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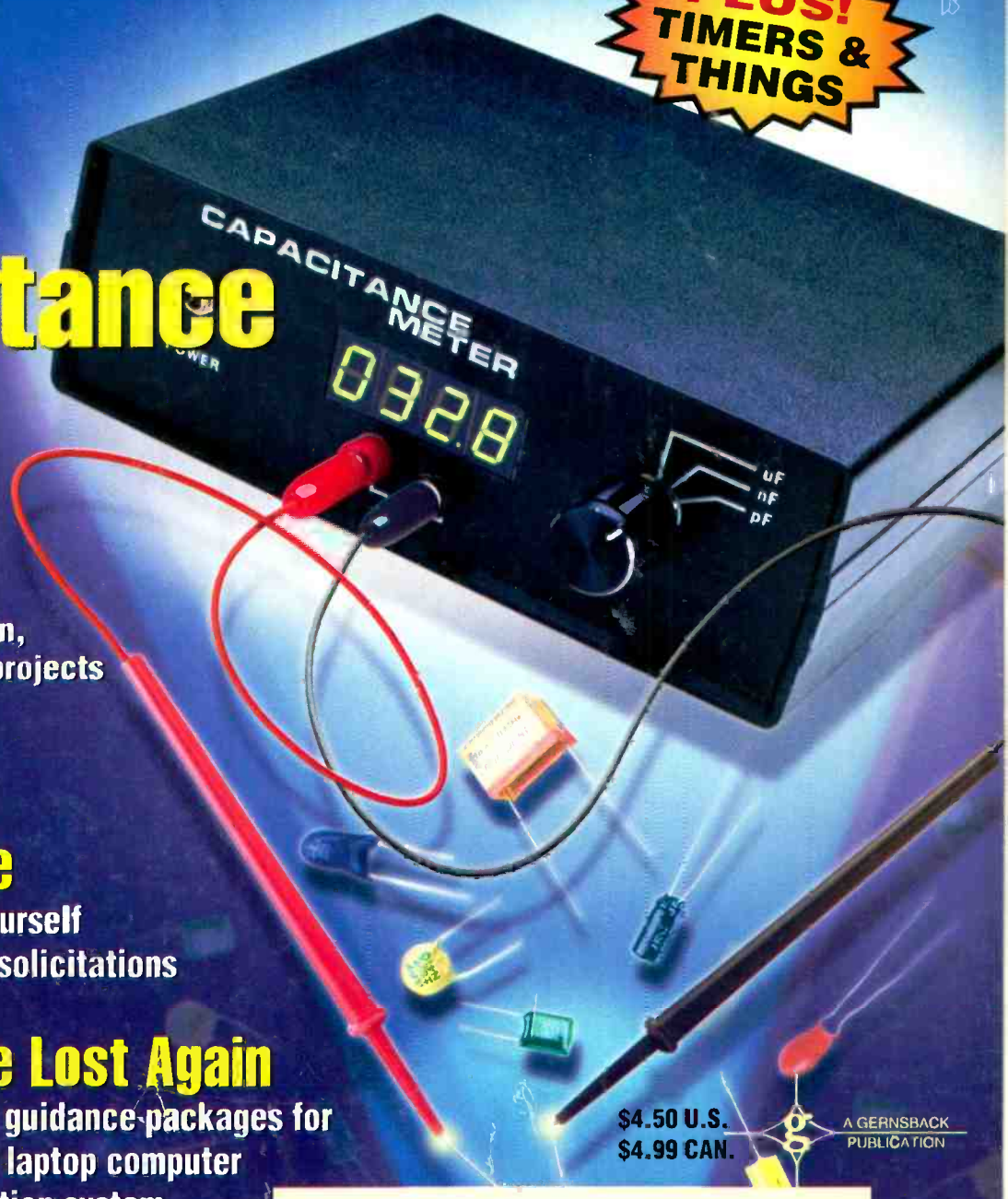

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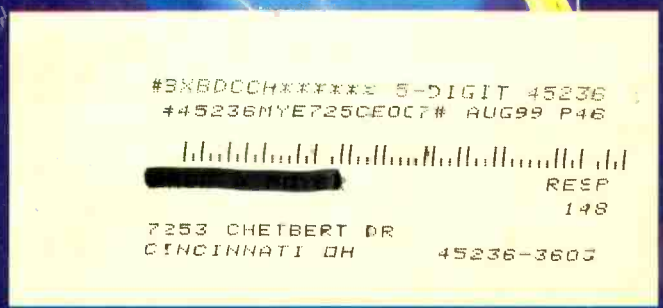

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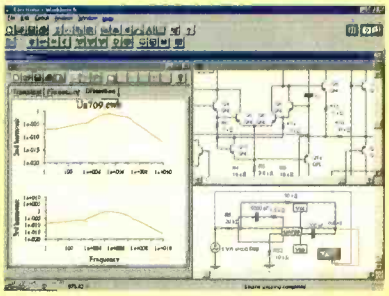

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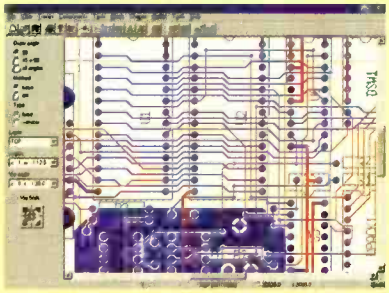

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Popular Electronics®

MARCH 1998
Vol. 15, No. 3

A GERNSBACK PUBLICATION

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March 1998

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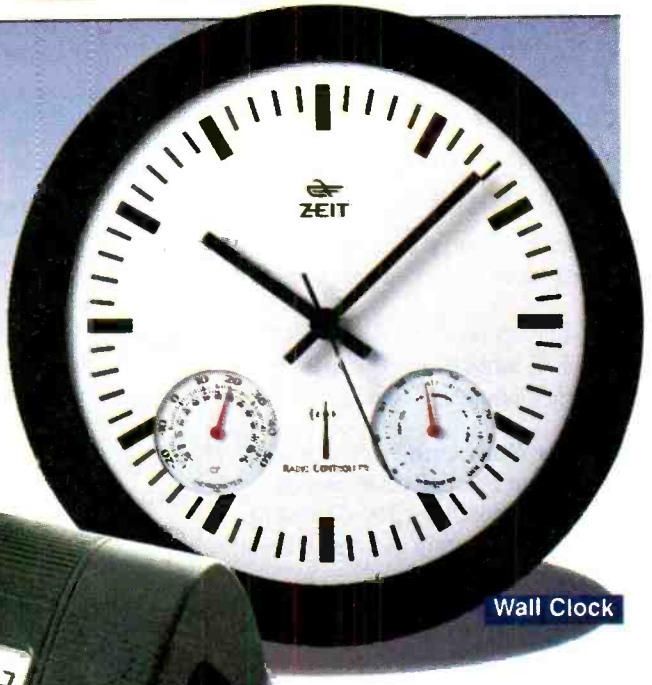
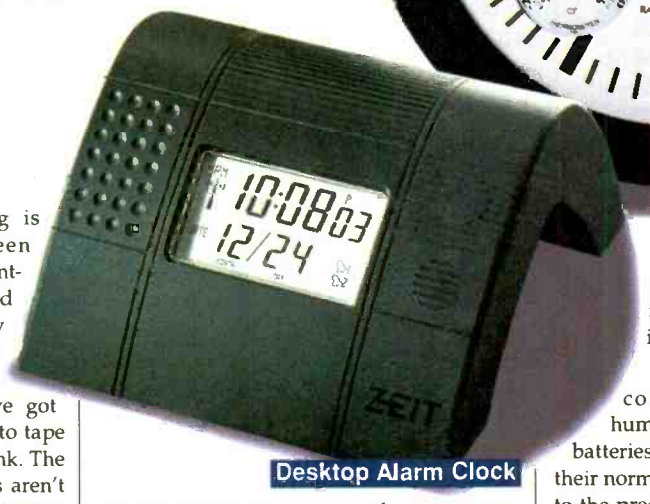
ABC AUDITED

The U.S. Government always knows exactly what time it is...do you?

New clock from Arcron uses radio signals from the U.S. Atomic Clock in Colorado to display the precise time, within a billionth of a second.

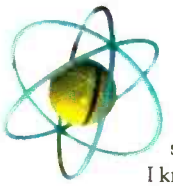


Wall Clock



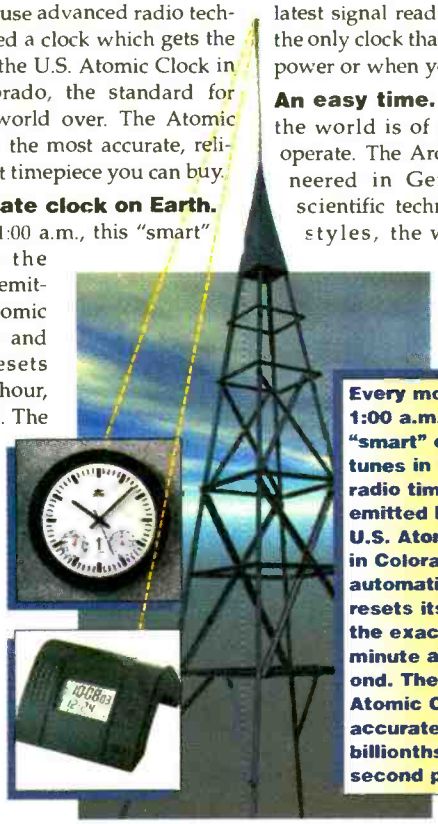
Desktop Alarm Clock

by Jake Prine



These days, timing is everything. Between meetings and appointments, deadlines and conference calls, my schedule requires that I know the time down to the minute. Even on weekends, I've got Little League games to coach, shows to tape and planes to catch. If I'm late, I'm sunk. The problem is that it's hard if my clocks aren't correct. Even the digital clocks can display time inaccurately. Power outages, dead batteries, time changes...any of these can cause a clock to be inaccurate. The next thing you know, you're strolling into that important conference...an hour late. Now there's no need to worry, because advanced radio technology has produced a clock which gets the time directly from the U.S. Atomic Clock in Fort Collins, Colorado, the standard for time-keeping the world over. The Atomic Clock by Arcron is the most accurate, reliable and convenient timepiece you can buy.

The most accurate clock on Earth. Every morning at 1:00 a.m., this "smart" clock tunes in to the radio time signal emitted by the U.S. Atomic Clock in Colorado and automatically resets itself to the exact hour, minute and second. The U.S. Atomic Clock is accurate to ten billionths of a second per day. Using molecular technology, it measures the vibration rate of atoms—a constant—to calibrate time. This means that the clock deviates less than one second over a one million year period! The Atomic Clock even adjusts automatically for daylight savings time so you don't have to remember to "spring forward" or "fall back". This clock is the only atomic clock with an internal calibrator that creates "intelligent" adjustments based on the latest signal readings. The desktop model is the only clock that will not lose time with low power or when you change its batteries.



Every morning at 1:00 a.m., this "smart" clock tunes in to the radio time signal emitted by the U.S. Atomic Clock in Colorado and automatically resets itself to the exact hour, minute and second. The U.S. Atomic Clock is accurate to ten billionths of a second per day.

An easy time. The most accurate clock in the world is of no use if it is difficult to operate. The Arcron Atomic Clock is engineered in Germany using the latest scientific technology. It comes in two styles, the wall clock and the executive desktop model. Both are designed to be functional *and* easy to use.

The desk clock's display features the exact time (in hours, minutes and seconds), month and date, or you can choose to display any two U.S. or world time zones. It features a sleek, European design, and, at only eight ounces, is the perfect travel clock. It also has dual alarms, perfect for couples, and one-touch illumination for nighttime viewing.

The handsome wall clock comes with temperature and humidity gauges. After you install the batteries, watch the hands spin at 20 times their normal rate, until the clock has adjusted to the precise time. Both the executive desktop and the wall model have an internal antenna for superior reception sensitivity, without unattractive wires.

Imagine having the ability to know the exact time, all the time. The Atomic Clock probably costs less than most of the clocks and watches you own, but you'll be able to use it to set them all correctly. Isn't it about time you had a clock you can trust?

The time to buy is now! Act now and you can own the world's most precise timepiece. Both the executive desktop and the wall model come with a one-year manufacturer's limited warranty and Comtrad's risk-free home trial. If you are not completely satisfied, return your purchase within 90 days for a full "No Questions Asked" refund.

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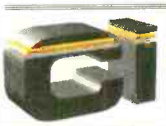

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Editorial

Let's Hear From You

I recently looked in the **Popular Electronics** storage room for incoming construction projects, and noticed that the shelves were starting to get a little bare. What that means is that we need your help! We are looking for authors out there in reader-land who have manuscripts they want to see published in our magazine. What type of articles are we seeking? We seek first-rate articles covering communications, computers, test equipment, audio, video and virtually every other electronics subject. If you would like our **Popular Electronics** Writer's Guide—drop us a note or you can download it from our Web site—go through the **Popular Electronics** home page link to find the guide.

Good construction projects, tutorial, informational, and how-to-do articles are always in demand. If they are timely, their appeal and chances of acceptance are further enhanced. Construction articles should be provided with working prototypes and/or photographs, where possible, and should show readers how to build electronic projects. The projects discussed must be of practical use in the field of electronics, in hobby pursuits, or around the house or car. So put on your thinking caps, warm up your soldering irons, turn on your word processors and let's hear from you!

On a different note, give your attention to the ads you find in the magazine from our various advertisers. These companies bring in a major source of revenue for this publication. When you are in the market for new products, parts, gadgets, *etc.*, please give our advertisers your first consideration. Where available, circle those numbers on the bingo card and mail it to the Reader Service Department for more information. Shop with advertisers who value you and the magazine. When you contact them—tell them where you saw their ads. This works two ways; it makes them feel that they should continue to advertise with us, and it also lets them know that they are reaching the world's best electronic activist—a **Popular Electronics** reader.

Ed Whitman

Ed Whitman
Managing Editor

LETTERS

OUR ANNUAL INDEX—ONLINE!

We have received numerous letters from readers asking why the 1997 ***Popular Electronics*** *Annual Index did not appear in the January 1998 issue as in the past. The answer is twofold. First, we did not want to use up valuable magazine space with the index—we'd rather fill these pages with new and exciting features and construction articles. Second, we* ***are still*** *presenting this index—and more, through our Web site home page:* http://www.gernsback.com. *Not only is the 1997 index available online, but the present database includes* ***Popular Electronics*** *issues back to January 1995. What makes this online index more attractive is its "search engine" capability. As with most online search engines,* OR *and* AND *operators are available, so you can enter keywords of interest and then find the selected issue(s) in which the topic appears—including the column(s) and page(s). Our goal is to compile a detailed index of* ***Electronics Now*** *and* ***Popular Electronics*** *that encompasses the past five years.*

To find this index, bring up our Web site home page. By the big "Navigation Knob" pointer in the upper right-hand corner of your screen, click on the ***Popular Electronics*** *logo. When the new image appears, go to the left side of the screen and look for the link "Access our Article Index Search Engine" (both magazines are available). This will connect you to the index page. At this point, follow the instructions and begin your search! Let us know what you think about this online index.—Editor*

GUITAR AMPLIFIER MISLABELINGS

My son is currently constructing the 50-watt amplifier project you published in the December issue of **Popular Electronics** ("Build the Guitar Amplifier") and has located some mislabeled components on the board layout. Although his experience is limited, he has solved all but one of the mistakes. Apparently there are two R11s on the layout (Fig. 3, page 39), but only one on the schematic diagram (Fig. 1, page 34). The extra R11 (whose value we cannot figure out) in the circuit diagram, goes from the common of switch S2 to ground—according to the PC board layout. Could you tell us the value of this component?. There is only one R11 in the circuit diagram, and all the other components in the parts list are accounted for. We would really appreciate your help, as my son is more than anxious to complete his guitar amp—to my ears' delight!

J.N.
via e-mail

Your son's observation is correct. Not only is R11 shown twice in the layout, but also R14 is repeated. The extra R11, which is connected to the common of switch S2, should be removed completely. The R11 (100,000-ohm) which ties with R10 remains. Similarly R14 which is shown tying with R19 should be replaced with R18 (1000-ohm)—omitted from the layout figure. The schematic diagram is correct in both cases. I hope that these corrections will enable your son to get the amp operational. Just don't blame us, if he rocks you out of the house!—Editor

THINK TANK CORRECTIONS

I just received the January 1998 issue of **Popular Electronics**. Thanks for publishing my work in "Think Tank;" however, I noticed a few errors in the Intercom circuit shown in Fig.1. The bridge rectifier is connected incorrectly—rotate the bridge 90° from that shown in the schematic to correct it. Although it is not marked (just implied), the secondary of audio transformer T1 (impedance of 1000-ohm) does go to R1, the volume control, and the primary side (8-ohm) does go to S2, the talk switch.

There is also an error in Fig. 3, the Clap-Twice Sound Switch. Pins 6, 9, and 10 of the 74C08 quad AND gate (IC3) are omitted from the schematic. They should all be connected together. On another note, if readers can't find a 74C08 (or NTE74C08), use a 74ACT08 instead. I hope this helps.

Craig Kendrick Sellen
Waymart, PA

CLIMATE CONTROLLER: REVERSED POLARITY DIODE

I am a first-year student at Pickens Tech in Denver, CO, and I really enjoy every issue of **Popular Electronics**. I immediately noticed that something didn't look right with the schematic for the article "The Electronic Climate Controller" (**Popular Electronics**, January 1998). The relay, RL1, could not function the way it is drawn. Diode D1 should have its polarity reversed. Since we are presently studying inductance, I realized that the purpose of diode D1 would be to protect transistor Q1 from the inductive kickback caused by the collapsing field of relay RY1.

T.G.
via e-mail

You're right! It was wrong in the schematic, but correct in the parts layout.—Editor

READERS COMMENT ON FUSESAVER

The article, "Build the FuseSaver" (**Popular Electronics**, November 1997) by Larry Ball presents a really useful project. It can be used in place of the often-recommended (but expensive) variac for troubleshooting and initial power-up of a project. I especially liked the idea of making T1 into a current transformer by reverse connecting it to step up the voltage across R1–R4. The power resistors selected for R1–R4 should be "flame-proof" or "flame-resistant" for maximum safety; cement types are usually rated this way.

I noticed that the unused section of IC1 was left unconnected on the PC board layout. Any unused op-amp in a multi-amplifier IC **must** be properly terminated. The inputs are high-impedance antennas. If unterminated, the unused section of the IC would go into oscillation causing current flow in the IC substrate, which would adversely affect the other amplifiers in the package. The recommended method is to connect the unused inverting input to the output, and the non-inverting input to ground or to the output of another amplifier in the package. This config-

(Continued on page 11)

Multimedia Watch

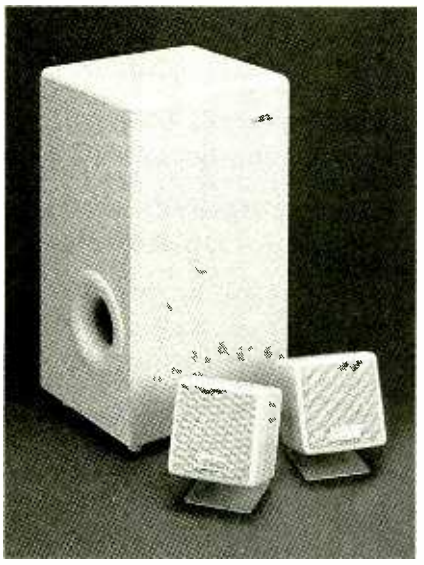
A Powerhouse PC

MARC SPIWAK
ASSOCIATE TECHNICAL EDITOR
COMPUTER RESELLER NEWS

My new powerhouse PC started out with a sample motherboard from TYAN Computer, manufacturer of one of today's more popular brands in that market. You see, soon after I started working at *Computer Reseller News (CRN)*, I benchmarked TYAN's new *Tahoe-2 ATX* motherboard, a dual-CPU motherboard with two very-rare-at-the-time 300-MHz Pentium II CPUs attached—I was told they were two of only a handful in existence. That board literally screamed, but I didn't do anything other than run some low-level benchmarks on it. Then it left the CRN Test Center along with the people from TYAN who had brought it in. A couple of months later, I received a production sample of the motherboard in the mail.

The motherboard was, at first, useless to me. The main problem was that we don't have extra CPUs just floating around the Test Center, not to mention the new Pentium II CPUs. When TYAN later asked how I was doing with the motherboard, I mentioned that I hadn't had any luck in getting CPUs. TYAN said they would try to get me two CPUs to test the board, but that 300-MHz units were still pretty hard to get. Evidently they were, because we had recently done a roundup of Windows NT workstations and only two out of 22 were 300-MHz machines—none of them had two CPUs. Anyway, a couple of days later I received two 266 MHz Pentium II CPUs in the mail.

At that point I was on a mission to gather the best peripherals I could find that would best befit something with two CPUs. Even though I didn't have the fastest CPUs in the world, there are other things that can be more important than clock cycles for certain applications. From the results of our workstation roundup (see the Test Center Web section of CRN at *www.crn.com*) and past experience, I knew that I would want a SCSI hard drive and an ultra wide one at that. I called a contact at Adaptec Inc. and asked about hard drives and what was the fastest out there. My contact sent me their SCSI adapters models *2940W* (wide) and *2940UW* (ultra-wide) to use. He also said that Seagate's 10,000 rpm *Cheetah* drive was one of the fastest hard drives. My contact at Seagate sent me a couple of *Cheetah* drives to play with. None of the workstations in that roundup had 10,000 rpm drives either.



Creative Labs' MicroWorks is a powerful amplified speaker system with 13-watt satellites and a 42-watt subwoofer.

Although I wanted to use a high-end OpenGL graphics adapter, I haven't been able to get my hands on one yet—full-blown ones cost a couple grand. So I decided to use a Matrox *Millennium II* sample that I had, which was the most popular graphics adapter in the workstation roundup. I grabbed 64 MB of RAM we had in the lab and was ready to fire up the motherboard.

I used both SCSI cards in the system—the ultra-wide for the hard drive and the wide one for connecting external SCSI peripherals and an internal CD-R drive. If you put a narrow, or 8-bit SCSI drive on an ultra-wide SCSI chain (16-bit), the whole chain drops down to narrow performance. That's why I let the ultra-wide card work exclusively with the hard drive. I used a 24X IDE CD-ROM drive from Teac that's as fast as any drive I've seen. And to top off the system I installed Creative Labs' *AWE64 Gold* sound card, which is my favorite sound card at the moment (see my review in the August 1997 column). The *AWE64 Gold* has no amplifier or IDE controller on board. I have good amplified speakers, and I never liked having the IDE controllers on my *AWE32*. Instead the *AWE64 Gold* has a SPDIF (Sony/Philips Digital Interface) output for a direct digital connection to DAT recorders or other equipment.

My hand-picked system sure is nice, and it's very fast with the right applications. For one, It has to run Windows NT—Windows 95 cannot use two CPUs, and neither can most applications, even under NT. NT can dole out individual applications to different CPUs, but an application itself must be written to support multiple CPUs for it to benefit from them. Microsoft *Access*, a database program, supports multiple CPUs.

Windows NT sure is strange in how it decides what to do with multiple CPUs. A benchmark test that a friend of mine over at *Windows Magazine* developed should have shown what two CPUs can do. The benchmark is a macro for *Access*, and it used to show the effect of two CPUs on a dual 200-MHz Pentium Pro machine. But there were reports that it wouldn't run any faster on a dual 266-MHz Pentium II system than it would on a single-processor system. My friend said that the macro took 97 seconds to complete on 166-MHz Pentium. I ran it on my dual-CPU system in 26 seconds.

My results being more than three times faster than a Pentium 166, I thought that it must be showing the effect of having two processors. Then I ran the macro on a single 266 system in the same 26 seconds. What gives? I ran NT's performance monitor and sure enough, only one CPU was active. As it turned out, Windows NT didn't see fit to use both CPUs on my dual Pentium II system, while it did on a dual Pentium Pro system. I had to run two instances of the benchmark concurrently (twice at the same time) to see the effect of the

two CPUs—it ran both in 27 seconds! And sure enough both CPUs were active. And, finally, I was happy. On hard disk-intensive tests my system excels, as it does with Windows graphics.

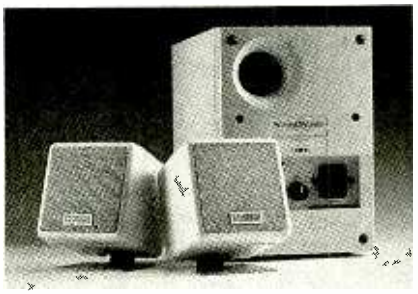
I recommend TYAN motherboards, as I've seen them in high-end systems for quite some time now, and the *Tahoe-2 ATX* at ($399) is a real screamer. Now I have to figure cut what to do with the system. I have it set up to dual boot either Windows NT 4.0 or Windows 95. But Windows 95, the multimedia operating system of choice, can't use both CPUs. The system would actually make a terrific server, but it would be nice if Microsoft could figure out how to let multimedia take advantage of multiple processors before this system becomes obsolete—or before I have to send all the parts back to the different companies. Oh well, by then state-of-the-art will be something completely different.

SOMETHING NEW FROM THE LABS

Creative Labs has partnered with 3Dlabs and its PERMEDIA 2 processor to create the new *Graphics Blaster Exxtreme.* It delivers superior 2-D and 3-D quality and upgradeability to future technology such as hardware DVD playback—all with affordable pricing. The *Graphics Blaster Exxtreme Value Edition* comes with 4 MB of 100-MHz SGRAM (Synchronous Graphics Random Access Memory) and with an estimated street price (ESP) of only $129.99. The *Graphics Blaster Exxtreme Home Edition* costs $149.99, comes bundled with a number of popular 3-D game titles, and it's upgradeable to 8 MB of SGRAM. The *Graphics Blaster Exxtreme Professional Edition* comes loaded with 8 MB of 100-MHz SGRAM for high-end resolutions, color depths, and refresh rates. It's a bargain at $199.99.

The *Graphics Blaster Exxtreme* provides full OpenGL support in both Windows 95 and Windows NT using an Installable Client Driver, which provides better performance over Mini-Client Drivers. It's hard to explain, but lots of cards "support" OpenGL, meaning that they can basically show it but not accelerate it. I haven't played with OpenGL very much, but demo programs for it crawl with most graphics accelerators. However they run acceptably well with a PERMEDIA 2 card—3Dlabs knows how to do OpenGL. And the *Graphics Blaster Exxtreme* is a bargain-priced PERMEDIA 2 card.

Creative Labs also sent me some



MicroWorks' younger brother, SoundWorks, has 8-watt satellites and a 33-watt subwoofer—and a much lower price tag.

PC speaker systems to look at or, more specifically, to listen to. The speakers are manufactured by Cambridge SoundWorks, a leading hi-fi manufacturer, and are designed by Henry Kloss. *MicroWorks* is a powerful amplified speaker system with tiny 13-watt satellites and a 42-watt subwoofer. The cube satellites are 4 inches square and the tower-style subwoofer is 17-½ inches tall with a relatively small footprint. The system's stereo mini-jack connector is compatible with PCs, CD players, TVs, or anything else with a headphone jack. It has a wired volume control that can be attached to any convenient surface. This *MicroWorks* system has great sound and plenty of power, delivered by compact satellites that don't clutter up my desk. I like this system, but with an estimated street price (ESP) of $349.99 it's obviously not intended for the casual PC user.

Creative Labs' *SoundWorks* system is well suited for people who wish they could have *MicroWorks* but can't really afford it. *SoundWorks* offers similar great sound but with less power and slightly smaller drivers. *SoundWorks* comes with 3-½-inch cube satellites with 8 watts of power each and a 33-watt subwoofer. Best of all, *SoundWorks* is priced at $219.99. *PCWorks* is a budget satellite/subwoofer speaker system that's a great step up from the cheap speakers that come with a lot of PCs. It offers Cambridge SoundWorks sound for the affordable price of $99.

NEW SOFTWARE

I often have to use Traveling Software's *LapLink* to transfer stuff from one PC to another. The latest revision of *LapLink*, version 7.5, works in Windows 95 or Windows NT, so it's even more useful to me. The software lets you transfer files, synchronize data, read and send e-mail, remotely control PCs, and more. Internet support provides worldwide remote control and file transfer. In fact, *LapLink* can connect over modem, serial or parallel cable, Internet, IPX and TCP/IP network, dial-up networking, IrDA, and ISDN. *LapLink* can connect PCs running Windows 95, NT, and 3.1, something Windows 95 can't do on its own. A simplified installation and configuration gets it up and running quickly. When you remotely access an NT system, you can use all of NT's built-in security such as user profiles with defined access rights. The ESP is $149.99.

Lockheed Martin and Boeing have been chosen by the Pentagon to design a prototype aircraft, using the latest in weapon and stealth technology, to service the U.S. Air Force, U.S. Navy and U.S. Marine Corps in the 21st century. Presently available as a new simulator game is the *Joint Strike Fighter* from Eidos Interactive. Ten million square miles of accurately modeled map data creates a very expansive and realistic terrain with an advanced graphics engine that provides a virtual 3-D environment in 16-bit color at resolutions up to 1024×768. Four flight campaigns are packed with ground targets, flight groups, and surface-to-air installations. In addition to the expected heads-up display (HUD) modes, *Joint Strike Fighter* also simulates views onto the HUD for a near-perfect view of the terrain at night or in bad weather. If a mission ends badly with you leaving the cockpit in an ejection seat, you still have to control your descent via parachute and perhaps evade the enemy on foot, armed with an automatic pistol. There's a lot to this game, and it's also one of the most advanced flight simulators in the world. Fly away with this simulator for $49.95.

Now you can beat the pros to the course with the latest addition to the Access software golf course lineup for Links, *Valderrama*, the site of the 1997 Ryder Cup. Desktop golfers can actually play the course before, during, and after the world's greatest golf contest. Resting between the Sierra Blanca mountains and the Mediterranean, *Valderrama* features distant views of Gibraltar and North Africa. Gnarled

WHERE TO GET IT

Activision
11601 Wilshire Blvd., Suite 1000
Los Angeles, CA 90025
310-255-2000
www.activision.com
CIRCLE 60 ON FREE INFORMATION CARD

Adaptec, Inc.
691 South Milpitas Boulevard
Milpitas, California 95035
408-945-8600
www.adaptec.com
CIRCLE 61 ON FREE INFORMATION CARD

Creative Labs
1901 McCarthy Blvd.
Milpitas, CA 95035
800-998-5227, 408-428-6600
www.creativelabs.com
CIRCLE 62 ON FREE INFORMATION CARD

Eidos Interactive
651 Brannan Street, 4th Floor
San Francisco, CA 94107
415-547-1200
www.eidos.com
CIRCLE 63 ON FREE INFORMATION CARD

LucasArts Entertainment Company
PO Box 10307
San Rafael, CA 94912
415-472-3400
www.lucasarts.com
CIRCLE 64 ON FREE INFORMATION CARD

Seagate Technology, Inc.
920 Disc Drive
Scotts Valley, CA 95066
408-438-6550
www.seagate.com
CIRCLE 65 ON FREE INFORMATION CARD

TouchStone Software
2124 Main Street
Huntington Beach, CA, 92648
800-932-5566
www.touchstonesoftware.com.
CIRCLE 66 ON FREE INFORMATION CARD

Traveling Software, Inc.
18702 North Creek Parkway
Bothell, WA 98011
425-483-8088
www.travsoft.com
CIRCLE 67 ON FREE INFORMATION CARD

TYAN Computer Corporation USA
1753 South Main Street
Milpitas, CA 95035
408-956-8000
www.tyan.com
CIRCLE 68 ON FREE INFORMATION CARD

cork trees garnish the terrain, accompanied by olive trees and wildflowers. This home of the annual Volvo Masters tournament was richly rewarded in '94 when the Ryder Cup committee selected Valderrama as the host of the '97 matches. Greens' fee for this program is at a manufacturer's suggested retail price (MSRP) of $29.95.

Shadows of the Empire from LucasArts is now available for 3-D accelerated PCs. Originally available as one of the first titles for Nintendo's new 64-bit home video game system, *Shadows of the Empire* chronicles a new chapter in the Star Wars saga in which the emergence of a criminal underground threatens to upset the balance of power in the galaxy. Set in the time between the Star Wars films, *The Empire Strikes Back* and *Return of the Jedi*, *Shadows of the Empire* features incredible high-resolution graphics; five types of gameplay; ten levels spread throughout four storyline twists; intense Star Wars sound effects and music; and new characters, vehicles and locales. *Shadows of the Empire* (at an ESP of $49.95) will take advantage of Direct 3D and supports a variety of 3-D acceleration cards. Also from LucasArts comes a *Handful of Missions* for the *Outlaws* game. This new collection of nine single and multiplayer levels requires the popular spaghetti western-inspired game *Outlaws*. *Handful of Missions* (free downloadable software at their Web site) is set in a time period years before *Outlaws*, when a young James Anderson is serving as a government agent and receiving assignments from the Attorney General.

Hexen II (MSRP of $54.99) from Activision goes to new gaming heights. You'll face death, pestilence, war, and famine on your quest to destroy Eidolon and all that he covets. Fortunately, you need not face this final battle alone, as you have made a truce with your prior enemies. *Hexen II* is like *Quake* but better—with more color, light, and several exterior levels to break up that dark, cave feeling. It uses the *Quake* engine, so everything in *Quake* shows up in *Hexen II*, but with different characters. Also from Activision comes *Blood Omen, Legacy of Kain* (MSRP of $42.99). Kain is forced into a quest that leads him on a tortuous journey of self-discovery as his curse of vampirism takes hold on his soul. You are Kain, damned to the savage existence of a vampire for all eternity. Revenge consumes you, as you journey through the depraved lands of Nosgoth in search of your murderers.

Last this month is TouchStone Software's recently released *PC-cillin 3.0*. This utility program arms computer users of all experience levels with protection from all types of viruses, with free Internet virus pattern updates for the life of the product. When an infected file is discovered, *PC-cillin* instantly removes the virus in the background, allowing the user to continue working without interruption. Its Active Update feature schedules virus pattern file updates to be downloaded from the Internet. *PC-cillin* makes all virus pattern updates free for the life of the product. If users are not satisfied with its performance, they can contact TouchStone Software within 90 days of purchase for a full refund. *PC-cillin v3.0* is available for an ESP of $44.95—and you won't have to call your doctor in the morning! ■

"Oh, I get it now. You throw some stuff in a box and then it does something or other."

DX LISTENING

Hallicrafters and Other Nostalgia

DON JENSEN

A while back I professed nostalgia about my first real shortwave receiver, a used Hallicrafters S-41G Skyrider Jr. This six-tuber, circa 1946, was no wimpy living room console with a furniture finish. It had a clunky metal cabinet, finished in black and crackled-finish gray enamel, a front full of slide switches and knobs, and even a place to plug in a nifty set of WWII Air Corps surplus headphones. It was, at least to my innocent eyes, way back when—a true DX machine.

Reader Robert Davey sent along a photo of his 50-year-old shortwave receiver, a Hallicrafters Skyrider Jr.

Well, it seems I was not alone with my memories of yesteryears' shortwave radios. I received a number of letters from readers with similar nostalgia for a favorite receiver.

Robert S. Davey of Frankfort, IN, also has an S-41G Skyrider Jr. "I purchased it several years ago at an Indiana Historical Radio Society Show," Robert writes. "It's still in use, and while it is not an ICOM, it does a very good job despite its age."

Robert says he also has several other vintage communications sets, including an old Hallicrafters S-20R Sky Champion and a pair of RadioShack receivers from more recent years, a Heathkit DX-160 and a DX-302. "And several years ago, I built a replica SW receiver, called the 'DX-er,' whose plans first appeared in *Shortwave Craft* magazine in July 1934. It is a two-tuber (number 30 tubes) regenerative receiver. I wound the coils on four-pin tube bases. It works fairly well too."

I also heard from Gerald Edson of Branson, MO, whose ham radio call is WAØKNW.

"I could directly relate to your nostalgic comments," Gerry writes. "I also grew up during the '40s and was an avid shortwave listener. I built a two-tube regenerative receiver at the age of 10. Strangely enough, it worked the first time I turned it on. My projects today should do so well!"

I wonder, Gerry, if it was the same "DX-er" regen that Robert built.

Edson continues, "Our family receiver was a General Electric table model. If memory serves me correctly, it had eight or nine tubes and was AC powered. Band selection was via a set of push buttons on top of the cabinet, which was beautifully finished wood. There was no back cover, making it very tempting for a curious young boy to peek in and see what was there. I must admit there were a few times when the fingers entered that sacred space. Fortunately, I never received any electrical shocks!"

The Edson family radio had no beat frequency oscillator (BFO), so code transmissions sounded like a series of thumps. "Nonetheless," Gerry continues, "I still learned to copy those thumps well enough to eavesdrop on CW transmissions. Who could have guessed that this 'cast-iron' knowledge of the code would, many years later, lead to an amateur radio license. What this all boils down to is thank you for bringing back fond memories of an earlier time when, it seems, everything was simpler, less complicated, and more exciting. Sometimes it seems as though the challenge is gone with today's technological advances."

Thanks, Gerry and Robert, for the memories! But maybe there are some challenges left.

SOMETHING OLD

Skip Arey, writing in *The Journal of the North American SW Association*, put it this way, recently: "Building crystal sets is Fun!" Reviewing a new book by an organization called *The Xtal Set Society*, Arey says that "taking a bunch of inexpensive parts and several everyday items around the home and turning them into a working radio is a great extension of the radio art." The 160-page book is called *Crystal Set Projects: 15 Radio Projects You Can Build.*

"Most anyone who has been in the radio hobby for a bit knows the basic crystal set design," says Arey. "A coil of wire, a diode, and a high impedance earphone; and you are on your way.

(CREDITS: Brian Alexander, PA; Mark Humenyk, ONT; William McGuire, MD; Mark Mohrmann, VT; Bob Montgomery, PA; Ed Newbury, NE; Jay Novello, NC; Denis Pasquale, PA; Sheryl Paszkiewicz, WI; Gerald Readore, TX; Giovanni Serra, ITALY; John Sgruletta, NY; North American SW Association, 45 Wildflower Road, Levittown, PA 19057).

But I remain constantly amazed at how people have been able to update and improve upon this basic design to create some devices with real performance quite literally worth listening to."

