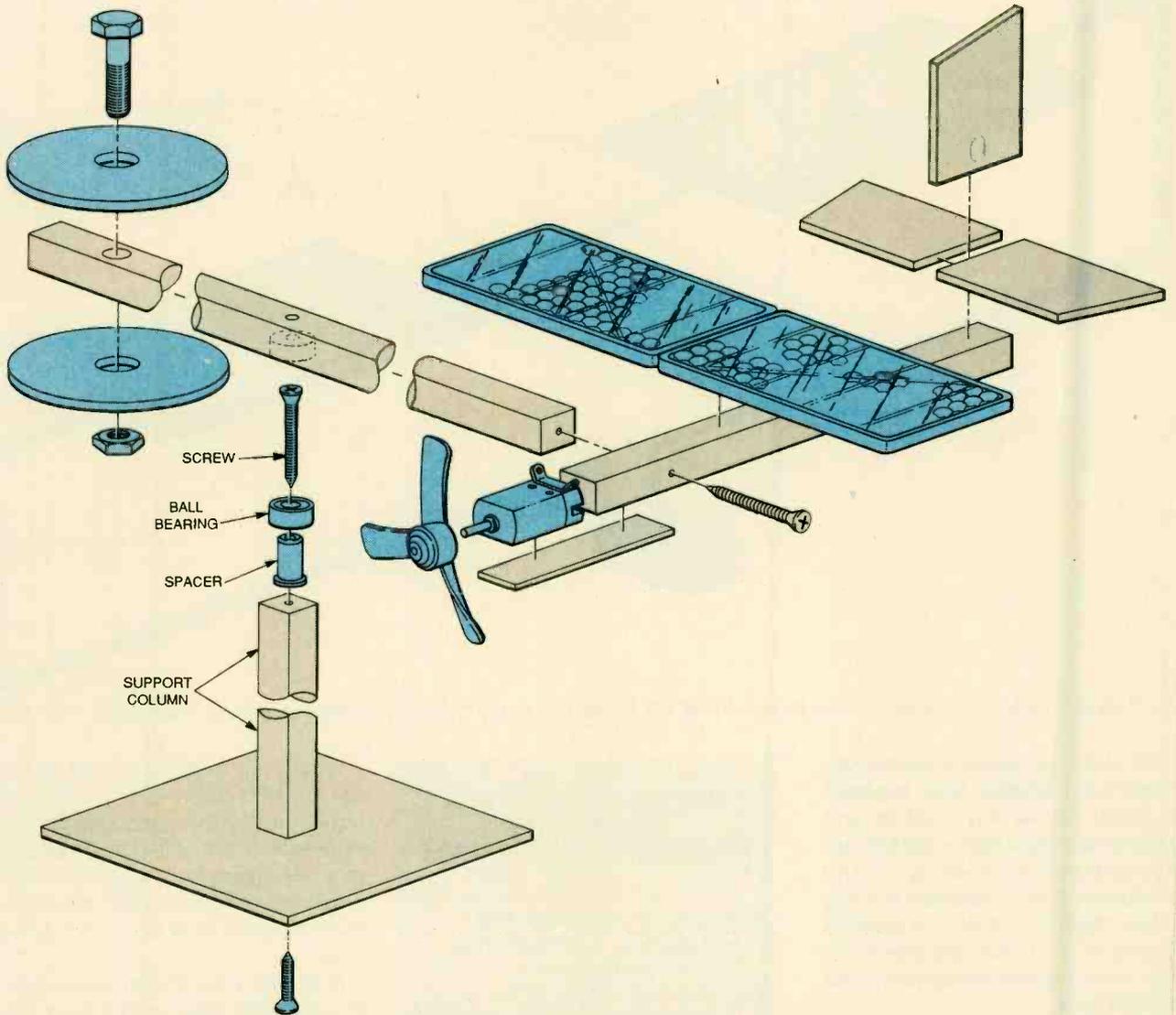


Fig. 2. This is the general assembly of the airplane and its stand. Hot-melt glue, double-sided tape, and a few screws hold everything together.

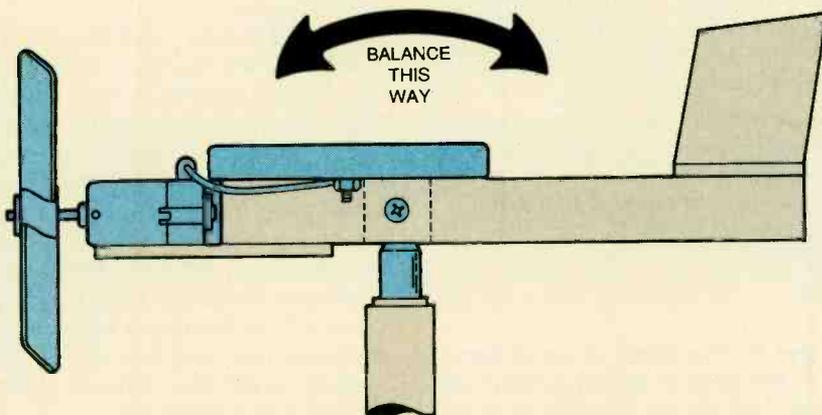


Fig. 3. The pivot arm must be connected so that the plane is balanced front-to-back.

gigantic washers. All together, that hardware was slightly heavier than the plane, so I mounted it about  $\frac{1}{4}$  of an inch from the end of the arm. Ex-

periment to find the perfect balance between the weight of your counterbalance, and its distance from the end of the arm.

Using a bolt and washers makes it easy to balance the arm. Temporarily tighten them on the edge of the arm to find the spot of balance, and drill a hole for the bolt. You might find it easier to balance the plane by drilling a hole for the bolt in a position where the counterweight is a little lighter than the plane. Then, you can fine-balance the arm by adding lighter washers to the counterweight.

After everything is balanced, you can disassemble the plane and paint it, or you can skip the paint and connect the power leads from the motor to the solar panels. Before you permanently attach the power leads, however, go outdoors and test for the polarity that will drive the propeller in the proper direction for forward movement.

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# A Survival Guide for PC Owners

*Get a handle on PC troubleshooting and get the most from PC technical support with these helpful tips.*

BY KARL T. THURBER, JR.

**A**s a rule, personal computers are reliable appliances that stand ready to do your bidding. Sometimes, though, they do break down and require service. But before you take your "broken" PC to a repair shop, try some of the troubleshooting techniques in this article. You might just save yourself a bundle of money.

Troubleshooting is often made easier if you can get some on-the-phone technical support. If you already own a PC, familiarize yourself with the support available to you. That way, you will know what to expect when you need help. If you haven't bought a computer yet, the following tip section might help you make a decision and save you some trouble in the process. After that, we'll get right into troubleshooting.

**Starting Out.** When shopping for a PC, make sure you buy from an established vendor that will be around to provide service and support if something goes wrong. Most offer lifetime, toll-free technical support. Consider the fact that the highest user-ranked service and reliability ratings are achieved by direct-selling companies like Compaq, Dell, Gateway, IBM, and ZEOS.

Also, check to see what kind of warranty the vendor offers. Most offer a 1-year parts and labor limited warranty, and you can expect 1–2 years of free on-site service from most vendors. No matter what, insist on a 30-day, no-questions-asked, money-back guarantee.

When you buy a computer, read the user's manual that comes with it to become familiar with the overview of

the system's capabilities and limitations, troubleshooting guide, technical sections, lists of error messages, and tech support and upgrade information.

**Preventive Maintenance.** The first troubleshooting step is to head-off problems before they start. Providing a safe, clean, well-ventilated, and moisture-free environment for your PC is a good way to do that.

To prolong the life of your system, you should take both active and passive maintenance approaches. The active approach involves cleaning the system and keeping it clean—try not to let excessive dust accumulate.

The passive approach involves undertaking procedures to protect the PC from the environment, such as using power and telephone-line pro-



tectors. It also includes keeping your hands and the work area clean, not allowing smoking around the computer, making any interconnections with the power removed, handling circuit boards carefully, and avoiding static electricity.

Unfortunately, many of us take neither active nor passive precautions. Ultimately we pay for that neglect, especially if we don't have backups when the chips go down—as they might someday.

Caution: cleaning your PC internally is fine, but don't do it with a vacuum—not even with a tiny computer vac. A vacuum of any sort, particularly one with a brush, is a generator of static electricity that can damage your PC's chips. A source of compressed or canned air, sometimes called a "dust blaster," is useful for internal cleaning (to blow out dust, lint, and debris). It is available for \$24.95 from Global Computer Supplies, with gas refills costing \$4.95.

Many of the things you can do to minimize the risk of PC disaster focus on your hard drive (HD). Here are some suggestions: optimize or defragment the drive regularly; make regular file backups; copy critical DOS system areas to a safe place using PC Tools' *MIRROR* or a comparable utility; record or save CMOS configuration settings; and guard against virus intrusions. Also, periodically run third party "disk medic" utilities.

To be safe, besides at least two sets of full HD backups, you should have your original DOS, Windows, and application-software diskettes or CD-ROM's; data-backup diskettes or tapes (unless covered by full HD backups); disk-medic utility software; and a bootable "emergency rescue" disk. Popular utility packages such as PC Tools and The Norton Utilities automatically create an emergency rescue disk upon installation.

If yours is a portable computer, when traveling you should bring with you copies of the master disks of essential programs. Those normally include DOS, Windows (if applicable), and key applications such as your word-processing program or spreadsheet. You also should bring a file transfer program, Fax/modem, file conversion utility, disk medic utility, and necessary cables.

New software often overwrites the

AUTOEXEC.BAT and CONFIG.SYS boot files and Windows information files during installation. So, besides using a comprehensive backup scheme, you should also keep copies of those important files both on a floppy and in a HD backup directory. Should those files be corrupted, erased, or overwritten through accident or experimentation, you'll be able to restore them easily. Also, keep printouts of those files for quick reference.

**Computer Tools.** You will need a few basic tools, even if you're not going to actually "repair" your PC. First, you'll need basic hand tools such as needle-nose pliers, wire cutters and strippers, adjustable wrenches, and small knives, all of which you might already have in your home-workshop toolbox.

Other, more specialized tools are needed for board-level maintenance as well as disassembly and reassembly. Those include: assorted hexagonal-headed nut drivers; various Phillips, flat-blade, *TORX*, and jeweler's screwdrivers; chip extractors and inserters; tweezers; small brushes; lint-free cleaning swabs; cable and connector crimpers; claw-style parts retrievers or grabbers; and an anti-static wrist-grounding strap. Avoid using magnetized tools around your computer.

If you're going to dig deeper into your PC (there's a risk involved here, of course), you'll also need soldering

and unsoldering tools. Those include a low-wattage soldering iron, a heat-sink to absorb excessive heat, solder, and a "solder sucker".

You might also need simple test equipment such as a volt-ohm-milliammeter (VOM) for making voltage, current, and resistance measurements; a logic probe and logic pulser for diagnosing digital circuits; and cable testers for network problems. Major computer suppliers, like Global, regularly stock all the above tools and supplies.

An assortment of cables, adapters, and gender-changers of all types are also useful. In addition, you should get loopback testers to check serial and parallel ports.

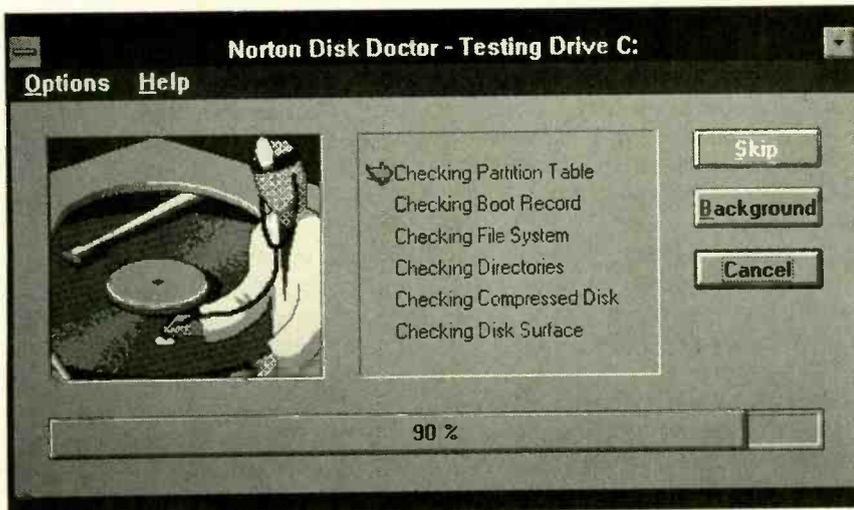
**PC Troubleshooting.** Despite the repair problems IBM PC's and compatibles might present, most are open-architecture systems. That design helps to make troubleshooting a straightforward process.

To diagnose and isolate faults in your PC, check the simple stuff first. Don't overlook obvious problems such as no power to the PC, no paper in the printer, a disconnected modem or keyboard, or a recent hardware or configuration change. Often, an apparently dead computer isn't the result of a real malfunction, so consider the many possibilities before spending hours tearing it apart.

The trick is to search for clues to



Shown here is a CompuAdd specialist providing troubleshooting tips via remote-control software, which allows him to view and control PC's via modem.



*Disk Doctor, one of the over 40 tools in Norton Utilities 8.0, is a powerful data recovery feature that diagnoses and repairs disks and files.*

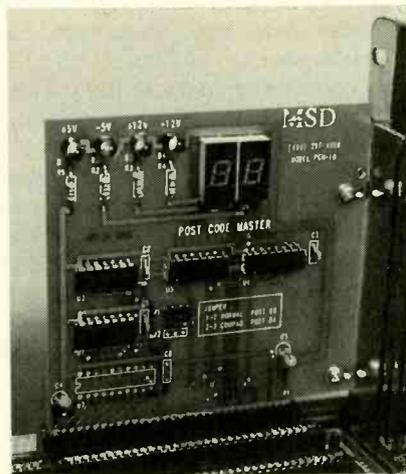
locate where the failure has actually occurred—in other words, to logically attribute failure to the CPU, monitor, keyboard, printer, or peripherals. Sometimes you can make a simple “fix” just by rebooting the PC to clear a seemingly serious, but nevertheless minor, transitory problem.

Even if you have to turn the repair over to a technician, it's wise to have some idea of the scope of the problem. Before flashing your credit card, do at least minimal troubleshooting (for a recommended reading list on PC troubleshooting, see the “Repair and Troubleshooting Books” box).

By one estimate, cables connecting peripherals to the PC cause 50 percent of all hardware problems. With power removed, check cables carefully to ensure they're not only plugged in, but also are securely seated and screwed-in snugly. That also goes for IC's, circuit boards, and plugs: reseating them sometimes solves vexing PC problems.

The operative word on cables, peripherals, and circuit cards is substitution. Whenever you can get your hands on substitutes, replace suspected defective items with known good ones to narrow possibilities. If your cables are spliced or taped, buy new ones, and replace gender-changers and extension-cable extenders with one-piece cables of the proper sex. Look for oxidation on connectors and boards.

Sometimes the remedy isn't as simple as plugging something in or turning it on. Dead computers often are caused by failed power supplies.



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Startup failures are frequently associated with memory problems or other errors disclosed by the power-on self-test (POST) that initially checks system hardware.

Other turn-on problems are caused by a lost or corrupted CMOS setup. That setup contains critical configuration details about key peripherals, disk drives, display type, memory, and other information. Always observe any startup messages that you see on the monitor screen. Are they different from the startup messages you normally receive when you boot?

It is a good idea to record all CMOS-configuration settings on a new computer and log any changes. Without that information, you might be unable to reconfigure the PC if a

dead battery or errant program causes you to lose the settings, unless you contact the manufacturer for help. (Many manufacturers furnish a CMOS printout with your PC. Keep it in a safe place; you might need it.)

Troubleshooting keyboards is usually simple; they rarely fail entirely. However, some keys might get sticky and the whole keyboard might need cleaning or replacement due to accumulation of foreign matter. If the keyboard doesn't respond correctly or if the PC doesn't recognize that a keyboard is present, check for a loose keyboard connector.

If that doesn't help, check that the keyboard lock (if any) is unlocked, and that the XT/AT keyboard switch (found on some keyboards) is toggled to the correct position. If your keyboard is reconfigurable, follow the instructions on reinitializing it; some keys might have become reprogrammed.

**Hardware or Software?** How do you tell if a problem is hardware or software caused? Sometimes it's hard to draw a distinction between the two, but the best clues lie in the boot-up process. If your computer won't boot, or if you don't hear the cooling fan, see a power light, or get a cursor on the screen, you're probably facing a hardware problem. On the other hand, if the PC starts to boot and then something goes astray, or if problems are application-specific, you likely have a software problem or a software conflict with the installed hardware. If you can boot successfully with a minimally configured, DOS boot disk, your problem almost certainly isn't hardware. Rebooting the PC typically clears software-caused errors.

If rebooting doesn't clear the problem, that suggests a hardware problem. Another good way to spot hardware errors is to note what error messages are displayed on your screen, because they usually refer to hardware. Errors in DOS, Windows, and application programs also might result in error messages on the screen.

Overheating is the biggest cause of hardware failure. Increasing ventilation, minimizing mechanical jarring and vibration (especially from impact printers), and reducing electrical fluctuations can extend your equipment's life.

Even though the mechanical parts

of a PC are more prone to failure than are the electronic ones, electronic component failures do occur—both on motherboards and expansion cards as well. Isolating and diagnosing problems with expansion cards is easiest once the cards are all removed. That way you can test them individually.

Many hardware-based “malfunctions” are actually the results of hardware/hardware or hardware/software configuration conflicts. You do have some control over those conflicts, but they can be frustrating to overcome with many accessory boards installed. (Those problems could be reduced considerably by Microsoft’s new *Chicago*, or *Windows 4.0*, operating system that integrates DOS and Windows, and reportedly features automatic hardware configuration.)

Sometimes, there’s a problem with software. In addition to programming bugs and other quirks, consider compatibility issues. Most software is written to behave on a variety of hardware, but “compatibility” rarely is total: there are some things you need to watch out for. You’re likely to have problems if your PC has: less than 640 KB conventional RAM, an old DOS version, a dated BIOS chip or motherboard, a nonstandard video adapter, an early LCD display, an early (pre-V3.0) version of Windows, or outdated printer and video drivers.

**Diagnostic Software.** Finding the problem when a computer fails is not always easy. That’s when diagnostic software comes in handy. It might not be a substitute for a qualified service technician, but diagnostic software can help locate problems with your system, and can provide a point of departure for productively dealing with vendor technical support.

Of course, your PC must at least be “up and running” for you to use diagnostic software. The real purpose of such utilities is not to resurrect a “dead” PC. Rather, it is to diagnose and resolve non-fatal problems; provide detailed information about the PC and its subsystems; resolve port address, interrupt, and other hardware and software conflicts; and help you work through hardware and software upgrades that might create new compatibility problems.

Many utilities also produce a com-



*If your PC suffers from data loss, firms like Ontrack might be able to help you out. They rebuild information from damaged drives, and claim a high success rate on recovering data.*

prehensive system information (SI) printout, which is useful in dealing with tech-support specialists. SI printouts provide you with a complete rundown of your PC’s hardware, software, operating system, and memory.

We have room here to sample three multipurpose utilities. All three are for general use rather than for use by PC technicians, and focus on protection—data-loss prevention, data recovery, and disk repair.

Because of its multifaceted nature, Central Point Software’s *PC Tools Pro 9.0 for DOS* (\$179, or \$49 for upgrades) often is, like its predecessors, called the “Swiss Army Knife” of PC utilities. It’s a powerful group of integrated programs for disk repair, data protection and recovery, disk backup, file management, desktop organization, productivity and performance enhancement, task switching, and virus detection.

One of PC Tools’ most impressive features is a new hardware-diagnostics utility. The diagnostics are part of the enhanced SI Pro, which provides data on over 170 local and network parameters. Compressed drives and drives up to 2 gigabytes with

more than 50,000 files are supported.

The package also has the exclusive “CPR” work-recovery system. CPR takes a snapshot of your PC’s RAM at timed intervals, backing it up to your hard drive, so files that you haven’t saved can be recovered after a system crash or power loss. If a crash occurs, you can restore an entire session, including multiple applications running under Windows.

*PC Tools for Windows* provides a more flexible approach to desktop and file management than Windows does alone, and also offers complete data-recovery capabilities. It even includes essential PC Tools for DOS recovery utilities that you can install on an emergency rescue disk. That makes recovery possible when you can’t access your hard drive or if Windows won’t start.

Key features include MultiDesk with File Folder and Desktop Synchronization; a new File Manager that has over 100 file viewers; WinShield, a group of utilities that protect Windows data; Optimizer, which defragments drives within Windows; and System Consultant, which analyzes your system’s configuration.

A Version 2.0 update is available for \$179 (\$49 for upgrades). It adds features that help improve Windows' reliability and data protection. Those features include CrashGuard, which monitors memory, system resources, and disk space for dangerous conditions; an enhanced System Consultant that can implement its configuration recommendations; INIConsultant, which offers line-by-line, plain English explanations of INI and boot-file contents; better compressed-volume support; and improved antivirus and backup capabilities.

*The Norton Utilities 8.0* is a sophisticated collection of more than 40 tools that offers advanced methods of protecting data, enhancing PC performance, and conducting preventive disk maintenance under DOS and Windows.

Included are Windows utilities that provide comprehensive diagnosis, troubleshooting, and repairs. Tools to track, edit, and advise on Windows information (INI) files also come with Norton, as do utilities that let you compare files and watch over vital system resources. Norton data-recovery features include an enhanced Disk Doctor for file diagnostics and repair of compressed disks and files, an improved File Fix, a disk editor, and an unformat capability.

Norton also offers comprehensive diagnostics and performance utilities for disk optimization, hardware diagnosis, and the reporting of SI. The new version lets you accomplish several program functions, such as disk optimization and file-system analysis and repair, in the background.

The Norton Utilities (\$179; \$49 for upgrades) is largely dedicated to disk and file maintenance, so it doesn't offer the diversity of features found in PC Tools. On the other hand, most jack-of-all-trades products don't quite equal Norton in disk repair and data recovery horsepower.

Use caution with PC utilities and diagnostic software, especially with routines that write to your HD, perform destructive tests, or edit CMOS data. Don't casually "try-out" utilities and diagnostics unless you know their exact purpose and desired outcome. Also, check that all of your software is backed-up and restorable before running tests. Two complete backups are good insurance against disaster.

## REPAIR AND TROUBLESHOOTING BOOKS

Get smart on PC repair and troubleshooting through a personal reference library. The following books cover a variety of topics relating to repair, troubleshooting, and upgrading:

*OOPS!* (3rd Edition), by Mike Miller, is a complete computer-problem solver aimed at intimidated beginners. Its friendly, entertaining, and lighthearted style offers solutions to the most commonly encountered computer problems. Easy-to-follow sidebars allow quick access to important information and tips (Que, 1994, softcover, 400 pages, \$19.99).

*Keeping Your PC Alive* (2nd Edition), by Jim Boyce, teaches beginners how to make repairs, upgrade a PC, and install and configure CD-ROM drives, Fax modems, memory, and other accessories and peripherals. Step-by-step procedures explain how to diagnose and fix problems, and how to get the most from a PC (New Riders Publishing, 1994, 400 pages, \$27.95).

*Memory Management for the Rest of Us* (Deluxe Edition), by John Goodman, Ph.D., is a physically massive book that covers all aspects of PC memory. Special tips, notes, and cautions simplify your search for answers to common DOS and Windows memory problems, which are often confused with hardware malfunctions. Separate sections deal with memory "gremlins" and PC optimization (Sams Publishing, 1993, softcover, 1300 pages, \$39.95; disk included).

*Upgrading and Repairing PC's* (3rd Edition), by Scott Mueller, is an authoritative resource aimed at those who want to repair, maintain, troubleshoot, and upgrade their PC's. It provides very detailed coverage of the technical specifications of popular IBM PC, PS/2, and compatible systems. A thick technical appendix is included (Que, 1993, 1254 pages, \$34.95). A pocket companion, *Upgrading and Repairing PC's Quick Reference*, is also available (Que, 1994, 384 pages, \$19.99).

*Upgrading Your PC Illustrated*, by Allen Wyatt, takes a magazine article approach to giving helpful instructions on the proper installation of peripherals. The book covers installing memory, disk drives, video cards, modems, and more. It's in full color, with numerous photographs, color charts, and tables (Que, 1994, 320 pages, \$24.99).

The *Certified Tech Support* series, from Osborne/McGraw-Hill, was developed in conjunction with Corporate Software, Inc. (CSI), a large provider of technical support. The problem-solutions are based on the empirical data amassed by CSI in responding to more than 250,000 support calls per year. Available editions include support for Lotus 1-2-3, DOS, Excel for Windows, Word for Windows, Lotus Notes, Microsoft Access, NetWare, and WordPerfect for Windows. Each book is \$16.95. ■

**Diagnostic Hardware.** No software utility can help you if your PC won't boot, or if the display is blank so that

the POST codes don't appear. Then, you'll need a plug-in, POST circuit card and knowledge of your computer's diagnostic messages. Such cards let you identify computer problems even when the monitor, keyboard, or disk drives aren't working.

The above cards are based on the POST codes generated by the PC. The POST is a series of tests that the BIOS on the motherboard runs at power-on to check the circuits and components of the computer. The speaker sounds a single, short beep if the test indicates proper performance. A series of beeps, or no beeps, might indicate hardware problems.

Before each test, the BIOS sends a code to the bus. If a test fails, the last code displayed by the diagnostic board indicates the failure. Therefore, POST circuit cards are invaluable to help you diagnose what appears to be a dead motherboard or PC. Just pop the card into a slot and observe the code that's presented on the card's display. Then, look up the code in a list corresponding to the specific motherboard BIOS. Finding the exact problem is a little more involved and subject to some interpretation, but that's the basic idea.

Probably the least-expensive POST display card is *POST Code Master*, at \$59, by MicroSystems Development (MSD). With it, you can diagnose up to 256 different system failures by displaying the POST codes generated by the PC. The board displays POST codes using built-in routines and has LED's for 12- and 5-volts DC. The printed manual interprets POST codes for many popular BIOS chips; the codes also are provided on disk.

Do you really need a POST-code card? It's up to you to decide how deeply you want to delve into your hardware. But if you have anything to do with multiple PC support, service, or repair, consider purchasing such a hardware-diagnostic tool to help slash troubleshooting time and costs.

When choosing diagnostic software and hardware, keep in mind that some companies offer both. For example, Landmark Research International offers the *KickStart 1* POST card, as well as *PC Probe* diagnostic software, and *AlignIt* floppy-drive alignment products.

**Computer Viruses.** How do you

know if your PC is infected with a virus? Common symptoms include unusual messages or screen graphics, strange sounds from the speaker, decreased free disk space, and changes in program time stamps. Other symptoms include COM and EXE file-size increases, erratic program behavior, random file deletion, system sluggishness, and boot failure.

A virus must be detected promptly and removed, along with any damaged files, before it spreads. If you suspect your computer has been invaded by a destructive virus, don't panic. Turn your PC off, leave it off for at least 15 seconds, and reboot from a write-protected DOS disk. You can then run an antiviral program to try to remove the virus.

