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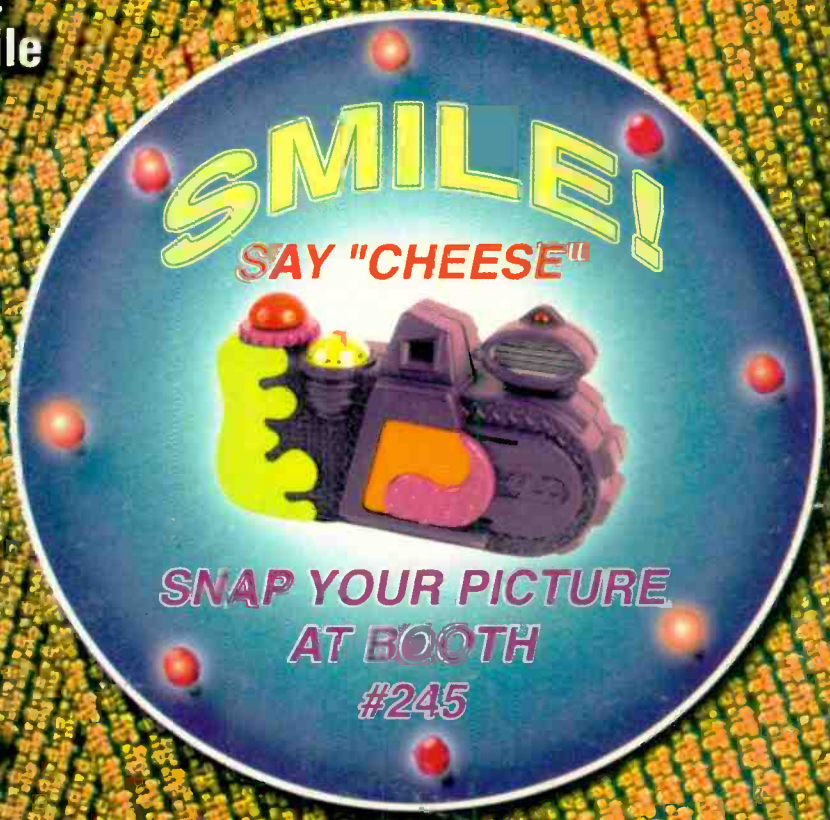

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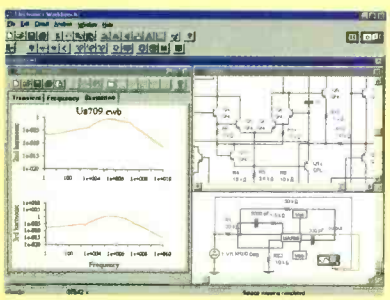

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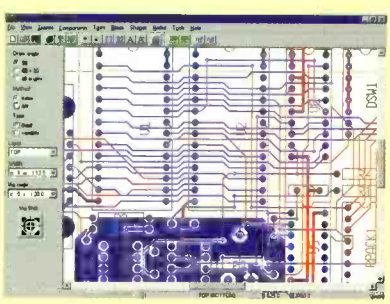

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One scientist's vision revolutionizes the hearing industry, benefiting millions of people...

Crystal Ear® uses sophisticated electronics to provide affordable, cosmetically-pleasing and easy-to-use hearing amplification.

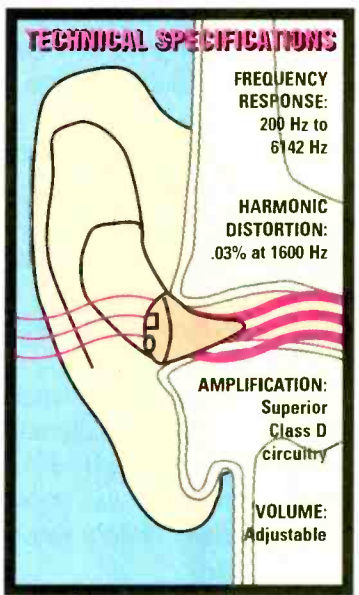
by Harold Sturman

One day a friend asked my wife Jill if I had a hearing aid. "He certainly does," replied Jill, "Me!" After hearing about a remarkable new product, Jill finally got up the nerve to ask me if I'd ever thought about getting a hearing aid. "No way," I said. "It would make me look 20 years older and cost a fortune." "No, no," she replied. "This is entirely different. It's not a hearing aid...it's Crystal Ear!"

No one will know. Jill was right. Crystal Ear *is* different—not the bulky, old-styled body-worn or over-the-ear aid, but an advanced personal sound system so small it's like contacts for your ears. And Crystal Ear is super-sensitive and powerful, too. You will hear sounds your ears have been missing for years. Crystal Ear will make speech louder, and the sound is pure and natural.

I couldn't believe how tiny it is. It is smaller than the tip of my little finger and it's almost invisible when worn. There are no wires, no behind-the-ear devices. Put it in your ear and its ready-to-wear mold fits comfortably. Since it's not too loud or too tight, you may even forget that you're wearing it! Use it at work or at play. And if your hearing problem is worse in certain situations, use Crystal Ear only when you need it.

A fraction of the price. Hearing loss is the world's number-one health problem, but in most cases it goes completely untreated. For many millions of people, hearing devices are way too expensive, and the retail middlemen want to keep it that way. What's more, treating hearing loss the old retail way can involve numerous office visits, expensive testing and adjustments to fit your ear. Thanks to Crystal Ear, the "sound solution" is now affordable and convenient. Almost 90% of people with mild hearing loss, and millions more with just a little hearing dropoff, can be dramatically helped with Crystal Ear. Plus, its superior design is energy-efficient, so batteries can last months, not just weeks.



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You'll feel years younger! Wear Crystal Ear indoors, outdoors, at home and at work. Crystal Ear arrives ready to use, complete with batteries, two different fitting sleeves, a cleaning brush and even a carrying case. Crystal Ear is a breakthrough advance in the hearing device field. It is made in the USA, using state-of-the-art micro-manufacturing techniques that cut costs dramatically—savings that we can pass on to you. The conventional companies, domestic and foreign, don't like that!

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—Dr. Dale Massad, MD

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Editorial

SMT for Beginners

In my March editorial, "Let's Hear From You," I requested that would-be authors out in reader-land warm up your soldering irons, turn on your word processors, and start sending in manuscripts to us. I also raised the rhetorical question "What type of articles are we seeking?" Well I am happy to say that the floodgates for manuscripts have opened and projects are starting to fill up the storage room at **Popular Electronics** again. In short, you can look forward to a wealth of good construction projects, tutorials, informational, and how-to-do-it articles for the future.

On the other hand, we have received lots of mail requesting certain projects. One topic that keeps coming up is construction projects using Surface-Mount Technology, or SMT for short. For those unfamiliar with this technique, it is the manufacturer's dream-come-true, which was developed mostly in the automation packaging industry for manufacturing ease and reliability. SMT uses printed-circuit boards without holes, tiny grain-sized components (which many times are supplied on a strip or reel), and millimeter lead spacing and component spacing. Special tools and materials may be required along with good eyesight and a steady hand. Some of you will avoid this construction technique, and others will enjoy using their skill and dexterity to fabricate these ultra-miniature light-weight projects.

To kick off this technique, we present on page 31 the simplest of these SMT projects, "Build the Promotional Pin." This is a fun-to-build and useful project, which will break the ice in using this new technology. In the following months, we will present several more projects and assemblies. In each issue, several new modules will be introduced, their construction carefully described and explained, and then their use as "building blocks" in the assembly of a small system or specific application will be shown.

We hope you enjoy your exposure to this new field, and, as always, we welcome your feedback on this construction subject.

Ed Whitman

Ed Whitman
Managing Editor

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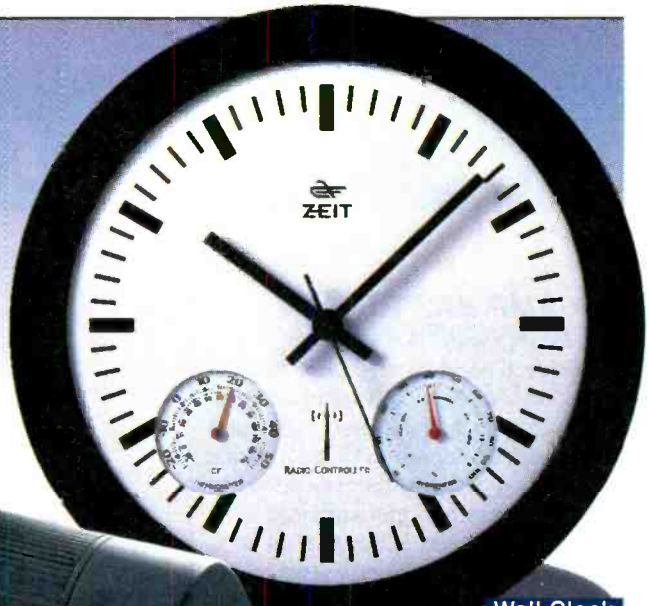
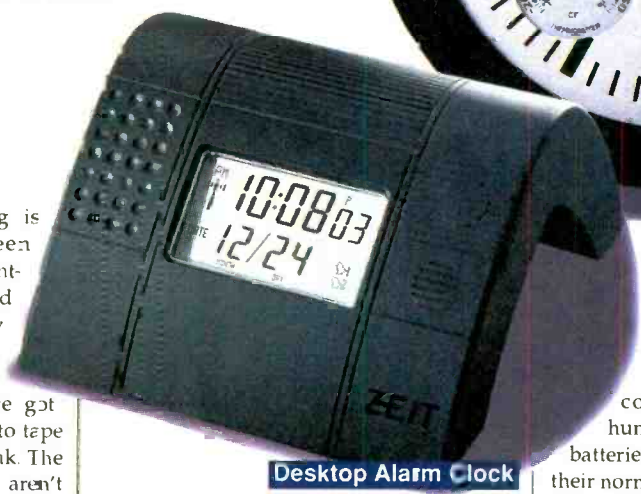
TECHNOLOGY UPDATE

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.

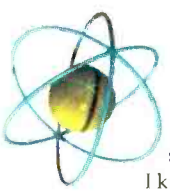


Wall Clock



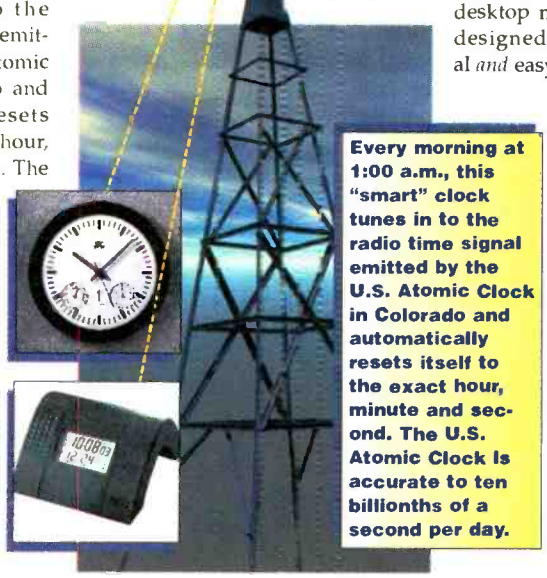
Desktop Alarm Clock

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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LETTERS

OP-AMP BASICS CLARIFICATIONS

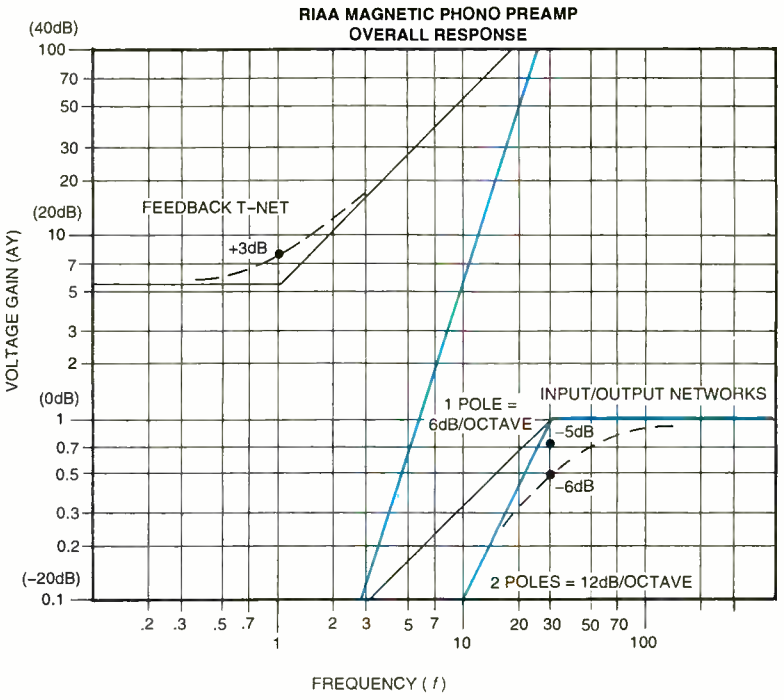
Since I have received other questions on my article, "Hands-on Approach to Op-Amp Basics" (**Popular Electronics**, February 1998), I would like to make some further clarifications. (See my previous correspondence in the *Letters* column of the April issue.)

I discovered another error that could be the source of some confusion. The values for C1 and C6 were given as 1 μF in the schematic and parts list; these should have read "0.1 μF." Also, in the last paragraph on page 39, references to R8 should be replaced with "R9."

Regarding Figure 3: As printed (and in the original graph) there are two sets of numbers for the vertical scale. The intention was to provide both linear (actual voltage gain) and logarithmic (dBv) indications. The large numbers represent decibels, and the small numbers represent actual voltage gain: "0" dB (bottom of the graph) represents unity gain. The small numbers go up from there to voltage gains of 2, 3, 4, *etc.* to 10, which represents 20 dB relative to unity. (Note that since we're working with voltage, each decade represents 20 dB, not 10 dB, since power is proportional to voltage squared.) Since this is a log-log graph, the small numbers marking the next divisions would represent voltage gains of 20, 30, 40 *etc.* to 100, which is 40 dB. Similarly, above 40 dB the small numbers would indicate voltage gains of 200, 300, 400...up to 1000, representing a gain of 60 dB relative to unity.

The markers for 10, 30, and 50 dB were omitted simply because they are awkward, falling at voltage gains of 3.16, 31.6 and 316, respectively. Again, though, since we're using a log-log graph, these points would be exactly at the midpoints between the 0, 20, 40, and 60 dB markers.

I'm sorry if using this dual axis-marking approach was a source of confusion. It's common engineering practice to plot the actual voltage response (since the readings are gathered using an AC voltmeter) on log paper, then adding the decibel equivalents at convenient intervals. Saves a lot of tomfoolery with taking logarithms, but makes it confusing to people unfamiliar with this shortcut plotting method.



Lower frequency response characteristics of the RIAA Magnetic Phono Preamp

I should have stated that the 3 dB corners imposed by the input and output networks are in addition to the roll-off inherent in the RIAA filter itself (imposed by the T-network composed of R4, R6, and C3, and the corresponding parts in the right channel amplifier). This "built-in" rolloff is partly responsible for the peak at about 80 Hz, and causes the rolloff below that to "shelf" at 10 Hz. The magnitude of the shelf can be computed by calculating the DC gain of the amplifier, which is 1 + (15k+51k)/15k, or 5.4. Taking 20 × log (5.4) gives an equivalent dBv figure of almost 15 dB.

The presence of the input and output high-pass poles at 30 Hz is responsible for eliminating this shelf. You can barely see the change in direction of the curve of Fig. 3. Coming down from the peak, the curve appears to be headed towards the shelf, and then changes direction and starts heading more sharply downwards again. Each pole causes the response to be down 3 dB at the corner frequency (this is also called the half-power point, and represents a linear voltage-gain ratio of about 71%). Below the corner frequency, the response asymptotically approaches a straight line with a slope of 6 dB per octave. Since there are two poles involved (input and output), the total rolloff is therefore 12 dB per octave.

The corner frequencies are given by the equation

$$f_C = 1/(2\pi RC)$$

For example, using the input network, we get

$$f_C = 1/(6.28 \times 51 \times 10^3 \times 0.1 \times 10^{-6}) = 1/(32 \times 10^{-3}) = 1/.032 = 31.3 \text{ Hz}$$

If the circuit is modified as mentioned in the text (increasing C1/C6 to 1 μF, *etc.*), the corner frequency is lowered to about 3 Hz, and the "built-in" rolloff is allowed to reach the shelf starting around 10 Hz before the 12 dB per octave coupling circuit rolloff kicks

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in around 3 Hz.

Attached is a graph of the lower region of the amplifier's response which might help clarify this. At the left, near the top of the page, is the natural response of the T-net within the feedback loop. This is what the response would look like if the inputs and outputs were DC-coupled. At the lower right corner of the page is the effect of the input and output coupling networks. (Note that these straight line segments are the asymptotes; the actual response would of course be a curve passing through the 3 dB point and asymptotically approaching the straight lines as suggested by the dashed lines.) In the case of the input and output networks, since the corner frequencies are the same, the attenuation is doubled (in decibels) so that our corner is actually 6 dB down (not just 3 dB as would be the case with a single pole filter), and the slope of the rolloff is 12 dB per octave (not just 6 dB/oct. as for a single pole). The heavy line represents the net effect, which is to give a total of 18 dB per octave rolloff down to the 10 Hz shelf, at which point it decreases to 12 dB per octave.

I was hesitant to get too deeply into the AC analysis of this circuit, because this can rapidly become verbose and unnecessarily complicated. Given that these questions have been raised, it is possible that others will find these clarifications of interest also.

—Fred Nachbaur

ARTICLE SUGGESTION

I have been a subscriber for many years, and I have found **Popular Electronics** and **Electronics Now** to be my favorites. It has been years since there has been any thing on the hobby of metal detecting. An article on the various methodologies and theories of detection or any project connected to this subject would be appreciated. Thanks for your help.

D.B.S.
Stamford, NY

STEREO, ANYONE?

I would like to devise a receiver that would pick out the FM stereo signal from my TV cable converter (a Time Warner unit set on Channel 3) which would then provide FM stereo to speakers. All of our TV sets and VCRs are non-stereo, and I don't want to purchase new ones just to get stereo sound. Perhaps a receiver that would feed its output into a conventional FM stereo set would work.

Can any reader help me with a solution to this question?

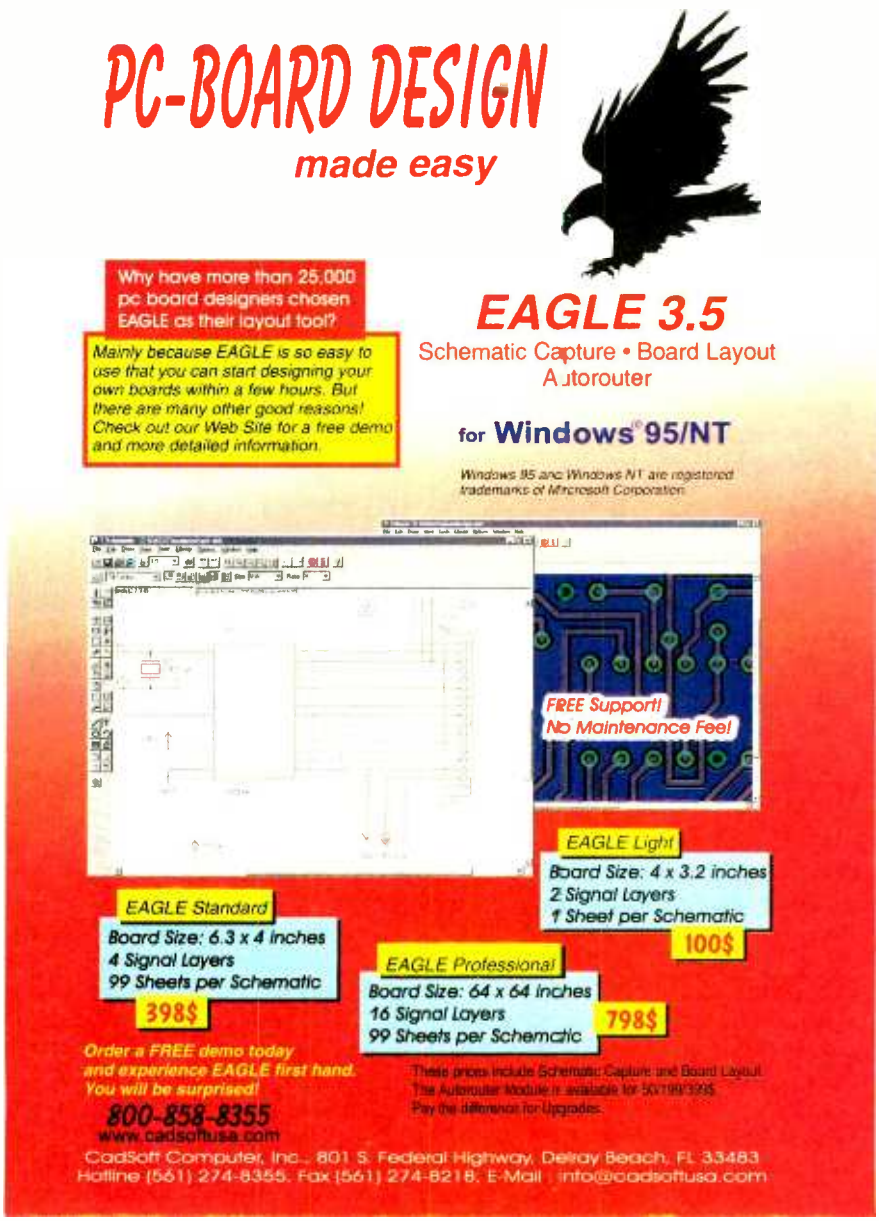
James A. Waite
Oakland Street Electronics
3341 Oakland Street
Eau Claire, WI 54703

HAVES & NEEDS

One of my hobbies is bringing old radios and electronic equipment back to life. I recently picked up a Commodore Plus4 Computer at a thrift store. Of course, it's inoperative, and I would like to get it working. Could anyone provide me with the circuit diagram that I need to service this old-timer? I would gladly pay for a usable copy.

Steve Rustyak
1102 N. Cayuga Street
Ithaca, NY 14850

Some Commodore sources on the Web are: www.jbrain.com/cswap/ (classified ads), www.jbrain. com/caboom (a Commodore meta-index), and www.jbrain.com/vicug (Commodore user's group).—Editor ■



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SCANNER SCENE

Everyone's Tracking Trunks

MARC SAXON

Add *RadioShack* to the list of scanner manufacturers ready, willing, and fully able to meet the needs of scannists who require monitoring gear that can wrangle with standard two-way FM communications, plus the most popularly encountered 800-MHz trunked communications systems. You got it! Here comes the *PRO-90 Trunk Tracker*, a 300-channel triple-conversion handheld whizbang.

The PRO-90 offers its channels set up in ten banks of 30 each, and it covers the 29–54, 137–174, 406–512, 806–824, 849–869, and 894–960 MHz communications bands, plus the 108–136 MHz VHF aeronautical band. There are ten priority channels, plus pre-programmed service-search channels for police, fire, aeronautic, maritime, and weather operations.

The trunk-tracking properties allow you to identify the various user groups within a trunked system shared by several agencies. Then you can search for those you want and lock out the unwanted users. Triple-conversion circuitry means virtual elimination of almost all annoying interference from image signals. Data skip and search skip lets you shut-out irritating lockups during searches.

The PRO-90 comes with a rechargeable battery pack, plus an AC adapter/charger, a belt clip, and a detachable rubber duckie antenna (with BNC connector). A leather case is optionally available as an accessory.

What with trunked 800-MHz systems becoming popular with municipal systems, especially in major cities, the PRO-90 Trunk Tracker handheld looks to be a serious contender. You can get a looksee at your nearest *RadioShack* store.

SECRET STUFF

Looking for surveillance communications and wondering where they are? Well, one reader wrote in to say that he monitored two DEA surveillance helicopters in New Jersey. They were working one another on 120.775 MHz, while communicating on 418.75 MHz with ground surveillance vehicles.

The PRO-90 Trunk Tracker from RadioShack is a 300-channel triple-conversion handheld unit.

Generally speaking, search the 418.00-419.00-MHz band for DEA surveillance operations. Some FBI surveillance operations, in conjunction with various combined police/FBI task forces, have been reported in the 172.00–173.00-MHz band.

Recently, the FCC issued an experimental license (WA2XKW) to *CBS Communications Services*, of Ft. Lauderdale, FL, "for test, development, and demonstrations of communications and surveillance equipment for federal, state, and local governments." The license is for fixed and mobile operation anywhere in the continental United States. Among the frequency bands authorized are: 138.00–140.00, 150.05–174.00, 216.00–222.00, 410.00–413.00, 450.00–512.00, 806.00–824.00, and 851.00–869.00 MHz.

According to several recent reports from readers, Secret Service and related communications during visits of the President have been most frequently noted on 164.65, 164.8875, 165.2125, 165.375, 165.7875, and 166.5125 MHz. Some transmissions are sent "in the clear" (that is, unscrambled). The AF-1 plane-to-limo phone circuit (162.6875/171.2875 MHz) has been observed being tested while the plane is on the ground. The trusty old 415.70 MHz AF-1 air/ground phone channel appears to have fallen into disuse.

If you hear odd signals occasionally on 173.075 MHz, that's the channel used nationally by the *Lojack* stolen-vehicle recovery system. When a Lojack-equipped vehicle is reported to the police as being stolen, the police transmit a coded data signal on this frequency. That turns on (only) the stolen vehicle's hidden Lojack tracking transmitter, which also operates on this frequency. The vehicle sends out a series of beep signals. The signals enable police mobile units equipped with radio direction finders to track down the location of the stolen vehicle in a short time. Lojack is used in many areas now, and you may be unhappily surprised to notice how often this frequency comes alive in your community!

MYSTERY SIGNAL?

"What about an open carrier with no modulation that often appears on 288.0 MHz?" asks Harry Konrad, of Indianapolis, IN. He reports it can stay there for an hour or more, causing his scanner to lock up when he is searching the UHF aeronautical band. It's not there every day though, but it's a real signal. That's to say, he knows it isn't a birdie because it is not listed in his owner's manual as such; also the signal vanishes when the antenna is disconnected. Harry wants to know if we can tell him who uses this frequency in his area and what reason they would

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have to transmit on it in this manner.

