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MAY 1997

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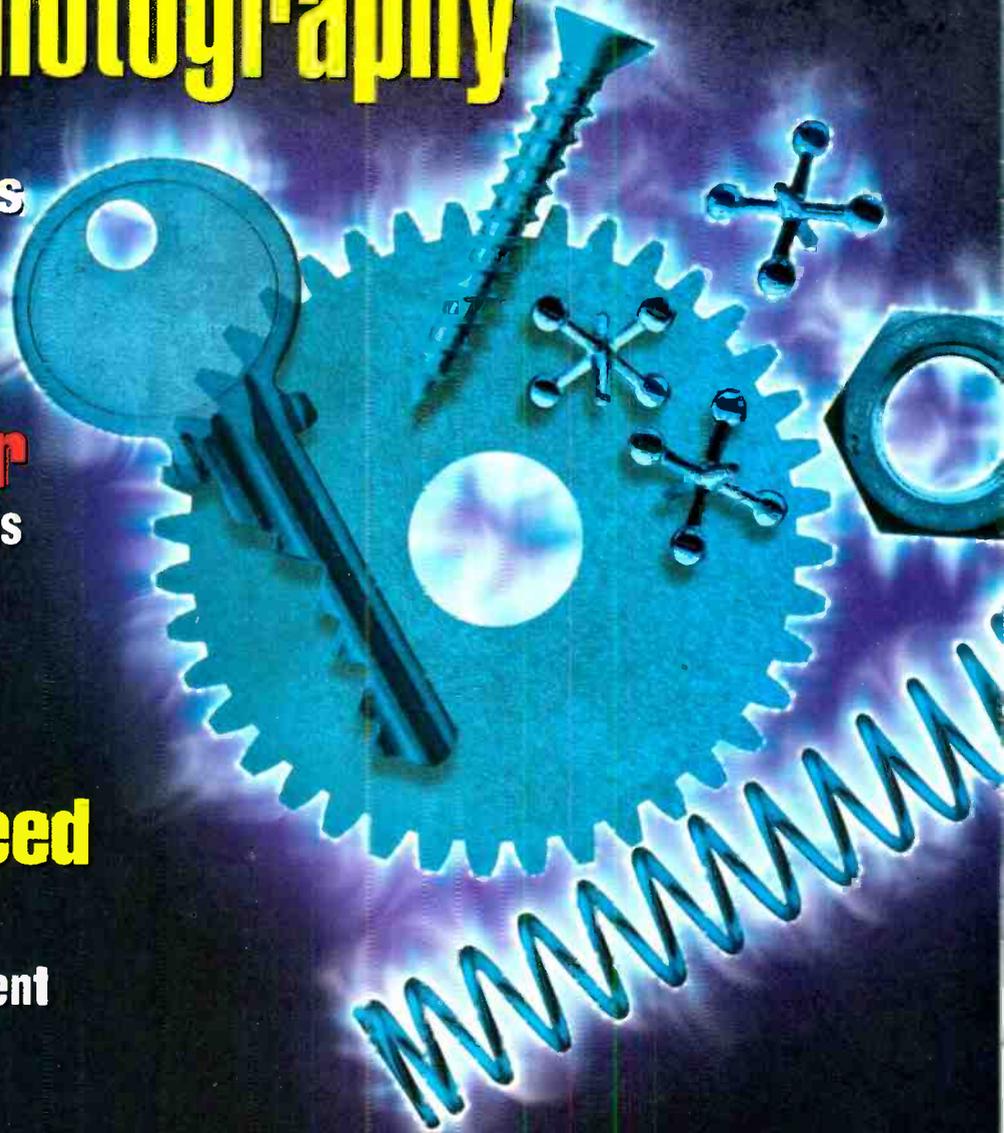
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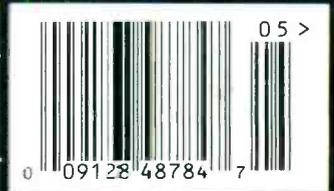
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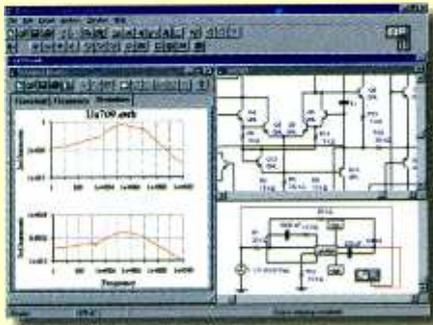
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## High-End Features

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HIERARCHICAL CIRCUITS	YES
VIRTUAL INSTRUMENTS	YES
ON-SCREEN GRAPHS	YES
ANALOG COMPONENTS	OVER 100
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DEVICE MODELS	OVER 4,000
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TECHNICAL SUPPORT	FREE

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AC FREQUENCY	YES
TRANSIENT	YES
FOURIER	YES
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DISTORTION	YES

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## FEATURES OF ELECTRONICS WORKBENCH VERSION 5

### WHAT'S NEW

Now 10 times faster. Handles 3 times larger circuits. More and better device models. New thermal modeling. New on-screen graphs. New analyses (Fourier, Noise and Distortion). 25 new components including vacuum tubes, arbitrary sources. 50 new ICs. Improved accuracy. Improved schematic editor with zoom and growing pages. Improved printing. Improved fonts. Improved interface. Redesigned word generator and logic analyzer.

### GENERAL

Integrated Tool: Fully integrated schematic editing, SPICE simulation and waveform generation and analysis. Supports modifications to the circuit during simulation. Circuit analysis through virtual test instrument, or six analyses listed below.  
Simulation Engine: Interactive 32-bit SPICE 3F5 enhanced with native-mode digital and mixed analog/digital support. Automatic insertion of signal translation interface. Supports multiple reuse of hierarchical blocks. GMIN stepping for better convergence. No preset limits on circuit size or complexity.  
Schematic Capture: Click-and-drag interface. Hierarchical work space. Automatic wire routing with automatic reference designation.  
Analysis: Six analyses for quick and simple analysis. Six analyses for on-screen graphs and more (described below).  
Simulation: All design information, including simulation parameters, setup and series of all models stored in a design file to be reused.  
Compatibility: Support standard SPICE models and netlists into reusable Electronics Workbench components. Exports to standard PCB layout packages such as OrCAD, Protel and Tango.

### ANALYSES

DC Operating Point: Calculates DC operating point and reports voltage at each node.  
Transient: Circuit voltages and currents over time of any number of nodes. Specify start and stop times.  
AC Frequency Sweep: Small signal gain and phase over range of AC frequencies at any number of nodes. Specify range, type (decade, octave or linear) and resolution (number of steps) of frequency sweep.  
Fourier: Magnitude and phase of DC and Fourier spectral components of transient response. Specify fundamental frequency and an unlimited number of harmonics.  
Noise: Resistor and semiconductor noise contribution reported as RMS sum. Specify device of interest, output and reference nodes, and range, type and resolution of frequency sweep.  
Distortion: Small signal steady-state harmonic and intermodulation products over a range of frequencies. Specify any number of nodes and sweep range, type and resolution. Optionally exclude devices on an individual basis.

### VIRTUAL TEST INSTRUMENTS

Digital: Models for ICs, Gates and Flip-Flops in HC, LS, CMOS, EPLD, and PAL families. Includes 4008, 4011, 4012, 4013, 4014, 4015, 4016, 4017, 4018, 4019, 4020, 4021, 4022, 4023, 4024, 4025, 4026, 4027, 4028, 4029, 4030, 4031, 4032, 4033, 4034, 4035, 4036, 4037, 4038, 4039, 4040, 4041, 4042, 4043, 4044, 4045, 4046, 4047, 4048, 4049, 4050, 4051, 4052, 4053, 4054, 4055, 4056, 4057, 4058, 4059, 4060, 4061, 4062, 4063, 4064, 4065, 4066, 4067, 4068, 4069, 4070, 4071, 4072, 4073, 4074, 4075, 4076, 4077, 4078, 4079, 4080, 4081, 4082, 4083, 4084, 4085, 4086, 4087, 4088, 4089, 4090, 4091, 4092, 4093, 4094, 4095, 4096, 4097, 4098, 4099, 4100, 4101, 4102, 4103, 4104, 4105, 4106, 4107, 4108, 4109, 4110, 4111, 4112, 4113, 4114, 4115, 4116, 4117, 4118, 4119, 4120, 4121, 4122, 4123, 4124, 4125, 4126, 4127, 4128, 4129, 4130, 4131, 4132, 4133, 4134, 4135, 4136, 4137, 4138, 4139, 4140, 4141, 4142, 4143, 4144, 4145, 4146, 4147, 4148, 4149, 4150, 4151, 4152, 4153, 4154, 4155, 4156, 4157, 4158, 4159, 4160, 4161, 4162, 4163, 4164, 4165, 4166, 4167, 4168, 4169, 4170, 4171, 4172, 4173, 4174, 4175, 4176, 4177, 4178, 4179, 4180, 4181, 4182, 4183, 4184, 4185, 4186, 4187, 4188, 4189, 4190, 4191, 4192, 4193, 4194, 4195, 4196, 4197, 4198, 4199, 4200, 4201, 4202, 4203, 4204, 4205, 4206, 4207, 4208, 4209, 4210, 4211, 4212, 4213, 4214, 4215, 4216, 4217, 4218, 4219, 4220, 4221, 4222, 4223, 4224, 4225, 4226, 4227, 4228, 4229, 4230, 4231, 4232, 4233, 4234, 4235, 4236, 4237, 4238, 4239, 4240, 4241, 4242, 4243, 4244, 4245, 4246, 4247, 4248, 4249, 4250, 4251, 4252, 4253, 4254, 4255, 4256, 4257, 4258, 4259, 4260, 4261, 4262, 4263, 4264, 4265, 4266, 4267, 4268, 4269, 4270, 4271, 4272, 4273, 4274, 4275, 4276, 4277, 4278, 4279, 4280, 4281, 4282, 4283, 4284, 4285, 4286, 4287, 4288, 4289, 4290, 4291, 4292, 4293, 4294, 4295, 4296, 4297, 4298, 4299, 4300, 4301, 4302, 4303, 4304, 4305, 4306, 4307, 4308, 4309, 4310, 4311, 4312, 4313, 4314, 4315, 4316, 4317, 4318, 4319, 4320, 4321, 4322, 4323, 4324, 4325, 4326, 4327, 4328, 4329, 4330, 4331, 4332, 4333, 4334, 4335, 4336, 4337, 4338, 4339, 4340, 4341, 4342, 4343, 4344, 4345, 4346, 4347, 4348, 4349, 4350, 4351, 4352, 4353, 4354, 4355, 4356, 4357, 4358, 4359, 4360, 4361, 4362, 4363, 4364, 4365, 4366, 4367, 4368, 4369, 4370, 4371, 4372, 4373, 4374, 4375, 4376, 4377, 4378, 4379, 4380, 4381, 4382, 4383, 4384, 4385, 4386, 4387, 4388, 4389, 4390, 4391, 4392, 4393, 4394, 4395, 4396, 4397, 4398, 4399, 4400, 4401, 4402, 4403, 4404, 4405, 4406, 4407, 4408, 4409, 4410, 4411, 4412, 4413, 4414, 4415, 4416, 4417, 4418, 4419, 4420, 4421, 4422, 4423, 4424, 4425, 4426, 4427, 4428, 4429, 4430, 4431, 4432, 4433, 4434, 4435, 4436, 4437, 4438, 4439, 4440, 4441, 4442, 4443, 4444, 4445, 4446, 4447, 4448, 4449, 4450, 4451, 4452, 4453, 4454, 4455, 4456, 4457, 4458, 4459, 4460, 4461, 4462, 4463, 4464, 4465, 4466, 4467, 4468, 4469, 4470, 4471, 4472, 4473, 4474, 4475, 4476, 4477, 4478, 4479, 4480, 4481, 4482, 4483, 4484, 4485, 4486, 4487, 4488, 4489, 4490, 4491, 4492, 4493, 4494, 4495, 4496, 4497, 4498, 4499, 4500, 4501, 4502, 4503, 4512, 4516, 41013.

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# Electronics Workbench

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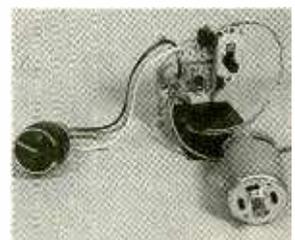
In recognition of the skilled electronics technicians of the world, who keep our increasingly electronic dependent world humming right all, the Society of Certified Electronics Technicians has proclaimed April 22, 1997 International Electronics Technician's Day—*Barbara Rubin*  
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# 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



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

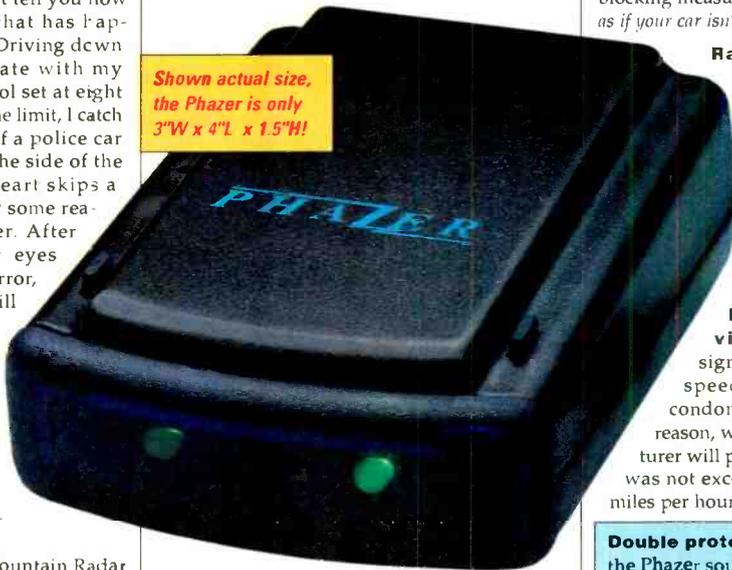
If your heart doesn't skip a beat when you drive past a speed trap—even if you aren't speeding—don't bother reading this. I can't tell you how many times that has happened to me. Driving down the interstate with my cruise control set at eight miles over the limit, I catch a glimpse of a police car parked 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."

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

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

The radar component works by mixing an X, K or Ka radar signal with an FM "chirp" and bouncing it back at the squad car by way of a

waveguide antenna, effectively confusing the computer inside the radar gun. The laser component transmits an infrared beam that has the same effect on laser Lidar units.



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

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

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



**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!



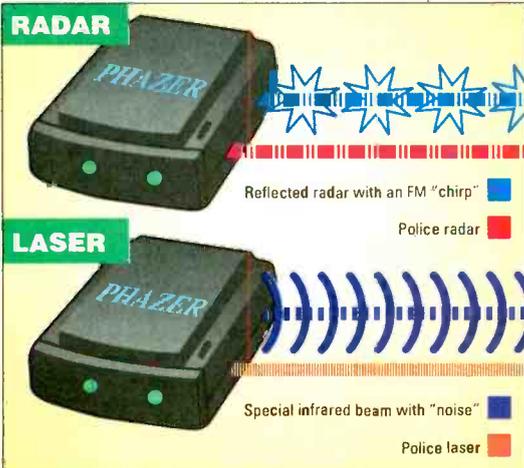
4"W x 4"L x 1.5"H

**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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**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.

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# Editorial

## The Fun Is In Working

This great computer age in which we are now living is not so great after all. What was once lots of fun is rapidly diminishing. By the time I became a DOS expert, in came Windows. Even Windows had a rebirth—Windows 95. Windows 97 is now in the wings. Of course the Internet opened vast new spaces to enlighten me and offer practically unlimited knowledge. But I've got to be honest with you. I've given up cigarettes. Gone are regular coffee and colas; and so is the keyboard and mouse. I was addicted to both of them!

That's what makes Popular Electronics so valuable to me. I burned a hole in my pants last week with hot solder. I scraped skin cutting a chassis box to size. I snaked a coaxial cable through the walls of my house. I spent hours thumbing catalogs and magazines looking for a supplier for some CMOS chips. I spent over sixty dollars to build a project that sells for forty dollars. I am alive again and very happy!

The hams can tell a similar story. They would build most of their equipment many years ago. Then came cheap, quality communication appliances and that equipment changed the entire hobby. Hamdom is reverting somewhat. Amateur TV is still a build-it group that looks down on appliances. The flea-power QRP group likes to build some gear. The hams are finding the workbench again and enjoying it.

So it will be for everyone when all the homes in the North American continent have two or three computers with network ties. What will be new and what will be exciting? You may have guessed it. The excitement will be in building and applying electronics for a new generation of projects. Using your brains and handicraft can be rewarding and a lot of fun. That's why going to work every weekday is a fun-filled adventure, and I wouldn't miss it for the world!

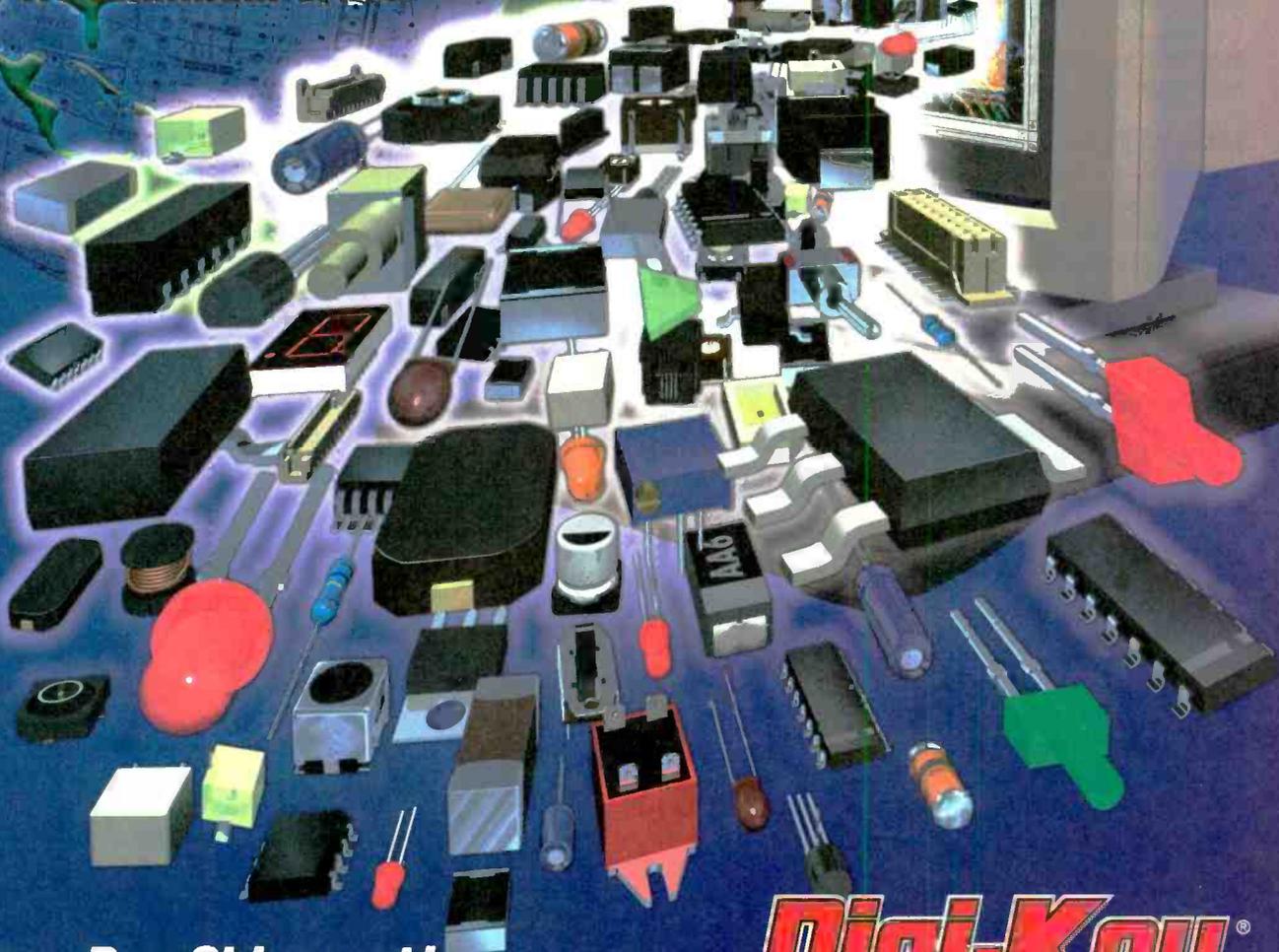
Julian S. Martin  
Working Editor

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# LETTERS

## Decoding the Decode

### A CORRECTION

I have some corrections to make to the schematic of my Infrared Decoder article, which appeared in the February 1997 issue of **Popular Electronics**.

For starters, pin 11 of the 8031 must be connected to pin 11 of the MAX232. Also, C5 and C10 are reversed; in other words, they are showing the wrong polarity in the schematic.

The Parts List calls out a 27256 EPROM; the schematic is wired for a 2764. A 27256 can be used if pins 26 and 27 are connected to ground.

Sorry for any inconvenience this may have caused you.

—Stuart R. Ball

### MUSIC FOR PLEASURE

Thanks so much for publishing the 22-Watt Amplifier in your February issue. I built two right away and got them to work in my Jeep on the first try.

What a sound! I tested it with a tape of my favorite band, The Damned, and cranked it up really loud. I'm sure my neighbors heard it in their living rooms.

Please keep publishing such useful projects in the future. How about a graphic equalizer?

D.V.

Los Angeles, CA

*Thanks for writing. We appreciate your happiness with our cover story. As for your suggestion, we'd love to publish a graphic equalizer. However, as with most of our stories, they are generated out of house. That basically means we can only publish it if someone out there designs it and writes it up.*

*Any takers?*

—Editor

### PAGER DECODER PRAISE

I just got my March issue of **Popular Electronics** and I have to say I'm impressed. The cover story, which shows you how to build an alphanumeric pager decoder, is amazing!

Innovative stories like this are the reason that I got into electronics in the first place. I'm looking forward to building my own unit and getting it up and running.

I was also glad to notice that files are being posted to the Gernsback FTP site now. It looks like the bell is finally tolling for BBSes, which add up long-distance bills quite fast.

B.R.

Philadelphia, PA

*We're glad you like the story. And to be honest with you, I agree about the phone bills incurred through BBSing. Before the days of the Internet I received quite a few shocking bills myself!*

—Editor

### MS-TRAP

I bought a new computer. It's a P-166 because I wanted the price to be reasonable, but I did get all the bells and whistles. It came loaded with Windows 95 and the OEM CD disk was provided. I figured to load my old computer with Windows 95 in place of the old Windows, but to no avail. Microsoft locked me out! What do I do?

J.J.

Sparks, NV

*Oh, boy! Did you read the license agreement before you unpacked the Windows 95 packet? I believe you*

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*cannot load a second computer; one is the limit. I could be wrong. I imagine that a single user may load two or more machines provided only that person use those computers. Does anyone know?*

*If the MS answer is yes to my question, the best thing to do is reformat the C drive and load everything again. Be sure you got MS-DOS handy and the CD-ROM drive disk available. Be sure to save your old files.*

### HELP

Does anyone out there know of a good Pinochle program? Also, what is the best Bridge game program you ever used? Please drop a note to the Editor. Thank you.

### HAVES AND NEEDS

I'm looking for PC boards for a Tripp Lite battery backup unit, model number SB/BC 2000 LAN. The PC board numbers are 16-942, 16-891, 16-895, and 16-893M.

Thank you in advance for your time and any help your readers could provide.

Marc De Loach

P.O. Box 107

Hewitt, NJ 07421

I recently saw a band called Bell, Book & Candle in concert and the singer was playing a strange instrument I later learned was a Theremin. Does anyone out there know of any clubs or organizations that offer information on this strange instrument?

I'd like to find out what different types of Theremins there are, and if any are commercially available. I know that *Electronics Now* recently ran an article on one, but I'm new to electronics and I don't think I'd like to try building such an obviously sensitive device just yet.

Can anyone out there help me? I'd really appreciate any help you can give me. Thanks.

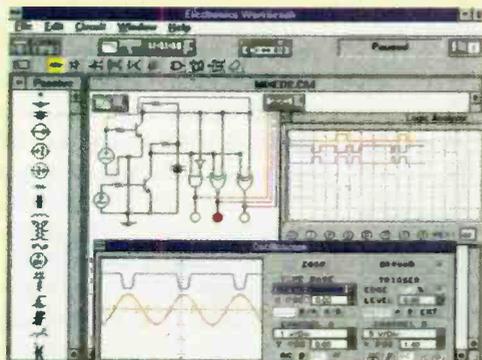
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# MULTIMEDIA WATCH

## The PC-TV Merger

BY MARC SPIWAK  
TECHNICAL EDITOR  
WINDOWS MAGAZINE

People keep talking about the merger between PCs and home entertainment systems, when in fact it has already happened. With a push from Microsoft, PC manufacturers are equipping computer systems with hardware that makes the merge possible. PC TV tuners have been available for years, and systems are starting to ship with them. These are basically just video-capture cards with built-in TV

game playing. Pretty soon most graphics accelerators will have a TV output. I've been playing with a lot of very affordable video conferencing packages. You can buy them with or without a video camera, because you can use a camcorder if you have one. Video-conferencing kits that include a color camera already sell for under \$500. New transmission standards let you video conference with people on the Internet

ally as good as NTSC, a format we're on the verge of abandoning. Yes, the hardware merger has already taken place. But the change we're really waiting for will take place very soon.

An agreement has recently been reached regarding an HDTV signal standard for the United States. This is the high-resolution, wide-screen picture we've all been waiting for. HDTV sets will be out before you know it, and wide-screen monitors are already available for both PCs and home video systems. The last missing link is DVD, which is the storage solution for high-definition video. Once DVD player/recorders are a standard item, the final "marriage" between the TV and the PC will have taken place. You'll then be able to record and play the same discs on either system. But you'll still want to have two separate systems. One with a 17- to 20-inch display that's easy on the eyes when used close-up, and another with a big, wide-screen display to watch movies on.

### ANOTHER FORM OF PC

I recently saw a demonstration of Xybernaut's Mobile Assistant II. This is basically notebook-computer hardware rearranged so that you can wear it. It's a voice-activated, 75-MHz belt-worn Pentium with a head-mounted display that is suspended in front of one eye only. The whole system weighs only a few pounds and costs around \$7995.

Understand, however, that this is not your next PC. Rather, this is intended for remote technicians who need to access data while keeping their hands free. For example, an airplane mechanic might need to access blueprints or schematics to complete a repair. A front-line medic might need to look up someone's medical files or other critical data before administering treatment. I imagine that in time, we'll see an entire computer built into a pair of glasses.

### SOME NEAT ACCESSORIES

I recently received some very useful



*The Mobile Assistant II is a voice-activated Pentium system that you wear.*

tuners. They usually accept an NTSC, PAL, SECAM, or S- video input, and convert the signal into one you can watch in a window on your PC. Software lets you capture still images, video clips, closed-captioned text, and more. I have a TV tuner card made by Philips that includes an infrared remote control.

We're even starting to see merged hardware packages on the market. Gateway 2000's Destination system is essentially a PC with a built-in TV tuner and a hybrid monitor that's good for both PC and video use. TV Internet boxes have also hit the scene, for web-surfing without a PC.

More recently, graphics accelerators have started to include a TV output, which lets you connect your computer to your big-screen TV for enhanced

who have similar hardware. But these hardware packages are really just another variation of video-capture. In reality, the hardware necessary for the PC-TV merger to take place has been around for quite some time. It's the computers that have finally caught up to the task at hand.

Today's PC also ships with a multi-gigabyte hard drive, so it's essentially the equivalent of a digital VCR. You can't really store all that much video on one of these hard drives, but at least you have plenty of editing room. But a hardware or software MPEG encoder, along with a CD-R drive, lets you put your own edited movies on CD.

The main reason for not wanting to dive into this right now is that the picture quality on a PC (MPEG-1 or some other compression scheme) isn't usu-

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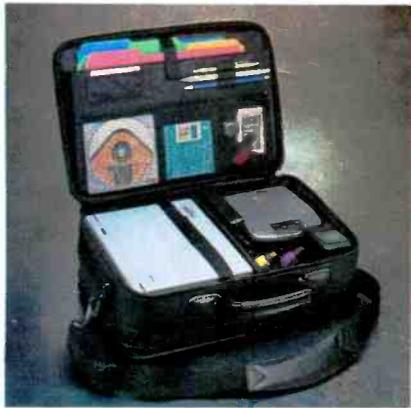
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The NC-3 Commuter Notebook Computer Case is a pleasure to travel with.

computer accessories from Case Logic. For \$69.95, the NC-3 Commuter Notebook Computer Case is a great bag to travel with. It's rugged and water-repellent. (I also have a beautiful leather notebook bag that's a bit too nice to jam under an airplane seat, and it doesn't like to be rained on.) The padded nylon NC-3 has plenty of room for a notebook computer and all of its accessories, with adjustable straps and barriers to hold everything in place. It also has all of the nooks and crannies you'd expect in a briefcase, and then some. Zippered interior mesh pockets let you see what's in them, and there's a pouch for a cellular phone. There's a ticket pocket, pen loops, and a key ring. Pleated compartments can hold plenty of files, magazines, or whatever. I've traveled with this bag, and it was a pleasure.

I also received some more unusual product samples that I didn't know I needed until I saw them. Among various CD-carriers, including padded pouches of different sizes, there's a CDV-12 CD Visor that mounts on your car's sun visor. For \$9.95 it puts 12 discs without the jewel boxes easily in reach while driving, and there's also a mesh pocket and pen loop. I particularly like using the Gel-eez Wrist Rest mouse pad. I tend to lean on my hand when I'm using my mouse, and the Gel-eez has a gel-filled cushion that makes it a lot more comfortable. Also useful are the Cable Ties, which sell for \$2.99 a six-pack. These Velcro straps quickly wrap around and tame wires for storage in a closet or travel bag.

## NEW STUFF

Solar System Explorer is the latest product from Maris Multimedia. This neat title lets you explore our solar system from the pilot's seat of the Explorer, mankind's most advanced spacecraft-in the year 2019, that is. You can fly to any planet, experience atmospheric storms on Jupiter, see what the Magellan space probe saw when it orbited Venus, and a whole lot more. You're the pilot, researcher, and scientist, so it's up to you to plot interplanetary courses, fly famous missions, launch probes, and basically run the show. There's a huge scientific database for you to access whenever necessary, panoramic views, relief

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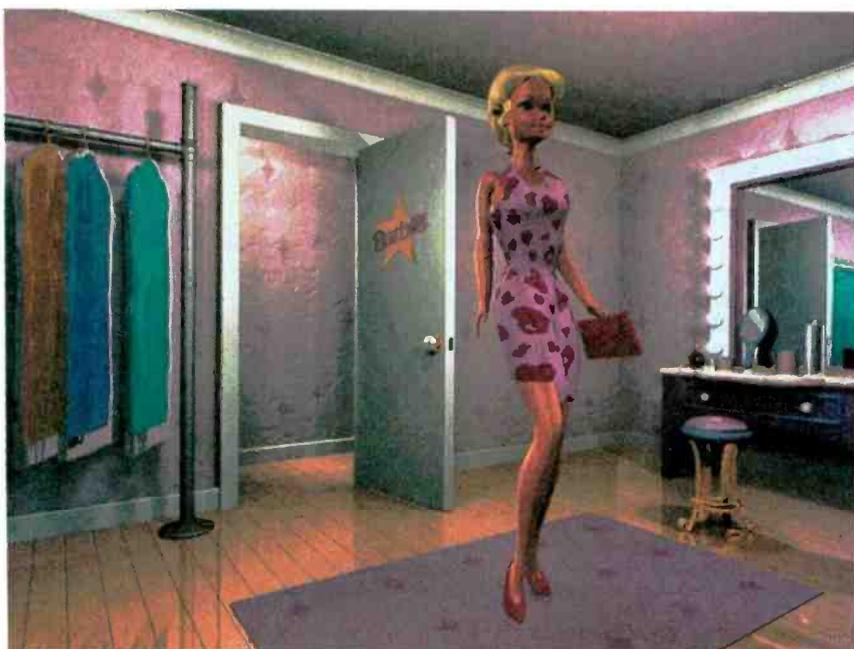
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maps, 3D models, and so on. Virtual reality finally puts the planets within reach of the average couch potato. You can set your sights on the planets with Solar System Explorer for \$45.95.

New from The Voyager Company comes Sound Toys, a very bizarre multimedia title that lets you compose and record your own unique music. You don't have to be a musician to play it either-the program translates intuitive visual gestures into music. There are over three hundred original samples including harmonica, wooden flute, bells, marimba, drums, and acoustic and electric guitar. You can create endless combinations of loops and solos by sliding and clicking the mouse. But, as warned on the CD case, this game can soak up a lot of your time if you really get into it. If you play it at work, your productivity will suffer. Sound Toys has a suggested retail price of \$19.95.

If you've ever dreamed about freely



roaming around a 95,000 ton nuclear-powered aircraft carrier, then Discovery Channel Multimedia's Carrier: Fortress At Sea is a title you'll be interested in. You get a pass from the captain for an unescorted tour of the ship. You can explore every crevice of a 3D model of the USS Carl Vinson, the vessel which led the U.S. battle group in the Operation Desert Strike missile launch against Iraq. 85 video locations let you meet the virtual crew of this floating city, and there's also a comprehensive database of carrier facts and statistics and briefings on carrier history. Once you feel comfortable on board the ship, you can take the controls of an F-14 Tomcat and land it on the flight deck if you're skilled enough. This title has an estimated street price of \$40.

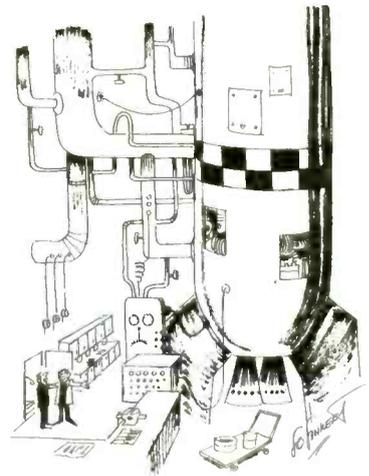
Also new this month from Discovery Channel Multimedia for kids ages 9 and up is Animal Planet, a new CD-ROM that's much more than an animal encyclopedia. It features stunning graphics and in-depth information on more than 1,100 animals. Beautiful 3-D vistas range from mountain tops to the ocean depths to the frozen polar regions. Animal Planet also offers instant access

to the World Wide Web with its Bio Web feature, a direct link to over 1,000 animal websites on the Internet. Updated quarterly, the Bio Web offers plenty of information-rich websites, ranging from official museum, aquarium, and zoo sites to those written by veterinarians. A short description of each site is provided as well as a rating.

Many of the toy companies we remember from childhood are still around today in a big way, and multimedia is the new name of the game. I have a bunch of new titles from Mattel Media. Mother Goose's Farm 4 Learning teaches kids ages 3 to 6 arithmetic, reading, rhythm, rhyming, and more. With four separate discs, there's enough here to keep kids busy for months.

Mattel is also on track to produce lots of software intended for girls, and to start off with there's a bunch of Barbie titles. Barbie is celebrating her 37th anniversary, and it makes sense that girls would be interested in Barbie software. Barbie Fashion Designer lets girls create original fashion designs that their Barbie dolls can actually wear. Patterns can be printed on printer-compatible

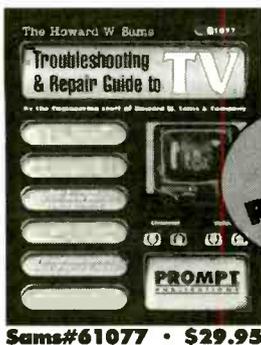
fabric. No sewing is required. Barbie Storymaker lets girls create their own Barbie movies using different locations, scenery, sound effects, and characters. Barbie Print 'n Play lets girls produce their own custom stationary, calendars, and stickers. Of course boys are welcome to play with the software, too—they probably just won't tell their friends about it. ■



"Bob, you have a lovely hobby-room!"

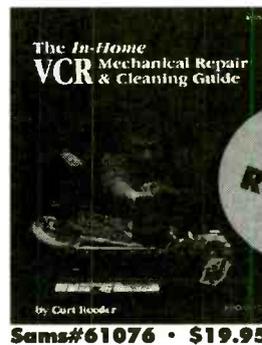
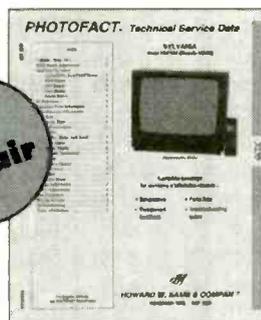
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# NET WATCH

## Pay Channels Online

BY DAN KARAGIANNIS

Whether you have cable or digital-satellite television, you're paying for programming. As you probably know, having dozens of channels to choose from can be both fun and frustrating, but always better than using "rabbit ears" to tune in a few local stations. But what exactly are you paying for?

In a word: Content.

Whether you love having lots of

to flourish, so I figured we'd add a few more this time around.

### THE WEATHER CHANNEL

Here's a site that everyone can benefit from, whether they have pay TV or not (I know, I just mentioned that this certainly isn't the intention of the channels, but "I call them as I see them"). If you ever care about what Mother Nature has in store for you—

International Conditions & Forecasts, read some Text-Only Conditions & Forecasts, examine US Maps or International Maps, visit some other Weather Links, or take a look at The Weather Channel City of the Day.

At the bottom of this page, as well as on the main page, you can choose from a scrolling list of states. This feature is basically the heart of The Weather Channel site. Why? Because once you pick a state, you can then choose from a list of cities that have local radar and weather stations.

The best way to really experience the significance of this is to go to the site itself, but I'll try and give you an idea of how useful this feature is. Imagine selecting the city you live in (or one close enough to make no difference) and instantly being provided with current conditions, a graphical five-day outlook, regularly updated radar images, weather warnings and watches, and descriptive forecasts.

Whether you'd like to stay informed of what your current surroundings will be like for days to come, or are planning on visiting a certain city in the near future, you'll find yourself bookmarking this feature of the site and returning to it regularly. I love to travel and have not only my own hometown bookmarked, but several other favorite destinations as well.

Having written this column in February, the Weather Channel site had a few winter-related seasonal links that I won't go into simply because they'll most likely be gone by the time you ever see these words. Just to give you an idea (now that winter's just about gone as you read this), the site had Winter Weather and Check on the Slopes links, to name a few. Start looking for thunderstorm, tornado, and eventually hurricane information.

And finally, although they do give away a bit too much at their site, do check out the Weather Channel if it's available in your viewing area. As hooked on the Net as I am, I still check out this channel in the mornings before I start my commute. After all, signing



The Weather Channel website brings you so much useful information that you might never tune in to the channel again!

movies at your disposal, or enjoy choosing from several documentaries and information sources, a cable- or satellite-equipped TV brings quite a lot to your living room. In this month's column we'll look at a couple of information pay channels that have brought some of their content online. Though they're certainly not trying to get people to tune out their broadcasts, these channels have found the Internet to be a great medium for bringing viewers complementary information.

Some of you might recall that when this column first started I covered the Sci-Fi Channel's Dominion at <http://www.scifi.com>. That site has continued

and few can honestly claim not to—then you might want to point your web browser to the Weather Channel's excellent Net presence.

When you first access the opening page, you're provided with several choices, some permanent, some seasonal. On the left there's a vertical banner that lets you select from the all-year links; the seasonal ones are arrayed around the channel's logo.

The permanent link on the top of the banner is called, simply, The Weather. When you click it on, you are presented with a great wealth of information. You can take graphical views of US Conditions & Forecasts or

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

You must be delighted with what you see, or you pay nothing. Examine this remark-

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

### RISK-FREE ORDER FORM

**YES!** I want to try *Speed Learning* for 15 days without risk. Enclosed is the first of 4 monthly payments of \$32.25\*. If I'm not completely satisfied, I may return it for a prompt refund.

**SAVE \$8.00!** I prefer to pay the \$129.00 now, and save the \$8.00 shipping & handling charge. I may still return the program for a full refund.

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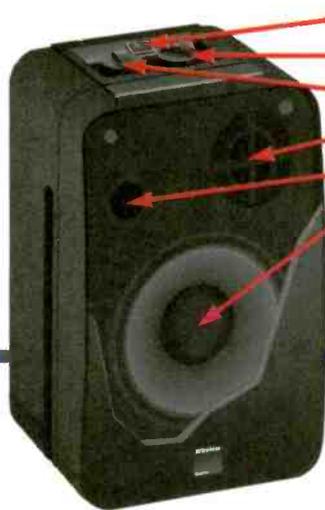
Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

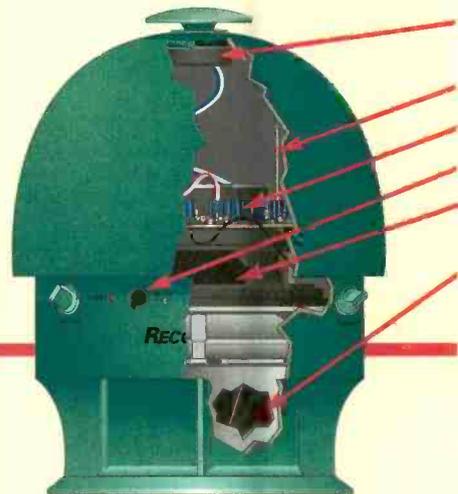
\*Plus \$8.00 shipping and handling. U.S. funds only. For New Jersey residents, sales tax will be added.

**learn** Dept. LPE-01, 113 Gaither Drive,  
INCORPORATED Mt. Laurel, NJ 08054-9987

# Recoton wireless speakers blanket your



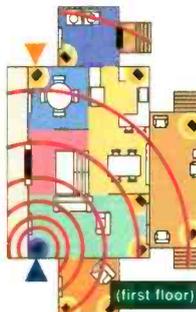
- Power control
- Tuning control
- Volume control
- Two-inch tweeter
- Tuned ports
- Four-inch woofer
- Individual left, right and mono switch and Individual bass boost control (on back)



In June of 1989, the Federal Communications Commission allocated a band of radio frequencies stretching from 902 to 928 MHz for wireless, in-home product applications. Recoton utilized this new technology to introduce this whole new generation of powerful wireless speakers that rival the sound quality of expensive wired speakers. From high-fidelity sound to weather resistance to

## BLANKET YOUR HOME WITH MUSIC

One Recoton transmitter will broadcast to any number of speakers, up to 150 feet away...through walls, ceilings and floors...indoors or out!



being totally cordless, this line of wireless speakers from Recoton is the perfect solution for listening to music anywhere you want in your home.

