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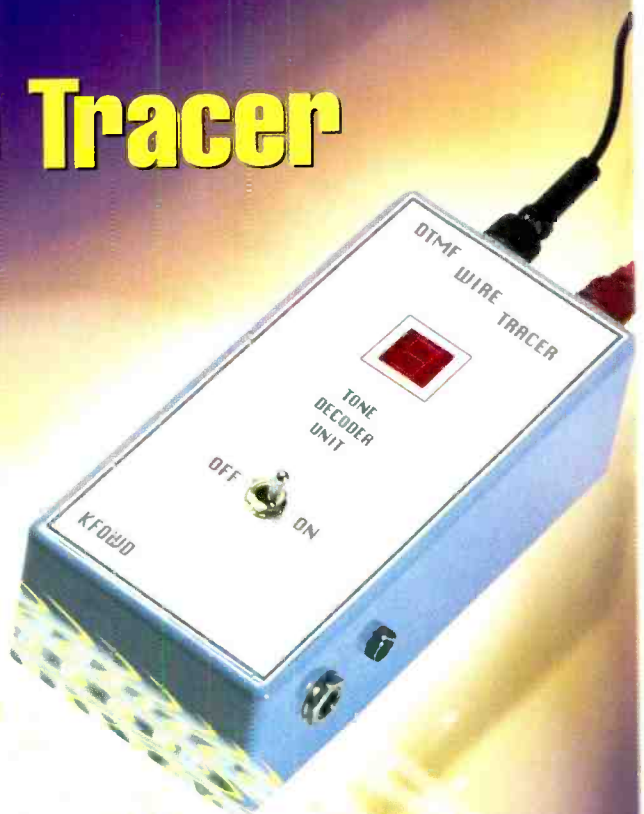

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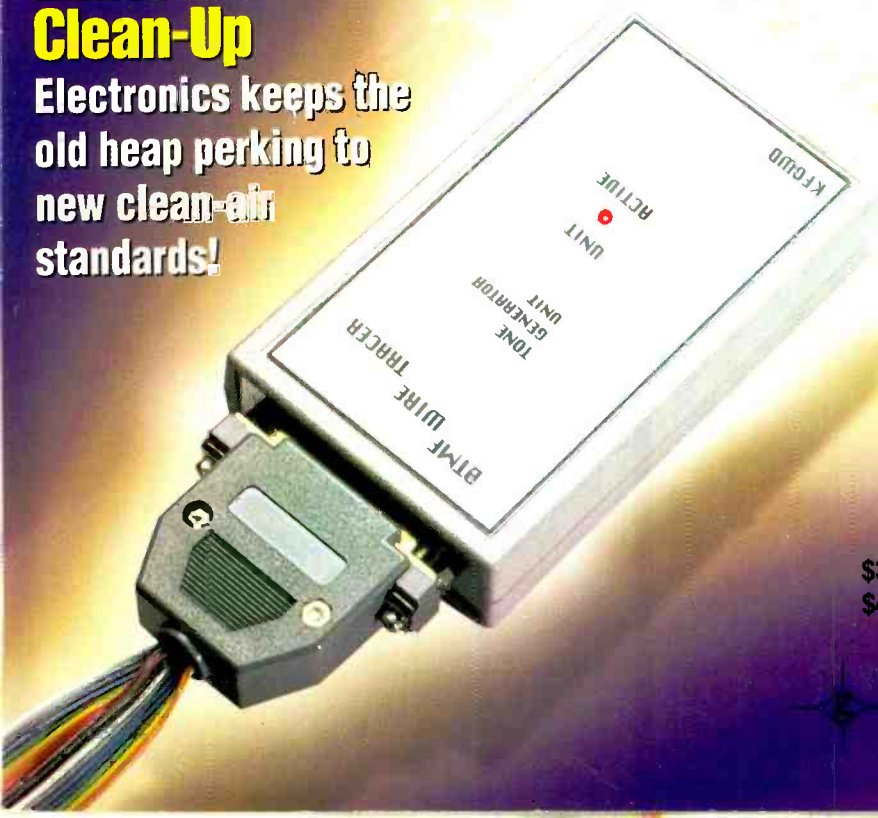

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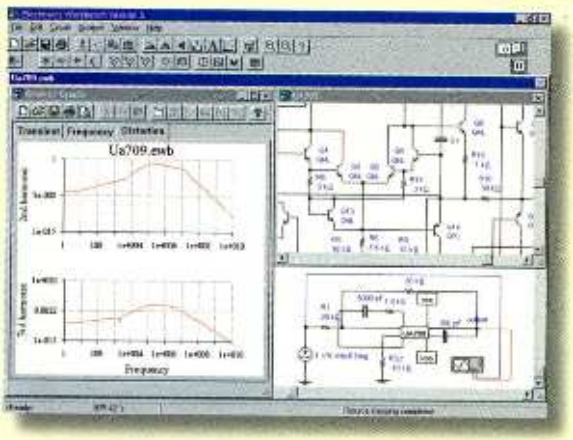

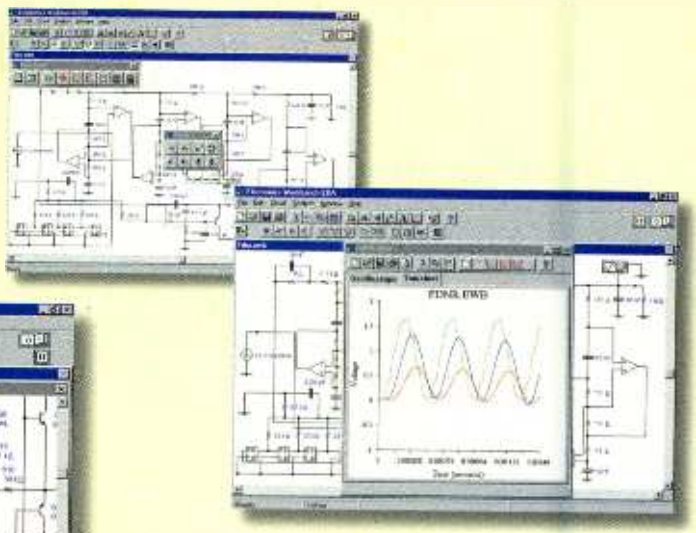

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Popular Electronics®

JULY 1997
Vol. 14, No. 7

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July 1997

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Editorial

Pandora's Part Box

Obtaining parts for a project can be a problem.

I received a letter from a reader who was distressed, because he had trouble obtaining the parts he sought for a project published in a previous issue of **Popular Electronics**. His gripe was that he had to go to several mail-order sources to obtain all the parts. The total cost of shipping and handling from all the sources was excessive. I agreed with him until I looked at the published article. The author offered a kit of parts with PC board and the cost with shipping and handling was less than the reader's cost derived from several mail-order sources. I guess for most of us, the ultimate buying decision would have been simple without traumatic reaction.

The reader had a problem. He had a few of the parts in his junk box and saw no reason why he should purchase the same parts in a complete kit. I agree with the reader's reaction; however you can't ask the kit supplier to sculpture the kit set up so that selected parts are removed and prices lowered. Most kit suppliers are either authors or small businesses that would lose money should they provide the services of large electronic parts suppliers. Even large suppliers say that you either buy the kit or the parts you require from their catalog. You may very well overpay should you take the latter course.

Is there a solution to the parts problem? Not for all cases but with a full junk box of spare parts you can save bucks. Whenever I visit a ham fest or computer show, I buy bags of resistors, capacitors of all types, chips of all types, etc. These parts are usually manufacturers' over-stocked parts that are surplus once a production run finished. They are inexpensive. Last year I picked up a bag of PC board electrolytics that came out to 15 cents per capacitor. That's cheap. Now, all you may need to complete a project are the chip(s) required.

From time to time, there are good buys listed in the 30 to 40 pages of the Market Center in this magazine. Thumb through it, today! If you don't whip out your check book and buy something, you are a stronger person than I am.

Back to our distressed reader. For the most part, for the kit of parts listed in the Parts List for construction projects we publish, the prices are *good*. A one-source supplier makes buying easy and gets you into the project quickly.

Whoops! Just spotted a $14.95 TV notch filter in the Market Center. Gotta go now. Where is my checkbook?

Julian Martin

Julian Martin, Editor

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LETTERS

SPEAKER CLARIFICATION

I plan to build Gary Clifton's "22-Watt Amplifier" project, which was featured in the February 1997 issue of **Popular Electronics**. Before I begin, however, I have one question. Would I have to modify the circuit if I were to use 8-ohm speakers with the amplifier instead of the 4-ohm speakers mentioned in the article?

R.S.
Goshen, OH

The simple answer to your question is that you can use 8-ohm speakers with this amplifier, without modification. As I state in the article, the amp is intended *for use with 4-ohm speakers. I will try to explain this sensibly rather than with a bunch of hocus-pocus.*

Most car audio systems work with 4-ohm speakers, and most in-home equipment uses 8-ohm speakers. While "watts is watts," Ohm's Law defines the relationship between voltage, resistance (or, in this case, impedance), and current. To put 22 watts into a 4-ohm speaker requires less voltage, but more current, than putting 22 watts into 8 ohms. If an amplifier is designed for a 4-ohm load and you use an 8-ohm load instead, the result will be that the amplifier works just fine but it cannot put out its full rated power. Typically it will deliver just over half the rated power. (I'll describe "ratings" further on.) This does not harm the amplifier in any way—it's rather like driving a car at 50 mph when its top speed is 95 mph.

Going the other way is a different story. If an amp is designed for an 8-ohm load and you use a 4-ohm load instead, the results could be fatal to the amp. Because it has half the load impedance, it will attempt to deliver twice as much power as it should—typically by trying to produce twice as much current at the same voltage. That can cause output transistors to fail as they exceed their current-carrying capabilities—like using a $^1/_2$-ton pickup to haul five tons of gravel.

Amplifier ratings used to be a slippery business, with manufacturers making all kinds of wild claims. The so-called "rms" rating is the most reliable. To rate output power in watts using the rms method, the amplifier is set up with a dummy load of the rated impedance—typically 8 ohms for home gear and 4 ohms for car equipment. A 1-kHz sinewave is used as a signal source to drive the amplifier. The input signal is increased until the output signal begins to clip. The output voltage is then measured across the load with an rms voltage meter.

As an alternative, the signal can be measured on a calibrated oscilloscope. When using the scope, the peak-to-peak voltage is measured; and the rms voltage calculated from the measured peak-to-peak. rms voltage is 35.35% of the peak-to-peak (or $^1/_2$ the peak-to-peak voltage multiplied by 0.707). Power is I^2R, so the rms voltage and the load resistance are used to calculate the current and finally the rated power in watts. "Peak power" can mean anything. An amplifier rated at 50 watts rms into 4 ohms could claim as much as 400 watts "Peak power."

Because the TDA1554Q used in this amplifier project is rated at 4 ohms, I relied on the manufacturer's ratings and verified that my amplifier design performed up to the IC-maker's specifications. Partly out of laziness and partly out of the fact that most car audio uses 4 ohms, I did not record, calculate, and rate performance into 8 ohms. As I recall, the results were approximately 14 watts per channel into 8 ohms, measured at a maximum clipping distortion of 10%.

I started listening tests with 8-ohm speakers because I had 8-ohm speaker boxes but no 4-ohm speakers. In fact, to listen to 4-ohm speakers, I had to put two 8-ohm boxes in parallel to make a 4-ohm load. Although it didn't blow out the windows, driving 8-ohm speakers with this amp still got loud enough that I could not stand full volume for very long at a time.

I hope this answers your question without causing further confusion. —Gary Clifton

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FOND MEMORIES

I restore radios and test equipment as a hobby, and I am a regular reader of Marc Ellis' *Antique Radio* column. I also love to build crystal sets, and greatly enjoyed building the NBS set.

Mr. Ellis' recent restoration of the Knight Star Roamer brought back memories. That was my second shortwave receiver (my first was a Knight Space Spanner). I enjoyed many hours of shortwave listening all through my teens on the Star Roamer, oblivious to the fact that the BFO drifted, image rejection was terrible, etc. As a collector, I now wish that I still had both sets, and I look forward to adding them to my collection some day.

I have approximately 40 pieces of restored Heathkit test equipment, most of which I use constantly. Poor solder joints, as Mr. Ellis experienced in the Star Roamer, are common when restoring kits. You are at the mercy of the original builder. I have, on more than one occasion, opted to simply resolder an entire unit, thus eliminating any future problems.

Although I have several modern receivers (Icom R71a and Kenwood R1000), I would much rather fire up one that glows, whistles, or uses no power! Keep up the good work.

B.M.
Des Plaines, IL

PAGER DECODER LEGALITIES

Is it legal to use the "Pager Decoder" (**Popular Electronics**, March 1997) to decode messages other than one's own?

I would think not, because of the Communications Act of 1934 and the Electronic Communications Privacy Act of 1986, but I would appreciate an expert opinion. The article mentions police agencies that intercept pager

(Continued on page 10)

How to make your car invisible to radar and laser...*legally!*

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

by Phil Jones

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

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

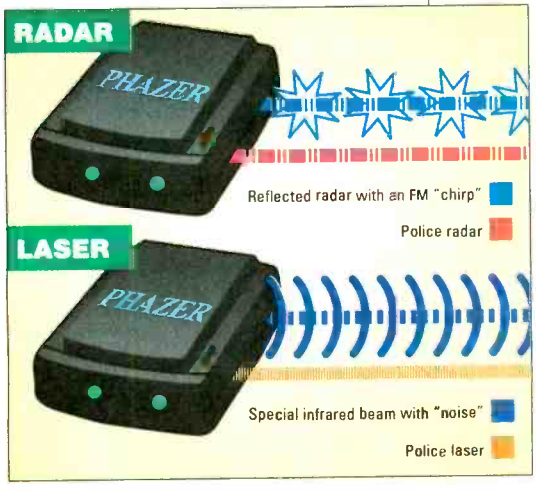
It seems that as speed-detection technology has gotten more and more advanced, speeding tickets have become virtually unavoidable. And although devices exist that enable motorists to detect these speed traps, they are outlawed in many states. . including mine.

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

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

Perfectly legal. Some radar devices have been outlawed because they *transmit* scrambling radar beams back to the waiting law enforcement vehicle. The Phazer, however, *reflects* a portion of the signal plus an added FM signal back to the police car. This, in effect, gives the waiting radar unit an electronic "lobotomy."

Best of all, unless you are a resident of Minnesota, Oklahoma or Washington, D.C., using the Phazer is completely within your legal rights.



HOW TO MAKE YOUR CAR DISAPPEAR

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

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

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

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

Works with laser, too! The Phazer also protects your vehicle from Lidar guns that use the change in distance over time to detect a vehicle's speed. The Phazer uses light-emitting diodes (LEDs) to fire invisible infrared pulses through the windshield. Laser guns interpret those pulses as a false indication of the car's distance, blocking measurement of your speed. *Again, it's as if your car isn't even on the road.*

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

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

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

Risk-free. Thanks to Rocky Mountain Radar, speed traps don't make my heart skip a beat anymore. Try the Phazer or the Phantom yourself. They're both backed by our risk-free trial and three-year manufacturer's warranty. If you're not satisfied, return them within 90 days for a full "No Questions Asked" refund.

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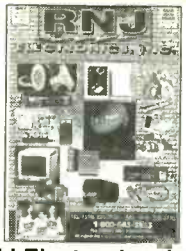

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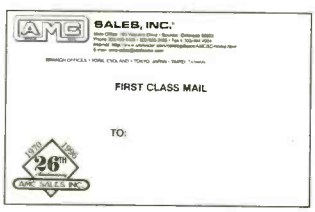

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American Eagle Publications offers a unique catalog of educational information about computer viruses, computer hacking, security and cryptography that you just won't find anywhere else. The information offered here goes far beyond the vague descriptions offered by most publications, giving you the solid how-to information you need if you want to explore these little-discussed subjects from a technical point of view. ***$2.00***

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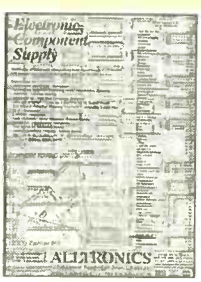

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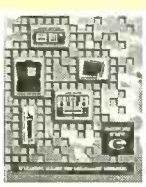

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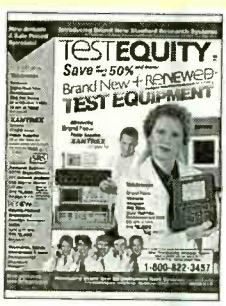

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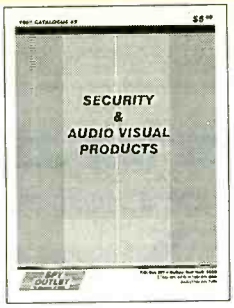

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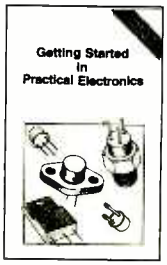
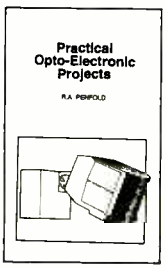


☐ **BP345—GETTING STARTED IN PRACTICAL ELECTRONICS $5.95**

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



☐ **BP349—PRACTICAL OPTO-ELECTRONIC PROJECTS $5.95**

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

☐ **BP363—PRACTICAL ELECTRONIC MUSIC PROJECTS $5.95**

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

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LETTERS

continued from page 6

messages—do they have to get a court's permission to do so?
M.A.C.
Athens, GA

The Communications Act of 1934 authorized rules and regulations—including provisions for privacy—to be established. I cannot give you an expert legal opinion; however, I believe the following to be an excellent guideline: You can listen to (or view, i.e. TV) anything that you can receive, but private conversations (other than broadcasts) are not to be shared with anyone, nor can you profit from information gleaned from them.—Editor

DON'T FORGET THE MAC USERS!

I have been reading **Popular Electronics** for almost five years and have enjoyed it very much. I have just one problem. I see articles now and then for projects using the computer. That would be great if I had a PC. I don't. I have a Macintosh.

The truth is, I hate PCs. The Mac is many times easier to use. You only have one type of system software, instead of Windows and DOS. Even though there are different versions of the system software, applications that run on one version will usually work on a later version and, in some cases, vice versa.

Also, the Macintosh usually warns you that a problem is about to occur, instead of letting you know after the fact, when it is too late. For example, if you are copying a file to a floppy disk that doesn't have enough memory left, the Macintosh lets you know before you copy, not when you are halfway done.

I realize that many electronics hobbyists do use PCs. But please realize that there are some of us that don't. It would be nice to see a project now and then that was based on the Macintosh.
M.C.
Hudson, FL

We'll keep you in mind, Michael. The staff agrees that the Mac should get some coverage, but articles are scarce and Mac readers even scarcer.—Editor

HAVES & NEEDS

I need the readout display board from any of the following Heath televisions: GR2000, GR2001, GR2050, GR300, GR400, or GR500. The board contains an MM584 IC (Heath part number 443-616), which is in the video generator for the clock and channel number on-screen display.

I have not been able to locate a source for the IC, so maybe someone has a readout display board from which I can salvage one. I'll be glad to buy the board (or even the TV, if necessary). Thanks.
ROBERT M. HARKEY
14401 Cabarrus Road
Charlotte, NC 28227

I am looking for information on frequency grabbers. I'm into scanning and it would be really cool to make one or order a kit for one. I'd also like plans for making a field strength signal meter so that I can get an idea of how far the signals are coming in. Does anyone know where I could get the plans for either of those projects?
J. FISHER
4401 Hillside
Lincoln, NE 68506

I have the *Most Often Needed Radio Diagrams* published by Supreme Publications for the years 1940-1942 and 1947 and up. Is there anyone out there willing to give a new, loving home to the Supreme Publications published before 1940 and for 1943-1946? Also, does anyone have a list of all the Supreme Publications books for consumer radios. I am not interested in TV receivers. Drop a note to the Editor, and he will contact me. Thank you.
J.V.
Brooklyn, NY

I have an old multi-band, 5-tube, superhet Howard Radio receiver (vintage 1939-40) that still works like a dream. My dad used it aboard a merchant ship throughout WWII. It has a metal case and a black, crinkled finish. I believe the paint finish is refered to as "Japaning." The paint is worn to the metal in some places, and I'd like to refinish the case. How do I get to crinkle (wrinkle) the finish on black paint? Can anyone help?
June Houser
Chicago, IL ■

Multimedia Watch

Unbelievably Affordable GPS Navigation plus New Software

Marc Spiwak
Technical Editor
Windows Magazine

Usually I start off this column with an interesting piece or two of hardware, and then go through all the new software. This month I'm still starting with hardware, but it would be nothing without its marvelous companion software. I'm talking about the *Delorme Tripmate Hyperformance GPS Navigation System*. It's a portable GPS receiver that's packaged with the mapping program *Street Atlas USA 4.0*. I've talked about that amazing program before. A single CD-ROM containing maps of every street in the country. When Street Atlas has a GPS receiver to work with, it can show you exactly where you are and on what road. And get this: The receiver is bundled with Street Atlas for only $149! The only catch is that you need a notebook computer.

Maps can't tell you where you are, but the Global Positioning System, or GPS, can. This constellation of satellites lets a GPS receiver lock onto a position fix. The general public can't use the GPS system to the same degree of accuracy that the military has access to. Even so, Tripmate's accuracy is limited to 328 feet horizontally and 512 feet vertically, 95 percent of the time. But because Street Atlas compares the GPS fix to road maps, it usually knows exactly where you are. Street Atlas lets you search for any city, town, or street, and prints maps as well. It costs $45 without the GPS receiver. But if you have a notebook computer, you'd be crazy not to purchase the software with the GPS receiver.

The GPS receiver connects to the serial port of a notebook PC. You need at least a 386SX/33 and Windows 3.1 or higher, 8 MB of RAM, 8 MB of hard disk space, SVGA graphics, and a CD-ROM drive to run Street Atlas. But because the receiver connects to a serial port, at least you don't need PCMCIA slots. If your notebook computer doesn't have a built-in CD-ROM drive, or if you don't want to run a CD-ROM drive continuously, you can extract what you need from the Street Atlas disc to your hard drive using a portable CD-ROM drive.

The GPS receiver is about the size of a Walkman stereo, and it sits on the dashboard of your car. It's powered by 4 AA batteries, so it doesn't suck power off your computer's batteries. The first time you start Street Atlas with GPS, you must enter the state or province where you are. In a few minutes the GPS starts tracking. A green arrow marks your location and follows you through the map. It also gives you latitude and longitude, elevation, heading, and speed information. This is a great toy for only $149, not to mention an extremely useful navigational tool.

New Stuff

New games from Microsoft abound this month, with two sports titles, two flying games, a lizard game that's a bit more unusual, and something to help plan trips. To start off, there's *Microsoft Golf 3.0*, the latest update to the now-classic title. It's now been redesigned for Windows 95, with instant hole rendering, an improved user interface, and more. Two new courses include Banff Springs and Harbour Town. *Microsoft Soccer* for Windows 95 puts you right on the field with rich graphics and sounds, realistic player movements, field types and conditions, as well as the usual unruly crowds. Both titles will sell for $44.95.

People who have been using com-

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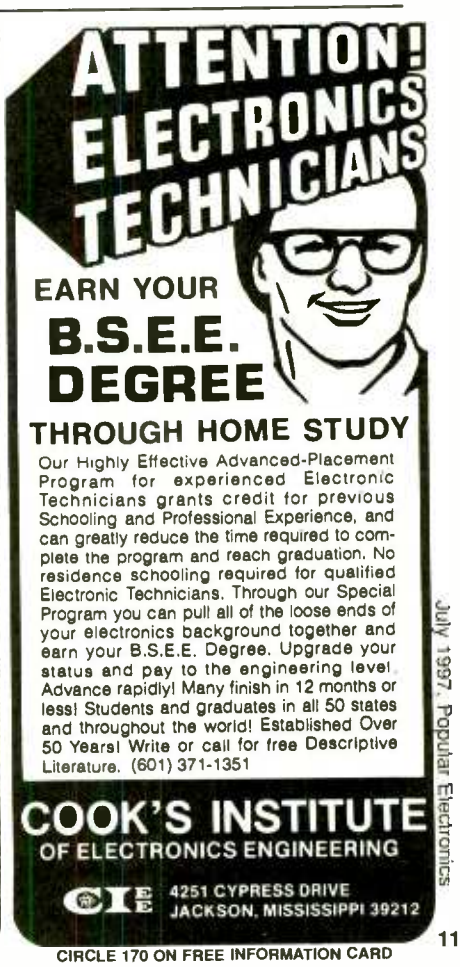

CIRCLE 170 ON FREE INFORMATION CARD

The Tripmate Hyperformance GPS Navigation System is a portable GPS receiver for a notebook computer. It comes with Street Atlas, a CD-ROM containing maps of every street in the country. You get both for only $149.

puters for years should remember the time it was very important that a PC-compatible system could run Microsoft Flight Simulator—if it couldn't, it wasn't compatible enough. Most ads for PCs even stated that "this system runs Microsoft Flight Simulator," so it really was important. That's because the program was extremely complex for its time, but it was nothing compared to *Microsoft Flight Simulator for Windows 95*. This version features ultra-realistic planes, with two new planes—the Boeing 737-400 and the aerobatic Extra 300S—joining the Cessna 182 RG, Learjet 35A, Schweitzer 2-32, and Sopwith Camel. You fly the plane you like best. You can start flying in seconds if you like, and fly over 3D-detailed cities including San Francisco, London, Tokyo, New York, Paris, Chicago, Seattle, and more. Flight Simulator for Windows 95 takes you to new heights of flight and realism.

Another flight game for Windows 95, one that's more of a fantasy shoot-em-up type scene, is *Hellbender*. This one makes you the commander of the Hellbender prototype attack craft, a warship that bristles with high technology. You must destroy the Bion invaders before it's too late. *GEX* for Windows 95 is a more unusual game. This one features a wise-cracking gecko lizard named GEX who takes you for rides through five worlds based on classic TV shows and "B" movies. This is a Super Mario type game, except that GEX can whip his tail; stick to surfaces including faces, swim under water, and more. This one's also $44.95.

The *Microsoft Automap Trip Planner* is an all-new version of the popular road atlas and travel guide for North America. Featuring over one million miles of roadways, detailed city maps, and tons of information on key attractions and places to visit, this is a complete travel-planning package. The Route Wizard will help you design a trip tailored to your personal driving preferences, and you can specify the quickest, shortest, and most scenic route. The highly detailed maps can be viewed on-screen or printed. No matter what kind of trip you're planning, the Automap Trip Planner can help you get there for $44.95.

I just took a trip into the past with E.M.M.E. Interactive's *Myths and Legends, Volumes 1 and 2* which are available separately or as a set. *Volume 1: Monsters and Mythical Creatures* deals with the Yeti, Cyclops, Leviathan, Pegasus, The Golem, The Unicorn, The Gorgons, The Phoenix, and more of the same. *Volume 2: Legendary Lands and Lost Cities* covers The Garden of Eden, The Fountain of Youth, Easter Island, Atlantis, The Bermuda Triangle, and more. These mythical creatures and lost lands are brought to life through photos, videos, animation, text, and a lot more. If you're as fascinated by these mysterious creatures and places as I am, you'll enjoy these titles.

WHERE TO GET IT

DeLorme
181 US Route 1 South
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http://www.delorme.com

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Stamford, CT 06905
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http://www.microprose.com

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052
206-882-8080
http://www.microsoft.com/games/

7th Level, Inc.
1110 E. Collins Blvd., #122
Richardson, TX 75081
972-498-8100
http://www.7thlevel.com

Monty Python and the Quest for the Holy Grail (on CD Rom) takes you through the story with King Arthur interacting with nutty Pythonesque.

I was just playing *Monty Python and the Quest for the Holy Grail* on CD-ROM from 7th Level. Monty Python's Complete Waste Of Time was a great disc when it came out, and so is this one especially if you've seen and liked the film. Basically you get to go through the story in your own quest for the Holy Grail, with nutty Pythonesque interactivity with the cast and scenery along the way. Plenty of wacky games are thrown in as well, including Burn the Witch and Kill the Black Knight. $49.95 is the suggested admission fee to this fun-filled desktop romp through 932 AD. Also from 7th Level comes *Ace Ventura* on CD-ROM. In over 60 exotic locations, Ace must battle animal-hating villains, dodge obstacles, and solve puzzles. You keep inventory of the clues you've collected along the way to help Ace solve the case. Danger, babes, and butt yodeling can be yours for $39.99.

I've got two new discs from MicroProse, one's a sequel and the other's an expansion pack. *Master of Orion II: Battle at Antares* is the Sequel game to Master of Orion, and it continues the theme of space exploration, colonization, and combat. Not for the casual game player, Orion II can be a very involving game, and the instruction manual is practically a soft cover book in itself. If you're a fan of Sid Meier's Civilization II, you'll want to pick up *Sid Meier's Civilization II Scenarios*, an expansion disc with 20 new challenges including the Civil War, Alien Invasion, the Crusades, and more. ■

NET WATCH

Shopping for a Car Web Style

DAN KARAGIANNIS

Never trust a used-car salesman. That's a bit of advice you might have heard from a friend or seen in old movies. However, what if a sales person trying to get you to buy a new or used set of wheels wasn't able to use his or her pushiness? What if you were free of all the pressure that dealing with a live individual brings? While sales people are only doing their job, you should still be able to shop at your own pace.

AutoWeb is also a site that was named appropriately. You'll find it *all* here.

Of course, a lot of information can seem a bit intimidating at first glance. Don't get scared by all the data and options that you'll be assaulted by when you first log on to this site. There are miniature versions of some of AutoWeb's features found here. For example, you can enter a make of a particular used car you're looking for, and then be whisked away to that section of the site (more on this later). If you're not into chaos, look instead at the listing of areas of interest found to the left of the site.

AutoWeb gives you a real edge when it comes to shopping for new or used cars. The site even makes it easy to sell a car you have.

Now, thanks to the Web, you can shop for a car or truck from the silence of your home, without a smiling guy asking you every five seconds how much of a deposit you'd like to leave. Of course, you'll still have to commit to see in person both a car and the person selling it, but only after you're confident you've chosen the right vehicle to meet your needs.

Autoweb

When I first learned about the World Wide Web, I thought it was aptly named. Webs convey a sense of broad coverage, and for that reason,

Choose from Dealers, 1997 Vehicles, Used Vehicles, Free Ads, Autos Wanted, AutoTalk, Specials, Loan Calculator, and others. Let's look at each.

Dealers lets you find a good car dealer in your area who is affiliated with AutoWeb. What are the benefits to choosing such a person or dealership? Well, for starters, not only can you be armed with important make and model information before you enter the showroom, but you just might be able to get a price quote as well. That way, you don't have to put up with an hour of hard sell to find out a car's too expensive for you at this time.

Want a new car? 1997 Vehicles will provide you with an interactive way of finding what's out there right now. First choose what kind of car or truck you're interested in, then submit a form with your location. AutoWeb will find a dealer close to you that can help you get just the right vehicle.

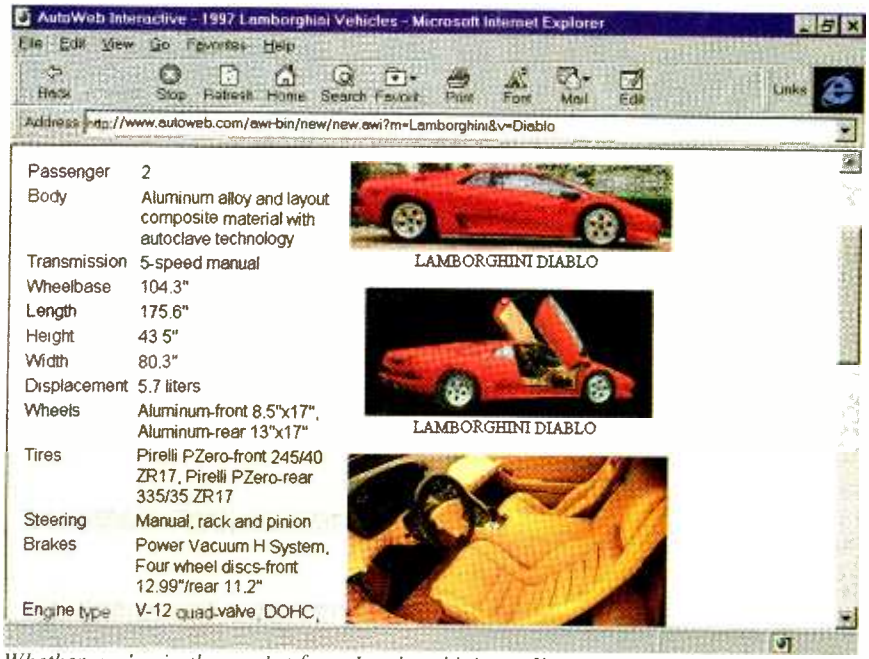
Used Vehicles provides you with several helpful ways to buy and even sell a pre-owned set of wheels. There are so many features under this link, we'll have to spend a moment on each.

The Used Vehicles Listing presents you with, as the name implies, listings of all types of advertised used vehicles by region and make. Have something particular in mind? Use AutoFinder to search through all those used vehicles to find the ones that match your particular criteria. For example, you can ask for a listing of all Cadillac Eldorados costing between $5,000 and $12,000 from New York that are later models than 1986.

If you can't find what you're looking for, AutoAgent might be able to help. It's a free service that sends you e-mail when a vehicle matching your needs becomes available in the site's database. Maybe you'd like instead to go down to a showroom. Used Car Dealers will "bring you" to the pre-owned areas of many of AutoWeb's dealers.

But perhaps the most useful feature of the Used Vehicles section is the Blue Book Values link. This is the online version of the Official Kelley Blue Book used to obtain vehicle price information. Simply enter the model, make, and year of the car, then answer some questions about how many miles the vehicle has, what features it contains, and so on. In the blink of an eye you can receive one of two values: either the trade-in value of your car, or what it's worth if sold privately.

Free Ads lets you actively become a

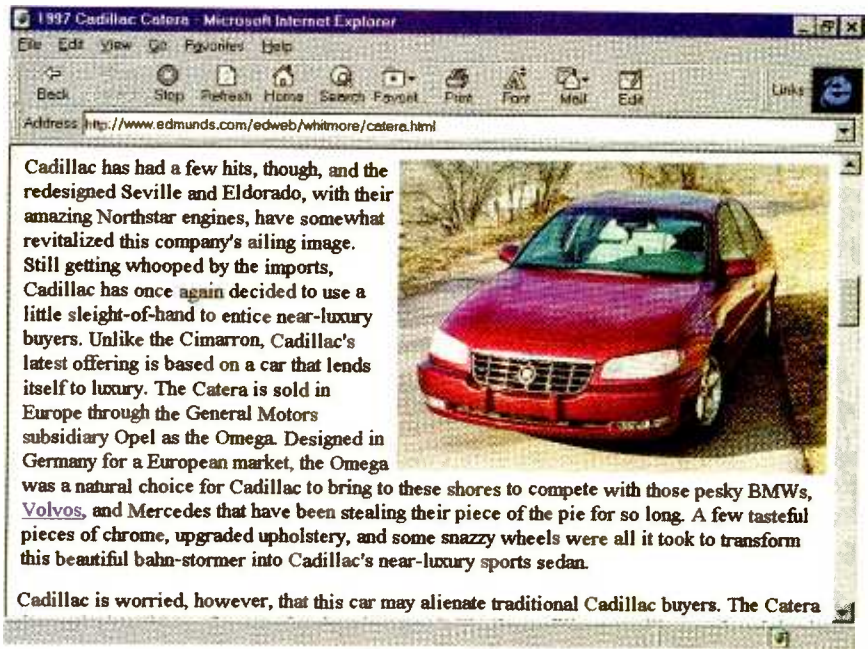


Whether you're in the market for a Lamborghini or a Yugo, AutoWeb can help you find the car that's right for you.

part of the trading that's always going on at AutoWeb. If you have a car or truck to sell, Place a For Sale By Owner ad. Looking for a particular automobile, and want car owners to come to you? Just place an Autos Wanted ad. AutoWeb makes these ads available for free for private owners.

Autos Wanted lets you read the ads we just described, while AutoTalk lets you find out what's available in a BBS fashion. You can also share tips with others, or pick up a few pointers from someone else's experience. Specials lets you in on hot deals that you won't want to miss.

Another great interactive feature of this site is the Loan Calculator. Most people have a difficult time translating a new car's sticker price into monthly payments. With the Calculator, you just enter in three of the following factors to solve for the remaining one: the amount of your loan in dollars, the interest rate as a percentage, the number of payments, and the amount of your payment in dollars.



Without getting into dealership information, Edmund's Buying Guides online still provide lots of useful information like actual test-drive reports of cars such as this Cadillac Catera.

Edmund's Buying Guides

Interactive sites are not the only types of places worth your time on the Web. We should never take for granted the power of information. That's the benefit of visiting Edmund's Automobile Buyer's Guides. An informed shopper is truly the best shopper, especially when that consumer is planning on spending thousands of dollars.

The Edmund's site lets you choose from a few headings. First there's the New Car listing. Here you'll find the HTMLized version of Edmund's Complete, Updated, New Cars Book. Check out over 565 models, including MSRP and dealer invoice prices, standard and optional equipment, specifications, reviews, and more. You can also click on Edmund's Road Tests of New Cars! to find out how vehicles performed, and even get advice on affordable car insurance.

HOT SITES

AutoWeb
http://www.autoweb.com

Edmund's Buying Guides
http://www.edmunds.com

New Truck Information is also available. Edmund's Complete, Updated New Trucks Book features over 500 pickups, vans, and sport utilities. Similar information to the New Car listings is given here as well.

Previously owned vehicles are a growing market, and Edmund's is keeping up with it in Used Car Information. Just like with the other headings, there's an Edmund's Complete, Updated Used Cars Book. Read about prices, ratings, reviews, recalls, and more, dealing with cars from 1987-1996.

But information on buying isn't the only thing you'll find here. Edmund's Safety Information fills you in on what cars will protect you the most, and contains facts about things like daytime running lights and traction control.

That about wraps it up for this month. I hope your vehicle hunting goes well. Join us again next time for another look at all the Net and Web have to offer. ■

A Hands-on Electronics REPORT

CASIO CASSIOPEIA POCKET PC with Windows CE

Takes two to tango! Now the pocket PC can dance all night with Microsoft as a partner!

Pocket computers haven't caught on like desktop systems, or even notebook systems have. It's just that they're usually so small and have such limited resources that most people find themselves able to resist purchasing one. Sometimes it's very confusing to figure out how to get all the functions to work on these gadgets. But a recent software development in the pocket-PC arena might lead to more people latching onto them and yet another windfall for Microsoft.

Windows CE is Microsoft's new operating system for hand-held computers. It brings with it all of the familiarity of Windows 95, and some of its functionality, to the world of palmtop computing. If you're familiar with Windows 95, then you'll immediately be able to use one of these hand-held PCs, or HPCs. Windows CE provides most of the tools you need on the road, and it runs in a computer that can fit in your shirt pocket. Of course the computers have to be designed to run Windows CE. We look at a Casio unit.

Casio Cassiopeia. Casio's new *Cassiopeia has a* suggested retail price of $499 for the Model A10 and $599 for the Model A11, depending on the configuration you choose. We tested one with 2 MB of RAM and 4 MB of ROM (Model A10). It's also available with 4 MB of RAM (Model A11). It has no hard drive. It contains one Type II PCMCIA slot, an infrared port, integrated sound and a tiny speaker, a serial-port, and a data communication jack for equipment such as digital cameras. The unit is powered by two AA batteries, and a lithium ion battery provides backup power when changing the batteries. An AC power adapter is optional. (Casio, 570 Mt. Pleasant Ave., PO Box 7000, Dover, NJ 07801, 800-962-2746, 201-361-5400.)

Cassiopeia is small, measuring 1-inch high by $6\frac{7}{8}$-inches wide by $3\frac{5}{8}$-inches deep when folded shut, and weighs 13.4 ounces including the batteries. The two AA cells can provide up to 20 hours of use, but you generally get less than that if you use it continuously, and much, much less when you run a PCMCIA card. A lithium battery provides backup power when you change the AA batteries. The unit's single PCMCIA slot can be used to add memory cards or peripherals. If you already own a PCMCIA modem, it will work with the Cassiopeia.

A serial port on the Cassiopeia and the included cable connect it to a desktop or notebook host system. This lets you exchange data and synchronize files with your desktop system. Cassiopeia also has an IrDA standard infrared port that eliminates the hassle of wires, but to use it your desktop system must also have an IR transceiver.

The keyboard has a standard, although miniature arrangement. While you can't touch type on the tiny keyboard, it's easy enough to find the keys. Keyboard use is minimized by having a touch-screen and pointing stylus. It lets you tap your way through the screen much as you would with a mouse. The 4-grayscale monochrome screen has a resolution of 480 x 240 dots, and measures about $5\frac{1}{4}$ inches diagonally. A contrast dial is very effective, although the screen isn't very readable when the contrast is set low.

Cassiopeia comes with two CDs (Windows CE and a bonus application disc), a serial cable, and two manuals; a hardware manual basically explains how to work the controls and a Windows CE manual explains everything else. When you first turn on the system, you have to calibrate the touch screen by pointing at an "X" that moves around the screen. The pointing pen slides out of a holder built into the front of the unit. Next, a welcome wizard helps you set up the system with the proper date, time, time zone, user information, and so on. The LCD screen is hard to see in dim light, but at least it has a backlight for when it's too dark to see. Unfortunately the backlight really drains the batteries, so it shuts off automatically after several seconds.

You load Windows CE and all of its

(Continued on page 83)

COMPUTER BITS

Indispensable PC Utilities

JEFF HOLTZMAN

Utility programs fill in gaps left by operating system vendors. Here are several indispensable yet reasonably priced programs; many cost less than $50. I use all of these programs, usually on NT 4.0, but also on Win95 and occasionally on DOS or other operating systems.

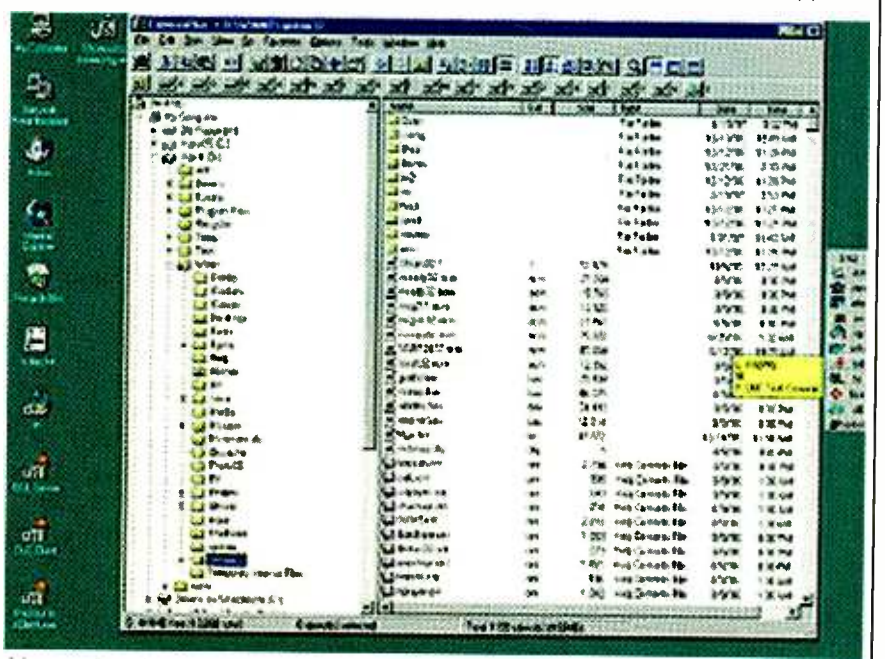
PowerDesk Utilities

The PowerDesk Utility set includes a combination launch and toolbar, a file finder, a disk-space display and management utility, and the star of the show, Explorer Plus, which is unequivocally my most used utility. Explorer Plus starts where the Windows Explorer leaves off. Highlights include better file sorting options, multiple windows, built-in zip file handling, extensive customization options, built-in launchbar, access to a one-line DOS prompt, viewing pane for seeing file internals, and for even better file viewing, tight integration with QuickView Plus.

The zip file handler is dynamite. Zip files work just like directories, so you can click on a zip file to view its contents and drag-and-drop files into and out of zip files directly. The handler even operates with nested zip files, although in a slightly awkward fashion.

QuickView Plus

QuickView Plus is a file-viewing utility that functions with either (or both) the Windows Explorer, and Mijenix Explorer Plus. The program supports over 200 file formats, including most common word processing (including HTML), spreadsheet and graphics formats. The current 4.0 version lacks support for Office 97 file formats, but the company is working on it. My only complaint is that the program supports Access database files only through version 2.0, which is now two revisions out of date.



My two favorite Win95/NT utilities: The large window is Explorer Plus, from Mijenix Corporation. It has built-in zip-file handling, a wealth of sorting options, and extensive customizability. Stiletto is the small rectangle on the right. It allows me to create my own program launchbar in the size and position I want, lets me use all the mouse buttons to select different options, and even displays launch programs as tooltips.

Stiletto

Stiletto is an ultra-customizable launch-bar utility. You can easily create buttons to launch your favorite programs, group programs into menus, configure the size and position of the toolbar, and configure the size, icon, and caption of the buttons. Each button can have an associated program or menu that can be launched by the left, right, or middle mouse button. With a two-button mouse, you can simulate the third button by clicking the other two simultaneously. It also works with Microsoft's new IntelliMouse.

Stiletto has an innovative approach to positioning its toolbar. You can embed it in one of almost three dozen screen positions, or in one of several positions in the title bar of the current application. The three applications (or menus) associated with each button may be listed in a pop-up window (like a tooltip). You can also define button labels to display system information such as time, date, free memory, and free disk space. Stiletto also provides an integrated set of functions for generating alarms, and changing desktop wallpaper and sound themes.

