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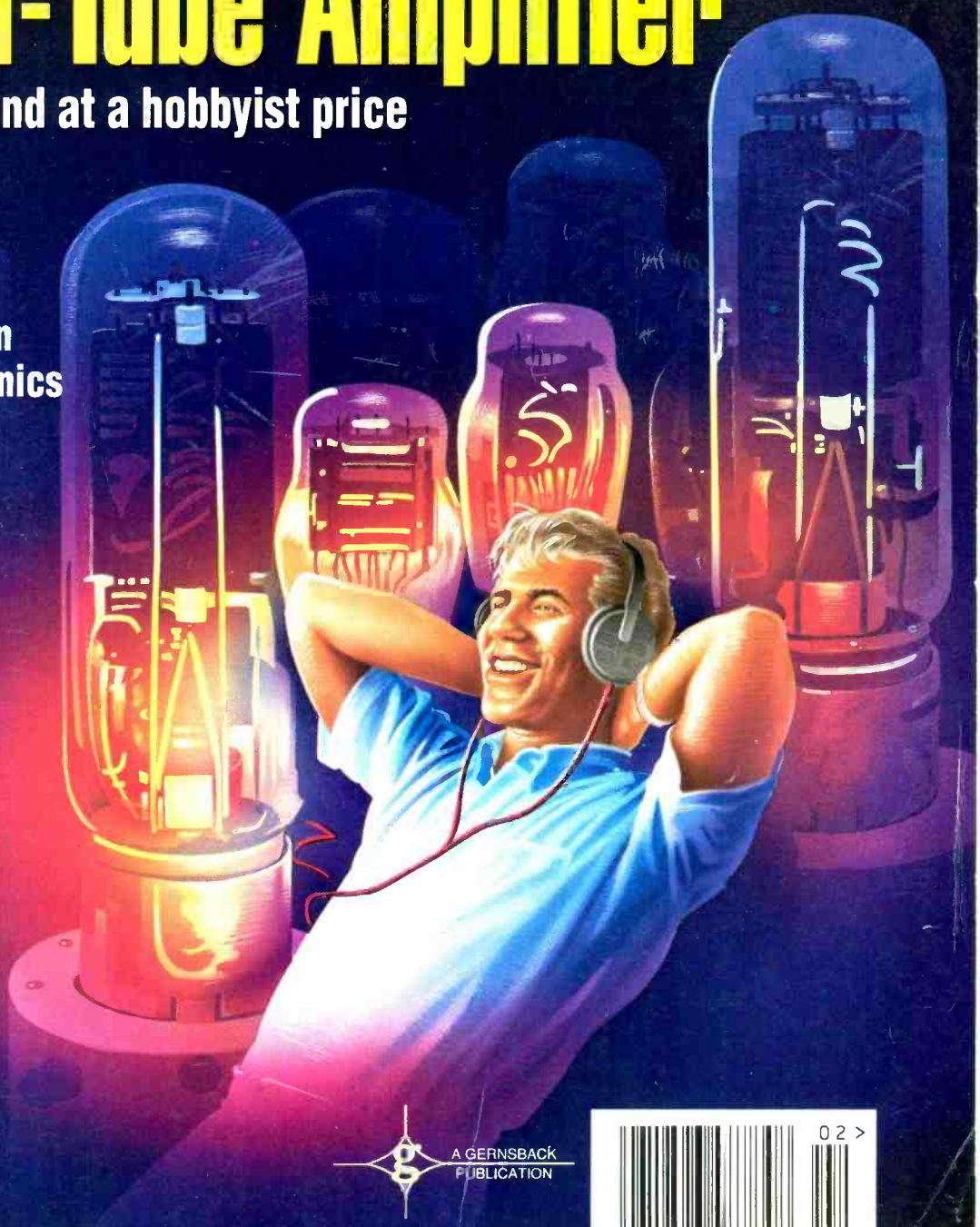

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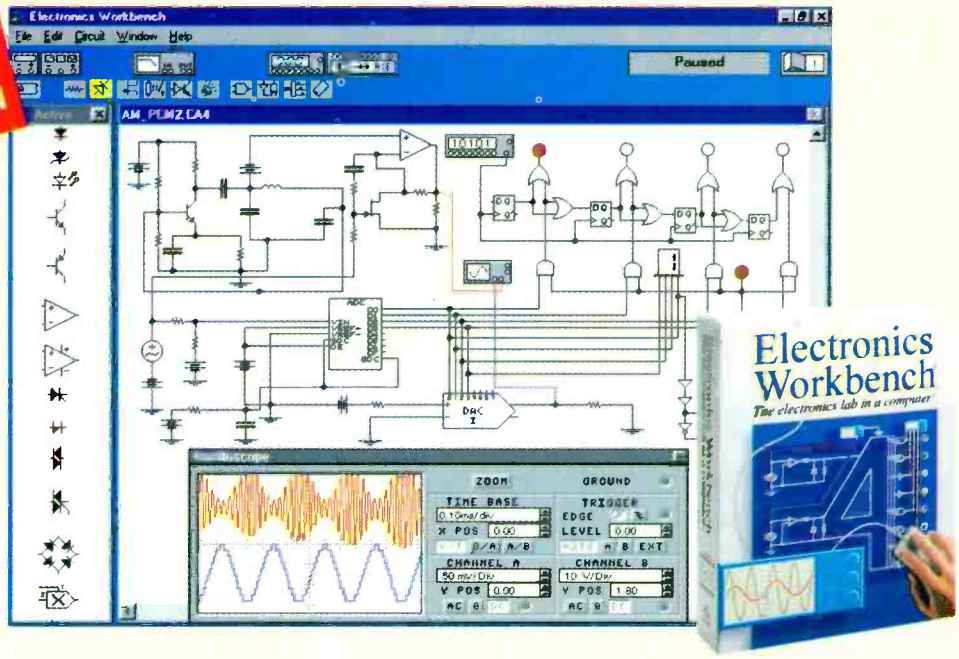

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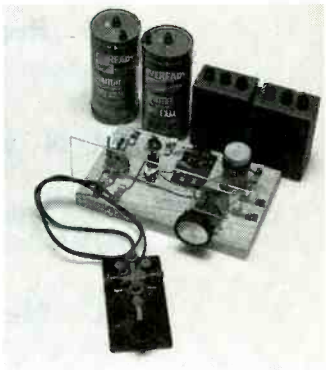

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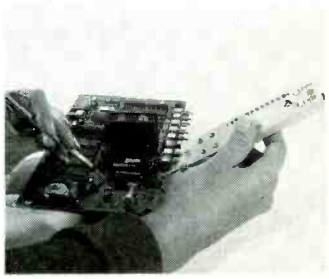

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EDITORIAL

A TIME OF CHANGE

Regular readers of **Popular Electronics** might notice that a few things are different in this issue. Those are but a portent of things to come as we enter into a period of change for this magazine.

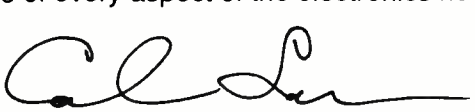
First, and foremost, you might note that there is no Gizmo in this issue. If you are a fan of that section, don't worry: It will return next month, and will continue to appear on a bi-monthly basis.

Why the change? Survey after survey tells us that one of the chief reasons most of you read this magazine is our projects. By making Gizmo bi-monthly, we can squeeze a few extra projects and other articles into the issues when it does not appear. By the way, that change might not be permanent, so if you feel strongly about it one way or another, write and let us know.

The other change has to do with the symbols and component designations we use in our articles. We've begun to make several changes that will bring them more into line with what is more commonly used in industry today. The changes are subtle and should not cause too much confusion, but because both the old and new symbols and designations will be used for awhile, and might appear in different stories in the same issue, I thought I should mention the change in case anyone wonders what's going on.

What else is going on? Next month will begin the introduction of a new look for some sections of the magazine. Beyond that, well, I don't want to tip my hand yet, so you'll have to just wait and see!

One thing I will promise, however, is that the basic content and mission of **Popular Electronics** will NOT change. We will continue to bring you, our readers, the most complete coverage possible of every aspect of the electronics hobby.



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Editor

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LETTERS

Ghost Voices: The Readers Talk Back!

OUR READERS WRITE

*Our publishing of the recent article, "Ghost Voices" (***Popular Electronics**, *October 1995), has resulted in quite a bit of mail from our readers. Unfortunately, due to space limitations, we are unable to print all of the letters we received. The following is what we consider to be a fair sampling of expressed viewpoints.*

—Editor

SPEAKING OUT ON GHOST VOICES

I read with interest the article "Ghost Voices". The "voices of the dead" theme is simply an example of the phenomenon known to engineers as audio rectification, wherein broadband radio frequency energy impinging on an unintentional "antenna" is demodulated by accidental nonlinearities. That results in a mishmash of audio signals being heard simultaneously. Occasionally, a few words might be heard clearly through the garbled mess.

Fifty years ago, I was playing with crystal sets. Once I disconnected the tank circuit so that my entire installation consisted of an antenna wire running the length of my basement, a connection of that antenna to a crystal detector and high-impedance headphones, and a connection to a water-pipe ground. As you might have expected, I heard a mixture of perhaps a half-dozen broadcast-band AM stations, all simultaneously. I learned then that a tank circuit is needed to select one of the many signals picked up by the antenna.

A similar thing occurred with the equipment described in the referenced article. The very short antenna is extremely broadband, so it will receive a very wide range of broadcasts. Being excessively short, it will have almost negligible gain. However, if the diode or transistor detector is followed by a high-gain audio amplifier, the expected mix of simultaneous audio will be heard, usually sounding like noise with an occasional word or two being readily identified.

R.E.
Littleton, CO

Talk about serendipity! The day before I saw the October issue of **Popular Electronics**, with its "Ghost Voices" cover story, I had decided to sell my old reel-to-reel TEAC tape recorder. I also had a dozen reels of audio tapes that I planned to include with the recorder. In checking through the tapes, I found three labeled, "Mystery Voices, 1979." That was the year I had read *Breakthrough* and experimented with the electronic voice phenomenon (EVP).

I used my TEAC recorder connected to the FM output of a radio tuned to the white noise between stations. After spending many evenings recording and hearing nothing but white noise, I decided to try just one more time. I sat listening to the white noise and watching the meters holding steady as it was being recorded. I had just decided to give up when I saw the needles make four distinct jumps. When I played the tape back, I could hear a voice buried under the white noise. The voice contained a four-word message that seemed to directly respond to my thinking of discontinuing the experiment.

Although I did continue for a few more months, and did get some additional results, other life events began demanding my time and attention. I put the tapes on a shelf and forgot about them until I was preparing to sell the old recorder. After listening to them again, I found myself wishing I could find some updated material, if any existed, on EVP. I had no idea how soon my wish would come true.

The next day I agreed to go grocery shopping with my wife. Knowing that I get impatient walking up and down the aisles, she insisted that I wait for her at the store's magazine rack, where **Popular Electronics** practically leaped out at me. Finding the tapes and your article has rekindled my interest in electronic voice phenomena.

I have had broadcast engineers, ham-radio operators, and pilots listen to my tapes. In each case, while they didn't agree on what was being said, they did agree that the voices were not from broadcast, a ham radio, or a passing plane. And, although cellular and cordless phones might now have to be considered, they did not exist in 1979 when I recorded the voices.

So what's the bottom line? I think that the EVP is something that can't be explained away. Are the voices from the dead? Maybe. Are they from a different dimension in space and time? That's possible. Or could it be, as a psychologist friend of mine claims, that the voices are "simply the result of my intense desire to hear voices, and because of that desire I created a mental electronic imprint on the tape resulting in recorded voices on tape." It didn't seem to bother him that because I did not have a microphone connected to the recorder, that alone would be an amazing electronic feat, worthy of serious exploration.

If any of your readers are seriously interested in exploring this strange phenomenon, I would welcome their letters. I would also be happy to send them a copy of my tapes, along with a copy of a radio interview with William Blattey, author of *The Exorcist*, in which he talks about his experiences with the electronic voice phenomenon.

RICHARD SZUMSKI
3356 Mortar Court
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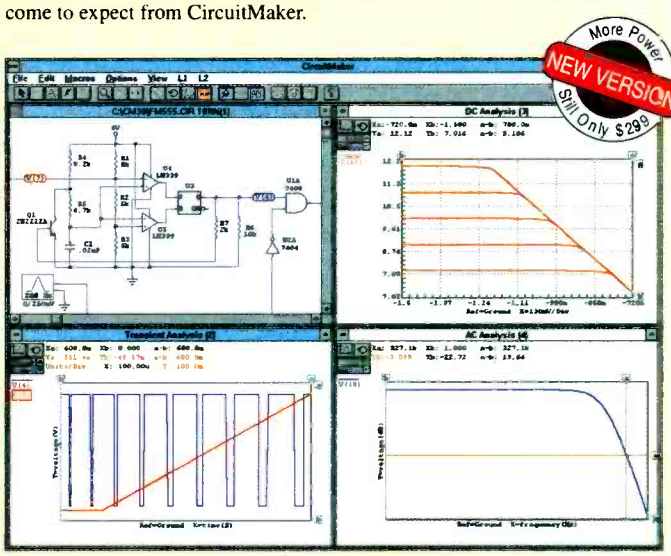

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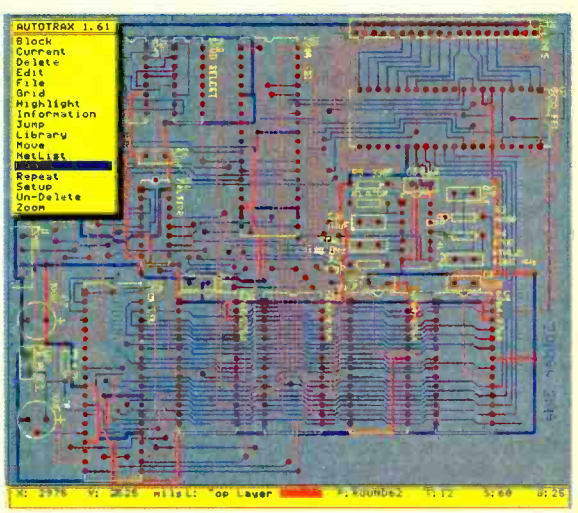

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story, "Ghost Voices?" And Halloween is *not* an excuse.

I've been reading **Popular Electronics** steadily (except for its brief hiatus) since I was ten years old. It was a serious educational influence on me early on, and inspired many of my career interests.

I'm sure that there are still plenty of kids like me who read your magazine. To expose them to such shop-worn pseudoscience—not even new or imaginative pseudoscience!—seems irresponsible, especially since you didn't include so much as a sidebar about alternative explanations, such as the tendency of human perception to assign "meaning" to white noise.

I suspect your mailbags are bulging with similar complaints. This is indeed a low point for the same magazine that, two decades ago, used its cover to introduce America's young technologists to the personal computer.

M.R.
San Francisco, CA

I was fascinated by the article, "Ghost Voices." At first glance, I wondered whether **Popular Electronics** was lowering itself to the point of tabloid journalism. But after reading the complete article, I realized that you were taking the subject very seriously.

I have some suggestions for improving some of the methods that you described.

First, I would use an open-reel deck, which can monitor off the tape while recording. That should be done so that the participants can hear any voices as the recording is being made, not after the fact. I would place headphones on all the participants in the experiment in order to let them hear any faint voices, and also to prevent any feedback from a microphone.

Second, in the case of using only a microphone to receive the voices, I would choose a mic that was ultra-sensitive, and possibly even apply extra stages of amplification between the microphone and the mic input on the recorder to boost the volume of the faint voices.

Third, in the case of the radio method, I wonder what would happen if you used an FM transmitter whose output is connected to the input of the recorder. I'd like to see what happens if you install an inductor made of extremely fine wire that can be used as a tuning coil, modulating the transmitter frequency if its turns are expanded and contracted by the slightest air pressure. If a faint voice were to disturb it, then a frequency shift should be able to be amplified and detected. That is, of course, assuming that air pressure would have a bearing on the experiment. I am assuming so because the article stated that a microphone alone can be used. And, of course, a microphone works on air pressure.

Finally, in the case of using radio frequencies, why can't a transmitter be used without any modifications to it just to create a dead silence out of the radio due to an unmodulated carrier? That would eliminate interstation noise, which could obscure faint voices.

What I'd really like to know is: Do you think that any of my ideas has a ghost of a chance?

R.J.M
Austin, TX

I just finished reading "Ghost Voices" and felt compelled to comment to fellow readers who might consider exploring this mystery.

We, as electronics technicians and engineers and hobbyists, are different from others because. I believe, we are curious about physical phenomena. We seek to know more and more about the physical nature of our universe. We are students of the physical world. The article provides us with a means to delve into another aspect of our universe, namely the spiritual.

The fact is, we are not in our element if we do that. I am writing to warn you against it. Do not communicate with the dead, for it is written in Deuteronomy 18:10-12:
"There shall not be found among you anyone that ... useth divination, or an observer of times, or an enchanter, or a witch, or a charmer, or a consulter of familiar spirits, or a wizard, or a necromancer. For all that do these things are an abomination unto the Lord ..."

If anyone feels they must persist, please follow this advice offered in 1 John 4:1-3:
"Believe not every spirit, but try the spirits whether they are of God: because many false prophets are gone out into the world. Hereby know ye the Spirit of God: Every spirit that confesseth that Jesus Christ is come in the flesh is of God. And every spirit that confesseth not that Jesus Christ is come in the flesh is not of God: and this is that spirit of antichrist, whereof ye have heard that it should come, and even now already is it in the world."

I pray that everyone heed these words in their pursuit of knowledge.

R.W., CET
Lee's Summit, MO

ADVERTISING CORRECTION

A full-page ad for our books, *Communications Licensing and Certification Examinations*, and *Practice Tests for Communications Licensing and Certification Examinations* recently ran in **Popular Electronics**.

As often happens with new books, a few errors crept into these two. Errata sheets are available to any readers who have purchased one or both books. Anyone interested can send a stamped, self-addressed envelope to the address below.

We offer our sincere apologies.

SAM WILSON AND
JOE RISSE
P.O. Box 2077
Melbourne, FL 32902-2077

DEFENDING HACKERS

I am extremely dismayed at the stereotypes of hackers presented in a review of the book *Protection and Security on the Information Superhighway* (*Electronics Library*, **Popular Electronics**, August, 1995). Kevin Mitnick was not charged with the crimes you mentioned. Hackers and phreakers do not destroy computer systems and use credit-card numbers for fun or personal profit as you stated. If you do that you are a criminal.

Hackers have helped expose the fact that your personal information might be stored on insecure computers that can be accessed by anyone. Hackers have revealed various scandals done by phone companies. In fact, many hackers have paved the way to what your magazine is all about.

The hacker community does not appreciate the media's false stereotypes. I expected that an electronics magazine such as **Popular Electronics** would better understand the computer- and phone-related issues so as not to judge hackers as "cyberthugs." I was wrong.

R.H.
East Meadow, NY

HAVES & NEEDS

Help! I'm in need of the schematic page from the user manual for a Radio Shack APM-200 Audio Peak and RMS Power Meter, #42-2102. If you could send the whole manual, or a copy of it, that would be fine, too.

I'll reimburse the postage and copying costs. Thank you!

KEN SIMMONS
29101 38th Avenue South
Auburn, WA 98001-1447

I have a Realistic (Tandy) Clarinette-120 stereo system, cat. no. 13-1224, for which I need a replacement AC power transformer. Neither Tandy nor their parts supplier can provide a replacement.

As an alternative to a replacement transformer, I can use information on the transformer secondary voltage and current ratings. There is only one secondary winding.

I will appreciate any help!

ED CARTOTTO
641 West Hillsdale Blvd.
San Mateo, CA 94403

I have enjoyed reading **Popular Electronics** for many years and hope you will continue its winning format.

I'm writing in hopes that another reader will be able to supply a copy of the operator's manual for Rockwell's AIM 65 microcomputer. I would gladly pay any photocopying expense.

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NEW PRODUCTS

Interactive TV Program Listings

Radio Shack's VideoGuide set-top box adds a new dimension to channel surfing and makes VCR programming easier. The interactive program system provides an on-screen guide with seven day's worth of program information, including times, channels, and detailed show descriptions. To view a program, you just select it from the on-screen guide using the VideoGuide remote. To record a program, you just select it and press another button on the remote, and the VCR is ready to record that show. "Smart-sorting" allows you to arrange the program grid to suit your personal viewing habits.

VideoGuide services are linked directly to the set-top receiver by BellSouth's MobileComm wireless paging network. A monthly subscription starts at less than one dollar a week.

Besides the on-screen guide and one-touch recording, the VideoGuide provides regional, national, and international news and weather through the Associated Press, United Press International, and other news sources. Up-to-the-minute sports scores and detailed summaries of completed games and games in progress are also offered.

The VideoGuide set-top receiver costs $99.99 at Radio Shack stores nationwide. For more information, contact Radio Shack, 700 One Tandy Center, Fort Worth, TX 76102; Tel. 817-390-3300; Fax: 817-878-6508.

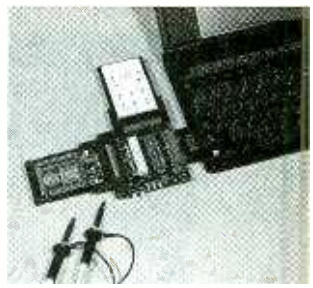
CIRCLE 50 ON FREE INFORMATION CARD

PCMCIA DIAGNOSTIC CARD AND EXTENDER CARD

Accurite Technologies' PC ReportCard makes easy work of developing and troubleshooting software or hardware on a PC card. By using the PC ReportCard in conjunction with the *PC ExtenderCard*, all the PC Card I/O and memory access cycles are displayed on a series of LEDs, allowing you to make a quick and convenient diagnosis of the card's hardware or software without using expensive test equipment.

Aimed at engineers involved in designing and developing PC cards and technicians who debug PC cards during the manufacturing process, the PC ReportCard is a passive device that monitors PC-card activity without any special software. Its external trigger signal can easily be connected to an oscilloscope or logic analyzer to aid with the capture of all the timing cycles. It also contains a general-purpose logic probe that can be used to look at bus signals or signals on the PC card.

The PC ExtenderCard includes a four-layer printed-circuit board with extensive use of grounding to minimize noise and maximize the integrity of the various signals. That allows for an extended length, providing adequate clearance for commonly used PC-card sockets. Test points for each of the 68 pins of the bus are clearly labeled. The PC ExtenderCard also includes 16 DIP switches that allow breaking of key signals to the PC card to isolate problems. The three power sources have a convenient point



for a current meter. Push buttons are provided to interrupt card detect 1 and 2, which simulates the wear and tear on the card's sockets and pins. A second socket provides direct access to all bus signals of the computer's PC card slot, accepting adapter cards for logic analyzers of the PC ReportCard.

The PC ReportCard and the PC ExtenderCard cost $229 each, or $425 for both if purchased together. For more information, contact Accurite Technologies Inc., 231 Charcot Avenue, San Jose, CA 95131-1107; Tel. 408-433-1980; Fax: 408-433-1716.

CIRCLE 51 ON FREE INFORMATION CARD

ECONOMICAL D/A CONVERTER

According to *AMC/Weltronics*, anyone with an older CD player, portable CD player with digital output, or a laserdisc player used as the basis of a home-theater system can improve the sound quality of CDs and laserdiscs with the *DAC 8* digital-to-analog (D/A) converter. The DAC 8 features four switched inputs, a tape loop for digital recording, and EIA-standard output. It supports up to 18-bit input data.

Using high-grade components on a double-sided PC board, the DAC 8 offers low-

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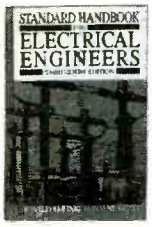

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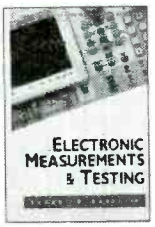

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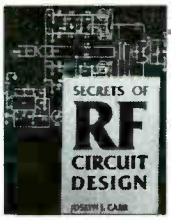

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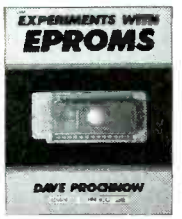

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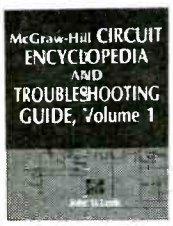

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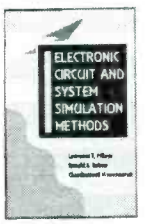

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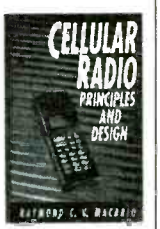
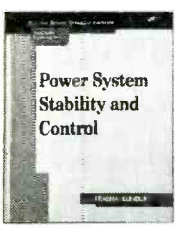


0443017 $50.00



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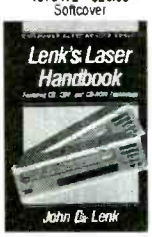

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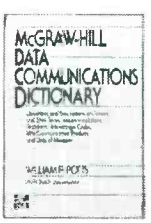

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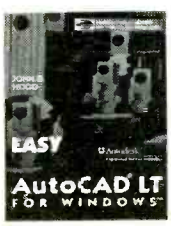

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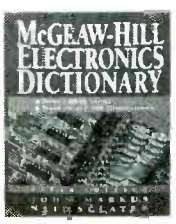

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noise, high-resolution, digital-to-analog conversion using Philips' latest bit-stream DAC with continuous calibration up to 18 bits. Automatic detection and lock for 32K, 44.1K, and 48K digital signals are provided. The unit's output provides an optimum signal level for Dolby Pro Logic circuits, eliminating input overload.

The DAC 8 D/A converter costs $199.95. For additional information, contact AMC/Weltronics, P.O. Box 80584, San Marino, CA 91108; Tel. 818-799-6396; Fax: 818-799-6396.

CIRCLE 52 ON FREE INFORMATION CARD

DIGITAL MULTITESTERS

Four additions to *Wavetek's XL Series* of handheld digital multitesters include two autoranging models, one extended function unit, and one capacitance/resistance meter. In addition to the standard DMM functions—voltage, current, diode test, and continuity—each meter in the XL series offers specialized functions.

The autoranging *DM30XL* and *DM35XL* offer special features such as a 3200-count display, bar graph, data hold (which freezes the reading on the display for later viewing), an auto-off feature to preserve battery life, a diode tester, and continuity beeper. Both models measure resistance to 30 megohms and AC/DC voltage to 600 volts.

The pocket-sized *DM16XL* includes a dependable frequency counter that measures frequencies to 15 MHz. It reliably tests capacitance, transistor gain, and logic, and measures resistance to 20 megohms.

The *CR50* is a full-range capacitance and resistance meter with zero adjust to eliminate the effects of the test leads. It feature seven resistance ranges—20 ohms to 20 megohms with a 0.01 resolution—and nine capacitance ranges—200 pF to 20 mF with 0.1-pF resolution. As an added value, the *CR50* offers continuity and diode tests.

All XL-series meters come with safety test leads that are shrouded with plastic to eliminate the risk of shock. The DM30XL and DM35XL feature an incorrect input warning, which sounds a beeper for incorrect test-lead placement. Each meter comes with a manual, alligator clips, a battery, and an extra fuse.

The DM30XL costs $79.95, the DM35XL and DM16XL each cost $99.95, and the CR50 costs $69.95. For further information, contact Wavetek Corporation, Instruments Division, 9045 Balboa Avenue, San Diego, CA 92123; Tel. 619-279-2200; Fax: 619-565-9558.

CIRCLE 53 ON FREE INFORMATION CARD

POCKET-SIZED FREQUENCY COUNTER

The *CUB 3300* frequency counter from *Optoelectronics* is designed for use in traditional lab settings as well as in field service, counter surveillance, police work, military situations, private investigations, two-way radio, and ham radio. Aimed at novice users and experienced technicians alike, it is simple to operate, yet is sophisticated and accurate.

The CUB features a digital filter that reduces false counts, and an auto capture mode that acts like an intelligent auto hold button. It allows a frequency to remain displayed as long as you want it to, with no chance of being overridden by surrounding RF. Other features include eight selectable gate times, a 9-digit LCD readout, 1- to 250-MHz direct-count capability for high resolution, maximized sensitivity for picking up radio transmissions, a 10-MHz timebase, extended (10-hour) battery life, and direct and prescaled ranges. Its frequency range is 1 MHz to 2.8 GHz.

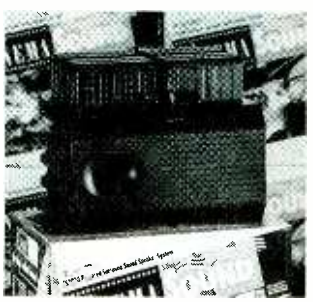
The CUB 3000 frequency counter costs $149. For additional information, contact Optoelectronics, Inc., 5821 NE 14th Avenue, Ft. Lauderdale, FL 33334; Tel. 1-800-327-5912 or 305-771-2050; Fax: 305-771-2052.

CIRCLE 54 ON FREE INFORMATION CARD

PORTABLE SURROUND-SOUND SYSTEM

Audio-Technica's CS2000 can give your multimedia business presentations the same great sound that you've come to expect from your home-theater system. The system includes a powered subwoofer; powered lett, center, right, and rear speakers (the rear channel information is transmitted via the 900-MHz UHF band); a Dolby Pro Logic decoder; and remote control. The "plug-and-play" transportable home-theater system can also be carried along to a vacation house, or between rooms at home.

The CS2000 was designed for portability and easy setup. The subwoofer module contains its own amplifier plus amplifiers for the three front speakers, the Dolby Pro Logic decoder, and the wireless transmitter for the rear channel. All four satellite



speakers slide into locking grooves on the top of subwoofer module. Once the satellite speakers are locked into place, you can lift the 38-pound package by its built-in handle holds and move it where desired.

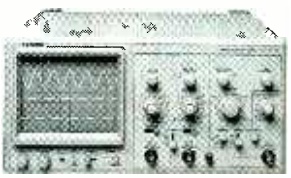
One audio cable connects the subwoofer module to either the line-level or headphone audio output of your computer or VCR. Arrange the speakers, plug the subwoofer and rear speakers into AC sockets, and the system is ready to use.

The CS2000 costs $599.95. For further information, contact Audio-Technica U.S., Inc., 1221 Commerce Drive, Stow, OH 44224-1760; Tel. 216-686-2600; Fax: 216-688-3752; e-mail: cs2000@atus.com.

CIRCLE 55 ON FREE INFORMATION CARD

LOW-COST OSCILLOSCOPE

Leader Instruments' Model LS 1020 is a 20-MHz dual-trace oscilloscope designed to meet general-purpose bench and field needs. It features a maximum sensitivity in both channels of 0.5-mV per division and a maximum, calibrated sweep speed of 50-nanoseconds per division. The scope provides sharp, bright traces. It uses switch-selected scale illumination, which is a necessity for oscilloscope photography.



Vertical mode selection offers CH1, CH2, chop, alt, and ADD (subtract with CH2 inverted). H timebase selections range from 0.2-ms/div to 0.1-μs/div in 20 steps with continuous sweep speed control. A ×10 magnifier shortens the time base by a factor of ten to yield a maximum observable speed of 10 ns/div.

Trigger coupling includes AC, RF reject, DC, TVH, and V settings. The trigger source selector sets source triggering to CH1, CH2, Alt (alternate trigger for stable display of asynchronous signals, power line, and external. Auto triggering is standard, with continuous control of trigger level and variable hold-off to view complex pulse trains. XY operation is standard with 1-MHz X-axis bandwidth and less than 3° phase difference between X and Y at 100 kHz. Other features include channel-1 output and Z-axis modulation.

The LS 1020 general-purpose oscilloscope costs $525. For more information, contact Leader Instruments Corporation, 380 Oser Avenue, Hauppauge, NY 11788; Tel. 800-645-5104, or (in NY) 516-231-6900. ■

CIRCLE 56 ON FREE INFORMATION CARD

www.americanradiohistory.com

New microprocessor puts the brain of a $50,000 car under your hood...

Breakthrough remote control lets you start your car, turn on its headlights, sound a panic alarm and unlock the doors and trunk...from up to 400 feet away.

by Charles Anton

How many times have you had to bundle up and brave freezing weather to start your car? Or sit in a sticky car and touch a blistering-hot steering wheel to get your car started? What else can you do besides shiver while a defroster blows cold air in your face or roast in the scorching heat of your car?

A better way. The new AutoCommand keychain transmitter gives you the power to start your car from the comfort of your home or office. Simply press a button to start warming up or cooling off your car from up to 400 feet away. You can turn on the heater, air conditioner or defroster without leaving your seat.

The powerful microprocessor brain learns your car's starting pattern. It adjusts the starting routine based on the outside temperature, battery voltage and the amount of time since your car was last run to guarantee starting every time.

Why AutoCommand is better...

- **Range.** *Most remotes only work up to 100 feet away. AutoCommand gives you a range of up to 400 feet.*
- **Self-diagnostics.** *The unique feedback lights on AutoCommand confirm proper wire connections during and after installation, just like a car's on-board computer.*
- **Total security and convenience.** *AutoCommand gives your car the capability of remote car starting, keyless entry, panic alarm and car security. It also has built-in low temperature and low battery voltage start options.*

Give your car a brain. AutoCommand gives your car the same features as luxury cars, and even some they don't have, by adding this microprocessor brain. In addition to remote car starting, your car will have features such as keyless entry and built-in car security.

You can call for help or scare someone away with the panic alarm; locate your car with CarFinder; and have your car automatically turn on its headlights when it gets dark or turn them off 20 seconds after leaving your car. You can even leave your car running with the doors locked and no key in the ignition. If you forget your car is running, it will automatically shut off after 10 or 15 minutes, you choose.

Intelligent benefits. With AutoCommand, your car can't be driven until a key is put into the ignition. The AutoCommand immediately cuts off the engine if your vehicle's hood is raised, brake pedal is pressed or the vehicle is shifted out of gear without the key in the ignition, preventing theft or tampering.

AutoCommand also monitors your car while you are away. The built-in Vacation Option will automatically start and run your car for 10 minutes every four to six hours when the temperature drops below zero. On hot summer days, AutoCommand will also start your car when the interior reaches 140 degrees. If your battery drops below 11 volts, AutoCommand will start your car to recharge it.

Try it risk-free. At Comtrad, we back all our products with a risk-free home trial. Try AutoCommand in your car and if you're not completely satisfied with its value and performance, return it within 90 days for a full refund, "No Questions Asked." AutoCommand is also backed by a two-year manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

UPGRADE OPTIONS.

You can replace your existing garage door remote control with the Garage Door Remote Control replacement system. This system can be added to any garage door that has an existing electrical garage lift unit. It will share the same transmitter as the AutoCommand, eliminating extra keychain remotes! You can also add the Shock Sensor option to the built-in car security system. It detects any impact on your car, giving you added protection.

The keychain transmitter works with all the available features.

Exclusive $50 installation discount

AutoCommand comes with an installation video and has patented self-diagnostic feedback lights which confirm wire connections step-by-step during installation. But for those who prefer to have AutoCommand professionally installed, we offer a $50 installation discount. Use the money for professional installation, or install it yourself and keep the money. Either way, AutoCommand makes it easy and affordable to add luxury car features to your automobile.

AutoCommand	~~$349~~	$14 S&H
with installation discount	$299	$14 S&H
AutoCommand Upgrade Features		
Garage Door Opener	$79	$8 S&H
add Shock Sensor to alarm	$49	$4 S&H

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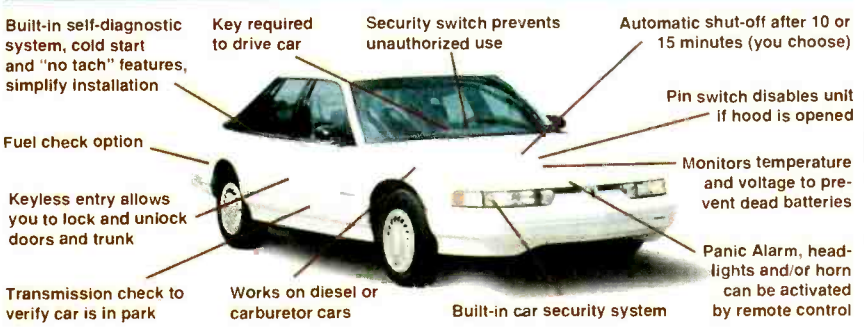
AUTOCOMMAND FEATURES



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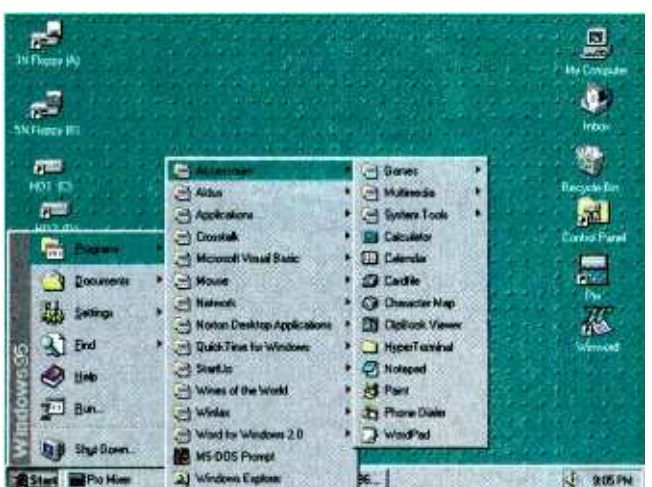
MULTIMEDIA WATCH

By Marc Spiwak
Technical Editor
Windows Magazine

Upgrading to Windows 95

I recently upgraded my home computer (a DX2/50) to Windows 95. While I'm happy with the results, I wasn't too happy during the upgrade process. Windows 95 offers many great improvements for someone who really knows how to use and configure computers. And that person shouldn't have too much trouble performing the upgrade. But the guy who needs help with that kind of stuff should wait for help, because the upgrade going can get rough.



Here's my new Windows 95 desktop. While I had problems during the install procedure, the effort was worth it.

Although I had access to the beta versions, I avoided upgrading my home computer to Windows 95 before the product's official release. It was hard enough to get many CD-ROMs to run on that system using "good old" Windows 3.11. So to be fair to software manufacturers and myself, I figured I ought to wait for the official release of Windows 95 before I installed it. The main benefit to upgrading to Windows 95 is that once it's properly loaded, you end up with a more stable, more integrated machine.

WHAT TO EXPECT

Windows 95 requires an awful lot of hard-disk space. If you're stuck with, say, only a 100-megabyte hard disk, forget about upgrading—Windows 95 can easily gobble up half of it depending on the configuration you choose. I have two hard drives in my computer: C: is 200 megabytes and D: is 540 megabytes. Neither of them is compressed. The C: drive pretty much contains my operating system and programs I have used for a long time—Winword for example. The D: drive is where I have been stashing all the multimedia stuff in recent years.

My C: drive was nearly full, so before I began the upgrade process I deleted anything I really didn't want from it and moved anything I didn't immediately need over to D:. That left me with about 20 megabytes free on C: and I figured that installing Windows 95 over Windows 3.11 wouldn't require more space than that. But it turned out that I was wrong. It also turns out that if you have the free disk space, then you should install Windows 95 in a new directory leaving your old Windows intact. I just didn't want to install Windows 95 on a different drive for the sake of efficiency.

I backed up all the important system files before starting, but the install software also gave me a chance to back them up. It also recommended that I back up several other files, so I did. Just to be safe I let Windows back up all the files it wanted to.

The first time I tried to install Windows 95, it told me to disable a Norton antivirus TSR before it could install itself. I had to "REM out" all references to the TSR in my startup files before I could continue. The next time around Windows informed me that I would need another 25 megabytes free on C: for any upgrade or else it would have to go on D:. Now I had to move all my screen saver stuff to D: along with all my .WAV files and some other assorted stuff.

The next try was going OK until Windows told me I should close any applications that were running by pressing ALT-TAB. I didn't think any were running but I tried it anyway—that crashed the computer! The next go around informed me that the previous attempt was unsuccessful (oh really!) and that I should take certain precautions during the next try (making a startup diskette, for example) to allow for a safe recovery in the future—as if I wouldn't take the precautions without Windows' recommendation.

The next stumbling block came when Windows told me that for the install option I selected ("Typical"), I would need even more

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free space on C:. As it turned out, Windows 95 needed more disk space to perform the install procedure than it actually ended up using once it was installed. I guess it needs the extra space for various temporary files during the install procedure—or at least it thinks it needs the space!

Disk-space issues aside, Windows 95 installed and ran—not without problems, but at least it was running. Windows 95 boots straight into Windows—DOS is gone for the most part. The first time it runs it configures startup files and hardware to run with the new operating system. During a fairly lengthy procedure, Windows 95 examines and automatically configures the hardware. My hardware was all nearly four years old, none of it plug-n-play, and Windows 95 properly identified all of it. A sound-card problem during bootup (it sounded like an IRQ conflict) seemed to clear itself up—at first.

Windows 95 was now up and running, but all of my Norton desktop groups were gone. Instead I was left with an ancient set of icons for which most of the software was long gone. Fortunately I was able to customize Windows 95 with shortcuts (look them up in Help) to mimic my old Norton desktop.

You can easily customize Windows 95 however you like, and all the controls are more integrated. For example, there's a master volume control on the main button bar. Another example is that if you want to change your desktop settings (wallpaper, colors, resolution, etc.), all you have to do is click on the desktop with the right mouse button and adjust its properties. Everything has properties (files, functions, desktop items, etc.), and they are all accessed and changed in the same convenient manner. And if you can't figure out what to do, you can launch programs and get to control panels through the help box.

Another benefit I received is that my old computer can perform new tricks when it comes to scrolling through menus and image files, and when playing .AVI files. That boost in performance is due to the new 32-bit applets included with Windows 95. My old apps probably run a bit slower, although it's not apparent.

TROUBLE UP AHEAD

Just when I was getting into the new features, the apparent IRQ problem with the sound card reappeared. All I could get in the way of audio was stuttering, and .AVI files wouldn't play with the broken audio. A reboot would only generate stuttering audio right at startup—something was obviously "permanently" screwed up. After a few nights of tinkering, it was time to talk to others who had a little more experience with the idiosyncracies of the new operating system.

Because the card appeared to work fine at first, then later failed, the general consensus was that Windows 95 first matched the old Win 3.11 settings and everything worked properly. Later on it automatically made some changes that messed up the sound card. The trick would be to see how Windows would set up the sound card initially, when it would work properly, and then manually make those settings permanent. To do that a "make settings automatically" box in the Windows Device Manager would have to be unchecked when the sound card was working properly, the settings changed, and then changed back. If you uncheck the automatic check box without changing anything, Windows 95 automatically rechecks it for you! How's that for automatic?

Of course, that meant uninstalling and reinstalling Windows 95. The Windows 95 uninstall procedure was uneventful, except when it came time to run the old Windows 3.11. It seems that the old swap file was gone and Windows wouldn't run. The way around that was to disable everything that took up memory (drivers, hundreds of fonts, and so on) so that Windows would run without a swap file. That way we could get back Windows 3.11 so that we could re-begin the reinstall procedure. Believe it or not, it worked, and Windows 3.11 was back. The reinstall procedure went OK except for hard-disk space problems again because I had put some stuff back on C:. After some fiddling with the sound-card settings as described, it seemed to be working. But the sound demon soon reappeared.