**Superior sound anywhere.** Each of these speakers let you listen to your stereo, TV, VCR or CD player in any room of your home—even outdoors—without running miles of speaker wire. You'll never have to worry about range because the new 900 MHz technology allows stereo signals to travel up to 150 feet through walls, ceilings and floors!

*The Recoton transmitter will operate any combination of these speakers, wirelessly, from up to 150 feet away...through walls, ceilings and floors!*



## RECOTON W440s

**Full dynamic range.** The W440s are set in a bookshelf-sized acoustically constructed cabinet, providing a two-way bass reflex design for individual bass boost control. Full dynamic range is achieved with a two-inch tweeter and four-inch woofer. Automatic digital lock-in tuning guarantees optimum reception and eliminates drift. The new technology provides static-free sound in virtually any environment. The W440s are self-amplified; they can't be blown out no matter what your stereo's wattage.

**Stereo or hi-fi, you decide.** The W440s have the option of either stereo or hi-fi sound. Use two speakers (one set on right channel and the other on left) for full stereo separation. Or, if you just want to add an extra speaker to a room, set it on mono and listen to both channels on one speaker. Mono combines both left and right channels for hi-fi sound.

**Special offer.** These speakers are the perfect addition to any audio lineup. And for a limited time, we're offering a special discount. Individually, this speaker costs \$89, but if you buy more than one W440, you can get them for just \$69 each!



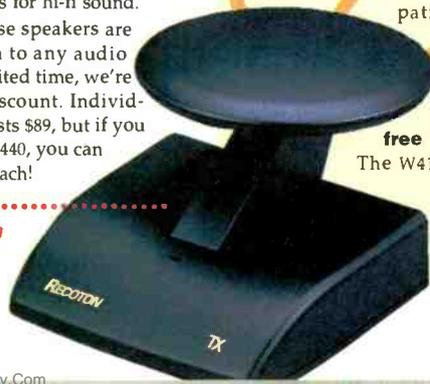
Until now, there was no such thing as a completely weatherproof and wireless 900 MHz outdoor speaker. Today there is—introducing the new Recoton W410.

## How omnidirectional speakers work.

You'll never again fret over where to put speakers so you can hear them outside because Recoton's W410s deliver extraordinary omnidirectional sound out-of-doors. Within the green weatherproof housing, a two-inch tweeter and a six-inch woofer deliver 10 watts per channel of clear, strong sound. The tweeter fires upward and the sound is dispersed by the dome-shape of the speaker itself. The woofer, which fires downward, bounces sound waves off of the ground (or whatever surface the speaker is on) to disperse the sound, resulting in intense omnidirectional sound.

**Totally weatherproof.** The W410s are the first speakers of their kind to combine the best features of both indoor and outdoor speakers. They have the power and sound quality of indoor speakers and the wireless convenience and complete weatherproofing that is required in outdoor speakers. In addition, their unique design makes the W410s a discreet addition to your yard, patio or pool—you can enjoy music outdoors without a clutter of unsightly speakers!

**Powerful, static-free high-fidelity sound.** The W410s combine left and right channels for rich, high-fidelity sound. The six-inch full-range speaker



# home (and yard) with high-fidelity sound!

- Two-inch tweeter
- Copper wire antenna
- Capacitors
- Charging port
- Six-inch woofer
- Lead-acid rechargeable battery



## RECOTON W410s

has both treble and bass and provides an above-average bass response. The speakers produce a frequency range from 30 Hz to 19.5 KHz. Since we hear from 20 Hz to 20 KHz, that means the sound produced covers virtually all of our hearing range. With 10-watt RMS output and 20-watt peak output, the W410s provide powerful, static-free sound.

The W410s have a lead-acid rechargeable battery that gives 18 hours of straight play on a full charge. An AC adapter lets you listen to your speakers indoors and charge your battery at the same time!

**Use them anywhere.** The W410s are extremely versatile. While they were designed for outdoor use, they can also be used indoors. Their stylish design will match almost any decor!

**Don't wait! Special offer.** These wireless 900 MHz outdoor speakers are what you've been looking for to enjoy your favorite music on your deck, patio, around the pool... wherever you want. And for a limited time, we're offering a special discount. Buy one W410 for just \$149 and get additional W410s for \$99—that's a \$50 savings on each additional speaker. Call us now!

Recoton's wireless headphones make a great addition to any audio set-up. Look for our special headphone package offer!



- Power-saving low-battery light
- Robust 10-watt RMS amplifier
- Automatic shut-off/bass boost circuitry
- Dynamic tweeter
- Power option battery compartment
- Extended-range woofer
- Pulsating tuned bass port
- Individual control panel (on back)



Recoton's line of wireless speakers just got better. Now you can truly listen to music anywhere because where you put these W445s isn't limited to where you have an outlet!

**No speaker wires. No power cords. No kidding.** The W445s are the ultimate in wireless speakers, because they are also cordless. They are powered by eight "D" batteries, an optional rechargeable lead-acid battery or AC power. Put these cordless speakers anywhere you want within the 150-foot range of the transmitter, indoors or out...and enjoy!

A timer automatically cuts the speaker off 20 to 30 minutes after the music stops, or if the battery voltage drops too low. These speakers also have a built-in handle for easy carrying.

**Super sound quality.** Like the W440s, the W445s provide a two-way bass reflex design for individual bass boost control, full dynamic range and automatic digital lock-in tuning that guarantees good reception and eliminates drift.

With static-free sound in virtually any environment, the W445s are also self-amplified. So no matter what your stereo's wattage, they can't be blown out. In addition, these speakers have a feature that automatically "mutes" the speaker when the music stops playing so no noisy hiss is heard.

**Stereo or hi-fi.** The W445s also give you the option of either stereo or hi-fi sound. You can put two speakers, one set on right channel and the other on left, in the den for full stereo separation. Or add one speaker, set on mono, in the kitchen and listen to both channels at once for hi-fidelity sound. Recoton gives you music how you want it, where you want it!



## RECOTON W445s

**Special offer.** Our factory-direct pricing lets us sell more wireless speakers than anyone! For this reason, if you purchase two or more W445s, they're just \$99 each (save \$30 each!).

*It's time you surround yourself with music throughout your home. All of these products are backed by Comtrad's 90-day risk-free trial and a 90-day manufacturer's warranty. Try them in your home! If you're not thrilled with their quality and versatility (which we're sure you will be), return them for a full refund.*

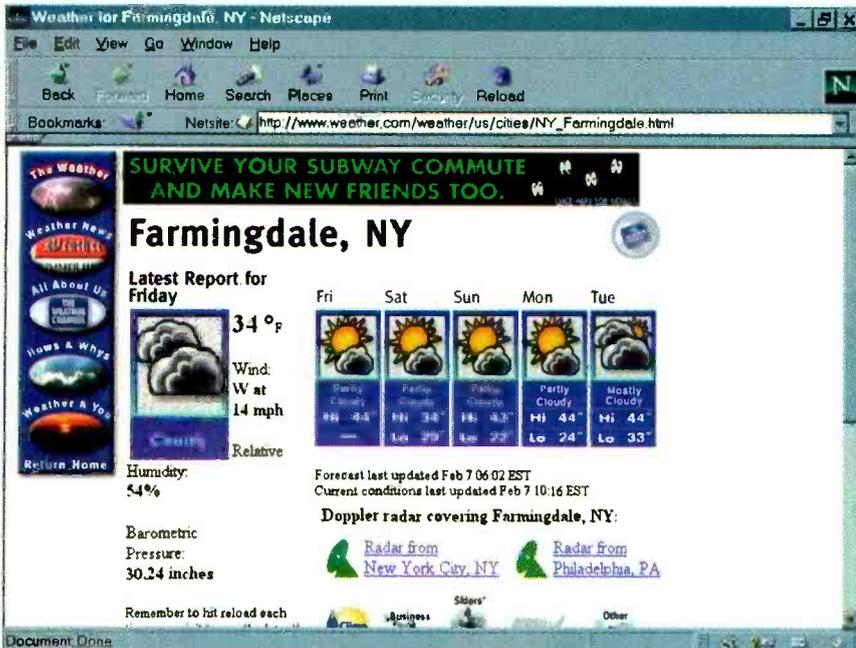
- Recoton transmitter . . . . . \$69 \$8 S&H
- Recoton W440 speaker . . . \$99 \$9 S&H
- Buy two or more 440s for just \$69 each!
- Recoton W410 speaker . . \$149 \$9 S&H
- Additional W410s . . . . . \$99 \$9 S&H
- Recoton W445 speaker . . \$129 \$9 S&H
- Buy two or more 445s for just \$99 each!

Wireless headphones . . . . \$149 \$9 S&H  
Buy a transmitter and any two speakers and get the headphone system for \$49!  
Mention promotional code 2221-10518.

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Here's the weather outlook at the time of this writing for the *Popular Electronics* offices. What's it like in your neck of the woods? Finding out is easy with *The Weather Channel's* site.

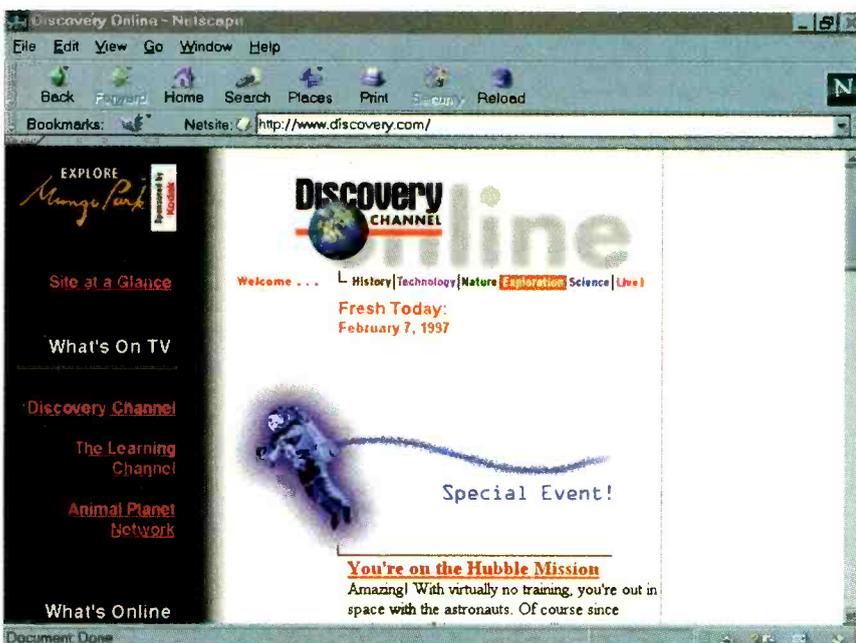
on to your online account is a bit difficult when you first open up your eyes in the morning.

## DISCOVERY CHANNEL

If you have children and want them watching some really educational quality programming, or are just interested in learning more about the world you live in yourself, the Discovery Channel is hard to beat. There's something of interest to practically everyone

on this station every day, and the same holds true for the channel's impressive website, Discovery Channel Online.

Like other sites based on channels, the Discovery Channel Online provides you with information on what shows you can expect to tune in. Of course, this information always changes so we won't deal with it here more than to say that you'll always know what's on, regardless of where you live.



The Discovery Channel Online lets you know what's on the tube and links you to equally fascinating web material.

A great feature of this online presence is that it also gives you current articles of interest to viewers. For example, when I visited the site I found a fascinating link to the Hitchhiker's Guide to the Hubble. Here you can download video footage and information relating to various space missions. As I've said before, I love amateur astronomy, and it's refreshing to get this close to the cosmos on occasion.

You'll also find regular sections of the site dealing with History, Technology, Nature, Exploration, and Science. All of these are pretty self-explanatory and relate to current features on the channel dealing with each category. There's also a great search engine that lets you look for programming related to whatever text you enter.

### HOT SITES

**The Weather Channel**  
<http://www.weather.com>

**The Discovery Channel Online**  
<http://www.discovery.com>

In short, this site has plenty to offer, but it's very timely. The content changes daily and as a result I can only encourage you to check it out for yourself before you waste time searching through a TV guide of some type. Who knows how many fascinating, yet awkwardly scheduled programs we've all missed by relying on such a scanning method in the past.

Sites like these are an innovation that couldn't have come sooner. In these days of media overload, it's nice to be able to find out what's on of interest. Channel surfing can sometimes get you nowhere, but Net surfing is thankfully providing an option.

That's all for this month. Until next time, feel free to drop me a line via snail mail at *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. I'll be publishing a new e-mail address next time; please be sure to look for it. ■



# NEW PRODUCTS

## "PLUG & PLAY" PHONE SYSTEMS

TMC Corporation's SOHO family of multi-line, "plug & play" phone systems are specifically designed for the small-office/home-office (SOHO) market. The six models are compatible with each other and with a host of add-on feature modules to provide small-business professionals with telephone systems to meet their particular needs.



The plug & play design, in which the "brains" are built into each phone, ensures that there is no complicated wiring or expensive controller unit. Up to 24 extensions can share the same system, with full access to all lines and features. A full-featured intercom lets you call any extension in the system at the touch of a button and answer intercom calls via speakerphone. Toll restriction allows you to prevent unauthorized long-distance calls, and call privacy lets you prevent others from listening to your conversations unless you include them in a conference call. Off-hook voice announce enables discreet intercom announcements to others without interrupting their calls in progress. Each phone offers a personal 34-number memory dial; 40 more numbers can be added to extension number one for system-wide use. Several models are equipped with a two-line, 16-character, pivoting LCD that includes clock, day and date, call-timer, number dialed, and internal messages.

Optional add-on modules include music on hold, which allows you to connect a radio or tape player to the system; a compatibility box to provide "line-in-use" indicators on all system phones when a line has been accessed by a standard telephone, and allows you to take calls off hold from any standard phone; caller ID

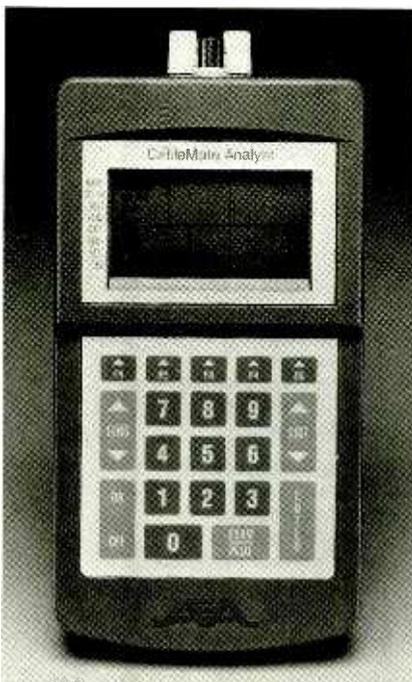
(with the service from the phone company); external paging, which allows you to connect to the system a door intercom speaker, as well as a magnetic door lock that can be opened from any extension; and a cordless phone adapter.

**CIRCLE 80 ON FREE  
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## MICROWAVE TESTER ACCESSORY HEAD

Intended for use by field-service or repair-depot technicians, the AMD1 accessory head from Fieldpiece is specifically designed to test microwave ovens for catastrophically failed diodes. When attached to a digital multimeter's test leads or to a Fieldpiece stick-style DMM, the head allows a meter to measure voltage across a resistor in series with the diode. The AMD1 identifies forward and reverse opens and shorts. In the forward direction, it can distinguish between a diode conducting current properly and a shorted diode. Diodes should be tested without connection to live circuits, as the accessory supplies adequate power to perform the test.

The AMD1 installs on top of the Fieldpiece Stick meter via jacks in a recessed housing. Those industry-stan-



dard jacks also accept Fieldpiece's deluxe test leads for remote testing versatility and compatibility with most other DMMs.

The AMD1 microwave tester accessory head costs \$18.95. For additional information, contact Fieldpiece Instruments, 231 Imperial Highway, Suite 250, Fullerton, CA 92635; Tel. 714-992-1239; Fax: 714-992-6541.

**CIRCLE 81 ON FREE  
INFORMATION CARD**

## SELF-SETTING ALARM CLOCK

*The Time Machine™* from Oregon Scientific always provides the most accurate time possible. The alarm clock sets itself automatically by receiving radio-frequency time signals from the U.S. Atomic Clock. One of the most accurate clocks in the world, the Atomic Clock is located in Boulder, Colorado, and is operated by the U.S. Department of Commerce's National Institute of Standards and Technology.



The Atomic Clock's signal was previously available only for use by commercial and industrial applications, including aircraft and ship navigation, broadcasting stations, and scientific facilities. Now, however, the Time Machine's internal omnidirectional antenna can pick up Atomic Clock signals from anywhere in the continental United States. (A small external antenna is provided for use in urban areas

and high-rise buildings where RF interference can be a problem.) The Time Machine not only sets itself to synchronize its digital time and date display with the Atomic Clock's signals, it also automatically adjusts for daylight-savings time. Once the Atomic Clock is up and running, so is the accurate time.

The Time Machine's oversized LCD readout features bright-blue "HiGlo" illumination, activated by pressing a large bar on top of the clock, for night-time viewing. A map icon on the display indicates which of the four U.S. time zones has been selected by the user. A radio-tower icon indicates reception of the Atomic Clock signal.

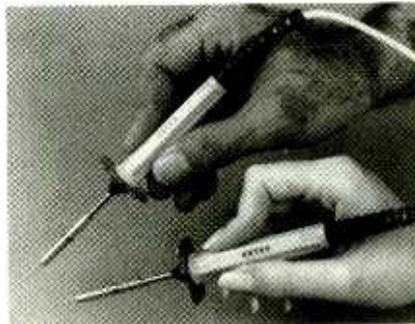
The Time Machine has a suggested retail price of \$99.95. For more information, contact Oregon Scientific, 18383 SW Boones Ferry Road, Portland, OR 97224; Tel. 800-869-7779 or 503-639-8883; Fax: 503-684-8883.

**CIRCLE 82 ON FREE INFORMATION CARD**

### CABLE CHECKER

With on-screen menus and help functions, the handheld *CableMate* time-

domain reflectometer (TDR) from *Advanced Electronic Applications* makes easy work of pinpointing faults in coaxial and two-wire cables. It can



be used for detecting breaks in cables that are buried or otherwise hidden, and for measuring a length of cable whether it is installed or still on the spool. The *CableMate*'s large LCD device graphically indicates the severity of faults and the distance from the user end to the fault. It displays the distance in feet or meters, and the amplitude in decibels down from the injected pulses.

A built-in table of more than 65 common cable types makes it easy to

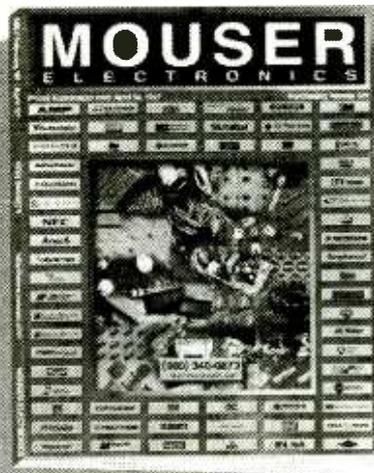
choose characteristic impedance and velocity factor. The table has room for a total of 96 cable types. The user can add or delete cables, and give a description up to 14 characters long. The *CableMate* can also measure the velocity factor of a known length of cable. In addition, as many as 15 plots and their parameters can be saved in nonvolatile memory for later reference. Each plot can be assigned a name that appears whenever the plot is displayed.

The *CableMate* is equipped with a computer serial port. The optional *CableCon* serial cable and software package allows the *CableMate* device to be linked to a PC for real-time remote control and display, uploading and downloading plots and cable lists, and for printing plots.

The *CableMate* time domain reflectometer costs \$499. For more information, contact *Advanced Electronic Applications*, P.O. Box C2160, Lynnwood, WA 98036; Tel. 206-774-5554; Fax: 206-775-2340; Web: <http://www.aeainc.com>.

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**CIRCLE 164 ON FREE INFORMATION CARD**

## Turn Your Multimedia PC into a Powerful Real-Time Spectrum Analyzer

### Features

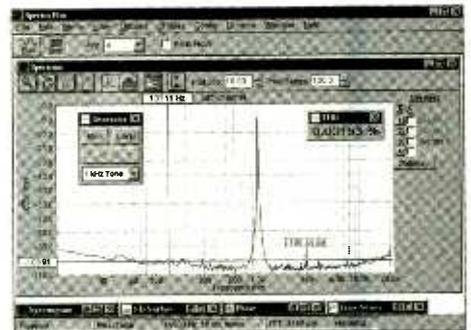
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- Triggering, Decimation
- Transfer Functions, Coherence
- Dynamic Data Exchange (DDE)
- Time Series, Spectrum Phase, Spectrogram and 3-D Surface plots
- Real-Time Recording and Post-Processing modes

### Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

### System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor



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# Budget Project and Computer Books

**BP317—Practical Electronic Timing \$6.95.** Time measurement projects are among the most constructed gadgets by hobbyists. This book provides the theory and backs it with a wide range of practical construction projects. Each project has how-it-works theory and how to check it for correct operation.

**BP415—Using Net-scape on the Internet** **BRAND NEW** **\$7.95.** Get with the Internet and with surfing, or browsing, the World Wide Web, and with the Netscape Navigator in particular. The book explains: The Internet and how the World Wide Web fits into the general scenario; how do you go about getting an Internet connection of your own; how to download and install the various versions of Netscape browsing software that are available; and how to use Netscape Navigator to surf the Web, and to find and maintain lists of useful sites. There's a heck of a lot more, too!

**BP325—A Concise User's Guide to Windows 3.1 \$7.95.** Now you can manage Microsoft's Windows with confidence. Understand what hardware specification you need to run Windows 3.1 successfully, and how to install, customize, fine-tune and optimize your system. Then you'll get into understanding the Program Manager, File Manager and Print Manager. Next follows tips on the word processor, plus how to use Paintbrush. There's more on the Cardfile database with its auto-dial feature, Windows Calendar, Terminal, Notepad, etc.

**BP327—DOS: One Step at a Time \$5.95.** Although you spend most of your time working with a word processor, spreadsheet or database, and are probably quite happy using its file management facilities, there will be times when you absolutely need to use DOS to carry out 'house-keeping' functions. The book starts with an overview of DOS, and later chapters cover the commands for handling disks, directories and files.

**PCP119—Electronic Music and Midi Projects \$14.95.** Save cash by building the MIDI gadgets you need. Want a MIDI THRU box, program change pedal, Metronome, analog echo unit, MIDI patchbay or switcher? Over 16 practical and very useful music and MIDI projects—all in this book! The projects are explained in detail with full instructions on assembly.

**PCP120—Multimedia on the PC! \$14.95.** What is Multimedia? What can it do for you? It can do lots of nice things! This 184-page book helps you create your own multimedia presentation. Multimedia applications by people like you can revolutionize educational and business applications as well bring more fun, fun, fun into your leisure computer activities.

**BP404—How To Create Pages for the Web Using HTML \$6.95.** Companies around the world, as well as PC users, are fast becoming aware of the World Wide Web as a means of publishing information over the Internet. HTML is the language used to create documents for Web browsers such as Mosaic, Net-scape and the Internet Explorer. These programs recognize this language as the method used to format the text, insert images, create hypertext and fill-in forms. HTML is easy to learn and use. This book explains the main features of the language and suggests some principles of style and design. Within a few hours, you can create a personal Home Page, research paper, company profile, questionnaire, etc., for world-wide publication on the Web.



**BP377—Practical Electronic Control Projects \$6.95.** Electronic control theory is presented in simple, non-mathematical terms and is illustrated by many practical projects suitable for the student or hobbyist to build. Discover how to use sensors as an input to the control system, and how to provide output to lamps, heaters, solenoids, relays and motors. Also the text reveals how to use control circuits to link input to output including signal processing, control loops, and feedback. Computer-based control is explained by practical examples.

**BP411—A Practical Introduction to Surface Mount Devices \$5.95.** This book takes you from the simplest possible starting point to a high level of competence in working with Surface Mount Devices (SMD's). Surface mount hobby-type construction is ideal for constructing small projects. Subjects such as PCB design, chip control, soldering techniques and specialist tools for SMD are fully explained. Some useful constructional projects are included.

**BP136—25 Simple Indoor and Window Aerials \$5.50.** Many people live in flats and apartments where outdoor antennas are prohibited. This does not mean you have to forgo shortwave listening, for even a 20-foot length of wire stretched out under a rug in a room can produce acceptable results. However, with experimentation and some tips, you may well be able to improve further your radio's reception. Included are 25 indoor and window antennas that are proven performers. Much information is also given on shortwave bands, antenna directivity, time zones, dimensions, etc. A must book for all amateur radio enthusiasts.

**BP336—A Concise User's Guide to Lotus 1-2-3 Release 3.4 \$7.25.** Discover how to use a three-dimensional Lotus spreadsheet in the shortest and most effective way. The book explains how: to generate and manipulate 3-dimensional worksheets and how to link different files together; to generate and add graphs to a worksheet, edit them, and then preview and print the worksheet; to use the SmartIcons and become more productive with your time; to use the WYSIWYG add-in to produce top quality screen and printed displays; and much more.

**BP379—30 Simple IC Terminal Block Projects \$6.50.** Here are 30 easy-to-build IC projects almost anyone can build. Requiring an IC and a few additional components, the book's 'black-box' building technique enables and encourages the constructor to progress to more advanced projects. Some of which are: timer projects, op-amp projects, counter projects, NAND-gate projects, and more.

**BP401—Transistor Data Tables \$6.95.** The tables in this book contain information about the package shape, pin connections and basic electrical data for each of the many thousands of transistors listed. The data includes maximum reverse voltage, forward current and power dissipation, current gain and forward transmittance and resistance, cut-off frequency and details of applications.

**BP403—The Internet and World Wide Web Explained \$6.95.** You've heard about the Information Superhighway. Sort of makes you feel timid about getting on the Web. Put your fears aside! This book eliminates the mystery and presents clear, concise information to build your confidence. The jargon used is explained in simple English. Once the tech-talk is understood, and with an hour or two of Web time under your belt, your friends will call you an Internet guru!

**BP92—Electronics Simplified: Crystal Set Construction \$2.69.** This book is written for those who wish to participate in electronics more through practical construction than by theoretical study. It is designed for all ages upwards from the day when one can read intelligently and handle simple tools. The crystal set projects are designed to use modern inexpensive components and home-wound coils. A book highly recommended for all newcomers.

**ETT1—Wireless & Electrical Cyclopedic \$5.75.** Step back to the 1920's with this reprinted catalog from the Electro Importing Company. Antiquity displayed on every page with items priced as low as 3 cents. Product descriptions include: Radio components, kits, motors and dynamos, Leyden jars, hot-wire meters, carbon mikes and more. The perfect gift for a radio antique collector.

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NW2

Allow 6-8 weeks for delivery

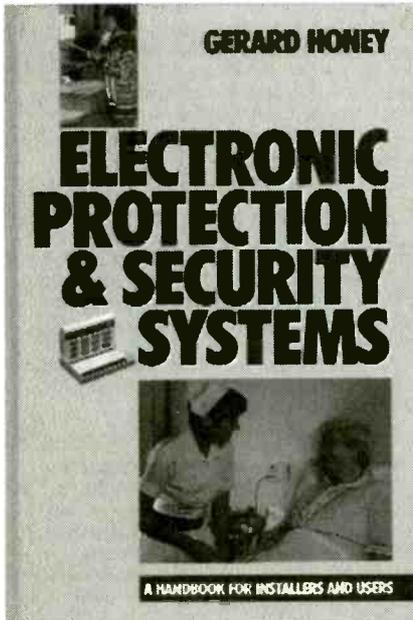
May 1997, Popular Electronics

# ELECTRONICS LIBRARY

## ELECTRONIC PROTECTION & SECURITY SYSTEMS: A Handbook for Installers and Users

by Gerard Honey

This book presents an overview of the many electronic alarm systems available today. It is intended to help security professionals, system designers, installers, and users to protect the people and property under their care—from looking after children to infirm or elderly people, and securing buildings from homes to industrial installations or shopping centers.



The book examines the large and growing selection of intruder alarms, and presents ways to correctly choose and use the most appropriate ones. System layouts and wiring diagrams are provided where appropriate. Wireless systems are covered in detail. The book also covers fire alarms, call systems, access control, vehicle protection, emergency and security lighting, closed-circuit TV, and intercoms.

*Electronic Protection & Security Systems costs \$39.95 and is published by Butterworth-Heinemann, 313 Washington Street, Newton, MA 02158-1626; Tel. 617-928-2500; Fax: 617-928-2620.*

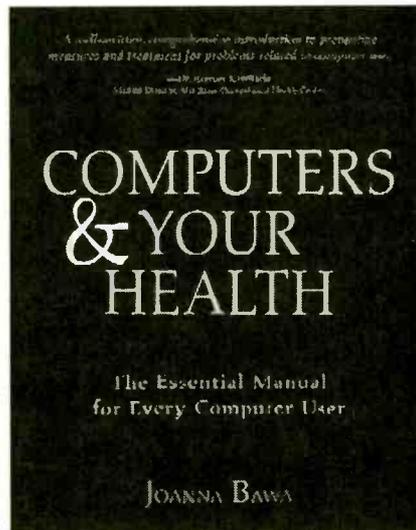
CIRCLE 90 ON FREE INFORMATION CARD

## COMPUTERS & YOUR HEALTH: The Essential Manual for Every Computer User

by Joanna Bawa

An awful lot of us spend hours a day in front of a computer, both at home and at work. We use PCs to write memos or novels, handle financial records for large corporations or the family check-book, play games against the computer or with other on-line gamers, shop, bank, conduct research, and surf the 'Net.

This holistic handbook examines the ways in which extensive computer use can affect your health and well-being. The comprehensive guide draws upon the expertise of physical therapists, optometrists, osteopaths, and ergonomists, with the goal of creating a healthier work and home environment.



The book includes information about well-known hazards, such as repetitive strain injuries, electromagnetic radiation, and eye strain. It also looks at the psychological side of frequent computer use, examining such phenomena as video-game addiction and the effect of software design on our mental well-being. The book offers advice on how to manage your children's computing time and how to cope with stress. It suggests specific accessories—ergonomic keyboards, lighting, and furniture.

*Computers & Your Health: The Essential Manual For Every Computer*

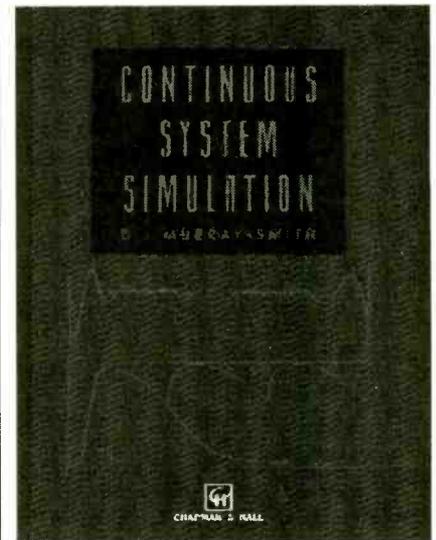
*User costs \$12.95 and is published by Celestial Arts, P. O. Box 7123; Berkeley, CA 94707; Tel. 800-841-2665; Fax: 510-559-1600.*

CIRCLE 91 ON FREE INFORMATION CARD

## CONTINUOUS SYSTEM SIMULATION

by D.J. Murray-Smith

This book provides an introduction to modern methods for computer simulation of systems involving continuous variables. Aimed at students, engineers, and scientists, it explains both the theory and the practice of those techniques. Taking a practical approach, the book places particular emphasis on the use of simulation languages and other software tools widely used in the field.



A simple simulation language is provided on disk with the book and used with examples and case studies from control, aeronautical, and biomedical engineering applications. Commercially available software is also described and applied. Model validation and real-time simulation techniques and applications are covered in detail.

*Continuous System Simulation costs \$59.95 and is published by Chapman and Hall, One Penn Plaza, 41st Floor, New York, NY 10119; Tel. 212-564-1060.*

CIRCLE 92 ON FREE INFORMATION CARD

# GIZMO®

## Life Saver

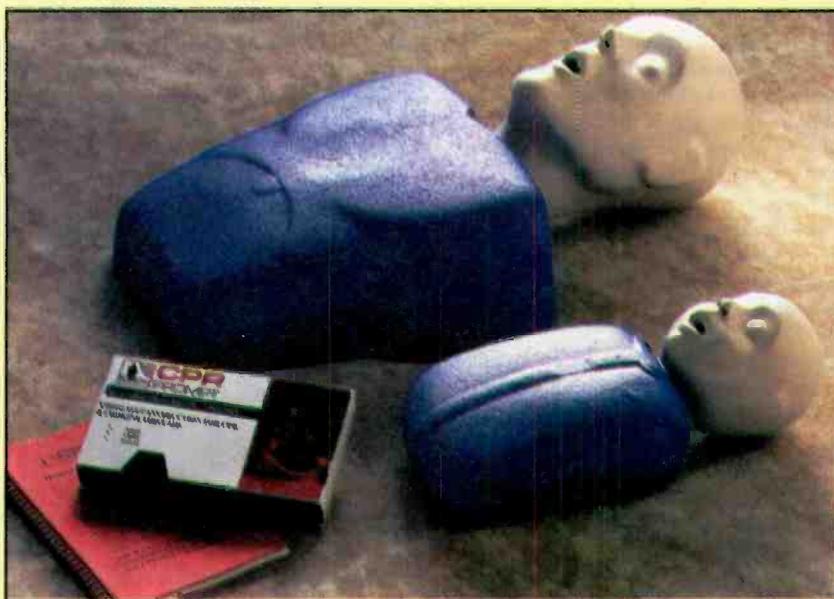
**CPR PROMPT HOME LEARNING SYSTEM.** Manufactured by County Line Limited, Health & Safety Products Division, 4543 Taylor Lane, Warrensville, OH 44128; Tel. 216-765-1234 or 888-728-4533; Fax: 216-765-0278. Price: \$59.95.

How would you feel if your toddler swallowed a Lego piece and you didn't know how to make her cough it up? If your neighbor's child fell into your pool and wasn't breathing when you pulled him out? If your spouse suffered a heart attack? Could you do anything to help besides calling 911—and then waiting those seemingly endless minutes until help arrives?

There's no reason for you to be so helpless. You could—and should—know how to perform some basic life-saving procedures.

In a medical emergency, minutes literally can mean life or death. It takes only four to six minutes after breathing stops for brain damage or death to occur. In fact, the American Heart Association (AHA) estimates that between 100,000 and 200,000 lives could be saved each year in the United States by the timely use of CPR, or cardio-pulmonary resuscitation. CPR keeps blood and oxygen circulating through the brain and other vital organs—in effect, keeping those organs alive and functioning—until professional help can get to the scene. And studies have shown that victims' chances for survival improve up to ten-fold when CPR is started immediately instead of six minutes later.

We've always thought that it would be neat to know CPR and other life-saving techniques—to be able to save someone who was choking in a restaurant or had suffered a heart attack. But our reasons for wanting to learn have become a bit more personal and immediate. Since the birth of our son, almost two years ago, we haven't felt fully qualified as parents because we haven't known what to do in an emergency medical situation. Taking a CPR course has



been on our list of New Year's Resolutions two years running.

On our doctors' advice, we took just about every pre-natal course offered to expectant parents, from Lamaze to diaper-changing. Yet no one suggested that we enroll in a CPR class, and we didn't think of it ourselves until after we brought the baby home from the hospital. Unfortunately, as any working parent of small children knows, fitting CPR classes into days already bursting with office hours, long commutes, business trips, bath time, and play time can be next to impossible.

We can't keep cutting the baby's food into little tiny pieces forever—nor can we continue feeling anxious every time he eats a whole grape. We try to keep him away from toys with tiny parts that might be swallowed, but it's impossible to completely baby-proof any environment. Yet every time a CPR course has been offered by the local library or hospital, the class times have conflicted with a business trip or our daily work schedules.

That's why we were so glad to hear about *County Line Limited's CPR Prompt Home Learning System*. The system allows us to learn CPR at home, when time permits. There's no need adjust our hectic

schedules to meet the class offerings—we could study during nap time or after the baby is in his crib for the night. The system costs less than what a couple would have to pay to take the CPR course offered at our library—and the baby's grandparents can learn, too.

The CPR Prompt system follows the American Heart Association's guidelines, which are intended to give rescuers every possible advantage in an emergency situation. The Home Learning System includes an instructional videotape, practice "manikins" that provide feedback to let you know if you're doing it right, and a supplemental study manual that answers some common questions about CPR. The booklet also offers advice on baby-proofing to avoid accidents, and describes the early warning signs of heart attacks and even strokes.

We began by assembling the two manikins—a large one that is used for learning the procedures for adults as well as for children aged one through eight years old, and a small one for infants under the age of one. Each comes in two pieces: a hard plastic head and a blue foam-covered torso. In addition, the system includes two different sizes of plastic bags that simulate

lungs. When you are breathing into the manikin correctly, the bag expands and makes the chest rise visibly. (For health reasons, the bags should be changed, and the heads washed, when more than one person is using the manikins.) Three bags of each size are included; extra bags can be ordered.

After washing the heads (in the dishwasher or by hand), it took less than five minutes to attach the bags, position the heads atop the torsos, and latch them on. We were then ready to begin watching the video.

Nine different life-saving techniques are demonstrated. The three basic procedures—CPR and rescue breathing, saving a conscious choking victim, and saving an unconscious choking victim—vary depending on the age of the victim—adult, child, or infant. The video is color- and number-coded so that you can easily find and repeat the subjects that most interest you, or that require more practice. A competent-looking man and woman guide you through the steps you need to learn—and make it look very easy.

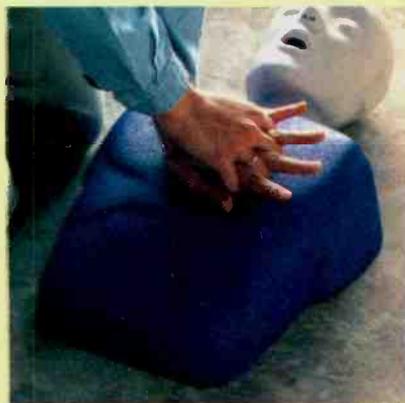
In fact, the demonstrated procedures are quite easy to learn. As the video instructors are fond of repeating, "It's a matter of A, B, C." A for airway, B for breathing, and C for circulation. The tape clearly demonstrates precisely how to tilt the manikin's head back to open an airway; check for breathing and, if necessary, give rescue breaths; and check for a pulse and, if needed, perform chest compressions. The video shows how to apply all of those basic practices in a real-life emergency, including when to call for help, how to position the victim, and what to do in a variety of scenarios (restored pulse but no breathing, blocked airway, etc.). It also shows you how to determine if a person is choking, and how to respond properly depending on the victim's size and condition.

The instructors provide clear, straightforward directions, and the manikins are designed to provide immediate feedback. When you properly breathe into the mouth of either manikin, the lung bag inflates and the chest rises. If you correctly compress the chest of the adult/child manikin, you will hear a clicking sound at each press. (Inside the manikin is a pump, or piston, that can be adjusted between adult and child modes. Different amounts of pressure are required in each.) A chest plate inside the infant manikin prevents you from pressing too hard.

**Gizmo is published by Gernsback Publications, Inc., 500-B Bi-County Blvd., Farmingdale, NY 11735. Senior Writers: Christopher Scott and Teri Scaduto. Copyright 1997 by Gernsback Publications, Inc. Gizmo is a registered trademark. All rights reserved.**

The manikins also offer some anatomical pointers. The infant manikin has nipples, and a raised bar runs down the middle of its chest. About an inch below the nipple line, the bar is interrupted—that spot is where you should press. Of course, a real infant has no such bar, but the instructional tape advises you to find the right spot by measuring down one adult finger's width. On the adult/child manikin, the bottom of the rib cage is clearly visible, as is the navel, and the video explains how to place your hand in relation to both when trying to dislodge an object that is obstructing breathing.

We were surprised at how easy it is to master the basics of CPR, the Heimlich Maneuver, and abdominal thrusts. In fact, the tape is only about 40 minutes long. It will take you at least twice that amount of time to gain some working knowledge of the



**When you properly apply chest compressions to the adult/child manikin, a pump inside the unit provides positive feedback by audibly clicking.**

procedures. It is recommended that you watch a segment of the tape, then rewind and carry out the procedures on your manikin while they do it on screen. After each segment, you are instructed to pause the tape and practice the techniques you've just been taught. When you hit PLAY again, you are given a brief quiz to test your mastery of the subject. You can then repeat it or move on to the next portion of the tape. And, of course, practice is vital to properly learning these techniques.

We were equally surprised to learn how physically demanding CPR is. The cycle of two breaths/15 compressions (one breath/five compressions for children and babies) can quickly wear out a person who is not used to physical activity. Even the relatively light pressure applied with two fingers to the infants' chest causes a strain in your hand in a couple of minutes. And you'll find that you must apply quite a bit of force to the adult manikin's chest before you hear the click that means you're doing it right.

One of the few complaints we had about

the CPR Prompt Home Learning System was that it raised several questions that went unanswered by the videotape or the Supplemental Learning Guide. How old do you have to be to perform CPR? Why are the techniques and procedures for different aged victims so different? We wished for a more extensive Supplemental Learning Guide, or at least a list of suggested reading.

We gave County Line Limited a call, and their representative graciously answered most of our inquiries. For instance, we learned that the American Heart Association says that children as young as 7 or 8 years old can learn CPR—as long as they are strong and heavy enough to perform the techniques. Even if they lack the muscles and body weight to do chest compressions on an adult, they should be able to perform CPR on an infant or another child. And, as the AHA stresses, in most cases any trained intervention is better than doing nothing at all.

We were also curious about the differences in the techniques used for resuscitating adults and children—15 compressions and two breaths for adults, 5 compressions and one breath for children and infants. It seems that children's hearts beat faster and they breathe more frequently than adults. Finally, why are you supposed to call 911 immediately if an adult stops breathing, but perform CPR for one minute before calling for help if you are alone with a young victim? According to the AHA, it is common for a child's breathing problems to be caused by a blocked airway, which can be corrected quickly by a trained lay person. There's a good enough chance that you can get the child breathing again on your own that it's worth trying for a minute before calling in the pros. With adults, however, cardiac arrest is likely to be the problem, and the time it takes the paramedics to arrive with their portable defibrillator can be even more crucial than the few seconds it might take you to get to a phone to call for help.