If you like to have a fine degree of control over how you launch programs, you will love Stiletto. You will also love its $22 price, and you can download an evaluation copy from CompuServe or the author's home page.

Partition Magic

In case you have not run across the concept yet, the FAT file system, which has been in use since DOS 2.0, becomes less and less efficient as hard disk size increases. You can easily end up wasting virtually hundreds of megabytes on a 1-GB or larger drive. One way around the problem is to break the drive down into two or more partitions. The key is to reduce the value of the cluster size, where a cluster is a group of sectors.

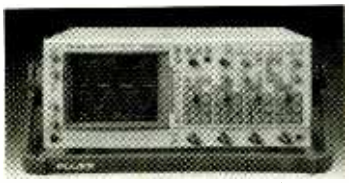
Until Partition Magic came along, the problem was that there was no way to change partition size, hence cluster size, without reformatting a drive from scratch. This would involve backing up everything, partitioning, formatting, and

(Continued on page 83)

New Products

Combiscope Oscilloscopes

The five new models of Fluke's CombiScope Oscilloscope, offer a combination of an analog oscilloscope and a digital storage scope (DSO). All of them add functionality and improved performance with a number of features that were previously available only as options.



The CombiScope B Series have higher sampling rates on some models and deeper memory per channel, along with built-in software for mathematical processing of waveforms. The latest models include the PM 3384B and PM 3394B, *which* are 4-channel models with 100- or 200-MHz bandwidth; and the PM 3370B, *PM 3380B*, and PM 3390B, 2-channel models with bandwidths of 60, 100, or 200 MHz.

For repetitive signals, the PM 3390B and PM 3394B have a random repetitive sampling mode that results in an equivalent sampling rate of 25 GS/s (10 GS/s on the 60- and 100-MHz models). That mode allows users to view repetitive signals at a much higher resolution than is possible with more traditional sampling methods. A single-shoot sampling rate of 200 MS/s is standard on all models.

The four-channel models have 32K deep memory as a standard feature, allowing users to scroll time windows several screens wide for convenient viewing of all single shot events. The memory can also be used to study a single screen time window acquired with greater time axis resolution, and zoom in to study a particular area of a waveform.

All five CombiScope B Series DSOs offer a multiple signal shot mode, which lets users capture a series of single-shot waveforms and automatically store them for later analysis or comparison. The feature makes it possible to find all the malfunctions that occurred during long-term monitoring without constantly having to watch the screen.

All models also feature add, subtract, and multiply mathematical processing. The Fluke Math+ package adds advanced mathematical processing of waveforms such as Fast Fourier Transformation (FFT), integration, differentiation, and histogram. The built-in digital signal processor can run two mathematical operations at any one time on any waveform. Other Math+ features include automatic pass/fail testing and amplitude qualified cursors, and a program for customer-specified test setups.

The CombiScope B Series is priced at $2995 for the PM 3370B, $3575 for the PM 3380B, $5850 for the PM 3384B, $4790 for the PM 3390B, and $6925 for the PM 3394B. For more information, contact Fluke Corporation, P. O. Box 9090, Everett, WA 98206; Tel: 1-800-44-FLUKE; Fax: 1-800-FLUKE-FAX; e-mail: fluke-info@tc.fluke.com; Web : *http://www.fluke.com.*

CIRCLE 80 ON FREE INFORMATION CARD

Camera/Digital Video Modulator

According to *NetMedia*, its CAModulator is the world's first and only black-and-white camera combined with a digital video channel modulator. The modulator allows you to view the camera signal on any TV and combine that signal with existing cable service or other video in the home or business. The combination of small size, easy use, discrete installation, and coax power makes the CAModulator ideal for security, surveillance, and monitoring applications, indoors or out. Travelers can take advantage of the 12-volt operation to use the device for a back-up camera in their RVs. A homeowner can watch the front door on channel 60 and the back door on channel 62, while monitoring the baby's room on 64. An office can watch the warehouse and the front door.

The CAModulator uses coax-powered™ technology. It requires only one wire to the camera for both power and video signal. It can use UHF channels 14–44 and cable channels 45–94. Well-suited for stealth surveillance, the CAModulator weighs only 3.5 ounces and fits in a single-gang junction box or mud ring (preferred). It comes with a 12 volt DC transformer; the power injector that lets you power the unit through the coax cable; and a choice of clear, IR, or smoke-gray lens cover. No one knows there is a camera behind the wall plate.

The device does not need to see straight ahead. It adjusts up and down and right and left to match most installations. Thanks to its ability to see with infrared illumination, the CAModulator can be used for all forms of nighttime surveillance. Other features include adjustable focus from one foot to infinity, electronic automatic iris, and built-in wide-angle lens.

The CAModulator has a suggested retail price of $399. For more information, contact NetMedia, Inc., P. O. Box 68416, 10940 North Stallard, Tucson, AZ 85737-8416; Tel: 1-888-RUN-TABS.

CIRCLE 81 ON FREE INFORMATION CARD

Two-Terminal Digital Voltmeter

Datel's DMS-20PC-3-DCM digital voltmeter (DVM) is designed for applications such as large client servers or MPP (massively paralleled processing) computers, in which multiple, low-voltage, high-current processors operate from a single power bus, and where it is imperative to closely monitor and carefully regulate the bus voltage. The DVM is totally self-contained and has only two input terminals. The DVM is "self-powered" in that it is powered by the voltage it is measuring and requires no external components. Absolutely no technical skills or special tools are required for installation.

The DMS-20PC-3-DCM measures just 1.38 × 0.88 inches with a "behind-the-panel" depth of exactly one inch. It features a large bright-red LED display

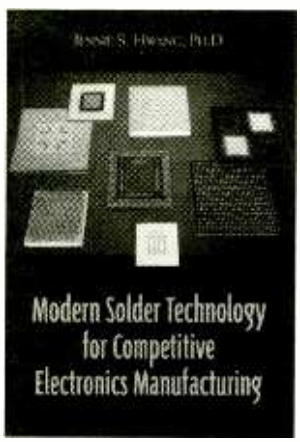
(Continued on page 74)

Electronics Library

Modern Solder Technology For Competitve Electronics Manufacturing

by Jennie S. Hwang, Ph.D.

Today's and tomorrow's electronics products must deliver faster speeds, lighter weights, and smaller sizes at lower cost and with increased durability—a continuing challenge for manufacturers. This comprehensive book helps you meet that challenge and exceed the demands of the global marketplace.



Aimed at anyone who is involved in research, production, quality control, or decision-making management, the book provides complete coverage of all relevant technologies that are associated with the application of solder for electronic and microelectronic packaging and assembly. It explores the underlying fundamentals and focuses on real-world applications. The book is an integrated source of knowledge and information for implementing a manufacturing system that will produce ever-improved electrical, thermal, and mechanical performance of electronic circuits.

The book examines market-driving forces and benchmark technologies, as well as future prospects and emerging technologies, including flip chip and chip-scale packaging and assembly. It covers surface-mount soldering chemistry, wetting and solderability, no-clean and water-clean manufacturing, fine-pitch technology, solder joint failure modes and reliability, materials characteristics and process troubleshooting, state-of-the-art IC packages, IC lead coating and PCB surface finish, atmosphere soldering, lead-free solders, and new specifications and standards. A wealth of data and tables are provided for quick reference.

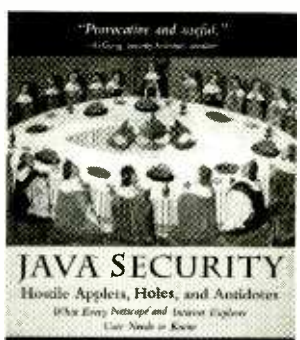
Modern Solder Technology for Competitive Electronics Engineering costs $69 and is published by McGraw-Hill, Inc., 11 West 19th Street, New York, NY 10011; Tel: 212-337-5951; Fax: 212-337-4092.

CIRCLE 91 ON FREE INFORMATION CARD

Java Security: Hostile Applets, Holes, and Antidotes

by Gary McGraw & Edward Felten

In March, 1996, the Safe Internet Programming Team at Princeton University discovered a serious security flaw in the Java programming language. More recently, additional flaws in Java-enabled Web browsers have been discovered and patched, only for new flaws to appear.



This book informs readers of the risks and provides an intelligent security policy for safe Java use. Written for Webmasters, information technology managers, and concerned Web users, the book explains the three prongs of the current Java security model—the byte code verifier, the applet class loader, and the security manager. It points out the deficiencies in the Java security situation, and provides guidelines for safer Java use. The book not only identifies and differentiates between dangerous attack applets and annoying malicious applets, it also suggests improvements in future Java design for a secure, mission-critical language.

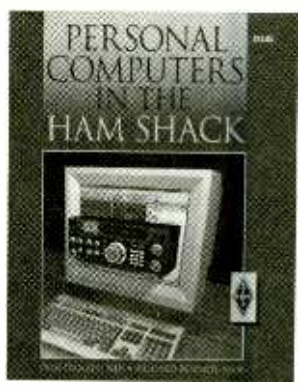
Java Security: Hostile Applets, Holes, and Antidotes costs $19.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel: 1-800-225-5945; Web: http://www/wiley.com.

CIRCLE 92 ON FREE INFORMATION CARD

Personal Computers In The Ham Shack

by Paul Danser, N1II & Richard Roznoy, K1OF

A recent survey conducted by the American Radio Relay League (ARRL) about hams and computers revealed not only that the majority of hams have and use PCs in their shacks, but that most of them were equipped with state-of-the-art systems with fast processors and CD-ROM drives.



Regardless of how long you've been a ham, and how much or how little computer experience you have, this book will come in handy. Organized to cover the most common uses of PCs in the ham shack, the book opens with a few basic definitions followed by discussions of PC hardware and software. It explains how to choose an operating system and the computer accessories that are right for you. The next chapter looks at the PC as a communications terminal that can get you on packet, RTTY, AMTOR, SSTV, and many other digital modes with just software and a simple interface.

(Continued on page 73)

GIZMO®

Photography's Future?

Gizmo zooms in on digital cameras

It's 4 A.M., and you've just left your wife and brand new baby sleeping soundly at the hospital. You phoned family and friends hours ago with the good news and basic statistics. Now the house is empty, and you're just too wired for sleep. Too bad there are no one-hour photo places open so that you could see the first pictures of your newborn.

If you had snapped those photos with a digital camera, you wouldn't be at the mercy of any photo developer—your PC could serve as a desktop darkroom. You could download those pictures to your computer and be able to view them almost immediately.

A digital camera is like an electronic Polaroid, but with some high-tech advantages. For instance, you could e-mail those electronic images to both sets of new grandparents, all the aunts and uncles, and family friends. Wherever they might live, they'd be able to see the baby as soon as they turned on their computers. If you have a Web page, you could post a photo for everyone on the Internet to see. And—perhaps after getting some much-needed sleep—you could create your own custom birth announcements incorporating one of those photos.

Beginning to wonder why you're hanging onto your old 35mm job? Don't shelve it yet. Digital cameras are beginning to make inroads, but they're not going to replace standard 35mm cameras any time soon. That's because there are a few major drawbacks to the format.

First, "within reach" doesn't mean cheap. Digital cameras are now available for less than $500. Similarly equipped point-and-shoot 35mm cameras can be bought for well under $50, often under $25—even under $10 for a disposable one.

Second, the potential market is limited to computer users. Some digital cameras are equipped with (or offer as options) LCD screens for immediate viewing. But to take advantage of all they have to offer, you must have a PC. That immediately eliminates as potential digital-camera buyers the 60%–70% of U.S. households that somehow manage to muddle along without a computer. (That percentage does drop to around 50% if you take into account only those households with children, which are the ones most likely to be taking pictures anyway.)

Third, very few consumer-priced digital cameras offer more than basic point-and-shoot features. Serious photographers would sorely miss the lack of control over focus and exposure, not to mention the paucity (or complete unavailability) of lens options.

Fourth, and perhaps most important, the picture quality of digital images is not quite up to par with standard photos. All of them produce images that are adequate for viewing on a computer screen, but prints are another thing altogether. You can actually get better pictures from a $10 disposable camera than from a $500 digital camera.

The difference in picture quality is directly linked to the differences in technology between 35mm and digital cameras. Traditional cameras capture images on light-sensitive silver-halide film, which can reproduce an almost infinite number of colors and tones. Instead of film, digital cameras use light-sensitive chips called charged-coupled devices or CCDs, to collect images. CCDs are semiconductor devices that convert light into picture elements (pixels). To create color information, the light must be passed through red, green, and blue color filters. The accumulated electronic information is sampled and converted into digital data, which is then compressed and saved

Fujifilm's DS-220 digital camera stores images on a PC card that conforms to the ATA storage standard.

in the camera's electronic memory.

The process works admirably, but there are some limitations in color reproduction. In addition, silver-halide crystals are much more closely spaced than the pixels of even the highest resolution digital cameras. That results in a loss of detail that becomes particularly apparent in enlargements. You can blow up a 3×5 image taken with a 35mm camera to 11×14-inch size, without any detectable image degradation. On a digital photograph with a resolution of 640×480, the image becomes pixelated (it is possible to see the individual pixels) on any size larger than 2.4×3.2 inches.

Why would anyone spend so much money on a camera that produced inferior pictures? How could market-research firm Dataquest possibly estimate that close to 2,000,000 consumer digital cameras will be sold this year?

The answer lies not in the camera, per se, but in its role as a gateway to the future. Those of us who regularly use the Internet and online services find them liberating. They free us from having to stand on line at the bank, travel to a library to conduct research, wait for snail-mail responses to consumer inquiries, or depend on some local kid to deliver our newspaper on time. They allow us to communicate quickly and efficiently with far-flung family members and friends, and to leave messages for business contacts without having to negotiate through voice mail systems.

Similarly, a digital camera—along with the necessary software and your computer—can free you from having to buy film, change rolls in the middle of an event, pay a photo lab to develop your pictures, trust them to do it without over- or under-exposing them, pay for photos that make you look awful, pay for copies of good pictures, or rely on snail-mail to get copies to your friends and relatives.

The software designed to manipulate digital photos offers a different type of freedom: It unleashes your creativity. You can crop photos, correct "red eye," remove blemishes, and correct color balance and contrast.

Digital cameras have been around for more than a decade. Professional models, ranging in price from $10,000 to more than $40,000, allow photojournalists to get late-breaking stories, complete with pictures, back to the main office as quickly as possible. And digital cameras can actually reduce costs by speeding up the production schedules in the fast-paced fields of magazine publishing, print advertisements, and catalogs.

Lower priced models have been popular choices for realtors who include photographs on computer listing sheets and insurance adjusters who require picture documentation for claims. The speed and ease of posting such business photos more than made up for the initial price of the camera and the less-than-ideal image quality. The camera pays for itself over time when frequent camera users no longer rack up costly film purchases and developing fees.

In the past couple of years, dropping prices and improved resolution have made digital cameras more appealing to consumers. But what is really driving the market for digital cameras is the skyrocketing consumer involvement in the Internet.

YOU'D BETTER SHOP AROUND

Once you've decided to take the digital-camera plunge, you'll soon discover that you have plenty of other decisions to make. Today's crop of digital cameras includes dozens of models from a wide variety of manufacturers—from traditional camera companies like Kodak, Fuji, Polaroid, Ricoh, and Canon; computer companies such as Apple; and consumer-electronic giants including Sony and Panasonic. Many look just like pocket-sized point-and-shoot film cameras; some sport high-tech, futuristic packaging. Some offer auto focus, and others have fixed-focus lenses. Some have built-in LCD screens for immediate viewing of photos.

Prices currently range from $300 up to almost $3000, resolutions from 480×240 up to 1600×1200 on Polaroid's $2995 PDC-2000/T. (A resolution of 640×480 is considered standard on entry-level digital cameras.) Making matters difficult for comparison shoppers (but better for consumers in general), prices are coming down and resolutions are getting better all the time.

Less obvious differences abound in the capacity and type of memory storage used in different models. No standard has been agreed upon, and three incompatible technologies—Compact Flash (CF), Miniature Card, and Solid State Floppy Disk Card (SSFDC)—are now competing. All three use tiny memory cards that can be plugged into special PCMCIA adapters.

The Compact Flash, manufactured by San Disk and backed by Kodak, currently seems to have the edge. Not much larger than a postage stamp, the Compact Flash card is compatible (with an adapter) with Type I/II PC ATA devices.

You'll want to buy a camera with sufficient storage capacity to keep up with your picture-shooting style. Keep in mind that digital photography encourages you to take lots and lots of photos—it doesn't cost anything to develop them, and if you don't like one (or a dozen), you can easily erase it and try for a better shot.

Picture capacity varies widely from camera to camera—and the numbers don't tell the whole story. Some offer two or even three resolution levels; the higher the resolution, the fewer pictures you can store.

Low-end cameras have only a limited amount of built-in memory; use it up, and you'll have to erase some pictures or download them to a computer before you can take any more. To squeeze in as many photos as possible, they compress the data from each image file. You can take a lot of photos before running out of memory, but the compression degrades the image quality. (Casio's $650 QV 100, for instance, stores 64 compressed high-resolution pictures or a whopping 192 low-resolution photos.) Other digital cameras have enough built-in RAM to store a small number of high-resolution pictures,

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but also use removable memory cards. (Kodak's DC50, priced at $1000, stores 7 high-resolution, 11 medium-resolution, or 22 low-resolution photos in 1MB of internal RAM; it also accepts CF cards.) You can remove a storage card that's full and insert a new one without having to pause and download the images to a PC.

Downloading is another factor to consider. It should be—but isn't always—a quick and easy process. Downloading an image can take as little as two seconds, or as long as a minute. The time factor depends on the type and amount of compression used (the more an image is compressed, the less time it takes to transfer it), as well as the software driver supplied with the camera.

Once the images are stored in your computer, the fun begins. Popular digital image-processing programs like Adobe PhotoDeluxe are included with many digital cameras. Such programs allow you to touch up your pictures, alter them artistically, use them in cards and calendars, and post them on the Internet.

Read on for close-up looks at the Olympus D-200L digital camera and PhotoDeluxe software, as well as a different type of digital photography with the Snappy Video SnapShot.

Image-ine That!

MODEL D-200L DIGITAL CAMERA. From Olympus America Inc., Two Corporate Center Drive, Melville, NY 11747-3157; Tel: 1-800-622-6372; Web: http://www.olympus.com/digital. Price: $599.

One of the main reasons that digital cameras are not likely to replace their film-based counterparts any time soon is that they hold very little appeal for anyone who does not know how to use a computer. After all, you can't take advantage of all the neat things that a digital camera does without linking it to a laptop or PC. And people who don't even *want* to know how to use a computer or surf the Net are even less likely to want to switch from their trusty old 35mm cameras.

Olympus is trying hard not to scare off the large segment of our population that feels overwhelmed by computer technology. It's *D-200L* digital camera is designed to look and feel like a regular camera. It is also supposed to be so easy and familiar to use that consumers intuitively know just how it works. "It's a digital camera, not a computer in a camera bag," the press material proudly states.

The D-200L does look quite a bit like a regular camera. Attractively styled in black and gray, the pocket-sized (5.7 × 2.8 × 1.8 inches) camera weighs 10.4 ounces without its one lithium and four "AA" (alkaline, NiCd, nickel-hydride, or lithium) batteries installed. Its "lens cap" is actually a door that slides shut to protect the lens—you never have to worry about losing it. The flash and an indicator that lets you know when the self-timer is engaged are also on the front of the camera.

The top panel also looks like that of a standard camera, with its large, round SHUTTER RELEASE button; a small LCD screen that displays number of photos, battery status, and the like; and buttons for setting the flash mode and the timer.

Looks can be deceiving. The SHUTTER RELEASE button doubles as an ERASE OK control, the SELF-TIMER is also a SLIDE-SHOW button. The control panel displays not the number of pictures taken, but the number remaining. It also uses some icons you won't find on 35mm cameras—resolution setting, write, and erase—along with the more common macro (close-up) mode, self-timer, and flash mode icons. Two additional top panel buttons are used to select macro mode/protect mode, and to select the resolution/display type.

Other differences are apparent at the back of the camera. There you'll find a traditional optical viewfinder—but there's also a 1.8-inch color LCD monitor, a button for turning it on and off, and two buttons for viewing previous/next images on the LCD. On the side of the camera, a covered compartment holds a jack for a DC power adapter—and one for an RS232C computer interface.

Although the differences are not readily apparent to the eye, they are sufficient to cast a technophobe into a state of confusion. We loaned the D-200L to a friend who was on the way to watch her son march in his first parade—she had forgotten her pocket camera and didn't have time to go home for it. Nor was there time to explain the workings of the D-200L; we didn't really think it was necessary, anyway. But when she returned the camera, she reported that she didn't get a single picture—she couldn't figure out how to turn it on. She thought her problem was solved when she noticed a computer-savvy neighbor accompanying his son's scout troop in the parade—he couldn't get it going either.

In reality, all you do is slide open the lens cover, and the D-200L is ready to go. You can tell it's on when indicators appear on the control panel. Our friend's problem arose when she opened the lens cover several minutes before she was ready to shoot; the D-200L automatically turns itself off after three minutes of inactivity to conserve battery life. Our friend—and her neighbor—didn't realize that she had to close and reopen the cover, or press the SHUTTER RELEASE button halfway, to turn it on again.

Another potential source of confusion is that when "01" appears in the control panel, you're not about to take your first photo, you're on your last one. The D-200L stores 20 high-resolution, or 80 standard, pictures in its 6MB of internal RAM. No provision is provided for external image storage cards; when the internal

memory is full, you must either erase some of the stored images or download them to a PC.

When the high-resolution mode is selected, an "HQ" icon appears in the control panel; there is no icon in standard mode. The pictures-remaining count changes when you change modes. For instance, you might have four pictures left in standard mode, but just one if you switch to HQ. In high-quality mode, the picture resolution is 640×480 pixels; in standard mode, it is 320×240.

Had our friend managed to turn the camera on properly, and figure out how many shots she had left, she might still have had trouble with the SHUTTER RELEASE button. Taking a picture is a two-step process. The button must be depressed halfway first, and then fully to release the shutter and snap the shot.

The D-200L captures images at shutter speeds of up to 1/10,000 second. The camera beeps twice to let you know the shot was taken, and a writing indicator appears in the control panel to show that the image is being transferred to memory. After about six seconds in HQ mode, or two seconds in standard, the indicator disappears, and the camera is ready for the next picture.

You can use either the optical viewfinder or the LCD monitor to frame your photos. The manual suggests using the standard viewfinder because it's easier to hold the camera steady when it is pressed up close to your face. Besides, using the LCD runs down the batteries faster.

The LCD is really intended to view the photos that you've just taken. With the lens cover closed, a press of the green ON/OFF turns on the monitor. The last picture taken appears on the monitor, scrolling down from the top line-by-line until it fills the screen. The frame number and battery power indicators are also displayed. If you selected high-quality or protection mode or set the date when you took (view) the pictures, those indicators will also be shown. Pressing the PREVIOUS button moves you backward through the pictures; the NEXT button moves you forward.

If you want to be sure to keep one of the images, you can press the PROTECT button while that image is displayed in the monitor. A second press of the button cancels protection. If you don't want to keep a picture, and that picture isn't being protected, pressing first the ERASE button and then the ERASE OK (shutter release) button will permanently delete that picture.

Suppose your child got his hands on the D-200L and used up its entire picture memory taking pictures of the floor, the ceiling, and his shoes. You can easily erase all of the pictures in one fell swoop by simultaneously pressing the ERASE and the FLASH buttons, and then pressing the ERASE OK button to verify. Any protected pictures will remain in the camera's memory.

The monitor also performs a couple of neat tricks. In slide-show mode, it automatically runs through all of the pictures, in the order in which they were taken. In multi-display mode, nine frames appear on the LCD monitor at the same time, in three rows of three. You can even combine the two modes for a multi-image slide-show.

Besides the LCD monitor, the D-200L offers a number of features not found on many entry-level digital cameras. Those include a self-timer, macro mode, and several flash modes. The self-timer gives you 12 seconds to get into the picture before the shutter is released. Macro mode is used for taking close-up shots, from a range of 0.65–2.46 feet.

The above is an actual image, real size, taken with the D-200L in 640×480 resolution.

The D-200L has four flash modes to meet various conditions. Autoflash automatically fires in low-light and backlight conditions. Fill-in flash forces the flash to fire even under bright light conditions—when the subject is sitting in front of a sunny window, for instance. Flash override turns off the flash even in low light conditions. Red-eye reducing mode helps avoid pictures in which the subject's eyes appear to glow red. The camera emits a series of low-power flashes, which make the subject's pupils contract, before the regular flash goes off.

If you forget to use red-eye reduction, don't worry. You can correct red-eye, and all sorts of other flaws, when you "develop" your photos on your computer.

The D-200L is compatible with IBM PCs and Macs; interface cables for each type of computer are included with the camera. They plug into either the COM 1 or COM 2 serial port on an IBM-compatible PC, or to the printer or modem serial port of your Mac. Windows 3.1 or 95, or MacOS 7.0 or higher are required, as is a monitor with a minimum of 256 colors and 640×480 resolution. The version of Adobe PhotoDeluxe that is included with the D-200L also requires a double-speed CD-ROM drive, as well as more than 45MB of free hard disk space, and more than 16MB of RAM.

The supplied disk contains all the software needed to download photos from the camera and manipulate them on your computer. For Windows-based systems, the D-200L's software uses the TWAIN standard interface. For Macintosh systems, the software uses an Adobe PhotoShop-compatible plug-in module. Installation is an easy question-and-answer process that takes just a few minutes. (A separate review of Adobe PhotoDeluxe follows.)

Comparing digital and 35mm point-and-shoot cameras is like comparing apples and oranges—they're really two completely separate product categories. Despite Olympus's attempts to "maintain a modicum of familiarity" in styling the D-200L, the digital camera is not likely to hold much appeal for avowed technophobes. If you aren't comfortable using a computer, you can't take full advantage of digital photography. About all it has to offer "camera-shy" users is freedom from having to load film (which actually throws many amateur photographers for a loop.)

If you have a good rapport with your Mac or PC, enjoy taking photos, and have any artistic bent at all, you'll have a blast using the D-200L and its supplied software. In no time, you'll be making digital photo albums, flyers, and greeting cards, or including photos on your Web page.

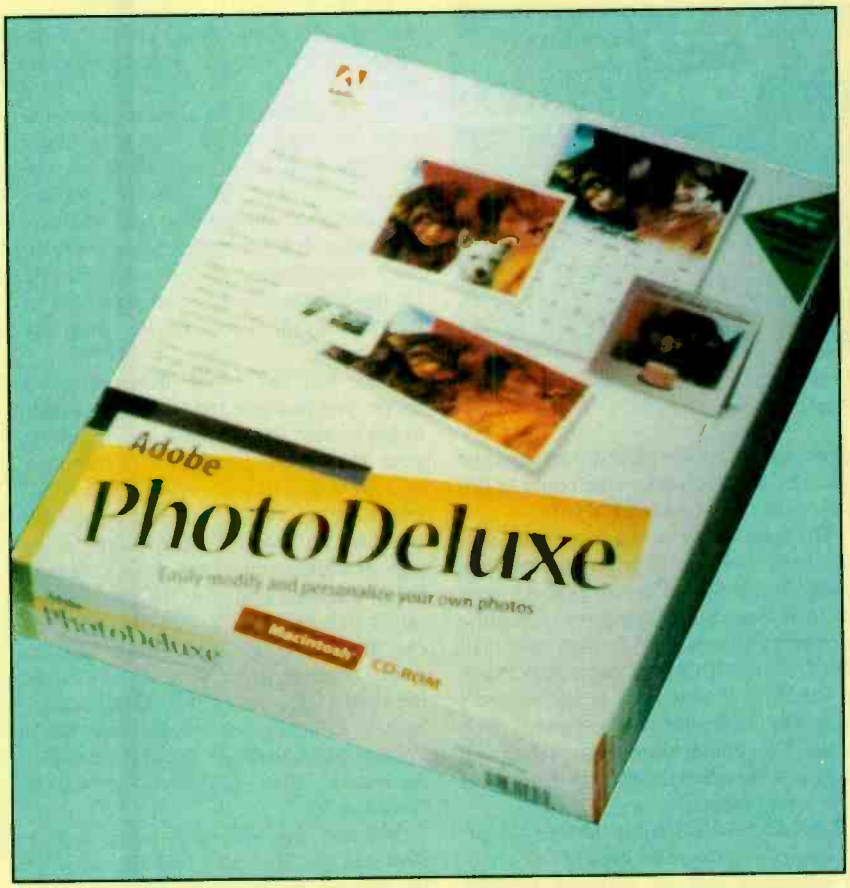
The D-200L is easy to use and offers a few features that have not yet become standard fare on consumer digital cameras. Our only major complaint is that it does not accept any type of photo-storage memory card. If you're at a wedding, or on vacation, and don't have access to a laptop or desktop PC, you can soon find yourself running out of "film." It doesn't take much time to snap the maximum 20 high-quality photos—especially when the camera is so much fun to use.

Olympus has introduced a "big brother" to the D-200L. The D-300L can store ten extra high-quality photos, for a total of 30 (or 120 in standard mode). And high-quality is not an exaggeration: In HQ mode, the resolution is 1024×768 pixels. Actually, standard-quality is not bad either—at 512×384 pixels, it's still better than what passes for high-res on some of the lowest priced digital cameras out there.

The D-300L, whose suggested retail price is $899, also offers auto focus and something called "focus lock," which allows you to focus on something, lock it, and then move the camera so that something else is in the center of the frame. ■

Desktop Darkroom

ADOBE PHOTODELUXE 1.0. From Adobe Systems, Mountain View, CA; Tel: 1-800-833-6687; Web: http://www.adobe.com. Price: $90.



Digital photography is wonderful—in concept. But, let's face it: The straight-from-the-camera images leave a lot to be desired. They simply can't compete with 35mm photos in terms of resolution and color quality. In reality, it takes digital image processing to bring those digital photos to life—to insert them into school projects or business presentations, post them on the Web, or create customized calendars or greeting cards.

In the world of professional digital image processing, Adobe Photoshop is highly touted for its sophisticated, innovative handling of high-end graphics tasks. Unfortunately, the software carries an $895 price tag and takes a lot of time and effort to learn.

Adobe Systems has wisely come up with a scaled-down version of Photoshop: *PhotoDeluxe*. With a street price of about $90 and an interface that couldn't be easier to use, the program is aimed squarely at the growing population of consumer digital-camera users. In fact, PhotoDeluxe is included with many models, including the Olympus D-200L (also reviewed in this issue).

The PhotoDeluxe program does not provide the full functionality of Photoshop; nor does it plague users with Photoshop's complexities. What it does—and does quite well—is allow anyone with basic computer skills to take a so-so digital image and convert it into a work of art. So what if the color isn't quite right—you can adjust it. Red-eye making your little darlings look like little devils? "Paint" away the red and turn the pupil black again. Is your subject a mere speck in the corner of a photo? Crop the shot and enlarge the subject. Don't stop there. Adobe PhotoDeluxe lets you change all the colors in your photos, create posterized or Impressionist versions of your pictures, "frame" them, turn them into screen-savers, and post the finished product on the Internet.

The program is exceptionally easy to use. It offers two modes: Guided Activities and On Your Own. As its name implies, Guided Activities walks beginners step-by-step through each specific task required to complete a goal. On Your Own provides users with more freedom, but still retains the simple interface.

Three general categories are presented in Guided Activities mode: Touch-Up Photo, Transform Photo, and Cards and More. Within each, numbered "folders" are used to represent every step required to complete the activity. You simply click on each number in order to open the folder, follow the instructions provided inside, and move onto the next—from "Get Photo" right through to instructions for saving and printing your finished product.

You might be tempted to jump right into the creative categories, but it's a good idea to start off with Touch-Up. There, you can select Size/Orientation to straighten out the image or crop it to better focus in on the subject; Quality to adjust the overall lighting and colors; and Remove Red-Eye to restore the subject's eye color. Once you've fixed any basic problems with the original, you can start to put your own personal stamp on the image.

The Transform category offers dozens of different options, arranged into five sub-sections: Collage, Fun, Art, Cool, and Internet. In the Collage folder, for instance, you can create Funny Money by replacing Ben Franklin on a $100 bill with your face (or your cat's face); or you can opt to disguise a subject's face by adding glasses, a moustache, or a hat. Select Change Background to put your subject in front of a famous landmark or have him float in outer space, choosing from Adobe's library of backgrounds or using one of your own. Finally, Body Switch allows you to swap between photos to put your cat's head on your dog's body, for instance. Or you can replace any subject's body with one of Adobe's selection of "famous bodies."

Options within the Fun folder include the ability to warp, bend, or twirl all or part of an image; add type that swirls and warps; add the illusion of motion; play with the perspective to create a feeling of depth; or turn your photos into black-outlined coloring-book pictures, which can then be "painted" on- or off-screen.

The Art category provides six ways to create artistically stylized versions of your photos. You can turn a photo into a line drawing, or achieve an old-fashioned look by making a color image black-and-white or sepia-toned. You can create "posterized" images that exaggerate pixels and reduce the number of colors, or create soft, impressionistic versions of your photos. You can hand-color your images to add color to black-and-white shots or to highlight elements of color shots. Finally, you can alter colors in all or part of the image.

In the Cool folder, you'll find some of Kai's Power Tools, a sampling of special effects filters from MetaTools. They include Page Curl, which makes your photo seem to be peeling up off the page; Vortex, for a kaleidoscope effect; Charcoal Edges, which transforms the

This image was modified using Adobe PhotoDeluxe.

photo into a colored-pencil drawing; and Glass Lens, which warps the photo as if it were reflected in a curved mirror.

The final folder in the Transform section helps you get your photos Internet-ready. Select Web Page to prepare your photo for use on a Web page (including converting it to a .GIF format) or e-mail (JPEG format). Or you can select Photo to PageMill if you want to use Adobe's PageMill software for creating Web pages. This option allows you to drag and drop a photo directly to a Web page of your own creation.

PhotoDeluxe's Cards and More category allows you to create monthly or annual calendars and all sorts of greeting cards. In addition, you can create magazine covers, album covers, report covers, flyers, signs, labels, and gift tags that incorporate your digital photos.

Novice image-processors will find enough variety in the Guided Activities area to keep them happily creative for a long time. Those who are looking for more artistic freedom can find it in the On Your Own mode. There you'll find the same basic interface, although you no longer have to proceed through numbered steps to accomplish various tasks.

On Your Own offers three main categories from which to select: Get Photo, Modify Photo, and Save/Print. Get Photo offers the same options as in the Guided Activities mode, plus one. You can open an existing file or one of Adobe's sample photos, use a scanned image, or download a photo from a digital camera, a Photo CD, Snappy, Fuji Film, Kodak Photo Disk, Konica Picture Show, or Floppy Shots. In addition, you can use Adobe's decorations, which aren't available in Guided Activities.

Modify Photo allows you to unleash your creativity. You can edit the photo—cut, copy, paste, duplicate, or delete it, or delete the background only. Several tools are available, including a paintbrush, color change, lines, text, an eraser, and "smudge." You can change the orientation of a photo by rotating it left or right and flipping it horizontally or vertically. And you can even modify the size of the image, trim it, distort it, or change its perspective.

Digital photographs often require quite a bit of touching up, which is easily accomplished after you click on the "quality" folder. Two automatic options are available: instant fix, and sharpen. The color balance, brightness, contrast, hue, saturation, and lightness can be changed manually. It's even possible to remove any dust or scratches from the photograph.

Once you have your photos in good shape, you can select the "effects" folder to have some fun. It's possible to outline your subject to distinguish it from the background, and then change the background to a solid or gradiated color. You can draw an oval, circle, rectangle, polygon, or square around the subject, or outline it freehand (which is a bit difficult—rather like using an Etch-a-Sketch). You can also erase any part of the image, select areas to move around, or change the entire image to black-and-white. Special Effects gives you the same Kai's Power Tools that are found in Guided Activities, plus a fifth one called "smudge."

We had a good time using Adobe PhotoDeluxe. To get a feel for some of the options, we took a photo of our son, "matted" it with an oval outline, colored the mat, wrote his name in contrasting letters down the side, and framed the entire image. We liked it so much, we used the framed image for his birthday party invitations. Next, we made a calendar using seasonal photos taken in the garden, at the beach, raking leaves, and building a snowman. We plan to create home-made Christmas cards next year—and to "mail" quite a few of them electronically! ■

It's a Snap!

SNAPPY VIDEO SNAPSHOT VIDEO DIGITIZER. From Play Inc., 2890 Kilgore Road, Rancho Cordova, CA 95670-6133; Tel: 800-306-PLAY; 916-851-0800; Web: http://www.play.com. Price: $199.95.

Digital cameras are still in their infancy—and the pictures that they take show it. But the things that you can do with them, from creating custom greeting cards to posting them on the Web, sound like a blast. Fortunately, you don't have to invest big bucks on an emerging technology to be able to have the fun of playing with digital photos on your computer. If you own a camcorder, there's an easy—and relatively cheap—way to get high-quality images into your PC: the *Snappy Video SnapShot V2.0* from *Play, Inc.* Snappy digitizes video images from your camcorder, and allows you to download them to a computer. It's easy, and you can actually get better quality images than you can with consumer digital cameras.

The Snappy is a small, simple-looking device, about the size of a deck of playing cards. (Or a Walkman. Or a cellular phone.) It measures about 5×2½×¾ inches. On one edge is a DB-25 connector that plugs into a computer's parallel port. Two RCA phono jacks are on one side of the unit. One accepts a video input, and the other passes the video on to another device. The 9-volt battery compartment is concealed by a bright-blue plastic cover that sports the Snappy logo. A 5-pin "mystery connector" is located by the video jacks. We don't know what it's for, and it's not mentioned in the manual. But we're sure that Play, Inc. has some interesting plans for it down the road a bit.

The manual accompanying the Snappy is a thin 20 pages—which is more than enough to explain how to get started. A more detailed manual is included as a PDF (portable document format) file. The Adobe Acrobat PDF reader is also included.

Using the hardware could hardly be easier. (Once you plug the Snappy into the computer's parallel port and connect a video source to it, you're done.) A pass-through video connector is provided, allowing you to watch on a video monitor the video from which you were looking to capture images. The Snappy doesn't offer pass-through printer support, however. So you might have to unplug your printer to use it, or get a switch box that would let you go back and forth between the two. Although that sounds like a bit of a hassle, we never found it to be. Acquiring images and printing them were never things we did at the same time.

(Actually, we usually used the Snappy on our notebook computer, attached to our camcorder, because most of the images we wanted to capture were found outside the confines of our office. We could have taped the images, and then played them back later at our desktop computer. But images captured directly from a video camera can have higher resolution than those taken from tape. We'll discuss resolution in more detail—no pun intended—later.)

What we did find to be a hassle was Snappy's size—it's a wee bit too fat. Although we had no problem connecting it to most computers, we did run into trouble on some computers with tightly spaced jacks on their rear panels. In one instance, we had to remove the serial cable to get Snappy to wedge in beside the video cable. Getting to the back side

of a computer is usually a bit of a job in itself because of all the cables. Trying to wedge something in just makes it more difficult. Of course, a short connecting cable could cure that problem.

Snappy is supplied with software on two CD-ROMs. The acquisition software serves as the main interface with the device. Other software includes Adobe PhotoDeluxe, Gryphon Morph, and Kai's Power Goo SE. (PhotoDeluxe is reviewed elsewhere in this issue of *Gizmo*. Morph and Kai's Power Goo will be covered in detail following our description of the basic acquisition software.)

Installing the Snappy software is as simple a process as you'd expect. If you're running Windows 95 (or NT 4.0), you just pop in the CD-ROM, and it will run automatically. Otherwise, with older versions of Windows, you just have to run SETUP.EXE from the CD-ROM. Answer the usual install questions, and you'll painlessly install the Snappy software. You can do the same for Kai's Power Goo SE and for Gryphon Morph. PhotoDeluxe is on its own CD-ROM, and can be installed equally painlessly.

When you launch the Snappy software, you're greeted by a main screen. If the hardware isn't detected, you're warned immediately. Otherwise, you're greeted with a large Snappy logo in a rectangular box with seven buttons down the left side; from top to bottom, they are SNAP, PREVIEW, ADJUST, SAVE, PRINT, SETUP, and HELP.

Their order has little to do with the order in which they're used. We'd suggest starting with the SETUP button, which brings up the setup menu. As the user's manual says in its typical flippant fashion, "No, this menu isn't about betrayal, but rather, flexibility."

From the Setup screen, you can select the type of snap (normal, continuous, or delayed); the video source (videotape or live camera); the picture quality (moving picture, still, high-quality still, or highest quality still); the picture type (color, black-and white, color negative, or black-and-white negative); and whether new pictures use the same window, create a new one, or create a storyboard. You can choose whether to show the picture while the software is processing it, or to wait until it's finished. You must also tell it whether you are using the video-through jack to connect to a video monitor. Snappy will electronically terminate the output if it's not in use.

The Preview mode presents a 160× 120-pixel black-and-white thumbnail of what the video source sees—sort of. Its low frame rate (about two frames per second) makes it a poor way to snap just the frame you want. That's why the video-through jack is there. It allows you to watch the video real-time on a monitor.

Once you see the shot you want, it's time to hit the Snap button. The magic begins, and Snappy grabs a field of video—or maybe more, depending on your choices in the Setup menu. If you are snapping a moving image and you chose that in the Setup menu, then you'll capture one field of video. If you're shooting a still image, and you have a stable video source (playing laserdisc, TV broadcast, or live camera—but not a video tape) then you can grab a one-frame (two-field) image for higher resolution. Choosing High-Quality Still will tell Snappy to grab four fields, and Highest-Quality Still will grab eight fields.

What happens if you set the software for "highest quality still," when you are really capturing a moving image? It's worse than what happens if you try to shoot sports action with a still camera set to a shutter speed of 1/60th of a second. With the still camera, you'll get a blurred image (which can be a good thing if you're trying to convey speed and motion).

Snappy is different, however. One of the ways that it's able to capture high resolution (1500× 1125—higher than NTSC can produce) is by examining the video and processing it, interpolating to fill in the gaps. That processing takes time. So while the Snappy will capture eight fields of video, it can't capture eight *consecutive* fields. Motion can really throw off its interpolation routines. Moving around when acquiring images, for example, isn't a good idea—your moving shadow can mess up your image. A camcorder's auto iris or auto focus can do the same—set them to manual control.

Once you've taken your snapshot, it appears on the screen behind the preview window. If you're not happy with the results—or even if you are—you can call up the Adjust screen. Down the right side of the screen are various centered sliders for changing the color saturation, brightness, contrast, and other picture parameters. For example, the PICTURE slide lets you adjust the picture's gamma correction, or the range from the lightest to darkest areas of the frame. The SHARPNESS slide can add a little snap to object edges. Color can be controlled with a TV-like tint control, or with separate red, green, and blue sliders.

Any changes are updated quickly in the low-resolution preview window. If you want to see them full size, just hit the PROCESS button. From the Adjust screen, you can also zoom into a part of the image, and crop it.

Images can be saved in a variety of typical Windows sizes, or you can create a custom size by adjusting the pixel width and height. Images can also be saved with different color depths, from 24-bit true color down to 16 color.

Acquiring images that look good on your PC monitor is relatively easy. Getting images that look good in more demanding applications is a little more difficult.

The most important part of getting good pictures is starting with good lighting. Most people are tempted to just point their camcorder at a person or object and press the SNAP button. After all, that's

pretty much how they shoot video. With the Snappy, however, you should pretend that you are in a photo studio. Set up those lights!

Shooting people is more difficult if quality is what you're after, because moving video can't produce the same quality as still video. If you can get your subject to stay *really* still, however, you can achieve success. (Very still for a long time—remember, although Snappy grabs eight video fields, it doesn't grab eight consecutive video fields.)

Keeping that factor in mind, we found one of the most impressive things about the Snappy is the packaging that it comes in. OK, it's just a cardboard box with four-color images—just what you'd expect to find on a typical computer-peripheral box on the shelf of your local computer superstore. But those professional-looking, glossy images were all acquired by a Snappy. Now, that indicates that Play has confidence in its products. And why not? There's really nothing that comes close to what the Snappy can do—especially when you take price into consideration.

Once you've captured your images and saved them to your disk, it's time to start putting them to use. The Snappy Version 2 package gives you a couple of excellent ways to start making the most of your captured images—and to start having fun. Keep reading for descriptions of Morph and Kai's Power Goo. ■

Cool Tools

KAI'S POWER GOO SE. Published by MetaTools, Inc., 6303 Carpinteria Ave, Carpinteria, CA 93031; Price: N/A, OEM version supplied with Snappy Video SnapShot.

Every once in a while (unfortunately, not very often), someone comes along and shows how things can be done differently. Before Aldus introduced PageMaker, for example, WYSIWYG and personal computers had never met. Before NCSA Mosaic, Web pages containing both text and graphics didn't exist.

Photo- or graphic-manipulation tools are nothing new. But *MetaTools* has certainly put a new spin on things with its *Kai's Power Goo* . We examined only the SE edition ("special edition"—which usually means "stripped") that we received with the Snappy Video SnapShot. We can't say how it differs from the full retail version, but we *can* tell you how it differs from any other image-manipulation program that we've ever used.

Although we writers here at *Gizmo* are far from being graphic artists, we are somewhat adept at image manipulation. In our work, we sometimes have to crop images, or touch up some color on occasion. Now, however, we also might find the need to create some cool birthday invitations, or T-shirt iron-ons, or whatever strikes our fancy. After all, now that we have Kai's Power Goo, we can do things that previously couldn't be done by mere mortals (with the exception of those who work at TV studios, and those real artists who are wiling to invest in serious image-manipulation systems).