It was time to take another approach. Again turning for help, it was suggested that I jot down the settings of all my peripherals before I begin the upgrade (too late for me, of course, although I was able to look them up in my old setup files) and then set everything manually from within Windows 95 to match those settings. Then, disable everything in CONFIG.SYS (which is still used in Windows 95) and re-enable just enough of it to get everything to work.

That seems to have somewhat—but not completely—solved the problem. My Windows 95 setup is much better now and the sound glitch crops up only on occasion. A reboot clears up the problem, so now it only gets screwed up temporarily instead of permanently. I'll get the bugs "completely" ironed out yet—maybe I don't have quite enough of CONFIG.SYS disabled! But more than likely, I'll replace the "ancient" system before that happens.

GO FOR IT

I won't say that you shouldn't upgrade to Windows 95, because it really is kind of neat. Once it's set up properly you'll enjoy the greater stability of the new operating system. For example, even when my computer is suffering from the sound-card problem, I can still do whatever else I want. It's not that I like having problems with my sound card, but just that it demonstrates Win 95's true multitasking capabilities.

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Breakthrough device creates a wall of silent noise that drives away annoying animal pests...

Now you can use ultrasonic power to repel annoying dogs, cats and many wild animals—without harming them.

by Charles Anton

Be honest. Even if you like animals, you don't want strange animals in your yard. You know what I'm talking about: dogs that dig holes and foul your lawn or cats that trample flowers and sleep on your car.

Common problem. If you live in a rural area, you've probably had trouble with raccoons, skunks or possums. If you live in the southwest, you may even have had problems with armadillos.

Until now, there weren't many options. You wouldn't want to harm a stray animal, and an animal control agency may take days to respond, if they do.

Modern solution. Fortunately, modern technology has provided an answer: the new Yard Gard. It uses high-frequency sound waves to force unwanted animals to leave the area. Yard Gard eliminates the need for repellents, trapping or physical attacks. Pests learn to avoid the areas Yard Gard watches over.

Ultrasonic power. Yard Gard's electronic ultrasonic generator broadcasts powerful "high frequency noises" that repels four-legged yard pests, yet is generally unobtrusive to people. * Tones are harmless, but animals find the sounds unpleasant, so they flee.

Why it works. Small animals depend on their acute hearing for survival. They can hear in the 18 to 25.5 kilohertz range which is beyond the range of most humans. When critical hearing frequencies are disrupted by strong pulses, animals feel threatened and leave the noisy area. Yard Gard takes advantage of this fact to protect your yard from pests.

Break their habits. Animals are creatures of habit. They establish a territory and generally follow the same travel routes. Yard Gard forces animals to change their patterns and establish new ones. They soon modify their habitual routes to avoid Yard Gard zones. Once that has happened, they'll no longer be a an irritating problem.

Just plug it in. Yard Gard plugs into any standard household outlet. Electricity consumption is very low and costs only about 25¢ a month to operate.

Yard Gard is designed for outdoor operation in all types of weather. You can use your Yard Gard all year round.

Three settings. Yard Gard has three frequency settings. At its lowest frequency setting, one Yard Gard covers an oval area of approximately 4,000 square feet—the size of an average city lot. Additional units can be added to accommodate especially large yards.

Optional motion sensor. The Yard Gard's optional motion sensor turns the unit on when pests approach, increasing the surprise factor and effectiveness. An optional 50 feet extension cord allows you to place Yard Gard in remote areas that don't have electricity.

Keep the birds. Do you love to watch and feed birds in your yard? If you have problems with cats chasing birds away or killing them, Yard Gard is the answer. Birds are not affected by high frequency sound waves, but cats hate them.

Try it risk-free. For a limited time, you can get the new Yard Gard at the introductory price of just $99. Call today to take advantage of this special factory-direct pricing. Yard Gard is backed by Comtrad's exclusive risk-free home trial. Try it and if you're not completely satisfied, return it within 90 days for a full "No Questions Asked" refund. Yard Gard is also backed by a two-year manufacturer's warranty. Most orders are processed within 72 hours and shipped UPS.

**People that are more sensitive to high frequency sounds may hear the Yard Gard.*

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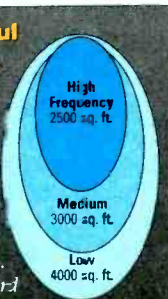
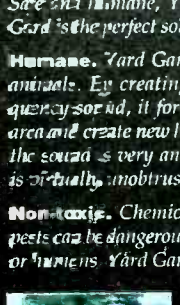


Humane. *Yard Gard causes no harm to animals. By creating a wall of high-frequency sound, it forces them to leave the area and create new habitual routes. While the sound is very annoying to animals, it is virtually unobtrusive to people.*

Non-toxic. *Chemicals used to eliminate pests can be dangerous to neighborhood pets or humans. Yard Gard poses no health risk when used properly.*



Nature-friendly. *Poisons and pesticides can pollute soil and water sources. Yard Gard deters pests with sound so it causes no damage to the environment.*

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Another simple example of that is how you can resize a window as the information in it is being updated. Supposedly when one application crashes—even though that shouldn't happen!—the operating system and all other applications should remain intact. I haven't had anything crash yet, but I'll keep you posted.

If you want to give Windows 95 a try, I recommend the following: First clean up your hard drive(s). Get rid of any software you don't use. You can always put it back, but now's a good time to give your computer a fresh, clean start. You should have 50 to 60 megabytes free before you begin the upgrade to avoid hassles down the road. Back up all of your system files and maybe even your whole hard disk if you have the equipment and the initiative. I didn't really risk losing anything important, as all of my work is always backed up. So I didn't bother backing up anything but my system files (AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, and SYSTEM.INI). Other files are sometimes important, but those four are the ones you should really be concerned with. Now is also a good time to defragment your hard drives if you haven't done it in a while.

I highly recommend installing from the CD-ROM version of Windows 95, which avoids a lot of diskette swapping. There's also lots of extra goodies on the CD. If you have the hard-disk space, it's convenient to copy the entire Windows 95 subdirectory from the CD-ROM to your hard drive and install it from there. Then all the install stuff will always be there if you need it, and reinstalls or loading new parts of the system are much quicker. And with any luck, you'll have less trouble getting Windows 95 up and running than I did.

NEW STUFF

It's Activision's big month this month—not that they or I am celebrating anything. It's just that I have received a large number of new Activision CD-ROMs over the past couple of months and so I figured I would mention all of them at once.

To begin with, *MechWarrior 2* is a really neat combat-simulation game that straps you into a highly destructive robot that you customize yourself. Multiple players can stomp around destroying everything in their path. About 50 different missions take place on different worlds with various terrains and environments. An instant action mode lets you customize missions and jump right into game play. A career mode lets you join a clan and advance in rank through competition. MechWarrior has a suggested retail price of $59.95.

Paparazzi! Tales of Tinseltown turns you into a tabloid photographer in search of candid celebrity shots. But to find those celebrities you have to do a little sleuthing to figure out where they will show up next. The player interacts with over two hours of video and more than 60 characters. Only the most strategic photographers will get the best shots. Paparazzi has a suggested retail price of $49.95.

Many readers probably remember the old Pitfall game where you had to swing from vines, jump over pits, hop on logs, and avoid crocodiles. Activision's new *Pitfall: The Mayan Adventure* features Harry Jr., the son of Pitfall Harry from the original game. In much more realistic settings than the original game, Harry Jr. is trying to rescue his father from the spirit of an evil Mayan warrior. The new Pitfall, written for Windows 95, has a suggested retail price of $49.95.

The *Atari 2600 Action Pack 2* is the second title in a four-volume series that lets people re-play their favorite old Atari games in Windows. Fifteen best selling titles are featured: Atlantis, Barnstorming, Dolphin, Dragster, Enduro, Ice Hockey, Keystone Kapers, Laser Blast, Megamania, Oink!, Plague Attack, River Raid II, Skiing, Stampede, and Tennis.

Activision's *Infocom Classics* features five volumes of classic text adventures revisited. The Mystery Collection contains Deadline, Suspect, The Lurking Horror, Witness, Moonmist, and Sherlock. The Comedy Collection features Ballyhoo, Bureaucracy, Hollywood, and Nord and Bert Couldn t Make Head or Tail of it. The Sci-Fi Collection includes The Hitchhiker's Guide to the Galaxy, A Mind Forever Voyaging, Starcross, Stationfall, and Suspended. The Adventure Collection features Border Zone, Cutthroats, Infidel, Plundered Hearts, and Trinity. Last but not least, The Fantasy Collection includes Enchanter, Seastalker, Sorcerer, Spellbreaker, and Wishbringer.

LucasArts has a new archive of its own for sale, but this one is actually one box containing six separate discs that you would normally have to buy individually, and all for only $29.95. *The LucasArts Archive Vol. I* includes Indiana Jones and the Fate of Atlantis, Day of the Tentacle, Sam & Max Hit the Road, Rebel Assault, Star Wars Screen Entertainment, and LucasArts Super Sampler.

Available through Electronic Arts, *Bloodwings: Pumpkinhead's Revenge* pits you against the tormented spirit of Pumpkinhead who is seeking vengeance among the living. The game is based on the cult-classic horror movie series, Pumpkinhead. It has a retail price of $54.95.

Pure Motivation from Insight Software is a combination screen saver, quote of the day inspirational guide, and affirmation generator, all designed to motivate you to do something new and different. It sells for $24.95.

I've got two new titles from Creative Multimedia this month: *Air & Space Smithsonian Dreams of Flight* is a guide to the history of flight as seen through the eyes of pilots, inventors, and ordinary people, and it sells for about $29.99. The *Blockbuster Video Guide to Movies and Videos* includes over 21,000 reviews of films, videos, and made-for-TV movies. Also contained are over 5000 photos and 40 video clips. It sells for $19.95 at Blockbuster Video stores and elsewhere. ■

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NET WATCH

By Dan Karagiannis

Internet Phone

Anyone with a friend or relative living in another state or country knows all too well the horror of long-distance phone bills. For that reason, unfortunately, many people have to limit the amount of time they spend communicating with loved ones, or must resort to letter writing, which is slow and just not the same.

With the Internet Phone software found at this site, your PC, sound card, microphone, and Net connection could be used to communicate long-distance for the cost of a local phone call.

With the introduction of e-mail and Internet Relay Chat (IRC), new options for communicating quicker and cheaper were presented, though neither could replace hearing the voice of someone you miss. Now, the Internet (and one particularly innovative company) provides us with yet another option, the Internet Phone.

A SOUND SOLUTION

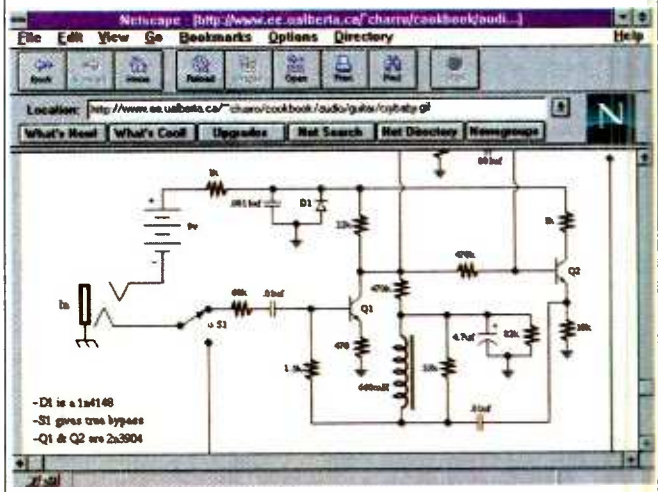
Internet Phone is a piece of software that lets you use the Internet to speak with any other user, from anywhere, for only the cost of a local phone call (assuming, of course, that your Net connection is a local phone call). To use the program, you need at least a 486SX-25 PC with 8MB of RAM, Windows 3.1, a 14,400 or faster modem, and a Winsock-1.1-compatible TCP/IP Internet connection. Also, your computer must have a standard, Windows-compatible sound card, a microphone, and speakers or headphones.

You can download an evaluation copy of the software from our first site of the month, VocalTec's Internet Phone page. That version of the program only works for 60 seconds of transmission time, however. The bad news for those who like to take advantage of the many gigabytes of free software on the Net is that VocalTec does charge a registration fee of $69 for Internet Phone version 3.0. With that fee, you get a code that removes the 60-second restriction from the software.

While that fee might rub some "internauts" the wrong way, at least you do get a chance to try the program before paying. Besides, Internet Phone will pay for itself in saved telephone charges after about eight hours of long-distance conversations.

Version 3.0 of the program lets you have either half- or full-duplex conversations, depending on what type of sound card you have. A half-duplex conversation resembles CB radio in that one person can talk and transmit at a time. Unfortunately, most sound cards are limited to that mode of communication (you could configure two half-duplex cards to work together, providing full duplex; see the web site for more details).

Full-duplex conversations are similar to regular phone calls. You can talk and listen at the same time, which sounds confusing on paper, yet is actually the way that most people talk on the phone. The site tells you which sound cards have full-duplex capability; I was pleased to see that my Gravis Ultrasound Max



The Circuit Cookbook WWW Page lets you access dozens of circuit diagrams of all types.

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would support that mode of communication.

In addition to providing demo software, the VocalTec site also offers a lot of useful information that will help you make your decision as to whether Internet Phone is right for you. Of course the best way to find that out is to download the free software and give it a try. But here are a few points to keep in mind:

Internet Phone works through the IRC network. Similar to IRC, the program provides you with a list of online users and topics of conversation when you connect. You can simply select a user from the list and call him or her, or create your own topic and wait for others to contact you.

Now, that raises the question about privacy. VocalTec addresses that concern in detail: "Internet Phone provides you with 'private topics' that only you and your family, friends or business associates can use. These topics are 'unlisted,' and can be accessed only by the users who know about them. In this way you can conduct your conversations quietly, without getting calls from all the other online users. When you only use private topics, your name does not appear on the global list of online users. Only users who know where to look can reach you."

Another concern some users might have is that of multitasking. In other words, do you have to devote your computer to nothing but waiting for an Internet Phone call? Definitely not, you can do other work and keep the program minimized. Then if someone calls, you can "answer" it.

As you can see, you really have nothing to lose by giving the program a try. Visit VocalTec's easy-to-use site and prepare for a new experience in communication.

A CIRCUIT COOKBOOK

And now, let's not forget who the primary readers of this column are—electronics hobbyists! To keep all of you with a hunger for technical knowledge satisfied, we'll now turn our attention to a really great electronics site with numerous circuit diagrams, descriptions, and FAQs, and computer programs.

The site, called the "Circuit Cookbook," is actually a page that links you to FTP files. That link allows you to just type in the address given in the "Hot Links" box while using your browser, and explore the FTP files with an interface, instead of being launched into meaningless directories, which is what happens when you normally access FTP sites.

The first thing you'll notice when you access the site is the list of readme files. Those are meant to introduce the types of formats that files are posted in, and to show you how you can contribute to the archive with any circuits or tips you might have. Once you familiarize yourself with the site, which should take all of two minutes, you can take advantage of the wealth of information found there.

Scrolling down past the readme files, you'll find a list of file subjects that can each be selected and linked to. Those are: Audio, Computers, Digital, Frequently Asked Questions, Integrated Circuits, Miscellaneous, Optics, Power, RF Information, Software, SPICE Files, Telecommunications, Video, and Wave Shaping.

As you'll find out either by entering those subject directories, or by reading the readme files, the posted programs, schematics, and electronics documents appear in various formats, including several for IBM-compatible and Unix formats. IBM users should be happy to find that there are also instructions for converting the Unix files for use (and there are some good ones here). A quick note to IBM users: The .GIF schematics are really the best way to go; they're clear and easy to read.

HOT LINKS

VocalTec Internet Phone
http://www.vocaltec.com

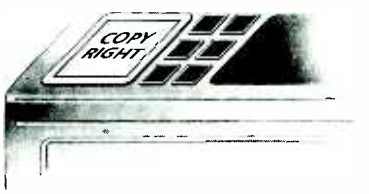
Circuit Cookbook WWW Page
ftp://ftp.ee.ualberta.ca/pub/cookbook/index.html

We obviously can't explore in this column what each of the subject directories contain (that's what your Net connection is for!). But here's a sample of what you can expect:

The first directory, Audio, contains schematics of simple through advanced projects, including a guitar-project subdirectory. Circuits include a 100-watt RMS amplifier, guitar distortion box, and guitar "crybaby." You'll also find a Windows speaker-design program that helps you generate enclosures and crossovers.

The Program directory is another interesting grouping of files. As my reference to the speaker-design program just showed, not all the software found in this FTP site is grouped in the Program directory, but a large number of useful programs are. In addition to the PC-board-design pro-

(Continued on page 26)



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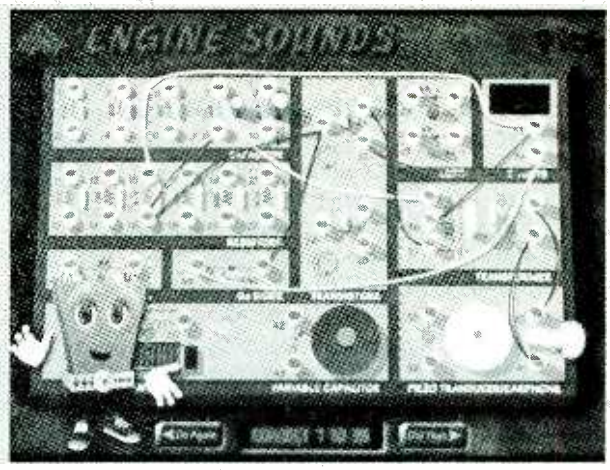
A Hands-on Electronics REPORT

Philips Fun with Electronics CD-ROM and Experimenter's Lab



CIRCLE 119 ON FREE INFORMATION CARD

Children, and the young-at-heart, will have fun learning about electronics with this multimedia learning lab.

In the old days, the only way to learn was with books, a blackboard, and a good teacher. Modern technology introduced records, tapes, slides, video, and more lively entertainment to the classroom, whether it be at school or at home. Now, thanks to the advent of multimedia, learning has never been more fun.

A picture says a thousand words, and video maybe more. From the old "please advance the frame at the sound of the beep" classroom film strips, to more-modern multimedia learning aids, any narrated picture show really helps make learning more effective and more fun. As a matter of fact, it is more effective *because* it is more fun.

Multimedia has opened up a whole new area in the learning arena. People can now study with the aid of sound, pictures, and video, and with the ability to skip around the media from place to place instantaneously—try that with an audio cassette or video tape!

The electronics field has its many learning aids as well, including breadboards, trainers, and kits that are designed to make it easier to learn. But until recently, if you were the owner of a multimedia home computer, there was very little you could do with it to help you or your kids learn about electronics. But all that has changed with the introduction of *CyberCrafts: Hands-on-Learning* series Fun with Electronics combination CD-ROM and experimenter's lab from Philips Media Home & Family Entertainment (for Mac and PC-compatible computers—a CD-i version should be available in January 1996).

The animated multimedia CD-ROM is geared toward kids ages 8 and up with its entertaining characters based on electronic components. But any adult into multimedia and wanting to learn about electronics might also enjoy this program. It takes a lighthearted approach to teaching the basics of electronics, and the funny characters make it easy to remember what each component does.

The Fun with Electronics package includes a colorful work bench and a storage box containing over 100 electronic components. Step-by-step instructions, both in a printed manual and on CD-ROM, guide the user through 25 exciting experiments including sirens, radios, metal detectors, and more. Fun with Electronics is priced at $44.99.

Fun With Electronics. The first step in having fun with electronics is to assemble the work bench. The work bench consists of a sturdy, flat cardboard box colorfully printed on the outside with pre-punched holes on top for mounting the electronic components. Component locations and necessary values are clearly labeled.

A divided, plastic storage box comes loaded with various components and breadboard springs that screw into the pre-punched holes in the box cover. Components include various resistors and capacitors, a diode, LEDs, transistors, a variable capacitor and tuning wheel, a wire-wound antenna, an earphone, a piezoelectric transducer, a 9-volt battery connector, and a transformer. Insulated jumper leads in different lengths are also included.

Component leads pass through small holes in the work-bench cover and wrap around the bottom ends of the breadboard springs. Once all the component leads are connected to springs on the underside, circuits can be made quickly and easily by connecting wire jumpers from spring to spring on the top side. Building the workbench gives the user a hands-on feel for the components themselves. The multimedia fun comes next.

The CD-ROM program installed and ran with no hassles. The program also runs fast. There are no long waits after you press a button, and the program does not crash or lock up from pressing one too quickly. New icons

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appear in Windows after the software is installed. One of them controls online assembly instructions for the workbench should you prefer them over the printed instructions. The other icon controls the project's software.

The software is hosted by Mr. Battery, an animated 9-volt battery with hands and a snap connector for a hat. He always tips his hat to remind you to remove the connector when necessary. Pressing an overview button guides the user through the different parts of the software. The overview recommends that you start with the Basics, then Meet the Stars, then go Behind the Scenes, and then start picking Projects to build.

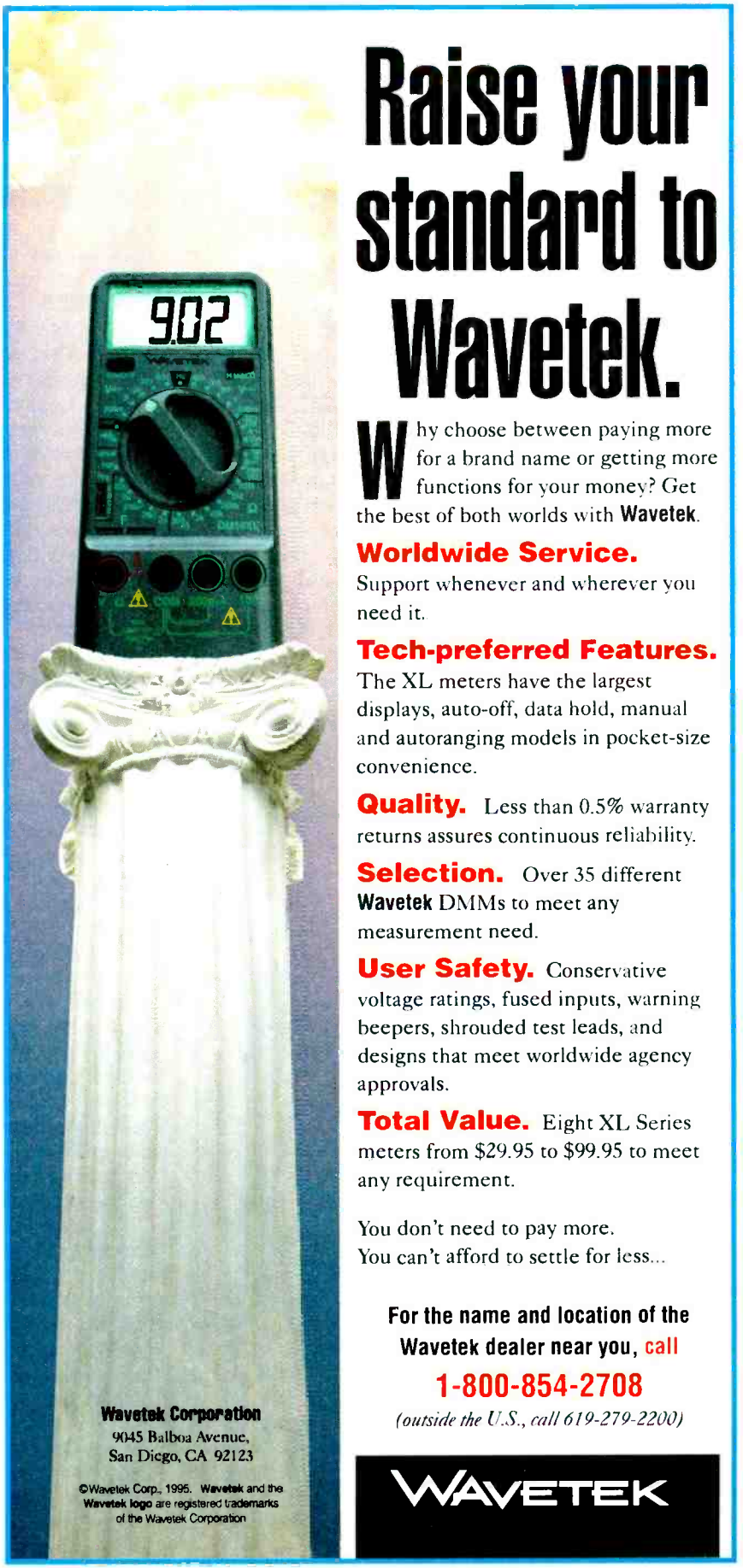
The Basics is an animated movie that explains how electricity works, from atoms and their proton-neutron-electron activity, to insulators and conductors, to oscillators (in which it is explained that "an oscillator is not a cross between an ocelot and an alligator"), to schematics.

Meet the Stars is an animated presentation that looks like a TV game show with a panel of electronic component stars. You'll be introduced to the "Transistor sisters;" "Mr. Piezo Transducer" from Italy, whose hat vibrates; a sun-worshipping photocell girl; and "Officer Diode," who only allows current to flow one way. There are plenty of other funny characters, too. An electronic quiz show asks questions about the different components and you have to point to the right one.

Behind the Scenes is a multimedia tutorial on how common, everyday things work. Items include a light bulb, telephone, television, radio, microwave oven, tape recorder, metal detector, bar-code scanner, electric guitar, light switch, and vending machine. Pressing different parts of each machine illustrates what each part does.

The 25 projects are divided into three categories of varying difficulty. The "no sweat" category includes step-by-step instructions on how to build an engine-sound circuit, a light fader, a traffic light, a burglar alarm, a light-activated switch, a conductance checker, an electronic rooster, and an electronic tag game. The "mind benders" category includes sirens and lights, a touch switch, a light organ, an electronic

(Continued on page 102)



CIRCLE 178 ON FREE INFORMATION CARD

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PRODUCT TEST REPORTS

By Stephen A. Booth

Panasonic CT-27SF31S 27-Inch Color TV

Every once in a while, a TV comes along that sets itself apart from the crowd. One such set is the *Panasonic CT-27SF32S* 27-inch "SuperFlat" TV. In addition to its wonderful picture tube, which shows 30% less curvature than garden-variety CRTs, this set comes loaded with frills and features—and a sticker price—that guarantees you won't mistake it for "light-and-play" sets of the same size.

CIRCLE 120 ON FREE INFORMATION CARD

The Panasonic CT-27SF31S 27-inch "SuperFlat" color TV.

Happily, so does its performance. Based on subjective appraisal and laboratory bench-tests, this is one outstanding example of TV technology.

FEATURES

SuperFlat is Panasonic's version of the dark-glass, high-contrast, reduced-curvature tubes that most TV makers now incorporate in their premium receivers. Besides better off-axis viewing, the benefits of the new geometry include less optical-distortion and, especially in the corners, reduced color distortion caused by misregistration of the electron beam. The more-planar screens also cut the amount of glare from reflected ambient light, which otherwise would rob contrast.

What you see in the 27-inch screen of this Panasonic set is a pretty picture—as many as two of them if you use the picture-in-picture (PIP) function. The PIP can be located in any corner of the screen, or swapped with the main picture. The input isn't limited to an external video source, because the CT-27SF31 has two tuners built-in. Whatever the source, though, audio accompanies only the video on the main screen.

Virtually every feature and setting for the CT-27SF31S is operated through Panasonic's "Easicon" on-screen menu, which is about as intuitive as any I've seen. It's all point-and-click via the unit's universal remote control, whose spacious layout has large buttons and cursor-like keypads, which, alas, isn't illuminated (one of the set's very few shortcomings—the only other ones of note are the lack of front-panel audio/video jacks for a camcorder and no headphone jack anywhere).

Noteworthy features within the Easicon menu include AI (Artificial Intelligence) Picture and Audio, and user-selectable White Balance that lets you alter the color temperature of the video. Those features, unlike many buzzword items in consumer electronics, do actually make a demonstrable difference in what you see and hear.

AI Picture monitors flesh-tone accuracy and brightness, color-edge distortion, and color noise. It's a dynamic, on-the-fly system well-suited to the vagaries among cable, broadcast, and external-video signals. You'll find noise-reduction to be its strong suit when you're the one-thousandth renter of that hit-movie tape.

AI Sound is another multi-function feature that really works. One of its functions is to apply corrective equalization to soundtracks that have lost or picked up something along the way (like the bass and noise, respectively, on those rental tapes). Better still, AI Sound maintains the volume level between programming and commercials—no more waking the dead when that late-night pitch comes on. It does the same for channel-to-channel level differences, or differences between external sources.

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Like most TVs, the CT-27SF31S comes with its color temperature preset to compete on the retail showfloor. APEL measured that "Standard" mode at 12,000°K—very typical for out-of-the-box performance, but rather feverish to videophiles who want the perfectly-cinematic 6500°K written into the NTSC standard.

Fortunately, the White Balance can be adjusted through the Easicon menu. Besides Standard, there's a Warm setting (10,000°K) that is the closest to NTSC this TV gets, and a Cool setting (15,900°K) that will positively delight retailers (or football fans who like to simulate the stadium experience by viewing TV outdoors). The difference among those settings is evident on the CT-27SF31S. For the record, when dealing with °K (degrees Kelvin), the higher the temperature the cooler (icy-blue whites) the picture seems. Lower temperatures mean "warm" in the sense of sunshine-dappled yellow on a snowscape.

One final note on the Easicon menu. You can take Parental Lockout (of taboo channels) for granted these days, but a sign of the times has got to be "Game Lockout." That feature cuts off the Channel-3 or -4 video inputs where videogame consoles (among other sources) tend to be installed. Presumably, the idea is to get Johnny and Susie to read "Great Expectations" when they'd rather be plucking out livers in a friendly game of "Mortal Kombat."

PERFORMANCE

As usual, this piece of gear went on the rack at the Advanced Product Evaluation Laboratory, an independent testing facility in Bethel, Connecticut.

Whatever color temperature you choose, the CT-27SF31S will be plenty bright—APEL measured maximum usable luminance at 75 foot-lamberts. And with horizontal resolution clocked at 560 lines, it'll handle the sharpest input sources you can feed it—laserdisc, direct-broadcast satellite, high-band camcorders, and even the new Digital Video Cassette home-moviemakers (which yield some 500 lines of resolution). Meanwhile, color quality (saturation and hue) referenced to the standard Macbeth chart was excellent.

In geometry class the CT-27SF31S scores high, but not a perfect 100%—few TVs do. Its shortfalls from perfection in overscan, convergence, interlace and transient response are negligible, in the sense that test-equipment is faster than the eye. Meanwhile, the tuner in this TV is exceptionally good. Under worst-case conditions, reception showed minimal snow.

Audio quality ought to complement video this good, and in the CT-27SF31S it does. Performance from the MTS broadcast stereo decoder is no less than you should expect in a TV of this caliber—though no one would complain about getting more channel-separation than the 20.4 dB measured by APEL. It's a typical reading for TVs, though VCRs usually have greater separation, and extends across a broad frequency range from 23 Hz to 10.1 kHz. Signal-to-noise ratio (59.7 dB) is

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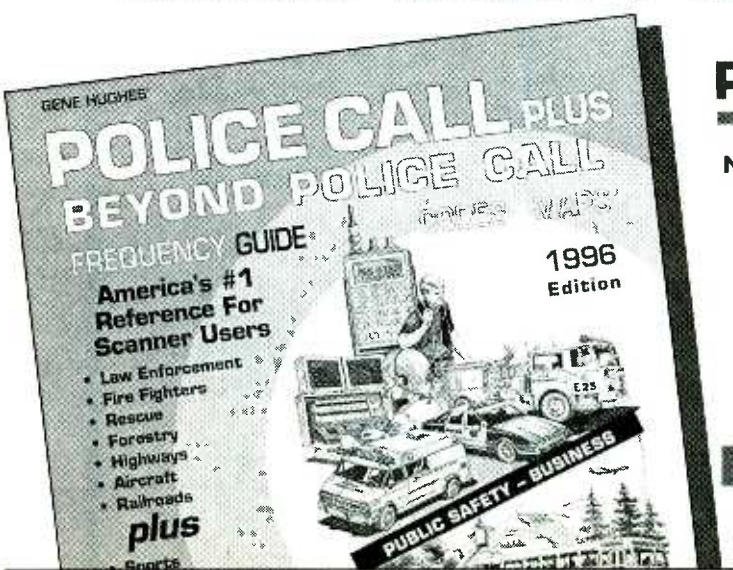

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TABLE 1—TEST RESULTS

Brand:	Panasonic
Model:	CT-27SF31S
Price:	$950
VIDEO MEASUREMENTS:	
Maximum usable luminance	75 foot-lamberts
Horizontal resolution	560 lines
Convergence (center)	0.0%
Convergence (corners)	0.2%
Overscan (horizontal)	1.0%
Overscan (vertical)	0.0%
Interlace	60/40
Transient response	Slight ringing
Color temperature (standard)	12,000°K
Color temperature (warm)	10,000°K
Color temperature (cool)	15,900°K
Color quality	Excellent
Reception (100 µV/M)	Very good
AUDIO MEASUREMENTS:	
Audio Out	
0-dB reference level (@ 1 kHz, 3.00% THD)	2.85 volts
Signal-to-noise ratio	69.1 dB
Total harmonic distortion (1 kHz)	0.08%
Frequency response	20 Hz–20 kHz
MTS STEREO TV DECORDER MEASUREMENTS:	
Stereo Mode/Left Channel	
Signal-to-noise ratio (re 100% modulation)	59.7 dB
THD (@ 1 Khz, –20 dB)	0.36%
Frequency response*	23 Hz–10.1 kHz
Separation*	20.4 dB
S.A.P. Mode	
Signal-to-noise ratio (re 100% modulation)	69.0 dB
THD (@ 1 kHz, –20 dB)	0.66%
Frequency response (re 100% modulation)	20 Hz–6.0 kHz
Mono Mode	
Signal-to-noise ratio (re 100% modulation)	60.5 dB
THD (@ 1 Khz, – 20 dB)	0.47%
Frequency response (re 100% modulation)	20 Hz–5.8 kHz
ADDITIONAL DATA:	
Picture size	27-inch (diagonal)
Loudspeakers (2)	5 x 3.5 inch oval
Power requirements	145 watts
Dimensions (HxWxD, inches)	21.25 x 26.5 x 19

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

excellent, and distortion (0.36%) is inaudible.

Those measurements, in conjunction with the TV's very-clean audio-output section, mean you'll get satisfying results if you connect the CT-27SF31S to an outboard stereo system, possibly one with Dolby Surround decoding. Test results for monaural reception and for the monaural, SAP (Second Audio Program) channel were equally good: wide frequency response, low noise, and negligible distortion.

Even with retail discounts, the CT-27SF31S ($950 list) doesn't come cheap for a 27-inch TV. But its features and performance won't disappoint.

For more information on the Panasonic CT-27SF31S, contact the manufacturer at the address that follows, or circle no. 120 on the Free Information Card. ■

VENDOR INFORMATION

Matsushita Consumer Electronics Company
One Panasonic Way
Secaucus, NJ 07094

NET WATCH

(Continued from page 21)

grams you might expect to find here, there are also quite a few useful shareware programs that can aid in the math behind electronics design (such as determining what value components to use, etc.).

A final word on the site before we leave off. There is a disclaimer basically stating that the circuits can't all be tested before they are posted. Some might not work, but according to the disclaimer, many do seem to. So, if you find a circuit that doesn't work, or that could be better, follow the readme-file instructions and make a contribution to the site. It can only make the archive a better resource for all of us.

Until next time, enjoy your Net explorations. If you have any questions or comments, or perhaps a neat site you'd like to see covered in future columns, you can e-mail me at peeditor@aol.com, or send snail-mail to *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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CIRCUIT CIRCUS

By Charles D. Rakes

Let's Make Some Noise!

While the cover date on this magazine may say February, it will be in your hands well before January. So let's dedicate this visit to some electronic noise makers that could liven up your New Year celebrations.

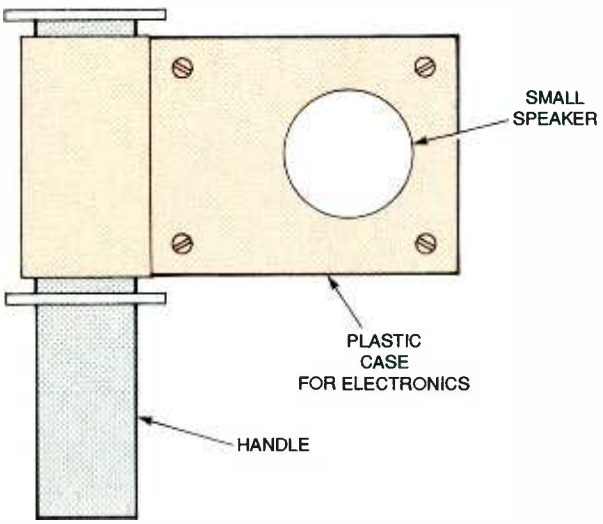

Fig. 1. Does this look familiar? It is the case for an electronic version of a noise maker that has been around for a long time.

ELECTRONIC NOISE MAKER

A long time ago, kids used to play with an ear-hurting, hand-cranked noise maker that produced a rat-a-tat sound. Our first entry is an electronic version of that device. Take a look a the sketch in Fig. 1 and see if it doesn't look a little familiar. No matter if it doesn't, we'll explain as we proceed.

Figure 2A shows a length of wood dowel rod, about 6-inches long, with a cut out made to hold a small magnet. The cut-out should be made deep enough so that, when in place, the magnet's outside surface will be flush with the dowel's outer surface. A section of plastic pipe, sized so that it slides smoothly over the dowel rod, serves as both a holder for six reed switches (see Fig. 2B) and a place to mount the plastic case shown in Fig. 1.

Two fiber or plastic washers keep the plastic pipe in place but free enough to turn around the dowel rod. The small plastic case should be attached to the plastic pipe with a good plastic glue. One that actually melts the two joining surfaces would be the best choice.

Now let's look at the circuitry itself, which is shown in Fig. 3. The noise maker's circuit is about as straightforward as you can get. A single unijunction transistor, Q1, generates the different tones, and a general-purpose NPN transistor, Q2, raises the level to drive a small speaker. The six reed switches, S1–S6, are mounted around the outside of the plastic pipe as shown in Fig. 1B. As the pipe turns over the magnet, the reed switches open and close, tying a different-valued resistor to the oscillator's frequency-control circuitry. It's also possible for two reed switches to be closed at the same time. When that happens, the output tone will be much higher in frequency than when one at a time is activated.

The oscillator's frequency range could be lowered by increasing the value of C1, and raised by decreasing C1's value. To operate just grab the noise maker by the dowel rod and give it a twist to start the plastic case turning.

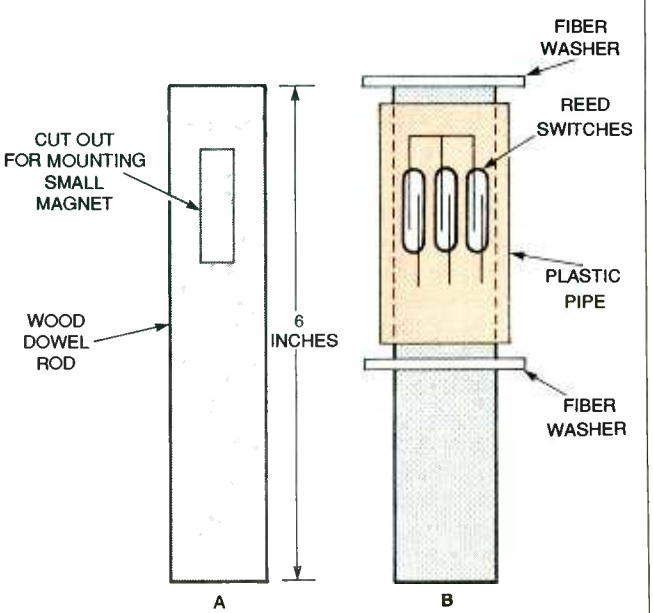

Fig. 2. Here's the handle for the noise maker. The location of a cut out for a small magnet is shown in A; the positioning of a plastic pipe on which the switches and the case with rest of the circuitry mount is shown in B. The fiber washers keep the plastic pipe in place but free enough to turn around the dowel.

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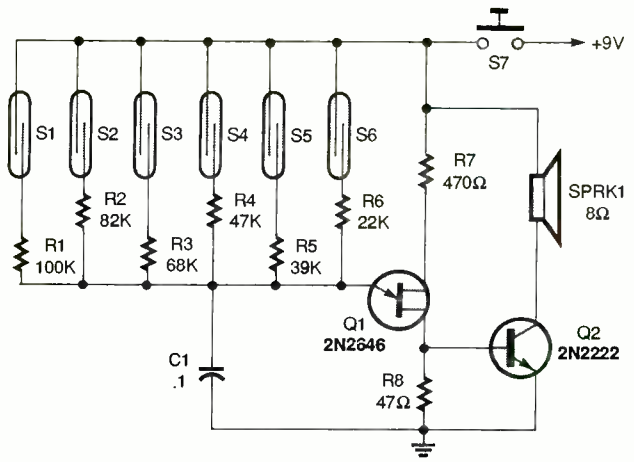

Fig. 3. Here's the circuitry for the noise maker. As it swings around the handle, the magnet activates the reed switches, constantly changing the frequency of the audio oscillator.

PARTS LIST FOR THE ELECTRONIC NOISE MAKER (Fig. 3)

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—100,000-ohm
R2—82,000-ohm
R3—68,000-ohm
R4—47,000-ohm
R5—39,000-ohm
R6—22,000-ohm
R7—470-ohm
R8—47-ohm

ADDITONAL PARTS AND MATERIALS

Q1—2N2646 unijunction transistor
Q2—2N2222 NPN transistor
C1—0.1-μF ceramic-disc capacitor
S1–S6—Reed switch
S7—SPST normally-open pushbutton switch
SPKR1—8-ohm speaker
Magnet, wood dowel, plastic pipe, fiber washers, plastic case, perfboard, wire, hardware, etc.

A WAILING WITCH

Our next noise maker, see Fig. 4, is an electronic "wailing witch." After you play with the circuit awhile, you might find a more fitting moniker for it—feel free to name it what you like.

Whatever you call it, here's how the circuit works. Two unijunction transistors, Q1 and Q2, are connected in a dual oscillator circuit. Transistor Q1 is connected in a very-low-frequency relaxation oscillator circuit with C1, R1, R5, and R9 setting the operating frequency. Transistor Q2 is connected in a similar oscillator circuit that operates at a much higher audio frequency. That oscillator's frequency is set by R6, R10, and C2. Resistor R7, a 1-megohm potentiometer, sets the mixing level of the two oscillators. By adjusting R5, R7, and R6, many strange sounds are created.