When you're watching the video, or even practicing on your own, it's easy to remember just how many breaths to give, how many chest compressions, when to call 911, and all the other variables. But practice is vital if you want to keep your skills sharp. So, now that we can cross "Learn CPR" of our resolutions list, we find ourselves adding a new entry: "Hold regular CPR practice sessions."

If "Learn CPR" wasn't one of your resolutions, maybe you should rethink your priorities. We would highly recommend that every able-bodied person take the time to learn the techniques that could save a life. And we would highly recommend the CPR Prompt Home Learning System to help you become proficient at these important techniques. ■

## Prompt Assistance

CPR PROMPT RESCUE AND PRACTICE AID MODEL CPR100. Manufactured by County Line Limited, Health & Safety Products Division, 4543 Taylor Lane, Warrensville, OH 44128; Tel. 216-765-1234 or 888-728-4533; Fax: 216-765-0278. Price: \$99.95.

Considering the fact that learning CPR is one of the very few New Year's resolutions we have ever kept, we have doubts about whether we would stick with our new-found resolve to practice the rescue techniques often. That's why we're happy to hear that *County Line Limited* also offers the *CPR Prompt Rescue and Practice Aid (Model CPR100)*, a handheld device that actually talks trained rescuers through any of twelve different CPR and choking emergencies. If you're out of practice—or if everything you ever knew about CPR flies right out of your head in the face of an actual emergency—the portable device can calmly guide you through the proper rescue procedure.

The Practice Aid is an FDA-registered Class I medical device. It measures about 8 × 3½ × 2 inches, and is intended to be wall-mounted in the home—preferably next to a telephone at which emergency numbers have been clearly posted. Mounting hardware is included.

The unit uses four "AA" batteries, which are not included. The batteries should be checked every 45 days, and a green LED lights 45 days after the unit was last used to remind you to do so. If batteries are low, when the power is turned on, the unit will say: "Warning. Replace batteries."

There's a round speaker at the top of the Rescue and Practice Aid, with the ON/OFF button located directly below it. A horizontal row of round buttons labeled A - ADULT, B - BABY, and C - CHILD is used to select the age category of the victim. A row of buttons numbered 1 through 4, running down the center of the device, is used to choose the condition requiring treatment. To the left of each rescue/condition button is a written description of the problem (from top to bottom: choking/conscious, choking/unconscious, pulse OK/no breathing, and no pulse/no breathing). To the right of each button is a written description of the proper response (Heimlich maneuver, abdominal thrusts, rescue breathing, and CPR) as well as a drawing illustrating the technique to be used. A PAUSE button rounds out the front-panel controls.

A volume control on the right side of the unit has two settings, which sounded to our ears like loud and louder. The softer of the two is intended for use during practice ses-



sions; the louder during emergencies when, presumably, there might be other people making phone calls or just making various types of noise.

During an actual emergency, there is likely to be quite a bit of confusion, if not actual panic. The Rescue and Practice Aid provides a calm voice of reason, giving the rescuer the confidence to carry out the necessary procedures. The first words it utters are "Remain calm." It then instructs you to select the age of the victim. If you don't immediately press one of the rescue/condition keys, the CPR100 gives you instructions for selecting the right procedure to follow.

When you select one of the rescue/condition keys, the device walks you through the entire procedure in real time, keeping accurate count of rescue breaths and chest compressions. In the case of a child or infant, it lets you know when one minute has elapsed and it is time to phone for professional help. If the victim's condition changes, you can simply press a different key to hear a new set of instructions. In rescue mode, the unit will keep repeating the directions until you turn it off, or the batteries run out.

During practice sessions, the Model CPR100 provides a straightforward—though dull—reminder of precisely how each rescue procedure should be performed. The digital voice, which is soothingly steady during an emergency, is annoyingly monotonous during practice

sessions. We would certainly prefer to use the Home Learning System and practice on our manikins, following along with the video. The question is: Would we remember to pull the kit out of the closet or attic every few months and actually do it? Unfortunately, being very ordinary folks, we probably would not.

Would we practice CPR every 45 days when the Rescue and Practice Aid reminded us to? Again, the answer is probably not. All the more reason to keep the unit conspicuously mounted in a convenient location, where we could find it immediately when needed.

We worry, however, about gaining a false sense of security. It's reassuring to have "someone" on hand to guide us in the event of a real emergency. But what if the crisis occurred away from our home and the trusty CPR100?

If used properly—as a practice aid as well as an emergency tool—the CPR100 will keep you as prepared as possible to save a life in several different emergency situations, wherever they might occur. And having it on hand during an emergency could help you stay composed and focused, better able to do whatever was needed to keep a victim alive until professional help arrived.

With that in mind, we'd rank the CPR Prompt Rescue and Practice Aid right up there with smoke detectors—essential to both our family's safety and peace of mind. ■



## Shake, Rattle, and Roll

**FORCE FX FORCE-FEEDBACK JOYSTICK.** From CH Products, 970 Park Center Drive, Vista, CA 92083. Tel. 619-598-2518; Web: <http://www.chproducts.com>. Price: \$249.95.

Do you like playing computer games? We don't—as surprising as that might sound. Although we've found a few strategy games that are enjoyable—and waste more of our time than we like to admit—most action games just leave us flat. They have nothing to draw us in. They just don't seem real.

At least they didn't, before we tried the *Force FX* force-feedback joystick from *CH Products*.

The *Force FX* adds a whole new dimension to game play. Now, as you bank your jet fighter for a better shot at the bad guy, you have to struggle with the stick to retain control of the jet. When you fire your missiles, the controller will recoil. Climb too steeply, and the control stick will buffet as your engines begin to stall.

Whether your favorite game is a flight

simulator, a shoot 'em up, or a racing, sport, or combat simulator, you'll enjoy it more with force feedback.

*Force FX* won't work with just any game—the game must be written to support it. As of this writing there are nine titles that either support the joystick outright or that can be updated to do so with a patch.

We received “*The Need for Speed SE*,” from Electronics Arts, with our evaluation joystick. The racing simulation game allows players to feel vibrations from driving on rough roads, g-forces from hard cornering, and collisions with cars, curbs, road signs, and other obstacles.

“*Descent II*,” from Parallax Software, allows players to feel explosions, force fields, and other robots. A patch is required to add force-feedback compatibility.

Flight simulators “*Jet Fighter III*” (Mission Studios and Interplay), “*Warbirds*” (ICI Games), “*Flying Nightmares 2*” (Domark UK), “*Silent Thunder*” (Sierra Online, requires patch), and “*Fighter Duel SE*” (Philips Media Games) all let players feel g-forces and combat explosions.

“*Unnecessary Roughness '96*” (Accolade) and “*Monday Night Football*” (Overtime Sports) turn the computer football game into the contact sport it should be. Both titles require patches.

Future games that will support the *Force FX* are: “*Confirmed Kill*” (Domark UK), “*Red Baron 2*” (On-Line), “*Air Warrior II*” (Kesmai), “*Mag Zone*” (Trimark Interactive), and “*Rocket Jockey Sierra*” (Rocket Science Games). And this is just the beginning—many other future games are expected to add the force-feedback support as well.

Developers have many options to choose from when implementing force-feedback into their games, and those choices will determine whether the game is really improved by the technology.

As mentioned previously, we received “*The Need For Speed SE*” with our joystick. We've never found driving games to be too compelling on the PC. We normally don't drive with a joystick, after all. The addition of force feedback did absolutely nothing for us.

But a silly little demo program supplied to test the stick was actually kind of fun to play with. It was simply an elastic sling and a ball that you could throw and catch with it. The mass of the ball, the gravity, and the sling's damping were adjustable. That's it—it was just a simple demo, and not a game. But it sure did feel real, as the ball flew up, then landed in the sling, stretching it taut before rebounding up into the air again.

At a trade show, when we had our first encounter with a CH force-feedback prototype, we played a game of “*Pong*”—the first home videogame—that had been retrofitted with force-feedback drivers. “*Pong*” is a simple enough game, something we would not usually find compelling. But with force feedback, it turned into a whole new experience.

The developer of the new version of “*Pong*” is Immersion Corp, the same company whose I-Force technology makes possible the *Force FX* joystick. I-Force allows six effects to be built into the joystick: jolt, vector force, vibration, spring, button reflex, and buffeting.

A jolt command causes a jolt or whack to be felt on the joystick. Jolt parameters include magnitude, direction, and duration. A game developer would use it when a plane is hit, when a car bumps into another car, or when a spaceship hits an asteroid.

The reflex jolt command causes the joystick to react in response to a specific joystick button press. The advantage of the reflex jolt over the standard jolt command is that it allows the stick to produce the desired jolts by itself. For example, the joystick can be set up to give a jolt of a given magnitude and direction whenever the trigger button is pulled. A different type of jolt can be set up for whenever a second button is pushed. The host computer doesn't have to monitor what the joystick is doing (with respect to jolts), so the jolts can be produced without consuming any process-

(Continued on page 31)

# Report from Las Vegas

## THE 1997 WINTER CONSUMER ELECTRONICS SHOW

As we joined the throng at the crowded Las Vegas Convention Center for this year's Winter Consumer Electronics Show, we found ourselves wondering if some enterprising manufacturer had managed to invent a working time machine—we were that sure we'd been transported back to *last year's* show. The signs of the past were all around us: Coming Soon—DVD! Internet-Convergence Technologies!

As soon as we got back to New York, we checked out last year's "Report from Las Vegas" (*Gizmo*, *Popular Electronics*, May 1996), and verified that we had not just experienced a four-day case of *deja vu*. There it was in black-and-white: "RCA DVD player, debuting at a store near you by Labor Day." "Toshiba unveiled plans for two players ... available this fall." "Sony ... plans to market DVD players later this year, with DVD-ROM drives to follow shortly thereafter."

One year later, those same manufacturers and more were demonstrating not prototypes, but actual products. Can you go out and buy a DVD player? Not as we go to press, but—maybe, just maybe—by the time this magazine hits the newsstands DVD will have hit the shelves of a store near you.

Why would you want to buy a DVD player? The format provides laser-quality video and Dolby Digital sound on a five-inch disc. Each disc has the storage capacity for a full-length movie, and then some. Software providers can opt to include subtitles and/or soundtracks in several different languages, add biographical information on the stars, present the movie in two or more aspect ratios (4:3 and widescreen), or in versions edited for different ratings, and even throw in the director's cut—a version of the film that the viewing public rarely gets to see. DVD is not just for video, however; DVD-ROM drives will bring increased storage capacity to PCs. (We won't go into the technical details on DVD here. Check out the "DVD Basics" box for a brief overview, or pull out the May 1996 issue for the whole DVD story.)

The DVD format has a lot going for it—including the support of virtually the entire consumer-electronics industry. So what's the holdup?

Two thorny issues are at the root of the delay: copy-protection and regional coding. The first has been tackled time and again—remember when the motion-picture industry was up in arms against VCRs, fearing that profits would take a nose dive

when folks watched films at home? Those fears were put to rest years ago, as video sales and rentals proved a gold mine for the studios. (According to Julie B. Schwerin founder and CEO of the electronic-media market research firm InfoTech, "In the 15 year period between 1980 and 1995 in which the home video industry grew into a \$15 billion industry, box office receipts doubled. It's in Hollywood's best interests to maintain as many channels of distribution as possible.") But new technology breeds new problems.

Everyone agreed from the get-go that some form of DVD copy protection was necessary, particularly with DVD home recorders looming on the not-too-distant horizon. Unfortunately, the original proposed copy-protection scheme had a disastrous effect on the performance of DVD-ROM drives—too much CPU horsepower was required to decrypt the data encoded on the disc. The computer industry quite rightly cried foul, and a new system had to be developed.

It wasn't until the end of October—well after the anticipated DVD player release dates—that the Consumer Electronics Manufacturers Association (CEMA) announced that the multi-industry Copy Protection Technical Working Group (CPTWG) had devised a new system to prevent the unauthorized duplication of movies and other entertainment of prerecorded DVD discs. The new scrambling technique will encrypt the contents of the discs—not the entire contents, but strategically chosen frames that would make a copied disc unusable. In addition, CPTWG will push for Congressional legislation prohibiting "the circumvention of the copy control technology and other technologies as they are developed and implemented."

The second issue slowing the introduction of DVD was the need for some sort of regional coding. Just as major motion pictures are often premiered in a few big cities before they begin playing "at a theater near

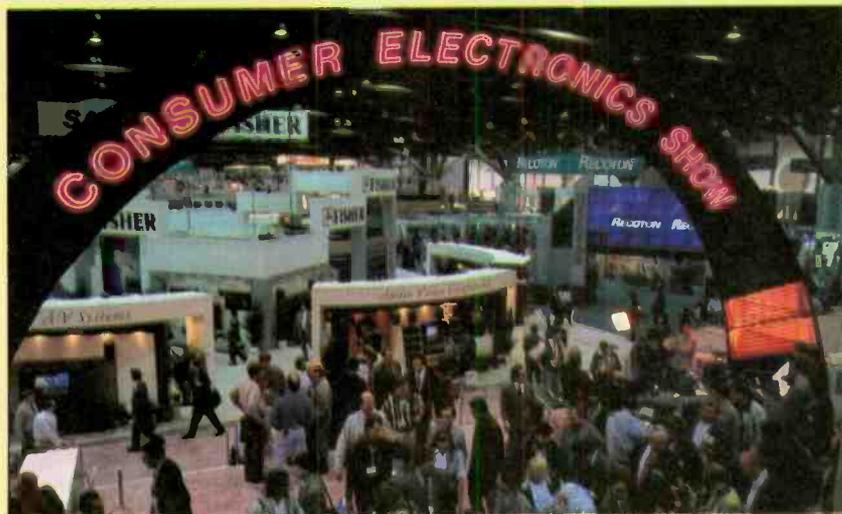
you," there are worldwide time frames for film releases. For example, a film is released first to theaters in the U.S. After the theater run is complete, the pay-per-view window opens. After that, the films make it to premium movie channels and video distribution. All that happens before the movie makes it to Europe and other parts of the world. The movie studios wanted to protect that tiered release schedule.

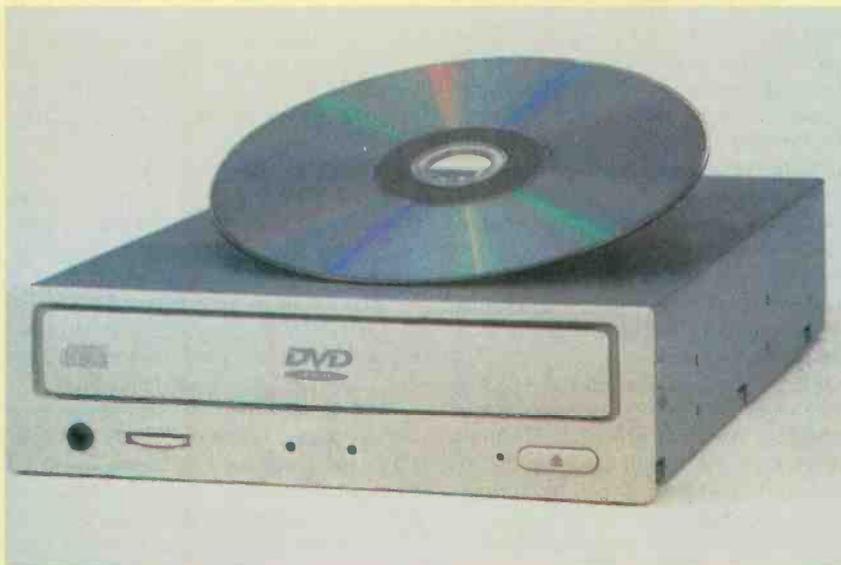
The solution they came up with was regional coding. Six geographical zones were created. Discs that play in one zone will not play on machines sold in another.

With those two issues resolved, the motion-picture industry is ready to back DVD—although not with the whole-hearted commitment that hardware manufacturers were expecting. At DVD's projected April roll-out at the end of April, you might have more DVD players to choose from than DVD movies to play.

### THE FIRST WAVE

Toshiba is introducing two DVD players in the first quarter of 1997: the \$599 SD-2006 and the \$699 SD-3006. Long-time laserdisc champion Pioneer Electronics is rolling out two lines of combi players. Under the Pioneer label, the DV-500 DVD/CD player will carry a \$599 price tag, while the DV-700DVD/LD/CD player will cost \$999. The Pioneer Elite DVL-90 DVD/LD/CD player is expected to retail for a whopping \$1750. Thomson, whose DVD offering is the only one priced at less than \$500, plans to follow the same marketing strategy it used for DSS—an initial limited market-by-market rollout this spring, followed in the fall by a full nationwide approach. Matsushita, which previously had been hedging its bets on the new format, announced at WCES that it had set a March 1 delivery date on its two Panasonic DVD players, the \$600 DVD-A100 and the \$750 DVD-A300. Denon's initial entry into the DVD market is the DVD-200, priced at \$999. Zenith's 2000





Sony began shipping sample units of its DVD-ROM drive to OEM PC manufacturers in January. It will be available in Sony PCs this summer.

DVD player will cost \$749. Prices have yet to be announced for DVD players from Zenith Inteq, Harmon Kardon, and Philips Magnavox.

While the strategy—at least among most of the big players—is to attract the mass market by keeping introductory prices at a palatable \$500–\$700, Sony has taken a different stance. Billing its DVP-S7000 DVD/CD player as a “reference standard” deck and pricing it at \$1000, Sony is targeting serious videophiles and music enthusiasts. The player uses Sony’s own MPEG IC to provide accurate MPEG decompression, and a 10-bit video D/A converter to minimize digital artifacts. The 32-bit RISC processor allows Smooth Scan™ operation in forward or reverse, in high-speed, slow-motion, or frame-by-frame mode. On the audio side, The DVP-S7000 features current-pulse D/A converters, a 45-bit “Full Feed Forward” digital filter for high music resolution, and a Dual Discrete™ optical pickup with both 650nm red laser and 788nm laser diodes to optimize the tracking of different substrate thicknesses and pit sizes in CD and DVD discs. The DVP-S7000 can be coupled with Sony’s SDP-EP9ES Dolby Digital™ AC-3 decoder processor (\$800). The company is depending upon highly satisfied early adopters to tout the new format, leading to increased demand from your average Joe.

Sony is providing some added incentives for those early adopters. The DVP-S7000 will come bundled with four free software discs. And the company announced a deal with Blockbuster in which buyers of the Sony DVD deck will receive coupons good for free DVD rentals at Blockbuster. Sony DVD demonstration kiosks will also appear in about 50 Blockbuster stores in select major markets.

Software introductions, timed to coin-



Toshiba plans to begin selling its Model SD-3006 DVD player in April at a suggested retail price of \$699.

cide with the spring hardware releases, were announced by Columbia TriStar Home Video, Sony Music Video, Warner Home Video, New Line Home Video, and MGM Home Entertainment. In an attempt to gauge the market, most are planning a mix of new releases, old favorites, and children’s films. From Columbia TriStar Home Video, expect to see *Close Encounters of the Third Kind: Special Edition*, *Fly Away Home*, *In the Line of Fire*, *Jumanji*, *Legends of the Fall*, *Matilda*, and *Taxi Driver*. Sony Music will offer *Beavis and Butt-head’s Final Judgment*, *Sesame Street’s 25th Birthday: A Musical Celebration*, and *Tony Bennett Unplugged*. The ten April DVD releases from MGM Entertainment—*The Wizard of Oz*, *Get Shorty*, *Rocky*, *Singin’ in the Rain*, *Midnight Cowboy*, *Casablanca*, *The Birdcage*, *Species*, *GoldenEye*, and *Raging Bull*—will be followed by 30 more DVD titles by the end of 1997.

Warner and New Line Home Video are sticking with more recent fare. Warner will debut DVD versions of *Twister*, *The Bridges of Madison County*, *Heat*, *Eraser*, *A Time to Kill*, and *Space Jam* this spring, to be followed by films currently in the theaters—*Mars Attacks*, *Michael*,

*Michael Collins* and *Sleepers*—available at the same time they are released on VHS. The six titles announced by New Line are *Dumb and Dumber*, *Mortal Kombat*, *The Player*, *The Mask*, *Rumble in the Bronx*, and *Seven*. Polygram (Philips) announced that it will be releasing several titles this spring, but did not name names.

Prices for DVD discs are expected to be affordable—although no one was willing to reveal specific numbers. The general consensus was that DVD films would be priced—for sale and for rent—somewhere between the prices of VHS tapes and laserdiscs.

## FORMAT FORTUNE-TELLING

With everything in place for a spring launch of this new video format, what does the future hold for DVD? It depends on who you ask.

Warner hired the research firm Vantis International to gauge DVD’s potential. Vantis, which compared the launch to that of DSS, predicted that as many as three-million DVD players could sell in the U.S. in the first twelve months, and as many as 12 million by the end of the third year. Those numbers assume, of course, that the studios get behind the format wholeheartedly. According to the combined results of five Vantis surveys, in which more than 4000 consumer whose demographics categorized them as early adopters were interviewed, “consumer purchase interest” in DVD “is 2½ times greater than that of DSS” back in 1994, when DSS was at a comparable same stage of development. Thomson sold a million DSS receivers in the first year.

Toshiba, one of the more optimistic DVD manufacturers, predicts that first year U.S. sales will be between 650,000 and one million units. Sony, on the other hand, is more conservative, predicting first year U.S. sales of DVD players of a modest 500,000 units. The company does not expect DVD to be an overnight sensation; at its WCES press conference, Sony executives kept tossing around the word “evolution.” Sony hopes to duplicate its highly successful launch 13 years ago of the CD format, which, remember, caught on like wildfire—three or four years after its initial release.

InfoTech, a Woodstock, Vermont-based electronic-media market-research firm, projects worldwide sales of 820,000 DVD players in the first year, but believes that the quick acceptance of DVD-ROM by computer users will drive down costs of shared components. That will likely result in a \$250 mass-market price point by the year 2000, “stimulating a tenfold increase in demand and culminating in a worldwide installed base of over 80 million units by 2005.”

Addressing the problem of limited software ability at introduction, Julie Schwerin of InfoTech noted, “What tends to be forgotten is that the most successful consumer

electronics product of the 1980's, CD-Audio, was launched with a handful of titles, while VHS had none. Our analysis shows that it is far more critical that a large catalog of titles be in place when hardware prices fall from the high end to the mid-market."

The InfoTech study also foresaw a peaceful coexistence between VHS and DVD—likening the relationship to that of analog cassettes and CD. Instead, the report found that DVD's biggest competition "will come from digital transmission formats such as pay-per-view movies available from Digital Satellite System services." Fortunately, the market is robust enough to support both digital formats. In fact, when recordable DVD players become available, they might be used to record such digital satellite transmissions. Due to complex technical, cost, and copy-protection issues, however, mass-market DVD recorders are not expected for several years to come.

### COMMITTED TO CONVERGENCE

The next biggest story at the Winter Consumer Electronics Show was convergence. Last year's highly touted merger of the television and the PC was translated by at least a dozen of TV manufacturers to mean the merger of the channel surfer and the 'Net surfer. Several phone manufacturers and videogame companies also joined the fray.

It seemed as if *everybody* was showing some sort of TV-based Web-browser. And most of the manufacturers were spouting the same marketing strategy: They plan to target non-PC households, and to get viewers to consider the Internet simply another stop on the television "dial." To that end, both format and content will be designed to look and feel like traditional video.

The first to market were Sony and Philips, both of which began shipping their WebTV set-top boxes last fall. Sony wouldn't reveal any sales figures, except to note that they had "met or exceeded all of our sales targets" for the first three months.

The Magnavox-brand WebTV, a.k.a. Internet TV Terminal, actually has been selling at its suggested list price—certainly not normal practice in consumer electronics.

At the show, Thomson announced plans to introduce this spring a set-top Internet-access box costing about \$300. It will be the first in a family of interactive products that would allow people to surf the Web, send and receive e-mail, shop or bank at home, and participate in other interactive activities. The device was developed with Oracle subsidiary Network Computer, Inc. (NCI); NetChannel, Inc. will be the exclusive Internet service provider (ISP) in the RCA-brand devices. Several concept products were unveiled at WCES, including an under-counter kitchen device and a small-screen device for use in kids' bedrooms or home offices for low-cost word processing, information retrieval, and communications.

The prototype displayed at the Sharp



Sony's "reference-standard" DVD-player will cost \$1000 when it debuts this spring.



DVD packaging prototypes from Columbia TriStar Home Video.

booth—for which no concrete pricing or marketing plans were offered—was a wide-screen, Internet-ready TV, NTSC/VGA monitor/receiver that allowed side-by-side viewing of video and Web pages. We liked the concept for two reasons. First, you could use the 90% of your brain that's not required for television viewing to surf the 'Net simultaneously, and be entertained while waiting for pages to download. Second, in Web-only mode, you could get PC quality on your TV—no eyestrain when reading on-screen text.

(By the way, a *real* product available from Sharp doesn't provide Internet access, but does allow a computer image to be projected onto a large screen using a SharpVision video projector. The \$649 AN-SC1000 is an add-on RGB-to-NTSC converter that does not require a software driver, making it easy to connect your PC to your home-theater system.)

Zenith has promised that its NetVision line will be the first TVs with integrated Web browsers to hit the market—even though the introduction was delayed into the first half of 1997, due to "changing market dynamics" and the need to "incorporate the latest technology." The company plans to add some computer functions that will enhance the sets' entertainment value. Under the Zenith label, the first NetVision set will be a 27-inch table model with a retail price of about \$1100. Zenith will also launch 27- and 35-inch models under its new Inteq brand.

Products from several manufacturers, including Mitsubishi's DiamondWeb™ TV, a set-top device from Boca Research, and Sega's Net Link, will use View-Call America's On-TV™ service. On-TV provides e-mail, information tailored to viewer needs, and general Web access. The service offers content from USA Today, Yahoo!, InfoSpace, Reuters, TV Data, Sports Ticker, Interactive Imaginations, and American Express Travel, among others. ViewCall America also announced a partnership with Hitachi Home Electronics, and is working with several manufacturers to create open TV-HTML™ standards intended "to enhance a consumer's Internet experience" with "TV-based Web extensions, which will combine the power of multimedia Internet content with live television signals."

Sega was the first to market a game-based Internet-access device. Last November, the company began selling Net Link, which plugs into the Sega Saturn game console and lets game-players access the Web via their TVs. The game console and Net Link add-on cost less than \$400—and you get to play games, too. Sega marketing plans focus, understandably, on multi-player online gaming. The device will also offer e-mail and localized information on TV programming, news, weather, sports, and entertainment.



David Spomer, Thomson vice president of DBS and DVD product management, demonstrates the RCA-brand DVD player at WCES.

## DVD BASICS

A DVD disc might look like a standard compact disc, but there's a world of difference. A CD has a maximum capacity of 650 megabytes (MB). The most basic DVD has a capacity about seven times as much—4.7 gigabytes (GB).

That higher capacity was achieved mainly by reducing the size of the pits on the disc's reflective layer that represent the digital information. On a standard CD, the smallest pit has a length of 0.83 micrometers or microns. A DVD, by contrast, has a minimum pit length of 0.4 microns. The distance between each track was similarly reduced by about a half, from 1.6 to 0.74 microns. The DVD laser, which reads the information encoded in the pits, has a shorter wavelength, which enables it to resolve the smaller features.

Until recently, even DVD's enormous capacity wouldn't have been able to deliver more than about four minutes of full-motion, full-screen video with sound. The magic of MPEG-2 video compression is what makes the capacity of DVD stand up to the task.

MPEG-2 is a standard for video compression or bit-rate reduction developed by the Moving Pictures Experts Group of the International Standards Organization. It works basically by eliminating repetition or redundancy in video. Instead of repeating information in future frames, only descriptions of changes are described by the data. This works because there is more redundancy in video than you might think—a typical movie scene really changes very little from one frame to the next.

MPEG-2 Intra, or I-picture, frames contain all the information to describe the frame. Predictive, or P-picture, frames describe changes relative to the last I-picture. DVD's copy-protection scheme encrypts only the Intra frames to reduce the number-crunching that's required.

On a CD, all audio is encoded the same. Ten seconds of silence requires as much space as ten seconds of the

"1812 Overture." The average rate at which data is read from a DVD disc is about 3.5 megabits per second (Mbps). However, rates as low as 1 Mbps and higher than 10 Mbps are supported.

Other factors that affect the data rate—and therefore the time capacity of the disc—are the length of the movie and the number of audio and subtitle channels required. Each audio channel requires 384 kilobits per second (Kbps), and each subtitle language requires 10 Kbps.

The basic DVD specification assumes that a typical disc will have three separate audio channels, four subtitle channels, and video encoded at an average rate of 3.5 Mbps. The resulting capacity would then be 133 minutes. A disc manufacturer could, however, play around with the disc's contents and, for example, reduce the number of languages to one audio channel plus one subtitle channel, and increase the capacity to 160 minutes.

But what about *Gone with the Wind*, which would exceed even that? Disc producers hate the idea of distributing films on two discs. An ingenious solution was developed to almost double the capacity of a single-sided disc to 8.5 gigabytes. The information is stored on two layers. The topmost layer is semi-transparent, allowing the laser to focus on either the top or bottom layer to read the information encoded there. The shift from one layer to the next should appear seamless to the viewer, because players will contain buffer memories so that they can output a continuous stream of data even as the laser re-focuses to the next layer.

With so much capacity on a single-sided disc, you'll never have to get up and flip over a disc in the middle of a scene the way you must with today's laserdiscs. However, the DVD format does allow for double-sided discs, including double-sided, dual-layer discs with a capacity of 17 GB—enough for more than eight hours of video. ■

Thomson is not the only manufacturer that will be using Oracle's Network Computer open-architecture system, which—unlike proprietary systems such as that used in WebTV—allows the manufacturers to select their own Internet service providers (ISP). Akai, Curtis Mathes, Funai, Proton, Uniden, and Zenith also announced partnerships with NCI.

## ROOFTOP MODEM

As far as Hughes Network Systems is concerned, the sky's the limit when it

comes to convergence. At WCES '97, the company announced plans to merge two of their very successful products: DSS and DirecPC. A pioneer in satellites, Hughes is a supplier of DSS systems, with their 18-inch dishes, as well as the 21-inch elliptical dishes and ISA cards required for the DirecPC Turbo Internet service. DirecPC allows customers to download information from the 'Net at speeds of up to 400 kilobits per second (Kbps)—more than three times faster than ISDN and 14 times as fast as standard 28.8 modems. The hardware costs

\$499 (instant \$100 cash rebates are currently being offered), and various subscription plans are available.

Hughes' new product is the Convergence Antenna for all-in-one satellite delivery of the more than 200 channels of digital TV from DirecTV and USSB, as well as DirecPC Turbo Internet service. The Convergence Antenna is identical to the 21-inch elliptical DirecPC dish—the difference lies in its much larger "tri-mode" LNB. The LNB actually picks up signals from two different satellites. Up to three cables run from the LNB into the home. One runs to the ISA-card-equipped PC for DirecPC. The other two are for DSS receivers.

When you buy the Convergence Antenna, which will be available in April, you have a few options. Traditional consumers



Thomson's RCA/NC Internet-access device connects to the family TV to provide e-mail, on-line banking and shopping, and other interactive functions.



Sharp has yet to announce marketing plans for its Internet-ready widescreen NTSC/VGA receiver/monitor, whose prototype is shown here.



Several manufacturers will use View Call's On-TV service to bring the Internet to the family television.

might want to buy the dish and a DSS receiver, then decide to buy the DirecPC adapter card later. Techies might do just the opposite. Or you can buy the whole kit-and-kaboodle. Prices won't be announced until closer to the launch date.

#### CALLING ALL WEB SITES

Can't stand the idea of seeing your TV screen monopolized by Web pages? Don't want to spring for a PC? Don't worry, you can still get on the Internet—just dial it up on the telephone. Several companies—including Cidco, IntelliData, Nortel, Philips Home Services, and Uniden—displayed “smart phones” at the Winter Consumer Electronics Show. Built-in software from various Internet Service Providers allow Web access via integrated screens and keyboards. Most, however, provide text only.

Philips Home Services demonstrated its P200, which features a 32-bit RISC CPU, a 16-line by 40-character backlit LCD, a QWERTY keyboard, a built-in Smart Card reader, 1MB of flash memory, and 2 MB of RAM (up to 64 MB of memory can be added with plug-in Miniature Cards). A high-speed auxiliary connector allows a printer, scanner, or digital camera to be attached. The phone provides access to Internet services including Philips Multimedia Center's Planet Search web search engine, adaptations of InfoSpace's popular Internet directories. Users can send and receive e-mail to and from other screen phones, PCs, WebTV terminals, and pagers; access on-line banking, news headlines, and weather reports; and control home automation devices. It supports all type-3 ADSI (Analog Display Services Interface) services, including Call Waiting with Caller ID, and is expected to retail later this year



The Convergence Antenna from Hughes Network can receive signals from two satellites simultaneously, allowing users to pick up DSS TV programming and DirecPC Turbo Internet access from a single dish.



Uniden's Axis offers cordless, computer-less connection to the Internet.

for about \$350.

The Intelifone from IntelliData is another ADSI-based entry. It offers most advanced telephone features, organizer functions that can be integrated with Caller ID call logs, and Web-based e-mail and information services (weather, stock quotes, sports scores, etc.). It is currently shipping with a suggested retail price of \$299.

Uniden is offering two models of the



The iPhone from Cidco can display complete Web pages—text and graphics—on its LCD readout.

Axis. For \$399, you can buy a 900-MHz cordless phone coupled with an Internet access device; the corded version costs \$299. While they are compatible with virtually all Internet and on-line service providers, both models are preconfigured with CompuServe Network Services, which charges \$4.95 for e-mail services.

Cidco's iPhone provides full Internet access—graphics as well as text. The high-end speaker phone offers e-mail, graphical access to the Web, and advanced telephony features for less than \$500. A 7.4-inch touch screen, embedded on the face of the iPhone, allows users to access Internet services by touching the softkeys. A QWERTY keyboard slides out from under the console for typing in e-mail and commands. The iPhone's full VGA screen lets a complete Web page be viewed without scrolling. With its 16-bit gray-scale display and software preprocessing of some data, the 14.4 modem functions at speeds comparable to a 28.8 modem. A serial port for a printer is included. The iPhone is expected to be available at mid-year.

#### THAT'S NOT ALL, FOLKS!

Convergence products and DVD might have dominated the show, but there was plenty more to see and hear on the floor of the Las Vegas Convention Center. Audio, video, home theater, and personal electronics were all represented in full force. For a glimpse of some of the products shown at WCES that won Innovations 97 awards—and a few more worthy of a mention—keep an eye on these pages. ■

#### FORCE FX JOYSTICK

(Continued from page 26)

ing power. The command includes a parameter that describes the repeat rate, which causes a rapid series of jolts when the button is held down. It allows easy implementation of automatic-weapon fire sensations. Other parameters include the button assignment, direction, magnitude, and duration.

The vibration command establishes a vibration of a given frequency and magni-

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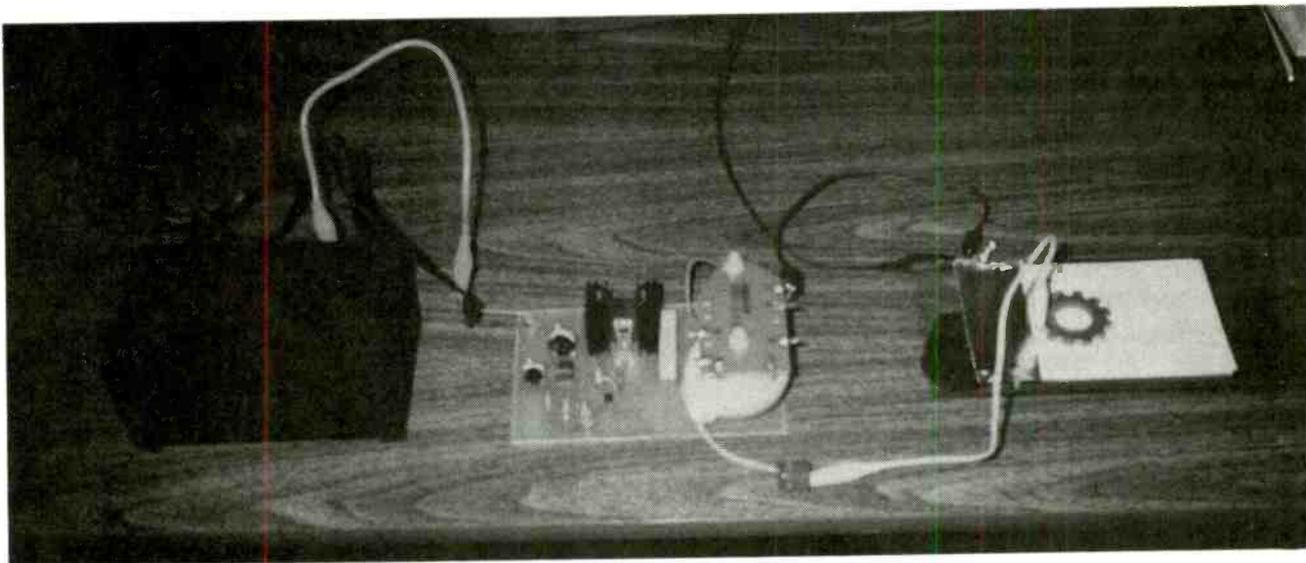
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# POOR MAN'S KIRLIAN PHOTOGRAPHY

*Take electrophotographs the inexpensive way with this radical new method that requires no film developing.*

By NICK CINQUINO

**M**any electronics experimenters dabble in the field of high-voltage circuit design. Also, many hobbyists understand the basic idea behind Kirlian photography or electrophotography, as it's often called. However, few actually get around to producing their own electrophotographs.

Why is that? Well, producing standard electrophotographs can be a pretty complicated task. It's also expensive. That's why this month we're bringing you a simple and affordable alternative: build the *Poor Man's Kirlian Photography* unit described in this article.

But before we get to why the Poor Man's project is such a great introduction to electrophotography, let's take a closer look at just what Kirlian photography really is.

## Basics of Electrophotography.

Standard Kirlian photography uses high voltage to cause an object to emit a corona discharge. The discharge pattern and colors are photographed using ordinary photographic film. A wide variety of sub-

jects are possible, such as gears, keys, coins, leaves, twigs, heatsinks, and anything else of reasonable

size that will sit still during the exposure. The discharge and photographic exposure are greatest near

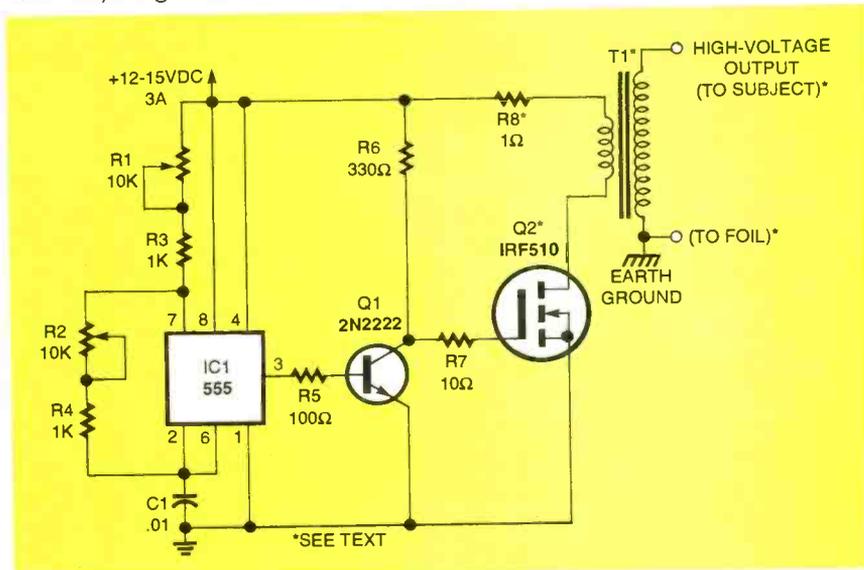


Fig. 1. This simple high-voltage supply will provide the "juice" for your electrophotographs.

an object's sharp points or edges.

Semyon and Valentina Kirlian are generally considered the originators of electrophotography, and most likely they were the first to use film or photographic emulsions for the process in the late '30s. Some of their findings were and still are controversial; for example, they claimed that electrophotographs of living things could indicate disease, or impending disease. They also apparently originated the "phantom leaf" claim, in which an electrophotograph of a trimmed leaf appears whole.

But if you research back to the late 1700's, you'll find that Georg Christoph Lichtenberg produced related images by the scattering of dust around a charged object. His basic techniques are still used, in fact. "Lichtenberg figures" aid in the study of corona loss from high-voltage wires. Other types of electrophotography have been used to check factors such as weld quality.

**Drawbacks and a Simpler Way.** In a typical electrophotography setup, you need to either severely modify a normal camera, or obtain sheets of unexposed film. Both choices offer big headaches. For example, if you elect to modify a regular camera, the camera is no longer usable for anything other than electrophotography. Also, your subject is severely limited in size to the film itself, such as 35mm or 11mm. If you choose sheet film, size is no longer a major limiting factor, but now you'll need to develop the exposed film yourself. So the project is doubly compounded by darkroom necessities like chemicals, trays, timers, plumbing, and of course the darkroom itself. And if those problems weren't enough, the photos require exact exposure times.