Kai's Power Goo, which MetaTools calls a "creative entertainment tool," lets you do extraordinary things with digital images in seconds. MetaTools claims that its user interface is revolutionary and intuitive. Well, it is different. We were able to use it without opening the on-disk user manuals (in PDF format), but not without a few stumbles along the way.

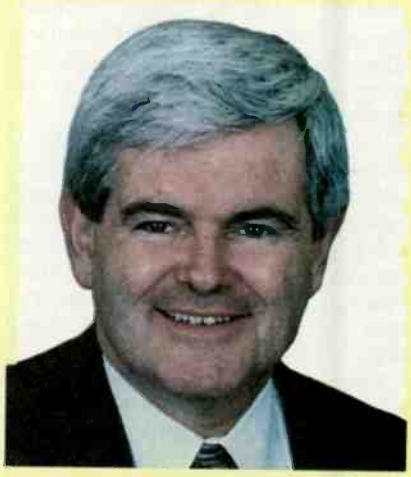
We'll readily admit that Windows 95 does not have the ideal user interface—such a thing probably doesn't exist. The advantage of Windows 95, of course, is that it allows software publishers to maintain some consistency in how their programs operate.

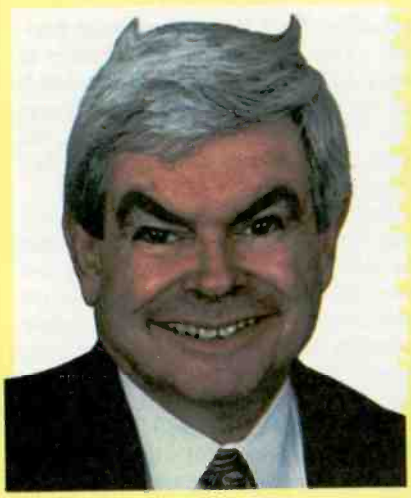
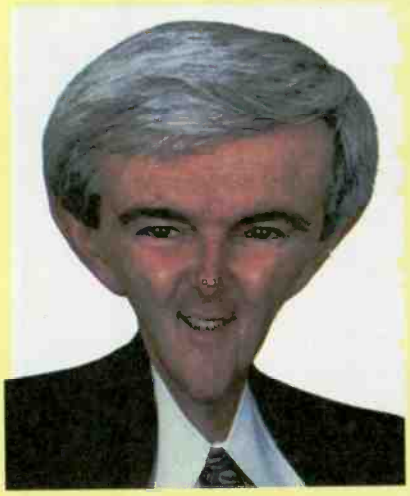
(Kai's Power Goo is a 32-bit program that runs under Windows 95 or NT only—it won't run on Windows 3.1. It requires a 486 or better processor. The software is also available for the Macintosh platform, and requires a 68040 or better processor.)

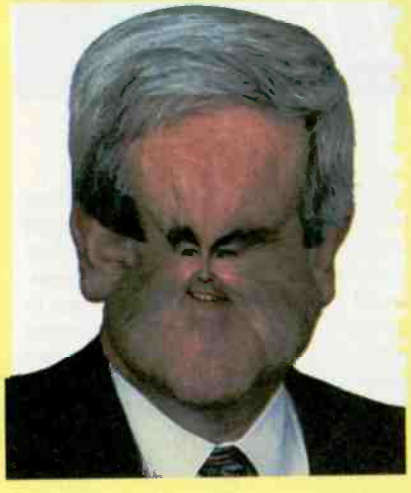
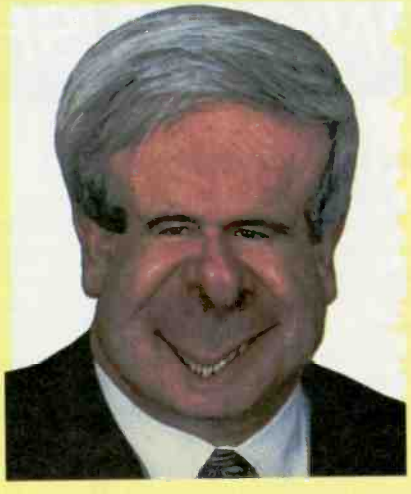
MetaTools does away with the "clutter and confusion of a complicated or rigid menu structure," but we're not convinced that it really advances the state of the art of user-interface design. Making it impossible to access the start menu or desktop is not our idea of an improvement—even if, as MetaTools claims, it reduces the clutter that might interfere with our creative processes.

Kai's Power Goo is primarily a way to have fun with digital images. Anyone can have a go at it—kids who want to make their friends look goofy, adults who want to make their bosses or favorite politicians look devilish. What makes it so much fun is that the effects are virtually immediate (at least on a 133-MHz Pentium-based machine.) Pick a "nudge" Goo brush, brush it on the image, and the image responds as if you literally had pushed it. (MetaTools calls what it does "liquid imaging.") If you're used to image-editing programs where every change takes a couple of minutes as the screen is refreshed, forget it. In that way, Kai's Power Goo is radically different.

For input, Kai's Power Goo supports TIFF, BMP, Photo-CD, and Photoshop



file formats. For output, only BMP and Photoshop formats are supported. When started, the program defaults to an image of the Mona Lisa. To import a different image, you don't choose File, Open as you might expect. No such menu exists (nor does a title bar). Instead, you click on the word "In" at the bottom left corner of the screen.

The main user interface—the Goo Room—contains a Goo Brush palette, a Goo Effects Palette, a control slider, and a playback slider. You put your "gooed" images into the Keyframe Palette found along the bottom of the screen.

The Goo Brush Palette contains nine different distortion brushes: Reset, Grow/Shrink, Move, Smear, Smudge, Nudge, Mirror Toggle, Smooth and UnGoo. The Goo Effects Palette also has nine different distortion effects: Reset, Bulge, Twirl, Rotate, Stretch, Squeeze, Spike, Static, and Unwind. The difference between the two palettes is that the brushes are used to create distortion where you "paint" the image, while the changes created by the Effects Palette are global to the image. The strength of the effect is determined by the position of the Control Slider. The control slider can also be used with the brushes to transition between the current Goo composite image and the original.

The Keyframe Palette can store up to 64 keyframes, which can be used to create animated AVI movies. Kai's Power Goo will morph from one image to the next—the speed of the animation can be controlled by the playback slider.

It's very easy to go way too far out of control when using Kai's Power Goo—creating what MetaTools calls Gootesque images. Just turning the Twirl effect on full, for example, will render an image unrecognizable. But untwirling it is just as easy—and you might want to create an animation that uses unrecognizable frames as part of a transition. You can always get back to your starting point by hitting the Reset button.

That's part of the fun—you really can't go wrong. Get as crazy as you like—turn your boss into a grotesque ogre—just be sure to hit Reset if you hear him approaching your cubicle! ■

Morphing Magic

MORPH V2.5. Published by Gryphon Software Corp., 7220 Trade St., Suite 120, San Diego, CA 92121; Tel: 619-536-8815. Price: N/A—included with the Snappy Video SnapShot.

What are you going to do with all of those images that you've been snapping, scanning, and digitizing? If you have no desire to post pictures on a Web page, and printing greeting cards just doesn't turn you on, then maybe you'd like to imitate some high-priced advertising agencies and rock-video makers and do a little morphing.

Just what is a morph? It's a mix of two images in which similar elements of each of the two images move to an intermediate position between them, so that one picture appears to meld into the other. Even if you've never heard the word used (it comes from the word metamorphosis), you know what morphing is—think of the Exxon video with the car that turns into a tiger (or is it the other way around?) Or think of the Michael Jackson video with the faces of people of all different ages, races, and gender that change seamlessly

from one to another. We don't remember the name of the song, but that morphing technology sure stuck in our minds.

Gryphon Software's Morph V2.5 lets you create morphs as either still images or AVI movies. Morph's interface is reasonably friendly and easy-to-use. It would have been easier if we had a user's manual to go along with the program, but the version supplied with Snappy doesn't even contain an on-disk one, and the help files were less than helpful when getting started. Just a short overview section would have been appreciated. But muddling through by trial and error got us on our way.

Morph lets you define how the points in a starting image and an ending image correspond to each other. For example, let's say that you want to morph your dog's face into your own. You would want to mark features that both you and the dog have in common—you both have two eyes, a nose, two ears, and a mouth. You would mark those points on the starting image, and then go to the final image and adjust them to the appropriate position. Then you can tell the software to create a still image—or a movie in which the dog's face fades, or morphs, into your own. The more key points you mark, the better. You can join the points with key lines.

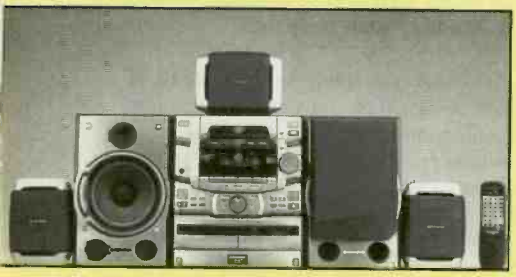
You can manipulate the points and lines from either direction, working from the start or the finish. Working in two directions makes it much easier to get good-looking morphs. (It took us a while to realize that this was possible, but once we did, our results improved dramatically.)

But good-looking morphs don't come without a fair amount of work. The more points you have, the better the results. And putting the points in the right place isn't so obvious without a little practice.

Morph saves movies as either AVI animations or QuickTime for Windows. You can also save them as Autodesk FLIC animations, but then they can't be played back in Morph.

As impressive as it is to morph two images together, it is also possible to morph two AVI videos. We were quite impressed by a couple of samples included with the software. For example, one morph movie showed a woman's head turning into a man's as her/his head turned. We didn't have the patience to get such good stuff, but we got pretty good at creating morphs between two images. ■

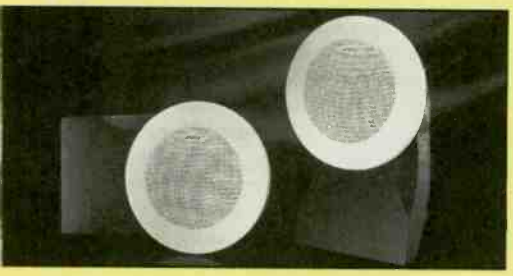
ELECTRONICS WISH LIST



Pioneer Model CCS-406 Mini-System

Pro Logic Mini-System

The *Model CCS-406* mini-system from *Pioneer Electronics (USA) Inc.* (2265 East 220th Street, Long Beach, CA 90810-1639) features full Dolby Pro Logic surround circuitry and high-power, high-fidelity amplification for powerhouse surround sound. The system's 25-disc CD File offers disc title input and 25 × 2 "best selection memory" functions for customizable music on demand listening. Discs can be stored in groups of five for easy access. The double auto-reverse cassette deck has a music search mode. The six-inch two-way speaker system includes three full-range surround sound speakers for center and rear channels. Other features include an integrated sleep timer, a full-function remote control, and one-touch Karaoke mode. Price: $785.



Bose Model 131 Marine Speakers

All-Weather Speakers

Just in time for the boating season, *Bose Corporation* (The Mountain, Framingham, MA 01701-9168) has introduced the *Model 131 Marine Speakers*. Providing a practical solution for achieving stereo sound in the marine environment, the round flush-mount 131 speakers are compatible with the pre-cut speaker holes on many boats. Their 3½-inch mounting depth and overall 8-inch grille diameter make installation easy on any water craft. The speakers feature Bose's proprietary full-range composite driver designed to meet and exceed industry standards for performance in harsh conditions. The 4½-inch drivers and tuned, ported enclosures allow the speakers to produce sound that is consistently clear, full, and rich. Price: $259/ pair, including mounting hardware.

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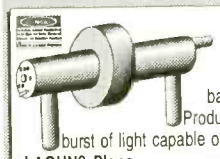

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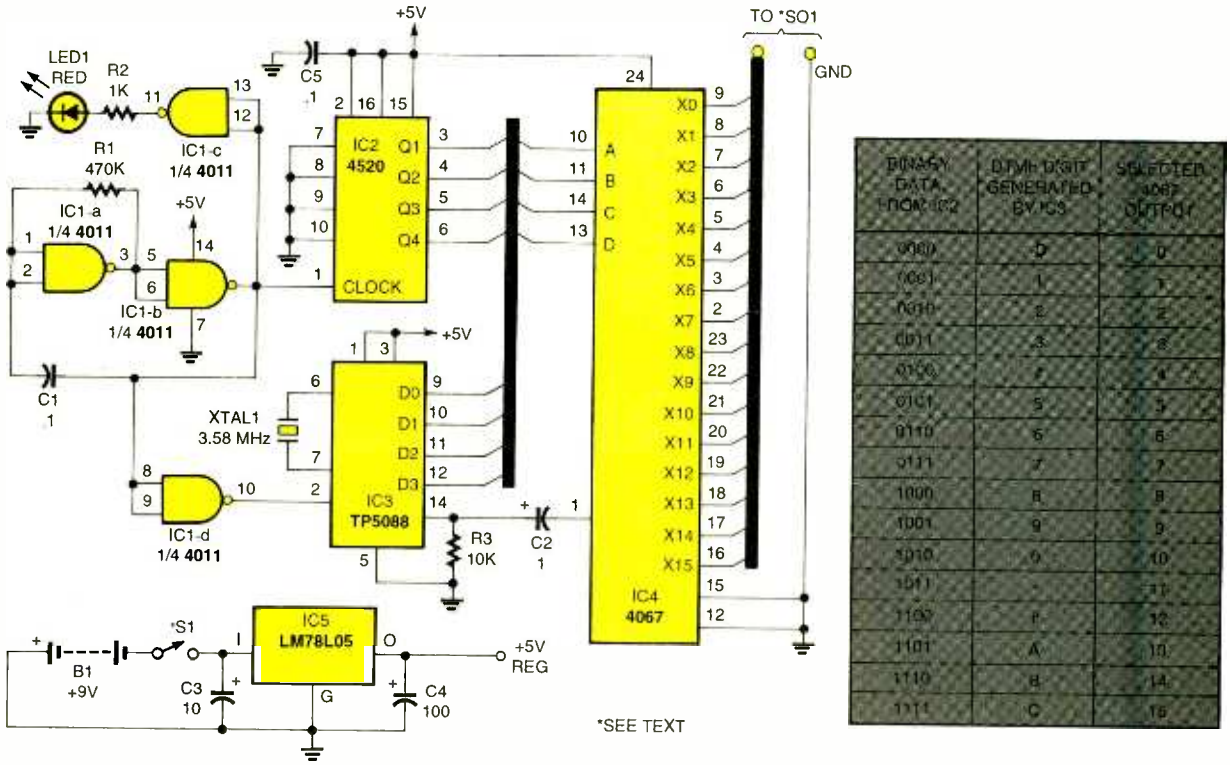
CHECKOUT THE DTMF WIRE TRACER

Popular Electronics
July 1997

Get a handle on those time-consuming wire sorting or installation jobs with an easy-to-build, two-piece, wire identification system!

BRIAN PLILER

If you have ever installed wiring for electronic equipment, such as telephones, intercoms, P.A. systems, home theater, alarms, or any type of multiconductor equipment, you are probably familiar with the frustration that goes along with the territory. If you're a professional wiring installer, then you probably already have most of the modern equipment that is available to make your job a little easier. But if you are a hobbyist (or even a handyman) who only occasionally must delve into the wiring maze that is part and parcel of modern electronic equipment, you probably can't justify the cost of

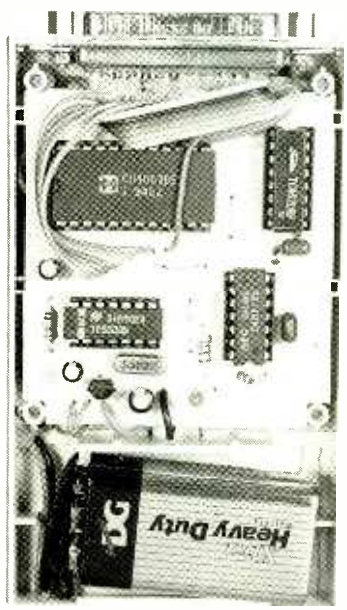


BINARY DATA FROM IC2	DTMF DIGIT GENERATED BY IC3	SELECTED 4067 OUTPUT
0000	D	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	0	10
1011	*	11
1100	#	12
1101	A	13
1110	B	14
1111	C	15

Fig. 1. The tone generator portion of the DTMF Wire Tracer is comprised of five integrated circuits—a 4011 quad 2-input NAND gate (IC1), a 4520 dual synchronous up counter (IC2), a National Semiconductor TP5088 DTMF generator (IC3), a CD4067BE 16-channel analog multiplexer/demultiplexer (IC4), and a 78L05 100-mA, 5-volt regulator (IC5)—along with a handful of support components.

adding a commercial wire tracer to your tool box. Fortunately, there is an alternative—the *DTMF Wire Tracer*. The DTMF Wire Tracer is somewhat similar to commercial units in that both a transmitter (tone generator), and a receiver (tone decoder) are required. But, unlike commercial units, the project described here allows up to 16 conductors to be easily identified in only a matter of seconds.

That feat is accomplished with the aid of a tone generator. The tone generator produces 16 distinctly different tone combinations (DTMF signals), by way of 16 separate outputs. The tone generator is paired up with a tone decoder that is capable of identifying all 16 DTMF tone combinations, and displaying the appropriate character on a dot-matrix alphanumeric LED display. For example: if the tone decoder is connected to output 1 of the tone generator, the number "1" will appear in the decoder's display. If, on the other hand, the decoder is connected to output 2, then the number "2" will be displayed. Both units are battery operated for maximum portability. The



The tone generator's completed printed-circuit board, along with its 9-volt battery power source, was installed into a small enclosure. The board was secured in place with double-sided tape, but hot glue will also do the job.

system has been used by the author to identify individual conductors in multiple runs of inexpensive telephone cable at lengths exceeding 50 feet. **CAUTION!!!:** The DTMF Wire Tracer is not designed, or intended, for use on "live" or otherwise "in-use" conductors whatsoever.

Tone Generator Description. The schematic diagram for the tone generator is shown in Fig. 1. In that circuit, half of a 4011 quad two-input NAND gate (IC1-a and IC1-b), along with R1 and C1, form a simple oscillator. The oscillator, operating at approximately 12 Hz with a 50% duty cycle, is used to generate the necessary clock and timing signals for the tone generator. The clock signal is used to drive IC2 (half of a 4520 dual synchronous up counter), which repeatedly counts from hexadecimal 0 to F (or in binary from 0000 to 1111), and outputs the count data in binary form. The binary output of the counter is fed along two paths: In one path, the output data is applied to the address/data select inputs of IC3 (a National Semiconductor TP5088 DTMF generator), and in the other path the signal is fed to IC4 (a CD4067BE 16-channel analog multiplexer/demultiplexer).

The DTMF generator (IC3), cou-

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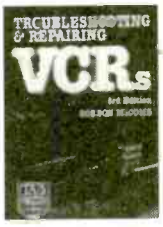

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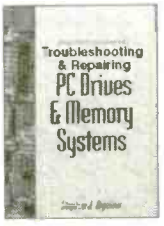

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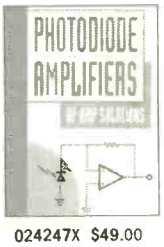

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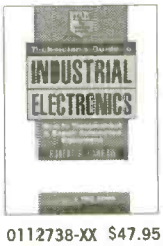

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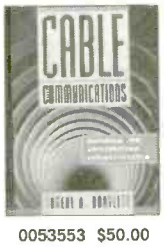

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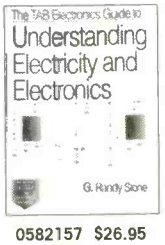

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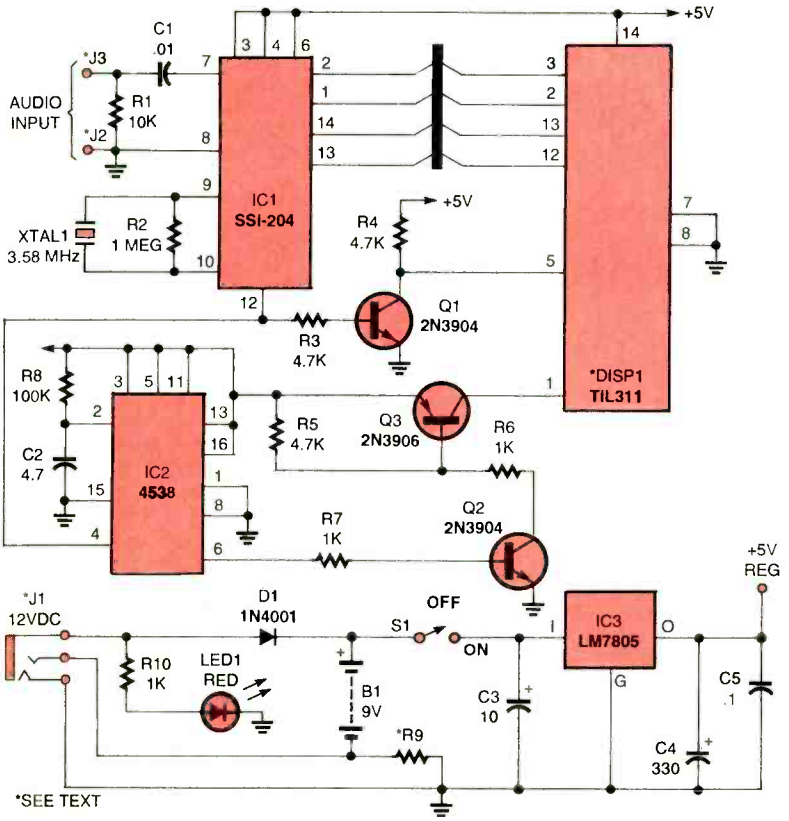
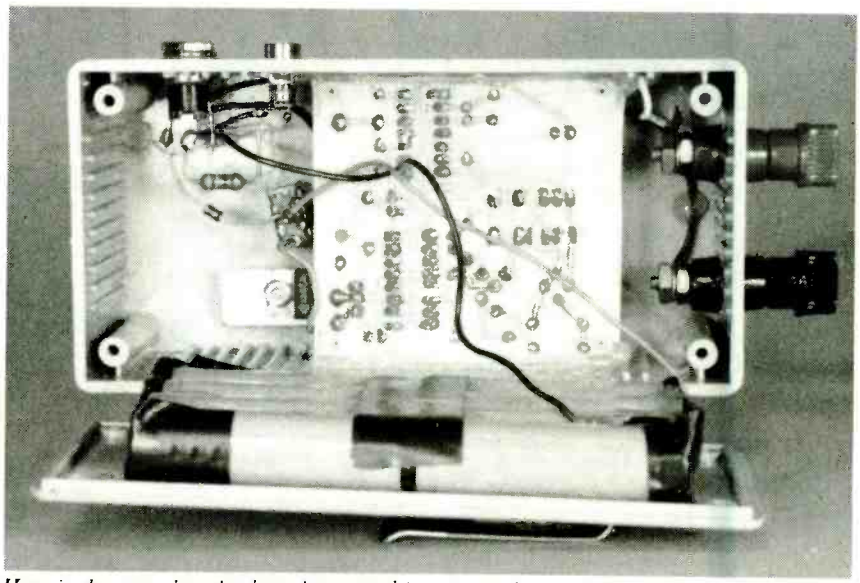


RECEIVED DTMF DIGITS	DECODED BINARY DATA	DISPLAYED HEXADECIMAL DIGIT
D	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
0	1010	A
*	1011	B
#	1100	C
A	1101	D
B	1110	E
C	1111	F

Fig. 2. The second half of the DTMF Wire Tracer—the tone decoder, which is designed to detect and identify signals produced by the tone generator—is composed of three ICs (an SSI-204 DTMF decoder, IC1; a 4538 dual monostable multivibrator, IC2; and an LM7805 5-volt, 1-amp voltage regulator, IC3), three transistors (Q1–Q3), and a display module (DISP1, a TIL311 Hybrid dot-matrix LED display, with built-in hex decoder/driver).

pled with a crystal reference (XTAL1), generates a DTMF tone in accordance with binary data applied to its inputs at pins 9 to 12. The binary data represents the DTMF digit to be generated. While the binary data is being applied to the inputs of IC3, a tone enable signal is applied to pin 2 by coupling the clock signal through an inverter comprised of IC1-d. The DTMF tones generated by IC3 are output at pin 14. Resistor R3 provides a reasonable load impedance for the audio output stages of IC3. Capacitor C2 is used for DC blocking, preventing any DC component of the output from reaching the following stage, while allowing the DTMF signals to travel on to the input of IC4, which is responsible for routing individual DTMF tone to their appropriate outputs. While IC3 is performing its job, binary data from IC2 is fed to IC4, and is used to select appropriate output pins of IC4, ensuring that each distinct tone has its own output terminal. The 16 outputs of IC4, plus a ground wire, are then connected to individual pins of a DB-25 female connector (SO1, which is not shown). The generator uses a mating male DB-25 connector outfitted with 17 leads (16 signal lines, plus a ground connection), each terminated in an alligator clip, to feed the tone signal(s) to the cable to be tested.



Here is the tone decoder board mounted into its enclosure, along with its rechargeable power pack. The power pack and binding posts (J1–J3), as well as DISP1, and the on/off switch (S1) are mounted at various locations of the enclosure.

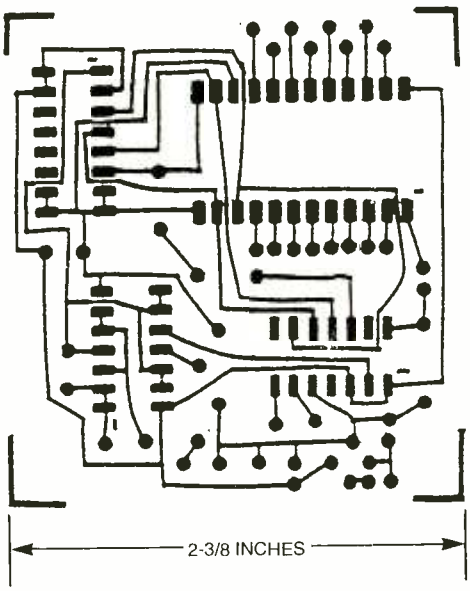


Fig. 3. The tone generator was assembled on a small printed-circuit board, measuring 2-3/8 by 2-7/16 inches. A template of the author's printed-circuit board pattern is shown here full-scale. Note that the layout is fairly tight with numerous traces routed between component pads. So once you've etched your printed-circuit, carefully inspect it for faults such as incomplete traces and copper bridges between traces.

Power for the tone generator is supplied by an ordinary 9-volt transistor radio battery. The source voltage is regulated to 5 volts by IC5 (a 78L05 100-mA, 5-volt regulator). Capacitors C1-C3 filter and stabilize the supply voltage. LED1 serves as the project's power on indicator, and is flashed on and off through IC1-c, which is also driven by the 12-Hz clock signal.

Tone Decoder Description. Figure 2 shows the schematic diagram for the second half of the DTMF Wire Tracer—the tone decoder—which is used to detect and identify signals produced by the tone generator. Tone bursts (from the tone generator) are applied to the wires being sorted. Test leads connected to J2 and J3 (black and red binding post, for the ground and signal leads, respectively) are used to route the signal to the tone decoder. Resistor R1 provides a suitable load impedance to the conductor being tested; it also helps to counteract any mutual coupling effects between conductors, which are often present in long multiconductor cables. The tone bursts are AC coupled, via C1 (which passes DTMF tones, while blocking DC voltages), to IC1 (an SSI-204 DTMF decoder).

The decoder (IC1), coupled with a 3.58 MHz colorburst crystal (XTAL1), decodes all 16 DTMF tone bursts output by the tone generator and, in turn, outputs a distinct 4-bit binary number for each decoded DTMF digit. The decoded data is applied to DISP1 (a TIL311 hybrid dot-matrix LED display), where the data is translated into its corresponding hexadecimal character, and to illuminate the readout. When IC1 decodes a DTMF digit, a DV (data valid) signal output at pin 12, signifying that the current binary output is correct.

The DV signal divides along two paths. In the first path, the DV signal is then inverted by transistor Q1 and is used to clock the binary data into DISP1. In the other path, the DV signal is used to activate half of a 4538 dual monostable multivibrator (IC2), which is configured as a 0.5 second timer. The output of IC2 at pin 6, a 5 volt pulse, is fed to the base of Q2. The pulses generated by IC2 causes Q2 to turn on, pulling the base of Q3 low, causing it to turn on. When Q3 turns on, power is supplied to DISP1 for 0.5 seconds, thereby allowing the hexadecimal character to be displayed. After 0.5 seconds has elapsed, the display goes blank. That arrangement not only extends battery life considerably, but also prevents incorrectly (or erroneously) identifying the conductors.

Power for the decoder circuit is supplied by a 9.6-volt Ni-Cd battery pack (B1). Battery voltage is fed through S1 to IC3 (an LM7805 5-volt, 1-amp voltage regulator) to provide regulated 5-volt power source for the project. Capacitors C3-C5 filter against voltage transients. The battery pack used in the author's prototype is made up of eight individual 800 mAh "AA" cells wired in series. The battery pack allows the project to operate for about 8 to 10 hours per charge. The prototype unit draws about 80 mA in standby (display blank) and 100 mA when the display is active. Battery recharging is accomplished by connecting jack J1 to a suitable 12 volt DC source.

The value of R9 determines the charge rate (normally 1/10 of rated battery capacity for a 14 hour charge), and can be found using Ohms law. Resistor R9 is automatically bypassed via the switching contacts of J1, whenever a plug is not inserted in J1. LED1 serves as the

PARTS LIST FOR THE TONE GENERATOR

SEMICONDUCTORS

IC1—CD4011 or similar, quad 2-input NAND-gate, integrated circuit
IC2—CD4520 or similar, dual binary up-counter, integrated circuit
IC3—TP5088 DTMF generator (Digi-Key #TP5088N-ND), integrated circuit
IC4—CD4067BE or similar, 16-channel, analog multiplexer/demultiplexer, integrated circuit
IC5—LM78L05 5-volt, 100 mA, voltage regulator, integrated circuit
LED1—Red, T-1 size, light-emitting diode

RESISTORS

(All fixed resistors are 1/4 watt, 5% units.)
R1—470,000 ohm
R2—1000 ohm
R3—10,000 ohm

CAPACITORS

C1, C5—0.1-µF, 50-WVDC, polyester film
C2—1-µF, 50-WVDC, miniature electrolytic
C3—10-µF, 16-WVDC, miniature electrolytic
C4—100-µF, 6.3-WVDC, miniature electrolytic

ADDITIONAL PARTS AND MATERIALS

XTAL1—3.58 MHz colorburst crystal (Mouser #520-HCU357-17 or similar)
SO1—Female DB-25 socket
B1—9-volt transistor battery
S1—See text
Printed-circuit board materials, alligator clips, male DB-25 connector, IC sockets, battery clip, wire markers (R.S.#278-1650A), enclosure (R.S. #270-211), wire, solder, hardware, *etc.*

PART LIST FOR THE TONE DECODER

SEMICONDUCTORS

IC1—SSI204, CD22204 or similar, DTMF decoder integrated circuit
IC2—CD4538 or similar, Dual monostable multivibrator integrated circuit
IC3—LM7805 or similar, +5 volt, 1 amp voltage regulator integrated circuit
Q1, Q2—2N3904 or similar, NPN general-purpose switching transistor
Q3—2N3906 or similar, PNP general-purpose switching transistor
D1—1N4001 or similar, 1-amp, 50 PIV silicon diode
DISP1—TIL311 Hybrid dot-matrix led display (with built-in hex decoder/driver)
LED1—Red light-emitting diode in chrome holder (R.S. #276-068 or similar)

RESISTORS

(All fixed resistors are 1/4 watt, 5 % units, unless otherwise noted.)
R1—10,000 ohms
R2—1000,000 ohms
R3–R5—4700 ohms
R6, R7, R10—1000 ohms
R8—100,000 ohms
R9—See text

CAPACITORS

C1—0.01-µF ceramic disc
C2—4.7-µF, 25-WVDC electrolytic
C3—10-µF, 25-WVDC electrolytic
C4—330-µF, 10-WVDC electrolytic
C5—0.1-µF, 50-WVDC polyester

ADDITIONAL PARTS AND MATERIALS

XTAL1—3.58 MHz colorburst crystal
S1—Miniature SPST toggle switch
J1—Male panel-mount barrel jack 2.0 mm × 5.5 mm
J2—Black binding post
J3—Red binding post
B1—9.6-volt battery pack (see text)
Printed-circuit materials, enclosure, IC sockets, dark red plastic lens for display, test leads, DC adapter, wire, solder, hardware, etc.

charging indicator, lighting only when the battery is being charged. Diode D1 prevents the battery pack voltage from appearing at J1. It should be noted that if the battery pack becomes discharged during use, the unit can still be used while recharging. An ordinary AC to DC power adapter, or other suitable 12 volt source capable of supplying at least 200 mA can be used instead.

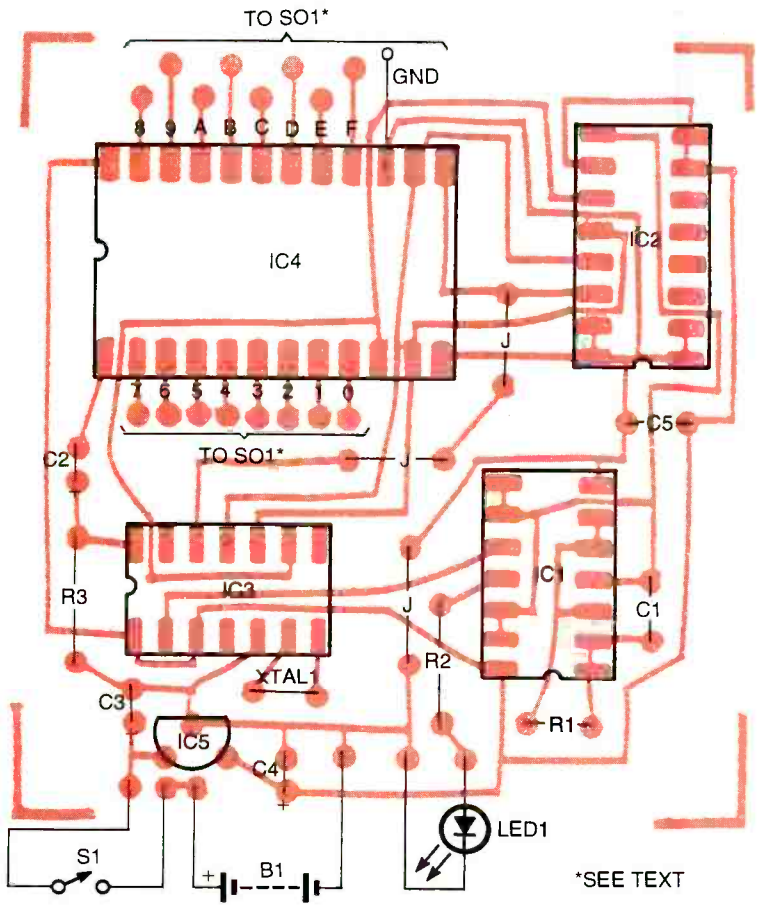


Fig. 4. Assemble the tone generator using this parts-placement diagram as a guide, installing the low-profile components (i.e., jumper wires and horizontally-installed resistors) first, followed by the taller units (IC sockets, capacitors, etc.).

Tone Generator Construction. Since the project is a portable test instrument, and is therefore likely to be subjected to somewhat rough handling in everyday use, it is strongly recommended that the unit be assembled on a printed-circuit board. A full-size template of the author's printed-circuit board pattern for the tone generator, measuring 2-3/8 by 2-7/16 inches, is shown in Fig. 3. The layout is fairly tight with numerous traces routed between component pads. That was done so that the completed board would fit into a compact enclosure. If you are uncomfortable with that layout, or plan to use a different enclosure, please feel free to redesign the circuit-board layout to suit your own needs.

In any case, once the printed-circuit board has been etched, carefully inspect it for faults such as incomplete traces and copper bridges between traces. After correcting any problems, install the components, using the Fig. 4 parts-placement diagram as a guide. It is suggested that low-profile components (*i.e.*, jumper wires and horizontally-installed resistors) be installed first, followed by the taller units (IC sockets, capacitors, *etc.*). Sockets are strongly recommended for all ICs, except the voltage regulator—not only do they simplify testing the project, but they also make any future IC replacements quick and easy.

After all of the board-mounted components have been installed, but before inserting any of the ICs, temporarily apply power to the board and confirm that 5 volts DC appears at the output of IC5. Remove power, install IC1 into its socket, and re-apply power. LED1 should now start blinking. Once again remove power, and install

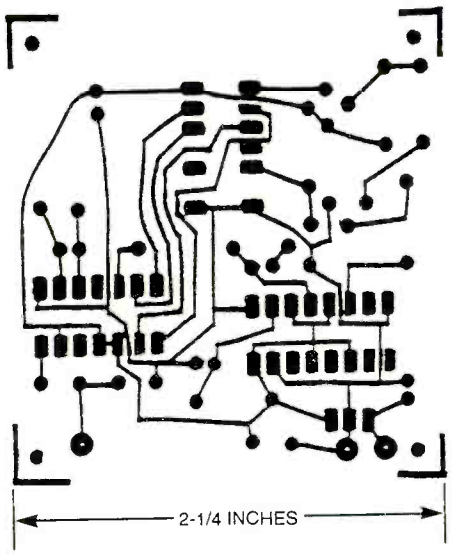


Fig. 5. The tone decoder was assembled on a small printed-circuit board, this one measuring 2-7/16 by 2-1/4 inches. A full-size template of that foil pattern is shown here.

template of that foil pattern is shown in Fig. 5. Once the printed-circuit board has been etched, and any problems corrected, begin installing the components, guided by the parts-placement diagram shown in Fig. 6. Just as with the tone generator, be sure to install the low-profile components first, followed by the taller components. Again sockets are recommended for all ICs except the regulator (IC3); a socket is absolutely necessary for the display (the reason for this will become apparent later). Several of the pins on the display socket must be clipped off or removed before it can be installed on the printed-circuit board. Note that diode D1, resistors R9 and R10, and LED1 are not installed onto the printed-circuit board, but are instead mounted to the leads of jack J1. Be sure to locate resistor R9 away from the other components, as it does dissipate heat while the batteries are charging.

After installing all of the board-mounted components, but before inserting IC1, IC2, and the display into their respective sockets, temporarily apply power to the board and confirm that 5-volts appears at the output of IC3. Once verified, remove power and insert IC1, IC2, and DISP1 into their respective sockets. With power applied once more, connect the unit to any one of the 16 available outputs from the tone generator. The hexadecimal character representing the connected generator output should appear in DISP1 for half a second, before the display goes blank. If left connected, the same character will reappear about one second later. That sequence of events will occur for as long as the

the remaining ICs in their respective sockets. With power re-applied, and using a small audio amplifier with its input connected to pin 1 of IC4, a continuous stream of DTMF tone bursts should be heard. Now check the individual output pins of IC4, and confirm that a different DTMF tone burst is heard at each output pin. Once it's confirmed, the 16 individual outputs of IC4 can be connected to SO1. The completed printed-circuit board can now be installed into a suitable enclosure using double-sided tape or hot glue. A bit of hot glue can also be used to help prevent the ICs from working out of their sockets. The DB-25 connector is mounted to one end of the enclosure.

It will also be necessary to prepare a 17-conductor test harness terminating to a male DB-25 connector. The author used a length of ribbon cable connected at one end to the male DB-25 connector and the other end connected to 17 miniature alligator clips—16 red jacked alligator clips for the signal leads and one black clip for the ground lead.

Tone Decoder Construction. The tone decoder, like the tone generator, was assembled on a small printed-circuit board, this one measuring 2-7/16 by 2-1/4 inches. A full-size

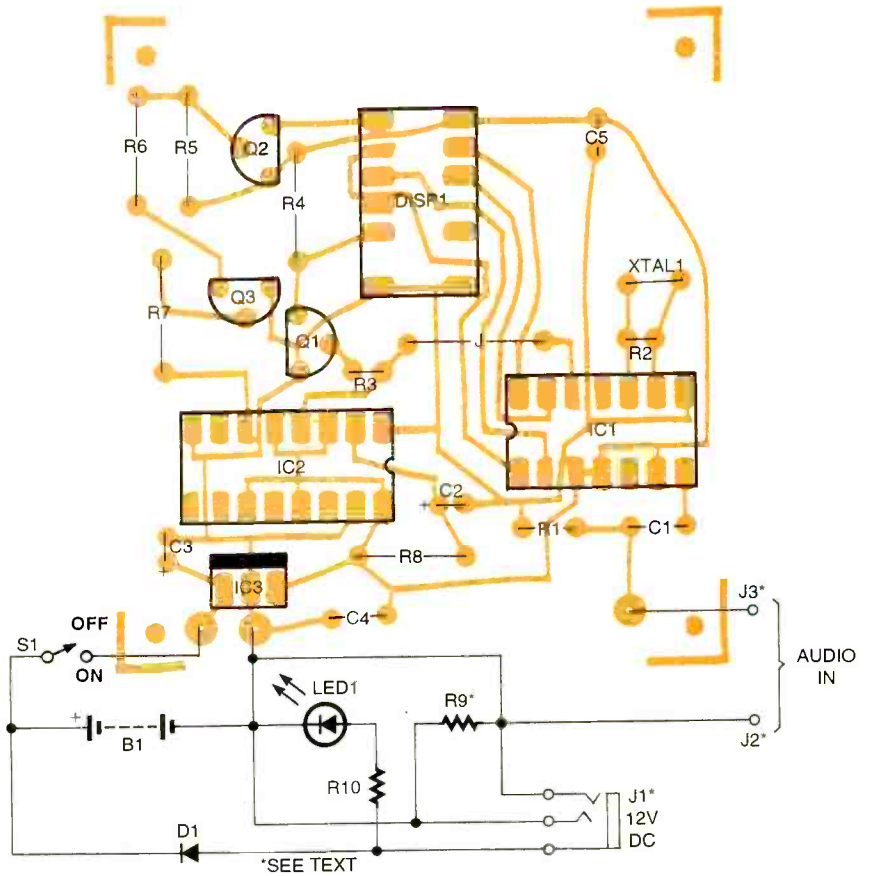


Fig. 6. Assemble the tone decoder board guided by this parts-placement diagram. As with the tone generator, be sure to install the low-profile components first, followed by the taller components. Again sockets are recommended for all ICs except the regulator (IC3). Note, however, that a socket is absolutely necessary for the display (DISP).

PARTS SOURCES

SURPLUS NI-CD BATTERIES

Falkner Enterprises,
PO Box 1378
Ottumwa, IA 52501
Tel: 515-683-7621
Fax: 515-683-7631
Free catalog upon request

PARTS SUPPLIERS

B.G. Micro
PO Box 280298
Dallas, TX 75228
Tel: 800-276-2206
Fax: 214-271-2462

Circuit Specialists, Inc.
PO Box 3047
Scottsdale, AZ 85271-3047
Tel. 800-528-1417
Fax: 602-464-5824

Debco Electronics, Inc.
4025 Edwards Road
Cincinnati, OH 45209
Tel. Orders: 800-423-4499
Tel. Inf.: 1-513-531-4499
Fax: 513-531-4455

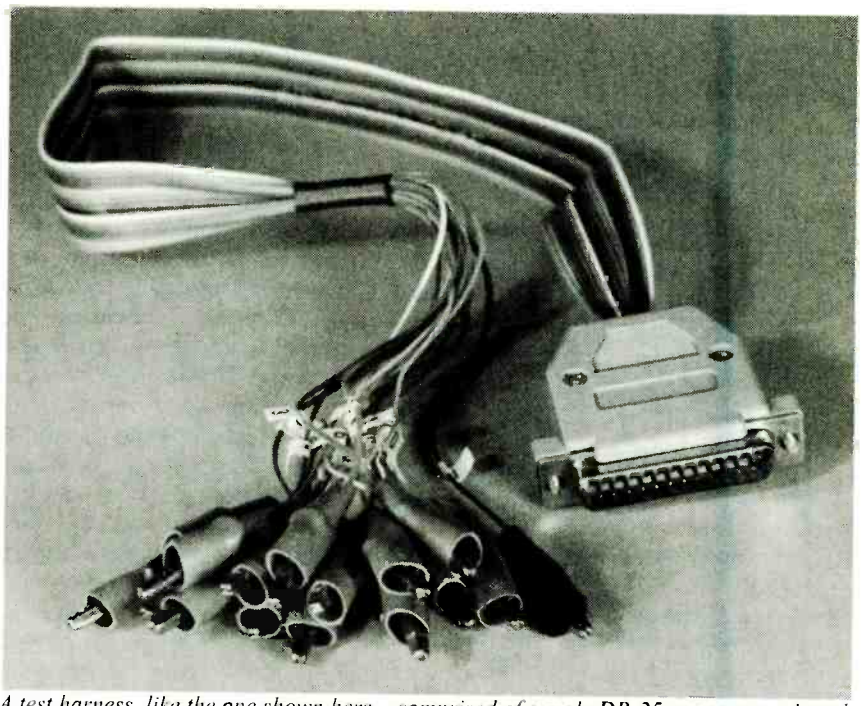
Jameco Electronics
1355 Shoreway Road
Belmont, CA 94002-4100
Tel. Orders: 800-831-4242
Fax: 800-237-6948
BBS: 415-637-9025

JDR Microdevices
1801 South 10th Street
San Jose, CA 95112-4108
Tel. Orders: 800-538-5000
Fax: 800-538-5005
BBS: 408-494-1430

Mouser Electronics
Mouser Central
958 North Main Street
Mansfield, TX 76063
Tel. Orders: 800-346-6873

Newark Electronics
(Has distributors nationwide)
To request a catalog, call:
800-298-3133 ext.48

input of the tone decoder is connected to any one of the 16 available tone generator outputs. Now connect the tone decoder's input to each of the other tone generator outputs one at a time, and verify that a different numerical character is displayed for each output. Refer to the table that is part of Fig. 2 if necessary.