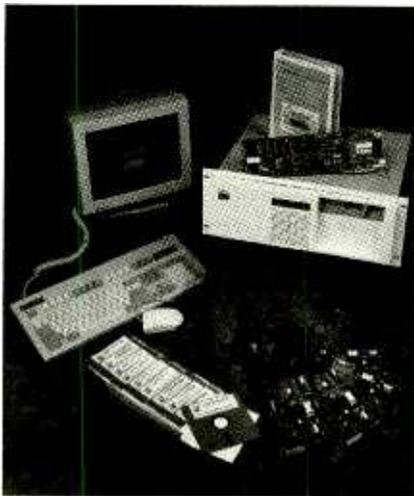
Highly regarded, commercial antiviral programs include Symantec's *The Norton AntiVirus*, Dr. Solomon's *Anti-Virus Toolkit* by Ontrack, and *Central Point AntiVirus*, among others. There are also many shareware and freeware virus programs. The better programs take multipronged approaches, although most are essentially scanners that check memory and the HD at boot-up to tell you if your PC is already infected.

Antiviral software is worth the modest cost and trouble, especially if you download software from bulletin boards (BBS's), exchange disks with others, or if your PC is used by others. Reduce your risk by faithfully backing up your HD and by being very selective in running "foreign" programs on your system.

Don't assume that all your data is irretrievably lost when a virus strikes. Frequently, software utilities or commercial disk-repair and data-recovery services can help you retrieve your data.

**Tech Support Tips.** If you come across a computer problem that you can't solve on your own, you might be able to find the solution by either going to a computer-user group meeting and asking someone, or asking a knowledgeable co-worker. However, sooner or later, you will probably have to rely on technical support. Tech-support specialists can often talk you through a solution to a problem, saving you time and money.

Technical support costs are often built into the cost of hardware or soft-



*Technical support customers can call a "Fax-on-demand" system from any Touch-Tone telephone and request documents to be delivered to their Fax machine or Fax-equipped PC. Shown is a basic FaxBack system offered by FaxBack, Inc., a pioneer in the Demand Publishing field.*

ware. In some cases, you have to pay for support as you use it—more often the case with software. Either way, it pays to take time to learn how to maximize the full range of support that's available to you.

Often, vendors go to great lengths to help solve customers' hardware and software problems, whether face-to-face, via telephone or Fax, through support BBS's, or otherwise. However, you never know what level of support you're actually going to get from a vendor until you try.

If you bought your PC or software locally, going back there with the problem is often the best solution. Some local dealers provide PC "loaners" and support for software they sell, or suggest outside technical resources. Face-to-face contact works wonders.

Most software vendors used to offer complimentary support for the life of the product, but today many software houses limit free support to 30, 60, or 90 days, and then offer various extra-cost, paid support plans. That is generally not the case with hardware, as support is free and unlimited, and many hardware vendors offer toll-free lines.

The high volume, direct-channel PC vendors have suffered from technical-support lines that are inadequate to handle the explosion of purchasers. However, most of them

have recognized the problems we users have in reaching them.

Gateway 2000, for example, expanded its telephone system to include several, separate toll-free lines for different purposes. In Gateway's 800-line system, besides the main operator, there are separate numbers for direct access to sales and customer-service extensions, add-on components, general technical support, portable-computer support, and other specialized functions.

When calling a support line, you'll often start out by talking to an automated, interactive voice-processing attendant that routes your call to the proper support area. Sometimes you'll be sent to a "general practitioner" representative who might be able to help you with simple problems. Complex problems, especially those dealing with specific PC subsystems such as video boards or disk drives, are then passed on to a specialist.

Here are some tips for getting the most effective support in the least amount of time: If the software or hardware manufacturer you are calling has a technical-support checklist, use it. Be at your PC, ready to use it, and ready to succinctly describe the problem and what you've done. Try to re-create the problem to provide the technician with an exact sequence of events and the error messages you see.

Also, have the following information ready: your customer number; the version of the hardware, operating system, or application software; the software serial number and file date (be sure you're registered); disk-drive, video card, and plug-in board information; memory-resident program and memory-management setup information; and the exact wording of any error messages. In addition, have ready the contents of your AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, and SYSTEM.INI files, and the Windows version, mode, and memory resources available.

Most of the above information is provided by the comprehensive SI programs included in PC Tools, The Norton Utilities, and other diagnostic packages. Print out the SI report and have it available during a support call, or Fax it to the technician. Some application software has special, in-

ternal diagnostic and reporting utilities that the technician might ask you to run during support calls.

**Costly Help?** Some vendors (mostly of software) have decided that technical support should be a profit center and have established 900-number support for out-of-warranty and older products. Typically, you're charged \$2 or more per minute on 900-number support lines.

While 900-number services run "against the grain" of the free support we expect, the services can actually be less expensive on a charge-per-call basis than the blanket-coverage annual-support plans offered by some software vendors after the free support runs out. Also, some firms offer little sweeteners to their 900-number services, such as training and tips on product usage.

One enterprising Florida firm, Software Support, Inc. (SSI), provides round-the-clock, third-party help for over 150 PC and Macintosh software titles, charging users \$2.95 per minute on its 900 help line. They also offer 90-day and full-year, 800-line service policies. Some PC vendors have arranged with SSI to offer low-cost, unlimited technical-support policies for the application-software packages bundled with their PC's.

Tailored support is also offered by Microtech Software, which operates the Microtech Technical-Support Help Line. Microtech offers options that include unlimited operating-system support for a single PC, a quarterly newsletter, bulletins, support for specific software, and discounts on other products and services. All support is by Fax or U.S. mail, or through the Prodigy or CompuServe on-line services.

**New Approaches.** The traditional ways of obtaining PC technical support might not always be the best approaches to obtaining satisfactory results. In fact, some new techniques might ultimately render traditional methods obsolete or too costly. Let's look at some new support options.

Automated Voice Response (AVR) support enables you to use a Touch-Tone telephone to receive automated voice answers to common support questions. You can also get "expert," automated, technical-sup-

port diagnostic sessions and "power tips" by phone.

Central Point Software, for example, offers 24-hour, AVR technical support through its toll-free "CPSOLVR" line. If you need to leave the system during a call, you can even save your place in the session and pick up where you left off during a later call. The AVR system can also send information to your Fax machine if the diagnostic session shows that a support document is available to help you with your problem (more on dial-up Fax information later).

Most vendors respond to Faxed requests and many won't charge for it. However, it is advisable to make initial contact with a live technical-support representative and then use the Fax to send system configurations, graphics printouts, and follow-ups to the rep you're dealing with. Initial, out-of-the-blue Fax requests often get lost in the shuffle.

After making initial contact, you can clearly summarize on paper the problem and the steps you've taken, and Fax it to the technician along with detailed system-configuration information. You can also send examples of program screens showing the problem, or graphics printouts depicting what's going awry. That spares you from the need to verbally describe complex program anomalies over the phone. Also, the support tech's often lengthy, return phone call is on the vendor's "dime," not yours.

Even if you prefer to speak directly with a technical-support representative, consider Faxing the contents of critical AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, and SYSTEM.INI files to save time. Also, you might wish to send the SI printouts.

There's a new twist to Fax-based support: automated "Fax-on-demand" or "Fax-retrieval" technology. You can now call a vendor's 24-hour Fax line, enter a simple voice-prompted menu, and have support information sent to your Fax machine or PC immediately. Many PC and software vendors have installed such "Demand Publishing systems."

Demand Publishing systems often have toll-free numbers. A typical system has a question-and-answer voice tree that tells you what technical-support documents it has available. You can choose from installation guides,

## FOR MORE INFORMATION

Central Point Software  
15220 N.W. Greenbrier Pkwy. #200  
Beaverton, OR 97006

Compaq Computer Corp.  
PO Box 692000  
Houston, TX 77269-2000

CompuAdd  
12301 Technology Blvd.  
Austin, TX 78727

Dell Computer Corp.  
9505 Arboretum Blvd.  
Austin, TX 78759-7299

FaxBack, Inc.  
15250 N.W. Greenbrier Pkwy.  
Beaverton, OR 97006-5674

Gateway 2000  
610 Gateway Drive  
PO Box 2000  
North Sioux City, SD 57049-2000

Global Computer Supplies  
1050 Northbrook Pkwy.  
Suwanee, GA 30174

IBM Personal Computer Co.  
Route 100  
Somers, NY 10589

Landmark Research International Corp.  
703 Grand Central St.  
Clearwater, FL 34616

Macmillan Computer Publishing (New  
Riders, Que, Sams)  
201 West 103rd St.  
Indianapolis, IN 46290

MicroSystems Development  
4100 Moorpark Ave.  
Suite 104  
San Jose, CA 95117

Microtech Software  
917 Boston Post Rd.  
Fairfield, CT 06430-6013

Ontrack Computer Systems, Inc.  
6321 Bury Drive  
Eden Prairie, MN 55346

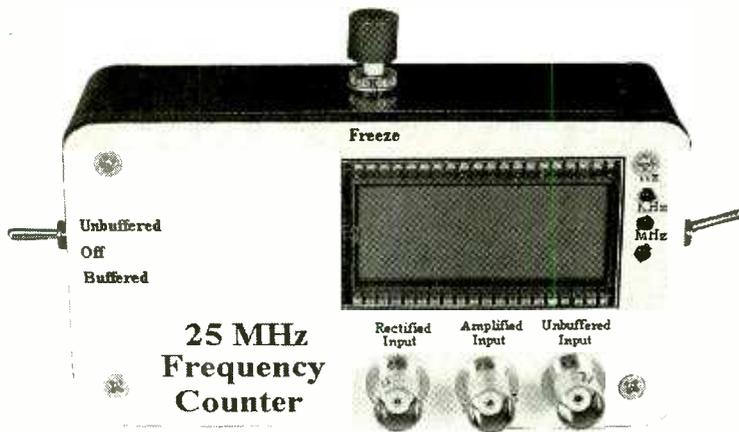
Osborne/McGraw-Hill, Inc.  
2600 Tenth St.  
Berkeley, CA 94710

Software Support, Inc.  
300 International Pkwy.  
Heathrow, FL 32746

Symantec Corporation  
2500 Broadway, Suite 200  
Santa Monica, CA 90404-3063

troubleshooting guides, application notes, problem notices and fixes, and more. The system then asks you for your own Fax number, and transmits the selected documents to your machine.

Dial-up Faxes are a good alternative if your favorite software house  
*(Continued on page 88)*



# Build A 25-MHz Frequency Counter

*Here's an inexpensive way to gain a valuable addition to any hobbyist's workbench.*

BY MARK EMERY BOLLES

**W**ith the way that the electronics world has changed in the last twenty years, a frequency counter is no longer a luxury; it is a necessity. Unfortunately, like most of us, I walk a delicate line between what my test bench needs and what my budget can afford. A few years back, I spent nearly \$200 on a fancy signal-generator/frequency-counter unit; but, unfortunately, it only goes to 2 MHz. As even the simplest circuits these days have clock speeds that exceed that many, many times over, I constantly found myself perusing the catalogs, looking for something I could afford.

Then I came up with the *25-MHz Frequency Counter* described in this article. It accurately counts frequencies to 25 MHz, is so small that it could fit in a coat pocket, and can be built for less than forty dollars.

The complete schematic for the frequency counter is shown in Fig. 1. Any frequency counter, including this one, can be broken down into five basic sections: counting, input conditioning, ranging, timing, and display. Let's look at each of those functions separately.

**Counting.** When building a frequency counter, it's hard to ignore the chips made by Intersil/Harris Semiconductor. Some of them are really complete frequency counters on a single chip; you just hook them up to a display, add some conditioning circuitry, throw it into a box, and *voila*, you have a frequency counter.

That said, I didn't use one of those chips for a variety of reasons. To start with, they generally only count to 10 MHz; that isn't high enough for many applications. Secondly, the chips are quite pricey; some of them cost more than this whole project. And finally, it just feels like cheating to throw a single chip in a box and say: "Hey! Look what I made!" Part of the joy of electronics, whether as a hobby or a profession, is the chance to exercise your gray matter a little and come up with something innovative. The single-chip solution is lacking in challenge.

Having discarded the one-chip solution, there are still some extremely good Intersil chips that we can use. For the heart of the frequency counter, I chose the Intersil ICM7224IPL. It is a higher performance version of the CMOS family 74C946 counter/latch/display driver, but where the latter tops out at around 3 MHz, the former is guaranteed to count to 15 MHz, and typically counts to 25 MHz or better. Best of all, the ICM7224IPL costs less than \$10.

The ICM7224 directly drives a four digit LCD display; it has reset, clock, and enable inputs. The reset input sets all counters to zero. The enable input essentially disables the clock input. That means that we can connect the output of the counter's input-conditioning circuitry directly to the chip's clock line, and control when counting occurs with the enable input.

**Input Conditioning.** Input con-

ditioning is the area where most home-brew frequency counters fall down. The reason is simple enough: Designing a good input-conditioning circuit is usually difficult, expensive, or both. For this design, I wanted to be able to count frequencies from 0 to 25 MHz, using input signals from 0 to 50 volts, allowing both AC and DC signals of any wave shape. For use with the selected counter chip, the input-conditioning circuit must be able to change sine, triangle, or any other wave shape to a clean square wave of 0 to 5 volts, with fast rise and fall times. And, of course, the input-conditioning circuit had to be simple and cheap.

I am not above stooping to theft (although I prefer to call it "research"), so the first thing I did was to pull out all the old books and magazines and try a few front-end circuits from other frequency counters. Amazingly, I found that very few worked as claimed, and none would work for my design. All of the circuits I checked used op-amps for signal conditioning. I bread-boarded the designs, but found that the chips required were either too expensive, required a dual power supply, or weren't fast enough. I needed a new approach.

Most of you are probably familiar with the CMOS 4049 chip. That chip houses six inverters in a 16-pin DIP. It was designed for use in digital circuits for logic purposes, as well as for interfacing between TTL and CMOS. What many people don't know is that it can



the chip, and we can convert slow rise and fall times into fast ones. Lastly, as is typical with the HC family, high level outputs go all the way to  $V_{CC}$ .

By choosing input and feedback resistors that give a gain of 100, we can be assured that any significant input signal will drive the chip's output from rail to rail, ensuring a nice clean square wave for us to feed to the ICM7224PL.

The one thing that the 74HC4049 does not like is a negative input voltage. The databooks say the minimum input voltage is 0 volts, but in reality, it will handle up to around  $-1$  volt without complaint. Also, although the chip is designed to handle up to 15 volts, it runs cooler if the maximum input does not exceed  $V_{CC}$  (5 volts in our design). Therefore, as part of our input conditioning, we need to be able to take signals that can range as far as  $-50$  to  $+50$  volts, and convert them so that they fit into a  $-1$  to  $+5$  volt range.

The obvious choice for that job is a Zener diode. The circuit uses a 1N751 5.1-volt Zener, along with a 47K resistor and capacitive coupling, so that a minimum load is put on the circuit under test.

When price is a factor, any circuit is a compromise. The one used here has two problems: The first is that the Zener diode has a relatively slow recovery time and starts to perform poorly at speeds above 8 MHz. The second problem is that the 74HC4049 uses a lot of supply current. So I chose to provide three different inputs to the frequency counter.

Input-jack J1 is used when the signal needs to be amplified and conditioned for the ICM7224 chip. The Zener rejects all signals that fall outside the range of  $-0.7$  to  $+5.1$  volts. Therefore, that input is used for sine waves and AC signals up to about 50 volts; it works well to about 8 MHz or more, depending on signal symmetry.

Input-jack J2 is used when the input signal needs conditioning, but not rectification; a 0- to 15-volt DC triangular wave, for example. The input works up to the full 25-MHz limit of the frequency counter.

Input-jack J3 is used for an unconditioned signal; it goes directly to the ICM7224's clock input. If you are counting the frequency in a typical digital circuit, where you generally find only 0- to 5-volt square waves,

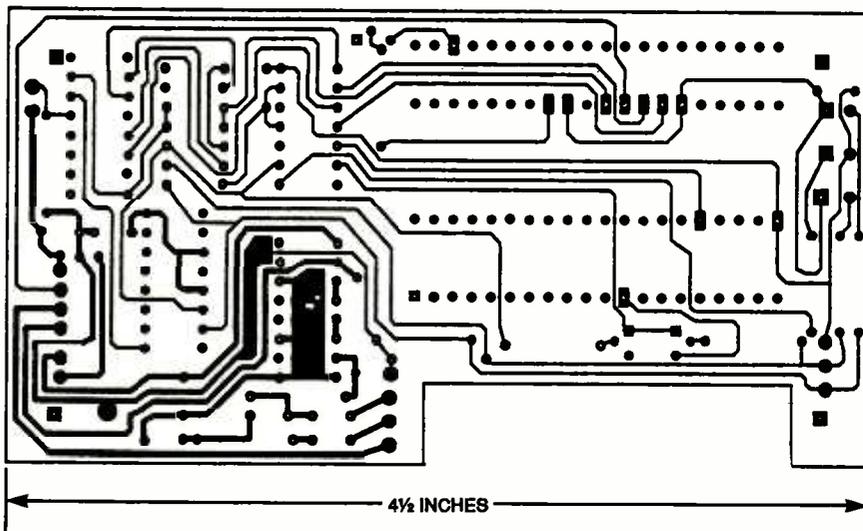


Fig 2. The counter is built on a compact double-sided PC-board. The artwork for the foil side of the board is shown here.

input conditioning is not required. When that input is used, switch S1 should be placed in position 3, the unbuffered position. Besides connecting the input directly to the counter chip's clock input, that removes supply power from the 74HC4049, which is not used in the unbuffered configuration. Since the input-conditioning circuitry consumes about 100 mA, that setting can extend battery life considerably.

**Ranging.** Since our design can display only 4 digits, some type of ranging is essential. The frequency counter has three ranges: 0000–9999 Hz; 000.0–999.9 kHz; and 00.00–99.99 MHz.

There are two different ways we could achieve the required ranging scheme: The first is to divide the incoming signal with counters so that the ICM7224 counts fewer pulses. The second method is to change the time period within which the input signal's pulses are counted. For the frequencies we will be dealing with, the second method is easier, cheaper, uses fewer chips, and is more accurate. All we need is a way of accurately controlling the timing period.

**Timing.** Actually, the term "frequency counter" is a misnomer; a frequency counter really doesn't count frequencies, it counts pulses. So when we design a frequency counter, we are really designing a piece of test equipment that shapes incoming pulses into a form it likes, counts them, and

displays the count. Of course, that sounds like the definition of an events counter; in order for it to be a frequency counter, it must count the pulses that occur within a specific time period. Therefore, we can think of a frequency counter as an events counter that contains accurate timing circuitry; that circuitry determines when the pulses (events) are counted.

It then becomes obvious that the accuracy of the frequency counter completely depends on the accuracy of the sampling period. If it is even a fraction of a second off, the ICM7224 will miss counts, or count more pulses than it should, giving an inaccurate readout.

As you can then see, next to the counter chip itself, the timing circuitry is the most critical part of an accurate frequency counter. For our design, we need a chip that will accurately define the three timing periods we require for the three different ranges.

The Statek PXO-1000 is a 16-pin DIP that contains a 1-MHz laser-trimmed crystal, along with internal logic and dividers that allow you to get 57 different frequencies from 1 MHz down to 0.0083 Hz, depending on the logic levels present at the chip's program pins. Also, the chip has good temperature stability (0.015% over its operating range), doesn't have start-up problems like crystal oscillators occasionally do, and runs on about 700  $\mu$ A of current. Epson America also makes a compatible chip, the SE3102 (available from Digi-Key, and elsewhere).

We can get the three frequencies

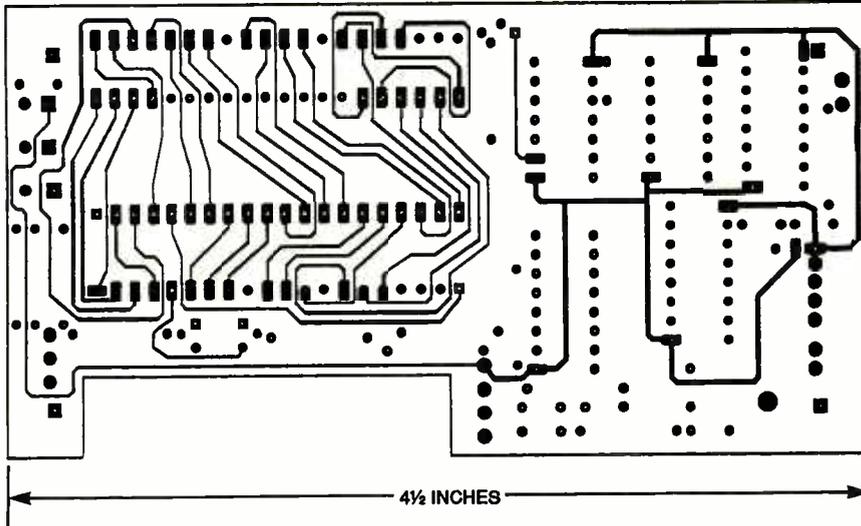


Fig. 3. Here is the component side of the project's PC-board. Like the foil side shown in Fig. 2, it appears full sized.

we need by changing the logic levels on just two of the chip's program pins. We can then take the frequencies that are output from the PXO-1000 and convert them into the timing periods that we need for the enable line.

Let's see how all of that works. The frequency from the PXO-1000 is fed to the clock input of the 74HC4017. As the clock counts, each of the 74HC4017's 6 outputs goes high in succession. Two of the outputs are fed into an RS latch, the output of which is fed to the 74HC7224's enable input.

There are a couple of advantages

to using that method. One is that the enable period becomes dependent only on the PXO-1000's output frequency, which in this case is easily controlled with just two logic pins. Secondly, we can use other outputs from the 74HC4017 to control the reset and latching inputs of the ICM7224. Lastly, and probably most important, is that the circuit, using the RS latch, is completely immune to propagation delays. Since the rise and fall propagation delays for the 74HC02 are exactly the same, the delay in turning on the RS latch is exactly the same as the

delay in turning off the latch; therefore, the enable period suffers no variations, and we can be confident that the ICM7224 is giving us an accurate count.

**Display.** Our frequency counter uses a 4-digit LCD display that is directly driven by the ICM7224. What the ICM7224 does not do is control the decimal points, nor does it directly control an overflow indicator; we must take care of that ourselves.

The ICM7224 generates a 150-Hz square wave for the display; that signal is called the backplane. When a segment of the LCD should be off, that segment is fed a square wave that is identical to, and in-phase with, the backplane. When a segment is to be on, the segment is fed a square wave that is 180° out-of-phase with the backplane, causing the segment to become visible.

Therefore, the easiest way to display the decimal points is to take the backplane signal, invert it, and gate it to the appropriate decimal point segments on the LCD with transistors. In strict theory, that isn't quite ideal. In our implementation we cause the decimal point segments to be on with a square wave 180° out-of-phase with the backplane, but cause the segment to be off by providing it with no signal at all. Strict theory would de-

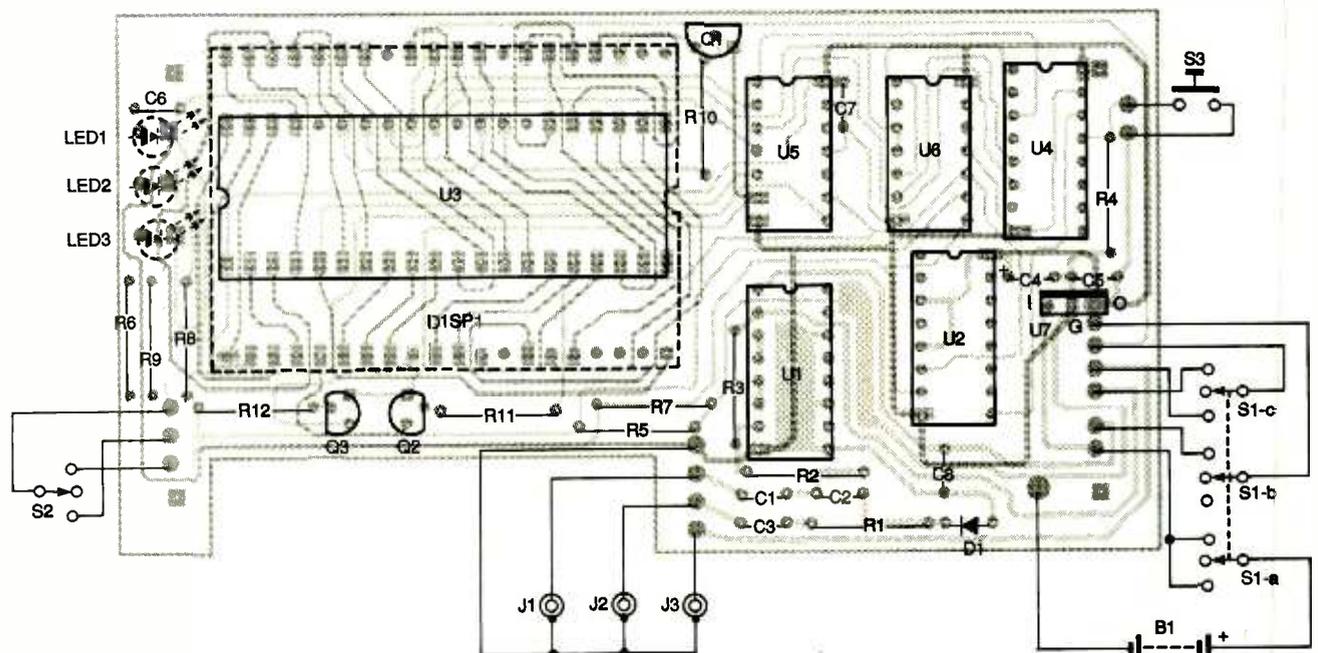


Fig. 4. Mount the components using this parts-placement diagram as a guide. Note that the LCD (DISP1) and the LED's mount on the foil side of the board. Be sure to solder all components on both sides of the board wherever pads are provided.

## PARTS LIST FOR THE 25 MHz FREQUENCY COUNTER

### SEMICONDUCTORS

- U1—74HC4049 high-speed CMOS hex inverter, integrated circuit
- U2—PXO-1000 or SE3102 programmable frequency source, integrated circuit (see text)
- U3—ICM7224IPL counter/latch/display-driver, integrated circuit
- U4—74HC4017 high-speed CMOS decade counter, integrated circuit
- U5—74HC04 high-speed CMOS hex inverter, integrated circuit
- U6—74HC02 high-speed CMOS quad 2-input NOR gate, integrated circuit
- U7—LM7805 5-volt regulator, integrated circuit
- DISP1—LCD003 4-digit liquid-crystal display, see text
- Q1-Q3—2N3904 NPN transistor
- D1—1N750 5.1-volt Zener diode
- LED1-LED3—20-mA light-emitting diode, 1/8-inch diameter

### RESISTORS

(All resistors are 1/8-watt, 5% units.)

- R1—47,000-ohm
- R2—100,000-ohm
- R3—10-megohm
- R4, R5, R7—2200-ohm
- R6, R8, R9—330-ohm
- R10-R12—10,000-ohm

### CAPACITORS

- C1-C3—0.022- $\mu$ F, Mylar
- C4—1- $\mu$ F, tantalum
- C5-C8—0.01- $\mu$ F, ceramic-disc

### ADDITIONAL PARTS AND MATERIALS

- S1—3PDT, mini toggle, center off
- S2—SPDT, mini toggle, center off
- S3—SPST momentary push-button, normally off
- J1-J3—BNC connector, female, panel mount
- B1—9-volt battery, transistor-radio type
- PC-board and materials, enclosure (Radio Shack 270-222 or similar), 9-volt battery clip, hardware, solder, wire, etc.

mand that we turn the decimal points off by feeding them the backplane signal, rather than no signal. However, that would increase the parts count of the circuit, and whatever "points" we lose by not adhering to strict theory, we gain back through our "admirable down-to-earth pragmatism!"