Now it's not that the author's a terribly lazy person or anything, but like many hobbyists he's constantly on the lookout for shortcuts to make life easier. In this case, the thought of demolishing a camera to electrophotograph tiny objects, and filling a basement with scary-sounding darkroom chemicals was-

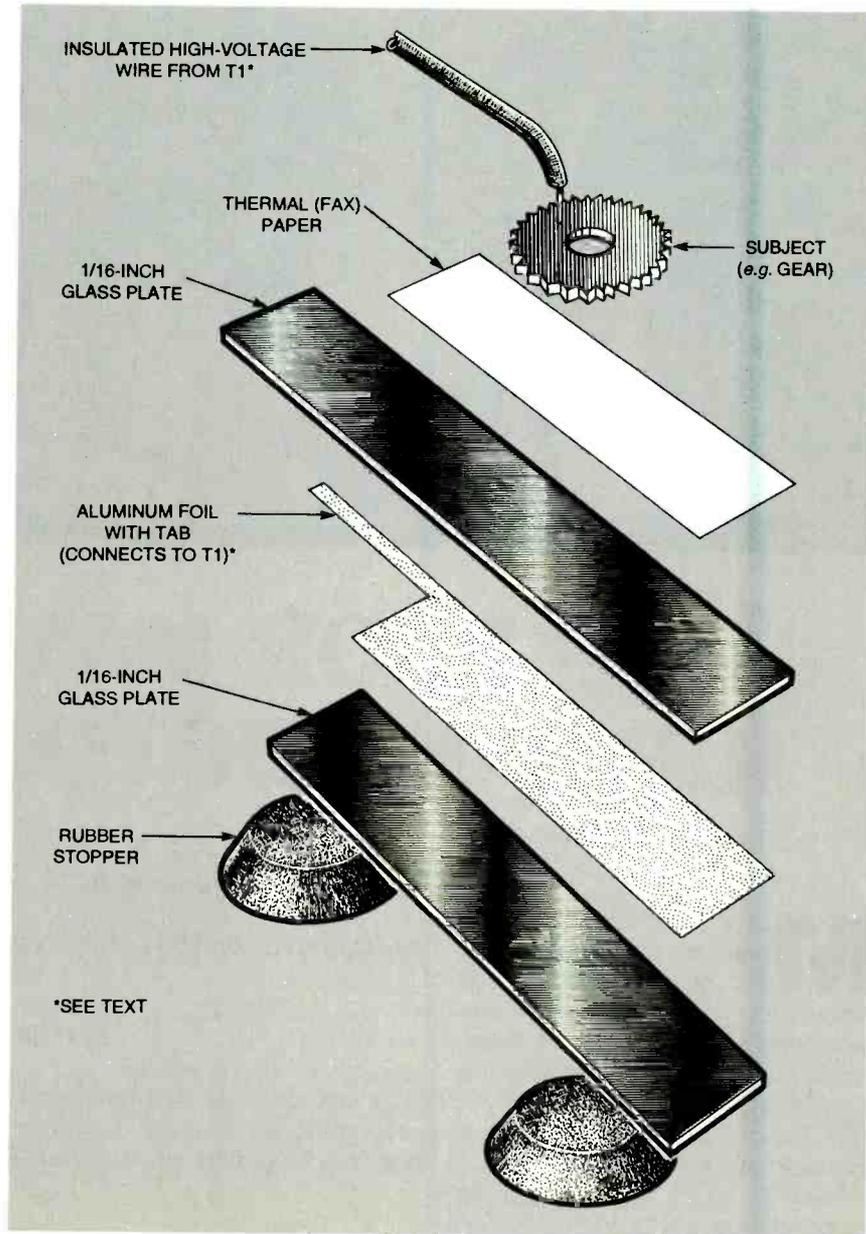


Fig. 2. As you can see, the physical stage required for electrophotographs is easy to assemble.

n't very appealing.

Because Mr. Lichtenberg's method proved that a form of electrophotography can be done without necessarily using film, the author decided to find a modern way to use his ideas. After rejecting a few absurd ideas, he came up with thermal paper as a possible medium; that's the type of paper used in older fax machines. Sure enough, thermal paper, it turns out, is a great way to make simple electrophotographs.

Thermal paper is dirt cheap, readily accessible from the nearest

fax machine, and can be used in ordinary room light to make an exposure. You can watch the paper and the developing image to get exactly the exposure you want. And while you'd expect the image to be monochromatic, a close inspection of the image reveals faint color/gray scale variations, for reasons unknown.

How does the corona form an image on thermal paper? We're not exactly sure! Is it strictly a thermal effect, or is UV light and/or ozone also involved? Try it yourself and find out.

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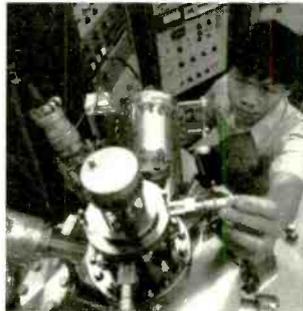
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**Circuit Description.** Many varieties of high-voltage/high-frequency power supplies have been presented in this magazine over the years. If you happen to have a spark-gap or tube-type Tesla coil, you need look no further for a power supply for this project. If not, you will need a simple solid-state flyback or trigger-coil high-voltage power supply. The schematic of the one used in the author's prototype is shown in Fig. 1. The circuit delivers about 10 kV at 50 kHz.

Power for the circuit is provided by a 12- to 15-volt DC supply capable of delivering 3 amperes. A 555 timer, IC1, generates a frequency-adjustable squarewave, which is buffered by Q1, a general-purpose NPN transistor.

The squarewave switches Q2, an IRF510 MOSFET, on and off, thereby allowing high-current pulses through the primary of T1, an ordinary TV flyback transformer (more on T1 later). The flyback's secondary output rings or resonates at a high voltage in response to the primary input, and

output is directly applied to the electrophotography subject.

**Construction.** Before you can build the Kirlian Photography unit, you will need to select and prepare a flyback transformer for use in the circuit. Make sure the flyback has no rectifier diode. Flybacks of this type are available from old TV sets and TV repair shops. Once you have a transformer, remove any preexisting primary (which is a turn or two opposite the "ball of wax") and wind ten turns of 14-gauge wire at the same area.

Wire the circuit on a piece of perforated board, beginning with a socket for IC1. Go on to connect the potentiometers, resistors, capacitor, and transformer. Then solder Q1 and Q2 to the circuit, making sure both are wired correctly. Insert the IC into its socket, making sure it is oriented properly.

Before continuing to assemble the electrophotograph stage (more on that in a moment), connect power to the circuit. Adjust

## PARTS LIST FOR POOR MAN'S KIRLIAN PHOTOGRAPHY

### SEMICONDUCTORS

IC1—555 timer, integrated circuit  
Q1—2N2222 NPN general-purpose transistor  
Q2—IRF510 MOSFET

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)  
R1, R2—10,000-ohm potentiometer  
R3, R4—1000-ohm  
R5—100-ohm  
R6—330-ohm  
R7—10-ohm  
R8—1-ohm

### ADDITIONAL PARTS AND MATERIALS

C1—0.01- $\mu$ F, ceramic-disc capacitor  
T1—Flyback transformer (see text)  
Perforated board, rubber stoppers (2), 1/16-inch glass plates (2), aluminum foil, thermal paper, metal subject (gear, etc.), insulated wire, solder, hardware, etc.

potentiometers R1 and R2 until you hear a high-pitched whistle. Now, check carefully for a spark output by bringing a grounded wire to within an 1/8 inch or so of the high-voltage output wire. Once an arc starts, you should be able to draw it out to about a 1/2 inch.

You're now ready to build the setup for exposing the thermal paper. This assembly, shown in Fig. 2, is nearly identical to that used for photographic sheets. The first step is to make an insulating base from rubber stoppers (you could get away with ceramic blocks or glass as well). On top of these, place a small glass plate measuring 1/16 by 4 by 7 inches. On this, place a slightly smaller piece of aluminum foil with a tab sticking out for the connection shown in Fig. 1. On this, place another plate of 1/16-inch glass.

The next layer of the setup is the thermal paper itself, followed by the subject, which in the diagram is shown to be a small gear. Finally, attach the subject to the high-voltage wire from T1 (as shown in Fig. 1).

### Making an Electrophotograph.

Connect a subject to the setup just described. Make sure the area

*continued on page 63*

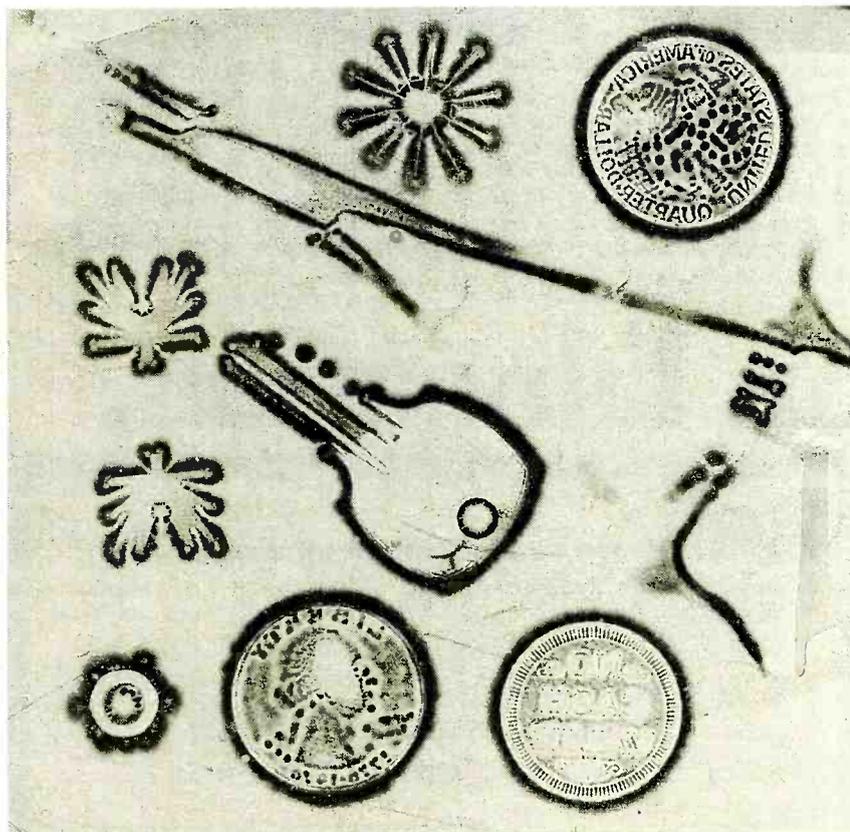
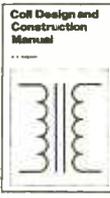


Fig. 3. Here are some sample, multi-exposure electrophotographs. Can you recognize all the objects?

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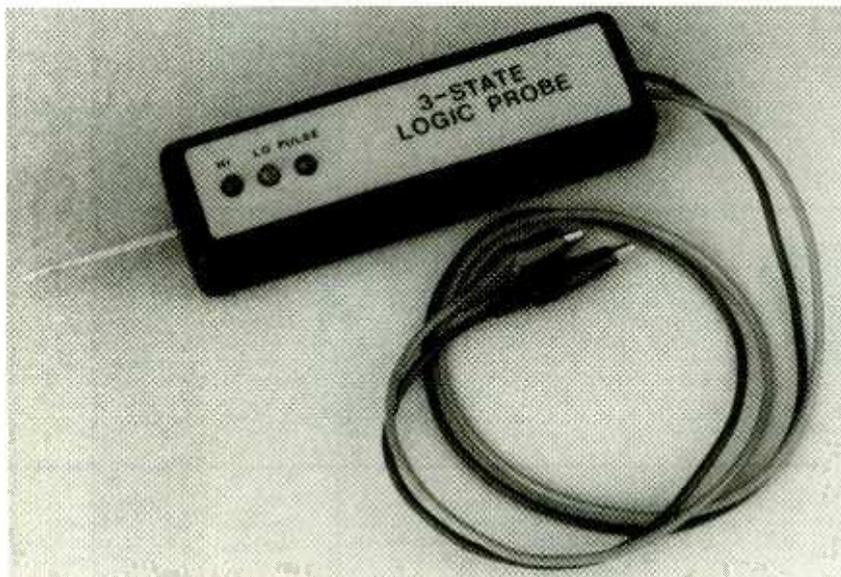
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# Build A Logic Probe

*Here's a useful device that every hobbyist needs on their workbench.*



If you enjoy experimenting with digital electronics, or work with such circuits professionally, you are probably well aware of the value of logic probes. These test instruments come in a variety of shapes, sizes, and price ranges, and can be as simple as a single transistor, configured as a switch, to systems employing several integrated circuits.

Widely regarded as the consummate digital diagnostic tool, a logic probe is a device that's prudent to keep on the work bench. Now, while commercial models are by no means prohibitive in cost, we find there's always satisfaction in building your own.

So, if you're ready to tackle the task, the *Logic Probe* described in this article is for you; the unit features a two-IC design that will indicate high, low, and pulse signals. It only takes about two hours to build the probe, and once you have it in hand, you'll no doubt be pleased you made the effort.

**Circuit Description.** The schematic diagram for the Logic Probe is shown in Fig. 1. A test signal is introduced to the input of one of six inverters in a

BY CARL J. BERGQUIST

74LS04 chip (IC1). This inverter, IC1-a, inverts the signal, and sends it to three additional sections: the inputs of IC1-b and IC1-c, and the enable input, pins 3 and 4, of IC2.

The output of IC1-b goes to the cathode of LED1, the "low" indicator; the anode of LED1 is tied to the +5-volt supply. Meanwhile, the output of IC1-c is sent to the input of IC1-d, and IC1-d's output is connected to the cathode of LED2, which indicates a "high" signal. There, the anode of LED2 is pulled high, through a dropping resistor (R2).

The final stage of the Probe employs a 74121 monostable multivibrator, IC2, which is used to detect a pulsing input. In this application the input signal acts as a trigger, while the negative output, pin 1, is tied to the cathode of LED3. Note that LED3's anode is also connected to the positive voltage supply.

In each stage, the output has to be low for the respective LED to light, so, let's take a look at how this is achieved. When a low signal is introduced to the probe, IC1-a inverts this to a high, and IC1-b

inverts it back to a low. Applying this low to the cathode of LED1, lights the diode.

In the case of a high signal, IC1-a inverts it to a low, IC1-c changes the signal to a high, and IC1-d inverts it back to the needed low. This in turn illuminates LED2.

When the input is a pulse, multivibrator IC2 detects this, and activates its outputs for a time constant set up by C1 and R4. The negative or "not Q" output, pin 1, then lights LED3. The indicated values of C1 and R4 are chosen to keep the time constant short, which results in a rapid set/re-set action. With some help from persistence of vision, LED3 appears to be "on" continuously.

So, as can be seen, this is really a very simple system. Simple, yet effective in determining the status of digital signals.

**Construction.** The author's prototype for the Logic Probe was built on a printed-circuit board, though most any form of assembly can be used. If you'd like to build the circuit on a PC board, a full-size template of the board is available in Fig. 2.

For those building the circuit on a PC board, a parts-placement

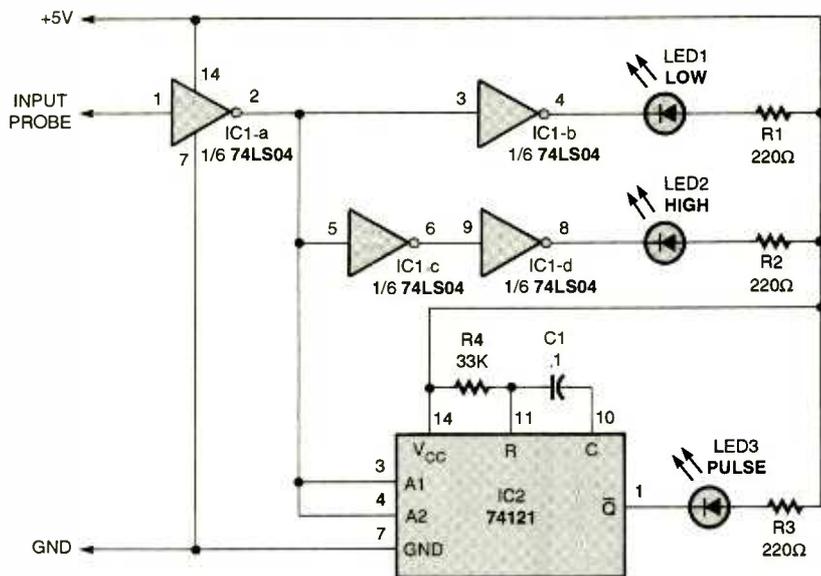


Fig. 1. As the schematic for the Logic Probe shows, this two-IC design provides an extremely low parts count.

diagram is shown in Fig. 3. If you don't use a PC board, be sure to ground the inputs of the unused inverters (pins 11 and 13). This is done to reduce power consumption and prevent the circuit from picking up extraneous noise.

The use of IC sockets, for IC1 and IC2, is not essential, but highly recommended; these should go on the board first. Then install the resistors and jumpers.

Solder the LEDs to the board next, making sure they are oriented properly. Mount the base of each

LED  $7/16$ -inch off the board. This will make it possible to use the enclosure mentioned in the Parts List. In this design, the LEDs are three different colors, with red indicating "high," green representing "low," and orange signifying "pulse."

Next, connect 24-inch lengths of red and black probe wire to the +5V and GND PC-board pads, respectively. Solder small alligator clips to the opposite ends *after* the leads are run through the proper holes in the case. As with most logic probes, this unit is powered by the circuit under test, and these leads will provide the positive and ground/negative connections.

Finally, connect a short section of wire from the input pad to the probe tip. The tip can be fashioned from a variety of materials, but the prototype uses a  $1\frac{1}{2}$ -inch "common" iron nail. Once the electrical connection is made, you'll have to secure the nail with epoxy to whatever case you'll use.

As for the case, it can be whatever is on hand. The author's prototype uses the housing from a surplus remote control (see the Parts List), and the foil pattern is customized for this case. However, a variety of different enclosures can be used, with little, or no, modification to the board.

Once the case has been selected, simply, drill holes for the LEDs, power leads, and probe tip. Label the high, low, and pulse diodes, with dry-transfer lettering. Mount the circuitry and remember to connect those alligator clips. You're now ready to proceed to the testing phase.

**Checkout and Use.** Before installing the integrated circuits, connect the red and black alligator clips to +5 volts and ground. Check

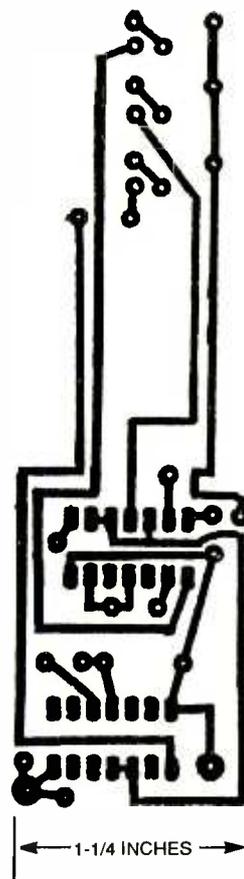


Fig. 2. Here's a full-size template for the Probe's PC board.

pin 14 of the sockets for both IC1 and IC2; make sure they have the proper voltage. If all is well, disconnect the power, install the ICs (observing proper orientation), and close up the case. The unit is ready for use.

To use the Probe, merely determine the +5-volt source and ground of the circuit to be tested, and attach the alligator clips. Now,

when you touch the tip to any point within the circuit, the LEDs will indicate the logical status of that point.

At power up, the high LED (LED2) will light; this is normal. If you place the probe tip on a test point, and there is no change in the LEDs, you have a high signal. When there is a low present, the low indicator (LED1) will illuminate, and LED2 will extinguish.

For pulsed inputs, a slow pulse, say one or two hertz, will result in the high LED staying on constantly, while the low and pulse LEDs flash in sequence with the signal swinging from positive to negative, and back. With fast pulses, the high will, again, remain on, and there will be a slight glow to the low LED, and a bright glow to the pulse indicator. A point to remember is that the pulse LED will not react unless a pulsing

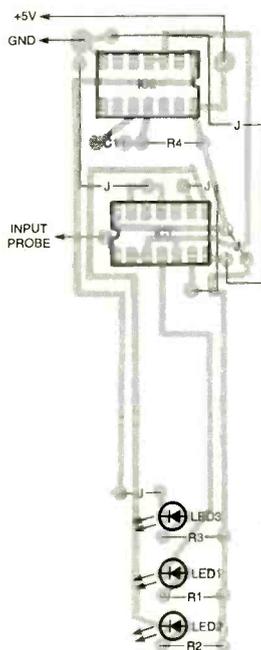


Fig. 3. If you're building the Probe on a PC board, use this parts-placement diagram as a guide.

signal is encountered.

If you have never used a logic probe, you'll be amazed at how handy this little test instrument can be. If you have used one, then you'll appreciate how well our Logic Probe performs. Building this project is well worth the time, materials, and effort required, as the Probe can quickly diagnose many seemingly difficult problems. With a little practice, you'll be able to analyze the operation of any digital device; a process extremely helpful in pinpointing trouble.

Additionally, the design easily lends itself to modification. For example, instead of standard LEDs, you can hardwire small, seven-segment displays to read "H," "L," and "P," or you could add audio annunciation. But even "as is," we're sure you'll be using your Logic Probe quite often. ■

## FORCE FX JOYSTICK

(Continued from page 26)

tude on one or both axes. A game developer would use the vibration command for simulating the feel of driving over rough terrain or the hum of an airplane engine. The command's parameters are magnitude, direction, and frequency.

The buffeting command is similar to the vibration command, but varies the direction and magnitude simultaneously. The sensation is similar to what you expect when flying a plane through turbulence.

The vector force command outputs a force of a given magnitude on a given axis. Its parameters are magnitude and direction. It's a basic command, but it can create a wide variety of force sensations such as g-forces when a plane makes a tight turn, strong cross-winds while flying, or driving into a wall at an angle.

More than one force effect can be active simultaneously, so for example, if you were to get blasted from the left and behind simultaneously, you would be able to feel both effects. By varying the magnitude of the effects, and by combining them in different ways, game developers can create a virtually unlimited variety of effects.

I-Force allows force effects to be generated with little burden on the game or

other host application because the joystick contains an on-board microcontroller. It receives only high-level commands from the host PC, and then produces all force-feedback effects independently. For example, the host computer might request the high-level command Vibration and specify the magnitude, frequency, and duration.

Immersion's I-Force force reflex is an automatic reaction that occurs on the joystick and does not require any supervision by the host. Those reflexes can be configured by the host to allow for custom force effects, but once set up, the host hands all responsibility for those force reflexes over to the on-board microprocessor for extended periods of time. The end result is that game play is just as fast as with a standard joystick.

With I-Force, many reflexes can be pre-programmed on the joystick, and they will remain active during game play. Reflexes can be modified or disabled at any time to allow the joystick to react appropriately as game conditions change.

Another powerful feature of the I-force architecture is the ability to download "Force Feedback Profiles" to the stick. The profiles allow custom force effects to be created by both game developers and game players. A utility supplied with the joystick setup software provides a way to experi-

ment with different effects. A developer who has designed a game with some new super weapon can make it have a signature feel when it is fired—say, a subtle vibration followed by a substantial kick to the left. The custom force profile can be downloaded to the joystick, and called with a simple instruction.

Installing the joystick is a rather simple affair. Its basic requirements are a PC with a 386 or better processor, a gameport, and—because two-way communication is essential—an available serial port. Because the joystick has two internal motors that create the feedback forces, it requires connection to a power supply as well.

The stick features two 4-way switches, five fire buttons, a trigger, and trim controls. It's completely backward-compatible with all the games for which you currently use a joystick. Even better, it allows you to add some effects to your existing non-feedback games. A LOADFX utility supplied with the joystick allows game players to get limited effects by programming the stick directly with custom effects.

When done right, force feedback makes game play compelling even for people who usually don't like playing games. Unlike other joysticks that have crossed our desks, this one is staying connected—we have no plans to unplug it anytime soon. ■



# LAND WARRIOR

*Learn how technology is helping ensure our foot soldiers will come home safely.*

BY BILL SIURU

It is the year 2003. Sergeant Comfort is on a peacekeeping patrol in a Middle Eastern country. Moving through hostile territory in near total darkness he can spot possible trouble through the Monocular Night Vision Sensor mounted on his helmet. Glancing in another direction he views another helmet-mounted display showing infrared images from the Thermal Weapon Sight (TWS), or pictures from the video camera mounted on his M4/M16 rifle. Clicking another control, he calls up a detailed digitized map on the display from the computer worn on his back. His precise position is pinpointed on the map by a Global Positioning System (GPS).

While patrolling he receives a call from another squad member,

Corporal Best, over his Squad Radio. Best has spotted the location of a sniper who has fired a few shots at him. Not wanting to expose himself to fire at the sniper, Best "passes off" the target location determined by Best's weapon-mounted Laser Rangefinder/Digital Compass to Sergeant Comfort. Comfort locates the target on his display and fires a couple of rounds at the designated target. Even though he never sees the sniper, Comfort silences him.

In our little futuristic scenario, Comfort and his platoon are operating in dangerous territory. But soldiers like them will probably be confident that they will return safely from patrol. That is because these soldiers of the future will be equipped with the Land Warrior

System that will be issued to U.S. soldiers around the year 2000. The Land Warrior System is currently being developed for the U.S. Army Soldier Command in Natick, MA by lead contractor Hughes plus Motorola, Honeywell, Battelle, Gentrex, Arthur D. Little, and several other subcontractors.

**An Integrated Approach.** While soldiers have used thermal sensors, laser rangefinders, computers, night-vision equipment, and other advanced technologies for years, such devices were usually issued on a piecemeal basis. These anything-but-seamless bundles of technology added immensely to the soldier's workload (especially under the stress of combat), not to mention that they greatly increased the physical load he had to carry. All that is about to change.

The Land Warrior System is the first totally integrated, high-tech "fighting system" for the foot soldier.



*This soldier is equipped with the Land Warrior System. A computer, radios, GPS receiver, antennas, and batteries are carried in a compact backpack.*

It integrates the latest in communications, sensor, computer, and materials technologies, as well as, wherever possible, off-the-shelf and commercial hardware to keep costs down.

**The Framework.** Physical damage is a main concern for a foot soldier. For this reason the Land Warrior System will feature a Protective Clothing and Individual Equipment Subsystem (PCIE) featuring modular body armor plus clothing, gloves, boots, and other similar items for protection against head-to-toe chemical and biological warfare. The PCIE is the platform that integrates all the pieces of the Land Warrior System.

A main component is the Load Carrying Equipment (LCE), which features a flexible frame allowing it to fit and function like part of the body. The unique design means one frame size fits all soldiers from the 5th to 95th percentile body size. The LCE's design allows redistribution of the load between the shoulder and waist to improve comfort even while the soldier is on the move. This frame serves as the support structure for the back-mounted Computer/Radio Subsystem.

Another great feature of the LCE

is that various packs can be quickly attached to it for different missions; a soldier can therefore plan ahead for varying degrees of assault. Soldiers can even rapidly shed bulky components in an emergency. The frame and LCE also houses and protects the integrated wiring harness that ties together all the electronic hardware.

**Heads Up.** As hinted in the scenario at the beginning of this article, another key component of the Land Warrior System is the Integrated Helmet Assembly Subsystem (IHAS). Beside providing head protection, the open face helmet supports detectors, sensors, and displays. A microphone is integrated into the chinstrap and speakers are built into the helmet suspension system.

The helmet's design truly makes a soldier's time in the field easier. For starters, the helmet is made of lightweight materials to keep its weight down. Designers decided to go a step further, though, and added the unique suspension to provide a stable platform for the optical devices attached to it.

These optical devices include a Monocular Night Vision Sensor for 60 degrees field-of-view under nighttime conditions. The helmet's flat panel display presents images from the video camera and Thermal Weapon Sight mounted on the soldier's weapon; there are also four laser detectors located on the helmet that provide the back-mounted computer with a 360-degree "field-of-view." All these devices can be used even when NBC (nuclear/biological/chemical), BLEEP (ballistic/laser eye protection), and other types of protective gear are donned.

**Computer Backbone.** As mentioned, the Land Warrior is based on a back-mounted computer. The Computer uses an IBM-compatible processor, PC-cards, and is setup for easy future upgrades. This backbone of the System controls various peripherals. Let's look at some of these.

First there's the Computer/Radio Subsystem (C/RS), which includes two radios: a Squad Radio for platoon-level communications and a Soldier Radio for communications with other soldiers within a squad. Both systems have the capability for both voice and data communications, are based on commercial Personal Communications Systems radio technology, and can have their communications encrypted for security.

Antennas for radios and the GPS are embedded in the load-carrying equipment frame. The very versatile C/RS also includes Mission Configurable Electronics and Removable Soldier Access and Mission Modules. Access to the computer and radios is via the Remote Input Pointing Device or a

*continued on page 52*



*Here are some typical video and digital map displays available on the Land Warrior helmet-mounted display.*

**A**re your squarewaves really "square?" Does your pulse train have the proper on/off ratio? The only way to be sure of the answers to such questions when working with a waveform is to measure its duty cycle.

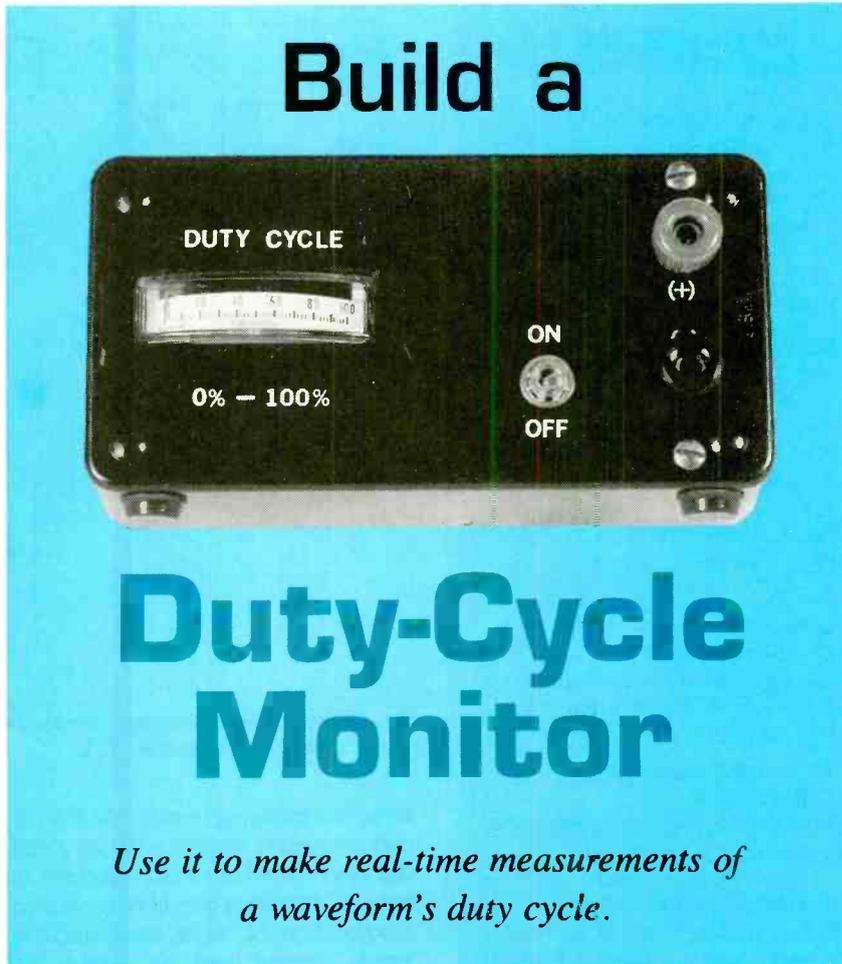
An accurate measurement of a pulse train's duty cycle, or mark/space ratio, is usually a tedious matter. First the period of the train must be measured along with the pulse width, and then the duty cycle must be calculated using those figures. Generally, an oscilloscope or a frequency counter incorporating time-period capability is required to do this.

If you have struggled with these techniques, you can put away your oscilloscope or counter and build the Duty-Cycle Monitor described in this article. It's simple enough to assemble in one weekend. This is a stand-alone instrument that displays a real-time duty-cycle reading of 0% to 100% on its built-in analog meter.

Using a 100-microamp-meter movement allows a direct reading of the duty cycle without using a multiplier (for example, a 45 microamp reading indicates a 45% duty cycle). The circuit is accurate to within 1% of full scale over the range of about 30 Hz to 100 kHz or higher, within an input voltage range of +1.5 to +15 volts, which covers most logic families. Maximum input voltage should be restricted to  $\pm 50$  volts peak. The input impedance is about 100,000 ohms, so circuit loading is not a problem.

**Circuit Description.** As you can see on the schematic diagram (see Fig. 1), the circuit is extremely simple, utilizing only two ICs and a handful of passive components. Power is obtained from a standard 9-volt battery, B1. Current drain is limited to about 10 to 15 milliamps total. The circuit is based on old-style, automotive "dwell meters," which performed a similar function at lower frequencies.

The input pulses are applied to IC1, an LM319 dual comparator, via R1, with C1 providing the necessary compensation for the capacitance appearing at the inputs of IC1. You may elect to adjust C1's value slightly to



display even higher frequency ranges. A yellow LED (LED1) provides input overvoltage protection and sets the minimum input level. Diode D1 provides reverse polarity protection for the comparators, while D2 and D3 supply the 1.3-volt threshold reference to IC1's inputs.

The comparator outputs drive display-meter M1 in a push-pull fashion. In other words, while IC1-a is high, IC1-b is low, thus completing the circuit through the meter. When the outputs are in the inverse state, D4 prevents current flow through the meter. The output pulse follows the input pulse timing exactly; therefore, when the input pulse goes high, M1 conducts for the pulse duration at its full-scale rating of 100 microamperes. When the input pulse goes low M1 is not conducting any current.

This on/off current through M1 is averaged by the inherent "damping" of the mechanical meter movement. As a result, M1 responds linearly with the input waveform's duty cycle. A stable display of the duty cycle appears

at frequencies above 30 Hz, while lower frequencies cause the meter needle to oscillate (with a swing determined by the damping effect that's caused by the torque required to move the needle).

The meter used in the prototype was a high-torque type that gave superior low-frequency stability down to 10 Hz. However, this higher damping itself causes small errors to appear: When calibration is done at a 50% duty cycle, signal displays below 50% d.c. "lag" and signal displays above 50% d.c. "lead." For example, an input at 10% d.c. reads between 9% to 10%, and an input of 90% d.c. reads between 90% to 91% duty cycle. If you are more interested in ultimate accuracy, use a low-torque meter movement. This is one case where the less expensive (low-torque) meter might be a better choice, if it has good DC linearity!

A LM78L05 voltage regulator, IC2, supplies +5 volts to IC1, and assures calibration stability within the limits of the circuit. Resistors R4 and R5 prop-

## PARTS LIST FOR THE DUTY-CYCLE MONITOR

### SEMICONDUCTORS

IC1—LM319 dual comparator, integrated circuit

IC2—78L05 5-volt regulator, integrated circuit

D1—D4—1N4148 silicon diode

LED1—Light-emitting diode, yellow

LED2—Light-emitting diode, red

### RESISTORS

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

R1—100,000-ohm

R2—22,000-ohm

R3—50,000-ohm trimmer potentiometer

R4, R5—1000-ohm

R6—3900-ohm

R7—2700-ohm

### CAPACITORS

C1—10-pF, ceramic-disc

C2, C5—0.1- $\mu$ F, ceramic-disc

C3—1- $\mu$ F, 16-WVDC, electrolytic

C4—10- $\mu$ F, 16-WVDC, electrolytic

### ADDITIONAL PARTS AND MATERIALS

M1—0- to 100-microampere analog panel meter

S1—SPDT toggle switch

B1—9-volt alkaline battery

Perforated board, enclosure, binding posts, battery connector, 22-gauge stranded insulated wire, hookup wire, solder, hardware, etc.

erly load the comparator outputs so that their rise and fall response times match within about 50 nanoseconds, thus assuring linear high-frequency response.

**Construction.** Before you begin assembling the Duty-Cycle Monitor,

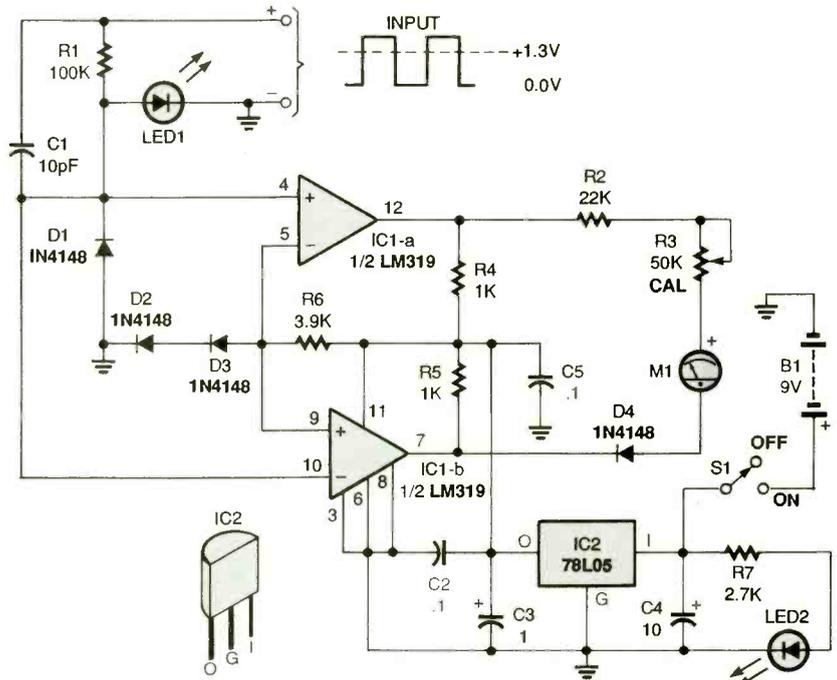


Fig. 1. This is the schematic for the Duty-Cycle Monitor. Note the three-dimensional pinout of the 78L05 regulator, IC2.

keep the following in mind: As this circuit processes signals with very fast rise and fall times, it is important to keep signal leads relatively short and isolated from DC leads. Also, keep the inputs isolated from the outputs, including the meter. The input leads to the binding posts can be standard clip leads about 12- to 18-inches long, terminated with banana plugs.

Begin assembly by dry fitting the panel meter and battery (in its holder) in your enclosure to estimate how much you will need to cut down your PC board for a good fit. The size of the meter you select will determine the actual enclosure you can use: the author's prototype was built in a 2½- ×

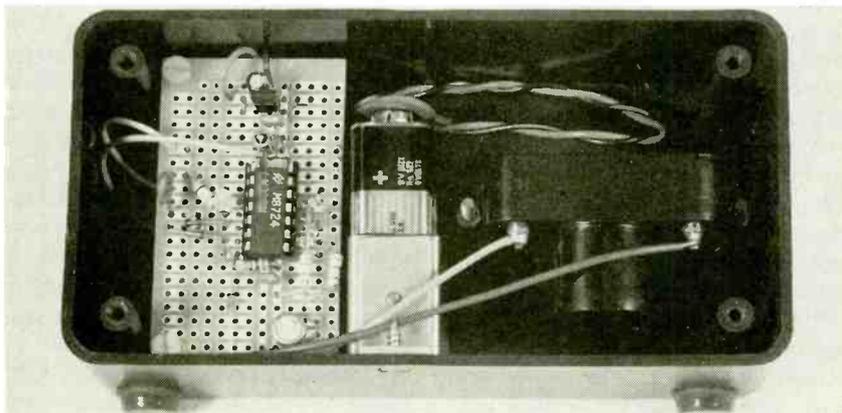
5½- × 1½ plastic cabinet to house the meter. The perforated board used in the assembly was cut to 1¾ × 2¼ inches, which allowed more than ample room for the board circuitry. With a larger cabinet, you may not have to cut down your board.

Once you have the board sized, locate and drill or punch two mounting holes in the corners of the board. Using the board as a template, scribe the holes in the cabinet at its appropriate mounting location and set the cabinet aside.

Install a 14-pin DIP socket for IC1 in about the center of the board. Then mount IC2 and add the remaining components, except for the binding posts (the + and - open input circles), S1, LED2, R7, and M1, making the connections illustrated in the schematic diagram. Using 22-gauge stranded hookup wire, connect 6-inch leads to the board as follows: two wires for the signal input, two wires for the output, and two wires for the power input. Install IC1 in the socket and set the board aside.

Lay out and cut the hole in the cabinet for the meter, along with its mounting holes. Locate and drill the mounting holes for the binding posts, power switch, and LED2. The author's prototype had these four compo-

(Continued on page 52)



As you can see, a nice and neat assembly is possible using perforated board building techniques.

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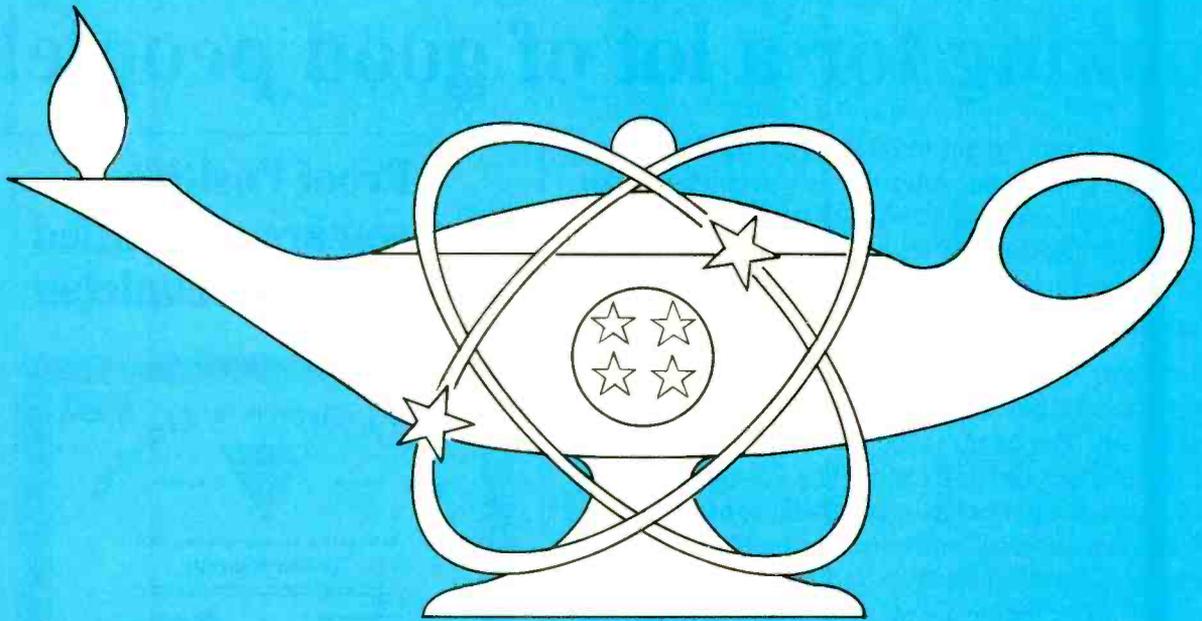
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# NATIONAL ELECTRONICS TECHNICIANS DAY

*A day to honor those electronics professionals that have demonstrated their mettle—  
and an opportunity to join their ranks*

More than ever, electronics touches nearly every aspect of human activity, and its influence is expanding at a near explosive rate. For example, the latest innovations in banking, business, communications, entertainment, finance, industry, medicine, military systems, and transportation all center around electronics devices and systems, and most of those make extensive use of microprocessors or microcontrollers.