A test harness, like the one shown here—comprised of a male DB-25 connector, a length of ribbon cable, and 17 miniature alligator clips (16 red and one black)—is used to feed individual tone signals to several different conductors simultaneously.

If one character is continually displayed, regardless of which tone-generator output is selected, check transistor Q1 of the tone decoder for it's proper operation. If the LED display fails to operate at all, then check transistors Q3 and Q2, followed by IC2 (in that order) for proper operation.

After the unit is operating correctly, it's time to prepare the enclosure that will house the unit. Before permanently installing the printed-circuit board into the enclosure, it might be necessary to increase the overall height of DISP1 by placing an additional IC socket between DISP1 and the board-mounted socket (*i.e.*, insert an empty socket into the board-mounted socket, and then install DISP1 into this socket). That will make the display easier to see once the unit is assembled. A suitable Ni-Cd battery pack can be assembled from individual tabbed "AA" size, or a 9.6-volt battery pack of the type commonly used in radio-controlled toys can also be used.

Use. Suppose that you needed to identify 16 individual conductors in a computer cable. First, connect the tone generator's ground lead to the shield wire on the cable. Then, simply connect one output from the tone generator to each conductor that's to be identified, and apply power to the generator. Now go to the opposite end of the cable, and connect the tone decoder's ground wire to the shield wire on the cable.

By simply "probing" each of the 16 wires one at a time, their identity will be clearly displayed by the Tone Decoder Unit. Now all that needs to be done is to apply the proper labels to each of the wires at both ends of the cable. Note that it is perfectly normal for a second or so to pass before a character is displayed on the tone decoder. That's because the tone generator takes approximately 1.25 seconds to completely cycle through all 16 possible DTMF tone pairs. If the probe on the tone decoder is left connected to a conductor being tested for several seconds or more, the displayed character will appear blinking in the display.

If you suspect some wires are crossed, check all of them for more than one responce.

The companies cited in the sidebar are valid parts sources for items listed in this feature. To the best of my knowledge, these suppliers are willing to sell parts and materials in small quantities by mail. ■

Monitor your "Ticker" With

THE HEARTBEAT MACHINE

This fascinating but simple circuit allows you to keep tabs on the rhythmic fluctuations of your heart.

ANTHONY J. CARISTI

For those who are interested in physiological electronic instruments, this project can be both educational and entertaining, especially at your next party. Its design is based on a medical instrument called a *plethysmograph*. The plethysmograph, derived from the Greek word "plethore," meaning filled, is used in physiology to study variations in the size of parts of the body, as caused by the quantity and circulation of blood. The *Heartbeat Machine* is specifically designed to respond to blood flow, and visually indicate the heartbeat or pulse rate of a human subject. As reported in the *Journal of the American Society of Psychical Research*, and the *International Journal of Neuropsychiatry*, such an instrument could also be used as an indicator of extra sensory perception (ESP) in telepathy experiments.

The Heartbeat Machine responds to the varying quantity of blood in the finger, and operates on the principle that transmission of light through the body is influenced by the pulsating flow of blood as caused by the heart. The project is a self-contained unit that allows the subject to rest his or her finger on a transducer assembly, thereby allowing the circuit to detect blood flow. Each time a heartbeat is detected, an LED will flash. An optional feature allows the builder to provide an audible tone burst in addition to, or in place of, the LED indicator.

The Heartbeat Machine is easy and fun to use. It is battery operated for portability, and completely harmless to the bystander and user. You can try it yourself or on your relatives and friends for entertainment purposes. Find out what external stimuli influence the heart rate. The next time you have a party, bring it out to break the ice!

About the Circuit. Figure 1 is a schematic diagram of the Heartbeat Machine. The circuit is comprised of three integrated circuits (IC1 through IC3), a transistor (Q1), (which is composed of two components: LED1 and R17, a cadmium sulfide photocell, also known as a light-dependent resistor), and a handful of support components. Key to the circuit's operation is the transducer, which is used to detect the flow of blood in the finger. The photocell and LED are placed in close proximity to each other surrounded by a light-proof enclosure.

The subject places a finger over both the LED and the photocell. Since human body tissue is somewhat transparent to red light while blood is not, light emitted by the LED is transmitted to the photocell through the finger. This process causes the resistance of the photocell to vary in accordance with the subject's heartbeat and pulse rate. The electrical change in photocell conductivity is detected and amplified to allow the instrument to visually display the heartbeat of the subject, by means of a synchronized flashing light.

When the circuit is turned on via S1, the battery voltage is regulated to 5 volts by IC1 (a fixed 5-volt, 100-mA regulator). That voltage is used to light LED1, which provides the light source that passes through the subject's finger, to drive the photocell (R17). The photocell is biased with a small current through R2. In total darkness the resistance of the photocell is about 500,000 ohms. But as light intensity striking the photosensitive area of the photocell increases, the photocell's resistance decreases. That's an important point, as we will soon see. The voltage drop across R17 is AC coupled to the non-inverting input of IC2-a—1/4 of an LM324N quad op-amp (which is configured as an AC amplifier, and has a gain of 46)—at pin 3.

The output of IC2-a is fed to the

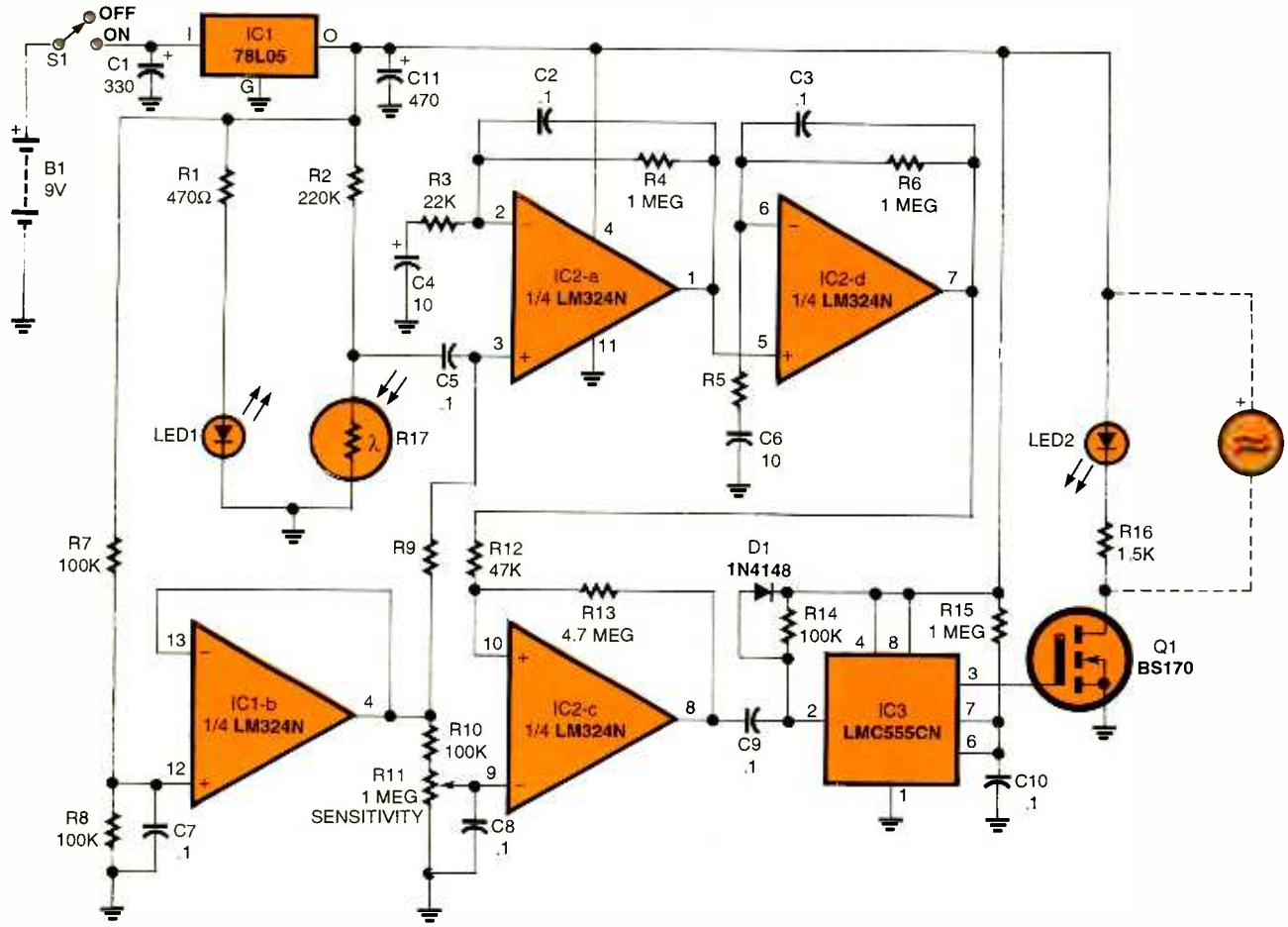


Fig. 1. The Heartbeat Machine is comprised of three integrated circuits (IC1 through IC3), a transistor (Q1), a transducer, and a handful of support components. Key to the circuit's operation is the transducer (composed of LED1 and R17), which is used to detect the flow of blood in the finger.

non-inverting input of IC2-d, another op-amp configured as an AC amp, with a gain of 46. Together those two amplifiers, (which are connected in cascade) provide a total gain of more than 2000. That produces an output voltage variation of one or more volts at the output of IC2-d at pin 7. Capacitors C2 and C3 are included in the feedback loops of the two AC amps to limit their high frequency responses. Note that a voltage follower, comprised of IC2-b, along with R7 and R8 form a low impedance voltage source. The output of the voltage follower divides along two paths. In one path, the output of IC2-b is used to bias the non-inverting input (pin 3) of IC2-a at about 2 -$^1/_2$ volts. Since IC2-a drives IC2-d directly, that amplifier is also biased at the same voltage.

Each time the heart beats, a surge of blood passes through the finger. That variation of blood flow causes a change in the amount of light striking R17 (the photocell, which has a resistance of 500,000-ohms in total darkness and increasing to 3000-20,000-ohms depending on increasing light intensity), causing its resistance to change. That, in turn, varies the voltage across the photocell and therefore, the voltage applied to U2-a. The waveform produced (see Fig. 2) represents the flow of blood. The output of IC2-d at pin 7 is fed through R12 to IC2-c, another op-amp, one configured as a voltage comparator. A voltage comparator is a high-gain amplifier that compares the voltage levels applied to its input terminals, and always generates either a logic 1 or logic 0 output. Hysteresis is provided by the positive feedback through R13.

In the second path, the output of IC2-b is applied to R11 (a 1-megohm potentiometer), which is used to set the circuit's sensitivity level. The output of U2-b is fed through the wiper of R11 to the non-inverting input of IC2-c to set the biased voltage (at pin 9) at somewhat less than 2-$^1/_2$ volts. Because of that, the output of IC2-c at pin 8 will always be near 5 volts when the circuit is at rest (no light excitation on R17). When a finger is placed in position, the amplifier produces the heartbeat waveform at IC2-d pin 7. That signal is fed to the voltage comparator through R12, producing a negative-going pulse train at pin 8 of IC2-c that's synchronized with the heart rate. That pulse train is used to trigger IC3 (an LMC555 CMOS oscillator/timer) that's connected as a monostable (or one-shot) multivibrator. The monostable produces a positive going pulse at its pin 3 output each time it's triggered.

The pulse duration (about $^1/_{10}$ second) is determined by R15 and C10. Transistor Q1 and LED2 are

PARTS LIST FOR THE HEARTBEAT MACHINE

SEMICONDUCTORS

IC1—78L05 5-volt, 100-mA, voltage regulator, integrated-circuit
IC2—LM324N quad op-amp, integrated circuit
IC3—LMC555CN CMOS oscillator/timer, integrated circuit
Q1—BS170 N-channel enhancement TMOS FET
D1—1N4148 or similar silicon switching diode
LED1—Light-emitting diode
LED2—Jumbo LED (Mouser 351-7542 or similar)

RESISTORS

(All fixed resistors are ¼-watt, 5% units, unless otherwise noted.)
R1—470-ohm
R2—220,000-ohm
R3, R5—22,000-ohm
R4, R6, R15—1-megohm
R7, R8, R10, R14—100,000-ohm
R9—470,000-ohm
R11—1-megohm cermet potentiometer (Digi-Key 36C105 or similar)
R12—47,000-ohm
R13—4.7-megohm
R16—1500-ohm
R17—Cadmium-sulphide light-dependent resistor, (Mouser 338-76C348)

CAPACITORS

C1—330-µF, 10-WVDC, low-leakage radial-lead electrolytic
C2, C3, C5, C7, C8, C9, C10—0.1-µF, ceramic disc
C4, C6—10-µF, 10-WVDC, radial-lead, electrolytic
C11—470-µF, 6.3-WVDC radial-lead electrolytic

ADDITIONAL PARTS AND MATERIALS

B1—9 volt alkaline transistor radio battery
S1—SPST toggle or slide switch
Battery clip, enclosure, hookup wire, hardware, adhesive, tape

Note: The following parts are available from A. Caristi, 69 White Pond Road, Waldwick, NJ 07463: Set of two boards @ $15.50; photocell (R17) @ $5.75; 78L05 regulator (IC1) @ $2.00; LM324N quad op-amp (IC2) @ $3.25; LMC555CN CMOS oscillator/timer (IC3) @ $3.25. Please add $5.00 postage/handling.

activated each time IC3 produces a pulse. That provides a visual indication of the heartbeat or pulse rate of the subject. Note that a piezo buzzer may also be used in addition to LED2 to produce an audible indication of the heart rate.

Transducer Construction. The Heartbeat Machine is made up of two parts: the transducer assembly—comprised of a piece of unetched printed-circuit material, containing R17 (the photocell) and LED1—and a printed-circuit containing the amplifier and indicator circuitry. The boards are stacked and separated by spacers, and held together with hardware.

The transducer assembly is made up of a piece of unetched circuit-board material, plus three lengths of $^3/_{16}$ or $^1/_4$-inch square, plastic, wood, or metal rod. The transducer assembly layout is shown in Fig. 3. Drill holes in the board at the locations shown for the photocell and LED. For ease of assembly, drill the holes for the LED and photocell ever so slightly smaller than those components so as to produce a snug fit. Note: Although not shown in Fig. 3, there should be four mounting holes drilled in the transducer board matching the mounting holes in the amplifier board. The easiest way to do that is to drill the mounting holes in both boards at the same time.

Once all of the holes are drilled, mount the photocell, LED, and square rods and secure them in place using RTV silicone rubber, epoxy, or other adhesive. The rods are placed so that they position the finger to rest squarely over the LED and photocell. The larger hole is for the photocell and the smaller one is for the LED. Cut the pieces of square rod to the length shown in Fig. 3. The top of the LED should be $^1/_8$ inch above the copper side of the board, and adhesive should be placed underneath. The photocell should be set so that its light sensitive surface is about $^1/_{32}$ inch above the copper side of the board. Do not get any of the adhesive on the surface of the photocell or on the top part of the LED. Set the assembly aside until the adhesive has fully cured. That can take a day.

Identify the cathode lead of the LED. Then, using a small drill bit (such as #57), drill a hole at a location away from the finger-rest area for the cathode lead of the LED. Solder the cathode lead to the copper surface of the board. Finally, drill one more small hole in the board for the common lead connection as indicated in Fig. 3. That completes the transducer assembly. The remaining three component wires and the common lead will be connected to the main circuit board later.

Circuit-Board Construction. Figure 4 shows a full-size template of the author's printed-circuit layout for the main board. An etched and drilled board is available from the source given in the parts list. Hardwiring the circuit on a perf-board is not recommended, due to the high gain of the amplifier. A parts-placement diagram for the author's circuit board is shown in Fig. 5. When installing the components, pay close attention to the orientation of the polarized parts. Just one part placed in the circuit backwards will render the circuit inoperative and may cause damage to one or more components. Sockets for the two integrated circuits are optional. Capacitors C1,

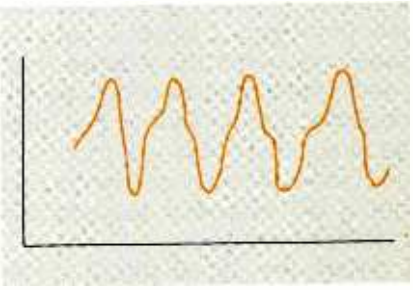


Fig. 2. The subject places a finger over both the LED and the photocell, which are placed in close proximity to each other surrounded by a light-proof enclosure. The circuit detects changes in blood flow and produces the waveform shown here. It is then processed to give a visual indication of the heartbeat or pulse rate of the subject.

C4, C6, and C11 can be mounted in a horizontal position to keep board height to a minimum.

Note the location of the four connections to the transducer assembly, as well as those for the battery, LED2, and power switch. LED2 should be temporarily connected to the circuit for the preliminary test, which must be performed before the transducer and circuit board are stacked and secured together. Attach a 9-volt battery connector to the board where indicated in Fig. 5. The connector can be salvaged from an old 9-volt battery by removing the connector, and soldering flexible

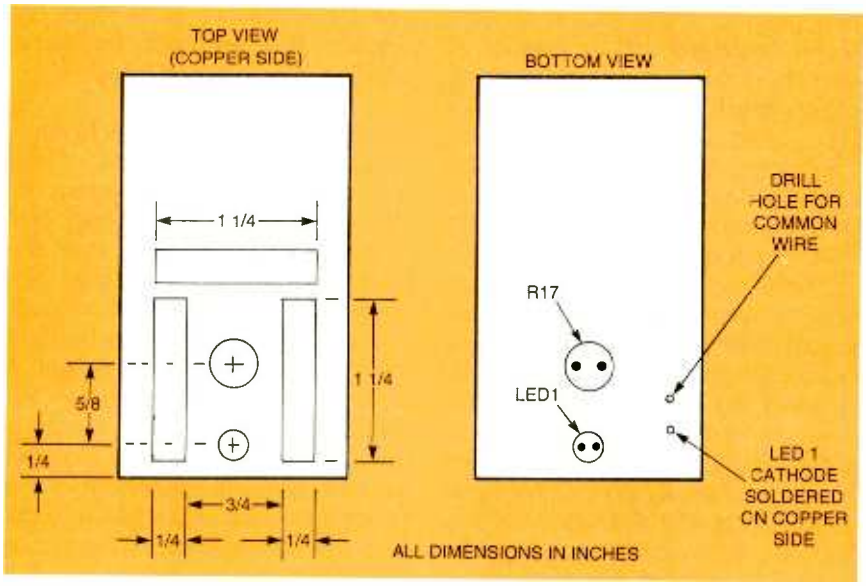


Fig. 3. The transducer assembly (details of which are shown here) is made up of a piece of unetched circuit-board material, containing R17 (the photocell) and LED1, plus three lengths of $^{3}/_{16}$- or $^{1}/_{4}$-inch square-plastic, wood, or metal-rod.

insulated wires to the terminals. Use red and black if possible, and be sure to connect the positive (red) wire to the female terminal and the negative (black) wire to the male terminal. When finished, plug a 9-volt battery into the connector and use a DC voltmeter to verify the polarity of the wires.

When the circuit board is fully assembled, examine it very carefully for opens, short circuits, and bad solder connections, which may appear as dull blobs of solder. Any solder joint which is suspect should be redone by removing the old solder with desoldering braid, cleaning the joint, and carefully applying new solder. It is far easier to correct problems at this stage rather than later on if you discover that your Heartbeat Machine does not work.

Preliminary Test. The circuit must be checked before final assembly, by first making four temporary connections between the transducer assembly (the LED1, photocell, and common) and main circuit board, using four pieces of small gauge flexible insulated wire about 12 inches long. Be careful when handling the transducer assembly so as not to break the wires on the photocell and LED. Additionally, LED2 should be temporarily connected into the circuit using wires that are long enough to position the LED so that none of its light can affect the photocell.

You'll need a DVM or VOM to check out the circuit. You can also use an oscilloscope to visualize the slow moving heartbeat waveform at pin 7 of IC2-d. The photocell must not be exposed to any light during the test, so that it can detect blood flow. One way to blackout its environment is to place the transducer into a small light-proof covered box. The box should have a small hole in it that allows your finger to be inserted to rest in its proper location. Another method is to perform the test in a very dark area.

Connect a 9-volt battery to the circuit, apply power, and measure the voltage at the output of the regulator. Your meter should read between 4.75 and 5.25 volts. Allow a few seconds for the circuit to settle down. With no light striking the photocell, measure the voltage at pins 1 and 7 of IC2. The reading should be about 2.5 volts. Expose the photocell to light while observing the voltage at pin 7. Note that it moves 1 or 2 volts in each direction as the light source is applied and removed from the photocell. If you get a different response, check battery voltage and polarity under load to be sure it is at least +8 volts. Check the orientation of C1, C11, and U1. Measure the voltage at pins 13 and 14 of IC2 to verify that it is about 2.5 volts. If not, remove power and check all components associated with IC2. Check the board for opens, shorts, and bad solder joints. Try a new chip. After repairing the fault, proceed with the test.

Set the sensitivity control to the maximum clockwise position so that the voltage at pin 9 of IC2-c is about 2 volts, for maximum circuit sensitivity. Place the transducer assembly into the light-proof box and rest your index finger firmly on the LED and photocell. Apply power and wait until the circuit settles down. Note that LED2 blinks for $^{1}/_{10}$ second at a rate that is synchronized with your pulse.

If LED2 flashes reliably with your pulse rate, the sensitivity control may be left in the maximum clockwise position. If the circuit seems to be too sensitive, set the control slightly CCW to reduce sensitivity. Try the circuit on more than one person if possible. If the Heartbeat Machine operates normally, proceed to the final assembly. Otherwise trou-

(Continued on page 84)

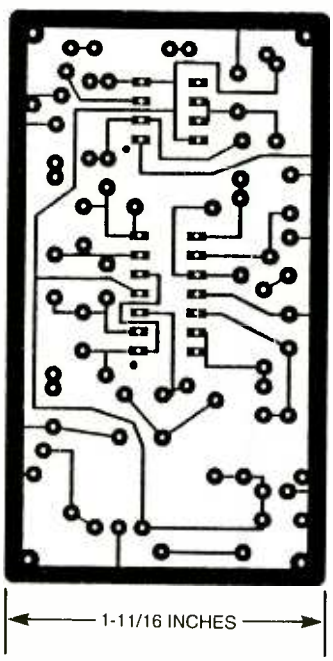
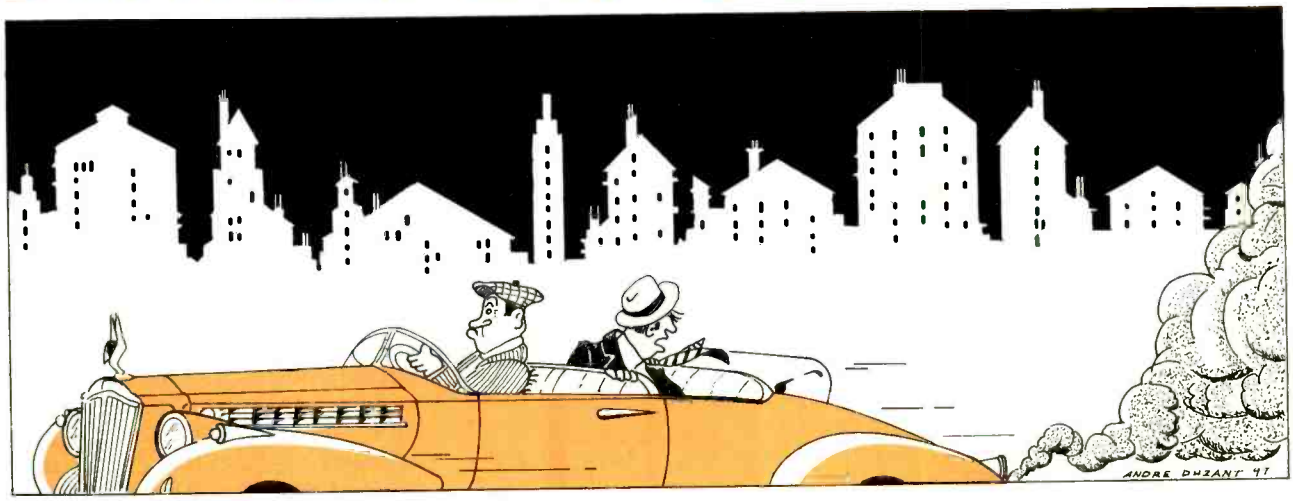


Fig. 4. This full-size template of the author's printed-circuit layout for the amplifier board can be lifted from the page and used to etch your own printed circuit board. Or, if you prefer, an etched and drilled board is available from the source given in the Parts List.

ELECTRONICS HELP CLEAN UP THE AIR

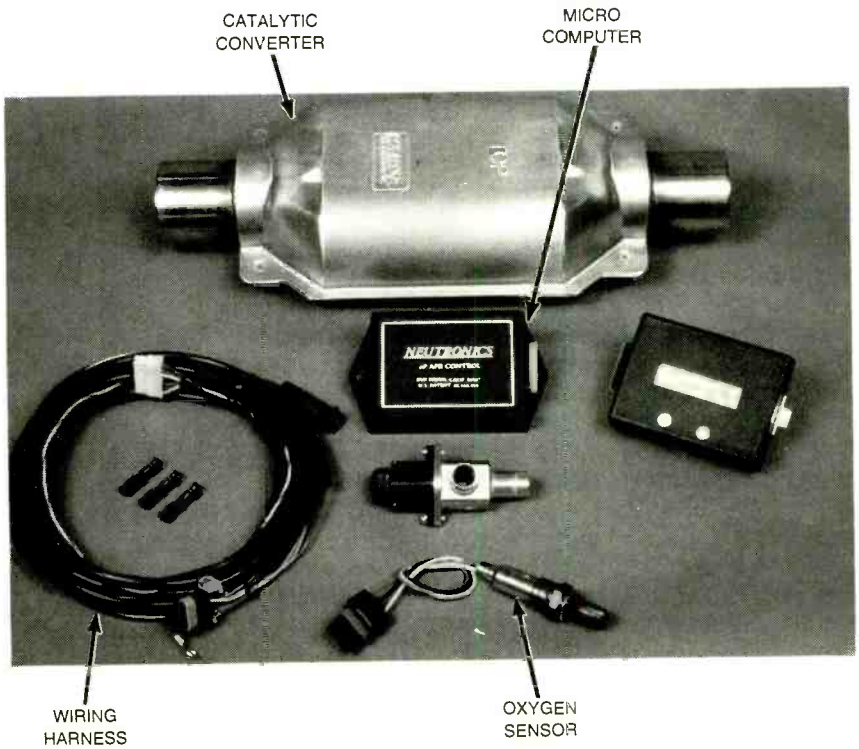


Rather than forcing people to junk those old "smoke generators," electronics manufacturers are now producing retrofit emission-control systems to help older vehicles comply with the new clean-air standards!

BILL SIURU

Now that new vehicles have become extremely clean running, greater attention is being focused on cleaning up the emissions produced by old cars and trucks. Those "gross emitters" contribute far more than their fair share to the air pollution problem. For instance, in California, 1980 and older vehicles account for only about 20% of the vehicle population and total miles driven. However, they produce about half of the vehicle emissions. One answer is to remove the high emitters from the road through accelerated retirement programs. There are "clunker" programs that purchase old cars for scrap for a few hundred dollars. Unfortunately, those old cars are often owned by the people who can least afford to replace them. The alternative for them is to install aftermarket emission-control equipment that will reduce the amount of pollutants that the cars produce, allowing them to provide daily transportation with minimum harm to the environment.

The KAT 200. One such retrofit emissions scrubber is the KAT 200 developed by Neutronic Enterprises Inc., San Diego, California. After retrofitting with the KAT 200 Micro Controlled Emission system, most vehicles, even those without either feedback controlled emission systems or three-way catalytic converters, can meet current U.S. Federal or E.C. (European Community) emission standards.



The Neutronics aftermarket emission system consists of a Kat 200 Micro computer, a heated or unheated oxygen sensor, a linear actuated stepper-motor induction control valve, wiring harness, and a three-way aftermarket catalytic converter which are added to the exhaust.

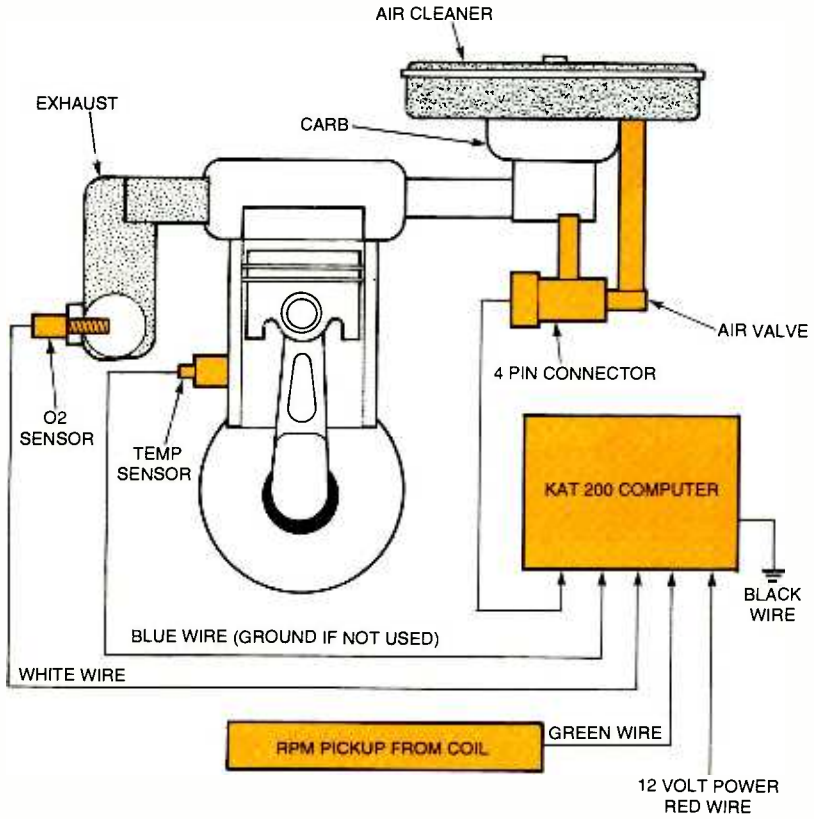


Fig. 1. The Neutronics system's oxygen sensor is mounted to or near the exhaust manifold, where it can measure the oxygen content of the exhaust. The oxygen content of the exhaust allows the computer to infer the air-to-fuel ratio of the air-fuel mixture. If the mixture is too rich, the computer commands the control valve to increase the amount of air in the mixture. On the other hand, if the mixture is too lean, the computer commands the control valve to reduce the amount of air entering the intake manifold. The particular catalytic converter used depends on engine size and vehicle weight.

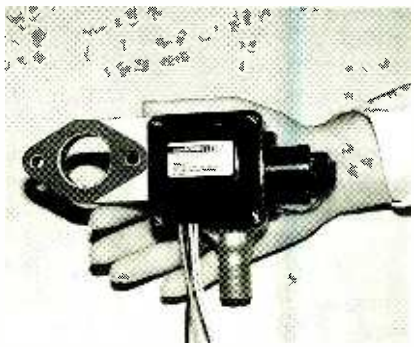
Neutronic Enterprises, Inc. already exports about 70% of its aftermarket air pollution control devices to Germany and South America.

The KAT 200 microprocessor feedback control system replaces the original oxidation catalytic converter used on cars with a new closed-loop control device and three-way catalytic converter. The system can be used with either carburetors or fuel injection systems. It can also be used on vehicles without catalytic converters. The device monitors the air-fuel mixture and maintains the air-fuel mixture close to the ideal, or stoichiometric, ratio. The term stoichiometric refers to a condition in which a precise amount of air is mixed with the optimal amount of fuel, so as to achieve complete and total combustion. If the mixture ratio is less than stoichiometric, the mixture is deemed rich because there is more fuel than needed for complete combustion. Greater than stroichiometric means that the mixture is lean with an excess amount of air.

The Neutronics system consists of a KAT 200 Micro computer, a heated or unheated oxygen sensor, a linear-actuated induction control valve with a stepper motor, wiring harness, and a three-way aftermarket catalytic converter. The Neutronics system's oxygen sensor is mounted to or near the exhaust manifold, where it can measure the oxygen content of the exhaust. The oxygen content of the exhaust allows the computer to infer the air-to-fuel ratio of the air-fuel mixture. If the mixture is too rich, the computer commands the control valve to increase the amount of air in the mixture. On the other hand, if the mixture is too lean, the computer commands the control valve to reduce the amount of air entering the intake manifold. The particular catalytic converter used depends on engine size and vehicle weight.

The Neutronics system is the only retrofit emission control device that has been certified by the California Air Resources Board for use on models with open-loop, oxidation catalyst systems. As required for certification, the device reduces two of the three measured emissions—nonmethane hydrocarbons (NMHC), carbon monoxide (CO) and nitrous oxides (NO_X)—by at least 20% without increasing the third emission gas. An extensive test program showed the system actually does much better. The testing was done on thirteen1975-80 American and imported vehicles (both cars and pickups) with 111,000 to 387,000 kilometers (68,800 to 240,000 miles) on their odometers.

Compared to the "baseline" measurements taken after the vehicles had received maintenance, but before the retrofit system was installed, the average emissions for the 13 vehicles was reduced by 72% for NMHC, 64% for CO and 62% for NO_X (see Fig. 2) with the installation of the device. Maintenance included oil and filter changes plus tune-ups, and repairs to the fuel and ignition systems that are normally performed to pass emission tests. Six of the vehicles were driven 48,000 kilometers in long-term road testing. The average reductions after 48,000 kilometers was still 51% for NMHC, 22% for CO, and 47% for NO_X.



In the LeanPower system, air is supplied via the intake tube at the bottom of the device. The carburetor plate at the left fits between the carburetor and intake manifold. The black box contains the Lean 2000 signal processor.

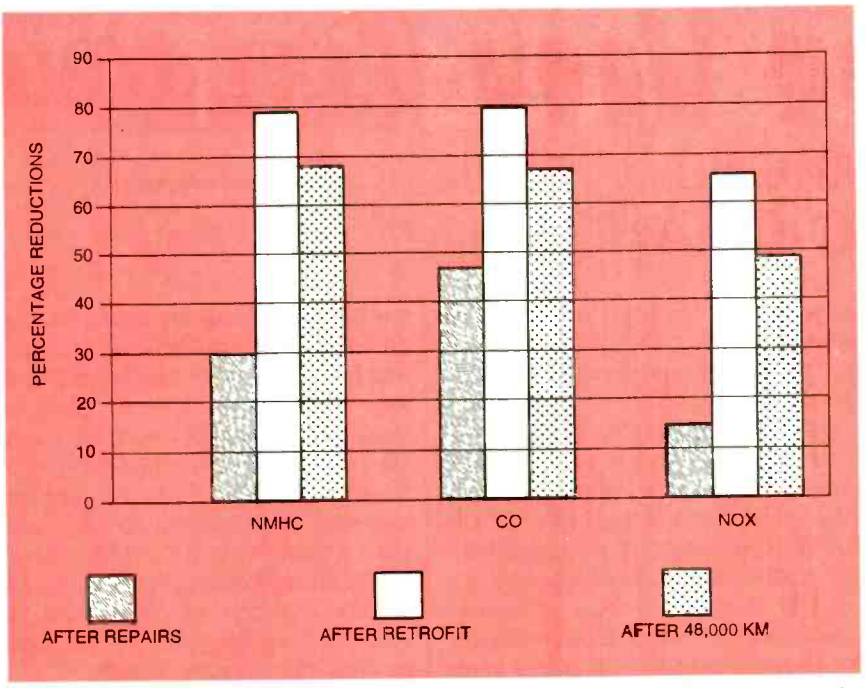


Fig. 2. Reduction in hydrocarbons, carbon monoxide and nitrogen oxide emissions in the various phases of testing the KAT 200 system. "As Is" emissions were measured as the vehicles were received at the testing site. The "48000 km" condition is only for the six vehicles in the duration testing.

A prototype retrofit program is being sponsored by the San Diego County Air Pollution Control District (SDCAPCD). The program has been funded to retrofit 1250 vehicles over the next three years. Using cost sharing with revenue collected from vehicle registration fees, the district can give owners of vehicles that fail bi-annual smog tests and cannot be repaired under California cost limits two options—scrap the vehicle and accept $600 or pay a maximum of $150 to prepare the vehicle for the KAT retrofit.

If the owner decides on the retrofit, the vehicle is taken to the retrofit repair station, which determines if it can be repaired. That ensures that the owner's or district's funds are not wasted on a non-repairable vehicle. If the vehicle is repairable, the owner pays up to $150 to tune and prepare the vehicle for retrofitting. The district then pays $500 to retrofit the vehicle. Now the owner has a vehicle that can be used for at least two more years, and the public gains a clean vehicle.

LeanPower. LeanPower Corporation of College Park, Maryland has also developed and patented an aftermarket emission control system to reduce pollution from older cars and light trucks. The LeanPower system controls the air/fuel mixture so that the engine operates at the leanest air-fuel mixture the engine can tolerate under most driving conditions. (See Fig. 3.) The leanest conditions minimize emissions.

The LeanPower closed-loop, feedback control system uses a signal processor, the *Lean 2000* chip, (see Fig. 4) to keep the engine running at its leanest limit. On carburetated engines, the engine is set up so that the air/fuel mixture is at stoichiometric, or perhaps slightly richer. The signal processor commands

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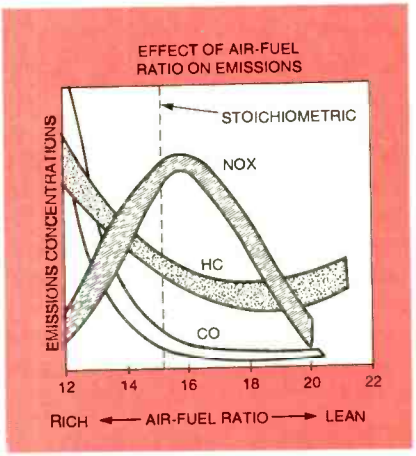
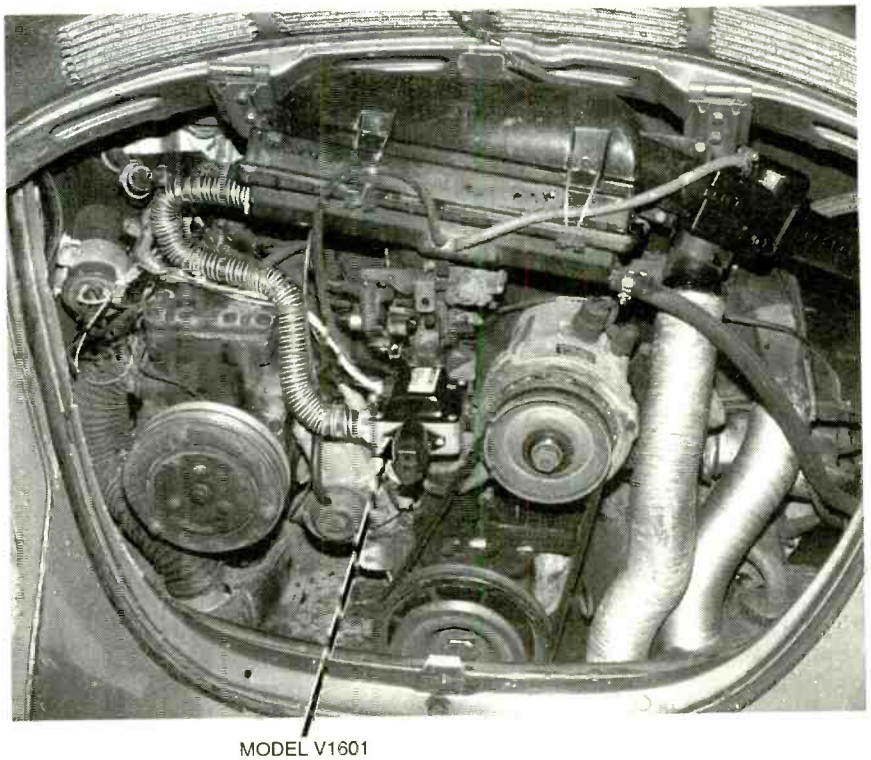


Fig. 3. It is desirable to operate an engine at the leanest mixture ratio possible in order to keep hydrocarbon, carbon monoxide and nitrogen oxide emissions at their lowest level.



The LeanPower emission system installed on an old Volkswagen Beetle.

PRODUCT TEST REPORT

TECHNICS SL-MC60 COMPACT DISC CHANGER

STEPHEN A. BOOTH

Multi-disc changers remain the most popular form of compact disc player. For some time, the so-called carousel changers have led the hit-parade. These house five CDs on a retracting-drawer turntable, and let you insert or change CDs even while one is playing. Lately jukebox-style "mega-changers," holding 24 discs or more, have been giving the carousel a run for the money.

With suggested retail prices as low as $250 for the 60-disc Technics SL-MC60 CD changer tested here, and dimensions no bigger than a carousel, the CD jukebox is finally a viable choice for many people limited by budget and space on the stereo shelf. They have just about all the same features and programmability options as single CD and carousel players, and sometimes more. What might be most interesting is that the access time from CD to CD isn't much longer than a carousel's despite the greater capacity of the jukebox.

For its price and convenience, the Technics SL-MC60 is a very alluring audio product. Operating instructions are well written and complete, and most important, its performance in electrical tests is respectable, though not spectacular. You will find a summary of these test results in the accompanying table, conducted by the Advanced Product Evaluation Laboratory (APEL), an independent testing facility located in Bethel, CT.

Features

The SL-MC60 holds 60 CDs standing on end side by side in a rack behind its drop-down front panel. There's also a slot for a single-disc play, which lets you insert or remove a CD without affecting the programming of the rest of the library. The actual player mechanism (laser pickup and CD drive) shunts back and forth laterally behind the rack and extracts the selected CD for playback. At any time, even when music's playing, you can open the front panel to load or swap discs. That's easy enough, and this way you can keep track of what's inside.

Some more expensive and elaborate jukeboxes have LCD readouts that identify the CDs within. But, unless connected to a personal computer and monitor, they seldom display the entire play list. You usually have to scroll through, title by title. Technics' solution is low-tech but decidedly easier. If direct access to the data is what you want, a photo-style album accompanies the player, so you can insert a CD's liner-notes in a transparent sleeve numbered to correspond with a disc's position in the changer. Simple-but effective, an easy way to store and manage your entire music collection. The CDs are always in the changer, eliminating the need to handle them. What you do with the unoccupied CD jewel-boxes is up to you!

The changer offers another easy way to at least organize, if not identify, the 60 titles behind the door. You can program the discs into five "groups", and then label the groups according to any of 14 musical genres (such as Rock, Jazz, Classical, Country, Ballads, Dance, Party, and others). Happily, this doesn't pigeon-hole the CD into an exclusive classification. You can program a disc into more than one "group." For example, a Rock title might also be in your selection for Dance and for Party, or a selection for Country might be cross-referenced to Ballads.

As you might suspect, all this cross-referencing might become a little tiresome if discs are widely separated in the changer rack, and you had to figuratively watch paint dry while waiting for the machine to get to one place from another! Here's where the relatively fast access-time of the SL-MC60 comes into play. The jukebox takes 6.1

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The Technics SL-MC60 60-CD changer.

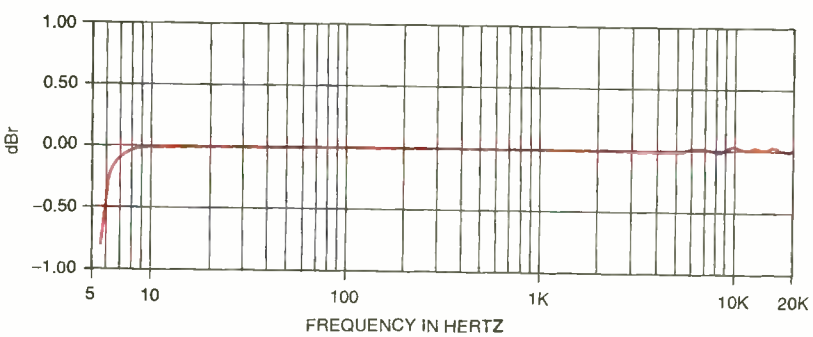
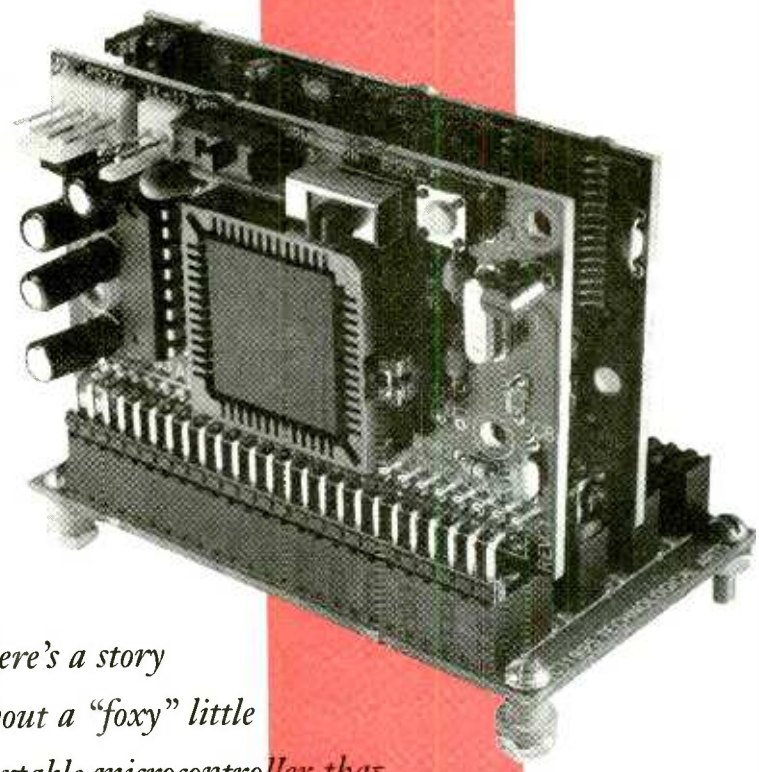


Fig. 1. As this figure shows, the frequency response of the SL-MC60 is virtually ruler-flat over the entire audio range.