The latest in a series of publications by The *Xtal Set Society*, the book includes both receiver and antenna projects, with "dozens of examples of down-home ingenuity," Arey notes. For example, the traditional crystal set used a cylindrical *Quaker Oats* box as a coil form. A modern update uses a plastic one liter soda bottle instead.

"It takes a heck of a lot less time to drain a soda bottle than it does to eat all those dishes of oatmeal," he points out. "Or, how about using *Tinker Toys* to construct a loop antenna frame? Crystal set builders in the *Xtal Set Society* take great pride in constructing as many of the components of their sets from raw materials as they can. Homemade capacitors thrive in this world."

If nothing else, Arey writes, "the book jogs your mind into looking at the world around you in different and more resourceful ways."

Crystal Set Projects: 15 Radio Projects You Can Build ($14.95) is available from *The Xtal Set Society*. Arey also recommends membership in the organization, which publishes a bimonthly newsletter. Membership costs $9.95 a year ($11 U.S. for Canadians, and $16 U.S. for those living overseas).The society's address is P.O. Box 3026, St. Louis, MO 63130. The Fax number is 314-725-7062; for e-mail: xtalset@midnightscience.com. There's also a Web site you may want to check out: *www.midnightscience.com*.

AND SOMETHING NEW

When grizzled old-time DXers get to talking over beers at radio gatherings about the world's toughest shortwave loggings, a handful of target stations (past or present—some heard and others still only hoped for) keep cropping up in the conversation. Invariably, this short list of nigh-impossible catches includes the low-powered broadcasts aired from Tristan da Cunha, a rocky dot in the south Atlantic; from Bhutan in the shadow of the mighty Himalayas, and from the Republic of Maldives, a set of idyllic isles off the tip of the Indian subcontinent.

Now, though, it seems that the Maldives may be a much easier SW logging.

A.W. Smith, Coral Gables, FL, writes that he heard an item on one of the DX programs about a new shortwave transmitter for the Voice of Maldives. "Australia," he writes, "is to provide a new 10-kilowatt shortwave transmitter for the Maldives. The Maldivian president was to visit Australia in late 1997 for formal ceremonies sealing the deal. The Maldives government supposedly already has selected the site for the new and upgraded shortwave station. No word on the frequency to be used, though."

That's good news for serious SW DX enthusiasts, A.W. With 10-kW power and, hopefully, a decent frequency and schedule, North American shortwave listeners should have a reasonable chance to finally log this station. With luck, this could be operating some time this year.

DOWN THE DIAL

Looking for some SW stations to tune? Try these listening tips.

ALBANIA—7,110 kHz, Radio Tirana observed in English at 2100 UTC with news and political talk. It broadcasts in parallel on 9,515 kHz. Later, around 0230 UTC, look for Tirana in English on 7,160 kHz.

CONGO—4,765 kHz, Radio Television Congolese. With two Congos these days, it can get confusing. This one is located at Brazzaville, in what once was known as French Congo. Look for it around 0430 UTC with African music and drums and French announcements.

GERMANY—6,085 kHz, Bayerischer Rundfunk, one of Germany's privately owned SW outlets, is noted with programming in German around 0220 UTC.

HONDURAS—4,820 kHz, La Voz Evangelica. The marimba is a Central American musical instrument, a sort of wooden xylophone, with a distinctive and melodious sound. When you hear marimba music on shortwave, you can be almost certain that the station you're hearing is in either Guatemala or Honduras. You may hear this Honduran SW outlet with marimba melodies and Spanish language announcements during the evening, from about 0030 UTC, and in the early morning, from around 1100 UTC.

HUNGARY—6,120 kHz, Radio Budapest broadcasts on this frequency at 0100 UTC. Or try 9,580 kHz. English programming includes news, identification and the program, "Hungary Today."

INDONESIA—9,525 kHz, Voice of Indonesia, Jakarta, has a full hour of English between 0800 and 0900 UTC. It has been heard here with news of Indonesia and Indonesian music. Many identifications as "Voice of Indonesia."

MEXICO—6,105 kHz, XEQM in Merida, Yucatan, returned to this longtime frequency, IDing in Spanish as Tus Panteras. It has been logged with Spanish programming, including political ads and promotions for its AM and FM sister stations. This, reportedly, uses a very modest 250 watts of power.

PERU—4,991 kHz, Radio Ancash, broadcasting from Huaraz, has been heard during the early morning time period, after around 1000 UTC, with great music with the flavor of the Andes region of South America. Spanish announcements and identification are heard at 1100 UTC.

SOLOMON ISLANDS—5,020 kHz, Solomon Islands Broadcasting has been heard from around 1000 UTC with programming in a Pidgin dialect, including sports, advertisements, identification, and news.

SOUTH AFRICA—3,955 kHz, Channel Africa broadcasts here with news in Chinyanjan, one of the many African tongues, about 0330 UTC. For English language programs, though, try Channel Africa on 5,955 kHz at 0315 UTC.

SURINAM—4,991 kHz, Radio Apintie may be audible here after 0800 UTC with Dutch programming, until Peru's Radio Ancash, (see above), signs on just before 0900 UTC.

SWEDEN—7,135 kHz, Radio Sweden can be heard here during the 0230 to 0300 UTC time slot with English programming, including a newscast and the Nordic feature, "60 Degrees North."

YEMEN—9,780 kHz, Radio Yemen, broadcasting from Sana´a, has Arabic language programming around 1745 UTC. Don't expect much more than a weak signal though, and interference may be a serious problem, too.

ZAMBIA—6,165 kHz, ZNBC's Radio 2, in English, operates here from 0246 UTC sign on. Look for its distinctive coming-on-the-air tuning signal, the screech of the native fish eagle. The playing of Zambia's national anthem follows. Expect interference from Radio Nederland. ■

LETTERS

(continued from page 5)

ures the unused amplifier section as a stable unity-gain voltage follower. For IC1 in the schematic (Fig. 1), simply connect pin 12 to pin 11, and connect pin 13 to pin 14. This is easy to correct on the PC board layout in Fig. 2, as well.

I have two suggestions that might make this excellent project a bit more flexible. Replacing S3 and all its trim pots with a single 50k-ohm pot and 100-ohm series resistor would provide a continuously variable fuse rating between 0.1 amps and 7 amps. You could hand-calibrate the scale for any individual fuse ratings you desire. Use a panel-mount conductive plastic pot, such as the Clarostat 381 for long service life (Digi-Key 381N253-ND or Mouser 560-381N-50K). My other idea is to add a switch and integrator circuit between IC1's pin 1 and pin 5. This could select between the present fast-trip and a simulation of the "slow-blow" or time-delay fuse characteristic.

C.H.
Tinton Falls, NJ

The article, "Build the FuseSaver" (**Popular Electronics**, November 1997) was an interesting one. However, it should have pointed out that this circuit will only work on AC circuits. If someone uses it on DC, it will never blow.

G.L.
via e-mail

AN AUTHOR RESPONDS

A reader asked about my article, "Safety for Electronics Hobbyists" (**Popular Electronics**, October 1997). He questioned why the power company grounds the center tap of the transformer, causing a potentially lethal hazard, and what purpose it serves. He had asked several electricians, who were unable to give him an answer.

My reply may be helpful to others; so here it is. The grounded power system is used in almost all countries of the world for two reasons. First, by using the Earth as a return, companies can get away with using half the copper or aluminum wire needed if a balanced system were used instead. A zillion miles of one wire cost a whole lot less than a zillion miles of two wires. This scheme is especially useful for long-distance and local transmissions. The other reason (which pertains more to your question) is that it allows them to use a balanced transformer, i.e. one with a center-tap, to provide two different voltages: 120 and 240 VAC. The 120-VAC circuits are optimal for small appliances, while 240 VAC is used for large high-powered items, where it reduces the needed current by half.

Another reader took me to task for using 110/220 VAC to indicate the standard system. He claims that it is really 120/240 volts. He's right, but also wrong. A local power company engineer told me that the standard is actually 105 to 125 volts (which includes both 110 and 120 VAC), although my company holds to a higher standard of 117 to 125 volts. As I am writing, the voltage monitor above my workbench reads "124 volts." In general, light bulbs are rated at 120 VAC, motors at 115 VAC, and old radio transformers at 117 VAC...but they all plug into the same 105 to125 volt line and work well!

Joseph J. Carr
via e-mail

(Continued on page 70)

SCANNER SCENE

Help is Here—with the Sound Enhancer!

MARC SAXON

For the ultimate refinement in scanning (or even HF monitoring), try reprocessing (read that "clean up") the received audio in order to enhance its intelligibility and quality. Modern communications equipment and accessories are noted for their poor audio. At times, this can make monitoring difficult, fatiguing, and frustrating. Did that dispatcher say "5 Fox Road" or "Firefox Road"? Those weak cordless phone signals from fringe coverage areas can't be understood. Help is here!

The new *Grove SP-200B Sound Enhancer* improves sound dramatically, often bringing barely readable sounds up out of the hiss and background mire. Using all-analog circuitry to avoid the distortion contributed by many digital signal processors (DSP), the SP-200B combines a powerful audio amplifier and a four-inch speaker with separate bass and treble equalizers. The variable notch/peak filter is used to reject interfering tones or to boost desirable audio. Also included is an adjustable noise limiter that reduces irritating pulse interference, a variable-hang 0–45 second squelch control that removes background noise between sound transmissions, and a tape-recorder activator. For privacy, the unit's internal speaker may be switched off while audio is monitored via a front-panel headphone jack, or redistributed from a rear-panel jack.

The Grove SP-200B Sound Enhancer improves sound dramatically, often bringing sounds up out of the hiss and background noise.

The Grove SP-200B Sound Enhancer is constructed of sturdy, black-finished aluminum, has white legends, and is housed in a good-looking oak cabinet. It operates from either 12 VDC for use as a mobile unit, or from an optional 12-VDC power supply for at-home use. The SP-200B sells for $199.95, plus shipping. This worthy scanning accessory comes from Grove Enterprises, Inc., 7540 Highway 64 West, P.O. Box 98, Brasstown, NC 28902; Tel. 800-438-8155; Web: *www.grove.net.*

MAILBAG: CAN WE HELP?

The *RadioShack Weatheradio* has the ability to be programmed with a FIPS code, but according to several letters we received, the owner's manual doesn't list the various codes. The question is do we have these codes.

No, but we can tell you where to get them. FIPS (also known as SAME) is an encrypted signal sent out to alert owners of certain programmable weather receivers about approaching severe weather. FAQ about this is on the NOAA Web site (*www.nws.noaa.gov/ohx/sr/same.htm*), which also links you to information about the codes. You can also get the codes by calling their toll-free number: 888-NWR-SAME.

Ronnie, in Paducah, KY, reports that the Tennessee Valley Authority (TVA) Police have vehicles operating in his area and asks for the frequency they use. Says he's never read any information about this agency or its communications, yet he regularly sees their vehicles.

The TVA is a federal agency, and its police vehicles regularly operate in Lyon, Livingston, Marshall, Calloway, McCracken, and Trigg Counties, KY, and in Stewart and Henry Counties, TN. TVA Police have full law-enforcement powers and routinely pull vehicles over for traffic violations on public highways. They also participate with other police agencies in weekend alcohol roadblocks. The TVA Police HQ in Golden Pond, KY, operates on 166.325 MHz. Their signal covers a wide area and has been reported by monitors as far north as Evansville, IN. The TVA Police mobile units are also capable of operation on Kentucky State Police and Tennessee Highway Patrol channels during joint operations.

A letter from Alan, in Florida, asks "Where'd they go?" He's referring to the Security Police and Base Fire Dept. channels at MacDill Air Force Base, which used to be very active but sud-

denly went dead. We found out that the Security Police are now officially known as Security Forces, reflecting their increased role in protection and anti-terrorist activities. With the name change came a frequency switch from the old 163.4875-MHz channel to the new 163.4625 MHz. And, for whatever reasons, the Base Fire Dept. has now dropped 173.5875 MHz and moved on up to 408.75 MHz.

TRUNKED COMMUNICATIONS

Two questions about trunked communications appear to be on the minds of a number of readers. First, they ask why trunking is done only in the 800-MHz bands. The answer is that trunking isn't restricted to those bands, even though the *Uniden Trunk Tracker* scanner is designed to work only with 800-MHz systems.

True that, at the present, the FCC has licensed trunked systems in only these bands; however a number of federal agencies now operate trunked systems in other bands. Federal agency stations (as well as those operated by the military) aren't licensed by the FCC. For example, the Army's Fort A. P. Hill (in VA) has five trunked frequencies in the 141.20–143.40-MHz range. Some civilian agencies use trunked systems in the 406–420-MHz band.

Our other popular trunking-related question asks if it's true that Motorola is suing Uniden because of its manufacture of the Trunk Tracker scanner, as per the popular buzz that has been circulating in the hobby. According to the people who should be in the know, there is no truth whatsoever to this rumor.

AIR AND SPACE TALK

Interesting monitoring on 129.5 MHz and 131.175 MHz. These frequencies appear to be used respectively by Delta Airlines and American Airlines, and possibly used on a national level. Lots of fascinating chatter as pilots complain about difficult passengers and unresolved equipment problems. These complaints range from hilarious to scary. You wouldn't believe half of them without monitoring them yourself. Check out the 128.8–132.0-MHz band for many of these types of frequencies, as every airline has them scattered amongst their other communications.

What with all of the trouble they have been having aboard the MIR space lab, you might wish to keep an ear peeled on 143.625 MHz (NFM). When it passes over my radio horizon, it puts out a rather decent signal for a few minutes. They're mostly speaking in Russian. Once, however, I heard the Russian cosmonaut explaining in flawless English to someone on the ground that while he can *speak* English, he doesn't reply quickly because he *thinks* in Russian. He felt this could be a problem should an emergency arise if the American astronaut went on a space walk with him. MIR's ham radio downlink is 145.20 MHz, with simplex on 145.80 MHz. Though I have not personally monitored the following, supposedly MIR has a beacon operating on 121.75 MHz, as well as data transmissions on 166.13 and 165.875 MHz.

KEEP IN TOUCH

Let us hear from you with frequencies, ideas, and questions. Our direct e-mail address is: Sigintt@aol.com. Or write to Scanner Scene, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

GIZMO®

HOME THEATER, PART III

Whew! This is it, the wrap-up of our special Home Theater designs, plus some great new products.

HEARD, BUT NOT SEEN

ACOUSTIMASS-6 HOME THEATER SPEAKER SYSTEM. Manufactured by Bose Corporation, The Mountain, Framingham, MA 01701-9168; Tel. 800-288-BOSE. Price: $699.

Speakers can make or break your home-theater system. Their tonal qualities can color the sound of movie soundtracks and music. Mismatched or unbalanced speakers can distort the surround-sound so that the on-screen action and the accompanying sound are not properly in synch. With such speakers, bass performance can sound boomy; conversely, with inadequate bass response, much of the exciting, you-are-there feeling is lost.

For all those reasons, buying a matched set of speakers specifically intended for home-theater use is a logical, safe choice. Add economy and unobtrusiveness to the mix if the package you buy is the *Bose Acoustimass-6*.

The set consists of five tiny (3-½ ×3×4-¾ inch) cube speakers and the Acoustimass bass module, which measures 14×7-½×16-½ inches. Three of the five cubes are intended to be arrayed at the front of the room (center, right and left); the other two provide the surround sound. The module can be hidden anywhere in the room. To make the set even more invisible, you can choose either from scratch-resistant black or textured Arctic white finish, depending on your decor. Color-coordinated floor stands, wall/ceiling-mount brackets, and table stands are available options.

The speaker system is based on Bose's patented Acoustimass technology, which overcomes two traditional speaker-design obstacles: bulk and placement. Conventional speakers require both tweeters and woofers to reproduce the complete frequency range. Bose designed a 2-½-inch speaker driver that was not any smaller than an ordinary tweeter, but was able to produce much of the midrange as well as the high notes. That driver is housed in a cube that is literally pint-sized. The cube is a Direct/Reflecting speaker designed to deliver sound waves to the ear both directly and by bouncing them off surfaces, much as sound is heard in a concert hall. The cube disperses the sound more widely and covers a larger area than a conventional speaker can.

While high-frequency sounds are directional, low-frequency sounds cannot be localized—you shouldn't be able to distinguish their source, unless distortion gives their location away. Ideally, the bass sounds should envelop you. To get rid of the excessive vibration that can cause distortion, Acoustimass technology does away with the traditional method of launching low-frequency sound waves: vibrating a large woofer cone. Instead, bass sound waves are dispersed on a mass of air. Two 5-¼-inch woofers are located in between separate acoustic compression chambers in the Acoustimass module. Speaker-cone movement excites the air trapped within those chambers. The trapped air acts as "an acoustic spring" that produces more bass sounds with less power. The more efficient system requires less cone motion for less distortion. And, according to Bose, any distortion that might be produced

remains trapped within the acoustic chambers.

The module also incorporates Bose's Adaptive Energy Summing speaker design, said to "electro-acoustically combine multichannel low-frequency energy in a controlled and predictable manner from a single Acoustimass module." In other words, it does away with the need for additional subwoofers and allows the use of the tiny cube speakers.

The Acoustimass module can be placed just about anywhere in the room, as long as it is not within two feet of the screen (it is not magnetically shielded). Ideally, however, it should go at the same end of the room as the front- and center-channel speakers, and corner placement will emphasize its bass output. With proper placement of the six speakers (the manual suggests a few possible arrangements), it's possible to achieve realistic surround sound from both Dolby Pro Logic and Dolby Digital sources.

Setup is simplified by the inclusion of adequate lengths of cable—and by the cables themselves. Bose provide enough cable to allow up to 20 feet between the Acoustimass module and the receiver (the Acoustimass-6 is compatible with A/V receivers rated from 10 to 100 watts designed to be used with speakers rated for 4 to 8 ohms), up to 20 feet between the module and the front and center speakers, and up to 50 feet between the module and the surround speakers. All three cables come connected to the Acoustimass module. Each set is joined together to form a flat ribbon of cable that can be separated as needed to reach the various speakers or receiver inputs. Each cable run ends in black or gray cable connectors that are embossed with a letter to identify the cube speaker, output, or input it matches. All connections are clearly explained and illustrated in the manual. We had all six speakers up and running in less than five minutes—albeit with rather sloppy cable runs. With the installation complete, the included module end cover can be installed at the back of the Acoustimass module to hide the cable connections.

The Acoustimass-6 sounds incredible given the cube speakers' diminutive size. The Acoustimass module was ready to deliver that extra oomph when it was called on by the home-theater program material—just what's expected of a true home-theater speaker system. That's not to say that the Acoustimass-6 is strictly a home-theater system. The speakers performed wonderfully on any music we steered their way. They created a seamless soundfield, and individual speakers couldn't be localized. Heck, they were so small, we couldn't even see 'em!

THE BEST OF BOTH WORLDS

PIONEER ELITE DVL-700 DVD/LD/CD PLAYER. From Pioneer Electronics (USA) Inc., 2265 East 220th Street, Long Beach, CA 90810-1639; Tel. 800-746-6337; Web: http://www.pioneerelectronics.com. Estimated street price: $999.

Not everyone is 100% gung-ho on the new DVD format. Many videophiles out there shudder at the thought of their extensive—and expensive—collections of laserdiscs becoming obsolete, and their LD players becoming dinosaurs like reel-to-reel or Elcassette tape recorders or Betamax video recorders.

It's a dilemma, all right. Do you add a DVD player to the ever-increasing crowd of components in your entertainment center, while leaving your aging LD player in place? That way you can keep watching your laserdisc library while you begin to collect DVDs. Hopefully, by the time your old LD player finally bites the dust, you'll have amassed a sufficient number of DVDs so that you can relegate your LDs to the attic (with your LPs). Or do you sit on the fence for a while, waiting to see if DVD really takes off (but missing out on the thrill of being the first to have the best)?

For true video *aficionados*, nothing short of DVD—*now!*—will do. Its better than 500 lines of resolution really do represent a noticeable improvement not only over VHS's 240 lines, but also over LD's 450 lines. Also, video is encoded on DVD discs as component video, not composite video, so that it is possible to eliminate the NTSC cross-chroma and cross-luma artifacts that plague even laserdiscs.

Pioneer offers a solution to bridge the gap between today and tomorrow. The *DVL-700* deck plays DVDs, LDs, and CDs, allowing you to continue enjoying your laserdiscs, and also jump right onto the DVD bandwagon.

This unique combi-player features an unusual tray-within-a-tray design. The 12-inch laserdisc tray spans the center of the front panel. Right in the middle of the laserdisc tray is a smaller DC/DVD tray. At the upper-right side of the front panel are two separate OPEN/CLOSE buttons, one for each tray, along with a STOP button. Below those, directly to the right of the laserdisc tray, is a large square PLAY/PAUSE button, flanked by two LEDs that indicate whether side A or side B of a laserdisc is playing. Above the tray is a light that indicates when a disc is inserted in the player. It glows blue for DVDs and green for CDs and laserdiscs.

The lower portion of the front panel contains the fluorescent display with the POWER button to its left. To its right are found a button labeled FL OFF (which extinguishes the display), the remote sensor, and forward and reverse buttons.

Like much current A/V gear, the rear panel of the DVL-700 can be a little confusing at first glance, but almost without a doubt, it is simpler than any A/V receiver you're going to hook it up to. Its video outputs consist of a pair of composite-video jacks and a pair of S-video jacks. Its audio outputs consist of two pairs of RCA-type audio jacks for right- and left-channel audio, two coaxial digital output jacks, one optical (Toslink) digital audio output jack, and one AC-3 RF output.

So what audio output should you use? Well, if you have a Dolby Pro Logic A/V receiver without any digital inputs, then the obvious (and only) choice is to use the standard R/L audio outputs. If you have a Pro Logic receiver that includes a PCM input for direct digital connection to a CD player, then you'd want to use a combination of the standard audio outputs and either the Toslink or coaxial digital output. If you have a Dolby Digital receiver, then you'd want to use a digital output for DVDs and CDs. However, for laserdiscs, your receiver would have to have an AC-3 RF input, because the Dolby Digital information on a laserdisc is encoded as an FM signal on the audio track, and it is output from the laserdisc player as an AC3-encoded RF signal.

Except for loading discs, you'll find yourself using the remote control for virtu-

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ally all operations. The remote features a rounded portion toward the top that contains the most-often-used controls, arrayed around the ENTER button. The "inner circle" of controls comprises the PLAY/PAUSE button on top, the FORWARD and REVERSE buttons to the right and left, respectively, and the STOP button on the bottom. Surrounding those are found, clockwise from the top, MENU, RETURN, NEXT, PREVIOUS, and TITLE buttons. At the very top of the remote control are two round buttons labeled POWER and STOP/OPEN/CLOSE. A set of nine buttons (arranged in rows of three) found just below the rounded portion of the remote includes controls for taking advantage of some of the convenience/user preference features offered on some DVD discs, as well as volume level. The VOLUME control, however, affects only the analog outputs. It's intended mainly as a way to match the output of the player to the outputs of other components in your system.

The bottom half of the remote control slides open to reveal yet more buttons. There's a numeric keypad, as well as buttons used for programming, selecting play mode, and for changing sides on a two-sided laserdisc.

One of the drawbacks of laserdisc viewing is the need to get up and manually flip over a disc to see the second half of a film. The DVL-700 does the flipping for you, with just a press of the disc side a/b button. Unfortunately, you'll still have to get up and flip over a two-sided DVD. What—you thought that a movie could fit on a single-sided DVD? Well most movies can. Interestingly, however, not all do.

Take *Michael Collins*, for example. It's about 135 minutes long—theoretically long enough to fit on a single-sided, single-layer disc. However, the capacity of the DVD format is based on an assumed video bit rate of, say, 10.5 megabits per second (mbps). However, that's just an average. Scenes with more detail or more action can take more. Scenes with neither take less. When the producers of the disc were encoding the scenes from the epic film, they chose quality over convenience. (They knew that since they were including a 50-minute documentary on the historical Collins figure, they were going to need two sides, anyway.) The result is a movie that looks as close to film as we've ever seen on TV. Unfortunately, the first side ends in the same abrupt fashion as a laserdisc.

The DVL-700 has a convenient Last Memo mode, which remembers various picture, audio, display, and mode settings, and even the location to begin playing from when it is started up again. The settings for up to five DVDs can be remembered. Information for only one laserdisc can be stored; when the laserdisc is played, the location will be deleted from memory.

In addition, a Condition memory can store the aspect ratio, display mode, subtitle mode, audio mode, and on-screen display position for up to 30 DVD discs. That's a great convenience. For example, Columbia Tristar DVDs that we've seen automatically come up in subtitle mode, while others automatically come up in Pro Logic instead of Dolby Digital. The DVD standard gives discs that kind of control over player operation. The DVL-700's Condition memory takes that control back.

Several display modes are available on the DVL-700. Cinema 1 leaves the picture alone, but turns off any display window. Cinema 2 leaves the display window off, but changes the picture to increase the contrast and sharpen the blacks. The Animation mode emphasizes colors so that cartoon animation is enhanced. The standard mode turns everything back to normal.

The on-screen display of the DVL-700 provides a convenient, easy-to-use way to control some of the player's functions. One of the best selections from the menu is "Click Sound" that causes the player to emit a beep through its digital outputs with each push of a remote-control button. That might sound like an annoyance. But in our opinion, it isn't. Typically, because DVD players are somewhat slow to respond to button pushes—when compared, at least, to something like a channel-change command—we often found ourselves not knowing whether players had accepted our commands. With other DVD players we'd tried—and this one, before activating the beeps—by the time the player responded, we had impatiently pushed the button again, and ended up fast-forwarding further than we'd intended. With the "click" turned on, we knew immediately.

We've mentioned that the DVL-700 is compatible with DVDs, laserdiscs, and CDs. It can also read CD singles, 5-inch CD videos and Video Single Discs (which are discs that hold digital audio and up to 5 minutes of video), 8-inch LaserVision discs, and 8-inch LD Singles. However, Video CDs, which are MPEG-1 discs that hold up to 74 minutes of digital video and audio, cannot be played.

In operation, the DVL-700 performed well when playing laserdiscs, CDs, and DVDs. For the most part, it did an excellent job playing DVDs, but there were a couple of exceptions. First, when we were putting the player through its paces as we were learning how it worked, there were a couple of times that it just hung up. We didn't get any error messages or the like, the player just stopped responding. Then we found the following note in the manual: "During some function operations, the picture may be stopped or the operation buttons may become inoperable during playback. In this case re-start playback after stopping the player." It wasn't a frequent occurrence, but we would be remiss not to mention it.

The only other anomaly that showed up was a rare display of MPEG artifacts. We have seen this kind of pixelization in other players, too, and it seems to be due to peculiarities in the MPEG decoders. It happens infrequently enough (we saw it once in one scene in *Michael Collins*) to write it off as inconsequential.

All in all, the DVL-700 is a solid performer. Its fit and finish is top-notch. Although it's got plenty of features, it's easy to use. Perhaps most important, it not only gives you access to the more than 8000 laserdisc titles available—and saves your laserdisc library from obsolescence—but it opens the world of DVD video to your home theater. And once you get used to DVD, there's just no turning back.

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TESTING 1-2-3

VIDEO ESSENTIALS DVD: OPTIMIZING YOUR AUDIO/VIDEO SYSTEM. From Joe Kane Productions, 831 State Route 10 East, Suite 12, Whippany, NJ 07981-1154; Fax: 201-386-0203; Web: http://www.videoessentials.com. Suggested retail price: $49.99.

Your new home theater is all set up. Dolby Digital A/V receiver, DVD player, large-screen TV, surround-sound speakers, all ready to go. But when you pop in a movie, everything seems, well, just a bit *off* somehow. The colors are not quite right, it's difficult to make out the action in low-light scenes, the dialog gets lost whenever the background sound swells, or perhaps the movement of the soundtrack doesn't seem to match the on-screen action.

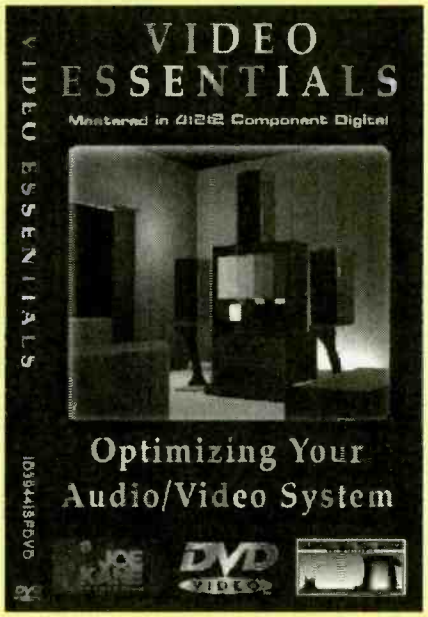
Let's face it: Home theater doesn't come out of the box looking and sounding perfect. It's not a microwave oven that you can just take home, plug in, and pop a perfect bag of popcorn. Even after you've checked and double-checked all your A/V connections, some adjustments are likely to be needed. Speaker placement can make a big difference in sound, as can surround-sound timing. Those color and contrast adjustments on your TV can make the difference between realism and a poor substitute.

Even subtle changes can make major differences in your listening and viewing pleasure. But not all of us have perfect ears or eyes. And even if we did, it wouldn't matter. We've all been taught and trained to set up our home theaters the wrong way. So how can we tell if our home theaters are properly configured to produce the optimum sound and video? We can do it the way the pros do, using a test video such as *Video Essentials: Optimizing Your Audio/Video System*. A similar laserdisc version has been available for years; here, we'll look at the newer *Video Essentials* DVD disc.

The disc serves two complementary purposes: It shows you how to fine-tune your audio/video system so that it provides the best possible performance, and it clearly explains each component's role, separately, and as part of a system.

You'll have to get your DVD player connected to your monitor and receiver, before you can use the disc, which must be played on your DVD deck. Fortunately, the disc's "liner notes" include a rundown on properly connecting a DVD player to a display device and audio gear. It emphasizes the importance of using component- and S-video connections rather than composite (which will add artifacts such as dot crawl and color moire), or RF (still more noise and less picture detail) connections.

The notes included on the packaging go on to discuss the type of video cable to use, calibration techniques, and audio connections, providing some interesting pointers and insights across the board. For all the details, however, let's turn to the disc itself.



Video Essentials is divided into 16 Chapters. You can watch the disc all the way through—which we would highly recommend for new home-theater installations—or use your DVD deck's search capabilities to go to the chapter that deals with a specific problem plaguing your system.

Video Essentials states its purpose from the start. It's designed to allow you to "experience the intentions of the artist"—the film maker—"without letting your home-theater system get in the way." That means relying not on what you think the picture *should* look like, but on objective tests that reveal what the picture is *supposed* to look like. It means setting up speakers and a surround-sound system to recreate as closely as possible the original soundtrack.

Although most of the disc is devoted to video concerns, audio tests are tackled first, for an important reason. It takes at least a half hour for your monitor to warm up completely. By the time you've finished the audio portion of the disc, your equipment should be ready for the video tests. No final video adjustments should be made unless the set has been on for at least 30 minutes.

The first chapter of the disc offers a tour of the audio/video system. This overview is must viewing for newcomers to home theater. Without going into confusing detail, it explains the basic functions of picture-adjustment controls and that their proper setting requires test patterns *and* the knowledge of how to use them. It looks at other factors, such as ambient light and the color of the wall behind the TV, that affect the picture. *Video Essentials* goes on to explain the basics of stereo, Dolby Pro Logic, THX, and Dolby Digital sound systems, with brief demonstrations of how each should sound if properly calibrated. Accompanied by on-screen graphics that indicate where the sound should be coming from at all times, the sound moves from left to right to center channel, briefly becomes diffuse ("lost in space"), and then moves back to specific speakers.

At the close of the audio/video introduction, viewers are instructed to find a seat in the center of the room and to gather up the remote controls for their A/V receiver, TV, and DVD deck. Once you are prepared, the tests begin.

The first test starts off with a repeat of sounds moving around the room, which should match the on-screen graphics. If the sound and picture don't match, check the system connections. If diffuse sounds still easily occur, the test disc instructs you how to check the polarity of the wires.

Once you're sure of the proper connections, check the sound from source to speakers. This series of tests requires the use of an inexpensive sound level meter, readily available at RadioShack. After explaining how to properly set the meter and how to hold it for testing speakers and subwoofers, *Video Essentials* walks you through tests of the output level of the surround-sound decoder, by playing pink noise through the left, right, center and surround channels. There's also a subwoofer-level check and a center-channel polarity check.

If needed, you can set up an A-B loop to give you more time for each of the tests. Don't rush through it—the idea is to do it correctly and to be confident that the audio portion is tweaked for peak performance.

The video test portion of *Video Essentials* is more intensive. An overview of the video system describes the five controls—brightness, contrast, color, tint, and sharpness—that will be adjusted. Because some of them interact with others, many adjustments will need to be rechecked time and again before all are in proper alignment. The video overview explains how the remainder of the test disc is organized into

sections for each control. Each section opens by listing the various names that the control might be called depending on manufacturer, with the most common at the top of the list, and the most descriptive one underlined. An explanation of that control's function comes next, followed by a list of the test patterns to be used for adjusting that control. Finally, you're reminded to have your TV remote control on hand.

The brightness control is used for setting the black level. In video, black is defined as "the absence of visible light." You should not be able to see information at or below black level. A test pattern called a "PLUGE" (Picture Line-Up Generation Equipment) is the reference used for setting black level. Against a black background, two vertical stripes appear slightly apart from one another on the left side of the screen. One is blacker-than-black—the other, above black. With the contrast properly calibrated, the blacker-than-black bar should be invisible, while the above-black bar is clearly seen.

Contrast, on the other hand, deals with white level. The contrast, or picture, control is used to set the distance between black and peak white levels—or the *contrast* of the picture. For contrast tests, a needle pulse pattern and a PLUGE pattern with gray scale are used. If the white level is set too high, it can introduce two types of distortion. Geometric distortion is the bending of straight lines, and blooming is a distortion, in which objects become slightly enlarged as they get brighter.

Using the two different test patterns, you must set the peak white level just below the point at which the line in the needle pulse pattern bends and just before the white at the top of the gray scale blooms. Ideally, the peak white level should be identical in both tests, but that's not always the case; and compromise is often required. Making matters a bit more complicated is the fact that brightness and contrast are interactive, and each setting must be checked and rechecked against the other.

We've all been told to set color by "flesh tone"—but who can accurately describe what flesh tone means? That's why professionals use SMPTE color bars (that test pattern you used to see back in the days when television stations signed off the air late at night) to properly calibrate a set's color-decoding system. The decoder converts the NTSC signal into red, green, and blue.

Video Essentials uses intensive tests of the blue signal to adjust the color intensity (a.k.a. chroma, chroma level, saturation). The test requires the use of a strip of blue film to filter the test pattern. Peering through the included blue filter, you must adjust the blue level as instructed on the video, matching patches within gray, cyan, and magenta bars to the bars themselves.

With the blue level set properly, red and green should be easy to adjust using the SMPTE color test bars. If the red is over-saturated, however, you might have to turn down the color control, even if that means losing some blue and green.

Video Essentials is full of interesting industry tidbits. For instance: Have you ever noticed that no two TVs seem to produce the same colors? Believe it or not, that's done intentionally by the manufacturers, each of whom strives to have its sets stand out from the rest. Unfortunately, those differences are not always beneficial to the viewer. It's one of the primary reasons that NTSC has been said to stand for the "Never Twice the Same Color" as well as National Television System Committee.

Tint (or hue or chroma phase) is used to set the type of color in the picture. Once again, the blue filter and SMPTE color bars are used to make adjustments.

The sharpness (or detail) control is used to "accentuate the visibility of fine detail by adding high-frequency peaking to the video." A line drawing is used to determine the proper amount of detail enhancement. *Video Essentials* is careful to remind you that it's easy to add details that do not appear in the original signal, which is the antithesis of our goal of "experiencing the intentions of the artist." Excess sharpness can also introduce excess noise into the picture, another no-no. The correct sharpness setting is just below the point at which extra lines are added to the picture.

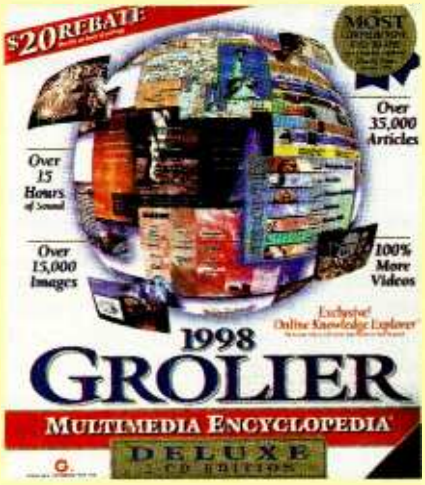
The next few chapters on the disc provide individual test patterns. Once you've become familiar with the tests, you can skip right to this section to make adjustments as needed. *Video Essentials* recommends recalibrating your set every few weeks—or whenever you've temporarily changed a setting—to keep it in peak form.

We've all watched TV for years now—most of us have lived with television for our entire lives. We might feel as though we know our sets backward and forward, but few of us truly understand how to get the most out of them. According to *Video Essentials*, "There's about 40 years of misinformation—or total lack of information—to undo." And that's what this disc does, for audio as well as video, commendably well. If you've made the investment in a home theater, you shouldn't be without *Video Essentials: Optimizing Your Audio/Video System.*

INFORMATION, PLEASE!

GROLIER MULTIMEDIA ENCYCLOPEDIA 1998—2-CD DELUXE EDITION. From Grolier Interactive, Inc., 90 Sherman Turnpike, Danbury, CT 06816; Tel. 800-217-1495; Web: http://www.grolier.com. Price: $59.99.

Research used to be cut and dry—mostly dry. You'd go into the reference room of the library, pull out the encyclopedia volume that contained your topic, and begin reading. Sometimes you could supplement the information in the encyclopedia with equally dull atlas data, or perhaps some old newspaper clippings on microfilm.



The age of the personal computer changed all that. Once computer manufacturers began targeting families as customers, a multimedia encyclopedia became part of the software bundled with virtually every PC sold. Interactive multimedia encyclopedias allowed users to use hyperlinks to quickly reach related articles, view pictures and brief film clips, and listen to spoken or musical tidbits. Research was no longer a static affair, as interactive reference books made it easy for "readers" to hop around, browsing from subject to subject.