That's also true of the products each of us use every day. Increasingly, cars, cameras, dish-washers, refrigerators, telephones, and TVs—to mention but a few—make use of microprocessors or some other type of "intelligent"

**BY BARBARA RUBIN**  
ISCET Director of Member Services

controller. And the personal computer is fast becoming a standard appliance in many households. With the increasing popularity of the Internet, that's a trend that is likely to continue.

All of that creates a tremendous opportunity for those with an affinity for electronics. The combination of a growing worldwide demand for electronics products, and the rising complexity of those products and systems, has increased the demand for professionals trained in developing, integrating, maintaining and repairing high-tech hardware.

Expert electronics technicians participate in the development, prototyping, and testing of new products. They also integrate and maintain all kinds of electronics systems and networks. And they are the people you call when today's generally reliable electronics products malfunction or fail. Their years of professional training and experience permit them to make needed repairs in a timely and economical manner.

In recognition of the skilled electronics technicians of the world, the International Society of Certified Electronics Technicians (ISCET) has proclaimed April 22, 1997 as International Electronics Technicians Day. In addition, the

entire week of April 20 through April 26, has been set aside as a National Testing Week for technician certification.

ISCET's professional certification of electronics technicians has been recognized internationally for more than 32 years; possession of ISCET certification indicates that the holder has met the highest professional performance standards. The voluntary certification program also helps employers to differentiate between qualified applicants and those with less training and skills.

So far, more than 150 ISCET Certification Test Administrators have volunteered to serve during National Testing Week. They will offer CET, CAT, and FCC testing from April 20 through April 26. A complete list of test sites (including **Popular Electronic's** editorial offices in Farmingdale, NY) are presented elsewhere in this article.

**CET, CAT and FCC Exams.** A wide range of CET, CAT and FCC examinations are now available through ISCET. To become fully certified by ISCET, an electronics technician must have at least four years of formal electronics training and experience. In addition, the demanding criteria for certification requires technicians to be knowledgeable in both fundamental electronics and the more advanced theory applicable to their specialty. To demonstrate that, he or she must pass both a 75-question Associate test, covering basic electronics fundamentals, and a 75-question Journeyman test, covering the applicant's area of specialization. The passing grade for each of the multiple-choice exams is 75%. An electronics technician or student with less than four years of experience may apply for Associate-level certification.

The Associate exam requires a broad knowledge of electronics plus the ability to analyze and troubleshoot circuit problems. The basic subjects on which the candidate will be examined include: electronics math, DC and AC circuits, transistors and semiconductors, elec-

tronic components, instruments, tests and measurements, and troubleshooting. A technician may also use an Associate exam issued by the Electronics Technician Association (ETA) to qualify to take one of the Journeyman Options.

Individual Journeyman exams focus on many different electronic specialties. The present set includes:

• **Audio**—The questions cover amplifiers and sound quality, system integration, speaker installation, servicing audio products, and troubleshooting audio systems. The exam includes questions on both digital and analog audio.

• **Communications**—The questions address communications circuits and transmission systems, AM and FM transmitters and their adjustment, receiver adjustment, and the servicing and troubleshooting of systems.

• **Computers**—The questions cover binary mathematics, logic gates, the basics of digital electronics and computers, local-area network organization, input and output peripherals, memory, elementary programming, and the troubleshooting of computer systems.

• **Consumer**—The questions cover both digital and analog circuits in consumer electronics products. There are, for example, specific questions on the troubleshooting and servicing of televisions and VCRs, and the operation of applicable service test instruments.

• **Industrial**—The questions cover DC and AC power supplies, transducers, sensors, switches, differential amplifiers, logic circuits, analog and digital circuitry, microprocessors and computer systems, and circuit analysis and troubleshooting of industrial electronic systems.

• **Medical**—The questions cover the principles of electrical safety, basic circuitry, the operation of electronic test instruments, telemetry, and the calibration of typical biomedical instrumentation.

• **Radar**—The questions cover both pulse and continuous-wave radar operation, radar transmitters and receivers, CRT display systems,

radar power supplies, antennas, and the principles of transmission lines.

• **Video**—The questions cover the basics of video, knowledge of NTSC standards, test-signal generation, the principals of video tape recording, VCR tape-drive mechanisms, camcorders, TV cameras and monitors, and the microprocessor as it applies to video.

ISCET is also in the process of developing specialized endorsements to the Journeyman Options that signify advanced expertise in a specific field. Endorsements presently available are VCR and Camera, Camcorder, 8mm, Endorsements will soon be available for Monitors, Data communications, FAX, and Cellular.

**CAT Testing.** CAT (Certified Appliance Technician) testing opens a whole new field for the trained and certified technician. Whether it's a microwave oven, washing machine, dishwasher, or air conditioner, it's likely to include electronic circuits—perhaps even a microcontroller. The appliance service technician who service that equipment must learn about electronics as well as learning how to make the electrical and mechanical repairs they have traditionally made.

The Certified Appliance Technician examination is independent of the CET Associate or Journeyman certifications. However, just as for the Journeyman CET option, four years of practical, hands-on experience are required. The CAT examination consists of 100 multiple-choice questions on such subjects as electrical circuits and components, basic electronics, and the operating principles and repair practices for appliances such as refrigerators, ranges, ovens, dishwashers, and trash compactors. Appliance technicians who pass the ISCET CAT are eligible to join ISCET.

**FCC Testing.** ISCET test administrators can give tests covering FCC elements 1, 3, 5, 6, 7, 8 and 9. Element 1 is Basic Radio Law and Operating practice. Element 3 is

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Electronic Fundamentals and Techniques Required to Adjust, Repair, and Maintain Radio Transmitters and Receivers. By passing both of those tests, the candidate will qualify for an FCC General Radiotelephone License.

The total gamut of FCC license exams include tests needed for a First Class Radiotelegraph Operator's Certificate (Telegraphy Elements 3 and 4 and written Elements 1, 5, and 6), Second Class Radiotelegraph Operator's Certificate (Telegraphy Elements 1 and 2 and written Elements 1 and 5), Third Class Radiotelegraph Operator's Certificate (Telegraphy Elements 1 and 2 and Written Elements 1 and 5), General Radiotelephone

License (Written Elements 1 and 3), Marine Radio Operator Permit (Written Element 1), GMDSS (Global Maritime Distress and Safety Systems) Radio Operator's License (Written Elements 1 and 7), and GMDSS Radio Maintainer's License (Written Elements 1, 3 and 9).

The FCC released its first question pool to examiners on September 6, 1993. The first technician to be FCC certified by IS CET was Antonio C. Gomez of Santa Isabel, Puerto Rico. All FCC Question Pools were upgraded at the beginning of 1995.

**In The Beginning.** IS CET was founded in 1970 by a committee of Certified Electronics Technicians.

Their main purpose was to foster respect and recognition for their profession. By maintaining the rigorous standards of its certification program, IS CET can identify and recognize highly skilled and knowledgeable technicians. Membership is open only to those technicians who have passed the Journeyman CET exam, the CAT exam, or the Associate CET exam.

In addition to receiving regular newsletters and magazines, members are informed about IS CET-sponsored conventions and technical-training seminars. Members also receive frequent updates on new technology, an annual directory of industry information, and many other valuable benefits available

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Since its creation in 1965 by the National Electronic Association, the CET program has been widely recognized by technicians, Government agencies, manufacturers, and consumers. Many electronics companies encourage their technicians to qualify for ISCET certification and some even require it. Almost technicians have proven their ability by earning the coveted ISCET certification.

**Exam Fees.** The fee for the CET

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There is a different set of fees for the FCC exams, but the minimum fee is \$25 for one session. The fee for Element 1 is \$25, and the fee for Element 3 is \$30. If the two examinations for the General Radio-telephone Operator's License are taken in a single session, the fee is

only \$35. There are other combinations of elements and fees for the other elements. .

**Preparing For An Exam.** The best way to prepare for any of these exams is to study the available background subject material. IS CET offers excellent, inexpensive study materials that will help all candidates prepare for each of its exams. If you are at the entry level, the Study Guide for the Associate CET Test will give you an excellent review for this first test. The 96-page booklet is priced at \$10. The Software Study Guide and Practice Test with 300 sample questions is price at \$39.95 plus \$2 shipping. In addition, IS CET offers practice tests for most of the Journeyman options as well as excellent review texts on each of those options.

The FCC examinations are assembled from questions in a published question pool. By making the complete question pool available, the FCC has defined the limits of the basic knowledge that it expects each successful candidate to have. The availability of the pool also assures all persons taking the test that there will be no nasty surprises. A study guide and compete question pools for Elements 1, 3, and 8 is available for \$29.95 plus \$3 for shipping and handling costs. In addition, self-test computer software packages are available. Not surprisingly, being well prepared for all examinations can make the difference between passing and failing!

If, after reading this, you decide that you would like to take the CET CAT, or any of the FCC exams, contact one of IS CET's volunteer test administrators listed elsewhere in this article for details. As stated earlier, the exams are scheduled for the week of April 20 through April 26. For additional information, or to obtain an order form listing all of the available guidance and help materials, contact IS CET directly at 2708 West Berry St., Fort Worth, TX 76109; Tel: 817-921-9101, FAX 817-921-3741.

See you at Testing Week 97, and on Electronics Technicians Day! ■

## LAND WARRIOR

(continued from page 44)

separate, hand-held QWERTY keyboard. The C/RS can capture and transmit still-frame video.

At the heart of the Land Warrior is the Software System. This provides navigation, digitized map display, location databases, laser detection and warning, command and control, fire control, and communications capabilities.

Finally there is the Weapon Subsystem featuring a modified M4/M16. The Thermal Weapon Sight attached to the weapon can detect targets out to 1000 meters through fog, smoke, dust, and other obscurants, at day or night. The Laser Rangefinder/Digital Compass Assembly provides the ability to accurately and rapidly pass off targets for indirect fire support when linked to the computer, GPS, and radio. Being able to view outputs of these devices on the helmet displays means the wearer can "see" without exposing his position.

All these electronics are powered by a non-rechargeable battery that provides 12 hours of operation. Batteries can be quickly changed in the field where recharging of batteries is not really practical. However, rechargeable batteries are used during training. Even with all this sophistication, the Land Warrior's weaponry still includes a bayonet.

With the Land Warrior System, soldiers will always have answers to the questions, "Where Am I?, Where is the Enemy?," and "Where are other friendly troops?" ■



## DUTY CYCLE MONITOR

(Continued from page 46)

nents mounted behind the circuit board. Drill the battery-holder mounting hole, and the already scribed board-mounting holes. Install the meter, binding posts, LED2, battery holder, and power switch in cabinet.

Connect R7 from the anode lead of LED2 to one lug on the power switch. Connect the positive lead from a 9-volt battery "snap" connector to the other switch lug, and the negative lead to the cathode of LED2, using shrink tubing on each LED lead. Cut down the 6-inch wires on the circuit board as short as possible for ease of connection and installation of the board on spacers. Connect these leads as follows: the two signal input leads go to the binding posts, the two output leads go to the meter, and the positive power lead goes to the S1/R7 lug connection, with the negative power lead going to the cathode of LED2. Observe proper polarity on all connections. Install the board on the spacers, place the battery in its holder and attach the battery connector.

**Calibration and Use.** A very simple and fairly accurate method of calibrating the unit is to connect the positive-input binding post to +5 volts at the output of IC2. Turn on the power and adjust trimmer potentiometer R3 for a reading of just a "hair" over full scale (about 101 microamps) on your meter. (**Note:** Make sure that the meter is mechanically zeroed before calibration.) That method will get you within about 1%, but for best accuracy, input a signal of about 1 to 10 kHz from a flip-flop configured in its "toggle" mode, and adjust R3 for a 50-microamp or 50%-duty-cycle reading. An oscilloscope or counter along with a pulse generator could also be used to complete this task.

To use the Duty-Cycle Monitor, input any rectangular pulse waveform to the binding posts observing proper polarity and the voltage range of the device. The pulse has to cross the 1.3-volt threshold for proper operation. Read the duty cycle directly in percentages: 100 microamperes equal a 100% duty cycle. The input is fully protected for reverse-polarity and over-voltage conditions. ■

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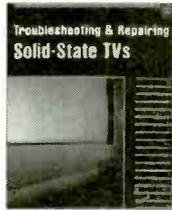
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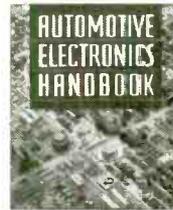
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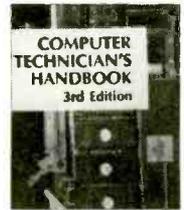
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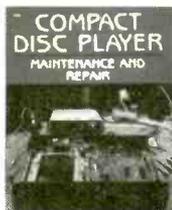
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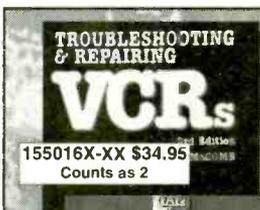
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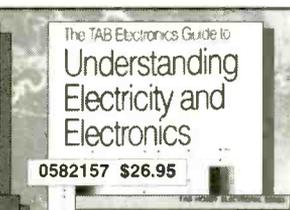
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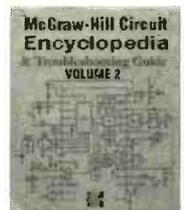
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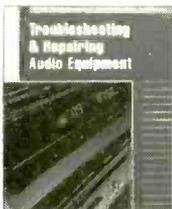
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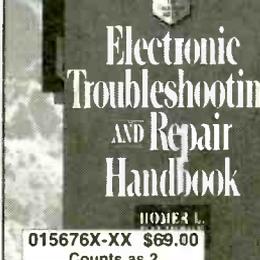
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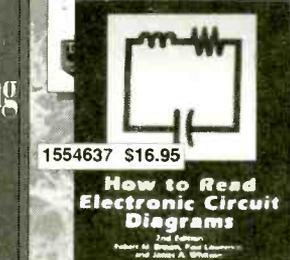
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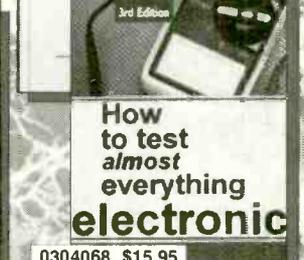
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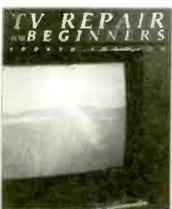
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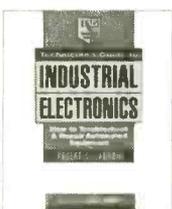
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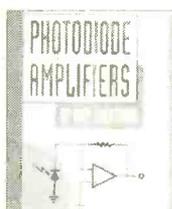
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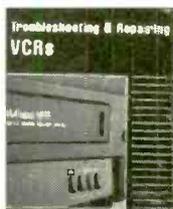
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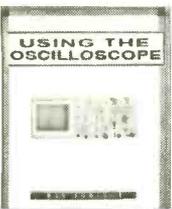
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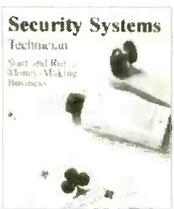
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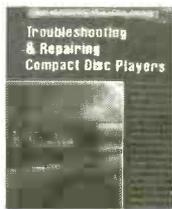
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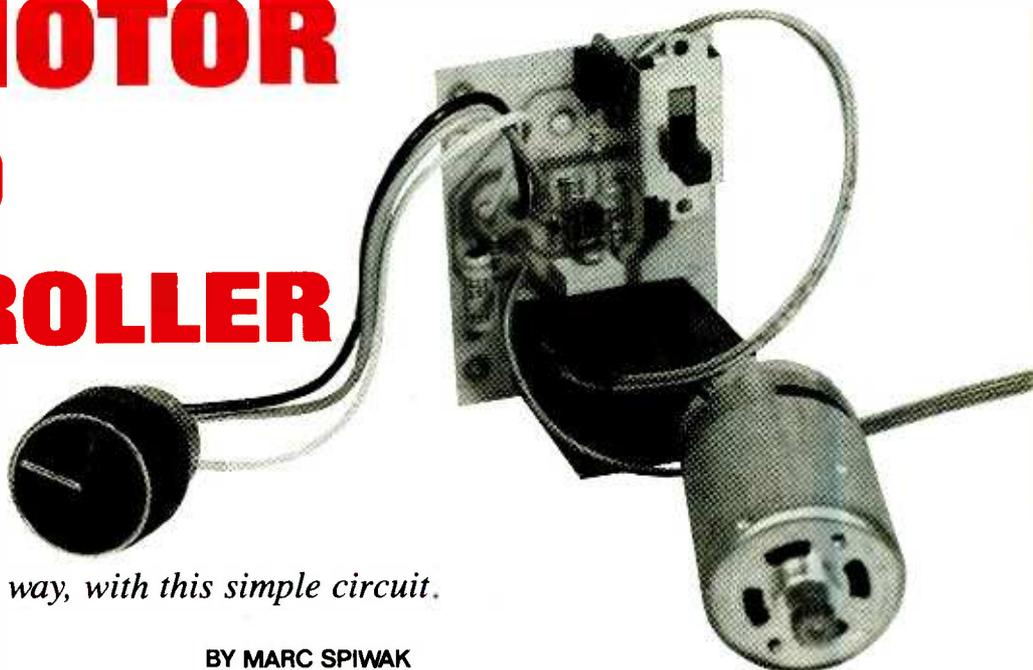
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# BUILD A DC-MOTOR SPEED CONTROLLER



*Vary the speed of a DC motor, the right way, with this simple circuit.*

BY MARC SPIWAK

Everyone who reads this magazine probably played with DC motors as a kid; they were just too fascinating to throw away like other broken appliances. Motors are magical—connect a battery and away they go. Controlling their speed, though, is a bit trickier.

While I had a nice collection of motors going by the age of 10, I never had an electronic speed controller. The best I could come up with at the time was a wire-wound pistol-grip speed controller from an old slot-car set. I actually built my own "radio control" car, which contained two motors, using that very same speed controller.

Back then I connected a rack-and-pinion steering mechanism, that I made from the geared-down starter motor taken from a defunct Visible V8 Engine model, to the chassis of an old Cox car, which had steerable front wheels. With the Cox car's original rear wheels removed (they came off with the engine/tranny combo, which never lasted more than a few hours), I installed a new motor/gearbox/rear-wheel package made from Capsela pieces. A long, four-conductor wire then let me drive the car forward and reverse in variable speed, and make left and right turns, all with a controller box that I made from a couple of power-reversing switches and the

slot-car power supply. Sure the car was tethered to the controller, but I had made it myself. It was a lot of fun to play with, and it didn't cost me anything. I guess that's why I got into electric radio-control cars once I was earning enough money to afford them! But I digress.

Still, DC motors are used in many different devices—pretty much anything that moves. And one of the main design consideration problems is

controlling the speed of a motor. Simple resistive speed controllers can be used, but these waste a lot of energy in the form of heat. In addition, it's not easy to precisely control the speed of a motor with such a simple type of controller.

The best kind of speed controller is an electronic one—a device that basically chops up the DC power and feeds it to the motor in a pulsed form. Very little power is wasted, and none

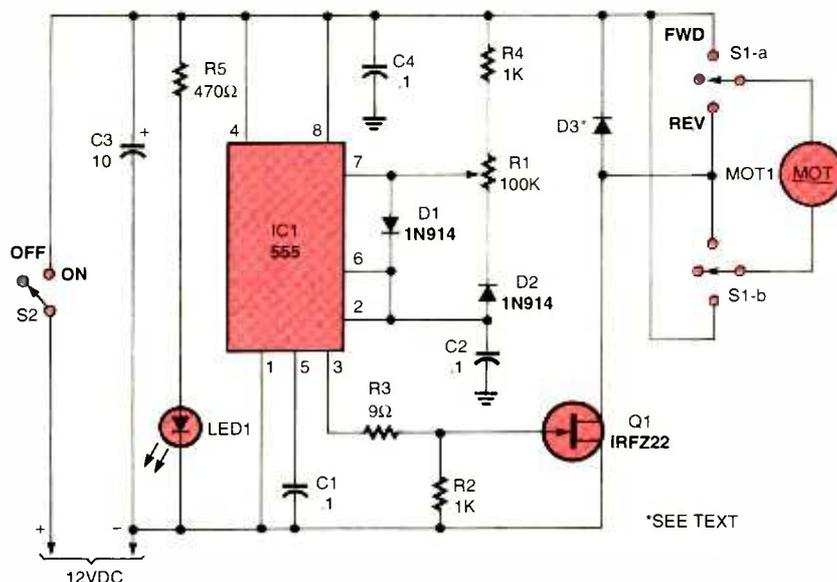


Fig. 1. Here's the schematic for the DC-Motor Speed Controller. At its heart is a 555 timer circuit, which oscillates at a frequency determined by capacitor C1 and potentiometer R1.

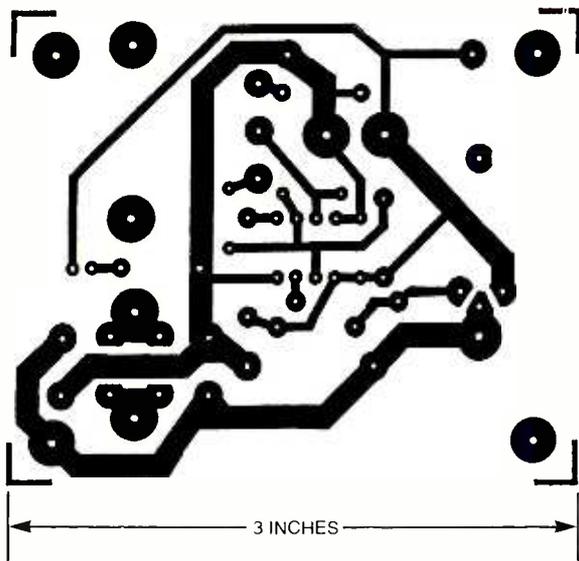


Fig. 2. You can make your own PC board for the Speed Controller using this foil pattern. It is shown full size.

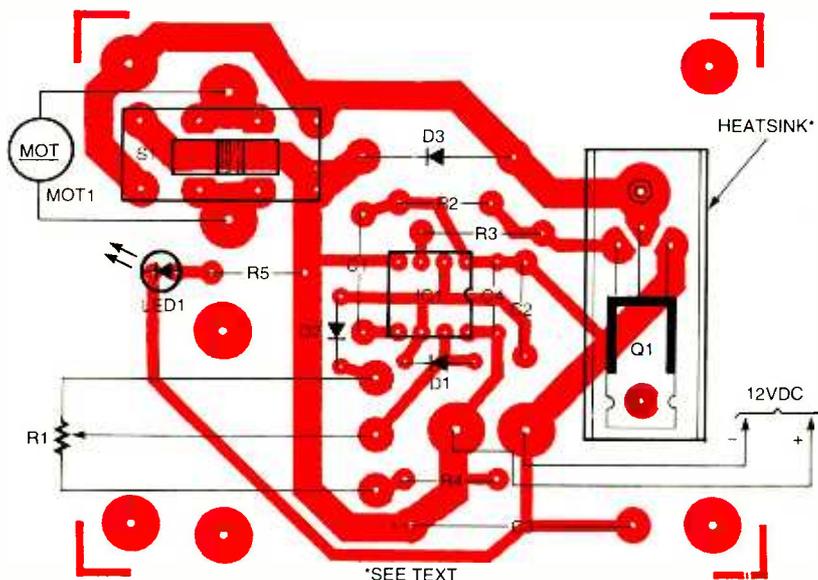


Fig. 3. If you're building the circuit on a PC board, use this parts-placement diagram as a guide.

of it is simply burned up across a resistor. The power output from such an electronic speed controller is basically a squarewave with a variable duty cycle. The more time the voltage output stays high, the higher the average voltage that's fed to the motor. The higher the voltage, the faster the motor spins. Conversely, the less time that the squarewave output stays high, the lower the average voltage and the slower the motor runs.

The DC-Motor Speed Controller described in this article is just such a device, which gives an approximate 5% to 98% control range of a motor. You

can build the simple circuit in an hour or so from parts you probably have lurking in your junk box. If you don't have a good collection of parts, however, don't worry. There's a kit available from the source mentioned in the Parts List that includes a PC board and a nice big motor, plus all the necessary parts. All you have to provide then, besides some solder and tools, is a 12-volt battery or power supply.

**Circuit Description.** The schematic for the Speed Controller is shown in Fig. 1. The circuit is centered around a 555 timer circuit that runs at a fre-

## PARTS LIST FOR THE DC-MOTOR SPEED CONTROLLER

### SEMICONDUCTORS

IC1—555 timer, integrated circuit  
 Q1—IRFZ22 MOSFET or equivalent  
 D1, D2—1N914 or 1N4148 silicon diode  
 D3—3-ampere, 300-volt diode  
 LED1—Light-emitting diode, any color

### RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)  
 R1—100,000-ohm potentiometer  
 R2, R4—1000-ohm  
 R3—9-ohm  
 R5—470-ohm

### ADDITIONAL PARTS AND MATERIALS

C1, C2, C4—0.1- $\mu$ F, ceramic-disc capacitor  
 C3—10- to 15- $\mu$ F, 50-WVDC, electrolytic capacitor  
 MOT1—12-volt DC hobby motor  
 S1—2P3T switch  
 S2—SPDT switch  
 Printed-circuit materials, 12-volt battery pack or power supply, heat sink for MOSFET Q1, hardware, wire, solder, etc.

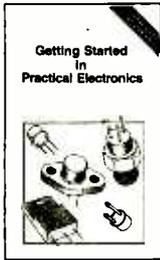
**Note:** The following is available from Marlin P. Jones & Associates, Inc. (P.O. Box 12685, Lake Park, FL 33403-0685; Tel. 800-652-6733): kit for the Speed Controller (Kit # 4057-MD) including a PC board, all components, and a 12-volt DC motor—\$15.95 plus \$5 shipping and handling. Florida residents please add appropriate sales tax.

quency determined by capacitor C1 and potentiometer R1. Varying R1 changes the discharge rate of the oscillator circuit and the output signal at pin 3. That output turns power MOSFET Q1 on an off, thereby supplying power to the motor (MOT1). As hinted at earlier, the longer the MOSFET is turned on, the higher the average DC voltage applied to the motor, and the faster it will run.

The circuit requires a 12-volt battery pack or power supply that can supply up to 10 amperes (depending on what you are going to use it for). Switch S2 applies power to the circuit and light-emitting diode LED1 indicates when power is turned on. The other switch, S1, toggles the polarity of the power applied to the motor, thus

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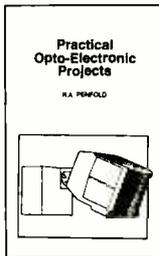
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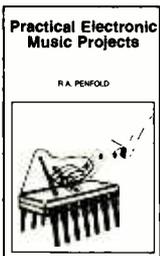
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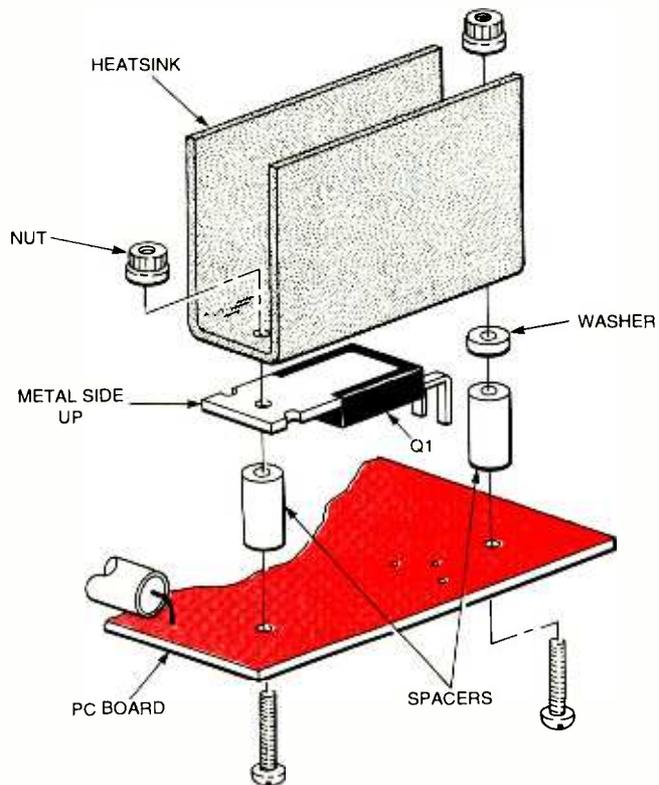


Fig. 4. The heatsink mounts above MOSFET Q1 on spacers with Q1 bent over forward.

changing its direction of rotation between forward and reverse.

**Construction.** If you're building the circuit from scratch, and would like to use a printed-circuit board, you can make your own from the foil pattern provided in Fig. 2. You can also order a board as part of the kit mentioned earlier. Otherwise, you can build the circuit on a piece of perforated construction board and use point-to-point wiring.

If you're going the PC-board route use the parts-placement diagram shown in Fig. 3 as a guide when assembling the circuit. Solder the parts to the board basically in size order, starting with the fixed resistors. The 555 timer IC, diodes, and capacitor C3 must be mounted with the indicated proper polarity. Solder the motor leads to the board before installing switch S1 or else they will be difficult to insert. All leads should be fairly heavy gauge and capable of handling 10 amperes, simply because the circuit is capable of supplying it. The polarity of the motor leads isn't really all that important since you can reverse it with switch S1.

The DPDT switch included with the

kit has an extra row of pins that must be cut off for it to fit the PC board. Position the switch for best fit before cutting off the extra pins. Be careful of the polarity when connecting the power-input leads.

The MOSFET must be heatsinked. The kit includes a heatsink that mounts above the MOSFET bent over forward as shown in Fig. 4. If you're building from scratch, just use any decent-sized heat sink that fits the MOSFET. Some thermal grease applied to the MOSFET tab isn't a bad idea either. After building the circuit be sure to check your soldering and parts placement.

When you are sure the board is in tip-top shape, you can apply power. If all goes well, the motor should start to run and you'll be able to control the speed of it by adjusting potentiometer R1. The board is now ready to be installed in something. Your own model car, perhaps, or maybe some exotic robot to be!

Wherever you use it, and most important when using batteries, the circuit is going to save as much power as possible. That translates into more run time!

# HAM Radio

## Going for Gigahertz

JOSEPH J. CARR, K4IPV

Many readers are familiar with the Mini-Circuits MAR-x devices (they have been covered in this column in the past). Those devices are monolithic microwave integrated circuits (MMIC) that work over frequency ranges of DC to 1000 MHz or DC to 2000 MHz, depending on the model.

Now Mini-Circuits has expanded their MMIC line with a new series that works to 3 gigahertz (GHz), 4 GHz, 6 GHz, or 8 GHz, depending on the type number. The series is called the ERA-x amplifiers, where "x" indicates the specific device. For those who came in late, 1 GHz is 1000 MHz, so 8 GHz is 8000 MHz!

### ERA-x

Figure 1 shows a greatly blown up view of the ERA-x package. The actual size of the plastic package is about the size of the MAR-x package, or about 2-3 mm, but the leads are only about two thirds as long. Also, while the type number can be detected by the color of the dot that indicates lead 1, on the ERA-x they are all red.

One aspect of the MMIC type of device is that the internal circuitry sets the input and output impedances. While most RF devices have a natural input or output impedance that is anything but the standard RF system impedance of 50 ohms, the MMIC devices, including both MAR-x and ERA-x devices, have inherent 50-ohm input and 50-ohm output impedances. As a result, these devices can be used as "drop-in" amplifiers over their entire range of frequency.

Note that there are two ground leads on the ERA-x devices. You must use both grounds. The reason why they do this on RF devices is to prevent lead inductance from causing ground loop problems. A pair of parallel ground leads effectively reduces the apparent lead inductance.

Figure 2 shows the standard circuit for both ERA-x and MAR-x devices. Note that the DC power is applied to the device through the output terminal (pin 3), rather than through any special

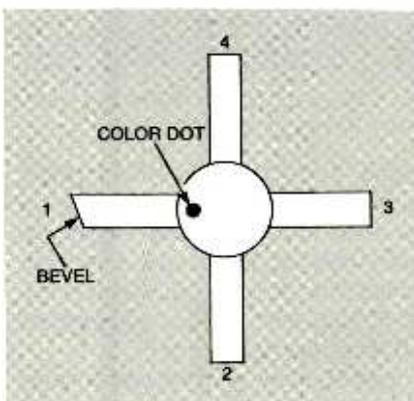


Fig. 1. The package for an ERA-x device is smaller than a MAR-x package, but otherwise similar.

DC terminal. The +5 VDC voltage required at pin 3 by the ERA-x devices (MAR-x devices may use either +5 VDC or +3.5 VDC, depending on type) is derived through the bias resistor, R1. The value of R1 depends on the value of current required by the ERA-x device, which is dependent on the type. The value for each amplifier can be found on the Mini-Circuits spec sheet for the ERA-x devices (see below for details on how to contact them). Let's suppose, for the sake of example, that the desired current is 40 mA (0.040 A). The resistor, R1, must drop  $V+$  to +5 VDC at the desired current level, so by Ohm's law, and assuming  $V+ = 9$  VDC:

$$R1 = ((V+) - V1) / I = (9\text{VDC} - 5\text{VDC}) / 0.040 = 4 / 0.040 = 100 \text{ ohms}$$

The value of R1 will be different for other devices, so please check the spec sheet for the device that you want to use. Table 1 lists some of the devices that are available.

The RF choke (L1) in Fig. 2 is optional, and sometimes causes problems in wideband amplifiers. If the choke is self-resonant at a frequency that is within the amplifier's capability, then the amplifier might oscillate. For VHF/UHF and up, it is recommended that you use a ferrite bead slipped over a short (0.25 to 0.50 inch) length of 22-gauge solid hook-up wire. Suitable ferrite beads can be obtained from sources that also sell toroid cores.

The DC blocking capacitors, C1 and C2, set the lower end of the frequency response curve. Generally, you will use 0.1  $\mu\text{F}$  for the lowest frequencies (<1 MHz), 0.01  $\mu\text{F}$  for 10 MHz, 0.001  $\mu\text{F}$  for 100 MHz, 100 pF for 500 MHz, and 10 pF for above 500 MHz. For frequencies above about 200 MHz, don't use ceramic-disc capacitors because they tend to have a self-resonant frequency that is set by the lead inductance. For those frequencies use surface-mount "chip" capacitors. Below 200 MHz, however, quality ceramic-disc units should work fine.

As mentioned earlier, Table 1 shows some of the devices in the ERA-x line. Note that surface mount versions are also available, and are indicated by an "SM" on the end of the part number (e.g. an ERA-4 is "ERA-4SM" in surface-mount packaging).

The ERA-x devices, like the MAR-x devices, can be used for frequencies from near-DC to the maximum frequency for the device. Keep in mind, however, that not all capacitors (for C1 and C2) are created equal. If you want to have a low-end frequency of around 100 MHz, then a 0.001- $\mu\text{F}$  ceramic-disc capacitor will do nicely at that frequency, but will fall off in performance (or cause problems) at some frequen-

TABLE 1

Type	Gain	-1 dB Comp.	TOIP	NF	Freq. (GHz)
ERA-1	11.8 dB	13 dBm	26 dBm	7 dB	8
ERA-2	14.9 dB	14 dBm	27 dBm	6 dB	6
ERA-3	20.2 dB	11 dBm	23 dBm	4.5 dB	3
ERA-4	11 dB	19.1 dBm	36 dBm	5.2 dB	4
ERA-5	16 dB	19.6 dBm	36 dBm	4 dB	4

cy above 200 MHz because of self-resonance. And those 0.01- $\mu$ F and 0.1- $\mu$ F capacitors used at lower frequencies might look more like blocks of wood than capacitors to GHz-level frequencies. Make sure the capacitor you select works over the entire range.

The DC decoupling capacitor, C3, is nominally set at 0.1  $\mu$ F, but at higher frequencies a value similar to C1 and C2 can be used. In some cases, it is wise to use two capacitors for C3, one being a 0.1- $\mu$ F unit and the other being a 100-pF chip capacitor for the higher frequencies.

Mini-Circuits can be contacted via mail at P.O. Box 350166, Brooklyn, NY, 11235-0003; via phone at 718-934-4500; via FAX at 718-332-4661; or on the Internet at <http://www.minicircuits.com>. Their WWW site allows you to download a complete spec sheet for the ERA-x devices. While you are at the Mini-Circuits website, also download the spec sheets for the POS-x series of RF voltage-controlled oscillators.

## 11-METERS

In this column and elsewhere I have told you that hams lost the 11-meter "ham band" to CBers back in 1957. That's not quite right. A friend at ARRL headquarters (225 Main Street, Newington, CT, 06111; e-mail [hq@arrl.org](mailto:hq@arrl.org)) wrote and reminded me that 11-meters was never a ham band. Hams were *allowed* to operate on the 27 MHz 11-meter band, but only on a shared basis. It was a multi-use band for scientific, industrial, and other devices. Early medical diathermy and industrial-induction heating equipment operated (at high power levels!) on the 11-meter band.

My own 11-meter experience was on CB in the late 1950's to mid-1960's (I got off when it got popular), and medical diathermy noise chewed up a lot of spectrum space on that band. Driving by certain doctors' offices (even many blocks away), or near a hospital, causes a raucous raw interference (caused by the fact that medical diathermy tended to operate using unfiltered pulsating DC on the anodes of the power amplifiers). Fortunately, medical diathermy went into the UHF band a long time ago.

Even though it wasn't a "ham band," we did have a "Save Eleven" contest back in 1956 or 1957. Of

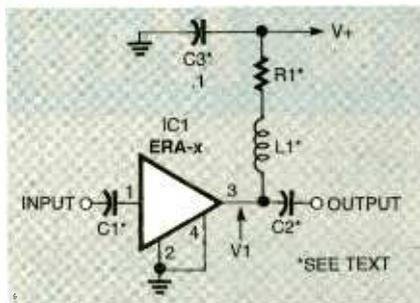


Fig. 2. Here's a circuit for ERA-x and MAR-x devices. See text for component values.

course, a lot of hams disdained CBers, but in the earliest of the early days a few of us in Bruno Paras' electronics shop class at Washington-Lee High School (Arlington, VA) converted a few BC-603/BC-604 military transmitters and receivers for CB use.

Indeed, early in World War II hams who were experimenting with what was then called "UHF" (everything above 25 MHz) heard German language voices on 11-meters. They reported it to the FBI, who found out that the 5-watt transmitters in Rommel's *Afrika Korps* panzers were skipping into Massachusetts quite easily from North Africa.

## OTHER STUFF

A long period of illness in 1994-1995 kind of crimped my book writing, but now there are several new ones on the market that may interest readers of this column. Butterworth-Heinemann, a British publisher that also operates in the USA from Newton, MA, just published *Microwave and Wireless Communications Technology*. It contains a lot of stuff about microwave devices and systems. TAB/McGraw-Hill just published *Secrets of RF Circuit Design-2nd Edition*, and *Technician's Guide to DC Power Supplies*.

Butterworth-Heinemann also published my books *Linear Integrated Circuits* and *Designer's Guide to Applications of Linear ICs* in United Kingdom, but they should be available in the USA soon. Search for the various B-H web sites by typing "Butterworth-Heinemann" into your favorite web search engine.

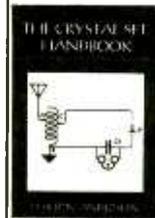
I can be reached by snail mail at P.O. Box 1099, Falls Church, VA, 22041, or by e-mail at [carrj@aol.com](mailto:carrj@aol.com). I appreciate your mail or e-mail, and much of what I hear from you winds up in this column. It is, after all is said and done, my goal to be of service to you. ■

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# Circuit Circus

## Junkbox Goodies

BY CHARLES D. RAKES

Welcome back, circueteers. This month we're going to stir the pot and pull out a number of simple circuits that you might be able to put to use in a present or upcoming project.

As you might have guessed from the title of this column, a good junkbox should have the majority of the parts needed for the goodies included here. So warm up your soldering iron, and let's get started.

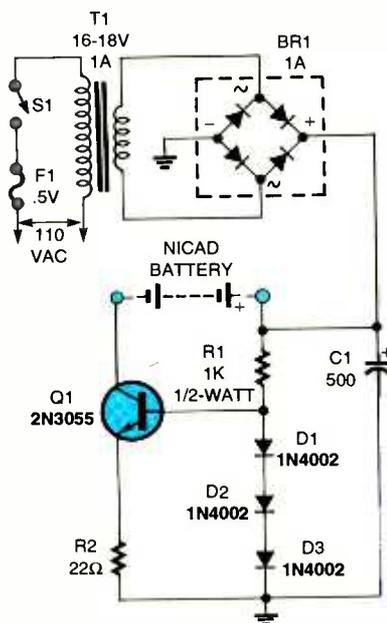


Fig. 1. This constant-current circuit can recharge 1.5- to 12-volt nicad batteries.

### PARTS LIST FOR THE NICAD CHARGER (Fig. 1)

#### SEMICONDUCTORS

Q1—2N3055 NPN power transistor  
BR1—1-ampere full-wave bridge rectifier  
D1-D3—1N4002 silicon diode

#### ADDITIONAL PARTS AND MATERIALS

R1—1000-ohm,  $\frac{1}{2}$ -watt, 5% resistor  
R2—22-ohm,  $\frac{1}{2}$ -watt, 5% resistor  
C1—500- $\mu$ F, 35-WVDC, electrolytic capacitor  
T1—16- to 18-volt, 1-ampere transformer  
S1—SPST toggle switch  
F1—0.5-ampere fuse  
AC line cord with plug, wire, solder, etc.

## NICAD CHARGER

Our first entry, see Fig. 1, features a few inexpensive components connected together to form a useful nicad-battery charger circuit. The charger is a constant-current circuit that can re-energize nicad batteries with voltages as high as 12 volts.

Diodes D1-D3 operate as a low-voltage Zener, setting Q1's base at a 2-volt reference level. Resistor R2's value sets the constant-current charging rate. With a 22-ohm resistor used, the current is close to 50 ma. A 10-ohm resistor will raise the charging rate to around 100 ma.

Most nicads can safely be charged at a rate equal to ten percent of their discharge rating. A battery with a one-amp rating should have no trouble taking a 100-ma charging current. If possible, check the manufacturer's specifications and follow their charging data.

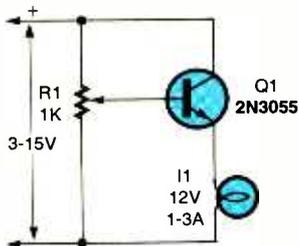


Fig. 2. Discharge nicad batteries with this circuit to help them "remember" what charge they're supposed to hold.