LARRY R. ANTONUK

MICROCONTROLLER STARTER KIT



Here's a story about a "foxy" little portable microcontroller that generates Morse code at variable time intervals! This microcontroller kit is perfect for learning electronics, computer fundamentals, hardware and software microcontroller design, and it can be incorporated as the core of custom or new gadget design.

The monthly ham radio meeting was just about over. I glanced at my watch as Randy, the club president, made a final announcement. "OK then— it's settled. We'll have our first hidden transmitter hunt, or "foxhunt" next month, on the Saturday before the next meeting."

I knew this was coming—the group had been kicking the idea back and forth for a few months now. Of course, none of them had ever actually been in a foxhunt, or even really knew what one was, but they thought it sounded like it could be fun.

"Just a minute. Just a minute!" It was Jim, the club pessimist. "I don't mean to rain on anyone's parade here, but to have a foxhunt you need a fox! There are plenty of spare radios around, but don't we need some sort of timer to turn the thing on and off? We can't just put a brick on the key and expect the thing to transmit for three hours! Besides, that would be too easy to find. We need some sort of timer—maybe a half a minute on, a couple of minutes off. You know, take a direction bearing, drive a little bit, take another bearing—like that. Who can whip us up some sort of timing circuit?"

I was glancing at my watch again, and when I looked up I noticed everyone looking in my direction. You see, I had some kind of reputation as the club's electronics expert. "Oh," I said. "Sure, no problem. I can throw something together by next month." Heck, I could throw that together on my way home tonight. Just take a 555 timer chip, set it up with a variable pot to change the duty cycle... .

"Hold it. Hold it!" It was Jim again. "I was at a foxhunt once where they sent the 'end of message' sign —you know, SK just before the transmitter turned off. That was great — it let you know when you were about to lose the signal, so you could take that one last reading. Can we get something like that?"

Well, uh.. sure, no problem." This was getting sticky. Now I had to put together a tone circuit—maybe another 555 timer chip—and something to make the SK signal in Morse code, dit-dit-dit-dah-dit-dah—maybe some sort of shift register chip, and a clocking circuit, and maybe a... .

"Excuse me, gentlemen. Aren't we forgetting something?" Oh boy, it was Bruce, the Public Service fanatic. "FCC Rules and Regulations clearly state that all transmitters shall be clearly identified, either by Morse code or in plain English, at an interval not to exceed ten minutes. I hope you foxhunters plan on having a callsign tacked on the end of those transmissions!"

Randy walked over to the podium, keeping one eye in my direction. "I'm sure that'll be no problem for 'Mr. Electronics' over there. Well, it's nine-o-clock. Hearing no further business, I declare this meeting adjourned!" He rapped on the podium with his gavel, and twenty-eight hams jumped up and headed for the coffee and brownies.

"Hang on!" I leapt to my feet. "You know, the Morse ID part may be a little tricky. Maybe we could do something else for the fox.

Maybe some remote control thing, or maybe a...".

It was no use. I was talking to myself. As I watched the feeding frenzy at the coffee maker, I pondered my situation. The fox required a variable timing circuit that would put a short bit of Morse code at the end of each push-to-talk (PTT) interval, and also had to transmit a call sign at ten minute intervals. It needed to be battery powered, and pretty small—the fox hider had to be pretty creative when he stashed the fox. The final package needed to be ready in three weeks. And my reputation as the club electronics guru depended on how well it worked. I was in deep trouble!

In Search of a Fox. When I got home that night I pulled out a few

Fig. 1. The ADAPT-11 starter package comes with an instruction manual, reference guide, programming cable, and a disk of firmware.

of my radio handbooks. I could handle the timing circuit, and the tone generation was no problem, but keying the tone on and off to create Morse code characters—Yikes! There was some serious circuitry involved there. Not only that, but it was digital circuitry, and I was really an analog kind of guy. I put the books on the shelf and went to bed in dismay.

T-minus twenty days, and counting. I awoke the next morning and reviewed the situation. I was still dismayed, but I was just as determined to find a solution. Later on at work I pulled out all the electronics journals and magazines. I knew that this was a job for some sort of microcontroller unit, but which one? I'd been saying that I needed to explore this technology for about five years now, but the prices for the development kits were always beyond my budget. As I thumbed through the back pages of the magazines, I found that things had changed. There were several chips available that were erasable and re-programmable, and the prices for the development kits now started at under one hundred dollars. I quickly narrowed the field down—I needed just a few I/O ports, some sort of timer capability, and I felt I wanted it to be programmable in a language other than BASIC. (I couldn't keep my guru status if I admitted I'd programmed something in BASIC!). Of course, it needed to be affordable.

ADAPT-11 Microcontroller Starter Kit. After much searching, I decided on the ADAPT-11 microcontroller modular system starter package from Technological Arts, in Toronto, Ontario, Canada. According to the ad, their board plugged right into a standard prototyping board; could be programmed from a PC; and the starter kit came with a board, a programming cable; and demo software. The ADAPT-11 used a Motorola MC68HC811E2 microcomputer chip, which contained 2K of electrically erasable on-chip memory, three eight-bit I/O ports, eight analog-to-digital converters, and an on-chip timer system. It was just the ticket! With much relief, I ordered their starter kit (P/N AD-11-SP) at a price of $74.95 postpaid (US dollars). It was T-minus nineteen days, but at least I had some direction in fox building!

Over the next several days I decided to do some research on the 68HC811 microcontroller, so I could get right into the thick of things when the ADAPT-11 arrived. I went to the public library, then the college library, and struck out in both places. What I was looking for was a complete foxhunt transmitter control program, ready to download into any 68HC811 microcontroller.

About a week passed, and I did not think the project much. However, I noticed that whenever I did think about it I was overcome with a vague feeling of gloom and despair. One night I came home from work and found a small parcel in the mailbox. Sure enough, it was from Canada—Technological Arts. But the box was only about 5 x 9 x 1 inches; maybe this was just the documentation. I opened it up, and found that this was indeed the whole order—the microcontroller board (a mere 2 × 3 inches), a couple of cables, a 3.5 inch disk, a Motorola Programming Reference Guide, a User manual along with data sheet and schematic from Technological Arts. Hmmm. I had to be at a meeting that evening, but I quickly popped the disk into my computer. A few .ARC files, some .ASM files, a few .BAT files — nothing like CW.EXE or FOXHUNT.TX. I flipped through the ADAPT-11 User's Guide —just a few notes on how to download files to the board. I grabbed the Programming Reference Guide — memory maps, opcode tables, control bit assignments.

It could just as well have been written in Greek. Maybe it was. Then it occurred to me—this whole kit was meant for someone who already knew what he was doing! The microcontroller kit looked insurmountable, but there wasn't enough time to go back to the discrete IC approach. I sure couldn't hide in the bushes and key the transmitter myself. There was only one solution—I was just going to have to buckle down and figure out enough about microcontroller programming to get myself out of this jam.

T-minus five days and counting. On the next available night, I sat down with the kit. The first thing to do was to figure out how to program the thing. The ADAPT-11 came with a three foot cable with a DB-9 connector on one end and a three conductor header plug on the other. I plugged the cable into my computer, and the other end into the ADAPT-11. I popped the board into a standard prototyping board, and jumped the five volt and ground pins to their respective sockets. According to the book, the board came pre-loaded with a

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demonstration program. I wired up a small amplified speaker to one of the output ports as the manual suggested, and hit the power. The speaker dutifully beeped twice. I stared at the board— no smoke or steam was coming from any of the parts—so far, so good. I loaded a terminal program into the computer, and set the communications parameters as the book stated. I hit the enter key, and a small menu appeared on the screen. Well, the board was alive! The menu was simply a system that let the user perform a variety of operations on the board via the RS-232 port. For example, hitting "A" caused the board to output the status of the eight different inputs on the A Port. Hitting "0" to "7" caused the corresponding output of the B Port to toggle from high or low. Hitting one key caused the speaker to beep, and another displayed all the values present at the inputs of all eight analog to digital converters.

While there wasn't a pre-built foxhunt transmitter controller program on the disk, I did have all the functions I needed right here in this demo program. At the basic level, I really needed only two functions. First, I needed a pin to go high or low following a time interval—this would key the transmitter via the push-to-talk line. Second, once the PTT was activated, I needed to send some tones to the audio input of the transmitter. Somehow, the demo program was making a beep, and a beep is fairly close to a Morse code tone! I had no use at all for the analog inputs, or even reading whether a single pin was high or low, but apparently the demo program could do that too. The only problem now was how to modify the demo program to make it do what I wanted.

Yikes! It's Assembly Language. I dumped the supplied disk onto my hard drive, and reviewed the files. There was a file called DEMO.ASM—that looked like a good choice. I highlighted the file and chose VIEW. At first, I thought I'd looked at the wrong file. You know, like when you print out an .EXE file by mistake—all gibberish.

```
rbase     equ    $1000
STACK     equ    $00FF
portb     equ    rbase+$04
```

As I looked closer I noticed that things were lined up a little too nicely for trash...wait a minute! I'd seen this stuff before—assembly language! Yikes! That was a long time ago, and it was scary then. *(Editor's note: For the non-guru's out there, software is also supplied to program the 68HC11 in C or BASIC language).* As I scrolled through the program listing, things slowly came into focus. I found what looked like the beginning of the actual program, after all of the variables and stuff. There was the following code:

```
    ldx     #TONE_440; generate two 100 ms beeps @ 440 Hz
    ldab    #2
    ldy     #_100MS
    jsr     PulseXToneB
```

Generate two beeps, eh? I wasn't exactly sure how they did it, but it looked like this loaded some stuff into some registers, then jumped-to-subroutine (jsr) PulseXToneB to make the beeps. I found the subroutine later on in the program and found that it let you load the frequency of the tone into the X register, load the number of beeps into the B register, load the duration of the beeps and the space between them in the Y register—and make beeps! (I eventually found that they were simply flipping an output pin high and low at an audio rate.) I clicked my cursor on the ldab #2 line, and changed the 2 to a 3. No problem. Now I just needed to get the new program into the chip.

Several cups of coffee later, I finally got through the directions in the manual and figured everything out. Most of us have compiled a program on a PC, creating an .EXE file, but it's a little different on a microcontroller chip. Still, the EDIT/COMPILE/TEST cycle remains mostly the same. In a nutshell, the .ASM file contains the assembly language code which can be modified as we did in the above paragraph. The assembly file is changed into an S-record file, which is a standard file format for Motorola microcontrollers. This S-record file is changed into a binary object file using a conversion utility. The binary file is then sent to the controller via the RS-232 port. This whole process takes longer to explain than to perform, and all of the necessary assemblers, converters, and batch files are included with the ADAPT-11 package.

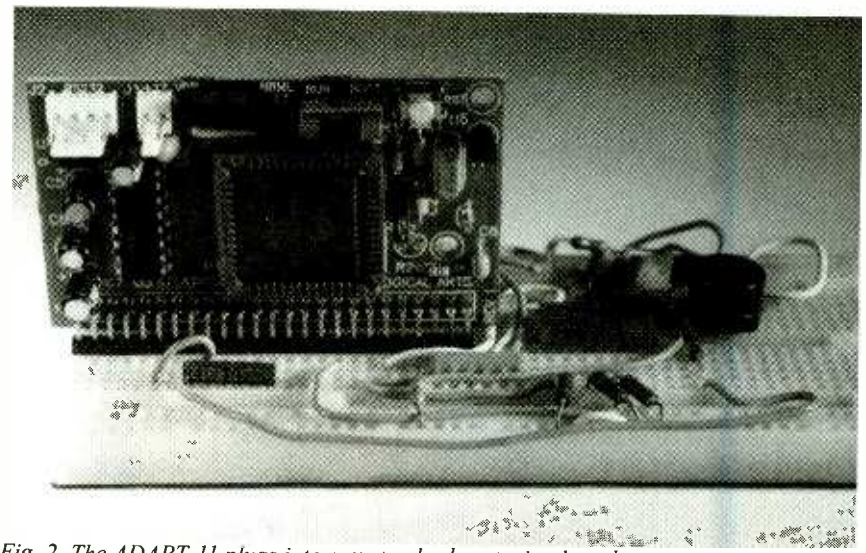


Fig. 2. The ADAPT-11 plugs into any standard protyping board.

Once the binary file is ready to send to the microcontroller, you simply load up a batch file, flip a switch on the board, and hit the board's RESET switch. This puts the board in a "ready to get programmed" mode. Hitting a key on your computer starts the batch file that sends the information to the micro. The download process takes about a minute and a half—the

(Continued on page 81)

STRETCHING RECHARGEABLE BATTERY TECHNOLOGY

Douglas Page

Tailoring a synthetic carbon fiber commonly found in socks, researchers have stretched rechargeable battery technology to new limits.

Scientists at Sandia National Laboratory in Livermore, California, have created safer, lighter, longer-lasting, and less-expensive rechargeable batteries, using a lithium-ion technology that shows considerable promise. The new batteries were specifically developed for use in electric vehicles. However, other industries, such as consumer electronics, aerospace, and defense, could potentially benefit—a prospect that excites researchers. "Lithiumion rechargeable batteries will eventually replace almost all rechargeable battery technologies," Sandia materials scientist Bob Crocker predicts, "because they have four times the energy density of lead-acid batteries, such as those used in automobiles, and two to three times the energy density of nickel-cadmium batteries. The heavy metals used in those conventional batteries are costly and pose environmental risks."

Lithium-ion Virtues. The new rechargeable lithium-ion batteries are safer to manufacture and operate, use less raw material, and are environmentally benign. The intercalation material for the new batteries was designed at Sandia from an inexpensive chemical called polyacrylonitrile. That is a fiber made of synthetic carbon and manganese dioxide, which is commonly used in socks and carpets. Sandia chars the polymer to create a carbon matrix that is then impregnated with extremely light lithium ions. That process eliminates the need to use inefficient and flammable, solid lithium metal. The carbon serves as a negative electrode where electrons are generated in a battery. The batteries convert the chemical energy into electrical energy.

The project is part of a three-year cooperative research and development agreement begun in 1992 with the U.S. Advanced Battery Consortium intended to develop new battery technologies. Its purpose is to meet the power needs of electric vehicles being developed to comply with approaching zero-emission standards. The requirements for zero-emission vehicle sales begin with ten percent of the vehicles sold in the Los Angeles area in 2003. Lithium-ion technology, using carbon and manganese oxide electrode materials, has an inherent advantage in cycle life and low material cost.

A lithium-ion battery the size of a book can store 400-watt hours and enable an electric vehicle to go four times farther than electric vehicles operated from lead-acid batteries. The bad news is, right now about 100 of the lithium-ion batteries would be needed for an electric vehicle to operate at acceptable range and acceleration demands. That liability does not apply to other applications. "In addition to electric vehicles, lithium-ion rechargeable batteries are useful in any power-hungry application," said Crocker, "such as laptop computers, cellular phones, lawn mowers, camcorders, and cordless power tools, because of their ability to work longer or lighter." Standard size batteries (currently dominated by NiCd cells, particularly 9-volt standard cells) could easily be

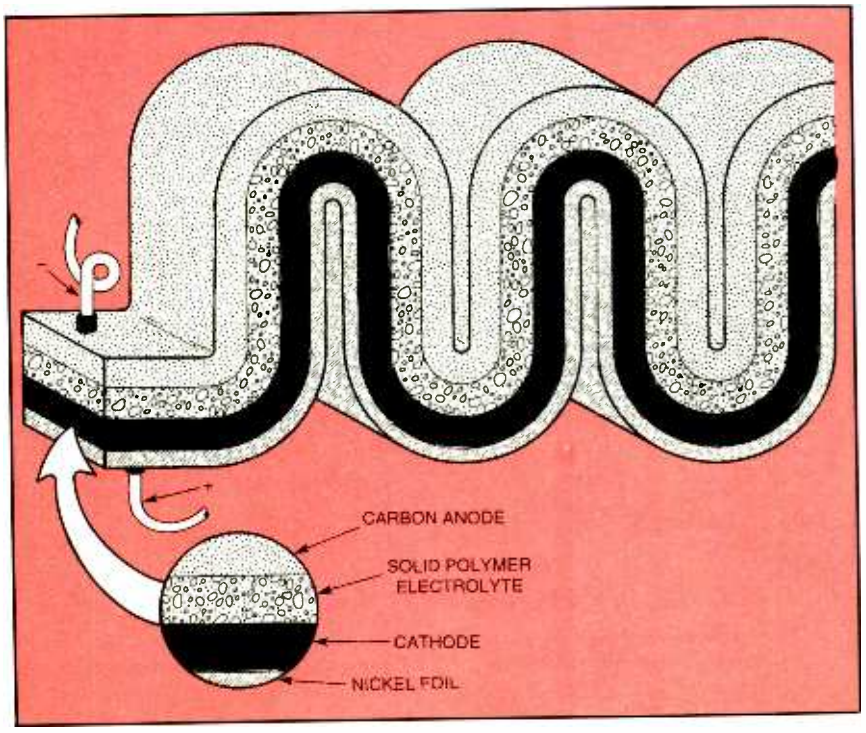


Fig. 1. Here is a cross-sectional view of the breakthrough rechargeable lithium-ion battery developed by researchers at Sandia National Laboratories using common carbon fibers found in ordinary socks and carpets.

replaced by lithium-manganese dioxide rechargeables, due to their low cost and low environmental impact. Sony and Sanyo are already marketing cellular phones and camcorders with lithium-ion batteries. Toshiba and Dell have laptop computers with lithium-ion batteries on the market.

The lithium-ion batteries are also attractive to aerospace and defense contractors. Their high energy density and potentially long life offers significant advantages to satellite technology, where launch weight is critical. Not only will they last four times longer than conventional batteries, but more instruments can be designed into satellites.

Lithium is a desirable anode material for rechargeable batteries because of its high energy density. Non-rechargeable lithium batteries have been available for years, but rechargeable lithium technology has been hampered by the electrode position of lithium metal during charging. During recharge, lithium metal is prone to form dendrites—metal whiskers—that tend to short the electrodes. Those shorts limit the number of charge-recharge cycles of the battery. The shorts also induce a fire risk. The development of the lithium-ion cells based on lithium intercalation materials heralds a breakthrough in rechargeable batteries. Lithium intercalation materials donate or accept lithium ions without dissolving or depositing lithium or any other solid.

Carbon's low-cost and high-charge density (comparable to lithium metal) has elevated it to the prime lithium intercalation anode material. That material is produced from a commercially available, low-cost polymer precursor, which is manufactured through an oxidative stabilization process, followed by heating to 1100° C, producing a fine powder whose particle size averages 5 microns. For battery manufacturing, the powder can be either bound into conventional porous electrodes for use in cells with liquid electrolytes or it can be processed into polymer composite electrodes for solid polymer electrolyte cells. ■

Computers ---- They're taking control!

"It's sneaky, but we let them play a game while we're really teaching them to read."

"I don't see how a child that does his family's income taxes can be failing at computer math!"

"Ms. Rose, it is very obvious to me that you are not IBM compatible!"

"I like working with the computer. It's so much easier to erase than the blackboard!"

"All my students read two grades above level. Is it me or the software?"

"I may not be a great wizard, but look at what I can do with a computer!"

Or are they?

RESEARCHERS INCH UP ON THE ULTIMATE

ELECTRONIC RULER

Government researchers have developed a ruler that will be hard to measure up to!

DOUGLAS PAGE

Scientists at the National Institute of Standards and Technology in Gaithersburg, Maryland, recently unveiled a tool, called the Molecular Measuring Machine, that, after some fine tuning, is expected to be able to precisely locate and measure molecule-sized features. The range of the new machine, the only one of its kind in the world, is 250,000 times greater than that of most scanning tunneling microscopes (STM), whose needle-like probes can already spot individual atoms.

The New Equipment

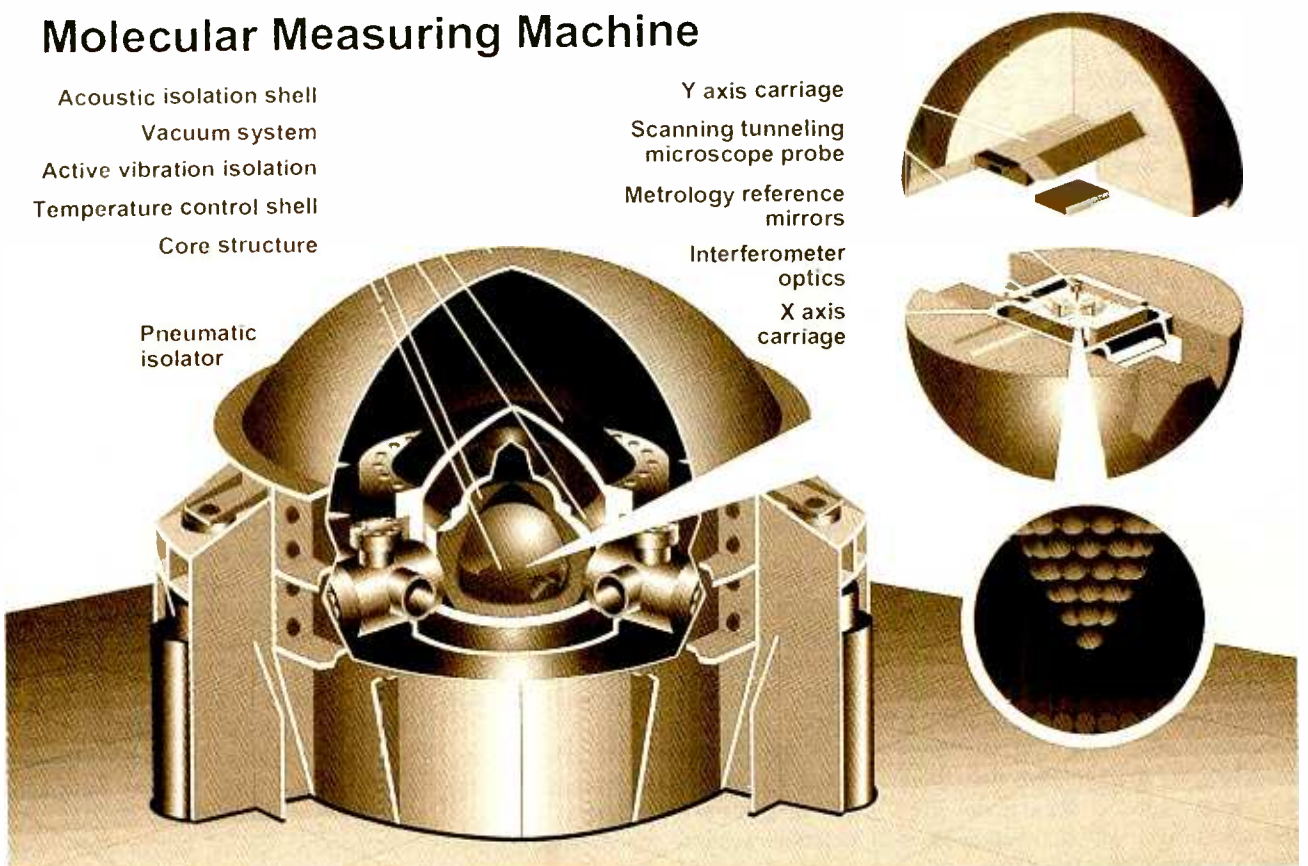
The new machine, known as M³, will be used to shrink the microelectronics world even further, allowing semiconductor manufacturers to align masks during the complex process of printing ever smaller circuit patterns. M³ will also be used to calibrate various manufacturing measurement references that manufacturers can use to check the accuracy of their own measurement equipment. The instrument is the invention of a team lead by Clayton Teague, chief of the Nanoscale Metrology Group in NIST's Manufacturing Engineering Laborator. He began the project in 1987 to meet the U.S. microelectronics industry's most advanced measurement requirements into the 1990s. M³ is the result of that effort.

The researchers expect M³ to measure, within one billionth of a meter—the equivalent of a string of four or five silicon atoms—the distance between two points. That's an area that is about a square 50 millimeters on a side, just smaller than a folded dollar bill. By comparison, the range of most STMs is about one thousandth of a meter, or one-tenth the diameter of a grain of sand. Figure 1 demonstrates M³'s measuring capabilities relative to common objects.

For perspective, M³'s capabilities are similar to being able to locate two widely separated grains of sand in a 2,500 square-kilometer (960 square-

(Continued on page 77)

Molecular Measuring Machine



Here are the components of the molecular measuring machine, known as M³, designed by the National Institute of Standards and Technology. The machine will help shrink the microelectronics world even further.

SCANNER SCENE

Tracking Trunked Transmissions

MARC SAXON

The prayers of many scanner fans were answered with the introduction of *Uniden America Corporation BC235XLT Trunk Tracker*, the world's first scanner capable of tracking a selected radio transmission as it moves across a trunked radio system. This is a revolutionary unit, to say the least.

Multi-channel trunked 800-MHz radio systems are now becoming very popular in the public-safety, business, and other radio services. Using standard scanners, monitoring enthusiasts have found it extremely difficult, if not altogether impossible, to track a conversation as it shifts from one frequency to another within a trunked system's repeaters. With a standard scanner, you need to initiate a new search each time the conversation breaks and the channel switches. You could end up in another conversation, and by the time you find the one you wanted, you might have missed most of the traffic. But the BC235XLT follows the conversation from channel to channel.

The BC235XLT can track Type I, II, and IIi, as well as hybrid systems. There are ten trunking banks. You program the repeater output channels for a particular trunked system into one of the banks, which will accommodate up to 30 channels. Program the system type: Type II (sort of the default) or Type I. If Type I is selected, then you can enter the individual fleet sizes and start locations; or you can select from 16 preset fleet maps. For hybrid systems, you enter all of the Type I and IIi fleets and everything else will be Type II. This is rather a nuisance if you don't know the fleet map for a particular system, but most now are Type II, and as time goes on you'll be better able to figure out the fleet maps.

Once the scanner is programmed, select trunked mode and one of the 10 trunking banks. The unit will begin searching for the system's data channel. When it's found, the scanner starts searching. IDs will be displayed as they are received. If the delay mode is activated, when the conversation pauses the ID remains in view. The scanner seeks out the rest of the conversation on another channel until the delay expires. If the feature is off, the scanner immediately grabs the next ID. Type II IDs are displayed as "2048"; Type I as: "1-5."

Uniden's revolutionary Trunk Tracker can actually follow trunked conversations as they jump from frequency to frequency.

There are ten scan lists for each trunking bank. You enter IDs that you want to scan into those lists. Each list can take ten IDs, and you can select or delete any of the lists while in scan mode.

While in search or scan mode, there are 15 repeater activity indicators across the top of the LCD screen to show system status. Each represents a repeater, and the ones displayed represent active conversations. When the scanner locks onto a conversation, the indicators turn off except for the control channel and the one being monitored.

When you find a conversation you want to monitor, push "hold," and the BC235XLT will look for and track it until you return to scan or search mode.

This is 300-channel scanner that receives 12 bands plus VHF aeronautical and preprogrammed Service Scan for police, fire, emergency, marine, and weather channels. There are ten priority channels. The internal memory backup will hold programmed frequencies for more than three days without power. The scanner's suggested retail price is $429.95.

Marines to the Rescue

Now is the time of year when the marine channels are at their most active and interesting. If you are monitoring within earshot of a coastline, navigable river, inland waterway, or large lake, why not tune up on at least some of these channels.

Pleasure craft, yacht clubs, marinas, and the like literally swarm on 156.425, 156.475, 156.50, 156.55, 156.875, 156.95, 156.975, and 157.025 MHz. Try 156.45 MHz as the calling channel.

Commercial craft, including ferries, tugs, water taxis, tankers, ore carriers, harbor pilots, etc., can be heard on 156.30, 156.35, 156.375, 156.40, 156.50, 156.55, 156.875, 156.90, 156.95, 156.975, and 157.025 MHz. Try 156.45 MHz as the calling channel.

Vessels report emergencies to the Coast Guard on 156.80 MHz, and are usually asked to switch to 157.10 to continue their communications.

The Coast Guard can be monitored on 156.60, 157.05, 157.075, and 157.15 MHz. The Coast Guard Auxiliary uses 157.175 MHz.

Near large commercial harbors, monitor 156.275, 156.30, 156.325, 156.60, 156.65, 156.675, 156.725, and 157.00 MHz. Some harbor police use 156.85 MHz. Vessels requesting that canal locks or drawbridges be opened

(Continued on page 79)

DX LISTENING

Hallicrafters S-41G Skyrider Jr.

DON JENSEN

One day, nearly 50 years ago, my father brought home a used shortwave receiver.

As a young boy I had already discovered the fun of tuning in stations in far off lands on the family's all-band console radio. I heard HCJB in Quito, Ecuador, stations in Australia, Switzerland and a few other countries. I'd even logged, somewhat furtively in those days, R. Moscow!

Rare and unusual shortwave receiver, the Hallicrafters S—41W Skyrider Jr., vintage 1945-46.

But this set changed things. Now I had a *real* shortwave receiver!

It was a Hallicrafters S-41G. This was no "living-room set;" it had no console-styling, varnished-wood cabinet. This was an honest-to-goodness, six-tube, shortwave receiver in a no-nonsense, boxy, metal cabinet, finished in black and crackled-finish gray enamel. On its face was stenciled the model number and its name, Skyrider Jr.

Its very appearance seemed to shout: This is a *DX machine*!

It served me well, for the next three or four years, allowing me to hear, maybe 40 or more countries. Then, though, it was time for something bigger, and better, and newer. So I sold the S-41G.

Many years later, I regretted doing it. I was, by then, using a new solid-state-of-the-art receiver that could perform rings around that old six-tuber. But middle-age nostalgia demanded I find another Skyrider Jr., the SW radio of my youth.

I advertised in radio magazines and, soon, a fellow responded saying he had one he was willing to sell me. I sent him a $60 check and, before long, a cardboard box arrived at my door.

With anticipation, I opened the carton. And there it was, a Skyrider Jr. But this was not the radio of my boyhood. Instead of the rugged looking gray and black cabinet, this metal cabinet was *white*! It was, I learned subsequently, an S-41W, for white, not an S-41G, for gray.

Well, I kept it anyway. And, a year or so later, I did come across another Skyrider Jr., this one an honest-to-goodness S-41G. I was pleased to have them both, but never switched them on, not wanting my memories dashed by the reality of 1940's vintage technology.

Ever since, these two table-toppers have served me as a set of bookends in my DXing corner. But just the other day, I received a copy of Fred Osterman's new book, *Shortwave Receivers Past & Present: Communications Receivers 1945-1996.* And as I paged through it, I came across, on page 121 of this 350-page softcover book, my Skyrider Jr., with photo and lots of information.

I found out a lot about my boyhood radio that I hadn't known before. It was, I learned, manufactured by Hallicrafters in 1945 and 1946, and sold new for $34 to $37. Even a half century later, Osterman indicates, it is a commonly found model with a value between $40 and $80, depending on condition.

As I looked a bit further down the page, though, I saw a smaller photo, a picture of my "mistake," an S-41W in its white metal cabinet. Next to it was the caption:

"The S-41W is very scarce and highly collectible model. In good condition it sells for $100 to $150."

Hey, Fred, you made my day!

Shortwave Receivers Past & Present (Universal Radio Inc., 6830 Americana Parkway, Reynoldsburg, OH 43068-4113; $19.95) is a great reference text and a fascinating read for anyone with an interest in SW receiver history, covering, in text and photos, over 500 SW receivers from 70 American and international manufacturers.

And may you also find your own first SW receiver, whatever it may be.

It's In The Mail

Coincidentally, this month I have a letter from Robert Johnson of Anacortes, WA, who also is interested in radios from an earlier era.

"I've looked in several radio shops at shortwave receivers," Robert writes. "And I wonder whatever became of Nordmende.

"I recall, some years back at least, Nordmende offered several models of

CREDITS—Erik Bueneman, MO; William Flynn, OR; Don Moore, MI; Ed Newbury, NE; Sheryl Paszkiewicz; Christos Rigas, IL; Betsy Robinson, TN

first class receivers. Now when I ask salespeople in stores or on the phone, they've never heard of the brand. I don't plan to part with my radio funds until I find out what, if anything, is available from Nordmende!"

I remember Nordmende, Robert! Back in the 1950s, this German firm—Norddeutsche Mende Rundfunk KG of Bremen—turned out some slick looking, AM-FM table model sets during the early days of "hi-fi" radio. They fiercely competed with similar looking and sounding Grundig sets, also German-made.

Though most people bought them for their FM sound, they were all-band sets, meaning shortwave, and they performed fairly well on the SW bands.

But I too lost track of what happened to this once well-known brand name. So I asked receiver guru, Larry Magne, editor-publisher of the well-known *Passport To World Band Radio*.

"Nordmende—it appeared as nordMende on the dial—made shortwave radios at least into the mid-1970s," says Larry. "During that decade, the company was taken over by French electronics giant, Thomson. A few years later, Thomson was nationalized by the French government, which moved it away from consumer products area and toward government—military, avionics and the like.

"Today, Thomson is being re-privatized, but is still effectively controlled by the French government, and Nordmende is under the division of Thomson known as Thomson multimedia (spelled with a lower-case "m").

"As a brand, Nordmende still exists, the name appearing on such products as TV sets. But I haven't seen a new Nordmende shortwave portable in a good 20 years."

So there you have it, Robert. Wait no longer for a new Nordmende radio. If you've set your heart on a German-made SW portable receiver, you might want to consider one of the new Grundig Yacht Boy models.

Down The Dial

Looking for something interesting in SW signals-to-tune?

Try these. You, no doubt, are hearing other stations, so why not drop me a note telling about your loggings. Please list reception times in Coordinated Universal Time (UTC), which is equivalent to EDT + 4 hours, CDT + 5 hours, MDT + 6 hours, or PDT + 7 hours. Your DX receptions could be listed here next month.

If you have any shortwave-related questions and/or topics we should cover, send them along too.

Address your letters in care of DX Listening, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735.

Antigua—6,160 kHz, Germany's Deutsche Welle has been heard via this West Indian island relay transmitter. Look for it in English at around 0930 until it leaves this frequency at 0950.

Armenia—9,965 kHz, Voice of Armenia noted in English at 2130 UTC, with talk about Armenian history and a newscast.

Czech Republic—13,580 kHz, R. Prague broadcasts in English here at 1400 UTC, with identification and news. At 1430 UTC, the programming language switches to Czech.

Hungary—5,905 kHz, R. Budapest has been heard here at 0225 UTC with English programs, including a shortwave DXing program.

Surinam—4,991 kHz, R. Apintie, broadcasting from this former Dutch colony in South America, is heard mornings around 1040 UTC, and evenings until sign off shortly after 0400 UTC. Programs usually consist of popular music and Dutch news announcements.

Taiwan—7,130 kHz, Taipei's Voice of Free China broadcasts here at 1200 UTC in English, with news, ID and a program called "Jade Bells and Bamboo Pipes." ■

Abbreviations

AM—amplitude modulation
CDT—Central Daylight Time
DX—distance, long distance reception
EDT—Eastern Daylight Time
FM—frequency modulation
ID—station identification
kHz—kilohertz
MDT—Mountain Daylight Time
PDT—Pacific Daylight Time
R.—Radio
SW—shortwave
UTC—Coordinated Universal Time

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ANTIQUE RADIO

Introducing the Freed-Eisemann NR-5

MARC ELLIS

Last issue, we discussed the development of the tuned-radio-frequency, or TRF, circuit and its application in the ubiquitous "three-dialer" radio so common during most of the 1920s. This month, we'll look in more detail at one particular three-dialer—the *Freed-Eisemann Model NR-5*. In future issues, we'll carefully check out an example of one of these radios and restore it as necessary. Then we'll apply the proper filament and plate voltages, hook up a speaker, antenna, and ground, and see what comes out!

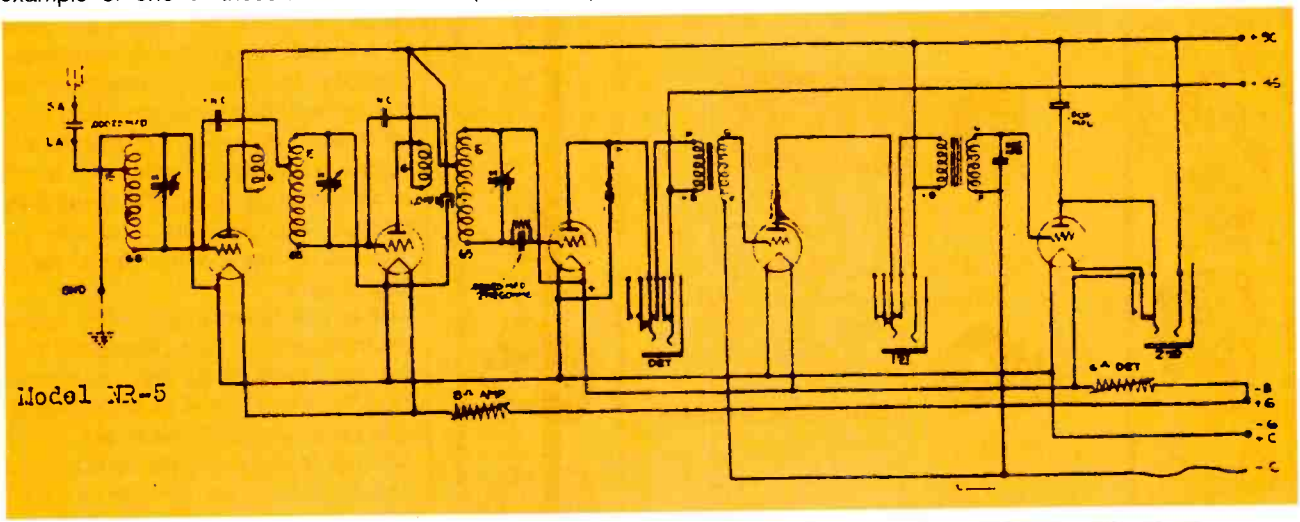

Fig. 1. Sorry! This is the best NR-5 schematic I've been able to find—but it does allow you to trace the basics of the circuit.

Why the NR-5?

A lot of 1920's manufacturers made three-dialers. Such sets typically included five tubes, two of which were used as RF amplifiers with inputs and outputs tuned to the same frequency. As was discussed last time, a few different approaches were used to suppress the feedback and resulting oscillations that were so apt to occur when the simple triode tubes of the era were hooked up in that manner.

Some manufacturers, among them Atwater Kent, Kolster, and Freshman, deliberately introduced inefficiencies or "losses" into the circuit to "tame" the triodes and reduce the likelihood of oscillation. But the elegant method was a circuit trick introduced by L. A. Hazeltine, a professor of electrical engineering at the Stevens Institute of Technology. The method was called *neutralization*, and Professor Hazeltine's circuit was dubbed the *Neutrodyne*.

In the Neutrodyne, some of the RF amplifier's output was coupled back to the input through a small, carefully adjusted capacitor. The result was a cancellation of the tube's internal capacitance, suppressing the tendency to oscillate. Many manufacturers resorted to other methods (as described above) to avoid paying royalties for the Hazeltine circuit. But the Freed-Eisemann firm bought in, and was one of the first companies to produce and heavily advertise (beginning in 1923) a Neutrodyne set.

That set was the Model NR-5, a radio I always think of as the classic three-dialer. In fact, one reason that I haven't done a three-dialer restoration in all the years I've been writing this column is that I didn't have a good NR-5 to work with. However, that is no longer true. There is now one waiting in the wings, ready to appear on stage when the restoration begins!

Freed-Eisemann and the Neutrodyne

According to Alan Douglass (*Radio Manufacturers of the 1920's, Volume 2*, copyright 1989, published by Sonoran Publishing, 116 North Roosevelt, Suite 121, Chandler, AZ 85226), the Freed-Eisemann company had its beginnings in 1921 with the introduction by Joseph Freed of an inexpensive crystal-set outfit dubbed "Marvel." The little set sold so well that Freed, seeking capital to expand, formed a partnership with his brother Arthur's employer, Alexander Eisemann. (Arthur eventually became secretary of the firm.)

But in 1922, the first major wave of broadcast set purchases was coming to an end, and sales were ebbing. On top of that, a company known as "The Wireless Specialty Apparatus Co.," which held key patents in crystal-set technology, had begun threatening to sue all other companies making or selling crystal detectors. Freed-Eisemann took an aggressive stance, organizing a group of New York crystal-set makers into the Independent Radio Manufacturers, Inc. for the purpose of filing counter-suits.

But the point became moot when the Hazeltine breakthrough was

This 1923 NR-5 ad also featured component parts made by Freed-Eisemann.

announced. Now it was possible to leave crystal technology behind and make a good tube radio, which previously could not be done without infringing upon the closely held Armstrong regenerative patents. Freed-Eisemann geared up its manufacturing operation to switch from simple crystal sets to five-tube Neutrodynes and, in 1923, began selling NR-5s hand over fist.

Advertising copy for the NR-5 (which sold for the hefty sum of one hundred and fifty 1923 dollars without tubes or batteries) promised: *"A startling advance in radio progress. Non-regenerative. Non-oscillating. No howling or hissing. Remarkable clarity and power and tremendous distance. Simple in operation. Built by the Freed-Eisemann engineering organization of master craftsman."*

Sales in 1923 and 1924 were excellent, and some model variations were introduced. But the numbers began to slump the following year due to competition from manufacturers turning out lower priced three-dialers using "losser" circuitry to circumvent the Hazeltine patents. The firm introduced a non-Neutrodyne model (the 10) to compete, but it didn't work well. Despite other innovations, including a pioneering but premature AC model introduced in 1927, Freed-Eisemann never regained its leadership position. In 1928, the company was sold to the Charles Freshman Company, soon to be renamed Earl Radio Corporation.

Basic NR-5 Circuitry

The NR-5 schematic diagram that accompanies this column, taken from *Rider's Volume 1*, is regretfully not the best quality. But it's the best one I've been able to get my hands on and presumably is the same one that many early radio servicemen also had to struggle with! In any case, it is good enough so that you can see the general design of the receiver.

The first thing you'll notice is that the set has five tubes, which is characteristic of the three-dialer receiver. Although not marked on the schematic diagram, these are intended to be the 01-A tubes found in almost every set of this type made during that era. Notice that there is a tuned circuit (coil and variable capacitor) in the antenna/ground circuit. It is followed by two RF amplifier tubes, each working into an RF transformer whose secondary is tuned with a coil and variable capacitor. The tuning dials for those capacitors are, of course, the "three dials" that give this type of set its jargon name.

Each of the two RF tubes has a neutralizing capacitor connected from the secondary of its RF transformer back to its grid. Although the schematic is fuzzy, you might be able to make out that these capacitors are labeled "N.C." The third tube is wired as a conventional grid leak detector. You can see the grid leak resistor, with its paralleled capacitor, in series with the grid of the tube.

The output of the detector is coupled, via an audio transformer, to the grid of the fourth tube, which is the first audio amplifier. This, in turn, is coupled via another audio transformer to the grid of the fifth tube, or final audio amplifier.

Notice that three audio-output jacks are provided. For local stations and other strong signals, the earphones can be plugged directly into the output of the detector tube. For weaker signals, the listener might plug the phones into the output of the next, or first audio, tube. Where room-filling volume is required, a loudspeaker would be plugged into the output of the last, or second-audio, tube.

It's interesting to study the automatic switching arrangements built into the

(Continued on page 80)

Audio Fun

JOHN J. YACONO
LAB TESTING COORDINATOR
WINDOWS MAGAZINE

This month's column is filled with audio circuits from readers. Before we get to those letters, let's continue our discussion about diodes and their uses by discussing "alternating current" (AC). With the exception of our discussion on transformers, we have mostly talked about direct current (DC), or current that flows in one direction through a component or conductor. To discuss the usefulness of diodes as rectifiers, we should start with a definition of AC, or current which flows first in one direction, then another. Most often, the change in current direction is not sudden but gradual, and is caused by a shift in polarity of the voltage source. For example, household AC is the result of voltage that rises, falls and changes direction 60 times a second. Plotting this voltage over time results in the sine wave graph shown in Fig. 1A. The voltage rises from zero (at time T0) to a maximum voltage (at time T1), falls back to zero (at time T2), and changes polarity as it falls to a negative maximum voltage (at time T3), and then rises to zero again (at time T4). For household outlets, this cycle occurs at 60 times a second, or 60 "Hz". If the resistor of Fig. 1B is exposed to such a voltage source, the current through the resistor would rise and fall as shown in Fig. 1C.

While motorized devices such as blenders, electric can openers, shop equipment, etc., are designed to run directly from AC current, many electronic devices require DC. Why do power authorities use alternating current and voltage to transmit electrical power? The main reason is it can be transmitted over long distances with much less loss than DC. Electrical utility power is also sent out at much higher voltages than required for most devices. Again that increases the effective distance you can transmit the power. Before it comes into your home, this voltage is reduced by a distribution transformer to 117 volts AC (actually two supplies at 117 volts each).