The Internet further revolutionized the way people do research, opening up a whole world of information resources to the average PC user. Want to know more about space exploration? Check out NASA's Web site. Weather? Hobbies?

GME's Atlas allows you to zoom in on maps for ever-increasing detail—right down to photographs of famous landmarks.

Interactivities allows you to go inside some of the most famous buildings in the world.

Favorite television shows? Pets? Virtually any topic you can dream up can be found on the World Wide Web.

Now, there's an electronic encyclopedia with links to the Web. *The Grolier Multimedia Encyclopedia 1998—2-CD Deluxe Edition* features the "Online Knowledge Explorer" or "OKE," which offers fast links to two other encyclopedias found online: the *Encyclopedia Americana* and *The New Book of Knowledge*. OKE also includes the Grolier Internet Index, which provides more than 21,000 links to selected Web sites, as well as updates to the encyclopedia articles. Offered with the Deluxe Edition are one month free Internet access from AT&T WorldNet Service and 45 days of free parental-block software from CyberPatrol.

Let's take a look at the encyclopedia itself before venturing into cyberspace. The *Grolier Multimedia Encyclopedia 1998* (which we'll call simply GME) has more than 35,000 articles, supplemented by more than 15 hours worth of sound, more than 15,000 images, and 1200 maps, as well as animations and videos. The articles don't skimp on the data; each is a content-rich, in-depth exploration of its subject. In fact, the language and style of writing might be too advanced for younger school-age kids. Even junior- and senior-high students will find themselves making use of the handy on-screen dictionary as they encounter unfamiliar words and terms.

That dictionary is just one of the on-screen tools and aids that make GME so easy to use. You'll find that you rarely need to resort to the printed manual, which fits inside the CD-ROM jewel box. All of the information provided in the manual is also offered as on-screen help, including an in-depth tutorial that walks new users through all of the program's many features.

GME's main screen is divided into four parts (besides the typical Windows toolbar). The Features bar, which provides direct access to the encyclopedia's special features, spans the top of the window. The List Panel, used to search for information, is at the left of the screen. Another row of "buttons" runs along the bottom of the screen, offering basic functions (print, save, etc.) as well as access to GME features including the dictionary and online activities.

The main portion of the screen is devoted to the Content Region, in which articles and related media are displayed. The content region resembles a file folder with tabs to indicate other information available. Long articles offer outlines, and tabs will appear if there are pictures or other media available to supplement the text.

The List Panel also features tabs: in this case, labeled Browse, Search, and Markers. Browse mode allows you to directly enter your topic of choice, to scroll through an alphabetic listing of all the articles in the encyclopedia, or to selectively view a filtered list of articles. Clicking on the filter button calls up lists of categories and subcategories. By selecting on specific categories, your search will be limited to those articles that fit the categories selected. In subsequent searches, clicking on "custom" will recall that specific search filter; click on the filter button again to create a different filter. The same filtering method works when browsing GME's "Gallery," a listing of all the available multimedia elements.

In Search mode, both simple and complex searches are permitted. For a simple search, type in a word and the program will list all the articles and media containing that word. The complex search allows you to search for more than one word, add operators (and, or, not), use wild cards, and select the scope of the search (how close the words must be to each other). It's possible to add filters to a search as well.

Marker mode allows you to create bookmarks to "collect" articles or multimedia items for future reference. The mark button appears in the tool bar at the bottom of the screen. Clicking on it while viewing an article or multimedia bit marks that item. Selecting the Marker tab in the list panel, you can view a list of marked items, delete or rename those items, and double-click on one to see it displayed.

Because GME's interactive nature invites users to wander through its contents, accidentally uncovering articles of interest, the marker function is quite convenient. You're likely to stumble upon a great topic for your next history paper when you thought you were researching a science project! The history button, found at the bottom of the List Panel, also helps you keep track of where you've been and what you've seen. Clicking on it brings up a chronological list of everything you've looked at.

The Features Bar has six buttons, labeled Articles, Gallery, Atlas, Timelines, Guided Tours, and Interactivities. The selected item appears in the List Panel. Articles represents all the text found in GME. To get a good idea of GME's multimedia offerings, click on Gallery in the Features Bar, and then use the List Panel to

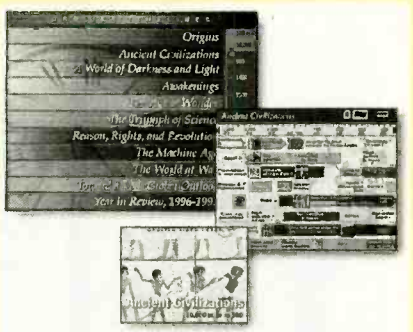
scroll through a complete listing of all the pictures, films, maps, and sounds that are available.

Selecting Atlas will reveal the extensive choice of maps—and we're not talking straight geography. GME offers maps showing the routes taken by famous explorers. Its map of the United States offers eight variations: agriculture, population, geography, vegetation, climatic zones, national parks, precipitation, and temperature. For the last two, it provides different maps for each month of the year.

Timelines divides history into 11 sections, each represented by a time line that provides an overview of world events during that period. An Events List within each Timeline lets you scroll through chronological events, each of which is linked to one or more relevant articles. The final Timeline is a 1996–97 Yearbook, which presents a narrated video overview of the past couple of years, including politics, world events, popular culture, and events that affected us all—the Olympics, the crash of TWA Flight 800, the Oklahoma City bombing, and the OJ Simpson trial.

Guided Tours presents 31 diverse subjects (The American Novel, Monsters and Giants, Insect World, Shakespeare, Engineering Wonders, Clowns, and Literary Characters, to name a few). We took a tour of The Fifties and were impressed by its scope and depth. We listened to Douglas MacArthur's Farewell Address to Congress, watched a video about the Korean War, examined maps of Cold War Europe and the U.S.S. Nautilus' underwater explorations of the North Pole, and read the text of the Supreme Court's Brown v. The Board of Education decision. There were photos (and usually related articles) on stars (Marilyn Monroe, James Dean, Elvis, Milton Berle, Brigitte Bardot, Grace Kelly), sports legends (Johnny Unitas, Bill Russell, Mickey Mantle, Willie Mays), world leaders (Castro, Mao, Khruschev, Nehru, de Gaulle), politicians (Joseph McCarthy, Adlai Stevenson), popular culture (*My Fair Lady, Peyton Place, On the Waterfront*), highbrow culture (Maria Callas, Nabokov, Camus), art (Matisse, de Koonig, Johns), plus articles on the Kinsey report, the hydrogen bomb, the Beat Generation, the launch of Explorer 1, the Hungarian revolution, and Allen Ginsberg's "Howl."

Finally, GME's feature bar offers "Interactivities." Divided into seven "networks"—Animal Anatomy, Aviation, Famous Buildings, Habitats, Human Body, Solar System, and Space Exploration—Interactivities allows you to explore a topic



Timelines let you explore the relationships between events in world history, discovering what was happening in Europe, for instance, while Genghis Khan was invading Asia.

in depth or to skip around to look at items of particular interest. In Famous Buildings, for instance, you see cut-away drawings of a medieval castle with various parts described (the drawbridge, the keep), although not in much detail. The subsection on the Great Pyramids provides a bit more information, including insights on building methods, modern photographs, and a map showing where they can be found.

Grolier has added a few other improvements over previous versions. Those include "Multiplex Videos"—groupings of six related videos. For example, under 20th Century Presidents, you'll find clips of both Roosevelts, Wilson, Johnson, Nixon, and Reagan. "Multimedia Maps" takes two of the dullest feats of memorization (dates and places) and spices them up at least a little bit. Under American Revolution, for instance, a map of the 13 colonies is used to show battle sites, and the narration emphasizes important dates (Boston Tea Party, Battle of Bunker Hill, Washington crossing the Delaware). Prehistoric Peoples of North America shows the movement of glaciers, the paths taken by waves of migrating people, and the sites of earliest settlements. "Points of Interest," photographs of famous landmarks, has been added to city maps in the atlas.

Unfortunately, the vast amount of data comprising GME would not fit on a single disc. That means that you must keep two discs on hand at all times and swap them when prompted. It's not enough to simply open the door and exchange them—that shuts down the program temporarily. You must first click on the swap discs button at the bottom of the screen, which causes a box to pop-up, telling you to insert the proper disc and then click on okay. It's a minor inconvenience—well worth the scope and depth of information included—but a bother nonetheless.

We looked up the "Human Body" in GME, and discovered that we preferred flipping through the transparent overlay pages that made up the multilayered "map" of the human body found in the old print version of the *Encyclopedia Britannica*. GME has a similar feature, showing the various systems of the body (endocrine, circulatory, digestive, muscular, and that old favorite of students perusing the encyclopedia—reproductive). The electronic version shows only one system at a time, however, and lacks the "depth" of the layered version.

On the other hand, with a couple of clicks in GME you can find out all about each of the systems of the human body, much more easily than flipping through the pages in the book version. And from within that electronic article, you can click on the online button found on the toolbar or the Online Knowledge Explorer icons found in the Content Region of the screen and be transported to the Internet, where a wealth of knowledge awaits. You can choose to go directly to an article on the human body in one of two other Grolier encyclopedias—*Encyclopedia Americana* or *The New Book of Knowledge*. Or you can select Grolier Internet Index to find the Web sites that Grolier has selected as particularly relevant to the subject.

In the case of the human body, we were offered quick access to three sites: The Talk Origins Archive, which deals with evolution and creationism; The Dictionary of All Biology, which offers "more than 5000 entries and 5000 hypertext cross-references;" and Frank Potter's Science Gems—Life Science I, with an emphasis on all levels of science education for teachers, parents, and students. We browsed the latter for a while, delving into sheep cloning in Scotland, taking a narrated tour of the dinosaur exhibit at the University of Hawaii, and looking at several class projects on whales (we passed on interactive frog dissection).

Next (after watching *Michael Collins* on the Pioneer LD/DVD deck), we looked up "Ireland, History" in GME. From there, we went online for more information. Grolier's recommended sites included A Directory of Royal Genealogical Data and England, and the Internet Medieval Sourcebook, neither of which seemed particularly relevant. We also found the sites of Fianna Fail, Ireland's largest political party, and Sinn Fein, Ireland's oldest political party. Both stated their aims and beliefs, printed policy papers and news releases—and sold party-related merchandise. That type of first-hand, up-to-

the-minute information has never been available in print encyclopedias, which offer a strictly finite amount of data.

In fact, about the only complaint we have about multimedia encyclopedias is that they make it so easy to browse and cross-reference that it's easy to lose track of your original goal (writing that term paper, perhaps?). That goes double for GME. When you add the lure of the Internet, the problem is exacerbated. It takes self-discipline to sit down and write a paper—and twice as much if you're using as fascinating a tool as the *1998 Grolier Multimedia Encyclopedia* to research it!

T(INY)-REX

REX PC COMPANION. From Franklin Electronic Publishers, One Franklin Plaza, Burlington, NJ 08016-4907; Tel. 888-REX-6400; Web: http://www.franklin.com/rex. Estimated street price: REX-1, $129.95; REX-3, $149.95; REX-3 bundled with docking station, $179.95; docking station alone, $39.95.

Do you carry a portable electronic organizer in your briefcase or purse? If your job includes frequent travel or meetings outside the office—or if you must juggle the demands of both work and family responsibilities—you probably depend on just such a handy little gizmo to keep track of everything from scheduled conference calls and sales presentations to birthdays, and grocery lists.

But—be honest, now—how much information do you actually input on-the-go, using that tiny little keypad? Personally, we never go back to the hotel room and enter all that data onto our handheld organizer, after we've collected a stack of business cards at an industry convention. Instead, we wait to get back to the office, where we can use a comfortable, full-size PC keyboard to type in the information, and then download it to our pocket organizer.

We're definitely in the majority when it comes to avoiding minuscule keypads. In fact, according to a Starfish Software survey of 1000 PalmPilot users, 75% used the device only to reference data—not to input it.

Armed with that useful nugget of marketing insight, Starfish, Citizen Watch Company of Japan, and Franklin Electronic Publishers got together and created the *REX PC Companion*, a credit-card-sized personal electronic organizer that weighs less than one-and-a-half ounces. The secret to its scaled-down proportions is its lack of any manual means of inputting data—its designers omitted the keypad and decided against any pen-based data input. After all, busy business people already have their vital appointments, memos, to-do lists, calendars, and contacts stored in a personal information manager (PIM) on their PCs. It's much more efficient to simply transfer that data directly to an organizer.

The software, called TrueSync, that is included with REX serves two purposes. First, it is a full-function desktop personal information manager. Second, it provides synchronization that allows REX users to transfer information from many popular personal information programs—including Starfish's Sidekick, Microsoft's Schedule and Outlook, Symantec's ACT!, and Lotus Organizer—to the device. Only data from Sidekick 98 can be directly downloaded to REX, however. If you use another PIM, you can use TrueSync as an intermediary, first downloading the data to TrueSync, and then to REX. If you want to directly transfer files from another PIM to REX, you must separately purchase from Starfish additional synchronization software called TrueSync 98 (Tel. 888-782-7342; Web: *www.starfish.com*)

If you like the REX concept and are not totally dependent upon your current PIM, you just might find it expedient to make the switch to TrueSync by downloading all your calendar, cardfile, and memo files to it from your PIM. Besides Outlook 97, Schedule+ 7.0, Lotus Organizer 97, and ACT! 3.0.6 and up, TrueSync supports dBASE III and IV, spreadsheet .DIF, tab-delineated text files, and comma-delineated text files.

REX can be connected to your PC in either of two ways. Because REX is actually a PCMCIA card, it can be inserted directly into your desktop (or, more likely, your laptop) PC's Type-II PC-Card slot. In the absence of such a slot, the REX docking station can be connected to your computer's serial port.

The docking station, which can be purchased bundled with the REX-3 or separately, is a compact (approximately 4-¼ ×3-½×1-inch) black-plastic unit that runs on four "AAA" batteries, which are included. Also included is a serial cable with a nine-pin plug, as well as a 25-pin adapter. A stand allows the docking station to rest on the desktop at a comfortable angle for viewing the screen. REX slides into the PCMCIA slot on the front of the docking station. An eject button is used to remove REX from the slot.

REX itself measures just $3\text{-}^{3}/_{8}\times2\text{-}^{1}/_{8}\times¼$ inches. Most of its face is taken up by its glare-free $2\text{-}^{1}/_{8}\times1\text{-}^{5}/_{16}$-inch screen. Running vertically along the right side of the screen is a row of five "soft" keys, labeled with icons only.

Fortunately, REX is so easy to use that no written reminders are necessary (although a quick-start reference card is included). The top button, with its house icon, is used to return to the home screen or to move back in an application. The second button, "view," is used to change the view within an application, from daily to weekly calendar, for instance. The middle button,

emblazoned with a circle within a circle, is the select button. The final two, marked with up/left and down/right arrows, are used to move around the screen.

The opening screen displays REX's five applications—calendar, contacts, to do, memos, clock—as well as the tools needed to customize the unit to meet your needs. Across the bottom of the screen is the REX status bar, which displays the date and time along with icons that provide warnings or information. The battery icon appears when batteries are running low. When the view icon is visible, it means that a press of the view button will access another view within the current application. Up and down arrows let you know that you can scroll to see more information, while the bell indicates that an alarm has been set. REX allows you to change the time zone when you travel; a home icon shows that you are in your home time zone, while a flag means that you are in the "World" time zone.

It takes just a couple of minutes to load REX's batteries, set the time and date, and familiarize oneself with the device's five buttons. A bit more time and effort is required to learn all the ins and outs of the TrueSync information manager, should you choose to go that route. However, because of its strong similarity to Sidekick, which was reviewed in a recent issue of *Gizmo*, we'll just provide a brief overview of TrueSync's features here.

In typical Windows fashion, the TrueSync Information Manager screen contains a status bar, menu bar, and toolbar, the main work area or "Deskpad," and deskpad icons used to access other views. Four of the six icons displayed represent various PIM functions: Calendar, EarthTime, Contacts, and Memos. The other two, TrueSync and Delete, are used for transferring and erasing files, respectively.

The Calendar Deskpad looks like a page in a printed day planner, with a daily schedule on one side and places to list calls to make and things to do on the other; alternate views show weekly and monthly calendars. EarthView keeps track of the time in eight cities of your choice, and provides information such as time differences and the beginning and end of Daylight Saving Time. Contacts allows you to create different "cardfiles" (address books) in which to store names, addresses, phone numbers, fax numbers, e-mail addresses, and other information. Up to four cardfiles can be transferred to and viewed on your REX card. The Memo function is used to create notes and letters in text files. Information from

If your laptop or desktop PC has a PCMCIA slot, you can simply slide REX in to download data.

The compact REX docking station is used when no PCMCIA slot is available.

Contacts, Calendar, and Memos can be printed in a variety of formats, including labels, envelopes, address books, and several popular appointment book formats (At-A-Glance, Day-Timer, Day Runner, Filofax, and Franklin Day Planner).

Okay, so you've input all your important data on your PC, and now you're ready to "synchronize your REX card." With the card inserted in either a PCMCIA slot or the docking station, it's time to meet the Configuration Wizard, which guides you through the synchronization process. It asks you which files you want to transfer and how you want information displayed. For instance, you can select "start from" and "through" dates for Calendar entries to be transferred—choosing to import schedules for a full year, a quarter, a month, a week, or just a day—and you can determine which Cardfile fields will be transferred to and displayed on REX. You won't need the Configuration Wizard again until you decide to change your preferences (switching time zones for a business trip, for instance). Clicking on the on-screen start button sets the downloading in motion.

Retrieving the transferred information couldn't be simpler. Use the arrow keys to highlight a function and the select button to choose it. Within the Calendar section, you'll find daily, weekly, and monthly views. REX doesn't provide much detail in weekly or monthly views; a highlighted date or time slot indicates that some activity is scheduled then. The Cardfile main view is a tabbed phone book that lists contacts alphabetically. Select a contact to see the full file—all of the fields that you've elected to transfer. If all the data won't fit on one screen, subsequent presses of the select button will keep scrolling through it all. The To-Do List allows you to describe the task and to mark it pending or done. REX-3 can hold up to 3000 items, while REX-1 stores 750.

The screen is easy on the eyes, yet manages to provide a lot of information in a relatively small space. Each screen has a heading at the top and a status bar on the bottom. In between is enough room for up to seven lines of tiny, but legible, type.

We appreciated the leather carrying case included with the REX-3. The designers recognized the fact that even though people don't like to input information while they're traveling, they're likely to be gathering it nonetheless. So the carrying case holds a tiny notebook inside and provides an outside pocket for business cards. Little elastic bands hold REX and the notepad securely in place. The case protects the electronic organizer from damage, as well as making it difficult—but not impossible—to accidentally press any buttons.

With no dedicated on/off button, a press of any of the function keys will activate the unit, which automatically shuts itself off after a specified period of inactivity. You can change the auto shut-off time using the tools menu. Other preferences that can be set include 12- or 24-hour time display, the sound of the alarm, whether or not key clicks should be audible, and the password lock. If you store sensitive information in REX, it's a good idea to set a password and use the optional password lock function.

We had no trouble downloading files from TrueSync to REX. Nor did we experience difficulty transferring data from Sidekick 97 to TrueSync. And accessing the data couldn't be simpler. If you're one of those people who are lugging around a hefty "portable" electronic organizer and using it just to look up information, you might want to give yourself a break and switch to REX.

NET WATCH

Time-Saving Web Utilities

KONSTANTINOS KARAGIANNIS

Let's face it—sometimes the World Wide Web feels more like the World Wide Wait! This perceived snail's pace of the Internet can be caused by a number of factors, including Net traffic, an overburdened pipeline at your ISP, "dirty" phone lines, and your own modem. What can you do to speed up your connection?

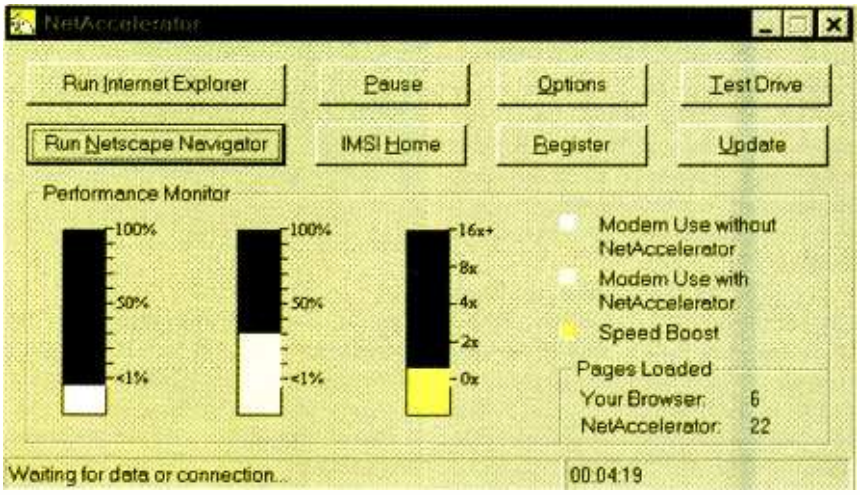
For starters, you can get a faster modem. Considering few people want the expense of an Integrated Services Digital Network (ISDN) line, you'll want to choose from one of the two competing 56-KB technologies available—x2 or K56Flex. Modems with either chipset will enable you to download off the Net at speeds of about 53 KB (there are still limitations on analog phone lines), assuming your provider supports the type of modem you choose. I use an x2 modem from 3Com that provides some really solid connections; and, believe me, once you get used to using such a device, you'll never understand how you were able to endure 28.8- or 33.6-KB units.

Okay, so say you've got a speed demon attached to your PC and phone line. Why are some of those pages still taking forever to download? Here's where the problems of traffic come into play. Even with an ISDN, which allows up to 128-KB downloads, you'd still find that some sites take forever to appear onscreen. And then, the problem gets worse. On top of slow Net response, you have to deal with trying to find pertinent information. Ever go from Search Engine to Search Engine, hopelessly aware that you will never be able to actually visit all the sites that come up as results? Sure, the first few sites that list as results from a particular search are the most likely candidates for what you're looking for, but if you go to a few engines, you'll see that each one picks its own most relevant results. Wouldn't it be nice to get the most significant responses from all the major engines at once?

If you find the Web tedious for any of the preceding reasons, read on. We'll take a look-see at some utilities that are sure to cut down on your online frustrations.

NETACCELERATOR

For the majority of the time you spend online, your modem isn't actually doing anything. You know the drill—you load a page, read it, and then choose another link. That middle step (reading) is time wasted inside your computer. Now there's a program that allows your PC to make the best use of those idle moments. Called *NetAccelerator*, it's IMSI Software's way to let you go up to "12X faster on the Internet."



NetAccelerator runs in the background, speeding up your browsing time on the Web. Any time you want to see how much your Net connection is being improved, just maximize the program's window.

It works like this: You install the software and run your browser like normal. Go to a page, and take a look. NetAccelerator transparently loads into a cache folder all the images and text from the next links that you'll be able to visit. Then, when you actually click one of those links, the page will appear on your screen like magic. Your favorites take priority with NetAccelerator. This means you can set the software to automatically keep your most-frequently visited sites current, so they'll be ready for you to visit instantly. Also, the program works with your preference of the big two Web Browsers—*Netscape Navigator* and *Internet Explorer*. If you can't choose between these two browsers, the program will allow you to switch back and forth between the two without a problem.

Does NetAccelerator really make browsing feel 12 times faster as IMSI Software claims? That depends. If you visit a lot of sites that don't have too many subsequent link options, then yes, you might feel as if the Web resided on your hard drive. However, if you plan on going to content-rich sites like the New York Times Online, then the program won't be able to download everything that's "next" quickly enough.

But browsing for the most part does seem much faster, and I'm not sure I'd like to remove the program from my PC now that I've gotten used to it. I especially like having it on my laptop for when I travel, because in hotels there's no such thing as a flat-rate phone call, and I hate overpaying for more time than I need. And at a price of $29.95, you won't overpay for the software. IMSI's site also lets you download a 30-day trial version, so you can try before you buy.

WEBCOMPASS 2.0

Quarterdeck's *WebCompass*—you might have heard of this product—ver-

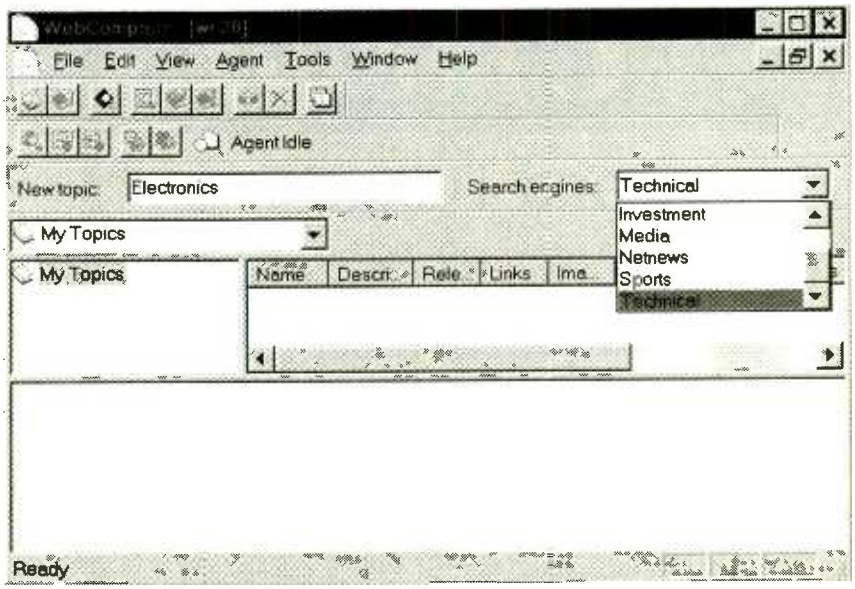
sion 1.0 has been out for a few years now. But even if you've never come across mention of the older incarnation of WebCompass yet, it doesn't matter, because 2.0 is wonderful enough to warrant the software's mention as a completely "new product."

For those of you who hate the multiple-search-engine, multiple-responses game, WebCompass is ideal. It allows you to do one search and get one set of results, while taking advantage of all the engines the Web has to offer. In addition to saving time, the program also saves you a learning curve. Each search engine uses its own advanced logic commands to execute a query; this means that no matter how many InfoSeek codes you learn to weed out information you don't want, few if any of those codes will help you at Excite. With WebCompass, you only have to master one simple set of advanced search commands—a form of Boolean logic—that the program converts to match each engine's protocol for you.

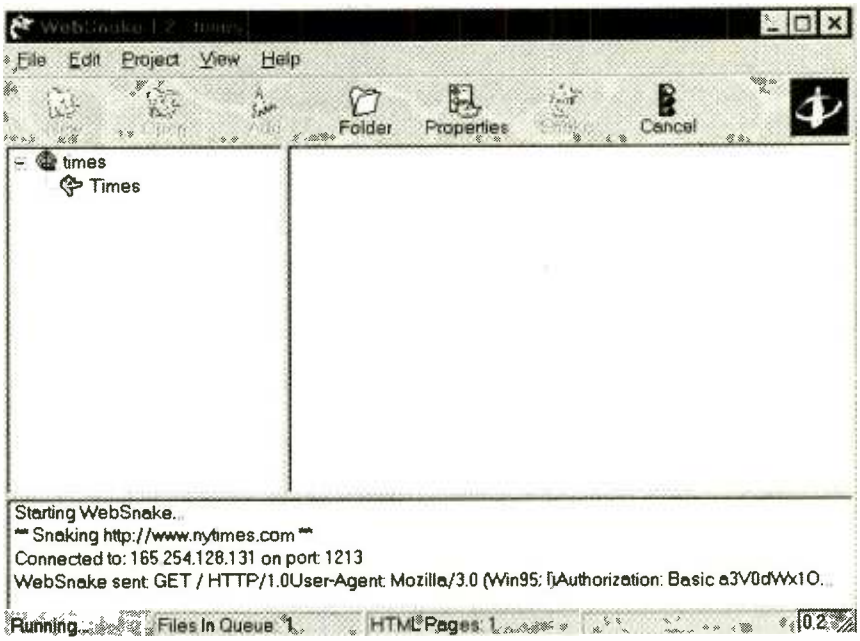
What's really great about the program is that, unlike most other software, it won't be obsolete before you have a chance to throw away the shrink-wrap it was sealed in. WebCompass lets you add new sites as you learn about them, and it makes it possible to search through non-standard search engines. To cite an earlier example again, you can add the New York Times Online's search engine to your list.

How does a search work? It's pretty simple. First, you enter a topic and select what types of search engines you'd like WebCompass to visit. For example, if you're searching for something having to do with electronics, you would select Technical from the list of engine types. Interested in learning who won the big game? Use Sports in the category.

The Explorer-style interface then allows you to see the results of your search, ranked from 100 to 1 in terms of relevance. Because the program builds comprehensive summaries of results gathered from searching and automatically organizes the results by topic, you only see the best of the sites out there. And with the software's ability to keep a database of search topics, it's able to automatically update results of a search if you feel that new information might be available in a few days, weeks, or months. To get a copy of WebCompass, you can either go to your local software store and buy it for $49.95, or first download a trial copy off Quarterdeck's site.



When selecting a topic in WebCompass, you can also choose what types of search engines the program should query. For electronics information, you would click on Technical.



While WebSnake's retrieving data from a Web site, the bottom window shows you the software's progress. When the process is finished, a map of the downloaded information will appear in the window to the right.

WEBSNAKE

Sometimes you want to be able to take it with you or be able to access it and use your phone line for something else. What are we talking about? The Web, of course. With Anawave's *WebSnake*, you can configure your computer to download Web pages while you do other things (like get a good night's sleep), and they'll be ready for you to look at when you have time. Laptop users can take the day's news with them on a train commute, for example.

Using the program's a snap. Built-in Wizards guide you through the steps to complete a WebSnake "project." First you enter the site's URL, and then a user name and password if the site needs one. The program then lets you choose how many levels you want to "snake." In other words, how many subsequent links in a series of sites will the software retrieve? Each mouse click you would have made, were you browsing, is a level. If you select a large num-

(Continued on page 30)

CIRCUIT CIRCUS

Timers and Things

CHARLES D. RAKES

This month's *Circus* starts off with a response to my friend, Jack, and his request for a circuit that would turn a light on in a room when the light level outside drops below a certain level. There's several ways to accomplish this, and the circuit I gave him is shown in Fig. 1.

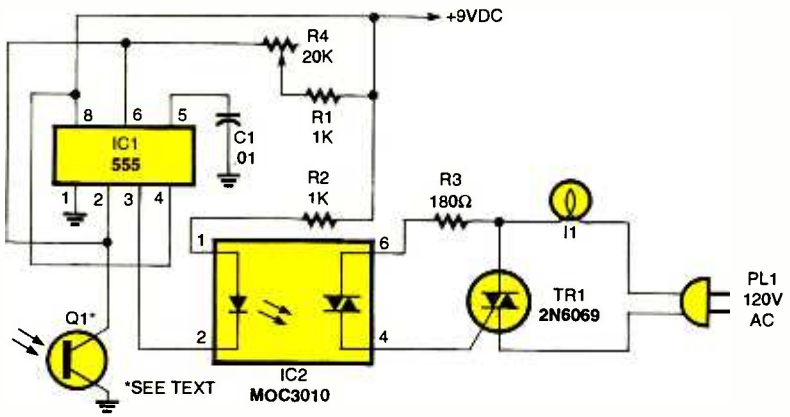


Fig. 1. Use this circuit to automatically turn on an inside light when the outside light level drops below a pre-set limit.

The heart of the light-control circuit is a 555 oscillator/timer IC that is operating in a non-timing application. The IC is used as a voltage-level detector with a Schmitt trigger-like function. When the voltage input level at pins 2 and 6 goes above 6 volts, the IC's output at pin 3 goes low and remains low until the input voltage goes below the 3-volt level. This hysteresis function helps to keep the lamp from flickering on and off, when there's a small variation in the light hitting the photo-transistor, Q1. With Q1 aimed outdoors on a sunny day, the internal resistance between the collector and emitter is low, and the voltage feeding the 555's input is too low to trigger the circuit. The circuit's sensitivity to outside light is set with control R4. As the light fades, the voltage at the collector of Q1 goes up to the point where IC1 changes state: pulling its output at pin 3 low and turning on the optoisolator/coupler triac, TR1, and the lamp, I1.

You can use just about any of the popular low-cost photo-transistors for the light sensor, such as a 512-L14G3, available from Mouser Electronics (Tel. 800-992-9943) or the RadioShack 267-145.

TIMER-CONTROL CIRCUIT

Jack also asked if I had a circuit he could use to activate an outdoor light, keep it on for a short period of time, and then turn it off automatically. He said that stumbling around in the dark, trying to get his car door unlocked, wasn't fun any more. Our next circuit in Fig. 2 will light up Jack's driveway or yours.

Here we have a 555 timer IC operating in a variable timer circuit that operates relay RY1, which can be used to control an outside light or any other electric circuit. Pressing normally-open switch S1 triggers the IC into its timing mode, bringing its output at pin 3 high, turning on Q1 and pulling in the relay. Resistors R3, R4, and capacitor C2 sets the IC's on-time period. Control R4 may be adjusted for a time period up to about three minutes. The type of relay chosen in the circuit depends on the device being controlled. The important relay requirement is that it have a 12-volt coil voltage.

Now if you would like to eliminate the relay and go all solid-state with the timer circuit, just remove R2, TR1, D1, and relay RY1, and replace these components with the circuit of Fig. 3. Here we're using the same lamp driver circuit that operated the light in Fig. 1. When the timer is activated, pin 3 of the 555 IC goes high, supplying power to the optoisolator/coupler that turns on the triac and the outdoor light.

PARTS LIST FOR LIGHT-CONTROLLED LAMP-DRIVER CIRCUIT (FIG. 1)

C1—0.05-µF, 50 WVDC, ceramic-disc capacitor
I1—Any 120-volt, 100- to 300-watt light bulb
IC1—555 oscillator/timer, integrated circuit (SK3564, NTE9555M, or equivalent)
IC2—MOC3010 optoisolator/coupler, integrated circuit (NTE3047, or equivalent)
Q1—Photo-transistor (see text)
R1, R2—1000-ohm, ¼-watt, 5% resistor
R3—180-ohm, ¼-watt, 5% resistor
R4—20,000-ohm, potentiometer
TR1—2N6069, 400-volt, 6-amp, triac (RadioShack 276-1000, or equivalent)

WATER-ALARM CIRCUIT

Our next entry came about after our pooch, Buster, fell into our swimming pool and got a real workout before being rescued by the wife. The splash alarm circuit, in Fig. 4, can be used to sound a warning if a pet or an animal ends up in your pool.

IC1, a 555 again, is connected in a timing circuit with R1, R7, and C2 setting the on-time period. The trigger input, pin 2, is connected to a stainless steel rod that is positioned slightly *above* the water level. A similar rod is tied to circuit common and extends *down* into the water, at a depth of 6 to 10 inches. When there is a splash in the pool and the water makes contact with the upper rod, or trigger probe, the timer is triggered on and IC1's output at pin 3 goes high for the pre-set timing period. The output is connected to two direct-coupled NPN transistors, with the collector of Q2 tied to pin 5 of IC2, which is also a 555 device. IC2 is con-

nected in a audio oscillator circuit with the frequency set by the values of R5, R8, and C4. The output frequency is made adjustable with R8 and should be set for a noticeable alarm tone.

With still water, there is no conductivity between the rods, the collector of Q2 has pin 5 of IC2 clamped to circuit common and the audio oscillator circuit is silent. A splash immerses the upper rod in water and completes the circuit between the rods. This reaction sets the timer off and turns Q2 off, allowing the audio oscillator to sing out for the timing period. The conductivity of your pool's water will mainly depend on the water treatment chemicals used. If the water resistance is too great, remove R2 and try it that way. If a longer on-time alarm is desired, increase the value of C2. The audio oscillator's frequency range may be raised by decreasing the value of C4 and lowered by increasing its value.

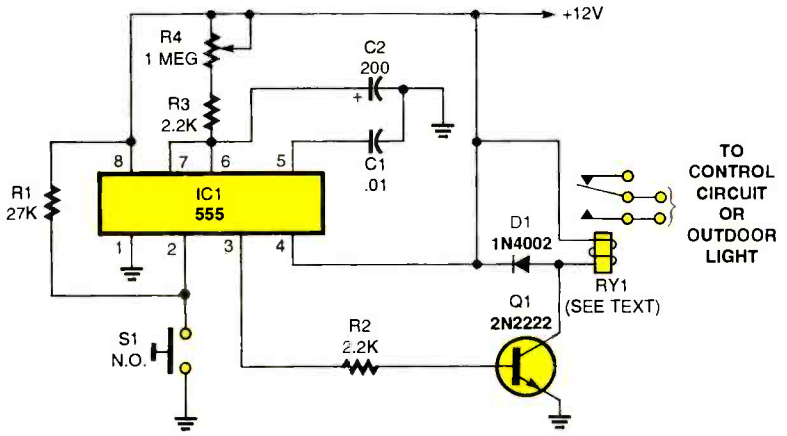


Fig. 2. With this circuit, you can activate an outdoor light or other devices and keep them turned on for a short period of time.

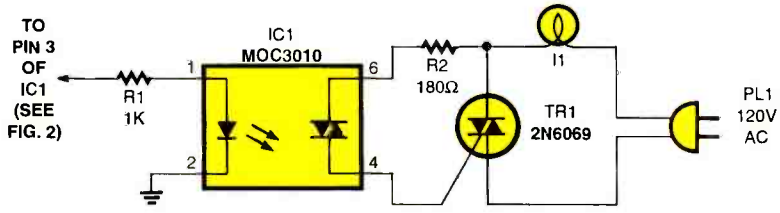


Fig. 3. Here's the same timer-control circuit, but with all solid-state components and a lamp load.