**Some Final Touches.** We have now described most of the major points of

the circuit shown in Fig. 1. However, there are still a few points we need to touch upon.

The range switch, S2, is a center-off SPDT toggle switch. In position 1, we feed  $V_{CC}$  to a Hz LED indicator, and pull PXO-1000 program pin 4 high. That results in a PXO-1000 output of 5 Hz, and a 1-second timing period on the ICM7224's enable line.

In switch position 3, we feed the MHz LED, and pull no program pins low. That results in a PXO-1000 output of 50 kHz, which corresponds to a 0.1 ms timing period.

For the "kHz" range, the center-off position (position 2) of the range switch causes a NOR gate (U6-d) to generate an output; that output pulls PXO-1000 pin 5 high, and feeds the kHz LED through an inverter.

We also need an over-range indication to tell us when the input frequency exceeds the range we have selected. The ICM7224 has a carry line, intended for cascading counters; it goes high whenever the count exceeds 9999, and remains high until a reset. While we don't need that line for its intended purpose, it is ideal for implementing an over-range indication.

The LCD display I used was originally intended for a variety of purposes, one of which was a digital-clock display. It has a "PM." indicator in the upper left display corner, in the form of a triangle; we will use that for our "over-range" indicator, and control it with the ICM7224's carry line in the same way we turn on the decimal points.

The 74HC4017 is used for more than just gating the enable line through the RS latch. Every timing cycle, just prior to the sampling period, we use the 74HC4017 to reset the counters in the ICM7224, and then after the timing period, we latch the count into the display.

Finally, we need to deal with one of those problems that you generally don't think about until you build and test a design like this. When we are using the MHz range, for example, the frequency counter is testing and displaying the frequency 5000 times every second. If the input frequency is, say, half way between 10.15 MHz and 10.16 MHz, then sometimes the last digit will be a "5", and sometimes it is a "6." The relatively slow recovery time of the LCD, coupled with an effect called "persistence of vision" (the slow

recovery time of the human eye) can cause that last digit to look like a 5 and a 6 combined, showing a weird character that looks like an 8 with one segment missing. It would be nice to be able to freeze the display for situations like this, as well as for those times when you are measuring a rapidly changing frequency, and want to take a "snapshot" of the frequency at a particular instant.

Therefore, you will notice in the schematic that there is a "freeze" switch (S3) hooked up to the 74HC4017's enable line. When closed, that normally open pushbutton disables the 74HC4017's clock input and stops the chip from cycling; the LCD display therefore becomes frozen.

That is not a perfect solution, though; although the display is frozen, if you press the freeze button during the sample period (statistically, the chances of that are 50%), then the counters will keep counting, even though that count will not be latched and displayed. What will be displayed is the over-range indicator. So, although the count displayed is accurate, you cannot expect an accurate over-range indication when the freeze button is pressed.

**Construction.** One of the design parameters for the frequency counter was portability; consequently, the whole circuit fits on a small double-sided board that measures just  $4\frac{1}{2} \times 2\frac{3}{8}$  inches. The artwork for the solder (foil) side of the board is shown in Fig. 2, while the component side is shown in Fig. 3. The board fits into a Radio Shack 270-222 project box, or a similar enclosure.

Start the construction by etching and drilling the board; check all traces for shorts and opens. Note the cut-out area; that area is necessary to allow room for the BNC connectors and can be made using a jeweler's saw or another suitable tool. Drill out the four areas indicated by square pads near the board's four corners to accommodate the project box's mounting screws; take care to not break any of the traces near the pads.

A parts-placement diagram is shown in Fig. 4. Note that DISP1 and the three LEDs mount on the foil side of the board. Begin assembly by  
*(Continued on page 94)*



# Learn How To Service VCR's

*Many VCR problems are easy to diagnose and repair if you know how. Here's one way to acquire the needed knowledge.*

BY MARC SPIWAK

**V**CR's contain a little bit of everything: belts, gears, motors, pulleys, springs, circuit boards, wires, transformers—you name it. Now, we know that most readers of this magazine can't resist getting their hands dirty in anything that contains a little bit of everything. However, VCR's are quite complicated electro-mechanical devices, and are easily damaged by tinkering. In other words, you have to know what you're doing to avoid causing even more damage.

We will get to some of the more basic ways that VCR's fail and what you can do to prevent or troubleshoot and repair those failures a little later. But first, I would like to suggest one way to acquire the skills and knowledge you need to service VCR's either as a hobby, or as a career. That is the *Heathkit VCR Servicing Course* (Heath Company, Benton Harbor, MI 49022; Tel. 800-253-0570). That \$799 course teaches you all about basic VCR maintenance and how to do advanced repairs. Like any other product from Heathkit, the materials are of the highest quality, the documentation is clearly written and error-free, and the course is one of the best in its class.

**What you get.** The Heathkit VCR Servicing Course comes with everything you need to learn how to service and maintain VCR's, including a top-quality RCA VCR to practice on. There is also plenty of documentation; in addition to the well-written Heathkit manual, two textbooks on VCR servicing are included. Two videotapes also come with the course: one on how to do surface-mount soldering repairs, and one that contains VHS test patterns.

Also included is a clear plastic VCR tape simulator that lets you observe how a VCR is operating without having an actual tape installed. That not only lets you see what would normally be blocked by an actual tape, but also prevents a good tape from getting ruined by a malfunctioning VCR. The course also includes lubricants; rubber revitalizer; tools, including a belt gauge; a VCR head cleaner and other cleaning supplies; and a collection of the most commonly replaced VCR parts for the VCR that is included in the course.

Speaking of the included VCR, it is a top-quality, RCA VHS 4-head hi-fi stereo VCR with MTS broadcast stereo reception, on-screen display, and VCR

Plus programming built-in. It has an 8-event, 1-year programmable timer that is battery-backed in case of a power failure. The unit also has a 181-channel cable-compatible tuner, and comes with a universal remote control that works with 30 brands of TV's.

In fact, the RCA VCR is such a nice machine that you might be afraid to open it up, but that's what it's intended for. After covering the course material, you should feel fully confident in opening up the case. Speaking of opening up the case, one reason why the RCA VCR was chosen for the course might be that it's so easy to open up. We've seen plenty of decks that are almost as hard to open as they are to fix. Complete servicing manuals and schematics for the RCA VCR are also included with the course.

The Heathkit VCR Servicing Course will let you keep any VCR in tip-top shape for years. You'll learn how to handle dirty heads, jammed tapes, worn belts and rollers, dirty contacts, and more. In addition, you'll also learn how to troubleshoot and repair all of the complex circuitry that is located inside a VCR.

**VCR Basics.** The inside of a VCR is a scary place for those unfamiliar with it. And unfortunately, any heavily used VCR is going to require servicing at some point, even if it's just to clean the heads and tape path. As a matter of fact, most VCR malfunctions are simply due to dirt and dust buildup inside the machine.

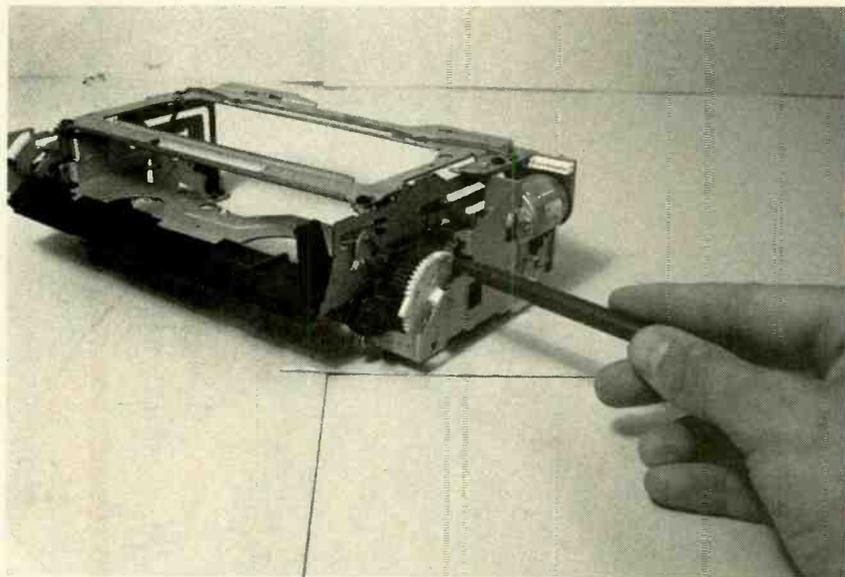
Older top-loading decks had a pop-up door that you would slide the cassette into and push down manually, where it would lock in place. Pushing the door down would mate the cassette take-up and supply reels with the deck's take-up and supply reels, open the tape cover on the cassette, and position various guides and rollers about the cassette. That tape-loading scheme, while quite simple, allowed plenty of dust to enter the deck every time the door was opened.

Top-loading decks gave way to front-loaders, the only kind you can buy today, which include automatic tape-loading mechanisms that properly seat the tape for you. While that certainly reduces dust intake, it also adds complex tape-loading mechanisms that are prone to problems, especially if the deck is abused (tapes forced in, backwards or otherwise), foreign objects are inserted, or if cheap or worn tapes are used on a regular basis.

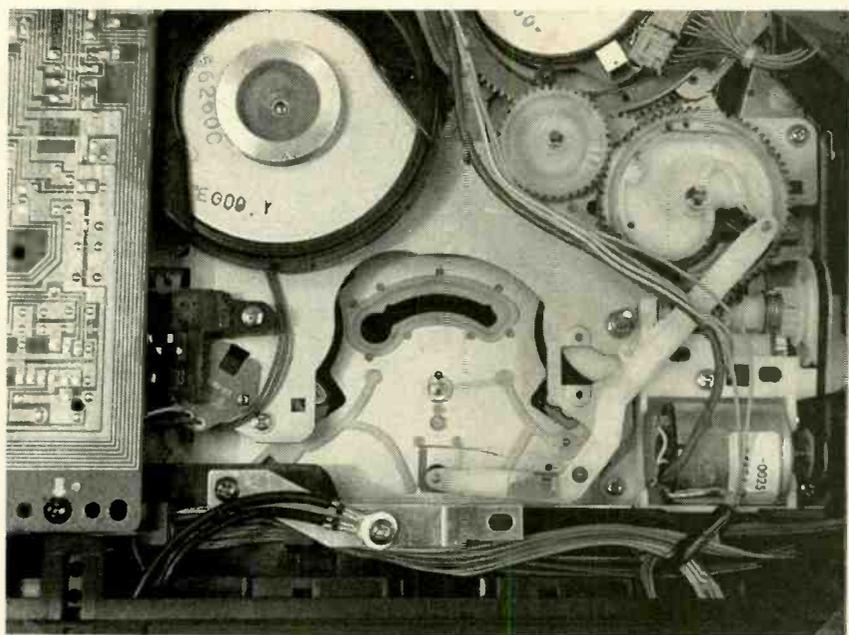
Once a tape was pushed down in a top-loading deck, it would just sit there. When you pressed play or record, the video-head drum assembly would start spinning and components called the slant poles would pull tape out of the cassette and "wrap" it around the drum.

At the same time, a pinch roller would position itself against the capstan shaft, which would pull the tape through the tape path. The aforementioned guide rollers and slant poles often get dirty, causing tape-loading problems. On any older top-loading deck, those components should be cleaned with foam-tipped swabs on a regular basis.

With a modern, automatic front-loading deck, the first minor problem you might encounter is a cassette-loading malfunction. The cassette carriage has the job of properly loading the cassette. Usually four screws hold the cassette carriage in place. The carriage gears and motor are



*Cassette-loading is accomplished by the cassette carriage, shown here removed from a VCR. If a cassette won't load properly, the carriage gears and motor are usually the culprits.*



*The VCR tape-load motor unwinds the tape from a cassette and wraps it around the drum for normal viewing, fast forwarding, and rewinding. The motor, and any gears, belts, or pulleys associated with it are usually to blame when the tape won't wrap around the drum properly.*

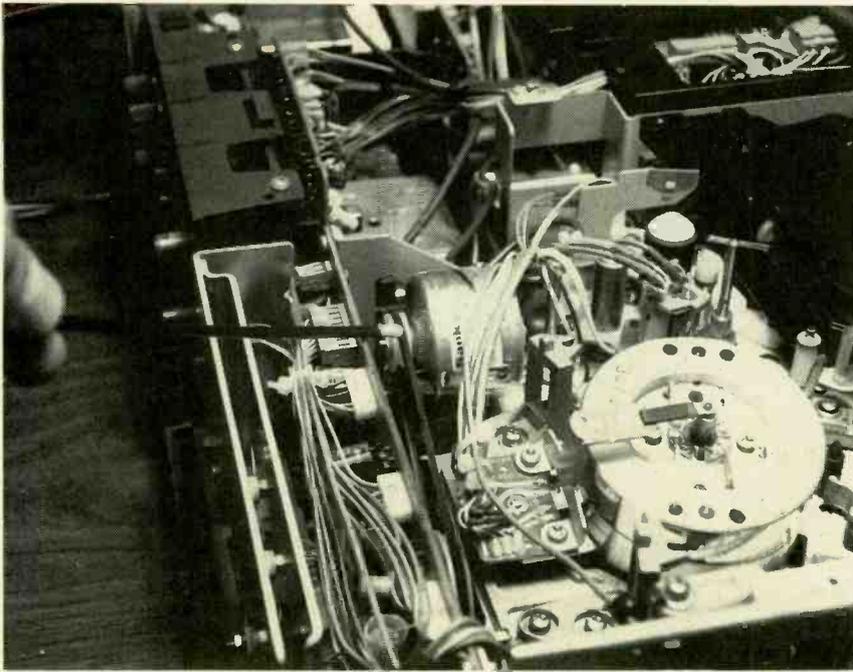
usually the culprits when a cassette won't load properly.

Worn gears always have to be replaced, but some gears just need to be lubricated. Other times, old lubricant has simply dried up and is causing gears or other parts to bind. Removing the old lube and re-lubricating the part might solve that type of problem.

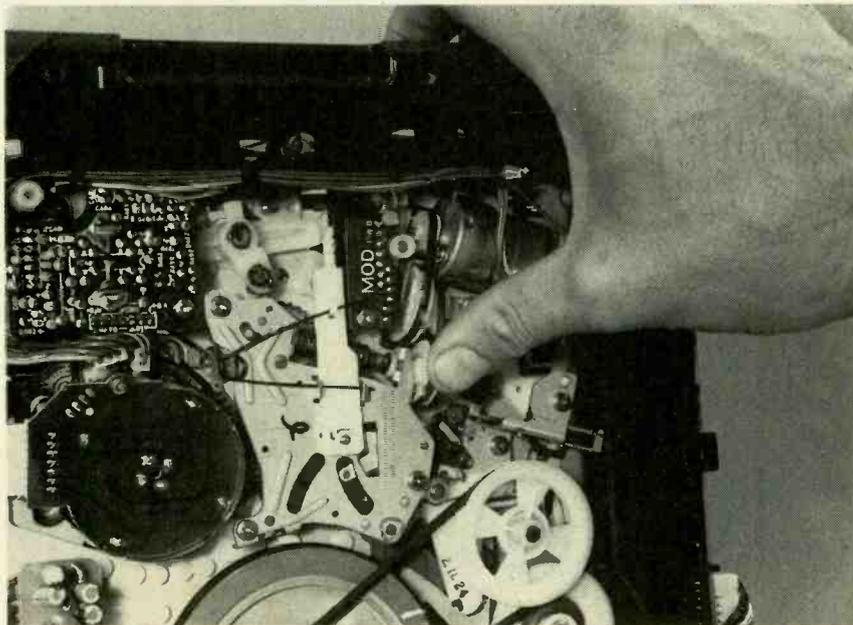
Similarly, worn belts and tires must be replaced, but can sometimes be

brought back to life (made "grippy" again) simply by applying a rubber revitalizer. A belt-gauge can help you to determine if belts meet allowable tolerances and if one belt matches another.

The tape-load motor unwinds the tape from the cassette and wraps it around the drum. That motor might be on either the bottom or top side of the VCR chassis. The motor and any gears, belts, or pulleys associated with



As shown here, the tape-load motor can also be located on the top side of a VCR's chassis.



Often, a mechanical tape-loading problem, such as a bad belt, can be verified by moving the pulley with your finger. That should assist the loading process if the problem really is mechanical and not electronic-sensor related.

it, are usually to blame when the tape won't wrap around the drum assembly properly.

During loading, unloading, and play, a plethora of sensors helps the microprocessor inside a VCR keep track of tape status; for example, whether or not the tape is loaded properly. A mechanical malfunction will usually cause a sensor to tell the microprocessor to shut down the

deck. A mechanical tape-loading problem, such as a bad belt, can often be verified by assisting the load process—moving the pulley manually—with your finger.

If mechanical problems are not present, electrical problems with the sensors themselves can be more difficult to diagnose and are beyond the scope of this article. Fortunately, the Heathkit course fully explains how to

deal with all of the sensors in the RCA deck, and the two VCR-repair books included with the course will help track down a sensor problem in any deck.

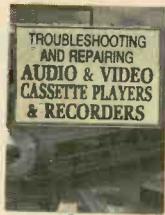
Sometimes a tape loads well but does not align itself properly with the tape path. In that case, an alignment adjustment might be necessary. Be careful, however, as it is very easy to misalign something that wasn't out of alignment in the first place. Get help if you are not sure of what you are doing. Incidentally, the Heathkit course is a good source of such help as it explains how to properly align everything.

As ironic as it might sound, many tape loading or transporting problems are difficult to detect with a tape in place. However, without a tape in place, a VCR will not perform most functions. To get around that, a clear plastic VHS tape simulator (like the one that comes with the course) is invaluable. It contains no tape but will trick the deck into thinking that one is in place. Such a tool makes it much easier to see why certain problems occur, and therefore can make troubleshooting much easier.

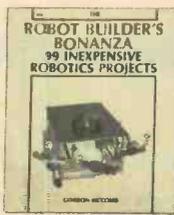
Assuming the tape loads and transports properly, the next problem you might encounter is a poor or missing picture. For that, look at the drum that contains the rotating video and hi-fi audio heads. The drum can always be cleaned with foam-tipped swabs. Heads that are too far gone must be replaced. However, if the heads are only dirty, they can be cleaned with a chamois-tipped stick.

**Major Headaches.** Mechanical and sensor problems are the easiest ones to diagnose and repair, often without any test equipment at all. However, when an IC or other electronic part buried somewhere in the unit goes belly-up, some heavy-duty troubleshooting might be in order. Again, those kinds of problems are beyond the scope and abilities of the typical hobbyist troubleshooter, and therefore of this article.

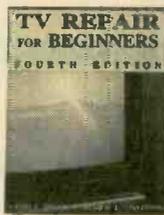
However, with the information provided in the Heathkit VCR Servicing Course, any electrical problem can be diagnosed and repaired. You just have to have the ambition to learn and apply what that excellent course has to offer. ■



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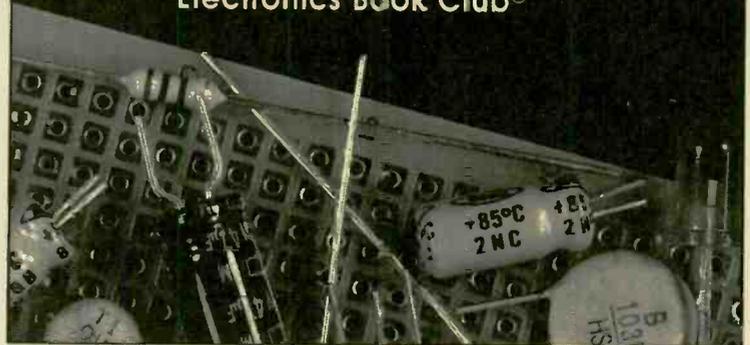
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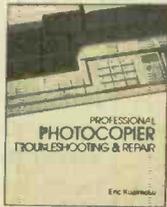
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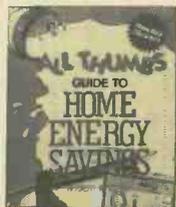
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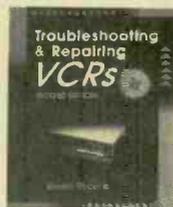
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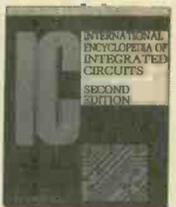
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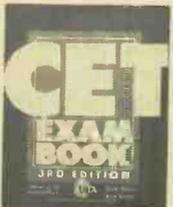
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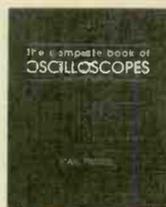
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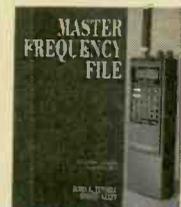
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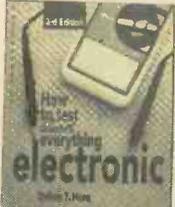
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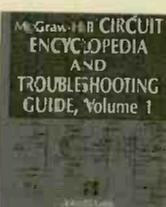
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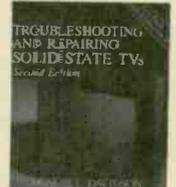
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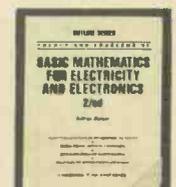
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# ANTIQUÉ RADIO

By Marc Ellis

## This 'N That

**T**his month we have some interesting publishing people to talk about, as well as a story about one of the few female antique-radio restorers ever to come to my attention. But first, some unfinished business from last month.

### TEL-OHMIKE POST SCRIPT

Those who followed the just-concluded story on the Sprague TO-4 Tel-Ohmike capacitor checker might remember that there were some problems with the 0.1–50- $\mu$ F capacitance range. The measurements I was getting seemed quite far off, and I was beginning to suspect the 2- $\mu$ F reference capacitor used for

measurements on the “problem” range, and I began to think that my initial poor results were caused by operator trouble.

Never being one to do any work that isn't absolutely necessary, I buttoned up the TO-4 and placed it in my workshop. A few days later, however, I decided to put the TO-4 through its paces again and once more observed poor accuracy on the 0.1–50- $\mu$ F range. It was definitely time to go after that reference capacitor.

As it happened, I had on hand about a dozen 2- $\mu$ F, 20% capacitors of good construction as well as several 0.5- $\mu$ F units. In preparation for making the replacement, I measured the capacitance of each one on the TO-4 and wrote the measured value on the capacitor with a marking pen. I didn't care about the observed absolute values, which were probably wrong, but I was interested in establishing relative capacitances.

Now I removed the old reference capacitor and connected my decade capacitor (set to 2  $\mu$ F) across the TO-4's test terminals. That value was chosen because it fell at the center of the measuring scale on the 0.1–50- $\mu$ F range. Connecting one of the previously-measured 2- $\mu$ F units (via clip leads) as the reference capacitor, I measured the decade capacitor on the TO-4. A result close to 2  $\mu$ F was obtained, but it wasn't close enough.

Experimenting with various combinations of my

previously measured capacitors as the reference cap, I finally got a “dead on” 2- $\mu$ F measurement using one of the lowest-value 2- $\mu$ F capacitors in parallel with one of the lowest-value 0.5- $\mu$ F units. Wiring those units permanently in place, I was pleasantly surprised by the improved performance of the TO-4. The “eye” shadow was much sharper on all ranges and the null (closing of the eye as the correct capacitance value is approached) was much more definite. And, yes, once the TO-4 was put back together, I did use it to check the removed, wax-covered reference capacitors for leakage; it was appreciable.

### REQUEST FROM A LADY RESTORER

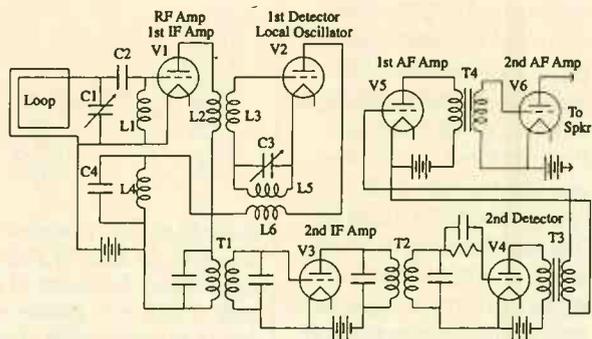
As an antique-radio columnist, I regularly hear from readers who are looking for schematics, parts, or assistance with their projects. Unfortunately, there are far too many requests for me to be able to respond personally. However, as most regular readers know, from time to time I print some of those letters in batches, hoping that good Samaritans will step forward and help. From the reports I've received over the years, I note that help is often forthcoming.

But when I received a note from Cindy Cookston requesting a schematic for the Majestic Model 70 she was beginning to restore, I decided to make an exception to the policy. Cindy got her Model 70 schematic, but with it I enclosed



Cindy, with instructor Richard Brainard, at Woodruff Regional Occupational Center electronics lab. The Majestic 70 cabinet and chassis are on the bench behind them.

that range. The capacitor was made up of two parallel 1- $\mu$ F units of the common wax-coated variety—the kind most modern radio restorers would replace on sight. But at the beginning of the last work session, the TO-4 turned in some accurate measure-



Among the many specially-drawn schematics in *Behind the Front Panel* is this one of the RCA Radiola AR812, the first commercial superheterodyne.

a note asking if she would be willing to tell me a little bit about herself and how she became interested in antique radios. It's very rare for me to hear from a female restorer and I was very curious.

She was kind enough to respond, and here's the story. Cindy is married (I guess that might disappoint some of you radio nuts hoping to date a kindred spirit), in her mid 30's, and the mother of three: two boys (aged 8 and 9) and a girl (13). Although radio restoration is a new thing for her, she and her husband have always enjoyed finding interesting items at swap meets and flea markets and restoring them to their original condition.

Cindy's interest in electronics came about through her activities as fix-it person for the family's broken toys. Eventually, she decided to become an electronics technician so that she could set up a home business servicing VCR's and other household electronics devices. To that end, she enrolled in the Electronics program at Woodruff Regional Occupational Center (Stockton, CA), completed the beginning level of the program, and is now in an intermediate section.

But how did she get into antique radios? The same way many of us did: Some-

one gave her one and she got hooked. Cindy's school and family activities leave her little time, or money, to scrounge parts for the Majestic and she could use some tubes: notably two 71-A's and a 26. If you have some or all of those, and can part with them for a modest price, contact Cindy at 133 W. Park St., Stockton, CA 95202. She could also use the separate "highboy" legs for the radio as she has only the cabinet section.

Are there any other lady restorers out there? I could probably also be talked into sending you schematics in return for your stories. Hope the guys won't accuse me of gender bias.

#### BEHIND THE FRONT PANEL

In traveling the antique-radio-meet circuit to promote *The Radio Collector*, my own new publication for antique-radio hobbyists, I've had an opportunity to talk with some interesting people also publishing in this field. One of them was David Rutland, who, with his wife, was exhibiting at a table next to mine at last September's Antique Wire-less Association conference in Rochester, New York. Dave is the author and publisher of *Behind the Front Panel* (158 pages, soft-bound), a recently

released, and very well-received, book covering the technological evolution of radio receivers during the 1920's.

The 1920's was a period of explosive development in radio-receiver circuits, each new one promising more miraculous performance than its predecessors and each with its critics and impassioned defenders. Becoming interested in this period of radio-receiver development, Mr. Rutland wasn't able to find a single source to provide perspective on the various "wonder circuits" and help him follow their evolutionary thread. So he decided to write the book himself.