Next month, we will discuss how that voltage is reduced further by transformers in most electronic devices and how diodes help convert that to DC. But now, it's time for the letters!

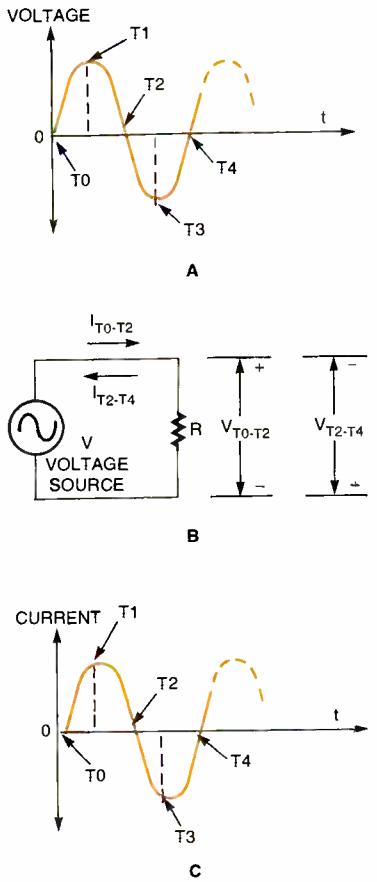

Fig. 1. Faster than you can blink your eyes, a household alternating voltage (A) completes 60 of these cycles in a second. (B) When resistor R is connected to this voltage source, alternating current flows in C. AC flows in the same time relationship as the voltage source.

Twenty Watt Audio Amplifier

This push-pull amplifier circuit of Fig. 2 uses two TO-220 monolithic Darlington transistors to produce the audio output. Frequency response is flat within ±1 dB from 30 Hz to 200 kHz, with typical harmonic distortion below 0.2%. One other transistor is needed, a 2N5961, to provide voltage gain for driving the Darlington pairs The input signal must reach 1.2-volts for a full 20-watt output into an 8-ohm

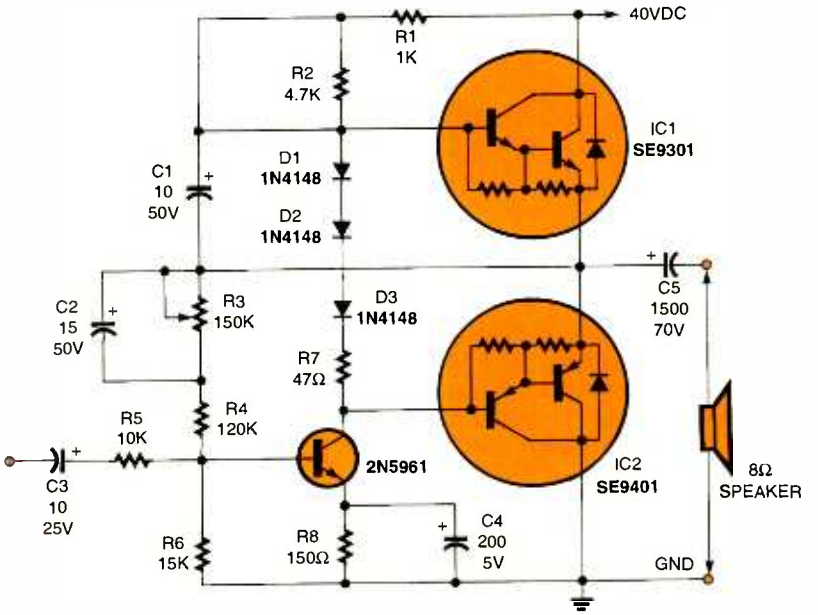

Fig. 2. This simple inexpensive audio amplifier delivers a punch of 20-watts. An equivalent Darlington pair to use is SK3180 for IC1 and SK3181A for IC2—and don't forget to heatsink these devices!

load. The input resistance of the source is 10,000-ohms.

—Alex Belenky, Brooklyn, NY

Very nice. Naturally, heat sinks are required for Darlingtons, and typical input signals will need some preamplification. The trimmer potentiometer needs adjusting to prevent distortion.

Amplifier Built With One Integrated Circuit

After seeing the various amplifier circuits (walkman amps, preamps, etc.) featured in your column, I thought it might be fun to build a power amplifier circuit. The circuit I came up with is shown in Fig. 3, and is surprisingly simple. It is based on the LM383 8-watt audio amplifier integrated circuit. This IC needs only a few additional components and a heat sink to make a high quality 8-watt audio amplifier. This circuit is a perfect match for simple one or two transistor preamps used in a PA system or intercom. If you have a portable CD player, you could build two of these and use them with some good speakers to get very high-quality sound.

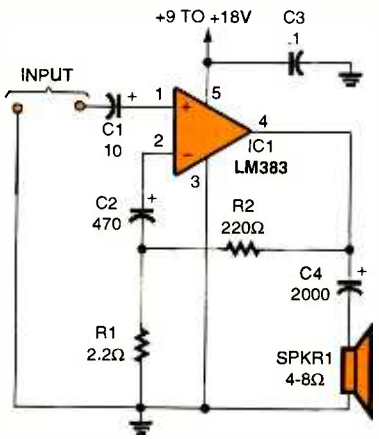

Fig. 3. This one-chip amplifier is the perfect circuit for any portable audio application.

The low current consumption (only 45-mA) makes the amplifier very portable and compact. I didn't include a volume control, because I wanted the amplifier's volume to always be "full out." I'm sure a 100-ohm potentiometer connected to the input would do the trick.

—Aaron Cake, London, Ontario

That is nice and simple. If you're going to build a stereo version of the circuit with the recommended 100-ohm volume control, make sure the potentiometer is a stereo (dual-ganged) unit.

Guitar Practice Amplifier

I've found that the most challenging aspect of amplifier design is avoiding 60 Hz noise. The power amplifier rarely adds much power line noise, so the preamplifier is usually the culprit. Typical common-emitter transistor preamplifiers seem to add the most noise, with op-amps being not far behind. I recently decided to try the LM382 low-noise dual preamplifier for my guitar preamplifier. The trick is likely that the preamplifier circuitry is run off a regulated supply, with the regulator being included inside the IC.

My resulting circuit (Fig. 4) has good volume and power levels, very low 60 Hz noise, and an output level or distortion meter—all with a minimum of parts and fuss. In the schematic, IC1 is the LM382 dual preamplifier (only one preamp is used), IC2 is an LM383 audio power amplifier, and IC3 is an LM3915 LED dot/bargraph display driver with an external LED bargraph display unit.

A curious feature of this circuit is the input at the preamplifier. Note that the inverting input (pin 2) is unconnected! This is not a schematic error. My IC Databook didn't give much guidance; I happened to try it as shown, and it works well. Maybe it's internally ground-referenced? I don't know for sure.

If you use component and power values exactly as shown, when the bargraph gets up to the 9th or 10th segment, you will start to get a clipped, distorted output, particularly notable at low audio frequencies. This is a very handy feature for bad, tone deaf musicians like me! Besides, it's just plain fun to watch the bargraph jump around in response to clumsy pickin'!

Anyway, the best suggestion is to breadboard it exactly as shown, see how it works, and then experiment with component values, if desired. Don't forget to heatsink the LM383. A particularly interesting area for experimentation with this circuit is to utilize the other half of the LM382 dual preamplifier for a second guitar or an effect feedback like reverberation. Naturally, the two preamplifiers would need to be mixed before being applied to the LM 383 power amplifier.

—Nick Cinquino, Schaumburg, IL

The bargraph is a good finishing touch. By changing the resistor values, the 382 portion of the circuit might make a nice preamplifier stage for the circuit in the previous letter.

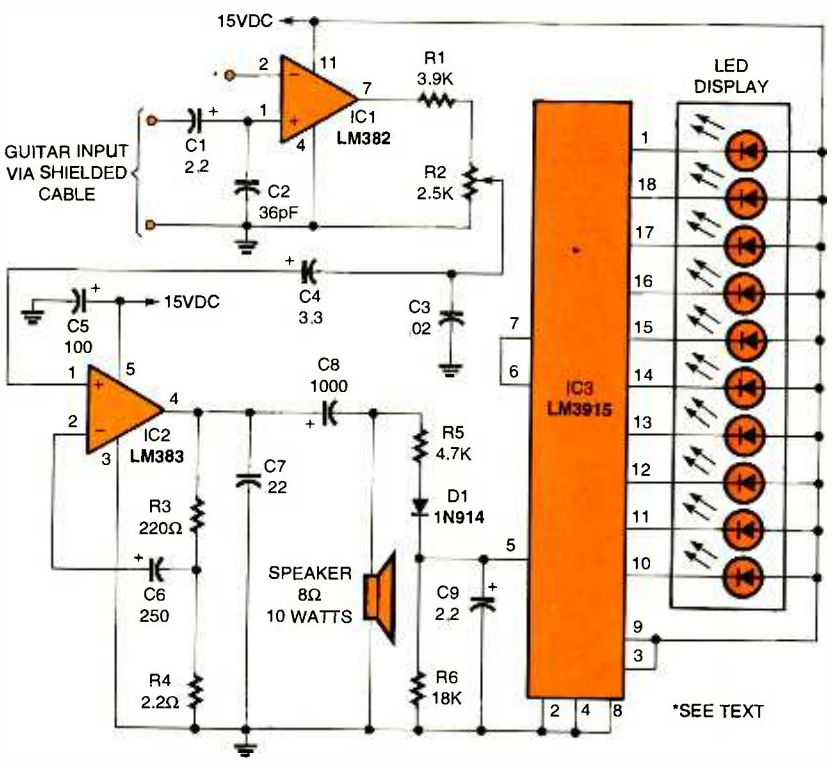

Fig. 4. Here's a guitar amplifier that lets you see the audio!

Microphone "Transformerless" Transformer

One of the advantages enjoyed by circuits employing solid-state devices over their vacuum tube counterparts is their ability to provide impedance matching in varied circuit configurations. That ability has been successfully exploited in transformerless amplifier drivers, resulting in almost unlimited frequency response and nearly perfect damping.

The transformerless circuit shown in Fig. 5 may prove valuable to the audiophile who wishes to eliminate all transformers from the sound system. Not only does that device surpass the specifications of typical impedance matching microphone transformers, but it can be built for about one-third the price. This design provides impedance matching for low impedance (50 to 150-ohm) professional microphones, and sufficient voltage gain to drive a 1-volt RMS amplifier input.

The circuit is a two-stage, direct-coupled op-amps with the input transistor Q1 in a common-base configuration. The input resistor R1 is chosen to match the microphone's nominal impedance, and the feedback resistor R2 sets the closed-loop voltage gain. By deriving Q1 base current from the divider network connected to the emitter of Q2, a high degree of DC feedback is established to compensate for component variations and temperature coefficients. Since the input and output signals are out of phase, neutralization is unnecessary for stabilization.

I constructed five of these units on a single circuit board. The microphone complex was terminated in a patch panel and powered by a well-regulated negative 24-volt supply. Since 50-ohm microphones were principally employed (the characteristic impedance of most moving-coil assemblies), the input resistor in each case was a 51-ohm unit. A feedback resistor of 100,000-ohms provided optimum gain to drive

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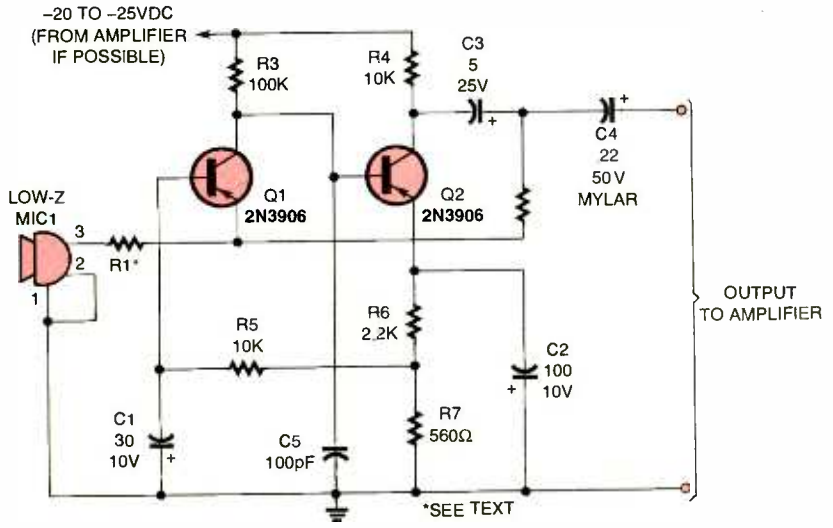


Fig. 5. This little preamp provides a transformerless match for low impedance microphones and can drive most system amplifiers.

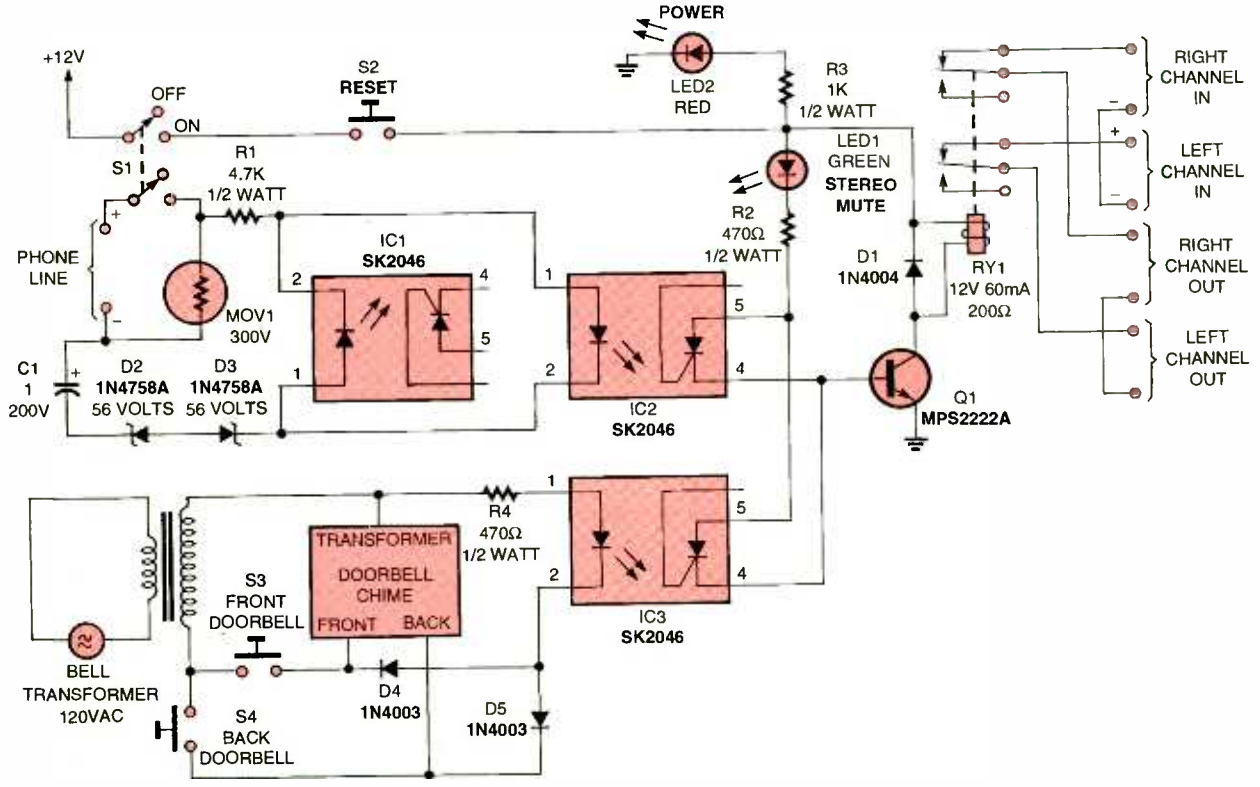


Fig. 6. If you need a device to mute your stereo when the doorbell rings, then this doorbell/stereo mute circuit is for you!

CIRCUIT CIRCUS

ICs that Oscillate

CHARLES D. RAKES

In our last visit we looked at a number of basic oscillator circuits using transistors and logic gates as the active elements. This month we are going to continue on with our oscillator lesson and take a look at several oscillator circuits using ICs that are designed for a variety of different applications.

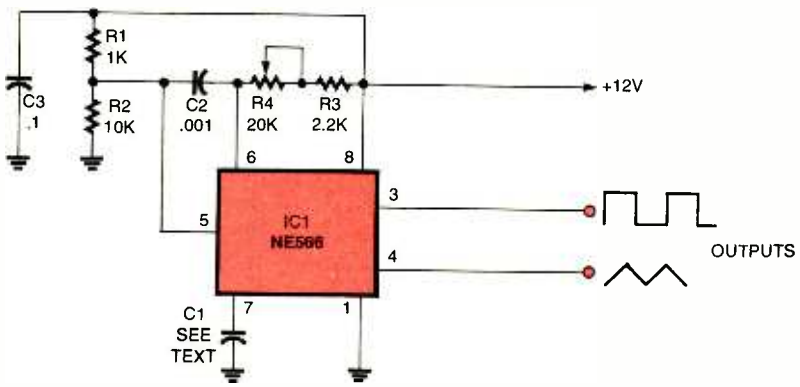


Fig. 1. Using a NE566 VCO IC to produce square and triangle wave outputs.

PARTS LIST (FIG. 1)

CAPACITORS
C1—See text
C2—0.001-uF, ceramic-disc
C3—0.1-uF, ceramic-disc

RESISTORS (All fixed resistors are ¼-watt, 5% units unless otherwise indicated.)
R1—1000-ohm
R2—10,000-ohm
R3—2200-ohm
R4—20,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS
IC1—NE566 (Radio Shack RSU 11392529, or equivalent)

Voltage-Controlled Oscillator

Our first oscillator, see Fig. 1, uses a NE566 IC in a basic function generator circuit that produces square wave and triangle wave outputs. The NE566 IC is a linear Voltage-Controlled Oscillator (VCO) that uses external resistors and a capacitor combination to cover an approximate frequency range between 1 Hz to 1 MHz. The resistance values of R3 and R4 should be between 2,000-ohm and 25,000-ohm. The oscillator's frequency tuning range, with a potentiometer for R4, is about ten to one.

Very low frequency operation is possible if a good quality low leakage electrolytic capacitor is used for C1. Using a 47-uF capacitor results in a variable frequency range of about 1 Hz to 10 Hz. Since the actual value of an electrolytic capacitor can vary greatly from its marked value, selecting a capacitor will probably be necessary to obtain the desired frequency range. C1 can be as small as a few hundred picofarads to operate near the maximum frequency range. Experimenting with different capacitor values will help in determining the needed value for a given frequency range. A square waveform is available at pin 3 and a triangle waveform at pin 4. The NE566 oscillator can also be used as a FM signal source by coupling an external AC modulating signal to pin 5.

Phase Locked Loop

Our next IC oscillator, see Fig. 2, uses a 567 Phase Locked Loop (PLL) Tone Decoder IC in an encoding circuit arrangement. The input to the PLL on pin 3 is tied to ground to disable the decode function of the IC and to help stabilize the oscillator. The decoder output at pin 8 is not used. A square waveform is available at pin 5 and a triangle waveform is produced at pin 6. The circuit's operating frequency is determined by the RC values of C4, R1 and R2. The values of R1 plus R2 should be no greater than 25,000-ohm, while the following capacitor values for C4 will help in selecting a frequency range:

4.7-uF = 10 Hz to 100 Hz;
0.47-uF = 100 Hz to 1 kHz;
0.047-uF = 1 kHz to 10 kHz;
0.1-uF = 500 Hz to 5 kHz;
and 0.01-uF = 5 kHz to 50 kHz.

The oscillator circuits of Figs. 1 and 2 are very similar and produce about the same frequency range with similar RC tuning values. Both outputs are high impedance and should be isolated with a buffer between the IC and any connected circuitry.

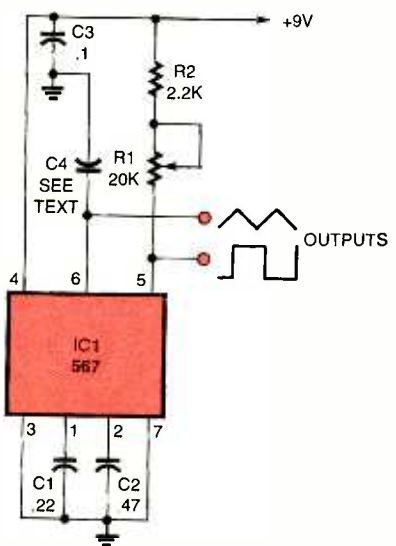


Fig. 2. A simple circuit with a 567 PLL Tone Decoder results in square wave and triangle wave outputs.

PARTS LIST (FIG. 2.)

CAPACITORS
C1—0.22-uF, ceramic-disc
C2—0.47-uF, ceramic-disc
C3—0.1-uF, ceramic-disc
C4—See text

ADDITIONAL PARTS AND MATERIALS
R1—20,000-ohm potentiometer
R2—2200-ohm, ¼-watt, 5%, resistor
IC1—567 (Radio Shack RSU 10872125, or equivalent)

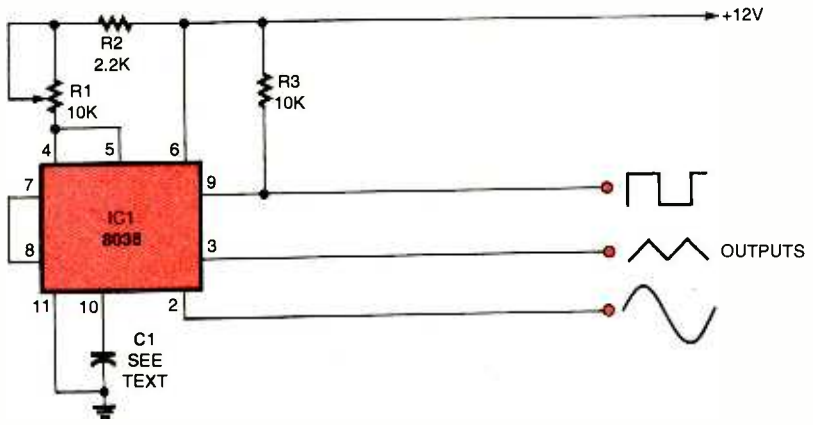


Fig. 3. The versatile 8038 Waveform Generator IC in its simplest configuration to generate several waveforms.

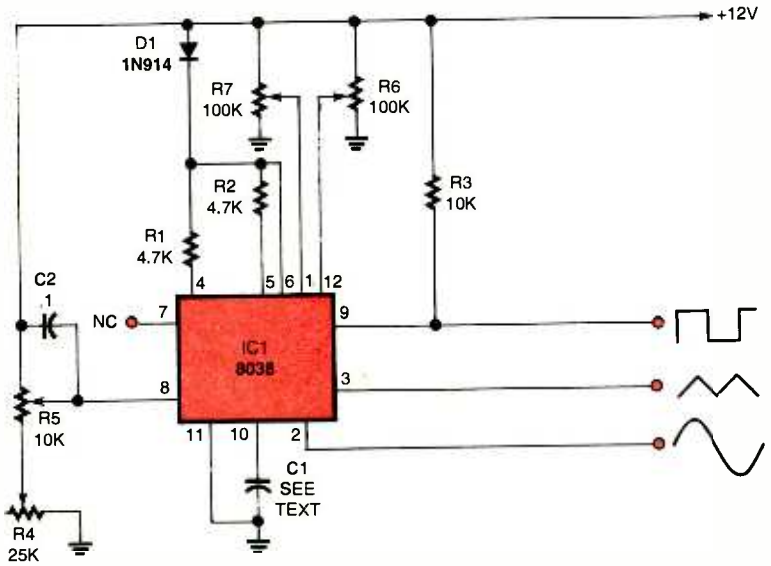


Fig. 4. Here's the 8038 Waveform Generator IC with additional circuitry to improve operation and control.

Versatile Waveform Generator

The next two oscillator circuits use an 8038, Waveform Generator IC that is designed to output a triangle, square, and sinusoidal waveforms simultaneously.

The first waveform generator circuit using the 8038, shown in Fig. 3, illustrates the minimum number of external components necessary to generate the three different output waveforms. The values of R1, R2, and C1 determine the frequency range of the generator. *(Editor's note: Component values can be determined by use of the approximate formula:*

$$f = 0.15/(R1 + R2) \times C1,$$

where f is the desired frequency of operation.)

There is a price to pay in performance for this circuit's simplicity. The output waveform symmetry suffers because no provision has been made to balance the current feeding the two duty cycle inputs at pins 4 and 5. A simple fix is to add two 500-ohm potentiometer controls to the circuit. Place one of the controls between pin 4 and R1, and the other potentiometer between pin 5 and R1. Adjust both controls for the best output waveform shape.

The 8038 waveform generator circuit in Fig. 4 has a number of components added to improve the circuit's operation. Diode D1 allows a greater tuning range by permitting the voltage at pin 8 to rise above the voltage at pins 4 and 5. The two variable resistors, R6 and R7 are used to adjust the output waveforms for best possible symmetry. Potentiometer R5 varies the voltage at pin 8 to control the oscillator's frequency, and R4 sets the maximum frequency range. The oscillator produces the lowest frequency when the voltage at pin 8 is at its maximum, and the highest frequency when the voltage is at its minimum. Note that pin 7 is disconnected from pin 8 in this circuit.

The following capacitor values for C1 will give you a starting point in setting up the oscillator for a desired frequency range:

1.0-uF = 1 Hz to 100 Hz;
0.1-uF = 100 Hz to 1 kHz;
0.01-uF = 1 kHz to 10 kHz; and
0.001-uF = 10 kHz to 100 kHz.

These values are only for starters because the actual value needed will also depend on the setting of R4 as well as R5. Once again here's where experimenting will help find the optimum results.

PARTS LIST (FIG. 3.)

C1—See text
R1—10,000-ohm potentiometer
R2—2200-ohm, 1/4-watt, 5%, resistor
R3—10,000-ohm, 1/4-watt, 5%, resistor
IC1—8038 (Intersil ICL8038CCJD)

PARTS LIST (FIG. 4.)

CAPACITORS
C1—See text
C2—0.1-uF, ceramic-disc

RESISTORS
(All fixed resistors are 1/4-watt, 5% units unless otherwise indicated.)
R1, R2—4700-ohm
R3—10,000-ohm
R4—25,000-ohm potentiometer
R5—10,000-ohm potentiometer
R6, R7—100,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS
IC1—8038 (Intersil ICL8038CCJD)
D1—1N914 diode

CMOS

The IC oscillator of Fig. 5 uses a versatile 4046 CMOS PLL IC in a simple variable frequency square wave generator circuit. The heart of the generator's circuitry is the IC's voltage-controlled oscillator. The circuit's operating frequency is determined by the voltage at

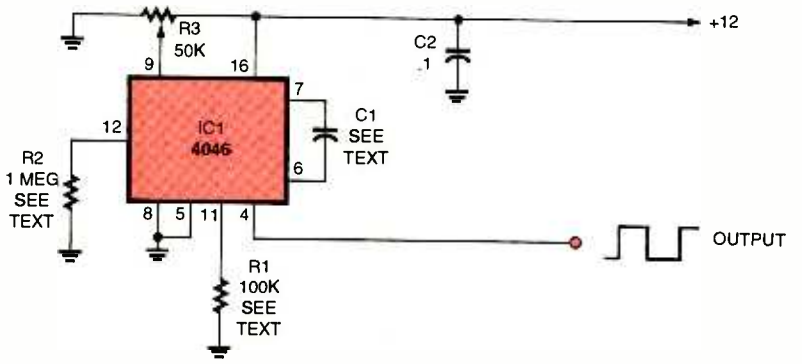


Fig. 5. This circuit uses the 4046 CMOS PLL IC to produce a variable frequency square wave generator.

PARTS LIST (FIG. 5.)

C1—See text
C2—0.1-uF, ceramic-disc
R1—100,000-ohm 1/4-watt, 5%, resistor
R2—1-megohm, 1/4-watt, 5%, resistor
R3—50,000-ohm potentiometer
IC1—4046 (Radio Shack RSU 10870616, or equivalent)

pin 9 (controlled by potentiometer R3), and the capacitor C1 across pins 6 and 7. The maximum and minimum frequency of the oscillator is determined by resistors R1 and R2 connected to pins 11 and 12, respectively. The 4046 frequency range goes from less than 1 Hz to about 1 MHz, depending on the external components.

With the component values shown in Fig. 5, the oscillator will range from a low of about 100 Hz to over 10 kHz. If we remove R2, leaving pin 12 open, the frequency range is increased above 10 kHz. The values of R1 and C1 set the basic frequency range and the voltage at pin 9 varies the frequency. Minimum voltage at pin 9 produces a minimum frequency and maximum voltage produces a maximum frequency. Resistance R2 determines a frequency operating "window" (minimum to maximum frequency range), by raising the minimum frequency and increasing the maximum frequency. One method to use in setting the frequency "window" is to make R2 a variable resistor, approximately ten times the value of R1, and use it to fine tune the "window" limits.

For a desired frequency range, choose capacitor C1 from the following values:

1.0-uF = less than 1 Hz to 100 Hz;
0.1-uF = 10 Hz to 1 kHz; and
0.01-uF = 100 Hz to 10 kHz.

The 4046 package also includes other goodies. A dual phase detector is included which allows the 4046, with added components, to become a full-fledged PLL. Since we are only dealing with oscillators this time around, these features might show up here at a later date.

Multivibrator

In our next circuit, see Fig. 6, we go up one number in the CMOS line to the 4047 Multivibrator IC operating in the astable (free running) mode. This IC offers three square wave output waveforms. The oscillator's fundamental frequency appears at pin 13. Outputs at pins 10 and 11 appear at one half this frequency and are phased 180-degrees apart.

If you need a square wave signal with a near perfect 50% duty cycle, this circuit can do it. The fundamental output signal is fine for many applications, but it is not always a 50% duty cycle waveform. If you run the oscillator at twice the desired frequency and take the signal at either pin 10 or 11, the output will be a perfect square wave.

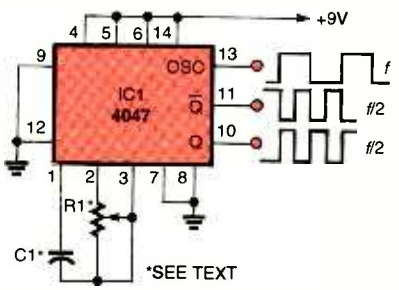


Fig. 6. This 4047 Multivibrator IC circuit results in three square wave output waveforms.

PARTS LIST (FIG. 6.)

C1—See text
R1—Potentiometer, see text
IC1—4047 (National Semiconductor CD4047BC)

The oscillator's frequency is determined by the values of C1 and R1. The value for resistor R1 can be any value from a few thousand ohms to over 1 megohm. The capacitor can be just about any good quality (low leakage) unit that is 100-pF or larger. Good low leakage electrolytic capacitors are necessary for very low frequency applications. Capacitor values for C1 can be selected from the following list—choose a value which sets up your circuit to oscillate over the desired frequency range:

1-uF = less than 1 Hz to 10 Hz;
0.1-uF = 10 Hz to 1 kHz; and
0.01-uF = 100 Hz to > 10 kHz.

LED Flasher/Oscillator

You have probably seen our next choice of IC operating in various circuit applications which make LEDs flash on and off. The popular LM3909 LED Flasher/Oscillator IC has been doing this for years. This versatile IC can

(Continued on page 79)

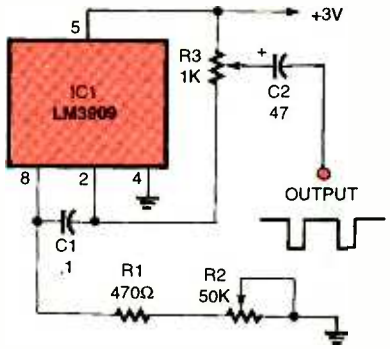


Fig. 7. The popular LM3909 LED Flasher/Oscillator IC designed to function as a simple audio oscillator.

PARTS LIST (FIG. 7.)

C1—0.2-μF, ceramic disc
C2—47-μF, 25 WVDC, electrolytic capacitor
R1—470-ohm, 1/4-watt, 5%, resistor
R2—50,000-ohm potentiometer
R3—1,000-ohm potentiometer
IC1—LM3909 (Radio Shack 276-1705)

Hanging Loop Antennas

JOSEPH J. CARR, K4IPV

There are a number of different loop antennas that can be built, and for the higher frequency bands they can be reasonably sized. I have received a lot of correspondence over the years about those antennas, and also about antennas for people who have limited space. The loop antenna described in this column is small and will find many applications. It is called the hanging loop antenna.

Figure 1 shows the basic concept for the hanging loop antenna. It consists of two half wavelength (λ/2) elements spaced one-sixth wavelength (λ/6) apart. The horizontal elements are made with aluminum or copper tubing of either 0.75-inch or 1-inch diameter. In a pinch, you can also use wooden dowels of about 1-inch diameter, with antenna wire running along the length. The vertical elements are made of ordinary antenna wire, although if you want to use aluminum tubing it's all right.

The feedline to the transmitter is 52-ohm coaxial cable, which is connected to the antenna with a 4:1 balun transformer. The connection points of the balun are along the vertical wires, and the exact point is found by testing for minimum VSWR. A good starting point is to make the connection point about one-third the way up from the bottom of the loop. Because the antenna is fed along the bottom edge, this antenna is horizontally polarized.

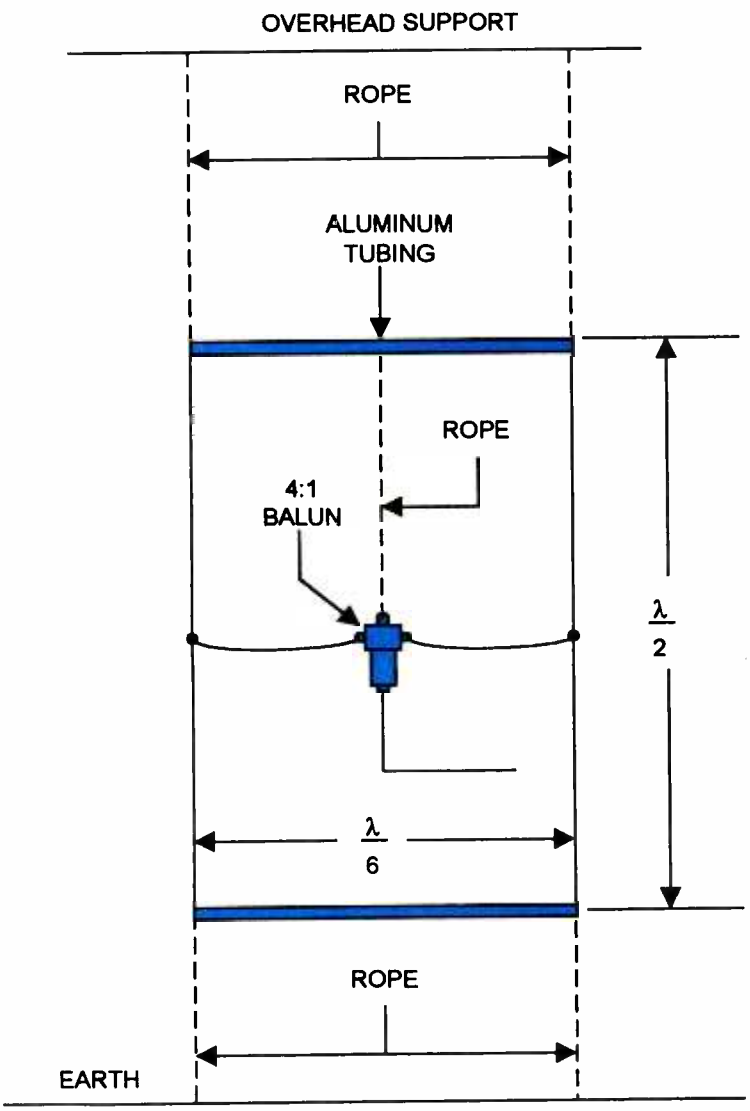


Fig. 1. Construction details for the hanging loop antenna.

The lengths of the elements are determined from simple equations given below. For a half-wavelength (λ/2), use:

$$L_{FT} = 468/F_{MHZ}$$

For a one-sixth wavelength (λ/6) lengths:

$$L_{FT} = 156/F_{MHZ}$$

In both equations, L_{FT} is a length in feet and F_{MHz} is frequency in MHz. Typical lengths for five popular ham bands and the Citizens Band are shown in Table 1 below.

TABLE 1 — Loop Antenna Element Lengths

Band (Meters)	Freq (Approx)	λ/6 (Feet)	λ/2 (Feet)
10 m	28.5 MHz	5.47 ft.	16.42 ft.
11	27	5.77	17.33
12	24.9	6.27	18.80
15	21.1	7.39	22.18
17	18.1	8.62	25.86
20	14.1	11.06	33.19

These lengths are approximate, of course, as with all antenna lengths calculated from equations. The actual lengths will be very close to these.

This type of antenna has a gain of about 2 to 2.5 dB over a dipole. It has a figure-8 radiation pattern, which means that the two main lobes are perpendicular to the plane of the loop (i.e. in and out of the page). The reason that this gain is higher than a dipole is that this the pattern is narrower in both the horizontal and vertical extent, putting more power into a narrower beam.

The electrical connections should be made permanent by soldering the wires from the balun transformer to the

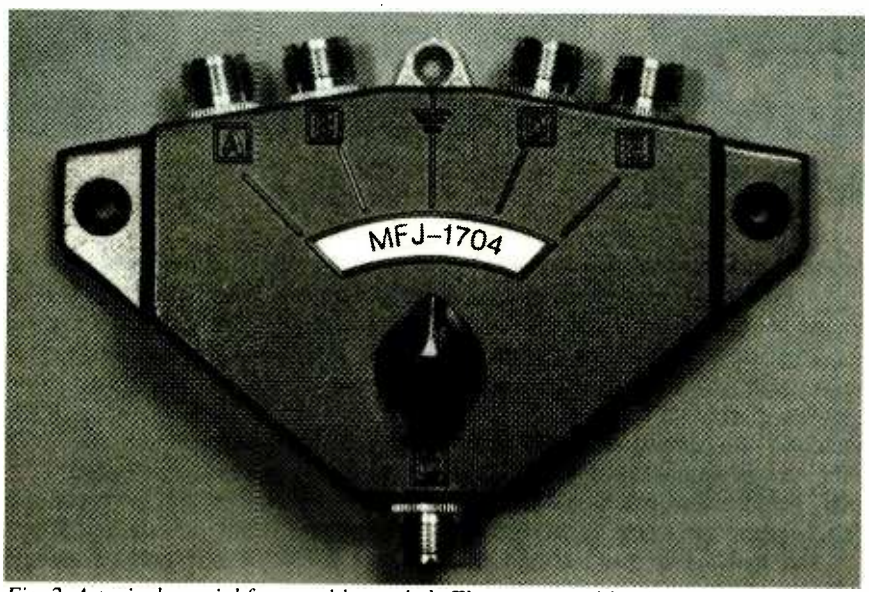


Fig. 2. A typical coaxial four-position switch. The center position is used to connect the receiver's antenna input terminal to ground when transmitting or shut down.

vertical members. When you are testing the antenna, however, use alligator clips to move the connection point up and down the vertical members. The alligator clip idea cannot be used with even moderate power levels, or else they may burn and cause problems.

I use an MFJ Enterprises, Inc. Model MFJ-259 VSWR analyzer (which runs micropower) to make adjustments before turning on the transmitter. Besides, it's rude and in some cases illegal to test antennas under power. At the very least you will cause unnecessary QRM to others on the same band.

If you use more than one antenna, or if you do a lot of antenna experimentation, then you might want to install a coaxial switch. These switches are used to allow a receiver or ham radio set to use one of several antennas. Up to 16-port switch models are available, but the one shown in Fig. 2 is a four-port model. This particular coaxial switch is the MFJ-1704 made by MFJ Enterprises, Inc. (Box 494, Mississippi State, MS, 39762). The common connector is for the receiver or transmitter, while each antenna is connected to one of the four switched ports. Alternatively, one can turn the switch around backwards (it's bi-directional, after all), and use the same antenna on different receivers or transmitters.

The use of the coaxial switch in antenna tuning is for comparing the antenna being tested with either another antenna or a dummy load. The kind of off-the-air checks that amateurs and SWLs can make are notoriously inaccurate, but can be made a lot more useful by making comparisons with known antennas.

A friend of mine, the late Johnnie H. Thorne (K4NFU/5), had an antenna farm in Texas (and it did seem that he grew antennas, judging from the number he had). He kept a standard dipole, optimally installed and cut for 20-meters, and made all of his test designs for the same frequency. He would compare new designs to the dipole by switching back and forth while monitoring the signal strength on the receiver S-meter. He could also compare two different antennas by comparing them against each other or against the dipole.

Antenna comparisons are a little fuzzy around the edges if you don't have an antenna test range. It is wise to make a number of observations, and then average the results. This is especially true with high-frequency antennas where variations along the transmission path are a wild card for the antenna experimenter.

I learned a lot about antennas from my friend, Johnnie. Unlike a lot of gurus, he had notebooks full of data to back up his claims. He also had a lot of old, but professional quality, instrumentation to make antenna measurements. Not to mention a Stoddard field strength meter mounted in a Taylorcraft airplane (a kit-built thing like a Piper Cub) to fly around and make antenna pattern measurements.

Most ham antenna builders have to satisfy their curiosity about the pattern by noting where the call signs seem to come from when the new antenna is erected. Unfortunately, there are so many variables in that technique that it is utterly useless in making any real observations.

Another friend of mine lived down in the Shenandoah Valley of Virginia. He complained that his "omni-directional" vertical seemed to have a gap in the pattern. He complained that signals to the east were a lot weaker than when he lived close to Washington, DC, and the signal reports he received were lower. I found the problem rather quickly: He lived on the west slope of a mountain, down at the bottom of the hill. Sighhhhh.

Hamfests

The summer months are the hamfest season in most areas of the country. My wife once referred to hamfests as a spasm of "musical junk" (after the child's game "Musical Chairs") in which otherwise grown people go out to buy, sell and trade all manner of ham-related equipment. I've even known a couple people who made a fair amount of their annual income buying and selling stuff. I've done my share of both, although I admit (and my basement lab testifies) that buying is more of what I do.

If you haven't done a hamfest, then I recommend that you find one and attend. If you want to buy stuff, then bring cash (only dealers can accept credit cards). Also, be careful about being out in the sun. I am one of those who burn easily, so use plenty of sun block lotion.

Most hamfests of any size will have amateur radio license examinations available (although many of them do the exams the day before the hamfest). You can contact the sponsors to find the exam schedule. Also, you can get a list of sanctioned events (not all hamfests fall into that category, but that doesn't mean that something is wrong with them) from American Radio Relay League (225 Main Street, Newington, CT 06111, or e-mail at *HQ@ARRL.ORG).*

Connections...

I can be reached by snail mail at PO Box 1099, Falls Church, VA, 22041, or by e-mail at *carrjj@aol.com.* I welcome your questions, comments, and suggestions. ■

ELECTRONICS LIBRARY

Continued from page 20

Subsequent chapters cover using the PC as a record keeper (to keep track of station logs and other databases), as a design tool (for antennas and other hardware), and for control and calculations; using the Internet to find ham information; and using simple software to log and enter contests.

Personal Computers in the Ham Shack costs $15.95 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111-1494; Tel: 860-594-0200; Fax: 860-594-0303; E-mail: pubsales@arrl.org; Web: http://www.arrl.org/.

CIRCLE 93 ON FREE INFORMATION CARD

1997 General Catalog
from Contact East

This 252-page, full-line catalog is packed with descriptions of hundreds of new test instruments and tools for engineers, managers, technicians, and hobbyists. It features quality products from brand-name manufacturers for testing, repairing, and assembling electronic equipment.

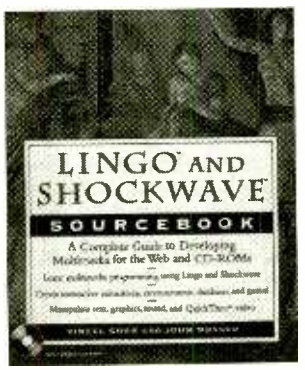
Highlighted new products include the Tektronix TDS 200 series compact digital scopes, Fluke's 105B Scopemeter, and B+K-Precision's spectrum analyzers. The catalog also offers a wide selection of DMMs, portable and benchtop digital storage scopes, tool kits, power supplies, EPROM programmers, soldering/desoldering equipment, breadboards, heat guns, data communications tools and testers, measuring tools, adhesives, precision hand tools, and reference books. Also featured are Contact East's popular lines of communication test equipment, static-protection products, ozone-safe cleaners, magnifiers, inspection equipment, work benches, and cases.

The 1997 General Catalog is free upon request from Contact East, Inc., 335 Willow Street, North Andover, MA 01845; Tel: 508-682-2000; Fax: 508-688-7829.

CIRCLE 94 ON FREE INFORMATION CARD

Lingo And Shockwave Sourcebook: A Complete Guide to Developing Multimedia for the Web and CD-ROMs
by Vineel Shah & John Musser

You don't need to be an experienced programmer to create sophisticated multimedia with Lingo and Shockwave. This friendly and fun book shows you how to deliver high-quality multimedia products that can be distributed on CD-ROM or the World Wide Web. It walks you step-by-step through planning, developing, and troubleshooting eight multimedia projects.



The book covers using and manipulating text, audio, and QuickTime video, as well as animating and synchronizing text, graphics, and audio. It explains how to use Lingo and Shockwave to create Java-like Web interfaces and to put dynamic, interactive multimedia on the Web. The book also serves as a multimedia programmer's primer on the subtleties of QuickTime video.

The included CD-ROM contains all of the completed projects featured in the book; movies, ready to be programmed with Lingo; and artwork, audio, and QuickTime video samples for you to work with. A fully functional graphical interface makes it easy to navigate through the material on the CD-ROM.