### PARTS LIST FOR THE NICAD DISCHARGER (Fig. 2)

Q1—2N3055 NPN power transistor  
R1—1000-ohm potentiometer  
I1—12-volt, 1 to 3-ampere auto lamp  
Wire, solder, etc.

## NICAD DISCHARGER

Our next circuit (see Fig. 2) is designed to discharge nicad batteries. Nicads can often develop a discharge memory and become "lazy." This basically means that they will not supply their rated output. Sometimes it helps

to zap such a lazy nicad at a safe discharge rate and recharge it again. In some cases this will turn the battery around and make it useful again. Facing the expense of replacing a battery makes it worth trying this rejuvenation trick. (The circuit may also be used in testing the regulation qualities of a power supply.)

A 2N3055 power NPN transistor, Q1, is connected in an emitter follower circuit with an auto lamp, I1, operating as the load resistance. A 1000-ohm potentiometer, R1, varies the transistor's base voltage and the load current. Using the auto lamp is less expensive than replacing it with a 20- or 30-watt resistor.

Before connecting a battery or power source to the circuit, it would be a good idea to heatsink the transistor. This is because Q1 is actually operating as a part of the load.

## POWER-LATCHING SWITCH

A power-latching circuit is shown in Fig. 3. Here we have an SCR connected in series with a power source and the operating circuitry. When S1 is

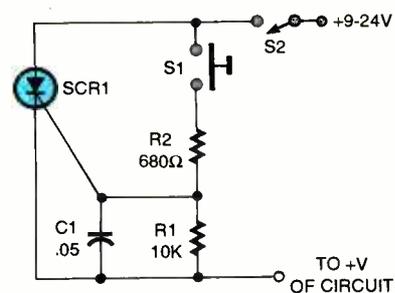


Fig. 3. When S2 is closed and S1 is momentarily pressed, power will stay on with this latching circuit.

### PARTS LIST FOR THE POWER-LATCHING SWITCH (Fig. 3)

SCR1—See text  
R1—10,000-ohm,  $\frac{1}{4}$ -watt, 5% resistor  
R2—680-ohm,  $\frac{1}{4}$ -watt, 5% resistor  
C1—0.05- $\mu$ F, ceramic-disc capacitor  
S1—Normally open pushbutton switch  
S2—SPST toggle switch  
Wire, solder, etc.

momentarily closed the SCR turns on supplying power to the connected circuit. The power remains on until the circuit is broken.

The attached circuitry must draw more current than the SCR's minimum holding current rating or the circuit will not latch. For this reason you will need to decide which SCR to use with your particular circuit.

One application that comes to mind is to use the latching switch to activate and keep an alarm operating until it's reset by a key switch. A tilt or mercury switch could replace S1 for a similar alarm application.

## 15-VOLT DC SUPPLY

If you need a 15-volt DC power supply, but don't have a 20- or 24-volt transformer handy, then take a look at the solution offered in Fig. 4. Here a common 12-volt transformer is connected to a two-diode, two-capacitor, voltage-doubler circuit. The doubled voltage is fed to a 7815 regulator, IC1, producing a 15-volt, 1-ampere regulated power supply.

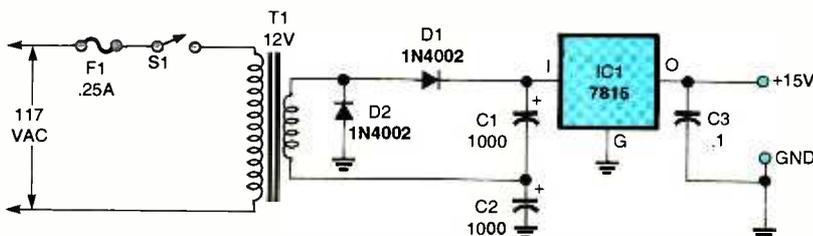


Fig. 4. If you need a 15-volt DC power supply, but don't have a 20- or 24-volt transformer handy, try this circuit.

### PARTS LIST FOR THE 15-VOLT DC SUPPLY (Fig. 4)

IC1—7815 voltage regulator, integrated circuit  
 D1-D2—1N4002 silicon diode  
 C1, C2—1000-µF, 35-WVDC, electrolytic capacitor  
 C3—0.1-µF, ceramic-disc capacitor  
 T1—12-volt, 1-ampere, transformer  
 F1— $\frac{1}{4}$ -ampere fuse  
 S1—SPST switch  
 AC line cord with plug, wire, solder, etc.

Most any 12-volt transformer will work for T1 as long as its current rating is at least 1 ampere. Larger-value filter capacitors may be used but must match each other in value.

## NEGATIVE SUPPLY

The circuit shown in Fig. 5 takes a positive voltage and turns it upside

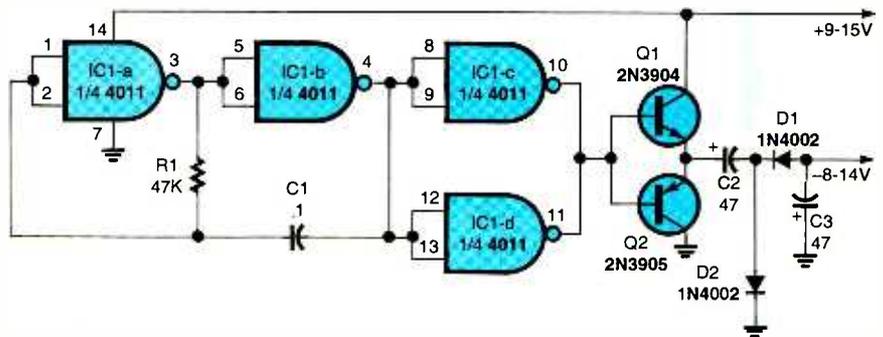


Fig. 5. This circuit takes a positive voltage and turns it "upside down" to produce a negative power supply.

### PARTS LIST FOR THE NEGATIVE SUPPLY (Fig. 5)

#### SEMICONDUCTORS

IC1—4011 quad two-input NAND gate, integrated circuit  
 Q1—2N3904 NPN transistor  
 Q2—2N3905 PNP transistor  
 D1, D2—1N4002 silicon diode

#### ADDITIONAL PARTS AND MATERIALS

R1—47,000-ohm,  $\frac{1}{4}$ -watt, 5% resistor  
 C1—0.1-µF, ceramic-disc capacitor  
 C2, C3—47-µF, 35-WVDC, electrolytic capacitor  
 Wire, solder, etc.

negative output. As you can see in the schematic, this negative output voltage will be slightly lower than the positive supply voltage.

## ISOLATED SUPPLY

In some circuits a separate power source is necessary to help isolate one sensitive circuit from interfering with another. The circuit shown in Fig. 6 generates just such an isolated positive power source.

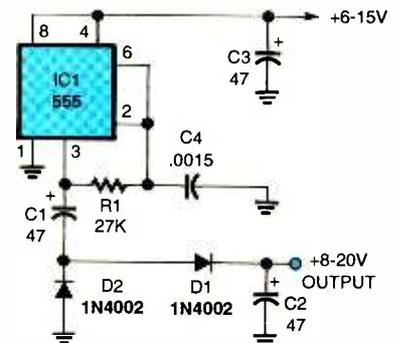


Fig. 6. If you need a separate power source to isolate one sensitive circuit from interfering with another, build this circuit.

### PARTS LIST FOR THE ISOLATED SUPPLY (Fig. 6)

IC1—555 timer, integrated circuit  
 D1, D2—1N4002 silicon diode  
 R1—27,000-ohm,  $\frac{1}{4}$ -watt, 5% resistor  
 C1-C3—47-µF, 35-WVDC, electrolytic capacitor  
 C4—0.0015-µF, Mylar or similar capacitor  
 Wire, solder, etc.

A 555 timer, IC1, is connected in an audio-oscillator circuit with R1 and C4 setting the operating frequency. A squarewave output is fed from pin 3 of IC1 to the input of a dual-diode voltage-doubler circuit. The DC output can supply several milliamperes of current to an isolated circuit.

## LED POLARITY TESTER

Our next entry, see Fig. 7, is a circuit for testing and determining the polarity of "orphan" LEDs. A 6-volt transformer, T1, supplies power to operate the test circuit. Just about any 6-volt transformer will do that can supply at least 20-milliamperes of current to the test circuitry.

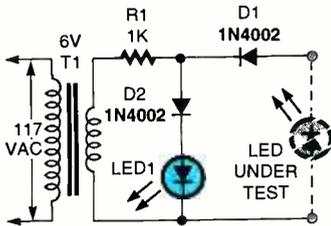


Fig. 7. Use this circuit to test and determine the polarity of "orphan" LEDs.

### PARTS LIST FOR THE LED POLARITY TESTER (Fig. 7)

LED1—Light-emitting diode, any color  
 D1, D2—1N4002 silicon diode  
 R1—1000-ohm, 1/4-watt, 5% resistor  
 T1—6-volt transformer  
 AC line cord with plug, wire, solder, etc.

Resistor R1 limits the total test current to a safe level that's under 10 milliamperes. Without an LED connected to the test terminals, LED1 receives current through diode D2 on each positive cycle. On the negative cycle LED1 is protected from receiving a reverse voltage by the blocking effect of D2.

When an LED is placed across the test terminals as shown in the schematic, and it is in good operating condition, it will light during the negative half cycle. If the LED leads are reversed, nothing happens. An open or shorted LED will indicate so by not giving off a glow. The circuit is obviously not designed to test IR LEDs, because they produce no visible light.

## PROPER-POLARITY ENSURER

Our next entry (see Fig. 8) is a very simple but useful circuit. The four-diode bridge circuit can be used to direct the proper polarity of a DC battery or supply to a circuit. How many times have you said, "Oh darn!" and had to fan the smoke away because you accidentally reversed a battery's connections? If that happens to you this circuit could be the cure.

The 1N4004 diodes indicated in the

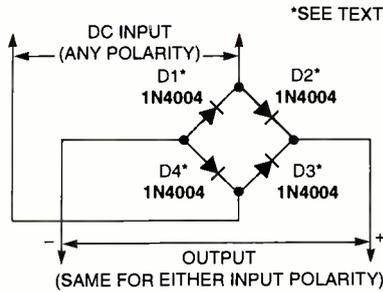


Fig. 8. With this diode bridge, incorrect battery polarity will never harm one of your circuits again.

### PARTS LIST FOR THE PROPER-POLARITY ENSURER (Fig. 8)

D1-D4—1N4004 silicon diode; see text  
 Wire, solder, etc.

schematic will work fine for operating currents below the one-ampere level. Always select diodes with a current and voltage rating greater than your circuit requires. We certainly don't want the cure to become another problem.

Oh, by the way, there is one downside to this circuit. The circuit being supplied with power will lose about 1.2 volts of the power source because of the diodes' forward-voltage drop. Keep that in mind when deciding on what source you'll use.

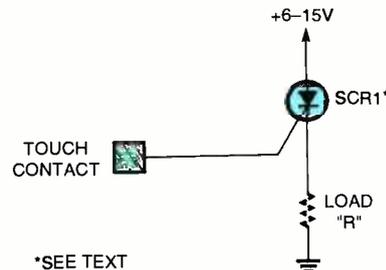


Fig. 9. Need an easy-to-build touch-activated switch? You can't find a simpler one than this one-component circuit.

### PARTS LIST FOR THE TOUCH SWITCH (Fig. 9)

SCR1—See text  
 Touch-contact material, wire, solder, etc.

## TOUCH SWITCH

Our last entry is another simple SCR circuit, which is shown in Fig. 9. Here we have a sensitive gate SCR connected in series with a power

source and a load. When you touch the contact connected to SCR1's gate, the thyristor turns on supplying current to the connected load. As long as the load current is greater than the SCR's holding-current rating the load will receive power.

Any sensitive gate SCR with a current rating suitable for the load can be used. For example, the 2N5060 and 2N5064 types are rated at a maximum load current of 0.8 ampere. Check your component catalogs and you will find a number of sensitive gate SCRs that you can use.

Well it looks like time is running short. So until next month, good circuitry. ■

## KIRLIAN PHOTOGRAPHY

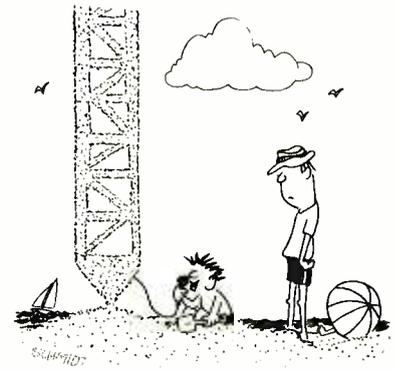
(continued from page 38)

around the entire Kirlian unit is well ventilated. Then stand clear and apply power.

You should hear a hissing sound coming from the electrophotograph stage; that's ozone. Soon you'll see the paper begin to darken in the vicinity of the subject's edges. After 30 to 60 seconds, or when you determine the exposure is long enough, disconnect power, wait a few seconds, and carefully remove the paper (you'll find that residual static charges make the paper stick to the glass plate).

Several exposures can be easily made on one piece of thermal paper, which would be incredibly tricky with regular photographic film. Figure 3 contains a few such sample multi-exposures.

And that's all there is to this Poor Man's Kirlian Photography method. Enjoy! ■



# COMPUTER BITS

## Completing Your Greatest Hits Page

BY JEFF HOLTZMANN

This is part three of a series on putting HTML to practical use. Last time we discussed the basis of all Web hyperlinking: the anchor (A NAME) and reference (A HREF) tags. We'll wrap up this series by showing you how to create basic HTML tables, and show an image of the page in action. We'll also draw some conclusions about what we've learned, and discuss a historical milestone reached this issue.

### HTML TABLES

The beginning of each table looks like this:

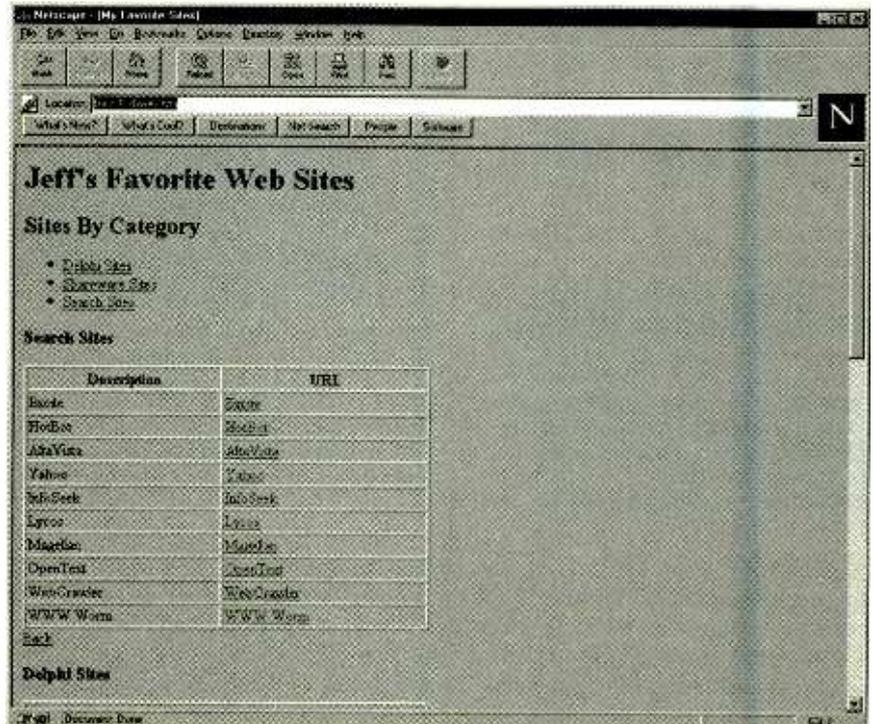
```
<H3><A Name = "ShareWare Sites">ShareWare Sites</A></H3>
<TABLE BORDER WIDTH=50%>
<TR>
<TH>Description</TH>
<TH>URL</TH>
</TR>
```

The first line says that the display will be in Heading 3 (H3) format. The anchor tag marks where in this HTML file the point called "ShareWare Sites" is located. The next line specifies the beginning of a table, where the table is to use half the width of the browser window. You can also specify an exact width, but I'll leave the details to you.

Line three specifies the beginning of a row in the table. Lines four and five specify two cells, each in the table heading format, which is typically rendered as centered, bold text in the default font. Line six signifies the end of the row.

Each subsequent row in the table looks like this:

```
<TR>
<TD>Windows95.COM</TD>
<TD><A HREF="http://www.windows95.com/">Win95.COM</A></TD>
>
</TR>
```



Create a "home" page like this for your browser. You'll learn something about the intricacies of HTML coding, and get something useful as well.

Each TD tag specifies a table cell in the default format: normal text, left justification. As we learned last time, the "A HREF" tag in line three specifies an Internet location where a document is located. The "in-between" text, here "Win95.COM," is what is actually displayed, usually underlined and in an alternate color.

Then we see several more table rows; finally, we close out the table as follows:

```
</TABLE>
<A HREF = "#TOP">Back</A>
```

Line one specifies the end of the table; line two provides a link back to the table of contents at the top of the page.

The rest of the file is then just a series of similar tables, with column one containing some descriptive text, and column two a URL.

### USING IT

The simplest way to use this page is to put a shortcut to it on your desktop. Then, whenever you double-click the icon, your browser will load the page. Assuming your Internet dialer is configured correctly, all you'll have to do is click on the desired links.

You can also designate it as your browser's "home" page, the page that will automatically be loaded whenever you run your browser or click the Home button. In Internet Explorer 3.0, choose View, Options, Navigation, and specify the page as your start page. Or you may want to link it to the Search button or one of the Quick Links. In any case, you'll always be no more than a click away from your favorite sites. In Navigator 3.0, choose Options, General Preferences, Appearance. Then, in Browser Starts With, click Home Page

*continued on page 66*

# DX LISTENING

## Listening From Another Locale

BY DON JENSEN

Most of us do our listening from one place. We quickly become familiar with the shortwave bands as they appear to us as we listen from our homes. But if, for example, we should move, say from New York to California, we would find things have changed dramatically.

We would find, perhaps, certain sig-

During his recent visit, he refreshed his recollections by tuning my receiver in my home.

"What are the differences," I asked him, "between listening to shortwave radio in Brazil and the U.S., particularly the DX-filled 60 meter band, the so-called 'tropical' frequencies just above and below 5,000 kHz?"

for some time now. Some in Colombia, others in Nicaragua and other parts of Central America or the Dominican Republic, just do not come through, or are not heard well, in Brazil, mostly because some strong local SW station is on the channel."

Another factor is the noise level from non-man-made sources.

"I was quite surprised to read, some time ago, that in the Amazon region of Brazil, at every single moment, there are more than 200 thunderstorms going on.

"So if you are, as in Sao Paulo, a few hundred miles from that region, you hear on your radio as static and noise the countless electrical discharges from these storms. It is almost like machine-gun bursts!"

North American SWLs may experience, to a lesser degree, those static crashes during summer T-storms. But in Brazil, a level of background noise can be year-round.

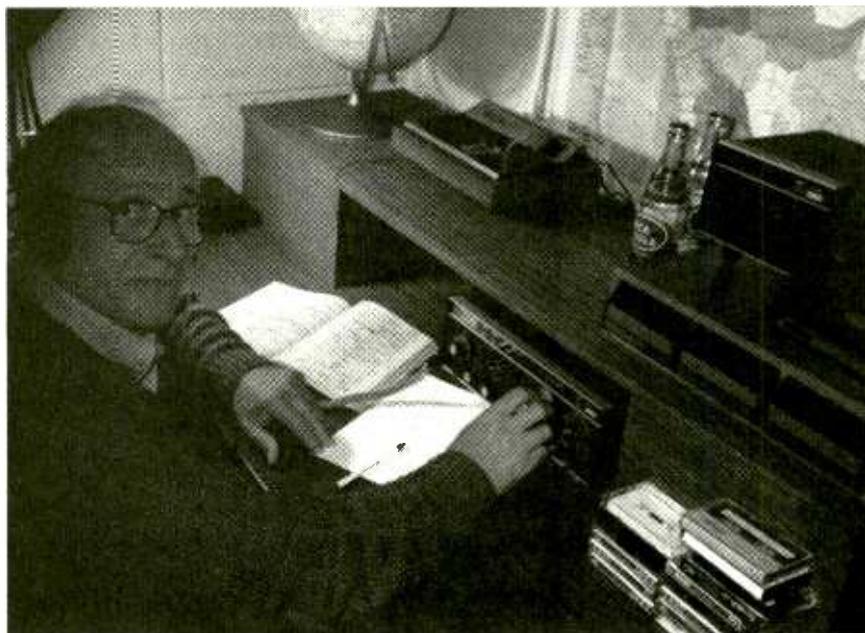
"I remember so darned well my time living in Milwaukee. Those cold winter nights were so quiet for DXing. You can turn your volume way up and really hear those weak stations without much static at all. The signal-to-noise ratio was very favorable, whereas at home, you turn the gain up, the amount of noise is just tremendous."

Finally, Jack observes, it seems better to tune low-frequency shortwave stations located toward the east, rather than to the west.

"It seems to have to do with propagational factors, but from my experience it is true. And for listeners in the U.S., and particularly in the Midwest and West, most South American stations are to the southeast."

In Brazil, on the other hand, SW stations in Bolivia, Peru, Ecuador, Colombia and Central America, are located to the north and west.

All in all, says Jack Perolo, when it comes to tuning in the lower-powered "tropical band" domestic shortwave stations of Latin America, the major tuning challenges of the southern hemisphere, Yankee SWLs may be much luckier than they think.



Here's a photo of Brazilian shortwave DXer Giacomo "Jack" Perolo at his listening post.

nals fade in earlier, or later. Interference may be a problem to a greater or lesser extent. Some SW stations that are commonly heard on the east coast may be difficult, even impossible to hear, on the west.

Imagine the differences in shortwave reception if the comparison points are farther apart, continents apart in opposite hemispheres.

Recently, I was visited by a long-time friend and expert DX listener, Giacomo "Jack" Perolo of Sao Paulo, Brazil. Jack once lived in the U.S. for several years, so he has experience in shortwave listening in Yankeeland.

(CREDITS—Bob Fraser, MA; Harold Levison, PA; Marie Lamb, NY; Ed Newbury, NE; Benton Owsley, CA; North American SW Association, 45 Wildflower Road, Levittown PA 19057)

"There are a number of broadcasting stations in Brazil with relatively high power that operate in these frequencies. They broadcast for long periods causing considerable interference.

"For instance, Radio Aparacida, 5,035 kHz. Depending on the time of night, its strong signal will block with interference a rather wide channel. It will display a rather bad side splash."

American SWLs may look with some envy on Jack's Brazilian location, believing that its proximity to other Latin American countries would make it easier to log some regional broadcasters rarely heard here in North America.

Not necessarily, states Jack.

"There are certain stations that I have been trying for, unsuccessfully,

## TARGET: ICELAND

Not an easy shortwave catch, but one well worth the tuning effort is Ríkisutvarpid RUV, the Icelandic National Broadcasting Service. Not easy because it uses only 10 kilowatts of power on SW and broadcasts in the upper sideband transmission mode. Not easy because it has no English programming. Not easy because its schedule is rather brief.

Still with some effort, and a good bit of patient tuning, logging this broadcaster surely is possible. This is especially the case in the eastern half of North America.

Iceland, of course, is an island of about 40,000 square miles, a bit smaller than Kentucky, located in the far North Atlantic, midway between Europe and Greenland. First settled by Norse colonists about a thousand years ago, the republic has a long history of representative, democratic government.

Ríkisutvarpid, broadcasting since 1930, is an independent public service, owned by the Icelandic government. However, it derives most of its operating funds from domestic listener license fees and advertising.

The broadcasting organization is headquartered in the Icelandic capital of Reykjavik. It has one television channel and two medium-wave stations that cover the whole of the country, plus local radio services for the northern, eastern, and western regions. There also are a number of short-range local FM outlets.

The station is chartered by law with promoting the Icelandic language and the nation's cultural heritage and history. Unfortunately, the former—limiting its SW programming to the Icelandic language—somewhat hampers the promotion of the latter—telling English-speaking listeners about the country's rich historical traditions.

Despite this, the Icelandic National Broadcasting Service is interested in overseas listeners and has an International Relations Department, headed by Dora Ingvadottir.

SW programs are directed toward North America from 1410 to 1440 UTC; 1935 to 2010 UTC; and 2300 to 2335 UTC. The service does tend to alter its frequency selection rather frequently. But during the first two transmission periods, 13,800 and 15,070 kHz seem good bets.

Other registered frequencies worth

trying include: 9,380, 11,580, 11,710 and 15,100 kHz.

Since several of these frequencies are well off the beaten path, if you should come across an upper sideband signal with Nordic-sounding language programming, chances are you've snared this bit of DX.

Your reports can be mailed to Ms. Ingvadottir in care of the International Relations Department, Icelandic National Broadcasting Service, Efstaleiti 1, 150 Reykjavik, Iceland. The e-mail address is [isradio@ruv.is](mailto:isradio@ruv.is).

## DOWN THE DIAL

This month, as every month, we offer a selection of shortwave stations, some easy, some hard to hear, for you to try. You are hearing other SW stations, no doubt, so why not write to get the rest of us know about your current loggings. Or, if you have a question or two about SWling or some special station you've been trying, without success, to hear, why not drop a line to *DX Listening*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735.

For now, check out these:

**BRAZIL**—15,265 kHz. Radio Nacional do Brasil was heard around 1835 UTC with an English-language program about the Brazilian economy.

**CHILE**—6,090kHz. Radio Esperanza has been heard around 0745 UTC with a recorded religious program in English. Later, Spanish programming resumes, with station identification and religious music.

**CROATIA**—5,895 kHz. Croatian Radio has been logged at 0300 UTC on this frequency with a program of English news, followed by station identification and an interval tuning signal. Programming in Croatian follows.

**NORTH KOREA**—6,575 kHz. Radio Pyongyang's English broadcast was noted shortly before 1200 UTC with a woman announcing station identification. The program continued with march music.

**NORWAY**—9,560 kHz. Radio Denmark's English service is relayed by Radio Norway International's shortwave transmitters. This relay signs off at 0255 UTC. It also can be heard at the same time on 7,465 kHz.

**SWITZERLAND**—13,635 kHz. Swiss Radio International has an English language commentary at 1500 UTC. The signal often is excellent. ■

## COMPUTER BITS

(continued from page 64)

Location. Then enter the URL to where the file is stored on your system. For example, assuming you call your file `faves.htm` and put it in the root of your C drive, enter the following:

```
file://C:\faves.htm
```

There is an old saying to the effect that the teacher always learns more than the students. I certainly learned a few things from doing this series. One thing that surprised me is that doing HTML by hand is no fun. Before beginning this project, I thought that all those WYSIWYG editors like PageMill and FrontPage were for wimps, that a good text editor should suffice for anyone with half a brain. I was wrong. It certainly is possible to write HTML by hand. I now recommend a WYSIWYG HTML editor. Anyway, it worked.

## MILESTONE

That's it for HTML. This, by the way, was the 100th installment of this column by yours truly for this magazine. The timestamp on column one reads 10/17/88, which appeared in the February 1989 issue. The subject of column one was buying your first computer. At that time, there were three levels to choose from: 8088, 80286, and 80386. There was also a newly introduced 80386sx, a hybrid 16/32-bit CPU. The screamers of the day ran at 16 MHz, and had maybe four megabytes of RAM. Both Windows and OS/2 were available.

Today, I'm writing this on a 180-MHz Pentium Pro system with 64 megabytes of RAM, and a 1.6-GB hard drive. The CPU clock is more than ten times faster, the data bus is twice as wide, there is sixteen times as much memory, and sixteen times more disk space on this machine than a 1989 hotrod. In other words, that's  $10 \times 2 \times 16 \times 16$  or roughly  $5 \times 103$  times more powerful. Few in 1989 would have predicted 5000 times the power in only eight years. What do you think will happen in our industry by the time column 200 hits the stands? Hint: Moore's law, which states that semiconductor density doubles every eighteen months, is expected to continue unabated for another 20 years before real physical limits are reached. ■

# Think Tank

## Another Winner

BY JOHN J. YACONO  
TECHNICAL EDITOR  
WINDOWS MAGAZINE

Carlos Eduardo Corpeno Dubon has sent in more than enough good circuits to fill this month's column. He'll be rewarded with the customary MCL1010 chip and a kit, in addition to the book we award for single submissions. If you'd like to take a shot at a book or the whole sha-bang, send a schematic and complete description of your circuit(s) to *Think Tank*, Popular Electronics, 500 Bi-County Blvd., Farmingdale, NY 11735.

Before we get to Carlos' circuits, let's continue our discussion on diodes. As I've mentioned in the past, although they're typically used to rectify current (permitting it to flow in only one direction), they can also be used as voltage sources, control-signal generators, or voltage references.

One rudimentary way to make a diode voltage source is to tap an ordinary diode's barrier potential—the voltage that develops across when it's forward biased. The barrier potential is around 0.7 volts for silicon-based diodes and 0.3 volts for germanium units. Note I said "around." In the real world, the potential is not a precise value. It changes with temperature, manufacturing processes, and other factors. So this method doesn't generate a precise or even constant voltage. But that's sometimes okay to power a forgiving analog circuit. It's also useful for generating voltages of an approximate value to signal the presence of current flow in a circuit, perhaps to trigger another circuit. In this context, the diode generates a control signal of some acceptable value, rather than a precise voltage.

To help visualize the concept, take a look at Fig. 1. Figure 1A shows a simple circuit in which an LED will light to indicate when the load receives at least enough current to illuminate the LED. The indicator is useful to signal when the voltage source switches on or off, or when the load resistance drops enough to permit sufficient current flow. (Note the LED just represents any current-sensitive indicator or circuit you want to activate when suffi-

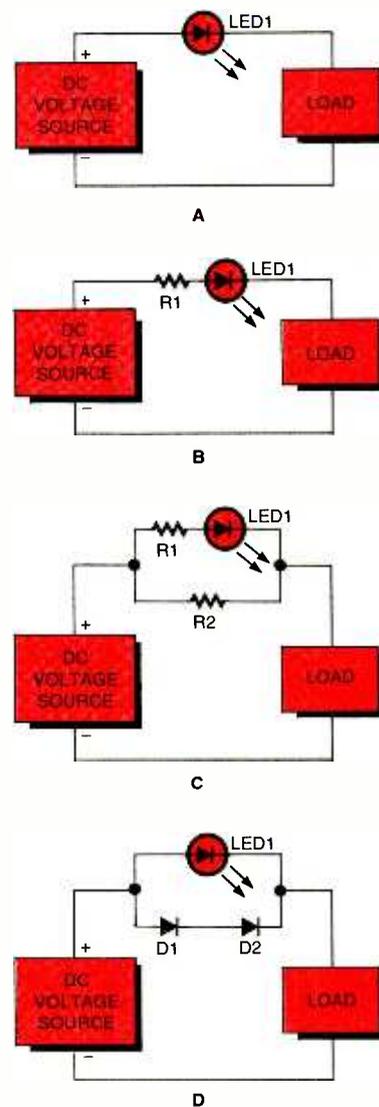


Fig. 1. Here are some ways to connect an LED as an indicator that a load is receiving current: with the LED alone (A), with a resistor in series (B), with a resistor in series and one in parallel (C), and with two diodes in parallel (D). See text for how each configuration works.

cient current flows to the load.)

In this scenario the indicator circuit is both activated and powered by the current to the load, which could present a problem: If the load/source combination in question typically produces more current than the LED can stand, the circuit will surely blow the LED.

Placing a current-limiting resistor of

the right value in the circuit, as shown in Fig. 1B, can reduce the current flow to a safe value for the LED. Unfortunately, it'll also deprive the load of the current it requires for normal operation. So what's obviously needed is to separate the current paths of the load and LED.

To that end, in Fig. 1C we add another resistor (with a value lower than R1's) to permit sufficient current to the load. Another way to look at it is we are using the voltage drop across R2 as a power supply for the R1/LED1 pair. This solution is fine except in circuits where the load current varies to the point it becomes impossible to specify values for R1 and R2 to suit both the current-sensing device (in this case the LED) and the load. It's also not suitable if the load current is so great R2 must be a low-resistance, high-wattage unit that wastes too much power.

What's clearly needed in that circumstance is a voltage that's generated by current flowing to the load, but still fairly independent of the actual value of load current. Something that's better behaved and more predictable would be nice, too, especially if the voltage is to trigger some circuit, rather than just powering a resistor/LED pair.

To that end, check out Fig. 1D. Resistor R2 has been replaced by silicon diodes D1 and D2, while R1 has been dropped altogether. Now when current flows to the load, the barrier potential of the diodes produces a voltage drop across them, rather like the voltage drop across R2. The voltage drop is about 0.7 volts each and since they're in series, the voltage drops combine to supply the LED with around 1.4 volts—regardless of the load or voltage source. If current flows, provided the voltage is sufficient to bias the diodes, the LED will light. You can string more diodes together if a higher signal/supply voltage is needed for the circuit to be triggered/powered.

We'll continue this discussion on using diodes as voltage references and sources next time. Let's turn to the letters now.

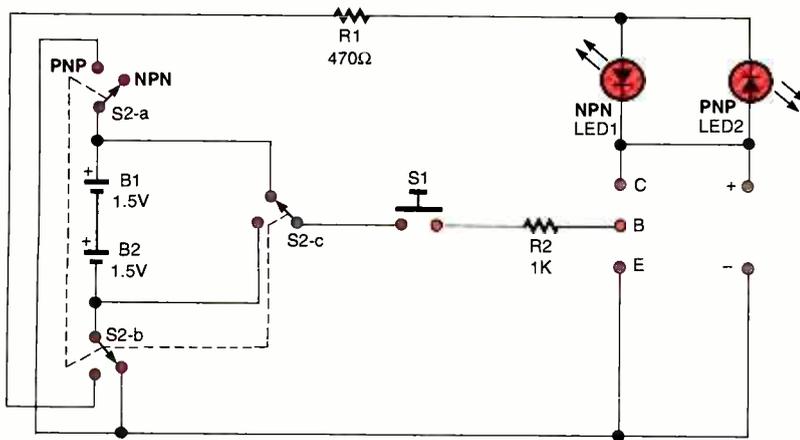


Fig. 2. This circuit is a great component checker that works by lighting corresponding LEDs.

## COMPONENT CHECKER

The circuit in Fig. 2 is a great component checker that works by lighting corresponding LEDs. If you insert a transistor's B and E leads (or a shorted transistor) to the C and E sockets, an LED will light, but you will know that the transistor is placed in the wrong position because the proper LED should light only when you press S1. You may want to use 5 sockets placed "C-E-B-C-E" to avoid bending the transistor leads. A bi-color LED may be used instead of the two plain LEDs shown.

With the transistor-lead sockets you can also check SCRs, LEDs, etc. For SCRs, place the polarity switch in the NPN position, and insert the A, K, and G leads in the C, E, and B sockets, respectively. Momentarily press S1 and the "NPN" LED should light and stay on when you release the switch. To check LEDs, place the polarity switch in the NPN position, and insert the LEDs anode and cathode in the B and E sockets, respectively. Pressing

S1 should cause a good LED under test to light.

There are two more sockets, labeled "+" and "-", which can be used to check diodes, continuity, capacitors, etc. To check a diode, place the polarity switch in the NPN position, insert the diode placing its anode and cathode into the + and - sockets. Press S1, the "NPN" LED should light. To check continuity, place the polarity switch in any position, insert test leads into the + and - sockets, press S1, and a polarity LED should light if the path under test conducts.

To check capacitors, insert the capacitor leads with the correct polarity in the + and - sockets. Then rapidly change the polarity to PNP, then to NPN, then back to PNP. The LEDs should light alternatively. This test only checks charge and discharge, not capacitance value.

—Carlos Eduardo Corpeno Dubon, Comayaguela, Honduras

For this type of test circuit, I like using SIP sockets to accept test leads.

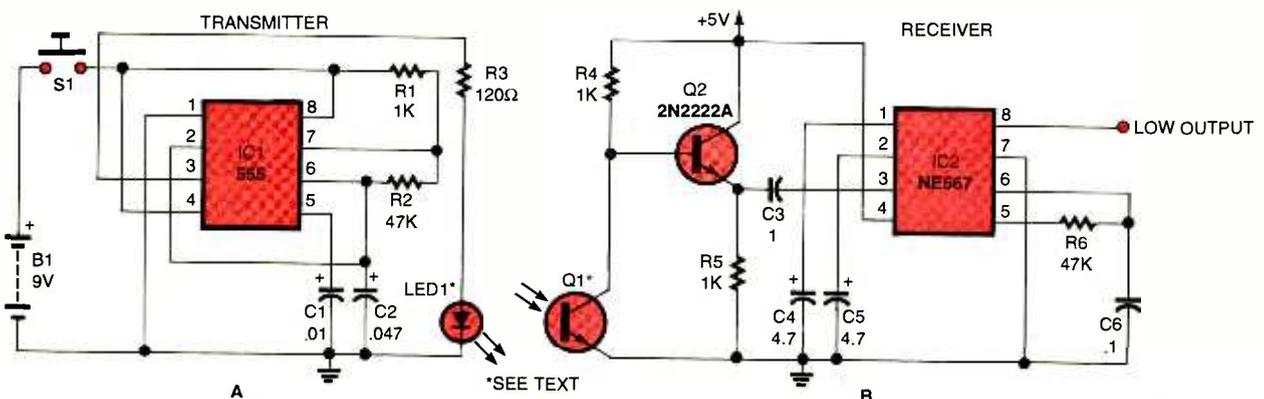
A strand of 5 positions for the C-E-B-C-E socket and 2 separate sockets for the + and - terminals. Alternatively, you can chop up an IC socket with a hacksaw or MotoTool to make the strips you need.

## REMOTE CONTROL

Figure 3 shows a remote-control transmitter and receiver. The theory of the circuit's operation is very simple. The transmitter (Fig. 3A) generates IR light pulses at a frequency of 320 Hz (set in part by R2). The pulses arrive at the collector of the phototransistor and are amplified by the 2N2222 transistor. An NE567, IC2, is tuned to 320 Hz (by R6), so if pulses of any other frequency arrive at the phototransistor, the NE567 recognizes this frequency and pulls its output low.

If you wish to change the NE567's operating frequency, you'll have to adjust R2 and R6 to the same value. Keep in mind that the NE567 will work between 100 Hz and 1 kHz. You can also add more resistors (for more frequencies) instead of R2, and more NE567s tuned at the desired frequencies in order to make a multi-channel remote control system.

If you want to control a DC motor, a momentary load or an on/off load, there are some useful interface circuits in Fig. 4. Figure 4A shows a DC-motor controller that requires the outputs of two different channels (CH1 and CH2). Note that it doesn't matter if the channel outputs are active low or high; what matters is that CH1 must be different from CH2 for the motor to be energized. The circuits in Figs. 4B and 4C are momentary load controllers for



both active high and low channel outputs, respectively. The circuit in Fig. 4D is a toggled-load controller. If you have an active-high channel output, you must add the inverter shown.

—Carlos Eduardo Corpeno Dubon, Comayaguela, Honduras

I'd recommend a lens system for the transmitter and receiver. Also be sure the IR components are a matched pair.

## LOGIC PROBE

Figure 5 shows the schematic for a versatile logic probe. The Zener diode clamps the input signal just above the TTL inverter's 2.2-volt trigger voltage. Zener-diode D1 can be left out if the probe is going to be used on only TTL circuits.

The logic probe is based mainly on inverters IC1-a and IC1-b, which are sections of a 7404 integrated circuit. Depending on whether the input is high or low, the inverters enable AND gate IC2-a or IC2-b, which are sections of a 4081. Each AND gate is connected to an oscillator, one low-frequency the other high. When an AND gate is made high, it passes the frequency of its oscillator to the Piezo buzzer (BZ1). Whenever there's a high at the input, the buzzer will produce the high tone, whenever there's a low at the input, the buzzer will sound the low tone.

With switch S2 in the "pulse" position, if there are pulses present at the input, a yellow LED will light and the buzzer will sound at the frequency of the pulses.

The CMOS/TTL switch selects the voltage from the circuit under test or the voltage from the 7805 regulator. Note that when this switch is in the TTL position, it can only work with 5-volts DC, but when the switch is in the CMOS position, it can work from 7.5- to 35-volts DC.

Since this circuit is intended for TTL and CMOS circuits, a 4049 can be used instead of the 7404, simplifying all the CMOS/TTL switching. But the only inverter available at the time of construction was the 7404.

—Carlos Eduardo Corpeno Dubon, Comayaguela, Honduras

A pulse stretcher at the input would be a nice addition for detecting brief pulses. A latch circuit at the output would also be useful for catching intermittent events.

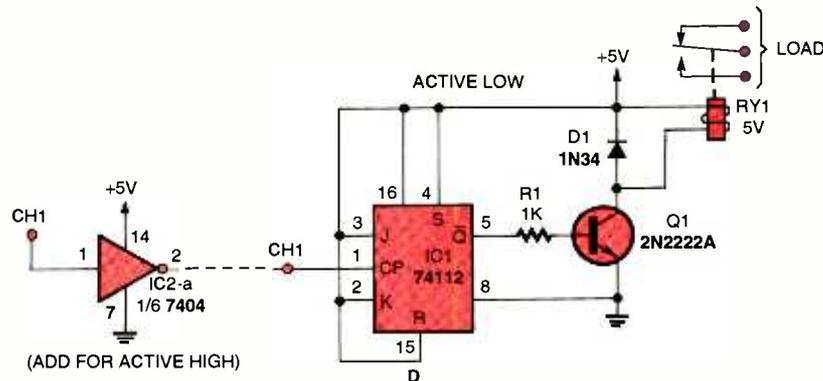
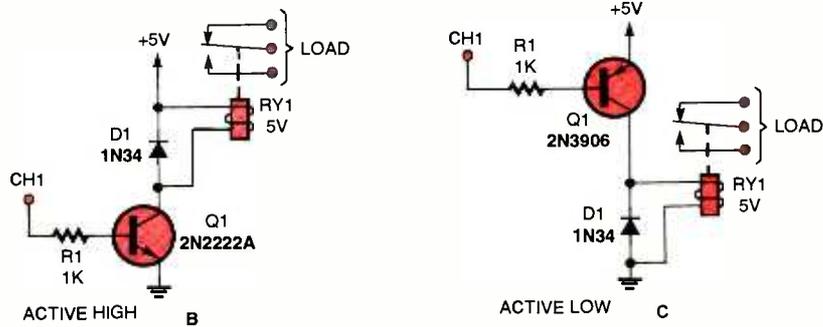
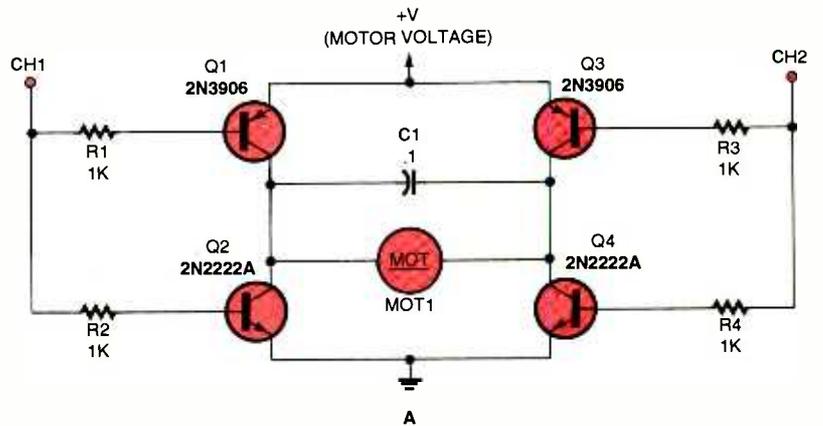


Fig. 4. These circuits work with the remote control in Fig. 3. There's a DC-motor controller, momentary load controllers for both active high- (B) and low-channel (C) outputs, and a toggled-load controller (D).