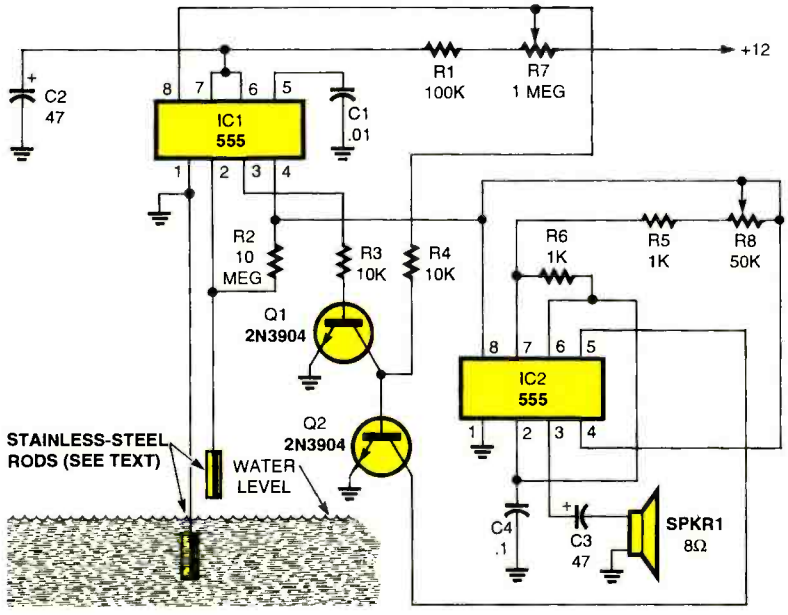


Fig. 4. This circuit will set off an audible alarm if water is detected between the steel rods.

PULSE-WIDTH DRIVER CIRCUIT

Our next circuit, see Fig. 5, also uses a 555 IC that's operating as an oscillator with a variable pulse-width output. The square wave output duty cycle can be adjusted with control R3 from less than 5% to near 100%. The oscillator's frequency with a 0.1-μF for C1 is about 200 Hz. Any size capacitor from 0.1-μF to 10-μF or larger may be

PARTS LIST FOR TIMER-CONTROL CIRCUIT (FIG. 2)

C1—0.01-μF, 50-WVDC, ceramic-disc capacitor
C2—200-μF, 25-WVDC, electrolytic capacitor.
D1—1N4002 silicon diode
IC1—555 oscillator/timer, integrated circuit
Q1—2N2222 NPN transistor (NTE123A, SK3444, or equivalent)
R1—27,000-ohm, ¼-watt, 5% resistor
R2, R3—2200-ohm, ¼-watt, 5% resistor
R4—1-megohm potentiometer
RY1—Power-control relay, 12-volt DC coil (see text)
S1—Normally-open push-button switch

PARTS LIST FOR TIMER-CONTROL CIRCUIT (ALL SOLID-STATE) (FIG. 3)

I1—120-volt lamp
IC1—MOC3010 optoisolator/coupler, integrated circuit
R1—1000-ohm, ¼-watt, 5% resistor
R2—180-ohm, ¼-watt, 5% resistor
TR1—2N6069, 400-volt, 6-amp, triac

PARTS LIST FOR WATER-ALARM CIRCUIT (FIG. 4)

C1—0.01-μF, 50-WVDC, ceramic-disc capacitor
C2, C3—47-μF, 25-WVDC, electrolytic capacitor
IC1, IC2—555 oscillator/timer integrated circuit
Q1, Q2—2N3904 NPN transistor (NTE123AP, SK3854, or equivalent)
R1—100,000-ohm, ¼-watt, 5% resistor
R2—10-megohm, ¼-watt, 5% resistor
R3, R4—10,000-ohm, ¼-watt, 5% resistor
R5, R6—1000-ohm, ¼-watt, 5% resistor
R7—1-megohm potentiometer
R8—50,000-ohm, ¼-watt, 5% resistor
SPKR1—8-ohm speaker
Stainless steel rods (see text)

used to set the frequency. The circuit may be used as an LED dimmer, a drive for a motor-speed control, a variable power supply, and any other application where a variable pulse-width generator is required.

TELEPHONE "ON-HOLD" CIRCUIT

If you use the telephone a lot and are tired of trying to cover the mouthpiece while conversing with a family member or fellow worker, our next circuit is especially designed for you. Our "ON-HOLD" telephone circuit, see Fig. 6, is simple, inexpensive, and will get the job done. There's no music or commercial playing for the other party while on hold with our circuit, and since we probably don't know what they would like to hear, it might be better this way.

The "ON-HOLD" circuit operates like this. The four-diode bridge allows the circuit to be connected across the phone lines without concern for the voltage polarity. The red and green wires are usually the ones used in the four-wire phone line cable; normally the green wire is positive and the red is negative, but with Murphy about—don't rely on it. With our circuit, the positive phone line output will be routed through either D2 or D4 and the negative through D1 or D3. Just connect it across the lines, and that's all there is to the installation. When the phone is on hook, the voltage across the phone lines is about 48-volts DC. When off hook, it's usually less than 6 volts.

To place a phone on hold, press and keep S1 closed until after the phone is hung up. When the phone is off hook, the voltage across the hold circuit is too low for SCR1 to turn on and latch, because of the voltage drop of the 6-volt Zener diode, D5, and the junction loss of the bridge diodes and LED1. When the phone is placed on hook, the voltage tries to rise to its original 48-volt level. However, when it climbs above about 10-volts, SCR1 turns on and latches, holding the line connected. When any phone on the same line is taken off hook, the hold circuit is automatically unlatched, and your conversation may continue. As soon as the phone comes off hook, the voltage once again goes back to about 6 volts, which is too low for the SCR to remain latched. You can add the on-hold circuit to each of your phones and not be caught with your hand over the mouthpiece ever again.

Looks like we're out of time for now, so look for the *Circus* to be by this way about this time next month. ■

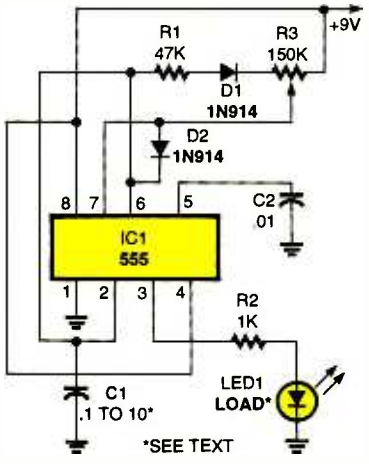


Fig. 5. This little pulse-width generator can drive low-current devices.

PARTS LIST FOR PULSE-WIDTH DRIVER CIRCUIT (FIG. 5)

C1—0.1 to 1.0-µF, 50-WVDC, Mylar or ceramic-disc capacitor
D1, D2—1N914 silicon diode
IC1—555 oscillator/timer integrated circuit
LED1—Any color light-emitting diode
R1—47,000-ohm, ¼-watt, 5% resistor
R2—1000-ohm, ¼-watt, 5% resistor
R3—150,000-ohm, potentiometer

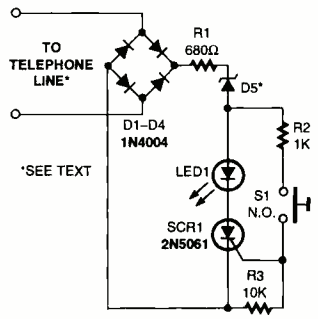


Fig 6. Build this neat "ON-HOLD" circuit to completely silence conversations on both ends end of the phone line.

PARTS LIST FOR TELEPHONE "ON-HOLD" CIRCUIT (FIG. 6)

D1-D4—1N4004, 1-amp, 400-PIV, silicon rectifier diode
D5—IN5233B, 6-volt, ½-watt, Zener diode (NTE5012, SK6AO, or equivalent)
LED1—Any color light-emitting diode
R1—680-ohm, ½-watt, 5% resistor
R2—1000-ohm, ¼-watt, 5% resistor
R3—10,000-ohm, ¼-watt, 5% resistor
S1—Normally-open push button switch
SCR1—2N5061 silicon-controlled rectifier (NTE5401, SK3638, or equivalent)

NET WATCH

(continued from page 27)

ber of levels, and the site you're snaking is large, then you might quickly begin to fill up your hard drive. Just in case you're planning on letting the software run while you're away from the PC, WebSnake next asks you when it should stop downloading with respect to how much drive space you have left. By the way, if the data you downloaded is taking up too much space, you can zip it with the program's built-in compression tools, and still be able to access the information.

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The program is quite remarkable. Once it's done, you have a complete Web site (including graphics and Java applets) that you can browse at any time, without waiting for each page to come up. Other great features are that it allows you to search and retrieve files from the World Wide Web (say you want every file from a site that contains the word "stocks"), e-mail addresses (if you want to compile a list of every e-mail mentioned in a site), and site maps (which is ideal for those who want to create a site that mimics another one). Like the other programs we covered, you can download a trial copy of the software from Anawave's Web site. When you're ready to buy, WebSnake costs $29.95.

Well, that's all the time we have this month. I hope one of these utilities helps ensure that you have more time to spend doing other things besides waiting for pages to load (like reading **Popular Electronics**!). If you've got a question, feel free to e-mail me at netwatch@comports.com, or send a good-old USPS letter to *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

PRODUCT TEST REPORT

Princeton Graphics Systems Arcadia AR2.7 Multimedia Monitor

STEPHEN A. BOOTH

There's something curious about the old saying that you can tell the pioneers by the arrows in their backs. Why their backs? One would think the pioneers were running into trouble, not away from it. Perhaps it has more to do with envy—back-stabbing by people who weren't quite comfortable with the enterprising spirit and new ideas espoused by individuals who push the envelope and challenge new frontiers. The world of multimedia, or "convergence" between the TV and Personal Computer (PC) domains, is just such a frontier. Rather than call it convergence, some pundits call it "collision." But pleasant or otherwise, you can bet the rent it is going to happen. As different media move toward the universal digital language of zeroes and ones, the existence of common displays is inevitable.

The *Arcadia* line of large-screen multimedia monitors from Princeton Graphics Systems is the first of that new breed. Like the *PC Theater* system by RCA and Compaq that shortly followed Princeton Graphics' lead (and the *Destination* multimedia package from Gateway 2000 that preceded them all), this is an attempt to use the tried-and-true Cathode Ray Tube (CRT) as a monitor *both* for computer applications *and* TV-video viewing. Call it a display with boob-tube pedigree and college degree!

The sad and honest truth is that Arcadia, PC Theater and Destination haven't yet lit any fires under the buying public, although they enjoy some success in the commercial and educational fields. It might be the concept of 27-, 31- and even 36-inch multimedia displays is "too much—too soon" for the average PC user. Pricing could be a factor too—this stuff doesn't come cheap.

The 27-inch *Arcadia AR2.7 Multimedia Monitor* reviewed here has a sticker price of $799—and that doesn't include an NTSC tuner or an audio amp and speakers (the "AV" package is available in the *Arcadia AR2.7AV* model at $999). You could buy a 27-inch stereo TV for less, but it wouldn't be capable of hookup to a PC, for Web-surfing from your couch, or switching on the fly to the evening's NBA offering. Also, it wouldn't give you that NBA match-up or even a "Seinfeld" rerun in progressively-scanned resolution—where a monitor like the Arcadia really shines in with video from digital sources such as a DVD player or a direct-broadcast satellite receiver. Let's go to the lab results for the low-down.

VIDEO-MODE PERFORMANCE

A large TV/PC monitor has two rather incompatible jobs. It has to project a bright image across typical TV viewing distances, say, eight feet for a 27-inch tube. Meanwhile, it has to deliver the resolution needed for largely static PC images, say, text, without aliasing or "jaggies." Brightness usually isn't an issue among PC monitors, given that viewing distance usually is just an arm's length away. Fine-pitch resolution isn't the strong suit of TV displays, owing to viewing distance from the raster and the fast-motion action that tricks the eyes.

It's amazing, then, that the AR2.7 does so well as a video monitor (we didn't test for TV reception, as this would require a tuner/video card in the PC). At 63 foot-Lamberts (ft-L), it's not as bright as other 27-inch sets we've tested (which hit 75 ft-L). However, it's got a lot more pop than the 20 ft-L typi-

(Continued on page 68)

The Arcadia monitor is used as the TV screen in your family Home Theater.

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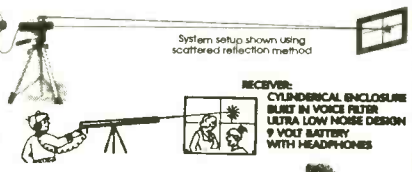

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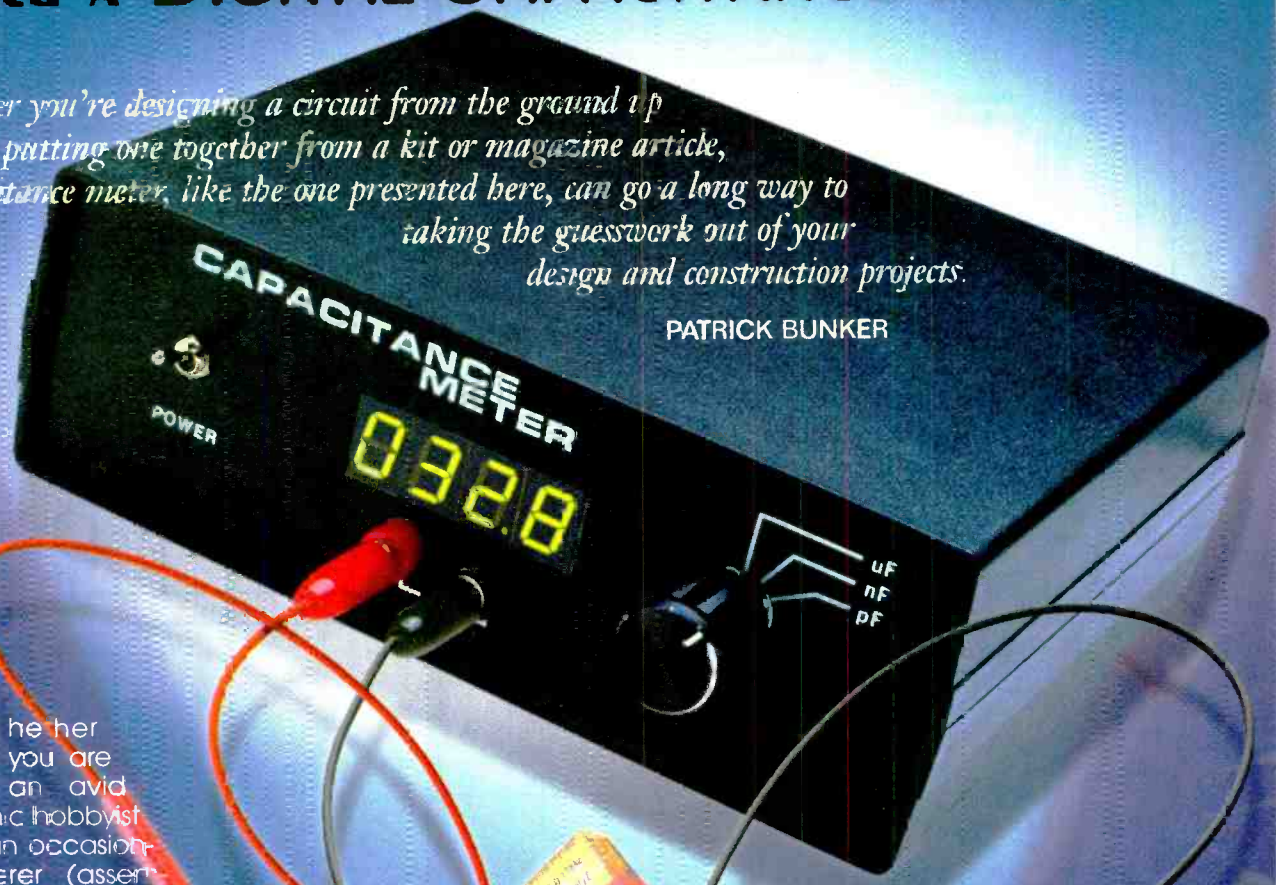
Build A Digital Capacitance Meter

Whether you're designing a circuit from the ground up or just putting one together from a kit or magazine article, a capacitance meter, like the one presented here, can go a long way to taking the guesswork out of your design and construction projects.

PATRICK BUNKER



Whether you are an avid electronic hobbyist or just an occasional tinkerer (assembling only those gadgets that are not available in the consumer market or those that are simply too expensive as an off-the-rack product), sooner or later you are going to need the services of a capacitance meter. Capacitance meters come in handy when you need matched capacitors to build identical circuits (with identical responses) for, say, the left and right channels of an audio system. They also come in handy when you are trying to determine whether a frequency-sensitive circuit (such as a low-pass, high-pass, or other filter or tuning circuit) is malfunctioning because of a bad capacitor.

That is where the *Digital Capacitance Meter* described in this article comes in. The Digital Capacitance Meter features a bright 4-digit LED display, and it offers three ranges (that provide full-scale readings of 9999 pF, 999.9 nF, and 99.99 µF). Other than range selection, no adjustments are necessary when taking a reading. You simply connect the capacitor to the test terminals and select the appropriate range. The meter can accurately measure capacitance down to 1 pF. That's made possible through a nulling circuit that cancels any stray capacitance between the two test terminals or test leads, so that when you measure a 5 pF capacitor, the unit displays 5 pF. The nulling feature also makes it possible to measure the capacitance of wiring and cables.

The Digital Capacitance Meter can also be used to check tantalum and electrolytic capacitors. The test terminals are actually polarized with a potential

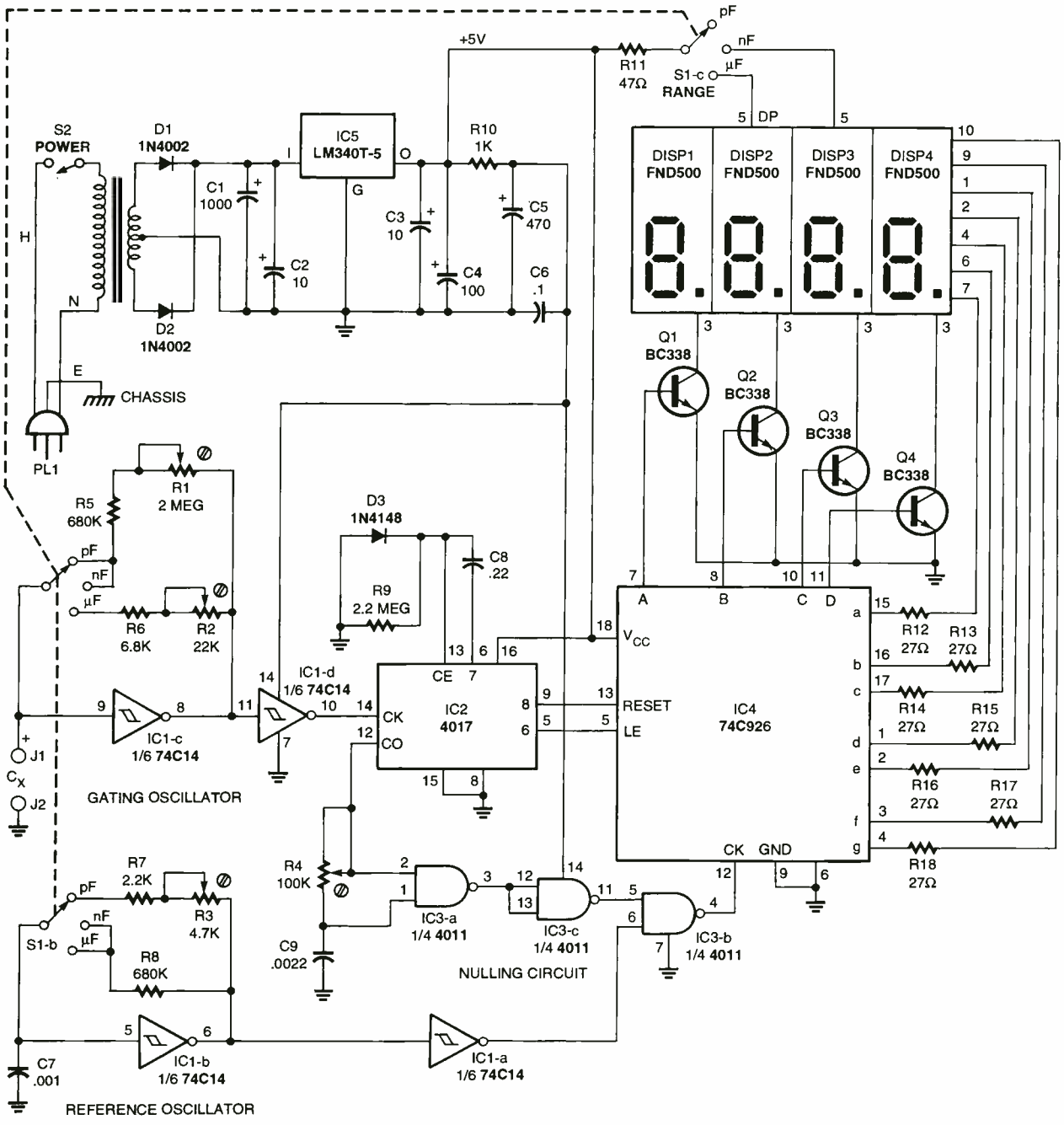


Fig. 1. The Digital Capacitance Meter is comprised of five ICs—a 74C14 hex inverting Schmitt trigger (IC1), a 4017 decade counter with 10 decoded outputs (IC2), a 4011 quad 2-input NAND gate (IC3), a 74C926 4-digit counter with multiplexed 7-segment drivers (IC4), and an LM340T-5 fixed 5-volt regulator (IC5)—four BC338 NPN transistors, four common-cathode, 7-segment LED display modules, and several support components.

difference of about 3 volts, so that all electrolytics with voltage ratings greater than 3 volts can be readily measured.

All that adds up to a very useful general-purpose test instrument. It is particularly useful for checking suspect components, for sorting through capacitors with unfamiliar markings, and for selecting close-tolerance capacitors for use in circuits that require matched pairs.

How It Works. Figure 1 shows a schematic diagram of the Digital Capacitance Meter. The circuit is comprised of five ICs—a 74C14 hex inverting Schmitt trigger (IC1), a 4017 decade counter/divider with 10 decoded outputs (IC2), a 4011 quad 2-input NAND gate (IC3), a 74C926 4-digit counter/display driver (IC4), and an LM340T-5 fixed 5-volt regulator (IC5)—four BC338 NPN transistors, four common-cathode, 7-segment LED display modules, and several support components.

Essential to the operation of the circuit are two simple RC oscillators. Schmitt trigger IC1-c forms the gating oscillator, while IC1-b forms the reference oscillator. Switches S1-a and S1-b, which are connected in

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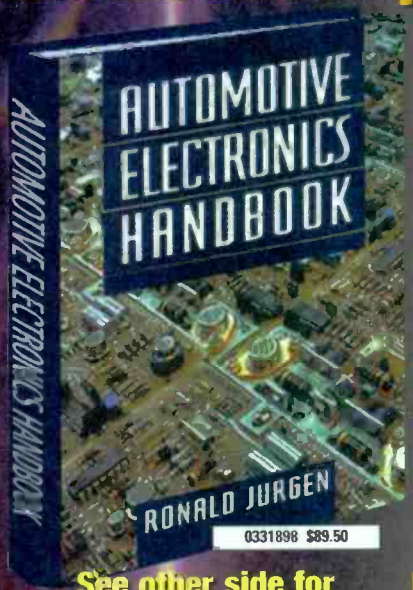

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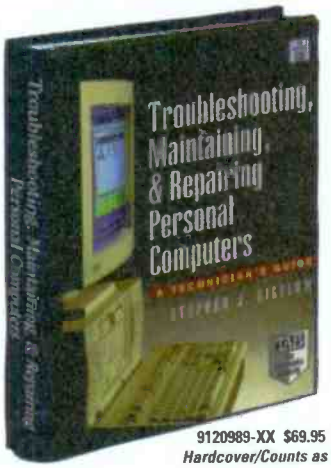

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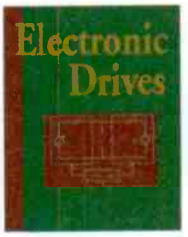

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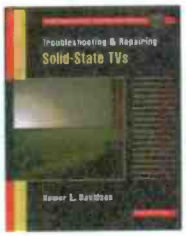

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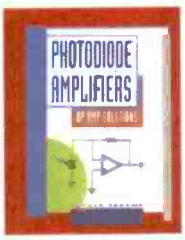

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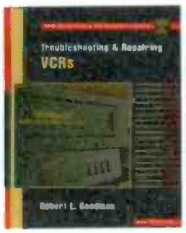

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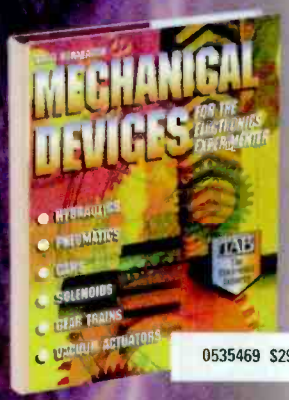

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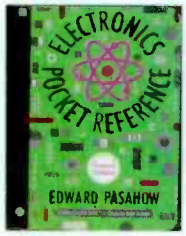

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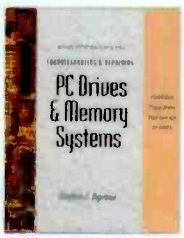

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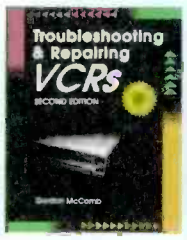

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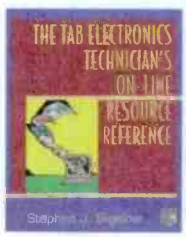

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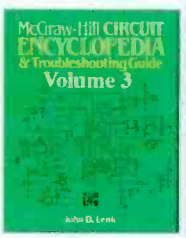

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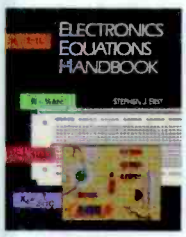

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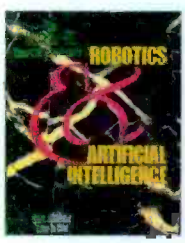

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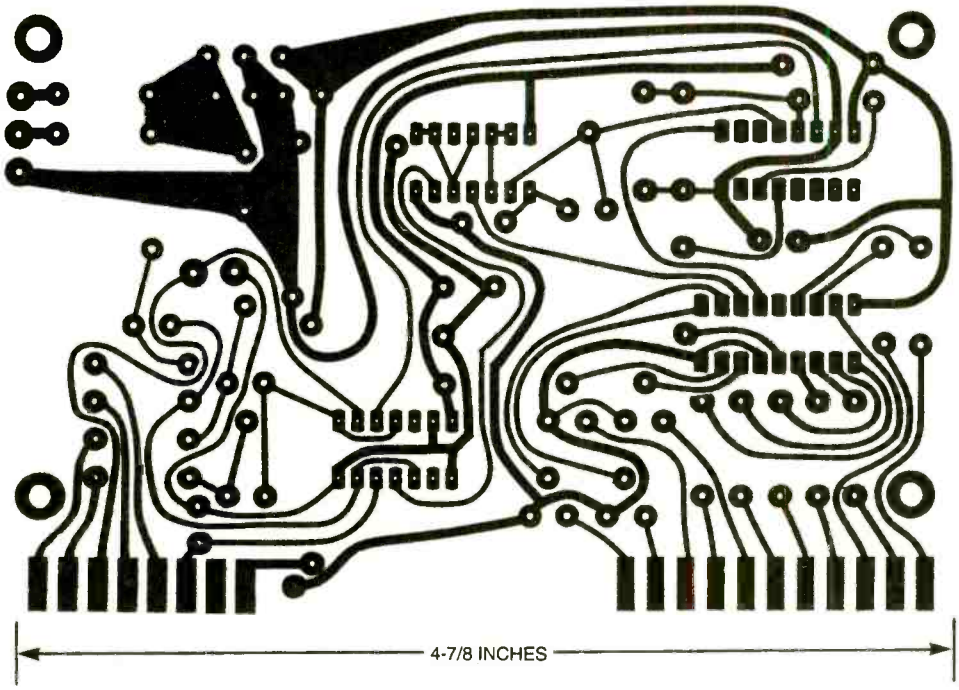


Fig. 2. The Digital Capacitance Meter was assembled on a pair of printed-circuit boards: the main board and the display board. A template for the main printed-circuit board is shown at full size.

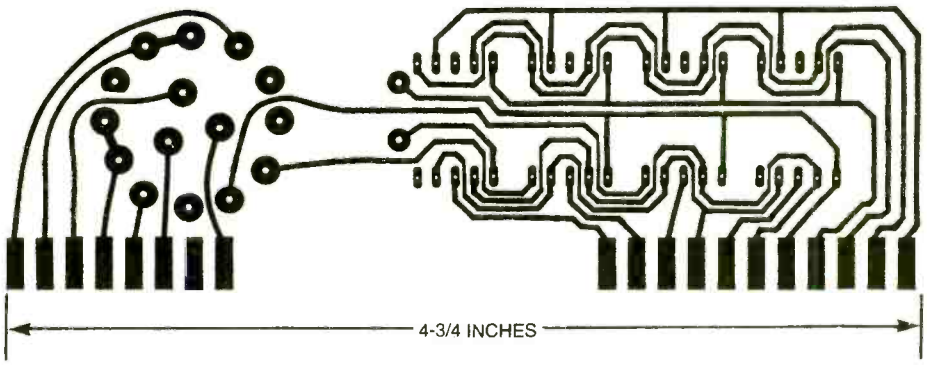


Fig. 3. The layout for the meter's display board, which contains only the four display modules and the RANGE-select switch (S1), is shown here full-scale.

the feedback loops of the gating and reference oscillator circuits, respectively, are used to provide range selection. Capacitor C7, along with the selected feedback network, sets the frequency of the reference oscillator, while the unknown capacitor, C_X, and the selected feedback network sets the frequency of the gating oscillator. The lower the value of the unknown capacitor, the longer the period of the output pulse train.

The output of the gating oscillator is inverted by IC1-d and applied to the clock input of IC2 at pin 14, causing each of IC2's decoded outputs to sequentially go high for the period of the clock signal. IC2 is used to control the reset and latch-enable inputs of IC4, as well as the gating operations.

The decoded-6 output (pin 5) of IC2 is used as the latch-enable control signal, and the decoded-8 output (pin 9) is used as the reset signal, while the signal from the gating oscillator is output at pin 12—the carry-out (co) terminal—of IC2. (The co terminal is high only during the time that the 0 through 4 decoded outputs are high.)

The co signal, an elongated pulse, is applied to a nulling circuit, built around IC3-a. The nulling circuit is used to reduce the duration of the elongated gating signal that is output at pin 12 of IC2 in order to remove the effects of stray capacitance. That's accomplished by feeding the gating signal directly to pin 2 of IC3-a and also to pin 1 via an RC delay network, comprised of C9 and R4 (a 100k potentiometer that allows the RC time constant of nulling circuit to be adjusted). When the original and delayed versions of the gating pulse are NANDed via IC3-

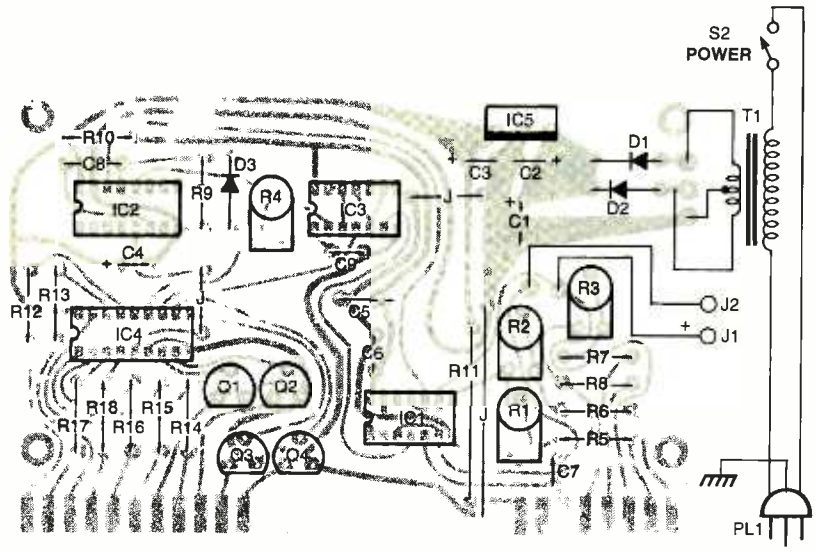


Fig. 4. Install the components on the main board guided by this parts-placement diagram. It is recommended that sockets be provided for the DIP ICs and that the ICs be the last components installed.

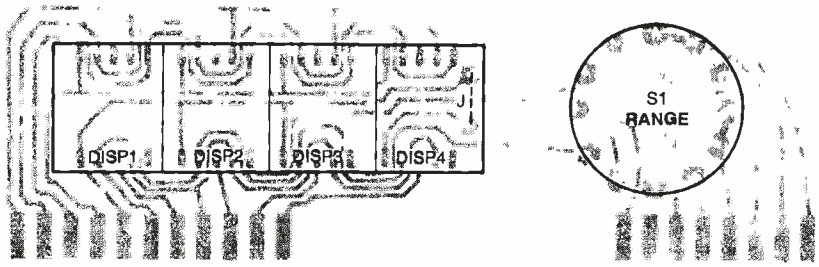


Fig. 5. When assembling the display board, note that the four display modules are mounted in a 40-pin IC socket. A second socket is installed in the first, so that the readout extends sufficiently from the board to allow it to protrude through a cutout in its enclosure.

a, the length of the output pulse is reduced by the amount set by the time constant.

The output of the nulling circuit is fed to IC3-c, which is configured as an inverter. The inverted output of the nulling circuit is fed to IC3-b, which is used to gate the pulses from the reference oscillator.

The output of the reference oscillator is inverted by IC1-a and fed to the gating circuit (IC3-b). The gated pulses from the reference oscillator are applied to the clock input of IC4, causing it to count the number of pulses received from the reference oscillator.

Meanwhile, as IC4 counts the gated pulses from the reference oscillator, IC2 continues to count the pulses from the gating oscillator. When IC2 reaches a count of 5, its co terminal at pin 12 goes low. That low removes the gate signal from IC3-b, preventing any additional pulses from the reference oscillator from reaching the clock input of IC4 at pin 12. After a delay of one count, pin 5 (the decoded-6 output) goes high. That high is applied to the latch-enable terminal of IC4, pulling it high, thereby causing the contents of IC4 to be latched. The latched data is used to drive the display, during which time the decade counters remain free to count up without affecting the reading.

Because the frequency of the gating oscillator determines the rate at which the display is updated, which can be quite rapid when small capacitors are being measured, a half second delay is designed into the circuit to prevent the display from flickering due to rapid updating. The delay is produced by connecting IC2's decoded-7output (pin 6) back to its clock enable (CE) input at pin 13 via a 0.22μF capacitor (C8). On the seventh clock pulse, when pin 6 of IC2 goes high, IC2's clock enable input is pulled high, as C8 begins to charge through R9. That process disables IC2, effectively freezing the display. After about a half second, pin 6 goes low, removing the high from pin 13, and allowing clocking to re-commence. Diode D3 is included in the circuit to prevent pin 13 of IC2 from being pulled below ground potential when pin 6 goes low.

When pin 6 returns to the low state, the next clock pulse causes pin 9 (the decoded-8 output) of IC2 to go high. That high is applied to the reset input (pin 13) of IC4, clearing the latches for the next set of gated, reference-oscillator pulses. Note that there is one complete clock period between each control signal to ensure that the circuit operates without glitches.

The multiplexer outputs of IC4 (at pins 7, 8, 10, and 11) are applied to a bank of four NPN transistors (QI–Q4). The collectors of the transistors are connected to the common-cathode terminals of the four LED display modules. The display segments are driven via seven 27-ohm current-limiting resistors (R12–R18). Switch pole S1-c provides decimal point switching for the displays.

Power for the circuit is derived from a 15-volt center-tapped transformer, whose output is rectified by a full-wave circuit (comprised of D1 and D2) and filtered by capacitor C1. The unregulated output of the rectifier (about 10.5 volts DC) is applied to a fixed 5-volt regulator, IC5 (an LM340T-5), which is used to provide a relatively ripple-free voltage to power the meter circuitry.

A pair of 10-μF capacitors (C2 and C3) are included in the circuit to ensure the stability of the regulator, while C4 (a 100-μF capacitor) is used to decouple the display multiplex hash. Note that the supply rail for IC1 has been decoupled from the regulator via a 1k resistor (R10) and a pair of capacitors (C5, a 470-μF unit and C6, a 0.1-μF unit). That resistor prevents interference to the oscillators from multiplex noise on the main 5-volt supply.

Construction. The Digital Capacitance Meter was assembled on a pair of printed-circuit boards: a main board that contains all of the electronic circuitry and a display board that contains the display modules and RANGE-select switch (S1). A template for the main printed-circuit board is shown in Fig. 2, and the layout for the display board is shown in Fig. 3. Once you've etched your boards and obtained all of the parts listed in the Parts List, construction can begin.

Begin construction by installing all the parts on the main circuit guided by the parts-placement diagram shown in Fig. 4. No special procedure need be followed when assembling the board, although it is recommended that sockets be provided for the DIP ICs and that the ICs be the last components to be installed. When installing the polarized components (the semiconductors and electrolytic capacitors), carefully note their orientation. A small, finned, TO-220-style heatsink should be fitted to the regulator to aid heat dissipation.

When the main board is complete, focus your attention on the display board. Begin construction of the display board by installing a 40-pin IC socket in the location shown in Fig. 5. Install a jumper wire to the right of the 40-pin socket. Next install a 3-gang, 3-position rotary switch in the display board for S1. Suitable switches are available from Mouser Electronics (800-346-6873) as 3-gang, user-selectable, 2- to 4-position units.

Once both boards have been completely assembled, the two boards must be soldered together by their foil edge-connector pads. Begin this operation by aligning the pads on the two boards with the boards at a right angle. Then tack solder the pads at each end of the boards and place the printed-circuit assembly to the side, while you prepare the front and rear panels of the enclosure.

The Digital Capacitance Meter was housed in a plastic instrument case, measuring $7\text{-}^{3}/_{4} \times 6\text{-}^{1}/_{4} \times 2\text{-}^{5}/_{8}$ inches. The front panel has a single cutout, measuring $1\text{-}^{7}/_{16}$ by $^{5}/_{8}$ inches for the display modules, and it has two $^{1}/_{4}$-inch holes (at the positions indicated by a donut pad) for the POWER and RANGE-select switches. A full-size template of the front-panel layout is shown in Fig. 6.