Lingo and Shockwave Sourcebook: A Complete Guide to Developing Multimedia for the Web and CD-ROMs costs $39.95, including CD-ROM, and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel: 1-800-225-5945; Web: http://www/wiley.com.

CIRCLE 95 ON FREE INFORMATION CARD

1997 Passport To Web Radio: Really Cool Wired Sounds from All Over the World
edited by Lawrence Magne

Did you know that there's a whole world of radio waiting to be explored over the Internet? As of last August, there were 178 Web Radio stations broadcasting from 32 countries. By the beginning of 1997, those figures had jumped to 390 stations from 50 counties. Most are in the United States, with Canada, Europe, and Asia strongly represented too. Others transmit from South America, Australia, Central America, Africa, and the Middle East. You get to hear actual local broadcasts from cities and small towns across the country—Cajun music from New Orleans; country music from Paris, Texas; and sporting events straight from dozens of home-town stadiums—and around the world. Most are live broadcasts, and some are on demand, allowing you to click on a program whenever you want to listen to it. And you can still use your computer for other applications while you're tuned into Web radio.

This book tells you all you need to know to get listening. It offers a brief history of and introduction to Web radio, and then describes all the hardware and software that's required to get started.

The rest of the book lets you know what's on, and what's worth hearing. An entire section—written by ESPN's Phil Schoen—is devoted to sports programming. Subsequent chapters describe Web radio transmissions from the United States, Canada, Latin America, Europe, Africa, Asia, and the Pacific.

1997 Passport to Web Radio costs $9.95 and is published by International Broadcasting Services, Ltd., Box 300, Penns Park, PA 18943; Tel: 215-794-8252; Fax: 215-794-3396; Web: http://www.passport.com. ■

CIRCLE 96 ON FREE INFORMATION CARD

NEW PRODUCTS

Continued from page 19

that can be read from as far away as 20 feet. The device has a +2.00 volt to +6-volt input voltage range. The DVM uses an advanced A/D converter, an ultra-stable reference, and metal-film resistors to achieve ±0.01-volt accuracy. It never requires adjustment or recalibration, and it is reverse-polarity input protected over its full rated operating range.

The DMS-20PC-3-DCM DVM costs $45 each in single quantities, $38 in hundreds. For further information, contact Datel, Inc., 11 Cabot Blvd., Mansfield, MA 02048; Tel: 508-339-3000 or 1-800-322-2765; Fax: 508-339-6356.

CIRCLE 82 ON FREE INFORMATION CARD

Pc Card Modems

Three models of high-speed, state-of-the-art data/fax PC Card modems; are available from Logicode Technology. The 33.6-bps modems include a basic, economy data/fax modem; one with voice mail; and one with speaker-

phone capabilities. Designed for laptops, notebooks, and sub-notebooks with standard Type II and Type III PCMCIA expansion slots, all three models feature a built-in, advanced power-management system. With full AT command capability, the PC Cards are optimized for high-speed, stable Internet connections. Dial tones, busy signals, and carrier signals are automatically detected, as are fax/modem/voice-mail functions. All models except the basic one are equipped with a corporate-style, digital voice-mail answering system with multiple password-protected mailboxes.

The PC Card modems come with a telephone cord, full-featured communications software, Internet and online access software, and an operating manual. The modems operate on DOS, Windows 3.X, Windows 95, and Apple System 7 or later.

Estimated street prices for the Models 33PC, 33PC-V, and 33PC-SP range from $189.95 to $269.95. For more information, contact Logicode Technology, Inc., 1380 Flynn Road, Camarillo, CA 93012; Tel: 805-383-2500 or 1-800-735-6442; 24-hour BBS: 805-445-9633; Web : *http://www.logicode.com.*

CIRCLE 83 ON FREE INFORMATION CARD

Touch-Screen Universal Remote

Instead of the host of often-confusing buttons found on most multi-component remote controls, Rotel's RR 990's front panel is a flat, touch-sensitive LCD panel measuring $2\text{-}^{3}/_{8} \times 4\text{-}^{1}/_{2}$ inches. The backlighted display allows easy use even in darkened rooms. A "beep" that usually confirms each operating step can be switched off for totally silent, non-intrusive operation.

The LCD touch-screen is divided into thirds. The top section contains five always-visible function buttons and five hidden confirmation indicators that appear on a "need to know" basis. The bottom portion contains selectors for eight different system components. Touching any one of them will call up a dedicated control panel for that component in the much larger center portion of the screen.

Three different center views—complete, basic, and custom—are available. The complete view shows a comprehensive array of pre-mapped button icons. The basic view displays only essential controls. The custom mode allows the end-user to configure a control panel specifically geared to his own system or a particular way of using it. Short-cut keys encourage quick customization based on a library of self-contained templates. Users can also reconfigure each control panel without deleting commands linked to individual buttons.

For easy setup, the RR 990 allows users to input only the codes needed to operate a particular system. It also supports custom "macro" programming in which a single key touch can trigger a string of up to ten consecutive commands.

The RR990 touch-screen remote control has a suggested list price of $199.90. For further information, contact Rotel of America, 54 Concord Street, North Reading, MA 01864-0008; Tel: 1-800-370-3741; Fax: 508-664-4109. ■

CIRCLE 84 ON FREE INFORMATION CARD

"Look, Carl, I got you a new potty-training program!"

TECHNICS SL-MC60—TEST RESULTS

Brand: Technics
Model: SL-MC60 Compact Disc Changer
Price: $250

Features
60+1-disc jukebox-type changer
Single-play CD slot
User-programmable disc/track play
Automatic random-play (250 tracks)
Custom groupings (5)
Music-type classifications (14 genres)
Wireless IR remote control

The following test results were performed by the Advanced Product Evaluation Laboratory, using the CBS CD-1 standard test disc.

Output voltage (@ 0 dB, 1 kHz)
Left: 2.24 volts
Right: 2.21 volts

Frequency response (10 Hz to 20 kHz) 0.0 dB to 0.0 dB (see Fig. 1)

Dynamic range
Left: 90.2 dB
Right: 90.3 dB

Signal-to-noise ratio ("A" weighted): -98.8 dB

Total harmonic distortion + noise (@ 0 dB)

Frequency	THD (%)
31 Hz:	0.005
1 kHz:	0.006
10 kHz:	0.011
16 kHz:	0.023

Wow and flutter: Unmeasurable

Channel separation (@ 0 dB, 1 kHz)
Left: 87.6 dB
Right: 87.2 dB

De-emphasis error

Frequency	Error
1 kHz:	0.02 dB
4 kHz:	0.06 dB
16 kHz:	0.05 dB

Linearity error (@ 1 kHz)

Signal level (dB)	Error (dB)
0	0
-10	-0.1
-20	0
-30	-0.1
-39.99	-0.2
-49.97	-0.1
-59.94	-0.3
-70.31	-0.2
-80.77	+0.3

Linearity error with dither (@ 1 kHz)

Signal level (dB)	Error (dB)
-70.31	-0.3
-80.77	-0.4
-90.31	-0.7
-100.0	+0.6

Additional data

Short Access Time (Track 1 to 2):	1.8 seconds
Long Access Time (Track 1 to 21):	4.1 seconds
Disc Access Time	
Disc 1 to Disc 15:	6.1 seconds
Disc 1 to Disc 30:	7.0 seconds
Disc 1 to Disc 45:	7.7 seconds
Disc 1 to Disc 60:	9.0 seconds
Power Requirements:	8.5 watts
Dimensions:(HxWxD, inches.):	$6\text{-}^{11}/_{16}$ x $16\text{-}^{15}/_{16}$ $15\text{-}^{3}/_{8}$
Weight:	14.5 pounds

TECHNICS TEST REPORT

Continued from page 50

seconds to get from Disc 1 to Disc 15, just 7 seconds to get from home plate to second base (Disc 30), and does 0 to 60 in 9 seconds. These are impressive times compared to a high-performance five-disc carousel tested here in the past (**Popular Electronics**, January 1996). That changer (the Marantz CC45U) took 6.9 seconds to get from Disc 1 to Disc 5—having only to reverse one position (and not spin past Discs 2, 3 and 4)!

Despite all its programmability options, the SL-MC60 works just fine in the lazy-man mode—also known as Automatic Random Play, where the machine's brain just picks and choose among discs and tracks at random. In this case, though, with 60 CDs to choose from, it can sustain this solo game for 250 selections.

Is there anything to regret about the SL-MC60? Perhaps only the lack of a headphone jack—so for private listening you will have to patch into your preamplifier or receiver.

FOR MORE INFORMATION

TECHNICS
One Panasonic Way
Secaucus, NJ 07094
Tel: (201) 348-7000

Performance

As the APEL measurements show, the changer's electrical performance is good in every area, though not the best ever measured. At some points where the SL-MC60 falls short of perfection, it doesn't really matter. These shortcomings can be measured by lab equipment but can't be heard by human ears.

The frequency response (Fig. 1) is virtually ruler-flat, as you should expect in the CD format. Likewise wow and flutter are nonexistent. Both signal-to-noise ratio and left/right channel separation are good, but no record-breaking marks. Dynamic range, which measures the spread between the softest and loudest sound the player will resolve, is adequate. The changer's 90 dB (decibels) reach will cover the range recorded on most CDs. As for total harmonic distortion (THD), APEL's readings for the SL-MC60 are par for the

(Continued on next page)

THINK TANK

Continued from page 67

the 1-volt program lines. Measured frequency response of the circuit was found to be within ±3 dB from 5 Hz to 250 kHz. Noise generated in this circuit is almost entirely dependent upon the power supply used. When used with battery operation, for all practical purposes, this circuit would be totally noiseless.

—Craig Kendrick Sellen, Waymart, PA

Wow, for budding musicians this is a nice companion to the guitar-practice amplifier mentioned earlier. It's simple and very inexpensive. A bunch of these connected to a home-brew mixer would be nice for a practicing band.

Telephone/Doorbell Stereo Mute Circuit

It has been a while since I have submitted a circuit to this column (November 1990 issue to be exact, entitled "Telephone Privacy"). So it's about time! The doorbell-stereo mute circuit in Fig. 6 has been in operation at my home now for around two years with no problems. My dad gave me the idea, as he knocked on my front door for around fifteen minutes while my stereo blasted! Well, that wasn't too cool so I built this circuit. The telephone muting portion came from ***Radio Electronics***, January 1990; in addition, as pointed out in the *May 1993 issue of* ***Electronics Now,*** I changed the circuit to make it more FCC acceptable.

When the front or back doorbell is pushed (closure of switch S3 or S4, respectively), AC flows from the bell transformer through resistor R4, the doorbell chime, the LED portion of the photo-SCR isolator IC3, diodes D4 or D5 (depending which doorbell switch was pushed), and back to the bell transformer. The current flowing through the LED in IC3 activates the light-sensitive gate of the SCR causing it to conduct. With the ON/OFF switch S1 and RESET switch S2 closed, current then flows from the 12-volt power source (noted by the illumination of the red LED2) through the switches into LED1 (the Stereo Mute Indicator) and R2, through the SCR of IC3 and then from the base to the emitter of Q1 to ground. Transistor Q1 conducts and collector current flows through relay RY1 to ground. RY1 energizes and pulls its DPDT normally closed contacts open, thereby muting the stereo speakers. Note that diodes D4 and D5 prevent both front and back door chimes from going off at the same time, since they both are tied to pin 2 of IC3.

In the telephone-activated part of the circuit, capacitor C1 and Zener diodes D2 and D3 block the phone line voltage, which is normally 48-volts. Ringing current is around 90-volts AC, which overcomes the breakdown voltage of these Zener diodes. The positive half-cycle flows from the positive end of the phone line through R1, the LED portion in IC2, D3, D2, and C1, to the negative side of the phone line. The flow of current through the LED of IC2 activates the light-sensitive gate of the SCR, causing conduction. Current then flows through the green Stereo Mute LED1, R2, the SCR of IC3, and from the base to the emitter of Q1 to ground. Transistor Q1 conducts and current flows through the collector and relay RY1 to ground. RY1 energizes and mutes the stereo as described for the doorbell circuit.

Note that the SCR portion of Photo-SCR Isolator IC1 is not connected because the positive half of the ringing current is enough to operate the circuit, and the LED in IC1 balances the phone line. A plain diode could replace IC1; however, I do not know just what diode would be sufficient (possibly a 1N4007). I do think the LED match is better by using IC1 as shown.

There is a bit of work involved in this circuit, but it is worth it! You will need to run a phone line near your stereo. I used a four conductor phone cable; two for the phone line (red and green wires) and the unused pair for the bell line. You will also need to run a line from the doorbell chime to the (unused pair) telephone line input of the circuit. The telephone stereo muting portion of the circuit is fairly simple, and you could build just that eliminating the extra doorbell wiring and components IC3, R4, D4 and 5. Whatever way you choose; have fun!

—Daniel P. Rieskamp, Cincinnati, OH

As a fellow listener to loud music, I can really appreciate this circuit. Builder be advised to use a relay with a high contact amperage rating, as the voltage, and therefore the current produced by some amplifiers can be significant at loud volumes.

That's all we have room for this time. Remember, if you'd like to win a book from our library, send a schematic of your working circuit and a thorough explanation to *Think Tank*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. If you send enough usable circuits to fill a column, you'll receive a MCL1010 chip and a kit, in addition to the book awarded for single submissions. ■

TECHNICS TEST REPORT

Continued from page 75

course. In any event, in the opinion of most experts, THD would have to reach 1.0% to be audible.

Similarly, for de-emphasis and linearity, 3 dB is considered the threshold beyond which other errors become audible. De-emphasis error measures how accurately the player's circuitry reverses the pre-emphasis curve on the disc recording. It should be a perfect mirror-image but seldom is symmetrical. The SL-MC60's errors here at least track with the curve with no gross diversions. Linearity error measures the accuracy of the CD player's digital-to-analog converter (DAC) section. Does it translate each of the 65,536 possible digital codes on the CD to its exact frequency and level? The Technics decoder does well enough—the worst error is within 0.3 dB and therefore not audible above the stereo system's inherent noise. To keep things honest, the linearity error with dither test accounts for system noise; again, the degree of DAC error is not audible.

So if you want a neat way to store and manage your entire CD music collection, be able to play any disc with utmost ease and convenience, and obtain a great performer in your stereo system—the Technics SL-MC60 is the CD changer for you! For more information on the Technics SL-MC60 compact disc changer, contact the manufacturer directly at the address provided in the box, or circle No. 123 on the Reader Service Card. ■

We're on the Web!
www.gernsback.com

ELECTRONICS RULER

(Continued from page 59)

mile) plot of desert and then to measure the distance between them to within one-millimeter. M³ works by combining the atomic imaging capability of an STM with technology for moving and positioning the STM probe over much larger areas with unprecedented precision. That gives M³ the ability to survey the landscape between atoms on the molecular frontier.

The Outlook

Right now, however, M³ is flying blind, without instruments. Like other STMs, M³ suffers from 'tunnel vision.' "The hard part is discerning and fixing the positions of things that are so far apart," Teague said. For objects at opposite ends of M³'s range... "the separating distance spans a billion times the diameter of the objects themselves." Without navigational aids, M³ would be limited to exploring only small corners of the molecular domain.

To locate and track the probe as it scans billions of atoms over the surface of a specimen, Teague's team uses what amounts to a Global Positioning System. Both M³ and the sample are mounted on sliding carriages machined to move in extremely precise increments. A "metrology box" made of an ultra-high-stability ceramic is used to provide coordinate reference frames when determining the positions of both the probe and specimen. Movements relative to the metrology box are tracked and measured with laser-based instruments called interferometers. The system is capable of measuring movements as small as 0.05 nanometers—less than the diameter of an atom.

Until recently, the machine has been limited to measuring only a small part of its full range. While the team continues to characterize precision and accuracy performance, NIST can, at this point, finally see the whole field. "There are some measurement uncertainties that remain," said metrologist John Kramar, the current project leader, "but we can now essentially measure specimens and map out surfaces over the full 50 × 50-millimeter range."

Measurement with M³ may be more accurate but it is not faster. "It takes a long time," said Kramar, "orders of magnitude longer than typical measurements from the measuring microscopes like those used in semiconductor manufacturing process control. Typically, for a 5×5 micrometer image with the raster scan lines spaced 50 nanometers apart, the scan time is 30 minutes." For example, in a comparison of different methods for measuring line width on integrated circuits, M³ operated for 40 straight hours, performing roughly one-million separate measurements of an area centered on a chrome line designed to be 750 nanometers wide. It made 16 overlapping images, each one 3 micrometers by 5 micrometers.

The results of M³'s line-width measurements in that test corresponded closely with those obtained with an electrical method. Although only suggestive because of the small sampling size, the results were consistent with other comparisons that found electrical and microscope-based methods to yield systematically differing results. The explanation of these differences is significant as the semiconductor industry demands greater measurement accuracy and reliability. The industry must understand the capabilities and limitations of existing measurement methods being considered for future generations of integrated circuits.

The results of the study were presented in Japan last year at the International Conference on Microelectronic Test Structures. Aside from its immediate industrial applications, M³ has physicists excited about investigating scientific questions. What happens when you remove a single atom or bunch of atoms from the surface of a crystal? "What distortion does that cause," Teague wonders. "How far does the disturbance propagate over the surface? Does it affect the squareness of the crystal lattice?" M³ may even be able to use nature's own geometry to validate measurements. Interatomic spacings in a crystal, for example, with its highly ordered, regularly repeating arrangement of atoms, could serve as the molecular world's version of a ruler. "For measuring squareness," says Teague, "the right angles of a cubic crystal lattice would be the ultimate reference." ■

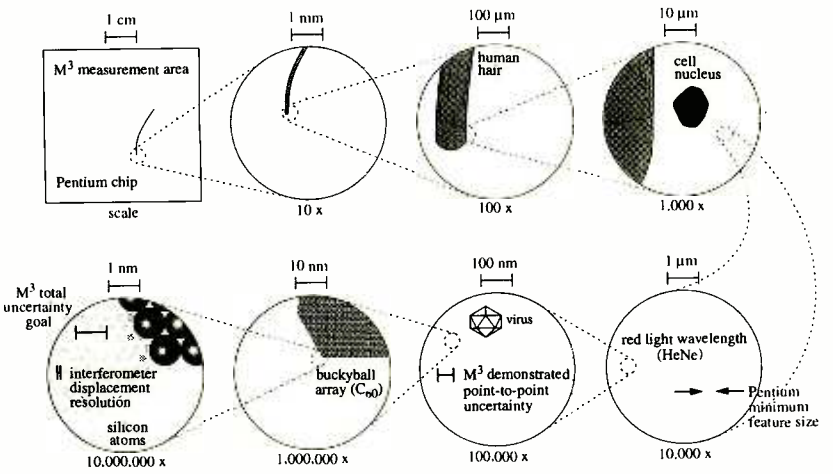
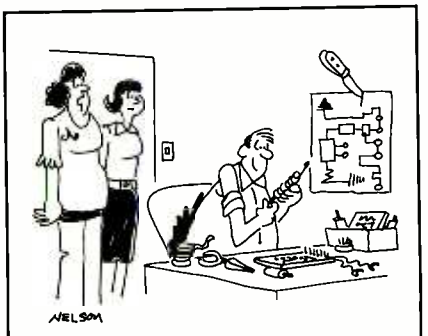


Fig. 1. The new M³ electronic ruler, which is expected to measure to within one billionth of a meter, works by combining the atomic imaging capability of an STM with the technology for moving and positioning STM probes over much larger areas with unprecedented precision; thus giving it the ability to survey the landscape between atoms.



"I dont know what Carl's up to but he's already de-furred the cat!"

CLEAN UP THE AIR

(Continued from page 49)

the opening of a servo valve that injects additional air into the intake manifold between the carburetor and intake manifold to produce the leaner mixture. Under normal conditions, the system keeps the engine running precisely at the lean limit. If performance falls off because the engine is operating beyond the lean limit, the computer senses that over-lean condition and commands the valve to reduce the amount of supplemental air so that the mixture ratio decreases.

Engine performance is monitored by a magnetic transducer that senses changes in the rotational speed of the flywheel by tracking the teeth on flywheel's ring-gear (as shown in Fig. 3). Flywheel speed is very sensitive to engine instabilities from too-lean conditions, which cause the motion of the pistons to become irregular. When performance improves, as indicated by a return to the flywheel's normal, smooth angular velocity, the processor starts adding air to lean the mixture again. All that happens very quickly—in about 2.5 milliseconds—so that the adjustment is as close as possible to the ideal. Ideal is an adjustment in the lean level happening before the next cycle fires. When the driver applies full throttle during acceleration, passing, or hill climbing, the computer rapidly commands a richer mixture.

According to LeanPower, retrofitting an old car with the LeanPower system would cost about $250, including a needed tune-up. That price, however, could decrease with a new sensor the company is working on to replace the flywheel sensor. The sensor would determine performance via an input from the tachometer. On fuel injected cars, the LeanPower system is tied in directly to the fuel injection control system.

Aftermarket emission equipment could be the ticket for anyone who wants to keep an old car, whether it is a daily-driver or a collectible, environmentally-friendly. By installing millions of them, cities like Cairo, Bombay, Mexico City, and many others notorious for their foul air could be cleaned up. ■

FOR MORE INFORMATION

Neutronics Enterprises, Inc.
11421 West Bernardo Court
San Diego, CA 92127

LeanPower Corporation
335 Paint Branch Dr.
College Park, MD 20742

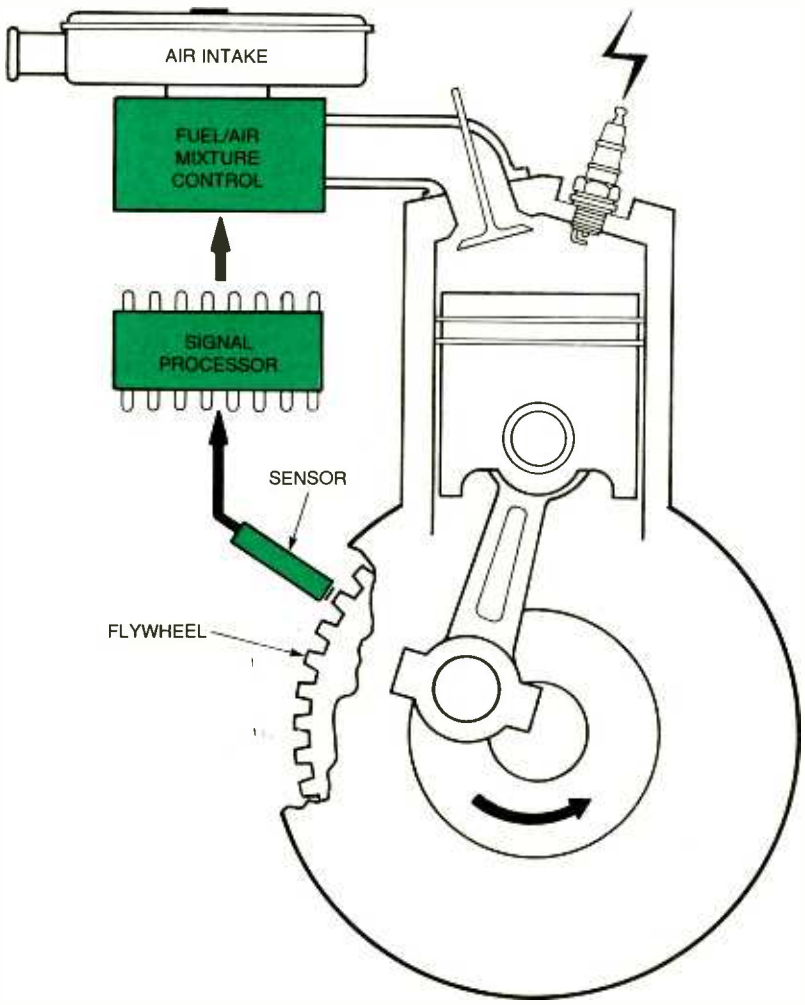


Fig. 4. The LeanPower system uses a magnetic transducer to sense minute changes in the flywheel's rotational speed. The Lean 2000 signal processor controls a servo valve that regulates the quantity of air (oxygen) injected into the intake manifold on engines with standard carburetors.

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CIRCUIT CIRCUS

Continued from page 70

also be used as a tone/pulse generator. The oscillator circuit in Fig. 7 produces narrow negative output pulses which can be tuned from about 100 Hz to over 10 kHz. The circuit may be used to drive a piezo transducer for high frequency audio experiments.

Double Balanced Mixer

Our last oscillator circuit uses a very popular and versatile NE602 Double-Balanced Mixer IC, complete with a built-in oscillator circuit that is good up to several hundred megahertz. This IC has been a real boom for the ham circuit builder in the front-end of many receiver and transceiver circuits. But for now we are only going to look at the IC's oscillator section.

The oscillator in Fig. 8 is configured as a Hartley circuit with inductor L1 and variable capacitor C1 setting the operating frequency. The following nominal L1/C1 values are a good start in choosing components for a desired center frequency for the oscillator:

L1 = 5-uH and C1 = 150-pF, for a center frequency of 5 MHz; and

L1= 1.5-mH and C1 = 50-pF, for a center frequency of 15 MHz.

PARTS LIST (FIG. 8.)

C1—Variable capacitor, see text
C2,C3—0.02-uF, ceramic disc
C4—0.1-uF, ceramic-disc
C5—100-uF, 25 WVDC, electrolytic capacitor
C6—See text
R1—470-ohm, 1/4-watt, 5%, resistor
L1—Inductor, see text
IC1—NE602 (Philips NE602A)

Feedback for the NE602 is taken off at the tap of coil L1. The feedback tap is about 1/4 to 1/5 of the way up from the ground end of L1. The sinusoidal wave output is sampled at pin 7 through coupling capacitor C6. Choose a value for this capacitor no greater than 15% of the value of tuning capacitor C1. The NE602's oscillator also operates with other resonance circuits such as crystals, piezo elements, and other LC configurations.

There's many more great ICs in circulation suitable for oscillator action, but we'll have to take a look at these at a later date. May all of your oscillators oscillate at the correct frequency! See you here next month. ■

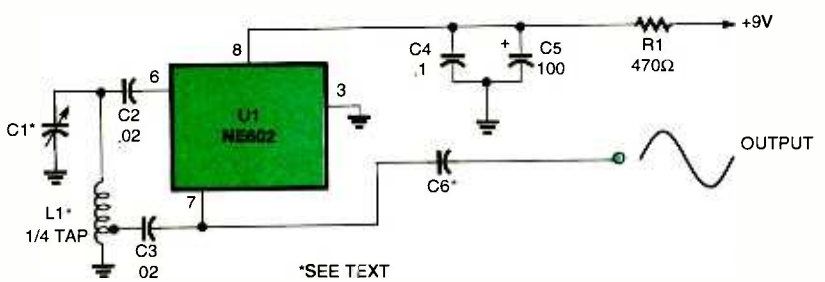

Fig. 8. The NE602 Double-Balanced Mixer IC can be used as a sinusoidal RF oscillator in this configuration.

Muscular Dystrophy Association
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SCANNER SCENE

Continued from page 60

use 156.65 MHz. Around busy harbors, you might also be able to monitor low-power dockside communications on the 457.525–457.60- and 467.75–467.825-MHz bands.

Digital Data

Responding to a reader last February, we stated that digital mode communications cannot be monitored successfully using present-era scanners. Well, you just knew we would get called out with a remark like that! We pass the following information along with neither comment nor confirmation, except to observe that it does sound very interesting.

Darryl Barry wrote, "There is a unit that can demodulate digital transmissions. I have used a working prototype of this unit on my scanner. There are actually two units working in prototype stages. One is a self-contained unit that is already programmed and attaches directly to a scanner. The second unit requires a notebook computer, SCSI card (internal or external), and software program."

He said that he is prepared to sell these units, and invites interested readers to get in touch with him. If you wish, to pursue this, contact Darryl Barry, Elite Security Professionals, 33331 Old Yale Road, #108, Abbotsford, BC, Canada V2S 2J6. His phone number is 604-859-4080.

Cellular Modification Update

Last issue, we mentioned that some new scanner models manufactured after the FCC's April 1994 cutoff date for readily restored cellular bands still could be unlocked to hear cell-phone calls if owners sent their sets to certain companies that knew how to do the job. Possibly as a backlash to the taping of Newt Gingrich's cellular call that was then turned over to the media, the FCC subsequently announced that companies are no longer allowed to offer that service.

Keep in Touch

We need your frequencies, loggings, and circuit ideas. Write to us at *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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Be sure to include copies of all correspondence.

ANTIQUE RADIO

Continued from page 64

three audio jacks. For example, no power reaches the filament of the second audio tube until a set of switch contacts is closed by the act of inserting a plug into the second audio jack. Thus the tube remains dark, conserving "A"-battery power, except when it is in use.

The switching arrangement built into the detector and first audio jacks doesn't involve the filament circuits (although there are some unused contacts on those jacks that could have been intended for possible filament switching). When a plug is inserted into one of those jacks, the connection from the plate of its associated tube to the following audio transformer is broken, and the phones are placed in series with the B+ supply.

Power Feeds

Before leaving the NR-5 circuit diagram, let's take a look at how plate, filament, and bias voltages are fed to the various portions of the circuit. The voltages (obtained from batteries, of course) reach the set through the group of labeled binding posts shown at the right of the schematic diagram.

The topmost post, labeled "+90," supplies the required 90-volt B+ to the RF and AF amplifier tube plates (the first two and last two tubes). Directly under that, labeled "+45," is the post supplying the 45-volt B+ required for the plate of the detector (middle) tube. Below that (labeled "B +6") is the filament and plate connection. And under that (labeled "–6 +C") is the post supplying filament ("A") voltage to the five 01-A tubes and serving as the return for the grid bias ("C") voltage. Finally, the bottom post (labeled "–C") supplies grid bias voltage to the audio amplifier tubes (the final two tubes).

Notice the two filament-control rheostats located toward the bottom of the schematic (one under the third tuned circuit, the other roughly under the second audio phone jack). Although you might not be able to make it out, the former is labeled as an amplifier control and the latter as a detector control. It would make sense to have the detector filament controlled separately because detector adjustments are more critical than amplifier adjustments.

However, tracing the wiring, it looks as if the "amplifier" rheostat controls only the filaments of the two RF amplifiers, while the "detector" rheostat controls everything else. It will be interesting, later, to compare the wiring of an actual NR-5 with this schematic to see if it is hooked up the same way.

The "Knock-Down" Neutrodyne

I do happen to have in my collection a five-tube Neutrodyne that, although not specifically identified as such, has to be the KD-50 Neutrodyne kit put on the market by Freed-Eisemann about 1924. Now that I've had a chance to compare it with the NR-5, I'm more convinced of that than ever. The set sold for $80, which was quite a savings over the $150 cost of a factory-assembled NR-5. The set did not come with a cabinet or tubes, although it did have a pre-drilled and labeled front panel.

Panel layout was a little different than that of the NR-5, with both filament control knobs on the right side of the panel instead of at opposite ends. And the audio output jacks are grouped under the filament knobs instead of being spread out across the bottom of the panel.

The kit schematic, which I traced out many years ago, is very similar to the NR-5 schematic. But there are a couple of interesting differences in the filament circuit. In this case, the "detector tube" rheostat does indeed control just the detector filament, and the "amplifier tubes" rheostat controls all of the other tubes. In addition, plugging phones into the detector socket kills the filament of the first audio stage. The second audio filament, just as in the NR-5, is always off except when a speaker is plugged into the second audio jack.

See you next issue! ■

most boring part of the process. Once the batch file is finished you simply flip the switch back to RUN, hit the RESET switch, and—Hey! Three Beeps, not two! It worked! My three beep modification was in the micro!

The next night I rushed right home from work buoyed by my success of the previous evening. The tones generated by the program were created using an "output compare" function, which is a built-in timer function on the 68HC11 chip. While the operation of this function was beyond my comprehension, I was still able to modify the existing code to produce a workable Morse code routine. As it turned out, I simply wrote subroutines to produce tones and spaces that were multiples of a basic unit. In other words, a dot was one unit long, a dash was three units long, a space between letters was three units of no tone, a space between words was five units long—all according to Morse code convention. I simply named these subroutines and called them as necessary to produce the desired code string. For example, to produce the SK prosign, I simply called these subroutines:

```
jsr     dit
jsr     dit
jsr     dit
jsr     dah
jsr     dit
jsr     dah
```

In other words, jump to subroutine dit, return, jump to subroutine dit, return, and so on. This allowed me to string together the following code: DE WB9RRT SK (from; my callsign; end-of-transmission). While not very elegant, this got the job done. Of course, it only sent the code each time the board was turned on. I needed a way to have it repeat at a given interval. While I was working out the code subroutines, I noticed that the Technological Arts programmers had set up a bunch of variables and a timing subroutine. To introduce a wait period, all you had to do was the following:

```
loadx   #_25SECONDS
jsr     WaitX
```

So just put the amount of time you want to wait in the X register, and jump to the subroutine called WaitX. It will dilly-dally for 25 seconds, then return to the program. I put that code before the Morse code section, and put a label at the top of the program (top:). At the end of the Morse code section I just said:

```
jmp     top
```

Now I was cycling through the Morse code, returning to the top of the program, waiting for 25 seconds, and hitting the Morse code again, and so on. I could fiddle with the timing once I got all the bugs worked out, but at least now I had the hard part of the program done. Of course, I still hadn't turned the transmitter on or off, but I did have

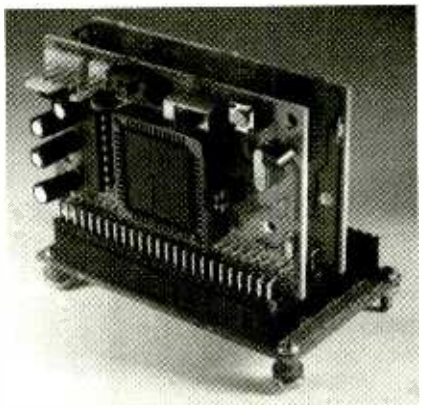

Fig. 3. Technological Arts produces a variety of plug-in carriers that make permanent installations a snap.

a few nights left.

T-minus three days and counting. I had plenty of time until Saturday, but wanted to get things working ahead of time—just in case. My objective for the evening was the PTT line. I needed to write a subroutine that would flip an output port high, and then flip it low after a delay.

I went back to the DEMO. ASM program to see how they did it. I knew that the 68HC11 used memory-mapped I/O. This means that the physical I/O ports are given addresses right along with the memory addresses, and that you can read to or write from a port the same way you can read a memory variable.

As I viewed the code the DEMO program used to toggle the B Port lines, I found that they were using a fairly elegant way of flipping the bits. Since the programmer wants to only affect a single bit, he can't just write a new variable into the I/O port location, as this would disrupt the other bits on the port. For instance, if I want the second and third bits high, I would just write a 6 to the port (binary 00000110). This sets the proper bits high, but also sets all the other bits low, which may not be what I want. In order to accomplish this properly I need to use a bitwise OR operator. In my case, I wanted to turn on the first bit of the port, so I used the following code:

```
TX_ON:
    ldab    #1
    orab    portb
    stab    portb
    rts
```

Create a subroutine called TX_ON. Load the value 00000001 in accumulator B. Use the OR function, and OR this with the value of Port B. The new value will be in accumulator B. (By ORing the values I know that the first bit will be a 1, no matter what is already in Port B, and the rest of the bits will remain as they are.) Store this value back in the slot for Port B, which will cause the output pins to toggle accordingly. Then, return from the subroutine (rts). Likewise, to turn the bit off I used the following:

```
TX_OFF:
    ldab    #1
    comb
    andb    portb
    stab    portb
    rts
```

The TX_OFF subroutine performs by loading the value of 00000001 in the B register. This is then complemented, changing it to 11111110. This value is then ANDed with whatever is in Port B, (the first bit will become 0 no matter what is in Port B, and all the rest of the bits will remain as they are). This is stored back in portb (written to the port), and the subroutine ends.

Using the TX_ON and TX_OFF functions with the WaitX function, I

was able to turn the transmitter PTT line on and off at will, for any duration of time. I had completed all the basic functions necessary for a foxhunt transmitter controller, and I still had two nights left.

As luck would have it, I heard Jim talking on the local ham repeater on the way home the next night. I broke in just to say hello. "Glad to hear from you," he said. "How's that controller coming along? I've got my yagi and attenuator all tuned up for Saturday morning!"

"Well, I've given it some thought," I said. "Should be able to whip something up the next night or two. Been pretty busy."

"Sure hope you whip something up! There's gonna be about thirty guys there looking for something to hunt—I hope it won't be you they'll be looking for! By the way, I got to thinking about the time interval on

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that thing. I hope you make it adjustable. Not really sure how much on time and off time we're supposed to get. Wouldn't want it to be too discouraging to the guys. Not really sure if we need that SK business either. Oh well, whatever you think." I signed off with Jim, and headed home. Great. Now I needed to vary the time off, at least the off interval to make it sporting, and I needed to make the SK optional. It was a good thing I had some extra time.

T-minus one day and counting. Friday night I rushed home, and hit the computer. I needed to make the off delay adjustable—not a bad idea, even if Jim did think of it. I knew that you could get an adjustable value into the micro by putting a potentiometer on one of the A/D converter inputs. I'd played with this on the DEMO program, and knew you could get a value from 0 to 255 based on the voltage coming off a simple voltage divider pot. I found out where this was stored in the program, and used that value to modify the time off period like this:

```
    ldab        adr4
timeoff:
    ldx         #_1SECOND
    jsr         WaitX
    decb
    bne         timeoff
```

This code simply takes whatever value (between 0 and 255) that comes in from the A/D converter address 4, and puts it in the B accumulator. "Timeoff:" is simply a label. The next two lines just perform a one second wait. The decb instruction decrements the value in the B accumulator by one. The next line, Branches if Not Equal (bne) loops back to the label "timeoff:". In effect, this code loops through the one second delay once for as many times as are stored in the B accumulator. The delay will be one second, multiplied by the value coming in from the potentiometer. In this case, the off delay will be from zero to four and one quarter minutes—a short enough wait time for even a total novice foxhunter.

The final problem turned out to be the easiest. In order to toggle the SK function on or off, I simply tied one of the input port lines high or low, and tested it with an AND function. If the result of the AND was zero, I simply skipped the SK code lines with a branching function, like so:

```
    ldab        porta
    andb        #1
    beq         no_SK
    jsr         dit
    jsr         dit
    ...rest of SK code...

    jsr         dah
no_SK:
```

It was 1:30 AM. I figured the rest could wait until morning.

The Fox is Alive! The foxhunt was at nine o' clock, so I had plenty of time to sleep. It had been a struggle, but I had accomplished my objectives. I had built a foxhunt transmitter that could generate a Morse code ID, an SK end-of-message signal, and had variable time intervals and a switchable SK function. Knowing absolutely nothing about microcontrollers, I had generated tones, controlled a transmitter, read an analog value, and read a switch—all in five night's work.With that all done, I hit the pillow, and slept like a log.

So much, in fact, that I slept right through the alarm.

"I thought I'd let you sleep for another hour or so, honey - you've been up so late all week. It is Saturday, you know. Are you still having that ham radio thing today?"

Yikes! Quarter after eight. I leapt out of bed, and bolted for the workshop. I hacked the end off an old mic cord, and hooked up the audio line to the cord via a small electrolytic capacitor. I jammed an NPN transistor into the protoboard, and tied the collector to the PTT line. I hooked the mess up to my two meter handheld, and fired it up. It worked! I gently squeezed the whole mess together, and wrapped it up with thirty-seven turns of duct tape. After stopping at McDonald's for coffee, I dropped the whole package into an outside garbage can. (It was the pre-arranged hiding place—I knew the manager). I rolled into the parking lot at the mall at ten minutes to nine. Several teams were already taking bearings from the starting point; the 1-watt signal was strong enough even four miles away!

I was chatting with Randy when Jim came over. "Sounds like you got something lashed together after all!", he said.

"Oh, yeah," I shrugged. "Nothing major. One of those new Motorola microcontrollers. I programmed it up in assembly language. They're really pretty simple, once you've worked with them a bit!"

Summary. This little package can accommodate a multitude of applications. In no time, you too can be the electronics guru in your neighborhood! Maybe the best one on the block! For more information on Technological Arts' ADAPT-11 series of microcontroller modular starter kits, contact the company at the address given in the box (middle of the first column), or circle no. 124 on the Reader Service Card. ■

COMPUTER BITS

Continued from page 16

then restoring the contents of the drive.

Partition Magic (PM) changes all that. With it, you can re-partition to your heart's content. (You should still back up in case anything goes wrong during the process!) Version 3.0 of PM is less an improvement over the previous version than I would have liked. The program has a Win95 look and feel, but still operates as a DOS-mode program. The company cleverly makes a transparent installation, so that when you click on the icon, PM shuts down Windows, runs itself, then runs Windows again. You can save the aggravation simply by running it from the DOS command line.

The new version includes an anemic boot manager (built by IBM and supplied as part of OS/2), that is certainly functional, but much weaker overall than System Commander. The new version of PM also includes an application-move utility that helps you move applications (Windows 3.x and 95) from one drive to another after re-partitioning. The mover updates all INI files and Registry settings. Both 16- and 32-bit versions are included.

Together, the PM bundle provides a lot of power, but I wish the components were better integrated. One good thing is the inclusion of a text-only version of PM, which can run from a floppy disk.

Version 3 supports the new FAT32 system that comes with new PCs as part of the Win95 service pack release (only). Version 3 also supports more options concerning conversion of partition among operating system formats (FAT, NTFS, HPFS).

As of this writing, Surplus Direct (800-753-7877) is selling Version 2.0 for about $25. That's a true bargain. It has an OS/2 look and feel, but does 90% of what the newer version does, for about one-third the cost.

System Commander

System Commander has one purpose in life—it enables you to run more than one operating system on one machine. In fact, you can install and run more than 100 OSs. Depending on the OS, you can install each to a different partition. However, all DOS and Windows (through Win95) OSs must reside on the primary partition (NT can boot from an extended partition). That is because the OSs themselves are hard-coded to boot only from the primary partition of the first physical drive.

I run my main workstation using DOS 6.2, Windows 3.11, Windows 95, and Windows NT 4.0. It would be possible to use just the built-in boot managers in Win95 and NT to handle this arrangement, but doing so would involve complex installation and making a series of choices from nested menus at every boot. System Commander allows standard installation and integrates all choices on one menu. You can set a default OS and a time-out, so that your normal configuration will boot unattended.

A truly integrated version of Partition Magic and System Commander would be unbeatable. ■

VENDOR INFORMATION

The prices shown below are suggested retail prices. Price discounts available through software retailers.

PowerDesk Utilities ($34.95, $24.95 for upgrade), Mijenix Corporation, 6666 Odana Road, Suite 122, Madison, WI, 53719. (800) 645-3649, (608) 277-1981. www.mijenix.com

PartitionMagic 3.0 ($69.95, $29.95 for upgrade), PowerQuest Corp., P.O. Box 1911, Orem, UT 84059-1911. (800) 379-2566, (801) 226-8977. www.powerquest.com

QuickView Plus 4.0 ($59.99, $29 for upgrade), Inso Corp., 330 North Wabash, 15th floor, Chicago, IL 60611. (800) 333-1395, (312) 329-0700. www.inso.com

Stiletto ($22), Bruce Switzer, 204 Duplex Avenue, Toronto, Ontario, Canada, M5P 2B2. bswitzer@ican.net, 104722.1260@compuserve.com, www.inforamp.net/~crs2086/index.htm

System Commander, V Communications, Inc., 2290 North 1st Street, Suite 101, San Jose, CA 95131. (408) 965-4000. The version reviewed 2.26, is no longer available. The latest version 3.0, with added features, is available for $99.95.

Guess whose skull is found 750,000 years hence!

CASIO CASSIOPEIA

Continued from page 15

accessories onto a desktop or notebook system from one of the included discs. You then connect the host system to Cassiopeia with a serial cable. Cassiopeia comes pre-loaded with Windows CE, but you modify your setup by connecting to a host system that has a CD-ROM drive. Our test system found Cassiopeia right away, and synchronized right up. We were able to control Cassiopeia from the desktop system, and easily drag and drop files between the two. You can also synchronize appointments with desktop applications such as Schedule+.

Windows CE applications include Pocket Word, Pocket Excel, Pocket Mail, and Pocket Internet Explorer. There's also a calculator, world clock, calendar with scheduling and desktop synchronization, and more. You even get the solitaire game!

Pocket Word and Excel are neat little programs, both very much like the full-blown products in look and feel. In Word, for example, you can define words and paragraphs, drag and drop text, change fonts, point size, and so on, all with the pen. While you probably won't want to type anything very long, you can send completed files to a desktop system for printing.

It was pretty neat to surf the web with Pocket Internet Explorer. We used a 28.8 modem to connect to an ISP provider, and were able to view tiny, plain web pages. One major problem is very excessive power usage when you have a modem running. Our 28.8-rated modem caused a low-battery warning to trigger after only about 15 minutes of use on a brand-new set of batteries. Then the unit shuts off, cutting off our connection. You really need an optional AC adapter when you're using a modem. Of course you can go through lots of batteries, rechargeable or otherwise, but you'll still get cut off when they run out.

Without trying to send even more business Microsoft's way, Windows CE makes pocket computing more productive than ever, and Cassiopeia is a neat little gadget that provides you with all the connectivity you need when you're on the go. If you've never been satisfied with what palmtop PCs have offered in the past, you might want to take a new look at the Cassiopeia. ■

HEARTBEAT MACHINE

(Continued from page 46)

bleshoot the circuit by checking the voltage at pin 8 of IC2-c. It should be about 5 volts when the photocell is completely dark with no variation of ambient light striking it. When the subject's finger is in place, the voltage should switch back and forth between zero and five volts. If not, check R10-R13 and IC2-c.