This type of complaint isn't all that uncommon these days, sorry to say. Yes, it is a very real signal, but not from a communications station deliberately sending it out. Unfortunately, many modern devices now in common use contain chips and other circuitry that seem to oscillate low-level radio signals on all sorts of strange and unexpected frequencies. These devices often include, for example, computers, word processors, other radios, control circuits, timers, vehicle ignition systems, and cordless telephones (even some phones that transmit when not in actual use). Granted these signals don't travel far. Yet, if a scanner happens to be close enough to one or more such devices, their signals will enter via the antenna and cause the type of grief Harry describes.

In Harry's particular case, it sounds to us like the culprit is someone's personal computer. Possibly one being used by a neighbor, or even a member of Harry's own household. We receive at least two letters per month here concerning similar mystery signals.

LIGHTS! CAMERA!

A reader reports having a handheld scanner available while watching a Hollywood crew do location filming of a major motion picture. Putting the unit into search mode, he discovered eight channels in use by the director and crew (props, transportation, carpenters, *etc.*). They were referred to as Channels 1-8 in the following order: 467.06, 468.98, 466.63, 469.34, 466.60, 469.05, 464.15, and 464.40 MHz. These frequencies may well be standard for location shoots, so make a note of them just in case you have the opportunity to use them!

Please keep us posted with your monitored frequencies, questions, and comments. Our e-mail address is: Sigintt@aol.com, or you can write to us at: *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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—*Roland E. Larson*
The Pennsylvania State University

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Multimedia Watch

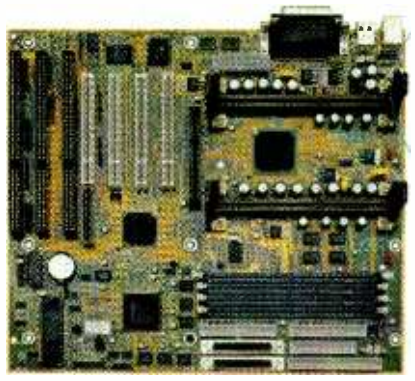
SCSI Motherboards, a 100× CD-ROM Drive, and More!

Marc Spiwak
Technical Editor
Windows Magazine

Before I start this month's column, I'd like to make a correction to something I said in my March column. I mentioned that if you put a narrow SCSI device (8-bits) on a wide SCSI chain (16-bits), the whole chain would drop down to narrow performance. The fact is, however, that performance suffers only when the narrow device is active—but even that is not entirely true. Let me just say that there is a tremendous amount of confusion out there regarding SCSI basics. I got my misinformation from a tech for a well-known SCSI vendor. And plenty of computer-savvy people confirmed what I heard. Basically all SCSI devices should negotiate their own proper connection speed, regardless of the controller type. Fast devices must wait for slower ones to finish what they're doing, but they would also have to wait for faster ones as well—just not quite as long. That's why servers usually isolate fast SCSI devices from slower ones by providing separate controllers.

Anyway, I'm seeing a new trend in high-end motherboards these days, and that is to have SCSI built right into Pentium II motherboards. I think it's going to become pretty much standard, just as IDE controllers are always featured on motherboards. However, IDE controllers are standard on all motherboards, while SCSI will only become standard at the high end. That's because low-end systems have no need for expensive SCSI—expensive in relative terms, that is. A low-end motherboard might feature built-in video, but not SCSI. The boards are using genuine Adaptec Ultra-Wide SCSI controller chips, too, so they can be trusted completely. Having SCSI built into the motherboard leaves valuable expansion slots free for use with other peripherals.

A company called Iwill recently sent me a couple of its latest motherboards to check out, both Pentium II units, and both with SCSI and an Accelerated Graphics Port (AGP) built in. I haven't tested any AGP graphics adapters that are much more impressive than their PCI counterparts, but I've seen some impressive demos, and some really cool stuff is on the way. Anyway, one of Iwill's motherboards, the *DPIILS2* at a manufacturer's suggested retail price (MSRP) of $499, accepts two Pentium II CPUs, while its lower-cost sibling, the *PIILS* (MSRP of $359) accepts only one CPU, but is otherwise identical in design.



Iwill's DPIILS2 ATX form factor motherboard will accept two Pentium II processors and has Adaptec SCSI and Accelerated Graphics Port built in.

Iwill's new ATX form factor motherboards use Intel's latest 440 LX chipset that supports the new AGP function and new Ultra DMA33 interface, which boost the IDE interface data transfer rate up to 33 MB/second. The *DPIILS2* features an Adaptec AIC 7895 ASIC with dual Ultra-Wide SCSI channels—it's equivalent to having an AHA 3940UW card. The two channels can hook up to 30 devices with a total data transfer rate up to 80 MB/second to satisfy server applications. The *PIILS* features an Adaptec AIC 7880 ASIC with a single-channel Ultra-Wide SCSI interface—this is equivalent to having an Adaptec AHA 2940UW card. The single channel can connect up to 15 devices with a data transfer rate up to 40 MB/second to serve CAD/CAM and multimedia applications. You can find out more about Iwill's motherboards at *www.iwillusa.com*.

100× CD-ROM DRIVE

A while back I was talking about CD-ROM drives and how they really can't get much faster than they are now. Well they still can't, but there is, and always has been, a way to make the apparent speed of a CD-ROM drive faster—and that is to copy the data to a hard drive first. It's just that one is more likely to do this with today's huge hard drives. I'm not talking about permanently copying data off a CD-ROM—simply buffering data to a hard drive is enough.

Elitegroup Computer Systems' *Smart 100×* CD ROM drive ($89) uses a system's hard disk drive as a CD buffer, enabling transfer rates as fast as 33.3 MB/second and access times as low as 10 ms. The bundled buffering software lets users choose the desired buffer size. Up to 100% of the CD ROM disc can be buffered. The buffering software automatically copies some or all of a CD's contents to disk, but only when both the hard drive and CD-ROM are inactive so as not to affect system performance. The scheme works, but the penalty is that a portion of the hard drive is lost to buffering forever. Nonetheless, it is one way to speed up a CD-ROM.

CD SCRATCH REMOVER

Scratches on CDs and CD-ROMs are not good and can sometimes cause a disc to fail or skip. I recently learned of a product designed to repair most scratches to restore operation of a disc. *ScratchAway*, from ScratchAway of North America, comes in two flavors—one for music CDs and another for CD-ROMs. Apparently there is a difference in the plastic used on the two types of discs. At least that's what *ScratchAway* claims.

ScratchAway uses a two-part for-

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mula to remove the milkiness caused by a scratch, again making the plastic coating clear. Scratches might still be visible, but the disc should still play properly. The product is useless—and so is your disc—if the scratch is made through the silk-screened side and into the foil layer containing the data. I have personally seen the product work on at least one disc—a music CD that would no longer play. The scratch repair kits will restore more than 40 discs. I just hope you don't have that many ruined discs on hand. The audio CD repair kit costs $19.95 and the CD-ROM kits costs $29.95. Add $3.95 to either for shipping and handling.

Elitegroup Computer Systems' Smart 100× CD-ROM drive uses a system's hard disk-drive as a CD buffer, enabling transfer rates as fast as 33.3 MB/second and access times as low as 10 ms.

NEW SOFTWARE

LucasArts' *Balance of Power* offers challenging new campaigns for *X-Wing vs. Tie Fighter*. Players engaging in the Rebel Campaign can enlist in the elite Rogue Squadron to continue the fight for freedom. The Imperial Campaign lets players join the Galactic Empire's infamous Avenger Squadron to battle for the glory of Emperor Palpatine. Each campaign can be flown in single or multiplayer mode. *Balance of Power* includes new melee missions and combat engagements. In addition to other enhancements, *Balance of Power* features a new B-wing starfighter and a non-pilotable Super Star Destroyer—a key battle target. Should you wish to accept this mission, be prepared to spend $29.95 estimated street price (ESP).

Personal Roots, from Expert Software, is an easy way to preserve your family heritage. You begin by entering basic information about parents, children, and marriages. Then you enter your favorite family stories in the notes section. You can even store digital images of family photographs. You can enter up to two million relatives for each family tree—although I doubt that anyone could live long enough to enter that much data. There are ten additional fields that you can customize. It's easy to search for ancestors or descendants as long as you've already entered the information. You can easily print ancestor trees with up to 30 generations on a single sheet of paper. *Personal Roots* costs $14.99. Also from Expert Software comes *Bicycle Solitaire*. This lets you match wits against the odds in over 50 different solitaire variations—some involving up to four decks. Other titles from Expert Software include *Calendar Shop*, *Sonic CD*, and *McDonaldland Silly Games* for kids. All of these cost $14.99.

Sweet! Digizine has a new issue out. This quarterly CD-ROM uses popular entertainment to expose teenagers to valuable life skills such as leadership, decision-making, and self-esteem. Each issue of Sweet! includes carefully selected celebrity interviews designed to motivate teens into positive action. The second issue features interviews with boxer Oscar de la Hoya, actress Jessica Biel, and blues musician Jonny Lang. It also features film clips from *Men in Black*. *Sweet! Digizine*, is offered in an educational version which includes a facilitator's guide and printable lesson plans designed to assist teachers in using Sweet! in the classroom. Schools can order an annual, four-issue subscription for $99. An entertainment version is targeted at teens and is available as single issues in magazine-style packaging. It can be purchased at newsstands, book stores, and music stores for $6.95.

Activision's *Quake II* is loose, and it delivers non-stop action as players attempt to annihilate alien aggressors and save Earth from mass destruction. The future of humanity is at stake as Earth launches its final assault against alien aggressors. Players must infiltrate the alien planet and fight their way through heavily fortified military installations. Gamers must duck gunfire and crawl through narrow shafts to annihilate enemies in 39 different levels, while 18 flesh-hungry monsters relentlessly hunt players down. *Quake II* has a suggested retail price of $54.95.

Nightmare Creatures, also from Activision, is now available on the PC

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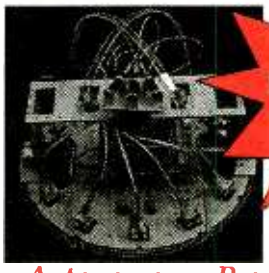

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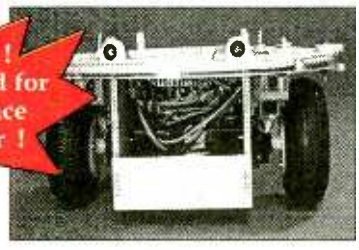

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platform. Nightmare Creatures plunges players into the underworld of 19th-century London to uncover a mysterious cult. Players must destroy the monsters lurking in the city's sewers and back alleys. Another game, *Heavy Gear*, immerses players in a brutal civil war on Terra Nova in the 62nd century. Players pilot a sophisticated battle chassis known as a Gear, loaded with rifles, lasers, and grenades. These cost $49.95 each.

Access Software is now bundling multiple expansion golf courses in a single set—The *Links 5-Course Library, Volume 4* includes Torrey Pines South, a spectacular setting with the surging Pacific Ocean and steep 300-foot canyons; the Oakland Hills South Course, home to numerous U.S. Opens and PGA Championships including the 1996 U.S. Open; the Hyatt Dorado Beach East Course in Puerto Rico, a 6985-yard tropical masterpiece; Castle Pines in Castle Rock, Colorado, which is 7495 yards, the longest course on the PGA Tour; and the Ocean Course at Pelican Hill, carved into the bluffs north of Crystal Cove in Southern California, and featuring the Pacific as backdrop on every hole. Greens fee for these courses run $29.95 MSRP.

New from Virgin Interactive comes *SubSpace*, an outer-space shoot-em-up game. The playing field consists of various obstacles, safe zones, and power-ups—players must collect power-ups to increase their ship's fire power, armament, maneuverability, and special weapons. Players can form teams or have themselves assigned to one through the computer. Points are scored for collecting power-ups and destroying opponents. *SubSpace* is divided into different zones, with each zone having unique team or player goals and levels of difficulty. Players can communicate in real-time with each other through an on-screen chat system. Arm-up with this game for $29.99.

Syracuse Language Systems is offering multimedia software to help people learn another language. *Success in Spanish* is an interactive course of 12 structured lessons. Speech recognition evaluates the pronunciation of words, phrases, and sentences, guiding the learner towards a proper accent. The software can help users enhance leisure travel, prepare for a business trip, or improve language grades in school. A multimedia glossary provides the translations and pronunciation of 2600 words. *Success in Spanish* sells for $24.95. A higher-level package, *The Spanish Self-Study Edition* is a 60-lesson stand-alone multimedia course. It's ideal for business and leisure travelers, as well as high school and college students. This is the only language-learning software with IBM continuous speech recognition built-in. Courses include speaking, listening, reading, writing, grammar, and vocabulary. The product includes a 60,000-word multimedia dictionary, plus express links to selected language and travel websites. The package includes four CD-ROMs, a microphone, two audiocassettes, a two-volume workbook set, grammar guide, and pocket bilingual dictionary. The *Spanish Self-Study Edition* sells for $79.95.

Frogger is back, thanks to Hasbro Interactive, and he's armed with new moves, power croak, heat-seeking tongue, and super jump. The coolest amphibian in town is lost in strange new worlds filled with hungry enemies. Quick reflexes help *Frogger* navigate polluted ponds, hostile deserts, dark caves, and more. The disc includes the original *Frogger* play pattern, plus ten new worlds and 50 levels of game play. Based on the arcade hit of the early 1980s, the new *Frogger* is rebuilt with 3D graphics. Players must guide *Frogger* to safety past multiple lanes of traffic, and a river filled with logs, swimming turtles, and hungry alligators. Jump at this for a MSRP of $39.95. ■

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A Hands-on Electronics REPORT

Nickelodeon PhotoBlaster

Novel new camera for kids takes four different pictures in each frame and quadruples the number of images per roll.

If you've ever purchased a camera for a young child over the age of 6 years, you've probably gone through quite a few rolls of film before the child "mastered" their photographic aptitude. Leave it to Nickelodeon to come up with a camera that gives your child four times the chances to practice snapping a picture and, I might add, create some really cool shots. The Nickelodeon *PhotoBlaster* is a 35-mm precision camera, with two focus-free lenses, which takes four 2- × 3-inch pictures on each 4- × 6-inch print. This concept is relatively new to the juvenile photo industry and means that a roll of 24-exposure film will give you a whopping 96 different shots (four per print). The *PhotoBlaster* comes complete with two required AA batteries and a roll of 12 exposure Kodak 35-mm film. This way your enthusiastic photographer can be handed the camera, and it's ready to go.

Nickelodeon PhotoBlaster features a "Big Red Shoot Button," "Green Slime" sure-grip handle, an easy-view film counter, built-in flash, easy-wind film advance knob, and best of all—four times the number of pictures per roll as a standard camera!

The *PhotoBlaster* is indeed a child-friendly camera. The instructions were quite thorough (printed in English and Spanish) and were set up to easily locate the highlighted direction you were looking for. After an adult loads the camera and advances the film to the first picture, the *PhotoBlaster* is ready to be kid-handled. The camera size is designed to avoid common child-related mishaps. For example, by placing one hand on the "Green Slime" hand-grip and the other on the purple side of the camera, small fingers would really have to stretch to cover the lens. This almost completely prevents those discouraging fingertip shots. Similarly, the "Big Red Button" shutter release knob is quite easy to push, but not easy enough to take unwanted pictures. The bright purple film advance wheel is also designed with the child in mind. It's simple enough for little fingers to turn, but not overturn and break. The camera is equipped with auto-flash, a bright red LED indicator that shows when the built-in flash is activated, and auto-focus

Besides its easy-to-use features, the *PhotoBlaster* meets the most stringent safety standards. Nickelodeon's entire line of "serious electronics" are deemed child-safe by its distributor Long Shore Technologies, are rigorously tested and reviewed for child safety by a nationally recognized testing laboratory, and are fully compliant with national safety standards. There are many safety features which set this camera apart from its competitors. For example, it has no sharp edges or loose parts, and the knobs are made in shapes and sizes which can be readily manipulated by children. The external walls are up to 50% thicker than similar products, which adds to the camera's strength and durability. The camera goes through extensive abuse testing (drop, torque, tension and impact tests) and must meet the standard before and after testing. Construction of the body is in a tough, impact-resistant ABS plastic. The paint, ink, and other coatings are tested for toxicity and confirmed appropriate for children's products. They are also tested for electrical safety. Nickelodeon's tag line, "serious electronics built to last" found on all Nickelodeon electronic products, is backed by a six-month "no-nonsense" warranty that guarantees free replacement of a defective product.

Four Times the Fun. Besides the lure of the Nickelodeon name, what differentiates the *PhotoBlaster* from other "kid-cameras" is that the *PhotoBlaster* is a "half-frame" cam-

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era—so each shot is only half as wide as a regular 35-mm negative. This doubles the number of pictures you can take. Furthermore, the two lenses on the camera then divide each frame into a top and bottom half. Ergo, the first shot exposes the top right quarter, the second the bottom right, the third top left, *etc.* Each of these mini- 2- × 3-inch pictures can be cut out easily by kids along the black division lines which separate each shot.

We took our *PhotoBlaster* with our six-year-old daughter to her elementary school to practice our picture taking. The amount of positive feedback the camera generated was overwhelming. All the kids, both boys and girls, wanted to get a look at the "cool Nickelodeon camera" and tell their parents "I want one!" And this was before they even saw how unique the pictures were. The moms were also relieved to learn that the camera was quite accessible. Besides the local toy stores, the camera is available at stores nationwide: Target, Amway, FAO Schwarz, the Sears catalog, and more. As a parent who wants to provide her child with the same popular toy "all the other kids have," being able to locate the item is an extremely beneficial feature. The manufacturer's suggested list price, $39.95, is quite reasonable for this camera, and discounts may be available. And when you develop the film you only pay for one picture when you're really getting four. This comes to a 75% saving in developing alone.

Pros and Cons. We tested the *Photoblaster* quite extensively with two rolls of film. Another 12-exposure roll was difficult to locate, so we had to settle for a 24-exposure roll (or 96 separate pictures)—we were shooting everything in sight! We ran the camera through its paces and came across a few flaws which prevented us from giving the product a "picture-perfect" review.

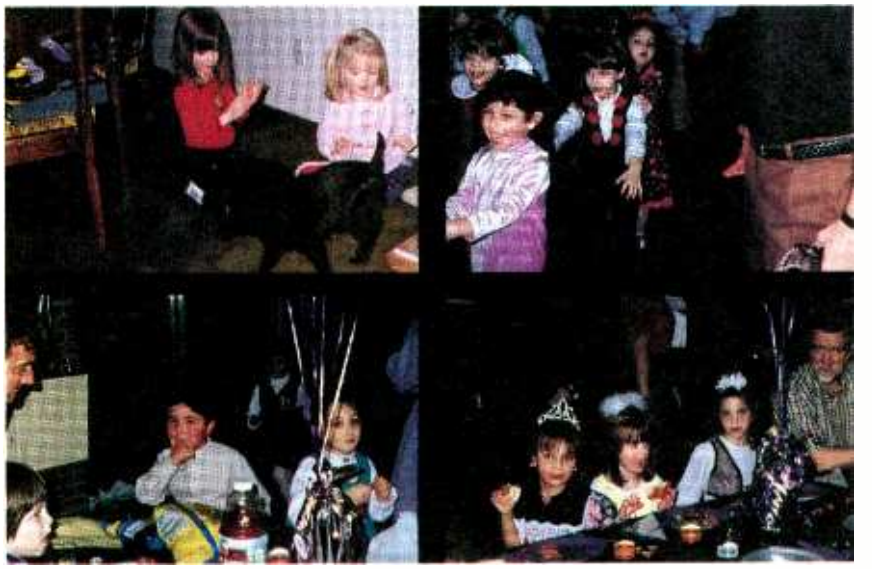
Loading the batteries is quite easy, even for a child; however, the closure on the bottom of the camera kept opening. Our child-tester placed the camera down a few times and was discouraged to find the batteries on the floor. Also, on impact, the batteries could fall out.

The frame counter is imprecise. To begin shooting, you must take pictures until the frame counter reaches #1. This is very hard to judge because of the unclear reading of exposures in the frame counter. You may end up taking pictures too soon or wasting the beginning shots. The counter is indexed from 1 to 144 (the last frame in a 36-exposure roll), with index marks every 8 exposures. You are never **exactly** sure what exposure you are up to—not that it really matters as the camera is completely double-exposure proof—just turn the bright purple knurled knob a short distance to advance the frame.

One feature which definitely has its pros and cons is the lens cover mechanism, which turns off the camera flash after one minute if you do not take a picture. This feature is great because we all know how easily kids waste batteries. If they leave the lens open and walk away, the camera shuts off and the batteries are saved. However, if the child is contemplating that perfect shot and it takes longer than a minute, the flash won't go off. As we were walking around inside the school, we didn't realize the lens cover had been open for over a minute. We saw a photo opportunity, aimed the camera, and depressed the "Big Red Button"—nothing happened—the flash didn't work—we unwittingly timed out! This was very discouraging; we missed a few good shots and had to repeatedly ask the question, "Did the flash go off?" The lens door must be closed and opened again to turn the flash on and reactivate the flash sensor. By the way, the flash range is from 4 feet to about 10 feet from your subject.

After taking our 12 exposures (48 pictures) and manually rewinding the film, we took the film over to the local one-hour supermarket-type photo lab. We explained to the technician what type of camera it was (even though our *PhotoBlaster* claims to need no special developing). He examined the film and said there should be no problem. Subsequently, the negatives came out fine, but some of the positive prints were cut off at the ends. The technician explained to us that his print-developing machine "reads" the wide black bands between frames to determine the end of one standard 4- × 6-inch picture. However the *PhotoBlaster* process also produces a thinner black band between the four individual pictures in this standard frame. Depending upon the setting of the print-developing machine, it didn't know where one picture ended and the next began; hence some of the prints were partially printed full 2- × 3-inch size. We then took these negatives to our neighborhood photo store and explained to them the situation. They said it would be no problem to produce prints from

(Continued on page 40)



Typical presentation of four mini-sized pictures developed in a standard 4- × 6-inch frame.

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NET WATCH

Online Updates and Free Stuff

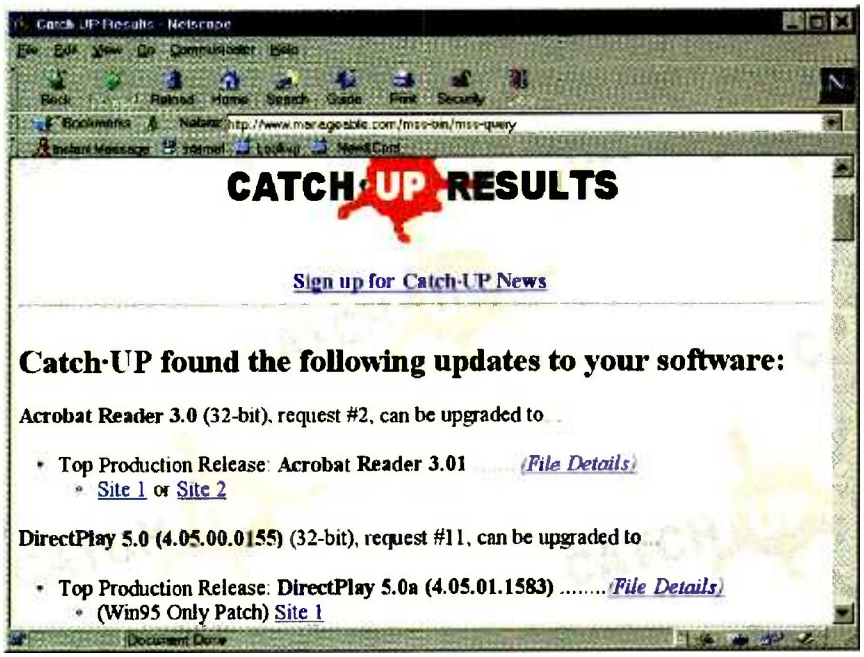
KONSTANTINOS KARAGIANNIS

One of the most wonderful things that the Internet has done for the typical computer user is save him or her time and money. Time, because it's faster to download than wait for a FedEx or USPS truck, and money, because a lot of what you download doesn't cost anything.

And, fellow computer user, just what are you downloading out there in cyberspace? "What aren't you downloading?" might be a more appropriate question. If it's an application that can be run on a PC of any type, chances are a version of it is sitting on an FTP server on the Net just waiting to be summoned.

Some of you might already have megabytes or gigabytes of programs stored on your system, but want to get the latest versions of each. Many software companies provide free upgrades, patches, and add-ons that are definitely worth the download time. But how do you find all these goodies and sometimes necessities? Enter our two very useful, yet very different sites of choice for this month's column.

For the most part, the sites we're going to look at are free. Neither of them cost anything to access and use, and one of them provides you with absolutely free downloads. So fire up your browser and make room on your hard drive—it's time to get some freebies!



Catch UP makes it easy to stay current with the versions of the software that you have on your system. Choose your upgrade options and the software will find any upgrades, patches, and plug-ins you need.

CATCH·UP

Our first site is more of a virtual application than a static page. Catch UP, from Manageable Software Services, is a free service that makes it possible for you to keep current with the latest versions of whatever software is on your machine, without the hassle of searching through countless Web sites.

To get set up, all you need to do is download the free Catch UP utility. It's a 780k or so file that should not take long to stream down over a 28.8-kbps connection. Copy the .EXE file to a new directory and run it. The application will automatically install and perform a scan of your hard drive. Once this is done, the software will know every updateable program that's currently on your computer. These results are given to you in HTML format on your computer's Web browser. You can then check boxes next to the ones you want information about.

Once you've decided which software you actually care to upgrade, select from one or more of these four options—Find newer production releases; Find the most recent releases; Find the most recent 32-bit production releases of the 16-bit applications; and Find the most recent 32-bit releases of the 16-bit applications. Then click the update button and watch the results appear.