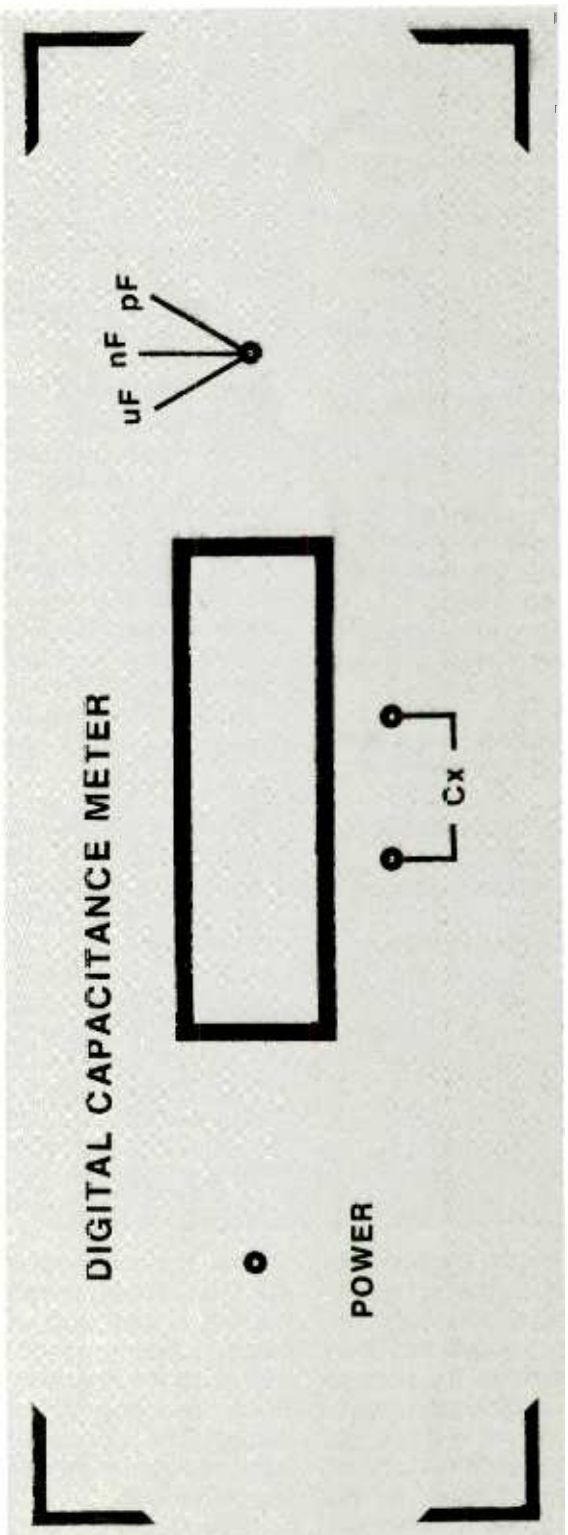


Fig. 6. The Digital Capacitance Meter was housed in a $7\text{-}^{3}/_{4}" \times 6\text{-}^{1}/_{4}" \times 2\text{-}^{5}/_{8}$-inch plastic instrument case, whose front panel contains a cutout (measuring $1\text{-}^{7}/_{16}$ by $^{5}/_{8}$ inches) for the display modules, and two $^{1}/_{4}$-inch holes (at the positions indicated by donut pads) for the POWER and RANGE-select switches. This full-size template can be clipped from the page and used to prepare your enclosure.

Once the enclosure has been prepared, place the printed-circuit assembly in its enclosure so that the display socket is aligned with the cutout in the front panel. The display board may have to be adjusted to achieve the proper positioning. Once you are satisfied that all is well, solder the remaining interboard connections.

Insert the display modules in the 40-pin socket. Another 40-pin IC socket is mounted in the first socket so that when the display modules

PARTS LIST FOR THE DIGITAL CAPACITANCE METER

SEMICONDUCTORS

D1, D2—1N4002, 1-amp, 100-PIV, silicon rectifier diode
D3—1N4148, 1N914 general-purpose, small-signal diode
DISP1–DISP4—FND500, HD1133R, or D35OPKG common-cathode, 7-segment LED display
IC1—74C14, 40106 or 14584 hex inverting Schmitt trigger, integrated circuit
IC2—4017 decade counter/divider, integrated circuit
IC3—4011 quad 2-input NAND gate, integrated circuit
IC4—74C926 4-digit counter, 7-segment display driver, integrated circuit
IC5—LM340T-5 or 7805 fixed 5-volt 1.5-amp, voltages regulator
Q1–Q4—BC338 or similar general-purpose NPN silicon transistor

RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)
R1—2-megohm, horizontal, trimmer potentiometer
R2—22,000-ohm, horizontal, trimmer potentiometer
R3—4700-ohm, horizontal, trimmer potentiometer
R4—100,000-ohm, horizontal, trimmer potentiometer
R5, R8—680,000-ohm
R6—6800-ohm
R7—2200-ohm
R9—2.2-megohm
R10—1000-ohm
R11—47-ohm
R12–R18—27-ohm

CAPACITORS

C1—1000-µF, 16-WVDC, electrolytic
C2, C3—10-µF, 16-WVDC, electrolytic
C4—100-µF, 16-WVDC, electrolytic
C5—470-µF, 16-WVDC, electrolytic
C6—0.1-µF, ceramic-disc
C7—0 .001-µF, metallized polyester
C8—0.22-µF, metallized polyester
C9—0.0022-µF, metallized polyester

ADDITIONAL PARTS AND MATERIALS

J1, J2—Panel-mount banana jack
PL1—AC line cord with molded plug
S1—3-gang, 3-position, rotary switch (see text)
T1—15-volt, center-tapped transformer
Printed-circuit board materials, plastic instrument case, cord-clamp grommet, 1/4-inch spacers, solder lug, knob, 8-inch length of 75-ohm coaxial cable, TO-220 heatsink, 40-pin IC sockets, wire, solder, hardware, *etc.*

Note: The 74C926 4-digit counter, 7-segment display driver (IC4) is available from Digi-Key (800-344-4539) and Allied Electronics (800-433-5700). If you cannot find FND500, HD1133R, or D35OPKG common-cathode, 7-segment display modules (DISP1–DISP4), they can be replaced with NTE-3079 or TCE/SK-2079 units. Also the BC338 transistors (Q1–Q4) can be replaced by any of the following units: ECG-123AP, GE-123AP, MPSA05, TCG-123AP, TCE/SK-3854/123AP.

are installed, they will be flush with the front panel of the enclosure. **Note:** The display modules are polarized, so make sure that they are correctly oriented. The printed-circuit board assembly and power transformer T1 mount to a 6-1/4- by 5-1/2-inch piece of sheet metal, which serves as a chassis for the project. The transformer's secondary winding was connected to the printed-circuit board through hookup wire.

All that remains now is to complete the internal wiring. The AC line cord enters the enclosure through a cord clamp mounted to the rear panel of the enclosure. The hot lead goes to switch S2, while the neutral lead is connected directly to the transformer terminals. The earth (or chassis) ground wire connects to a solder lug, which is then placed under one of the screws that holds the transformer in place. Place insulating sleeves over all exposed AC connections to prevent accidental shock while working on the unit.

Note: Good quality 75-ohm coaxial cable should be used between the board and test terminals. Normal audio cable is unsuitable, because its capacitance changes markedly with temperature.

Once the circuit is completely assembled, it is time for the smoke test. Apply power to the circuit and check for 5-volts DC at the output of the regulator. If you don't get a +5-volt reading, immediately turn the circuit off and troubleshoot the circuit, looking for the common construction errors—cold solder joints, solder bridges, misoriented components, *etc.*

Calibration. To calibrate the circuit using the preferred method, you'll need three capacitors with known (verified) capacitances. Of course, to determine the actual value of a capacitor, you need access to a capacitance meter.

If a capacitance meter is not available, you can either resort to precision capacitors (5% tolerance or less) for the calibration, or you can wire several like-value capacitors—for example, four or five 270-pF units—in parallel. With that method, the tolerances of all the units essentially cancel out each other, thereby giving a capacitance very close to the rated value.

In any event, start the calibration procedure with the nanofarad (nF) range. Set all trimmer potentiometers to mid-position and connect the nF reference capacitor to the test terminals. Adjust R1 for the correct reading. Remove the capacitor, set the range switch to picofarads (pF), and adjust R4 (the null control) for a reading of 0000. The correct procedure here is to first adjust R4 for an initial reading of 0001, and then nudge it back for the 0000 reading. After that, connect the pF reference capacitor and adjust R3 until the display reads the correct value.

Finally, connect the microfarad (µF) reference capacitor to the test terminals and calibrate the µF range, using trimmer potentiometer R2. **Note:** An electrolytic capacitor's actual value can vary as much as ±80% from its nominal (rated) value: Even with so wide a variance, the actual value is still within the standard tolerance of a normal electrolytic capacitor. Also note that the positive lead of the capacitor should go to the positive test terminal.

The Digital Capacitance Meter is now ready for use. Note that the least-significant digit (LSD) jitters when the test capacitance is beyond the selected range of the Digital Capacitance Meter. ■

BUILD THE TELEPHONE HANGUP MODULE

Rid yourself of unwanted telephone solicitations and sales pitches without having to sit through the whole spiel with an easy-to-build circuit that quickly terminates the conversation, disconnects the line, and gets you off the hook.

ANTHONY J. CARISTI

Everyone has been bothered, at one time or another, by unwanted telephone calls from people trying to sell you something you don't want or trying to extract a donation from you for some organization you never heard of. Although these type of calls tend to annoy many people no end, a lot of them find it extremely difficult to terminate such calls. If you are among those that find it hard to call a halt to the pitch, the project presented in this article is for you.

Dubbed the *Telephone HangUp Module*, the circuit provides an easy, gentle way to hang up on the offending caller. The Telephone HangUp Module, which is permanently attached to the telephone line, has no effect on telephone operation except to deliver a polite hang-up message when the playback mode is activated. Once you've decided that you no longer wish to stay on the line, simply press the button and hang up. The module then delivers a message that says, in as pleasant a voice as you can provide, "We're sorry. This telephone number does not accept calls of this nature. Please do not call again."

The module can be placed at any location where it can be connected to the telephone line, and it can be operated from all extensions. The module and each extension telephone can be equipped with a pushbutton switch, allowing the Telephone HangUp Module to be activated from the module location or any of the connected extensions. No additional wiring is required. Once the button is pushed, the module goes into the playback mode, delivering the message. There's no need to keep the phone off hook. Simply hang up just before or just after pushing the button.

How It Works. A schematic diagram of the Telephone HangUp Module is shown in Fig. 1. At the heart of the Telephone HangUp Module is an Information Storage Devices (ISD) integrated circuit (ISD1110P)—a high-quality, solid-state, record/playback system in a single-chip. The chip contains a clock oscillator, microphone amplifier, automatic gain control circuit, and power amplifier; and it can record or play back a message up to 10-seconds long.

Voice recordings are stored in non-volatile memory cells. This means that the recorded message is retained in memory even if power is interrupted. High-quality audio processing provides natural sounding voice reproduction.

The circuit is powered from a common 9-volt, transistor-radio battery. Battery voltage is fed to a fixed 5-volt regulator (IC1), which provides a stable voltage to run the circuit. In stand-by mode, the circuit draws less than 15 μA, providing a battery life of about a year, depending on how frequently the circuit is activated.

The record/playback chip, IC2, has two control inputs: pin 27 record and pin 24 playback. When the record terminal is pulled low (by closing S1) and held in that state, IC2 goes into record mode. At that point, the circuit records any audio sounds, up to 10 seconds in dura-

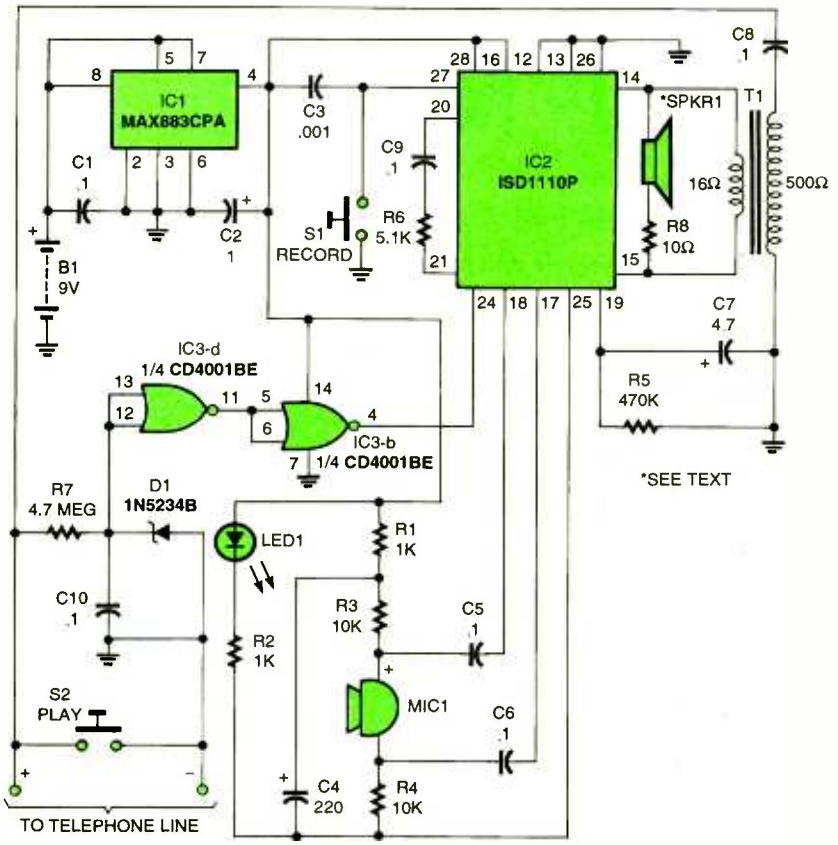


Fig. 1. At the heart of the Telephone HangUp Module is an ISD1110P, a single-chip record/playback system, which contains a clock oscillator, microphone amplifier, automatic gain control circuit, and power amplifier.

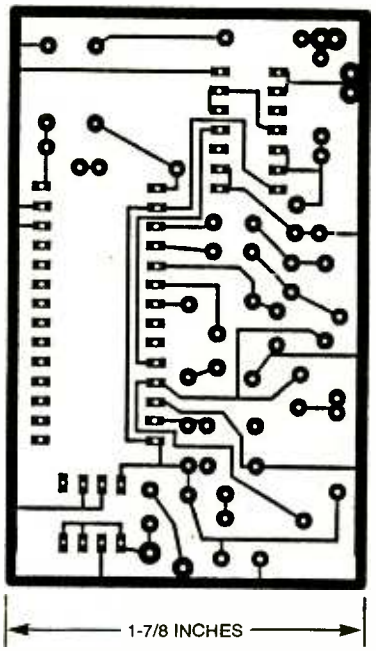


Fig. 2. The Telephone HangUp Module was assembled on a printed-circuit board, a full-size template of which is shown here.

tion, detected by the microphone. When the record mode is activated, a light-emitting diode (LED1) lights to visually indicate the status of the circuit.

When S1 is released, the LED goes out; and the chip goes into the standby mode, awaiting playback activation. In the standby mode, capacitor C10 charges from the telephone line through R7. The charge on C10 is applied to IC3-d (which is configured as an inverter), causing its output at pin 11 to go low. That low is applied to IC3-b (which is also configured as an inverter), causing its output to go high. That high is fed to pin 24 of IC2, keeping it set to the standby mode.

Playback is initiated by pressing S2 (PLAY). When S2 is pressed, a couple of things happen. First C10 begins to discharge through R7, causing the output of IC3-d to go high and the output of IC3-b to go low. That low is applied to pin 24 of IC2, placing IC2 in the playback mode. At that point, the recorded voice message is output at pins 14 and 15, applying the audio to SPKR1. At the same time, the output audio is applied to an impedance matching/isolation transformer, T1, which is used to couple the recorded message to the telephone line. At the end of the message, IC2 goes back to the stand-by mode and is ready for the next playback cycle.

The telephone handset may be placed on-hook at any time, either before or after the message has been transmitted. Telephone system equipment provides an automatic delay of about 10 seconds after hang-up before an incoming call is disconnected.

Construction. The Telephone HangUp Module was assembled on a printed-circuit board. A full-size template of the author's printed-circuit artwork is shown in Fig. 2. If you don't care to etch and drill your own board, one can be obtained from the source given in the Parts List.

Once you've obtained all of the parts listed in the Parts List, construction can begin. The parts-placement diagram for the printed-circuit layout is shown in Fig. 3. When installing the polarized components—the microphone, solid-state devices, and electrolytic capacitors—on the board, be sure that they are properly oriented. Just one part placed in the circuit backwards will render it inoperative and may damage one or more components.

Sockets can be used for the integrated circuits to allow ease of service should it ever become necessary. In addition, sockets allow the ICs to be re-oriented should they be installed improperly the first time. It is difficult to remove a multi-pin component from a printed-circuit board for servicing or re-orientation once it has been soldered in place. Do not insert the ICs into the board until instructed to do so—the ICs will be installed later during the checkout procedure.

The coupling transformer, T1, must be wired into the circuit so that its low-impedance winding is connected to the output of IC2. The center tap of each winding is not used. Take an ohmmeter and measure the resistance of both the pri-

mary and the secondary, noting that one side will read about 2 ohms and the other 40 ohms. Insert the transformer into the board so that the 2-ohm winding is connected to pins 14 and 15 of IC2. Secure the transformer to the board with a small amount of RTV silicone rubber or epoxy.

Solder the leads of a 9-volt battery connector to the points indicated in Fig. 3—the red lead goes to the positive pad, and the black one goes to the negative pad.

The speaker specified in the parts list has an impedance of 32 ohms. When speakers with 16- to 32-ohm impedances are used in the circuit, R8 is not required, and a jumper wire should be soldered in its place. If a 4- or 8-ohm speaker is used, R8 should be installed in the board where indicated to provide the proper impedance match for IC2. Note that switch S1 is a tiny board-mounted unit.

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

The assembly was mounted into a small enclosure. Switch S2 was mounted to the front panel of the enclosure, so that it can easily be actuated to transmit the recorded message.

The module is connected to the telephone line by means of a standard modular connector. If the telephone has sufficient room inside its case to house the circuit board, the module can be installed in the telephone housing. That way, no connector is necessary. Switch S2 can then be mounted on or near the telephone enclosure.

When the Telephone HangUp Module has been fully assembled, examine the wiring very carefully for proper connections. Do not attempt the checkout procedure unless you are thoroughly satisfied that the assembly and wiring are 100% correct.

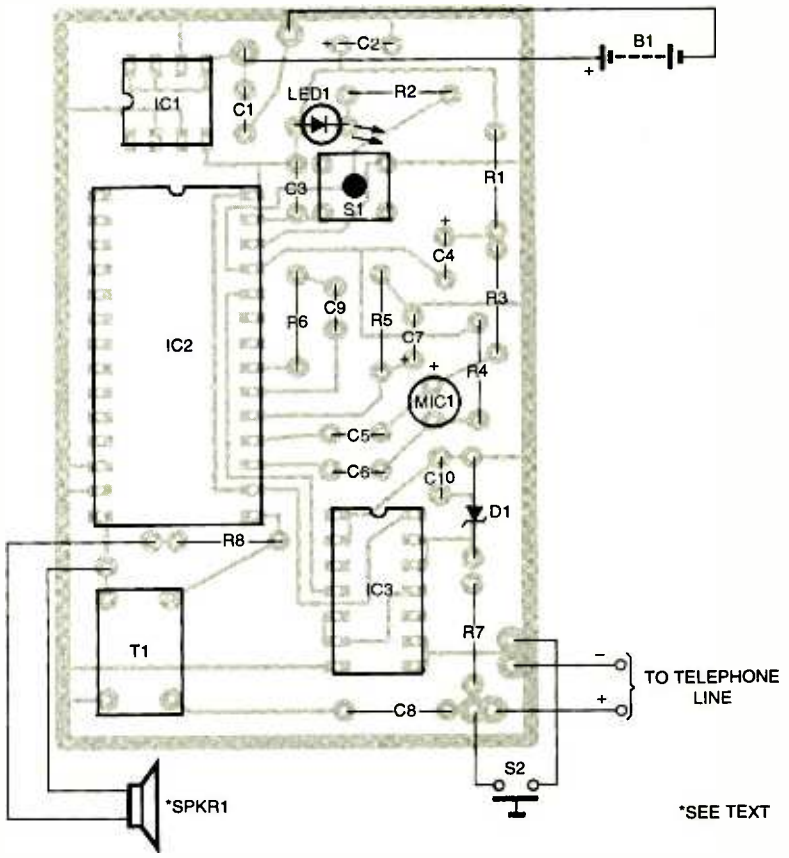


Fig. 3. Assemble the Telephone Hang Up Module's printed-circuit board guided by this parts-placement diagram.

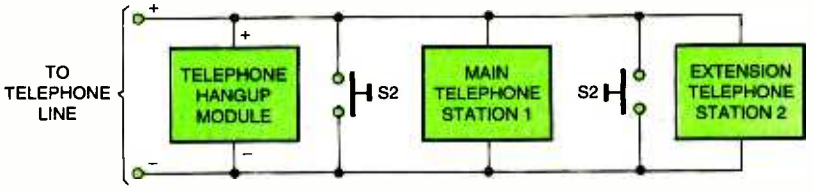


Fig. 4. Illustrated here is a typical Telephone HangUp Module installation, where two telephones (the main and the extension units) are connected to a single telephone line. Note: Locating additional SPST pushbutton switches at each extension telephone allows the message to be transmitted from any station.

Checkout. Checking the circuit's operation requires a DVM or VOM. Before inserting the ICs into the board or applying power, measure the resistance from the positive side of C2 to circuit common to be sure there is no short circuit. If everything is OK, the meter should indicate essentially an open circuit (infinite resistance). If you get a reading of zero or some low-resistance value, troubleshoot the circuit and correct the fault before proceeding. Check C2 and check all the other polarized components.

If all is well, continue with the checkout procedure. Temporarily connect a 100k resistor between pin 5 of IC1 and the positive wire of the telephone line to simulate the DC voltage across the phone line. Insert IC1 in the board and connect a fresh 9-volt battery to the circuit.

Measure the voltage from the positive side of C2 to ground. You should get a reading of +4.75 to +5.25 volts DC. If you get a reading outside of that parameter, check and verify that the battery is deliv-

PARTS LIST FOR THE TELEPHONE HANGUP MODULE

SEMICONDUCTORS

IC1—MAX883CPA fixed 5-volt voltage regulator, integrated circuit (Digi-Key)
IC2—ISD1110P record/playback system, integrated circuit (Digi-Key)
U3—CD4001BE quad 2-input NOR gate, integrated circuit (NTE-4001B or equivalent)
D1—1N5234B or similar 6.2-volt, ½-watt, Zener diode (NTE-5013A or equivalent)
LED1—Light-emitting diode, any color

RESISTORS

(All resistor are ½-watt, 5% carbon units.)
R1, R2—1000-ohm
R3, R4—10,000-ohm
R5—470,000-ohm
R6—5100-ohm
R7—4.7-megohm
R8—10-ohm (see text)

CAPACITORS

C1, C5, C6, C9, C10—0.1-µF, ceramic-disc
C2—1-µF, 50-WVDC, radial-lead, electrolytic
C3—0.001-µF, ceramic-disc
C4—220-µF, 16-WVDC, radial-lead, electrolytic
C7—4.7-µF, 25-WVDC, radial-lead, electrolytic
C8—0.1-µF, ceramic-disc or Mylar

ADDITIONAL PARTS AND MATERIALS

T1—16- to 500-ohm, impedance-matching transformer (Mouser 42TL026 or similar)
S1—SPST pushbutton switch (Mouser 101-0361 or similar)
S2—SPST pushbutton switch (Mouser 103-1012 or similar)
B1—9-volt, alkaline, transistor-radio battery
SPKR1—32-ohm speaker (Mouser 25SP222 or similar), see text
MIC1—Electret microphone (Mouser 25LM040 or similar)
Printed-circuit materials, battery clip, enclosure, IC sockets, wire solder, hardware, *etc.*

Note: The following parts are available from A. Caristi, 69 White Pond Road, Waldwick, NJ 07463: Printed-circuit board for $14.75, IC1 for $5.75, IC2 for $19.50, and IC3 for $2.00. Please add $5.00 postage/handling to all orders. New Jersey residents please add sales tax.

ering at least 7 volts under load to pin 5 of regulator IC1. Check the orientation of C2 and IC1. Correct the fault before proceeding.

If that test checks out, remove power and insert IC2 and IC3 into the board with the proper orientation. Apply power. Press and hold S1—LED1 should illuminate—while speaking into the microphone for a few seconds. Release S1; the LED should extinguish.

Press and hold S2 for one second. The voice recording should be reproduced in speaker SPKR1. A new message can be recorded by repeating the above procedure. Compose a suitable outgoing message—remember, you are limited to a 10-second recording. If you are able to record and playback a voice message, remove the temporary 100k resistor and proceed with the telephone line connection. Otherwise refer to the hints below to troubleshoot the circuit.

If the LED does not light when S1 is pressed, check its orientation. Check R2 and try a new LED. If IC2 does not record or playback, check its orientation and all associated components. Verify that the 100k resistor is properly connected. Check D1 and the speaker wiring. Verify that pin 27 of IC2 goes to zero volts when S1 is pressed, and pin 24 goes to zero volts when S2 is pressed and held for at least one second. Check IC3, and try a new chip if necessary.

Telephone Line Connection. It is imperative that the module be connected to the telephone line with the correct polarity as indicated in the schematic diagram; otherwise it will not work. Many telephone systems use a green wire and a red wire to carry the voice and ring signals, with green being positive and red negative. However, you must check telephone-line polarity with a meter to be sure.

Obtain a telephone-line cord with a modular connector at one end and tinned leads at the other. Plug the connector into a working telephone receptacle and use a voltmeter to locate the pair of wires that exhibit a 50-volt DC potential between them. Those are the wires that must be used to hook up the module. Carefully mark the wires with plus and minus so that they can be properly connected to the circuit. Refer to the parts-placement diagram (Fig. 3) for the location of the telephone-line connections on the printed-circuit board.

Installation and Use. Figure 4 illustrates a typical Telephone HangUp Module installation, where two telephones (the main and extension units) are connected to a single telephone line. Any number of extensions are permissible. Note that the module may be connected across the telephone line at any location. Additional SPST pushbutton switches should be located at each extension telephone so that the message can be transmitted from any extension.

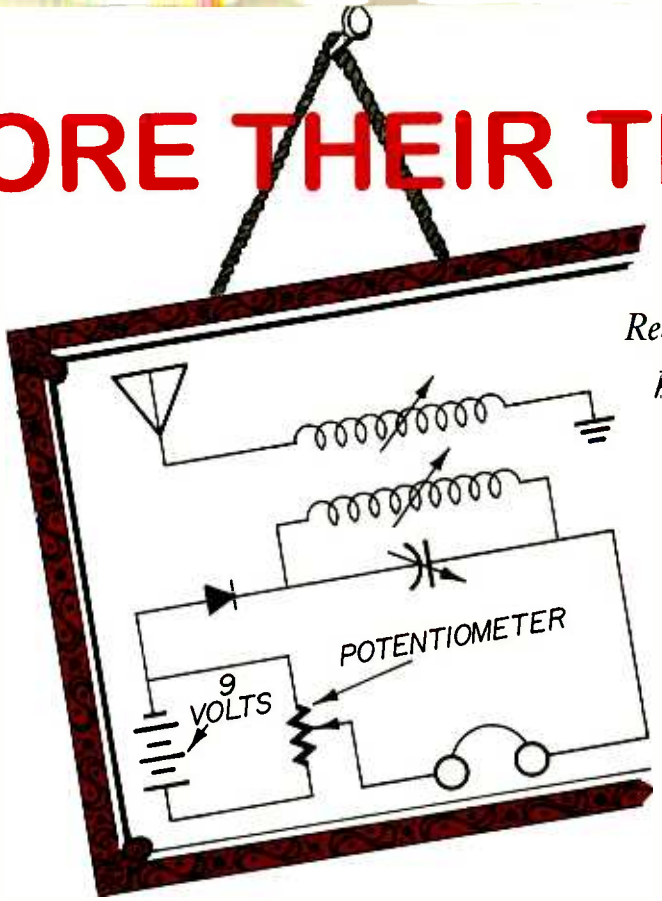
After the module is connected to the telephone line, a new message can be recorded at any time, if desired, by pressing and holding S1. Do not speak any longer than 10 seconds.

When you receive an unwanted call, press S2 for about a second to activate the recorded message. You can hang up or stay on the line as desired. Should the message sound distorted or disappear altogether, replace the battery.

Note: Always leave the module connected to the telephone line to ensure long battery life. If the circuit is disconnected for any length of time, disconnect the battery. ■

BEFORE THEIR TIME

LARRY LISLE, K9KZT



Read about the unsung heroes who helped bring about the Electronic Age, but whose efforts went unappreciated because they were too far ahead of their time.

Living as we do in a world of electric lights, radio, and solid-state marvels, it's hard to imagine a time when it wasn't like this. Many people helped to bring about the wonders we take for granted. Some of them, like Edison and Marconi, became widely known, while others who also made important discoveries were ignored in their own time and have been almost forgotten today. Let's look at the stories of some of the less well-known pioneers and examine the implications of their work.

The Incandescent Light. The idea of an electric light is almost as old as man's awareness of electricity. The earliest known attempt to produce illumination by passing an electric current through a wire was in 1820, when Warren de la Rue made a lamp consisting of a coil of platinum wire in a glass tube. De la Rue's lamp, and the similar ones that followed, burned out rapidly for two reasons. First, the temperature at which platinum glows is too near its melting point; second, unless the bulb was completely evacuated, the filament would oxidize. The mechanical vacuum pumps of the time just weren't good enough to remove a sufficient amount of air.

Both those difficulties were overcome in 1845 by J.W. Starr of Cincinnati, Ohio. Starr patented an incandescent lamp with a carbon filament in a "Torricellan-produced" vacuum. The high vacuum was produced by attaching the bulb to be evacuated to a long tube filled with mercury. The bulb was attached to the bottom of the tube by a stopcock that is initially closed. The tube of mercury was then inverted so it hung below the bulb, and the stopcock was opened. The weight of the mercury would then suck the air out of the bulb. The resulting vacuum was the nearest thing to a "hard" vacuum available at the time. Starr mounted 26 of his bulbs in a candelabra and took it to England where he demonstrated it later that year. Unfortunately, Starr died prematurely in 1847, and his death marked the beginning of a hiatus in the story of the incandescent lamp that lasted until the work of Thomas Edison in 1880.

Edison, of course, created an electrical system of dynamos, wiring, fuses, and connectors to supply current to his carbon-filament, high-vacuum lamp, while Starr had only batteries. Edison lit cities—but Starr did light 26 bulbs!

Wireless Telegraph. Many historians of science, point to the development of "wireless," or radio as we call it today, as a classic example of theory turning into practice. Briefly, the story goes something like this. In 1865, James Clerk Maxwell published a theory predicting the existence of electromagnetic waves similar to light, but of lower frequency. In 1887 Heinrich Hertz confirmed Maxwell's theory experimentally. And, beginning in 1894, Guglielmo Marconi experimented with using those waves for communication. His transmission range extended to nine miles in 1896, 74 miles in 1899, and succeeded in spanning the Atlantic in 1901.

Thus the story goes, and interesting as it is, it isn't complete—not without the story of Dr. Mahlon Loomis. Born In New York State in 1826, Loomis studied dentistry and began his practice in 1849. An inveterate experimenter, Loomis was investigating the effects of electricity on plant growth when he noticed a curious phenomenon. He had erected several kites, connected by wires to metal plates buried near his plants. He then observed that when one of the kite wires was connected to its plate, electricity flowed between another kite and its ground in a nearby wire. Others would have shrugged this off. Loomis saw the possibilities instantly—telegraphy without wires!

Loomis redirected his experiments along new lines, and in October, 1866, conducted a demonstration before members of Congress and other notables in which he succeeded in communicating by wireless over a distance of eighteen miles!

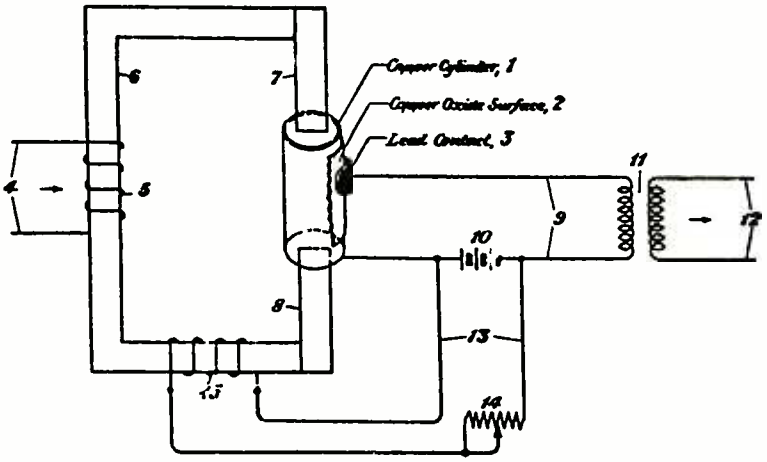
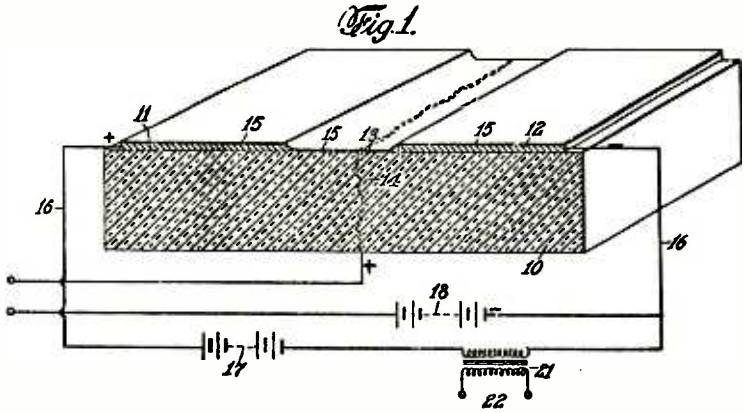


Fig. 1. Was this the first solid-state amplifier? It used a magnetic field to control the current across a copper/copper-oxide junction. The inventor, Russell Ohl, was a respected scientist who later invented the PN junction, so the amplifier probably worked. Unfortunately, tubes were on center stage in 1930.



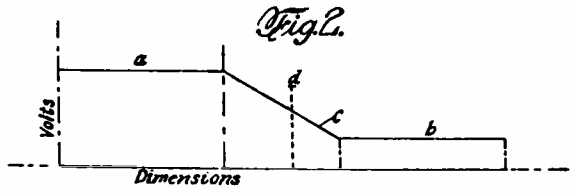


Fig. 2. It certainly looks like an NPN transistor and the circuitry appears correct, but whether it actually worked isn't known. Perhaps some readers know what became of Dr. Lilienfeld and his "transistor." Was it a casualty of the depression?

Loomis' equipment was simplicity itself. A six-hundred foot wire was held aloft by a kite and topped the voltage difference between the upper atmosphere and ground that's present even in clear weather and that rises to millions of volts in a thunderstorm. When the wire was connected to the Earth with a key, a spark was produced that created high-frequency oscillations in the wire, which acted as a transmitting antenna. These oscillations were picked up by the distant receiving antenna and detected by a galvanometer connected between the antenna and ground. Normally a galvanometer wouldn't be sensitive to radio waves, but any non-linear element in the system—a bit of rust for example—could act as a rectifying detector. Since both stations were identical, two-way communication was possible.

Loomis felt that the greatest potential for his discovery was in the West, where the problems of putting up telegraph wires and keeping them up were appalling. With a good imagination one can almost see the wagon trains heading West with a kite flying from the last wagon, cowboy "ham" operators exchanging news and gossip between the isolated towns and ranches, the cavalry sending up a kite when the fort was surrounded....

But it wasn't to be. One group of investors who had promised support was wiped out in the financial panic of 1869, and another in the Chicago fire of 1871. Loomis turned to Congress for aid in setting up experimental stations in the Rocky Mountains, but again in vain.

Called a crank, and a fool for giving up his lucrative practice, Dr. Mahlon Loomis died at the age of sixty, never having seen his inventions properly tested. An unknowing tribute was paid to Loomis in 1901, when the first signals to cross the Atlantic were picked up by an antenna suspended from a kite.

Solid-State Devices. Many people believe that, aside from the crystal set, the era of solid-state began in December, 1947 with the invention of the transistor at Bell Laboratories. In a practical sense this is true, but it wasn't for lack of trying.

The light-emitting diode or LED is an ubiquitous element of our modern world. But the emission of light from a rectifying junction was first reported by H.J. Round in a detailed letter to the editor of *Electrical World* in 1907! But we didn't need LEDs then, and a theory of why they worked was years in the future.

In 1958, readers of *Physical Review* learned of a new invention by Leo Esaki: the tunnel diode. A negative-resistance device—the tunnel diode caused a flurry of interest because it could work at higher frequencies and was smaller than the tubes or transistors of the time.

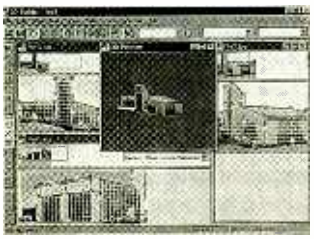
However, an oscillating diode receiver (schematically shown in the lead art), using exactly the some circuit as the Esaki diode, was described almost 40 years earlier by G.W. Pickard in the March, 1920 issue of *QST*, an amateur-radio magazine. Pickard was a widely-respected experimenter

(Continued on page 69)

New Products

3D-MODELING FROM PHOTOS

3D Builder Pro 3.0 from *3D Construction Company* builds detailed and accurate 3D-models from photographs, complete with full surround and seamless, photo-realistic textures. It has automatic perspective correction, so the 3D-models can be rotated in all directions and "walked around" as in real life. This close-range photogrammetry software allows for the processing of photos to obtain accurate field measurements and to create 3D "as-built" CAD-models.



Sub-pixel accuracy is produced by this modeler that comes with a photogrammetry solver. Using a powerful and comprehensive math solver, the program is able to combine information from a large number of photos. It then extracts and merges information together to form a single 3D-model ready to export to rendering, animation, and presentation programs.