A retired electronic engineer, David brought to this project over 25 years of experience in the design of vacuum-tube circuits as well as a facility for terse,

clear writing that involves and challenges the reader. The sixteen well-researched chapters trace developments in receiving from the earliest crude pre-tube detectors, through the emergence of tube detectors and RF amplifiers, to the various designs of multi-tube TRF receivers.

Continuing with a discussion of single-knob tuning designs, Rutland follows with special TRF circuits, audio amplifiers, reflex circuits, and the development of the screen-grid tube. The final chapters cover superheterodyne and AC-operated sets, and provide a glimpse of what the decades following the 1920's would bring.

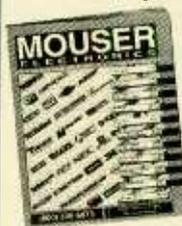
I highly recommend *Behind the Front Panel* to all antique-radio hobbyists. Purchase it from your favorite dealer or send \$18.95, plus \$2.00 for postage and

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### THE XTAL SET SOCIETY

I also had some interesting neighbors at the big Elgin, Illinois radio meet last August: Mr. and Mrs. Phil Anderson and their daughter Rebecca Hewes, who were there to promote the *Xtal Set Society*. The Society began as a hobby outlet for Phil who, as co-founder of the well-known Kantronics firm (makers of terminal units and related products for amateur-radio digital communications) was deeply involved in high-tech electronics.

Phil found it relaxing to work with the simpler technology of an earlier era and eventually decided to publish the bi-monthly *Xtal Set Society Newsletter* to discuss some of his ideas

and projects. The Society quickly grew, and daughter Rebecca signed on to handle production and marketing.

In addition to the regular articles by Mr. Anderson, whose engineering background is apparent in his knowledgeable analysis of crystal-set circuits, the newsletter is enriched by a wealth of lively correspondence from members. To join the Society and receive one year of the newsletter, send \$9.95 (Canadians, please send US \$11.00; if outside the US and Canada, send U.S. \$16.00) to The Xtal Set Society, P.O. Box 3026, St. Louis, MO 63130.

Phil has also recently published *The Crystal Set Handbook* (131 pages, soft-bound), a reference work for crystal-set experimenters. The introduction of that volume is aimed at begin-

ners, explaining the basic theory of set operation and providing instructions for building a simple, practical receiver. Chapters one through three reprint the July, September, and November 1993 issues of the *Xtal Set Society Newsletter*, which contain a variety of interesting articles and correspondence from readers.

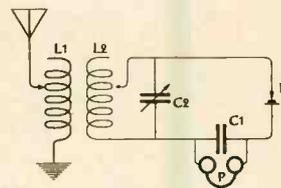
The remaining five chapters are for the more advanced experimenter and call for some knowledge of algebra, as well as AC and DC circuits. They include coil inductance formulas, coil "Q" and coil capacitance, detector loading, matching theory, and advanced matching.

A couple of helpful appendixes offer resistivity and conductivity information for several types of wire, as well as sizing and resistance information for several gauges of solid copper wire. A bibliography at the end of the book cites scores of books and articles, from pre-1920's through the present, containing material on crystal sets.

*The Crystal Set Handbook* is highly recommended to all present and prospective crystal set experimenters. It can be purchased directly from the publisher for \$10.95 plus \$2.00 shipping and handling. Use the St. Louis, MO address given above.

### A NEW CHALLENGE

Most readers of this column are familiar with Antique Electronic Supply, one of the major sources of parts, tubes, and literature for the electronics hobbyist. And many of you might already know that several months ago, founders and co-owners George Fathauer Jr. and Sr. sold the firm to Joseph Campanella,



Rebecca Hewes' schematic drawings for *Xtal Set Society* publications hark back to the style of Elmer E. Bucher, well-known wireless writer of the teens and twenties.

retired president of the Sperry (Honeywell) Aerospace and Marine group. AES continues business as usual and, in fact, has just released its 1995 catalog. (For more information contact Noreen Cravener, Antique Electronic Supply, 6221 South Maple Ave., Tempe, AZ 85283.)

But this story is about George, Jr. Although I had met his dad several times, I knew George himself only through our phone conversations and correspondence over the years. So I was pleased to have the opportunity to meet him in person at the AWA Rochester meet and to learn of his post-AES plans.

George, Jr. has purchased the publishing rights to, and inventory of, the antique radio and phonograph books published by The Vestal Press, Ltd. The books include *Radio Manufacturers of the 1920's* by Alan Douglas, *Crystal Clear* by Maurice Sievers, *70 Years of Radio Tubes and Valves* by John Stokes, and *The Compleat Talking Machine* by Eric Reiss.

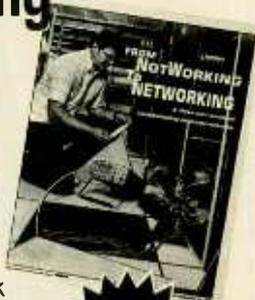
Those works will form the nucleus of Fathauer's new enterprise, Sonoran Publishing (116 N. Roosevelt, Suite 121, Chandler, AZ 85226; Tel. 602-961-5176), which will specialize in books on antiques and collectibles. Look for the Sonoran mark when you shop at your favorite book dealers.

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# COMPUTER BITS

By Jeff Holtzman

## Buy or Upgrade? Part II

Last month we started talking about upgrading an older 486 system. Before I began my system's upgrade, there was a large gap between what I had (a 25-MHz 486) and what I wanted (a 90-MHz Pentium with more silicon (i.e., DRAM) than my kids' sandbox). I couldn't justify the cost of a Pentium (not in '94, anyway), so the challenge was to find a compromise.

card from four or five years ago that, at the time, provided excellent performance in comparison with standard VGA cards. However, it had aged. So I tested a card that had just been introduced: ATI's Graphics Station Pro, which I discussed in detail in last November's issue. At last—satisfaction. The system was no Pentium, but it would certainly keep me happy for another 6–12 months.

### UPGRADE STRATEGY

Based on my experience, here's what I would recommend to anyone contemplating whether to buy or upgrade: To avoid hassle and wasted time, buy a new machine. Without the patience and willingness to do some troubleshooting, you'll only be letting yourself in for frustration. And you might not even end up saving any money.

If you are willing to put up with the stress, then make sure your PC is worth upgrading. If your computer has a 386 motherboard, a small hard disk, or less than 8 MB of RAM, the cost of upgrading will come close to what a new system would cost. An ideal upgrade candidate would be a 486 (any speed) with 8 MB or more of RAM, an older video adapter, and a monitor capable of at least 800 × 600 resolution.

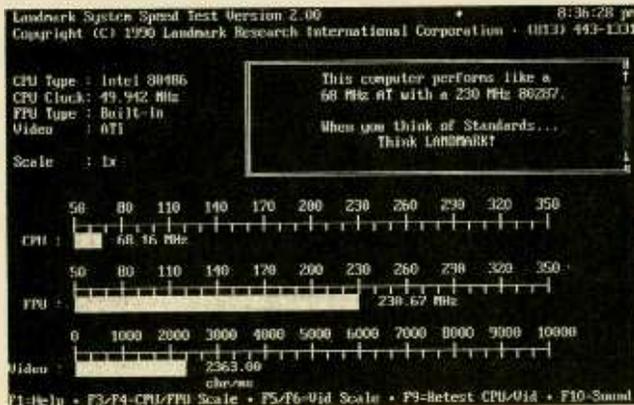
To upgrade such a system, you could install a new VLB motherboard, which I've seen without a CPU for as little as \$75, and an ATI Graphics Pro Turbo, which costs less than \$400 by mail

order for the 2-MB version. Then you just transfer your CPU, DRAM, and peripherals to the new motherboard and you're all set.

If you have a lesser system, and want to upgrade other components, costs mount quickly. For example, if you have a 386 PC, you'll need to buy a CPU as well, and a 66-MHz DX2 will set you back about \$300. If you need more RAM, figure on spending about \$150 per four megabytes. To run Windows, the absolute minimum is 4 MB of RAM, although many applications are not happy with anything less than 8 MB, and 16 MB provides a real comfort zone, especially if you run several applications simultaneously, or are into CD-ROM and multimedia. Worst case, if you bought a new CPU (\$300), a motherboard (\$100), a video card (\$400), and 8 MB of RAM (\$600), you'd end up spending \$1400, which gets you into the low end of an equivalent, complete new system.

If you do decide to go for the upgrade, be careful transferring the CPU. Find a friend with a CPU puller, or try your local computer repair shop—maybe they'll let you use the tool in the store. Pulling a 486 from a motherboard without a ZIF socket is challenging even with the correct tool; don't even think about trying it with just a screwdriver and pliers.

Other potential trouble spots are the SIMM modules. Those are often held in place by sockets with flimsy plastic locking pins that are



This Landmark speed-test screen shows the performance of the upgraded 486 DX2-50. It may not be a 90-MHz Pentium, but it does seem tolerable when running on a VESA motherboard with a fast video card.

The "before" system included a 25-MHz 486, 8 MB of DRAM, an ISA bus, and an 8-bit SCSI host adapter. The "after" system included a new, universal, VESA local-bus motherboard; a 50-MHz DX2; a 16-MB SIMM; and a 32-bit Adaptec SCSI adapter. Until that point, the upgrade had barely nudged me toward the rip-roaring performance I craved.

There was one subsystem left for consideration: video. The video adapter in my old system was a 16-bit Hercules Graphics Station. That was a rather expensive

easy to damage. It takes a fair amount of pressure to remove a SIMM; if you find yourself leveraging your whole body, you're taking the wrong approach.

One last warning: Be sure to buy components from a reputable dealer—ideally a local computer shop that has been around a while. After about six months of flawless operation, my original VLB motherboard suddenly refused to boot. The shop where I purchased the board exchanged it no questions asked.

### A NEED FULFILLED

If you have been following this column for a while, you'll know that I've been on the lookout for concise but meaty guides to networking and relational-database usage. The database slot remains wide open, but the network slot (so to speak) has been partially filled. The *Ethernet Pocket Reference Guide*, by Buddy Shipley and William F. Lyons, is a compact, 80-page, spiral-bound work available for \$24.95 from Shipley Consulting International. It doesn't contain everything a network engineer or technician needs to know in order to upgrade or troubleshoot an Ethernet LAN, but it's close.

The guide covers specifications for all ratified standards (thicknet, thinnet (coax), 10 Base-T), contains a draft description of the fiber-optic cable standards, and includes very useful wiring and connector specs. It also discusses repeaters and bridges in some detail, but avoids routers.

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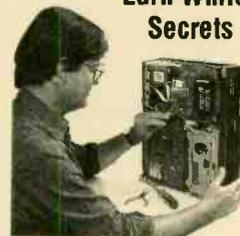
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# CIRCUIT CIRCUS

By Charles D. Rakes

## A Circuit Grab Bag

This visit we're going to reach into the circuit grab bag and bring forth a number of simple, but, we hope, useful circuits that might fill a present or future need. In any case sit back, make yourself comfortable, and we'll spend some time together looking over this month's circuit mix.

### TURN-SIGNAL MONITOR

Our first circuit (see Fig. 1) really makes a statement for simplicity when only three parts are used in a turn-signal monitor. I'm sure you have had the experience of traveling down the highway, watching the driver ahead going for miles with his or her left or right

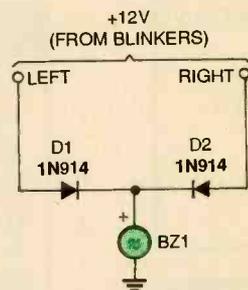


Fig. 1. With just three components, this turn-signal monitor could not be simpler.

blinker flashing without a care in the world, or a clue to his or her next move. This simple turn-signal monitor can help keep you from becoming just such a highway flasher.

A 1N914 signal diode is connected from each of the (left/right) directional blinkers to supply power to the piezo buzzer when either turn signal is activated. The piezo buzzer will sing out as long as either turn signal is operating. When

selecting the piezo buzzer, go for the one that has the loudest and most irritating sound.

IRF511 FET switches the negative side of the piezo buzzer to circuit ground, operating the sounder. If you

### PARTS LIST FOR THE TURN-SIGNAL MONITOR (Fig. 1)

D1, D2—1N914 silicon diode  
BZ1—Piezo buzzer  
Wire, solder, etc.

### DELAYED TURN-SIGNAL MONITOR

If you don't want to hear the piezo buzzer's irritating sound each time you use the turn signals, take a look at the time-delayed monitor circuit in Fig. 2. A simple RC time-delay circuit

would like a longer time period before the sounder goes off, increase the value of C1. To decrease the time period, just reduce the capacitor's value.

### BIKE ALARM

Our next item, shown in

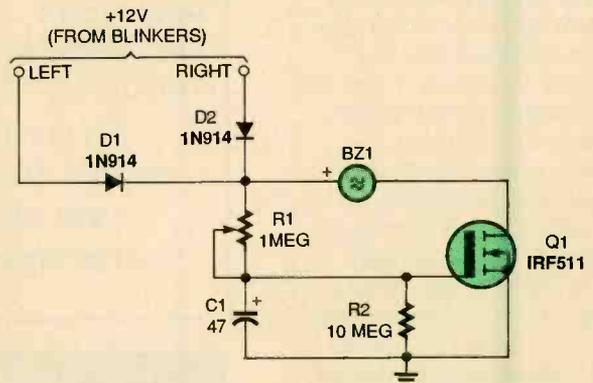


Fig. 2. To minimize driver irritation, a time delay can be added to the turn-signal monitor.

made up of R1 and C1 keeps the sounder from going off until the turn signal has been on for a number of flashes. Varying potentiometer R1 varies the number of flashes before the sounder is activated.

Here's how the delay circuit operates. The DC voltage from the 12-volt flasher goes through R1 and either D1 or D2 to charge C1. When the voltage across C1 reaches the gate turn-on voltage of Q1, that

Fig. 3, is a low-cost, no-frills motorcycle- or bicycle-alarm circuit. The sensor is a mercury switch that's mounted to the cycle in a manner that places it in the open-circuit condition when the cycle is resting on its kick stand. When the cycle is moved to the upright position, the mercury moves over the two switch contacts, completing the circuit supplying gate current to the SCR (SCR1) and turning it on. The voltage at

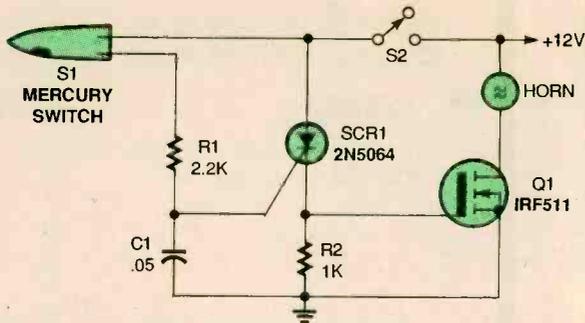


Fig. 3. Protect your bicycle or motorcycle with this simple alarm circuit.

the cathode of the SCR goes positive, turning on the FET (Q2) and sounding the horn. The horn will sound until S2 is opened or the battery goes dead. The IRF511 FET is rated for about 4 amps, which should be good for a small, loud horn, but if you opt for a higher current, super-loud horn you should substitute a IRF530 for Q2. That unit is rated to handle up to 14 amps.

### RAIN DETECTOR

If you like to leave your windows open and breathe the fresh air, our next entry might be just what you need to warn you when the rain blows in. The rain de-

tector, see Fig. 4, also uses an FET and a piezo buzzer. A grid made up of close-spaced wires or traces on a circuit board serves as the moisture sensor.

The string of the five 22-megohm resistors keeps Q1's gate voltage at zero and hence turned off with no current flow through the piezo buzzer. When a rain drop hits the sensor grid, a small current flows between the grid contacts, raising the voltage at the gate of the FET sufficiently to turn it on and operate the sounder. When you hear the sounder, it is time to close the windows.

A standard 9-volt transistor battery should

operate the circuit for about the shelf life of the battery. Of course, you'll need a monitor circuit for each window that's open. Always remove the grid from the wet area and clean it thoroughly between uses.

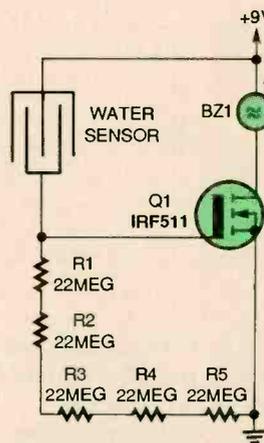


Fig. 4. You can prevent damage from the rain with this water-detector circuit.

### DC FUSE ALERT

Next up is a blown-fuse detector/alert circuit for DC circuits. As shown in Fig. 5, a single resistor and a piezo buzzer connect across the fuse (F1) in the circuit you wish to monitor. As long as the fuse remains intact, no voltage is supplied to the sounder. If the fuse goes, the piezo buzzer receives current through R1 and the monitored circuit to alert you of a problem.

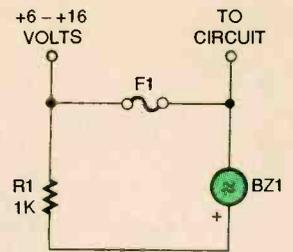


Fig. 5. You'll know immediately when a fuse has blown in a DC circuit when you use this fuse monitor.

The circuit can be used to monitor fuses operating at higher DC voltages by increasing the value of R1. The resistor should be selected to allow the piezo buzzer's rated voltage to appear across it when the fuse is removed from the circuit.

### AC FUSE ALERT

Our next blown-fuse detector, shown in Fig. 6, is designed to operate in conjunction with 110-volt AC circuits. A bridge-rectifier circuit, in series with a fixed resistor, is connected across the circuit's fuse, with the bridge's DC output feeding the piezo buzzer. A 12-volt Zener diode limits the maximum voltage feeding the sounder and a filter capacitor takes off the rough edges. Resistor R1 should be selected, with the fuse out of the circuit and the equipment on, to just pro-

### PARTS LIST FOR THE IMPROVED TURN-SIGNAL MONITOR (Fig. 2)

D1, D2—1N914 silicon diode  
Q1—IRF511 FET transistor  
R1—1-megohm, potentiometer  
R2—10-megohm, ¼-watt, 5% resistor  
C1—47-µF, 16-WVDC, electrolytic capacitor  
BZ1—Piezo buzzer  
Wire, solder, etc.

### PARTS LIST FOR THE SIMPLE ALARM (Fig. 3)

Q1—IRF511 FET transistor  
SCR1—2N5064 or similar SCR  
R1—2200-ohm, ¼-watt, 5% resistor  
R2—1000-ohm, ¼-watt, 5% resistor  
C1—0.05-µF, Mylar or ceramic-disc capacitor  
S1—Mercury switch  
S2—SPST switch, toggle or key switch  
Horn, wire, solder, etc.

### PARTS LIST FOR THE WATER ALERT (Fig. 4)

Q1—IRF511 FET transistor  
R1—R5—22-megohm, ¼-watt, 5%, resistor  
BZ1—Piezo buzzer  
Water sensor (see text), wire, solder, etc.

### PARTS LIST FOR THE DC FUSE MONITOR (Fig. 5)

R1—1000-ohm, ¼-watt, 5% resistor  
BZ1—Piezo sounder  
F1—Fuse, see text  
Wire, solder, etc.

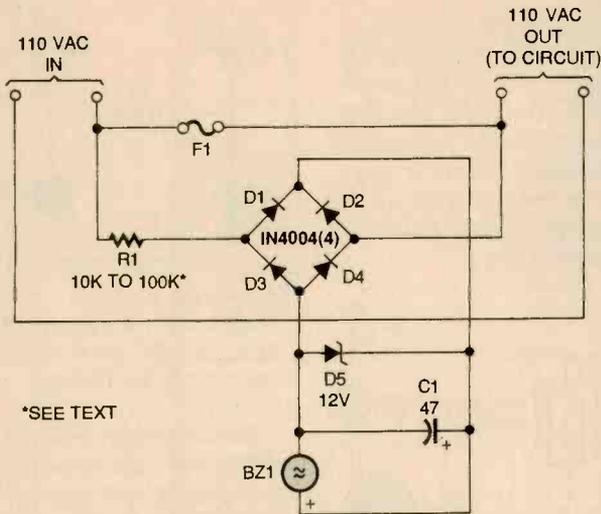


Fig. 6. To monitor the fuse in an AC circuit, you will have to use this AC version.

duce 12 volts across the sounder circuit.

### SIMPLE FM TRANSMITTER

Our last entry this visit (see Fig. 7) is an FM home- or office-monitoring transmitter circuit. By placing the transmitter inside your home or office, you can monitor what's going on inside on your car or portable radio before entering. That way, this simple circuit just might keep you out of harm's way.

A 12-volt DC plug-in supply powers the circuitry, and

a 78L09 9-volt regulator IC helps to keep the transmitter's frequency stable. Transistor Q1 amplifies the audio signal from the electret mike and feeds it to the base of the oscillator transistor, Q2. The audio at the base of Q2 frequency-modulates the oscillator's frequency. The setting of R7 determines the FM modulation level.

Coil L1 is homemade. It consists of about 6 inches of number-20 enamel-covered copper wire wound around a 1/4-inch diameter plastic form. The tap is one

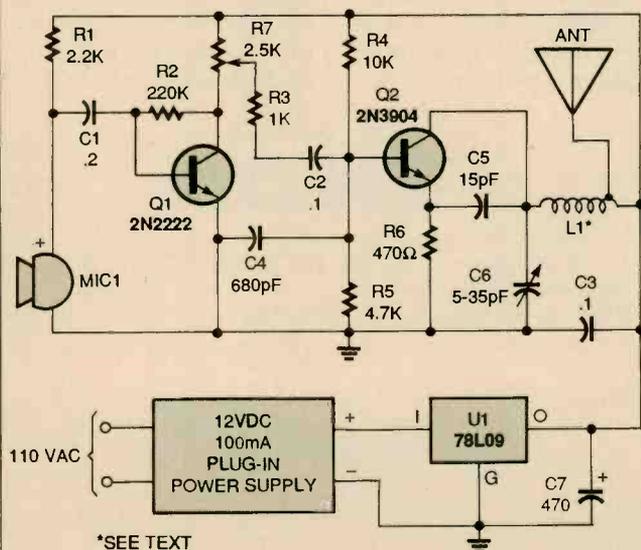


Fig. 7. This simple FM transmitter makes a great monitor circuit that can keep you out of harm's way.

### PARTS LIST FOR THE AC FUSE MONITOR (Fig. 6)

- D1-D4—1N4004 silicon diode
- D5—12-volt, 1-watt, Zener diode
- R1—10,000- to 100,000-ohm, 1/2-watt, 5% resistor, see text
- C1—47-µF, 16-WVDC, electrolytic capacitor
- BZ1—Piezo buzzer
- F1—Fuse, see text
- Wire, solder, etc.

### PARTS LIST FOR THE SIMPLE FM TRANSMITTER (Fig. 7)

#### SEMICONDUCTORS

- Q1—2N2222 NPN transistor
- Q2—2N3904 NPN transistor
- U1—78L09 9-volt regulator, integrated circuit

#### RESISTORS

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

- R1—2200-ohm
- R2—220,000-ohm
- R3—1000-ohm
- R4—10,000-ohm
- R5—4700-ohm
- R6—470-ohm
- R7—2500-ohm, potentiometer

#### CAPACITORS

- C1—0.2-µF, Mylar
- C2, C3—0.1-µF, ceramic-disc
- C4—680-pF, ceramic-disc
- C5—15-pF, ceramic-disc
- C6—5- to 35-pF, trimmer
- C7—470-µF, 16-WVDC, electrolytic

#### ADDITIONAL PARTS AND MATERIALS

- MIC1—Electret microphone
- L1—See text
- 12-volt 100-mA plug-in power supply, coil form, magnet wire, wire, solder, etc.

turn up from the cold end of the coil (that's the end that connects to the positive power source).

The trimmer capacitor, C6, may be any value with a maximum capacitance of no more than 40 pF. If you cannot locate a suitable trimmer capacitor, connect a fixed 33-pF capacitor in its place and tune to the desired frequency by spreading L1's windings. That tuning method will work, but makes setting the transmitter to an exact frequency very difficult.

Keep the circuitry wiring neat and compact. Make all of the component leads connecting to Q1 as short

and stable as possible. The antenna should be made as short as possible to cover a minimum operating range.

To set up the transmitter, tune your FM-broadcast receiver to a quiet frequency and adjust C6 until you hear a quieting sound. If, for some reason you can not get the transmitter to cover the desired frequency range, spread L1's windings to increase the transmitter's frequency and compress the windings to lower the frequency.

I hope you have found something of interest in our collection of circuits in this get-together. Until next time, good circuitry.

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**BP88—How to Use Op Amps...\$5.95.** A designer's guide that covers operational amplifiers. Serving as both a source book of circuits and a reference book for design calculations. The text is non-mathematical and easy to understand by most readers.



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**BP177—Introduction to Computer Communications...\$5.95.** Details on types of modems and their suitability for specific application, plus details of connecting various computers to modems, and modems to the telephone system.



**BP276—Shortwave Superhet Receiver Construction...\$6.95.** Provides construction details, including coil winding, of a number of advanced-design receivers which should have performance levels at least equal to commercial sets of similar complexity.



**BP61—Beginners Guide to Digital Techniques...\$5.00.** Covers the basics of digital techniques—decimal, binary, octal and hexadecimal numbering systems are covered plus insights on weighted and non-weighted binary-coded-decimal codes and alpha-numeric codes. The basic building blocks of circuit logic, the common AND, OR, NAND, NOR and EXCLUSIVE-OR gates and bi-stables, are thoroughly covered.



**BP285—A Beginners Guide to Modern Electronic Components...\$6.50.** It is easy for newcomers to electronics to become confused. There are a great many different types of components available often with numerous variations of each type. This book presents the reader with a vast amount of invaluable parts information to enable the right component to be selected every time for repairs and projects.



**PCP103—Practical MIDI Handbook...\$9.95.** The Musical Instrument Digital Interface (MIDI) is surrounded by a great deal of misunderstanding. This book is aimed at musicians and technicians who want to explore the vast capabilities of MIDI. It covers MIDI-based equipment you can use: keyboards, drum machines, sequencers, effects units, mixers, drum pads guitars. There's also a section on computer music.



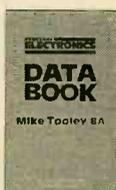
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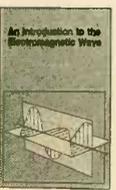
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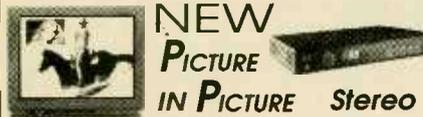
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**2. Understand the seller's return and/or refund policy**, including the allowable return period, who pays the postage for returned merchandise and whether there is any "restocking" or "return" charge.

**3. Understand the product's warranty.** Is there a manufacturer's warranty, and if so, is it for a U.S. or foreign manufacturer? Note that many manufacturers assert that, even if the product comes with a U.S. manufacturer's warranty, if you purchase from an unauthorized dealer, you are not covered by the manufacturer's warranty. If in doubt, contact the manufacturer directly. In addition to, or instead of the manufacturer's warranty, the seller may offer its own warranty. In either case, what is covered by warranty, how long is the warranty period, where will the product be serviced, is there a charge for service, what do you have to do to obtain service and will the product be repaired or replaced? You may want to receive a copy of the written warranty before placing your order.

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Be sure to include copies of all correspondence.