Each appropriate program result will have information on what versions are available, what kind of license the upgrade has (freeware, shareware, *etc.*), and a direct link to the upgrade. Not bad for a free service, huh? In fact, from what I've found so far, all of Catch UP's competition comes from companies that charge for update information. This makes this site and service a great choice for anyone.

What kind of software can you keep up with through the service? The list of every title is too long to print here, but here are some of the categories. Popular programs of these types are supported—Business, Career, Computing & Programming, Desktop, Drivers, Education, Fun & Games, Home & Personal, Internet & Telecom, Multimedia, Patches & Fixes, Utilities, and more.

I particularly liked the fact that Catch UP takes a look at basic Windows files like those with a .dll extension. When these dynamic link libraries are outdated, certain new programs won't run well or at all. Having the latest is

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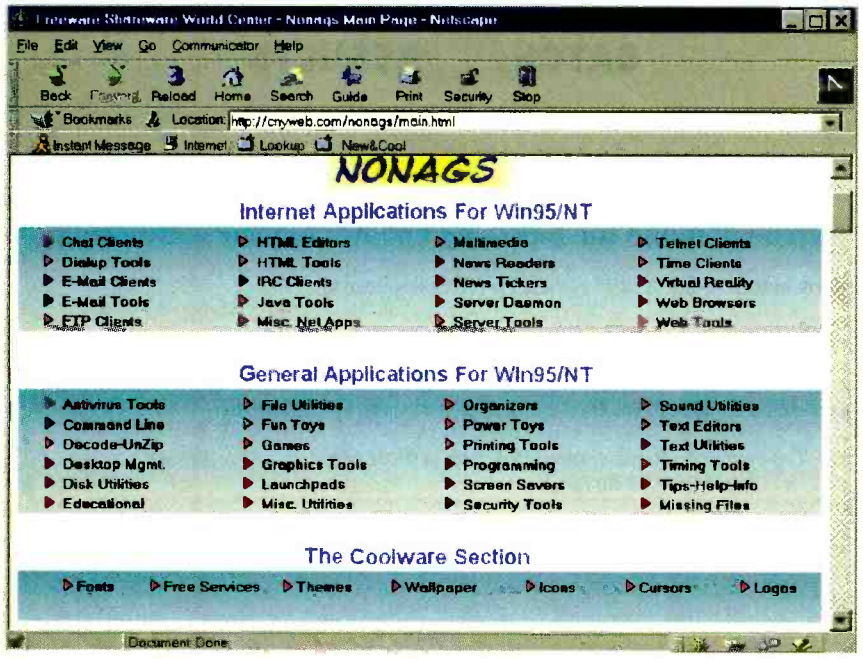
always a good idea and Catch UP makes that possible. Because it's so fast and foolproof, Catch UP is a service that you will find yourself using quite regularly. As a result, even that old PC on your desk will be able to better keep up with the quickly changing world of software. Whether it can actually run the latest software is another story, of course.

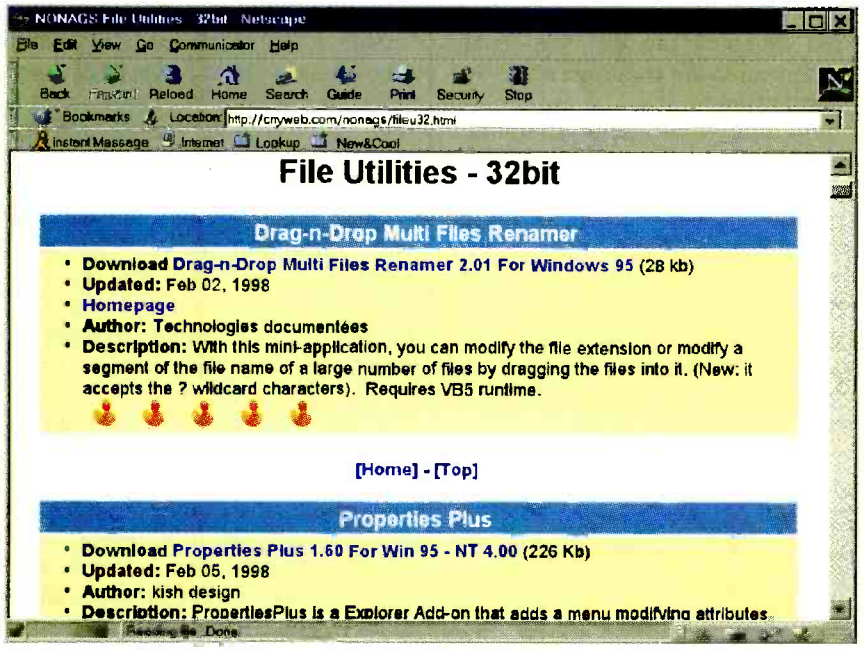
Finally, before moving onto our next site of interest, I should point out that if you read this column you're definitely in need of the type of service provided by Catch UP. After all, what program has more plug-ins, patches, and upgrades than a Web browser?

NONAGS

Here's a site that I've been using for years now, but only recently decided to pop into a column. Part of the reason for my delay is that the site has taken some time to really reach its prime. When I first logged on about three years ago, there weren't too many freebies available at Nonags. Now, the site has turned into one of the best spots to visit if you want to get something for nothing in the digital world.



As you can see, Nonags has an impressive collection of software types to choose from. Best of all, they're absolutely free.



Each program linked to the Nonags site has lots of useful information, including a brief review and the size of the download.

What exactly is Nonags? It's a freeware site. That means that after you download a program linked here and install it, you won't find the program shutting down in 30 days or constantly nagging you with reminders to pay some registration fee. Hence, the site's name.

Just picture it; you're sitting at your computer thinking that there must be a better way to keep track of files on your system, or perhaps you're fretting over a possible virus infection your system might have. Instead of heading out to the software store, you load up your browser, type in the Nonags URL, and you're on your way to getting what you want.

When you first log on to the site, you're greeted by a list of international sites. Choose from a server that's closest to you (several U.S. states are listed for those of us here), and you're in. Nonags designed its mirror sites this way to no doubt speed up access, as the farther away a server is from a user the more Net traffic could affect performance.

On the main page for your closest server, you're presented with a huge list of categories to choose from. If you're the type who just likes to know what's new, scroll to the bottom of the page for all the recent updates. The categories are broken into three main groupings. The first, Internet Applications For Win95/NT, will contain programs useful to anyone who visits the site. There are Chat Clients, Dialup Tools, E-Mail Clients, E-Mail Tools, FTP Clients, HTML Editors, HTML Tools, IRC Clients, Java Tools, News Readers, News Tickers, and Web Browsers, just to name a few.

For an eclectic collection of computer applications, check out the General Applications For Win95/NT, which contains Antivirus Tools, Decode-UnZip, Desktop Management, Disk Utilities, File Utilities, Games, Organizers, Printing Tools, Screen Savers, Security Tools, Sound Utilities, and several other useful aids. Finally, there's the Coolware Section, which satisfies every computer user's need to have

(Continued on page 62)

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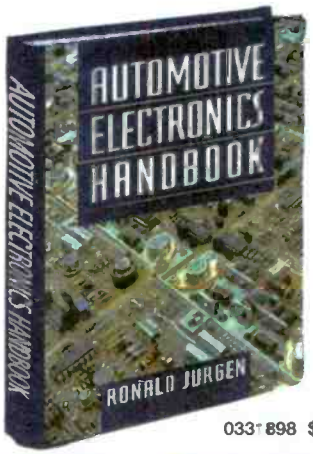

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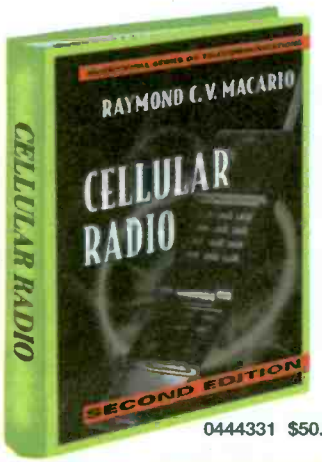

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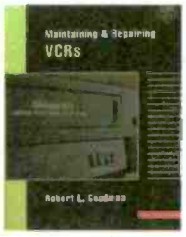

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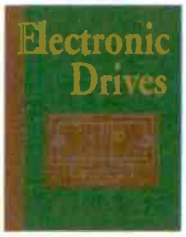

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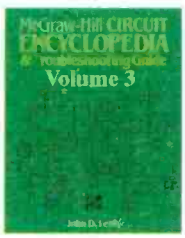

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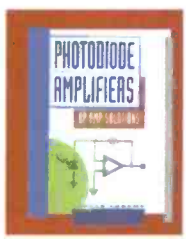

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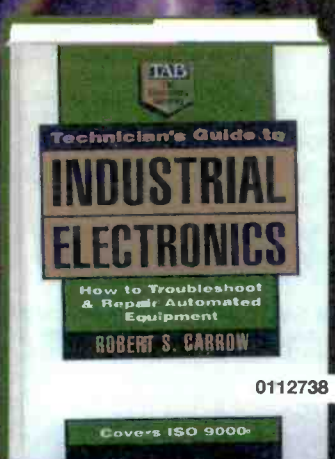

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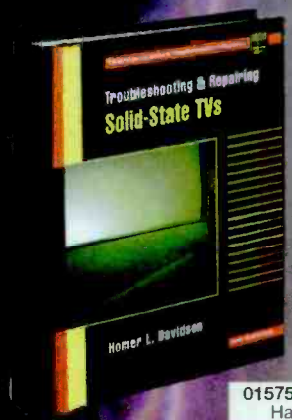

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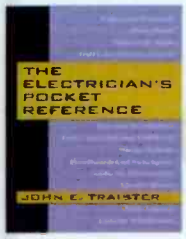

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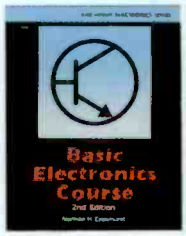

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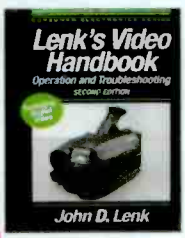

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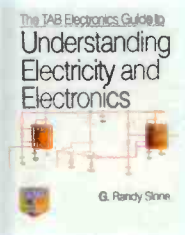

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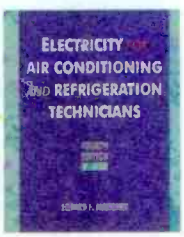

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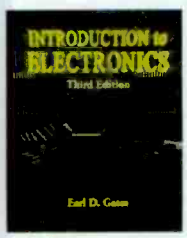

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Think Tank

More Goodies!

ALEX BIE

In last month's column we discussed one of the fundamental structures within semiconductor technology, namely the PN junction. In this issue we explore one of the first practical semiconductor devices using the properties of the PN junction—namely the point-contact diode. The PN junction is widely used both with integrated circuits and also as a discrete device for more conventional circuits.

WHAT IS A POINT-CONTACT DIODE?

The point-contact diode is the earliest form of a semiconductor device. It was very simple and was constructed around a crystal of a substance such as galena, zincite, or carborundum—all of which are semiconductor material. In its original form with a "cat's whisker," the diode was used as a cheap and effective method of detecting radio waves. A thin wire, or cat's whisker, preferably made of gold to avoid oxidation, was made to touch the crystal, as shown in Fig. 1. Other forms of detectors developed later, including more expensive germanium diodes and eventually costly detector tubes. As a result of this, the point-contact cat's whisker was used for many broadcast wireless receivers up through World War I.

The cat's whisker detector set or crystal set was not nearly as reliable as we expect modern semiconductors to be. The "whisker" had to be manually positioned on the crystal, locked in place, and then after a few hour's use the efficiency would fall and a new position would need to be found. Despite its shortcomings, the whisker and crystal was the first semiconductor to be used in radio or electronics. In those early days of wireless, people had no idea of how it operated, it worked comparatively well, and its price was within the reach of most wireless enthusiasts.

("What is A...?" series reprinted by permission from *Practical Wireless*, Arrowsmith Court, Station Approach, Broadstone, Dorset BH18 8PW, England.)

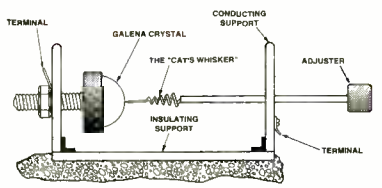

Fig. 1. A cat's whisker diode using galena crystal (lead sulfide, the most common form of lead ore).

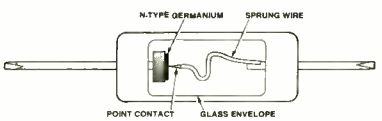

Fig. 2. A point-contact diode.

Germanium Diodes

Today's point-contact diodes are far more reliable. They are manufactured from a piece of N-type germanium on which a thin tungsten or gold wire (taking the place of the whisker) is placed as shown in Fig. 2. Where the wire touches the germanium, some migration of the metal occurs into the semiconductor. This acts as an impurity and forms a small P-type area, and it creates the PN junction.

The PN junction is very small, and this means that it cannot withstand large values of current. A few milliamps is usually the maximum. Another feature about the point-contact diode is that the reverse current is higher than that of a good silicon diode. Values of around five to ten microamps are typical. Also, the reverse voltage that the diode can withstand is not as high as many other silicon types. The value is usually measured as the peak inverse voltage (PIV), *i.e.* the peak value of reverse voltage that the diode can withstand. For one of these point-contact diodes, values of around 70 volts are typical.

Properties

Although the point-contact diode, or germanium diode, is elementary in many respects, it does have a number of advantages. The first is that it is easy to manufacture. Diffusion or epitaxial growth processes are needed to make a more conventional PN junction, and these processes are not required in the point-contact diode. It is simple enough for the manufacturer to cut up pieces of N-type germanium, mount them, and place a wire to them at the optimum rectification point. It is for this reason that these diodes were widely used in the early days of semiconductor technology.

Another advantage lies in the point-contact diode's simplicity. As the junction is very small, it has a very small value of capacitance. Although standard silicon diodes like the popular 1N914 and 1N916 have values of only a few picofarads, those of the point-contact diodes are even lower, making them ideal for radio-frequency applications.

Finally, the fact that the diode is made from germanium means that it has a low forward-voltage drop, making it ideal for use as a detector. This means a much lower voltage is needed for the device to conduct. The normal voltage is only 0.2 volts compared with 0.6 volts for a silicon diode.

A Crystal Set and Other Applications for the Diode

Anyone wanting to build a crystal set should use a germanium diode as the detector. I have tried silicon diodes before now and found they just do not work! Although it is easy to "roll your own" radio crystal set, the individual components might be difficult to find nowadays. It is easier to buy the set and then do your own experimenting. One source for crystal sets and parts is Antique Electronic Supply, P.O. Box 27468, Tempe, AZ 85285, Tel. 800-706-6789 or 602-820-5411, Fax: 602-820-4643, with a Web site: *www.tubesandmore.com.*

A more likely use for these diodes within hobbyists' circles is for RF probes using a simple circuit like that shown in Fig. 3. Here the low forward-voltage drop means that the circuit will detect much lower signal levels. While it

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is possible to determine the actual probe voltage by adding 0.2 volts to the DC voltage read on the meter in many cases the meter will almost give a direct reading.

The germanium type of point-contact diodes are not as common as they used to be. They are relatively old technology, but for the radio hobbyist they still perform well and can be used in a variety of detecting roles where a low capacitance and a low voltage drop are essential.

Next month, we will continue our "What is a ...?" series with the Schottky Diode. Right now let's look at all sorts of circuit goodies that you sent in.

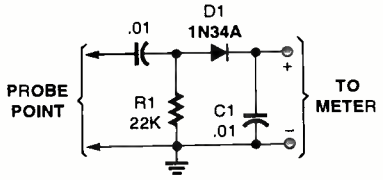

Fig. 3. A circuit for an RF probe using a point-contact diode.

REMOTE TELEPHONE ALARM

Did you ever miss an important telephone call because you were in your basement or garage and didn't hear the telephone ring? Or perhaps you heard it ring, but you heard it too late and, although you rushed as fast as you could, you couldn't get to the phone in time. Even if the call is not important, missing it by a few seconds can be annoying to say the least. The remote telephone alarm circuit shown in Fig. 4 will solve your problem.

The phone line ring signal fires through the two NE-2 neon bulbs. A metal-oxide varistor, MOV1, protects the circuit against possible high-transient voltage spikes on the input line. Just about any good MOV can be used (*e.g.*, RadioShack 276-568). Capacitor C1 blocks the DC-line voltage, but couples the AC-ring signal to the full-wave bridge rectifier through limiting resistor R1. The bridge is rated at 200 volts, 1A, which can be a RadioShack 276-1161 module or built around 1N270 diodes. The pulsating DC from this bridge rectifier is then coupled to capacitors C2 and C3. These capacitors isolate the circuit from the phone line. While R2 is the load resistor for the bridge and D1 is a diode clamp, capacitor C2 couples negative-going pulses to trigger the 555 IC, which acts as a monostable one-shot. This in turn sounds a buzzer or Sonalert audible signal device. The Sonalert can be replaced by a solid-state relay if some other alarm or indicator, such as a light in your workshop is to be used.

—Craig Kendrick Sellen, Waymart, PA

*Well done, Craig. From what I know of these Sonalerts, the audible sound pressure produced of 95 dB would be loud enough to hear throughout the house. Of course, if you still missed the call you can always dial *69 and ring back the caller (for a fee, of course!).*

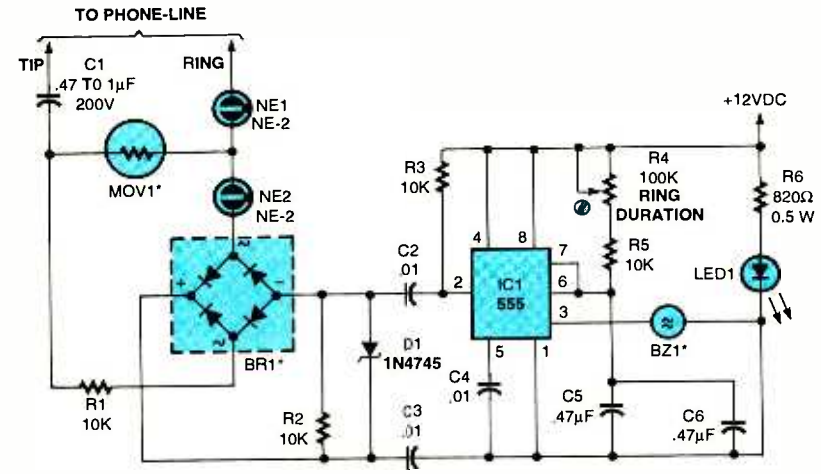

Fig. 4. When the telephone rings, this circuit will alert you with a resounding audible tone.

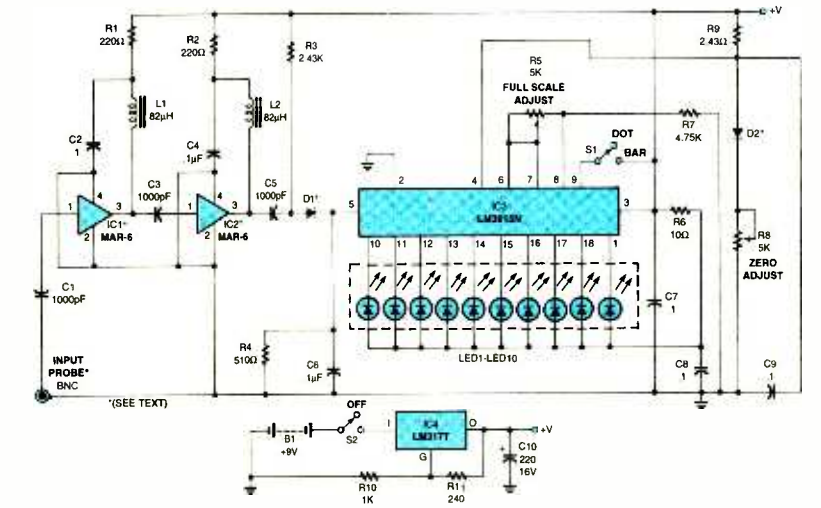

Fig. 5. Here's a neat little circuit to identify sources of "bugs" (and we don't mean the 8-legged types).

BUG DETECTOR

This "bug" detector, or RF detector, can locate small bugs that are as low in power as 1 mW at 20 feet. The closer you are to the bug, the more LEDs will light. The front end of the detector has a two-stage wideband RF amplifier with a hot-carrier (Schottky) diode for a detector. The detected signal is filtered and fed to the LM3915N IC bargraph driver, which has a logarithmic display output. Each LED lit represents a 3-dB step in received signal.

In constructing this circuit I found that any good "rubber-duckie" antenna can be used as the probe. The more wideband the antenna is, the better it will serve its purpose for this circuit. The MAR-6 ICs are wideband monolithic amplifiers that are manufactured by MiniCircuits in Brooklyn, NY (call 800-654-7949 for a local distributor, or the amplifiers can be conveniently obtained from DC Electronics, Tel. 800-467-7736). The amplifier covers a frequency range from DC to 2000 MHz. The only other critical circuit components are the RF diodes, which can be any good wideband Schottky detector diode (such as the Hewlett Packard 5082-2800). An

(Continued on page 28)

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ICES = HOT STUFF !

Last month, we looked at some of the exciting new technologies that were introduced and displayed at the 1998 International Consumer Electronics Show (ICES), held this January in Las Vegas. Most of them, however, foreshadow the future of consumer-electronics—that is to say, they won't be broadly available for some time to come.

This month, we'll give you a glimpse of some exciting new products that represent the here and now. Each year, a panel of 15 industry experts bestows awards on the most innovative products in a number of categories ranging from accessories to high-end audio, from mobile electronics to home integration systems. The winners of the Design & Engineering Honors Program are displayed in a special exhibit at ICES. Here's a small sampling of the 1998 winners; we hope to bring you in-depth reviews of many of them in upcoming issues.

INNOVATIONS WISH LIST

CIDCO iPhone

Phone Home-Page

The *iPhone* from *CIDCO Inc.* (220 Cochrane Circle, Morgan Hill, CA 95037; Tel: 408-779-1162; Web: *www.cidco.com*) provides out-of-the-box, plug-and-play access to the Internet, Web, and e-mail using a standard telephone connection. Combining the familiar convenience of a telephone with the power of the Internet, the device allows users to enjoy full graphical display of Web photographs and artwork in addition to text. (Although the screen images are not color, the 16-shade gray-scale graphics are comparable to a newspaper-quality black-and-white image.) No previous computer or Internet experience is required to use the iPhone. Users can be connected to a Web site by simply pressing an icon on the 7.4-inch screen and typing in a Web address on the pull-out keyboard. Phone calls can be placed by touching an on-screen phone number; the number will be dialed automatically. A built-in directory makes it easy to keep track of phone numbers and street and e-mail addresses. The phone itself features a speakerphone, Caller ID capability, and support for advanced telephone services such as three-way conferencing. Price: $499.

Interlink VersaPoint Wireless Keyboard

Wireless Computing

Billed as a "total wireless input station," the *VersaPoint* wireless keyboard from *Interlink Electronics, Inc.* (546 Flynn Road, Camarillo, CA 93012; Tel: 805-484-8855; Web: *www.interlinkelec.com*) combines an ergonomic 81-key PC keyboard with a semiconductive touchpad. Almost omni-directional infrared communications technology allows the keyboard to be held at just about any angle, and the integrated pointing device works with the touch of either a fingertip or a stylus. The wireless keyboard is designed for Internet browsing, cordless desktop computing, and interactive presentations. Sleep-mode firmware extends the estimated life of the requisite 4 AAA batteries up to one full year. Because the *VersaPoint* is compatible with Windows 95, no additional driver software is required. Price: $159.95.

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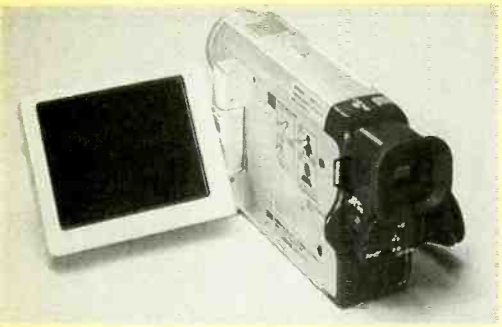

Sharp Digital Touch-Screen SlimCam

Touch-Screen Digital Camcorder

Sharp Electronics Corporation's (Sharp Plaza, Mahwah, NJ 07430-2135; Tel: 1-800-GO-SHARP; Web: *www.sharp-usa.com*) *VL-PD1U* is the first digital SlimCam to feature touchscreen control. Basic camcorder functions, including play/record, zoom, focus, and lighting changes, can be made by touching the 4-inch color LCD, which opens out when in use and can be stored flat when the color optical viewfinder is being used. For instance, if two people are in the image and you want to zoom in on one, press that person's image and the camera will zoom in on that person automatically. The VL-PD1U produces 500 lines of horizontal resolution and CD-quality sound. The digital SlimCam measures just over 2-$^1/_4$-inch thick and weighs less than 1-$^1/_2$ pounds. Price: $2999.95.

RCA Network Computer

Network Computerized TV

The *RCA Network Computer* from *Thomson Consumer Electronics* (10330 North Meridian Street, Indianapolis, IN 46290-1024; Tel: 317-587-3000; Web: *www.rcaelectronics.com*) adds Internet, e-mail, and other services to any television. The device allows the user to set up a personal Internet/television programming guide that automatically provides customized information and entertainment for up to seven family members. Once the guide is set up, specific information, from local weather to favorite sports or stocks, is available with one click of a button. Price: $199.

Desktop ViaTV Videophone

Desktop Videophone

The *Desktop ViaTV Videophone* from *8x8, Inc.* (2445 Mission College Blvd., Santa Clara, CA 95054; Tel: 800-VIEW8X8; Web: *www.8x8.com*) uses standard telephone lines to deliver full-color video and audio. The Desktop unit features a built-in, full-color, active-matrix LCD, a digital video camera, a high-performance analog modem, and a video communication processor. It can be used with 8x8's Modular speakerphone for hands-free operation, or can be connected to any touch-tone phone. Because it uses standard phone lines, it requires no additional or special wiring, and no additional local or long-distance fees. Video is displayed at up to 20 frames per second. Both resolution and frame rate can be adjusted by the user. The Desktop Videophone's electronic pan/tilt/zoom feature allows you to center the field of view on the object of interest, and the snapshot feature lets you take or send a still-frame image. Price: $649.