If LED2 is inoperative, check its polarity or try a new LED. The operation of IC3 can be checked by manually triggering it with a momentary short between pin 2 and circuit common. Each time that pin 2 is shorted, pin 3 should go to about five volts for a tenth of a second and LED2 should flash. Check Q1, D1, R14-R16, and C10. Try a new CMOS 555 chip and transistor.

Using four 1/2-inch spacers, with 2-56 or 4-40 machine screws and nuts, secure the boards together. Drill holes on the bottom of the enclosure to accommodate the four screws of the assembly. Temporarily assemble it to the enclosure with four spacers and nuts. Once the assembly is properly positioned in the enclosure, determine the location of the hole required for the subject's finger to rest on the transducer. Then remove the assembly and drill or cut a hole which is just large enough to accommodate your finger. Remember, the hole should be as small as practical to preclude ambient light striking the photocell.

The power switch and LED2 can be mounted at any convenient location on the top of the enclosure. It is mandatory that no light from LED2 strike the photocell. One way to accomplish that is to use black electrical tape to shield the bottom side of the LED. Install the assembly into the enclosure. Complete the wiring to LED2, S1, and the battery connector, as indicated in the schematic diagram.

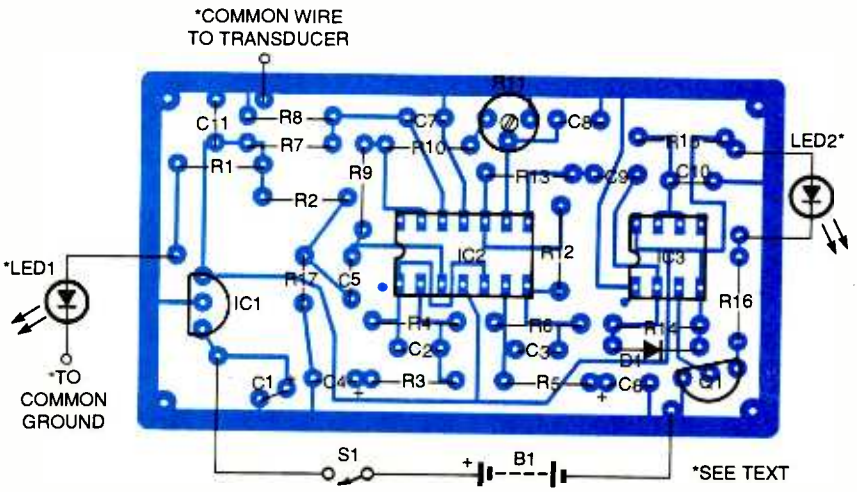

Fig. 5. Install the parts in the printed-circuit board guided by this parts-placement diagram. When installing the components, pay close attention to the orientation of the polarized parts—electrolytic capacitors transistors, etc.

Final Assembly. When you are satisfied that the circuit is operating properly, the two boards can be permanently stacked. Place the transducer assembly over the circuit board and feed the remaining leads of LED1 and the photocell into their respective holes. Allow 1/2 inch spacing between the boards and solder the leads in place. Then take a short piece of insulated wire and make the ground connection between the two boards.

Using the Heartbeat Machine. Operation of The Heartbeat Machine is very simple. Just turn power on and have the subject place an index finger into the enclosure so that it rests firmly in place on the LED and photocell. The tip of the finger must be in solid contact with the photocell to ensure adequate light transfer. Allow sufficient time for the circuit to stabilize. LED2 will then blink in synchronization with the subject's heartbeat. The pulse rate is easily determined by using the second hand of a watch to count the number of flashes that occur in 15 seconds. Multiply that number by four, and the result is the heartbeat rate of the subject.

The normal pulse rate for many adults is about 70 to 75 beats per minute; children typically exhibit noticeably higher rates. Some people experience an increase in the rate when they know it is being checked. After checking the subject's normal heart rate, you may provide any kind of external stimulation to see if and by how much it will increase. This could be a very entertaining exercise! When finished using the Heartbeat Machine, always turn power off to conserve the battery. A new 9 volt alkaline battery will provide more than 40 hours of intermittent use. If the display LED becomes dim or erratic, the battery should be replaced. ■

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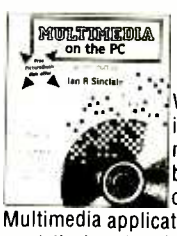

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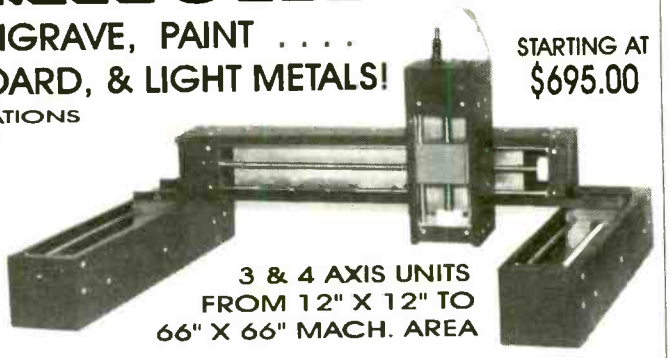

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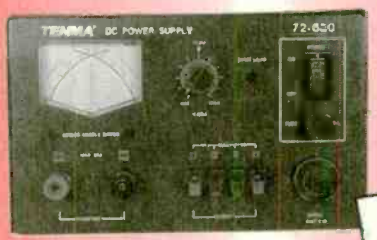

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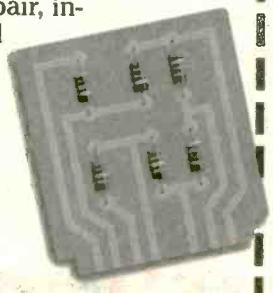

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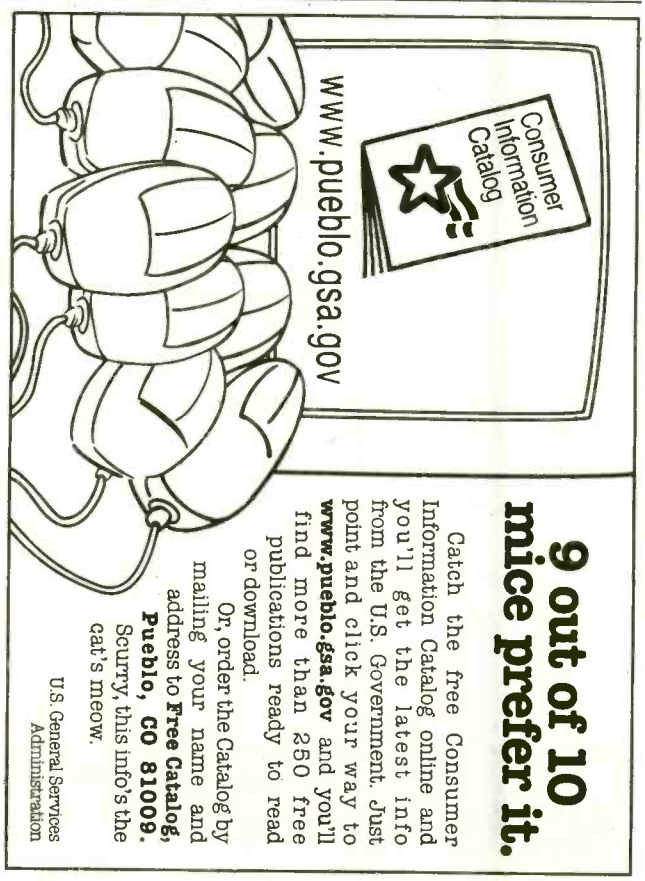

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Now's the perfect time to start building your own PC boards! A factory buyout enables us to bring you this premium quality copper clad PC boards at unheard of low prices. Each board is coated with .0014" copper and is at least .060" thick. Limited availability.

Part #	Description	Price (1-9)	Price (10-UP)
PO-055-204	6" x 18" single sided	$1.50	$1.35
PO-055-206	6" x 21" single sided	1.75	1.55
PO-055-222	8" x 24" single sided	2.65	2.40
PO-055-252	6" x 18" double sided	2.25	2.00

Speaker Surround Repair Kits

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- *Complete instructions*
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900 MHz Wireless Speaker System

- 900 MHz technology sends signal up to 180 ft., through walls, floors and ceilings.
- Ideal for use as rear surround speakers or for adding wireless sound to every room in the house!
- Full range, bass reflex design with built-in high power, low distortion amplifier.
- Weather resistant cabinet for outdoor use.
- Selectable battery (six C size for each speaker) or AC operation, adaptor included. Built-in recharging circuitry for ni-cad batteries.
- System includes: 900 MHz transmitter, wireless speaker pair, AC adaptors, and all cables necessary to hook up system.
- Limited availability. ◆ Net weight 9 lbs.
- Frequency response: 20-18KHz.

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- 8 CHANNEL- 8 BIT A/D/ IN
- 12 BIT COUNTER
- UP TO 14K SMP/SEC

MODEL 45 . . . . . $189
- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
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CRYSTAL TRANSMITTER KITS
- Ultra-miniature surface mount construction.
- E-Z kit approach makes assembly a snap.
- Miniature battery and holder will mount directly to the circuit board.
- Transmit to any scanner type receiver

XTR300
TRACKING TRANSMITTER KIT
Transmits continuous beep-beep-beep
Ideal for locating lost or stolen items
Range up to 1 mile

XTL3000
LONG RANGE TRANSMITTER KIT
Sensitive built in microphone
Range up to 1 mile
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XBD500 $129.95

- **Professional quality.**
- Assembly is a snap.
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Any intercepted signal causes an audio tone that increases from a low pitched growl to a high pitched squeal as the signal strength increases.

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- As small as a hearing aid.
- Weighs less than 1/4 oz.
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- Ideal for use with our 88-108MHz FM transmitters

88-108 MHz FM TRANSMITTER KITS

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XWB 1000EZ $46.95
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XSP 250EZ $34.95
XTR 100C $29.95
XTT 100C $19.95

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XWB 1000 Voice transmitter. Range up to 1/2 mile. Includes mic and battery on circuit board. Uses surface mount components.

XFM 100 Voice transmitter. Range up to 1 mile. 9 v battery and leaded components.

XSP 250 Super-miniature telephone transmitter. Range 1/4 mile. Powered by phone line. Uses surface mount component.

XTR 100 Tracking transmitter. Range up to 1 mile. Uses 9 volt battery. Transmits a BEEP - BEEP - BEEP tone

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PIN HOLE CAMERA
400 LINE RESOLUTION
- **Audio** and **Video** outputs.
- See entire room through pin sized hole.
- Use with any TV or VCR with audio & video input connectors.
- Other models available.

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TV TRANSMITTER
- Use with XVC200, VCR, Camcorder, etc.
- Power cube included.
- Uses VHF TV Band.
- Transmits video & audio.
- Up to 100 foot range.

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as a kit **$39.95**
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Use it to test radar detectors in other cars from your own vehicle! 10.450 to 10.550 GHz hand held transmitter. Extra high output level. Includes an input connector for keyed amateur band operation.

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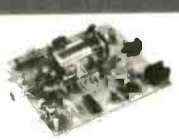

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- Easy to use LED display output.

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- Separate level control for both left and right channels.
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General

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%
Temperature Ranges:
Operating: 0°C to 40°C (32°F to 104°F)
Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery(NEDA 1604)
Low Battery Indication: BAT on Left of LCD Display
Dimensions: 188mm long x 87mm wide x 33mm thick
Net Weight: 400g

DC Voltage (DCV)

Range:	Resolution:	Accuracy:
200mV	100µV	
2000mV	1mV	
20V	10mV	±(1%rdg+2dgts)
200V	100mV	
1000V	1V	

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

Range:	Resolution:	Accuracy:
200µA	100nA	
2000µA	1µA	
20mA	10µA	±(1.2%rdg+2dgts)
200mA	100µA	
10A	10mA	±(1.2%rdg+2dgts)

Overload Protection: mA input, 2A/250V fuse.

AC Voltage (ACV)

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

Frequency Range: 45Hz-450Hz
Maximum Allowable Input: 750V rms
Response: Average Responding. Calibrated in rms of a Sine Wave.

Resistance (Ω)

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

Maximum Open Circuit Voltage: 2.8V

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

ohFE Test
Measures transistor hFE.

$19.00 any qty

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

Switchable Scope Probe Sets

(Selectable X1/Ref/X10) These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 50MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

CAT NO	DESCRIPTION	PRICE EACH 1	10	100
HP-9060	Scope Probe Set DC~60MHz	$16.49	$14.49	$11.58
HP-9150	Scope Probe SetDC~150MHz	24.95	21.95	18.62

Etching Chemicals/Ferric Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	PRICE EACH 1	5
ER-3	Makes 1 pint	$3.50	$2.75

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 165mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10
PP1212	305mm x 305mm/12" x 12" *NEW!*	12.78	10.65	8.52

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

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

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

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

Developer

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

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

Etching Tank

This handy etching system will handle PC boards up to 8"x9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	$37.95

Removeable Hard Drive Racks

The ideal solution for protecting highly sensitive data. Or, buy one computer and allow individual users to keep their hard drive with their own applications and set-ups. Just turn the system off, lift the handle and the hard drive pops right out. Key lock included to avoid accidental or unauthorized removal. Includes hard drive activity LED's. Rack includes mounting hardware, keylock, front panel LED, convenient pull out handle. Made from high impact ABS plastic. Fits in 5.25" bay.

Features: • Ideal for Hard Drive Portability • Solve Software Data Security Issues • Carry Your Hard Drive Between Home and Office • Each User Can Have His or Her Personal Hard Drive

CAT NO	DESCRIPTION	PRICE
SpecialHDRACK-IDE	For IDE Hard Drive	$14.95

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Digital Panel Meters (LCD & LED)

Don't let the prices fool you. These digital panel meters are not surplus, so even if you design them into an ongoing manufactured product, you can be assured of continued availability. These high quality digital panel meters are decimal point selectable with guaranteed zero reading at zero volts input.

3-1/2 Digit LCD 3-1/2 Digit LED 4-1/2 Digit LCD

PM-328: 4-1/2D LCD Digital Panel Meter

Features

- 200.00mV Full Scale Input Sensitivity
- Single 9V DC Operation
- Decimal Point Selectable
- 11mm LCD Figure Height
- Automatic Polarity Indication
- Low Battery Detection and Indication
- High Input Impedance (>100 Mohm)

Applications Include:

- Voltmeter
- Thermometer
- pH Meter
- dB Meter
- Watt Meter
- Current Meter
- Capacitance Meter
- LUX Meter
- LCR Meter
- Other Industrial & Domestic Uses

PM-128: 3-1/2D LCD Digital Panel Meter

PM-129: 3-1/2D LED Digital Panel Meter

Features

- 200mV Full Scale Input Sensitivity
- PM-128 - Single 9VDC Operation
- PM-129 - Single 9VDC Operation
- Decimal Point Selectable
- PM-128 - 13mm Figure Height
- Automatic Polarity Indication
- Guaranteed Zero Reading for 0 Volt Input
- High Input Impedance (>100Mohm)

Specifications - PM-128/PM-129

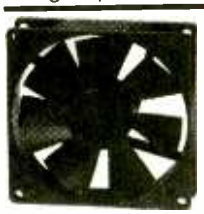
Maximum Input	: 199.9mV DC
Maximum Display	: 1999 counts (3-1/2 Digits) w/Automatic Polarity Indication
Indication Method	: PM-128 - LCD Display PM-129 - LED Display
Measuring Method	: Dual-Slope Integration A/D Converter System
Overrange Indication	: "1" Shown in the Display
Reading Rate Time	: 2-3 Readings per sec.
Input Impedance	: >100 Mohm
Accuracy	: +-0.5% (23+-5°C, <80% RH)
Power Dissipation	: PM-128 - 1mA DC PM-129 - 60mA DC
Decimal Point	: Selectable w/Wire Jumper
Supply Voltage	: PM-128 - 9V DC PM-129 - 9V DC
Size	: 67mm x 44mm

Specifications - PM-328

Maximum Input	: 199.99mV DC
Maximum Display	: 19999 counts (4-1/2 Digits) w/Automatic Polarity Indication
Indication Method	: LCD Display
Overrange Indication	: "1" Shown in the Display
Input Impedance	: >100 Mohm
Accuracy	: +-0.05% (23+-5°C, <80% RH)
Power Dissipation	: 1mA DC
Decimal Point	: Selectable w/Wire Jumper
Supply Voltage	: 9V DC
Size	: 67mm x 44mm

AS LOW AS $5.25 ea.

CAT NO	DESCRIPTION	PRICE EACH 1	10	25	100	250
PM-128	3-1/2 Digit LCD Panel Meter	$ 9.90	$ 7.09	$ 6.40	$ 5.86	$ 5.25
PM-129	3-1/2 Digit LED Panel Meter	11.49	9.54	8.67	7.95	6.95
PM-328	4-1/2 Digit LCD Panel Meter	19.88	16.40	14.90	13.66	11.93



Ball Bearing 12V DC Fans

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

INDUSTRY BEST PRICING!

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

Specifications

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

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

Tired of Paying Inflated Prices for Solder?

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
RH60-1	1-lb. Spool, .031", 60/40	$ 6.90	$ 5.96	$ 5.30
RH63-1	1-lb. Spool, .031", 63/37	6.95	6.10	5.41
RH60-4	4.4-lb. Spool, .031", 60/40	24.00	21.90	17.92
RH60-TUBE	6-oz. Tube, .031", 60/40	.99	.89	.79

CCD Camera - IR Responsive

As Low As $85!!

This black and white monochrome CCD Camera is totally contained on a PCB (70mm x 46mm). The lens is the tallest component on the board (27mm high from the back of the PCB) and it works with light as low as 0.1 lux. It is IR Responsive for use in total darkness. It comes with six IR LED's on board. It connects to any standard monitor, AUX or video input on a VCR or through a video modulator to a TV. Works with a REGULATED 12V power supply (11V-13V). Hooks up by connectiong three wires: red to 12V, black to ground (power & video) and brown to video signal output.

Power Supply Regulating Kit for CA-H34 This simple kit is designed to fit onto the back of the CA-H34 CCD camera. It resolves the problem of hooking up the camera to an UNREGULATED supply (which damages the camera) by providing safe regulated power from any 12V-14V DC supply. It also provides regulated 12V DC from a 12V AC source.

CAT NO	DESCRIPTION	PRICE EACH 1	5
CA-H34A	PCB Mounted IRCCD Camera	$99.00	$85.00
A34	Power Supply Regulating Kit	$6.95	-----

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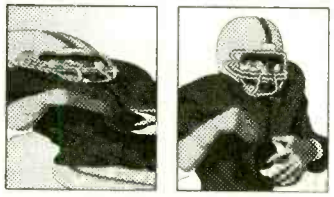

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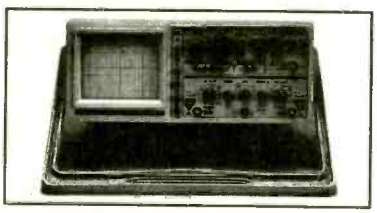

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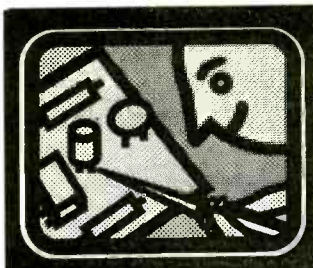

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Boost your microphones output up to line level!

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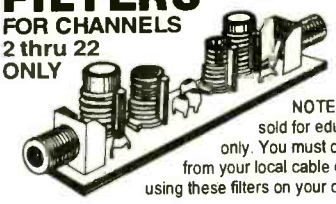

NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

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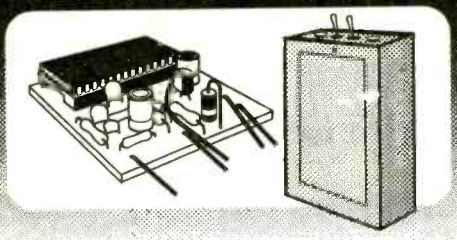
TIR-1 KIT $89.95

AUTO CALL ID'ER



Send your call sign or call CQ automatically with the push of a button.

Change your message as often as you like.

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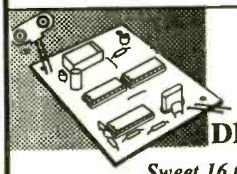
- (Your call sign or call CQ, for instance) and send it with the push of a button. Change your message as often as you like.
- Your message is stored in on board non-volatile memory cells. providing ***zero-power*** data storage. This is a high-quality voice recording and playback unit.

RX-1 KIT $49.95

RX-1C SIZE: 1"H x 2.4"W x 3.8"D CABINET $12.95



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- One relay & driver circuit on board.
- 9v battery powered.Size: 2 3/4" x 2 1/8"

TT-16 KIT $34.95

MICRO-MINIATURE WIRELESS MIKE

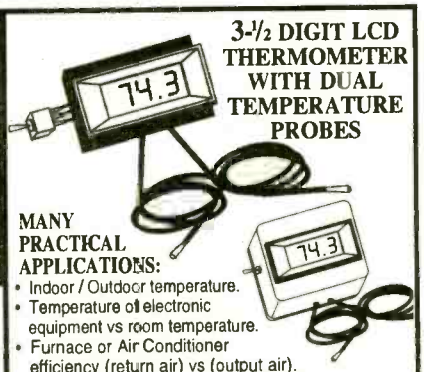
So small you could hide this one on some real bugs! It's the smallest we've ever seen. With it's super sensitive mike it transmits a whisper or a room of conversation to an FM radio, tunable from 88 to 108MHz FM. With a proper antenna it transmits about 1/2 mile. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. Power requirement 6 to 12v DC. Size .35"x.9"

MMWM5 KIT $34.95

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

KIT BOOK $14.95

$9.95 with the purchase of any kit.



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LCD-T1 KIT $34.95

LCD-T1C CABINET $9.95

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AA-1 BUILT $29.95 KIT $10.95

PHONE TRANSMITTER

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

TEL-B1 KIT $12.95

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WM-2 KIT $14.95

7A

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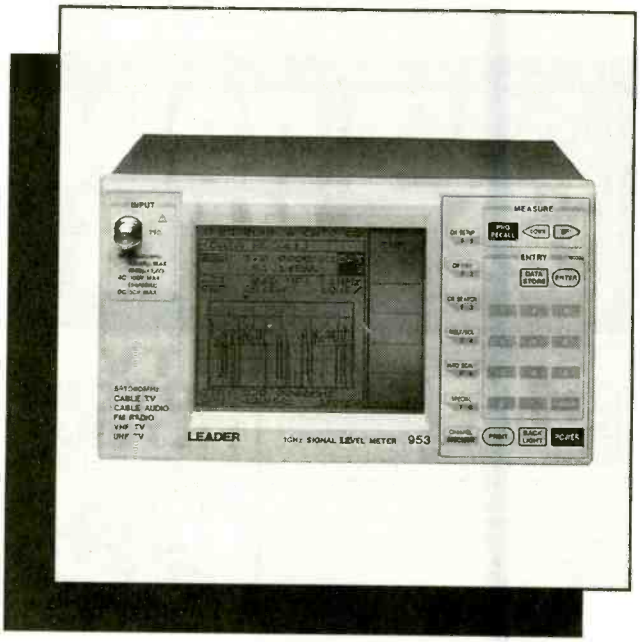

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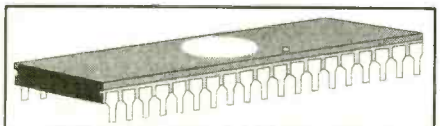

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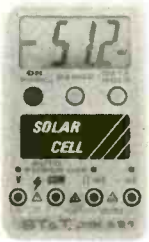

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Inductance: 10mH-10,000H
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Resistance:10Ω-10MΩ
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SMD and chip component test probe $25.00

LCR Meter 814 $189.95

Best Resolution LCR

Inductance: 200uH-200H
Capacitance: 200pF-20,000uF
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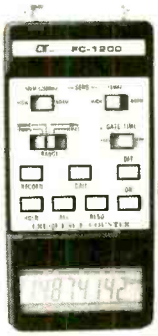

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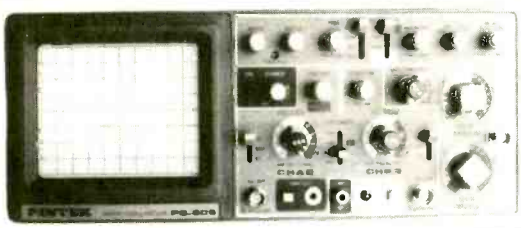

20 MHz Oscilloscope with Delay Sweep PS-205 $429.95

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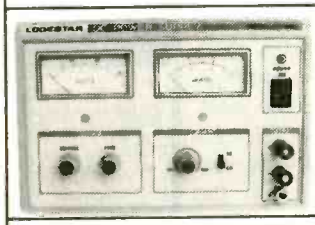

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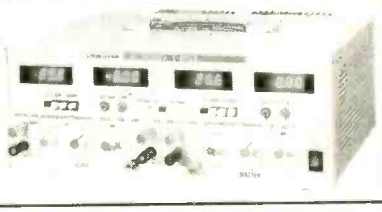

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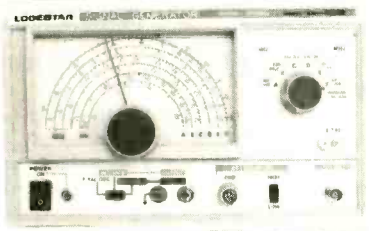

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Audio output 1 kHz, 1 Vrms
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0-10Vp-p squarewave
Synchronization: ±3% of oscillation frequency per Vrms
Output distortion:
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0.5 % 50Hz - 500kHz
Output impedance: 600 ohm

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6 digit frequency counter 10Hz-150MHz for internal and external sources Sensitivity <50mV

Function Generator FG-2100A $169.95

0.2 Hz -2 MHz in 7 ranges
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Output: 5mV-20Vp-p
1% distortion, DC offset ± 10V
VCF: 0-10V control freq. to 1000:1

Function Gen./Counter FG-2102AD $229.95

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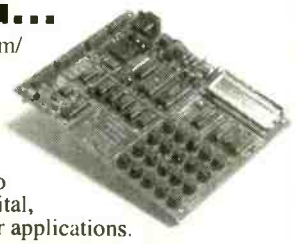

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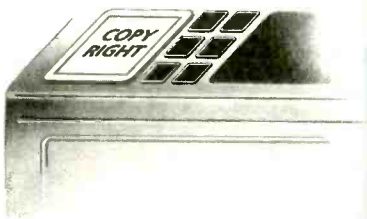

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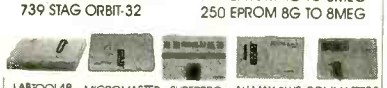

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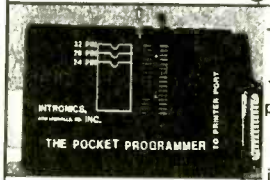

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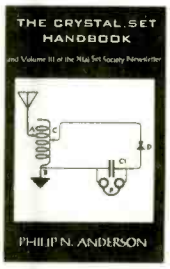

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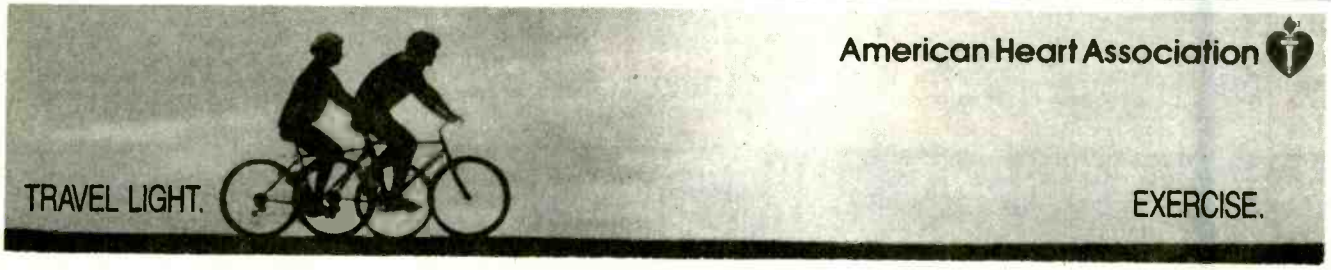

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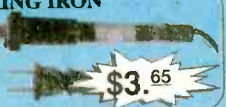

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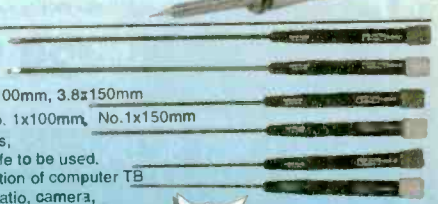

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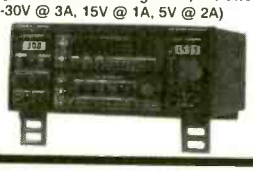

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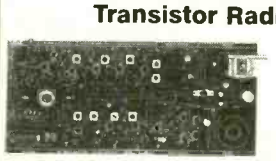

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- Component tester

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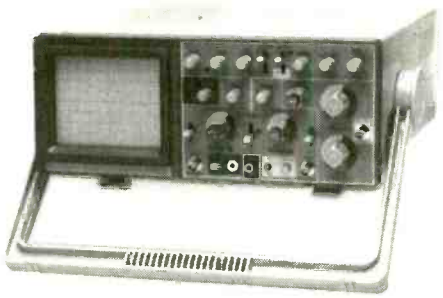

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ANALOG

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

DIGITAL STORAGE

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

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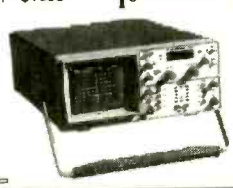

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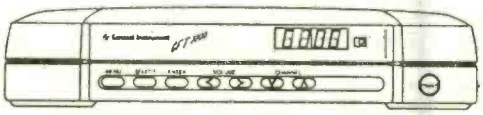

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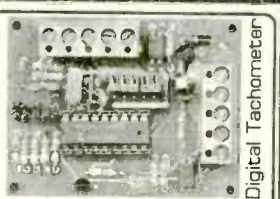

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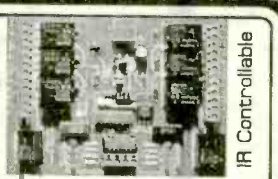

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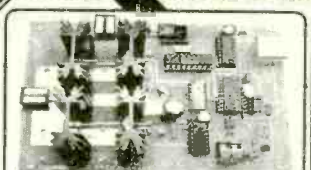

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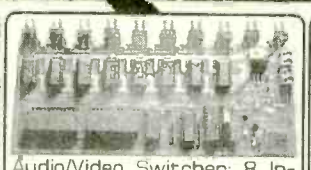

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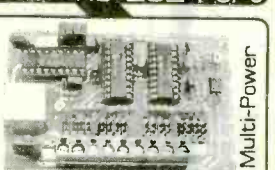

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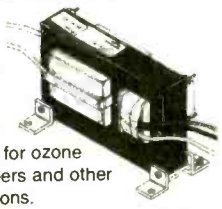

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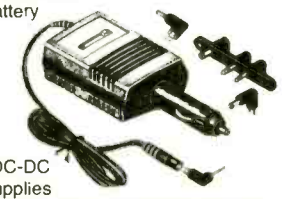

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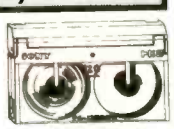

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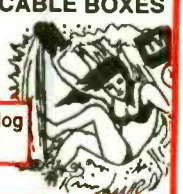

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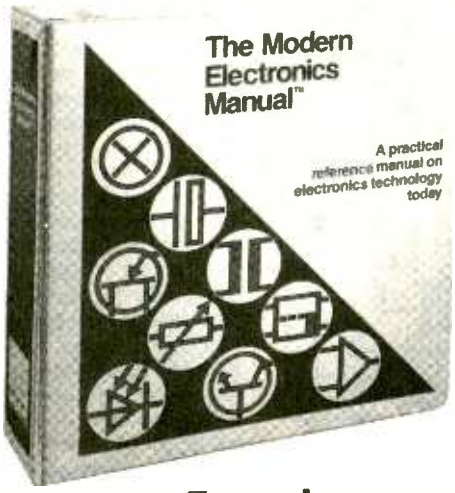

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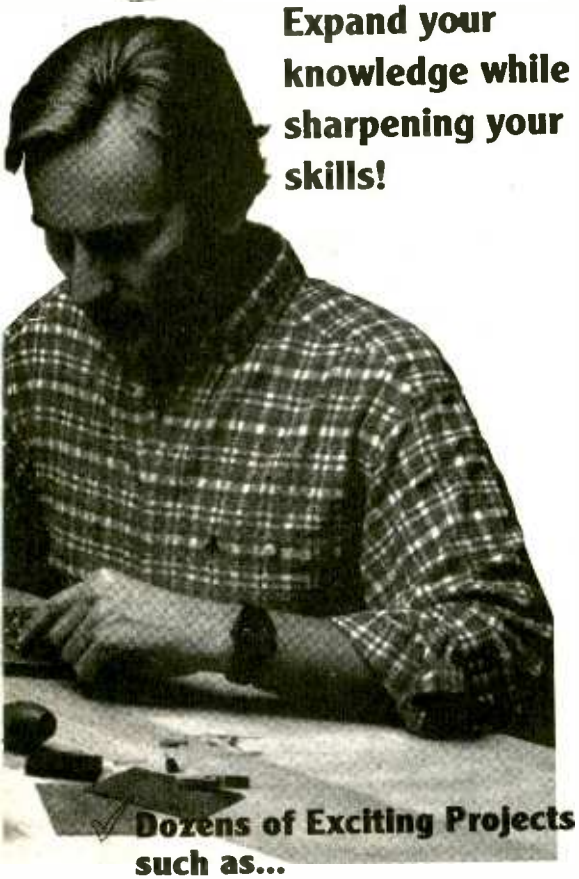

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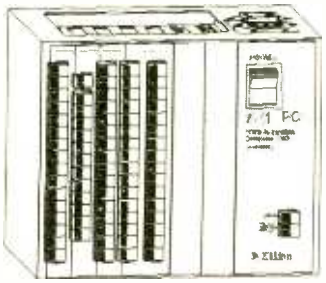

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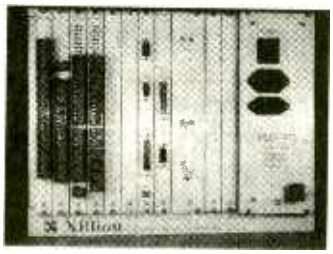

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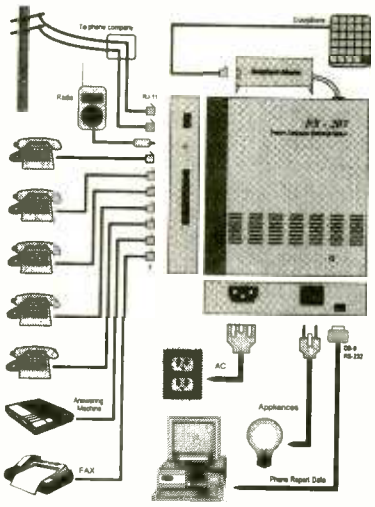

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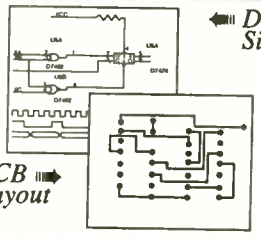

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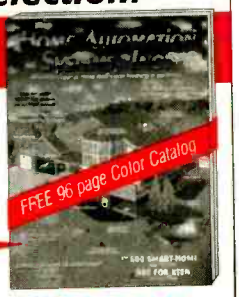

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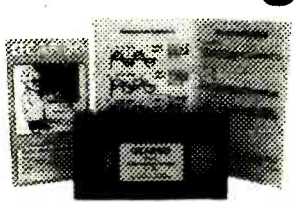

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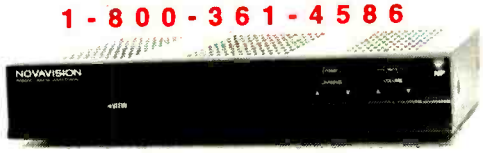

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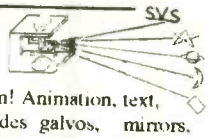

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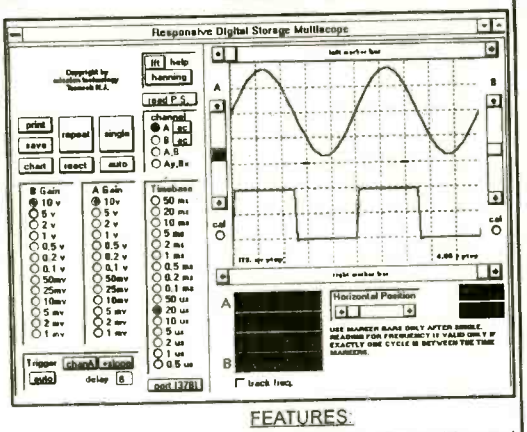

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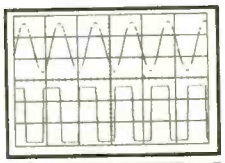

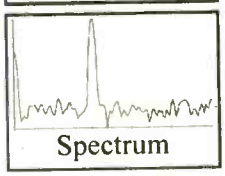

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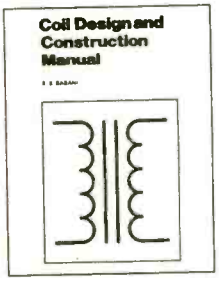

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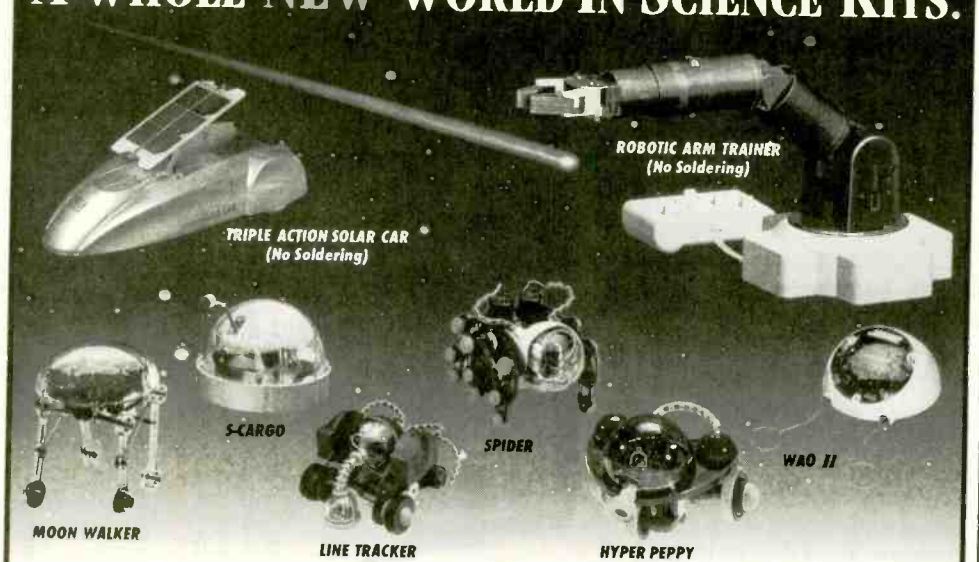

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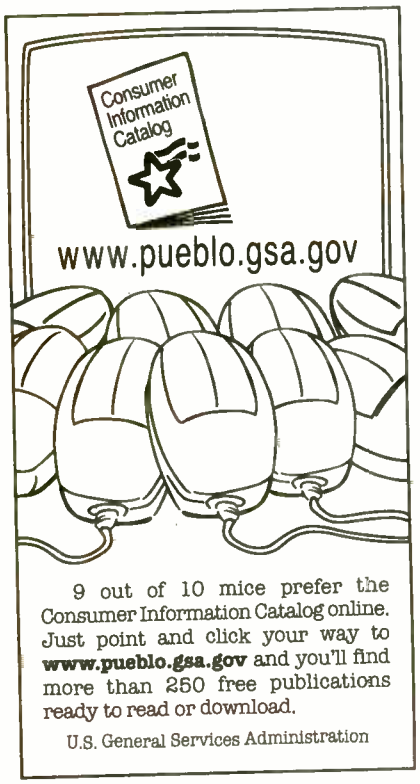

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Patented microelectronic antenna converts your home's wiring into a giant signal-grabbing magnet!

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

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

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

Advanced technology. If you live in a rural area, you may have resigned yourself to accept the fact that your local TV reception is poor. (This may be true even if you *don't* live in a rural area!) Now imagine watching TV and seeing a picture clearer than before. Simply plug the Spectrum Antenna into a standard AC outlet and plug your TV into the Spectrum. Get ready for great reception because your TV will display a clearer, focused picture, thanks to Spectrum's advanced signal controls.

Uses your home's electrical wiring. The Spectrum Antenna is a sophisticated electronic device that plugs into a standard wall outlet. Basically, the outlet interfaces the Spectrum with the huge antenna that is your home wiring network. Simply put, it turns the electrical wiring in your house or apartment into a multi-tunable TV reception antenna that will improve your TV's overall tuning capability.

How it works. Broadcast TV signals are sent out from the local broadcast station. Those signals interface with your home's AC power line system, creating an aerial antenna network of wiring as large as your home itself. When the Spectrum Antenna connects to the AC line, the signal is sent to its signal processing circuit. It processes and separates the signal into 12 of the best possible antenna configurations. These specially-processed signals route themselves into 12 separate circuits. A 12-position rotary tapping switch, the "Signal Switch" control, gathers 12 of the best antenna configurations resulting in improved picture quality.

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

Rural areas. Most TV signals in rural areas are weak, making them harder to fine tune. The "Gain Booster" is a high-frequency signal booster designed to increase the output level of the signal entering your television. It delivers a 10-fold greater signal which will bring richer color and a noise-free picture. By using the Gain Booster, Spectrum's fine tuning controls will function better, giving it a stronger signal to tune. It also works in conjunction with your outdoor antenna!

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

Spectrum Antenna

Parallel 75 ohm resistance
For minimum loss of signal

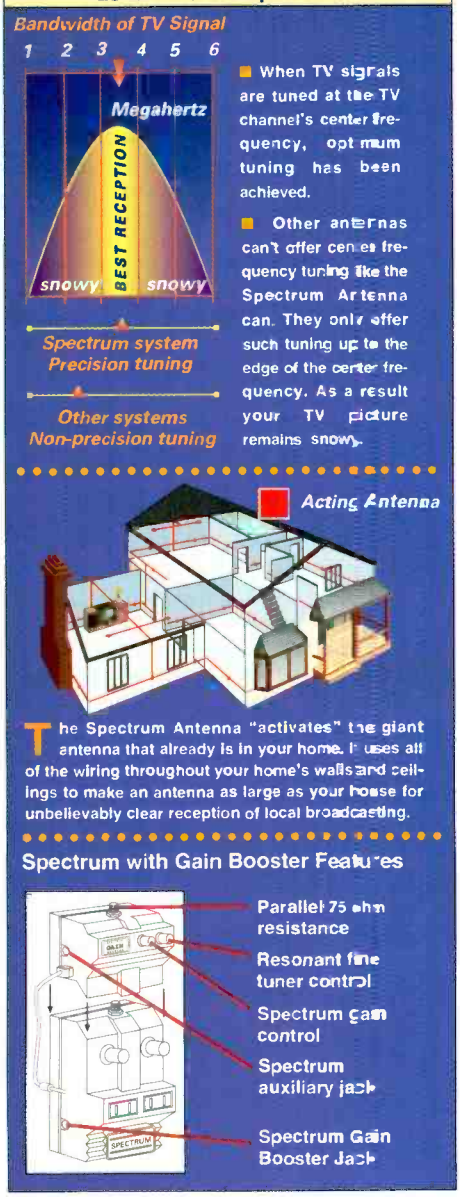
Signal search control
For selecting multiple antenna configurations

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

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

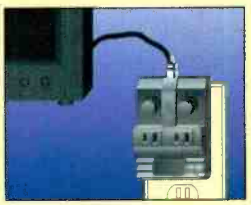
Polarized three-prong plug for grounding
For optimum signal grounding to stop noise and static

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



Who can use Spectrum?

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



The Spectrum Antenna gets plugged into a three-prong outlet and can accommodate two additional plugs in its surge protected ports.

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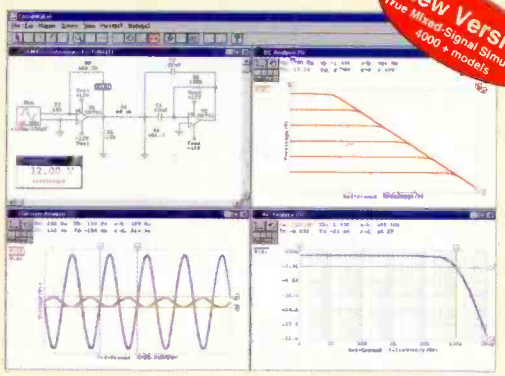

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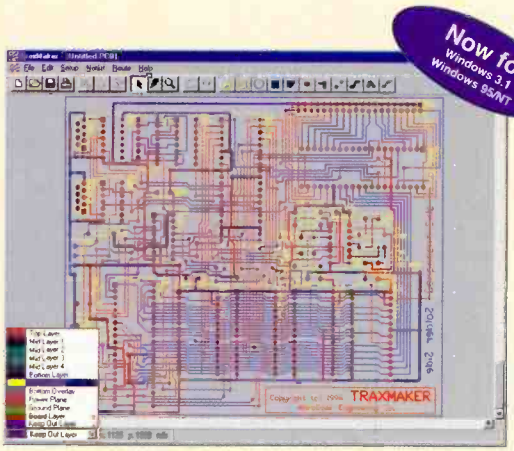

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