## MODEM PROTECTOR

A common problem in modem communication is that family members often pickup extensions during a modem call. In order to prevent this problem, I looked for modem-protection circuits, but all I found was a semiconductor (apparently an SBS), which had to be connected in series with each phone extension. I tried that semiconductor, but sometimes it just didn't work. So, I made the circuit in Fig. 6 because I thought it would be better to completely disconnect all the other phones whenever I'd like to use my modem.

The purpose of the LED is to indicate when S1 is in the Modem position but there's no modem connection. This LED is included because sometimes I left home with the switch in the Modem position, leaving my family phoneless! The LED is off when S1 is in the Telephone position or if the modem's in use. The indicator will also light alternatively if you've got S1 set to modem during an incoming call, letting the user know that the phone should be ringing.

Note that this circuit induces some noise when the switch is moved to a different position; however, this noise,

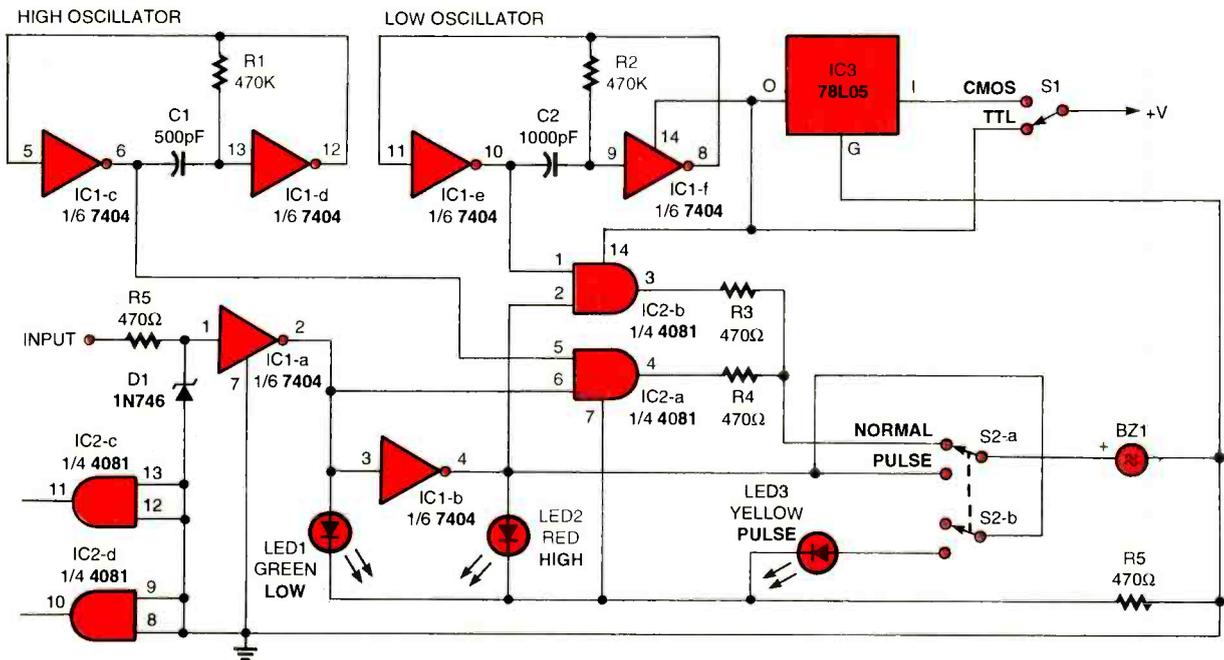


Fig. 5. Here's a versatile logic probe that's sure to impress any hobbyist.

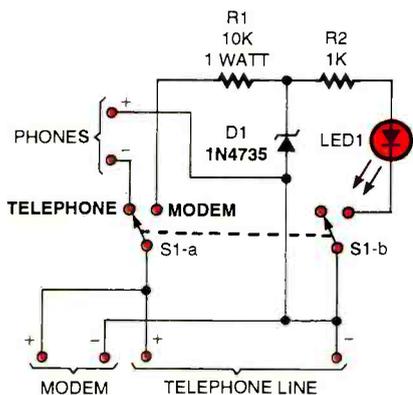


Fig. 6. Forget about having your downloads messed up by someone lifting a phone. This circuit completely disconnects all phones on a line when you are using a modem.

unlike the phone-pickup noise, doesn't make a pulse. So, if you have a pulse line, it's OK to switch while dialing. But remember never to move the switch while using your modem, always do it before dialing instead.

—Carlos Eduardo Corpeno Dubon, Comayaguela, Honduras

*Nice thinking. One last thing, this circuit should obviously be installed in front of the first telephone in the home circuit.*

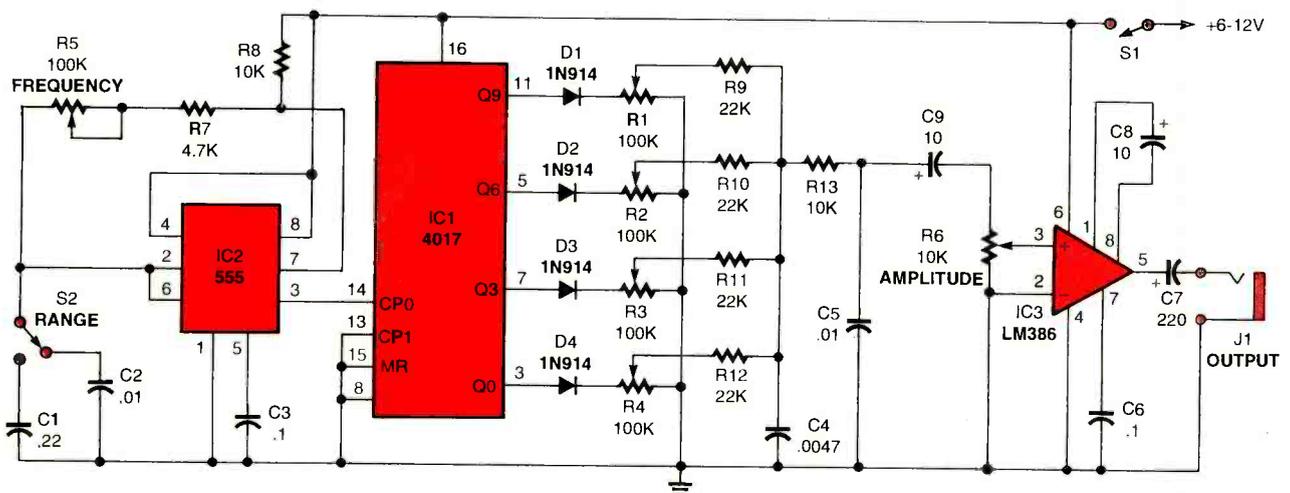
### DESIRED-WAVEFORM GENERATOR

I designed the circuit in Fig. 7 with a friend of mine. It is a filtered step-func-

tion generator in which the wave amplitude at each step is set by a linear potentiometer (R1-R4). By arranging the potentiometers in time order and side-by-side (the way they are in a graphic equalizer) the position of the knobs describe the output waveform.

The 555 oscillator, controlled by R5 and C1 or C2, sets the duration of each step, and therefore also the wave frequency. Potentiometer R5 controls the step frequency and the capacitors define the frequency range. If you wish to extend the frequency range, you may want to add some more capacitors, switched by a switch with more

*continued on page 74*



# ANTIQUE Radio

## Mailbag Time!

BY MARC ELLIS

It's been a while since we looked at the mailbag, so let's go through it now and see what's been piling up!

### STAR ROAMER MEMORIES

A good place to start, I think, would be with the comments that have accumulated on the recent Star Roamer restoration. Here's a quote from reader Dean Huster (Oklahoma City, OK):

receivers: the *middle of the line* Star Roamer, The R-55A, and the R-100A. (You may have been confused by the advertising, which may have emphasized the R-55A and R-100A as ham-band receivers. I assure you that they were general-coverage receivers with ham-band-only bandspread dials.)"

Dean's analysis of my thinking was accurate. I was comparing the Star Roamer with simple regenerative

The Star Roamer probably had appeal for both groups, although, as Dean suggests in his interesting letter, it had serious shortcomings as a ham set.

The Star Roamer series also resonated for Ron Rumble (Schaumburg, IL) because he built one in 1964 and has recently gone over the old kit and upgraded the circuitry. He substituted a full-wave rectifier for the selenium stack, put in larger filter capacitors, and installed a Zener-stabilized supply to supply key plate and screen voltages. Several improvements were made in the audio circuitry, and a serious noise-limiter circuit from an ARRL handbook replaced the perfunctory original hookup.

He also mounted the broadcast loopstick antenna on standoffs *outside* the perforated back (actually, I mounted mine similarly, assuming it was the original position). Moving that antenna further from the metal cabinet greatly increased sensitivity. A small winding was also added to the "cold" end of the loop to allow for the use of an outside antenna—an option not originally available on the broadcast band.

Talking about his modifications, Ron says: "This is what I would have done when I assembled the kit, had the technology been available 30 years ago. Granted, this is something like upgrading a Ford Model A to a Ford Escort engine, 12-volt electrical system, and hydraulic brakes. Some people wouldn't like the result, but I would rather use a *new* Model A to take me to and from work every day."

Howard Krausse (Ann Arbor, MI) writes that the Star Roamer was his first shortwave radio as well as his first electronic kit. He was so excited when he got the kit (he was 12 years old at the time) that he began working on it minutes after it arrived at the house, and continued non-stop until it was done. It worked well, and he's never forgotten the thrill of receiving those first shortwave stations.

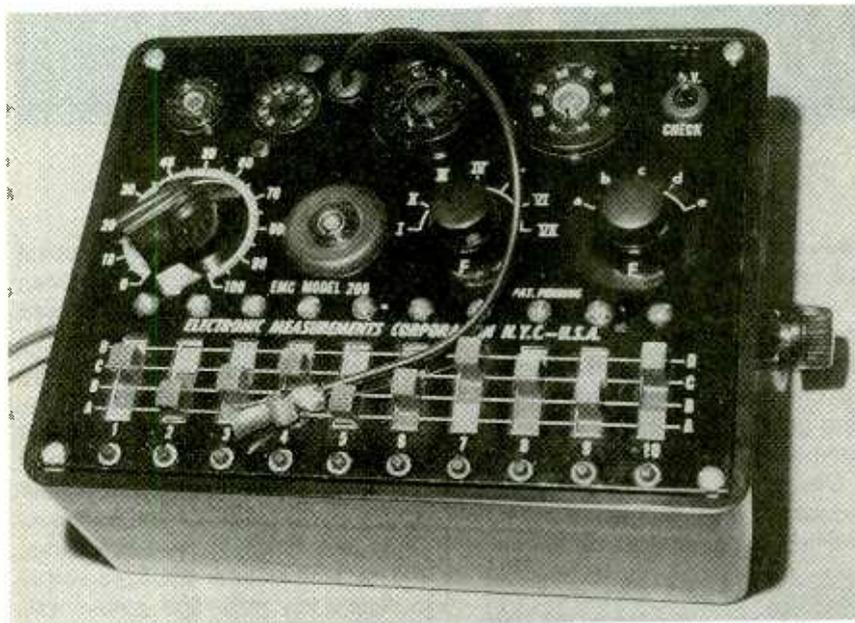
Later, Howard (reluctantly) sold the Star Roamer for \$15, which he put toward his first ham station (he is now



One of the three "low-end" regenerative receiver kits offered by Allied in the 1960's.

"I have to take exception with your statement that the Knight Kit Star Roamer 'was the top of the line of Knight shortwave receiver kits.' ... At the time, Knight-Kit made three decent

Knight Kit receivers such as the Span Master, Ocean Hopper, and Space Spanner—which were aimed at the less well-heeled shortwave listener rather than the ham-radio operator.



Can anyone help Doug Fox with the data on this cute little EMC 208 tube tester? (See text for details.)

KE8M). Last year, he had an opportunity to buy a mint Star Roamer, also for \$15, at the Dayton Hamvention and snapped it up. Says Howard, "The set works as well or better than my original, and the stations it picks up are somehow more exciting than the ones I receive on my fancy Japanese rig!"

Don Rapp (Ste. Genevieve, MO) acquired his Star Roamer as a Christmas gift when he was about 13. He still has the set, which he credits with sparking his interest in an electrical engineering career. Don replaced the filter caps about 15 years ago, and still takes out the set from time to time to do some listening. He has some interesting things to say about the therapeutic value of working with the technology of a less frantic era:

"Although I work with computers and do industrial controls professionally, there is something missing in the level of understanding associated with the new technology .... Knowledge and technology turn over in shorter and shorter time periods such that we are now in what seems like a perpetual learning curve to the future. I enjoy learning, but when you have to spend all your waking hours in pursuit of techno-knowledge, even the enjoyable can become a burden."

Thanks also to Earl Amdale (Palmer, AK), who sent along Star Roamer information and offered assistance. And a bit thank-you to Larry Cook (362 East South Street, Richland

Center, WI 53581-2721), who has a complete Star Roamer manual and offers to make copies for anyone needing one.

## BOAK CARTER REPRISE

W.R. Cobb (Laguna Hills, CA) writes: "I hate to keep harping on the subject of Boak Carter, but errors must be corrected before they become Gospel. You stated that he was a local New York City reporter (*Antique Radio*, July, 1996), but we regularly listened to him in Portland, Oregon. He was as well known as *Walter Winchell*."

G.L. Johnson (Wonewoc, WI) tells us that Boak was heard in the Milwaukee area in the later 1930's, probably on a Chicago station. His accent sounded "English" to the youthful Johnson's ears, and his standard sign-off was a grave and dignified "... and so Philco and I say to you, cheerio."

And, finally, here are some comments from reader L.D. Kelsey, NP4RH (Old San Juan, PR): "I recall clearly that Boak Carter was definitely on a nationwide hookup in the 1930's and part of the 40's. I regularly listened to him in the San Francisco area at about the same time in the afternoon as H. Von Kaltenborn and others did their broadcasts. Boak Carter was one of our better news commentators during the period when the nation was gradually awakening from its isolationist phase ..."

## LITERATURE AND PARTS FOR SALE

Because of the fairly long interval between our "mailbag" columns, and the fact that some three months go by between the time I write this column and the time it appears in print, the items below might no longer be available. Still, if you are interested, it would be worth the price of a postcard to inquire.

John K. Walcott (1862 Spruce Lane, Benbrook, TX 76126) has a large collection of radio parts dating from the late 1920's through the '40's. He has no use for the parts and would like to put them in the hands of people who share his interest in preserving things of the past. John would like to make contact with a radio-collector's club in his area to arrange a deal. Price is negotiable but he'd like it to be fair. Because his own collecting interests center around antique tools, there might be an opportunity for some horse trading.

Old literature enthusiasts might want to contact H.H. Bloom (Soundmaster, Ltd., 386 MacLaren Street, Ottawa, Canada K2P 0M8). He is interested in selling a collection of many old and well-preserved electronic catalogs.

## HELP WANTED!

When he was a boy, Bob Firhau (108 South Ellyn Street, Glenn Ellyn, IL 60137) built a "pocket" shortwave radio from plans in a circa-1934 issue of *Short Wave Craft*. It used a type 30 tube. The whole thing was housed in a Gorton's Codfish box that measured about 4x6x2 inches. Four-prong plug-in coils, wound on old '80 tube bases covered the broadcast band through 19 meters. Power came from two "D" cells and a small 45-volt battery.

Bob heard World War II unfold on this hot little set, which picked up a good selection of Allied and Axis stations. He'd like to recreate it—if he could find the original construction article. He'd also like to find a source for a type 30 tube or suggestions for transistorizing the circuit.

Julio Diaz Gonzalez (RR#3, Box 5022, Rio Piedras, San Juan, PR 00926) is looking for a good source of old radio parts, particularly five-prong tube sockets. Coincidentally, around the same time I received a letter from

*continued on page 74*

# SCANNER SCENE

## Variety is the Spice of Scanning

BY MARC SAXON

**R**adioShack has brought forth a nifty new mobile MHz inhaler dubbed the PRO-2046. It's amazing how these small mobile scanners can now incorporate many of the sophisticated and advanced features that once were the in the exclusive realm of desktop units.

Basically, the PRO-2046 provides 100 memory channels plus 10 more monitor channels. The frequency coverage takes in the 29- to 54-, 137- to 174-, and 806- to 956-MHz FM bands

The IF frequencies are 10.85 MHz and 450 kHz. Selectivity at  $\pm 11$  kHz is  $-6$  dB; at  $\pm 15$  kHz, it's  $-50$  dB. Sensitivity is rated at  $0.7 \mu\text{V}$  between 137 and 512 MHz, at  $0.5 \mu\text{V}$  below 54 MHz, and  $0.8 \mu\text{V}$  above 806 MHz. In the VHF aeronautics band, it is  $2.0 \mu\text{V}$ .

The PRO-2046 comes in a slick-looking package that weighs a tad over two pounds. This is a lot of radio for any mobile unit. You might want to check it out at your nearest RadioShack.



RadioShack's PRO-2046 packs a lot of features into a mobile scanner.

(except for the cell phone bands). It also receives the 108- to 137-MHz VHF aeronautics band. The memories, which are set up in 10 banks of 10 channels each, will retain stored data for at least 14 days without power.

Front-panel buttons permit instant scanning of preset VHF police, fire, emergency, Department of Transportation, highway, and other public-service channels. Of course, you can search out new frequencies, too. The PRO-2046 allows you to do it in 12 preset frequency ranges. While it's searching, it can skip over unwanted data signals plus any 20 other user-selected frequencies. Normal search/scan speed is 50 channels per second, but while searching it will do 100 channels per second and, between 29 and 54 MHz and 137 and 174 MHz, it will sort through up to 300 channels per second.

### WHICH ARE YOU?

Ron Cunningham, of Ontario, Canada, wrote to say that his friends sometimes tell him that they have become bored with scanning. He thinks it's because folks seem to get locked into one type of listening out of habit, forgetting that there are variations on a theme. He suggests that if you sometimes think that you're getting into a scanning rut, try mixing in one or more other approaches to the hobby, just to add some spice.

You say there's only one approach? No way!

One popular way to use a scanner is to spend most of the time monitoring the same group of agencies or frequencies in order to monitor their communications traffic.

Another way is to look up the frequencies of specific agencies and

companies that you have never before monitored, especially ones that are semi-local to you. Then see if you can receive them. Are your skills and equipment good enough to drag in those stations from the surrounding counties? You don't necessarily have to be fascinated by the contents of the communications traffic. Just pull it in and log it.

Then, another way to enjoy a scanner is by entering low and high frequency limits so that the radio can search through the spectrum, rooting out previously unknown stations and frequencies. Who knows what amazing new things you might discover, particularly in those bands that you seldom or never tune—such as 30-44, 72-76, and 148-150 MHz. Search in segments of no more than 1 MHz at a time, and plan to spend at least an hour or two before moving on to the next segment.

A worthy way to participate in the monitoring hobby is to concentrate one's efforts on a particular category of stations, seeing how many you can log. For instance, how many different law-enforcement agencies can you monitor from your location? How many hospitals? How many private security forces? There you go!

### V-LINK COMMUNICATORS

Several requests have come in asking if we know of the frequencies used by the 19-channel V-Link handheld communicators—license-free units intended to look like cellular phones. They are said to be sold for about \$70 at WalMart and several other large chains, including Toys-R-Us.

Actually, we did not know the frequencies for the V-Links. But reader Larry Burkett, of Lexington, Kentucky, was kind enough to send in a listing of all 19 V-Link channels. That solved our dilemma, so be sure to keep this information handy.

Beginning with Calling Channel 1,

and going through to Calling Channel 19, the frequencies are: 916.875, 915.8625, 915.00, 914.0875, 913.3375, 912.000, 910.9125, 910.2375, 909.3375, 908.500, 907.6625, 907.000, 906.3375, 905.6625, 904.500, 903.4865, 903.000, and 902.500 MHz. Yes, it looks odd, but it's not an error! Calling Channel 1 is the highest frequency, and the frequencies descend to the lowest one at the highest numbered Calling Channel.

## MAIL SACK

A note from David W. Jones, of Citrus Heights, California, provides information on the local U.S. Postal Service motor-vehicle services channel (on-the-road vehicles, mechanics, fleet control). The frequency is 164.985 MHz. David also mentions that the U.S. Postal Inspection Service tactical and surveillance frequencies in his area (see above) are 488.225 and 488.675 MHz, and notes that the operations are in WFM mode.

## AN OLD CUSTOM

If you have ever monitored 165.2375 MHz, then you've heard one of the busy operational channels of the U.S. Customs Service. Field portable and mobile units on the frequency identify by coded unit numbers that denote their type. According to the Radio Monitors Newsletter of Maryland (P.O. Box 394, Hampstead, MD 21074-0394), Alpha numbers are individual Customs Service agents, while India series numbers represent Customs Inspectors. Lima numbers are Customs aircraft, Mike units are vessels, and Papa numbers denote vehicles. If you hear a Kilo number on the Customs channel, it's an FBI aircraft.

It might be worth noting that FBI aircraft operating on FBI and other frequencies usually identify with Idaho numbers. In addition, U.S. Customs aircraft on surveillance missions often identify by the code name Omaha followed by numerals.

That's a wrap for this month, but be sure to join next time. We are always looking forward to hearing from you with information or questions about our hobby, reports on new frequencies you have discovered, suggestions or whatever. If it relates to VHF/UHF monitoring or scanning, write to *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

## ANTIQUÉ RADIO

(continued from page 72)

Dave Eley (Surrey, BC, Canada) recommending Steinmetz Electronics (7519 Maplewood Avenue, Hammond, IN 56324; Tel: 219-931-9316) as a gracious and resourceful parts source. Steinmetz welcomes inquiries for odd-ball items, but asks that they be accompanied by a #10 self-addressed stamped envelope.

New to the antique-radio hobby, 17-year-old Sean Barton, KB0OVD (RT-1 Box 247, Troy, MO 63379) has requested help with a couple of specific problems: 1) What markings were originally around the knobs of the Philco 39-35, and where can one obtain "Philco Style" square rubber shock mounts; and 2) Can someone supply a description or a good photo of the unusual grille cloth used on the Grigsby-Grunow Majestic 130A?

Joseph T. Coyle (1 South Maple Street, Corning, NY) accidentally left his AK Model 36 on all night and experienced a power-supply meltdown. The result: potting goo running all over the place. Joe's idea is to build a replacement supply. He wants to know how to determine the operating voltages to be placed on the 13-lead "umbilical" cable. An experienced restorer might be able to help Joe salvage the original supply.

Another person who sounds as if he is just getting his feet wet in the antique-radio hobby is about to come into possession of an early 1920's radio (not specified) and a 1940's Philco console. He has asked for advice on parts sources and restoration procedures. Stan Dereska lives at 5912 Dinwiddie Street, Springfield, VA 22150. Please contact him if you'd like to share your knowledge.

R. Buchborn (Astabula, OH), Phil Fries (Bayside, NY), and anyone else who would like to know more about the "full wave" crystal set, discussed in the October 1996 *Antique Radio* column, might like to try contacting the builder directly by mail. He is Gustaf O. Linja (848 Eighth Street, Lake Linden, MI 49945). Be sure to enclose a self-addressed stamped envelope if a reply is expected.

That's all for now. In the meantime, let us know about the pieces you have found or added to your collection. See you next month! ■

## THINK TANK

(continued from page 70)

poles than S2. (If you want to change the frequency, remember that the 4017 works up to a few MHz.)

The output of the 555 is applied to the clock input for the 4017 decimal counter, which activates its outputs one at a time. The linear potentiometers divide the voltage of each output, and thus determine the output voltage at a given step point. The schematic only shows potentiometers in Q0, Q3, Q6, and Q9, but for smoother waveforms there should be potentiometers at all the outputs except the Carry-Out pin. The composite waveform is now purified by the filter formed by R13, C4, and C5, so the output will be rounded.

The amplitude is controlled by the LM386 audio amplifier's input. If you're going to use the circuit for high frequencies, I recommend replacing the amplifier with a 741 or other high-frequency op-amp, provided you change some of the op-amp's external components.

—Carlos Eduardo Corpeno Dubon, Comayaguela, Honduras

*That's a real neat concept. Note that if you want more steps it is possible to wire in another 4017 and some logic so that each counter takes a turn counting. Hint: each counter's halt input (pin 13) should be connected to its tenth output (pin 11). That output should not have a linear potentiometer. Also, each chip's tenth output should supply a reset pulse to the other chip through some kind of pulse generator.*

That's all for this month. See you next month with more interesting circuits and such. ■



*"No, I didn't bring extra batteries. These are rechargeable types!"*

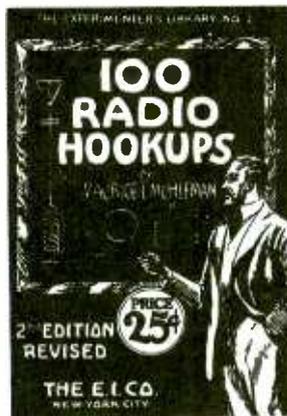
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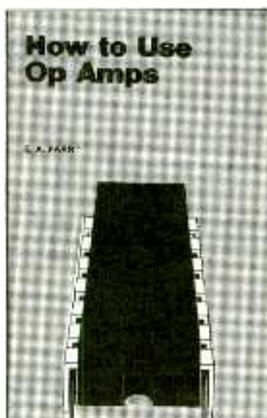
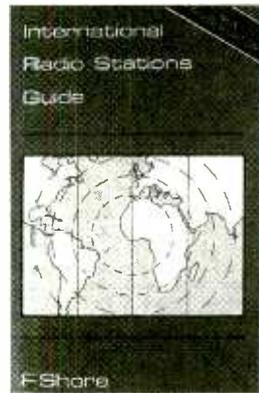
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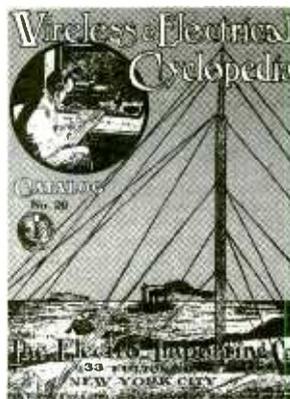
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Lasers, Tesla, Ions, Anti-Gravity, Magnetics & More!

Plans • Ready-to-Use • Easy-to-Build Kits

**Laser Ray Gun**  
Handheld, battery operated. Produces an intense burst of light capable of burning holes.  
LAGUN2 Plans ..... \$20.00  
LAGUN2K Kit / Plans ..... Price on Req



**250KV Tesla Coil**  
10-14" of Explosive Bolts of Lightning!  
• Transmit Wireless Energy  
• Ion Motors  
• Anti-Gravity  
• Strange and bizarre pyrotechnical effects  
• Many other experiments shown in detail  
• Award winning science project!  
BTC3 Plans ..... \$15.00  
BTC3K Kit/Plans with coil ..... \$299.50  
BTC30 Assbl'd Ready to Use ..... \$399.50  
BTC4 Plans, 500KV unit ..... \$20.00



**ATTENTION: Experimenters & Researchers!**  
Anti-Gravity, Rail & Coil Guns, Mass Warping, Levitation Research, Exploding Water, Propulsion Drivers, Lattice Snapping, EMP etc. Loss-less Energy Charger with triggered spark switch. • Adjustable 500 to 3KV out • Charges up to 25KJ • Programmable Output  
HEP1 Plans ..... \$15.00  
HEP1K Kit/Plans with 500J ..... \$399.50  
HEP10 Lab Assembled - to your spec's.  
Write, call or fax for price & delivery



HEP10  
...shown connected to potential rail gun system

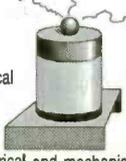
**Visible Beam Gas Lasers**  
Millions degree temp equiv. Illuminates low level clouds  
• Light Shows  
• Window Listener  
• Optical Projects  
• 12/115V  
• Science Project  
LAS1KM 1 mw, low cost Kit ..... \$69.50  
LGU6K 2-3mw Kit ..... \$119.50  
HNE70 5-7mw, ready to use ..... \$299.50



**Gravity Generator**  
Levitate an object!  
Great science fair project!  
GRA1 Plans ..... \$15.00  
GRA1K Power Supply Kit/Plans ..... \$99.50  
GRA10 Assbl'd Kit/Plans ..... \$149.50  
Includes text book on Anti-Gravity theory!



**Solid State Tesla Coil**  
• Generate fiery electrical plasma discharge  
• Powers light and objects without contact  
• Experiment with electrical and mechanical fields. TCL5 Plans ..... \$8.00  
TCL5K Kit/Plans 12VDC ..... \$49.50



**Pioneer a Futuristic Weapon!**  
Electric Gun - prototype designed in our lab - Join the research!  
• Ballistic Velocities  
• Handheld • Battery Operated  
• Labelled as DANGEROUS Product  
Experiment now before it is classified as a firearm! EGUN1 Plans ..... \$20.00  
(Must be 21 for purchase of hardware)



**Ion Ray Gun**  
Project Energy!  
Star Wars technology demonstrates weapons potential. IOG7K Kit/Plans \$99.50



**"Talking" Plasma Globe**  
Spectacular color. Pulsates to music, sounds!. 8-9", with intensity and sound controls. PLASMA1 Ready to Use . \$79.50



**Electronic Hypnotizer** *Caution Required*  
Control their minds! Programmable audible and visual stimuli induces hypnotic trances. HYP2K Kit with Book ..... \$39.95  
EH2 Hypnosis Book & Plans ..... \$14.95



**We can design and build high voltage systems - to your specs!**  
Call or fax us with your requirements!

## TACTICAL ELECTRONICS

**Cybernetic Ear!**  
Enhances normal hearing 3-4 times!  
Adjustable volume control, fits easily into either ear. Many, many uses.  
Ready to Use!  
CYBEREAR .... \$19.95



**ALL NEW Telephone Line Grabber/Infinity Transmitter**  
Use tone phone anywhere in the world to:  
• Monitor your premises - avoid break-ins  
• Access ongoing calls - longwinded kids  
• Control up to 8 appliances in your home!  
• Re-direct costly toll calls from pay phones!  
TELCON3 Plans (credit to purch) .. \$ 10.00  
TELCON3K Plans/Kit ..... \$99.50  
TELCON30 Ready to Use ..... \$149.50



**Long Range "Ultra-Ear"** Parabolic Mic can hear a distant whisper!  
20" dish uses satellite technology to capture distant sounds. PMS5 Plans ..... \$ 8.00  
PMS5K Kit/Plans ..... \$149.50  
• Optional Wireless Retrofit transmits captured sounds to an FM radio.  
WM5K Kit for Wireless Option .... \$29.50



**Phasor Sonic Blast Pistol**  
Rids areas of unwanted pests. Trains and conditions wild and domestic animals. Great for barns, attics, cellars, gardens.  
PPP1K Kit/Plans ..... \$39.50



**3 Mi Telephone Xmitter**  
• Tune-able 80-130 Mhz • Undetectable  
• Only transmits when phone is used  
VWPM7K Kit/Plans ..... \$39.50



**3 Mi Voice Transmitter**  
• Ultra-Sensitive Mike  
• Crystal Clear  
• Tunes 80-130 Mhz.  
FMV1K Kit/Plans ..... \$39.50



**FireBall Gun**  
Shoots flaming ball - two shot capacity. Great for special effects and remote fire starting. CAUTION REQUIRED!  
FIREBALL Plans (dangerous product) . \$10.00



**Shocker Force Field/Vehicle Electrifier**  
Make hand and shock balls, shock wands and electrify objects. Great payback for those wiseguys!  
SHK1K Easy to Assemble Kit ..... \$19.50



**Extended Play Telephone Taping System**  
• Tapes Phone Conversation • Extends Tape X4 • Check Local Laws before using!  
TAP30X Ready to Use ..... \$84.50



**"Drop-In" (Imi) Telephone Transmitter**  
Easily tunable over FM radio. Never needs battery! #DROPIN Kit/Plans ..... \$ 19.95



**See In Total DARKNESS!**  
• High Quality IR Night Vision Scope with IR illuminator.  
SD10 Ready to Use ..... \$199.50



**Electric Charge Gun**  
Life is Precious - PROTECT IT!  
Stuns & immobilizes attackers 15 feet away! Check your state laws for legality. More knockdown power than most handguns. No permanent injury. ID coded.  
ECG1 Data (Creditable to purch) ..... \$10.00  
ECG10 Charge Gun, Ready to Use, Includes FREE Stun Gun! ..... \$249.50  
STUN GUNS - sold separately:  
STUN100 100,000 Volts ..... \$34.50  
STUN200 200,000 Volts ..... \$49.50



**3 Mi Tracker Transmitter**  
• Tunable Output  
• Uses FM Radio  
• Excellent Signal Beacon  
HOD1K Kit/Plans ..... \$39.50



**MIND CONTROL!**  
Places subjects under your control. Programmable audible & visual stimuli with biofeedback. Induces strange & bizarre hallucinations without drugs. Caution - not FDA approved.  
MIND2 Plans ..... \$15.00  
MIND2K Kit and Plans ..... \$49.50  
MIND20 Assembled Unit ..... \$69.50



**FANTASTIC BRIGHTNESS!**  
High Quality Laser Pointer  
LAPN64 15mw equiv, 2000' ..... \$39.50  
LAPN61 50mw equiv, 4000' ..... \$84.50



**Window Bounce Laser Listener**  
Aim at window and listen to sounds from reflected light. -CAUTION- Not for illegal use. LWB3 Plans ..... \$10.00  
LWB3K Kit/Plans (req's vid tripod) ..... \$149.50



**1000' Potato Cannon**  
Not a Toy! Uses electronic or piezo ignition. CAUTION REQUIRED!  
POT1 Plans (dangerous product) ... \$10.00



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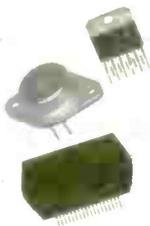


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BU-208/O	TOSHIBA	1	4.50
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2N-3773	TESLA	5	1.20
2SD-1398	SANYO	10	1.49
2SD-1650	SANYO	5	1.69
STRD-1005	SANKEN	1	4.15
STR-30130	SANKEN	1	2.66
STRS-6301	SANKEN	1	8.50
TA-7777N	TOSHIBA	1	6.96
TDA-2005	SGS	5	1.49



## COLOR CODED LEADS HEAVY DUTY ORDER N° 56-500

- 11" Long Wire Lead
- Insulated 1 1/2" Alligator Clips
- 20 Gauge Wire Size • 10 Leads
- BLACK, GREEN, RED, YELLOW, WHITE

**\$2.82**



## SOLDER WICK

- Solder Remover
- Length 5 Feet

**85¢**

Min. 2 pcs.



## TEMPERATURE CONTROLLED SOLDERING STATION

- Adjustable Temp.: 300°F - 790°F - 150°C - 480°C
- Grounded Tip for Soldering : Static Sensitive Devices, Heater Aid.
- Led Power Temperature Indicator
- Overheat Protection W/ Temperature Control
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- Comes in digital LED display
- 48 Watts soldering iron

**\$64.00**



ORDER N° 51-1035

## CODE PE96

**PLEASE MENTION  
WHEN ORDERING**

Items are subject to availability.  
Prices are subject to change without  
any prior notice.

## FLYBACK TRANSFORMERS



**\$12.50**

Replaces  
GOLDSTAR 154-074R  
ORDER N° 63-0189

## TUN-O-WASH® ORDER N° 30-0100

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(CFC Free)

Fast drying electronics  
grade cleaner for tuners,  
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TUN-O-WASH is excellent cleaner and  
degreaser for tuners, controllers and PC boards.

- Designed for cleaning and degreasing consumer electronics • Cleans in one step, no rinsing required • Contains no ozone depleting compounds • CFC and HCFC free
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The most popular

**\$24.99**

- VCR Head puller
- Retaining ring remover
- Spring hook
- Micro screwdriver
- Hex key set • Fitted vinyl • Soft zippered case
- Dimensions: 9 1/2"(W) X 12 1/4"(L)
- 7 Assorted head & guide aligners
- 3 Reverseable screwdrivers (Small-Flat-Philips)



## UNIQUE REALTIME OSCILLOSCOPE BUILT-IN FUNCTION GENERATOR

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1 MHZ FUNCTION  
GENERATOR

### Features

- Wider than specified frequency response • High deflection factor of 1mV/div. • Wide dynamic range up to 30MHz without waveform distortion • Algebraic sum of CH1 and CH2 • Low drift with compensation circuit • Superb trigger sensitivity • Maximum sweep rate of video signals with internal TV sync. separator • Jitterless trigger circuitry • CH1 signal output terminal available • Variable trigger hold-off • High precision X-Y phase difference measurement up to 50kHz • Built-in function generator with BNC output of 50Ω and TTL • Three kinds of waveform are available with 50Ω output • Flat output waveform frequency up to 1MHz

### Specifications:

- Vertical deflection: • Bandwidth: DC coupled (DC to 20MHz normal), AC coupled : (10Hz to 20MHz normal) • Deflection factor: 5mV/div to 5V/div in 10 calibrated steps of 1-2-5 sequence • Rise time: 17.5nS or less
- Horizontal deflection: • Time Base A: 0.2μs to 0.2S/div in 19 calibrated steps. 1-2-5 sequence • Uncalibrated continuous control between steps of at least 1: 2.5.



Manuf # OS-9020G

20MHz 2-CH DUAL TRACE



**\$498.00**

## DIGITAL MULTIMETERS

NEW! Digital

- Overload protect 1000VDC or peak AC on all other ranges
- Input Impedance 10M Ohm on all ranges • Base accuracy range ± 0.5 % to ± 1.0 % • Resistance 200Ω, 2K, 20K, 200K, 2M, 20M
- Audible continuity response lower than 50Ω • DC Voltage 200mV, 2V, 20V, 200V, 1000V
- AC Voltage 200mV, 2V, 20V, 200V, 700V

ORDER N° 50-815

## DALCO



**\$19.95**

## LOGIC Probe

ORDER N° 51-1015

- Length: 8 inches
- Range: 4.5 To 15 VDC
- Includes Test Leads • Compatible With TTL, DTL, RTL, HTL, CMOS, NMOS Logic

**\$8.99**

## SOLDER ROLL

- 1 LB Spool
- 370 deg F melting point
- Fastest solder
- Alloy 60/40, tin lead, non corrosive flux, Diam. 1.2mm

ORDER N° 51-1005

**\$3.95**



## Universal Audio/video Remote

ORDER N° 82-1055

- Controls basic functions of TV, VCR, cable box, and CD or laser player • Ergonomic design! Main buttons are in line with natural thumb motion • Two-minute memory allows time to replace batteries without re-programming • Programming reminder sticker inside battery compartment • Sleep time for 60, 30, or 15 minutes (according to your TV) • Set key recessed to prevent accidental deprogramming • Spanish instruction included. • Requires four AAA Batteries (not included)



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- TV (77 brands)
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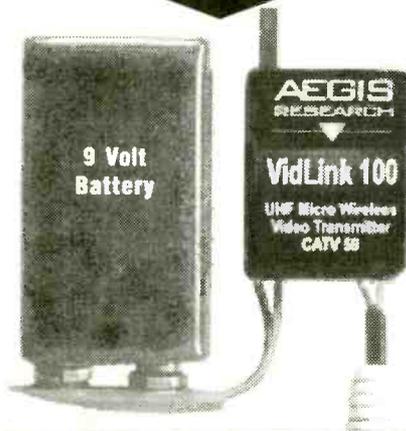
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## Wireless Video Transmitters

Used by hundreds of hobbyists and professionals alike in R/C models, Robots, Surveillance Video, movie Special Effects, and Law Enforcement.

"... previously, I used expensive wireless units from Pelco, MVP, and Supercircuits. Nothing approaches the VidLinks in power, picture quality, size, and value. Thank you." *R. Leslie, CCTV Installer, NY.*  
 "The best... Incredible color, resolution... very easy to use... cool." *P. Davis, Movie Props, CA.*

**Actual Size!!!**



## Live Remote Video From \$99.00

- Full 100 mW RF Power. Range 500ft. to 1/2mile •
- Crystal Controlled •
- High-Resolution Full Color/ B&W video •
- Fully epoxy encased- no exposed components •
- Fully assembled- only two wires to attach •
- MONEY BACK GUARANTEE. •

VidLink 100: 100mW Power- upto 1/4 Mile  
**\$199.00** New! High-Power!