Voice It Digital Voice Recorder with PC Link

Digital Recorder with PC Link

Allowing business travelers to communicate clearly and quickly with the home office—or just to record and store personal memos and reminders—the *VR 1000 Digital Voice Recorder with PC Link* from *Voice It Worldwide, Inc.* (2643 Midpoint Drive, Suite A, Fort Collins, CO 80525; Tel: 800-47-VOICE; Web: *www.voiceit.com*) allows users to download voice messages to a PC through a serial cable connection. PC Link software simplifies the data transfer. Once the voice recordings have been downloaded, they can be transcribed, organized, archived, and even sent on the Internet. The Digital Voice Recorder can store up to 50 minutes of audio on internal semiconductor memory; optional reusable memory cards each add another 50 minutes of recording time. Recordings can be organized into separate "folders" for easy retrieval. Digital recording allows you to use different playback speeds and to insert and delete portions within a recording. Flash memory ensures that recordings won't be lost when the batteries run down. Price: $219.

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Magnavox WebTV Plus

WebTV Plus PIP

The *Magnavox WebTV Plus Receiver* from *Philips Electronics* (64 Perimeter Center East, Atlanta, GA 30346-6401; Tel: 770-821-2400; Web: *www.philips magnavox.com*) allows you to retrieve your e-mail and watch your favorite TV fare at the same time, even if your TV doesn't offer picture-in-picture. You can remain connected to the Web while watching TV and instantly access Web site links embedded in television programs and commercials, thanks to the unit's unique WebPIP and WebTV Crossover Links features. WebTV Plus comes with an Electronic Program Guide, updated daily from the Web, that allows you to receive text and video information about all the programs available on your particular TV system. The included Web Eye remote infrared receiver and LED display, a small saucer-like receiver that sits atop your TV, allows the larger WebTV box to be placed out of sight. VideoFlash provides full-screen, full-motion video, and customized graphics acceleration. An optional universal remote wireless keyboard can be used to control home-theater equipment as well as the WebTV Plus, and a built-in printer port lets you print e-mail messages and Web site information. Price: $199.95.

Cobra FRS-200 Two-Way Radio

Family Communicator

The *FRS-200* hand-held two-way communicator from *Cobra Electronics Corporation* (6500 West Cortland Street, Chicago, IL 60707; Tel: 773-889-8870; Web: *www.cobraelec.com*) allows family members and friends to communicate over short distances. It is part of the rapidly growing Family Radio Service (FRS), which operates in the ultra-high-frequency range (462.5–467.7 MHz) that was recently approved for public use by the FCC. The FRS-200 offers clear, almost interference-free, wireless communications at distances up to two miles, without activation or monthly usage fees. Hikers, bikers, hunters, skiers, fishermen, and other outdoor enthusiasts can use the radios to stay in touch, and families can split up at malls or amusement parks without worrying about getting lost. Price: $159.95.

Philips CARiN Vehicle Navigation System

Are We There Yet?

Philips' (64 Perimeter Center East, Atlanta, GA 30346-6401; Tel: 770-821-2400; Web: *www.carin.com*) *CARiN Navigation System* uses Global Positioning System (GPS) satellites to help track a vehicle's position, while dead-reckoning and other software plot the best routes to a destination. The system, which includes the navigation computer, integrated CD-ROM drive, color LCD, infrared remote control, and a GPS antenna array, provides both visual and verbal directions. The computer, which features an eight-channel GPS receiver, a CD-ROM drive, and an integrated gyroscope, can be mounted under a seat, in the trunk, or under the rear deck. The price of the CARiN system includes a regional CD-ROM map and installation. Price: $2399.

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Magellan GPS 2000 XL Portable Navigator

Personal Navigation System

You could take a different approach to navigation with the *GPS Map'N'Track* from *Magellan Systems Corporation* (960 Overland Court, San Dimas, CA 91773; Tel: 909-394-5000; Web: *www.magellangps.com*). The personal navigation system consists of the GPS 2000 XL portable navigator, a cable for linking to a laptop, and three CD-ROM software mapping programs. GPS Link 3.0 links the GPS 2000 XL with Map'N'Track's land-mapping software, for use as a trip planner, an in-vehicle navigation system, and a trip recorder. The program allows you to locate any city, county, state, zip code, area code and prefix, street, address, crossroads, landmark, and latitude/longitude coordinate in the United States. With a laptop connected, you can view your current position and all surrounding streets on a moving map display, which also shows your speed, bearing, direction, and distance to go. Map 'N Track's DataTrack data management program allows you to use your computer to save, edit, and create more locations and routes. Precision Mapping Streets 3.0's 100 drawing and editing tools let you create custom, professional-quality maps. Price: $249.99.

Sanyo MCX-400 In-Dash Four-Disc Changer

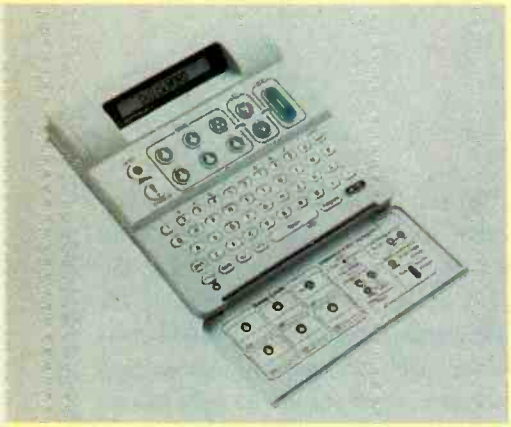
Four for the Road

The first single-DIN receiver/CD changer with a four-disc capacity is the model *MCX-400* from *Sanyo Mobile Audio* (21605 Plummer Street, Chatsworth, CA 91311; Tel: 818-998-7322). It features a detachable front control panel that folds down to reveal the built-in four-CD changer cassette. CD features include a 20-second anti-skip memory, 8× oversampling, 18-bit linear twin D-to-A converters, and an anti-vibration suspension mechanism. The MCX-400 offers 30-watts by four channels of amplification, along with BassXpander to boost the low frequencies. The tuner offers 30 station presets—six AM, 12 FM, and 12 Auto Travel. Price: $599.95.

Whistler Heavy-Duty Jump-Start System

Mobile Power Station

The *Model PP4700 Heavy-Duty Jump-Start System* from *Whistler Corporation* (16 Elizabeth Drive, Chelmsford, MA 01824; Tel: 508-244-1400) has the power needed to jump start any car, truck, or boat that has a 12-volt battery system—or to power a laptop computer, cellular phone, or any small appliance with a 12-volt adapter. The unit can be charged and stored in the trunk until it's needed. The system's 600-amp boost rate provides reliable power and jump-starting in adverse conditions. Color-coded booster cables and clamps store conveniently on the side of the unit. Price: $139.95.



Motorola QuickWord Message Sender

Family Message Sender

For families who rely on pagers to keep track of each other, *Motorola Paging Products Group* (1500 Gateway Blvd., Boynton Beach, FL 33426-8292; Web: *www.motorola.com/pagers*) offers *QuickWord*, a word-entry device that brings accuracy, privacy, and ease-of-use to word-message paging. When connected to any analog telephone line, QuickWord allows you to send text messages to alphanumeric pagers without operator assistance. Quick-access buttons provide simple three-step operation. First, select the person to whom you want to send the message; then select a pre-programmed message or type a message of up to 80 characters on the unit's QWERTY-style keyboard; then press the SEND button. QuickNames buttons store the names and pager information for up to ten people. Group page buttons store two groups of up to five people each, allowing you to let the entire family know that dinner has been moved up from 6:00 to 7:00, for instance. QuickNotes buttons allow four commonly used messages to be stored and then sent to any pager with one button press. QuickWord is easy enough that a latchkey child, arriving home from school, can press one button to let Mom know he got home safely. Designed for desktop or kitchen countertop use, the device is about the size of a desktop calculator. Its large, color-coded buttons have graphical icons that children can understand. Price: $79.99.

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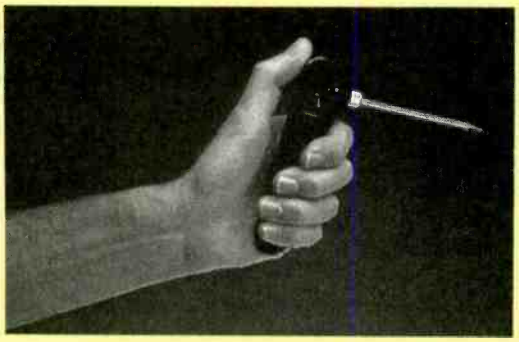

American Recorder Technologies CO_2 Dust and Particle Remover

Keep it Clean!

The *CO^2 Dust and Particle Remover* from *American Recorder Technologies* (P.O. Box 3539, Simi Valley, CA 93093; Tel: 805-527-9580) is the world's smallest high-velocity duster. It uses pure, safe carbon dioxide gas to remove dust and particles from all audio/video, computer, electronic, photographic, and office equipment. Unlike chemical dusters, carbon dioxide will not break down lubricants, inks, or plastics used in the manufacturing of such devices, and it does not contain CFCs, HCFCs, or any other harmful chemicals. The device's special dispenser, which fits in the palm of a hand, delivers a blast up to 800 pounds per square inch—six times more powerful than regular aerosol dispensers—through a precision-molded control valve and nozzle. The dispenser holds a replaceable, recyclable 12-gram steel cartridge of CO_2. Price: $20; additional cartridges: $4 for three, $7 for six, $12 for twelve.

On-Hold Plus Model OHP 3000

Hold, Please!

Even the smallest business can play digital music and messages for customers who have been placed on hold, with the *OHP 3000* from *On-Hold Plus* (5820 Oberlin Drive, Suite 203, San Diego, CA 92121-3744; Tel: 800-727-4642; Web: *www.onholdplus.com*). The device is intended to help home-based and other small companies create an illusion of being larger. Its flash-memory chip comes pre-loaded with six minutes of royalty-free music and messages. You can use any external tape or CD player to record your own music and messages. The OHP 3000 is compatible with virtually any music on-hold-ready PBX system. It includes a music/message CD with 12 additional royalty-free music tracks in four formats, each featuring six minutes of music combined with a variety of "thank you for calling" messages; audio cables; and free CustomWorks CD-ROM software that allows you to create your own custom on-hold messages. Price: $199.95.

Harmon Kardon Festival 60

"Intelligent" Audio System

Harmon Kardon (250 Crossways Park Drive, Woodbury, NY 11797; Tel: 516-496-3400; Web: *www.harmonkardon.com*) bills its *Festival 60* minisystem as an "intelligent" system that provides a single unified control center with computer style and multifunction "soft keys." Its unique operating system displays all functions and operations on a central display on an "as-needed" basis. Thus, when the CD player is being used, the display shows only CD-related information. Similarly, the unit's buttons take on different functions depending upon the source selected, serving as disc-selection controls in CD mode or station presets in tuner mode. The controls for the source in use are also illuminated. An ergonomic remote works in concert with the display and interface to simplify system operation. Festival 60 is a full-featured audio system comprised of three modules. All of the operating controls are centralized in the top module, which also houses the AM/FM/FM-stereo tuner with RDS data displays. The middle unit is a seven-disc CD changer, and the bottom unit contains the 2×35 watt amplifier (8 ohms, 20Hz 20 kHz, <0.09% THD, both channels driven). The system's two-way loudspeakers each incorporate a one-inch flare dome high-frequency transducer and a six-inch low-frequency transducer. Active equalization circuits are used to provide a frequency response of 50 Hz to 20 kHz. Price: $1399.

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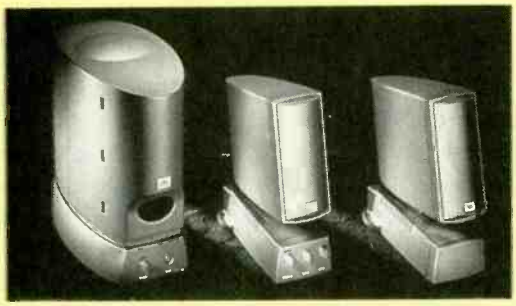


JBL Media 2000 Multimedia Loudspeaker System

Multimedia Speakers

Why shouldn't your PC sound as good as your audio system? No reason, according to *JBL Consumer Products* (250 Crossways Park Drive, Woodbury, NY 11797; Tel: 516-496-3400; Web: *www.jbl.com*), whose *Media 2000* series of multimedia loudspeakers includes the Media 2000 satellites, the Media Sub 2000 subwoofer, and the Media System 2000 three-piece set (pictured). The satellites use a proprietary elliptical three-inch driver with a 3 dB frequency response of 100 Hz to 15 kHz. The 30-watt amplifier integrates a pulse-width modulated power supply that can accept input voltages to 230 volts AC. Three-position tilt stands allow you to properly position the speakers for maximum stereo imaging and soundstage. The subwoofer uses a 35-watt amplifier and a four-inch driver mounted in an exclusive band-pass enclosure to deliver deep bass down to 50 Hz. Both satellites and subwoofer are magnetically shielded and offer auto on/off. Combined in the Media System 2000, they'll bring your PC games to life. Prices: Media 2000 Satellites, $139.95/pair; Media Sub2000, $139.95; Media System 2000, $229.95.

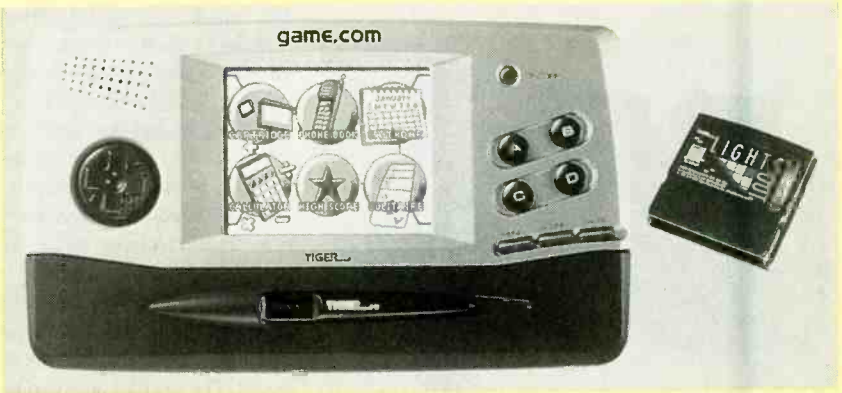
Proton NT-3860 36-inch Monitor/Receiver

36-inch Stereo Monitor/Receiver

With component-video input, the *NT-3860* 36-inch monitor/receiver from *Proton Corporation* (13855 Struikman Road, Cerritos, CA 90703-1031; Tel: 462-404-2222; Web: *www.proton-usa.com*) assures the best possible picture from high-end DVD players equipped with component-video output. The set incorporates Proton's proprietary Custom Installation Programmable Microprocessor (CIPM), which allows the system installer to directly access the unit's microprocessor for custom programming of operating functions. The NT-3860 delivers 650 lines of horizontal resolution, and the images displayed on its flat high-contrast picture tube are enhanced by 95% DC restoration and Proton's Dynamic Black Level Extension circuitry. Two color temperature settings allow you to tailor the video image from standard television broadcast (6500 Kelvin) to a theater setting (9300 Kelvin). For accurate audio reproduction, the set features dual bi-amplified, five-watt-per-channel, full-range speakers and an 18-watt subwoofer powered by a dedicated amplifier. Price: $2800.

GAMES + COMMUNICATIONS = game.com

game.com PORTABLE VIDEO GAMING SYSTEM. From Tiger Electronics, Inc., 980 Woodlands Parkway, Vernon Hills, IL 60061; Tel: 847-913-8100; Web: *www.tigertoys.com/www.game.com*. Price: game.com: $69.95; additional titles: $19.95-$29.95. Internet Cartridge: $19.95: Modem: $49.95



Handheld videogames are hard to resist. You can take them anywhere and never be bored on a plane or bus ride or while waiting for an appointment. And some of the games are just plain addictive.

On the other hand, the portable units are hard to justify. Aren't they just one more form of mindless entertainment? Couldn't we find better ways to occupy our free time? After all, a paperback book is just as transportable as a game player.

Tiger Electronics' game.com is a portable 8-bit gaming system that provides more than just game-playing. The stand-alone unit also performs some very basic Personal Information Manager (PIM) functions. Add the optional Internet Cartridge and game.com modem (and a subscription to a text-based Internet service provider), and you can use the game.com to check your e-mail, send e-mail, and access text-based Internet sites. How's that for justification?

The game.com player measures approximately 7 × 4-½ × ⅜ inches; its black-and-white, touch-sensitive LCD screen is 2-$^1/_2$× 2-$^1/_8$ inches. To the right of the screen are the ON/OFF button, four game-play buttons (A, B, C, and D), and

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Wheel of Fortune features the TV game show's familiar music and props—but no Vanna White or Pat Sajak.

three turquoise buttons (menu, sound, and pause). The speaker and a directional pad are found to the left of the screen. A stylus is housed in a groove just below the screen. Volume and contrast control dials are located along the left side of the unit; the right side houses two slots for game cartridges. A headphone jack is found on the front of the unit, and the serial (COM) port is on the back. Battery compartments are located on the bottom of the game.com. The four required "AA" batteries are not included, but our sample unit did come with the backup battery installed.

When you turn on the unit, after a short animated bit and the spoken pronouncement "game.com active," the main screen shows six dancing icons labeled cartridge, phone book, calendar, calculator, high score, and solitaire. You can move around the screen in a couple of ways. The stylus (or your fingertip) can be used to touch the on-screen icons. Or you can use the directional pad to position the cursor and the A button to select the highlighted item.

We (like most folks, we'd imagine) went directly to the built-in *Solitaire* game. It's not quite the standard game, but close. For one thing, you're playing against a clock. After the allotted four minutes expire, you can keep playing and adding points to your score, but you're no longer eligible for bonus points. Second, the deck deals out cards one at a time, instead of in stacks of three, so you have access to every card. Each game begins with a score of −52. For each card that you move up, you receive five points. The "bonus" gives you one point for every second left on the timer.

Game play is easy. Instead of clicking and dragging cards, you touch the card you want to move, and then touch the place you want it to go. To get to a card at the bottom of a stack, however, you must first touch each of the cards covering it. That can be a bit time-consuming, especially when you're trying to beat the clock. We also found it a little disconcerting to play in black and white, and had to keep reminding ourselves which suits were red and which were black. All four appear black, and the tiny diamonds, clubs, spades, and hearts are difficult to differentiate on such a small screen. But that didn't stop us from playing and playing, and generally neglecting responsibilities.

When we were finally ready to wrap up our Solitaire session, we went back to the main screen (by touching exit) and then checked out the high scores (by touching the high scores icon). The highest score from each of as many as 10 games can be displayed.

Next, we turned off the unit so that we could insert the *Lights Out* cartridge. We powered the game.com back up, pressed the cartridge icon, and were hooked by the time we'd solved the first game (in more moves than we're willing to admit). Lights Out presents players with a 36-square grid. Some of the squares are lighted, others are dark. Press any square and it—and any square directly touching it (top, bottom, left, and right)—does just the opposite of what it was doing before you pressed. An unlit square surrounded by four lighted squares, for instance, becomes a lighted square surrounded by four dark ones. The object of the game is to turn out all the lights in the number of moves specified. In precomputed (precomp) mode, the first few puzzles can be solved in just three steps; they become increasingly complex as play continues. There are 168 precomp puzzles. In random mode, there's no telling how complicated the next puzzle will be.

Need more of a challenge? There are two other *Lights Out* games to try. In Lit Only, you can only press the squares that are lighted. For the ultimate challenge, there's Toggle, in which you must alternate between pressing lighted and dark squares. Random mode can be selected for Lit Only and Toggle, and, according to the manual, there are 60 billion puzzles to solve in random mode.

We can't confirm that figure, although after a couple of hours of play, we felt as if we had! This is a truly challenging game that puts your spatial logic to the test—and can drive you crazy. After a while, you begin to recognize patterns and steps that make it a little easier. But as soon as you think you've got it licked, the games get harder again. If (by some unlikely chance) you begin to feel bored, you can always change the effects pattern so that the square you push and those that touch its corners (forming an "X") are affected by each touch!

Feeling a little guilty at the amount of time we'd spent playing *Solitaire* and *Lights Out*, we decided to check out the game.com's more practical functions. That didn't take long. The calendar is strictly rudimentary—just a picture of a one-month calendar. On the neat side, however, it will display any month from January 1901 through December 2099, allowing you to check out what day of the week you were born on, or if your 30th birthday might fall on a Saturday. (I realized, for the first time, that my birthday and my son's fall on the same day every year).

The calculator function displays a picture of a standard calculator, with basic arithmetic, percentage, square root, and memory functions. The stylus makes it fairly easy to use; fingertips weren't small enough to be accurate and using them resulted in a lot of mistakes.

The phone book function is a bit more

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sophisticated than the other two. It has a QWERTY-style keypad on the bottom of the screen, and room to display up to five names (listed alphabetically) on the top portion. Below and to the side of the keypad are "keys" labeled new, prev, next, and edit. New is used to add a record; edit to change existing ones. Previous and next are used to scroll up and down the list of entries. Each record provides space for a name, phone number, address, and an additional line for an e-mail address or notes. Once again, the stylus made it reasonably easy to input data with minimal mistypes.

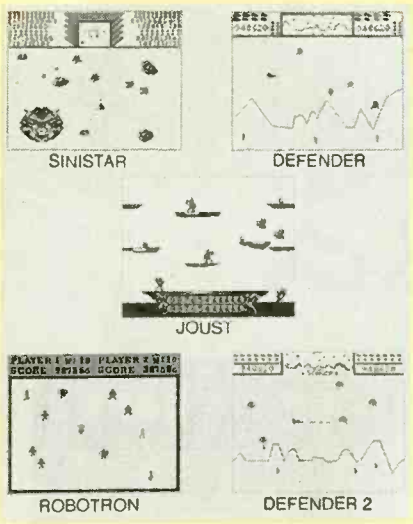
The game.com is not an executive's tool. There's no room for a person's title, company name, fax number, and all that other essential contact data. It does provide space for dozens of entries, however—enough to list your favorite URLs along with your friends' phone numbers (and their pagers, fax lines, or e-mail addresses, too).

You'll want to keep track of those Internet and e-mail addresses if you opt to purchase Tiger's *Internet Cartridge* and modem. Together, they allow you to access text-based Internet sites. Graphical web sites cannot be accessed.

A subscription to a text-based Internet Service Provider (ISP) is required as well. Tiger recommends Delphi Internet Services, Inc., with which it has made special arrangements, including a 10-hour free trial period. (All ten hours must be used within one calendar month, however.) Using Delphi isn't mandatory, as long as you make sure that the ISP you choose supports text-based services.

It's also not necessary to use the Tiger modem. Any 9600-baud modem will work without reconfiguration; if you use a slower modem, you must let the game.com system know by entering that information on screen. The manual warns that, although different modems "should" work, "the procedure will be slightly different" and refers you to the instructions that came with your own modem.

Tiger's modem is a standard external modem with a maximum throughput of 14.4 kbps. It's not limited to serving as a game.com accessory; with its included cable and AC adapter, it can be used with any PC. To use it with the game.com, you must insert the Internet Cartridge into the game.com, connect the cable included with the cartridge—a proprietary cable that connects the non-standard game.com port to the 25-pin D connector on the modem—to the game.com and modem,



Williams' Arcade Classics presents five different games.

connect the telephone line to the modem, and plug the modem into an AC outlet.

Once the hardware is connected, a press of the cartridge icon on the game.com main menu will access the Internet Terminal. It offers four choices—Connect to Delphi, Connect to Other Service, Join Delphi, and Modem Setup—each of which can be accessed by touch. By selecting Join Delphi (and providing a credit-card number), game.com owners can take advantage of a free trial of the service. After that initial period ends, you can either join one of Delphi's monthly service plans, or select another ISP.

It sounds easier than it is, especially if you're a newbie (a 'Net neophyte). For first-time users, navigating the Internet on a PC can be intimidating and confusing. With the game.com Internet Cartridge, you have the additional handicaps of trying to read extremely tiny type on a small screen and having to input information by "typing" with an on-screen keyboard using a stylus (fingertip typing is not accurate enough here).

Simply joining Delphi, selecting a local ISP, choosing a user name and password, and getting connected is no easy task, because everything (name, address, charge-card number, etc.) must be painstakingly typed in on that small, hard-to-use keyboard. When all the pertinent data has been input, a screen of log-in directions appears. Those instructions neglect to inform you that your game.com might not actually say "connected" when the connection is complete. Nor does it tell you that you have only a few seconds to input @D before you're automatically disconnected, or that sometimes @D appears on screen, sometimes it doesn't.

If you experience difficulties, make sure to call the help number provided on-screen; the one in the manual gets you Quaker Foods. Our call to Delphi was answered by a pleasant woman who provided the details omitted from the on-screen directions.

Finally (more than a half hour after we'd begun trying), we found ourselves at Delphi's main menu. We tried to use the on-screen up and down arrows to move through the options, only to discover that the arrows don't work here. To do anything at all, we had to pull up the dreaded keyboard and start typing again. Moreover, it appeared that we had to input the menu options exactly. To select Arts & Entertainment, for instance, we typed "Arts," then closed the QWERTY keyboard and opening the symbols keyboard to type in an ampersand (&), then returned to the keyboard to enter "Entertainment." When we were presented with a sub-menu that included such choices as Television, Pop Culture, and Music, we found ourselves selecting Music simply because it had the least amount of letters!

Then we showed the game.com to someone who was on the Internet before AOL became an ISP and who had used text-based Internet services in the past. He immediately typed in "A" and return to access Arts & Entertainment—and it worked. (Too bad there were no instructions for inexperienced users.) But even he, a champion of computer minimalism, complained loudly about the keyboard that would have to be relaunched for each entry—and even louder about the tiny, hard-to-read screen.