AN ELECTRONIC TROMBONE

Our next circuit, see Fig. 5, is a short-stroke electronic trombone. The heart of the trombone is R3, a slide potentiometer. Two gates of a quad two-input NAND gate,

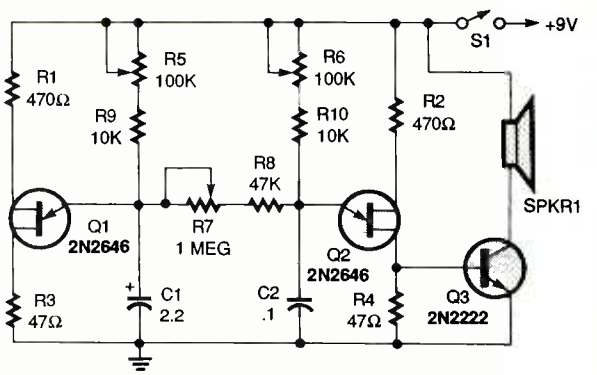

Fig. 4. Here's a "wailing witch" that you can build. After you've heard the racket it can produce for a while, you might come up with a different name for it!

PARTS LIST FOR THE WAILING WITCH (Fig. 4)

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1, R2—470-ohm
R3, R4—47-ohm
R5, R6—100,000-ohm, potentiometer
R7—1-megohm, potentiometer
R8—47,000-ohm
R9, R10—10,000-ohm

ADDITIONAL PARTS AND MATERIALS

Q1, Q2—2N2646 unijunction transistor
Q3—2N2222 NPN transistor
C1—2.2-μF, 35-WVDC, electrolytic capacitor
C2—0.1-μF, ceramic-disc capacitor
S1—SPST toggle switch
SPKR1—8-ohm speaker
Perfboard, case, wire, solder, etc.

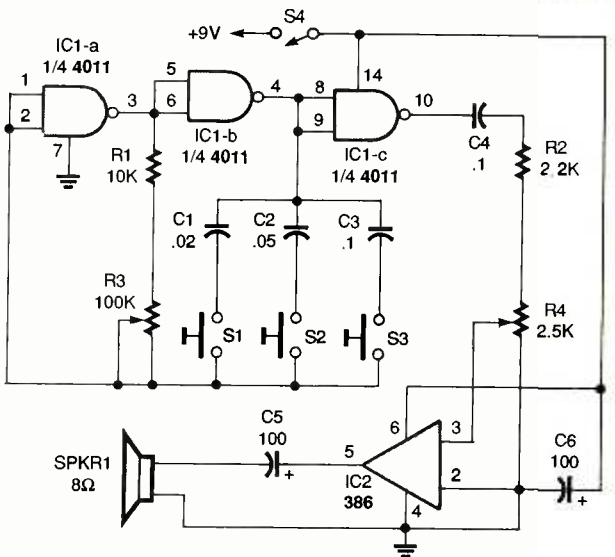

Fig. 5. The slide potentiometer, R3, in this electronic noise maker acts much like the slide of a trombone.

IC1-a and IC1-b, make up a simple audio-oscillator circuit with R1, R3, C1, C2, and C3 setting the oscillator's frequency. The oscillator's output is buffered by IC1-c, which also supplies the drive signal for the power amplifier, IC2. The trom-

(Continued on page 77)

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Breakthrough device repels pests... without chemicals or traps!

The new Transonic ESP generates ultrasonic and sonic noises to drive away annoying pests electronically.

by Thomas R. Buchannan

Ticks that torment your pet. Crickets that chirp incessantly. Bees and wasps that build nests under your eaves. Spiders that spin webs endlessly. Are you waging a constant battle to get rid of household pests? If you're like me, you don't like using poisons or traps, especially if you have small children. Until now, there weren't other options. Fortunately, now there is a solution.

Drive them away. Now, thanks to modern technology, there's a better way to get rid of household pests—the Transonic ESP. This remarkable new electronic device uses high-frequency sound waves to repel common pests. Best of all, the Transonic ESP doesn't trap or kill them—it drives them away. Pests are forced to flee the area to get away from the annoying and confusing sound waves. Therefore, there are no dead bodies or unsightly messes to clean up.

Tired of battling pests?

Fleas and ticks. *Famous for causing skin discomfort, these pests also spread disease and parasites.*

Spiders. *Eliminate webs draped across your furniture and in the corners of your living room.*

Bats. *Dark places invite bats to roost. They can make a mess of your attic or storage building.*

Squirrels. *Gnawing squirrels in your walls or attic can cause structural and electrical damage.*

Mice and rats. *Well-known carriers of disease, rodents can be hard to get rid of once they have infested your home or office.*

The Transonic ESP covers an area of up to 5,000 square feet.

Ultrasonic/sonic repellent. The key to the Transonic ESP is a patented electronic sound generator which broadcasts powerful ultrasonic and sonic noises in the five to 50 KHz range. These frequencies and pulse sequences are extremely uncomfortable to insects and small rodents. Pests are forced to leave or die.

Why it works. Most wild creatures depend on their acute hearing abilities for survival. They rely on hearing mechanisms for communicating with each other, for establishing territorial boundaries and for locating available food sources.

When critical hearing frequencies are disrupted by high-frequency pulses, insects and small rodents feel threatened and confused. They are forced to leave. Remaining in the area causes apathy and immobility.

Just plug it in. The Transonic ESP comes with its own transformer which plugs into any standard outlet. To operate, simply press the appropriate button on the front panel. You can repel fleas, ticks, spiders, bats, mice, rats or squirrels, depending upon the sound frequency you select. (For optimum performance, follow proper pest control practices.)

Are poisons and traps endangering more than just household pests?

Traps. In addition to the trouble of setting up a trap and the danger of accidentally stepping into it, you also face the unpleasant task of disposing of the animal once it is caught.

Foggers. Using a fogger is both time-consuming and inconvenient. You must cover up all of your belongings in order to shield them from the chemicals. You also must wait several hours for the fumes to disperse before re-entering the area.

Pest sprays. Exposing your carpet and furniture to chemicals can be potentially dangerous, especially if you have young children who are still crawling. Plus, chemical sprays are difficult to apply in a way that eliminates all the pests, especially the hidden ones.

Optional motion sensor. The Transonic ESP's optional motion sensor turns the unit on when pests approach, increasing the surprise factor and effectiveness. An optional 50 foot extension cord allows you to place the Transonic ESP unit in remote areas that don't have electricity, like the attic.

The versatile Transonic ESP is perfect for home, barn or storage shed.

Factory-direct offer. The Transonic ESP is an extremely cost-effective way to control pests. And through this special factory-direct offer, it's even more affordable. In order to introduce this product to the public, we're offering a $25 discount off the retail price. Right now, you can purchase the new Transonic ESP for only $99.

Risk-free. The Transonic ESP is backed by our exclusive 90-day risk-free home trial. Try it in your home, garage, barn—anywhere. If you're not completely satisfied, just return it for a full "No Questions Asked" refund. The Transonic ESP is also backed by a two-year manufacturer's warranty. Most orders are processed within 72 hours and shipped UPS.

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Motion Sensor	$39	$4 S&H
Extension Cord	$19	$3 S&H

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Send simple transmissions in the 40-meter amateur band.

BUILD A VACUUM-TUBE Transmitter

BY LARRY LISLE

If you're a licensed radio amateur, or you're just interested in how tube transmitters work, here's a little ham-radio transmitter that can provide you with hours of fun on 40 meters. The *Vacuum-Tube Transmitter* described in this article is an easy-to-build unit, with a fairly low parts count, that is an ideal project even for someone who's never built a transmitter before.

The Transmitter is a low-power (QRP) one-tube unit based around a type-3A5, twin-triode vacuum tube. The 3A5 was one of the few tubes actually designed to operate on battery power, and was widely used in portable and emergency transmitters in World-War II. Battery power is somewhat safer for a newcomer to tube voltages, and is actually practical with low-cost military surplus batteries. For those who wish to not bother with the hassle of replacing batteries, an optional power-supply circuit is also included.

Before we get to the actual circuit itself, a brief mention of the power output of the Transmitter should be made. Even though the unit outputs in the 1- to 2-watt range, that should be strong enough to establish plenty of contacts, provided that conditions are right, and that the unit is used with skill and patience.

Circuit Description. The schematic for the Transmitter is shown in Fig. 1. In the circuit, power is shown supplied by a 3-volt battery, B1, and a 135-volt battery, B2. The latter battery, B2, can be replaced by a power-supply circuit that we'll get to in a moment. Switch S1 is used to turn the circuit on or off.

The heart of the circuit is a 3A5 tube, V1. Both sections of V1 are connected in parallel in a conventional Miller oscillator. Resistor R1 sets the bias for the tube; the value of R1 might seem low to some because it is only 4700 ohms, but keep in mind that V1 is a transmitting triode operating at class C.

A 2.5-mH, RF-choke coil, L3, is needed to keep the radio frequency where it belongs. Capacitor C1 and inductor L1 resonate at the frequency of a 40-meter (7–7.3 MHz) amateur crystal, XTAL1. Inductor L2 couples RF energy to an attached antenna; C2 is a bypass capacitor.

Switch S2 is a telegraph-type keyswitch. That's used to generate the content of any transmissions you make.

As mentioned earlier, you can eliminate the need for battery B2 by building a simple power supply. It's schematic is shown in Fig. 2.

Transformer T1 provides isolation from the power line. The isolated AC voltage is rectified by diode D1 and filtered by capacitor C1.

Construction. The author's prototype for the Transmitter was built on a 9- × 5½-inch wood baseboard.

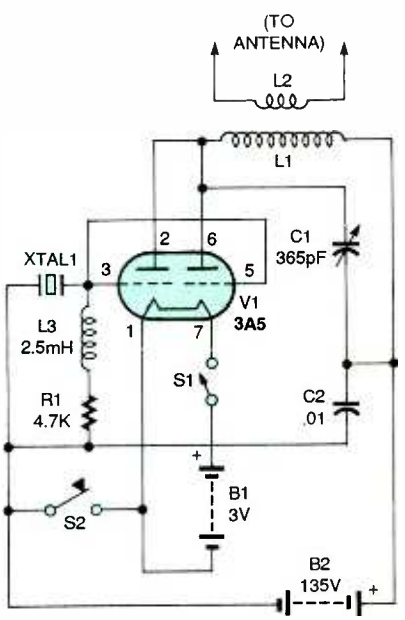

Fig. 1. This is the schematic for the Vacuum-Tube Transmitter. At the heart of the circuit is V1, a 3A5 tube with two sections that was designed for battery-powered transmitters.

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PARTS LIST FOR THE BATTERY-TUBE TRANSMITTER

R1—4700-ohm, 1-watt, 5% resistor
C1—365-pF, variable capacitor
C2—0.01-μF, ceramic-disc capacitor
L1—See text
L2—See text
L3—2.5-mH, radio-frequency choke coil
V1—3A5 vacuum tube
XTAL1—40-meter amateur crystal (see text)
S1—SPST knife switch
S2—Key-switch, telegraph type
B1—3-volt battery (two 1.5-volt D-type batteries in series)
B2—135-volt battery (three 45-volt batteries in series; see text)
Wood baseboard (9 × 5½ inches), Plexiglas (9 × 4½ inches), Fahnestock clips, 7-pin miniature tube socket, socket for XTAL1, knob for C1, screws, wire, solder, hardware, etc.

Note: The following is available from Antique Electronic Supply (6221 S. Maple Ave., Tempe, AZ 85283; Tel. 602-820-5411): a kit of parts for the Battery-Tube Transmitter, including everything except XTAL1, (K-PE-BT KIT)—$99.95 (contact Antique Electronic Supply for shipping cost). Arizona residents please add appropriate sales tax.

Fahnestock clips and tube sockets were used to mount the components.

Begin by mounting an octal tube socket (using wood screws) to hold crystal XTAL1. Then insert the crystal you want to use. Remember that you are "rock bound" with the Transmitter. That is, the crystal frequency you select is the only one you will be able to transmit on. Be sure to choose a frequency that's appropriate to your license class and in the CW-portion of the band. You might find it helpful to monitor the frequencies you have in mind before finalizing your decision.

For the preceding reasons, no crystal is supplied with the Transmitter kit available from the source mentioned in the Parts List (the octal socket is supplied, however). If you can't locate and buy the crystal locally, you can order one from either CW Crystals (570 N. Buffalo Street, Marshfield, MO 65706) or from International Crystal Mfg. Co., Inc. (10 N. Lee Street, Oklahoma City, OK 73102).

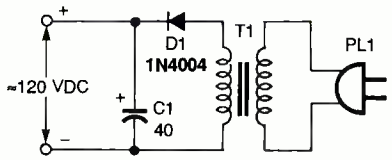


Fig. 2. Here's a simple circuit that can be used instead of batteries to power the Transmitter.

Next mount a 7-pin, miniature tube socket for V1, and insert the tube. Go on to wire R1, C2, and the choke coil. The variable capacitor, C1, is the type used in tube broadcast radios. Mount it towards the edge of the baseboard by passing machine screws through the board from below.

Attach S2, the key-switch, to the Transmitter using insulated wires. Keep S2 off-board, for safest operation.

Inductor-coil L1 should be made on a 1¼-inch-diameter piece of wood dowel rod. Wind 13 turns of 22-gauge enameled wire and space them so that the coil is 1-inch long. To make L2, wind two turns of wire over L1. Wire the coils into the circuit at this time, and connect Fahnestock clips so that you can attach an antenna later.

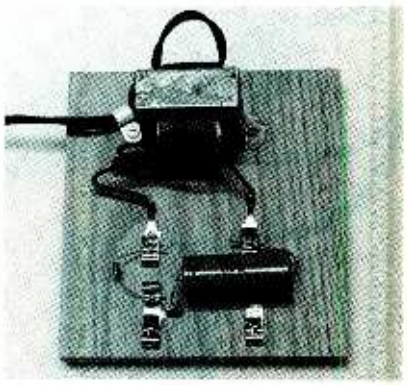
The last step in assembling the Transmitter is to wire the power connections. For starters, you will have to wire B1 (two 1.5-volt D cells in series) into the circuit. Then, you have to come to a decision about the other power source. If you would like to use B2, a 135-volt battery, just wire it into the circuit at this time, and you're almost done (note that B2 is made of three 45-volt batteries in series; use military-surplus types SZ-283 or SZ-284, which are included in the kit, or Eveready No. 455). If you would like to use the optional power supply shown in Fig. 2, just wire Fahnestock clips to the Transmitter for positive and negative connections to the supply. Whatever power source you use, though, make sure to position power connections as far away from C1 as possible.

PARTS LIST FOR THE OPTIONAL POWER SUPPLY

D1—1N4004 silicon rectifier diode
C1—40-μF, 250-WVDC, electrolytic capacitor
T1—Power transformer, 117-volt primary, 117- to 125-volt secondary
PL1—Two-terminal AC plug
Wood baseboard (5½ × 6 inches), Fahnestock clips, power cord, clamp, wire, solder, hardware, etc.

Cut a 9- × 4½-inch Plexiglas panel, and prepare to attach it to the edge of the baseboard where C1 is. Cut a hole for the shaft of C1 to protrude through, and drill holes to fasten the panel with screws. When the panel is attached, it will protect you from the voltages present in the unit.

If you would like to use the optional power supply, you will need another



Building this optional power supply will cost just a few dollars, but over time can save you much more than that in the cost of batteries.

wood baseboard, this one measuring approximately 5½ × 6 inches. Begin by mounting the transformer at one end of the board. Then go on to wire diode D1 and capacitor C1. Finally, attach a power cord and plug to the transformer, using a clamp to prevent strain on the cord.

Do not touch any of the components on the power supply when power is applied. Never touch C1 without first discharging it.

Using the Transmitter. Connect an antenna to the Transmitter, and then make sure all power connections are made as well. Before you proceed, you might want to use a good output indicator. If you don't have one, try using a number-49 pilot light in series with one of the antenna leads.

Tune your receiver to the Transmitter crystal frequency. Then close S1 and key the Transmitter using S2. Adjust C1 until a signal is heard in the receiver and the pilot light or output indicator shows that the greatest amount of power is flowing to the antenna. If necessary, you might want to try more or fewer turns on L2 to match the rig to your antenna system. ■

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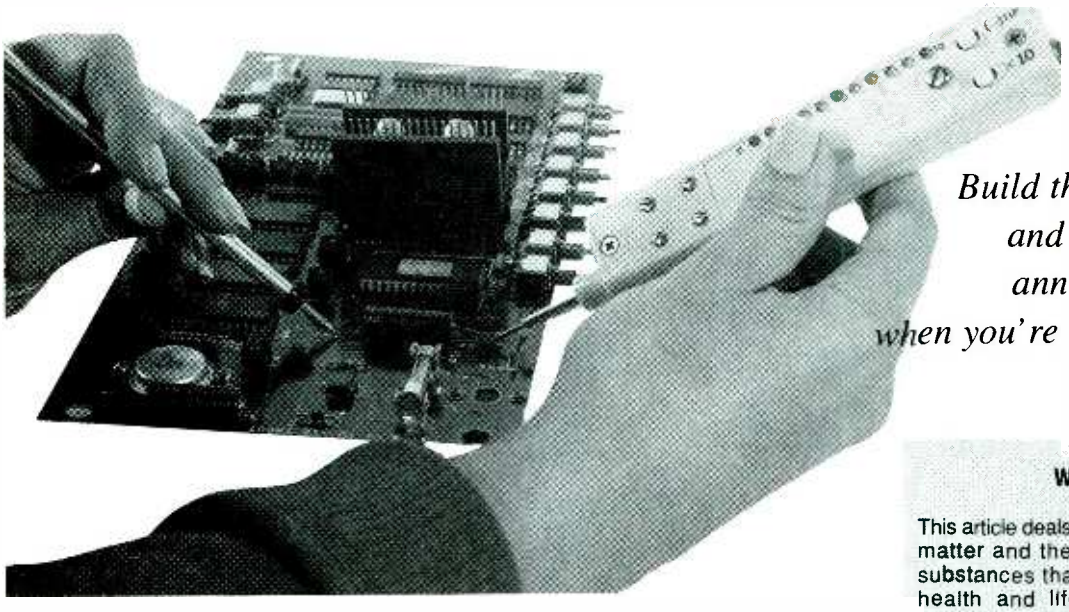
BUILD A WIRELESS DC VOLT PROBE



Build this handy probe and eliminate those annoying test-leads when you're in a tight spot.

BY SKIP CAMPISI

WARNING!!

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Have you ever leaned over a hot, running, car engine, and watched your expensive multimeter slide towards disaster as you attempted to get your test leads on the correct terminals? Or, perhaps you hate reaching into a piece of equipment with test leads and having to look over your shoulder at what the reading is.

The *Wireless DC Volt Probe* described in this article can eliminate those types of problems and more, as it does not use any interconnecting cables or wires between the probes or an external display. Rather, your own body becomes part of the signal path!

As you might suspect, including a human body in the signal path creates some unusual design problems, not the least of which is user safety. Therefore, heed the following **warning:** Although an effort has been made to fully protect the user to a peak voltage of ±250-volts DC, this instrument is *not* intended for use above 100-volts DC, or on any AC earth-ground-referenced equipment!

We'll see in a moment, how other design challenges were met as well. Those include the DC resistance of, and 60-Hz pickup by, your body (and the Hi-Z input circuit), which must be dealt with, and there is a possibility of radio-frequency interference (RFI) that should be prevented.

Circuit Description. The schematic for the DC Volt Meter is shown in Fig. 1. Power for the circuit is provided by two 1.5-volt N-type cells, B1 and B2, which are wired in series.

For the circuit to work, it must be completed or closed. That is accomplished when the passive probe is held in one hand and the active probe is held in the other, and the points of the two probes are placed across two points in a circuit under test. The resistor labeled R_{body} is simply the resistance of the user's body.

For R_{body} to be "swamped out," or kept from interfering with the reading, extremely high input-circuit impedances are used in the circuit. All of the people tested by the author for this project indicated a body resistance from hand-to-hand in the range of 200,000 to 500,000 ohms. Therefore, an input impedance of 50 megohms, resistor R3, was added. That resistor also provides an adequate safety isolation feature.

The reduction of RFI and 60-Hz pickup is accomplished by the use of a symmetrical difference amplifier (IC1) at the input; the inherent common-mode-rejection takes care of most of the AC-related problems. The amplifier used for IC1 is a TLC271 CMOS op-amp. Switch S1 is used to select polarity.

Note that 50 megohms of resistance are present at both of IC1's differential inputs (R3 at one input, and the combined series resistance of R1 and R2 at the other). That allows full protection for the TLC271's inputs. The user is placed in series with the 100-megohm loop containing a 10-megohm resistor (R1) as the protective device in the passive-probe section.

Capacitors C1 to C4 provide additional filtering of residual AC noise, and allow IC2, an LM3914 bar-graph-display driver, to step up sequentially. Switch S2 selects between two selectable input ranges: ×1, where each step equals 1 volt, and ×10, where each step equals 10 volts. The display

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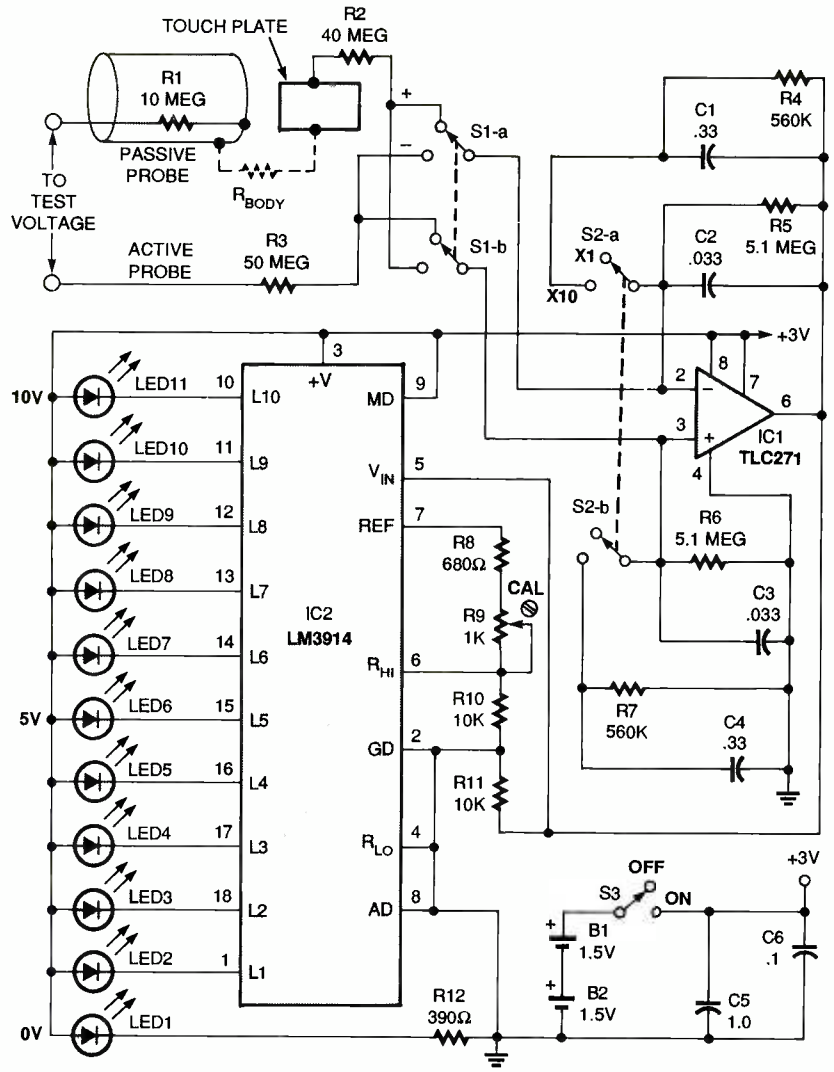

Fig. 1. This is the schematic for the DC Volt Probe. The passive probe is held in one hand and the active probe is held in the other, and the points of the two probes are placed across two points in a circuit under test.

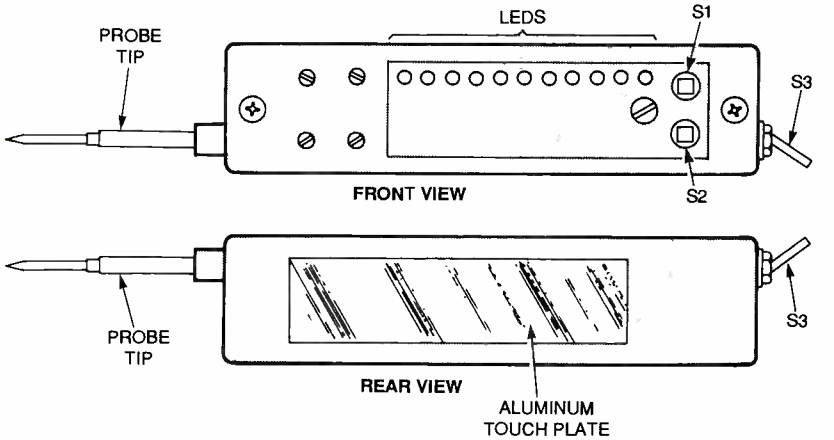

Fig. 2. Here's an illustration of the front and back of the prototype active probe, showing how the author placed the LEDs and switches.

is made up of LED1–LED11; LED2 through LED11 indicate each step, and LED1, the zero-volt indicator, is also the power-on indicator.

Construction. The author's prototype for the DC Volt Probe was built on a 1- × 2½-inch perforated board and mounted in a case available from Kelvin Electronics (10 Hub Drive, Melville, NY 11747; Tel. 800-535-8469) as part number 430068. The details of building this project are based on the assumption that you are using the Kelvin logic-probe case; however, any suitable plastic enclosure can be used along with any type of circuit board that you prefer. The other parts specified for the project are readily available from a number of hobbyist sources.

(Continued on page 78)

PARTS LIST FOR THE WIRELESS DC VOLT PROBE

SEMICONDUCTORS

IC1—TLC271 CMOS op-amp, integrated circuit
IC2—LM3914 display driver, integrated circuit
LED1, LED6, LED11—Light-emitting diode, T1 case, low-current, red
LED2–LED5, LED7–LED10—Light-emitting diode, T1 case, low-current, green

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—10-megohm
R2—40-megohm (see text)
R3—50-megohm (see text)
R4, R7—560,000-ohm
R5, R6—5.1-megohm
R8—680-ohm
R9—1000-ohm, mini trimmer potentiometer
R10, R11—10,000-ohm
R12—390-ohm

CAPACITORS

C1, C4—0.33-µF, ceramic-disc
C2, C3—0.033-µF, ceramic-disc
C5—1.0-µF, tantalum
C6—0.1-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

S1, S2—DPDT, subminiature toggle or latching pushbutton switch
S3—SPDT, subminiature toggle switch
B1, B2—1.5-volt, N-type cells
Perforated board, N-cell holders, five inches of ¼-inch-diameter aluminum tubing, insulated "tip" jack, 0.08-inch (2-mm) probe tip, 0.75- × 3.75- × 0.020-inch aluminum sheet, logic-probe-type plastic enclosure with probe tip (see text), ⅜-inch plastic or metal standoff/spacer, IC sockets, heat-shrink tubing, wire, solder, hardware, etc.

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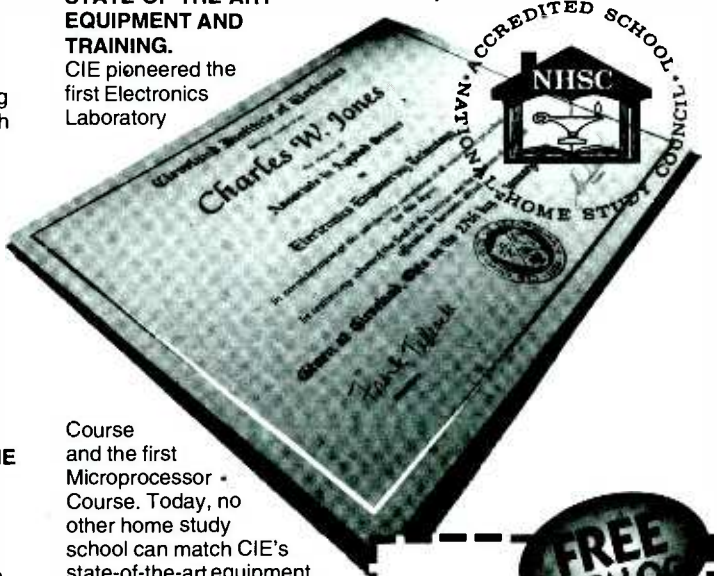

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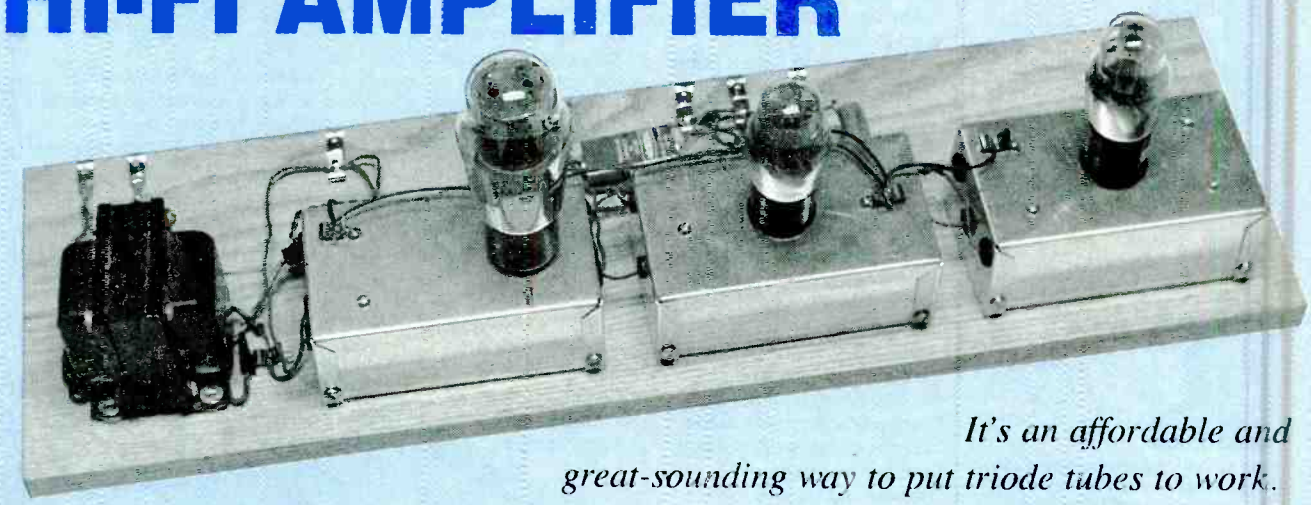
BUILD A SINGLE-ENDED HI-FI AMPLIFIER

BY LARRY LISLE



It's an affordable and great-sounding way to put triode tubes to work.

Many of the tubes produced today go into pricey, single-ended (not push-pull) hi-fi amplifiers. Now, not everyone wants to shell out the big bucks for a tube amp. So, if you'd like to own a great-sounding, all-triode, single-ended amp for a lot less than most audiophiles are paying, you can build the *Single-Ended Hi-Fi Amplifier* described in this article.

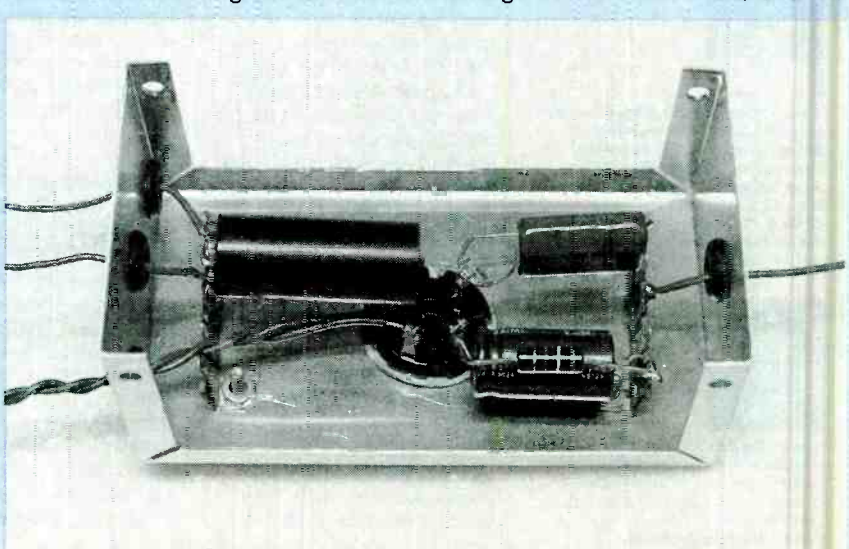
Why Single-Ended Amps? Many audiophiles are convinced that amplifiers using directly heated triodes in a single-ended configuration sound better than anything else. Those individuals attribute the audio superiority of such amps to the presence of small amounts of second-harmonic distortion and the (usual) absence of negative feedback (which supposedly makes the sound more natural).

A lot of ink has been shed on whether single-ended amps are really all that much better. If you would like to learn more about that debate, you might want to check out some of the references in the "Suggested Reading" box. But the purpose of this article is to show you how to build an amp for yourself, and that's exactly what we'll get to next.

One of the best features of the Single-Ended Amplifier is how easy it is to build; the parts-count is low and the circuitry is simple and straightforward. Some audiophiles might throw up their hands in protest because exotic parts and wire often found in high-end equipment were not used. While those amplifiers are most likely worth every penny they cost, the Single-Ended Amplifier is something that the average person could afford to build and be happy with afterwards. Most of the benefits of single-ended technology can be gained in a relatively simple manner with ordinary, good-quality parts.

Circuit Description. The schematic for the Amplifier is shown in Fig. 1. For quiet listening, an input of about 0.05 volt or less should be used. The circuit as shown will handle up to about 0.5 volt; above that, distortion will be present.

The input stage amplifies the signal voltage about seven times, and the



Here's an internal view of one of the Amplifier stages. Building each stage separately in an aluminum case helps reduce hum.

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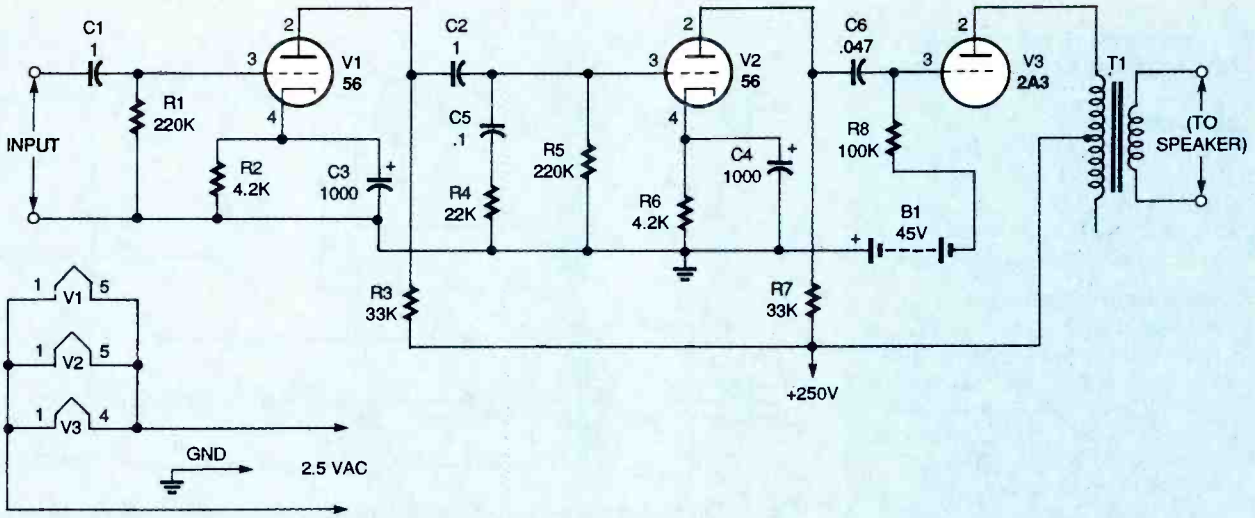

Fig. 1. This is the schematic of the Amplifier circuit; the single-ended design, and use of triodes, contributes to a great sound.

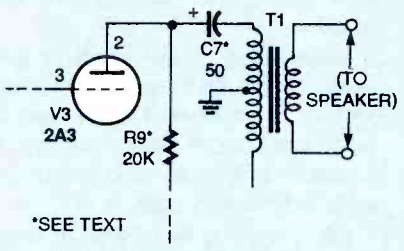

Fig. 2. Here's an alternate output section for the amplifier that keeps DC out of the primary winding of the transformer.

second stage amplifies the voltage about ten times. Both stages use type-56 triodes (V1 and V2).

The output stage uses a type-2A3 tube, V3. Battery bias seems to work well on output tubes, and for that reason two 22.5-volt batteries wired in series (B1) were used to provide 45 volts on the grid of V3.

In this circuit (and other single-ended amplifiers), direct current flows in the primary of the output transformer (T1). Transformers designed for single-ended use have an air-gap in the core to keep it from saturating, which would diminish the low-frequency response.

If you don't use a single-ended-style transformer for T1, an ordinary push-pull transformer (which can be bought at a more reasonable price) can be made to work with some restrictions. First of all, if you use a push-pull transformer with the Amplifier circuit shown in Fig. 1, you will have to live with a moderate roll-off below 60 Hz.

One way to make a push-pull transformer work better with the Amplifier is to use the circuit modification shown in Fig. 2. That change keeps DC out of the primary at some sacrifice in power. With the modification, the Amplifier will be flat (within 1 db) from 20 to 20,000 Hz. (As we'll see in a moment, the modified circuit requires that a higher-voltage transformer be used in the power-supply circuit.)

Note that in both Figs. 1 and 2, transformer T1 is shown connected from one end of the primary to the center tap. That was done because it is assumed the transformer used will have a primary impedance of about 8000 ohms. The recommended load for a 2A3 tube (V3) is 2500 ohms for maximum output, but increasing the impedance lowers the distortion while only slightly decreasing the power. For that reason, using the center tap will get the best sound without too much of a power loss.

You probably noticed that in addition to B1, the Amplifier circuit runs on additional 2.5- and 250-volt DC sources (the latter value is 350-volts DC in the case of the modified circuit). The power supply shown in Fig. 3 is a conventional, tube-type, full-wave rectifier circuit with a capacitor-choke-capacitor filter made up of C1, L1, and C2. The 5U4G tube rectifier, V1, was used instead of a solid-state rectifier to prevent radiating hash noise.

If you're using the modification shown in Fig. 2, the high-voltage secondary of transformer T1 in Fig. 3 should be about 350-0-350 volts. If you use the unmodified Amplifier circuit, a 250-0-250-volt transformer can be

PARTS LIST FOR THE SINGLE-ENDED HI-FI AMPLIFIER

RESISTORS

(All resistors are 1-watt, 5% units, except where noted.)
R1, R5—220,000-ohm
R2, R6—4200-ohm
R3, R7—33,000-ohm
R4—22,000-ohm
R8—100,000-ohm
R9—20,000-ohm, 10-watt (optional, see text)

CAPACITORS

C1, C2—1-μF, ceramic-disc
C3, C4—1000-μF, 50-WVDC, electrolytic
C5—0.1-μF, ceramic-disc
C6—0.047-μF, ceramic-disc
C7—50-μF, 450-WVDC, electrolytic (optional, see text)

ADDITIONAL PARTS AND MATERIALS

V1, V2—56 vacuum tube
V3—2A3 vacuum tube
T1—8000-ohm to speaker, hi-fi output transformer (Antique Electronic Supply PT-1608 or PT-S142A, or equivalent)
B1—45-volt battery (two 22.5-volt batteries in series; Eveready 412 or equivalent)
Baseboard (approximately 24 × 7½ inches), rubber mounting feet, three aluminum project boxes (5 × 3 × 2 inches), tube sockets (one 4-pin, two 5-pin), Fahnestock clips, screws, wire, solder, hardware, etc.

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PARTS LIST FOR THE AMPLIFIER POWER SUPPLY

RESISTORS

(All fixed resistors are 10-watt, 5% units.)

R1—2500-ohm

R2—50,000-ohm

R3—50-ohm, 2-watt potentiometer

ADDITIONAL PARTS AND MATERIALS

C1—50-μF, 450-WVDC, electrolytic

C2—40-μF, 450-WVDC, electrolytic

V1—5U4G or 5U4G-B vacuum tube

L1—8-H or greater, 90-mA or greater filter choke (Antique Electronic Supply PT-C-7X or equivalent)

T1, T2—Power transformer, 350-0-350 volts at 70 mA (see text), 5 volts at 3 A, and 2.5 volts at 4.5 A (Antique Electronic Supply PT-143 or equivalent)

PL1, PL2—3-conductor AC plug

Baseboard (approximately 24 × 10 inches), rubber mounting feet, octal tube socket, power cord, cable clamps, Fahnestock clips, screws, wire, solder, hardware, etc.

Note: The following is available from Antique Electronic Supply (6221 S. Maple Ave., Tempe, AZ 85283; Tel. 602-820-5411): a complete kit of parts for the Amplifier (K-PE-SE-A KIT)—$109.95; a partial kit of parts for the power supply, baseboard not included (K-PE-SE-P KIT)—$89.95. Please contact Antique Electronics Supply for shipping and handling information. Arizona residents please add appropriate sales tax.

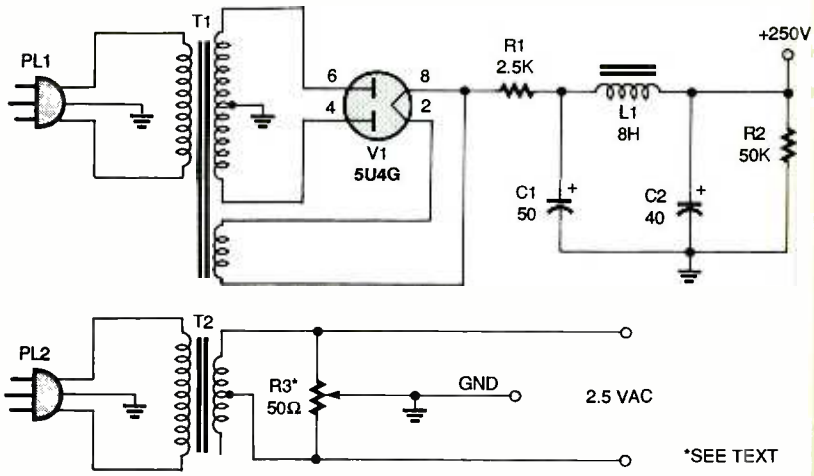

Fig. 3. This is the power-supply circuit for the Amplifier. A 5U4G tube rectifier was used instead of a solid-state one to reduce hash radiation.

used for T1, and R1 can be omitted.

The 2.5-volt source is supplied by transformer 2. As shown in Fig. 3, potentiometer R3 can be adjusted for minimum hum.

Construction. Like any tube project, sometimes the most difficult part of building it is to first get the components. If you find you can't locate the tubes or transformers on your own, you might want to order the amplifier and power supply kits that are available from the source that is mentioned in the Parts List.