# DX LISTENING

By Don Jensen

## Popular- Priced Shortwave Receivers

Just how good are today's popular-priced shortwave receivers? That's a question posed by one of our readers, Z. Field of San Leandro, CA. "In your experience," he writes, "are new shortwave receivers in the under-\$200 price range better or worse than the \$100 to \$150, silicon, solid-state single-conversion communications that one used to see in the 1970's?"

"In the 1970's, some manufacturers were so proud of

their products that they published their technical specifications, but not today. Is the consumer just being had, or are the new receivers in this popular price range better?"

You asked for my opinion, "Z," and it is this: Overall, I believe that today's receivers offer the SWL considerably more "band for the buck" than did earlier generations of comparably priced sets. I also posed the question to receiver expert Larry Magne, publisher of the annual *Passport To World Band Radio*. Larry has been evaluating shortwave receivers for many years. His critical equipment reviews have appeared in *Passport* for more than a decade.

Here is his response: "In general, the worst receivers since WWII have been the silicon-transistorized single-conversion receivers that you mention! By the early 1970's, earlier technology had been perfected to the point where some tube-type receivers actually performed superbly. On the other hand, transistors were relatively new and lacking in some performance characteristics. The only real advantages that the transistorized units then had over tube sets were that they required less maintenance and their lower current draw made them more suitable as portables.

"The biggest difference, however, was in dynamic range. The transistorized receivers of the 1970's were more likely to overload than were comparable tube sets of the earlier generation. The transistor models also

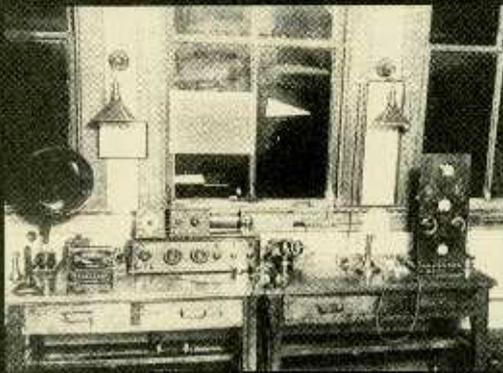
had poorer signal-to-noise ratios than some of the vacuum-tube sets. But that's all history. You asked for a comparison with today's receivers.

"First, the only models worth considering are those with digital frequency synthesis. That allows for punch-in-the-frequency keypad tuning and accurate numerical-frequency display. Memory technology allows presetting specific station frequencies. All of that makes it much easier to tune in stations, and return to those same frequencies again and again. That is a great improvement over the old tuning knobs and inaccurate slide-rule dials of receivers past. It should be noted, though, that today's synthesized models tend to have slightly poorer signal-to-noise ratios than do non-synthesized models.

"As to the lack of published specs for many of today's radios, consider that a plus! Remember the old saw about liars, damned liars, and—worst of all—statisticians? In the past, shortwave-radio specifications had more to do with marketing interests than technological candor. Favorable or meaningless measurements often were cited. Also, there are various ways to measure a receiver's specs, some of which can give misleadingly optimistic results.

"That's why at *Passport To World Band Radio* we developed our own standards for shortwave measurement, and apply them equally to all models in *Passport's* annual 'Buyer's

### SEVENTH-DAY ADVENTIST RADIO BROADCASTS 1923 • 1993



### ADVENTIST WORLD RADIO

Adventist World Radio now airs SW programs from stations in Costa Rica, Italy, Russia, Ivory Coast, and Guam. This 1993 QSL card commemorates the 70th anniversary of Seventh-Day Adventist broadcasting. In the 1920's, WEMC broadcast on 833-kHz medium wave from the campus of what now is Andrews University in Michigan.

Guide,' as well as in our detailed equipment-review monographs, the *RDI White Papers*. In fact, we even have a monograph, *How to Interpret Radio Receiver Specifications and Measurements* to explain that important issue in detail."

Thanks, Larry! To readers seeking more information, *Passport to World Band Radio*, with its "Buyer's Guide," is available at major bookstores. The more detailed *RDI White Papers* are available for many of today's popular sets. For more information on those monographs, send your request and a self-addressed stamped envelope to International Broadcasting Services Ltd., Dept. PE, Box 300, Penn's Park, PA 18943.

#### HAVE A HEART

A curious and not widely known station is the *Voice of the Mediterranean*, broadcasting from the tiny island nation of Malta. Dan Smith, reporting in *Contact*, the monthly publication of the British World DX Club, says that that broadcaster calls itself, for reasons not explained, "a little radio with a big heart." It has been operating for more than six years as a joint venture of the Malta government and the broadcasting arm of its larger and sometimes belligerent neighbor across the Mediterranean, Libya.

The Voice of the Mediterranean has a very abbreviated, daily English schedule: 0600 to 0700 UTC on 9.765 kHz, and 1400 to 1500 UTC on 11,925 kHz. On Mondays, the program includes a segment reading

\*CREDITS: William Davenport, TN; Marie Lamb, NY; John McDonald, WA; Sheryl Paszkiewicz, WI; North American Shortwave Association, 45 Wildflower Road, Levittown, PA 19057.

listener's letters and on Wednesdays there usually is a tourism feature. The station uses a powerful 250-kilowatt transmitter at Germany's *Deutsche Welle* broadcast relay facility, Cyclops, located on the island.

#### IN THE MAILBOX

A note from A.J. "Brad" Bradford of Syracuse, NY, explains that he's a movie buff who has long been intrigued by the classic Bogart film, *Casablanca*. He adds, "I haven't made it to *Casablanca* yet, though some day I'd like to travel to North Africa. But how about tuning in Morocco on shortwave? Is there a SW station and does it have English-language programming?"

Yes, Brad, shortwave can be your magic carpet to the Casbah! *Radiodiffusion Television Marocaine*, the government shortwave outlet, does have a single English broadcast, Sundays only, from 1400 to 1500 UTC on 17,595 kHz.

Fred Stapleton, Midland, MI, a long-time reader of this column, writes saying that he remembers a question in this column a few years ago from an SWL who wanted to get seasonal hurricane reports on shortwave. Fred writes, "Now, *Radio Miami International's* 'Viva Miami!' program includes regular tropical-weather updates from the National Hurricane Center in Coral Gables, FL, during the June to November storm season."

Thanks, Fred. The program, hosted by an old friend and well-known DX enthusiast, Jeff White, is aired during the week at 0100 UTC on 9,955 kHz. Jeff, by the way, is interested in receiving letters from listeners. Write to Radio Miami International, P.O. Box 526852, Miami, FL 33152.

#### DOWN THE DIAL

What are you hearing? Drop me a note, and be sure to include the SW frequency and the time heard, in Universal Coordinated Time (UTC, as it is abbreviated, is the world time standard and is equivalent to EST + 5 hours, CST + 6, MST + 7, and PST + 8).

Here are some stations being reported by your fellow listeners:

**ARGENTINA**—11,710 kHz. *Radiodifusion Argentina al Exterior*, abbreviated as R.A.E., can be heard with tangos and English-French programming at around 0250 UTC.

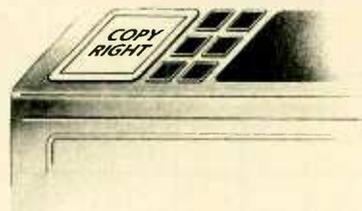
**COSTA RICA**—6,150 kHz. *Adventist World Radio's* Latin America broadcasts from Alajuela, Costa Rica include Spanish and English announcements, and contemporary Christian

music. It has been heard on this frequency at around 0700 UTC.

**HONG KONG**—15,280 kHz. *British Broadcasting Corp.* relays its "World Service" programming from Hong Kong. You can find the "Newsdesk" program at 0400 UTC.

**MOLDOVA**—15,290 kHz. From this former part of the Soviet Union, *Radio Dniester International* broadcasts in English from 2030 to 2100 UTC. The half-hour program includes identification, news, sports, press reviews, and a list of those shortwave listeners who have written the station.

**SOLOMON ISLANDS**—5,020 kHz. An exotic logging is the *Solomon Islands Broadcasting Co.* shortwave outlet in the Pacific, noted at 1100 UTC with a good signal and easy-listening music. ■



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# HAM RADIO

By Joseph J. Carr, K4IPV

## Monitoring SID's

Last May 10th, much of the United States and eastern Canada was treated to an annular solar eclipse. An eclipse occurs when the Moon passes between the Earth and the Sun during daylight hours, obscuring the Sun. A total

events, they tend to affect radio communications. Some sudden changes occur in shortwave propagation, especially in the bands most affected by the D-layer. Because the D-layer is the lowest and densest layer of the

those bands affected by the D-layer exhibit strange behavior.

A lot of experimenters monitor VLF bands for evidence of solar flares, which cause Sudden Ionospheric Disturbances (SID's). In the HF bands, SID's cause a decay of communications that often lasts hours. In the VLF bands, on the other hand, just the opposite occurs; there are often marked increases in signal levels.

Similar things occur during solar eclipses. Some people theorize that such behavior is due largely to the fact that lower-frequency (10–30 kHz) VLF signals have such long wavelengths that only a few waves fit between the Earth's surface and the bottom of the D-layer. As a result, the space between the surface and the D-layer acts much like a "duct" or microwave waveguide. Propagation is thus markedly different in the lower VLF bands than in the medium-wave and lower HF bands.

Reader Diane Lucas shared the results of her monitoring of the annular eclipse last May 10th. Diane is located in Ohio, and she monitored two U.S.-Navy VLF stations, NSS (Annapolis, MD) on 21.4 kHz and NAA (Cutler, ME) on 24 kHz. Her results are shown graphically in Fig. 1. The vertical axis of the graph plots the relative signal strength, while the horizontal axis plots time in UTC (Universal Coordinated Time).

The receiving equipment used by Diane Lucas consisted of an antenna

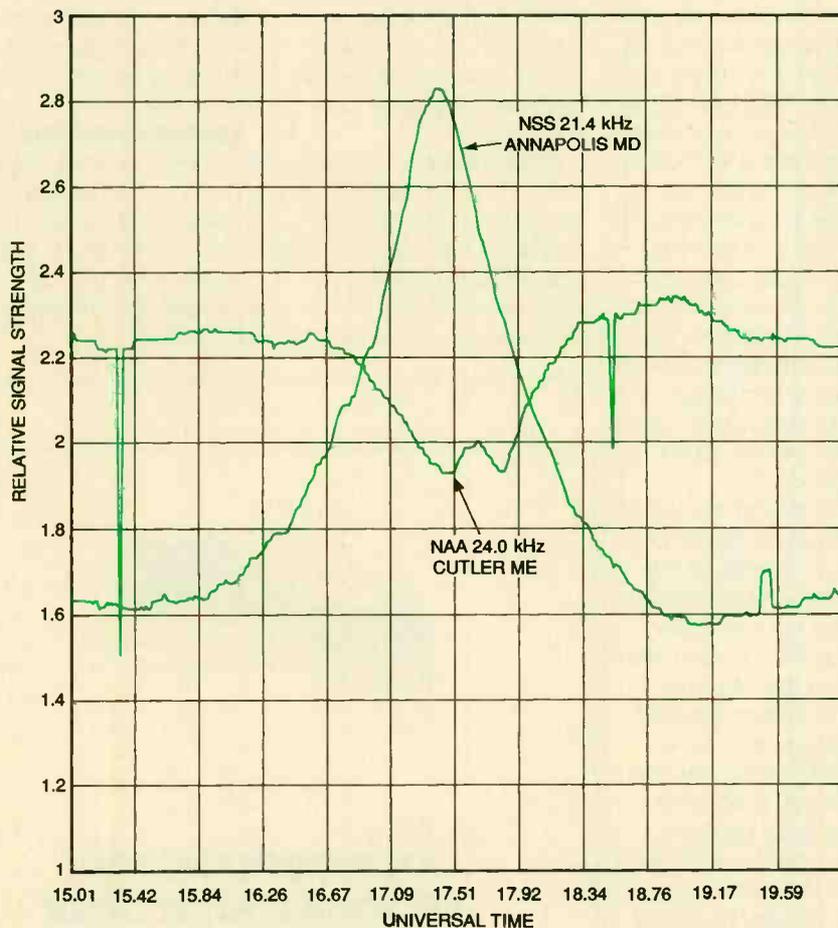


Fig. 1. This chart shows signal strength in Ohio during the May 10th, 1994 annular Solar eclipse.

solar eclipse covers the Sun entirely, resulting in blackout for a few moments. An annular eclipse, on the other hand, leaves a ring of solar light even during totality (hence the name "annular").

Eclipses are important to amateur-radio operators because, like many solar

ionosphere, its ionization level tends to decrease quickly after sundown because of rapid ion recombination. That's why the low-frequency HF bands tend to come alive with more distant stations right after sunset. Similar things occur during solar eclipses. As the Sun is blotted out,

connected to a homebrew tuned-radio-frequency (TRF) receiver. The receiver was designed by Art Stokes (N8BN) for use by members of the American Association of Variable Star Observers—Solar Division. The receiver consists of three transistor stages in a wide-band-amplifier configuration that produces up to 70 dB of gain throughout the VLF range of interest (10–30 kHz). The RF signal is then rectified in a full-wave voltage doubler made of 1N60 diodes, and integrated by a 100- to 270- $\mu$ F capacitor. The resulting DC output represents the relative signal strength, and can be recorded.

If you want to duplicate the receiver, and do a little SID hunting yourself, then send me a self-addressed stamped envelope (SASE). My address is P.O. Box 1099, Falls Church, VA, 22041. Overseas readers might want to include an international reply coupon or two. The circuit diagram is free, but I'd appreciate your help with the postage, so please send the SASE.

There is a printed-circuit board for the AAVSO receiver designed by Art Stokes. I no longer have any copies, but FAR Circuits (18N640 Field Court, Dundee, IL, 60118) can sell you one. Ask Fred at FAR Circuits for "Joe Carr's AAVSO receiver design" PC board. The printed-circuit board contains space for all the components except the tuning coils and a variable capacitor, which are mounted off-board.

Two basic configurations are seen in SID monitoring stations. Figure 2 shows the analog set-up in which the DC output of the VLF TRF receiver is directed to an analog strip-chart recorder. Many SID hunters use a Gulton 288 0–1-mA analog

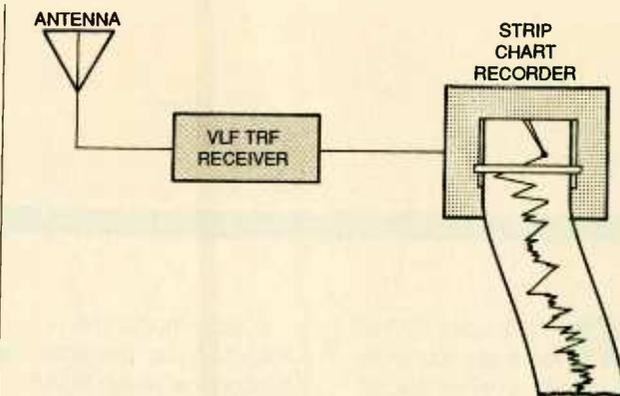


Fig. 2. This is an analog set-up for monitoring sudden ionospheric disturbances (SID's).

recorder for that. Others use a 0–5-volt recorder. The receiver normally produces a current output, but placing a 10K to 47K resistor across the output terminals produces a voltage output instead.

Figure 3 shows a digital configuration. It applies the output of the receiver to an A/D converter and the A/D converter's output to the input of a computer. Most A/D converters come with simple software to store the data, and some come with graphing capability as well. If your set-up can only store the data, then be advised that spreadsheet programs such as Excel can do the graphing for you. Incidentally, Doug Malone's Versatile Data Logger (*Popular Electronics*, July 1994) is ideal for this job (indeed, I bought one for my own SID-hunting station).

The antenna can be almost anything. I've used my 40- to 10-meter vertical and was surprised by the results. In talking with Art Stokes, who is, after all, the expert on SID-hunting hardware, I learned that most SID hunters use a straight vertical piece of aluminum tubing for an antenna. Diane Lucas reported using a 12-foot section of aluminum tubing to make the recordings shown in Fig. 1. Art Stokes told me that he has experimented with drain

downspouts and the aluminum roof of his (optical) observatory.

### MAR-X UPDATE

In this column, and elsewhere in *Popular Electronics*, I've discussed the Mini-Circuits MAR-x series of preamplifiers. A reader in Tacoma, WA wrote to me to let me know that he found the low-noise version (MAR-6) superior to his commercial preamp. He monitors satellites for reception of NOAA imagery. With the old preamp, his receiver set-up (Bearcat scanner and turnstile antenna) could receive 6 minutes of data as the "bird" passed overhead. With the MAR-6 device, he was able to consistently get 10 minutes. The reception allowed him to get imagery from Baja,

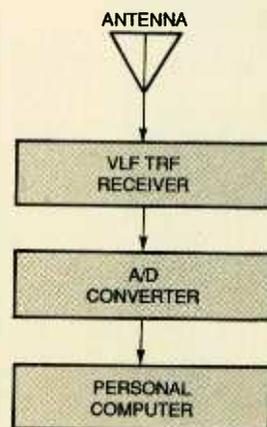


Fig. 3. Here is a suitable digital set-up for monitoring SID's.

Mexico all the way to northern Canada.

One thing that bothered me, however, was his report that the MAR-6 failed after six months. In his letter he said that he ran it from a 30-volt, unregulated, DC power source. I suspect that was the problem. The various MAR-x devices like voltages from 3.5- to about 5-volts DC, and use a resistor to drop the voltage from the DC power supply to that level. Unfortunately, too high a voltage, especially one that is unregulated, can cause damage. Other potential sources of damage include DC power-supply transients and lightning transients.

A good source for all of the MAR-x devices is Ocean State Electronics (6 Industrial Drive, P.O. Box 1458, Westerly, RI; Tel. 1-401-596-3080). I will still sell the kits (including a PC board) to those who want them, but I prefer that readers who want to buy the MAR-x devices without the PC board contact Ocean State. They can sell the MMIC chips cheaper than I can; the only reason I carried them in the first place was complaints from readers about not being able to obtain unusual but interesting chips in less than quantities of 50 each. After some rather stinging criticism, which was well taken, I stocked up on MAR-1 devices and sold them for an unholy (but nearly profitless) mark-up. Of course, if you want a whole bunch of them (25 or so), then the cheapest source is the manufacturer, Mini-Circuits (P.O. Box 350166, Brooklyn, NY 11235-0003).

By the way, when you write Ocean State, ask for the new parts catalog. It is particularly well stocked with parts for the radio and RF hobbyist, as well as for other interests.

# SCANNER SCENE

By Marc Saxon

## Monitoring "Bumper Beepers"

**R**adio Shack's *PRO-23* handheld, portable VHF/UHF scanner has 50 memory channels set up in five banks of ten channels each. That arrangement makes it convenient for you to group stored frequencies according to service or importance. In addition, there are five monitor-memory channels that allow you to temporarily store new frequencies discovered while

in search mode. The *PRO-23* is also programmed to scan the seven NOAA weather-service channels by means of an instant-access button.

The scanner doesn't cover the 30–50-MHz "low bands." It is focused on higher things. The unit covers the VHF aeronautics band from 108 to 137 MHz, then heads right into other action bands: 137 to 174 MHz, 406 to 512 MHz, and 806 to 956 MHz (minus the cellular bands, of course.)

Scanning speed is 12 channels per second, and search speed is 19 channels per second. The IF frequencies are 10.8 MHz and 450 kHz. Sensitivity is 0.6  $\mu\text{V}$  in the 137–174-MHz band; 0.5  $\mu\text{V}$  between 406 and 512 MHz; and 0.7  $\mu\text{V}$  above 806 MHz. In the VHF aeronautics band, it's 1.3  $\mu\text{V}$ .

Standard features include a priority channel, channel lockouts, a keyboard lock, a BNC antenna connector, and a rubberized antenna. The *PRO-23* requires four AA-type NiCd or alkaline batteries, and can also be used with an optional AC or DC adapter.

The *PRO-23* is attractively styled, easy to operate, and a good performer. For those who don't require coverage of the VHF "low band," or more than 50 channels, while they're on the go, the *PRO-23* is certainly worth serious consideration. It will save you some money when compared to handhelds with more channels and 30–50-MHz coverage.

### ON THE RIGHT TRACK

Scanning has many interesting and little-explored aspects that are seldom written about. It's easy to become so involved in listening in on two-way communications that you overlook the fact that there's some really puzzling other stuff to hear—stuff that puts you right in the middle of car thefts, intrigue, and undercover police operations. Let's take a peek at one of those areas.

"Electronic surveillance" can mean several things. In many instances it calls for tracking a person, item, or (often) a vehicle. A tiny, low-powered transmitter is hidden somewhere in or under the target vehicle. That sends out a signal that can be accessed by mobile or portable direction finders in order to pinpoint the exact location of the transmitter. Law-enforcement agencies use that method to follow the movement of a vehicle that might not be easy to tail. Or it can move along hidden in a shipment of illegal drugs.

Those tracking transmitters, usually called "bumper beepers" or simply "beepers," can be picked up by scanners. It's true that you won't know very much about what you're hearing, but you will know that the transmitter must be within a few miles of your location.

Usually what you'll hear is a series of beeps, which are repeated about every 5 or 10 minutes. One monitored a few weeks ago used 12



*Radio Shack's handheld PRO-23 is an attractive, easy-to-use VHF/UHF scanner that stores 50 channels set up in five banks of ten channels each.*

beeps and was repeating them every five minutes. After approximately two weeks, each unit shuts itself off automatically.

Many police and federal agencies have bumper beepers operating in the 30.86–31.94-MHz band. There are 28 such frequencies there, each spaced in 40-kHz steps (30.86, 30.90, 30.94, 30.98 MHz, etc.).

In addition, several federal agencies are reputed to be using certain other frequencies for that purpose. For instance, the FBI has long been reported using 40.17 and 40.22 MHz. You might want to see if you can pick anything up there.

The Secret Service has been said to use 406.75, 407.80, 408.50, and 408.975 MHz. The Bureau of Alcohol, Tobacco, and Firearms has allegedly used 165.5125 and 170.4125 MHz. The Customs Service has reportedly used 164.4625, 164.8625, 165.4875, 166.6625, and 166.8625 MHz.

In many ways, bumper beepers are very similar to the wildlife-tracking transmitters used by the National Park Service and other agencies, although land and sea wildlife trackers are intended for longer operational life. Some NPS trackers operate between 30.05 and 30.25 MHz.

The LoJack anti-car-theft device operates on 173.075 MHz. Mobile units use 2.5 watts and transmit a pulse once per second while they are in the process of being tracked by the police. When a vehicle is reported stolen, the owner calls the police. They then send out the mobile transmitter's activation signal from their 300-watt base station. The LoJack-equipped stolen car can then be tracked from police vehicles equipped with

special direction-finding Lo-Jack receivers. That system is not yet operational nationwide, but about 20 states have the system operating in some areas.

#### WHY NOT ASK?

Barney Troy, of Florida, writes to say that he often finds unusual activity on 464.50 MHz. He wonders what kind of frequency that is, since he can't quite pin down what kind of activities he is monitoring.

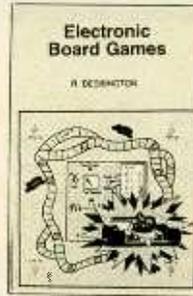
Barney might be monitoring practically anything on that so-called "itinerant" frequency. It's one of those "catch-all" channels that make scanning so much fun. Everybody turns up on those frequencies—from hot-air balloonists to private detectives, hospitals, construction crews, ranchers and farmers, truckers, sports teams, shipyards, and more.

Might as well plug in the other itinerant channels. They're just like 464.50 MHz, and should prove equally interesting. Tune in on 151.505, 151.625, 158.40, 464.55, 469.50, and 469.55 MHz and see what you can hear. They're all in use nationwide.

From La Junta, Colorado, comes a letter asking if we have any frequencies used by the USAF Thunderbirds. A recent edition of the *Radio Monitors Newsletter of Maryland* (P.O. Box 394, Hampstead, MD 21074-0394) reports reception on 141.85, 143.85, 235.24, 322.95, 413.10, and 413.15 MHz. Those include ground-crew channels. A sample issue of the RMNM newsletter is \$3; a yearly subscription (12 issues) costs \$29.

That's all for now. Until next time, write to us at *Scanner Scene*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735.

# 3 NEW BOOKS for the Project Builder

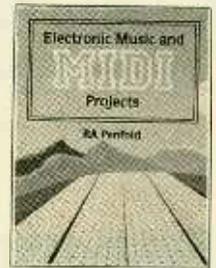


#### BP350—ELECTRONIC BOARD GAMES .....\$6.00

Twenty novel electronic board games that you can build from the plans in this book. Whether you are interested in motor racing, searching for buried treasure on a desert island or for gold in Fort Knox, spinning the wheel of fortune, or doing a musical quiz—there is something for you to build and enjoy!

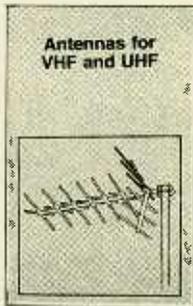
#### PCP119—ELECTRONIC MUSIC AND MIDI PROJECTS .....\$14.95

Save cash by building the MIDI gadgets you need. Want a MIDI THRU box, program change pedal, Metronome, analog echo unit, MIDI patchbay or switcher? Over 16 practical and very useful music and MIDI projects—all in this book! The projects are explained in detail with full instructions on assembly.



#### BP301—ANTENNAS FOR VHF AND UHF .....\$6.00

From installing a TV or FM antenna to setting up a multi-antenna array for shortwave listening or amateur radio, this book explains the basics of VHF and UHF antenna operation and installation. The text describes in easy-to-understand terms the essential information about how antennas work, the advantages of different antenna types, and how to get the best performance from an antenna.



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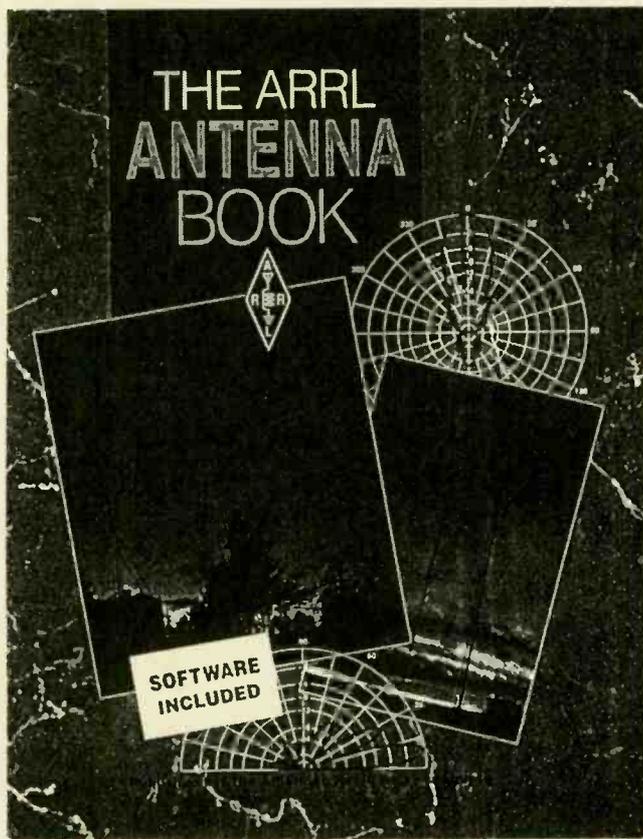
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## The ARRL Antenna Book 17th Edition

edited by R. Dean Straw



Regardless of how much amateur radio has changed since 1939, these words, from the foreword to the first edition of this book, remain true today: "...there is greater room for increased performance through superior antenna systems than in any other part of the equipment." Fifty-five years and 16 editions later, the antenna system is still the key to station performance.