Obviously, this is not the most sophisticated, efficient, or streamlined approach to surfing the 'Net. Such a small screen, displaying excruciatingly tiny type, is not comfortable to use for extended periods. (Our eyes were shot before we'd completed the connection process!) But if your family doesn't yet have a PC or WebTV-type device, and your kids are complaining that they're missing out on all the after-school e-mail gossip sessions, the game.com Internet connection can put them back in the loop. Of course, so could a set-top device like WebTV—which also provides access to web graphics. We wouldn't recommend buying the game.com solely for its Internet access ability.

But let's get real here: No matter how innovative or interesting you find the concept of an Internet Cartridge, the main rea-

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The game.com Tiger WebLink lets you connect your game.com to Tiger's web site to compare your scores to those of other players and to pick up useful game-playing hints.

son for buying a game.com, or any portable gaming system, is the software. Tiger has done its work in lining up some powerful licensing agreements. Titles currently on the shelves or expected to be available by the time you read this include *The Lost World: Jurassic Park; Mortal Combat Trilogy; Williams' Arcade Classics: Defender, Defender II, Joust, Robotron, and SiniStar; Quiz Whiz; Jeopardy; Batman & Robin; Madden Football '98; Duke Nukem;* and *Wheel of Fortune.*

We sampled three: *Wheel of Fortune, Batman & Robin, and Williams' Arcade Classics. Wheel of Fortune* features the familiar stage props and theme music from the popular TV game show. It allows you to compete against the game.com, or to play with two other people. You even get to pick out the character you'd like to be (from a cast of about a half dozen ordinary looking people). Assuming that there isn't a person in America who doesn't know the rules of the game, we won't describe them here. Suffice it to say that there are three rounds, followed by a bonus round for the high scorer. There is only one level of difficulty: Easy. We lost very few rounds and no games to the game.com opponent, who tended to pick a lot of Qs and Zs, and would occasionally solve an almost blank puzzle even though "he" had no money (go figure). It did seem as though "Lose a Turn" and "Bankrupt" occurred more often than usual (but it probably seems that way to actual contestants, too).

As well as we did on the first three rounds, that's how poorly we fared on the bonus rounds. It's not that we didn't know the answers, at least some of the time. We just couldn't beat the 15-second clock, which begins ticking as soon as R,S,T,N,L, and E are plugged in—*before* you pick the supplemental three consonants and a vowel.

Next, we sampled the sampler: *Williams' Arcade Classics.* Joust, in particular, brought back fond memories of the old Atari 2600 days. We have to admit, however, that game.com Joust barely resembled the game we remember, which was played using a joystick with full-screen, color action. It's much more difficult when you have trouble distinguishing the good guy from the bad guys on a tiny black-and-white screen with no backlight. The manual suggests: "Look out for Bounder, Hunter, and the Shadow Lord," but they all looked like shadows to us.

The game.com's display is slightly larger than that of the Game Boy, and the resolution is comparable, if not better. Perhaps we're just not used to small-screen game play, or maybe we lack the sharp eyes (and high testosterone levels) of the teenaged boys at which these games are targeted. Whatever the cause, we couldn't tell the robots from the humans in Robotron or the warriors from the worker drones in SiniStar. In Defender and Defender II, bombs were flying at us so quickly from every which way, that we usually were blown up before we had a chance to see who was firing.

With Joust and any other two-player game on this cartridge, it is possible to link one game.com unit with another for head-to-head Jousting, using the optional compete.com cable link from Tiger. (You'll also need two game cartridges and, of course, two game.coms.)

Next, we tried out *Batman & Robin,* and attempted to defend Gotham City from the evil clutches of Mr. Freeze and Poison Ivy. The graphics in this game are impressive: complex city streetscapes scroll by as our hero (you can opt to be either Batman or Robin) strides or jumps, confronting an ongoing stream of villains and thugs. Batman (or Robin) has a cache of weapons, although only two are at his disposal at any given time. Once again, we had trouble distinguishing between enemies, but it didn't seem to matter quite as much—everyone we encountered was a bad guy, and none seemed to have any special powers. Still, we're glad the fate of a real-life major metropolis does not rest in our less-than-agile hands!

Gotham City fared much better when entrusted to an eight-year-old neighbor who volunteered to test out the game.com. Peter jumped right in (without consulting a manual) and quickly racked up scores that put ours to shame. He also left us in the dust in all the *Arcade Classic* games! (We managed to salvage our pride in *Wheel of Fortune.*) According to Peter, the screen was easier to see than the one on his GameBoy, and the touch-sensitive screen definitely upped the game.com's wow factor.

Another interesting game.com option, for users who do have a computer with Internet access, is the *Tiger WebLink,* which costs $19.95. With it, you can visit Tiger's web site, where you can upload your high scores from your game.com and compete for a spot in the "Top 25" lists of top scorers from around the world (there's a list for each game.com game). You can view your ranking compared to other players, and can download secret codes to unlock bonus features and hidden characters in some of the games. You cannot, however, reach the Tiger web site via the text-only game.com Internet cartridge.

If you're in the market for a handheld gaming system, this one has a lot going for it—namely, some high-quality software, the touch-sensitive LCD, and the added PIM functions. In terms of Internet access, however, you'd do better with one of the TV- or telephone-based products that are cropping up all over the place these days.

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THINK TANK

(continued from page 18)

alternate source for the diodes is the 1N4148 (equivalent NTE519).

—Alex Belenky, Brooklyn, NY

Interesting circuit, Alex. I can just see Agent 007 walking around a room with one of these probes! Try to build this circuit using surface-mount components for real undercover work.

VACUUM-TUBE AUDIO AMPLIFIER

How can you tell if you like the sound of an amplifier using vacuum tubes—build this single-stage amplifier employing a pair of 60FX5 vacuum tubes, as shown in Fig. 6. This amplifier design prevents hum and unwanted feedback and can deliver about 2-watts output to a speaker (16, 8, or 4-ohms impedance). The amplifier operates on a 120-volt AC power supply that supplies the required tube voltages and the DC filament supply. The power supply uses two low-voltage transformers connected back-to-back. The full-wave bridge rectifier, BR1, provides 120 VDC for the filaments and 92 VDC for plates and screens.

PARTS LIST FOR VACUUM-TUBE AUDIO AMPLIFIER CIRCUIT (FIG. 6)

BR1—Full-wave bridge rectifier, 4-amp, 400-PIV (RadioShack 2767-1173)
C1, C2—100-μF, 250-WVDC, electrolytic capacitor
PL1—3-conductor power cord and plug
R1—25-ohm, 2-watt, potentiometer
R2, R3—47-ohm, 1/2-watt, 5% resistor
R4—220-ohm, 1-watt, 5% resistor
R5—300-ohm, 5-watt, 10% resistor
T1—Tube interstage transformer, 1:3 turns ratio, 10,000 to 90,000-ohms, 10-mA (Antique Electronic Supply P-T157, or equivalent)
T2—Tube-type audio output transformer, 8000-ohms CT to 16, 8, or 4-ohms, 10-watts output, 50-15,000 Hz response (Antique Electronic Supply P-T1608, or equivalent)
T3, T4—Power transformer, 117 volt to 12.6 volt, 3A (RadioShack *273-1511*, or equivalent)
V1, V2—60FX5 power pentode vacuum tube (available from Antique Electronic Supply)
Additional parts and materials: 2-× 1-foot laminated board, 9- × 11-inch pine board, knob for potentiometer, two 7-pin miniature tube sockets, Fahnestock clips, alligator clips, insulated wire, *etc.*

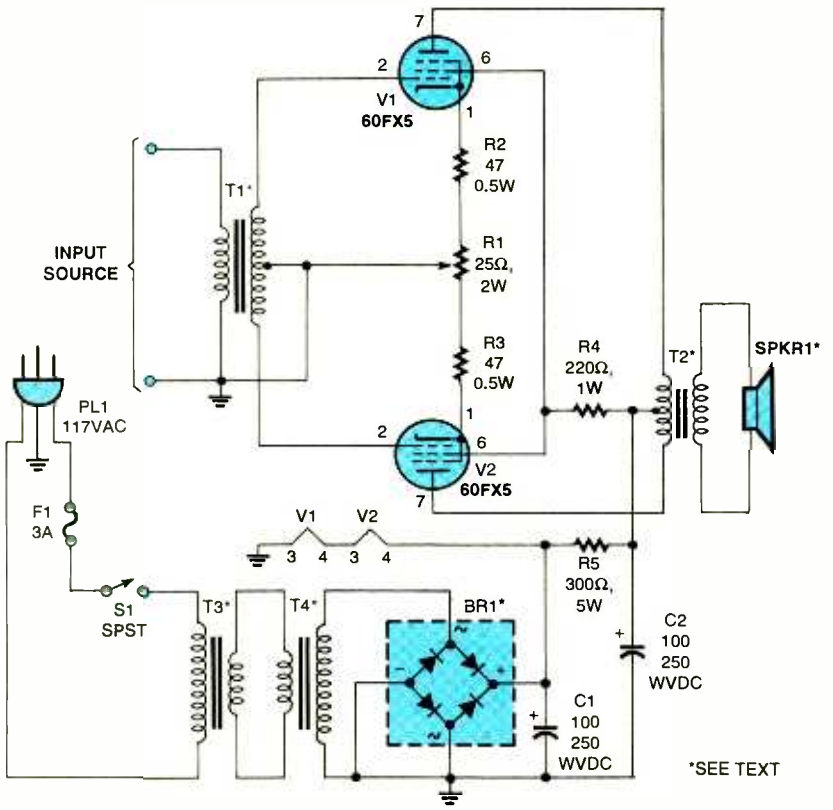

Fig. 6. Build this audio amplifier and power supply to hear the difference tubes make in a sound system.

I've built this amplifier on a 2- × 1-foot laminated board. This size was selected so I can have plenty of room to experiment with the components. I started by mounting R1 with its corner bracket off the board. Next I connected the tube sockets. Then I installed R2, R3, R4, T1, T2, and the wires from the tubes. For most connections I used Fahnestock clips. The hum-balance knob is installed next, then the tubes. The power supply for DC was built on a 9- × 11-inch pine board. Many of the critical parts can be obtained from Antique Electronic Supply. The assembly is straightforward. Remember when you power up the circuit **be careful of the voltages present—they can be lethal.**

For check out, take alligator clips (two per color) and 10–15 feet of wire the same color as the clips. Begin with the power supply unplugged. Hook one wire to ground and another to the filament clip. Temporarily connect the plate/screen lead clip from the amplifier to the filament clip on the power supply. Temporarily hook the plate/screen to the filament's clip. Hook up a speaker and short the input source connection. Plug in the power supply to the AC line and wait a minute or so for the tubes to come on. Then adjust R1 until minimum hum is heard—fix this setting of the potentiometer. Unplug the power and hook up all connections as in the circuit (ground to ground, plate/screen to plate/screen, filament to filament, *etc.*). Plug it in the supply and observe that there should be no output and very little hum. Now unplug the supply and remove the short across the input. Connect an input audio source from a battery-powered radio or tape player, and adjust the volume on this source for an audio comfort level—enjoy the music.

—Marc Collette, St. Malo, Manitoba, Canada

Fine job, Marc. Over the years there have been many arguments among true audiophiles regarding the sound quality of the present solid-state amplifiers versus the tube-type designs.

We started out with crystal sets and ended up on a vacuum-tube design. Somehow I think the pendulum of electronics has made a full swing! Anyway remember this is **your** column—keep those circuits and ideas coming in. Write me—Alex Bie, *Think Tank*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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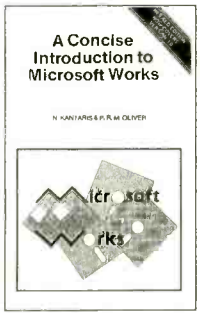

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Build the *Promotional Pin*

If you've got a product or service that you want to get noticed, get the word out with an eye-catching lighted lapel pin, while practicing surface-mount construction techniques.

JON J. VARTERESIAN

When it comes to getting out the message, nothing does it like a lighted sign. Now with a little electronic finesse, you can promote your latest product, service, or your company with the *Promotional Pin* described in this article. The Promotional Pin is a guaranteed eye catcher, sure to be noticed by friends, family, or prospective customers. You can customize the front with your own artwork or photograph. Then all you have to do to draw attention to your product or service is press a switch, and let the light show begin! Once activated, the pin will blink for about 10 minutes, then go into a power-saving mode. Another press of the button starts the light show over again.

The Promotional Pin is powered from a 400-milliamp-hour (mAh) lithium coin cell. When the Promotional Pin is powered from the specified unit, the pin should operate for approximately 43 hours. The extended battery life is due to the unique firmware, which shuts the circuit down after a pre-determined period.

The Circuit. A schematic diagram of the Promotional Pin is shown in Fig.1. The circuit is comprised of a Microchip Technologies PIC16LC54A microcontroller (IC1), eight light-emitting diodes (LED1–LED8), a switch (S1), a battery (B1), and a sprinkling of resistors and capacitors.

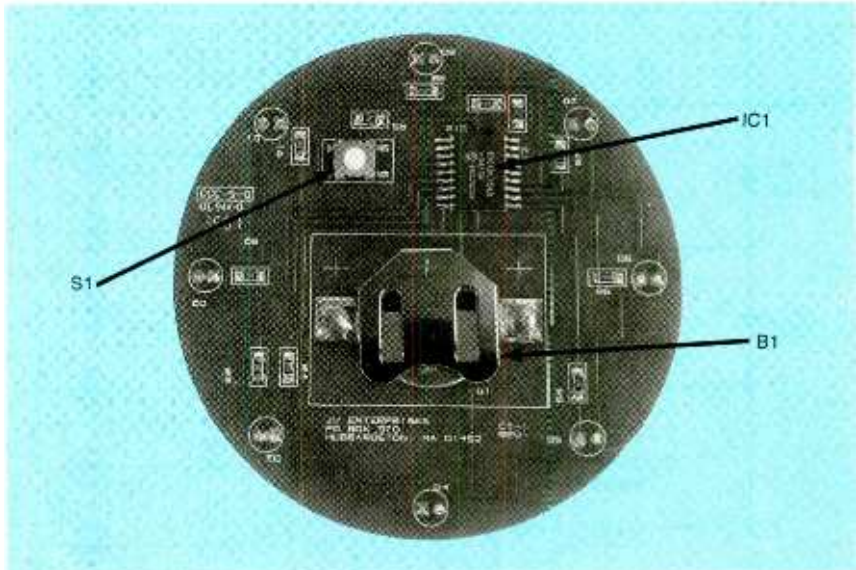
Pressing switch S1, which is connected to IC1's master clear (MCLR) input at pin 4, causes the voltage on pin 4 of IC1 to fall from 3.0 to 0.0 volts. That low-going voltage wakes up IC1, causing the blinking sequence to begin. The LEDs are then sequenced on and off in a random order for approximately 10 minutes. At the end of that period, IC1 goes back to sleep to conserve battery life. To begin the process all over again, simply press the start switch. The blinking sequence can be halted at any time by pressing S1 again.

Power for the circuit is supplied by a standard 3.0-volt coin-cell battery (B1). Resistor R10 and capacitor C1 are used to generate an RC clock input for IC1. The operating frequency is a nominal 256 kHz. The RC operating mode of IC1 is inherently not very precise and can vary by as much as 20%. Resistors R1 through R8 are used to limit the current through the LEDs to 25 mA.

The Firmware. The firmware for the Promotional Pin is very simple. Once the PIC is reset, it randomly selects an LED, blinks it over a two-second period, waits 0.15 seconds, and then chooses another. After 10 minutes, IC1 goes into a power-conserving mode. Pressing S1 causes the sequence to start again.

Note: The LEDs do not just turn on for 1 second, and then turn off, but are instead rapidly cycled on and off. That technique is usually referred to as pulse-width modulation, or PWM. As long as current to the LEDs is pulsed at a rate greater than 60 Hz, the human eye can not detect the pulsing, so the LEDs will appear as if they're continuously on.

Pulse-width modulating the LED current has the added benefit of conserving power. For example, if current were applied to an LED for 1 millisecond, and then removed for 15 milliseconds, and the cycle repeated endlessly, the LED would only consume $^1/_{16}$th of the power that would be used if the LED were kept on all of the time. That's a substantial power savings. At that rate, the human eye won't be able to detect the pulsing; however, the LED will seem dimmer than if it were continuously lit. If power to the LEDs was pulsed on for 6 milliseconds and off for 10 milliseconds, the LEDs would consume only $^6/_{16}$th of the power—



Assembling the Promotional Pin requires a needle-tipped soldering iron, a steady hand, and good eyesight, as the components and component pads on the board are very small, and too much heat can damage both.

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causing the LED to "burn" brighter than it would at $^1/_{16}$th PWM, but dimmer than at full on.

Each LED starts off at a power of $^1/_{16}$th, progresses linearly to $^{15}/_{16}$th (the on glow), and then falls back to $^1/_{16}$th (the off glow) for a total number of 29 power steps. The PIC waits at each power step for two PWM periods before proceeding to the next power step. The whole sequence of 29 power steps takes approximately 0.8 seconds. At the end of each LED cycle, the PIC waits approximately 0.15 seconds before selecting the next LED.

If the LEDs were turned fully on for 0.8 seconds and then turned fully off for 0.15 seconds, the battery would last for about 20 hours. With the PWM technique described herein, battery life is extended to over 43 hours!

Construction. The Promotional Pin was assembled on a small printed-circuit board, measuring about 3 by 3 inches. A full-size template of that printed-circuit layout is shown in Fig. 2 for those who prefer to etch their own board. For those who would rather not etch their own board, a complete kit of parts (with programmed PIC), as well as completed and tested units, is available from the supplier listed in the Parts List.

Once you've rounded up all of the materials needed to assemble the Promotional Pin, construction can begin. A parts-placement diagram for the Promotional Pin's printed-circuit layout is shown in Fig. 3. Note: All of the components except for the LEDs are surface-mount units. So, if you've been waiting to get some experience in soldering surface-mount components, this project is simple enough to begin with. Also note that all of the parts are available from Digi-Key.

Begin by programming the PIC. The source and programming files are available on the Gernsback web site (*www.gernsback.com*) as file "PROMO.ZIP." Once programmed, solder the PIC to the circuit board. Note the location of pin 1 of IC1 when installing the microcontroller. Pin 1 of the microcontroller is identified by a dot on the package. Pin 1 on the circuit board is identified by a slightly longer pad. Once the microcontroller is in place, mount and solder S1 into place. Then solder 10k resistors at the positions labeled R9 and R10, followed by a 300-pF capacitor where C1 is indicated. After that, solder eight 36-ohm resistors at the positions labeled R1–R8, followed by the coin-cell battery holder at the B1 position. That completes the main circuit assembly except for the LEDs.

Now it is time to place your artwork or photo on the face of the pin. You can use any type of picture that you desire. A photo of the kids, a photo of your latest project, or even your company logo printed on regular paper. Since the printed-circuit board is 3 inches round, the photo or printout should be at least 3 inches round to completely cover the face of the pin. The picture or artwork is attached to the face of the pin with double-sided tape.

Remove one side of the double-sided tape and stick it to the front of the pin. Now remove the other side of the double-sided tape and stick your artwork to the front being careful to get it straight. The next step is to laminate the artwork. Laminating helps protect the artwork from dirt and water. The laminate is just a piece of thick, clear plastic with a sticky back. You can get laminating

Here is the Promotional Pin advertising the new PhotoBlaster Camera.

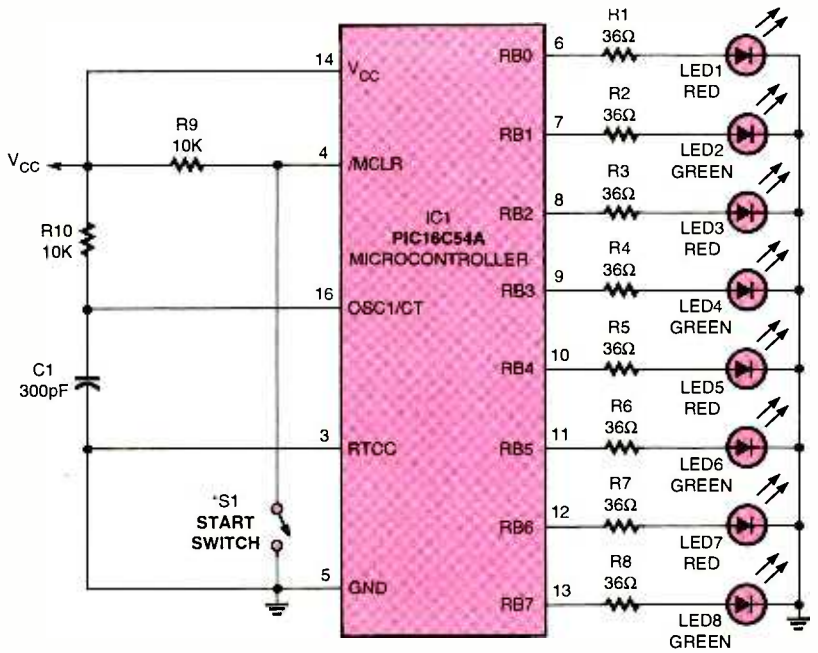

Fig. 1. The Promotional Pin is comprised of IC1 (a PIC16LC54A microcontroller), eight light-emitting diodes, a switch, a battery, and a sprinkling of resistors and capacitors.

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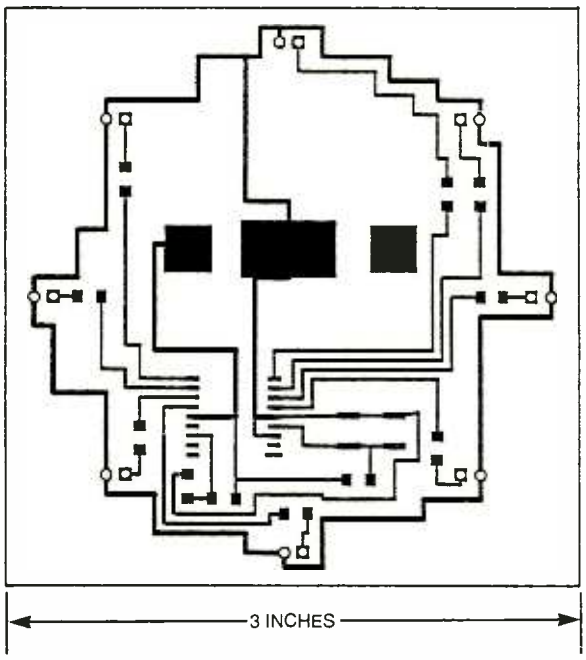

Fig. 2. Those who prefer to "roll their own" can use this full-size template of the Promotional Pin's printed-circuit layout to etch their own board.

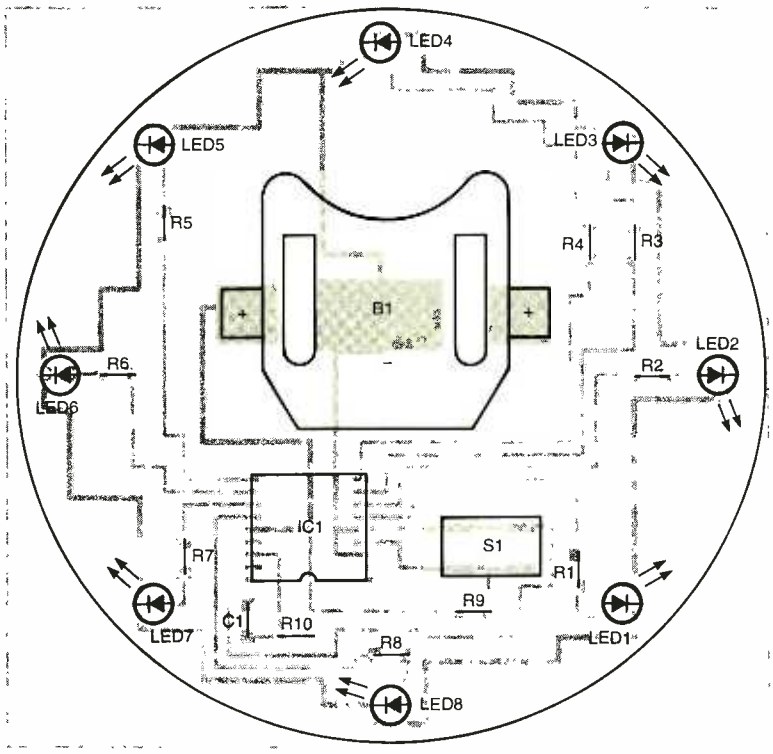

Fig. 3. Assemble the Promotional Pin's printed-circuit board guided by this parts-placement diagram. The circuit is constructed entirely of surface-mount components, with the exception of the LEDs.

material at any office supply store.

The laminate used in this project does not require a heat machine to apply it. You just peel the backing off the laminate and stick it on top of your artwork. Turn the pin over and, using an X-Acto knife, trim the artwork/laminate flush with the circuit board.

Using a common pin, poke all 16 holes for the LEDs. Mount the eight LEDs to the circuit board in the normal way (through the board) and bend the leads slightly to hold the LEDs in place. Note the location of the anode lead of each LED as it's being inserted. The anode must go to the square pad on the circuit board. When you are done, solder all 16 leads, and trim the excess lead as flush as possible to the circuit board. Use epoxy, or hot glue, and attach a foam back to the pin. The foam back will cover the circuitry while still leaving an access hole for the battery. Now use epoxy, or hot glue, and glue the safety pin to the foam back.