The Amplifier could be built on a common aluminum or steel chassis, but if there turns out to be a hum problem from the magnetic fields of the transformers or other causes, you might have to do a complete rebuild to solve it. A recommended alternative is to build each stage in a separate project box; that way you can tinker with one stage without disturbing the rest.

Building the project is therefore simple. Begin by wiring each stage into its respective project box, using Fahnestock clips. The filament wiring should be twisted to cancel the AC fields around the wires. When the stages are assembled, simply mount them on a wood baseboard, and connect them together.

Mount resistor R1 and capacitor C1 to the baseboard, and wire them to the circuit ground. Next install the output transformer. If you like, you could wire Fahnestock clips for the audio output terminals, or you could attach a connector that will match a particular speaker.

When all connections are made, wire Fahnestock clips for the 2.5- and 250-volt power connections shown in Fig. 1. Then complete the assembly by connecting the two 22.5-volt batteries.

Building the power supply is even easier. Begin by mounting the tube rectifier in a socket at the center of a wood baseboard. Go on to install the capacitors, resistors, and choke coil, using Fahnestock clips.

Next, wire the two transformers on one end of the baseboard. Connect potentiometer R2 to T2. Attach the power cords and plugs to the transformers, and secure the cords to the baseboard with clamps.

Note that the voltage present in the power supply is dangerous. Don't touch any components on the Amplifier or power supply when power is applied, and discharge *all* capacitors before touching anything after it's unplugged. For safety reasons you should consider enclosing the power supply in some way when it is finished.

Using the Amp. Connect a speaker to the Amplifier. Then make all the power and ground connections between the Amplifier and power supply. If you follow the input-signal requirements mentioned earlier, you should get a great sound out of your unit.

It goes without saying, of couse, that this is a mono amp. For stereo applications, two units will have to be used.

As this project shows, single-ended amplifiers are easy and fun to build, and are a real pleasure to listen to. Once you hear one, you're sure to be hooked. ■

SUGGESTED READING

The Absolute Sound (P.O. Box 360, Sea Cliff, NY 11579; Tel. 800-222-3201) Issue 96 had an interesting article in semi-technical language on tubes and single-ended amps.

Glass Audio (P.O. Box 176, Peterborough, NH 03458; Tel. 603-924-9464). Features articles on tube amps of all types.

Sound Practices (P.O. Box 180562, Austin, TX 78718; Tel. 512-339-6229). Another publication that contains articles on tube amps.

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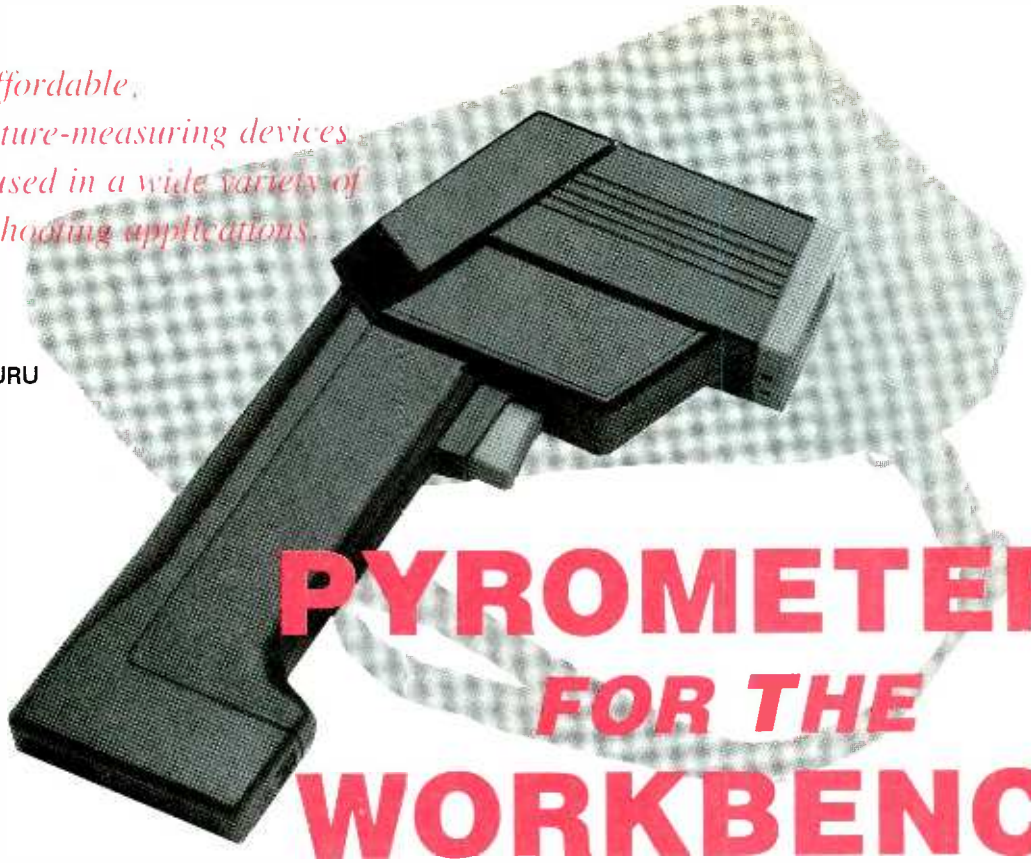
These affordable, temperature-measuring devices can be used in a wide variety of troubleshooting applications.

BY BILL SIURU



PYROMETERS FOR THE WORKBENCH

Temperature measurements often provide valuable information when troubleshooting problems around the home, workbench, or garage. For instance, faults in electrical connections and bad bearings in motors often result in excessive temperatures, whereas too-low temperatures come with malfunctioning ovens and furnaces. Problems in engines, drive trains, brakes, cooling systems, air-conditioning, and so forth often include abnormal temperatures. However, measuring temperatures beyond touching and finding the item "too hot" or "too cold" has not been very easy until now.

Portable, hand-held, non-contact pyrometers, developed for industrial applications and "discovered" by professional racers for measuring tire and track temperatures, are now priced low enough that they are good investments for serious home mechanics and electronics hobbyists. Besides prices that now run from $200 to $350, the latest pyrometers are also quite user friendly. In most cases, just aim, pull the trigger, and read the temperature.

What's a Pyrometer. Pyrometers, also called infrared (IR) non-contact thermometers, measure the infrared radiation emitted from an object and, in less than a second, calculate the object's temperature from that measurement. The heart of the unit is a thermopile detector whose voltage output is directly proportional to the amount of emitted infrared radiation detected; the unit's optics focus the infrared radiation on that detector (See Fig. 1). The voltage output is converted to Celsius and Fahrenheit temperature readings that are shown on a digital display.

Virtually every object absorbs heat energy and then emits that energy as IR radiation that is proportional to its temperature. To complicate things a bit, radiation can also be reflected (bounces off an object) or transmitted (travels through an object). Only a perfect "black-body" neither reflects nor transmits energy. The electronic circuitry and physical construction of today's non-contact pyrometers automatically reduce the influence of reflected and transmitted infrared radiation. Thus, for most diagnostic applications, reflected and transmitted IR energy do not influence the accuracy of temperature measurements enough to affect the results of a diagnosis.

Unfortunately, "most" applications does not mean "all" applications. One troublesome application is when the pyrometer is used to measure the temperature of shiny, polished, or unoxidized metal surfaces made of aluminum or stainless steel. In such cases you will have to do a bit more than point the instrument and take a reading; you now will have to compensate for reflected and transmitted radiation. The amount of compensation is called the "emissivity factor." That factor corrects for the difference in reflected and transmitted radiation for the test material and a perfect "emitter" (a black body). If you plan to use the non-contact pyrometer to measure shiny surfaces, be sure that any pyrometer you purchase includes an emissivity-compensation feature.

To determine the proper emissivity factor setting for a material, you will need some black friction tape or black paint, both nearly perfect radiators with emissivity factors of 0.95 (they radiate 95% of their thermal energy). Put the tape or paint on the shiny surface and take two measurements. First, after adjusting the pyrometer's emissivity factor to 0.95, measure the temperature of the surface with the tape or paint. Then point

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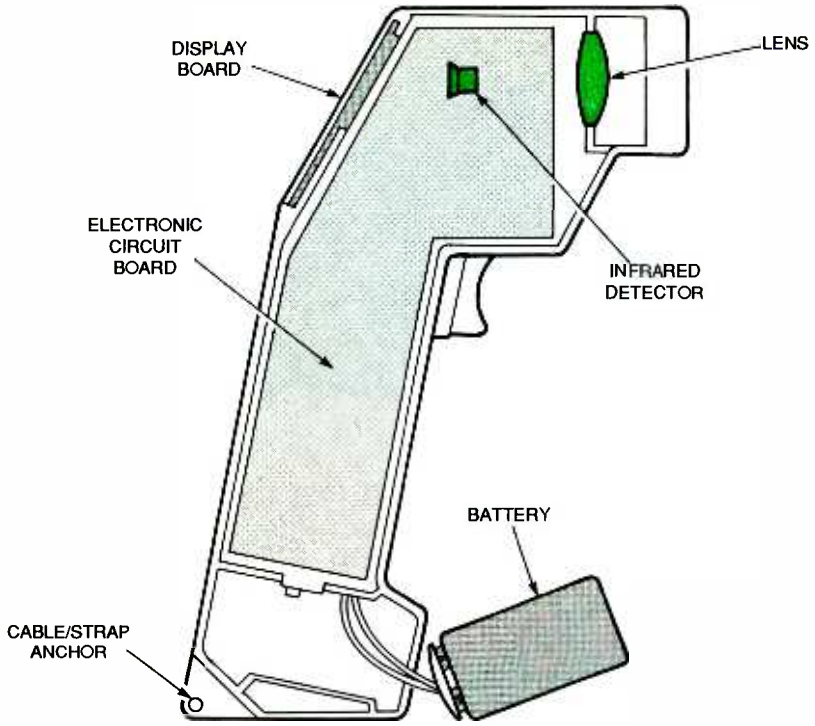

Fig. 1. Using a special optical system, a non-contact pyrometer focuses and filters infrared radiation onto its thermopile infrared detector.

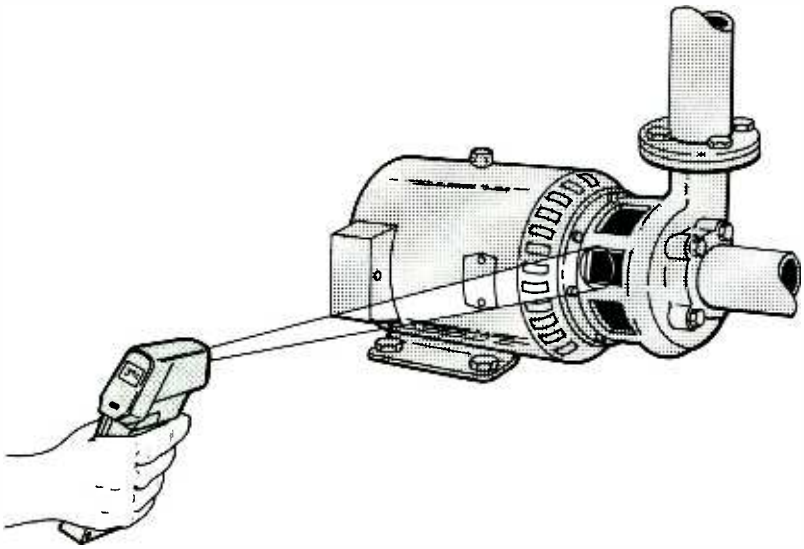

Fig. 2. You can detect a misfiring cylinder by measuring the exhaust manifold nearest to the cylinder head's exhaust ports. Look for a lower temperature.

the pyrometer at the bare surface and adjust the emissivity setting until the temperature reading matches the temperature measured previously. So the calibration procedure does not have to repeated, record the emission factor displayed because it can be used on all similar materials.

Using a Pyrometer. There are many diagnostic jobs that can be performed using a non-contact pyrometer. Because it reads temperatures visibly without physical contact, it can be used in hard-to-reach locations or where moving parts are a hazard. Not having to touch an object eliminates the possibility of burns or shocks, as well the possibility of contaminating the object or affecting its operation. Here are just some sample applications; over time, you will probably discover many more.

Troubleshooting Electrical Problems. A non-contact pyrometer can locate high resistance in connections by measuring the temperature of electrical connectors while current is flowing. A higher-than-normal temperature indicates excessive resistance. Likewise, the device can help locate high current or high resistance in fuse holders. Point the pyrometer at a fuse holder while current flows: Higher-than-normal temperatures indicate a worn fuse link, a poor fuseholder connection, or a short circuit.

Pyrometers really shine when it comes to testing the electronics in an automobile. You can check out automotive wiring harnesses, especially at the connectors and electrical components. There, a higher-than-normal temperature indicates a short circuit or a component in the circuit that is drawing too much current.

One specific automotive application is finding broken grids in the rear-window defoggers now found in most cars. Turn the defogger on and scan the entire defogger with the pyrometer. Move the pyrometer over each grid and watch the temperature. It should increase uniformly right over a grid. If it does not, the grid line is broken and current cannot flow through it to heat the tiny wire. That technique is the easiest way to verify that a defogger is operating properly; otherwise you would have to somehow fog the window to determine if an even pattern is produced.

There are, of course, many non-automotive uses for a pyrometer. For example, it can be used to check the accuracy of temperature controls in ovens, clothes dryers, refrigerators, freezers, etc. After the appliance is at operating temperature, open the door and quickly take a temperature measurement. You can then compare the temperatures read against the control setting or manufacturer's settings.

Troubleshooting Mechanical Devices. Once again, a pyrometer really excels at diagnosing mechanical problems in automobiles. For example, on cars suspected of braking problems, measure the drum or rotor temperature immediately after the vehicle has been driven and stopped in a straight line. Compare the temperature of all four brakes. Front

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brakes usually will have higher temperatures than rear ones, but they should have nearly the same temperature on the left and right side. Significant, right/left bias temperatures indicate uneven braking caused by sticking caliper pistons, adjusters, etc.

The pyrometer can also be used to identify drive train—driveshafts, transmissions, differentials, etc.—problems, again with abnormal temperatures indicating trouble. For instance, measure axle bearings and compare left- and right-side readings; they should be about the same, unless one is bad.

It is sometimes hard to isolate which cylinder is misfiring in a rough running engine without using an engine analyzer. However, it can be done easily and quickly with a non-contact pyrometer (see Fig. 2). Measure and compare the temperatures of the exhaust manifold for each cylinder. Lower temperatures indicate poor combustion or a misfire. On some vehicles, the front section of the exhaust manifold might normally by design run a little cooler than the rear, but not usually at the low temperature associated with a misfire. For best results, take readings from cold engines at startup before heat is distributed pretty uniformly over the whole manifold. The pyrometer is especially effective in finding misfiring or dead cylinders in a diesel engine.

If you suspect the coolant temperature gauge in the instrument cluster reads too hot or too cold, measure the block temperature near the temperature sensor after the engine has run for awhile. The temperature readings of the gauge and pyrometer should agree. However, that measurement only works with gauges that have numerical markings, or you can otherwise interpret the tick marks.

If an engine overheats and no coolant leaks are found, you can use the pyrometer to find other possible causes. For instance, scan the entire front and back of the radiator—a job that is easier on older cars with lots of space under the hood—with the pyrometer. Look for abrupt differences in temperatures indicating that the radiator core is plugged at that point obstructing coolant flow.

With a pyrometer, some automobile thermostats can be checked without removing them from their engines. When a thermostat opens, the temperature drops drastically, about 15°C (25°F). Start the engine and read the pyrometer as the engine warms up. Compare the temperature when it opens to the manufacturer's specifications. When performing that test, take your measurements from the surfaces at the radiator inlet or thermostat outlet because hose temperatures can be up to 15°C lower than the actual coolant temperature.

As you might expect, a pyrometer is a particularly useful tool for checking out a malfunctioning heater. For instance, you can check for coolant circulation through the heater core. Measure the temperatures of the inlet and outlet heater-core hoses—if there is a large difference, suspect a restricted heater core.

Pyrometers can also be used to troubleshoot non-automotive mechanical devices. One such application would be to find bad bearings in motors, pumps, compressors, etc. (see Fig. 3). Excessive temperatures in bearing locations usually indicate a bad bearing that needs replacement. Make sure the item is running long enough for a suspected bad bearing to heat up.

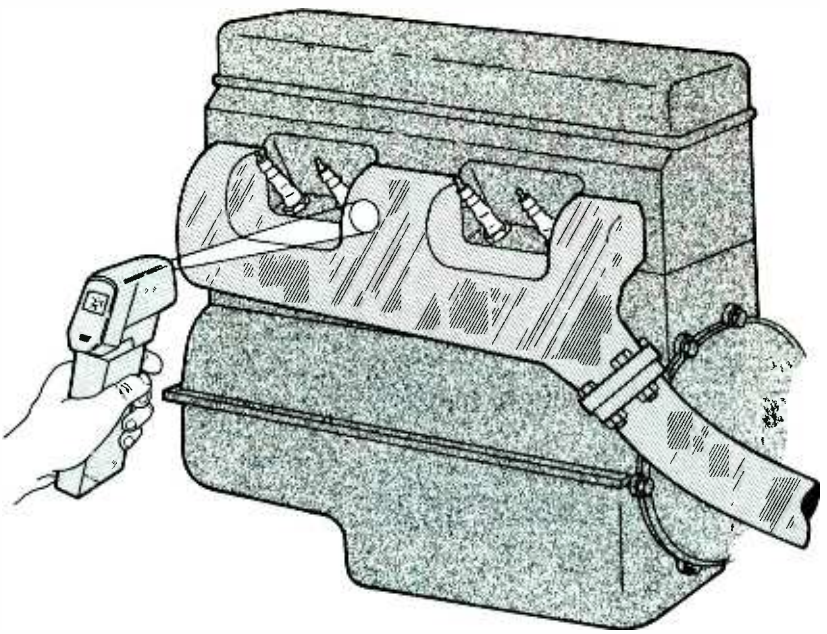

Fig. 3. A worn bearing in a motor, pump, etc. will give off excessive heat. That heat can be spotted easily by a pyrometer.

Battery-powered portable pyrometers are compact enough to fit in a toolbox.

Those who service air-conditioning or heating systems also would find a non-contact pyrometer invaluable. For example, one easy way to see if a system is not working correctly is to measure the temperatures in the system's outlets or vents. If higher-than-manufacturer's-specification temperatures are measured, you know something is malfunctioning. Likewise, too low a temperature indicates a problem in a furnace or space heater. For those types of measurements, do not point the pyrometer directly into the air flow; measure the vent openings from an angle. Of course, you will need manufacturer's temperatures settings to compare against.

As you can see, in situations where heat can pinpoint a problem in an electronic or mechanical system, it is hard to beat a pyrometer for quick troubleshooting tasks. Now that pyrometer prices have come down to where they are practical for the troubleshooting professional or a serious hobbyist, isn't it time you added one to your arsenal of test gear? ■

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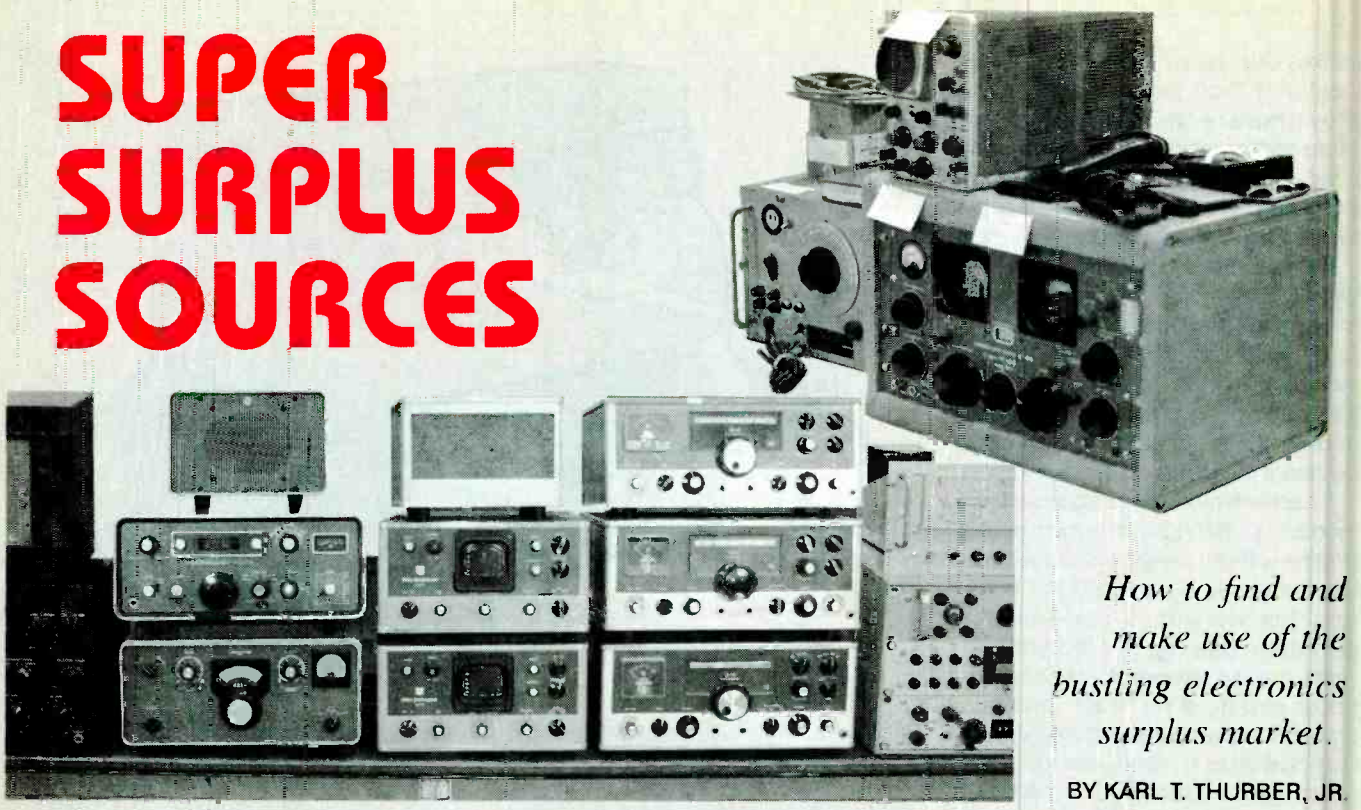
SUPER SURPLUS SOURCES



How to find and make use of the bustling electronics surplus market.

BY KARL T. THURBER, JR.

Do you love a bargain? Most people do, electronics hobbyists included. If you fit into that latter category, and chances are good that you do, then you most likely would like a good bargain when buying electronic equipment or parts. And the best way to get a good bargain is by buying surplus.

Most dictionaries define "surplus" as an amount or a quantity that is more than, or in excess of, what is needed. That is a very broad definition, one which might be more expansive than most hobbyists envision, so let's refine it. In the 1940s and 1950s, if you mentioned surplus to a radio hobbyist, the word would have conjured up visions of stacks of World-War-II-vintage GI gear, ready to be purchased for a dime on the dollar. That concept of "war surplus" is perhaps the classic meaning of the word from a hobbyist's viewpoint, but times truly have changed.

In the 1990s, hobbyists consider "surplus" as most anything that's clearance or bargain-priced and related to radio, electronics, and computers (including software, CD-ROMs, hardware, and the like), whether of commercial, industrial, government, or military origin. That includes equipment and components from overproduced, overrun, distressed, or overstocked inventories.

But where do you get all those goodies? That's exactly what we'll answer in the pages that follow. So read on, and prepare to save some money on your next electronics spending spree.

Traditional Surplus Sources. Finding electronic components for your next construction project at affordable prices is no longer as simple as a Saturday trip to the nearest Radio Row, a trip hobbyists might well have taken in the 1940s and 1950s (for more information on those hobbyist sources of yesteryear, see the article "Remembering Radio Row" in the January 1996 issue of **Popular Electronics**). Now, if your local franchise outlet can't supply what you need, what do you do?

In that case you use mail-order. The fact is that many local radio jobbers, distributors, parts houses, and wholesalers don't carry much of interest to the radio amateur, electronics buff, or computer user. So, when ordering specialty parts and accessories, it's prudent and convenient to look to mail-order houses for items that you can't obtain locally.

The two routes to parts-procurement success are: First, have a good supply of mail-order catalogs, flyers, and parts and equipment lists in your personal library. And, second, take advantage of a variety of marketplace publications to help meet your needs.

Most mail-order companies publish their own catalog or flyer; no home electronics library is complete without a representative selection of them. With a good variety to peruse, if you can't find what you're searching for in one supplier's catalog or flyer, you can simply try another. Many of the larger catalogs are splendid reference resources, whether or not you actually order from them.

We located a number of firms that specialize in surplus electronics, computers, and software (see the "Names and Numbers" box). Many of them publish catalogs, flyers, and price lists, though sometimes irregularly. Check out their publications, or call them for availability. Here are a few sources we've chosen to highlight:

American Science and Surplus: Some firms still carry the "classic" war surplus parts and equipment. American Science and Surplus, in Skokie, IL, has been one such resource since 1937. It's a very active mail-order organization that has a great deal of

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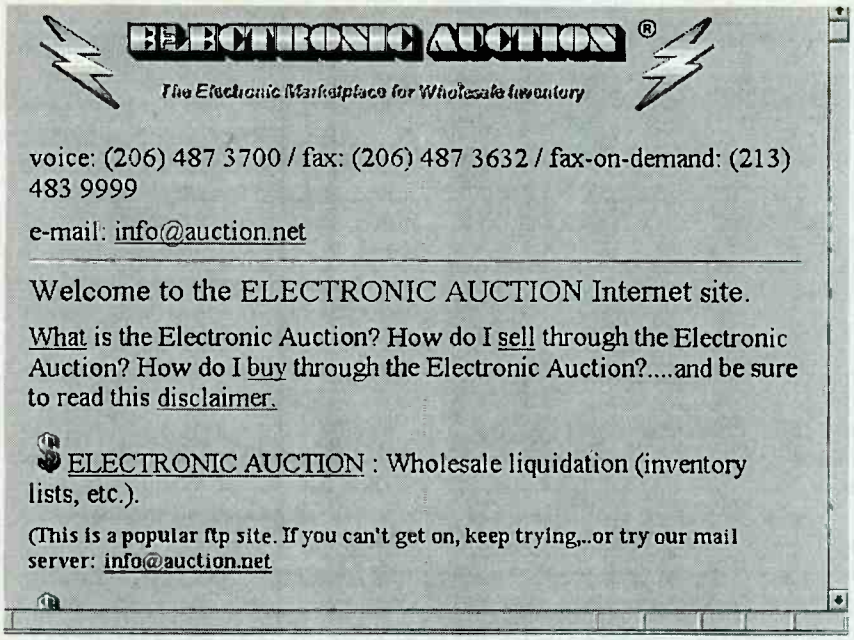


Fig. 1. The Electronic Auction bills itself as "the electronic marketplace for wholesale inventory." It moves wholesale overstock and surplus merchandise and equipment, including electronics, computers, software, CDs, videos game, hardware, office supplies, and the like. Look for it at the URL http://www.auction.net/index.html.

surplus parts and equipment available, including some that date back 50 years or more to the war years.

Fair Radio Sales: Another mail-order firm that carries on with "classic" radio surplus is Fair Radio Sales. The company has been in business since 1947 with the motto that it sells "the world's finest electronic surplus." Most of its 36-page catalog is devoted to military and government radio surplus, and it's a real gem.

Halted Specialties Co: The Santa Clara, CA firm specializes in "new," surplus electronics equipment, as well as new and used test equipment. The mail-order firm also operates three walk-in stores in the southern California area.

R&D Electronics: R&D Electronics stocks a wide variety of surplus electronics equipment and components. It does a booming mail-order business and also operates a surplus emporium, Electronic Surplus, Inc. In business since 1948, R&D Electronics has about 40,000 square feet of space devoted mostly to surplus stuff. No catalog is available, but R&D maintains a mailing list.

Surplus Sales of Nebraska: With its motto of "where the hard-to-find parts are found and on hand," Surplus Sales of Nebraska publishes a catalog full of capacitors, switches, filters, relays, insulators, cables, connectors, and sundry other goodies of interest to radio amateurs and electronics hobbyists. The firm also stocks manuals for Collins amateur gear (we'll deal with manual-supply resources later on).

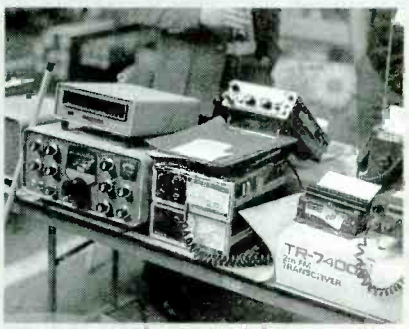
Surplus Software: Surplus Software is a clearinghouse for publishers and distributors with overstocked, overproduced, or distressed software inventories. The firm offers many current-version, previous-version, and promotional packages. While you might wonder why someone would want an older, perhaps obsolete version of a software package, remember that many software publishers allow owners of previous versions the option of inexpensively upgrading to the current releases. Their newsprint catalog runs about 40 pages.

Tucker Surplus Store: The Tucker Surplus Store is an adjunct to Tucker Electronics Co. The firm has a broad selection (96,000+ new and used items) and offers repair and reconditioning facilities. Tucker specializes in vacuum-tube test equipment and also handles some used amateur gear.

Publications of Interest. The contemporary surplus market isn't limited to military and government materials: there's abundant civilian surplus being advertised in radio, electronics, computer, and amateur-radio magazines. Several radio, electronics, and computer-marketplace publications have excellent component and/or surplus sections you can peruse.

Gernsback Publications: Good component and surplus sources include the magazine you're reading, **Popular Electronics**, and its sister Gernsback publication, *Electronics Now*. Both have large sections ("Market Center" in **Popular Electronics**, for example) devoted to procuring new and used equipment, parts, and components by mail-order. Check them out.

Other Resources: Other good surplus resources include the classified advertising sections of the major amateur-radio magazines, such as *QST*, *73 Amateur Radio Today*, *Amateur Radio Trader*, and *CQ*. Several of those magazines have at times published radio surplus handbooks and conversion guides. To my knowledge such vintage publications all are out of print. However, a few surplus-oriented books are available (see the "Suggested Reading" box for more information).



Though the firm quit making kits in the early 1990s, Heath's transmitters, transceivers, and receivers are still found at hamfests and swap meets. Take special care in purchasing used equipment built from kits, though; inspect the quality of the builder's assembly and soldering techniques before purchase.

For computers, computer peripherals, accessories, and software, *Computer Shopper* is difficult for direct buyers to beat. Each issue runs around 775–800 pages and is crammed with display and classified ads. Vendors and equipment are well-indexed.

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The American Computer Exchange: There's an old expression that goes, "the best day to sell your old computer is yesterday and the best day to buy your next one is tomorrow." Since 1988, *The American Computer Exchange* has acted as a computer broker, matching buyers and sellers of used microcomputer equipment. The Exchange serves individual and corporate buyers and sellers, resellers, liquidators, and retailers. It also offers consulting services, listings, and appraisals. In addition, over 130 trade magazines use the Exchange's "AmCoEx Index of Used Computer Prices" as benchmarks of current used computer prices.

Hamfests: Modern-Day Resources. Not all shopping has to be done by mail, however. Hamfests—amateur radio conventions or get-togethers—are popular activities, and well worth a bargain hunter's time. The main activity at most hamfests is the flea-market or swap-meet area where people buy, sell, and swap used radio equipment, parts, and components. Increasingly, computer shows are held in conjunction with many hamfests, and surplus computer hardware and software is seen side-by-side with radio equipment in the flea-market areas.

A hamfest is a grand meeting of radio amateurs and radio enthusiasts, and the name covers a variety of affairs. There are some small events that are strictly radio flea markets, swap meets, and auctions; some of the smaller ones attract but a few hundred visitors. Larger events can attract many thousands and have hundreds of exhibit booths and swap tables. Let's look at the range of them, beginning at the bottom.

The simpler hamfests often include an auction, a bid table (where the bidding is written rather than verbal), and "tailgaters," people who sell from their car trunks in the parking lot or "bone yard." Older, tube-type equipment (including gear euphemistically known as "boat anchors" or "white elephants") abounds in the bone yard and on the auction block.

But the main activity at such hamfests is really the swapping, selling, and buying of radio and electronic parts and equipment. Because of the numerous bargains, a shrewd shopper often can equip his or her radio shack and workbench at a rock-bottom cost.

USENET NEWSGROUPS

rec.radio.amateur.equipment
rec.radio.amateur.homebrew
rec.radio.amateur.miscellaneous
rec.radio.info
rec.radio.scanner
rec.radio.shortwave
rec.radio.swap
rpi.union.electronics
sci.electronics
sci.electronics.repair
tnn.radio.amateur
uk.radio.amateur

Now, the medium-size regional affairs are a cross between less-formal local swap meets and more-formal conventions. Many hamfest activities are featured, with swapping competing for attendees' attention with technical seminars and radio- and computer-equipment displays by manufacturers and dealers.

Moving up the scale, we come to the top hamfest ranks—the major amateur expos and conventions. Those often are affiliated with the American Radio Relay League (ARRL), which is a national association of radio amateurs. ARRL conventions are conducted on division and state levels, and a national convention is held yearly on a rotating basis—in 1996 it will be held September 13–15 in Peoria, IL.

And then there's Dayton. The Dayton HamVention, in a class by itself, is a huge, three-day affair held in the spring. It's by far the largest hamfest in the country. Some 35,000 to 40,000 hobbyists annually rummage through the Hara Arena and Exhibition Center's gigantic outdoor flea market, countless exhibit booths and meeting rooms, and dozens of interesting forums.

It's often said, with some truth, that if you can't find what you need at Dayton, you won't find it *anywhere*. Whether you're looking for a receiver, transmitter, transceiver, satellite station, packet gear, kit, UHF and microwave gear, computer hardware and software, or most anything else that's vaguely electronic, whether new or used or surplus, Dayton's the place to find it. In 1996 it's set for May 18–19.

Finding a Hamfest Near You. There are several ways you can find hamfests. The simplest is to ask the members of a local radio club. If you're not a member, listen to the chit-chat on local amateur FM repeaters. Another option is to check the postings of hamfests often found in radio stores. Also, check the hamfest and special-

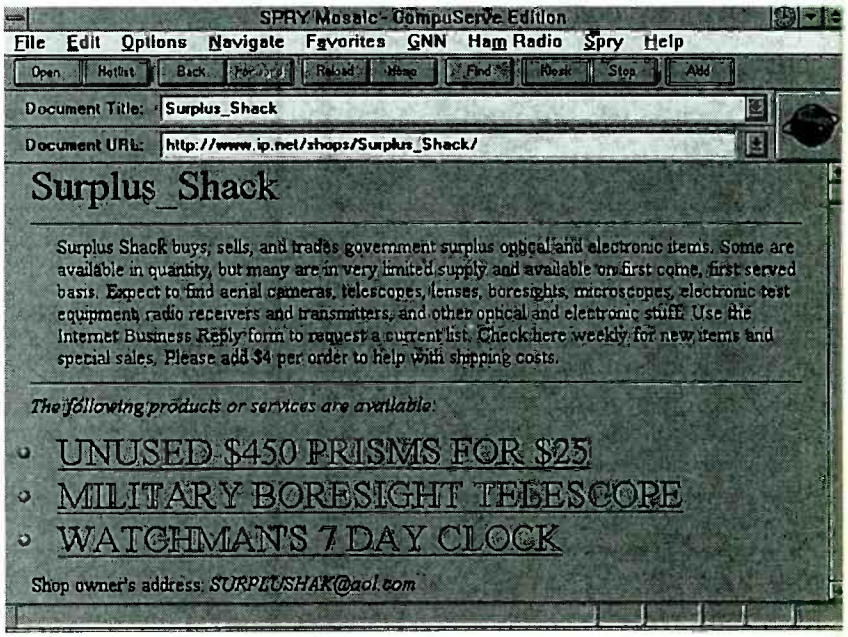

Fig. 2. Surplus—Shack buys, sells, and trades government-surplus optical and electronic items. Expect to find electronic test equipment, radio receivers and transmitters, and a variety of other optical and electronic stuff. Most equipment is offered on a first-come, first-served basis. Check out the URL http://www/ip.net/shops/Surplus—Shack/.

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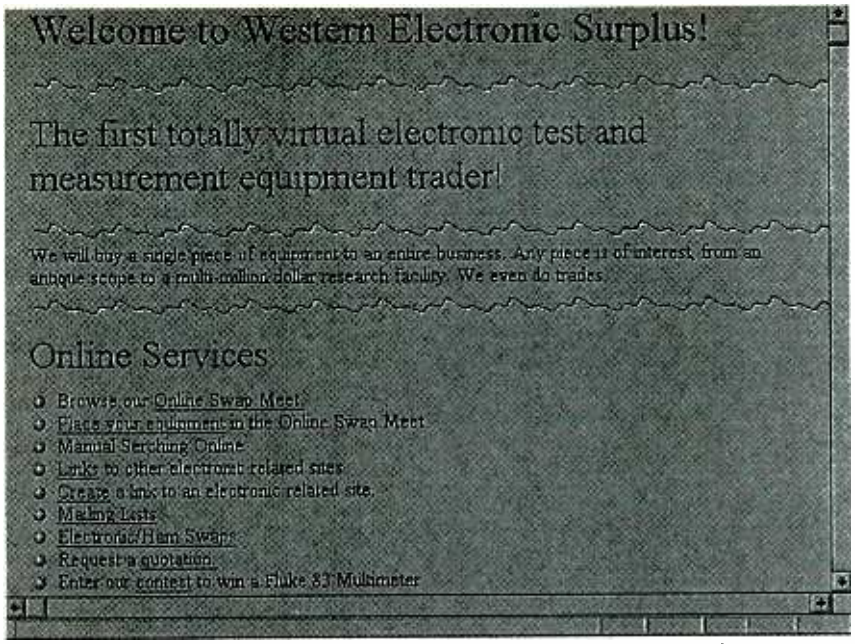

Fig. 3. Western Electronic Surplus claims to be "the first totally virtual electronic test and measurement equipment trader." It sponsors a variety of online services related to buying, selling, and trading surplus electronic and amateur radio equipment. The URL is http://www.westes.com/.

event calendars in *CQ, 73 Amateur Radio Today,* and *QST.* For a listing of some of the more major events, see the "1996 Flea Markets and Hamfests" box.

Your modem-equipped PC can also can help you find a hamfest. If you have an America Online (AOL) account, check the Ham Radio Club (Keyword: HAM or HAM RADIO) and ARRL areas (found in the Ham Radio Club). Those on Compuserve can check the HamNet Forum (GO HAMNET). You can also find ARRL hamfest lists, as well as a great deal of other radio-related information, on the ARRL Information Service; check out their BBS at 203-666-0578.

Another hi-tech way to access the ARRL's automated information server is by Internet "anonymous FTP" (file-transfer protocol). Access the oak.oakland.edu FTP site; the ARRL information files are found in the "pub/hamradio/arrl/infoserver" directories.

Surfing the Net for Surplus. The Internet is rapidly becoming an important resource to the electronics and computer hobbyist. Many electronics and computer manufacturers and surplus dealers have World-Wide Web pages or maintain other presences on the Net. However, finding exactly what you need can be confusing, frustrating, and even intimidating. To help alleviate that, we'll survey a few relevant links you'll want to hook up with and check out.

For better or worse, the Net is rapidly becoming a sort of universal marketing vehicle for all types of goods and services. Many business firms, individuals, and organizations have created Web "home pages" as "virtual storefronts" or "online stores" ready to accept your dollars.

Commercial Web pages typically include the firm's logo, as it would appear in a catalog or magazine advertisement. Customers visiting such a site simply point and click on the page to select ("go to") any of the choices listed. Those choices often include lists or profiles of products or services offered, as well as purchase information. The advantages of online marketing have not been lost on surplus firms, and several computer and electronics traders have online Web presences.

The Web pages you'll find offering surplus goods typically have the usual hypertext links, serving as on- and off-ramps as well as links to other Web sites. You'll also find e-mail addresses, searchable catalogs and listings, mail-server capabilities, instructions on using the online services, order forms, and the like as part of the total Web package. Those real-time features are eminently suited to the transitory and fast-moving, "here today but gone tomorrow" characteristics of all types of surplus stuff.

Here are a few Web pages featuring surplus that might be of some interest. Note that some are strictly online entities and don't publicize their physical addresses and telephone numbers; if that information is available, it's listed in the "Names and Numbers" box.

Defense Re-utilization and Marketing Service (DRMS): This federal government agency sells surplus Department of Defense (DOD) property to the public. There are bargains galore, and current DOD drawdowns and inventory likely will mean more surplus items coming to market. The site has a searchable online catalog for excess government property. Look for it at the following uniform resource locator (URL) http://www.drms.dla.mil/index.html. (Note: a free pamphlet, "How to Buy Surplus Personal Property from the Department of Defense" is available from DRMS or the Superintendent of Documents at the U. S. Government Printing Office.)

Electronics and Computers Surplus City: ECSC buys and sells surplus, excess and discontinued new and used electronic parts, assemblies, and systems, to the public and at wholesale. This self-proclaimed "super surplus store" operates the EIO (Electronics Information Online) WWW Server that lets you access inventory information. They're at http://www.eio.com. You also can call their BBS at 310-217-8021.

The Electronic Auction: The Electronic Auction bills itself as "the electronic marketplace for wholesale inventory." Acting as an information service and not being directly involved in transactions, the Auction moves overstock electronics and computer merchandise and equipment. Anyone who buys or sells in wholesale quantity can participate through online auctions, inventory listings, or advertising. Marketing services, a sample distribution center, and online trading services are available. The page is found at the URL http://www.auction.net/index.html (see Fig. 1). More information is available through their automated mail server at info@auction.net or via e-mail at admin@auction.net. There's also an FTP site at ftp.auction.net.

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SUGGESTED READING

Power UP! by Dave Strom. This book helps solve the problem of conveniently using military surplus equipment that requires hard-to-find, expensive, or unavailable military batteries for power. Strom shows you how to make commercial battery adapters for many popular units. The book is $14.95 plus $4 shipping and handling from CRB Research Books.

Understanding & Repairing CB Radios by Lou Franklin, K6NH. This is a 380-page technical reference that includes circuit descriptions and a troubleshooting guide for most CB radios. It's $29.95 plus $3.50 shipping from CBC International.

The Zenith Trans-Oceanic: The Royalty of Radios by Professors John H. Bryant and Harold N. Cones. This is the definitive book on the Zenith radio classics. The authors present a wealth of authoritative information concerning those fascinating radios, their collection, preservation, and restoration. The book is $24.95 plus $2 shipping and handling from The Radio Professors.