This book-and-software package provides a wealth of

re-written, to reflect the benefits stemming from the latest computer modeling programs. The HF Yagi Arrays chapter is completely new, with more than 70 optimized designs for the HF bands. The Propagation chapter contains extensive tables on the elevation angles necessary for communication throughout the world. Those tables cover the full solar cycle, from all regions of the U.S. They provide vital new information for antenna-system planning.

The software includes a state-of-the-art Yagi analysis program and a sophisticated propagation-prediction program, along with transmission-line analysis and other general-utility programs.

*The ARRL Antenna Book, 17th Edition, costs \$30 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111; Tel. 203-666-1541; Fax: 203-665-7531.*

**CIRCLE 90 ON FREE INFORMATION CARD**

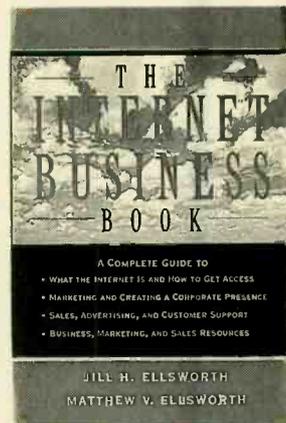
### THE INTERNET BUSINESS BOOK

by Jill H. Ellsworth and Matthew V. Ellsworth

As the Internet rapidly becomes an integral part of modern business, being on the Internet becomes important to a business' image and efficiency. To conduct business on the Internet safely and successfully, it is necessary to understand all the quirky rules and guidelines.

This book provides a complete, step-by-step guide to the Internet for all types of businesses. It helps users develop the strategies necessary to make the best use of this new interactive medium.

The book is divided into five main parts, beginning with an explanation of what the Internet



is and how to get connected. It goes on to discuss how to create a business presence on the Internet, including techniques currently used and those that are—and are not—considered acceptable. The book shows readers how to use the Internet's tools for e-mail, market research, test marketing, conferencing, and more. The section on doing business on the Internet includes designing a business plan and deciding which service provider best meets your needs. Finally, the book provides a listing of useful Internet resources, categorized by profession and function, which covers hundreds of databases, libraries and subject areas.

*The Internet Business Book costs \$22.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10058.*

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### ELECTRONIC COMPONENTS CATALOG

from Mouser Electronics

This 276-page catalog contains more than 45,000 in-stock, factory-authorized electronic-component selections from

practical information on antennas, feed lines, and propagation—subjects of great interest to radio amateurs and professionals alike. Several chapters have been completely

more than 100 quality-conscious manufacturers like AMP, Teccor, SGS Thomson, Littelfuse, Amphenol, 3M, and Belden. The catalog includes semiconductors, passive components, electromechanical devices, resistors, capacitors, switches, transformers, inductors, wire and cable, connectors, publications, equipment, and supplies.

Intended as a resource guide for buyers, engineers, and manufacturing managers, the catalog provides specification drawings and up-to-date, guaranteed prices. A quick-index on the front cover and a comprehensive index of both manufacturers and product categories make it easy to find specific products.

*The Electronic Components Catalog is free upon request from Mouser Electronics, 2401 Highway 287 North, Mansfield, TX 76063; Tel. 800-992-9943 or 817-483-4422.*

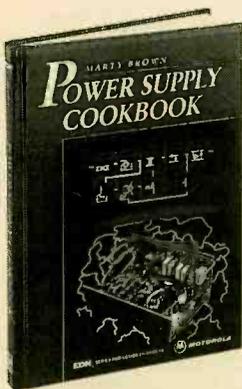
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## POWER SUPPLY COOKBOOK

by Marty Brown

This book provides an easy-to-follow, step-by-step design framework for a wide variety of power supplies. It allows readers with a basic knowledge of electronics to create a very complicated power-supply design in less than one day.

With the common, industry-standard design approaches presented in each section, the



book teaches readers to design linear, switching, and quasi-resonant switching power-loop supplies in an organized fash-

ion. Formerly complicated design topics—such as magnetics, feedback-loop compensation design, and EMI/RFI control—are all described in simple language and design steps. The book also details easy-to-modify design examples that provide readers with a design template useful for creating a variety of power supplies.

*Power Supply Cookbook costs \$39.95 in hardcover and is published by Butterworth Heinemann, 313 Washington Street, Newton, MA 02158-1626; Tel. 617-928-2500; Fax: 617-928-2620.*

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## MICROWAVE OVEN REPAIR

Third Edition

by Homer L. Davidson

The affordable, versatile microwave oven has changed the way we cook, eat, and live, and has become an essential kitchen appliance. This book gives students, apprentices, and technicians the hands-on infor-



mation they need to troubleshoot and repair almost any microwave-oven problem.

Reflecting the continual improvements in microwave technology, the third edition has been revised and updated. It includes dozens of all-new diagrams that illustrate today's microwave circuitry, as well as details on the latest test equipment and procedures used by major appliance manufacturers. Specific solutions to more than 200 common microwave-oven malfunctions are provided in the text.

The book's clear instructions, accompanied by hundreds of

illustrations and photographs, show readers how to perform radiation-leakage tests, fix defective switches, replace a magnetron, install a new fan motor, and more. Case histories are included to demonstrate what worked—and what didn't work—in real-life repair situations.

*Microwave Oven Repair, Third Edition costs \$24.95 and is published by Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.*

**CIRCLE 98 ON FREE INFORMATION CARD**

## HOTCAKE (HANDBOOK OF A THOUSAND COMMON ACRONYMS TO KNOW IN ELECTRONICS)

from Rothschild & Associates

Those who are stumped by terms such as "BORSCHT, BLOB, OOF, POTS," and "SWEAT," will appreciate this 28-page handbook, which defines hardware and software acronyms used in communications, IC design, computer architecture, RF and microwave, video graphics, and networking—including the Internet. The book, which is updated twice yearly, also includes acronyms for worldwide standards, organizations, societies, consortiums, and government agencies and programs. General terms used in electronic engineering and business are covered as well.

FYI: BORSCHT is defined as "battery-feed, overvoltage, ringing, supervision, coding, hybrid, and test (functions of all-inclusive telecommunications device)." BLOB is "binary large object (database)." OOF stands for "out of frame (communication error)." POTS is defined as "plain old telephone service," and SWEAT as "standard water-level electromigration-acceleration test."

*Individual copies of HOTCAKE are available for \$9.75, and a two-year subscription (four issues) for \$29, from Rothschild & Associates, 175 Knibloe Hill Road, Sharon, CT 06069-2215; Tel. 203-364-1915; Fax: 203-364-1917.*

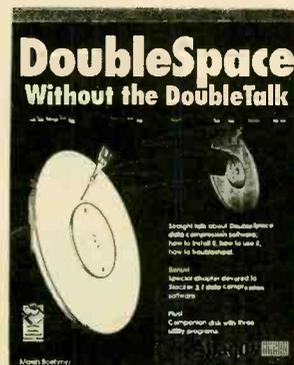
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## DOUBLESPACE WITHOUT THE DOUBLETALK

by Martin Boehmer

DoubleSpace is the data-compression program that ships with every copy of Microsoft's DOS 6.x. This book provides straight talk on how you can use the program with confidence to double your hard drive's capacity.

The book walks you through the important preliminary work required for installing DoubleSpace. It describes the concept of data compression, what it does to your hard drive, and how to make it work to your



advantage. The information is presented in short, complete learning units with icons that let you know in advance just how complicated each unit's topic is.

Highlights of the book include an overview of data-compression software applications, pointers on managing and deleting DoubleSpace drives, troubleshooting advice, advanced techniques, and three shareware utility programs. The included diskette contains "CheckIt PRO: CKMEDIA Applet," which detects and reports defects on hard drives, floppies, or SyQuest/Bernoulli drives; "Free Disk Space," which lets you view used/free space on all drives in text or graphic mode; and "Led's Stacker Directory," a quick fix for making a better Stacker directory command.

*DoubleSpace Without the DoubleTalk costs \$19.95 and is published by Abacus, 5370 52nd Street SE, Grand Rapids, MI 49512.*

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# NEW PRODUCTS

## Portable Scope-Plus- Meter

The *ScopeMeter Series II*, a new version of *Fluke's* award-winning *ScopeMeter* test tool, combines a dual-channel, 50-MHz digital-storage oscilloscope and a 3½-digit, true-rms multimeter in a rugged, battery-powered hand-held unit. The new models add measurement functions such as the "Measure Menu," which automatically configures Series II for any of 30 measurement tasks, and "Continuous Autoset," which eliminates the front-panel reconfiguring that other instru-



ments require as the user moves from one test point to the next.

The *ScopeMeter Series II* is easier to use than its predeces-

sor. With just a few keystrokes, the user can access a windowing menu structure that provides quick access to any function. The full-view waveform in the meter mode means that users who traditionally make readings with a multimeter no longer have to switch to scope mode to see a waveform view of a signal. The instrument continuously displays waveforms at the same time as it displays measurement values. Users who need greater waveform detail can get a full-screen view by switching to the scope mode.

Two min/max functions also have been added. The Min Max TrendPlot function simultaneously graphs the minimum, maximum, and average readings of a signal over time, anywhere between two minutes and 30 days. The Min Max Envelope function provides a record of all changes to the displayed scope waveform, simultaneously displaying the minimum and maximum values.

Four models are available. The single-channel *Fluke 91* and the dual-channel *Fluke 92*, like each of the Series II models, have a backlit display and include context-sensitive hints and a button for additional information about functions and instrument operation. The dual-channel *Fluke 96* and *Fluke 99* also feature a 600-volt, optically isolated RS-232 interface for direct print-out. The Model 99 adds a built-in signal generator capable of producing sine wave, square wave and component test signals. It also performs waveform mathematics and can store 10 screens, 20 waveforms, and 40 instrument setups. In addition, optional *FlukeView* software for DOS- or Windows-based PC's is available for the Model 99.

Manufacturer's preliminary prices for the Models 91, 92, 96, and 99 are \$1295, \$1595, \$1895, and \$2195, respectively. For more information, contact

Fluke Corporation, P. O. Box 9090, Everett, WA 98206; Tel. 800-44-FLUKE; Fax: 206-356-5116.

**CIRCLE 101 ON FREE INFORMATION CARD**

## BENCHTOP DIGITAL MULTIMETER

For use in electronic repair, production test, and laboratory applications, the *Model BDM35* digital multimeter from *Wavetek* features a built-in frequency counter and capacitance meter. The Model BDM35 measures AC and DC current in five ranges to 20A and resistance in six ranges to 40 megohms. It also performs a diode test and continuity functions. All functions on the autoranging meter are accessed via front-panel push buttons. For user safety and simplicity, input jacks are boldly labeled, and both the 2A and 20A jacks are fully fused. The large LCD readout has both a 42-segment bar graph and ½-inch-high digits.



Several useful troubleshooting features are included. Data Hold freezes readings for later viewing. Min/Max Record stores the highest and lowest reading over a period of time (like a data logger). Mem/Read records the meter's last function and the measurement taken in that function, which is helpful when aligning or troubleshooting electronics that require a comparison of two measurements taken using different functions. Hold freezes the display for later viewing.

In addition to its DMM functions, the BDM35 combines the convenience of a frequency

counter and a capacitance meter in a single unit. Adjusting oscillators, setting clock speeds, and verifying capacitors can all be accomplished quickly and easily using the standard test leads supplied with the meter.

The BDM35 benchtop multi-meter costs \$369. For more information, contact Wavetek Corporation, 9145 Balboa Avenue, San Diego, CA 92123; Tel. 619-279-2200.

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## UNDERWATER METAL DETECTOR

Fisher Research Laboratory has introduced the first waterproof version of their popular Quick-Silver metal detector. The CZ-20 is a target-I.D. machine that is submersible to 250 feet. It can detect buried metal in salt water, fresh water, shallow water, and on land.

The CZ-20 offers two search modes. In its silent-running,



slow-motion, target-I.D. mode, trash is ignored. A hot, wide-scan auto-tune mode is intended for all-metal searching. Two bright red LED's flash over the target, varying in intensity according to signal strength.

Other features include no-motion pinpointing, faint-target audio boost, Fourier Domain signal analysis for increased depth and accurate target identification, and a distinctive big-target alert. The CZ-20 also uses a three-tone target-I.D. system: a low tone for iron; a mid-tone for pull-tabs, foil, and most gold rings; and a high tone for U.S. coins, silver rings, and some gold rings.

The metal detector is easy to use. It features a cushioned arm rest, a soft foam grip, and control housing that slips off the handle for hip-mounting.

The CZ-20 has a suggested retail price of \$1250 with an

eight-inch search coil or \$1270 with a 10½-inch coil. For additional information, contact Fisher Research Laboratory, Department PE, 200 West Willmott Road, Los Banos, CA 93635; Tel. 209-826-3292; Fax: 209-826-0416.

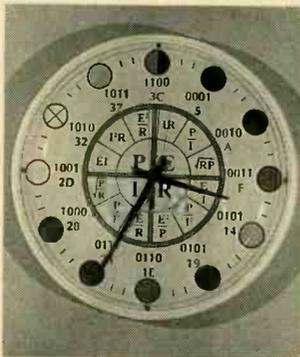
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## THE TECHNOLOGY CLOCK

The *Technology Clock* from *Hanover Clocks* allows you to forget about all the old memory aids used to learn the International Color Code. Instead, you can learn by watching the clock, relating the hours of the time to the colors. You will know that green means five o'clock, and that 7 o'clock is violet—without guessing or counting on your fingers.

The *Technology Clock* is a 14-inch diameter, quartz-movement, accurate wall clock that will automatically teach you the binary and the hexadecimal systems. It also includes the Ohm's Law for power, voltage, resistance, and current, right on the clock face.

The *Technology Clock* costs \$39.95 plus \$4 shipping and



handling. For additional information, contact Hanover Clocks, Inc., 5316 Highway 421 North, Wilmington, NC 28401; Tel. 1-800-426-6837; Fax: 910-343-0101.

**CIRCLE 104 ON FREE INFORMATION CARD**

## PRO-2005/6 COMPUTER INTERFACE

With its high speed and nearly unlimited memory, the computer makes the scanner really work. Even when the operator is away,



the computer can continue to search out frequencies and record them into memory channels. For use with the Realistic PRO-2005 and PRO-2006 scanners, the *OptoScan 456* computer interface from *Optoelectronics* provides hardware and software for full computer control of all scanning functions. It also includes CTCSS tone, DCS code, and DTMF character reading integrated with the software scan and log functions.

The hardware can sense when a computer interface is established and then places the radio's microprocessor into stand-by mode. Control over all radio functions then passes to

the computer. A 9-pin serial cable is provided for direct RS-232 interface with a computer's serial port. A 3.5-mm stereo cable can be used for CI-V multi-radio interface using the CX12 adapter, and a 2.5-mm phone jack provides software control of a tape recorder. Detachable cables and matching jacks eliminate the need for soldering, cutting, or drilling.

Included in the introductory package is Custom OptoScan 456 software, an OEM version of Scan\*Star. It supports tone, code, and touch-tone character decoding as well as received-signal level.

The OptoScan 465 complete installation kit, including the assembled and tested controller board, mounting hardware, cables, and software, costs \$299. For more information, contact Optoelectronics Inc., 5821 NE 14th Avenue, Ft. Lauderdale, FL 33334; Tel. 1-800-327-5912; Fax: 305-771-2052.

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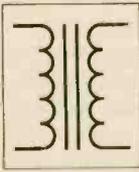
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## MULTIMEDIA WATCH

*(Continued from page 7)*

*Falcon Gold*, the complete Falcon 3.0 collection on CD-ROM. The disc includes *Falcon 3.0*, *MiG-29*, *Hornet: Naval Strike Fighter*, *Operation: Fighting Tiger*, and *Art of the Kill*. This is the most complete PC flight-game collection ever, and it sells for under \$75.

To help game enthusiasts

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fly better in any aircraft simulation game. CH Products' *Flightstick Pro*, in either a PC or Mac version, is a high-quality joystick with special features added to enhance flight games. While the features on the two joysticks differ slightly, both have built-in throttle controls and programmable fire buttons, triggers, and multi-function switches that can activate specific game commands right from the stick. Custom settings can be loaded for many popular flight games, including the ones from Spectrum Holobyte that I just mentioned. The *Flightstick Pro* sells for \$129.95 for a Mac version and \$99.95 for a PC version. Contact CH Products for information on more flight-control gear for home entertainment systems.

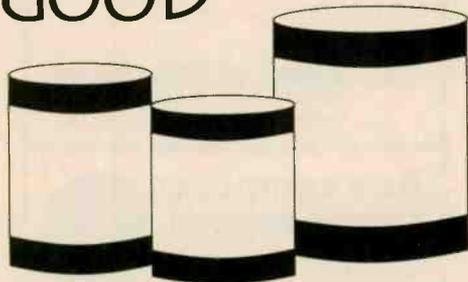
## THINK TANK

*(Continued from page 30)*

attach a piezoelectric annunciator across the resistor/LED circuit (i.e., in parallel with the LED/resistor series circuit.) If the voltage at that part of the circuit is too high, throw a current-limiting resistor in series with the annunciator. You'll have to experiment with resistor values (starting with a high one—say 1 megohm—and working down until you get sound), but it should work. If that part of the circuit receives AC, you will also need to place a rectifier in series with the buzzer.

That's all for this month. Until next time, you can write to me here at *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. If your letter appears here, you'll receive a *Think Tank II* or other book from our library.

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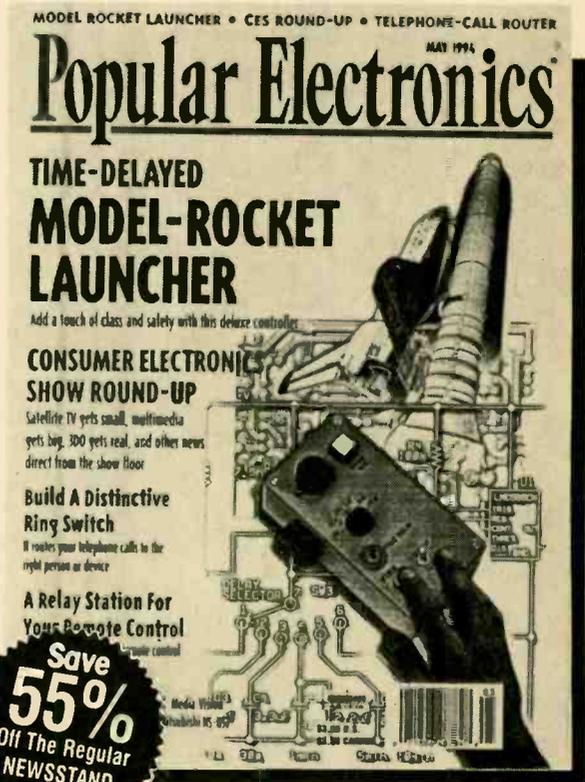
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Department of Health and Human Services

### PC TROUBLESHOOTING

(Continued from page 52)

charges for live, phone-in tech support. However, the systems are not likely to render phone-in tech support obsolete. That is because Fax documents are generic and tend to repeat material already contained in the user's manual. You also need to know what to ask for in the first place. When faced with a PC emergency you might prefer the comfort of a "live" support technician.

Many hardware vendors now use remote computing as a high-tech method of providing technical support. With on-line, remote diagnostic support, you make an initial voice call to tech support, and the technician can then dial up your system through a modem.

Once a tech accesses your computer, he or she can diagnose setup and hardware problems, and can even properly configure your PC. The tech can examine the AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, and SYSTEM.INI files, software and printer setups, and other configurations. He or she can also see exactly what's on your screen, diagnose problems, install files and software, and even watch you work. That way, you don't have to read setup files line by line on the phone or Fax a printout.

Further, the program's chat mode lets you and the technician compare notes during diagnosis. Even better results are possible if you have a second telephone line to maintain a separate voice connection with the tech during the session.

Remote diagnostic systems won't help you if your PC's power supply is dead or if the PC won't boot, but for most non-fatal problems it offers an alternative to conventional phone-in technical support. Try it; you might like it.

Most of us are familiar with the CompuServe on-line utility. Many hardware and software vendors offer free technical support there.

Computer support forums you can access typically include: technical bulletins, upgrade information, tips and shortcuts, printer and video drivers, software-bug fixes, user-submitted application files and templates, new-product information, and demos. You

can also find a "tell it like it is" product-experience database of messages from individual forum members discussing their systems or software. It's wise to check out the message traffic before buying a firm's product.

Over 300 hardware and software manufacturers strut their stuff on CompuServe. You can also access the wide range of ZiffNet computer services (GO ZIFFNET) through CompuServe, though you have to be a ZiffNet member to do so. Some vendors also have set-up shop with competitors such as America On-line, BIX, GENie, and Prodigy.

With software vendors focusing increasingly on support-for-a-fee methods, you might find that you have to repeat your on-line support request several times before it's answered. Also, the support you receive might be generic, and it might simply refer you to a Fax document you can request.

However, many hardware and software vendors have established 24-hour, dedicated multi-user BBS's to support their products. Their boards offer much of the same information as the support forums on CompuServe and other on-line utilities, although the vendor BBS's have more of a "company store" atmosphere. Most support BBS's are configured similarly to hobbyist boards and use similar software.

Vendor-sponsored BBS's let you read questions and answers of other product users, and they also offer a large library of technical notes and problem solutions. You might be required to be a registered user to use some BBS services.

The bottom line is, no matter what form of service and support you have access to, remove the lid of your PC before disaster strikes, and become familiar with what's inside. You might be surprised to find that what's underneath the lid might be considerably more friendly than what lies under the hood of your family car. ■

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## FM TRANSMITTER

(Continued from page 36)

(right) and J2 (left) inputs, but the input-voltage levels must fall within reasonable limits. For example, a microphone by itself does not put out enough voltage, so a pre-amplifier or an amplified mike mixer is necessary. The same applies to many record players.

The recommended inputs for the Transmitter are the line-level outputs of a stereo device, but many don't have those outputs. So instead, you can use the earphone or speaker output of a small radio, tape player, or CD player. However, be careful not to use the speaker output of a powerful Hi-Fi system as direct input to the Transmitter jacks. Using that output, or any other audio level that is too high, will result in a terribly distorted sound. If you suspect an audio source is too powerful, you can use an attenuating dubbing cord, an attenuating connector, or a similar device to drop the output to an appropriate level.

Shielded audio cables should be used for the interconnections. Depending on the cable terminations, you might need adapters for the many types of plugs and jacks in common use. Those are readily available at Radio Shack and elsewhere.

Note that you can use two entirely different audio sources—such as the outputs of a tape player and a CD player—as inputs to the FM Stereo Transmitter. Remember, the Transmitter has both a left and right channel, and an FM receiver will receive them both. On a stereo FM receiver, one input is heard on the right speaker and the other on the left speaker. The stereo's balance control can be used to mix or separate them.

**Checkout and Use.** You'll need a nearby stereo FM radio to adjust your transmitting frequency and balance. Tune the radio to a suitable "open" frequency that will not interfere with any broadcast stations (see the "Frequency Range Selection" box). With either the telescoping or external antenna connected, turn on the FM Stereo Transmitter. Then use a plastic (not metal) alignment tool to adjust inductor L1 while listening for a quieting in the FM radio's normal background

## FREQUENCY RANGE SELECTION

When deciding what frequency to transmit on, choose one that is not being used by an FM-broadcast station that can be received in your location. In order to comply with Federal Communications Commission (FCC) Part 15 regulations, it is your responsibility to determine fully that your operation will not cause interference to broadcast reception.

It is not sufficient to search for an apparently open frequency using a simple FM portable radio. Many medium power National Public Radio stations might be received by a neighbor with a good receiver and an outdoor antenna. Interfering with such reception is a direct violation of Federal law!

The most reliable way of finding a truly open frequency on the FM band is to check that band with a very good FM receiving system that uses an external antenna. If you don't have access to such a radio, most modern, FM car radios are also very sensitive.

When choosing an operating frequency, remember that most digital-tuned FM receivers—regardless of whether they are portable, mobile, or hi-fi—are designed to tune in 200-kHz increments. Therefore, they might not properly receive a signal operating between those pre-tuned, standard broadcasting frequencies.

Unauthorized operation of small transmitting devices is discussed in Part 15 of the FCC Rules. Licensed, FM-broadcast stations have the right to interference-free broadcasting, and their listeners have the right to interference-free reception. Make sure you are not interfering with those rights when you use your Transmitter. ■

noise. Maximum quieting indicates you are transmitting on the receiver's frequency.

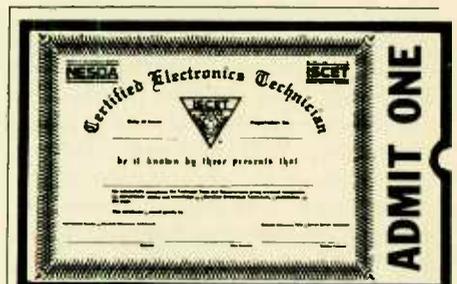
Adjust audio-level potentiometers R1 and R4 to their minimum level (fully counterclockwise) and set balance control R7 to the center position. Connect your audio sources to jacks J1 (right) and J2 (left). Advance R1 and R4 and you should begin to hear the audio on your stereo FM receiver. You might also have to increase the volume setting on your receiver.

When you have sufficient volume on each "channel" (left and right), adjust R7 all the way clockwise. You should only be able to receive one channel. Turning R7 all the way counterclockwise should enable you to receive only the other channel. To balance the audio, set R7 so that both channels can be received equally.

**Troubleshooting.** When operating with a fresh 9-volt alkaline battery, and without audio input, your Transmitter should draw about 32 milliamperes (about 37 milliamperes if you've added an LED power indicator). You can measure that with a milliammeter in series with the battery. If your Transmitter deviates more than 20% from that figure, you might have made an error in assembly.

If you think you have made an error, use Fig. 4 to double-check the placement and orientation of all components. Also, check all solder joints and cable connections.

If you can not get your Transmitter to transmit, check first to see if your audio sources are operating. If they are, then make sure you're tuning the correct portion of the broadcast band, based on the value you used for C16. That could be the problem, and you might end up unintentionally interfering with broadcast transmissions in another portion of the FM band. Frequency drift (caused by a weak battery or temperature extremes) can also cause you to broadcast out of the anticipated broadcast band. ■



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what was to be an embassy and private residence into the most sophisticated recording studio the world had ever known. The building had to be torn down in order to remove all the bugs.

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The professional discussions seen on the TV screen in your home reveals how to detect and disable wiretaps, midget radio-frequency transmitters, and other bugs, plus when to use disinformation to confuse the unwanted listener, and the technique of voice scrambling telephone communications. In fact, do you know how to look for a bug, where to look for a bug, and what to do when you find it?

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The professional is not without his tools. Special equipment has been designed so that the professional can sweep a room so that he can detect voice-activated (VOX) and remote-activated bugs. Some of this equipment can be operated by novices, others require a trained countersurveillance professional.

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This advertisement was not written by a countersurveillance professional, but by a beginner whose only experience came from viewing the video tape in the privacy of his home. After you review the video carefully and understand its contents, you have taken the first important step in either acquiring professional help with your surveillance problems, or you may very well consider a career as a countersurveillance professional.