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Covert Camera: 1 1/4" sq. Pinhole Lens  
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20 reference impedances  
True RMS  
Frequency counter: 100 Hz -10MHz  
Capacitance: 5nF-50mF  
Measure AC volt to 20kHz  
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Auto power off  
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Volt, amp, ohm, logic, diode, continuity  
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### Solar Cell Powered Large Display

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Volt, Amp, Ohm  
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7 functions, 19 ranges  
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Energy saver  
Student & hobbyist's favor



## DMM 20

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Inductance: 2mH-20H  
Capacitance: 2nF-200uF  
Resistance: 200-200MΩ  
Frequency: 2kHz-20MHz  
3.5 Digit, 0.5% accuracy  
DC/AC Current and Volts  
Transistor hFE, diode est  
Continuity, Duty %  
Peak hold/Max  
Ruggedized case  
Rubber holster \$8.00

Full line of DMMs,  
economy, compact,  
ruggedized, solar cell,  
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## Fluke Multimeter

Fluke 12 \$84.95  
Holster C-10 10  
Fluke 70 II \$75.95  
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Fluke 75 II \$129  
Holster C70 \$16  
Fluke 77 II \$155  
Fluke 79 II \$175  
Fluke 29 II \$175  
Fluke 76 \$175  
Fluke 87 \$287  
Fluke 867 \$1199  
Scope Meter  
Fluke 97 \$1785  
Fluke 105 \$2799



## LCR Meter 131D

\$229.95

### Most Advanced LCR

Dual display: L/Q or C/D  
Inductance: 10mH-10,000H  
Capacitance: 10nF-10mF  
Resistance: 10Ω-10MΩ  
Auto/manual range  
Dissipation factor & Q factor  
Serial & parallel mode  
Relative mode for comparison  
and to remove parasitics  
Statistics, tolerance,  
Best for design, incoming  
testing & production  
SMD and chip component  
test probe \$25.00



## LCR Meter 814

\$189.95

### Best Resolution LCR

Inductance: 200uH-200H  
Capacitance: 200pF-20,000uF  
Resistance: 2Ω-20MΩ  
Resolution of 0.1uF, 0.1pF, and  
1mΩ are useful for high frequency  
and SMD  
Dissipation factor indicates leakage  
in capacitor and Q factor in inductor  
Zero adjustment to reduce parasitics  
Best for high frequency RF  
SMD and chip component test probe  
\$25.00  
Padded deluxe case \$8.00



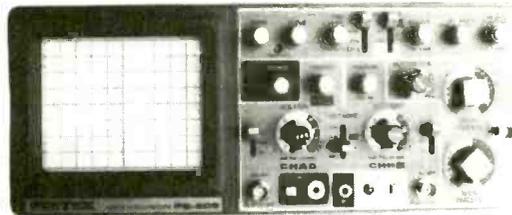
## Frequency Counter

FC-1200 \$129.95

Frequency: 10Hz-1.25GHz  
Display: 8 digit LCD  
Period: 0.1μs-0.1s  
Records Max/Min/Average  
Data hold, relative mode  
Telescoping antenna \$8.00  
Deluxe case \$5.00

### Also Available:

AC/DC clamp meter, Light meter,  
Thermometer, pH meter, High voltage  
Probe, Digital Calliper, Anemometer,  
Electronic scale, Force Gauge,  
Tachometer, Stroboscope, Humidity  
& EMF adapter, Sound level meter,  
Frequency counter, SWR/field  
strength/power meter, Dip meter



## 20 MHz Oscilloscope with Delay Sweep PS-205 \$429.95

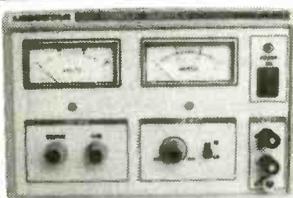
Dual Trace, Component test, 8" CRT, X-Y Operation, TV  
Sync, Z-Modulation, CH2 Output, Graticule Illum, 2 probes  
each has x1, x10 switch. Best price with delay sweep.  
PS-200 20 MHz DUAL TRACE \$339.95  
PS-400 40 MHz DUAL TRACE \$484.95  
PS-405 40 MHz DELAY SWEEP \$589.95  
PS-605 60 MHz DELAY SWEEP \$789.95  
PS-1000 100 MHz DUAL TRACE \$989.95  
Scope Probe: 60MHz x1, x10 \$15, 100MHz x1, x10 \$22  
250MHz x1, x10 \$29, 250MHz x100 \$39

## Digital Storage Scope

DS-303 30MHz, 20M Sample/sec \$849.95

DS-303P w/ RS-232 Interface \$1,049.95

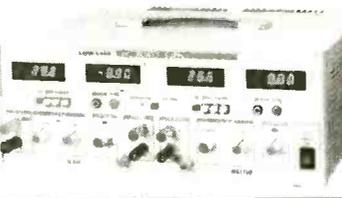
Switchable between digital and analog modes  
2 K word per channel resolution  
8 bit vertical resolution (25 Level/div)  
Expanded Timebase 10ms/div - 0.5 s/div  
Refresh, Roll, Save all, Save CH2, Pre-Trig  
Plotter control



## DC Power Supply

PS-303 \$159.00

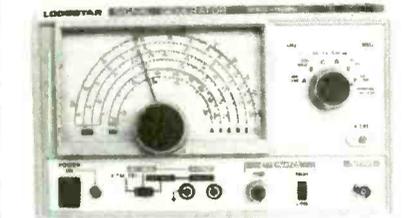
0-30 VDC, 0-3A output  
Constant voltage & constant current mode  
0.02% + 2mV line regulation  
0.02% + 3mV load regulation  
1 mVrms noise and ripple  
Short circuit and overload protected  
PS-8200 with digital voltmeter \$179.00  
Also available: 30V/5A, 60V/3A, 60V/5A  
16V/10A, 30V/10A



## DC Power Supply Triple

Output PS-8202 \$499.95

Two 0-30 VDC, 0-3A outputs  
One fixed 5VDC, 3A output  
Capable of independent or tracking operation  
Constant voltage and constant current mode  
Four digital meters for volt and current display  
Excellent regulation and low ripple  
Short circuit and overload protected  
Also available: 30V/5A, triple output \$549.95  
Dual tracking 30V/3A, 30V/5A, 60V/3A, 60V/5A



## RF Signal Generator

SG-4160B \$124.95

100 kHz-150MHz sinewave in 8  
ranges  
RF Output 100mVrms to 35 MHz  
Internal 1kHz, External 50Hz-  
20kHz  
AM modulation  
Audio output 1 kHz, 1 Vrms  
Output Impedance: 50 Ohm  
Size: 5.9"H x 9.8"W x 8.1"D

## Audio Generator

AG-2601A \$124.95

10Hz - 1MHz in 5 ranges  
Output: 0-8Vrms sinewave  
0-10Vp-p squarewave  
Synchronization: ±3% of oscillation  
frequency per Vrms  
Output distortion:  
0.05% 500Hz - 50kHz  
0.5% 50Hz - 500kHz  
Output impedance: 600 ohm

## Function Generator

FG-2100A \$169.95

0.2 Hz - 2 MHz in 7 ranges  
Sine/square/triangle/pulse/ramp  
Output: 5mV-20Vp-p  
1% distortion, DC offset ± 10V  
VCF: 0-10V control freq. to 1000:1

## Function Gen./Counter

FG-2102AD \$229.95

Generates signal same as FG-2100A  
Frequency counter 4 digits  
Feature TTL and CMOS output

## Sweep Function

Gen./Counter \$329.95

0.5Hz to 5 MHz in 7 ranges  
Sweep: Linear 10:1 Log 10:1 20ms-2s  
AM Modulation  
Gated Burst, Voltage Control Gener.  
Generator Control Voltage & 8 digit  
counter 1Hz-10MHz for internal &  
external sources



## RF Signal Generator

Counter SG-4162AD

\$229.95

Generates RF signal same as  
SG-4160B  
6 digit frequency counter 1Hz -  
150 MHz for internal and external  
source Sensitivity <50mV

## Audio

Generator/Counter

AG-2603AD \$229.95

Generates audio signal same as  
AG-2601A  
6 digit frequency counter 10Hz-  
150MHz for internal and external  
sources Sensitivity <50mV

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## Low Low Price! 25' BNC-BNC CABLE



25 foot RG58-A/U, 50 ohm co-ax cable with male BNC connectors molded with strain reliefs on both ends. Ideal for studio, lab or communications use. Inquire for quantity pricing.

**\$4.75**  
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10 for \$45.00

## SPECIAL PRICE! TWIST ON F-56 CONNECTOR

We recently made a large purchase of this twist-on co-ax connector for RG-6 cable. Special pricing while the supply lasts.



100 for \$15.00  
500 for \$50.00  
1000 for \$70.00

CAT #FTO-56R

## S-VHS VIDEO CORD



4' cable with miniature 4 pin mini DIN plugs on both ends.

CAT# CB-363

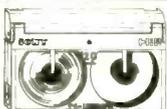
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## "HI-8" VIDEO CASSETTE (USED)

SONY Hi-8

Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box. Satisfaction Guaranteed.



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CAT # VCU-8

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## NOTEBOOK COMPUTER CARRYING CASE

Great looking, padded carrying case, suitable for most notebook computers or similar equipment.



Black leatherette exterior with separate zippered compartment for papers or accessories. Detachable nylon web shoulder strap. Interior space is 13.5" X 9" X 2.5"

CAT # CSE-12

**\$9.75**  
each

## EDGEVIEW PANEL METER FS=1 MILLIAMPS

Beautifully constructed edgeview meter movement. 2.75" X 0.8" face. Scale is labeled "BEATS/MINUTE" and is calibrated from 50-150. It can be easily removed or reversed to create a blank scale. The black bezel is 3.53" X 1.33" and can be adjusted or removed. 0.1" thick clear plexiglass case. Maximum case size behind mounting plane: 2.75" X 1.18" X 2.18". Solder lug terminals.



**\$5.50**  
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CAT # MET-48

## 3 WAY CROSSOVER, INFINITY

Designed for Infinity Studio Monitor, "SM-112", 3 way, 8 ohm speaker system. Rated for 10-175 watts. Crossover frequencies at 900 Hz and 5,500 HZ. Auto-reset circuit breaker protection.

Matte black plastic front panel assembly is 6.75" X 3.6" and has a control for tweeter level adjustment. Fits a cut-out of 5.4" X 2".

**\$7.50**  
each

CAT# LX-112

## THE INSULTINATOR A Programmable Electronic Insult Machine

"You're A Completely Slobbering Greasy Dweeb!"

"You're a totally ugly gross boring nerd!"

"You're A Totally Freaky Wacky Bonehead!"



Hand-held voice synthesizer plays a variety of insults which can be altered by selecting various programming buttons. Thousands of possible insults. Even though no profanity is used, a major nationwide retailer rejected these as being too insulting for their customers. Will green and black case with belt or pocket clip. Includes 3 AA batteries. Attractive display package.

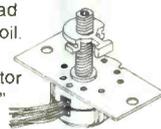
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case of 24  
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CAT# INS-5

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Unipolar, two phase, 6 lead stepper motor. 53 ohm coil. Operates well on 12 Vdc. 15 degrees per step. Motor body is 1" diameter X 0.5" 0.08" (2mm) diameter shaft is 0.365" long. The shaft is covered with a threaded plastic sheath (0.25" dia X 0.75" long) which acts as a worm gear. This mechanism, is easily removable. Rectangular mounting bracket, 1.73" X 1.10".



**\$1.50**  
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CAT# SMT-21

10 for \$12.50

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CAT# MAG-26

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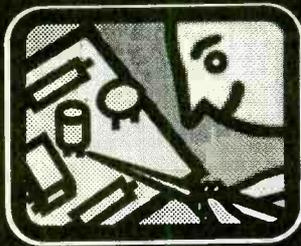
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# RAINBOW KITS

Many of our kits are available completely built!

## WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-2 kit is a buffered wireless

microphone that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. 6 to 12v DC. SIZE: 1.25" x 1

WM2 **KIT \$14.95**

## MICRO-MINIATURE PHONE TRANSMITTER

We haven't seen a smaller phone transmitter than the MMPT2 kit. Powered by the phone, it requires no battery. Transmits both sides of a phone conversation to an FM radio up to a 1/4 mile away. Tunable from 88 to 108MHz FM. Attach it to one phone or add it to the line to pick up all incoming calls. The MMPT2 is undetectable if properly installed. Unit has surface mounted parts, you install the leaded parts. Size .45" x .6"

MMPT2 **KIT \$29.95**

## 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**

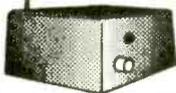
## STROBE LIGHT

Do you need an attention getter, warning light, or flashing light for model airplanes? Then this kit is for you. Use it as an emergency light for your auto,

radio tower, even use it on your bicycle. Has a variable flash rate. Power requirement 6 or 12v DC. Size 3.5" x 1.9"

ST-1 **KIT \$11.95**

## FM STEREO TRANSMITTER



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

tunable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your CD's while mowing the lawn. Play music on one channel sing on the other. Clarity is excellent, approx. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls & crystal for stereo separation. 9v battery operation. SIZE: 1.5" x 2.5" x 3"

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

## TV NOTCH FILTERS FOR CHANNELS 2 thru 22 ONLY

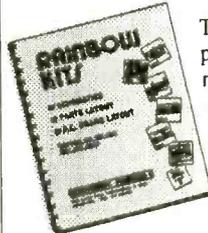


Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep beep beep. Works on cable channels (2 thru 22) only.

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.

DF-222

**KIT \$14.95**



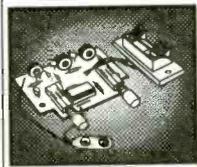
This Manual contains schematics, parts lists & P.C. board layouts for many of the Rainbow Kits. Use your own parts to construct our kits.

**KIT BOOK \$14.95**  
\$9.95 with the purchase of any kit.

## INDUCTANCE METER

This is the kit everyone has been asking for. Turn your digital volt ohm meter into an inductance meter. It will read inductors 3uH to 7MH. Power requirement 9v DC. SIZE: 1.75" x 2.5"

IA-1 **KIT \$14.95**  
IA-1 CABINET **\$8.95**



## DIGITAL THERMOMETER

The DT-3 kit will turn your digital volt ohm meter into an accurate digital thermometer with .1 degree resolution. Measure temperatures from -40° to 250F°. The remote sensor is .25" sq. and can be mounted many feet from the meter. Power requirement 9V DC. SIZE: 2" x 1.35"

**KIT \$8.95**



DT-3

## CAPACITANCE METER

This kit will turn your digital volt meter into a capacitance meter. Turn that junk box of unmarked capacitors into a fortune of usable parts. Measure capacitors from <2.2pF to 2.2uF. Power requirement 9v DC. SIZE: 1.80" x 2"

**KIT \$12.95**



CA-1

## TEMPERATURE GENIE



Ever lost frozen food because your freezer stopped? The TC-2 kit would have saved you money. An alarm activates when the temperature reaches a critical point. Turn ceiling fans on automatically when it gets too hot. This kit gives you 100mA of output. SIZE: 2" x 1.4" Power requirement 6 to 15V DC.

If you want to switch more power see our Triac (TP-1) or Relay (RP-1) Power kit.

TC-2

**KIT \$7.95**

## PHONE TRANSMITTER

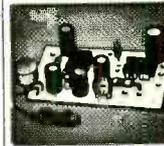


Small but mighty, it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz to 130MHz FM. You can also use it as a speaker phone. SIZE: 1.25" x .6"

TEL-B1

**KIT \$12.95**

## SUPER SNOOPER BIG EAR



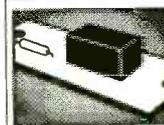
Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to 12v DC. SIZE: 1.75" x 1"

AA-1

BUILT \$29.95

**KIT \$10.95**

## RELAY POWER KIT



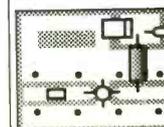
Increase the output of any kit from 100mA to 3 Amps. If you need to switch more power, up to 300 Watts, with the Light Genie,

Temperature Genie, Timer or Vox kits, use the Relay Kit. We supply a two pole relay 1.5 Amps ea., tie both poles together and get 3 Amps. Size .75" x 2"

RP-1

**KIT \$9.95**

## WIDE BAND PRE-AMP



Uses PCB and surface mount technology for better performance. Use for scan-

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- 1MHz to 2.5 GHz 2.8dB NF
- 1dB compression=OdBm
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- Power requirement: 12v @ 6Ma

WBA-6

**KIT \$19.95**



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**Assembled and Tested**  
**\$169.95**

**XK-550K - Kit**  
**\$139.95**

Tools and meter shown optional



**TK-3000**  
**\$89.95**

**Tools Included:**

- SR-2 - Deluxe Soldering Iron
- SH-1 - Soldering Iron Stand
- ST-1 - Diagonal Pliers
- ST-2 - Long Nose Pliers
- ST-30 - Deluxe Wire Stripper
- SE-1 - Solder Ease Kit
- ND-3 - 3 pc. Nut Driver Set
- TL-8 - Precision Screw Drivers
- ST-5 - Screw Driver Slotted 3/16"
- ST-6 - Screw Driver #1 Phillips
- ET-10 - IC Puller
- SP-2 - Solder Pump
- ST-20 - Safety Goggles
- ST-9 - Pocket Screw Driver
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- SW-3 - Solder Wick



A professional technician service tool kit in a metal reinforced tool case with heavy-duty handle and locks. A removable pallet handles most of the tools listed with more room for tools and parts in the lower half.

**GF-8026 w/ Frequency**

- Linear and Log Sweep
  - .02Hz to 2MHz
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  - 4 Digit Display
- \$225**



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**4 Fully Regulated DC Power Supplies In One Unit**  
 4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A  
 1 Variable - 2.5 - 20V @ 2A

**\$85**



**Auto Ranging Hand-Held DMM w/ Bar Graph Model EDM-163**

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**Digital Multimeter Model M-1700**

**\$39.95**

11 functions including freq to 20MHz, cap to 20µF. Meets UL-1244 safety specs.



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6 Functions & Transistor Test



**Model M-6100**

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Model 2560

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- RS-232 port
- 20MHz analog bandwidth
- 1GHz equivalent time sampling (at 0.1µs/div.)
- Prints via RS-232 port to any HP-GL printer

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### 20MHz ANALOG WITH DIGITAL STORAGE

Model 2522A

- 20MHz analog bandwidth
- 20MS/s sampling rate
- 2K memory per channel
- 300MHz equivalent time sampling
- Pre-trigger capture

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### 100MHz THREE-TRACE

Model 2190A

- 1mV/division sensitivity
- Sweeps to 5nd-division
- Dual time base
- Signal delay line
- 15KV accelerating voltage

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### 60MHz DUAL-TRACE

Model 2160A

- 1mV/division sensitivity
- Sweeps to 5nd-division
- Dual time base
- Signal delay line
- V mode-displays two signals unrelated in frequency
- Component tester

**\$949.95**

### 40MHz DUAL-TRACE

Model 1511C

- 1mV/division sensitivity
- Video sync separator
- Z-axis input
- Single Sweep
- V mode displays two signals unrelated in frequency
- Component tester

**\$695**

### 60MHz, CURSORS & READOUTS, DUAL TIME BASE

Model 2260

- Cursors and readouts
- 1mV/div sensitivity
- 23 calibrated ranges - main time base
- 18 calibrated ranges - delayed time base
- Signal delay time
- V mode - displays 2 signals unrelated in frequency
- Component tester
- Z-axis input
- Single sweep

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### 20MHz DUAL-TRACE

Model 2120 - 2 Year Warranty

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Model 2125 with delayed sweep

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- 1mV/division sensitivity
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- 20MS/s Sampling Rate

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**S-1340 \$475**

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**S-1325 \$325**

- 25MHz Analog

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Warranty**

### OSCILLOSCOPE SELECTION CHART

ANALOG Model		Bandwidth MHz	Sensitivity (max) mV/div	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) mV/div	No. of Channels	Sampling Rate	Memory Channel	Internally Backed Up	Pretrigger %	Output
DS-303	30	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232	
DS-603	60	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232	

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V-552 - 50MHz Was \$1195,  
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V-252 - 20MHz **\$419**

## Fluke Scopemeters



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96B ..... \$1695  
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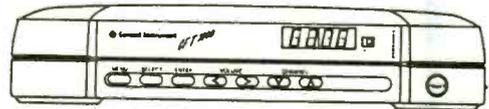
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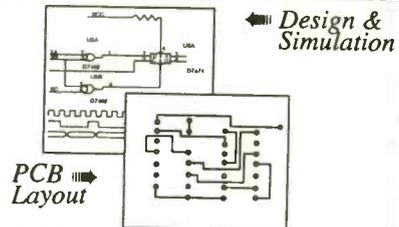
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Check our catalog for a full line of X10 Home Security and Home Automation products.



**Weller WLC100 Soldering Station**

The Weller WLC100 solder station is ideal for the professional, serious hobbyist, or kit builder who demands higher performance than usual of a standard iron, but without the high cost of an industrial unit. Power is adjustable from 5 to 40 watts. Includes 40 watt pencil iron. UL approved. Net weight: 1-3/4 lbs.



**\$39<sup>95</sup>** EACH

**"The Sound Bridge" FM Stereo  
Wireless Transmitter**

The Sound Bridge is a mini FM wireless transmitter that can be used to broadcast stereo sound from any audio source like portable CD players, TVs, electronic games, CD-ROM, even computer soundcards, to your home stereo receiver! Adjustable from 89 to 95.5 MHz.



**\$14<sup>95</sup>** EACH

**HOT  
NEW  
ITEM!**

**3 Way Indoor/Outdoor  
Speaker System**

These are the best sounding little speakers you can find anywhere near this price! Perfect for rear channel use in a home theatre system or for outdoor use. Features 4" polypropylene woofer, 2" polycone midrange, 3/4" dome tweeter housed in a weatherized polystyrene enclosure. Frequency response: 90-20,000 Hz. Impedance: 4 ohms. Power handling: 30 watts RMS/60 watts max. Mounting brackets included. 7-1/4" H x 4-5/8" W x 4-3/8" D. Net weight: 6 lbs.



**#PO-319-020 (Black)**

**#PO-319-025 (White)** ..... **\$45<sup>00</sup>** PAIR

Compare To

**Special  
\$29<sup>95</sup>** PAIR

**Home Theatre In-Floor Subwoofer**

To fully appreciate the potential of movie soundtracks, a dual voice coil subwoofer is a must! Many film special effects are extremely demanding in the low frequency range and require a subwoofer that can duplicate explosions, earthquakes, even the footsteps of Tyrannosaurus Rex! This subwoofer fits the bill by featuring a 10" dual voice coil woofer for true stereo operation and high pass filters for your main speakers. The most unique feature of this subwoofer is the fact that it is designed to be mounted in between the floor joists in new and existing home constructions. Simply mount the in-floor sub to the joists and mount a heat register grill above opening in subwoofer front enclosure. The subwoofer is now totally out of view and ready to rumble! Includes detailed installation manual.



**Specifications:** 10" dual voice coil treated paper cone woofer with poly foam surround • Frequency response: 30-100 Hz • Nominal impedance: 8 ohms per coil • Power handling: 100 watts RMS channel/140 watts max • SPL: 89 dB 1W/1m • Dimensions: 27" D x 14-5/8" W x 9" H • Net weight: 29 lbs.

**#PO-300-445** ..... **\$139<sup>95</sup>** EACH

**Peak Instrument Co.**

**"The Woofer Tester"**

Peak Instrument Co. proudly introduces "The Woofer Tester". Just ask any loudspeaker engineer, and they will tell that the only way to design enclosures of the correct size and tuning is to measure the Thiele-Small parameters for the actual drivers to be used. The reason? Manufacturers published specs can be off by as much as 50%! But until now, measuring the parameters yourself required expensive test equipment and tedious calculations, or super expensive measurement systems (\$1,200 to \$20,000). The Woofer Tester changes all that. Finally, a cost effective, yet extremely accurate way to derive Thiele-Small parameters, in only minutes! The Woofer Tester is a combination hardware and software system that will run on any IBM compatible computer that has EGA or better graphics capability and an RS232 serial port. The Woofer Tester will generate the following parameters. Raw driver data: Fs, Qms, Qrs, Qts, Vas, BL, SPL @ 1W/1m, Mmd, Cm, and Rm. Sealed box data: Fsb and system Q. Vented box data: Fsb, ha, alpha, and Q loss. The Woofer Tester system includes hardware, test leads, serial cable, AC wall adaptor, detailed instructions, and software.



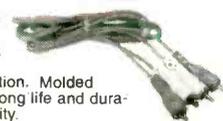
**QUICK! AND  
ACCURATELY  
MEASURES Fs,  
Qms, Qrs, Qts,  
Vas, BL, SPL @ 1W/1m,  
Mmd, Cm, and Rm  
IN MINUTES!**

◆ 30 DAY  
MONEY BACK  
GUARANTEE  
◆ 1 YEAR WARRANTY ◆ SAME DAY SHIPPING

**#PO-390-800** ..... **\$249<sup>00</sup>** EACH

**5 Foot Stereo RCA Patch Card**

High quality, Japanese made patch cord features color coded RCA plugs on each end for easy polarity identification. Molded strain reliefs for extra long life and durability. Limited availability.



Part #	Description	Price (1-9)	Price (10-UP)
PO-189-070	Red/white plugs	\$1.20	\$ .95
PO-189-072	Yellow/black plugs	1.20	.95

**Copper Clad PC Board**

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**



- ◆ Do it yourself
- ◆ Save Money
- ◆ Complete instructions
- ◆ Wide variety of sizes and styles
- ◆ Hard to find Advent Woofer and Red Foam kits available

**CALL NOW FOR  
SIZES AND MORE  
INFORMATION**

**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.



**#PO-319-030** ..... **\$169<sup>95</sup>** EACH



◆30 day money back guarantee ◆\$20.00 minimum order ◆We accept Mastercard, Visa, Discover, and company C.O.D. orders ◆24 hour shipping ◆Shipping charge = UPS chart rate + \$1.90 (\$5.00 minimum charge) ◆Hours 8:00 am - 8:00 pm ET, Monday - Friday ◆9:00 am - 5:00 pm Saturday. Mail order customers, please call for shipping estimate on orders exceeding 5 lbs. ◆Foreign destination customers please send \$5.00 U.S. funds for catalog. ◆Quantity pricing available.  
CIRCLE 146 ON FREE INFORMATION CARD

**1-800-338-0531**

340 E. First St., Dayton, OH 45402-1257  
Phone: 937-222-0173 ◆ Fax: 937-222-4644

# USE POPULAR ELECTRONICS

READ BY BUYERS OF ELECTRONIC EQUIPMENT ACCESSORIES AND PARTS

## INSTRUCTIONS FOR PLACING YOUR AD!

### HOW TO WRITE YOUR AD

**TYPE or PRINT** your classified ad copy **CLEARLY** (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but, in all cases, full payment must accompany your order.

### WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

### RATES

Our classified ad rate is \$1.75 per word. Minimum charge is \$26.25 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a **Box** number you must include your permanent address and phone number for our files. **ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.**

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Sorry, no discounts on credit-card orders. Boldface (not available as all caps), add .40 per word additional. Entire ad in boldface, add 20%. Tint screen behind entire ad, add 25%. Tint screen plus all boldface ad, add 45%. Expanded type ad, add \$2.25 per word.**

**General Information:** A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

### DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. **POPULAR ELECTRONICS** is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. **NO REFUNDS, advertising credit only. No phone orders.**

### CONTENT

All classified advertising in **POPULAR ELECTRONICS** is limited to electronics items only. All ads are subject to the publishers approval. **WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.**

**AD RATES:** \$1.75 per word, Minimum \$26.25

Send you ad payments to:

**POPULAR ELECTRONICS 500 Bi-County Blvd, Farmingdale, NY 11735-3931**

### CATEGORIES

100 - Antique Electronics	270 - Computer Equipment Wanted	450 - Ham Gear Wanted	630 - Repairs-Services
130 - Audio-Video Lasers	300 - Computer Hardware	480 - Miscellaneous Electronics For Sale	660 - Satellite Equipment
160 - Business Opportunities	330 - Computer Software	510 - Miscellaneous Electronics Wanted	690 - Security
190 - Cable TV	360 - Education	540 - Music & Accessories	710 - Telephone
210 - CB-Scanners	390 - FAX	570 - Plans-Kits-Schematics	720 - Test Equipment

### CLASSIFIED AD COPY ORDER FORM

Place this ad in Category # \_\_\_\_\_

Special Category \$20.00 Additional \_\_\_\_\_

1 - \$26.25	2 - \$26.25	3 - \$26.25	4 - \$26.25
5 - \$26.25	6 - \$26.25	7 - \$26.25	8 - \$26.25
9 - \$26.25	10 - \$26.25	11 - \$26.25	12 - \$26.25
13 - \$26.25	14 - \$26.25	15 - \$26.25	16 - \$28.00
17 - \$29.75	18 - \$31.50	19 - \$33.25	20 - \$35.00
21 - \$36.75	22 - \$38.50	23 - \$40.25	24 - \$42.00
25 - \$43.75	26 - \$45.50	27 - \$47.25	28 - \$49.00

29 - \$50.75	30 - \$52.50	31 - \$54.25	32 - \$56.00
33 - \$57.75	34 - \$59.50	35 - \$61.25	36 - \$63.00
37 - \$64.75	38 - \$66.50	39 - \$68.25	40 - \$70.00

Total words \_\_\_\_\_ \$1.75 per word = \$ \_\_\_\_\_

Bold Face \_\_\_\_\_ \$0.40 per word = \$ \_\_\_\_\_

Special Heading \_\_\_\_\_ \$20.00 = \$ \_\_\_\_\_

Other \_\_\_\_\_ = \$ \_\_\_\_\_

Total classified ad payment \$ \_\_\_\_\_ enclosed

**TOTAL COST OF AD \$ \_\_\_\_\_**

Check  Mastercard  Visa  Discover

Card # \_\_\_\_\_ Expiration Date \_\_\_\_/\_\_\_\_

Signature \_\_\_\_\_

Name \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_ City State Zip \_\_\_\_\_

Digital Entertainment  
also available through  
**Skyvision®**



USA SB



AlphaStar

4D TV  
FOR C-BAND



## BEST Values from Skyvision!

**Receivers**  
from \$259  
including 4DTV

**Actuators**  
12" to 52" for all  
C- and Ku-band dishes

**LNBS**  
All kinds  
to heat up your picture

**Tune-Up Kits**  
for C/Ku band & DBS

**Programming**  
Save 30% - 50% with Skypac™

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Customers enjoy toll-free technical help

Keep your C-band System Running Strong

Everything on the air for complete variety

Enjoy debut of new channels  
Often in the clear for months

Wild feeds... Action as it happens

Programming you want at a price  
you can afford to pay

Whether you're considering your first  
satellite TV entertainment system or  
looking for an upgrade to your  
current system, Skyvision provides  
the best in hardware, technical  
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Our Complete Catalog is now online

<http://www.cir.com>

**CIRCUIT SPECIALISTS INC.**

**Check Out What We Have To Offer:**

**Fantastic DMM Offer!!!**

Don't let the price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/RANGE selector rotary switch.

**Rubber Boot Included**

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



Our Best Offer Ever on a

High Quality Full Sized DMM

**\$19.00** any qty

**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 ±(1.2%rdg+2dgts)  
 20mA 10µA  
 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.

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	1	10	100
HP-9060	Scope Probe Set DC~60MHz	\$16.49	\$14.49	\$11.58
HP-9150	Scope Probe Set DC~150MHz	24.95	21.95	18.62

**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	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.

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" <b>NEW!</b>	12.78	10.65	8.52

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" <b>NEW!</b>	18.88	15.73	12.59

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" <b>NEW!</b>	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" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

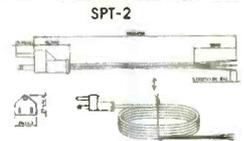


**REDUCES ETCHING TIME!**

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	\$37.95

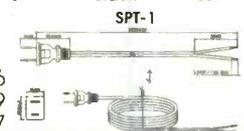
**AC Power Cords**

Our power supply cords are economical and practical for OEM and replacement applications. We stock 6' lengths, with the open end conveniently stripped and tinned (5mm).



CAT NO	SIZE	TYPE	RATING @ 125V (A)				LENGTH (ft)	COLOR	TEMP
			10	10	10	10			
SPT-1BLACK	18/2	SPT-1	10	6	6	6	Black	60°	
SPT-1GRAY	18/2	SPT-1	10	6	6	6	Gray	60°	
SPT-2BLACK	18/3	SPT-2	10	6	6	6	Black	60°	

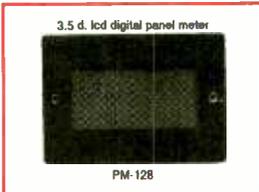
CAT NO	DESCRIPTION	PRICE EACH			
		1	10	100	500
SPT-1BLACK		\$.88	\$.57	\$.51	\$.46
SPT-1GRAY		.92	.61	.55	.49
SPT-2BLACK		1.97	1.21	1.07	.97



**SEE OUR ON-LINE CATALOG AT**  
<http://www.cir.com>

## 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: 4-1/2 Digit 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: 3-1/2 Digit LCD Digital Panel Meter

### PM-129: 3-1/2 Digit 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 <sub>2</sub> O)	SPEED (RPM)	NOISE LEVEL (dB)	WEIGHT (g)
CSD 4010-12	40x40x10mm	12	7	0.06	5.1	0.19	5,500	26	20
CSD 6025-12	60x60x25mm	12	5	0.13	13.7	0.165	4,500	28	65
CSD 8025-12	80x80x25mm	12	5	0.16	37.8	0.177	3,000	31	80
CSD 9225-12	92x92x25mm	12	5	0.32	42	0.18	2,800	37	95
CSD 1225-12	120x120x25mm	12	5	0.35	62	0.180	2,500	42	135

- SOLDER • SOLDER • SOLDER • SOLDER
- SOLDER • SOLDER • SOLDER • SOLDER

Weststock 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

CAT NO	DESCRIPTION	PRICE EACH	
		1	5
CA-H34A	PCB Mounted IRCCD Camera	\$99.00	\$85.00
A34	Power Supply Regulating Kit	\$6.95	---

### CCD Camera - IR Responsive As Low As \$85!!

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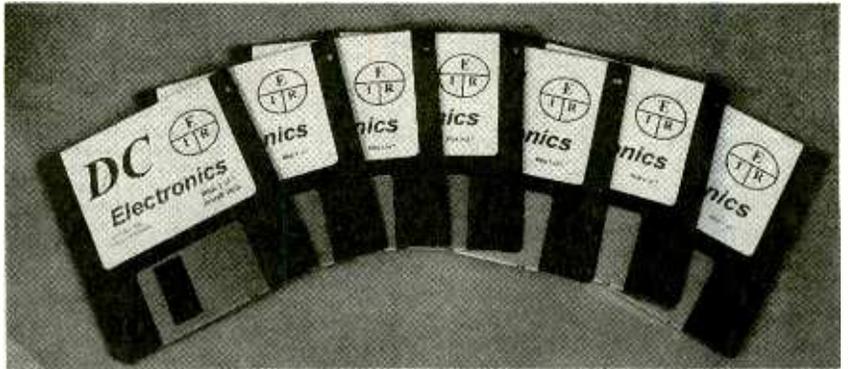
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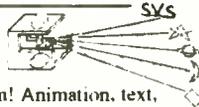
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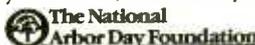
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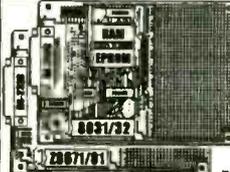
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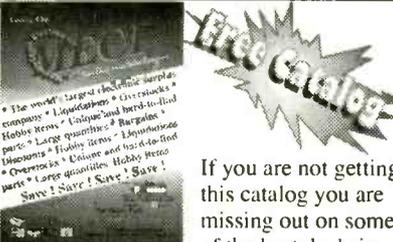
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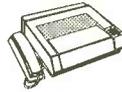
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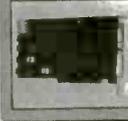
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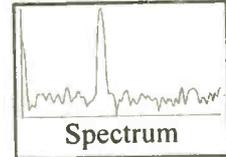
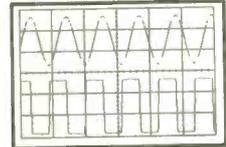
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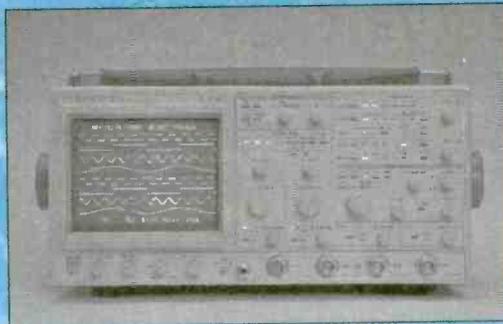
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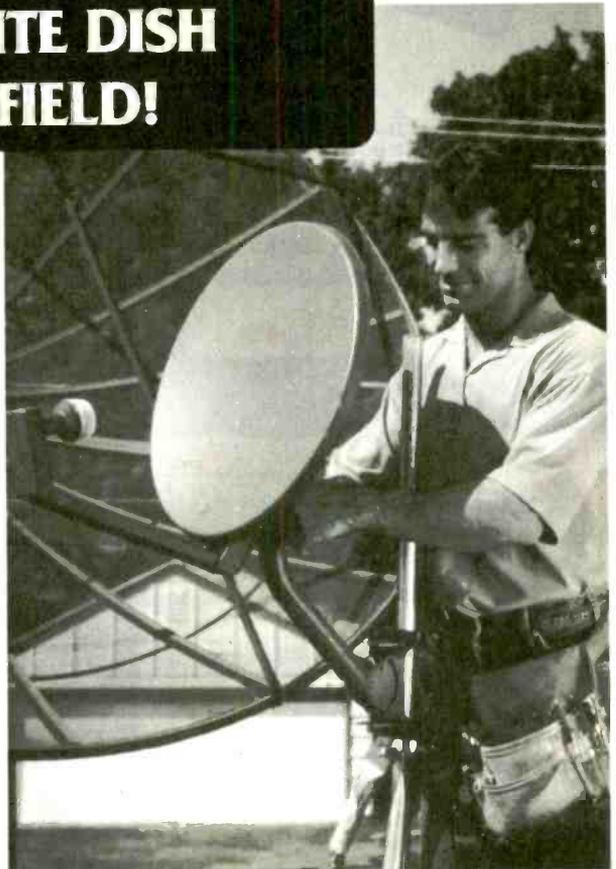
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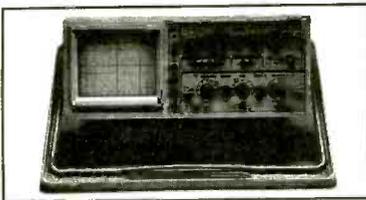
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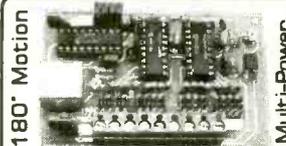
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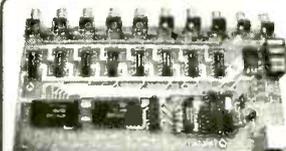
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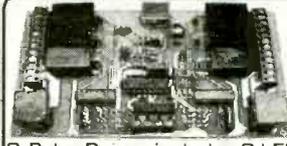
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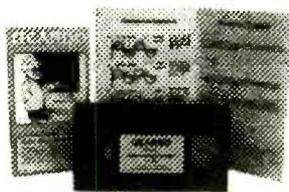


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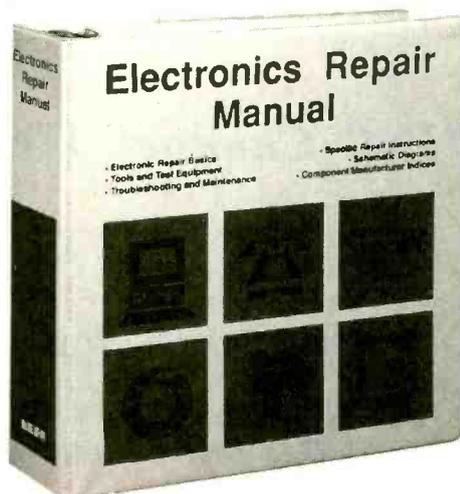
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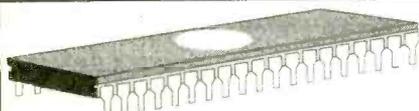
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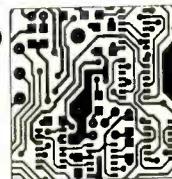
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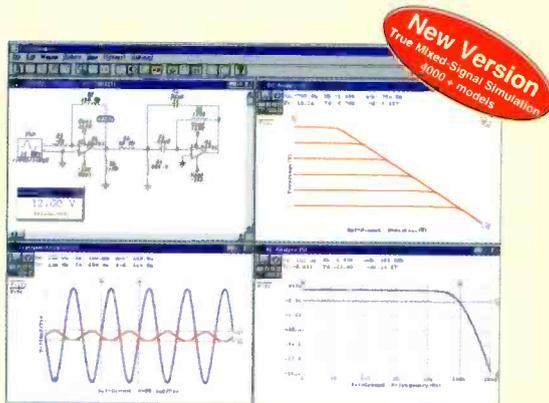
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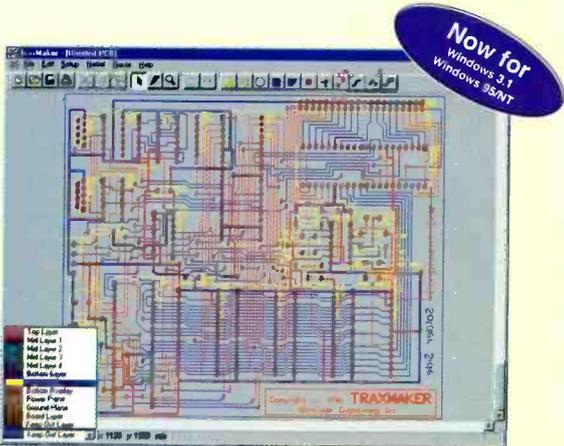
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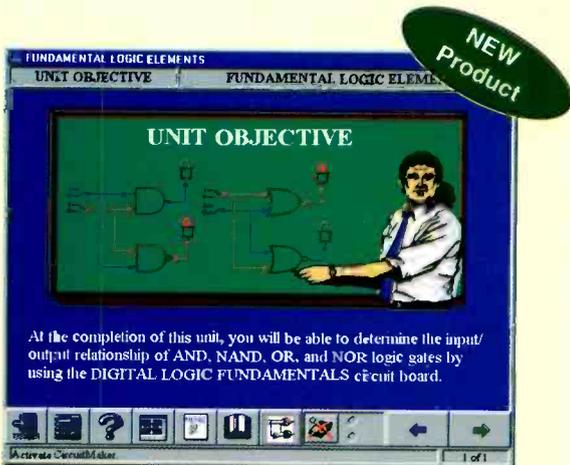
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