That's all there is to it. To operate the Promotional Pin, insert the battery (making sure to keep the positive side up) and press S1. If everything was done correctly, the LEDs should start to blink one at a time. In the unlikely event that the pin doesn't work, check your programming and soldering. ■

PARTS LIST FOR THE PROMOTIONAL PIN

B1—3.0-volt, 400-mAh, lithium coin-cell battery (Panasonic BR2025 P188 or similar)
C1—330-pF chip capacitor (Panasonic ECU-V1H331KBM P7CC331BCT)
IC1—PIC16LC54A or PIC16LC54A-04/SO microcontroller, surface-mount, integrated circuit (Microchip)
LED1–LED8—Red hi-bright, light-emitting diode (Panasonic LN28RAL P403 or similar)
R1–R8—36-ohm, 1/8-watt, 5% chip resistor (Panasonic ERJ-8GEY360 P36ECT)
R9, R10—10,000-ohm, 1/8-watt, 5% chip resistor (Panasonic ERJ-8GEYJ103 P10KECT)
S1—Pushbutton switch (Panasonic EVQ-QHQ03 P8005SCT)
Printed-circuit materials, 20mm coin-cell battery holder (Keystone 3002K), solder, *etc.*

Note: The following parts are available from JV Enterprises, P.O. Box 370 Hubbardston, MA 01452: A complete kit including professional circuit board with solder mask and silk-screen, programmed PIC with source code, all components, laminate material, double-sided tape, battery, solder, solder wick and accessories, and assembly manual for $19.95, plus $5 shipping and handling (unlimited technical support is available to kit purchasers); pre-programmed PIC with source code for $8, plus $3 shipping and handling. Check or money order only. Massachusetts residents, please add 5% sales tax.

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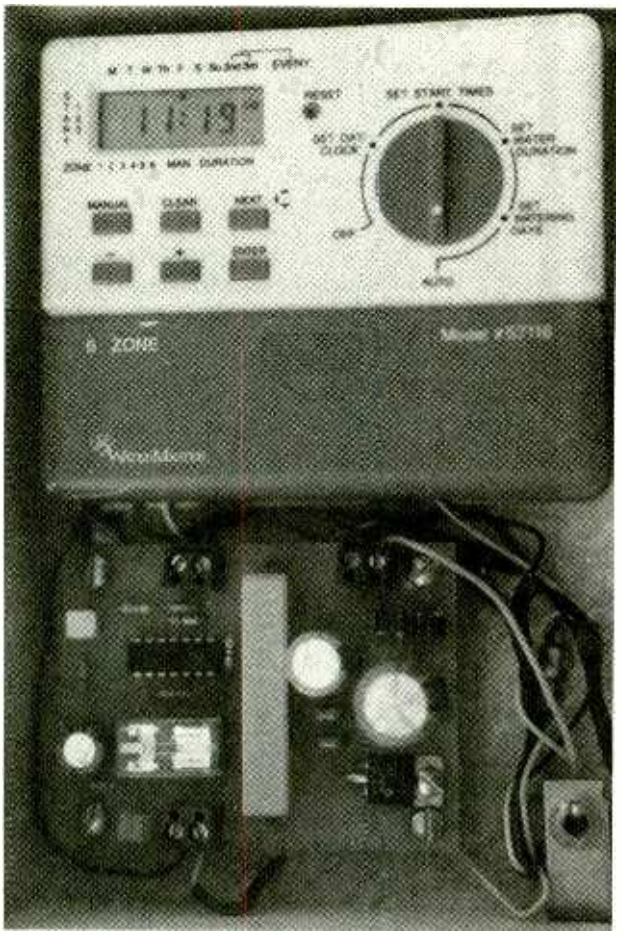

SPRINKLER GUARDIAN II, THE SEQUEL

Improve upon the operation of the original project with this updated version, which enhances the control circuitry and sensor monitoring.

WALTER W. SCHOPP

After building the "Sprinkler Guardian" described in the April 1995 issue of **Popular Electronics** and testing it for a year, it seemed as though electronics had won out over yet another menial household chore. But, as fate would have it, after a year of flawless operation, the unit started to become unreliable. It operated erratically for a time and then stopped sensing moisture all together. To my chagrin, I had joined the ranks of those whose sprinkler system waters the lawn during a rain storm.

The electronics were checked completely, but no problem was found. That's when I became obsessed with uncovering the cause of the problem. When the in-ground sensors were uncovered, it was discovered that electrolysis—the decay of a structure due to chemical reactions—had been overlooked in the original design as a possible source of trouble. Although using probes made of stainless steel and some exotic wires could cure the problem, it was decided that a new concept was called for. The first task was to design a sensor that needn't be buried in the ground to monitor the soil's moisture content. Additionally, it was decided that it would be better if the control circuit required no adjustments. With those requirements in mind, the *Sprinkler Guardian II* was born.

Using the in-ground sensing method to determine the soil's moisture content, as was used in the original design, required that some sort of timer be incorporated into the circuit to keep the sprinklers operating after the ground became damp. That problem is eliminated in the project's present incarnation by using a sensor designed to monitor the moisture content of the surrounding air, making the timer unnecessary.

About The Circuit. A schematic diagram of the Sprinkler Guardian is shown in Fig. 1. Power for the circuit is derived from the 24-volt AC source that powers the sprinkler-control unit. The *pirated* AC voltage is rectified by a full-wave bridge rectifier comprised of D1–D4. A 50-ohm, 10-watt resistor (R1) is connected in series with the output of the bridge rectifier. That resistor is used to drop the rectified DC output of the bridge to a level that can be handled by IC2 (a 7812 fixed 12-volt regulator). Capacitor C1 (a 220-μF unit) is included in the circuit to smooth the output DC, while C2 is used to bypass any voltage spikes to ground.

The DC voltage is then applied to IC2 (a 7812 fixed 12-volt regulator), which further reduces and maintains the supply voltage at 12 volts DC. The output of the regulator is then filtered by C3 and C4. At that point, the voltage divides along two paths. In one path, the voltage is fed through R2 (a 1k resistor) and used to light LED1, signifying that power has been applied to the circuit. In the other path, the voltage is used to operate Sprinkler Guardian II.

At the heart of the circuit is a 4001 CMOS quad 2-input NOR gate. Two NOR gates from that four-gate package, IC1-a and IC1-b, are configured as an astable multivibrator (oscillator). Pin 6 of IC1-b, is connected to a voltage divider, composed of R5 and the resistance of the sensor (sponge/screws), which connects to SO2. The oscillator, which operates at a frequency of about 450 Hz, is triggered when rain wets the sensor (which connects to SO2). The sensor, in this case, is little more than a small sponge with two electrodes buried in it. The wet sensor grounds pin 6 of IC1-b, causing the astable multivibrator to oscillate.

The square-wave output of the oscillator is fed to the inputs of IC1-c and IC1-d, which are wired in par-

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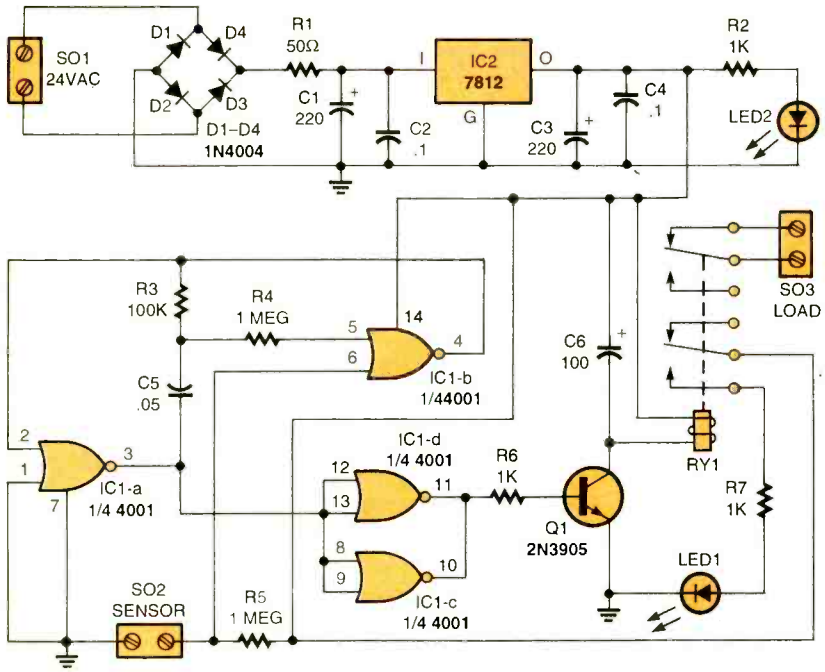

Fig. 1. The Sprinkler Guardian—which is fed from the 24-volt AC source that powers the sprinkler-control unit—is comprised of two integrated circuits (IC1, a 4001 quad 2-input NOR gate and IC2 a 7812 12-volt, 1-amp fixed voltage regulator), a full-wave bridge rectifier (composed of four 1-amp, 400-PIV rectifier diodes, D1–D4), a pair of LEDs, a 12-volt relay (RY1), and a small assortment of resistors and capacitors.

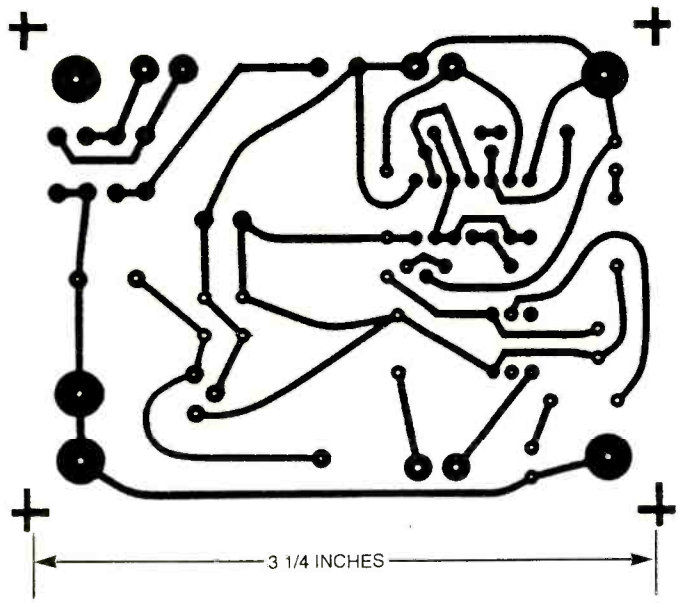

Fig. 2. The Sprinkler Guardian II was assembled on a printed-circuit board, measuring 3 1/4 by 2 1/2 inches. A full-size template of the author's printed-circuit layout is shown here.

PARTS LIST FOR THE SPRINKLER GUARDIAN II

SEMICONDUCTORS

D1–D4—1N4004 1-amp, 400-PIV rectifier diode
IC1—CD4001 CMOS quad 2-input, NOR gate, integrated circuit
IC2—7812 12-volt, 1-amp fixed voltage regulator, integrated circuit
LED1, LED2—Light-emitting diode
Q1—2N3905 general-purpose NPN silicon transistor

RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise noted.)
R1—50-ohm, 10-watt
R2, R6, R7—1000-ohm
R3—100,000-ohm
R4, R5—1-megohm

CAPACITORS

C1—220-µF, 50-WVDC, electrolytic
C2, C4—0.1-µF, ceramic-disc
C3—220-µF, 25-WVDC, electrolytic
C5—0.05-µF, ceramic-disc
C6—100-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

RY1—12-volt relay, AROMAT #HB2-DC12V (Jameco #18577)
SO1–SO3—Dual-wire, terminal block (Jameco #99426)
Printed-circuit materials, stainless steel bolts, nuts, plastic box, sponge, wire, solder, hardware, *etc.*

allel. Together, those gates increase the current and invert the signal output by the oscillator to provide sufficient drive for Q1. The inverted output of IC1-c/IC1-d is applied to the base of Q1 (a 2N3905 general-purpose NPN transistor), causing it to turn on. With Q1 turned on, providing a ground path through the transistor for the coil of RY1 (a DPDT 12-volt relay), the relay turns on, causing its normally-open contacts to close. One set of contacts applies power to LED1, causing it to light, indicating that the circuit has been triggered. The other set of contacts, which function as a simple SPST switch, are connected in series with one leg of the sprinkler-control circuit's output. When the circuit is triggered, that set of contacts opens, turning off the sprinkler system.

When the rain stops and the sensor (sponge) dries, pin 6 of IC1-b is pulled high by the voltage supplied through R5. Since both inputs of IC1-b are now high, the output of IC1-b goes low. That low is applied to pin 2 of IC1-a. Since both inputs of IC1-a are now low, the output of IC1-a goes high. That high is fed to the input of IC1-c and IC1-d, causing their outputs to go low, thereby turning off Q1. With Q1 turned off, RY1 drops out, allowing the relay's normally-closed contacts to close. That allows the sprinklers to come on any time that the sprinkler-control timer calls for it.

The sensor can be mounted in a rain gutter or somewhere out of the way, where it won't get wet when the sprinkler is on, therewith solving the major problem. Of course, elec-

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trolysis will still take place, but on a much smaller scale. The connecting wires are no longer a part of the equation, and the small electrodes needed can be easily made from stainless steel.

Construction. The Sprinkler Guardian II was assembled on a printed-circuit board, measuring $3^1/_4$ by $2^1/_2$ inches. A template of the author's printed-circuit layout is shown in Fig. 2. That pattern can be lifted from the page and used to etch your own printed-circuit board. Once the board has been etched and you've gathered all of the parts listed in the Parts List, assemble the circuit board guided by the parts-placement diagram shown in Fig. 3.

Once you've assembled the board and checked it for the usual construction errors, put the board aside and prepare the moisture sensor. Figure 4 gives details for the construction of the sensor assembly. The author's sensor was fabricated using a small enclosure, measuring approximately $^1/_2$-inch high, 1-inch wide, and 2-inches long and made of $^1/_8$-inch thick plastic. However, the box can be any size.

Two holes were drilled through the plastic box to accommodate two 6-32 stainless-steel screws. One side should be #28 clearance holes, and the other side should be tap size #36 holes. You could also use longer screws, of sufficient length to go through the box, and use 6-32 nuts on the outside. The exact dimensions of the box are quite loose as long as you have about 1 to $1^1/_4$ inch between the screws and as long as the sponge remains against the screws whether it's wet or dry. The two screws are the electrodes to which wires are attached using terminal lugs under the heads of the screws.

After the box is built, and the screws are in place, the sponge is cut to the inside dimensions of the box. The sponge is then pre-formed by wetting it and tucking it under and spanning both screws inside the box. After the sponge dries, it will be pre-formed so that when it rains, the sponge will swell and make a low-resistance connection across the terminals.

When the rain ceases and the sponge dries, the resistance between the screw electrodes will be very high. The drying time of the sponge is very close to the time it takes for the ground to dry out. The sensor box can be mounted in any location where it won't get wet when the sprinkler is on. The sensor assembly must also be situated clear of any structure that might shield the sensor from rain. A convenient out-of-the-way location for the box is bolted to the inside top of a rain gutter. Do not mount the sensor in the bottom of the gutter as it can get covered with debris and will not dry properly. The sensor can be bolted crosswise by the end of the box

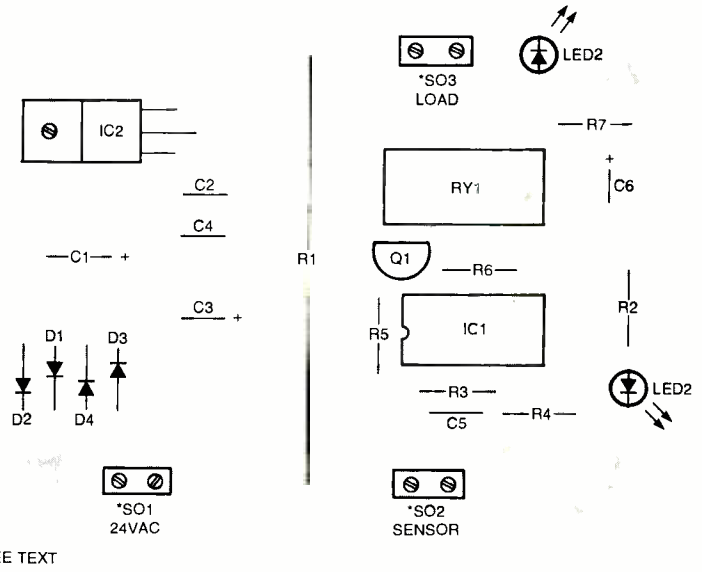

Fig. 3. Assemble the printed-circuit board guided by the parts-placement diagram. Once it is assembled, check the board for the usual construction errors.

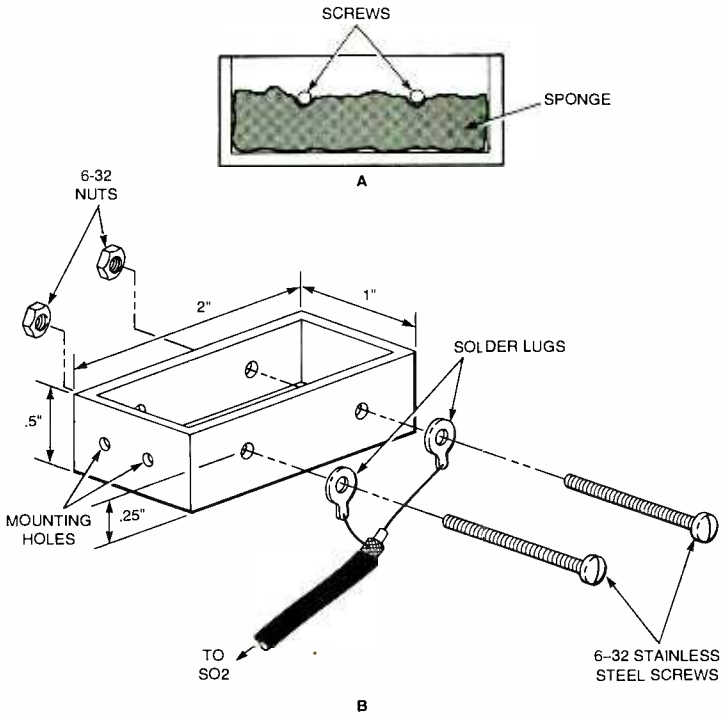

Fig. 4. The sensor for the Sprinkler Guardian II is little more than a pair of screws inserted through a small plastic box that contains a wall-to-wall section of sponge. Details for the construction of the sensor assembly are shown here.

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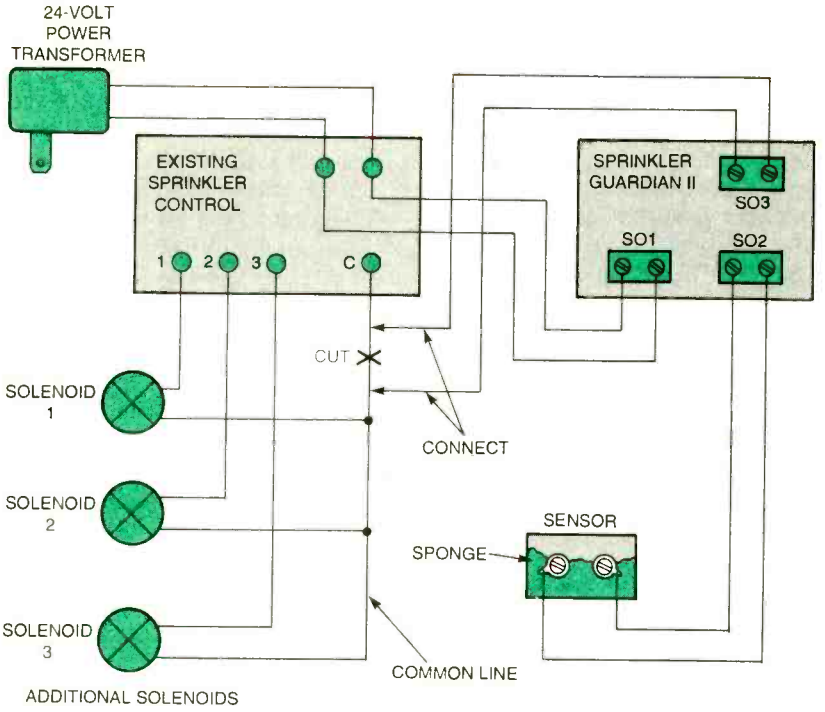
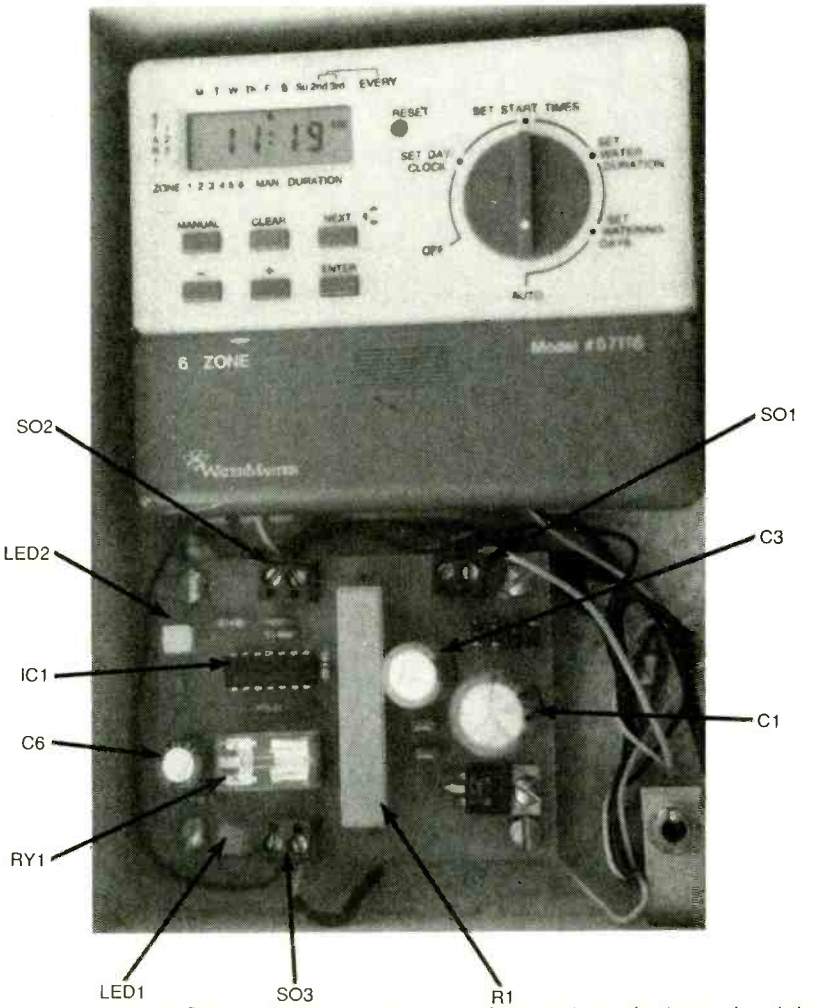


Fig. 5. Once completed, the Sprinkler Guardian II is integrated into the existing sprinkler control, as shown in this illustration.



In the author's setup, the Sprinkler Guardian II was mounted in the enclosure that houses the existing sprinkler-control unit, where it can easily be connected to the appropriate points on the sprinkler control.

to prevent shorting out the sensor electrodes on an aluminum or steel rain gutter.

The sensor assembly can be connected to the circuit board through a small coax line or telephone twisted pair.

Figure 5 shows how the Sprinkler Guardian II is integrated into the existing sprinkler-control system. Note that SO1 is connected in parallel with the existing sprinkler-control unit, tapping into its 24-volt power source. The Sprinkler Guardian II, along with the valve-control unit, can be mounted together in a common enclosure.

Now your sprinkler-control system is ready to prevent your lawn or garden from being watered in the rain (again). ■

HANDS-ON REPORT

(continued from page 14)

these negatives—just alert them when we bring the next roll of film in. After we managed to complete the next roll of 24 exposures, we brought this in, reminded them of the type of camera we used, and *voilà*, after a couple of hours picked up 24 perfect prints at the standard charge—but getting 96 pictures. Some of these pictures were later easily cut down to wallet-sized convenience. Shortly we will pick some of the better prints and have them enlarged to a standard size for framing. Although the instructions state correctly no special processing is required, when bringing the film in for developing it won't hurt to alert your photo shop about the unique images expected.

It's a Fun Thing! Right now these cameras are making it to the stores. As a gift for the budding young photographer (who burns up too much film), it's a great idea. Also consider it as a novelty gift for an adult photographer or even as a potential collector's item. Seek out a *PhotoBlaster* at a toy store near you—not a camera shop. Further information can be obtained by contacting Long Hall Technologies, 500 Eastern Parkway, Farmingdale, NY 11735; Tel. 516-293-6900; Fax: 516-293-7130, or circle no. 120 on the Free Information Card. ■

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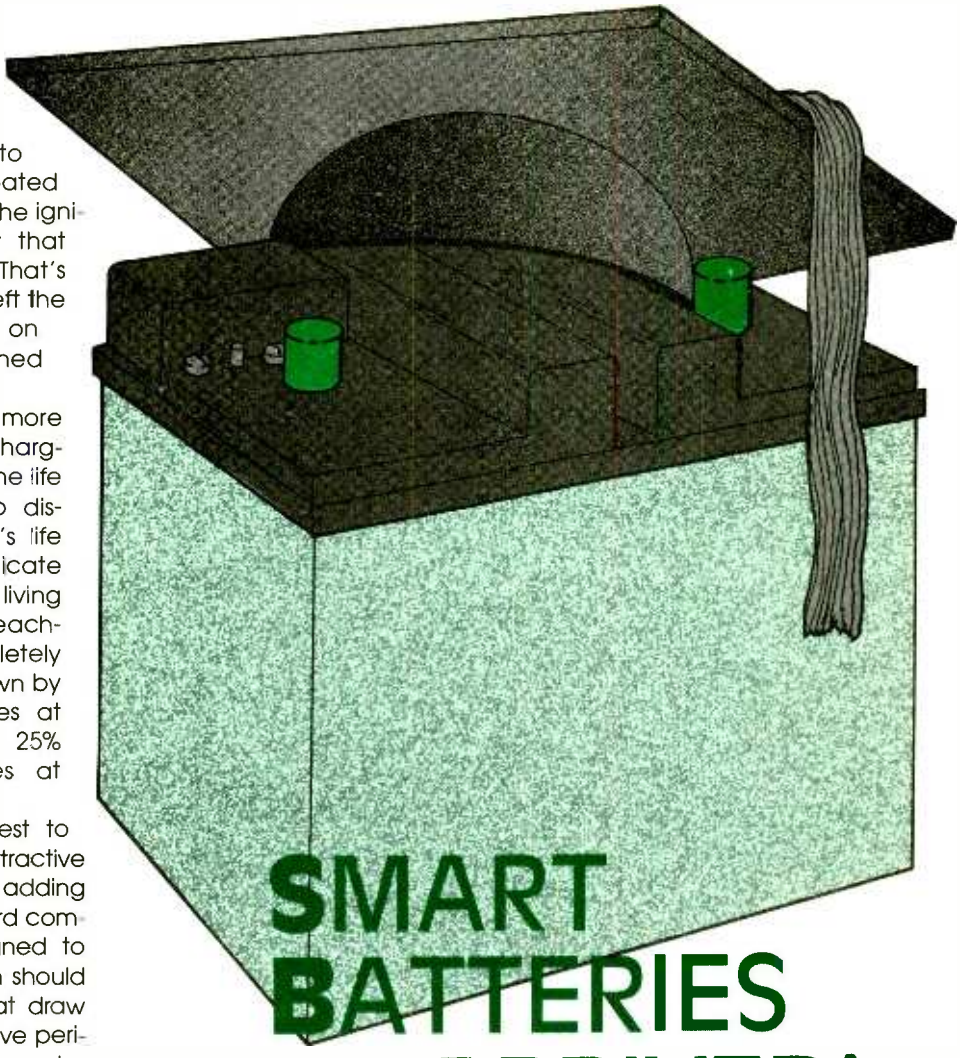

SMART BATTERIES HAVE ARRIVED!