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## HANDLING CONTROL

(Continued from page 39)

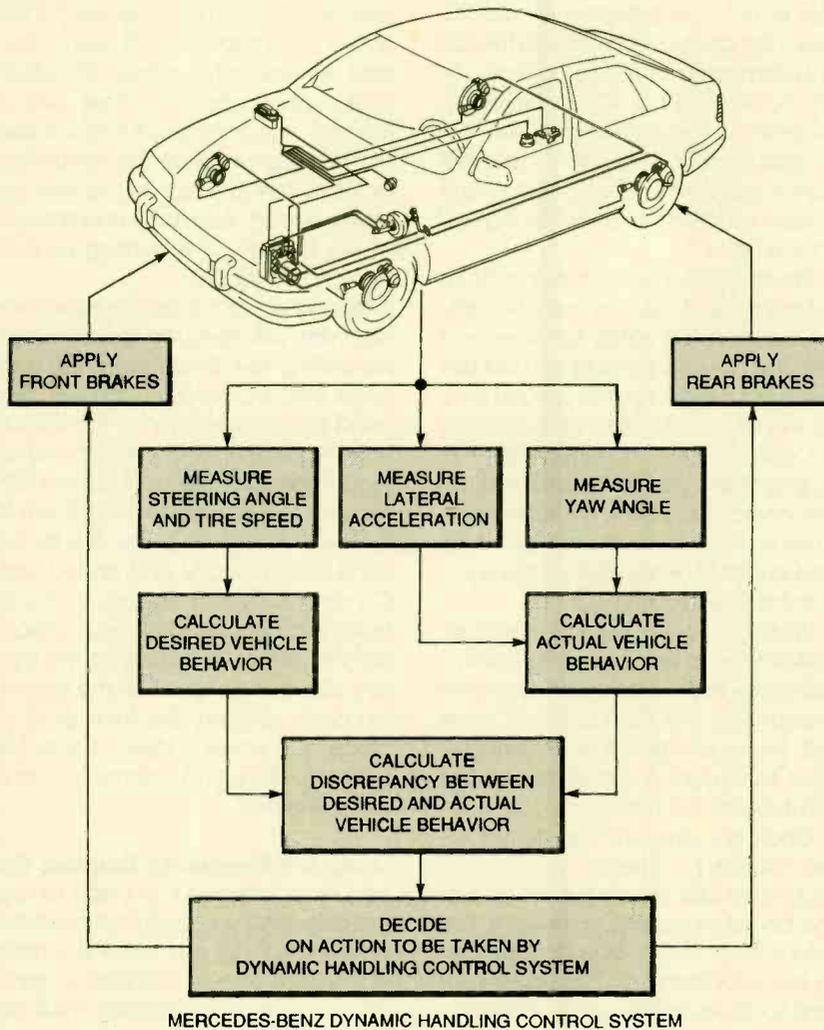


Fig. 3. This block diagram of the Mercedes-Benz/Bosch VDC system shows how braking commands are calculated from steering and wheel-speed sensors, a lateral accelerometer, and a yaw sensor.

while cutting the manufacturing cost drastically.

**Forgetting Old Habits.** Like cars equipped with ABS and TCS, driving a car with systems like VDC will require some changes in driving habits. Drivers of cars with ABS already know they have to firmly apply brakes rather than "pump the brakes" when they experience a skidding situation. With VDC, drivers have to overcome previously learned habits of applying opposite steering when they start skidding. Now they have to "trust" the system and keep the steering wheel

at a constant angle.

Finally, drivers should be cautioned that handling-control systems will not repeal the laws of physics. No electronic system will prevent disaster if you lose traction while attempting a turn designed for 35 mph at 70 mph!

Mercedes-Benz says that the VDC will initially be optional on its V-8 and V-12 cars at a cost of about \$3000. ABS, which Bosch also introduced in 1978, was also very expensive when it first appeared. However, costs have dropped drastically as ABS received widespread acceptance. The same thing will probably happen if and

## FOR MORE INFORMATION

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when this new safety feature becomes popular.

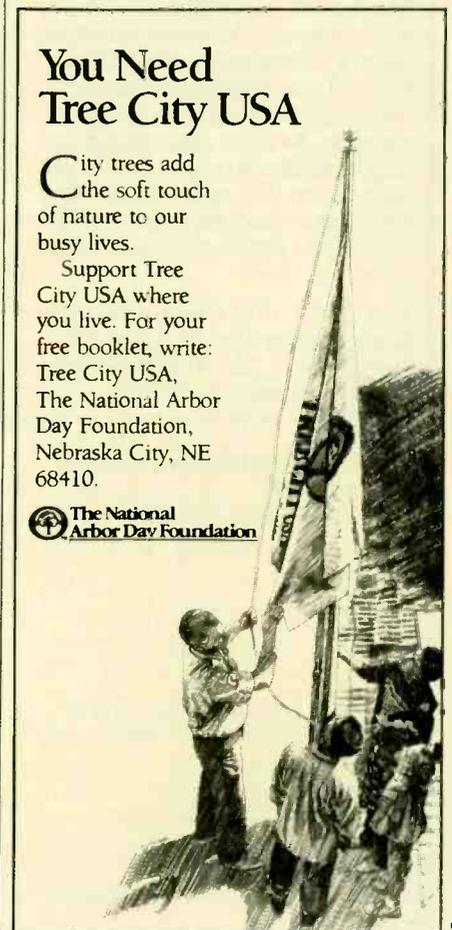
While a date for the availability of BMW's comparable DCS3 system has not been announced as of this writing, it has also been shown to the public. Considering the fierce competition between BMW and Mercedes-Benz, it probably will not be long. It is rumored that the BMW system's software would allow drivers to "dial in" the amount of drift allowed before the handling control starts operating. That is in keeping with BMW's philosophy of providing driver's cars for enthusiasts who like to "hang out" the tail a bit! ■

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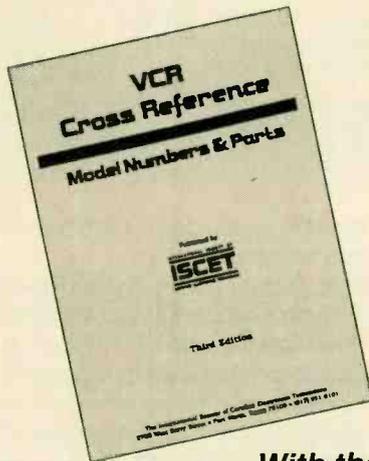
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## 25 MHz COUNTER

*(Continued from page 57)*

mounting the IC's on the component side of the board. Note that most IC pins must be soldered on both the foil and component sides. To do that, begin by tacking the IC's in place by soldering a couple of pins on the board's foil side. Because of the small board size and relatively high circuit density, use the smallest soldering iron tip you have.

When all the IC's are in place, finish soldering all of the pins that need soldering on the board's foil side, and then turn the board over. You will see that all of the power and ground pins, as well as certain other pins, must be soldered on the component side. The IC pins that need to be soldered on the component side all have large pads to make the soldering go easier, and to identify which pins on the component side require soldering.

When all of the IC's are soldered, check each of the connections with a continuity tester, particularly the connections for the ICM7224 (U3); once the display is in place, you will not be able to correct any mistakes on the U3's foil-side connections.

Once you are sure that all the IC's are installed correctly, it is time to mount the display on the foil side of the board as indicated in Fig. 4. First solder all of the foil-side connections to the LCD, then turn the board over and solder all of the component-side connections.

The next step is to mount and solder all of the discrete components. All of those mount on the component side, with the exception of the three LED's, which, like the LCD, are mounted on the foil side. Be sure to note the orientation for all of the polarized components and the Zener. Note that to aid in assembly, the LED cathodes and the transistor emitters were given square pads. When installing the LED's, mount them so that they stick up about 3/8 of an inch, measured from the board surface to the LED's extreme top. Be sure to solder all parts on both sides of the board anywhere that pads are provided.

Once all parts are mounted, double check all soldered connections to ensure you have not only good electrical connections, but also that there

are no shorts or solder bridges. The board is very compact, and mistakes are easy to make.

While the enclosure for the project is not critical, the one mentioned earlier is nearly ideal and was used by the author in his prototype; it does, however, require some minor modifications. Using a hand grinder (like a Dremel) and a miniature circular-saw blade, trim each of the mounting posts in the project box down by about 1/8-inch. Also, take a notch out of the upper left mounting post to make room for U4.

Regardless of the enclosure you select, you will need to drill holes for mounting the three switches and three BNC connectors. You will also need to drill openings for the display and the three LED's. Once that is done, mount the switches and connectors securely to the case and wire them to the appropriate points on the board using 5-inch lengths of stranded wire. Connect a 9V battery clip to the B1 terminals; be sure to observe proper polarity. Attach a battery to the battery clip, lay the board on the mounting posts, and put the face plate in place and screw it down. Label the switches, LED's, and connectors, and you are done.

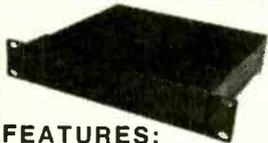
**Using the Frequency Counter.** The frequency counter is a cinch to use; the only thing you need to be careful of is which input you use. If you have any doubts about what kind of signal you are going to be testing, then use the rectifying input. The only time that you should use the unbuffered input is when you know you are working with TTL or 5-volt CMOS circuits. The ICM7224 has a certain degree of input-protection circuitry, but you can fry it if you try hard enough.

If you are using too low a range, then the over-range indicator will flash at you. Switch to a higher range.

Notice that although the display is only four digits, the ranging feature of the counter can give you up to eight digits of precision. Say, for example, the frequency you are measuring is 10.018763 MHz. In the "MHz" range, you will read "10.01" on the display; then switch to the "Hz" range, and you will read "8763", with an overflow indication. That way, you can achieve the same degree of precision as you would with an 8-digit display. ■

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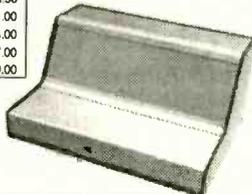


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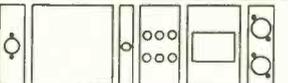
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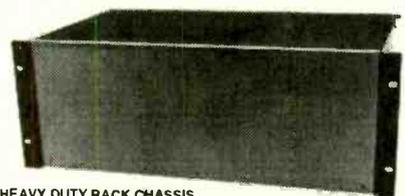


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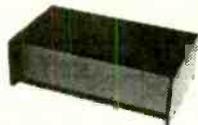
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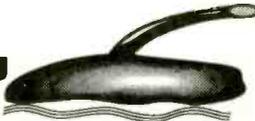


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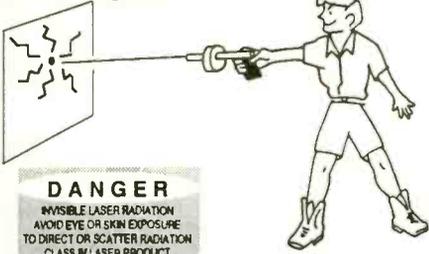
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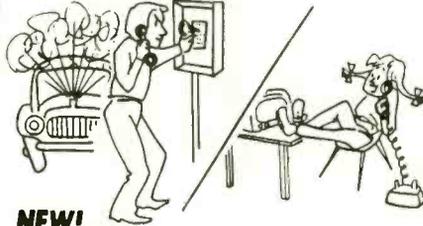
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Build an electrical device that is affective up to 20 feet. May be enclosed for handheld, portable field or laboratory applications. ITM2KM Easy-to-Assemble Electronics Kit ..... \$49.50  
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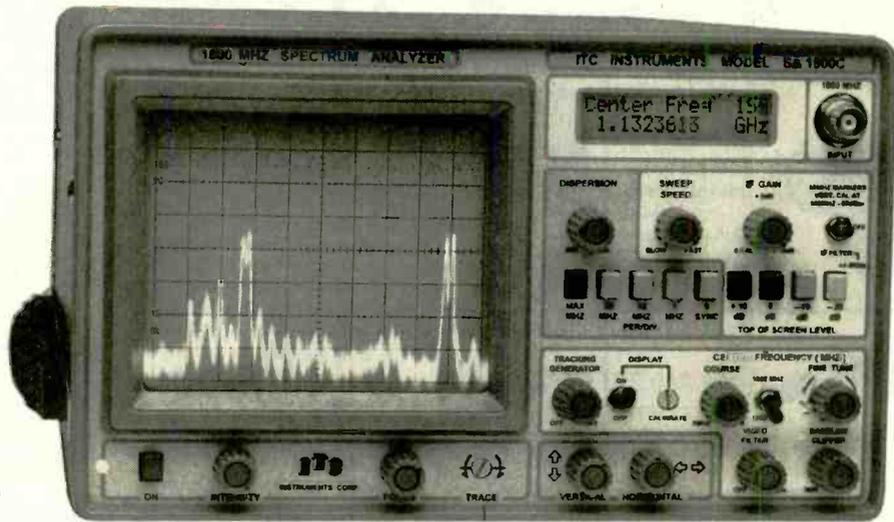
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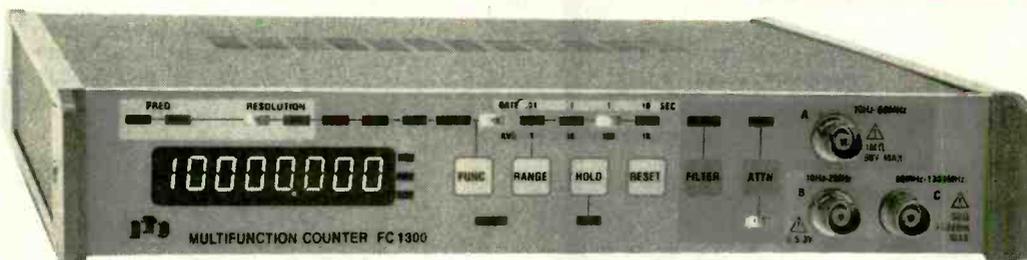
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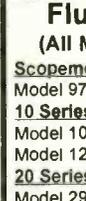
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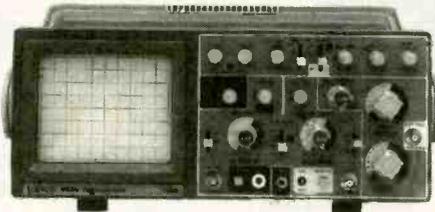
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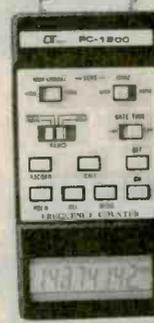
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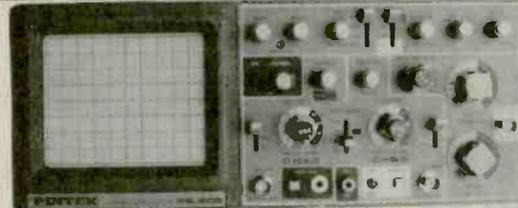
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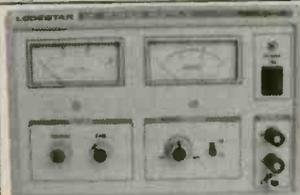


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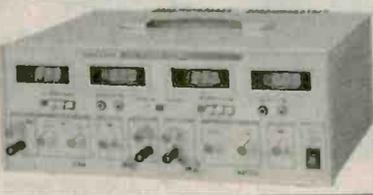
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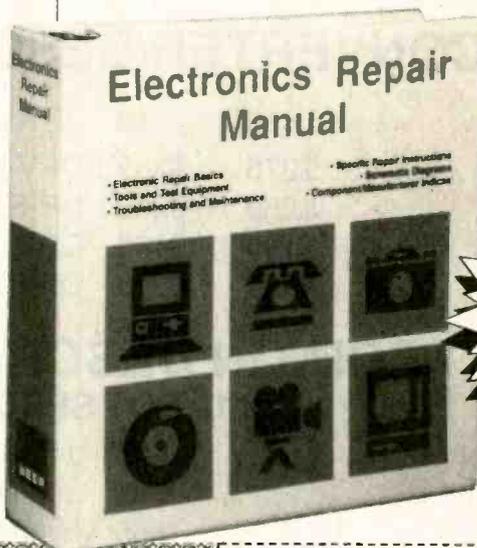
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Computer Control



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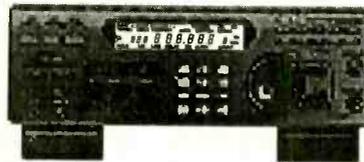
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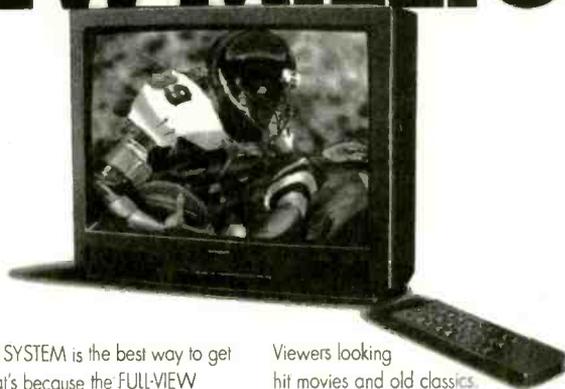


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10 Amp

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CAPACITANCE from 1pF to 20uF

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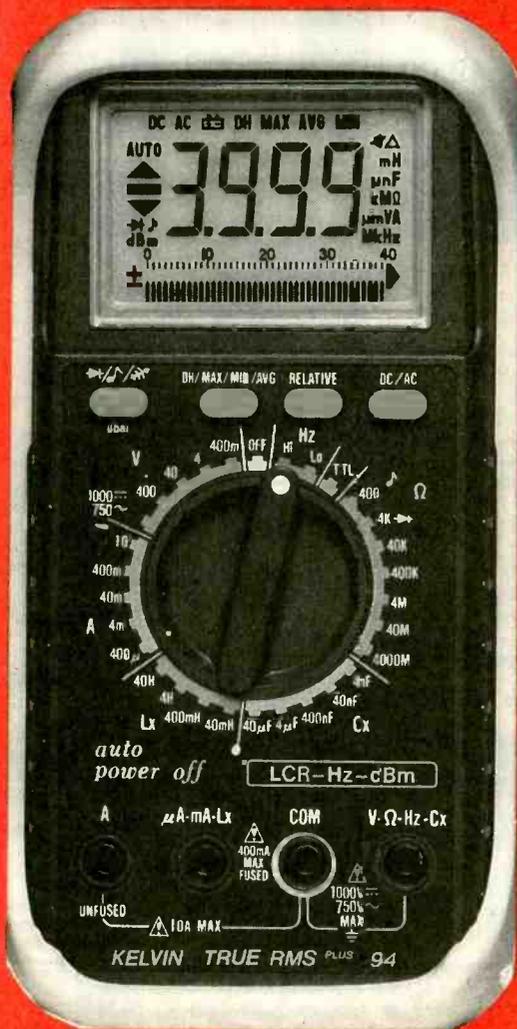
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Freq Counter to 20 MHz

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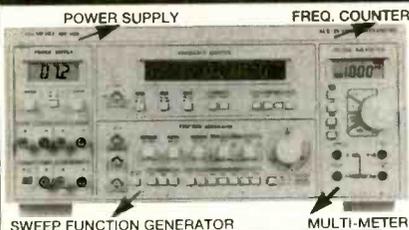
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  - ± (1 Hz + 1 dgt. + Time Base Error)
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  - Triple output: #1. 0-50V, 0.5A MAX #2, 15V, 1A #3. 5V, 2A
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- Acceleration Potential 12kV
- Variable Hold Off
- 16ns ~ 1.0s Time Base
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- Power: 115/230V AC

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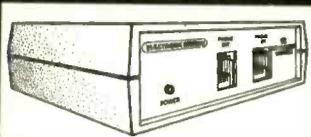
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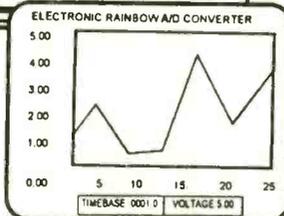
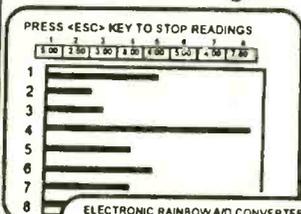
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AD-8 ONLY **\$89<sup>95</sup>**

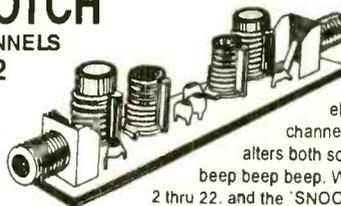


**THE ZAPPER** activates any radar detector within 3/4 of a mile. Check the brake lights of that sports car that just went by 90 miles an hour. Back off that 18 wheeler trying to eat your back bumper. Put the fun back in driving. THE ZAPPER is a 10GHz amateur transmitter the size of a cigarette pack, operates on a 9v battery, when the button is pushed, brake lights and radar detector light the skies. Complete with the rules of the new ROAD WARRIOR GAME... TROLLING FOR TAIL LIGHTS, Americas fastest growing highway participatory sport.

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FOR CHANNELS 2 thru 22 ONLY



## FILTERS

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, and the 'SNOOPER & BULLET'.

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DF-222 Kit **\$14.95**



## 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 .5"x1".

TEL-B1 **\$12.95**

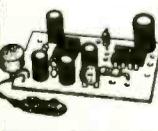


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This Manual contains all schematics, parts lists & P.C. board layouts for all of the Rainbow Kits. Use your own parts to construct any of our kits.

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Short bat handle, 0.25" long.

PC terminals

CAT # MTS-82PC

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3 FLUTE DESIGN W/SKIRT  
AND INDICATOR LINE

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skirt. 0.63" high. 6-32 set screw.

CAT # KNB-75

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## CPU HEATSINK



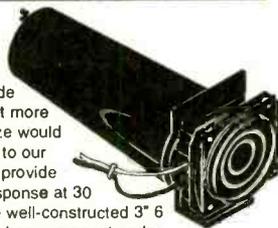
Wakefield 1.5" square X 0.25" high black anodized aluminum heatsink for 15 X 15 PGA type chips. 13 vertical fins for maximum cooling efficiency.

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CAT # HS-38

## 3" SPEAKER W/ BAFFLE

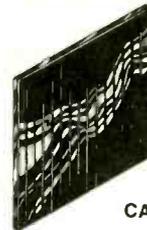
We don't know the original application for these speakers, but they're well made and will handle a lot more power than their size would indicate. According to our primitive tests they provide good mid range response at 30 watts or better. The well-constructed 3" 6 ohm speaker has a heavy magnet and a foam-edged paper cone. It's conservatively rated at 7 watts, but the 7" deep, fiberglass filled baffle enables it to sound good at much higher power. Give them a try for car or home applications.



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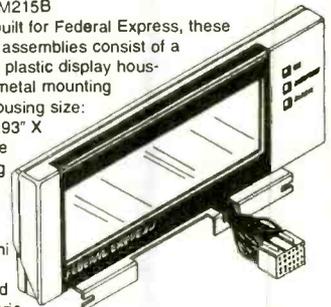
ard Hitachi

480 X 128

graphic and

alphanumeric

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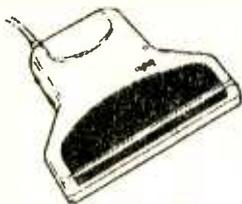
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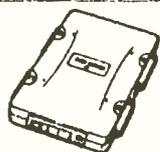
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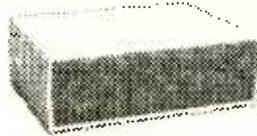
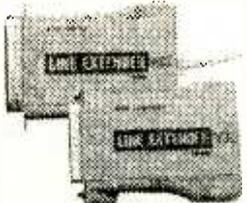
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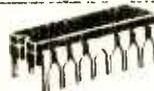
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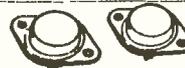


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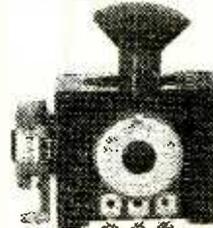
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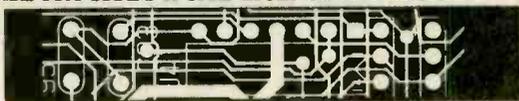
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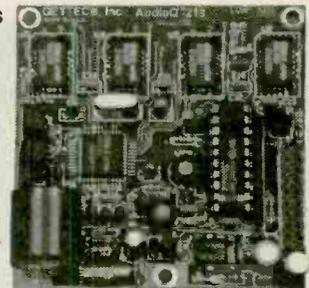
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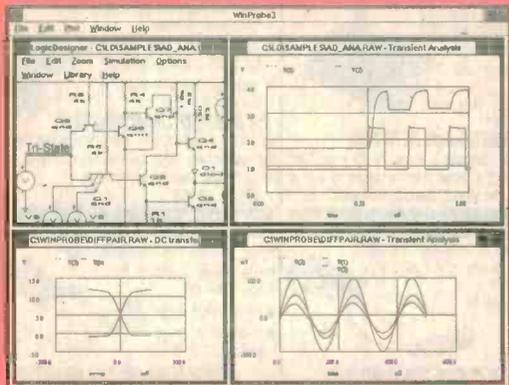
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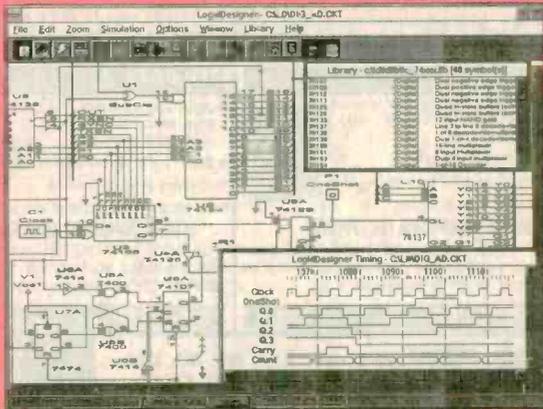
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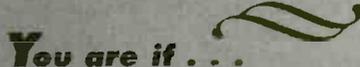
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- Tunes 88-108 MHz.
- Powerful 2 stage audio amplifier.
- Sensitive, picks up sounds at the level of a whisper.
- Up to 1 mile range.



### SUPER-MINIATURE FM TRANSMITTER

World's smallest FM transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip (SMT) parts are pre-assembled to the circuit board.

XST500 (E-Z) Kit ..... \$44.95

- Smallest Phone transmitter anywhere!
- Tunes 88-108 MHz.
- No batteries required, powered by phone line.
- Up to 1/4 mile range.
- Attach to phone line anywhere in house, even inside phone.



### SUPER-MINIATURE PHONE TRANSMITTER

World's smallest FM phone transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip components are pre-assembled to the circuit board.

XSP250 (E-Z) Kit ..... \$34.95

- Uses sensitive microwave transistor amplifier.
- Covers 1 to 2,000 MHz.
- Compact hand held unit.
- Includes miniature loud speaker for audio indication of detected signals.



### SUPER SENSITIVE BUG DETECTOR

When the XBD200 intercepts a signal in the 1 to 2,000 MHz range, it emits a growl that increases to a high pitched squeal as the signal strength increases.

XBD200 (C) Kit ..... \$49.95

- Transmit high quality stereo to any FM stereo receiver.
- Built-in output level monitor for quick and easy tuning.
- Ideal for use with personal CD player.



### FM STEREO TRANSMITTER

Transmit full-bodied Hi Fi stereo to any FM stereo receiver. Separate left and right inputs and gain controls. Includes an output booster stage for greater range.

XFS-CASE KIT ..... \$13.95

XFS108 (C) KIT ..... \$41.95

- Dial your phone from anywhere and listen to the sounds inside your home.
- Two digit Touch Tone code for secure operation.