Communications Receivers, third edition, by Ray Moore. If you're looking for detailed information on commercial and military-surplus communications receivers from the vacuum-tube era, 1932-1981, this book's for you. It covers about 400 receivers (over 700 with variations) from 68 major manufacturers, as well as military-surplus receivers such as the BC-312, BC-348, and BC-454. The 125-page book is $19.95 plus $2.50 shipping and handling from RSM Communications. A companion transmitter guide is planned. ■

JEM Computers: This Cambridge, MA firm functions as a sort of retail factory outlet that purports to offer good values in personal computers, selling surplus PCs, peripherals, and accessories at very low prices. Look for them at the URL http://www.tiac.net/biz/bargains/.

Surplus—Shack: Surplus—Shack buys, sells, and trades surplus optical and electronic items. Expect to find test equipment, radio receivers and transmitters, and optical and electronic stuff at attractive prices on a first-come, first-served basis. You can fill in an online "business reply form" to request a current listing; new items and sales are posted weekly. Their URL is http://www.ip.net/shops/Surplus—Shack/ (see Fig. 2).

Team America: Team America, located in southern California, buys excess and obsolete inventories. They purchase computer hardware, disk drives, and peripherals. Test equipment and electronic component parts are also available from the company. Check out the URL http://www.vir.com/JAM/team.html.

Western Electronic Surplus: Western Electronic Surplus claims to be "the first totally virtual electronic test and measurement equipment trader." It sponsors a variety of online services related to buying, selling, and trading surplus electronics and amateur radio equipment. Look for them at the URL http://www.westes.com/ (see Fig. 3). They also sponsor the Online Swap Meet (URL http://www.westes.com/Ads/Ads.html) and the Electronic/Ham Swap Meet listings (see Fig. 4). The latter is at the URL http://www.westes.com/swap—meets/swap—meets.html.

Zeke's General Store: Zeke's General Store, in Central, AZ, takes pride in being a "mom and pop" retail operation that sells a mixture of practically anything and everything, including computers, graphic arts materials, and electronic equipment. Zeke and Ellen are at the URL http://www.zekes.com/.

Other Online Resources. Besides the Web sites we looked at, there are other online surplus resources you can access easily. Here are several:

USENET Newsgroups: Today the commercial action on the Net is on the Web, but there are also considerable surplus electronic and computer resources you'll find in the USENET newsgroups. Those are a series of discussion groups that focus on specific subjects; they're the Internet equivalent of online service and BBS forums. There are over 10,000 such discussion groups on the Net; a number of them have to do with electronics and computers.

You might find the discussions and information postings on the several science, radio, and amateur radio newsgroups that deal with electronic-project building and related topics to be useful. Some of the more promising newsgroups are listed in the "USENET Newsgroups" box.

AOL Ham Radio Club and CompuServe HamNet Forum: Check out the Ham Radio Club (Keyword: HAM or HAM RADIO) and ARRL areas (found in the Ham Radio Club) on AOL, or in the HamNet Forum (GO HAMNET) on CompuServe. The CompuServe HamNet Forum has swap shop and vintage gear areas in which messages can be exchanged and software files downloaded. A HamNet Internet Web page is also at URL http://www.webcom.com/sjl/HamNet—Companion.

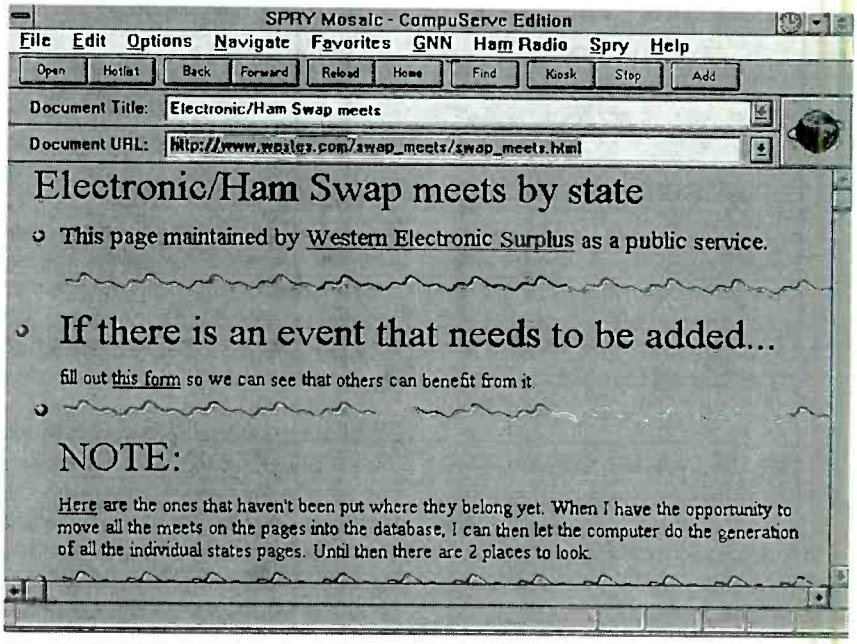

Fig. 4. The Electronic/Ham Swap Meets Web Page lists events by state so they can be easily found online. There's also an online form you can use to add events yourself. The page is sponsored by Western Electronic Surplus as a public service. It's found at the URL http://www.westes.com/swap—meets/swap—meets.html.

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NAMES AND NUMBERS

All Electronics
P.O. Box 567
Van Nuys, CA 91408
Tel. 800-826-5432

Altex Electronics, Inc.
11342 I-35 North
San Antonio, TX 78233
Tel. 800-531-5369

73 Amateur Radio Today
70 Route 220N
Peterborough, NH 03458
Tel. 800-677-8838

Amateur Radio Trader
P.O. Box 3729
Crossville, TN 38557
Tel. 800-774-2623

The American Computer Exchange
Northside Tower
6065 Roswell Rd. N.E.
Atlanta, GA 30328
Tel. 800-786-0717

American Design Components
P.O. Box 220
Fairview, NJ 07022
Tel. 800-776-3700

American Radio Relay League (QST Magazine)
225 Main St.
Newington, CT 06111
Tel. 203-666-1541

American Science and Surplus
3605 Howard St.
Skokie, IL 60076
Tel. 708-982-0870

Antique Audio
41560 Schoolcraft
Plymouth, MI 48170

Antique Electronic Supply
6221 S. Maple Ave.
Tempe, AZ 85283
Tel. 602-820-5411

Ardco Electronics
P.O. Box 95
Berwyn, IL 60402

A.R.E. Surplus
15272 East State Route 12
Findlay, OH 45840
Tel. 419-387-7771

Artsci, Inc.
P.O. Box 1428
Burbank, CA 91507
Tel. 818-843-4080

B.G. Micro, Inc.
P.O. Box 280298
Dallas, TX 75228
Tel. 800-276-2206

Bigelow Electronics
P.O. Box 125
186 E. Jefferson St.
Bluffton, OH 45817-0125
Tel. 419-358-7851

Brock Publications
P.O. Box 5004
Oceanside, CA 92052
Tel. 619-757-0372

Cardwell Condenser Corporation
80 East Montauk Highway
Lindenhurst, NY 11757
Tel. 516-957-7200

CBC International
Box 31500
Phoenix, AZ 85046

Center for Legislative Archives
National Archives
Washington, DC 20408
Tel. 202-501-5350

C & H Sales
P.O. Box 5356
Pasadena, CA 91107
Tel. 800-325-9465

Circuit Specialists, Inc.
P.O. Box 3047
Scottsdale, AZ 85271-3047
Tel. 800-528-1417

CQ Communications, Inc.
76 N. Broadway
Hicksville, NY 11801
Tel. 800-853-9797

CRB Research Books, Inc.
P.O. Box 56
Commack, NY 11725
Tel. 800-656-0056

C & S Sales, Inc.
1245 Rosewood
Deerfield, IL 60015
Tel. 800-292-7711

Dalco Electronics
275 Pioneer Blvd.
Springboro, OH 45066
Tel. 800-445-5342

Danbar Sales Co.
14455 North 79th St., Unit #C
Scottsdale, AZ 85260
Tel. 602-483-6202

Davilyn Corp.
13406 Saticoy St.
North Hollywood, CA 91605-3475
Tel. 800-235-6222

Dayton HamVention
P.O. Box 964
Dayton, OH 45401-0964

DBA National Radio Company
229 Marginal St.
Chelsea, MA 02150
Tel. 617-884-8100

Debco Electronics
4025 Edwards Rd.
Cincinnati, OH 45209
Tel. 800-423-4499

Defense Reutilization and Marketing Service (DRMS)
National Sales Office
2163 Airways Blvd.
Memphis, TN 38114-5210
Tel. 800-222-3767

Digi-Key
P.O. Box 677
Thief River Falls, MN 56701
Tel. 800-344-4539

Edlie Electronics
2700 Hempstead Turnpike
Levittown, NY 11756-1443
Tel. 800-645-4722

Eico Electronics Instrument Co, Inc.
363 Merrick Rd.
Lynbrook, NY 11563
Tel. 516-599-5744

Electronic Goldmine
P.O. Box 5408
Scottsdale, AZ 85261
Tel. 602-451-7454

Electronics & Computers Surplus City
1490 W. Artesia Blvd.
Gardena, CA 90248
Tel. 800-543-0540

Fair Radio Sales Co., Inc.
P.O. Box 1105
Lima, OH 45802
Tel. 419-227-6573

Gateway Electronics, Inc.
8123 Page Blvd.
St. Louis, MO 63130
Tel. 800-669-5810

Gernsback Publications, Inc.
500 Bi-County Blvd.
Farmingdale, NY 11735
Tel. 516-293-3000

Halted Specialties Co.
3500 Ryder St.
Santa Clara, CA 95051
Tel. 800-442-5833

Herbach and Rademan
18 Canal St.
Bristol, PA 19007
Tel. 215-788-5583

Hi-Manuals
P.O. Box 802
Council Bluffs, IA 51502

Hosfelt Electronics
2700 Sunset Blvd.
Steubenville, OH 43952
Tel. 800-524-6464

Howard W. Sams & Co.
2647 Waterfront Parkway East Dr.
Suite 300
Indianapolis, IN 46214-2041
Tel. 800-428-7267

HSC Electronic Supply
4837 Amber Lane
Sacramento, CA 95841
Tel. 916-338-2545

International Components Corporation
105 Maxess Rd.
Melville, NY 11747
Tel. 800-645-9154

Jameco Electronic Components
1355 Shoreway Rd.
Belmont, CA 94002
Tel. 800-831-4242

JEM Computers, Inc.
35 Spinelli Pl.
Cambridge, MA 02138
Tel. 617-497-2500

Marlin P. Jones & Associates
P.O. Box 12685
Lake Park, FL 33403-0685
Tel. 407-848-8236

The Manual Man
P. A. "Pete" Markavage
27 Walling St.
Sayreville, NJ 08872
Tel. 908-238-8964

MCM Electronics
650 Congress Park Dr.
Centerville, OH 45459-4072
Tel. 800-543-4330

MECI
340 East First St.
Dayton, OH 45402
Tel. 800-344-4465

Mendelson Electronics, Inc.
340 E. First St.
Dayton, OH 45402
Tel. 800-422-3525

John J. Meshna, Inc.
19 Allerton St.
Lynn, MA 01904
Tel. 800-637-4627

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NAMES AND NUMBERS (continued)

Mouser Electronics
2401 Highway 287 North
Mansfield, TX 76063
Tel. 800-992-9943

Musty Manuals
645 Wheeling Rd.
Wheeling, IL 60090
Tel. 708-634-6467

National Cable Brokers
1801 W. Jefferson St.
Plymouth, IN 46563
Tel. 219-935-4128

Nuova Fonte del Surplus
Via Taro
7 - Loc. Gorzano, 41050
Torre Maina, Modena, Italy
Tel. 0039-536-940253

Oatley Electronics
5 Lansdowne Parade
Oatley, Sydney
N.S.W., Australia 2223
Tel. 011 61 2 579 4985

Parts Express
340 E. First St.
Dayton, OH 45402
Tel. 800-338-0531

Pioneer Supply Co., Inc.
3524 Charlotte St.
Pittsburgh, PA 15201
Tel. 412-678-2300

Puett Electronics
P.O. Box 28572
Dallas, TX 75228
Tel. 214-321-0927

The Radio Professors
P.O. Box 592
Stillwater, OK 74076

R&D Electronics
5363 Broadway Ave.
Cleveland, OH 44127
Tel. 800-642-1123

Richardson Electronics, Ltd.
P.O. Box 393
LaFox, IL 60147-0393
Tel. 800-348-5580

RSM Communications
P.O. Box 1046
Key Largo, FL 33037-1046
Tel. 305-853-0379

Servo Systems
115 Main Rd.
Montville, NJ 07045-0097
Tel. 800-922-1103

Slep Electronics Company
P.O. Box 100
Otto, NC 28763-0100
Tel. 704-524-7519

Steinmetz Electronics
7519 Maplewood Ave.
Hammond, IN 46324
Tel. 219-931-9316

Superintendent of Documents
U. S. Government Printing Office
Washington, DC 20402

Surplus Al
P.O. Box 215
Hunlock Creek, PA 18621

Surplus Center
P.O. Box 82209
Lincoln, NE 68501
Tel. 800-488-3407

Surplus Sales of Nebraska
1502 Jones St.
Omaha, NE 68102-3112
Tel. 402-346-4750

Surplus Software Incorporated
489 North 8th St.
Hood River, OR 97031
Tel. 800-753-7877

Surplus Traders
P.O. Box 276
Alburg, VT 05440
Tel. 514-739-9328

Team America
16104 Corvello St.
Van Nuys, CA 91406
Tel. 818-787-1920

Timeline, Inc.
23605 Telo Ave.
Torrance, CA 90505
Tel. 800-872-8878

Tucker Electronics Co.
P.O. Box 551419
Dallas, TX 75355-1419
Tel. 800-527-4642

Unicorn Electronics
10010 Canoga Ave., Unit B-8
Chatsworth, CA 91311
Tel. 800-824-3432

Universal Radio, Inc.
6830 Americana Pkwy.
Reynoldsburg, OH 43068
Tel. 800-431-3939

U.S. Army Military History Institute
Carlisle Barracks, PA 17013-5008
Tel. 717-245-3611

Varian Associates, Inc.
301 Industrial Way
San Carlos, CA 94070-2682
Tel. 800-432-4432

W7FG Vintage Manuals
3300 Wayside Dr.
Bartlesville, OK 74006
Tel. 918-333-7893

Western Nebraska Electronics
P.O. Box 1
Potter, NE 69156
Tel. 308-879-4552

Zeke's General Store
5000 The Old West Highway
Central, AZ 85531-0373
Tel. 520-428-1117

ARRL Information Service: The ARRL has several downloadable text files that deal with surplus topics and project-building and parts-procurement information. One is a list of mail-order electronics companies that sell electronic components in small quantities, compiled by John Woods, WB7EEL. Classifications include new components, surplus electronics, specialty components, kits, and other categories. You can also access this and a variety of other amateur-radio and electronics-related information on the ARRL Information Service. Probably the easiest way to access the service is by anonymous FTP on the Net. If you have FTP access, access the oak.oakland.edu FTP site; you'll find the ARRL information files in the "pub/hamradio/arrl/infoserver" directories.

You can also have the ARRL's automated server (info@arrl.org) e-mail you the text files you desire once you have in hand the index.txt file that provides a complete listing of available files and file descriptions. Still another way to access the service is through the ARRL's BBS at 203-666-0578.

CompuServe and America Online Classifieds: Both online services have classified advertising sections you might wish to peruse for electronic and computer surplus equipment, parts, and components. It might, however, take some digging in a variety of ad classifications to find what you're looking for.

On CompuServe, GO CLASSIFIEDS; on AOL, use the Keyword: CLASSIFIEDS. You'll find that AOL, in particular, has a wide variety of appropriate classifications and offers several "trading boards." AOL also lets you access several major daily newspapers' classified advertisements.

PCBUILD: PCBUILD is an Internet mailing list for the do-it-yourselfer; it offers you tips on building your own PC, upgrading, and buying inexpensive hardware. The Internet list address is at pcbuild@scvm.trenton.edu; the subscription address is listserv@scvm.trenton.edu. (If you're unfamiliar with Internet LISTSERV procedures, view the LISTSERV Guide for General Users at the Web URL http://www.earn.net/lug/notice.html.)

PC Catalog: Peed Corporation's PC Catalog Online is a timesaving, Internet gopher resource. It contains more than 2000 PC products and nearly 200 companies that sell microcomputer, software, peripheral, and new technology products direct. This gopher (a popular Net tool that lets you search databases and presents you with a hierarchical distributed database of text documents) is updated weekly. It has price information, new-technology announcements, shoppers' checklists, and other items of interest. The gopher address is pc-catalog.peed.com. The catalog also is on the Web at http://www.peed.com/pccatalog.html. You can e-mail the company at market@pccatalog.peed.com.

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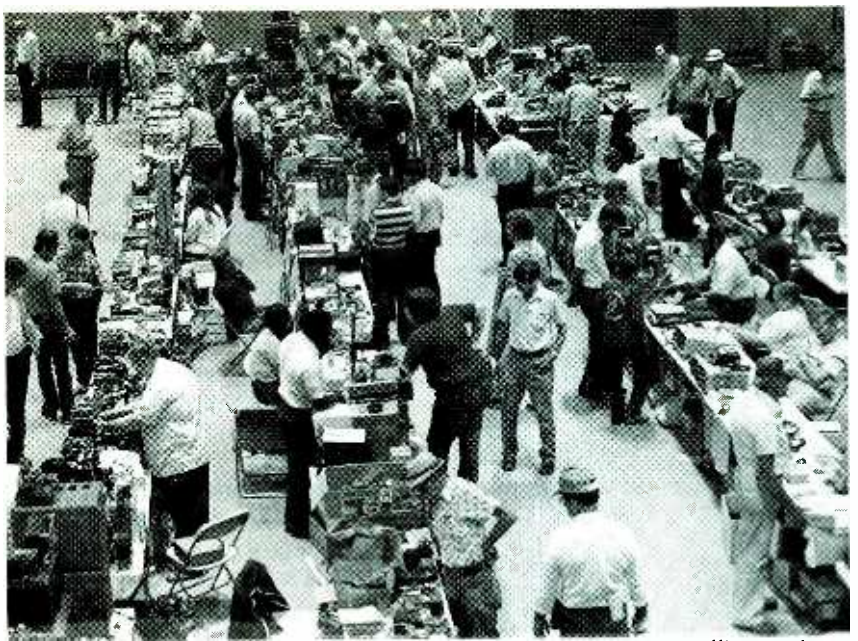

The main activity at radio swap meets was, and still is, the swapping, selling, and buying of radio and electronic parts and equipment. Here are several shoppers and buyers performing those very acts.

Locating Manuals. So let's assume you buy some equipment from the sources mentioned so far. You'll find it difficult to repair and maintain that electronic equipment without operating or service manuals and schematic diagrams. Unfortunately, many manufacturers of older equipment are defunct, or the manuals are out-of-print. Nevertheless, there is a good chance that documentation still exists somewhere for almost any gear you're likely to encounter.

Prevention is the best medicine. Manufacturers, even the top brand names, might go out of business someday. Keep that in mind the next time you purchase equipment. Obtaining a manual might take a little extra effort initially, but you'll be making a very worthwhile investment in the future well-being of your equipment. Let's look at the different types of manuals and service documentation available to you:

Owner's or Operating Manuals: These are the least useful for the would-be repairer of equipment. An owner's manual is furnished at the time of purchase and is primarily an operating manual. Such manuals usually do not contain a schematic, and service data is often minimal.

Manufacturer's Service Manuals: Service manuals are usually sold separately. They contain important repair, service, and alignment data. Most manufacturers offer service manuals, but they might not always have them available for obsolete equipment.

Other Manufacturer's Documentation: Besides owner's (operating) and service manuals, you might encounter other types of documentation. That could include combination assembly/operating and operating/service manuals, as well as charts, schematics, bulletins, and various technical specification sheets. For documentation, contact the manufacturer directly. If it's out of business, or if it no longer supplies the manual you need, you have other options (we'll deal with those later on in the "Possible Sources of Manuals" section).

Third-Party Service Documentation: Such documentation is published by companies other than the original manufacturer and is available in various forms from basic schematics to complete service manuals. That type of documentation offers a wealth of information on antique radio receivers and modern, consumer-electronics equipment, but amateur-radio equipment usually isn't covered.

Howard W. Sams & Company Photofacts: Sams began publishing *Photofacts* in 1946 to cover most consumer-electronics items. They offer *Photofacts* for TV sets; antique, ham, and CB radios; VCRs; computers; and other electronic equipment. Although they don't include modern amateur equipment, you'll find service data for some classic shortwave receivers made by Hammarlund, Hallicrafters, and several others. Photofacts are numbered. To obtain the correct one, you must find the equipment in the *Annual Index*, which is $5.95 plus $1 shipping and handling, or $12.95 for a disk-based version. You can order *Photofacts* through distributors, by mail, or by phone. Sams also offers a photocopy service for various manufacturer's manuals, *Rider's* data, and other manuals.

John F. Rider Perpetual Troubleshooters' Manuals: *Rider's* was first published in 1930. New volumes were published about one per year until the last one, volume 23, was issued in 1953. *Rider's* manuals are indexed by a system similar to *Photofacts*. Several index volumes were published.

Tip: If you think a *Photofact* or *Rider's* document might be available, based on the age and type of equipment involved, first check with your local library. Many larger libraries have them and will let you photocopy them.

Vacuum-Tube Data: The most common tube manuals are the ones published by RCA, especially in the case of receiving tubes. Manuals were also published for transmitting, special-purpose, and industrial tubes. The manuals first appeared in the 1930s and frequently were updated. Once common, they are now hard to find. Sylvania also published a comparable series.

As for tubes themselves, they're becoming very scarce and expensive, and are offered by just a few specialized dealers (they're still found at hamfests). Data for EIMAC tubes, frequently found in amateur amplifiers and other high-power RF applications, are available from Varian Associates. Transmitting tube data can also be found in the *ARRL Handbook*; look in the "Component Data" chapter of the most recent edition you can find.

Possible Sources of Manuals. Luckily, a seeker of documentation for a surplus item has a few options. For starters, there are a number of third-party resources that can furnish you with originals or reproductions of

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manuals (we'll get to some of those in a moment). Further, some military equipment manuals can still can be obtained from the government.

Hamfest flea markets and swap meets can also be good sources, as well. If you're having a particularly difficult time, however, it might be easier to try a classified advertisement in the hobbyist publication that most closely deals with your area of interest (**Popular Electronics** also publishes "Haves and Needs" sections in the "Letters" column).

Here are some possible sources of manuals and other documentation, listed in alphabetical order:

Antique Audio: This firm has older factory manuals for RCA, Zenith, and others. Most *Rider's, Photofacts, Transistor Service Manuals,* and *Beitman's* volumes are available.

Antique Electronic Supply: This company supplies pre-1960 service manuals for many electronic products and receivers. They offer reprints of older service manuals, tube manuals, a tube-substitution guidebook, and a catalog of radio parts and books.

Ardco Electronics: Most Hallicrafters service manuals for amateur/SWL equipment are available from Ardco Electronics. Specify the model numbers you're interested in when inquiring.

Artsci: Artsci specializes in reference publications for the amateur radio, SWL, and scanner communities. Those publications include *Lost Users Manuals* ($19.95), which offers over 150 pages of condensed charts, drawings, radio programming information, and operating instructions for most ICOM, Kenwood, Yaesu, Alinco, and Uniden mobile radios, handi-talkies (HTs), and scanners.

Brock Publications: Most manuals for amateur equipment sold by Swan, Cubic Communications, Atlas, Astro, and Siltronix, are available from this resource.

Cardwell Condenser Corporation: Manuals for Hammarlund equipment, along with some components for their receivers and transmitters, are available from this source.

DAR Electronics: For manuals for National Radio Company communications receivers, contact DAR Electronics, DBA National Radio Company.

Eico Electronics Instrument Co, Inc.: Eico has manuals for the last 25 years of its product lines. Those mostly are for test equipment, but there are also some for amateur radio and audio equipment.

Fair Radio Sales, Inc.: Manuals for a variety of surplus equipment, some Tektronix manuals, and vacuum-tube data are available from this Ohio radio-surplus dealer.

Hi-Manuals: Manuals for most ham gear made from 1935-1970 are available from Hi-Manuals. A catalog, which is required to order manuals, is $3. Tube data on RCA receiving and transmitting tubes also is available.

The Manual Man: P.A. "Pete" Markavage, "The Manual Man," offers vintage manuals for radio and audio equipment. His catalog shows a broad selection of operating, service, and assembly manuals, along with some charts, schematics, bulletins, technical specifications, and other equipment documentation.

Musty Manuals: Musty Manuals offers an extensive collection of owner's manuals, service and maintenance manuals, and other technical information on both early and late-model radio equipment, including amateur gear. A catalog is available.

National Archives: Photocopies of U.S. Army technical manuals for radio equipment from 1940 to 1949 are available from the Center for Legislative Archives of the National Archives. Requesting documents requires you to know the Army technical-manual number and to fill out a microfilm order form; a booklet describing how to determine the manual number is available.

Puett Electronics: This firm offers schematic diagrams for practically every radio receiver ever manufactured.

Slep Electronics: Slep Electronics offers manuals for commercial and military-surplus test equipment, commercial and military-surplus radios, antique radios, and equipment manuals.

Steinmetz Electronics: This firm offers *Rider's* and *Beitman's* manuals, plus older manufacturer's manuals.

Surplus Al: Surplus Al offers military technical manuals and has over 20,000 in stock. A nominal refundable charge is made for a current listing of available manuals.

(Continued on page 78)

1996 FLEA MARKETS AND HAMFESTS

Here's a chronological sampling of some of the flea market and hamfest events—large and small—you'll find across the U.S.A. in 1996. Check with your local radio club and the various amateur radio magazines' monthly hamfest calendars and special events listings to confirm these advance dates. Many of these events are ARRL-sanctioned.

January 28—Glen Burnie, MD: Maryland Mobileers ARC
February 3–4—Miami, FL: Southern Florida Section Convention
February 10—Pensacola, FL: Pensacola Area Hamfest Association
February 16–18—Orlando, FL: Florida State Convention
February 24–25—Cincinnati, OH: Great Lakes Division Convention
March 8–10—Norfolk, NE: Nebraska State Convention
April 12–13—Lawton, OK: Oklahoma State Convention
April 13—Spokane, WA: Inland NW Hamfest Association
April 13–14—Atlanta, GA: Georgia State Convention
April 13–14—Birmingham, AL: Alabama Section Convention (BirminghamFest)
May 18–19—Dayton, OH: Dayton Hamvention
May 31–June 2—Rochester, NY: Atlantic Division/New York State Convention
June 14–15—Albany, GA: Albany GA Amateur Radio Club
August 17–18—Huntsville, AL: Huntsville Hamfest
September 13–15—Peoria, IL: ARRL National Convention
October 5–6—Boxboro, MA: New England Division Convention
October 11–13—Mesa, AZ: Southwestern Division Convention
November 9—West Monroe, LA: Twin City Ham Club
November 16–17—Ft. Wayne, IN: Indiana State Convention
November 23–24—Tampa, FL: Southeastern Division Convention

Amateur radio hamfests are a big source of vintage communications equipment. Here a prospective buyer examines a classic, incredibly rugged, early 1960s Technical Material Corporation GPR-92 all-band HF communications receiver at a hamfest.

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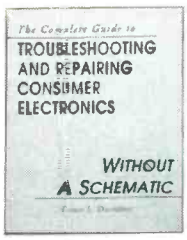

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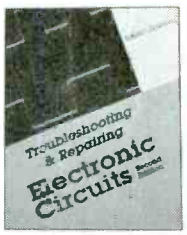

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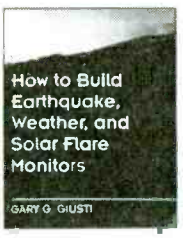

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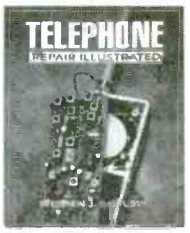

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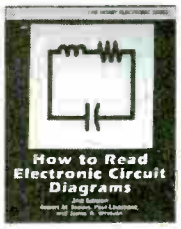

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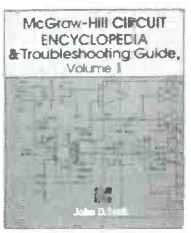

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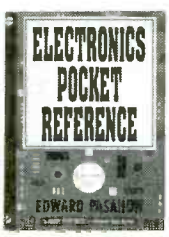

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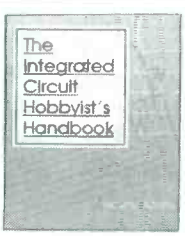

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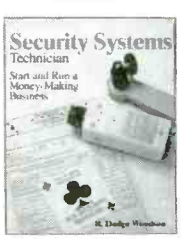

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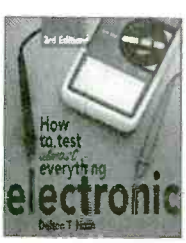

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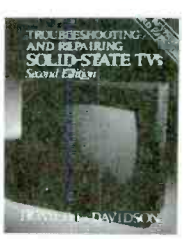

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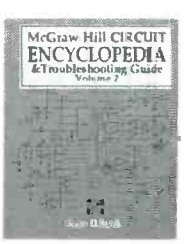

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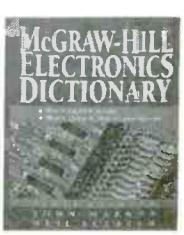

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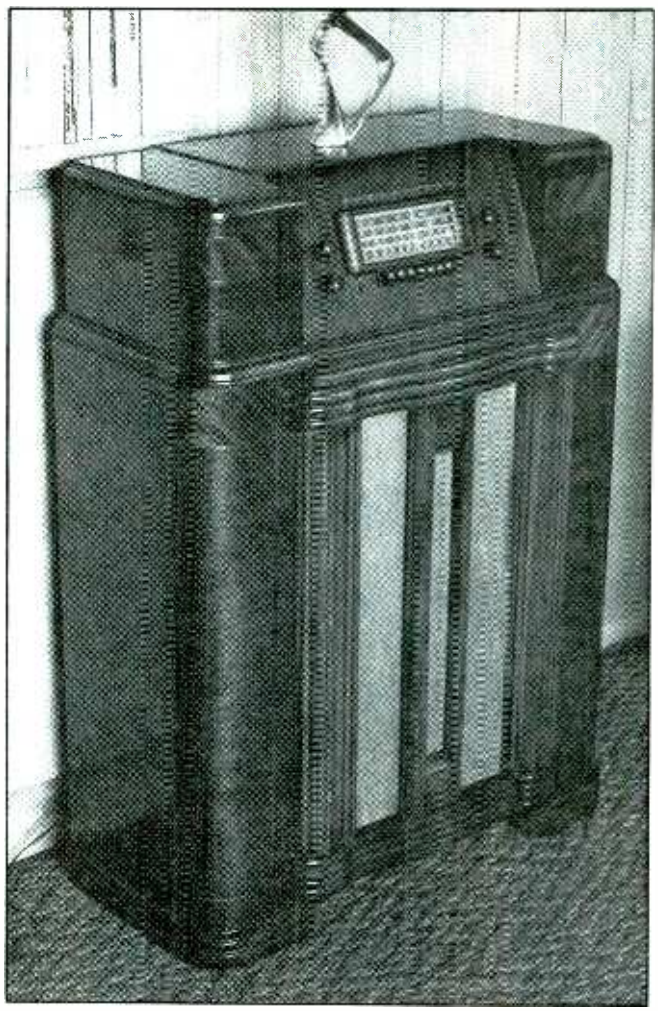
Restoring a Vintage Radio



BY L.G. ROBERTSON

Collecting antique radios is a fun hobby, especially if you can return your finds to their former glory. This article describes one such restoration project.

When you live in an apartment like I do, having a weakness for console radios from the 30's and 40's can cause problems. Still, when I saw that 1941 Silvertone console lying out there in the front yard of a small antique shop, I just couldn't let it die. Perhaps, I thought, I can leave the apartment to my radios, and go live in the car! Well, with these and similar thoughts in mind I stopped in, dickered a bit, and brought the behemoth home in the back of my tiny car. I'm sure my neighbors had consigned my sanity to the nether regions when they saw me haul yet another one up the stairs. The project had begun; 80 hours of fun was under way.

The First Steps. A simple cleaning was the first thing to be done. The set was so absolutely filthy that bringing it indoors was out of the question. Furthermore, it was evident that several interesting creatures had taken up residence in the cabinet over time. Fortunately, all had either died or moved. It's worth nothing that taking an old radio inside can be hazardous—one old set I took apart came complete with a very live Black Widow spider who was not at all happy about being disturbed, so be cautious. Cleaning the cabinet out made me feel a bit like an archaeologist.

I like to know right off the bat if I've got a good or bad chassis. By that I mean whether or not the thing can be restored at all. It's been my experience that few chassis are total losses. Still, a real bad one pops up from time to time, and I really didn't want to spend weeks restoring a cabinet to find that the radio was not repairable.

There are many that think even a poorly functioning antique radio is valuable. However, I still think it's a crime to spend hours and hours on restoring a cabinet and then shove it in a corner and merely look at it. It makes about as much sense as paying six figures for a classic car and then keeping it all locked up in a warehouse. All my sets work, and to original specifications, too.

The electrical part of the project was rather straightforward. I suppose my having played with radios for the past 25 years probably had something to do with it, but I must say that luck played a great part, too. Most of the set's vital components (IF cans, tuning condensers, coils, and dial-string parts) were present and intact. However, all the fixed capacitors and nearly all the resistors had to be replaced.

However, the first "start-up" was not without problems. The set was a bit grumpy, I guess, after being awakened from a 30-year snooze. Some "motorboating" occurred, but was cured with a thorough cleaning of the tube sockets—poor connections were responsible. Details like that help me appreciate the fact that these sets came from an era when radio was as much an art as a science.

There was also a problem with fungus (the set is from Seattle): It formed a short in the transformer, causing the rectifier to glow cherry red the first few times the set was switched on (and quickly off!). The problem vanished after the third start-up, never to re-appear. It seems that the fungus burned through, breaking the short circuit. Now that the unit was working I moved on to the more laborious stuff.

Rolling Up My Sleeves. The chassis was thoroughly rusted and pitted. It was only after many hours of sanding with medium, fine, and crocus-grade emery cloth that the bright metal emerged. Fifty years of rust is a formidable opponent. **Don't** use Naval Jelly no matter how tempting it might be. If it should drip, it will ruin wiring. Sorry, but good old-fashioned elbow grease works best for this step.

For sheer "fun" in chassis work, though, stringing the dial cord system

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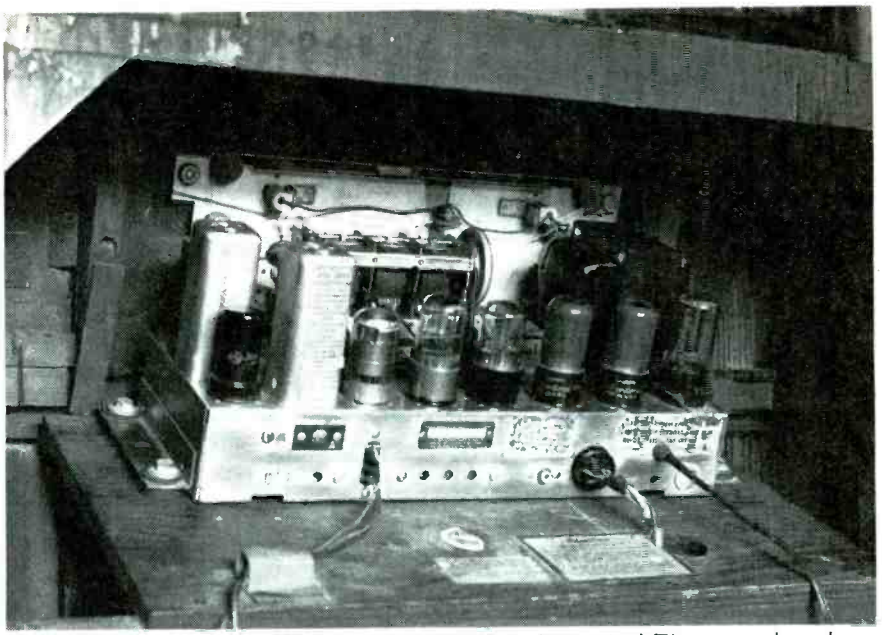
takes first place. If you're at a loss about how to get admitted to the violent ward of your local mental hospital, by all means try this. Imagine trying to juggle crystal stemware while your hands are enmeshed in the children's game of "Cat's Cradle," and you'll get the idea.

The dial in the set was the real heartbreaker. All the gold leaf on the dial needed to be replaced; little of the old stuff survived. When the set was first obtained, the gold was flaking and peeling at some points, but held as fast as iron where it was not. As there was some very slight difference between the old gold and the new material, it was decided to eliminate what remained of the old gilt entirely. That was rather tricky, as I didn't want to disturb some white silkscreened markings on the dial. A solution of 85% witch hazel and 15% alcohol was used to soften up the old gold leaf without ruining the white silkscreening. Fine manicure tools and some dental picks were also used.

The new material I used was Maimeri brand "Pale Gold #904" gold-leaf powder from Italy. That was then mixed with a polymer/acrylic medium, and applied to clear adhesive tape that I cut to fit in the tracks where the old gilt had lain.

This is the set before restoration. The cabinet has been thoroughly bashed, scratched and scarred. Fortunately, all the pieces were there, and, wonder of wonders, the speaker did not need reconing. The chassis has been removed for rust removal.



Here's the chassis, after extensive rust removal. Note the original Silvertone tubes; they were still good after nearly fifty years.

Stripping the cabinet provided me with yet another experience with products containing Toluene, and again I hated it. Still, the chemical stripper did a very good job. Incidentally, the ventilation advisories on the can are not to be taken lightly!

Once fully into the finish stripping, I found it necessary to use small brushes to get into the various crevices and crannies. It was well worth the effort. Once down to the wood, a beautiful deep-red stain was revealed that had nothing whatsoever to do with the color of the finish! Someone had used a one-step varnish/stain sometime in the past. (Utter heresy!) The red stain was matched very closely using present-day stain, and applied very lightly indeed, just enough to even things out all over. It was wiped up five minutes after application.

The cabinet was finished by hand rubbing nine coats of satin spar varnish, with 24–48 hours between coats. In between coats, sanding was done with 000 steel wool, as even fine sandpaper seemed to be too coarse for the stain and the Mahogany and Walnut wood veneers used in the unit. Before all this, however, some veneer did have to be replaced as it was damaged beyond repair. Fortunately, present-day materials make that easy. Some veneer even comes with adhesive backing!

This is the complete rear view. The ten-inch speaker and huge magnet assembly below provide impressive sound indeed.

Radio restoration is a very interesting sideroad of the radio avocation, and the number of collectors grows daily. If you're interested in some good tips and reading, try "A Flick of The Switch," by Morgan McMahon, or "Antique Radios: Restoration and Price Guide," by David and Betty Johnson. Both are available from Antique Electronic Supply (6221 S. Maple Ave., Tempe, AZ 85283).

And so, to paraphrase John Bunyan, "I pieced it back together until at last it came to be; For length and breadth the bigness which you see." ■

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ANNUAL INDEX 1995

Volume 12

Abbreviations: (AR)Antique Radio, (C)Construction, (CB)Computer Bits, (CC)Circuit Circus, (D)Department, (DX)DX Listening, (ED)Editorial, (G)Gizmo, (HOR)Hands-On Report, (HR)Ham Radio, (LET)Letter, (MW)Multimedia Watch, (NW)Net Watch, (PTR)Product Test Report, (SS)Scanner Scene, (TT)Think Tank

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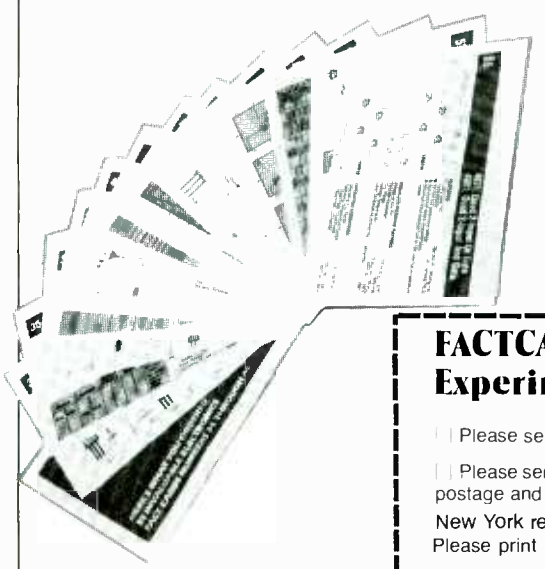

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ANTIQUE RADIO

By Marc Ellis

The 1930's Ham Receiver: Construction Continues

I hadn't intended for our "1930's Ham Receiver" project to be in work for quite this long. Part of the problem has been my extremely busy summer. Perhaps unwisely, I signed up to give talks at both of the major antique radio meets: Elgin (Antique Radio Club of Illinois) in early August and Rochester (Antique Wireless Association) in early September. Because the two talks were totally different, quite a bit of preparation was required.

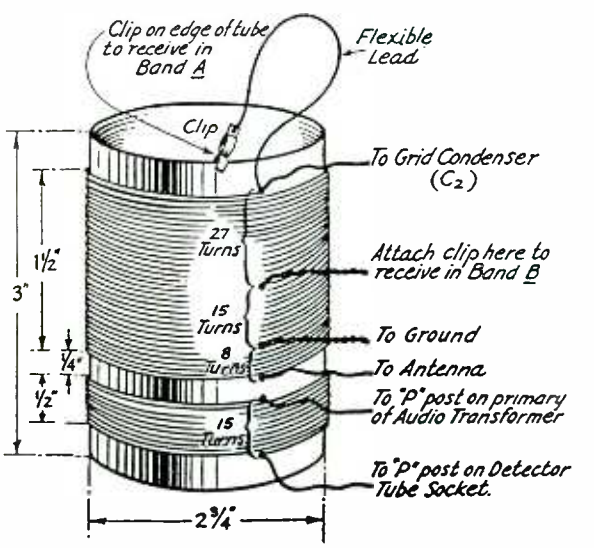

Fig. 1. Here's the pictorial diagram of the coil assembly from the original construction article. See text for the locations of extra "experimental" taps.

I thoroughly enjoyed the experience, but it certainly did limit my project-building time!

By the way, the Rochester meet was not troubled by the rainy weather that put such a damper on the Elgin flea market (see last month's column). For the most part, conditions were clear and sunny—though a bit windy at times. Trading was brisk throughout the "run of the show," except on the last half-day. Many vendors pulled out early rather than trying to cope with the intermittent showers that finally did loom up on the horizon.

The inside activities included the usual feast of interesting talks and exhibits—not to mention those all-important auctions. And, in keeping with the conference theme, "100 Years of Radio," the program for the Grand Banquet included a slide presentation by the charming and distinguished Gioia Marconi Braga—daughter of Guglielmo himself!