A real time saver, 3D Builder Pro 3.0 features automatic camera orientation, camera calibration, and new CAD modeling tools for curves and shapes—without the need for target points. Included with the program is the VRML 2.0 export with data files small enough to use on the Internet. Other export formats also supported include 3D Studio, DXF, IGES, Inventor, STL, VRML 1.0, and Wavefront.

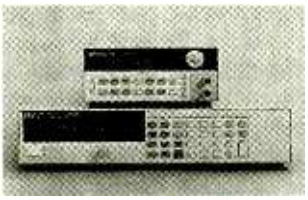
Running on a standard PC, the software—a full 32-bit application—is powerful, affordable, and easy-to-use. It supports Win95, Win NT 4.0 and 3.51, and Windows 3.1.

The 3D Builder Pro 3.0 costs $695. Also available is the 3D Builder PowerLite 3.0 for $189, the new low-priced version of the 3D Builder tool for constructing and texturing 3D models directly from photographs. This program exports DXF and fully textured VRML formats. For more information, contact 3D Construction Company, 122 Creative Station, Elizabethton, TN 37643-5305; Tel. 423-543-8917; Fax: 423-543-4011; e-mail: threedc@usit.net; Web: *www.3dconstruction.com.*

CIRCLE 80 ON FREE INFORMATION CARD

HIGH-PERFORMANCE DC POWER SUPPLIES

Hewlett-Packard has added four DC power supplies—*HP6611C, 6613C, 6614C,* and *6631B*—and an enhanced, compact version of its 40W-power supply, the *HP6612C,* to its product line. They offer high speed and precision measurements in a one-box solution.



The DC power supplies reduce test-system development time and perform precision testing, by providing current measurement down to the microamp (μA) level. Users can save valuable time because there is no need to configure external shunts, relays, and digital multimeters to make measurements. Their two-quadrant output source gives 6-ms output uptime and downtimes.

Key features of the power supplies are higher testing throughput and high-speed programming with under 4-ms response time. All the units now include VXI *plug&play* drivers and advanced programming capabilities in a wide range of industry platforms, including HP Vee, LabView, LabWindows, VB and VC++.

The 6611C and the 6631B have ratings of 8V, 5A and 8V, 10A, respectively. The cost is $1395 for the 6611C and $1795 for the 6631B. The 6613C supplies 50V, 1A, while the 6614C supplies 100V, 0.5A; and they cost $1395 each. The enhanced 6612C unit, which has reduced its chassis depth by 76mm to fit more easily into racked and unracked test-systems, provides 20V, 2A. It also costs $1395.

For more information, contact Hewlett-Packard Company, Test and Measurement Organization, P.O. Box 50637, Palo Alto, CA 94303-9512; Tel. 800-452-4844, ext. 5519; Web: *www.hp.com/info/precisepower.*

CIRCLE 81 ON FREE INFORMATION CARD

PORTABLE EMERGENCY PHONE

ORA Electronics has launched the *Travel Talk +911,* an addition to its carrier-designated product group. Travel Talk +911 combines a portable hands-free speakerphone with "one-touch" automatic 911 emergency access and one-touch information access. The Travel Talk unit features both a prominently-placed red button, labeled 911, and a green button that accesses other services.

When the caller presses the red button for at least two seconds, the attached cellular phone automatically dials 911, opening a line to the agency that monitors cellular 911 calls. If an emergency occurs during a routine call in progress, pressing the red button immediately terminates that call and initiates a 911 call instead. The red button is well-illuminated for enhanced nighttime visibility.

The green button is designed to allow subscribers "one-touch" access to information services. Pushing this button connects you directly to enhanced 411 (E411), roadside assistance providers, or other third parties providing value-added informational services.

The portability and adaptability of the Travel Talk +911 allows it to be carried and utilized in any automobile, including rental cars. Simply plug it into the vehicle's cigarette lighter receptacle and into the cellular handset, and the phone is fully operational.

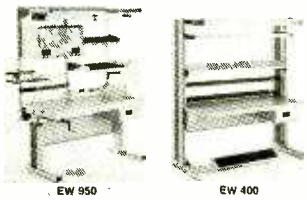
To begin with, the Travel Talk +911 will only be sold through cellular telephone carriers and information service providers, such as auto clubs. Initially, it will only support cellular handsets made by Motorola. In the future, Travel Talk will support other manufacturers, will be "bundled" with information provider programs, and will be sold on the retail market.

The Travel Talk +911 has a suggested retail price of $129.95. Contact ORA Electronics, 9410 Owensmouth Ave., Chatsworth, CA 91314; Tel. 818-772-2700; Fax: 818-718-8626; Web: *www.orausa.com* for more information.

CIRCLE 82 ON FREE INFORMATION CARD

ERGONOMIC WORKSTATIONS

The *ErgoNetic Workstations* from *Stanley Storage Systems* offer two models: the EW-900 and the EW-400. These ergonomic workstations can be precisely tailored to accommodate the diversity of people and tasks in the workplace today. Both these products embrace two vital principles in workstation design: Adjust the workstation to the person, and adjust the workstation accessories to the task.



The EW-900 has integrally adjusted workstations and accessory frames, while the EW-400 has adjustable work surfaces with independently adjustable accessory frames. The worksurface of the EW-900 can be adjusted in height from 30 to 42 inches, using either an electrically- or hand-crank-controlled hydraulic system. An employee can quickly position the workstation and the accessory frame together at the correct ergonomic height.

Both the EW-900 and the EW-400 are compatible with the complete line of ErgoNetic accessories, which allow the workstation to be tailored exactly to fit the task. Parts and materials, tools and instruments, lighting and electrical power can all be placed exactly where needed. Tasks can be optimally arranged by attaching swing arms, shelves, rails, bins, electrical outlets, air outlets, caddies, lights, platforms, soldering stations, and other accessories.

For more information, contact Stanley Storage Systems, P.O. Box 1151, 11 Grammes Road, Allentown, PA 18105; Tel. 800-523-9462; Fax: 610-776-3895; Web: *www.stanleyworks.com.*

CIRCLE 83 ON FREE INFORMATION CARD

TWO-CHANNEL AMPLIFIER

AMC/Weltronics recently introduced the *3020*—a 20-watt-per-channel *Integrated Amplifier* that bridges the gap between hi-fi and computers. Using a unique MIX switch, the 3020 allows users to listen to hi-fi audio (CD, DVD, tuner, etc.) while simultaneously working on a computer.

By selecting the MIX input, any five of the remaining inputs can be mixed together by simply adjusting their input level controls. These mixed signals also appear at the record output jacks to connect to a taping device or computer sound card input. Users can then create their own mixed-down recordings from the computer and the audio system.

The 3020 can also be used as the heart of an audiophile-quality hi-fi system. With close-tolerance components throughout, the amplifier assures exceptional tone-control accuracy. The exclusive AMC Turbo Output Stage (TOS) circuit topology offers high efficiency, low distortion, and strong sound quality. With a peak output current of ×17 amps into 1-ohm loads, the 3020 can drive virtually all types of speaker systems. It has the versatility to become a pre-amp or amplifier operating independently or simultaneously.

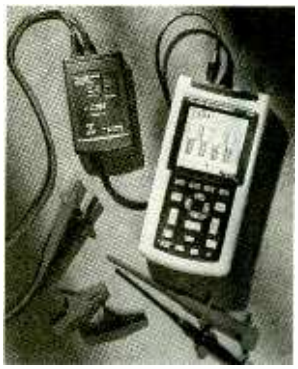
High-quality, five-way binding posts allow for the use of banana jacks and large-diameter speaker wire. A headphone jack on the front panel provides private listening without sacrificing sound quality. Measuring 17 × 3.3 × 3.5- inches, the amplifier weighs 11 pounds.

The 3020 Integrated Amplifier is priced at $249. For more information, contact Weltronics Corp., P.O. Box 80584, San Marino, CA 91108; Tel. 818-799-6396; Fax: 818-799-6541.

CIRCLE 84 ON FREE INFORMATION CARD

DIFFERENTIAL VOLTAGE PROBE

The *Fluke DP120 Differential Voltage Probe* for oscilloscopes allows users to safely make floating measurements on electrical and industrial power systems. The DP120 has a 20-MHz bandwidth and selectable 203 or 2003 attenuation. Each instrument channel can be connected to a different ground potential.



It is designed to be used with Fluke's range of ScopeMeter test tools, Combi-Scope instruments, and with analog oscilloscopes and accessories. When used with a battery-operated test instrument, a single DP120 provides dual-channel measurement on systems with two different ground potentials.

Typical situations in which the voltage probe works well include measurements on devices from variable-speed motor controls and uninterruptible power supplies to process controllers and systems with multiple grounds.

Control electronics are often connected to PLCs in industrial installations, and measurements need to be referenced to earth ground. However, in power circuits, the output devices are usually floating; therefore, measurements on the grounded and power sides may be necessary in a single session. The DP120 Differential Voltage Probe can easily accomplished this.

Included with the DP120 are shrouded 4-mm banana-probe tips, sets of pin-grabber test clips, and large-jaw alligator clips, and a 9-volt battery that saves power by automatically switching to standby after a half hour. A PM 8907 Line Voltage Adapter is optional.

The DP120 probe is priced at $395. Contact Fluke Corporation, P.O. Box 9090, Everett, WA 98206; Tel. 800-44-FLUKE; Fax: 800-FLUKE-FAX; e-mail: fluke-info@tc.fluke.com; Web: *http://www.fluke.com.*

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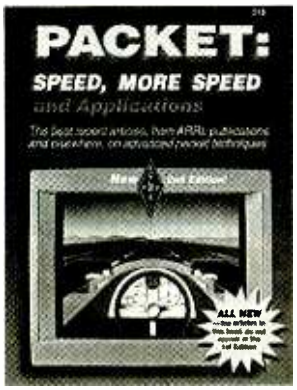
Electronics Library

PACKET: SPEED, MORE SPEED AND APPLICATIONS: 2nd EDITION

compiled by Rich Roznoy, K1OF

A collection of timely articles from a variety of authoritative sources is presented in this entirely new second edition. All the advances in packet technology can be found here in one convenient volume. The book contains a selection of the best recent articles from *ARRL Digital Communications Conference Proceedings, QEX, QST, The ARRL Satellite Anthology,* the Internet, and other sources.



Articles on APRS (Automatic Packet Reporting Service) inform readers of the latest advances in packet software and applications, such as weather tracking and improved mapping databases. Other articles discuss methods of tracking meteors with the first user-friendly 1200-baud satellite BBS on Fuji-OSCAR 29 and the subject of digital modulation with its high-speed—RS232 port speed of 9600 bps, and radio bit rates of 56 kbps—data links.

Still another article shows how easy it is to do TNC interfacing with wiring diagrams for all popular rigs. Readers can also learn how to modify their rigs for improved performance, how to build a "totally accurate clock," and how to construct a low-cost modem.

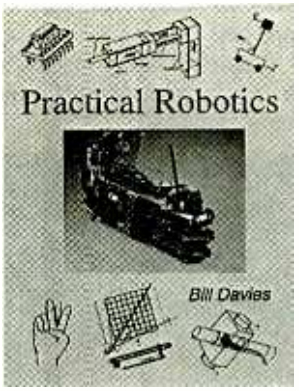
Packet: Speed, More Speed and Applications costs $15 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111-1494; Tel. 860-594-0200; e-mail: ead@arrl.org; Web: http://www.arrl.org.

CIRCLE 91 ON FREE INFORMATION CARD

PRACTICAL ROBOTICS

by Bill Davies

It is difficult to find information about robotics. When you do find it, it is often bits and pieces in many different places. This book, the first in a projected series on robotics, takes care of that problem with a wealth of material on robotics, both theoretical and practical.



Starting with the electronic equipment needed by the robot builder, such as oscilloscopes, meters, and logic probes, *Practical Robotics* goes on to review basic electronics. The rest of the book offers detailed descriptions of the components used in robotics—what they are and how to use them. Power sources, sensors, force transducers, motors, magnetic forces, resistors, and capacitors are thoroughly explained and diagrammed.

This 337-page compendium is profusely illustrated with over 250 drawings and photographs. Useful appendices present a bibliography of robotics publications and a list of manufacturers and suppliers. Aimed at students primarily, it will also be a handy reference for hobbyists, teachers and professionals—anyone interested in robotics.

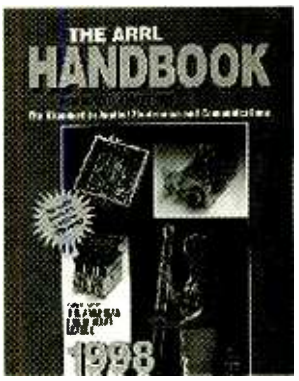
Practical Robotics costs $69 and is published by WERD Technology Inc., Unit 35, Suite 155,10520 Yonge Street, Richmond Hill, Ontario, Canada L4C 3C7. (Sales information: CPIC Technical Books, 908 Niagara Falls Blvd., Suite 724, N. Tonawanda, NY 14120-2060; Tel. 888-63ROBOT; e-mail: cpic@idrect.com; Web: http://web:idirect.com/~cpic.

CIRCLE 92 ON FREE INFORMATION CARD

THE ARRL HANDBOOK FOR RADIO AMATEURS: 1998 EDITION

edited by Paul Danzer, N1II

Published by the American Radio Relay League, the 75th edition of the ARRL Handbook covers Amateur Radio, from its earliest days to the approach of the 21st century. To generations of hams, engineers, and technicians, this handbook has served as an overview of everything that hams do and how they do it. To the technician and engineer, the guide is an invaluable supplement to reference books and data sheets—an unimpeachable source of reference data, project ideas, and theory. For newcomers it's provided a primer on ham equipment as well as an introduction to basic theory. The 1998 edition does all these things and more. It is truly "the standard in the applied electronics and communications" fields.



The three new items on the front cover are just some of the additional information in this edition. The projects are N1TEV's super regenerative receiver, which readers will enjoy building and using; K9EK's integrated L-band satellite antenna and amplifier; and a high-power antenna tuner by N6BV.

Reader comments on the last edition led to this edition's redesign. The book is now more user-friendly, with a minitable of contents and index tabs at the start of each chapter. The accompanying software for the book is now available as a separate item, since bundling the disk with the book increased its cost. It can be downloaded from the ARRL Web site, or from the League's

Hiram BBS, or it can be ordered for a nominal cost.

The handbook is divided into 30 chapters grouped under five headings: Introduction, Fundamental Theory, Practical Design and Projects, Construction Techniques, and Operating Practices. Projects include power supplies, RF power amps, modulators and demodulators, receivers and transmitters, and antennas, and many others.

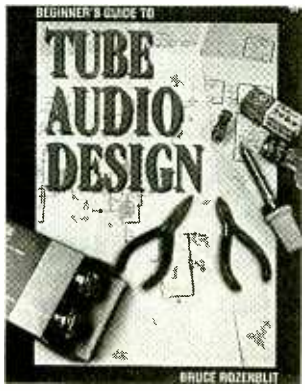
The ARRL Handbook for Radio Amateurs: 1998 Edition costs $32 and is published by the American Radio Relay League, 225 Main Street, Newington, CT 06111-1494; Tel. 860-594-0200 or 888-277-5289; Fax: 860-594-0259; e-mail: ubsales@arrl.org; Web: www.arrl.org.

CIRCLE 93 ON FREE INFORMATION CARD

BEGINNER'S GUIDE TO TUBE AUDIO DESIGN

by Bruce Rozenblit

For a comprehensive discussion of tubes and audio design, this beginner's guide describes what vacuum tubes do and how to use them. Showing readers how to design with tubes, the author starts with tube basics, what their characteristics mean, and how to read charts and specifications.



For more advanced readers, a complete explanation of audio design—including single one-stage amplifiers, a simple gain circuit, negative feedback and how to use it, and multistage basics and variations such as triode and ultralinear operation—is provided.

Chapters cover power sources for the amplifiers, how they work, and how to build them; stabilization and testing, and a description of 13 classic amps and pre-amps. Other chapters discuss how to work effectively as a designer, construction techniques, and how to choose tools and components. The book ends with complete instructions for building three working projects.

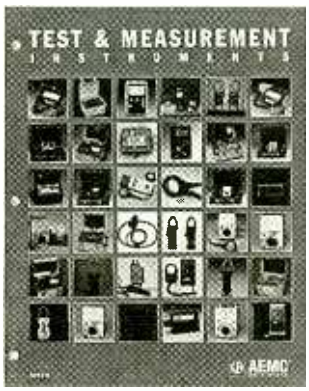
Beginner's Guide to Tube Audio Design costs $24.95 and is published by Audio Amateur Corporation, Old Colony Sound Laboratory, P.O. Box 243, Peterborough, NH 03458-0243.

CIRCLE 94 ON FREE INFORMATION CARD

TEST & MEASUREMENT INSTRUMENTS CATALOG

from AEMC Instruments

Highlighted in AEMC's *Test & Measurement Instruments Catalog* is a special new products section. Among the products included in these 16 pages are a digital lightmeter, digital megohmeters, a data logger, and differential voltage and current probes.



The Model 810 digital lightmeter that is featured is an accurate fast-responding instrument for field illumination measurements. This meter is cosine corrected and adjusted to the human eye's color response curve. Another featured product, the Simple Logger data logger is a single-channel, low-cost data logger that requires no user setup. It adjusts both its scale range and sample rate. A Windows-based software package that can graph and analyze data is included.

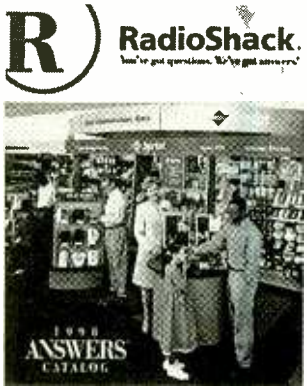
Other sections in this catalog cover current and temperature measurement instruments, ground resistance testers and bridges, megohmeters, power and phase circuit testers, motor testers, power- and light-meters, and substitution boxes. Data sheets are available for each instrument model.

The Test & Measurement Instruments Catalog is free upon request from AEMC Instruments, 99 Chauncy Street, Boston, MA 02111; Tel. 617-451-0227 or 800-343-1391; Fax: 617-423-2952; Web: www.aemc.industry. net.

1998 ANSWERS CATALOG

from RadioShack

This catalog presents the extensive line-up of telecommunications products and services of the Sprint Store at RadioShack. Among the Sprint products shown is the latest in wireless technology, the 100% digital Personal Communications Services (PCS) phone. The PCS offers many useful features including caller ID, call waiting, voice mail, call forwarding, three-way calling, clear reception, and easy payment and simple, flexible pricing plans.



A large assortment of other telephony products, such as corded and cordless phones, answering machines, caller-ID units, and cellular phones are described in the *1998 Answers Catalog.* In addition to telephones, the color-coded catalog divisions include a wide variety of products for home and office electronic needs. Products such as communications, audio, video, and computer equipment; as well as security devices, power controllers, adapters, meters, automotive instruments, and tools for the do-it-yourselfer fill this 300-page catalog. There's also electronic games and toys, plus products for people with special needs.

Readers of the catalog will find it serves as a handy reference tool for learning about electronics. There's a description of what a 21st-century computer system looks and sounds like: the IBM Aptiva Multimedia system with Bose speakers. There's also helpful how-to information on topics such as mini-satellite hookup.

The 1998 Answers Catalog is available at your RadioShack store or upon request from RadioShack, 1500 One Tandy Center, Ft. Worth, TX 76102; Tel. 800-THE-SHACK; Web: www.radioshack.com. ■

You'll Never Be Lost Again

Stay on course as you traverse the countryside with the aid of one of several guidance packages that turn your laptop computer into an on-board navigation system!

BILL SIURU

He is hopelessly lost. She says, "Stop and ask for directions." He replies, "I know where I am going" and proceeds to drive off in the *wrong* direction. New on-board navigation systems should eliminate that frequent source of arguments. Men who are "psychologically opposed" (*it's a man thing*) to stopping and asking for directions (that means most of us) will love these new electronic gadgets. Women, on the other hand, will relish the thought of being able to reach their destinations on time without getting lost.

On-board navigation systems are now options on BMWs, Oldsmobiles, Toyotas, and Acuras; and more are coming. Aftermarket systems are also available for virtually any vehicle. Ten of thousands of on-board navigation systems can already be found in Europe, and the Japanese have bought well over a million navigation systems for their vehicles.

If you already have an appropriate laptop computer, you don't have to fork out $40,000 for a new BMW or even a couple of thousand for an aftermarket, on-board, navigation system. Instead, you can purchase systems like the Etak SkyMap, DeLorme Tripmate, or the Chicago Map Compass 3800 navigation package for a few hundred dollars. Etak, Inc., DeLorme Corp., and Chicago Map Corp. are major publishers of digital maps and mapping software. EtakMap's digital map databases cover the United States and United Kingdom, and Etak products are used in Sony, Bosch, Delco, Clarion, and other navigation systems. DeLorme offers its Street Atlas USA and AAA Map'n'Go mapping software. Chicago Map markets products such as Precision Mapping, which provides street-level maps of the US.

The three companies have now added Global Positioning System (GPS) capability to their products, allowing you to locate your position on a digital map display. All the new software can be loaded into a reasonably capable notebook or laptop computer. To use the GPS to fix your position, you need a GPS receiver that can track at least three of the 24 GPS satellites. The systems use an 8- or 12-channel GPS capability. According to DeLorme, that ensures constant tracking of sufficient GPS satellites for the most accurate fix, as possible on your current position.

More expensive aftermarket and OEM (original equipment manufacturer) navigation systems typically have only one to four channels. However, these navigation systems usually also include dead reckoning and map-matching capabilities that can guide you right to an individual address. In contrast, SkyMap, TripMate, and Compass 3800 are limited to the accuracy that is available to civilian users through the Standard Positioning Service (SPS) version of GPS. That means 100 meters accuracy 95% of the time and better most of the time. At worst, your location may be off by half a block or so.

Etak SkyMap. The SkyMap package consists of a 12-channel GPS antenna, a PCMCIA card with infrared receiver, and two CD-ROMs containing the digital database to map the continental US. SkyMap features a Sony infrared remote control that can be used in addition to a mouse and keyboard. The SkyMap requires a 486, 75 MHz-class CPU or better portable or desktop PC with at least 8MB of RAM and a minimum of 20MB of hard-disk space. Also needed is a VGA display with 640×480 or better resolution, a PCMCIA Type II card slot, and a 2× or better CD-ROM drive. The SkyMap software is compatible with Windows 95.

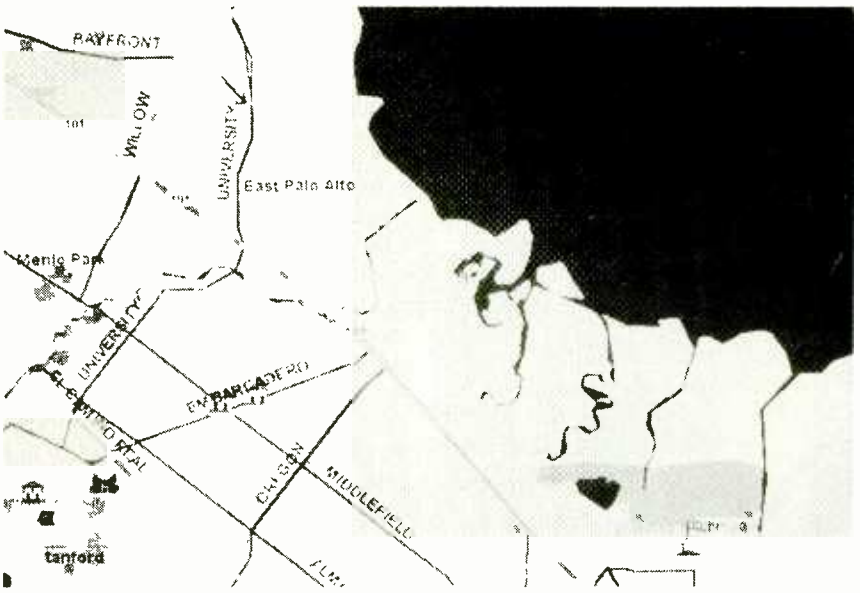
With the GPS receiver card inserted into the notebook PC, information received from the GPS satellites is used to pinpoint your current location on the map display. Using that pathfinding feature, travelers can pre-plan a route on Interstate freeways, US highways, and state expressways.

The path can be displayed on the PC screen or printed out. Etak's patented "heads up" digital mapping technology allows SkyMap users to follow their path with a continuous forward motion display on the moving maps. According to Etak, drivers do not have to turn their heads, and they can easily view the maps while the vehicle is in motion.

Without the GPS card installed, the SkyMap software can be used as a trip planner and reference tool. That can be done either with a laptop or on a desktop computer. Here users pre-plan their trip, viewing and downloading, or printing, maps of a city including intersections or addresses plus local points of interest along their routes. There are more than 500,000 tourist attractions and points of interest on the databases, including hotels, restaurants, shops, financial institutions, transportation (airports and bus terminals, etc.), gas stations, entertainment, and other destinations throughout the country. The points-of-interest travel information database contains the categories, and names, addresses, and phone numbers of the businesses and attractions. Travelers can even highlight personal landmarks or favorite sites for future reference.

The database is contained in a dual-CD ROM software package. Labeled east and west, each disk contains overview maps that provide highway coverage of the 48 contiguous states and the District of Columbia, as well as detailed street maps and travel information for cities throughout the US. SkyMap retails for $299.

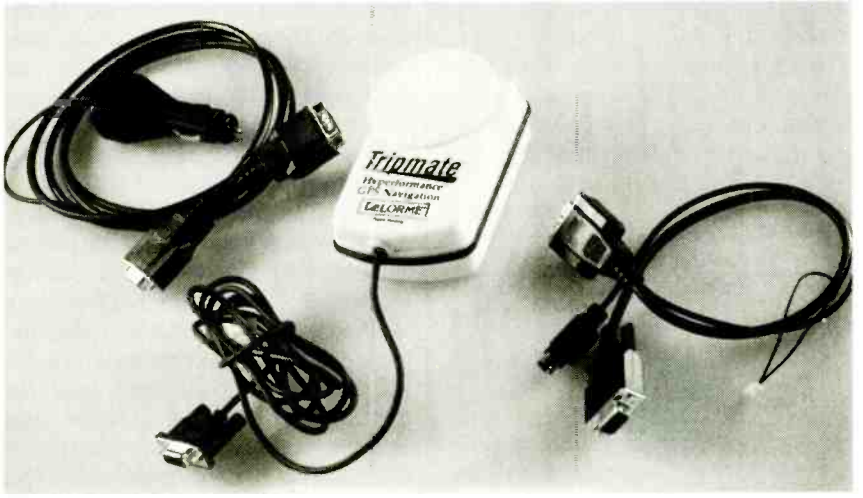
The Etak SkyMap package consists of a 12-channel PCMCIA card GPS receiver, a GPS antenna, and two CD-ROMs containing the digital database to map the continental US. The package also features a Sony IR remote control that can be used in addition to a mouse and keyboard.



Without the GPS card installed, the SkyMap software can be used as a trip planner and reference tool. Shown here is a typical Etak Skymap display. With the GPS receiver card installed in your notebook PC, information from the GPS satellites can be used to pinpoint your current location on the map display.

DeLorme Tripmate GPS Navigation. The DeLorme Tripmate offers similar capabilities through a 12-channel GPS receiver and antenna that is placed on the dashboard as close as possible to the windshield for best reception. The battery-powered device (it uses 4 AA batteries) plugs into the laptop's serial port via a six-foot cable. The map database in the package is DeLorme's Street Atlas USA 4.0, which maps the US. The TripMate package retails for $149. For $39, you can get a power adapter kit that lets you plug the

The DeLorme Tripmate Hyperformance GPS Navigation system offers capabilities similar to those of Etak's SkyMap through a 12- channel GPS receiver that plugs into the laptop's serial port via a six-foot cable. It's CD-ROM map database covers the entire North American continent and the Caribbean—and includes about 66,000 restaurants, hotels, and other points of interest.



The DeLorme Tripmate, which has two different power adapter kits, can be powered from 4 AA batteries, or through a cord that allows it to receive power from the vehicle's cigarette lighter or from the laptop itself.

Tripmate device into the cigarette lighter or the laptop.

TripMate requires an IBM-compatible computer with a 386 or higher processor running at 33 MHz or faster. It must have an MS-compatible SVGA card and monitor—256 color capability is recommended. If you have a portable computer with a CD-ROM drive, you can use the Street Atlas USA 4.0 or DeLorme's AAA Map'n'Go mapping software directly. If you do not have a CD-ROM drive in the laptop, but have a desktop with a CD-ROM capability, you can still use TripMate. In that case, you can select the portions of the CD-ROM databases you want and download them onto the laptop's hard drive. Tripmate comes with an Extractor feature for downloading. The basic TripMate requires about 10MB and the digital maps are stored on about 550MB.

Whether it is working from the entire database on a CD-ROM or a portion on the hard drive, arrows on the map display track your travels. The system uses a "bread crumbs" type arrangement, which indicates not only where you are, but also where you have been. If the entire database is available, you can display the entire continent or zoom in on block-by-block details. AAA Map'n' Go 2.0 is a worthwhile $40 addition because it contains the American Automobile Association's database. The database covers the entire North American continent—Canada, the US, and Mexico—and the Caribbean. It includes about 66,000 restaurants, hotels, and other points of interest. Updates are available via the Internet. Users can also download information on weather conditions, road construction, or special events from a DeLorme Web site dedicated to that purpose.

Chicago Map Compass 3800. In its Compass 3800 package, Chicago Map adds a Garmin 38, handheld, GPS receiver to its Precision Mapping software, which provides street-level maps of the entire US. The Garmin GPS 38 receiver tracks eight satellites and, unlike the other two systems, the receiver can be used independently of the computer for hiking, off-roading, biking, and so forth. The Compass 3800 system lists for just over $300 and includes the Garmin 38 receiver, data cable, and Precision Mapping 2.0 CD-ROM with the required GPS upgrade.

Conclusion. All three navigation aides are especially useful for anyone who spends much time on the road, and already has a laptop computer. However, one important word of caution. All three are complicated enough that they should not be manipulated while driving. Bring along a passenger to operate the navigation system or pull over and stop before using the keyboard or mouse. ■

FOR MORE INFORMATION

Chicago Map Corporation
15419 127th Street
Lemont, IL 60439
Tel. 800-257-9244
Web: www.chicagomap.com

DeLorme Corporation
181 US. Route 1 South
PO Box 298
Freeport, ME 04032
Tel. 207-865-1234
Fax: 207- 865-9291
Web: www.delorme.com

Etak, Inc.
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Menlo Park, CA 94025
Tel. 800-765-0555
Web: www.etak.com

Think Tank

Unusual Circuits and Unique Devices

JOHN J. YACONO
TECHNICAL EDITOR
COMPUTER RESELLER NEWS, IEEE

Let us pick up our discussion on voltage regulators where we left off last month. In the true spirit of the column, let's look at how to use them in an unusual way: to control current instead of voltage.

Most voltage regulators are designed to work with their ground pin floating. What that means is the regulator doesn't have to be referenced to ground—it can float above ground. The main advantage of a floating programmable regulator is that its programming resistor (R2 in Fig. 1) can be selected to be a pretty large value to produce a high output voltage. Another advantage is that the regulator can be used as a current limiter. You just have to check the regulator's application notes to determine if it can float.

Let's explore how this works. To perform as voltage regulators, members of the XX7 series all try to maintain a 1.25-volt potential between their output (O) and adjust (ADJ) terminals. They do that by regulating the current flow through R1. The current though the resistor can be found using Ohms Law:

$$I = (1.25)/R1$$

Since the current through the adjustment terminal is very small, approximately the same amount of current flows through both R1 and R2—and that current must be regulated to maintain the voltage across R1. To take advantage of that fact in a positive-regulator circuit, just replace R2 by a load. The current through the load must be less than or equal to I. The principle is the same when using a floating negative regulator as a current limiter; however, the circuit is a little different. Resistor R2 is shorted, and the load is placed in series with the entire current-limiting circuit.

For either positive or negative regulators, to set the maximum current through the load, just select the value of R1 with the aid of the equation:

$$R1 = (1.25)/I$$

By the way, for a member of the XX7 family in a TO-220 case, the value of R1 should be between 0.83 and 125 ohms. That gives the regulator device a usable range from 10 mA to 1.5A.

Now let's turn to this month's letters which are on various topics illustrating unusual circuits and unique devices.

THE ELECTRONIC BUZZER

Well, I admit that buzzers are easy to install. All you have to do is buy a buzzer, connect it to a power supply, insert a switch, and it is ready to go. But I decided to make one based on ICs just to stretch my knowledge. The circuit (shown in Fig. 2) produces sounds like a real buzzer. It requires only two ICs and a few external components.

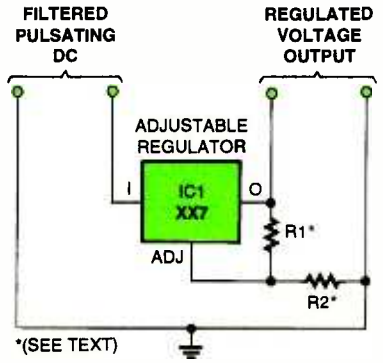

Fig. 1. Here's the typical adjustable regulator circuit. This time we are going to use it to control current rather than voltage.

When S1 is momentarily depressed, C1 starts to charge through resistors R1 and R2. Eventually it triggers pin 2 of the 555 oscillator/timer, IC1. The IC then begins to discharge the capacitor through R2 by pulling pin 7 low. This cycle repeats as long as S1 is depressed. The output of IC1 (pin 3) oscillates in step with the charging and discharging of the capacitor, supplying a tone frequency to IC2. IC2 is a LM386 low-voltage audio power amplifier that increases the amplitude of the tone frequency. The speaker is used to reproduce the tone frequency of IC1, which sounds similar to a real buzzer. You can increase the value of C1 to 0.1-μF for a low-frequency buzz. You can also bypass pin 7 of IC2 to ground with a 47-μF capacitor if you wish (*see the Letters column of the October 1996 issue for an interesting discussion on LM386-pin 7 bypassing—Editor*). This circuit can be used to replace a doorbell—and all parts are available locally from RadioShack (IC1 is 276-1723 and IC2 is 276-1731).

—Jose Ignatius A. Alea, Cebu, Phillipines

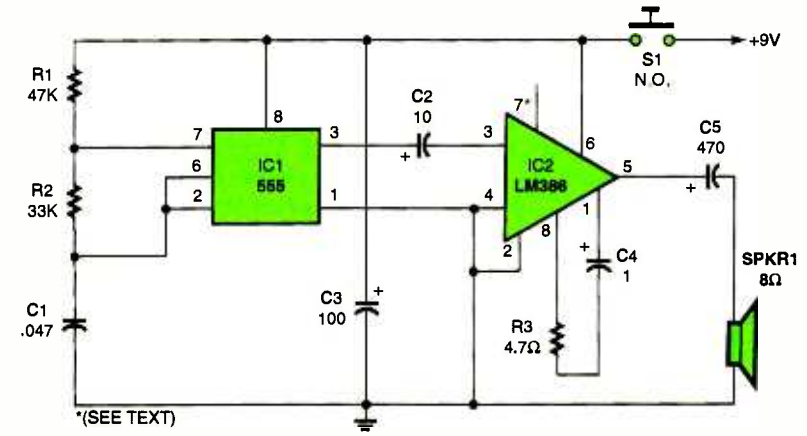

Fig. 2. Replace your electromechanical buzzer with this simple solid-state circuit.

It's kind of fun finding new approaches to old designs. By replacing the timing resistors with potentiometers, this could be turned into a first project for budding hobbyists.

LAGER-TEMPERATURE CONTROLLER

A friend of mine recently got very interested in home-brew making, and I was "drafted" as assistant for his first batch. An interesting circuit design problem surfaced as a result. In summertime, the only way to achieve a steady 60°F was to place the entire batch in a dedicated refrigerator. But most fridge controls don't go up to 60°F, so the refrigerator must be controlled by some other device. I came up with the cool (no pun intended) lager-making fridge-temperature controller circuit indicators, high- and low- temperature alarms, and a door-open alarm.

Resistor R1 is a precision thermistor, part 334-42153 (15k-ohms at room temperature, negative-temperature coefficient) and R9, the CdS light sensor is a photoconductive cell, part 338-76C569, or equivalent. Both parts are available at Mouser Electronics (Tel. 800-346-6873). Any thermistor will work, but you'll need to determine the resistances at various temperatures and adjust R2 accordingly. Preferably, resistor R2 is a multi-position switch with resistors, but it could also be a multi-turn potentiometer. In essence, R1 and R2 form a voltage divider. The value of R2 should be the same as the thermistor's resistance at the desired temperature setting. For example, we wanted to keep the lager at 60°F. Using Table 1 as a guide, we selected 14.8k-ohm as the value for R2, with the idea that the output of the divider will be exactly $\frac{1}{2}V_{in}$ at the desired temperature.

That voltage is fed into six comparators, IC1-a through IC2-b, (two LM324 quad low-power op-amps—equivalent to NTE987). The reference voltages for the comparators are picked off a divider string of resistors, R3 through R8. The center of this divider provides voltage that is equal to $\frac{1}{2}V_{in}$, the perfect value to compare to the thermistor's output. The voltages of the other points on the divider vary equally above and below $\frac{1}{2}V_{in}$, which indicate ±10°F and ±4°F from the optimal temperature. Each comparator output lights an LED.

TEMPERATURE (°F)	R2 VALUE (OHMS)
35°F	26.0K
40°F	22.3K
45°F	20.0K
50°F	18.0K
55°F	16.3K
60°F	14.8K
65°F	13.2K
70°F	11.9K
75°F	10.8K

Table 1. Temperature Settings vs. Resistor R2 Selection (see Fig. 3).