BILL SIURU

Like the Lone Ranger, technology rides to the rescue to help today's motorists avoid one of the most annoying aspects of motor vehicle operation—the unanticipated dead battery.

It's happened to most of us. After a long day at work, you head out to the parking lot to get into your car for the long-anticipated ride home. But, as you turn the ignition, you get nothing but that dreadful click, click sound. That's when you realize that you left the lights (or some accessory) on all day, which promptly drained the battery.

Dead batteries can be more than frustrating. Deep discharging can drastically reduce the life of the battery. One deep discharge reduces a battery's life by 30–40 percent. To complicate things, particularly for those living in (or visiting) the northern reaches of the country, a completely discharged battery (as shown by the chart in Fig. 1) freezes at around +20°F. One with a 25% charge remaining freezes at about +5°F.

Automakers, in their quest to make their products more attractive are starting to take heed, adding logic circuitry to their onboard computer systems that is designed to prevent excess current drain should the lights or other items that draw current be left on for excessive periods of time. Such systems go by names like Buick's "*Battery Rundown Protection System*" or Cadillac's "*Battery Storage Mode*." Typically, with such arrangements, the electrical system is put in a dormant mode or shut down if an exterior, interior, or trunk light is left on for more than 10–20 minutes.

To reactivate the electricc system, the driver need only turn the ignition switch, turn on or off a light switch, or open a front door. To prevent a dead battery during long-term storage, some systems turn off items like the radio, clock, and remote lock control if the car is left with the ignition off for more than three or four weeks. Others put the battery in a storage mode if the car is not used for a few days.

However, you can get protection from complete battery rundown without buying a new car or truck. A new product, *PriorityStart!* from BLI International, can prevent a complete battery drain.

PriorityStart! PriorityStart! is an electronic device that is attached to the positive terminal of the battery and grounded to the negative terminal. The device constantly monitors the vehicle's battery for a power drain to sense when the voltage drops below a preset level. Then, when PriorityStart! senses that the predetermined charge level has been reached, a switch capable of handling large amounts of current mechanically disconnects the battery, preventing any further battery drain. The battery is reconnected when the ignition key is turned to start the engine.

Of course, you'll have to reset the clock, radio, and seat memories, but the onboard computers will reprogram themselves. Resetting would also have to be done if you had a dead battery. You can rewire alarms directly to the battery so that they bypass the unit and still work, although doing so would also allow them to continue draining the battery (but at least you'll be "protected").

The PriorityStart! costs $79.95.

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That is a pretty reasonable investment against the hassle of having to get a jump start in an airport parking lot after having left your lights on in your haste to make that all important flight.

POWERBEAT. The *POWERBEAT*—a new battery from New Zealand—also eliminates the cause of most dead batteries; lights, radios, *etc.*, left on while the car is parked for long periods of time. The POWERBEAT battery has separate auxiliary and starter cells. The auxiliary cells connect to vehicle accessories (see Fig. 2): lights, radio, and so forth. The starter cells provide current *only* to the starter (see Fig. 3). When parked, the auxiliary and starter cells are isolated from each other, so if the lights, radio, or other items are left on, the starter cells are not drained. That leaves the battery ready for a quick start.

The POWERBEAT battery also features a *Discharge Management System* (DMS). The DMS senses when the vehicle is not in use and isolates the starter cells to prevent their discharge. The DMS's sensor detects when a door is shut or an attempt is made to start the vehicle. Then the starter and auxiliary cells are connected together. The rather simple sensor consists of a small steel ball placed on a piezoceramic disk. Opening a door jostles the ball, generating a voltage that is amplified and relayed to the DMS, which reconnects the auxiliary cells to the starter cells. The DMS also manages the recharging of both sets of cells, preventing overcharging and undercharging.

Rather than the six cells that sup-

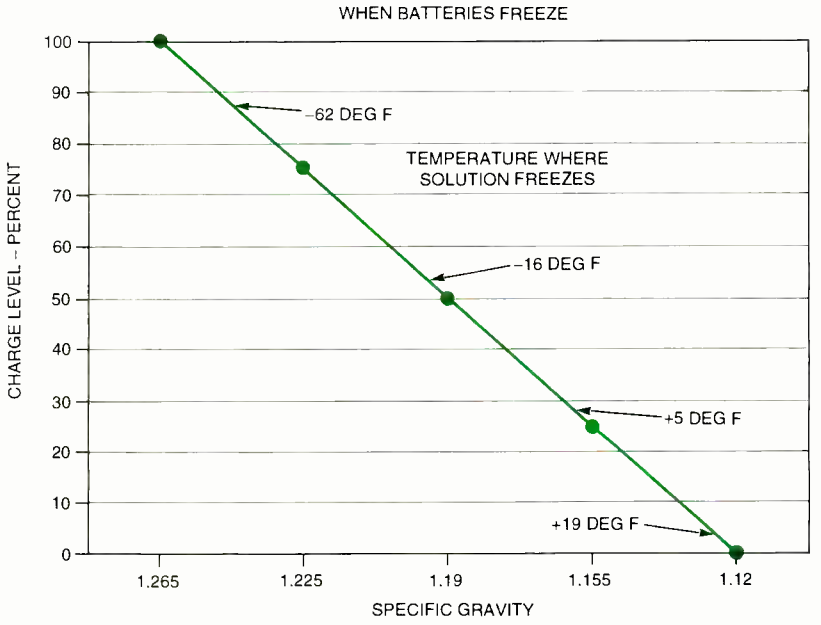

Fig. 1. A fully charged battery won't freeze unless it's a very cold night in North Dakota. However, a fully discharged battery will freeze on a chilly winter night almost anywhere.

LOCATING A CURRENT DRAIN

Your car has been sitting for a few days, and again the battery did not have enough juice to turn the engine over. You suspect a current drain is sapping the battery's charge while the car is parked. Tracking down current drains can be done by even the most amateur mechanic. You can do the job with a $5 test light as well as a multimeter or ammeter that reads currents up to 10 amperes.

First, place pieces of tape over door dome light and the under-the-hood lamp switch (if you have an under-the-hood lamp) so they will be off and not drawing current, which will appear as a current drain. Connect the test light, multimeter, or ammeter in series with the positive side of the battery. This means disconnecting the positive battery terminal and connecting the light or meter so it completes the circuit between the battery terminal and battery cable. **Do not** crank the engine or operate accessories that might draw more than 10 amperes. You might blow the fuse in the multimeter or ammeter.

If the light glows or you get a noticeable ampere reading, you have a current drain. If not, you have either a battery or charging system problem. Incidentally, modern cars with computers have Keep Alive Memories, which draw small amounts of current (on the order of a few milliamps) all the time, causing the light to glow quite dimly—but, nowhere near the brilliance of a normal current drain. If you are using a meter, read the current drain for the entire system and record that value.

To find the circuit, and ultimately the individual component, causing the current drain, start pulling one fuse after another from the fuse box while watching the test light or meter. (A fuse puller makes the job a bit easier and prevents damaging the fuses.) The light will go out or the current reading will drop to nearly zero when the fuse protecting the offending circuit is pulled. Reinstall the fuse and disconnect the components in the circuit that are protected by that fuse one-by-one. Use a wiring diagram to determine the components in the particular circuit. If you do not have a wiring diagram, you can find out which components are in a particular circuit by removing the fuse and determining which components no longer work. Note: The listings of components in a circuit given in the owner's manual or on fuse-box covers are sometimes in error.

If the current drain is not in the circuits protected by fuses, you might check for leakage current through the alternator diodes. Connect the multimeter or ammeter in series with the alternator with the car not running. Take care in disconnecting the alternator output wire. The battery side must be disconnected before disconnecting the output wire at the alternator to prevent arcing at the alternator terminals, which could damage the unit.

Once the wire at the alternator terminal has been removed, reconnect the battery side. Leakage current should be on the order of a couple of milliamps at most, more likely only about 0.5 milliamps. Values approaching the total current drain tell you that the diodes could be the culprit. **Do not** run the car with the alternator disconnected—expensive damage can result.

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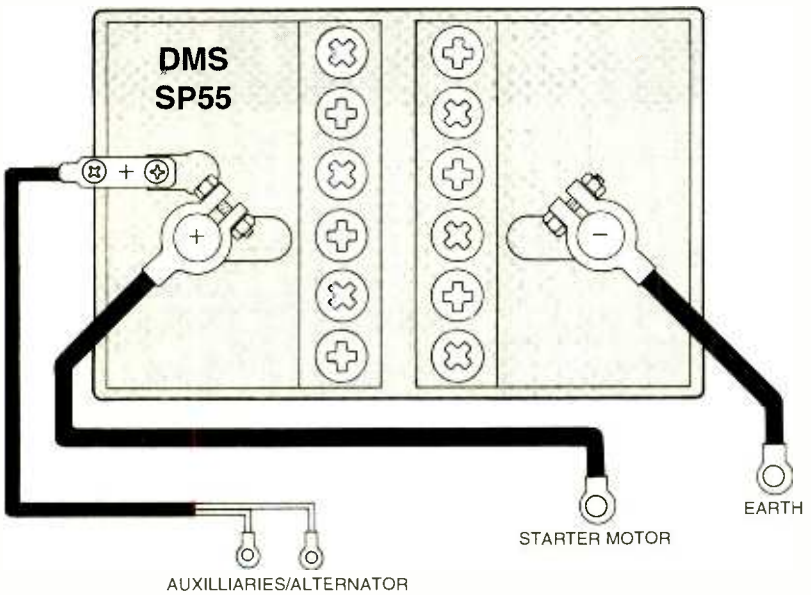

Fig. 2. Since the mid-1970s, most vehicles have been equipped with split wiring harnesses, in which a pair of cables (one handling current to the starter motor, and the other feeding everything else) attaches to the positive battery terminal.

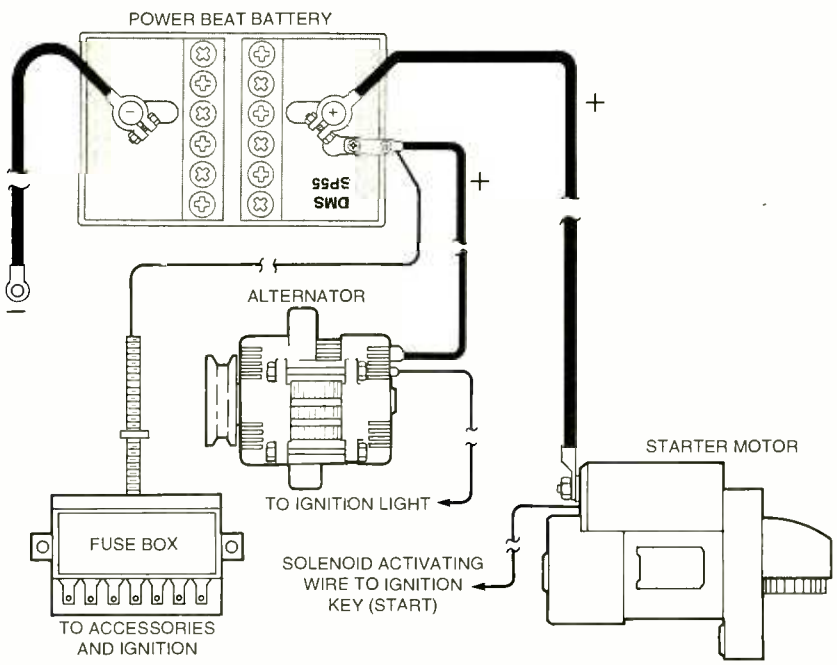

Fig. 3. Installing the POWERBEAT requires attaching the thinner wire, or in some cases wires, of the vehicle's wiring harness to the separate positive terminal of the battery. That wire runs to the fuse box as well as to the alternator. (The alternator supplies recharging current to both sets of cells when the engine is running.) The thicker wire is attached between the positive terminal and the starter motor, and the negative ground wire is retained.

ply both levels of power in a conventional battery, the POWERBEAT has two sets of six cells. Each set is optimized for each (quite different) requirement. The auxiliary cells are optimized for low current for extended periods of time and repeated deep cycling without damage. In a conventional battery, deep cycling—discharging to a very low level and then recharging—results in sulfation, which greatly reduces battery life.

The POWERBEAT's auxiliary cells use a special double-grid electrode plate made of a high-density active material. The heavy-duty plates are folded like the pages in a book. Electrolytes are trapped in the folds so that battery solution is distributed over their surfaces to control sulfation and to eliminate damaging deep discharge of the auxiliary cells.

In contrast, the starter cells are designed to provide large amounts of current for short periods of time. The cells are manufactured with thin electrode plates and low-density, active material. They are extremely efficient at supplying the high amounts of current required for engine cranking, but do not have to be designed for deep discharge.

The POWERBEAT battery is a *drop-in* replacement for a conventional battery. The first POWERBEAT prototypes were tested in 1987, and the first US patents were obtained in 1989. The new batteries have been sold in New Zealand since 1993, including installation in new cars sold in New Zealand. Plans are to soon start test marketing the POWERBEAT in the US, probably starting in California. ■

The PriorityStart! is easy to install as shown here. The system is simply strapped to the battery and is then connected between the battery and the positive distribution cable.

FOR MORE INFORMATION

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COMPUTER BITS

Microcontrollers III

JEFF HOLTZMAN

Our microcontroller of choice for this series, at least to get started, is the Atmel AVR series, in particular—the *AT90S1200*. In fact, we're going to use a special version of it, known as the *MV1200*, which is basically an *AT90S1200* with a mini-built-in BASIC interpreter. This month, we just want to get the *MV1200* up and running, verify that we can communicate with it, download a program to it, execute that program, and verify proper execution. In a future installment, we will dispense with BASIC and do some lower-level stuff.

THE MV1200

The *MV1200* is a 20-pin IC. Five pins are for housekeeping (power, ground, reset, xtal in, xtal out), and the remaining fifteen pins are split between two bi-directional I/Os: one seven-bit (Port D), and one eight-bit (Port B), as shown in Fig. 1A. (In case you're wondering, other members of Atmel's AVR family do have ports labeled A and C—more later.)

Through the capabilities provided by the BASIC interpreter, the *MV1200* has the *virtual* architecture shown in Fig. 1B. In essence, Port B becomes the LPT port, and Port D becomes almost everything else (including the LPT port's strobe line, but not including the inputs to the analog comparator). If you add them up, there are nineteen functions, but only fifteen pins. Several functions are multiplexed onto the same pins, as indicated by the dashed lines. From the MVS BASIC perspective, you can work with either architecture, or a mixture of both. Of course, you can't doubly allocate resources at the hardware level; namely, you can't use Port D as both an LPT port and also for bit twiddling.

GETTING STARTED

Getting a minimal *MV1200* system up and running doesn't take much, as shown in Fig. 2. Aside from the 1200 itself, all you need are two resistors, a diode, and a D-connector for attaching to the serial port of your PC. To verify

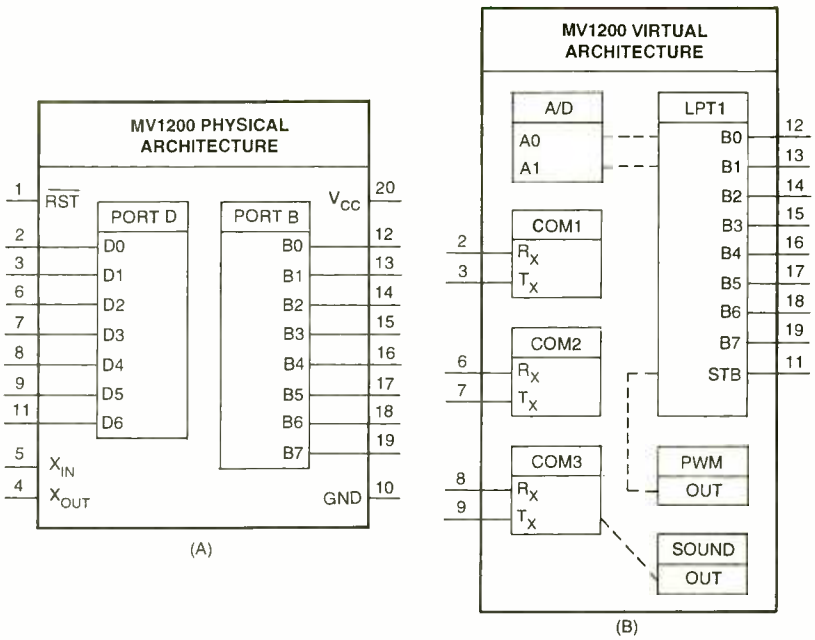

Fig. 1. Atmel's basic AT90S1200 microcontroller in A has the virtual software architecture, shown in B, of MVS's implementation of the MV1200.

that the device can really do anything, we will also want eight LEDs and associated current-limiting resistors, and seven input switches and pull-ups, as shown in Fig. 3. (By the way, to perform the experiments in this installment, I suggest using a solderless breadboard; we'll be assembling a more permanent and versatile development platform in the future.) Use the Fig. 2 circuit for downloading, and the Fig. 3 circuit to run the program. You can leave both circuits connected as long as you disconnect the serial cable after downloading.

Wire up the Fig. 2 circuit, and double-check all your connections, especially those going to the PC. If you're working from DOS, issue the command

mode com1 2400,n,8,1

Then run a terminal-emulation program, such as ProComm, Telix, or Commo (in DOS), or Terminal or HyperTerminal (in Windows). Set your terminal program to run at 2400 N81 on COM1. Connect the circuit to your serial port, and apply power. You should

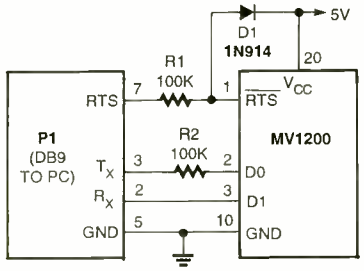

Fig. 2. Use this circuit to download MVS BASIC programs to the MV1200.

see "121MVS" displayed on the screen of your PC. You may see a slightly different message, indicating a change in the firmware. That's OK. You may also see gibberish. That's a good sign. If you see nothing, that's a bad sign. Check your wiring, and make sure you're really using COM1.

If you see gibberish, here's how to resolve the problem. MVS BASIC has an AutoBaud command that allows it to determine the baud rate of incoming data. It is undocumented (as are many facets of MVS BASIC), but evidently

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TABLE 1—MVS BASIC COMMANDS

COMMAND	A	B	DESCRIPTION
autobaud	x	x	wait for ASCII "0" character (30h), set baud, then save to ee
defmem I	x	x	set EE memory pointer for poke/peek, max=63, default=0
end	x	x	power down until interrupt or reset
gosub I	x	x	unconditional subroutine call (1 level), use ret to return
goto I	x	x	unconditional goto
if v I	x	x	if v not=0 then goto I
if v@x I	x	x	conditional goto, @ is <,>,=, or & (and)
inp v	x		read port d byte into variable
input v		x	get 3 digit numeric ASCII string from com1
[let] v=x	x	x	assign direct, "let" is not used
[let] v=v#x	x	x	assign expression, "let" is not used, # is +,-,&,|(or),^(xor)
out x	x		write variable or immediate to port d
parin v	x		make pb0–7 inputs, pd6 lo, get parallel data, pd6 hi
parout x	x		make pb0–7 outputs, set up parallel data, pd6 lo then hi
peek v	x	x	read ee data memory into variable, auto increment, starts at 0
poke x	x	x	write to ee data memory, auto increment, starts at 0
print x		x	send 3 digit numeric ASCII string out com1
pwm x		x	send 256 cycles, x=hi time, 0=0 V,...128=2.5 V,...255=5 V
ret	x	x	return from subroutine
serin1 v		x	get serial byte from com1
serin2 v		x	get serial byte from com2
serin3 v		x	get serial byte from com3
serout1 x		x	send serial byte to com1
serout2 x		x	send serial byte to com2
serout3 x		x	send serial byte to com3
sleep tics	x	x	pause for 1–256 ticks, picks up where it left off
sound I		x	make 256 cycle tone on com3 tx pin, 1=40 kHz, 2=20 kHz,... 256=200 Hz
test b I	x		make port b bit input and if it's 1 goto i
toggle b	x		make port b bit output and change its state

b is bit 0–7
i is immediate value 0–255
tics: 1=16 ms, 2=32 ms, 4=64 ms, 8=128 ms, 16=256 ms, 32=512 ms, 64=1 sec, 128=2 sec, 0=4 sec
v is 8 bit variable a–h
x is 8 bit variable a–h or immediate value 0–255

true, that the AutoBaud command is executed when the *MV1200* powers up. It stores the baud rate that it detects in its internal EEPROM, but evidently doesn't start using it until the next time it boots.

So set your terminal program to the desired baud rate, power down the *MV1200*, power it back up, and immediately send several 0s (that's the number zero, ASCII 48). Wait a few seconds, power down, and power back up. If all has gone well, you should see the sign-on message. If not, try again. The timing is not super critical, but it is sensitive. Note that this procedure only affects the default rate of serial port 1 in user programs. Program downloads must always occur at 2400 bps.

Once you've established communication at a specific baud rate, you're ready to write some code, "compile" it, download it, and run it. Keep in mind that all program code is stored in the 1200's internal memory. This means that the last program you downloaded automatically starts running the next time the 1200 boots.

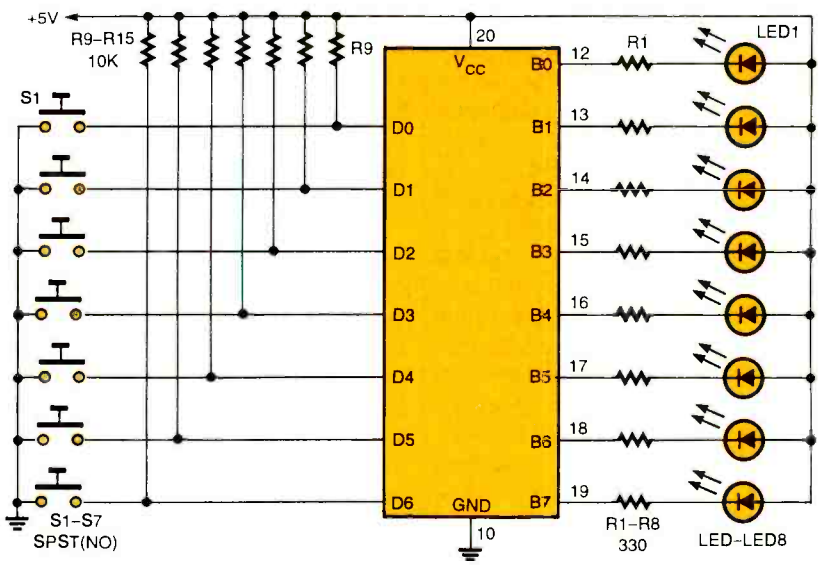

Fig. 3. Use this circuit, and the accompanying BASIC program in Listing 1, to test basic I/O functionality of the MV1200.

MVS BASIC

With only 29 commands, MVS BASIC is pretty simple, but it provides some interesting capabilities. For example, it gives three-"bit-banged" serial ports, a pseudo-printer port, and a pulse-width modulation output.

(Continued on page 58)

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DX LISTENING

Kol Israel

DON JENSEN

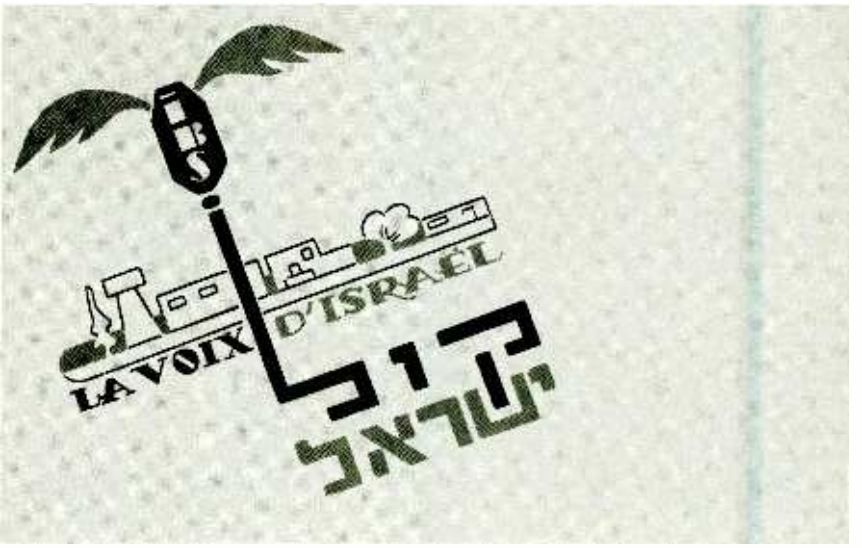
Fifty years ago, the Voice of Israel, or Kol Israel went on the air. It was on May 14, 1948, the day the State of Israel was proclaimed, when this radio station made its inaugural broadcast, an address by the new nation's first prime minister, David Ben-Gurion.