HISTORY OF THE RECEIVER PROJECT

For those who might be just joining us, this project began in the October 1995 issue—when we discussed the background and theory of a starter ham receiver of the 1930s as recommended by contemporary ARRL (Amateur Radio Relay League) publications. Construction of the two-tube (regenerative detector plus audio amplifier) short-wave set officially began with a parts-scrounging session covered in the following issue.

There was no progress on the set in the next (December, 1995) issue, which was devoted to reader mail. But last month (January, 1996), the front panel and baseboard were assembled and stained, and the front-panel controls were mounted. We also arrived at a layout for the parts to be mounted on the baseboard. Now, let's see what this month brings!

COIL CONSTRUCTION

This month's work session began with construction of the coil. The original pictorial diagram of that unit is shown in Fig. 1. Note that the upper portion can be shorted out, via a clip lead, to provide coverage on a second band.

With all coil turns active, the set is designed to cover the 160-meter ham band (indicated as "Band A" on the diagram). With the shorting clip attached at the designated spot, the set tunes to 80 meters (indicated as "Band B" on the diagram).

It was my original intention to redesign that coil so that it would cover 80 and 40 meters, rather than 160 and 80 meters—figuring that there would be more stations to hear that way. Referring to some coil tables, I first checked to see that the 80-meter tap (as originally designed) was in the correct spot.

Based on the inductances required for 160- and 80-meter coverage with the 100-pF tuning capacitor used, the 15-turn (above ground) location for the 80-meter tap is in the correct proportional relationship to the 42-turn location of the 160-meter tap. However, using the same methods of calculation, a 40-meter tap would be only four turns above ground on the coil.

I was concerned that a different coil geometry—one requiring many more turns than four to reach 40 meters—might be required for efficient operation on that frequency. It also occurred to me that I might

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also have to lose some turns from the tickler coil (bottom winding on the diagram) as well as from the antenna-ground section of the coil for proper operation at the higher frequency range.

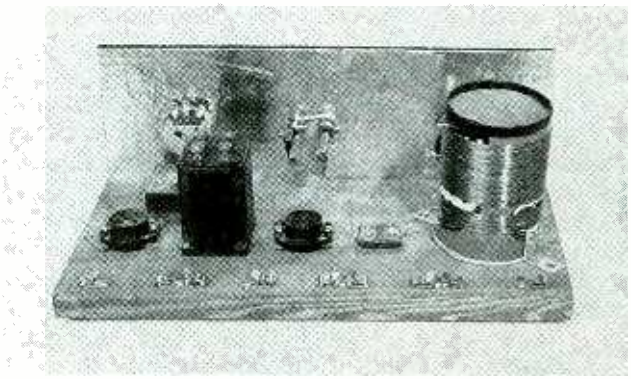
Not being sure how to arrive at the necessary design in a definitive manner, I decided to wind a 160-/80-meter coil more-or-less as described in the original construction article. That way, I'd be reasonably sure of having a coil that worked. However, I would add *extra* taps—at locations determined by educated guesses—that might make 40-meter operation possible.

If things worked out, I'd have a coil that would permit 160-, 80-, *and* 40-meter operation. If not, I could ignore the experimental taps and at least be able to receive on 160 and 80 meters as originally intended.

To that end, I placed an extra tap about half-way up from the bottom (7 turns) of the 15-turn tickler. I also placed one half-way between the antenna and ground taps (at four turns up from the antenna tap). I located the last extra tap four turns up from the ground tap, at the location calculated to be correct to tune 40 meters. Using temporary clip leads instead of permanent connections, I'll be able to experiment with different tap configurations to see which (if any) might make it possible to receive on 40 meters.

By the way, for a schematic representation of the original coil, see the October 1995 issue—where you will find the schematic of the complete receiver. However, for some reason, the 80-meter tap ("Band B" on the pictorial diagram) is not shown on the schematic. Perhaps that extra band was an afterthought.

Here's a front view of the receiver with all parts in place. Filament rheostat and regeneration control are at left and right, respectively, of tuning dial.



This rear view of the set shows the arrangement of parts on breadboard.

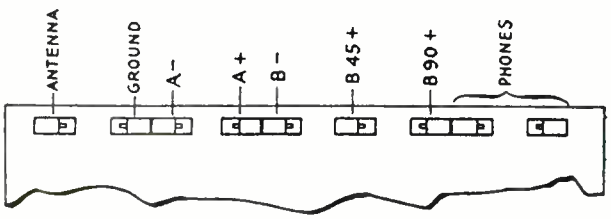


Fig. 2. This is the layout and function of Fahnestock-clip connection points.

My version of the coil was wound with some 20-gauge, enamel-covered wire that I had on hand, instead of with the 22-gauge double-cotton-covered (DCC) wire specified in the original construction article. I figured that even though my wire was heavier, its enamel insulation would be thinner than DCC and the resulting coil would be physically quite similar to what was intended.

That did indeed turn out to be the case with the tickler coil, which came out very close to the ½-inch height specified on the diagram. The main coil wasn't too far off either. Specified at 1½ inches, it measured out at about 1¾ inches. It'll be quite interesting to see what frequency ranges the coil will actually tune when the receiver is completed.

FIRST AID FOR OLD PARTS

Though I had all of the other parts for the set already in hand, a few of them needed some help before they would be usable. As mentioned in an earlier column, the vintage 1-µF bypass capacitor tested out at only a fraction of its rated value. But it required only the bending of a couple of tabs to release the connection strip, with its attached capacitor, so that they could be slid out of the case.

The old capacitor was then removed from the strip and a new 1-µF orange drop installed in its place. That assembly was then slid back into the case and reinstalled.

The standard 15-ohm filament rheostat, which I'm using as a substitute for the exotic "Lynch Equalizer" filament voltage control originally specified, also needed some attention. On the rheostat, contact with the resistance element and wiper arm is made via nut and bolt assemblies that also serve to secure the solder lugs used to make electrical connections to the unit. Both of those assemblies were quite loose, and also quite tarnished.

Removing both nut-and-bolt sets and their associated lugs, I steel-wooled all of the surfaces intended to be in electrical contact with each other or with metal parts in the rheostat itself. The latter were also steel-wooled until they were made bright. Now the unit was reassembled, using a screwdriver and nutdriver to draw up the screws and nuts so that all parts were in firm contact.

A little contact cleaner/lubricant sprayed on the wiper arm and resistance element—followed by vigorous working of the control—completed the job. And while I had the can in my hand, I also sprayed and worked all bearing surfaces in the tuning capacitor to make sure that the moving parts of the very tarnished unit would

(Continued on page 76)

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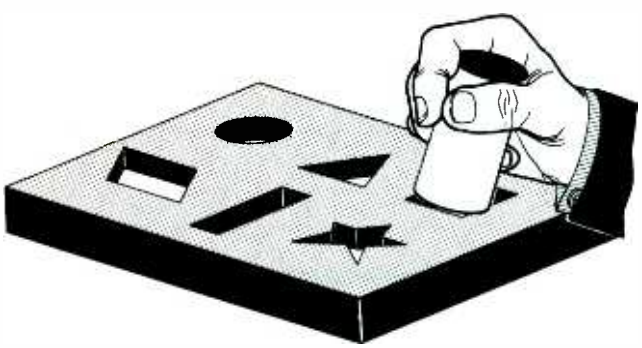
COMPUTER BITS

By Jeff Holtzman

Cleaning Up, Part Two

Last month, I sent out a cry of frustration over DOS's antiquated file system. The frustration arose as part of a project that would: 1) Upgrade a system to Win95, but 2) Simultaneously retain the ability to run Win3.11 and all the 16-bit apps on it. In particular, to support existing clients, I need to run Windows for Workgroups, Microsoft Office Pro 4.3, 16-bit programming tools such as Visual Basic 3.0 and Visual C+ 1.5, and assorted other 16-bit tools and applications. But to support clients who are making the transition to Win95, I also need to run Win95, along with an upgraded complement of productivity and programming tools.



Getting the same set of applications to run under several different operating systems on the same PC can turn out to be as hard as fitting a round peg into a square hole.

I also have several constraints. For one, due to economics, the purchase of a new machine must wait several months. Second, I don't want to waste time (and disk space) reinstalling scads of software so that the necessary tools will work in both environments. Third, I don't want to waste existing resources. Fourth, I would prefer not to use disk compression. And finally, I would prefer not to add another hard disk.

I started off with a 90%-full, 1-GB hard disk; after housecleaning, I ended up with an 80%-full, 1-GB hard disk. What galled me was that of that 80%, approximately 20% was simply wasted, because of the stupid, brain-dead, idiotic way DOS allocates disk space. Twenty percent might not seem like much, but it translates to 150 MB!

The problem is that the larger the hard disk, the larger the minimum amount of space that can be allocated at once. That minimum chunk is variously known as a cluster or an allocation unit. Cluster size ranges from 2K for 128-MB and smaller drives, to 64K for 4-GB drives.

A 1-GB drive has 16K clusters. So on a 1-GB drive, every file that has fewer than 16,384 bytes will nonetheless swallow up a 16K chunk of disk space. In addition, it's not just small files that are affected. Any file larger than a single cluster can still waste as many as (ClusterSize–1) bytes. For example, a file containing 32,769 (16,384 + 16,384 + 1) bytes requires three clusters. The first two clusters will be full. The last cluster will use one byte and waste the other 16,383. By reducing cluster size, wasted space can be reduced, but maximum drive size must also be reduced.

OPTIONS

In some ways, adding a new disk makes the most sense. All my systems are based on the SCSI standard. On the machine in question, there are currently three hard drives plus a CD-ROM. In a SCSI system, every device must have a unique ID, ranging from zero to seven. Some time ago, I ran a ribbon cable through the machine. At one end is an eight-position DIP switch. At the other are small female header blocks that plug onto the SCSI ID jumpers. That way, I can change SCSI IDs whenever I need or want to.

In practice, that setup allows me to change the boot drive without opening the case, removing the drives, and reconfiguring the jumpers. In the past, I used that setup to test versions of OS/2, Win95 betas, etc. As far as running different operating systems on one machine, the setup works great. But that does not mean that there have not been problems.

One is that simply shuffling the drives around affects the "bootability" of the drives. For example, the last time I installed a Win95 beta on one of the subsidiary drives, it disabled the ability of the main (Win3.1) drive to boot. A few terrifying minutes with FDISK and SYS restored bootability, but, needless to say, that experience left a rather bad taste in my mouth.

Another problem concerns application programs. The little pests get used to living in one spot (e.g., C:\MSOFFICE\WINWORD), and usually don't take kindly to suddenly being uprooted and plunked down somewhere else (*i.e.*, D:\MSOFFICE\WINWORD). On the other hand, the Uninstall application that was dis-

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cussed here last time, Remove-IT, is supposed to be able to help in that type of situation. Hmmm . . . .

Another possibility would be to install all the applications on a drive that always appeared at the same drive letter, regardless of which physical drive (and OS) actually booted the machine. For example, if all the apps ran from a drive that always had SCSI ID 1, and the other drives with their different operating systems swapped through SCSI ID 0—that might work.

That might work—but getting a specific drive to appear at a specific letter is trickier than it might first appear. When booting, DOS allocates drive letters according to both physical ID and partition type. Under DOS (and Windows), a hard disk can have as many as four partitions. There are several types of partitions, including primary partitions, extended partitions, and partitions for other operating systems. Primary partitions are bootable, and are allocated before extended partitions.

Using those capabilities, we might then get all the applications and data into an extended partition on one drive. The extended partition would be allocated after all the physical drives and DOS partitions. So, assuming only the one extended partition, regardless which drive was set as the boot drive, the extended partition would always appear at the same drive letter. Does it really need to be that complicated?

In a similar fashion, we might be able to use disk-compression software to force the apps and data to appear at specific drive letters. I have used compression on and off for years, typically toward the end of a machine's life, when hardware upgrades are no longer cost effective, but the machine is not really quite ready to be put out to pasture yet either.

I have other concerns as well. Win95 has new, more powerful compression software than previous DOS versions. The new software allows larger compressed drive sizes (2 GB), and better compression. However, using the new features would practically guarantee incompatibility with any other operating system (except Windows NT 3.5 or greater).

Next month, with luck, I hope to have this issue resolved once and for all. I'll let you know how everything turns out. ■

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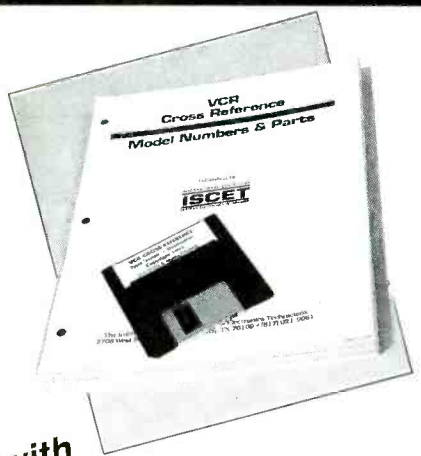

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THINK TANK

By John J. Yacono
Technical Editor
Windows Magazine

Weather Circuits

This month's circuits deal with wind and rain, while the tutorial continues the overview of capacitor types and properties. But first, I'd like to remind everyone about our current contest: send in enough quality circuits to fill a column, and get a kit, a 1967 MCL1010 and a book. Submissions with too few qualifying circuits will be printed one at a time, with the author getting a different book for each circuit printed.

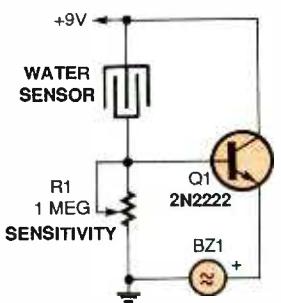

Fig. 1. Don't let rain water destroy your basement. Build this circuit to alert you to flooding, or with some modification, make it start a pump when trouble strikes.

Also, before we get on with this month's tutorial, I'd like to bring up the fact that in a tutorial a couple of months ago, I used the word "electrolytic" in place of the word "dielectric." While electrolytics have dielectric properties, I was speaking of all dielectrics at that point in the series. Thanks to reader Keith Kundane for pointing out the slip up. And now, let's move on.

One old capacitor type that endures today is the paper capacitor, then considered a "film-type" capacitor. Shortly after its introduction it was improved upon by the addition of oil. The result was a capacitor capable of withstanding high voltages. Thus they are typically used in heavy-duty applications, and sometimes built in large-form factors to store large amounts of charge. Those capacitors make their home in industrial applications.

Another variant, called the "metalized-paper" capacitor, has a zinc or aluminum coating on the paper. The capacitors are also good for high-current, high-voltage use, but the dielectric is prone to breakdown, losing its insulating property if the voltage gets too high too quickly. That makes metalized-paper capacitors poor at handling sudden surges. Those units can be best used in high-current, high-voltage, large-value applications where the conditions are predictable, space is not at a premium, and cost-per-microfarad is an important concern.

Both paper and metalized-paper capacitors are usually made of two long strips of metal foil surrounding a long strip of the dielectric. That "sandwich" is rolled up tightly, and electrodes are added to the plates. The roll is placed in a cylindrical case of metal, plastic, or, less often, paper.

RAIN DETECTOR

This simple circuit (see Fig. 1) can save your house from a water-inundation. Also, it can save your electric equipment from water damage. When rain drops fall on the water sensor, a small current flows, turning on Q1 and the buzzer. Alternatively, you could replace the buzzer with a relay to drive a pump. The water sensor can be made from an etched circuit board. — *Enrique A. Compan, Monterrey, N.L. Mexico*

Short and sweet. By the way, if you substitute a Darlington pair for the single transistor, the circuit becomes a very sensitive touch sensor.

ANEMOMETER

Here's a really simple and inexpensive anemometer I have been using for years (see Fig. 2). You can use any small DC motor for MOT1. Meter M1 can be any milliamp or microamp meter with markings from 0 to 50 or 100. You can easily find the parts, including the 1000-ohm, 15-turn potentiometer, at Radio Shack and other hobbyist sources.

A three-paddle wheel for the motor can be made with golf-ball-sized "wiffle" balls. Cut two of them in half, and bolt three of the halves to a PVC hub, using 6-32 machine screws. Calibrate the circuit by holding it out of a car window while someone drives steadily be-

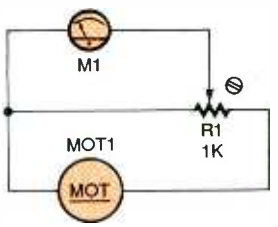

Fig. 2. Perhaps the world's simplest anemometer, you'll spend more time working on the wind cups than the circuit. A trip in a car is needed to calibrate the unit, however.

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tween 20 and 30 miles per hour on a still day. —

Lawrence Fiedler, Garden Grove, CA

Thanks; the circuit's so simple that the mechanics are the only real job. Placing the motor in an enclosed and water-proofed container is necessary for protection against the rain.

ADVANCED WATER DETECTOR

I've looked through several years of electronics magazines for articles about detecting the presence or absence of water, but I have never seen mention of two ICs specifically designed to detect water: the LM1830 and ULN2429. They sell for under $2.00 a piece, are very easy to use, and have at least one very distinct feature: the probes receive a very small oscillating (AC) signal. That is preferable to using a DC signal, which would electroplate the probes.

I have included a circuit that I've been using on my boat since 1983 to detect and pump out the bilge (see Fig. 3). The heart of the circuit is the LM1830 fluid detector. It contains all the circuitry needed to sense fluid levels and activate an external device (relay, etc.). The IC generates an AC signal that is passed through two probes in the fluid. The IC's detector circuit senses the presence or absence of fluid by comparing the resistance between the probes with its internal reference resistance. When the probes detect the presence of water, the LM1830 will trigger Q1, and that in turn will trigger IC2 (an LM555), which starts a timing period. The output from pin 3 of IC2 closes the relay and the bilge pump is activated for the duration of the timing period. The timing period is adjustable, using R6, a 1-megohm potentiometer. For the values shown, and depending on the setting of R6, the timing period is about 5–120 seconds. Components R4, D1, and C7 are tied to pin 4 of IC2 to hold the timer at reset when power is first applied.

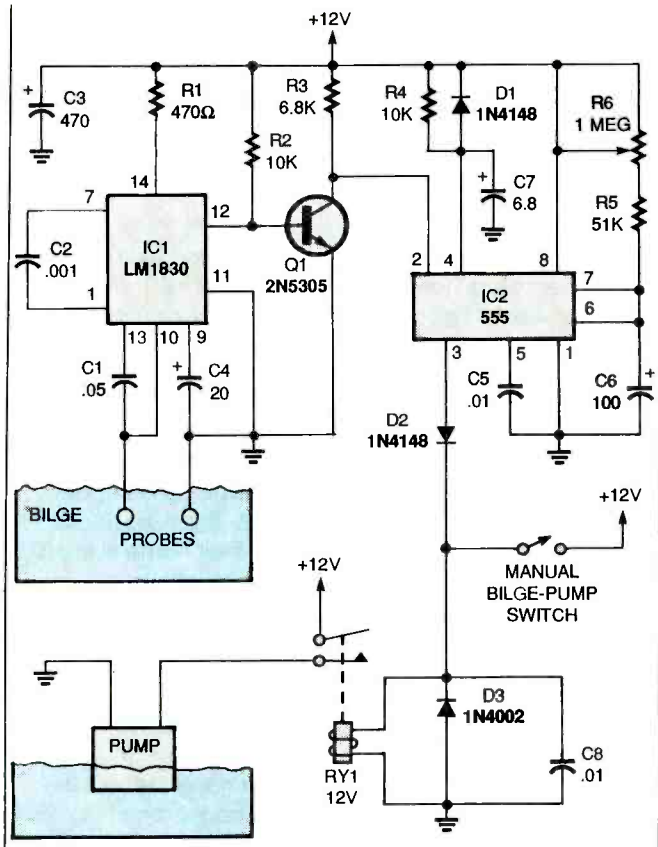

Fig. 3. Useful for chronic basement flooding or a boat bilge, this circuit detects the presence of water and activates a pump.

A few notes on the circuit's use: Mount the probes at about ⅓ the total height of bilge. The probes should be cleaned periodically. Although my circuit hasn't failed in eight years, I would advise the use of a manual bilge-pump switch as an alternate means for operating the pump. The circuit draws about 12 mA in stand-by mode.

The advantage of using the type of bilge-pump switch I've described here is that most bilge pumps use a float-type switch, which will cycle the pump on and off due to the sloshing action of the water in the bilge. My application will keep the pump on and eliminate the cycling of the pump. —

Dick Foster, Middleburg Heights, OH

Well, you're certainly using the right chips for the right job. Something worth considering is using the manual switch as a bypass for the relay contacts, instead of activating the relay with it. That way, if on a fluke the relay refuses to work properly, the manual switch can still save the day.

WIND VANE

I have a rather complete hobbyist machine shop as well as a pretty good electronics bench and so was able to come up with a digital weathervane. The tedious part of this project was building a suitable transducer that was weatherproof and could be mounted on the roof.

To make the weathervane, I needed a 360° variable resistance that could be controlled by a wind vane attached to the shaft of the resistance element. I solved that by etching a disk composed of 36 segments (like pie slices). All but one of the gaps between the slices is bridged by a 22,000-ohm resistor to form the stator of a giant variable resistor. The slices across the one unbridged gap are the clockwise and counter clockwise terminals. I made a housing of two 2-inch, PVC-pipe caps threaded into each other, installed bushings, a shaft (a threaded rod), a wiper, a moisture shield, etc. and mounted it on a ½-inch galvanized pipe that could easily be installed on my rooftop.

Now let's look at the circuit (see Fig. 4). There, IC1-a and IC1-b form an astable oscillator in which IC1-a produces a positive pulse-width proportional to the resistance of the segmented potentiometer, R1. The negative pulse width, determined by IC1-b, is fixed. The third section, IC1-c, is triggered by the falling edge of IC1-b. Its pulse width is set by potentiometer R7 so that it is exactly equal to the width of the IC1-a's pulse when the vane is at zero resistance. Potentiometer R8 and IC1-d make up the frequency-reference.

An astable oscillator formed out of IC1-d and its surrounding components provide a clock signal to IC2, a 555 timer IC. The reset pulse from IC1-c starts the count at zero, and the latch pulse from IC1-a freezes the instantaneous reading in the timer. So U2 counts for the time be-

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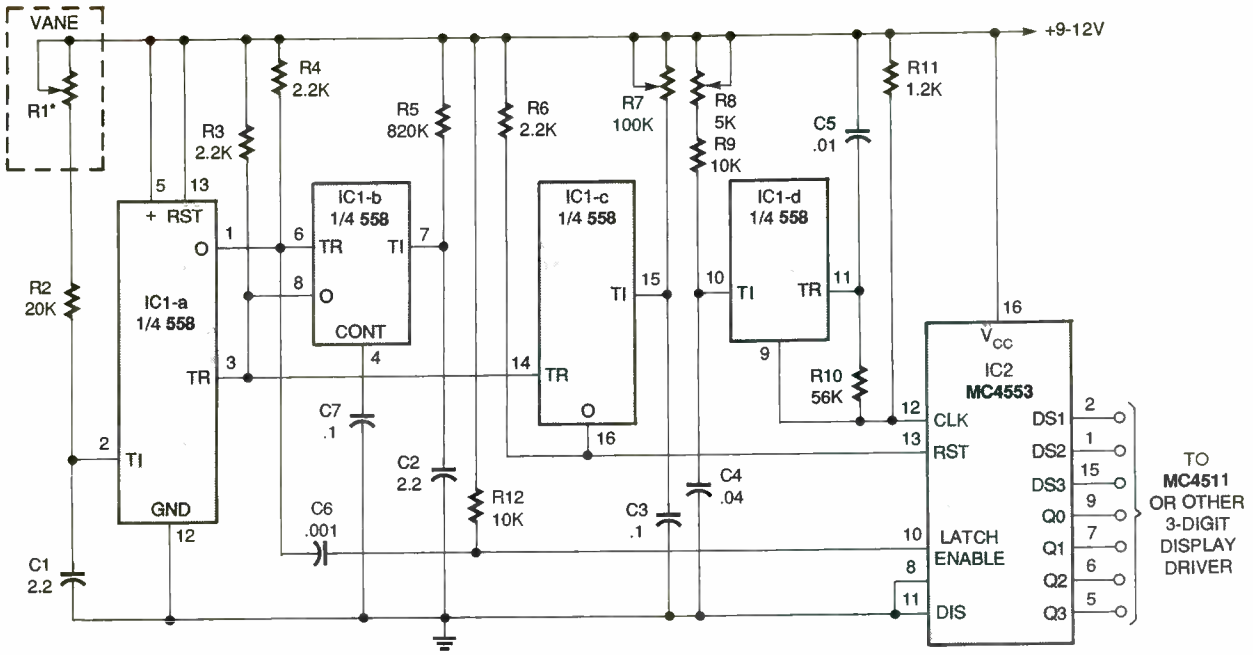


Fig. 4. The electronic weather vane relies on a home-brew transducer and a latching counter to display wind direction.

tween the falling edge of IC1-a and the falling edge of IC1-c, which is determined by the position of the vane. The timer can feed its digital output to the 3-digit display circuit of your choosing (such as an MC4511 display driver).

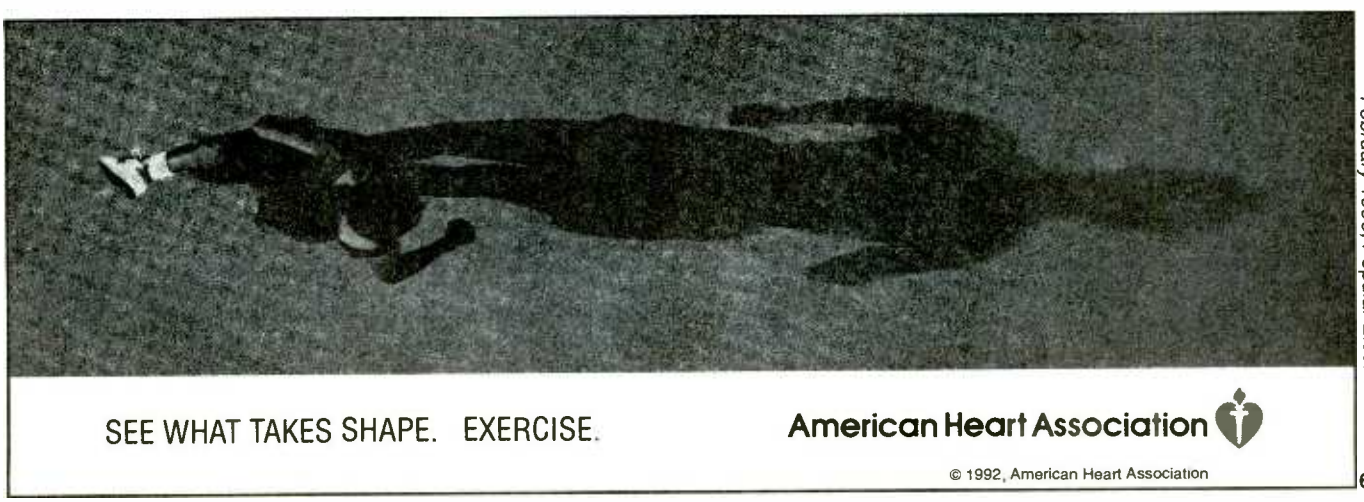
To adjust the circuit, rotate R1 (the transducer) to its zero-resistance position (North) and adjust R7 until the readout is zero. Second, rotate R1 to its maximum resistance position and adjust R8 until the readout is 350. That will give, theoretically, readings between zero and 350 in 10-degree increments as the vane is rotated.

Some people don't understand the concept of a digital readout in degrees magnetic because they are more familiar with N, S, E, W etc. But, I have found that once they understand that the wind direction is always given for the direction from which the wind is blowing and that there are 360° in a full circle, with 0° being N, 90° as E, 180° as S, and 270° as W, they accept it readily.

The circuit could be adapted to form an antenna rotator indicator. Or it can be used almost anywhere rotational motion or position is measured. — *Sidney E. Buck, Key Largo, FL*

That's a very interesting circuit. The concept behind your design could be used to test the output of RC receivers. The readout could display the degrees of rotation the receiver should move a servo when provided an RF signal.

That wraps up another month. Until next time, be sure to submit your work to *Think Tank*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. If you send in enough circuits, you could have a whole column dedicated to your work as well as a kit, an MCL1010, and a book. ■



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DX LISTENING

By Don Jensen

Watch your Intervals

The easiest way to identify a shortwave station, naturally, is to listen to the announcements, at least if the programs are in English. But it's not the only way. SWLs also can tell what they're tuning by noting their individual and unique tuning or "interval signals."

That brings us to a question from DX-Listening reader Robert Farley of Portsmouth, VA:

Cuba's Radio Rebelde, noted after 0100 UTC on 5,025 kHz, is a great source for hot Latin rhythms.

"When listening to the *RAI*, the Italian Radio and Television service broadcasting from Rome, I've noted bird chirping at the start of the transmission. Is that what is known as an interval signal?"

Yes, indeed, Rome has used a distinctive bird call IS for as long as I can recall.

Interval signals—abbreviated as IS by shortwave listeners—are unique identifiers. They could be a few bars of melody, horns, drumbeats, chimes, or electronic tones. One southern African station even uses a brief recorded segment of barnyard sounds, including cows mooing and roosters crowing, as its IS.

An interval signal can be heard before a station's sign on or preceding each scheduled transmission. It might be heard between programs at "station-break" times. Each broadcaster's IS is unique and can help you identify the station even when it is programming in an unknown language.

The *Voice of America*, for example, uses the musical signature, "Yankee Doodle" as its interval signal. South Africa's external service, *Channel Africa*, features the call of a native bird, the *Bokmakierie*, combined with a few bars of a folk melody played on the guitar.

Vatican Radio uses a segment of church melody, "Christus Vincit," played on the bell-like celeste, with orchestra. Also using a celeste IS, though the tune is an old Dutch folk song, is *Radio Nederland*.

Transmissions from *Radio Portugal* begin and end with a gong time signal and the national anthem, "A Portuguesa." And on the *British Broadcasting Corporation's* World Service you'll hear its famed Bow Bells IS before the start of programs each hour.

The list of shortwave interval signals is long and varied. Make note of them. They might help you identify a station when it's not broadcasting in English.

MORE MAIL

"I read an item in a European shortwave-club bulletin," writes a reader, "about a clandestine shortwave station that supposedly is run on coconut oil. Don't use my name, please. I don't want to seem gullible if this is just some sort of hoax."

I saw the same item, Ms. "A. Nonymous." It referred to the broadcasts of *Radio Free Bougainville*. As WW2-vintage ex-Marines know, Bougainville is a tropical Pacific isle, the scene of bloody fighting back in 1943. Now, more than a half-century later, again there's trouble in paradise.

For several years, the world's least-known civil war has been waged between separatist islanders and the government of Papua New Guinea, of which Bougainville is a remote part. The dissidents, indeed, have established their own makeshift clandestine shortwave station that broadcasts their views.

Radio Free Bougainville is on the air on 3,850 kHz around 0900 to 1100 UTC. Though feeble at best, its signal has been heard in the U.S. on a few rare occasions.

The rest of the story, though, I can't confirm. A French source reports that the SW transmitter is powered by a coconut-oil-fueled generator. Supposedly it takes the oil of 40 coconuts per hour of broadcasting. I'm even more dubious about the further claim that PNG sol-

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diers have executed four people caught harvesting coconuts for the station.

THE LAW AND YOU

Back in the chilliest days of the Cold War Era, some SWLs worried if they would get in trouble by monitoring and sending reception reports to Communist stations like Radio Moscow and Radio Peking. The answer, of course, was no. SWLing ordinary shortwave programming, no matter its country of origin was, and is, perfectly legal. But in this day of scanners and cordless telephones, the general issue of monitoring radio signals is a bit more complex.

Art Sanchez, Miami, FL, offers this tip: "A friend of mine belongs to one of the SWL clubs and showed me a copy of the ANARC Guide to U.S. Monitoring Laws written by Frank Terranella. Since I also have a scanner as well as a SW receiver, I found it interesting and helpful. Maybe others will also."

Good suggestion, Art. ANARC stands for the Association of North American Radio Clubs, the umbrella organization linking most of the major listening clubs in the United States and Canada. Terranella, ANARC's legal counsel, has written this 39-page guide through the Electronic Communications Privacy Act (ECPA) of 1986, which covers the legal aspects of monitoring and scanning.

It's available for $7.50 from ANARC, 2216 Burkey Drive, Wyomissing, PA 19610.

*CREDITS: Brian Alexander, PA; Skip Campisi, NJ; Bruce Conti, NH; Mark Humenyk, ONT; Marie Lamb, NY; William McGuire, MD; Denis Pasqual, PA; Ed Rausch, NJ; North American SW Association, 45 Wildflower Road, Levittown, PA 19057.

ON THE ROAD AGAIN

"I commute to work," writes B.C. Eckert, Fayetteville, NC, "about 50 minutes each way. As an avid SWL, I hate to waste this time. I'd prefer listening to, say, a BBC news broadcast rather than the same old 'same-old' on my AM car radio. I've tried using my SW portable but it doesn't bring in much in the car. Any suggestions?"

I think your answer is to install a converter, B.C. One manufacturer, MFJ Enterprises, has a neat little unit, the MFJ-306 World Band Mobile Shortwave Converter, for under $80. It's a small box, about the size of an index card and just an inch-and-a-half deep, that installs between your car radio and its antenna. It covers the popular SW bands, 49, 31, 25, and 19 meters, converting those signals for reception on the car radio's AM band.

You probably should not expect performance to equal your SW receiver at home. And because you're using your car radio's tuning, you might have to guess a bit at the SW frequencies. But a converter should provide decent reception of the major international broadcasters you want to hear as you drive to and from work. For more information, you can contact MFJ Enterprises, P.O. Box 494, Mississippi State, MS 39762, or call 601-323-5869.

Another alternative, if you are comfortable with a soldering iron, is to build the single-band converter described in "Build a Shortwave Converter for your Car" in the September 1995 issue of **Popular Electronics**.

Your suggestions and comments about SWLing are always welcome. The address is DX Listening, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735.

DOWN THE DIAL

February is usually a great month for DXing, particularly on the lower SW frequencies. Here are some targets to keep you tuning. Times are listed in 24-hour Universal Coordinated Time (UTC).

ALGERIA—15,160 kHz. *Radio Algiers International* is now heard on this frequency, in English, from 1800 to 1900, and 2000 to 2100 UTC.

AUSTRALIA—17,750 kHz. *Radio Australia* from Melbourne is on this frequency, and simulcast on three or four other channels, in English at 0300 UTC.

BOSNIA-HERCEGOVINA—7,108 kHz. *Radio Bosnia-Hercegovina* has been heard at 0200 UTC with a 5-pip time signal, station identification, and folk music.

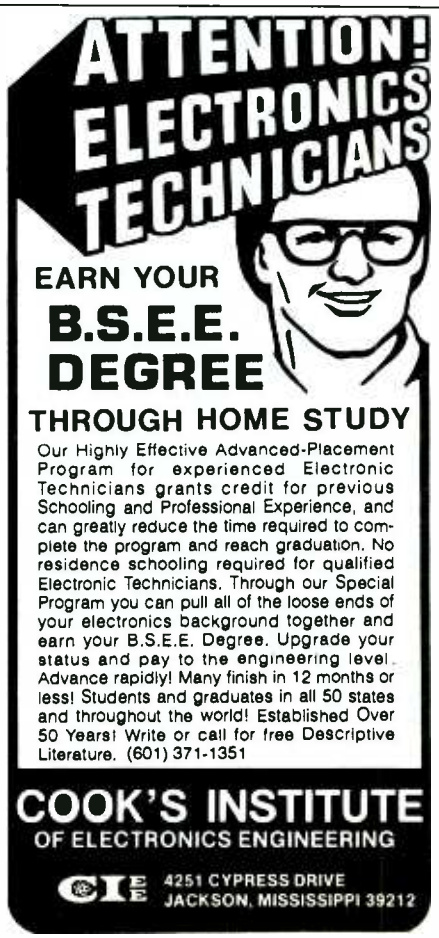
COLOMBIA—5,075 kHz. *CARACOL* Bogota has been noted around 0800 UTC with a late-night music program and taped Spanish announcements.

CUBA—5,025 kHz. *Radio Rebelde* noted after 0100 UTC with an excellent program of salsa music.

INDONESIA—9,535 kHz. *Radio Republik Indonesia*, broadcasting in Indonesian, is logged on this frequency at 1030 UTC with western popular music, then interval signal, identification, and the 1100-UTC news from the capital, Jakarta.

MOROCCO—17,595 kHz. *Radio Morocco's* English programming is audible on Sundays when Radio Cairo signs off at 1432 UTC.

YUGOSALVIA—11,870 kHz. *Radio Yugoslavia* from Belgrade airs an hour-long English program starting at 0400 UTC. ■



CIRCLE 179 ON FREE INFORMATION CARD

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By Joseph J. Carr, K4IPV

Some Ham-Radio Accessories

There are a number of devices that a ham can use to enhance his or her hobby, dress up the shack, or use in the workshop. Over the decades that I've been hamming, my shack and workshop have accumulated a lot of different things . . . some useful, some very useful, and some that make me wish I'd saved my money. This month, let's look at some ham accessories that I consider essential, or at least very useful.

An antenna-resistance bridge like this one can make it easier to check the performance of your antenna.

ANTENNA-RESISTANCE BRIDGE

Hams use antennas, and antennas sometimes need adjusting, troubleshooting, or fixing. There are a number of ways to adjust an antenna, but in the main, the resonant frequency is changed by changing the length of the radiating elements. And how do you know when the correct length is found? There are several different approaches, but the two main methods involve measuring the VSWR or feedpoint impedance (especially the resistive component of impedance). The VSWR approach is usually taken care of for most hams because most of us own at least one RF power meter or VSWR meter, even if it is only the one built into our rig.

The other approach is to measure the feedpoint impedance using a device known as an antenna-impedance meter or an antenna-resistance bridge. At resonance, most antennas offer a resistive impedance that will have a low value (*e.g.* 3 to 37 ohms for a vertical, or 75 ohms for a correctly installed dipole). On a dipole, for example, the impedance will vary from the minimum of 75 ohms at resonance, to several-thousand ohms at frequencies that are very removed from resonance.

If you use an antenna-resistance bridge you can find the resonant point by varying the frequency until the dip in resistance is found. Some models have a built-in signal generator. Others use a digital frequency readout, and a resistance readout. At least one new model graphs the VSWR over a 500-kHz range.

An antenna-resistance bridge can be used to find out a whole lot about an antenna that either doesn't work as intended when it is installed, or that has suddenly stopped working correctly (indicated perhaps by a sudden increase in VSWR).

ANTENNA COAXIAL SWITCH

Many hams use two or more antennas at their station; for example, a multiband trap vertical and either a horizontal dipole or some kind of directional beam antenna. Switching between them can be a problem if you have to stretch behind the rig and unscrew coaxial connectors one-by-one. In other cases, hams might connect an antenna to the rig to operate, and a 50-ohm dummy load to either test the rig, or to find the correct settings for an antenna-tuning unit. Again, the problem of switch-over presents itself.

Ordinary switches don't work well at radio frequencies, and most will not handle either the voltages or the power levels typically found in amateur-radio transmitters. A regular switch, even if it can withstand the power/voltage problem, will interrupt the impedance of the system causing a VSWR problem. The answer is to use a coaxial switch. Those switches are specially designed to withstand high power and voltage levels, and present as constant an impedance as possible to the rig. I own about five simple two-antenna switches, and one that is an eight-antenna model. Those switches are distributed e-

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Step attenuators have many applications including calibrating a receiver's S-meter, comparing two signal levels, or reducing the signal level to a receiver to prevent overload and a host of other ills.

tween my station and workshop. I need several antennas because I develop circuits, receivers, and test antennas for this column and my other writing . . . the switches make it a lot easier.

One use for an antenna switch is to make comparisons between antennas. Getting a handle on things like gain and directivity are difficult for the amateur, but it is quite easy to make comparisons by observing distant signals using both antennas. Switching between the two antennas will provide some measure of their relative effectiveness.

PRECISION STEP ATTENUATOR

An attenuator is a circuit or device that reduces the level of a signal by a certain amount. Proper attenuators for use in RF circuits have input and output impedances of 50 ohms (except for TV, in which case 75 ohms is the standard), and reduce the signal by a fixed, precise amount.

Attenuators can be used for quite a lot of different applications. For example, calibrating a receiver's S-meter; comparing two signal levels; or reducing the signal level to a receiver to prevent overload, intermodulation distortion, or a host of other ills.

They can also be used to provide precision levels from relatively cheap signal generators. Normally, such generators are roughly calibrated, at best. But if you know the signal level at some standard output-level setting, then you can reduce that level with precision using a step attenuator.

If you work on AC-powered circuits, an isolation transformer like this one is a necessary accessory for your workbench.

One step attenuator that I am familiar with uses eight different attenuator stages, each of which can be either in or out of the circuit, depending on the switch setting. The ranges of that particular attenuator are: 1, 2, 3, 5, 10, and 20 dB (three 20 dB stages are provided); that's more than 80 dB of attenuation with a 1-dB minimum step.

Note: in RF circuits it is common to use the power level to represent signal levels. The unit is the dBm, which is power dB (10 LOG (P1/P2)), relative to 1 milliwatt dissipated in a 50-ohm load. If you know the dBm level at the input of the attenuator, then it is relatively easy to calculate the output level in dBm. But to find the dBm level at the input you might have to measure the voltage level with an RF voltmeter or an oscilloscope.

Most low-cost meters/scopes will measure the peak or peak-to-peak value of the voltage, but to calculate the power level you need the rms value. Divide the peak value by 1.414, or the peak-to-peak by 2.828, in order to find the rms voltage. The power level in milliwatts (mW) is found from $V^2/50$, when V is in millivolts, or (V^2 × 1000)/50 when V is in volts. If you can only measure the voltage, then the signal level in dBm is found from either:

$$dBm = 10 \log ((V^2/50)/0.001)$$

when V is in volts, or:

$$dBm = 10 \log (V/50)$$

ISOLATION TRANSFORMER

In my opinion, an isolation transformer is one of the most necessary accessories on a ham or any other electronics workbench. Safety is an essential issue when working on electronics circuits. The 117-volt AC power line can be a real killer! And some hams also use 220 VAC for high-power linear amplifiers, and that is even deadlier. On my workbench I always use an isolation transformer for the greatest possible safety.

The reason for that is that the power system in this country is grounded. That is, the power transformer feeding your house has a center-tapped secondary that is grounded, and two hot lines carrying 117-volts each (out of phase with each other), which is distributed to the circuits in your house. If you accidentally touch one of those 117-volt hot lines while grounded, you will complete a circuit and the result will be a serious, and potentially lethal, shock.

That's where an isolation transformer comes in. That unit is a 1:1 ratio transformer for 117 VAC-to-117 VAC conversions, and 2:1 for 220 VAC-to-117 VAC conversions. The isolation transformer lifts the ground connection, making a "floating" electrical system for the workbench. Instead of a hot wire and a neutral, the 117 VAC is obtained from a pair of floating lines from the unit's 117-VAC secondary. That is a much safer set up.