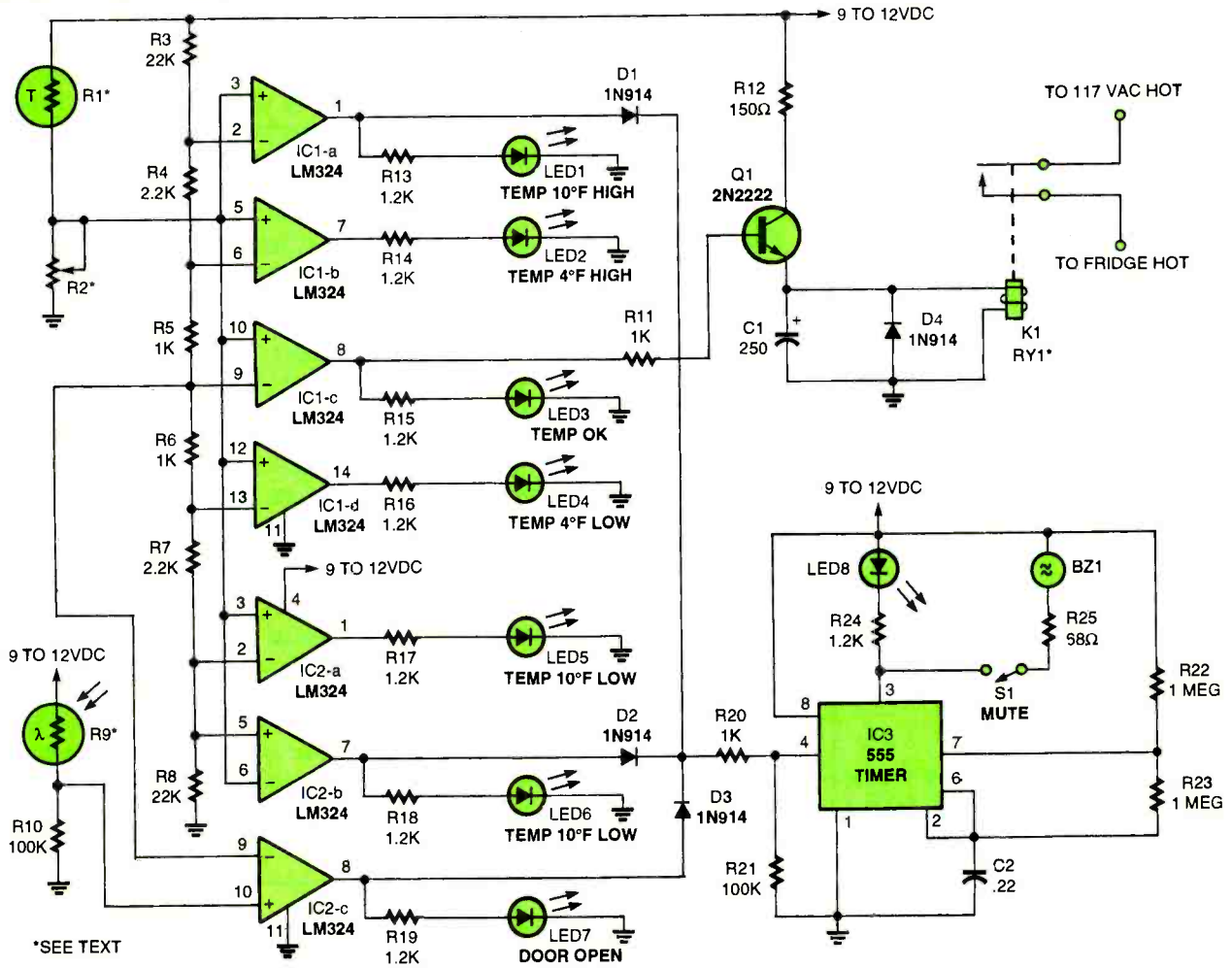

Fig. 3. This circuit maintains your refrigerator's temperature to within four degrees of a preset value. Audible and visual alarms indicate temperature status.

Comparators IC1-a ("10°F too warm"), IC2-b ("10°F too cold") and IC2-c ("light sensor-door open") are OR-gated by diodes D1 through D3. The output gate controls a 555 timer/oscillator IC in astable mode that powers a piezo buzzer module and LED to provide a blinking and beeping warning. Note that the 555 is sourcing instead of sinking current in this application.

The center comparator (±0°F) operates transistor Q1, a 2N2222 general-purpose NPN unit (NTE123A, or equivalent), which energizes a relay to close the contacts to supply the fridge with 120 VAC. Just be sure the relay selected is rated for your fridge's peak current. I'm using a relay with contacts rated at 7A at 120 VAC for a medium-size fridge.

In operation, attach the thermistor and CdS light sensor directly to the lager container inside the fridge. Run the wires to the fridge's hot circuit through the relay contacts to control its operation. Power up the circuit with a 9 to 12 VDC supply, select the desired temperature (using the table, pick the R2 value), and you'll immediately see the temperature status on the bargraph.

—Nick Cinquino, Schaumburg, IL

I've gotten one of those home-brew brew kits, too (no pun intended). Up to now, I've placed my brew in the coolest spot in the house (a landing in the basement) and hoped for the right weather. This circuit is great!

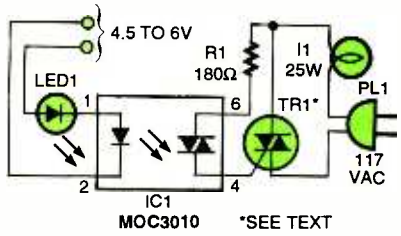

Fig. 4. Use this neat little circuit to blink on and off a 117-volt incandescent lamp. An LED provides a circuit function and also an additional blinker.

BLINKING LAMP MADE EASY

I thought of an alternate way to blink a 117-volt lamp, using a MOC3010 optoisolator/coupler IC (NTE3047, or equivalent) without an LM3909 LED flasher/oscillator IC (see Fig. 4). Insert a blinker LED in series with the MOC3010's positive input lead. When the LED blinks, it switches triac TR1 on and off, which turns the triac/lamp circuit on and off. The blinker LED is available at Radio Shack (276-030 for green or 276-036 for red); either LED will work. The triac is any standard 200V, 6A device, such as the RadioShack 276-1000.

—Clif Ridley, Columbus, OH

That is very original. I guess you could use a blinking LED in all sorts of oscillator circuits (to beep a buzzer for example). Something like that could replace the alarm circuit in the lager temperature control presented in the last circuit. ***Note: All builders should use caution and good insulation practices when making the AC connections.***

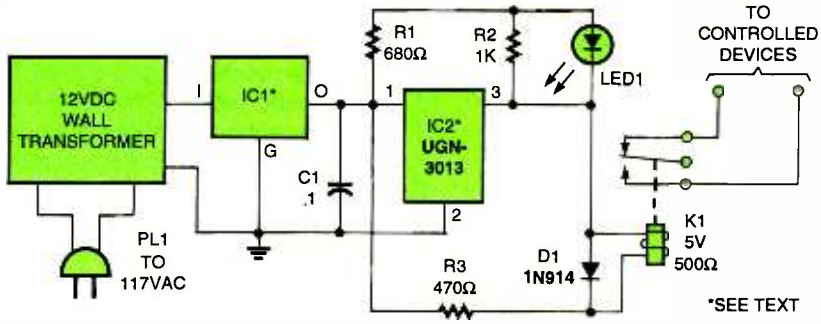

Fig. 5. Experiment with Hall-effect switches! In this circuit, the magnetically-activated Hall-effect switch, IC2, controls operation of a low-power relay.

MAGNETIC SWITCH

Here is a circuit that makes use of a relatively little-used or written-about device that actually has been around for many years. The device is known as a Hall-effect, magnetically activated, solid-state switch. It comes in a TO-92 size plastic case with three leads. It switches its output on when the south pole of a strong enough magnet is brought near it. This low-cost Sprague UGN3013 Hall-effect switch integrated circuit is available for 45 cents as part No. 25-204 from Hosfelt-Electronics, (Tel. 888-264-6464). Also the low-power requirement and solid-state reliability make this device quite unique to use in many applications. It can sink a maximum of 25 mA when in its ON state. It has about a 3-mA drain current when in its quiescent mode and 12-VDC input is applied. It has a maximum DC voltage of 16 volts.

To use one as a switch, place it in the circuit as shown in Fig. 5. If a 12-VDC wall adapter is used, I recommend using a 78L12 regulator (12V at 100 mA), as wall supplies can go over 18 volts when in an unloaded condition. The 78L12 regulator is available as an NTE950.

Make sure that the relay connected between pin 3 and 12 volts has enough resistance to stay within the 25-mA limit of the switch. I used a 5-volt relay with a 500-ohm winding in series with a 470-ohm resistor. The LED in the schematic is not required, but was used as a visual indicator of circuit operation.

The device should switch on (pin 3 goes low), when the magnet's south pole is about 3/16-inch away. Due to a hysteresis effect, the magnet then has to be backed away another 1/8-inch from the spot where it switched on, in order to turn it off again.

The magnet you use must be quite strong. I had one on hand from a cabinet latch that is about 1 inch by 3/4 inch and about 3/16-inch thick that worked just fine. You will find a steel plate on both sides. Remove the south-pole side for maximum flux. A little advice learned the hard way—keep your magnet far away from the relay as it can temporarily upset it. By using the relay contacts as an output switch, this circuit can be applied to many projects, such as a weather-vane position indicator, a burglar alarm switch, and perhaps many uses in the robotics field.

—Roger W. Hamel, Cedarville, MI

You know, that circuit can be used to experiment with all kinds of sensors. One magnetic switch that's less fussy is a reed switch; they don't require a strong magnet and can handle pretty significant current.

Well that's it for this month's *Think Tank.* ■

Hardware? Software? Hardware + Software!

JEFF HOLTZMAN

When I was a kid, I loved LEDs. They had just been invented. It was still easier to buy vacuum tubes than semiconductors. My fascination with things hardware stayed with me through high school, but then I started losing interest. I slowly began to feel that the things you could do with electronic hardware were limited. My interests drifted to things as disparate as machine-shop operations, to welding, to classical guitar, to literature in several languages. Then, when I was in college, articles started appearing in **Popular Electronics** and **Radio Electronics** about computers. At that time, I hated computers. I thought they were only good for screwing up telephone bills, and that they were a symbol of a rapidly approaching Orwellian society. Big brother? No thanks.

Then a friend bought an Altair kit (actually, a psychology professor wanted one to run some statistical models—he provided the funding). Next thing I knew, I was entering boot programs via toggle switches and learning hex and binary arithmetic. Pretty soon, it was clear that I would have to have one for myself.

Eventually I purchased a 6502-based machine. I ended up building my own EPROM programmer, and created custom development tools and a text editor. Then my friend and I branched out into 6800-based systems, with the purchase of a unit from a prestigious firm of that time, SWTPC, Southwest Technical Products Corporation, which also (and primarily, at least at first) sold audio kits.

It was around that time that I really started losing interest in LEDs My whole perception changed. Whereas before LEDs existed to be assembled into cool devices, now they existed to be connected to I/O ports and driven at my (or the program's) command. Perhaps I should state that when I say "LED," that's really a metaphor for electronic hardware devices in general.

Popular Electronics
JANUARY, 1975

PE TESTED

EXCLUSIVE!

ALTAIR 8800
The most powerful minicomputer project ever presented—can be built for under $400

BY H. EDWARD ROBERTS AND WILLIAM YATES

THE era of the computer in every home—a favorite topic among science-fiction writers—has arrived! It's made possible by the POPULAR ELECTRONICS/MITS Altair 8800, a full-blown computer that can hold its own against sophisticated minicomputers now on the market. And it doesn't cost several thousand dollars, in fact, it's in a color TV-receiver's price class —under $400 for a complete kit.

The Altair 8800 is not a "demonstrator" or souped-up calculator. It is the most powerful computer ever presented as a construction project in any electronics magazine. In many ways, it represents a revolutionary development in electronic design and thinking.

The Altair 8800 is a parallel 8-bit word/16-bit address computer with an instruction cycle time of 2 μs. Its central processing unit is a new LSI chip that is many times more powerful than previous IC processors. It can accommodate 256 inputs and 256 outputs, all directly addressable, and has 78 basic machine instructions (as compared with 40 in the usual minicomputer). This means that you can write an extensive and detailed program. The basic computer has 256 words of memory, but it can be economically expanded for 65,000 words. Thus, with full expansion, up to 65,000 subroutines can all be going at the same time.

The basic computer is a complete system. The program can be entered via switches located on the front panel, providing a LED readout in binary format. The very-low-cost terminal presented in POPULAR ELECTRONICS last month can also be used.

PROCESSOR DESCRIPTION

Processor: 8 bit parallel
Max. memory: 65,000 words (all directly addressable)
Instruction cycle time: 2 μs (min.)
Inputs and outputs: 256 (all directly addressable)
Number of basic machine instructions: 78 (181 with variants)
Add/substract time: 2 μs
Number of subroutine levels: 65,000
Interrupt structure: 8 hardwire vectored levels plus software levels
Number of auxiliary registers: 8 plus stack pointer, program counter and accumulator
Memory type: semiconductor (dynamic or static RAM, ROM, PROM)
Memory access time: 850 ns static RAM; 420 or 150 ns dynamic Ram

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The opening page of the January 1975 ***Popular Electronics*** *two-part feature article on building your own Altair 8800 minicomputer kit—a classic collector's item!*

HANDS-OFF ELECTRONICS

That "hands-off" view of electronics and electronic devices grew and pretty much dominated my interests for the next fifteen years, during which time I learned lots about the abstract (programming languages, software engineering, and so on), and all but lost touch with the "hardware" world.

However, for several reasons, I have recently been getting more and more interested in "hands-on" types of things. For one, my own kids are now developing interest in some of these things. For another, through a combination of circumstances, I've come to see that a lot of very interesting hardware devices have come to market

(Continued on page 62)

Some Odd Loop Antennas

JOSEPH J. CARR, K4IPV

One of my passions is loop antennas. Any type of loop antenna. I first used small loops (<0.15λ) in the early 1960s for "hidden transmitter hunts" on 10 meters near Washington, DC. I also participated in a couple of hunts on 75 meters in the Norfolk, VA area with John Finner, WA4EPI (you would not *believe* the car he drove!). Later, I used quad loops tacked up to my attic student boarding house room. Still later, the late Johnnie Harper Thorne (K4NFU/5) showed me a number of transmitting loops that he designed on his antenna farm near Austin, TX. This month, we will take a look at a couple of loop styles that are a little out of the ordinary.

THE RING ANTENNA

The ring antenna is shown in Fig. 1. This antenna is made of a five-foot loop of ½-inch diameter soft-drawn copper plumbing pipe. Two versions are shown in Fig. 1. The single-ended version is shown in Fig. 1A. In this antenna, the loop is open ended. The center conductor of the coaxial cable feedline is connected to one end of the ring radiator, while the coax shield is connected to a chicken wire ground plane. The balanced version in Fig. 1B has an RF transformer, T1, at the feedpoint.

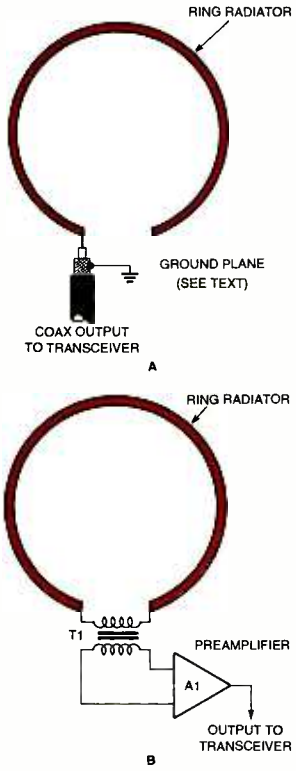


Fig. 1. Two cases of the ring loop antenna. In (A), the antenna is unbalanced, or single-ended, requiring a good ground connection; while in (B) the balanced ring loop antenna is transformer-coupled to a differential preamplifier.

The ring antenna should have a bandpass preamplifier. The preamp is needed because of the low pick-up of this kind of antenna. Also that preamp should be mounted as close as possible to the antenna. A typical preamplifier is broadbanded (which is what we want), so it will pick up, not only the desired signals, but others as well (which is what we don't want). Even a 5-watt QRP transmitter a few blocks away can drive the preamp into saturation, so it is wise to eliminate the undesired signals *before* they get in. This bandpass characteristic is obtained by preamp-filtering. The idea is to get rid of signals in the adjacent bands. In the case of the single-ended antenna, a single-ended preamp is used. But for the balanced version of Fig. 1B, a differential preamp is used (these types of amplifiers are often used for radio direction-finding small loops).

The ring loop (both versions) is mounted about 7 or 8 inches above a ground plane made of chicken wire, metal window screen, copper sheeting, or copper foil. The copper sheeting or foil is best, but costs a lot of money and turns ugly green after a couple of weeks in the elements. If you use screen, make sure that it is a metallic conducting screen. Some window and porch screening material is made of synthetic materials that have insulating properties with high dielectric content.

Figure 2A is a top view of the ring radiator antenna, while Fig. 2B is its front view. The antenna is mounted above the screen using insulators. These can be made of wood, plastic or any other insulating material. The frame holding the ground plane screen (Fig. 2A) can be made from 1- by 2-inch lumber. Note that the frame has interior crosspieces to support the antenna, as well as the outer perimeter. The larger outer perimeter is needed because the screen ground plane should extend beyond the diameter of the radiator element by about 10 to 15 percent.

THE DDRR ANTENNA

The Directional Discontinuity Ring Radiator (DDRR) antenna is shown in Fig. 3A, while a side view showing the mounting scheme is shown in Fig. 3B. The DDRR consists of two sections, one vertical and one horizontal. The

TABLE 1
PRACTICAL DETAILS FOR A ¼-WAVELENGTH DDRR LOOP ANTENNA

FREQUENCY (MHz)	1.8	3.7	7.0	14.0	21.0	28.0	50.0	146.0
G (inches)	16	7	5	3	2.5	2	1.5	1
C1 (pF)	150	100	75	35	15	12	10	6
F (inches)	12	6	5	2	1.5	1	1	0.5
H (inches)	48	24	11	6	4.75	3	1.5	1
D (feet)	36	18	9	4.5	3.33	2.33	1.4	0.5
E (inches)	5	4	2	1	0.75	0.75	0.5	0.25

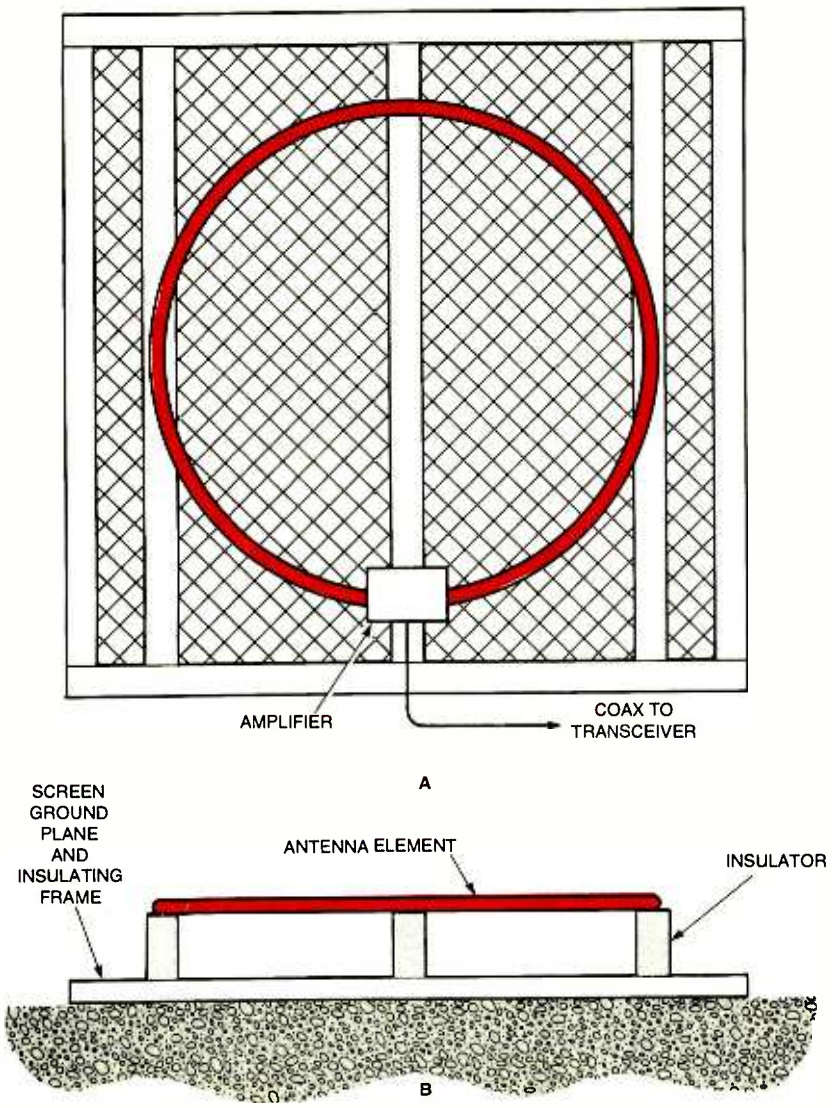


Fig. 2 Mounting the ring antenna in the horizontal plane. In (A) the top view is shown over a conductive screen ground plane, while (B) illustrates the front view including the insulated supports.

short vertical section has a length equal to the height of the antenna off the ground. One end of the vertical segment is grounded.

For amateur radio use in specific low-frequency bands, the ¼-wavelength DDRR loop antenna is very popular. The horizontal section is a loop with a diameter (D), measuring in length from 2.3 feet for use at 28 MHz to 18 feet at 3.7 MHz. The conductor diameter (E) is at least 0.75 inch for 28 MHz and 4 inches for 3.7 MHz. Because of the loop configuration, some people call this the "Hula hoop antenna." One author recommends using a 2-inch automobile exhaust pipe bent into the correct shape by an auto muffler dealer. Table 1 lists the dimensions of a typical quarter-wavelength DDRR antenna for operation in the primary amateur bands. The far end of the loop is connected to ground through a small-value tuning capacitor, C1, under 150 pF. The actual value of C1 is found experimentally and is used to resonate the antenna to a particular operating frequency (see Table 1).

The feedline of the DDRR antenna uses coaxial cable connected such that the shield is grounded at the bottom end of the vertical section. The center conductor is connected to the ring radiator at a feedpoint distance (F) from the vertical section. Its value is determined by the impedance that must be matched. As with most small loops, the radiation resistance is quite low, and C1 is adjusted to achieve resonance and increase efficiency.

The approximate lengths for the various dimensions of the DDRR are given below in general terms as a function of operating wavelength. Recall that wavelength (λ), in feet, can be found from the selected frequency (*f*), in MHz, by the formula (983.6/*f*):

D = 0.078 × λ
E = 0.5 to 4 inches
F = 0.001725 × λ
G = see Table 1
H = 0.00858 × λ

where D is the ring diameter, E is the tubing diameter, F is the feedpoint spacing along the ring, G is the gap opening or discontinuity, and H is the distance of the loop above the ground (or the length of the vertical section). The construction details of the DDRR are so similar to those of the ring radiator that the same diagram can be used (see Fig. 3). Use the above formulas for general use, and Table 1 for specific design details in the primary ham bands.

The normal orientation of the DDRR for communications is horizontal with essentially an omnidirectional pattern in the azimuthal plane (horizon) and a relatively low angle of radiation in the elevation plane (less than 30 degrees). However, for radio astronomy applications like Jupiter radio reception, the antenna ground plane screen can be tilted to face Jupiter's point in the sky.

The DDRR principles are finding use in cellular telephone antennas. Some circular DDRR antennas are now available in the UHF range with diameters under 3 inches. Their low profile and portability (especially with a magnetic base) makes them ideal candidates as antennas for mobile cellular phone users.

A COMMERCIAL INDOOR/ OUTDOOR LOOP ANTENNA

A commercial loop antenna is shown in Fig. 4. This antenna is the Model MFJ-1788 *Super Hi-Q Loop Antenna*. It is made by MFJ Enterprises, Inc. (P.O. Box 494, Mississippi State, MS 39762; Tel. 800-647-1800, Web: *www.mfjenterprises. com*). This antenna works on 15- through 40-meters, where antennas are quite large—but this one is only 36 inches in diameter. It requires no radials, counterpoise or ground plane. Obviously, this antenna is intended for limited space applications.

One place where this antenna might

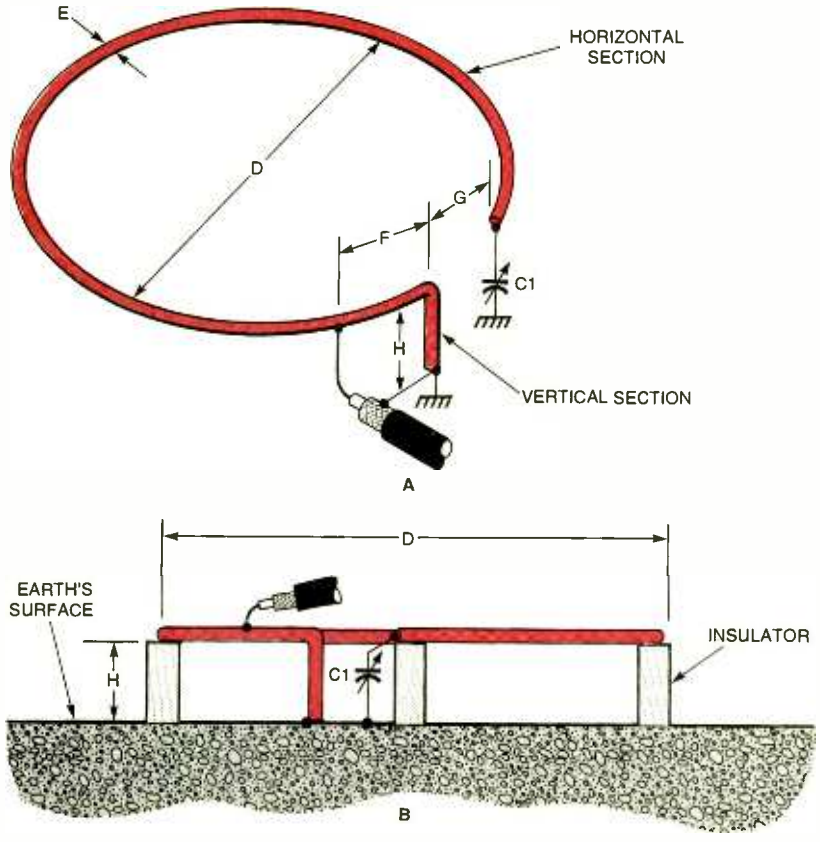


Fig. 3. A typical Directional Discontinuity Ring Radiator (DDRR) antenna design. All necessary design considerations are illustrated in (A). The mounting requirements are illustrated in (B). Use Table 1 to determine the necessary dimensions for the frequency of operation you need

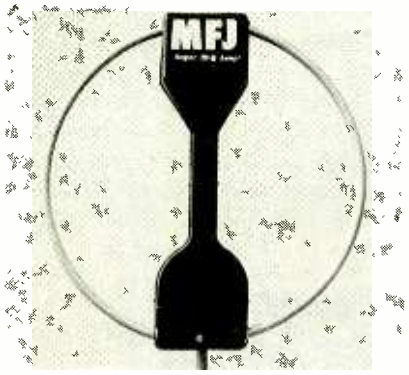


Fig. 4. A commercial ham radio loop antenna for limited space—the MFJ-1788.

be really useful is in apartments and town houses where the local homeowners' association forbids outdoor antennas. Although some people have told me that some of the covenants have been broken in the courts, the fact remains that it is an expensive legal process that is more than likely doomed to failure. A better solution is to keep your legal fees and operate "legally" with a small antenna in the attic. The MFJ-1788 is also well-suited to trips, vacations, DXpeditions, camping, mobile homes, or just bopping around the boonies with your rig. The MFJ-1788 will handle up to 150-watts. It has an auto-tune feature and built-in VSWR/RF wattmeter. Price is $359.95 plus shipping.

If you have any favorite loop antennas (large or small), then I would be interested in hearing from you. I can be reached by snail-mail at P.O. Box 1099, Falls Church, VA, 22041, or by e-mail at carrjj@aol.com. ■

COMPUTER BITS

(continued from page 59)

since I stopped paying close attention.

Part of the reason I lost interest before was that hardware design seemed rote, mechanical, and repetitive. Creating things out of hex inverters and NAND gates just didn't cut it. But now we have three key elements that bring the hardware world back to life for me: (1) an incredible breadth of microcontrollers, (2) an equally broad variety of digitally-oriented-intelligent-sensing devices and conversion devices, and (3) powerful PCs to serve both as host development environments, and as "hubs" to which intelligent sensors and converters may be connected via—you guessed it—microcontrollers.

OK, so maybe I had my head in the sand about this. But gimme a break; I was doing other things. In any case, I'm back, and looking for ideas and opportunities. Over the next few months, topics I plan to investigate include microcontroller families and family members, prototyping environments, low-cost development systems, and interesting and odd sensing-conversion and control components.

I don't plan, nor do I want, to do this solely on my own. I really want your help and input. If you know of something special in the previously mentioned categories, drop me a line. On the other hand, if you're looking for something special, let me know; and I will keep an eye out for it, too. Together, I think we can come up with some interesting ideas. The best of those ideas will be explored here, with the intent of creating salable products, including kits.

OUR NEW WEB SITE

In other news...it's a proverbial case of the shoeless children of the shoemaker. Everybody and their grandmother has a Web site—except yours truly. That was the case until recently. Now, at long last, as eagerly anticipated by millions (right!), my company, *Ingeneering Inc.*, has its own Web site: *www.ingeninc.com*. Initially the site has areas dedicated to the following topics: Delphi programming, PostScript programming, *3Com PalmPilot* programming—and a section on microcontrollers, sensors, controllers and other software component. An additional section provides sales and support information for a software development tool we introduced last fall. If you have any interest in user-interface design, stop by and check out "Wanda the Wizard Wizard." It's a tool for creating, maintaining, and running Wizards in the Win32 environment and it works with Visual Basic, Delphi, C/C++, and any language that can call a DLL. Stop by and let me know what you think about the site—jkh@acm.org. ■

ANTIQUE RADIO

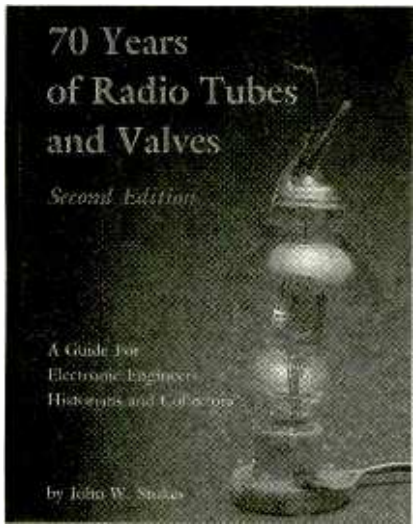
Reading, Resources, and Reference Materials

MARC ELLIS

I come home every year from the big early-September Antique Wireless Association Conference (Rochester, NY) with a briefcase full of materials—including books and other publications targeted for review on these pages. This year was no exception.

We weren't able to turn our attention to these publications in last month's column (which would have been the first possible opportunity), because I needed the space to report on the (almost!) conclusion of the Neutrodyne NR-5 restoration. However, let's take some time and examine them now!

70 YEARS OF RADIO TUBES AND VALVES: Second Edition
by John W. Stokes
Published by Sonoran Publishing, LLC, 116 N. Roosevelt, Suite 121, Chandler, AZ 85226; Soft-cover; 264 pages; $29.95.



I've had a copy of the first edition of this book on my easiest-to-reach reference shelf for many years, and it is really remarkable how such an authoritative book on such a technical subject can be so engaging to read. The beautifully photographed and/or reproduced illustrations (over 730 in the current edition) certainly contribute—as does the author's lively and friendly writing style.

The presentation is particularly strong in tracing the evolution of early tube styles and types, but woven into the text are histories of the major manufacturers and the contributions of key inventors and researchers. The treatment is truly an international one (the author is himself a New Zealander) that reviews parallel developments in Britain, Holland, Germany, Canada and Australia, as well as in the United States.

Beginning with primitive examples from the dawn of tube technology, *70 Years of Radio Tubes and Valves* explores the development of the vacuum tube, in detail, through the late 1930s. There is also some coverage of later tubes (through about 1960), including a chapter devoted to "USA After World War II." Those who own the original edition of this book will be interested in the new material in this Second Edition. These additions include a new chapter on tubes for audio applications that contains 20 additional photos and reproduced magazine ads, as well as a very welcome index by tube number.

TUBEDATA
by Ake Holm
Distributed by Sonoran Publishing, LLC, 116 N. Roosevelt, Suite 121, Chandler, AZ 85226; 3½-inch disk for IBM-compatible computers; $39.95.

This easy-to-use program is essentially a searchable database containing data on over 27,000 tube types from the US, Canada, Great Britain, Holland, Germany, Russia and other countries. It requires an IBM-compatible computer with at least 4 MB RAM and VGA graphics or better. *Tubedata* is a DOS program and runs under the DOS prompt in Windows 3.1 or Windows 95. It requires about 3.5 MB of hard disk space.

I had a little difficulty starting the program, since it claimed that my system (Windows 95) was out of memory even though there were about 15 MB of free RAM. I don't know what caused that problem, but it eventually went away and an attractive twin tube data display appeared on the screen.

The dual display makes it possible to compare two tubes, perhaps for the purpose of deciding on substitutions. Each display has three windows. The left window has a selectable scrollable list of all the tube types in the database; the center contains key data for the tube selected at left, including function, manufacturer, year of introduction, alternate designations (such as military and foreign), and operating voltages; the right window shows a schematic diagram of the tube and a pin-out chart, if available.

The tube elements on the schematic are not numbered, and the accompanying pin-out is in list form. Hence, we do not get the usual pin number/tube element correlation presented in the standard tube manual basing view. This isn't too big a problem, but it is important to keep in mind the standard scheme for numbering pins. They are numbered clockwise when looking at the bottom of the tube, beginning with the left pin of the "fatter" pair and/or the pair with the wider separation, or (in the case of Octals and Loctals) the pair straddling the locating key.

I wondered how the program might handle tubes with a "non-standard" pin configuration, so I looked up the type

11. This has four equally-spaced pins, including just one "fat" pin for locating purposes. It turns out that, for this type, the pinout is prudently omitted and only the schematic is shown. So if the program were the only source of information for this vintage tube, you'd still be at sea for base connections.

Tubes are selected for display by either scrolling the list past a fixed indicator and stopping at the desired number or by entering the desired tube number in the field provided for that purpose in the built-in search function. You may select or search by the common designation or by any of the variations in the database. This gives you a very powerful tool for identifying military and foreign tubes and others with "mystery" designations.

Tubedata is a very useful program, making a tremendous amount of information accessible in a tiny package. It should be a fine addition to the reference arsenal of the general electronics hobbyist who is into tube gear. However, it might be a bit of overkill for the collector/restorer of antique American "golden age of radio" sets—whose tube information needs are restricted to a limited number of fairly standard types. For him or her, a five-dollar vintage tube manual picked up at a radio meet might serve very well.

A TASTE OF TUBES—THE CONNOISSEUR'S COOKBOOK: Second Edition
Published by Sonic Frontiers, Inc., Ontario, Canada. Available from Sonic Frontiers dealers (such as Arizona Tube Audio, 688 W. First St., #4, Tempe, AZ 85281. They'll send you a copy by mail postage-paid). Soft-cover; 60 pages; $5.00.

Most tube publications (with the notable exception of the Stokes book reviewed above) are either staid texts written by engineers or equally serious manuals supplied by manufacturers. And most of them are apt to precate the early 1950s, when the transistor became king and interest in "hollow-state" devices waned.

This little book is not from either of those molds. It is as current as next week, written in a chatty tongue-in-cheek style reminiscent of John Muir's beloved Volkswagen repair manuals. The guide is aimed at the relatively uninformed aficionado, who is just beginning to realize that tubes have certain undeniable advantages over transistors in hi-fi circuits.

As its title implies, *A Taste of Tubes* is set up in a cookbook style, with section headings such as "Amplifiers du Jour," Spicing the Circuits," and "Cooking with Triodes." The first content section ("Appetizers") is a whirlwind journey through the combined evolution of tube and amplifier technology. Beginning with the Edison Effect, Fleming valve, and DeForest's Audion amplifier, the story culminates with the classic Williamson, Ultra-Linear, and Quad amplifiers of the 1950s.

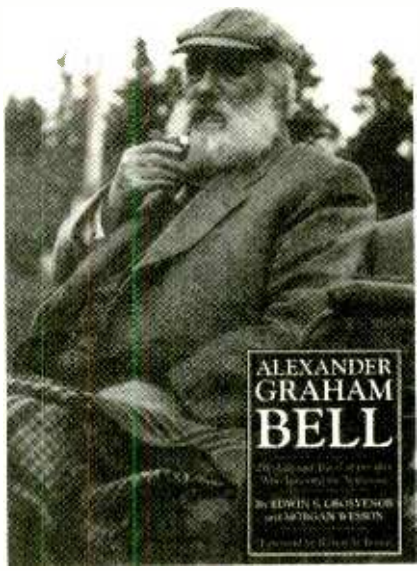
Immediately following is an appropriately named "Meat and Potatoes" section, which introduces vacuum tube construction and theory as well as classical vacuum circuitry (with special emphasis on amplifier design). The wrap-up section ("Just Desserts") reviews tube care and selection, the advantages of tubes over transistors, and the future of the vacuum tube. The bibliography that follows ("Food for Thought") cites some very interesting publications—several of which I'd certainly like to have in MY library.

This book was originally published as a promotional giveaway by Sonic Frontiers, but became so popular (I can see why!) that the current edition was made available for a nominal price. It is well worth your five bucks!

ALEXANDER GRAHAM BELL
by Edwin S. Grosvenor
and Morgan Wesson
Published by Harry N. Abrams, Inc., 100 Fifth Avenue, New York, NY; Hardcover; 304 pages; $45.00.

No, this outstanding book does not exactly relate to antique radio, but be patient for a moment, and you'll see why I am mentioning it here! An important new illustrated biography of the inventor Alexander Graham Bell, it was co-authored by Morgan Wesson (known to antique radio buffs for his work with Ken Burns on the video documentary *Empire of the Air*) and Bell's great-grandson Edwin Grosvenor. It chronicles Bell's upbringing in Scotland, his early career as a teacher of the deaf, his interests in acoustics and telegraphy, and the experiments in electrical communication that changed our world.

Along with Bell's accomplishments,



the profusely-illustrated (400 illustrations), handsomely printed book puts into perspective the work of competing inventors, such as Thomas Edison and Elisha Gray. Also well covered are Bell's later inventing career and his involvement with aviation, hydrofoils, and the founding of *National Geographic*.