### TELEPHONE SNOOP

The latest in home or office security. Call home from anywhere, enter a two digit security code, and hear the sounds in your home. Automatically turns on without ringing the phone, verifies code, then activates for one and a half minutes.

XPS-CASE KIT ..... \$13.95

XPS1000 (C) KIT ..... \$49.95

- Transmits a continuous beeping tone.
- Adjustable from 88 to 108 MHz.
- Up to 1 mile range.
- Works with any FM broadcast receiver.



### TRACKING TRANSMITTER

Only 0.7 by 2.4 inches, the XTR100 operates at voltages of 3 to 18 Volts and is ideal for use in locating lost model rockets, bicycles, automobiles, games of hide and seek, and contests.

XTR100 (C) Kit ..... \$33.95

- Works with any FM broadcast receiver.
- Turns off when phone is not in use to extend battery life.
- Adjustable from 88 to 108 MHz.
- Up to 1 mile range.



### LONG RANGE PHONE TRANSMITTER

Similar to our very popular XSP250, the XTT100 is battery powered for greater range. It plugs into any phone jack and transmits both sides of conversations on that line.

XTT100 (C) Kit ..... \$32.95

- Use with any FM broadcast receiver.
- Hear every sound in an entire house!
- Up to 1 mile range.
- Powerful 2 stage audio amplifier.



### MINIATURE FM TRANSMITTER

The XFM100 has a super sensitive microphone and is capable of picking up sounds at the level of a whisper and transmitting them to any FM broadcast receiver.

XFM100 (C) Kit ..... \$32.95

- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Anonymity on any call.
- Button for normal operation.
- 16 levels of voice masking.



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STOP THOSE ANNOYING TELEPHONE CALLS! Sound older and tougher when you want to. Not a kit. Fully assembled. Single phone operation only.

TRANSITION 2000 ..... \$89.95

- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Use with any modular phone.
- 16 levels of voice masking.
- Connects between handset and phone.



### VOICE CHANGING ACCESSORY

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TRANSITION 2001 ..... \$59.95

- Uninterrupted coverage of 800 to 950 MHz.
- Works with any scanner that can receive 400 to 550 MHz.



### 800-950 MHz SCANNER CONVERTER KIT

If your scanner can receive 400-550 MHz, just add the XLC900 for uninterrupted 800-950 MHz coverage. It converts all 800-950 MHz signals down to 400-550 MHz so your scanner can receive them! Add our custom case kit for that "Professional" look.

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XLC900 (C) KIT ..... \$49.95

- Works with most any scanner.
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- 3 dB typical noise figure.



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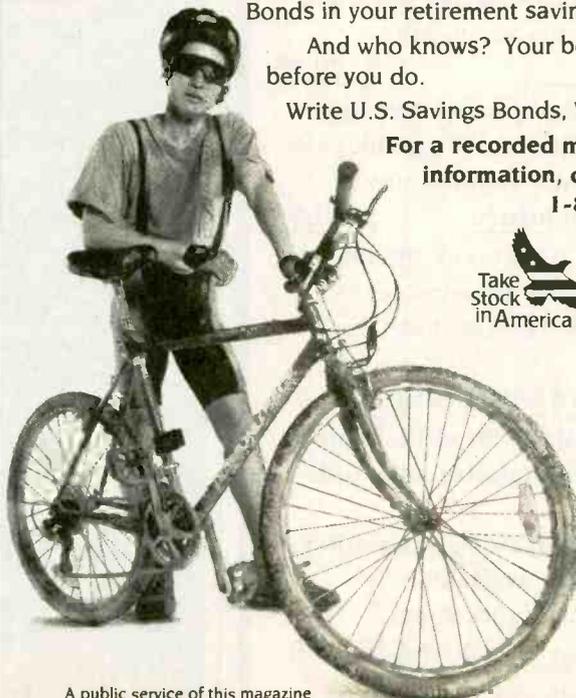
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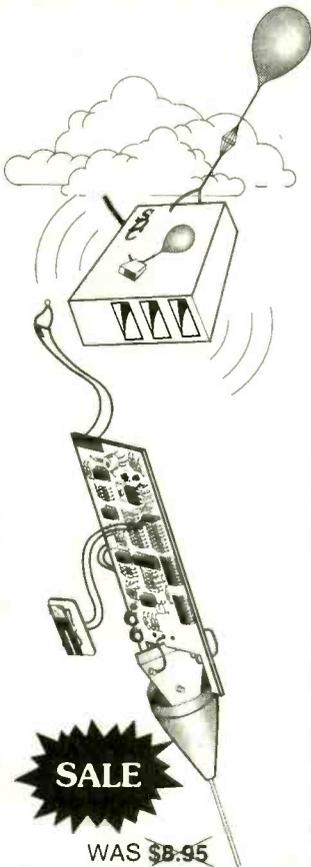
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## THE AMAZING RADIOSONDE



**SALE**

WAS \$8.95

**G5058 \$6.95**  
2/\$12.00

Very late model Radiosonde made for tracking all types of weather data. These were to be sent aloft attached to a weather balloon (not included). Each is about 10 1/2" long x 3 3/8" thick x 8" wide. Inside of the removable cardboard sleeve is a styrofoam chamber housing a sophisticated IC circuit board which has sensors attached to measure atmospheric pressure, temperature and humidity. As it gathers the information, it transmits the data at about 1.677 gigahertz (GHz). These are prime, brand new units that were waiting shipment from the manufacturer (Space Data Corporation) to the government when the contract ended. These are complete except for the 24V battery (we connected two 9V batteries in series and the unit worked perfectly from them). Sorry, no schematic available. These cost the government a bundle to have made but we are selling them at a giveaway price. Hurry, get your Radiosonde today!

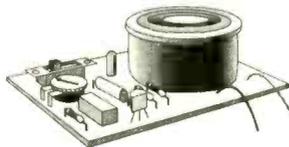
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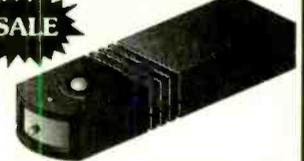
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## SUPER POWER MINIATURE IR TRANSMITTER UNIT

**SALE**

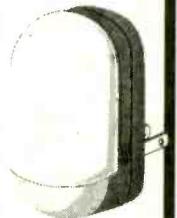


**G5535 \$1.25**  
12/\$12.00 • 120/\$100.00

Make all kinds of IR remote activated projects with this transmitter and an IR receiver module. These were originally designed to activate a burglar alarm system (which we don't have) by remote control. The transmitter features a red activation button, a dip switch inside to change output code, operation from 9V battery (not included), red LED transmit indicator to show when IR energy is being transmitted and a compact 4 1/4" x 1 3/16" x 3/4" black stylish case. Brand new in blister pack with 2 peel and stick "premise protected" stickers. We also supply an info sheet that shows how to convert this transmitter unit into a programmable IR receiver so a pair of these transmitter units could cover both transmit and receive functions.

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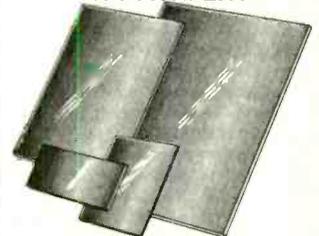
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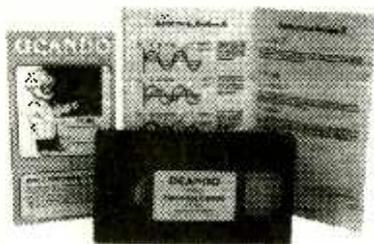
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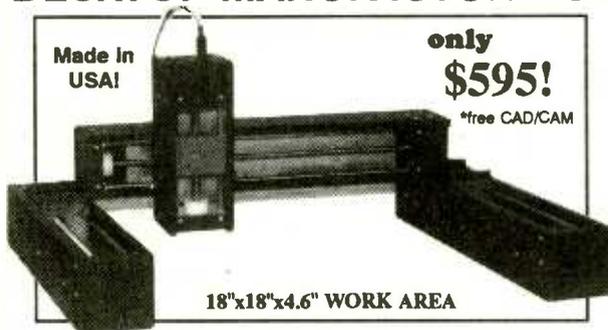
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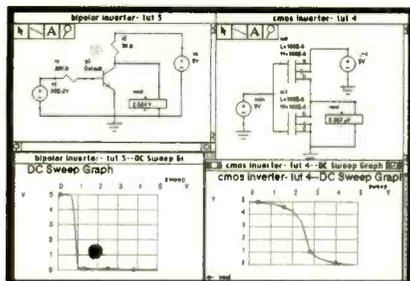
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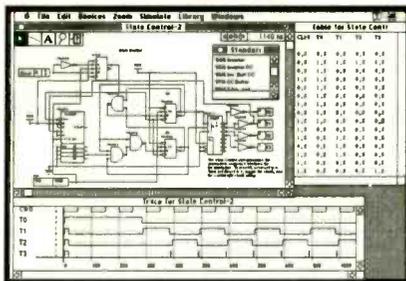
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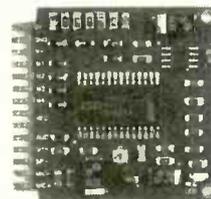


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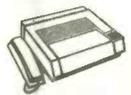
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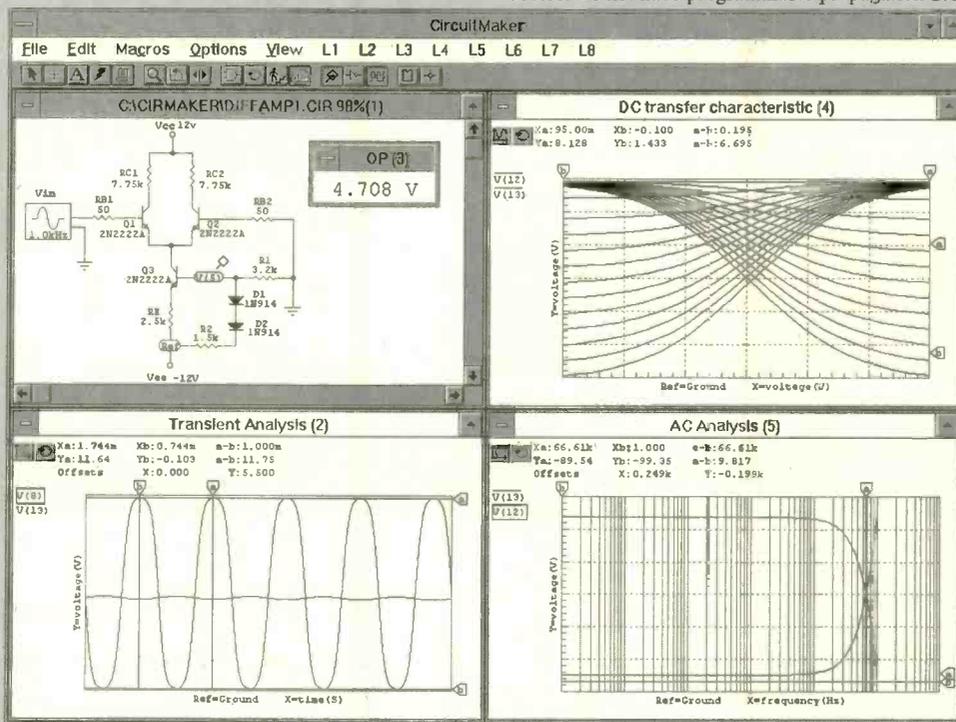
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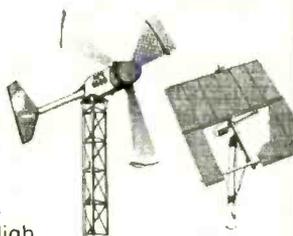
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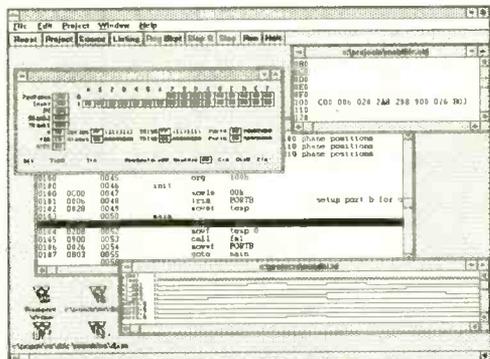


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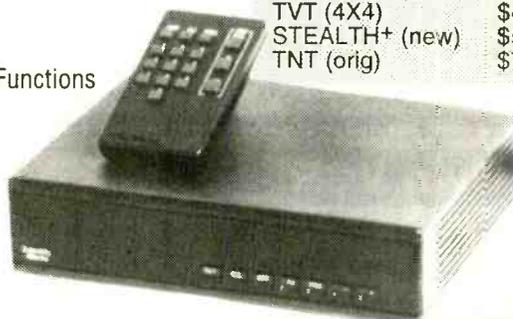
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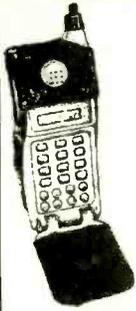


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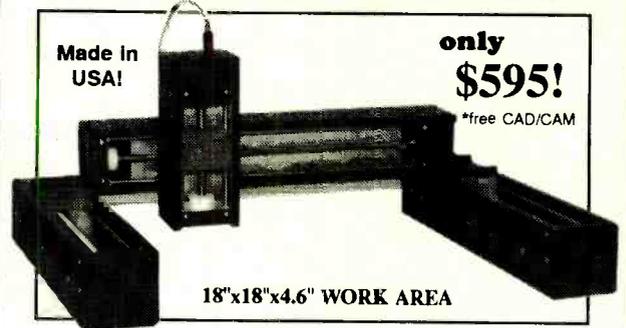
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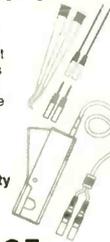
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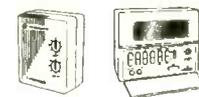
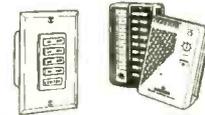
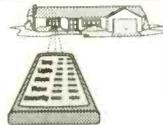


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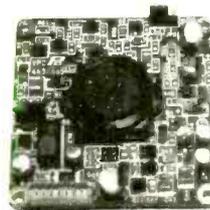
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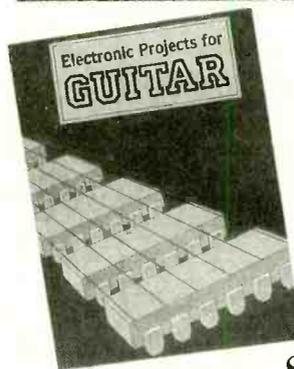


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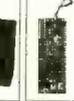
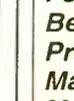
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All classified advertising in the **PE Market Center** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

#### DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March, 1995 issue that is on sale January 17. The PE Market Center 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.

**AD RATES: \$1.00 per word, Minimum \$15.00.**

Send your ads with payment to:

**Popular Electronics Market Center, 500-B Bi-County Blvd. Farmingdale, NY 11735**

### CATEGORIES

- |                              |                                 |  |                           |
|------------------------------|---------------------------------|--|---------------------------|
| 100 — Antique Electronics    | 270 — Computer Equipment Wanted | 450 — Ham Gear Wanted                    | 630 — Repairs-Services    |
| 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      |
| 240 — Components             | 420 — Ham Gear For Sale         | 600 — Publications                       |                           |

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1 - \$15.00	2 - \$15.00	3 - \$15.00	4 - \$15.00
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17 - \$17.00	18 - \$18.00	19 - \$19.00	20 - \$20.00
21 - \$21.00	22 - \$22.00	23 - \$23.00	24 - \$24.00
25 - \$25.00	26 - \$26.00	27 - \$27.00	28 - \$28.00

29 - \$29.00	30 - \$30.00	31 - \$31.00	32 - \$32.00
33 - \$33.00	34 - \$34.00	35 - \$35.00	36 - \$36.00
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 Check  MasterCard  Visa (\$15.00 minimum credit card order)

Name \_\_\_\_\_ Phone \_\_\_\_\_

Card # \_\_\_\_\_

Expiration Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

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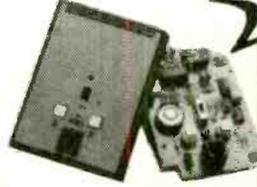
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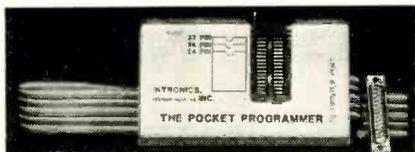
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# Scanners/CB/Ham/Shortwave

**COMMUNICATIONS ELECTRONICS INC.**  
Emergency Operations Center



## Bearcat 8500XLT-K Radio Scanner

Mfg. suggested list price \$689.95/CE price \$368.95  
500 Channels • 20 banks • Alphanumeric display  
Turbo Scan • VFO Control • Priority channels  
Auto Store • Auto Recording • Reception counter  
Frequency step resolution 5, 12.5, 25 & 50 KHz.  
Size: 10-1/2" Wide x 7-1/2" Deep x 3-3/8" High

**Frequency Coverage:**  
25,000 - 28,995 MHz. (AM), 29,000 - 54,000 MHz. (NFM),  
54,000 - 71,995 MHz. (WFM), 72,000 - 75,995 MHz. (NFM),  
76,000 - 107,995 MHz. (WFM), 108,000 - 136,995 MHz. (AM)  
137,000 - 173,995 MHz. (NFM), 174,000 - 215,995 MHz. (WFM),  
216,000 - 224,995 MHz. (NFM), 225,000 - 399,995 MHz. (AM)  
400,000 - 511,995 MHz. (NFM), 512,000 - 549,995 MHz. (WFM)  
760,000 - 823,9875 MHz. (NFM), 849.0125 - 868,9875 MHz. (NFM)  
894.0125 - 1,300,000 MHz. (NFM).

The new Bearcat 8500XLT gives you pure scanning satisfaction with amazing features like Turbo Scan. This lightning fast technology featuring a triple conversion RF system, enables Uniden's best scanner to scan and search up to 100 channels per second. Because the frequency coverage is so large, a very fast scanning system is essential to keep up with the action. Other features include **VFO Control** - (Variable Frequency Oscillator) which allows you to adjust the large rotary tuner to select the desired frequency or channel. **Counter Display** - Lets you count and record each channel while scanning. **Auto Store** - Automatically stores all active frequencies within the specified bank(s). **Auto Recording** - This feature lets you record channel activity from the scanner onto a tape recorder. You can even get an optional **TCSS Tone Board** (Continuous Tone Control Squelch System) which allows the squelch to be broken during scanning only when a correct TCSS tone is received. **20 banks** - Each bank contains 25 channels, useful for storing similar frequencies in order to maintain faster scanning cycles. For maximum scanning enjoyment, order the following optional accessories: **PS001** Cigarette lighter power cord for temporary operation from your vehicle's cigarette lighter \$14.95; **PS002** DC power cord - enables permanent operation from your vehicle's fuse box \$14.95; **MB001** Mobile mounting bracket \$14.95; **BC005** TCSS Tone Board \$54.95; **EX711** External speaker with mounting bracket & 10 feet of cable with plug attached \$19.95. The BC8500XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited warranty from Uniden. Order your BC8500XLT from Communications Electronics Inc. today.

## 26th Anniversary Special Save \$30.00

on Grundig® Satellit 700 or Yacht Boy 400 shortwave radio.  
Celebrate our 26th anniversary with special savings on your choice of a new Grundig Satellit 700 or Grundig Yacht Boy 400 shortwave receiver. This coupon must be included with your prepaid order. Offer valid only on orders mailed directly to Communications Electronics Inc., P.O. Box 1045 - Dept. PE0295, Ann Arbor, Michigan 48106 U.S.A. Coupon expires February 28, 1995. Limit one coupon per item. Coupon may be photocopied. Coupon may not be used in conjunction with any other offer. Credit cards are excluded from this offer. Void where prohibited.

## Bearcat Scanners

### Bearcat 200XLT-K Radio Scanner

Mfg. suggested list price \$509.95/CE price \$198.95  
200 Channels • 10 Banks • Cellular Modifiable  
Heavy duty carry case • Illuminated LCD • Search  
Size: 2-3/4" Wide x 1-1/4" Deep x 7-1/2" High  
Frequency Coverage: 29,000 - 54,000, 118,000-174,000, 406,000-512,000,  
806,000 - 823,9875, 849.0125 - 868,9875, 894.0125 - 956,0000 MHz.

Recently, the FCC amended Parts 2 and 15 of its rules to prohibit the manufacture and importation of scanning radios capable of intercepting the 800 MHz. cellular telephone service. The Electronics Communications Privacy Act prohibits the intentional interception of cellular telephone transmissions. Supplies of scanners that are capable of being easily modified to receive full 800 MHz. coverage such as the Bearcat 200XLT are in *critically* short supply. Today could be your last chance to buy your Bearcat 200XLT scanner. Signal intelligence experts, public safety agencies and people with inquiring minds that want to know, depend on the Bearcat 200XLT handheld scanner to intercept just about any radio transmission. You can also program frequencies such as police, fire, emergency, race cars, marine, weather, and other broadcasts into 10 banks of 20 channels each.

A modification sheet with instructions to restore full 800 MHz. coverage for our Bearcat 200XLT may be ordered for \$8.00. To order your Bearcat scanner, call 1-800-USA-SCAN.

### Other Bearcat Scanners

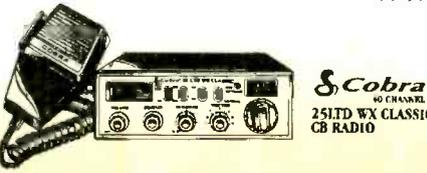
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## CB/GMRS Radios



A National Weather Service (NWS) receiver with automatic emergency broadcast activation has been added to the legendary Cobra 29 CB radio. The integrated NWS receiver in the Cobra 29LTDXW will *automatically* activate to receive emergency announcements about severe weather and travel conditions. A special tone-alert signal broadcast by the NWS activates the weather receiver and overrides any CB radio reception for monitoring the warning message.

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- Uniden GRANTX1-K SSB CB Mobile ..... \$139.95
- Uniden PRO538W-K CB & Weather ..... \$59.95



## Weather Stations

Now you can be your own weather reporter with the Davis Weather Monitor II. Our top-of-the-line weather station combines the most advanced weather monitoring technologies available into one incredible package. Glance at the display, and see wind direction and wind speed on the compass rose. Check the barometric trend arrow to see if the pressure is rising or falling. Push a button, and read indoor and outdoor temperature, wind chill, humidity and barometric pressure. Our package deal includes the ultra high resolution 1/100 inch rain collector part #7852-K, and the external temperature/humidity sensor, part #7859-K. The package deal is order #DAV1-K for \$479.95 plus \$15.00 shipping. If you have a personal computer, when you order the optional Weatherlink computer software for \$139.95, you'll have a powerful computerized weather station at an incredible price. For the IBM PC or equivalent order part #7862-K. Apple Mac Plus or higher including PowerBook, order part number 7866-K.

**The Weather Monitor II (7440-K) comes complete with anemometer with 40 feet of cable, external temperature sensor with 25 feet of cable, junction box with 8 feet of cable, AC power adapter, detailed instruction booklet and one year limited factory warranty.**



- Davis Weather Monitor II 7440-K ..... \$334.95
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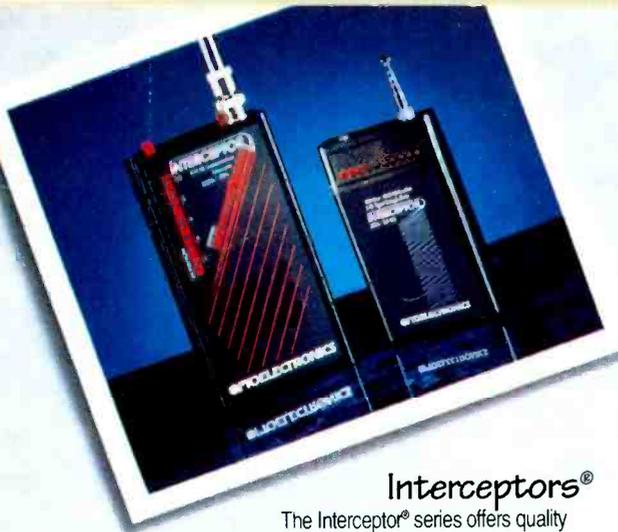
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## Interceptors®

The Interceptor® series offers quality design in a portable package. The R10 and R20

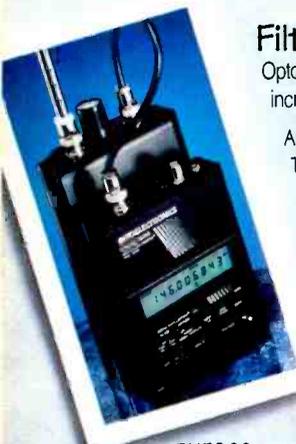
Interceptors® are near field receivers used for communications monitoring and counter surveillance applications. With use of the signal strength bargraphs they are ideal for locating stuck transmitters. Unlike scanners and receivers that must be tuned to a specific frequency or scanned through a fixed frequency range, The Interceptors® will instantly tune to strong signals.

R10..... \$359.

- *New* squelch delay feature
- *New* high intensity LEDs & low battery indicator
- Continuous 30MHz - 2GHz coverage in less than 1 second
- Check deviation & signal strength
- Skip button lets R10 scan to next signal
- Completely automatic, no tuning necessary
- Built in speaker or headphones

R20..... \$119.

- Pager sized, with built in telescoping whip antenna
- 9 volt battery operation
- Monitor Aircraft, CB, AM broadcast transmissions when close
- Check Microwave oven leakage
- Wide .5MHz - 3GHz frequency range



## Filters Filters Filters!

Opto offers a full line of filters and amplifiers to increase maximum performance.

APS104..... \$995.

Tunable band pass filter system from 10MHz - 1GHz. Maintains a constant 4MHz band width over the entire range. Extends near field detection 10x typical.

N100..... \$99.

FM broadcast band notch filter. Reduces interference from FM stations.

CFB02..... \$149.

Cellular Band Pass Filter and Amplifier. 825 - 845 MHz pass band with 10dB gain amplifier.

BHP800..... \$40.

High Pass filter for frequencies above 800MHz.

BLP70..... \$36.

Low pass filter for frequencies below 70MHz.



## Decoders

To measure Tones and Codes off the air, the TC200 & DC440 Decoders are the units of choice. The Optoelectronics Decoder line can be used with any scanner, service monitor, or communications receiver to monitor PL and DPL tones.

DC440..... \$259.

- 50 CTCSS tones, 106 DCS codes and 16 DTMF characters

- Convenient front panel controls for Power, Mode and Recall

- New CI-V compatible interface for PC
- Compact Size ideal for mobile or portable operation with optional NiCad battery pack (\$39.)
- 2 line by 16 character back-lit display

TC200..... \$179.

- Measures CTCSS tones only
  - Fast .1Hz resolution with .2 second display update
- Large 4 digit, .5" LCD display
- Low power design, 5+ hours operation

**MORE THAN JUST COUNTERS!**

## Computer Controlled Scanning Board



OptoScan OS456..... \$299.

Computer controlled scanning board for the popular Radio Shack Pro 2005/6 scanners. The OS456 takes full computer control of your scanner allowing it to perform simply and effortlessly. You will be amazed at the OS456's 50 channels per second scanning. With its ability to Decode CTCSS Tones, DCS Codes and DTMF Characters, the OS456 becomes a necessary tool for the serious Radio Monitoring Enthusiast.

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- CTCSS & DCS Controlled Scanning and Logging
- DTMF Decode & Log with Channel and Time
- RS 232C & CI-V Interface
- No drill or solder installation

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