That's all for this month. I can be contacted at P.O. Box 1099, Falls Church, VA, 22041, or by e-mail at carrjj@aol.com. The e-mail address is new, and readers are encouraged to use it for suggestions, questions, comments, and criticisms. I will endeavor to answer questions, but please keep them reasonable! ■

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SCANNER SCENE

By Marc Saxon

Disaster Scanning

Scanners keep getting better looking with each new model, and *Radio Shack's PRO-2040* desktop is an eye-catching example. Forget about decorative styling to fit unobtrusively into your room—this one has the macho look that the gutsy PRO-2040 deserves.

Radio Shack's PRO-2040 is more than just another pretty face—the versatile desktop scanner offers 100 memory channels, two scanning speeds, and three search speeds.

The PRO-2040 gives you 100 memory channels set up in 10 bands of 10 channels each. An additional 10 monitor memories allow you to temporarily store worthwhile frequencies discovered during band searches. Frequency coverage is 29–54 MHz, 137–174 MHz, 406–512 MHz, 806–956 MHz, and the 108–136-MHz aeronautics band. The cellular bands are permanently locked out and cannot be restored internally. There is a direct-access key to the NOAA weather band.

This unit has several versatile features, such as allowing the user to select from two scanning speeds, either 12 channels per second or 73 channels per second. There are no less than three selectable search speeds—50 channels per second, 100 channels per second, and (in 5-kHz steps) 300 channels per second. A data-skip feature allows the unit to ignore data signals (such as pager tones) during searches. You can even select up to 50 specific channels for the scanner to skip during a search so that you can avoid unwanted frequencies.

The IF frequencies are 10.8 MHz and 450 MHz. Selectivity at −6 dB is ±11 kHz, and at −50 dB it is ±15 kHz. Sensitivity is rated at 0.5 μV below 54 MHz and between 406 and 512 MHz; it's rated at 0.7 μV from 137 to 174 MHz, and 1.0 μV above 806 MHz.

Power requirements are 117 VAC. The stored channels will remain in the scanner's memory for up to three days during a power loss.

Take a look at the PRO-2040 at your local Radio Shack store. It's a rather interesting new addition to the scanner market.

DOOMSDAY SCANNING

Sophisticated and extensive contingency arrangements exist for the emergency operation of our government in the event of certain disasters or crises that make it risky, unsafe, or somehow impossible to conduct the government from existing facilities. You might imagine that enemy attack, or the imminent threat of one, could temporarily create such a situation. So could natural disasters, as well as some other major events.

At such times, your scanner would be humming with a myriad of communications. Let's hope that never happens. But, remember, those systems and the staffs that operate them must be maintained at a level of instant readiness. That means that the communications associated with those systems can be monitored at almost any time, and numerous active frequencies have been reported by scanner owners. They're worthy of keeping on tap.

The Federal Emergency Management Agency (FEMA) plays an important role in the government's contingency-operations planning. The agency has dozens of frequencies, but nationally, the following seem to be among the more important ones in the VHF-FM range: 138.225, 141.725, 166.225, 168.35, 169.60, 169.875, and 170.20 MHz.

The National Emergency Airborne Command Post (NEACP) is an E-4B aircraft outfitted as a "Doomsday Plane." At a time of threat

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or attack, the craft can serve as a flying headquarters for governmental and military leaders. There are extensive communication facilities aboard.

The NEACP facility most often reported by scanner owners has been the one classified as *Nightwatch*. It is a duplex air/ground link that sometimes uses WFM mode. Much of the traffic has been sent in clear voice, although data transmissions have been noted as well. It has also been monitored with wide-band (±50-kHz) Frequency Division Multiplex containing AM, LSB, and USB voice traffic.

The downlink frequencies for NEACP's *Nightwatch* are: 246.95, 305.55, 322.75, 326.0, 336.8, 345.5, 366.0, 382.35, 390.0, and 397.05 MHz. Several different VIP ("SAM") military aircraft, as well as FEMA stations, have been reported, in addition to Air Force One.

The Joint Emergency Evacuation Plan (JEEP) is a FEMA operation. Under that plan, in the event of an emergency, threat, or attack, certain government and military personnel would be evacuated by helicopter from Washington, D.C. to support sites in Maryland, Virginia, and Pennsylvania that have been reserved for that purpose.

JEEP's primary frequency is 293.5 MHz, while the secondary is 287.6 MHz; 268.0 MHz is also used. JEEP's code name is "Wheelhouse."

By the way, FEMA's Urban Search and Rescue Task Force Teams operate in several dozen cities coast-to-coast. They swing into action in the aftermath of hurricanes, earthquakes, tornadoes, floods, and other major disasters. Although they work in conjunction with local and state agencies, the teams have their own special frequencies. Among them are 163.10, 164.8625, 165.6625, 168.35, 408.40, 408.5125, 409.4875, 410.4875, 410.5125, 413.2125, 416.0375, 416.8125, 416.9375, 417.5875, 417.6625, 418.05, 418.075, and 418.575 MHz.

WHITHER 220 MHZ?

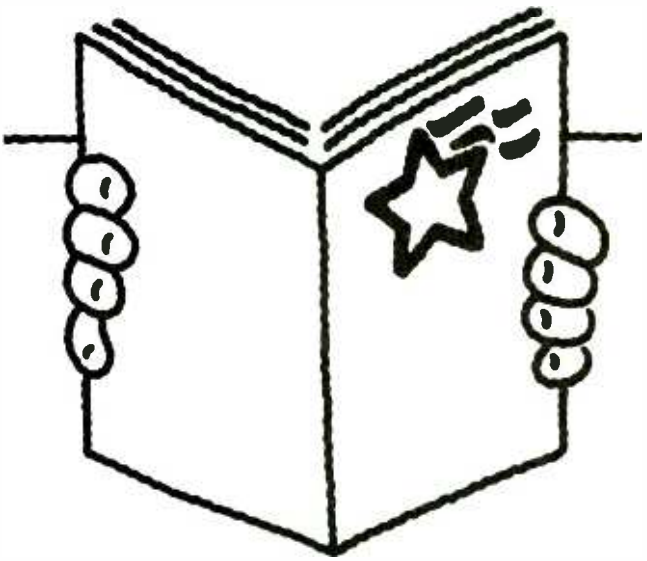
A few years ago, the FCC accused the ham radio service of underusing its 220- to 225-MHz frequency band. That resulted in the 220- to 222-MHz portion of the ham band being reallocated for other uses so that the chunk of spectrum could attain increased usage. It was a hollow gesture. Today, if you scan from 220 to 222 MHz, you will notice that those frequencies are very quiet. The FCC recently has been working overtime to pump life into them. That's good news for scanner owners.

The FCC foresees the band as primarily used for public-safety radio, emergency medical services, and subscriber-based services such as paging and dispatching.

JOIN IN

For those of you who continue to request the names of worthwhile scanner organizations, here are two whose monthly membership publications brim over with news and frequencies. The Radio Communications Monitoring Association, Inc. can be reached at P. O. Box 542, Silverado, CA 92676. A one-year membership is $24 ($30 in Canada). A one-year subscription to "The Radio Monitors Newsletter of Maryland" (P. O. Box 394, Hampstead, MD 21074-0394) costs $15. A sample issue is $1. ■

This could be a best seller.



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ANTIQUE RADIO

(Continued from page 64)

make good electrical contact.

Those cleaning and polishing activities might seem quite simplistic to you. And, indeed, they're hardly rocket science. Yet one can't underestimate the importance of housekeeping when dealing with antique parts and/or sets. A very large percentage of problems with simple battery sets of that kind comes from poor electrical contact caused by loose and dirty connections.

As long as I had the tuning capacitor and filament rheostat off of the front panel, I also removed the last remaining control (the regeneration control) and unscrewed the panel from the baseboard. I'd been dissatisfied with the appearance of that panel, which had been simply treated with varnish stain. Now I could go ahead and spray it with gloss enamel as originally planned.

After receiving several coats, the panel's appearance resembled that of the Bakelite or hard rubber material that would probably have been originally used. I like it much better now.

FINAL PARTS ASSEMBLY

Reinstalling the front panel and front-panel controls, I arranged the baseboard-mounted components pretty much as shown in the original ARRL photograph (see October 1995 issue) and fastened them in place with wood screws. The coil assembly was screwed down using a pair of hardware-store angle irons attached to the coil form with machine screws and nuts.

The nine Fahnestock clips required for connections to antenna, ground, power, and headset were screwed down along the rear edge of the baseboard as specified in the original construction article (see Fig. 2). Note that pairs of clips that connect to the same circuit point (i.e. Ground and A-, A+ and B-, +B90 and phones) are mounted back-to-back under the same screw.

That's about all of the work I had time for this month, but the set is now ready to wire up and test. Hopefully, I'll be able to report on that next time.

Until then, I'd enjoy hearing from *you*. Send your comments and questions to me c/o *Antique Radio*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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Internal Revenue Service

A public service message

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CIRCUIT CIRCUS

(Continued from page 28)

bone's output level is set by R4.

A slide handle made of plastic or wood should be attached to the slider of R3, and the complete circuit enclosed in a small plastic cabinet with the three pushbutton switches, S1–S3, mounted in a convenient location for playing. The actual arrangement is up to you, but if you use your imagination, you could create a masterpiece.

Making irritating noise with the electronic trombone is easy. Just press one or more of the tone-control switches, S1–S3, and work the slide.

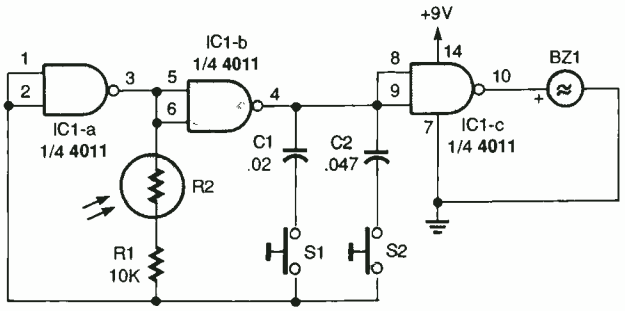

Fig. 6. Point the photocell, R2, at a light source and this circuit will produce a tone; wave it around, and it will produce a melody.

Fig. 6, is easy to use: Just aim the wand at a light source and listen to the tone; move it around and you could create a melody.

Two gates, IC1-a and IC1-b, of a quad two-input NAND gate are connected in a audio-oscillator circuit with R1; the photocell, R2; C1; and C2 setting the tone frequency. A third gate of IC1, IC1-c, acts as a buffer to the oscillator and a driver for a small piezo speaker, BZ1. When the photocell is aimed at a light source, its resistance drops and the oscillator's output tone increases in frequency. When either of tone switches S1 or S2 is pressed, the frequency range goes up. Pressing S2 shifts the oscillator into its highest frequency range. Only one tone switch may be pressed at a time; if both switches are pressed simultaneously, the output stops.

Building the magic wand is an easy evening project. The complete circuit, with the exception of the photocell, could be built on perfboard and housed in a small plastic case. A 3- to 5-inch length of opaque plastic tubing, just large enough in diameter for the photocell to slide in, will serve as the wand. Place the photocell in one end of the tube, facing out the full length of the tube. Make the back of the tube light proof and seal it with silicon rubber.

Looks like that's enough racket for one visit. Happy New Years to one and all. ■

PARTS LIST FOR THE ELECTRONIC TROMBONE (Fig. 5)

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—10,000-ohm
R2—2200-ohm
R3—100,000-ohm, slide potentiometer
R4—2500-ohm, potentiometer

CAPACITORS

C1—0.02-μF, Mylar or similar
C2—0.05-μF, Mylar or similar
C3, C4—0.1-μF, Mylar or similar
C5, C6—100-μF, 35-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

IC1—4011 quad NAND gate, integrated circuit
IC2—386 audio power amp, integrated circuit
S1–S3—SPST normally-open pushbutton switch
S4—SPST toggle switch
SPKR1—8-ohm speaker
Perfboard, case, handle for R3 slider (see text), wire, solder, etc.

PARTS LIST FOR THE MAGIC WAND (Fig. 6)

IC1—4011 quad NAND gate, integrated circuit
R1—10,000-ohm, ¼-watt, 5% resistor
R2—Photoconductive cell, Mouser #338-54C679 or similar
C1—0.02-μF, Mylar or similar capacitor
C2—0.047-μF, Mylar or similar capacitor
S1, S2—SPST normally closed pushbutton switch
BZ1—Small piezo speaker
Perfboard, plastic tubing, case, wire, solder, hardware, etc.

A MAGIC WAND

Our next noise producer is a light-activated magic wand. The circuit, shown in

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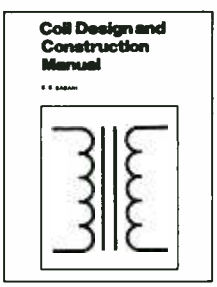

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DC VOLT PROBE

(Continued from page 34)

While the arrangement of components on perfboard is not critical, a few common-sense guidelines should be followed. For example, begin assembly on your board by mounting the 11 LEDs. You can use the drawing of the prototype shown in Fig. 2 to get an idea of how those should be arranged. Next mount switches S1 and S2 flush to the edge and centered on the board, spaced about a half-inch apart.

Before going any further with circuit-board assembly, drill clearance holes for the switches and LEDs. Drill ⅛-inch holes for the latter, so that you can accommodate the T1 LED cases. Once you're sure the switches and LEDs match up with their drilled holes, you can go on with assembly.

Install sockets for IC1 and IC2 on the board. Then mount the resistors and capacitors, fitting the board occasionally into the case to check for clearance. In the author's prototype, R2, the 40-megohm resistor, was assembled from four 10-megohm resistors connected in series. Also, for R3, the 50-megohm resistor, the author used five 10-megohm resistors connected in series. You might want to cover them with heat-shrink tubing before installing them onto the board, just in case one of the leads causes a short with another component.

Attach a short lead to the circuit for the "touch-plate" connection indicated in Fig. 1. Drop a 0.1-inch-diameter × ¼-inch-long compression spring on the lead, and solder the joint.

Notice that the rear side of the Kelvin case has a depression in it. That's where you will install the touch plate. But first, drill a clearance hole in that depression so that the compression-spring lead protrudes through when the halves are assembled. Then cut a ¾- × 3¾-inch piece of aluminum "flashing" with shears and use silicone sealant to affix it in the depression. The touch plate must cover the spring hole.

Next, install the N-type battery holder in the front half of the case near the probe tip. Mount power-switch S3 at the rear of the case with its leads running at the side up to the battery holder. Install the ICs in their sockets,

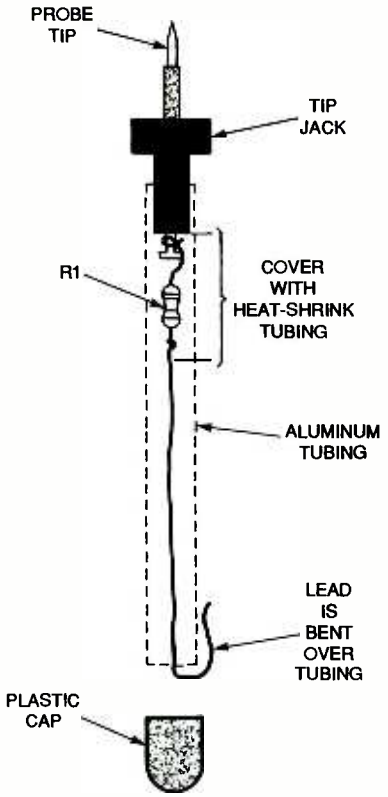

Fig. 3. This is how the passive probe is assembled. Note that the wire lead is bent over the end of the tube and covered with a plastic cap to establish an electrical connection.

connect the power leads and a lead to the probe tip, and install the batteries. Turn on the power and adjust potentiometer R9 for a reading of 1.0 volt at pin 6 of IC2 (use a DMM to determine that). Finally, mount the board and secure it.

With the active probe complete, you can begin assembling the passive probe. Solder one end of R1, the 10-megohm resistor, to an insulated "tip" jack (see Fig. 3) and extend the other lead with a 5-inch length of 24-gauge wire. Cover the joints and R1 with heat-shrink tubing, then slide the assembly into a 5-inch length of thin-wall, ¼-inch-diameter, aluminum tubing. Press the jack into the end of the tube; you might have to sand down the threads on the jack for a nice fit.

Next, wrap the protruding lead from R1 around the end of the tube and secure it with a plastic cap. Make a probe tip from 0.08-inch (2-mm) diameter steel (a nail will work) and insert it into the jack. That completes your passive probe.

Checkout and Use. Turn on the power and LED1, the zero-volt indicator, should light up. Grasp the active probe so that your fingers rest on the touch plate, and grasp the passive probe with your other hand. Apply the probe tips to a 1.5-volt cell and note that LED1 and LED2 are lit. Pushing in S1 will give you a negative tip polarity. If you find the unit doesn't work as described, double-check your wiring.

Apply the probes to a 9-volt battery and note the sequential lighting of the display until LED1 through LED10 are lit. Then push in S2 for a × 10 scale, apply the probes to two series-connected, 9-volt batteries, and note that LED1, LED2, and possibly LED3 are lit. Over-voltage will not harm either scale, but please heed the warnings already given! ■

SUPER SURPLUS SOURCES

(Continued from page 52)

U.S. Army Military History Institute: Technical manuals for obsolete military radio equipment could be obtained from the U.S. Army Military History Institute. In some cases, if duplicates are on hand, you can photocopy manuals or borrow them.

Universal Radio, Inc.: The firm publishes a 100+ page communications catalog that features about a dozen books that offer guidance on classic radio repair and restoration, radio collectibles, servicing, and related topics. The catalog is free.

W7FG Vintage Manuals: W7FG provides manuals and also offers repair and restoration work for most vintage to present-day radio gear. A list is available for an SASE.

Western Nebraska Electronics: This firm reportedly offers a complete collection of Collins manuals as well as a good selection of parts for Collins communications equipment.

Conclusion. Radio, electronic, and computer surplus—who says you can't find it in the 1990s? As we've seen, there are a number of sources out there for both surplus and the documentation that goes with it. We hope that this guide to available surplus helps you out in your search for the right part or piece of equipment. Good bargain hunting! ■

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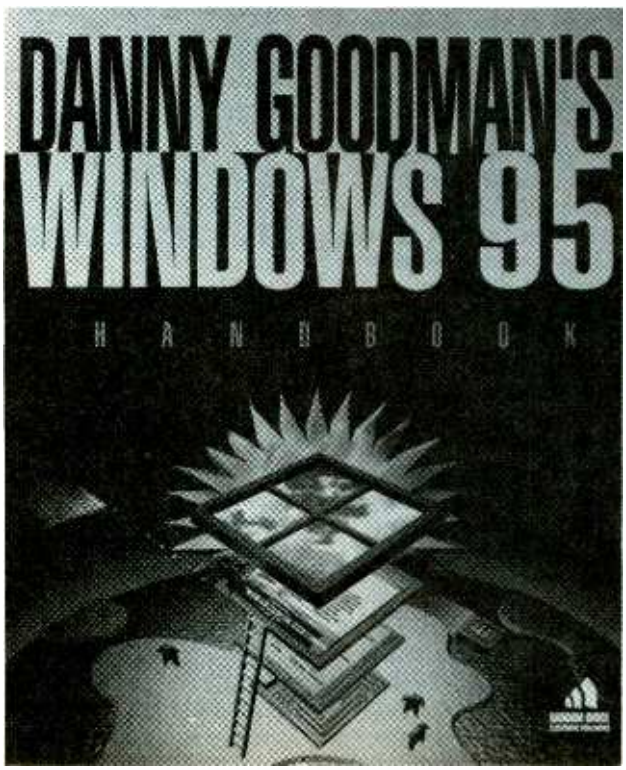
ELECTRONICS LIBRARY

Danny Goodman's Windows 95 Handbook

by Danny Goodman



Designed to be as colorful and appealing as Windows 95 itself, this book features four-color, two-page spreads that are accessible and easy to navigate. Each spread includes a Windows 95-like menu bar that shows the section, chapter, and page number; and color-coded information that separately addresses the concerns of new, average, and advanced users. Within the text, cross references set in bold face to resemble hypertext link topics through the book. Illustrations and screen shots show how Windows 95 actually looks, and icons and mini-screens provide detailed close-ups of screen elements. Highlighted words help users quickly locate the information they need.

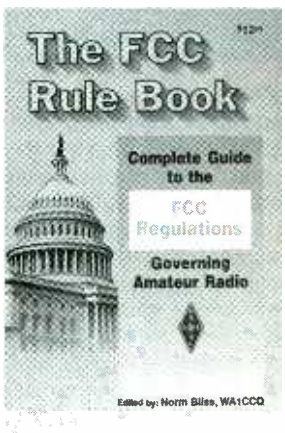
The book is divided into four color-coded sections: Hardware, Software, Troubleshooting, and Glossary/Index. All aspects of using Windows 95 are covered, including installation and setup, file management with the Desktop and Windows Explorer, optimizing memory and hard-disk space, using shortcuts to access frequently used documents, installing hardware and software easily using Wizards, and using and mixing applications efficiently. The glossary and index are combined to help users find fast answers to their questions.

Danny Goodman's Windows 95 Handbook costs $30 and is published by Random House Electronic Publishing, division of Random House, Inc., 201 East 50th Street, New York, NY 10022; Tel. 410-848-1900, ext. 3000; on CompuServe: GO RANDOM.

CIRCLE 101 ON FREE INFORMATION CARD

THE FCC RULE BOOK Complete Guide to the FCC Regulations Governing Amateur Radio

edited by Norm Bliss, WA1CCQ



The 10th Edition of this handy reference has been revised and updated to include all of the exciting changes in Amateur Radio rules and regulations. It covers changes in licensing, describing the six separate classes of Amateur Radio licenses now available—Technician Plus is now a separate class—and providing all the details you need on the first new Club Station licenses to be issued since 1979. The book also explains how you can begin operating with your new privileges as soon as they are granted by the FCC, *before* you receive your actual license in the mail. Other new rules include "vanity call signs," allowing hams to request their own call signs; and the approval of automatic digital operation in certain parts of the HF bands.

As in previous editions, this book contains the complete text of the rules and regulations, along with easy-to-understand explanations of Part 97. Appendices have also been expanded with the addition of more original material, and now include the FCC's Internet addresses as well as fax and BBS numbers.

The FCC Rule Book, 10th Edition costs $12 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111; Tel. 203-666-1541; Fax: 203-665-7531.

CIRCLE 102 ON FREE INFORMATION CARD

C AND UNIX: Tools for Software Design

by Marten L. Barrett and Clifford H. Wagner

This book shows readers how to combine the efficiency of C with the productivity of UNIX to create more powerful computer programs. It is written for experienced programmers, as well as those with a background in mathematics, engineering, and science.

The book introduces five principles to guide readers through a complete course in programming. First, an emphasis on

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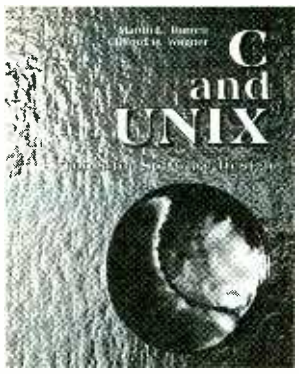

software design via program and data structure design, the design of tables, data encapsulation, and the use of abstract data types solidifies all aspects of the design process. Second, the development of C and UNIX simultaneously, yet independently of one another, allows designers to develop skills in both languages, or focus on them individually. Chapter summaries, review problems, and many practical programming problems allow readers to tie several different concepts together in a coherent scheme. A focus on basic principles provides the groundwork for understanding data structures, analysis of algorithms, numerical analysis, computer graphics, and compiler design.

Finally, extensive examples covering scientific problems, applied mathematics, and floating-point arithmetic broaden the spectrum of computer science and programming. Problems feature the ideal gas law, the accuracy of summations, root finding, the future value of an annuity, simulation, time series smoothing, image processing, integrals, descriptive statistics, fuzzy sets, and sparse arrays.

C and UNIX: Tools for Software Design costs $46.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-CALL-WILEY.

CIRCLE 103 ON FREE INFORMATION CARD

ELECTRONIC TESTING AND PROTOTYPING EQUIPMENT CATALOG

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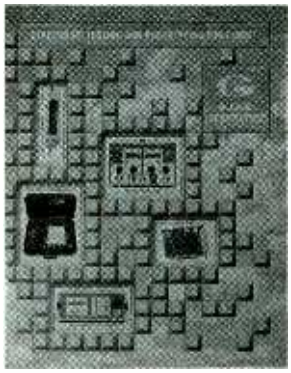

The Electronic Testing and Prototyping Equipment Catalog is free upon request from Global Specialties, 70 Fulton Terrace, New Haven, CT 06512; Tel. 800-572-1028; Fax: 203-468-0060.

CIRCLE 104 ON FREE INFORMATION CARD

NET TECH: Your Guide to Tech Support, Product News, and Software Resources on the Info Highway

by Kelly Maloni, Ben Greenman, and Jeff Hearn

As you might expect, the biggest topic of interest on the Internet is computers, and this book maps the wealth of online computer information and support resources. It helps you find the right online technical staff to solve your problems. It puts you in touch with fellow brand-name users. It helps you find people who can solve your "unsolvable" computer problems. And it directs you to valuable, free software resources. More than 3500 computer-related Web sites, chat areas, and software and file archives, are listed and described.

Net Tech shows readers how to find computer magazines, industry gossip, product introductions, help forums, and the latest software, online. It covers Windows 95, multimedia, shopping, and more. It helps readers avoid waiting on hold for telephone help by pointing the way to online support for virtually every PC, modem, printer, and software manufacturer.

Readers seeking specific information can look for it in the book's index, where every subject and site in the book is listed alphabetically. Otherwise, they can browse through the book's six sections. "Booting Up" is a collection of cross-platform sites, from online computer primers to online computer stores. "The Big Two" lists and describes hundreds of sites with resources for Apple and IBM hardware and software, while "The Rest of the Field" covers other platforms and operating systems. "A Small Matter" is devoted to online resources for microcomputers: portables, PDAs, palmtops, and calculators. A variety of applications, including word processors, spreadsheets, and desktop publishing, are covered in "PC Power." "Creativity in Cyberspace" includes sections on graphics, sound, multimedia, and hypermedia. "The Cutting Edge" highlights the latest news in computing, and "Getting Wired" offers the basics of Internet connection and navigation. Every entry includes a name, description, and address, with updates available instantly online.

Net Tech costs $19 and is co-published by Michael Wolff & Company, Inc., 1633 Broadway, 27th Floor, New York, NY 10019, Tel. 212-841-1572, e-mail: editors@ypn.com; and Random House Electronic Publishing, a division of Random House, Inc., 201 East 50th Street, New York, NY 10022, Tel. 800-793-BOOK.

CIRCLE 105 ON FREE INFORMATION CARD

OPERATIONAL AMPLIFIER CIRCUITS: Analysis and Design

by John C.C. Nelson

This book provides the nonspecialist with the tools needed to make use of readily available, integrated-circuit operational amplifiers for a broad range of applications. The widespread availability of op-amps in the form of low-cost ICs makes possible a modular approach to analog electronic circuit design. In many cases, a single op-amp, in conjunction with a small number of passive components, might be all that is required to perform a particular function. Interconnection of several such subsystems allows the required configuration to be assembled with a minimum of design effort.

Because the book uses a simple, consistent notation throughout its pages, the only background required is that of basic circuit analysis. A range of computer programs illustrate the text, providing rapid determination of component values and assistance in designing circuits for practical applications.

Operational Amplifier Circuits: Analysis and Design costs $22.95 and is published by Butterworth-Heinemann, 313 Washington Street, Newton, MA 02158-1626; Tel. 617-928-2500; Fax: 617-933-6333. ■

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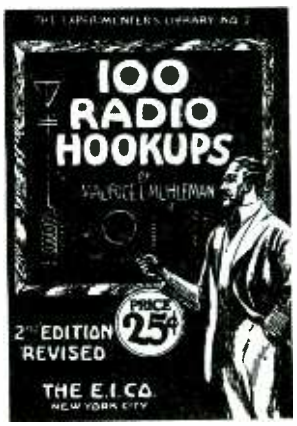

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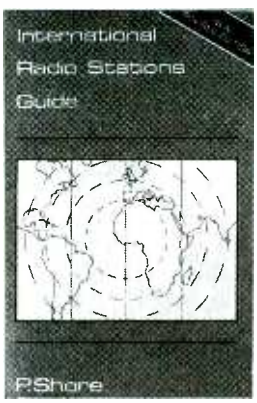

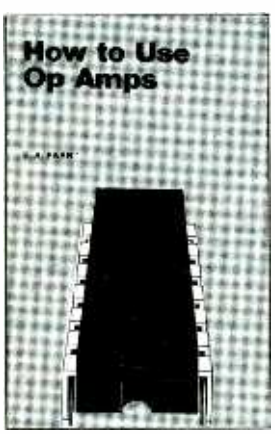

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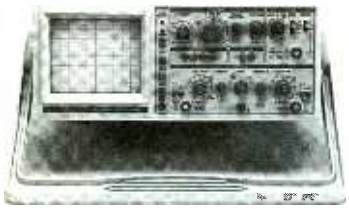

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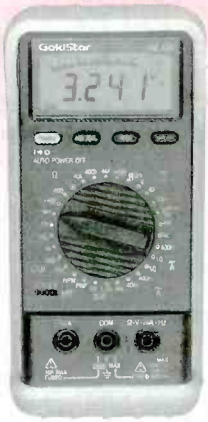

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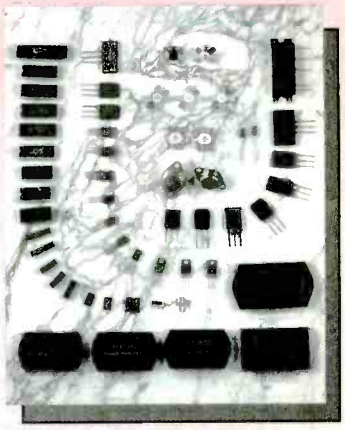

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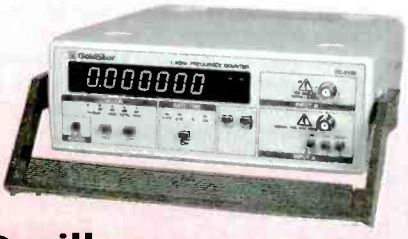

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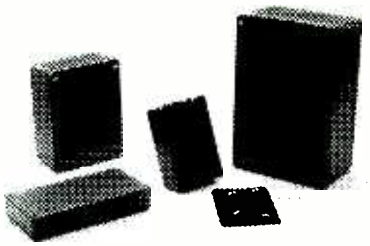

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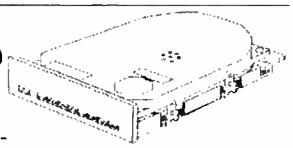

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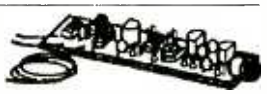

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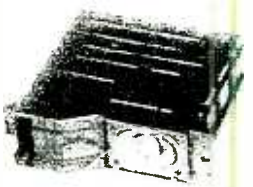

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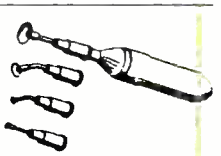

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Clever infrared sensors system lets this robot wander around & avoids objects - even solve mazes! Dual motors, rubber tires, preassembled gears & circuit board. *No Soldering Required!* Three AA NiCads INCLUDED!

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Classic robot design escapes mazes using the "Left Hand Rule". Two motors & sensing switch guide it along walls and around corners. Preassembled gear box, plastic base & body. *No Soldering Required!* One C NiCad INCLUDED!

Mobile Robots Brains & Brawn Kit #3-148 $489.00
Serious research robot platform from MIT. Develop programs in C or assembly. Includes 68HC11 CPU, memory, sensors, wheels, motors, chassis, software. Companion to Mobile Robots book (3-098). *NOTE: Indicate PC or Mac Interface.*

Accessory Kits!

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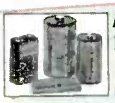

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High quality nickel-cadmium cells replace *hundreds* of disposables! Save money! reduce waste! Keep your robots rolling!

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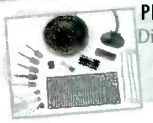

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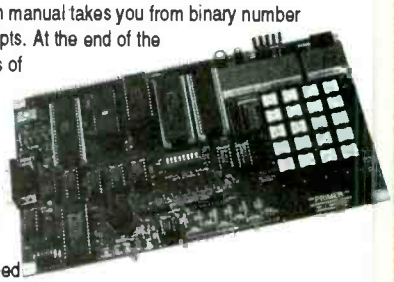

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- Fully assembled not a kit
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- Cascadeable for more time

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Great for Fox-hunting, tracking, wireless modems, etc...

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- Scramble/bypass feature
- 1/2 watt audio amplifier
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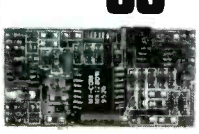

MICRO-3 $129.95

Same features as Micro-1.4 but available in 2 & 3 minute versions

PLUS -

- Small size 1.910" x 2.272"
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- Variable line level audio output
- External trip pins for first 8 messages in memory
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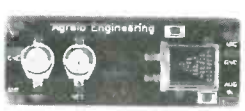
MANY MORE FEATURES



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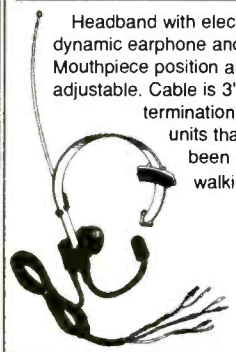


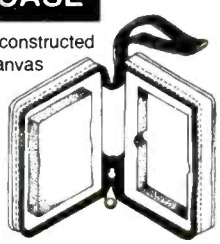
Headband with electret microphone, dynamic earphone and antenna. Mouthpiece position and headband are adjustable. Cable is 3' long with 6 wire termination. These are new units that appear to have been removed from walkie-talkie radios.

CAT# PHN-8

$5.00 each

10 for $45.00

CANVAS CASE



Good-looking, well constructed 7.5" X 6" X 1.95" canvas carrying case with zipper on three sides. Webbed nylon hand strap and ample foam padding inside. Probably designed for transporting memory storage media. The black foam padding inside can easily be reconfigured to accommodate photographic, audio or video components. The removal of one large chunk of foam gives you a well padded interior volume of 5.9" x 4.3" x 0.75". All black with red and white embroidered "K-stor" (tm) logo on front.

$3.75 each

CAT# CSE-3

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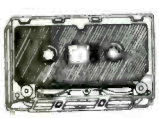
C-30 AUDIO CASSETTE



Brand-new, good-quality 30 minute (15 min. per side) audio cassettes. Excellent for demos or instruction tapes. Manufactured without record-prevent knockout tabs, so the indentations must be taped over before use.

CAT # C-30

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

CAT# S12-3

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case of 10 - $120.00

HEAVY DUTY HEAT SINK

Black anodized aluminum heatsink for heavy-duty heat dissipation. 15 cooling fins. Three threaded brass inserts embedded in ends of heatsink to facilitate mounting. 10.75" X 4.82" X 1.43".

CAT# HS-18

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MINIATURE BLACK & WHITE CAMERA w/ AUDIO

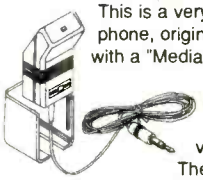
High-resolution, ultra-compact pc board CCD camera. 1.58" X 1.79" X 0.84".

Equipped with pinhole lens which can view objects from 2" to infinity in extremely low light (.5 Lux @ F 1.6). Infrared sensitive - works in total darkness with an infrared light source. Auto-iris for automatic light compensation. Includes electret mike, audio board and 20" audio output cable with RCA plug. 18" shielded cable with RCA plug for video output. 20" cable with co-ax DC power plug (2.1mm center positive) 12vdc @ 150 ma. operation.

CAT# VC-200PA

$169.00 each

MULTI-MEDIA ELECTRET MIKE & HOLDER



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

CAT# MIKE-25

$3.50 each

LARGE QUANTITY AVAILABLE!

9 FOOT DUAL AUDIO CABLE

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

$1.00 each

CAT# DCB-108

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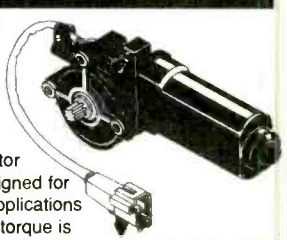
12 Vdc GEAR MOTOR



Denso Brand 40 RPM @ 12.6 Vdc @ 600 ma. (no load). Right-angle drive gearhead motor originally designed for automotive applications where lots of torque is required. 6.68" long X 3.5" X 1.62" thick. Three mounting holes on 1.9" and 2.6" centers.

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CAT# DCM-64

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  - Trigger Mode: Software trigger only
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- **16 Digital Inputs**
- **16 Digital Outputs**
- **ACLD-7115** Wiring terminal board (furnished with ACL-711S)
- **Utility Software Disk** Driver routines for BASIC and Quick-BASIC, demo and example programs

ACL-711S $199

24-BIT COLOR FLATBED SCANNER

- High-Speed 3-Pass Scanner
- Long Lasting Cold Cathode Technology (10,000Hrs)
- Up to 2400x2400dpi (300x600 hardware)
- Intelligent LCD Panel
- TWAIN Compliant
- Includes: PhotoStacker, WordLinx OCR & Media-House Multimedia Document Manager Software
- Includes SCSI Interface Card

A6000C

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A6ADF Optional 50pg Doc Feeder

$359

A6TK Optional Transparency Kit

$259

DIGITAL PANEL METERS

- 200mV Full Scale Input Sensitivity
- Single 9 Volt DC Operation
- Decimal Point Selectable
- Auto Polarity Indication
- High Input Impedence (>100M ohm)

AS LOW AS $5.25 EACH

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

This very easy to use tool is a "must have" if you need to straighten the pins on your IC's. Made from anti-static material, this tool is suitable for IC's from 8 to 20 pins (narrow side) and 24-48 pins (wide side). A grounding terminal is also built-in to the tool allowing for easy grounding when using this tool at a fixed location.

CAT NO	PRICE EACH 1	10	100
ICS-01	$7.18	$6.44	$4.89

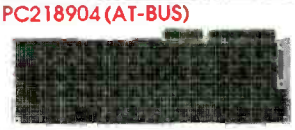
PC218902 (AT-BUS)

- Board Length: 13-1/8" (333mm)
- Board Width: 4-5/16" (110mm)
- Double Sided, 3-Hole Solder Pads and Power Buses
- Space Reserved for: Header, 32x2, 0.1" Spacing and Pin Grid Array

Vector Cross Ref. #4617

CAT NO	PRICE EACH 1	5
PC218902	$25.66	$20.25

PC218904 (AT-BUS)

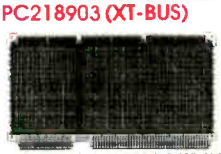


- Board Length: 13-1/8" (333mm)
- Board Width: 4-5/16" (110mm)
- Double Sided, Pad-Per-Hole and Power Buses
- Space Reserved for: 1 D-Type Connector, 25-pin

Vector Cross Ref. #4617-3

CAT NO	PRICE EACH 1	5
PC218904	$25.42	$20.06

PC218903 (XT-BUS)



- Board Length: 13-1/8" (333mm)
- Board Width: 4-5/16" (110mm)
- Double Sided, Pad-Per-Hole and Power Buses
- Space Reserved for 1 D-Type Connector, 25-Pin

Vector Cross Ref. #4613-3

CAT NO	PRICE EACH 1	5
PC218903	$23.51	$18.63

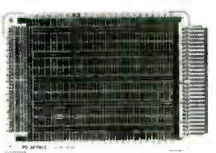
PC232904 (Multi-BUS)

- Board Length: 12" (305mm)
- Board Width: 6-3/4" (171mm)
- Double Sided, Pad-Per-Hole and Power Buses
- Space Reserved for 1 Header, 100x2, 0.1" Spacing

Vector Cross Ref. #4608

CAT NO	PRICE EACH 1	5
PC232904	$38.40	$29.80

PC207905 (STD-BUS)

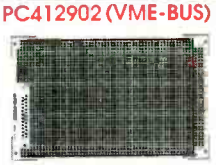


- Board Length: 6-1/2" (165mm)
- Board Width: 4-7/16" (113mm)
- Double Sided, 3-hole Solder Pads, Ground Plane and Power Bus
- Space Reserved for 1 Header, 34x3, 0.1" Spacing

Vector Cross Ref. #4610

CAT NO	PRICE EACH 1	5
PC207905	$13.66	$11.25

PC412902 (VME-BUS)



- Board Length: 6-5/16" (160mm)
- Board Width: 3-15/16" (100mm)
- Single Sided, Pad-Per-Hole and Power Buses
- Space Reserved for 1 D-Type Connector, 25-Pin

Vector Cross Ref. #4614-3

CAT NO	PRICE EACH 1	5
PC412902	$7.06	$6.00

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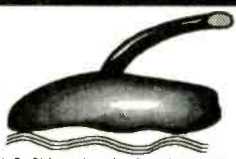
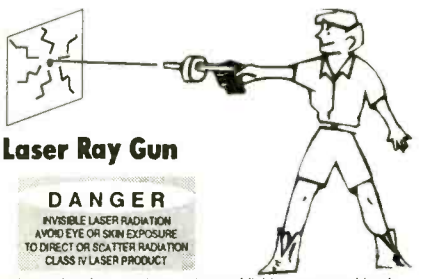


Remember War of the Worlds? Objects float in air and move to the touch. Defies gravity, amazing gift, conversation piece, magic trick or great science project.

ANT1K Easy to Assemble Kit / Plans $19.50

Laser Ray Gun



Advanced project produces a burst of light energy capable of burning holes in most materials. Hand-held device uses rechargeable batteries. 500 joules of flash energy excite either a neodynium glass, yag or other suitable 3" laser rod. This is a dangerous CLASS IV project (individual parts/assemblies available). LAGUN1 Plans $20.00

LAGUN1K Kit / Plans ..... Price on Request

Extended Play Telephone Recording System

READY TO USE! Automatically controls and records on our X-4 extended play recorder, taping both sides of a telephone conversation. Intended for order entry verification. Check your local laws as some states may require an alerting beeper.

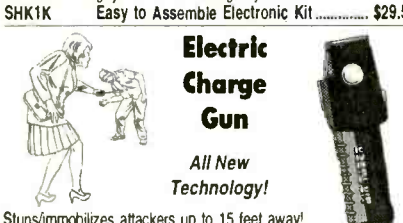
TAP20X Ready to Use System $129.50

Shocker Force Field/ Vehicle Electrifier

Neat little device allows you to make hand and shock balls, shock wands and electrify objects, charge capacitors. Great payback for those wise guys who have wronged you!

SHK1K Easy to Assemble Electronic Kit $29.50

Electric Charge Gun



All New Technology!

Stuns/immobilizes attackers up to 15 feet away! •Legal in most state (not in NY, NJ, MA, WI) • More knock-down power than most handguns • No permanent injury • ID coded • Free 80KV stun gun with every purchase.