If you're interested, but concerned about the (very well justified) substantial price, here's an alternative. Join the Antique Wireless Association and pick up a copy for the discounted price of $37.95 (plus $2.05 S&H) offered to AWA members only. Then take a $17.50 tax deduction for the portion of your purchase that counts as a contribution to the Association. Want a copy autographed by both authors? No problem if you are a member and can come up with $47.95 (same S&H), $27.50 of which is tax deductible.

The AWA membership will set you back $15.00 ($27.00 for two years), but you'll be in the excellent company of over 4000 hard-core antique radio buffs. You will also receive *The Old Timer's Bulletin*, an excellent quarterly club publication, which I have the privilege of editing. Contact Joyce Peckham, Secretary, AWA, Box E, Breesport, NY 14816. ■

cal of 17-inch PC monitors. As you'll see in the accompanying table, the other video measurements are quite good. You'll find higher horizontal resolution, in some TVs. But the AR2.7 sticks to VGA computer resolution even for NTSC video—with one perhaps pleasing exception. Its built-in line double converts the interlaced video image to progressive scan. In any event, 480 lines of horizontal resolution still is close enough to the maximum afforded even by digital video sources, such as DVD, satellite, and mini-DV camcorders.

The greatest flaw of this monitor, to our minds, is its lack of any user control over color temperature. The tube comes preset at 9900-degrees Kelvin. That's pretty typical of PC monitors and a bit on the cool or blue side of the color range. But high-end TVs and video monitors (and even many PC monitors) do provide color temperature controls, either as presets or as user-variable. Bottom line: videophiles who like their NTSC-spec 6500-degrees Kelvin (especially for high-fidelity DVD and laserdisc movie transfers) are out of luck. (Note: The fancier AR2.7AV does offer individual gain for red, green, and blue through its on-screen menu, but you'd have to adjust by eye instead of a temperature scale).

PC-MODE PERFORMANCE

People accustomed to PC monitor dot-pitch (in the 0.28mm area for 17-inch CRTs) might find the term "stripe pitch" unfamiliar—and shockingly large at 0.83mm. Stripe pitch is TV-talk—the perforation in the shadow mask is a vertical rectangle or slot needed to get more brightness to the phosphors, compared to the more uniform "dot" of a PC monitor. As for the size, it's actually quite fine when you consider the monitor will be viewed from across a room rather than a keyboard.

By and large, the AR2.7 operates well for a PC monitor its size. When you read the accompanying APEL (Advanced Product Evaluation Laboratory—an independent testing facility located in Bethel, CT) test results, remember that it has two screen-size functions. For video, it goes into full-scan (or overscan) so as to display the image across the full area of the faceplate (26.5-inches diagonally). For PC use, the monitor kicks down to 24.6-inches diagonally, leaving a black border around the PC desktop. This is done not only to keep icons, *etc.* out of the overscan area, but also away from the periphery of the CRT where geo-

ARCADIA AR2.7 MULTIMEDIA MONITOR—TEST RESULTS

Brand:	Princeton Graphics Systems
Model:	Arcadia AR2.7 Home Monitor
Price:	$799 (manufacturer's suggested retail price)

Many of the measurements were taken using the Display Mate Professional test program from Professional Video Utilities. All reflect factory-preset conditions and were made in the 800 × 600 resolution mode.

MEASUREMENTS—VIDEO MONITOR MODE

Maximum Usable Luminance	63 foot-Lamberts
Horizontal Resolution	480 lines
Frequency Response	6.0 MHz
Convergence (center)	0.0%
Convergence (corners)	0.2%
Overscan (Horizontal)	2.0%
Overscan (Vertical)	0.0%
Interlace	50/50
Transient Response	Very Good
Color Temperature (preset)	9900 degrees Kelvin (@ 63 ft-L)
Color Quality	Excellent

MEASUREMENTS—COMPUTER MONITOR MODE

Display Image Height	37.5 cm (14.8 in.)
Display Image Width	50.0 cm (19.7 in.)
Display Image Diagonal	62.5 cm (24.6 in.)
Aspect Ratio	1.33:1
Aspect Ratio Error	0.1%
Squareness Error	1.7%
Horizontal Keystone Error	0.0%
Vertical Keystone Error	3.0%
Horizontal Pincushion Error	0.9%
Vertical Pincushion Error	0.7%
Horizontal Bow Error	-0.3%
Vertical Bow Error	-0.2%
Horizontal Linearity Error	1.5%
Vertical Linearity Error	1.2%
Screen Distortion Index	2.5%

FEATURES CHART

Screen size for PC	24.6-in. diagonal (default)
Screen size for video	26.5-in. diagonal (full-scan)
Stripe (Dot) Pitch	0.83mm at center
Scanning	Non-interlaced
Resolutions Supported	VESA; IBM and Macintosh, 640 × 480 @ 75- or 60 Hz, 800 × 600 @ 60 Hz
Maximum Resolution	800 × 600 non-interlaced
Vertical Scan Range	Auto-synchronizing, 50–90 Hz
Horizontal Scan Range	Auto-synchronizing, 30–38 kHz
Video Input	RGB analog, standard 15-pin mini D-sub
Certifications	FCC Class B; CSA; DHHS; TUV; UL; CE
Plug-and-Play compatible	VESA DDC1/2B
Auto-degaussing on start-up	
EPA Energy Star compliant	

User Controls (on-screen menu) includes Power; Volume; Brightness; Contrast; Horizontal/Vertical position and size; Pincushion; Rotation (image tilt); *etc.*

ADDITIONAL DATA

Display	27-in. diagonal (maximum 26.5-in. viewable)
Dimensions (W×H×D)	29.1 × 22.5 × 19.5 inches
Power:	150 watts
Weight:	81 pounds

metric distortion becomes most noticeable with PC images.

As usual, APEL ran electrical measurements for screen distortion. Here's what they mean.

ASPECT RATIO refers to the width-to-height ratio of the display area. It's commonly expressed as 4:3 (1.33:1). The factory-preset 1.33 here is close enough.

SQUARENESS ERROR, like these other measurements, represents deviations from perfection—in this case, perfect 90-degree angles at each corner of the display. The 1.7% here compares to 0.5% we've seen in 17-inch monitors.

KEYSTONE, **PINCUSHION** and **BARREL** distortion would look just like the objects they describe. Keystone distortion creates a parallelogram, wider either at the top or the base. Pincushioning gives the display the appearance of being pinched inward from the sides, while Barrel distortion is just the opposite—the borders appear to bellow outwards. The AR2.7 had more vertical keystone than we've seen in smaller CRTs but less horizontal error. Both kinds of pincushioning were greater in absolute percentages, but proportionate to 17-inch tubes.

BOW distortion means opposite borders of the display—top and bottom, or left and right sides—might appear concave and convex. Another way to look at it: one side seems pincushioned, its opposite barreled. The AR2.7 did quite well here.

LINEARITY ERROR looks for any variation from straight lines on any side of a square—waviness, for example. It's a pretty exacting exam that puts a variety of square patterns across the screen, from large to minute, and looks for non-linearities in any size and at any point on the display. Again, error in the 27-inch display was greater than in smaller tubes, but in similar proportions.

SCREEEN DISTORTION INDEX measures 2.5% for the AR2.7, compared with 0.5% in 17-inchers we've tested. Although there's no objective correlation, keep in mind that the 27-inch tube yields 336 square inches of display (three times the area of 17-inch screens) and it's viewed from at least three times the distance. APEL's test procedure also involves subjective visual exams based on viewing computer-generated images and patterns. These are Pass/Fail tests—either you see a problem or you don't. Except for some glare noted, the AR2.7 looked just fine.

Use this monitor as a full-sized 27-inch computer screen.

CONCLUSION

Not too long ago, $800 was the price of a 17-inch monitor. These, too, have come down, but so has the price of 27-inch TVs. A convergence TV/PC monitor really is more of a lifestyle issue than one of specs—it's not so much for doing spreadsheets or word-processing in the living room, but for Web-surfing or PC-gaming away from the desk and its small-screen monitor. If that's what appeals to you, the AR2.7 (or its larger 31-inch and soon-to-come 36-inch siblings) will do the job. Just remember, you'll need to buy a TV tuner card for the PC, and if you're finicky about the color temperature of your video, you'll need the "AV" version at about $200 more. ■

FOR MORE INFORMATION

Princeton Graphics Systems
Arcadia Div.
2801 South Yale Street
Santa Ana, CA 92704
Fax: 714-751-5736; Tel. 800-747-6249
Web: *www.prgr.com*

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"It works fine now, but it melts in the spring."

BEFORE THEIR TIME

(continued from page 46)

and had invented the silicon detector in 1906. Unfortunately, Pickard ran into the major problems of early solid-state workers: purity of materials and difficult-to-reproduce results.

One of the earliest solid-state amplifiers was invented by R.S. Ohl of Bell Laboratories in 1928 (see Fig. 1). Ohl's amplifier used a magnetic field to control the current flow across a junction formed by copper and copper oxide. Ohl, who invented the PN junction in 1941, was a well-known researcher, so the amplifier almost certainly worked. However, it probably wasn't sufficiently superior to the vacuum tube to make development seem worthwhile.

Finally, take a look at the device patented by Julius Lilienfeld in 1930 (see Fig. 2). It certainly looks like a junction transistor, doesn't it? According to the patent, the device was constructed on a sheet of glass with two terminals of sprayed copper separated by a very thin (1/10,000 inch) partition of aluminum. The three elements were then covered by a thin film of a compound of copper and sulfur. Did it work? Frankly, I wouldn't want to bet that it didn't!

There's a common thread running through all of these stories. All of the inventors were working in advance of theories (at least as known to them) that would have explained why their devices worked.

We electronic hobbyists and experimenters often do the same thing—though usually unintentionally. Consequently, we might have a better chance of discovering something revolutionary than someone who works from theory to practice, if we keep our eyes open.

So—if you should find your new home-brew stereo amplifier floating a foot off the workbench, do drop the editor a line! ■

LETTERS

(continued from page 11)

BAR CODE SECURITY?

My friend bought a small box of cigars, and there was a bar code on the cellophane wrapper with a printed circuit foil on the box. After taking the wrapper off, he noticed that there was another bar code on the bottom of the box. The bar code on the cellophane was directly over the one on the box. Why were there two bar codes? Was one for security detection? I would like to know more about these systems, especially in relation to bar codes. I also would like to see more articles on robotics—from the amateur standpoint.
B.K.
via e-mail

As far as we could figure, the printed circuit foil on the outer wrapper might be used for security detection. Sometimes a small spiral loop antenna can be designed in this manner and be resonant as the buyer passes near a low-level transmitter by the checkpoint at the store exit. If this loop is not deactivated at checkout time, then it will set off the security alarm. We are not sure why this wrapper would have an ***additional*** *bar code. Readers—any other thoughts? Concerning your interests in future articles—read on!—Editor*

ARTICLE REQUESTS

I have been a subscriber to your fine magazine for many years. I have seen many letters asking for this project or that. Do you publish a list of articles you would like submitted? I do not know if I could write articles for you, but I would like to try. It would be nice to know what you are looking for.
R.R.
Mecosta, MI

Your comments are in-line with this month's editorial requesting new and exciting manuscripts for ***Popular Electronics****. We seek construction stories at different levels—some for novices and some for those who have the training to carry out complex building instructions, possibly with software programming. We recently compiled a list of construction projects that readers have requested over the past year. The list also contains similar successful projects we have previously run, and updates of them would be welcome. This is not an all-inclusive list; if you have your own pet project that you feel would be appropriate, we'd like to hear about it. Here are some topics (listed in no particular order)—robotics; gadgets; unusual crystal radios; construction using surface-mounted components; TV descramblers; auto, surveillance, ham radio, and darkroom projects; Theremin musical-instruments; unusual telephone devices; novel test equipment; etc.*

Articles about new technology or the theory behind new devices are particularly valuable and make for interesting reading. Some readers wrote us and said they would like to get more theory and operation articles on wireless applications, bar code systems, infra-red remote control units, CATV theory with addressable decoders, retail security detectors, electronic protection...the list goes on.

How-to-do-it features are among the most interesting types of articles that you can write. Show ten new ways to use an oscilloscope, explain simple computer repairing or upgrading, or an easy way to make printed-circuit boards—and your story will be enjoyed by our readers. Be aware that troubleshooting and service manuscripts, require an experienced author.—Editor

NOSTALGIA DEPARTMENT

Your December 1997 editorial reminded me of my early days in the electronics field. I am a charter reader of **Popular Electronics**. I remember the October 1954 issue as if it were yesterday. It's what got me interested in electronics. I built just about everything in the magazine that followed. Most of the circuits worked right, as soon as I plugged them. I would like you to run a nostalgia series in **Popular Electronics**—especially the series "Carl and Jerry." The story was about two teen-age boys who experimented in making various projects, from their junior high school years to the time they graduated from college. This serial was run every month—sort of like the soap opera of today. The reader actually had a chance to grow up with these boys and share in their electronic adventures.
S.L.
Buffalo, NY

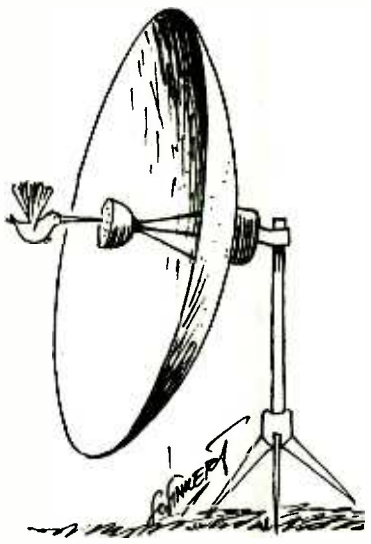
Other letters similar to the above concerning this editorial have come in. Apparently every reader who grew up with ***Popular Electronics*** *has fond memories of particular areas of interest. We certainly will try to find some space in* ***Popular Electronics*** *to set up a "Then and Now"-type column, which would take us back to those early days. How and when we would do this, we're not sure—just don't touch that dial and keep tuned!—Editor*

HAVES & NEEDS

Help! We recently bought a rural home, which included a satellite receiving system on the property. The previous owner was unable to locate any manuals. We also contacted both Howard Sams and Zenith Electronics, without success.

We would like to ask your readers for help in locating a source where we could purchase owners' manuals for the following components for the Zenith Satellite System: LNA unit (ZS-9100), Receiver (ZS-3000), Antenna Positioner (ZS-3500), and Video Cypher (VC-2100E). Thanks.
Wilfred Sato
46-801 Kainokoi Place
Kaneohe, HI 96744

I am in the need of a schematic of a DC analog-controlled AC dimmer. It must handle at least 600-watts AC and have a parts list. Thanks a lot!
Chris Grosek
34 Bungay Terrace
Seymour, CT 06483 ■



Supplement to Popular Electronics
March 1998

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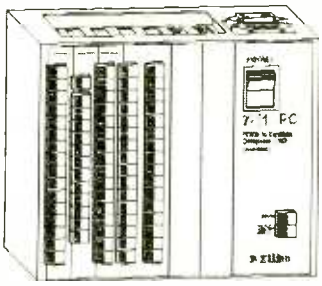
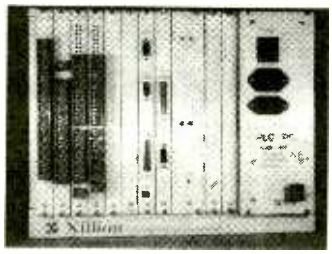
7-11 PC **--- 24-hour Working Computer** from $600



For Computer Telephony Server or Home Automation or Network Computer
Fanless, compact size
9.0"W 7.5"H 6.5"D

Handy PC **--- Field Computer** from $700
In between of Laptop & Desktop for the size,
Using regular CD-ROM, HD, FD and mini keyboard
Easy to carry around, 10.5"W 11"H 6.5"D

PLC PC **--- Industrial Computer** from $900
Accessibility like PLC (Programmable Logic Controller)
Euro Bus and PCI Bus for higher reliability & better performance.
17"W 11"H 6.5"D



All above 3 models accept ISA or PCI interface cards, and proprietary front panel connecting cards: I/O, A/D, D/A, X-10, up to 10A/220V

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Boost your telecommunication performance.
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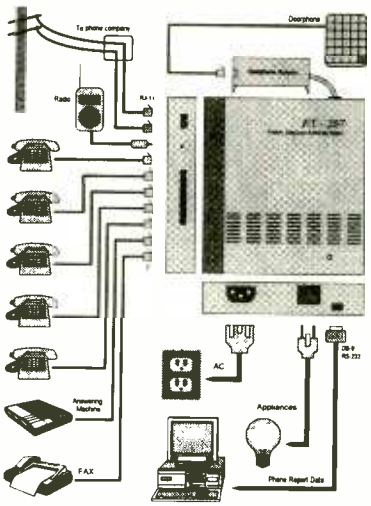

This small device provides same functions found in big, expensive PBX units; call transfer, conference, intercom, do not disturb, call restriction (blocking) call pickup, call waiting,.... Plus some extras you don't normally find in most regular PBX units such as: Voice direct incoming calls with your own message, transfer fax automatically, Tele-remote control your appliances or computer, Record and manage call numbers & time usage through your computer. You might even use it for phone projects - control phone operation with PC.

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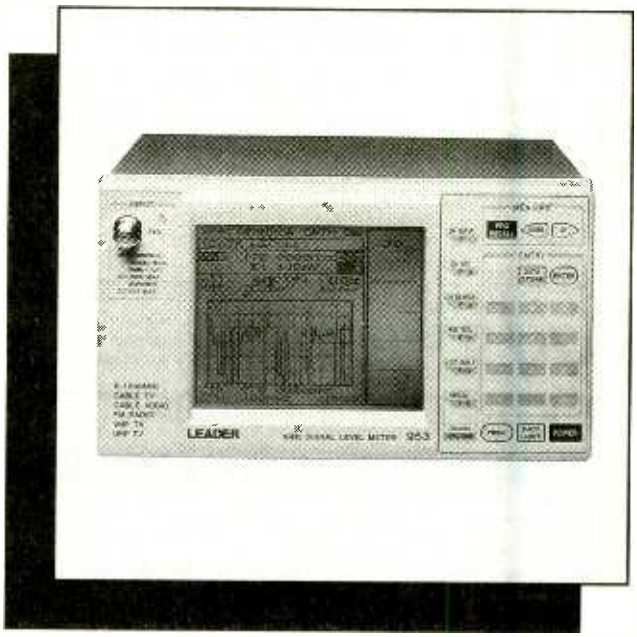

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General

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%
Temperature Ranges: Operating: 0°C to 40°C (32°F to 104°F) Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery(NEDA1604)
Low Battery Indication: BAT on Left of LCD Display
Dimensions: 188mm long x 87mm wide x 33mm thick
Net Weight: 400g

DC Voltage (DCV)

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

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

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

Overload Protection: mA Input. 2A/250V fuse.

Resistance (Ω)

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

Maximum Open Circuit Voltage: 2.8V

Diode Test

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

ohFE Test

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

AC Voltage (ACV)

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

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

Special Offer! The next generation of Digital Multimeters with 3-3/4 digits, 4000 count, auto-ranging and analog bargraph, 10MHz frequency counter, True RMS mode and RS-232C interface. **LIMITED TIME OFFER! You MUST enter your order by December 31st, 1997 to receive this special price!** Regular C.S.I. price $169.00. ***Plus we'll even include the optional temperature adaptor and K-type thermocouple probe! We even include the holster!***

CAT NO	DESCRIPTION	PRICE
PROTEK506	Digital Multimeter	$139.00

Developer This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
POSDEV	Positive Developer	$.95	$.80	$.50

Etching Chemicals/Ferric Chloride

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

CAT NO	DESCRIPTION	PRICE EACH 1	5
ER-3	Makes 1 pint	$3.50	$2.75

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 165mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10
PP1212	305mm x 305mm/12" x 12"	12.78	10.65	8.52

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
GS114	114mm x 165mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80
GS1212	305mm x 305mm/12" x 12"	18.88	15.73	12.59

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114	114mm x 165mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30
GD1212	305mm x 305mm/12" x 12"	22.09	18.35	14.68

Etching Tank

This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	$37.95

1/3" CCD Board Cameras

Available with **PINHOLE LENS** with **AUDIO**; **STANDARD LENS** with **AUDIO**; and **STANDARD LENS** with **INFRA-RED**. These are the world's smallest commercially available CCD board cameras!

World's Smallest B&W Board Cameras

Specifications

Image Pick-Up Device	1/3" CCD area Sensor
Picture Elements	EIA=512(H) x 492(V)
Pixel Pitch	EIA=9.6UM (H) x 7.5UM (V)
Scanning System	2 : 1 Interlace
Scanning Frequency	EIA=525 lines, 60 field/sec (II) 15.750 KHz x 60 HK
Resolution	430 Lines
Minimum Illumination	0.03 LUX
S/N Ratio	45DB
Lens Mounting	4.3mm standard, 5mm pinhole
Video Output	1.0 VP-P/750OHM composite signal
Power Requirement	8-12 VDC (9VDC standard)
Power Consumption	100mA
Operating Temperature	-20C -+ 70 C RH 95% Max
Storage Temperature	-40C -= 85 C RH 95% Max
Audio Pick-Up Sensitivity	-60 DB (0DB = 1B/UBAR. 1KNZ)
Audio Frequency Range	20 Hz to 20KHz
Audio S/N Ratio	More than 35DB
Audio Output Level	1VP-P/600 OHM

Dimensions

WDP-2000	30mm (H) x 30mm (W)
WDS-2005	30mm (H) x 30mm (W)
WDI-4000	44mm (H) x 30mm (W)

WDP-2000

WDS-2005

WDI-4000

CAT NO	DESCRIPTION	PRICE EACH 1	5
WDP-2000	1/3" B&W Pinhole Lens with Audio	$89.00	$77.00
WDS-2005	1/3" B&W Standard Lens with Audio	89.00	77.00
WDI-4000	1/3" B&W Infra-RED (no audio)	89.00	77.00
WDPH-55BW	Plastic Housing Option for B&W Board Cameras	13.00	12.00

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Perfect for replacement, upgrade or original manufacturing in most speaker applications. They feature polypropylene cone, foam surround and high temperature voice coil. Power capacity 70W/100W RMS/peak, 40Hz~3KHz response, 1½" voice coil, 18 oz. magnet and SPL 87dB.

Order #	Impedance	Regular
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55-1605	4ohm	10.95

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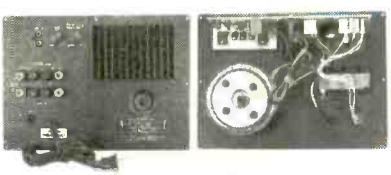
Order #	(ea.)
28-2200	$16.95



110 Watt Subwoofer Power Amp Module

MCM now offers the ultimate subwoofer power amp module for all your home audio and home theater projects. It can be built directly into most any existing subwoofer enclosure, requiring a cut-out of only 10" x 7", and accepts either speaker level or RCA inputs. Features include an auto sense circuit to turn on amp when music is present, and 60~160Hz continuously variable 12dB crossover.

Order #	(ea.)
50-4465	$179.00

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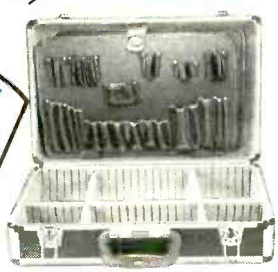

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- PS-1000 100MHz Dual Trace $999.95

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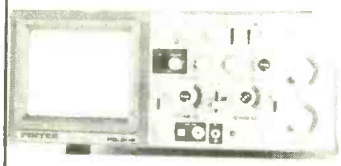
Scope Probe:

HP-9060 (60MHz) $15, HP-9150 (150MHz) $22, HP-9250 (250MHz)$29, HP-9258 (250MHz,100:1)$39



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- **SG-4160** ($124.95) 100kHz-150MHz sinewaves in 8 ranges, 100mV at 35MHz
- **SG-4162** ($229.95): Generate same signal as SG-4160, but with int. counter (150MHz).

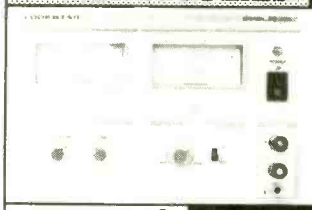
Audio Generator

- **AG-2601** ($124.95)10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave
- **AG-2603** ($229.95): Same as AG-2601, but with additional counter and digital display.

Function Generator

- **FG-2100A**($169.95).2Hz-2MHz,5mV-20Vpp
- **FG-2102AD** ($229.95) same as FG-2100A, but with int. counter and TTL, CMOS output.
- **FG-2103** ($329.95) *Sweep* 0.5Hz-5MHz, linear/log, VCG, GCV, and int. counter

POWER SUPPLIES



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- Short Circuit and overload protected
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PS-8112 ($399.95) 60V/5A
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Digital Volt & Current Display

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- Constant current & constant mode
- Independent or Tracking

Dual Tracking (Analog V & I Displays)

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PS-8108 ($549.95) 60V/3A/60V/3A
PS-8109 ($699.95) 60V/5A/60V/5A

Triple Output

- One fixed 5VDC, 3 Amp output
- Parallel to double current output (PS-8102 & PS-8103 only)

Triple Output (Analog displays)

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Digital Displays

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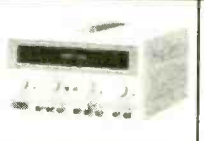
- Zaxis input,CH1 output
- Hold off, TV syn.
- 2 probes (x1, x10)

- Dual CH/X-Y operation
- 1 mV/div sensitivity
- Z-axis input,CH1 output
- TV syn., trigger level lock
- 2 probes (x1, x10)

OS-305 ($209.95) - 5 MHz One Channel
OS-310 ($324.95) - 10 MHz One channel

DC POWER SUPPLIES

Triple Output



- 2 variable out 0-30V,0-3A
- One fixed 5V,3A output
- Auto track, serial, parallel
- Const. volt, current mode
- 4 analog or 2 digital display

PC-3030 ($499.95)
PC-3030D ($549.95)

Single Output

- Const voltage, current mod
- Voltage regulation ≤0.01%
- Current regulation ≤0.2%
- PS: 2 analog or 1 digital dis
- PR: 2 analog or 2 digital dis

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PR-6030 ($314.95)60V/3A

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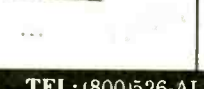

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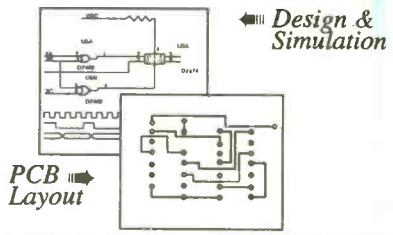

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- Analog simulator **(mentalSPICE)** for $199. Allows AC, DC and transient circuit analysis. Includes models of transistors, discretes, and op amps.
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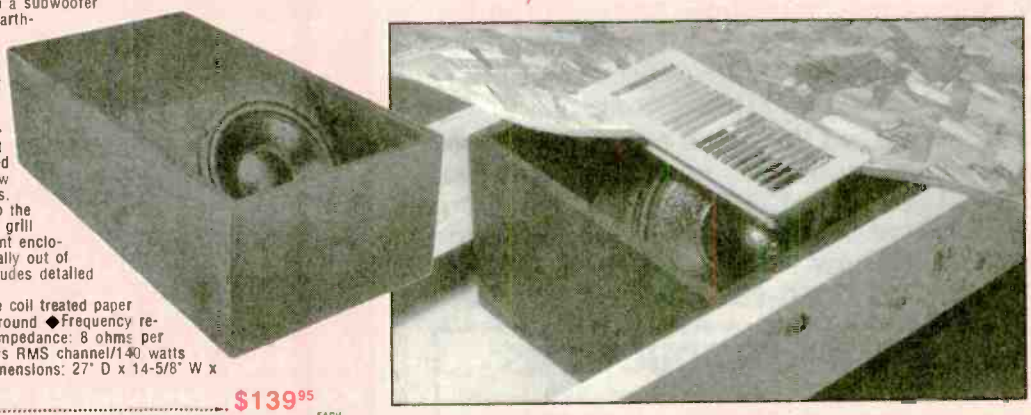

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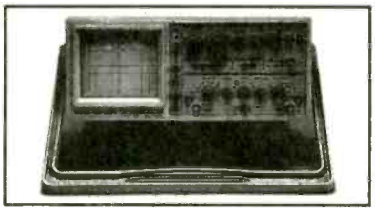

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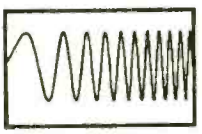

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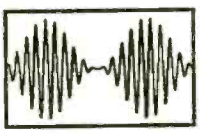

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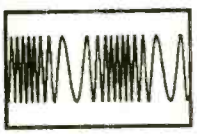

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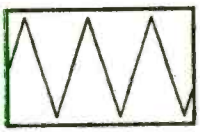

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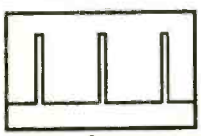

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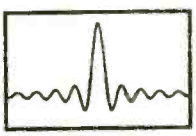

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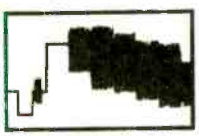

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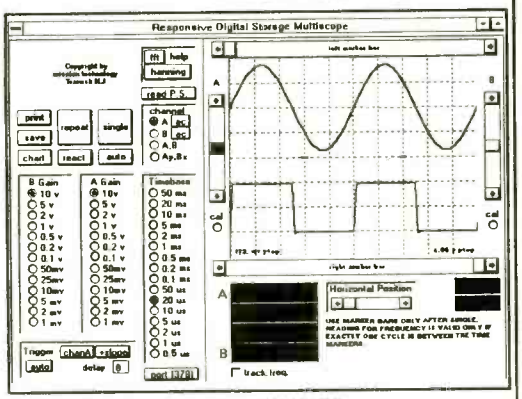

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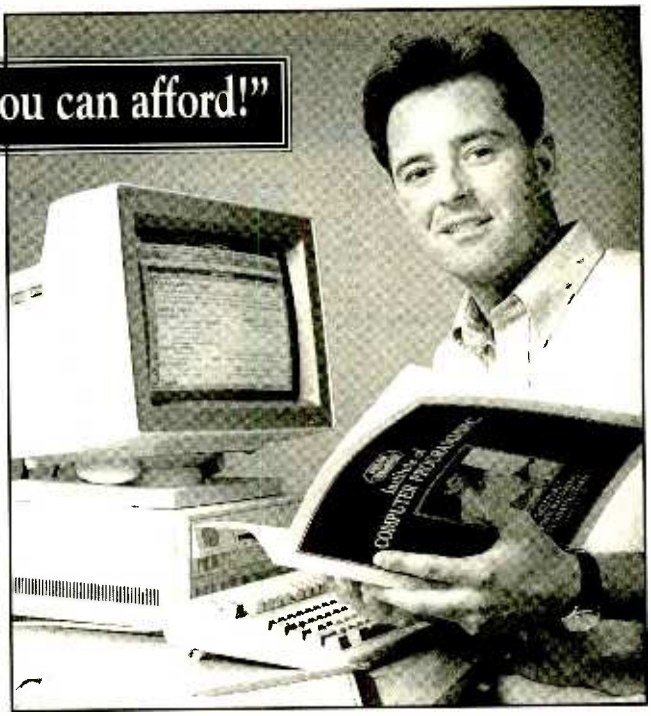

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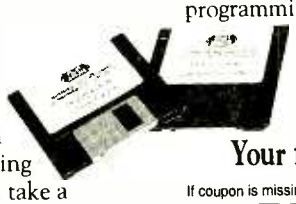

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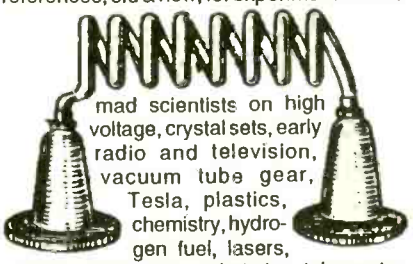

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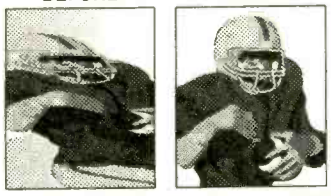

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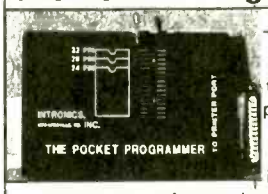

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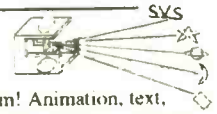

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2. The transmitter on the TV sends input from the keyboard to your PC—through walls, ceilings and floors up to 100 feet away—via RF technology.

by Carrie Stone

The other day, my family and I were watching an interesting show on TV. My son had a question that none of us could answer, so we decided to look up the subject on the World Wide Web. Our TV's in the family room, and the computer is in my study on the second floor, so after the show ended we all went upstairs and crowded around the tiny PC monitor. I wondered if there was a way to use TV and PC technology in the same room, without moving any hardware. There is...it's called PC/TV AirLink™. Now we turn computer time into family time, as we all enjoy the Internet, educational software and computer games on our easy-to-see TV screen.

TV or PC? Over the past few years, PC technology has made amazing advances in its ability to provide education and entertainment. The Internet has proven to be a fantastic resource with virtually limitless potential for growth. Meanwhile, through cable and satellite systems, television now provides an increasingly broad range of programming. This development has created the need to integrate the information we receive from television, the Internet and other sources. This idea, known as *convergence*, will play a huge role in determining how we receive information in the future. AITech, a leader in convergence technology, has developed a product that combines TV and PC activities easily, affordably and wirelessly.

1. The wireless keyboard communicates via IR technology with the transmitter connected to your TV.

Convenient convergence. For years, scientists and engineers have been working to develop a product that links the PC and TV in homes and offices. Now, using the latest 2.4 GHz technology, they've created a transmitter/receiver that lets the user control their PC with a remote keyboard/mouse, viewing the screen on their TV. PC/TV AirLink is a wireless digital scan converter capable of transmitting audio/video signal through walls up to 100 feet away. Because they are broadcast on a higher frequency, these signals don't interfere with the crowded 900 MHz band used by cordless phones and many other devices.

Sofa surfing. Imagine the possibilities. You can bring the power of your PC right into your family room, without wires. The whole family can enjoy surfing the net, playing CD-ROM games or studying educational programs. Because the relay signal can be easily switched off, you can switch back and forth between PC and TV quickly, easily and as often as you like.

Unlimited possibilities. With this amazing system, you'll never be limited by the capabilities of a set-top box or web TV systems...

Because the system uses 2.4 GHz technology, installation is simple, with no cables to run. One transmitter plugs into your PC or laptop and one transmitter plugs into your TV. It's that simple! Just sit back on the sofa—with the wireless keyboard, complete with integrated mouse and joystick—and you're ready to go. You can even use the PC/TV AirLink as a wireless video sender by plugging the receiver into any other A/V source such as a VCR, DVD, satellite receiver or cable box to send movies, games and programs to other TVs in your home.

3. The computer interprets and processes the commands sent from the transmitter on your TV. In the meantime, the transmitter connected to your PC is broadcasting your PC screen to your TV.

increase your performance capabilities by simply upgrading your PC. And since it is totally portable and sets up in seconds, the PC/TV AirLink is perfect for the office. Use it for multimedia presentations or training wherever there's a TV.

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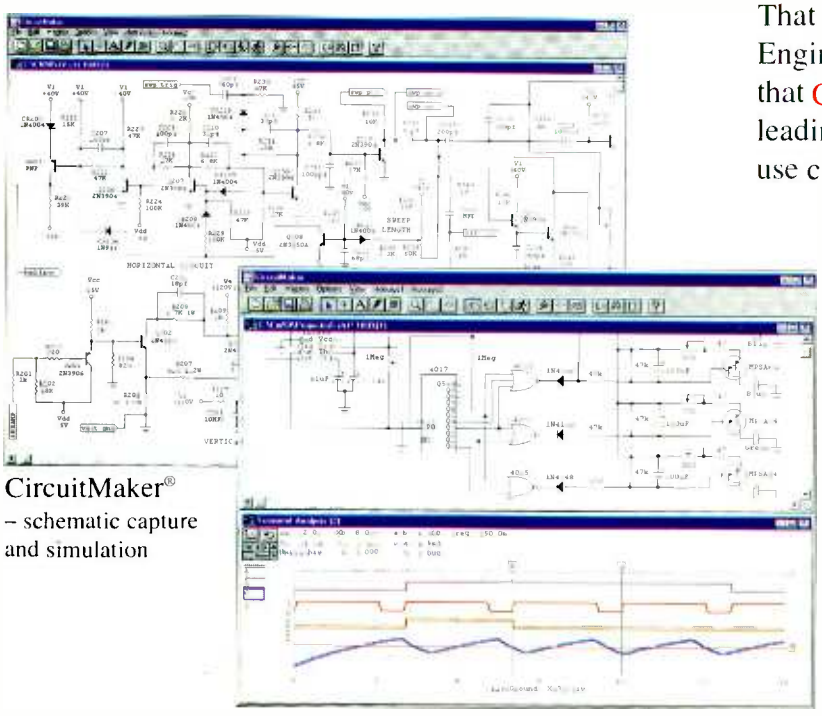

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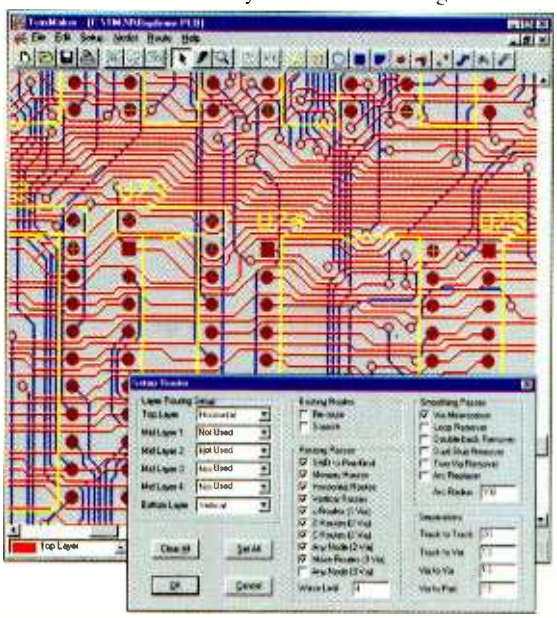

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