ECG1 Data Packet, Creditable toward purcase $10.00

ECG10 Charge Gun, Ready to Use, w/Free 80KV Gun $249.50

Homing / Tracking Transmitter

Beeper device, 3 mile range.

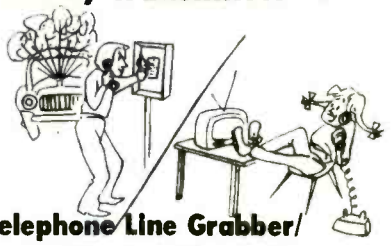
HOD1 Plans .....$10.00 HOD1K Kit / Plans $49.50

Listen Through Walls, Floors

Highly sensitive stethoscope mike.

STETH1 Plans.....$8.00 STETH1K Kit/Plans $44.50

Infinity Transmitter ++



Telephone Line Grabber/ Room Monitor / Controller

All New - The Ultimate in Home/Office Security & Safety!

Simple to use! Call your home or office, push a secret tone on your telephone keypad to access: • On premises sounds and voices • Ongoing phone conversation w/break-in capability • Up to 10 external electrical functions, lights, TV, alarms, coffee pots, heater, etc. CAUTION! Check legality with your state's attorney general's office before use for monitoring of voices.

TELECON1K Kit, includes PC board $149.50

TELECON10 Ready to Use $199.50

Visible Beam Laser

Easy to build, RED Beam, visible for miles. Use for light shows, window bounce holography, cloud illumination and much more! LAS1KM Kit w/1mw Laser Tube, Class II. $69.50

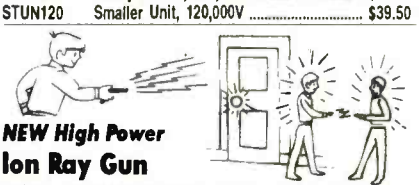
LAS3KM Kit w/2.5mw Laser Tube, Class IIIA $99.50

Life is Precious - *PROTECT IT!*

Hard hitting, crackling, sizzling HIGH VOLTAGE plasma! Stuns and immobilizes most attackers

STUN200 Ready to Use, 200,000V $69.50

STUN120 Smaller Unit, 120,000V $39.50

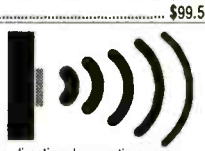


NEW High Power Ion Ray Gun

Projects charged ions that induce shocks in people and objects without any connection! Great science project as well as a high tech party prank. IOG7 Plans $15.00

IOG7K Kit/Plans $99.50

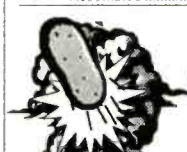
Invisible Pain Field Generator



Shirt pocket size electronic device produces time variant complex shock waves of intense directional acoustic energy, capable of warding off aggressive animals, etc.

IPG7 Plans .....$8.00 IPG7K Kit/Plans ...$49.50

IPG70 Assembled $74.50



1000 Ft++ Potato Cannon

NOT A TOY. Uses electronic or piezo ignition. CAUTION REQUIRED!

POT1 Plans..... (Dangerous Product)..... $10.00

FireBall Gun

Shoots flaming ball - two shot capacity Great for special effects and remote fire starting. CAUTION REQUIRED!

FIREBALL Plans (Dangerous Product)..... $10.00

TV & FM Joker / Jammer

Shirt pocket device allows you to totally control and remotely disrupt TV or radio reception. Great gag to play on family or friends. Discretion required.

EJK1KM Easy to Assemble Electronic Kit $24.50

ATTENTION: High Voltage Fans!

4,000 volts in the palm of your hand! Experiment with anit-gravity, hovercraft, ion guns, force fields, plasma guns, shock devices, wireless energy and electrical pyrotechnics. Input: 9-14VDC.

MINIMAX4 Ready to Use ..... $ 19.50

"Laser Bounce" Listener System

NEW - Latest Technology! Allows you to hear sounds from a premises without gaining access. Aim at room window and listen to sounds from within via reflected laser light. Not for illegal use. Requires video tripods.

LWB3K 5mw Laser and Receiver Kit $149.50

LWB30 Ready to Use $199.50

5mw Visible Red Pocket Laser

Utilizes our touch power control!

VRL5KM Kit / Plans..... $ 74.50

Electronic Hypnotism

Puts subjects under control using highly effective electronic stimuli. Intended for parties and entertainment but must be used with caution. Includes valuable text book reference and plans.

EH2 Plans and Text Book $19.50

Automotive NEON

Easy-to-Install 4-Tube Kit for Cars, Trucks, Vans! Available in Pink, Purple, Blue or Green - please specify color when ordering.

RG4K (Specify Color) .....$ 129.50

License Frame Kit (Specify Color)

LIC1K .....$ 24.50

Flash-To-Music Option for above kit FMU1.....$ 29.50

3 Mi FM Wireless Microphone

Subminiature! Crystal clear, ultra sensitive pickup transmits voices and sounds to FM radio. Excellent for security, monitering of children or invalids. Become the neighborhood disk jockey!

FMV1 Plans.....$7.00 FMV1K Kit and Plans $39.50

Telephone Transmitter - 3 Mi

Automatically transmits both sides of a telephone conversation to an FM radio. • Tunable Frequency • Undetectable on Phone • Easy to Build and Use • Up to 3 Mile Range • Only transmits during phone use. VWPM7 Plans $7.00

VWPM7K Kit/Plans $39.50

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Most Advanced DMM

All Purpose & Communication

-80.7 to 81.4 dBm with 4Ω –1200Ω 20 reference impedances
True RMS
Frequency counter: 0.01Hz-10MHz
Capacitance: 1pF-50,000µF
Measure AC volt to 20kHz
5000 counts, 0.1% accuracy
Auto/manual range, fast bar graph
Min/Max/Ave/DH/Relative/Zoom
Auto power off
Input warning
Splash proof
Volt, amp, ohm, logic, diode, continuity
Ruggerdized case
Rubber holster included

DMM 2360 $119.95

DMM+LCR Meter

Very Versatile DMM

Inductance: 1µH-40H
Capacitance: 1pF-40µF
Frequency: 1Hz - 4MHz
Temperature: -40-302 °F
TTL Logic Test: 20MHz
Diode, Continuity
Volt, Amp, Ohm
3999 count display
Peak Hold
Auto power off
Ruggerdized case.
Temperature probe included
Rubber Holster $8.00

DMM 20 $74.95

Inductance: 1µH-40H
Capacitance: 1pF-200µF
Frequency: 1Hz-20MHz
Volt, amp, ohm, diode, 20 Amp AC/DC current
Transistor HFE
Continuity, duty %
Peak hold/Max
Ruggerdized case
Rubber holster $8.00

Full line of DMMs, economy, compact, ruggerdized, solar cell, automotive, heavy duty, industrial, starts from $15.95

Fluke Multimeter

Fluke 12	$84.95
Holster C-10	$10
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Fluke 73 II	$97.50
Fluke 75 II	$129
Holster C-70	$16
Fluke 77 II	$155
Fluke 79 II	$175
Fluke 29 II	$175
Fluke 76	$175
Fluke 87	$287
Fluke 867	$1199
Fluke 97 Scope Meter	$1785

LCR Meter 131D $229.95

Most Advanced LCR

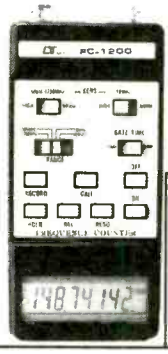
Dual display:L/Q or C/D
Inductance: 0.1µH-1000H
Capacitance:0.1pF-10,000µF
Impedance:1mΩ-10MΩ
0.7% basic accuracy
Auto/manual range
Dissipation factor & Q factor
Serial & parallel mode
Relative mode for comparison and to remove parasitics
Statistics, tolerance,
Best for design, incoming testing & production
SMD and chip component test probe $25.00

LCR Meter 814 $189.95

Best Resolution LCR

Inductance: 0.1µH-200H
Capacitance: 0.1pF-20,000µF
Resistance: 1mΩ-20MΩ
1% basic accuracy
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

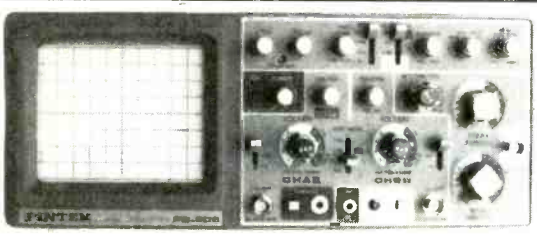
LIMITED QUANTITY SPECIAL
DIGITAL LCR 680 $74.95
0.1pF, 1µH, 10mΩ resolution



Frequency Counter FC-1200 $129.95

Frequency:0.1Hz-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 caliper, 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, 6" 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	$494.95
PS-405 40 MHz DELAY SWEEP	$569.95
PS-605 60 MHz DELAY SWEEP	$769.95

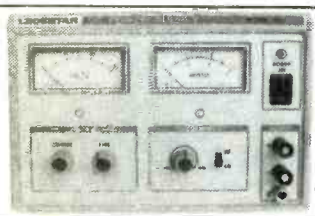
Scope Probe: 60MHz x1, x10 $15, 100MHz x1, x10 $22
250MHz x1, x10 $29, 250MHz x100 $39

Digital Storage Scope

DS-303 30MHz, 20M Sample/sec $849.95

DS-303P with RS-232 interface $1,049.95

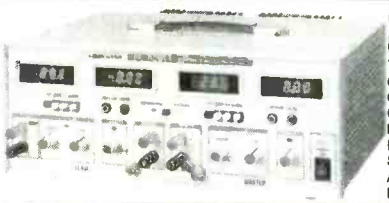
Switchable between digital and analog modes
2 K word per channel storage
8 bit vertical resolution (25 Lerel/div)
Expanded Timebase 10ms/div - 0.5 s/div
Refresh, Roll, Save all , Save CH2, Pre-Trig
Plotter control



DC Power Supply PS-303 $159.00

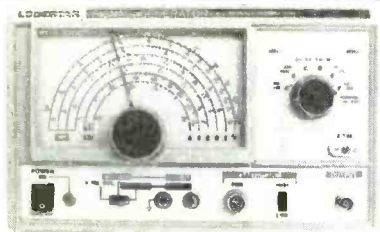
0-30 VDC , 0-3A output

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



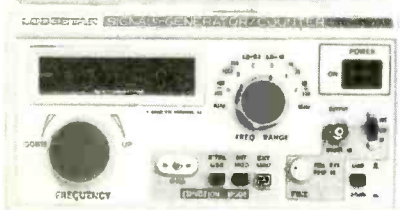
DC Power Supply Triple Output PS-8202 $499.95

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 6 ranges
RF Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz AM modulation
Audio output 1 kHz, 1 Vrms



RF SIGNAL GEN./COUNTER SG-4162 AD $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 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

AUDIO GEN./COUNTER AG-2603AD $229.95

Generates audio signal same as AG-2601A
6 digit frequency counter 1Hz-150MHz for internal and external sources Sensitivity <50mV

FUNCTION GENERATOR FG-2100A $169.95

0.2 Hz -2 MHz in 7 ranges
Sine, square, triangle, pulse and ramp
Output: 5mV-20Vp-p
1% distortion, DC offset ± 10V
VCF: 0-10V control frequency 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 to 2s
AM Modulation
Gated Burst, Voltage Control Generator
Generator Control Voltage & 6 digit counter
1Hz-10MHz for internal & external sources

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AOR	SDU5000	$995.95
AOR	AR5000	$CALL
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	BC120XLT	$179.95
	SC150Y/B	$169.95
	BC220XLT	$224.95
	BC890XLT	$229.95
	BC3000XLT	$369.95
	BC9000XLT	$369.95
Radio Shack	PRO26	$339.95
	PRO46	$179.95
	PRO60	$299.95
	PRO2039	$229.95*
	PRO2040	$219.95*
	PRO2042	$429.95*

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GRUNDIG	YB305	$129.95*
	YB400	$179.95
	SAT700	$459.95
SANGEAN	ATS202	$89.95
	ATS303	$89.95
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	ATS818	$147.95
SONY	ICF30	$104.95
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	ICF55	$344.95
	ICF77	$469.95
	ICFSW100	$349.95
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	ICF7600G	$179.95

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DRAKE	R8A	$1069
ICOM	R71A	$CALL*
	R7100	$CALL*
	R100	$CALL*
JRC	NRD535DB	$1699
Kenwood	R5000	$1069
LOWE	HF150	$569.95
	HF225E	$959.95
	HR250	$CALL*
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• AR8000	list $799.95	EEB $599.95
• Mods & system check		EEB $50
• Cable CB-RT		EEB $20
• Scout 40	list $449.95	EEB $399.95

CYBER SCAN AOR AR5000

The new AOR AR5000 is on it's way. At this writing (mid Sept) details are sketchy. *Internet* is buzzing and here are some of the tentative specs.
•10KHz-2600 MHz •1000 memories •All mode AM/FMN/ FMW/LSB/USB/CW •IF band width 3 to 200KHz (7 filters) •12VDC computer control 10.7 MHz IF output

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#M12ERA-08 $98.95

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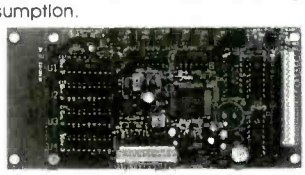
The DVM-58D has variable length message capabilities and can store up to 16 individual messages for immediate playback. Use it to add real voice prompting or instruction to any project, via the mic. input. Standard 1Mb DRAM on-board (32 sec.@ 32K bps) with options to expand up to 16Mb (8 min.@ 32K bps). ADM recording with selectable 16/32/44K bps sampling rates and very low power consumption.



#M105858	$89.95
1Mb DRAM	$5.15
4Mb DRAM	$21.95

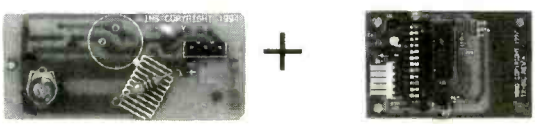
RF TRANSMITTER + ENCODER MODULES

The TX-99 interfaces with the TX-01 as the RF carrier module. 300 MHz AM with a typical range of 50' -100' line-of-sight. (Key-chain transmitter is also available, model TX-99K $15.95)

#M109903 $5.95

The TX-01 Motherboard can encode a 12-bit address code with 4096 possible code combinations or can be used to encode an 8-bit address code with a 4-bit data code.

#M10001 $9.95



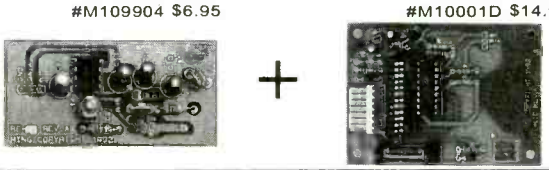
RF RECEIVER + DECODER MODULES

The RE-99 interfaces with the RE-01 as the RF carrier's receiver module and requires only a few solder connections to mate the two. 300 MHz AM.

#M109904 $6.95

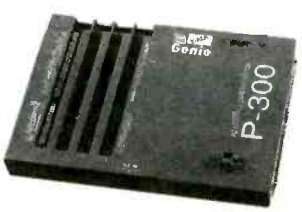
The RE-01 Motherboard will decode a 12-bit address or 8-bit address with 4-bits of data, depending on which of the two included IC's is installed into the board.

#M10001D $14.95



PC INTERFACE CARD PROTECTOR

The Data Genie P-300 is a device that allows quick and easy installation of add-on cards or prototype circuits for testing externally on your PC without having to turn off the computer. Maintains complete protection for your motherboard via the built-in protection circuitry & current limit fuses. Adds 3 expansion slots.



#M12P300 $349.95

PIR DETECTOR

The Medusa Passive Infrared Detector has been tested at 20V/m over the frequency range 20 to 1000 MHz, proving that the unit has ultra-high RFI protection and reliability. With N.C contacts including tamper, plus selectable pulse counts of 1,3 or 5, Medusa makes for confident installations.

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#M113300 $24.95
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LASER POINTER

The Infiniter Laser Pointer is lightweight, durable and can project a beam over 150' to enhance any demonstration or presentation. It even works well on overhead projection screens and can be used in conference rooms, exhibition hall, construction sites, museums, etc.

(2-"AAA" Batteries not included)

#M160012 $49.95

MELODY DEMO KIT

The HT-38DPB Demo Board comes complete with a preassembled playback board, battery holder and ten Holtek melody IC's. Great for experimenting or adding a musical melody to a project.

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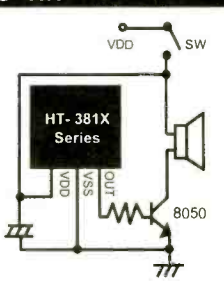

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MODEL	SIZE (mm) W x D x H	PRICE $ A	B
LC-1	100 x 100 x 50	45.00	47.50
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LC-3	200 x 100 x 50	55.00	57.50
LC-4	300 x 100 x 50	60.00	62.50
LC-5	150 x 150 x 75	50.00	54.00
LC-6	200 x 150 x 75	55.00	59.00
LC-7	300 x 150 x 75	80.08	84.00
LC-8	400 x 150 x 75	85.08	89.00
LC-9	200 x 200 x 75	60.08	64.00
LC-10	250 x 200 x 75	65.08	69.00
LC-11	300 x 200 x 75	70.08	74.00
LC-12	425 x 200 x 75	75.08	79.00
LC-13	250 x 250 x 100	70.08	76.00
LC-14	300 x 250 x 100	75.00	81.00
LC-15	350 x 200 x 100	80.00	86.00
LC-16	425 x 250 x 100	85.00	91.00

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MC-3A	8 x 3 x 2	16.00	18.00
MC-4A	4 x 5 x 3	14.00	16.00
MC-5A	6 x 5 x 3	16.00	18.00
MC-6A	8 x 5 x 3	18.00	20.00
MC-7A	4 x 7 x 4	16.00	18.00
MC-8A	6 x 7 x 4	18.00	20.00
MC-9A	8 x 7 x 4	20.00	22.00
*MC-10A	8.5 x 7 x 1.75	32.00	34.50
*MC-11A	8.5 x 10 x 1.75	34.00	36.50
*MC-12A	8.5 x 14 x 1.75	36.00	38.50
*MC-13A	8.5 x 7 x 3.5	33.50	36.00
*MC-14A	8.5 x 10 x 3.5	35.50	38.00
*MC-15A	8.5 x 14 x 3.5	37.50	40.00
*MC-16A	17 x 7 x 1.75	34.50	38.00
*MC-17A	17 x 10 x 1.75	36.75	40.25
*MC-18A	17 x 14 x 1.75	42.75	46.25
*MC-19A	17 x 7 x 3.5	36.75	40.25
*MC-20A	17 x 10 x 3.5	39.25	42.75
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MODEL	HEIGHT IN RACK UNITS	PRICE $ A	B
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RSR-8	8	75.00	87.50
RSR-10	10	70.00	80.00
RSR-12	12	70.00	80.00

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Rack Chassis

MODEL	W x D x H (IN)	PRICE $ A	B
1RU5	19 x 5 x 1.75	34.00	44.00
1RU7	19 x 7 x 1.75	36.50	48.50
1RU10	19 x 10 x 1.75	38.75	50.00
1RU12	19 x 12 x 1.75	42.75	56.00
1RU15	19 x 15 x 1.75	45.75	58.00
1RU17	19 x 17 x 1.75	48.75	60.00
2RU5	19 x 5 x 3.5	36.50	46.50
2RU7	19 x 7 x 3.5	38.75	50.75
2RU10	19 x 10 x 3.5	41.25	53.00
2RU12	19 x 12 x 3.5	45.25	58.25
2RU15	19 x 15 x 3.5	48.25	60.50
2RU17	19 x 17 x 3.5	51.25	62.50
3RU5	19 x 5 x 5.25	46.00	56.50
3RU7	19 x 7 x 5.25	48.50	60.75
3RU10	19 x 10 x 5.25	51.00	63.00
3RU12	19 x 12 x 5.25	54.00	68.25
3RU15	19 x 15 x 5.25	57.00	70.50
3RU17	19 x 17 x 5.25	60.00	72.50

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Audio Transformers for Tube Construction

Inputs – Line/Mic

MODEL	PRI Ω	SEC Ω	CASE STYLE	USE	PRICE $ A	B
AT-1	150	600k	A	MIC INPUT	40.50	42.50
AT-2	15k	15k	A	LINE INPUT	40.50	42.50
AT-3	15k	600	B	LINE OUTPUT	46.75	48.50

Tube Outputs

OT-1	5k	8	B	EL84 3 WATT	9.00	11.00
OT-2	8k	4,8,16	B	EL84 10 WATT	12.00	16.00
OT-3	7k	4,8,16	B	EL34 20 WATT	18.00	24.00

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OUTPUT TRANSFORMERS DESIGNED FOR SIMPLE OUTPUT STAGES AND FEATURE FREQUENCY RESPONSE ±2 dB 40-15k Hz.

Power Supply

MODEL	SECONDARY #1	#2	#3	CASE STYLE	USE	PRICE $ A	B
PT-1	125V/ 25mA	6V/3A		B	PRE AMP	9.00	11.00
PT-2	250-0-300 70mA	5V/ 4A	6V/3A	B	5W AMP	18.00	24.00
PT-3	300-0-300 70mA	5V/ 2A	6V/3A	B	10W AMP	20.00	26.00
PT-4	400-0-400 180mA	5V/ 3A	6V/ 4A	B	20W AMP	24.00	30.00

Pots

PART #	Ω	TYPE	PRICE $ A	B
APOT-1	100k	S LIN	2.75	3.00
APOT-2	100k	S LOG	2.75	3.00
APOT-3	100k	D LIN	5.50	6.00
APOT-4	100k	D LOG	5.50	6.00
APOT-5	470k	S LIN	2.75	3.00
APOT-6	470k	S LOG	2.75	3.00
APOT-7	1M	S LIN	2.75	3.00
APOT-8	1M	S LOG	2.75	3.00
APOT-9	1M	D LIN	5.50	6.00
APOT-10	1M	D LOG	5.50	6.00
APOT-11	100k	D LOG (FOR BALANCING)	5.50	7.00

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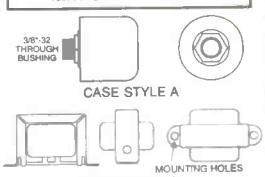

CASE STYLE A

MOUNTING HOLES

CASE STYLE B

Sockets

PART	TYPE	PRICE $ A	B
TS-1	7 PIN S	1.90	2.10
TS-2	7 PIN P	1.90	2.10
TS-3	9 PIN S	1.90	2.10
TS-4	9 PIN P	1.90	2.10
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MPB-1	1 x 2 x 1	1.95	2.25
MPB-2	1 x 4 x 1	2.40	2.75
MPB-3	1 x 6 x 1	2.85	3.25
MPB-4	1.5 x 2 x 1.5	2.05	2.25
MPB-5	1.5 x 4 x 1.5	2.55	2.85
MPB-6	1.5 x 6 x 1.5	3.00	3.60
MPB-7	1.5 x 2 x 3	2.25	2.56
MPB-8	1.5 x 4 x 3	2.75	3.15
MPB-9	1.5 x 6 x 3	4.00	4.50
MPB-10	1.5 x 2 x 5	2.50	3.00
MPB-11	1.5 x 4 x 5	2.95	3.55
MPB-12	1.5 x 6 x 5	4.25	5.05
MPB-13	2 x 2 x 2	2.20	2.60
MPB-14	2 x 4 x 2	2.65	3.15
MPB-15	2 x 6 x 2	4.40	5.00
MPB-16	2 x 8 x 2	6.65	7.30
MPB-17	3 x 2 x 3	2.45	2.95
MPB-18	3 x 4 x 3	2.90	3.50
MPB-19	3 x 6 x 3	4.20	4.90
MPB-20	3 x 8 x 3	4.65	5.45
MPB-21	4 x 6 x 3	4.55	5.15
MPB-22	4 x 10 x 3	4.75	5.45
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MODEL	W x D x H (IN)	PRICE $ A	B
RSB-2	7.5 x 3 x 1.65	25.00	30.00
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RSB-7	7.5 x 3 x 1.65	38.00	43.00
RSB-9	7.5 x 3 x 1.65	45.00	50.00
RSB-11	7.5 x 3 x 1.65	51.50	56.50
RSB-13	7.5 x 3 x 1.65	56.25	63.25

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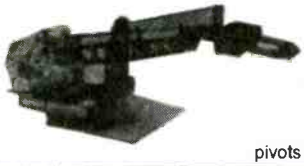

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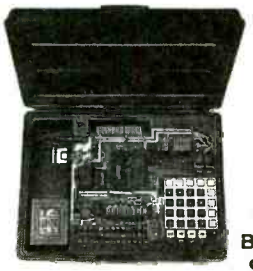

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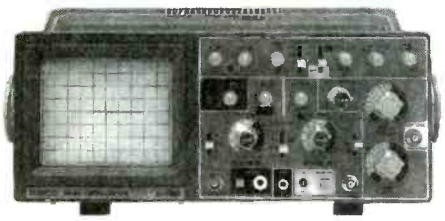

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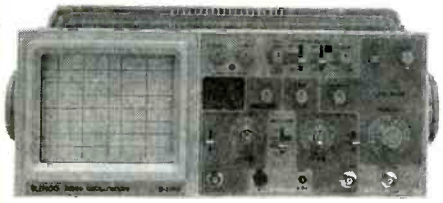
S-1360 $775

Delayed Sweep

S-1365 $849

Cursor Readout

- Voltage, Time
- Frequency differences displayed on CRT



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2- Channel

S-1345 $575

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- Beam Find
- Component Tester

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VC-6045A - 100MHz, Digital Stor	CALL
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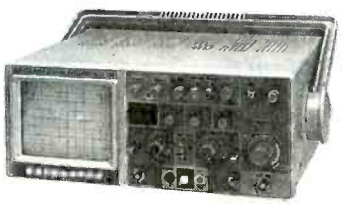

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CAT #VC-1 **$49.95 each**

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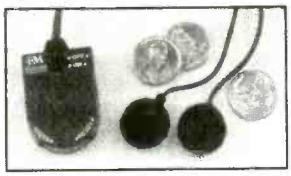

WOW! SOUNDS GREAT!

Fit an entire orchestra in the palm of your hand and still have room for the concert tickets with this Mini FM Radio that has an incredible sound. Features on/off button, seek button and reset button. Includes battery. If this isn't the world's smallest, it's close to it. But the sharp, clear sound that comes out will make you think you have a jam box. Black.

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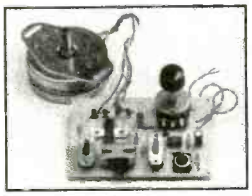
This meter has many useful applications such as Voltmeter, Thermometer, Db Meter, Watt Meter, Current Meter, Capacitance Meter, Lux Meter and LCR Meter. Features include: 200mV full scale input sensitivity, single 9VDC operation and decimal point selectable. In addition, it has 13mm figure height, automatic polarity indication, guaranteed zero reading for 0 volt input and high input impedance (>100M ohms). Specifications: Max input 199.9mV DC-Max. Display: 1999 counts (3-1/2 digits). Measuring method: Dual slope integration A-D converter system, plus many other features.

CAT #PM-1 **$9.95 each**

STEPPER MOTOR CONTROLLER KIT



This kit allows you to adjust the speed and direction of a stepper motor. You can move the motor in one step increments or rotate it at a constant speed. There are a set of visual indicators that show the sequence of motor. Includes stepper motor, pc board, parts and instructions.

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SUPER VHS PRO VIDEO TAPES

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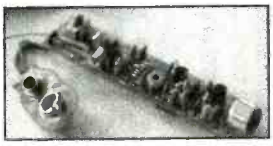
CAT #S-VHS **$3.00 each - 10 for $8.00**

FM WIRELESS MIKE KIT

POWERFUL



2 stage, wireless mike kit transmits over .5 mile (up to 1 Km in the open) Tunable to the upper part of FM broadcast band. Circuit does require the ability to "Tweak" RF circuits by stretching or compressing coils. With mike and 9V battery clip. Operates from 6-12V DC. 2.75" x .625" x .5" WT .06

CAT #FM-32 **$10.95 each**

9V DC FM TRANSMITTER KIT

POWERFUL

FM transmitter. Transmits over 100 meters in building and over 500 meters outside using .25 or .5 wavelength of wire. Transmits to the upper part of FM broadcast band (100-108MHz). Circuit requires the ability to "Tweak" RF circuits. Operates on 9V DC. 1.75" x .75" x .375" WT .05

CAT #FM-18 **$9.95 each**

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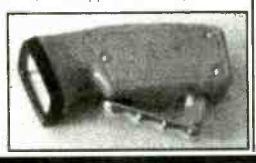

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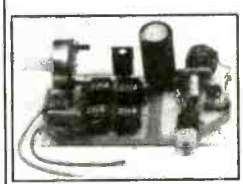

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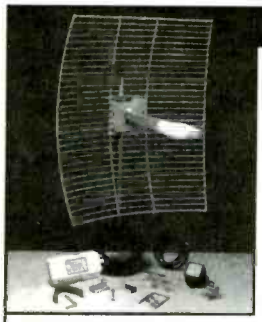

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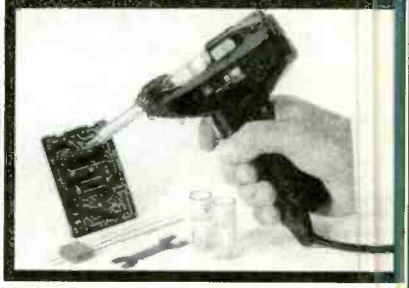

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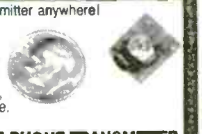

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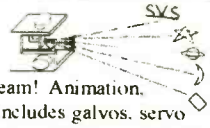

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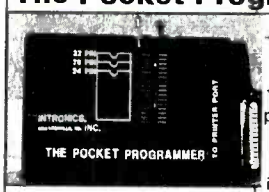

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(Continued from page 23)

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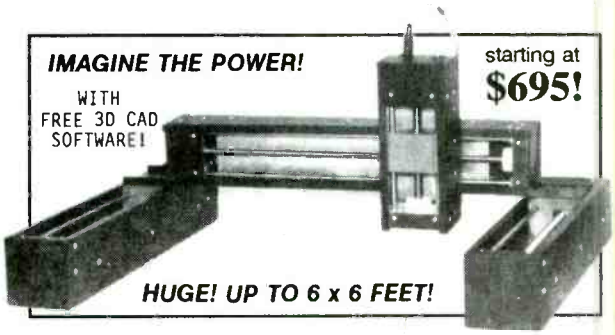

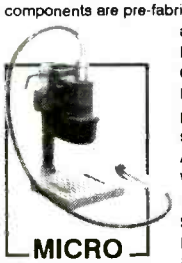

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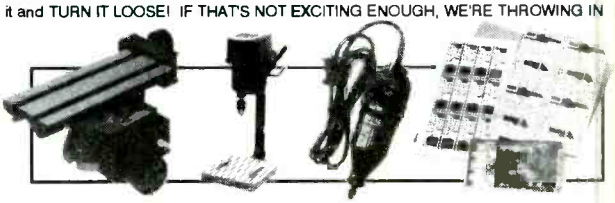

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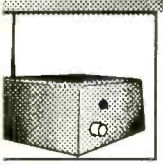

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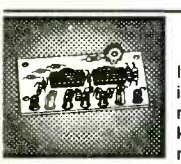
Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to12v DC SIZE:1.75" x 1"

AA-1 KIT **$10.95** BUILT **$29.95**

WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-1 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. 6 to 12v DC. SIZE: 1.25" x 1"

WM-1 KIT **$14.95**



DC VOLTAGE MONITOR

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

VM-1 KIT **$7.95**

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

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

BUILT **$49.95** KIT **$39.95**

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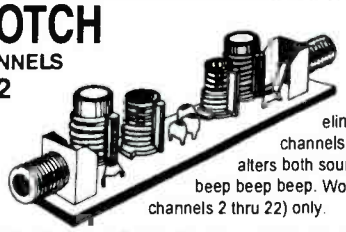
FOR CHANNELS **2 thru 22** ONLY



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.

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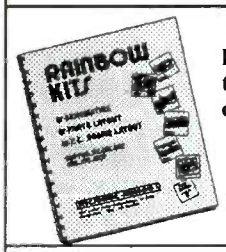
DF-222 KIT **$14.95**



This Manual contains schematics, parts lists & P.C. board layouts for many of the Rainbow Kits. Use your own parts to construct our kits.

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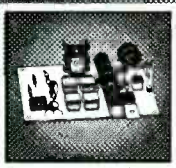

STROBE LIGHT

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"x1.9"

ST-1 KIT **$9.95**

MICRO-LIGHT

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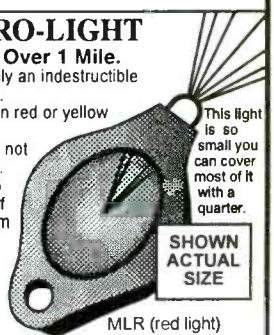

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MLY (yellow light) CHOICE **$9.95**

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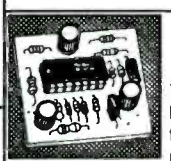
LDM-5 New Low Price **$59.95**



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

VOX-1 KIT **$6.95**

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WBA-6 KIT **$19.95**

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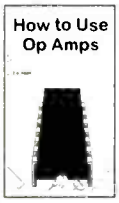

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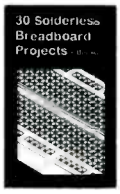

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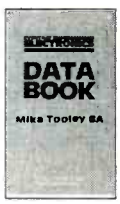

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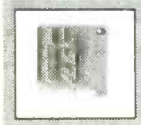

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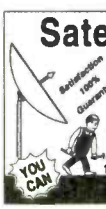

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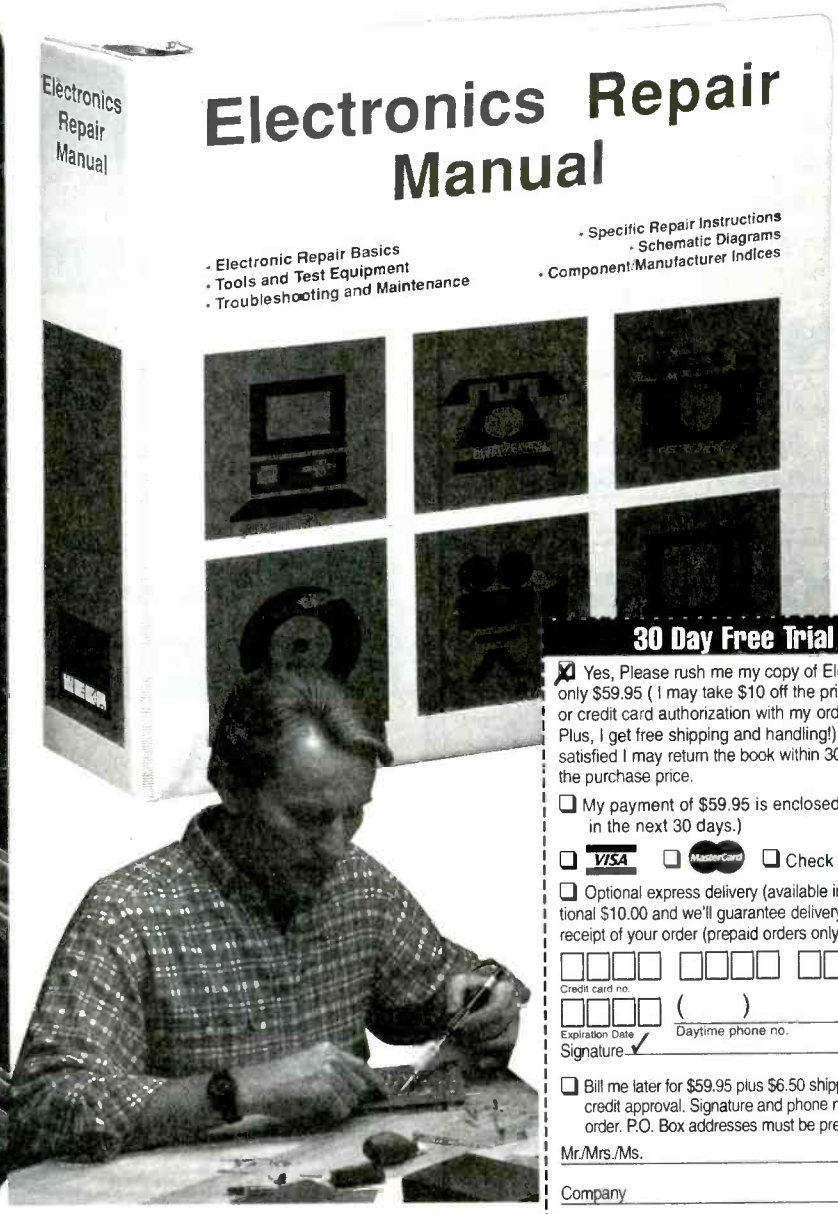

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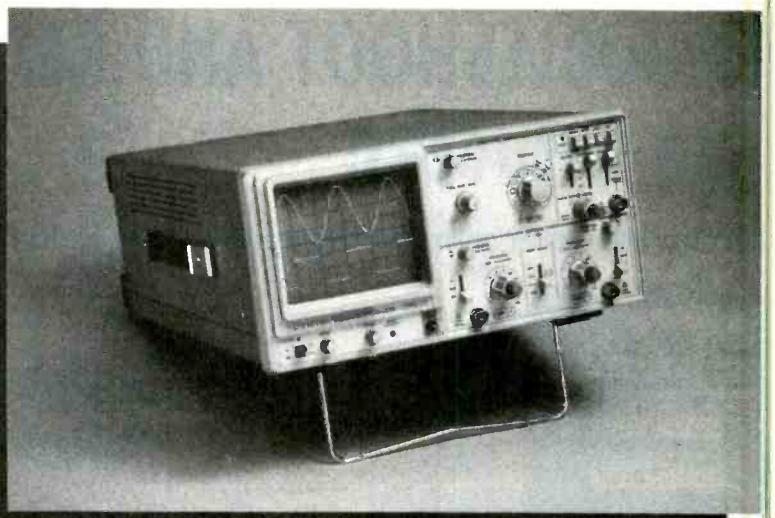

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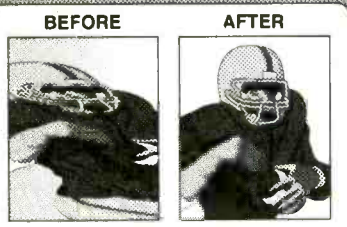

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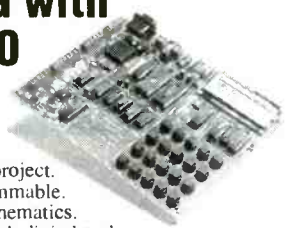

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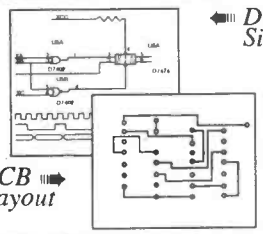

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TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but, in all cases, full payment must accompany your order.

WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.75 per word. Minimum charge is $26.25 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a Box number you must include your permanent address and phone number for our files. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Boldface (not available as all caps),** add .40 per word additional. **Entire ad in boldface,** add 20%. **Tint screen behind entire ad,** add 25%. **Tint screen plus all boldface ad,** add 45%. **Expanded type ad,** add $2.25 per word.

General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. POPULAR ELECTRONICS is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

CONTENT

All classified advertising in POPULAR ELECTRONICS is limited to electronics items only. All ads are subject to the publishers approval. WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.

AD RATES: $1.75 per word. Minimum $26.25

Send you ad payments to:
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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
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17 - $29.75	18 - $31.50	19 - $ 33.25	20 - $35.00				
21 - $36.75	22 - $38.50	23 - $40.25	24 - $42.00				
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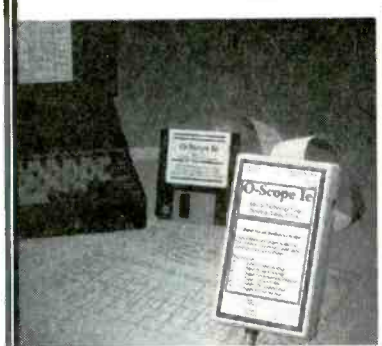

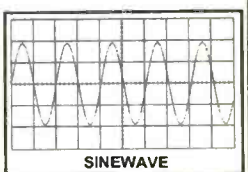

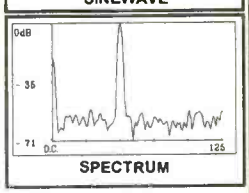

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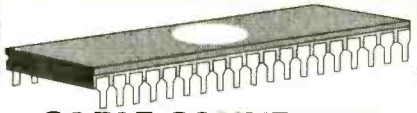

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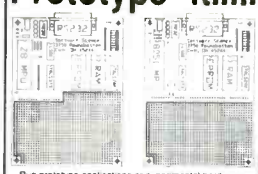

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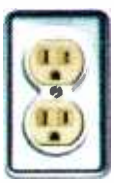

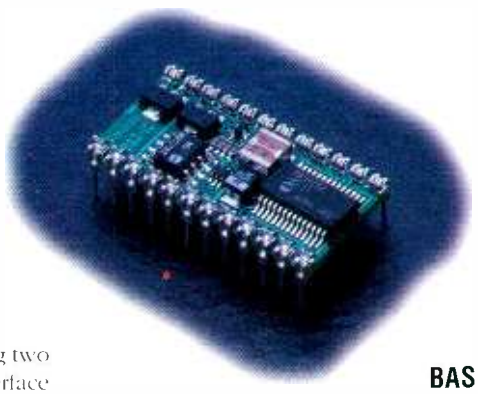

BS2-IC Module
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XOUT

Generates X-10 powerline control signals using two I/O pins and an inexpensive TTL-to-AC interface module (X-10 part #PL513 or #TW523). Signals are received by small modules that control lights and appliances. Receiver modules are available from Parallax, Radio Shack, and other convenient sources.

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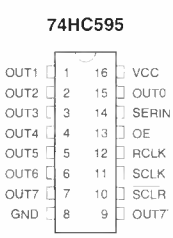

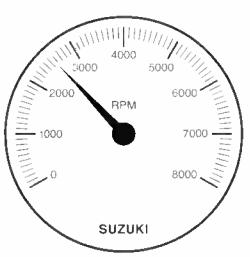

SHIFTOUT

Uses two I/O pins to control common serial-to-parallel shift registers.

COUNT

Counts cycles on a pin. Makes tachometer applications simple.

"Robo-Cat"

Guy Gustavson of Maple Grove, Minnesota, turned in a very interesting Stamp application. His cat, Kesha, developed Heptic Lipodosis, or "fatty liver." The treatment called for tube feeding every three hours. Guy couldn't be home all day, so he combined a BASIC Stamp, electric pump, some switches, and various other parts. Instead of a 100ml feeding every three hours, Kesha received a continuous feeding, which seemed to work even better. Now, Kesha is doing fine. If his experience could be of any help, Guy would like to hear from you. Please send any email to bigfoot@winternet.com.

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