That first shortwave transmitter was located in Tel Aviv, notes Salvatore Placanica, writing in *Current*, the *Adventist World Radio Listener* newsletter. It was, even by that era's standards, a very modest station, putting out a rather feeble 7.5-kilowatt signal. By contrast, a typical international broadcast from Israel to North America today uses a 300-kilowatt shortwave transmitter, and broadcasts SW programming in 16 languages to the mid-East, Europe, Asia, and North America.

But broadcasting in what is now Israel has a longer history. In March 1936, under the British Mandate administration, the Palestine Broadcasting Service began programming in Hebrew, Arabic and English, announcing as the Voice of Jerusalem. Programming expanded during World War II, particularly broadcasts in Hebrew. There also were armed forces stations located in Palestine, which broadcast to British and American troops in the Middle East.

In the five decades since the post-W.W.II Voice of Israel began, the Kol Israel radio has grown to an around-the-clock broadcasting operation that includes domestic home networks with AM and FM transmissions, in addition to the shortwave programs intended for listeners outside this small nation.

Kol Israel features five networks, Placanica notes in his article on Israeli radio—each with a different flavor of broadcasting. Network A features cultural programming, including musical broadcasts of the Jerusalem Symphony. Network B has news, sports, and political programs for Israeli audiences. Network C, which was begun in 1996, is Israel's popular music broadcaster. Network D airs programming in the Arabic language. Network E is the overseas shortwave radio operation—which operated independently, but in 1965 was incorporated into Kol Israel.



QSL card from the Voice of Israel's early days of shortwave broadcasting.

Look for 15 minutes of English news from Israeli radio's domestic network at 0400 UTC during the summer months. Transmissions to North America and Europe are on 7465 and 9435 kHz, with 17545 kHz used for transmissions to Australia and Down Under. Or try 1400 to 1430 UTC during the warmer months for another relay from the home service networks on 9365 and 11605 kHz . And also during the summer months, another half-hour of English domestic programming is aired from 1900 UTC to North America on 7465 and 9435 kHz. You may also want to try 9365 and 15640 kHz during this time period. Send your reception reports to Israeli Broadcasting Authority, Kol Israel English Service, P.O. Box 1082, Jerusalem, Israel 91010.

A BIT OF CULTURE

The late Melina Mercouri, famed movie actress and, later, Greek Cultural Minister, had a good idea. Promote the wonderful cultural attractions and traditions of Europe, she urged, by annually naming a major city as "The Cultural Capital of Europe." This year, the European Union bestowed that title on Stockholm, the capital of Sweden. The choice of Stockholm is important since the city has a significant role in linking Europe's East and West in the Baltic region.

A thousand years ago and more, Viking longships crossed the Baltic and North Seas, engaging in a significant, though not necessarily voluntary, cultural exchange with and among the Nordic land's neighbors. In later centuries, Swedish monarchs—Queen Kristina in the 1600s—and Gustaf III in the 1700s helped to open their nation to the rest of Europe.

Today, Stockholm, with some 70 live-performance stages, is, per capita, the most theatrical city in Europe. Called the Venice of the North, the city also has more than 50 museums of history and culture. Not surprisingly, many special events have been planned for Europe's culture capital

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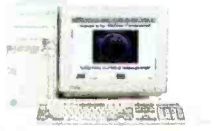

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For more information on this station, drop a line to Radio Sweden, SE-105 10, Stockholm, Sweden, or check the station's English Service Web page: *www.sr.se/rs/english/*. Or just tune in at 0100 to 0130 UTC on 6090 kHz, 0300 to 0330 UTC on 7115 kHz, 1030 to 1100 UTC on 6065 kHz, 1400 to 1430 UTC on 15240 kHz, or 1445 to 1500 UTC on 6000 kHz.

ALL ABOUT TRANSMITTERS

An odd but curiously interesting publication for the SWLing enthusiast is Ludo Maes' *Transmitter Documentation Project*, now in its fourth annual edition. Maes has collected detailed data on some 3400 different shortwave transmitters that broadcast, or have broadcast in the past, around the world. It contains, in fact, just about anything a listener might want to know about the transmitting facilities of most of the SW stations you can hear. Listed are the individual transmitter units of shortwave stations operating in 193 different countries around the world.

Where are these transmitters located? What are their individual call signs, their precise latitude and longitude coordinates? Which electronics companies made these units, and what are their transmitting powers? When did each go into service and, for those now retired transmitters, out of service? You can find all the answers in this 80-page book. Maes has done an astonishing amount of research to come up with all this data.

But why would you want to know all this arcane information about the SW transmitters you hear? Frankly, I'm not sure, but I must admit I found it a fascinating read. Maybe it is the shortwave trivia buff in me. The *Transmitter Documentation Project* is available directly from Ludo Maes, P.O. Box 2310, Rijkevorsel, Belgium. The cost is seven International Reply Coupons, or IRC's, (presently $1.05 US each), which can be purchased at your local post office's stamp counter.

IN THE MAIL

"In the January column," writes Tom Franklyn, of Yuma, AZ, "you had some information about how to hear the Voice of Mongolia, Radio Ulaanbaatar on shortwave. Well I did, and sent my report to the station for a QSL card. Months have passed and no reply. Any suggestions?"

I'd try writing again, Tom, with a copy of your first letter. Enclose one or two International Reply Coupons, which the station can exchange for postage to mail a reply to you. And this time, address your letter to David O'Connor, at Radio Ulaanbaatar, Central Post Office Box 365, Ulaanbaatar, 13, Mongolia. O'Connor is an Australian working on a two-year assignment at this remote Asian SW broadcaster.

And speaking of Mongolia, another reader, Carole Martinovich, of Richmond, VA, sends along a bit of information, which she said she heard on one of the DXer programs. "A new shortwave station is supposed to be on the air soon," Carole writes. "It is to operate on 4790 kHz with low power—just 2 kilowatts, from Sayshand in Mongolia's Gobi desert. The Danish government is providing aid to the Mongolian nomadic desert people, and this new SW station is intended to bring news, weather information, and education programs to these shepherd families. Wouldn't that be a neat station to hear?"

It sure would! But it will be VERY tough logging in the US and Canada, given its currently unknown schedule, the low-powered transmitter, and less-than-optimum SW frequency. With its special mission, I can't imagine any English language programming from this one—but hope springs eternal! So if anyone logs this station, please let us know.

DOWN THE DIAL

Looking for some listening targets? Try these:

ALGERIA—15160 kHz, Radiodifusion TV Algerienne has an English news broadcast at 2000 UTC. It operates in parallel on 17715 kHz.

BRAZIL—11780 kHz, Radio Nacional da Amazonia operates on this frequency at around 2200 UTC. It has been reported with play-by-play of a soccer match in Portuguese. Also on 11812 kHz, Radio Brasil Central is heard at 0015 UTC with Portuguese identification, ads, and jingles.

CANADA—5960 kHz, Radio Japan, relayed by a Canadian transmitter, is noted here in English at 0130 UTC.

CHINA—7385 kHz, China Radio International was reported on this frequency at 1340 UTC with an English language program, "Life in China."

FRANCE—15460 kHz, Radio France International is heard here in English at 1600 UTC.

GERMANY—15625 kHz, the Irish broadcaster West Coast Radio is relayed on shortwave by a German transmitter on occasion. Try at 1925 UTC, when it has been heard with Irish fiddle music and a listeners' letters program.

HUNGARY—9580 kHz, Radio Budapest's "Hungary Today," in English is heard at 0100 UTC.

PAPUA NEW GUINEA—9675 kHz, National Broadcasting Corp., in Port Moresby has been heard at 0800 UTC with an English newscast. At 0805 UTC the station switches abruptly from this 31-meter band frequency to 4890 kHz in the 60-meter band.

SLOVAKIA—5930 kHz, Radio Slovakia International's English program is heard at 0100 UTC, announcing its frequency and schedule, continuing with a newscast and tourism program.

SOUTH AFRICA—11900 kHz, Channel Africa is logged here in English at 1700 UTC, with its tuning signal, identification, and regional newscast.

TADJIKISTAN—11620 kHz, Radio Dushanbe noted at 0200 UTC sign on, identifying in the local language as "Injo Dushanbe." Reception was blocked when Vatican Radio signed on at 0338 UTC.

TAHITI—15167 kHz, Radio Tahiti broadcasts here in French after 0300 UTC, with news until 0309 UTC, then Polynesian-type music with occasional announcements by a woman announcer.

THAILAND—15395 kHz, Radio Thailand's English transmission at 0030 UTC includes a program of world and local news and a weather report.

UKRAINE—12050 kHz, Radio Ukraine International has a program in English, featuring listeners' letters and called "Hello from Kiev," shortly after 1200 UTC.

UZBEKISTAN—7255 kHz, Radio Tashkent's English service signs on at 1200 UTC, with a tuning signal, identification, news, and commentary. It also operates at this time on 9715 kHz. ■

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How Many Volts to Light a Tube?—Part 2

MARC ELLIS

In last month's column, we began to discuss the very interesting story behind the evolution of tube filament and heater voltages. Beginning with the 1.1-, 2-, 3.3-, and 5-volt tubes used in battery sets of the 1920s and early 1930s, we moved to the 1.5-, 2.5-, and 5-volt types found in the mass-market AC sets that began to appear about 1927. By the close of the column, we had discussed three of the four types typically used in such sets: the UX-80 rectifier (5 volts), UX-226 RF and AF amplifiers (1.5 volts), and UX-171-A power AF amplifier (5 volts), (referred to by their abbreviated designation 80, 26, and 71-A, respectively). And we had just touched on the development of the remaining type, the 2.5-volt UY-227, or 27.

A WATERSHED DEVELOPMENT

The type 26, as discussed last month, was the first American tube designed specifically for AC operation. But though it performed very well as an RF or AF amplifier, it introduced too much hum into the signal when used in the more sensitive detector position. The type 27, a truly watershed design, was developed to fill this need.

The approach used to suppress hum in the type 27 was totally different from that used in the 26. While the 26 relies on a careful balance of filament voltage and filament current to achieve hum cancellation, the 27 employs a more direct solution. The filament (now more correctly called the *heater*) of the 27 passes through channels in a surrounding ceramic cylinder. The ceramic is coated with a metallic oxide compound. Its temperature raised to red heat by the heater, the ceramic, in turn, heats the oxide, causing it to emit the electron stream needed to operate the tube. Isolated from the alternating current variations by the "heat inertia" of the ceramic, the electron stream introduces little hum.

The voltage chosen to operate the heater was 2.5 volts. Finding little in my own library to shed light on the reason for that selection, I appealed to Lauren Peckham of The Antique Wireless Association, an enthusiastic collector of tubes and tube literature. Lauren's library contains a series of books on the early history of electronics at G.E. written in 1955 by prominent tube design engineer William C. White. White worked with Irving Langmuir in the refinement of the DeForest Audion tube and was active in tube development at G.E. for many years.

When auto radios appeared in the early 1930s, a new range of 6.3-volt tubes was developed to be powered from the car battery.

According to White's notes, the original choice for the 27's heater voltage was 5 volts (to provide compatibility with the voltage used for storage battery tube filaments). However, by the time the 27 was placed in production, the rating was changed to 2.5 volts so a "more rugged construction" of cathode and heater elements could be used. (I'm guessing that the lower voltage would have had to be delivered at higher current to provide equivalent heating. And, since a higher current draw would require heavier-gauge wire in the filament, the filament would of necessity have a more rugged construction.)

From that point on, virtually every tube (with the exception of certain rectifiers and power audio amplifiers) intended for AC operation was equipped with a heater and cathode. RCA introduced a new five-pin ("UY" style) tube base to accommodate the required electrical connection to the cathode of the type 27, and for the next few years, practically all receiving tube types had 2.5-volt heaters and "UY" bases.

IMPACT OF AUTO AND AC-DC SETS

All this began to change around 1931, when a new range of radio tubes, the 36, 37, 38 and 39 entered the market. These were cathode-equipped tubes with the standard 5-pin base. But their heaters were rated at 6.3 volts and drew a mere 0.3 amperes of current (compare with the 27's 1.75-amperes). Why the switch to 6.3-volt heaters? Enter, the auto radio!

As soon as designers began to work on sets intended for installation in autos, the problem of filament voltage (and current) came up. The existing 2.5-volt tubes were inconvenient to power from the then-standard 6-volt auto battery, and their high current draw represented a serious battery drain. The voltage of a fully charged 6-volt lead-acid storage battery (since auto batteries "floated" on generators, they were generally fully charged) was 6.3. Hence the 6.3-volt, 0.3-ampere filaments.

These tubes didn't really need their cathodes for storage battery operation in auto radio service (though it is possible that the cathodes helped to filter out "hash" from the sparking commutators of the early auto generators). However, the same range of tubes also found use in a new type of home radio born during the cash-starved depression years—the AC-DC set.

The AC-DC set was a minimal radio designed to be sold at a very low price. One way the price was kept

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One of Atwater Kent's earliest plug-in sets, the model 37, used the type 26 tube in the RF and AF amplifier positions, a type 27 detector, and a type 71A output amplifier.

down was through the elimination of the power transformer. The tube heaters, rather than being wired in parallel and powered from the low-voltage winding of a transformer, were wired in series and connected across the 110-volt line through a voltage-dropping resistor. One classic radio of this type was the International Kadette Universal of about 1932, which used four tubes from the new range. The heaters were placed in series with a 310-ohm power resistor to drop the difference between the heater requirements (24 volts) and the line voltage (nominally 110 volts).

The higher heater voltage of the new tubes was an advantage in this service, because it was desirable for the tube set to drop as high a voltage as possible. Then the series resistor could be smaller, thereby wasting less power (which was dissipated as destructive heat inside the radio cabinet).

The fact that there was no power transformer made it possible to operate the set from either AC or DC mains (DC was still common in the downtown areas of many cities). And when AC was the source, those cathodes were definitely needed!

FURTHER DEVELOPMENTS

Soon virtually all 6.3-volt receiving tubes were being manufactured with cathodes, since a given tube type might just as easily be employed in a home radio as an auto set. And 6.3 replaced 2.5 as the standard heater voltage, even in transformer-powered sets, which could very easily be designed to meet any heater voltage and current requirement.

Around 1933, the tube's heater voltage was made part of its standard designation. The original two-digit tube numbering system had become exhausted, and a new "number-and-letter" system was introduced. The first number represented the filament voltage rounded off to the nearest digit. For example, the 6C6 and 6D6 are both tubes with 6.3-volt heaters.

Just about the same time, a rectifier tube especially designed for AC-DC sets was released. The 25Z5's 25-volt filament was very helpful in raising the voltage drop across the series string, thereby reducing the voltage that had to be dropped (and the accompanying heat dissipation) in the series power resistor. An audio power output tube for this service, the 25-volt-heater type 43, had appeared a few years earlier.

In 1935, after two more pins had been successively added to the original 5-pin "UY" tube base to accommodate the additional connections required by more sophisticated tubes, a completely new base design was introduced. The eight-pin "octal" base featured smaller pins in a more compact design, as well as a central locating post with a key to facilitate proper insertion.

In the late 1930s a new range of 1.4-volt filament tubes (no cathodes!) was introduced for battery operation in "carry-around" portables. These were the 1A7G converter, 1N5G RF/IF amplifier, 1H5G detector/audio amplifier, and the 1A5 and 1C5 output amplifiers.

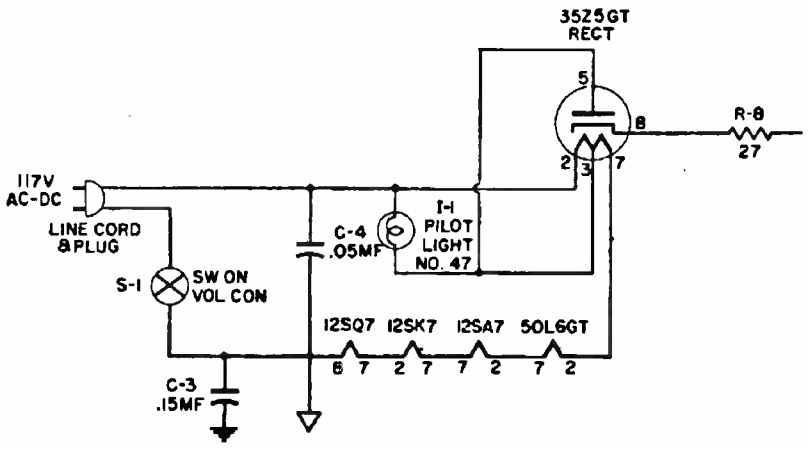
Following soon after was an improved range of tubes for AC-DC sets. The heater voltages of the 35Z5 rectifier, 12SA7 converter, 12SK7 RF/IF amplifier, 12SQ7 detector/audio amplifier, and 50L6 beam power amplifier added up to 121. That meant that a set using this range of five tubes (fondly called the "All-American Five") could drop the entire line voltage across its heater string without using a series resistor at all. "All-American Five" sets were made by the hundreds of thousands, if not millions, during the 30s, 40s, and 50s.

No article on filament/heater voltages would be complete without mentioning the "Loctal" tube design pioneered by Philco and Sylvania in 1939. These had a special compact 8-pin base incorporating a locking feature into the central locating post. The Loctal series, which had glass envelopes, was introduced to complete with RCA's highly-promoted metal-shell octal series. The initial number of the designation of these tubes (such as the 7B6, 7C5, and 7B7) would suggest a 7-volt heater. However, the heaters of these tubes were all rated at the standard 6.3-volts. The purpose of the 7 was simply to identify the tubes as 6-volt Loctal types.

Very soon after the introduction of the Loctal, a new range of miniature battery tubes with 1.4-volt filaments (including the 1R5, 1T4, 1S5, and 1S4) was released to allow portable radios to be further downsized. These baseless, 7-pin, glass tubes were a few hundred percent smaller than their octal relatives. They were virtually the last new types to be introduced prior to World War II, when all production of civilian radios ceased.

Of course, many new special tube types were developed to meet the needs of the war, most of them outside the scope of this article. But it's worth

(Continued on page 55)



Typical 1940s heater circuit using series-connected "All-American Five" tubes. Pilot light runs off a tap in the heater of the 35Z5 rectifier.

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Zepp-It!

JOSEPH J. CARR, K4IPV

I am convinced that ham interest in different antennas runs in cycles. Recently, I've been getting inquiries on antenna types that were popular in the 1920s through 1940s. Today, we seem to prefer resonant antennas such as the half-wavelength folded dipole. But in earlier times, certain different forms of antennas were popular. Some sources claim that some of these antennas are a bit more efficient than the dipole antenna.

Figure 1 shows the end-fed Zepp antenna. It was quite popular many years ago, and seems to be gaining fans today. It is capable of multiband operation, and I suspect that's one reason for its comeback.

The end-fed Zepp antenna consists of a radiator wire element that is one-half wavelength on the lowest frequency of operation. To research this article, I ran some free-space patterns with the Nittany-Scientific *Nec-Win Basic* antenna modeling program. The end-fed Zepp antenna selected is to be used across all the high-frequency ham bands, from 3.5 to 29 MHz. The physical length of the antenna must, therefore, be one-half wavelength at 3.5 MHz, or L = 468/3.5 = 134-feet long.

The feedline can be any length, so I set it at 50-feet long. There are sometimes some problems tuning this antenna when the feedline is a multiple of a quarter wavelength, so be careful to not set the feedline length inappropriately. The feedline can be made of 600-ohm open parallel transmission line, 300-ohm TV-type twin-lead, or 450-ohm twin-lead (the latter is probably the best bet, for it combines higher power handling capability than 300-ohm twin-lead with the lower losses of 600-ohm twin-lead). Note the odd feedline connections. The feedline has two conductors. One conductor is connected to the wire radiator element. The other conductor, however, is simply tied off to the end insulator—it doesn't go anywhere!

As with other horizontal wire antennas, this one is supported by end insulators and ropes to supports. The supports can be a building, trees, or artificial masts erected for the purpose.

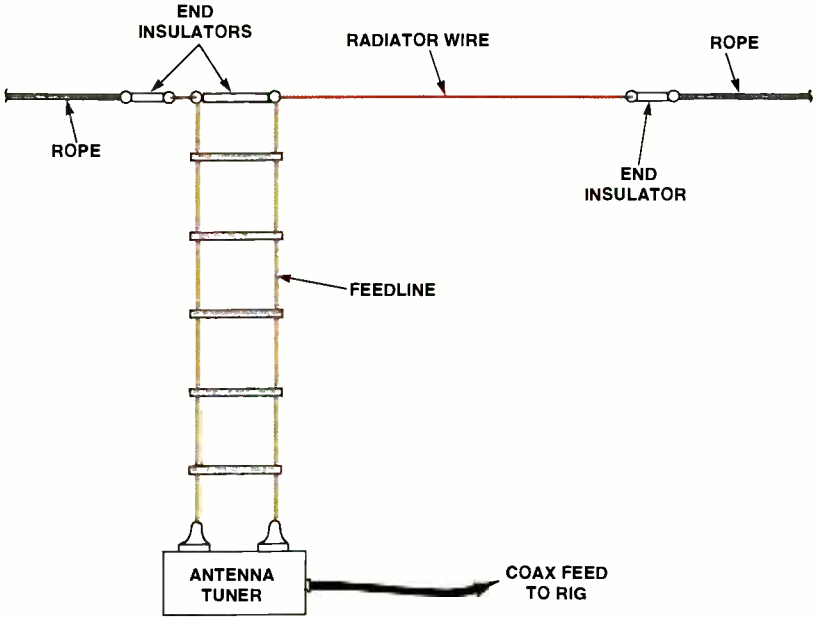

Fig. 1. End-fed Zepp antenna configuration.

ZEPP PATTERNS

Figure 2 shows the azimuthal pattern for the base frequency of the antenna, 3.5-MHz (75/80-meter band). It has the familiar "figure-8" shape that one expects of a half-wavelength horizontal antenna (similar to a dipole pattern). This pattern is characterized by major lobes perpendicular to the antenna wire, and sharp nulls (or "minima") off the ends. Interesting results now follow for some of the selected remaining amateur bands.

When the frequency of operation increases to 7 MHz (40-meter band), we see the pattern of Fig. 3. This pattern splits the two main lobes into two additional lobes, forming a "clover-leaf" pattern. The four main lobes are at angles to the wire. The nulls appear off the ends of the antenna wire and perpendicular to the wire. This antenna is electrically one-wavelength long at 7 MHz.

The surprising pattern is the 10.1-MHz (30-meter) WARC band pattern shown in Fig. 4. This pattern becomes nearly omnidirectional, which is the surprising feature for a horizontal antenna. However, one expects severe distortions of regular patterns at 30-meters because that band is not harmonically-related (1.44λ) to the 3.5-MHz base band for the particular antenna shown in Fig. 1.

When we increase the operating frequency still further to 14 MHz (20-meters), we get the multi-lobed pattern shown in Fig. 5. There are four main lobes at high angles to the wire, and four minor lobes at angles closer to the wire. The gain of the antenna in the main lobes is higher than the gain in the minor lobes. There are also eight nulls, six of which are at angles spaced around the wire, and two of which are perpendicular to the wire.

When excited with a 21-MHz (15-meter) signal, the antenna's pattern really blossoms out into an array of major and minor lobes (Fig. 6). The four "clover-leaf" major lobes are centered about the line perpendicular to the wire, while the eight minor lobes are spaced at various angles around the running length of the wire.

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ANTENNA TUNING UNITS

Many of the antenna tuning units (ATUs) on the market today are coax-to-coax models, and so are unsuited for use on the end-fed Zepp antenna. Select a model that has a balanced output. These can usually be recognized by the existence of a pair of ceramic "beehive" insulators, or similar insulators, on the rear panel of the ATU. Some balanced ATUs are also coax-to-coax (unbalanced) models, but have a balun transformer inside the ATU. Sometimes, the design of an unbalanced ATU allows it to be used with an external balun transformer, so give it a try. Other ATUs are designed as balanced models to begin with, and are suitable for this type of antenna. Indeed, because of the balanced tuning scheme they may be even better.

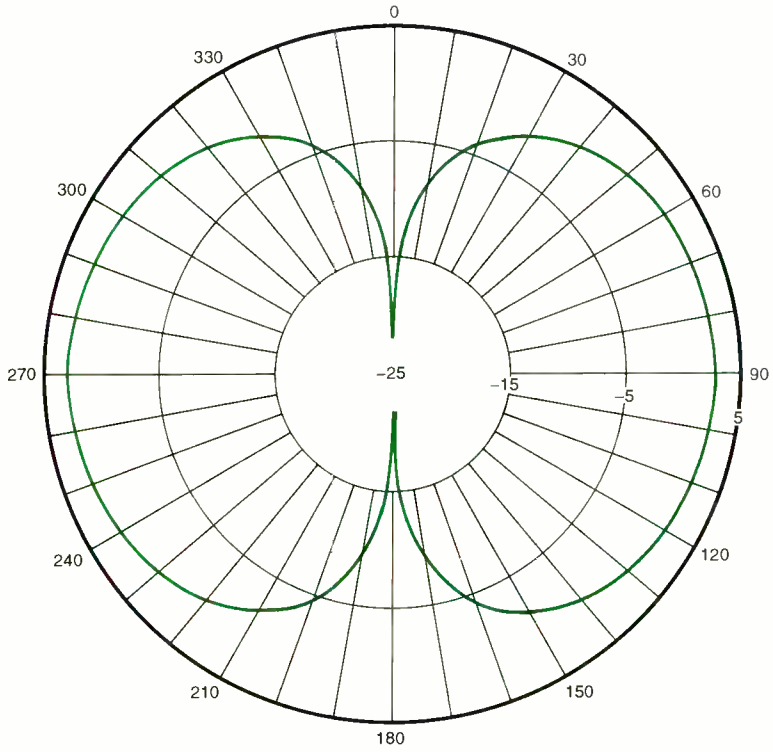

Fig. 2. 3.5-MHz pattern (λ/2 wavelength long).

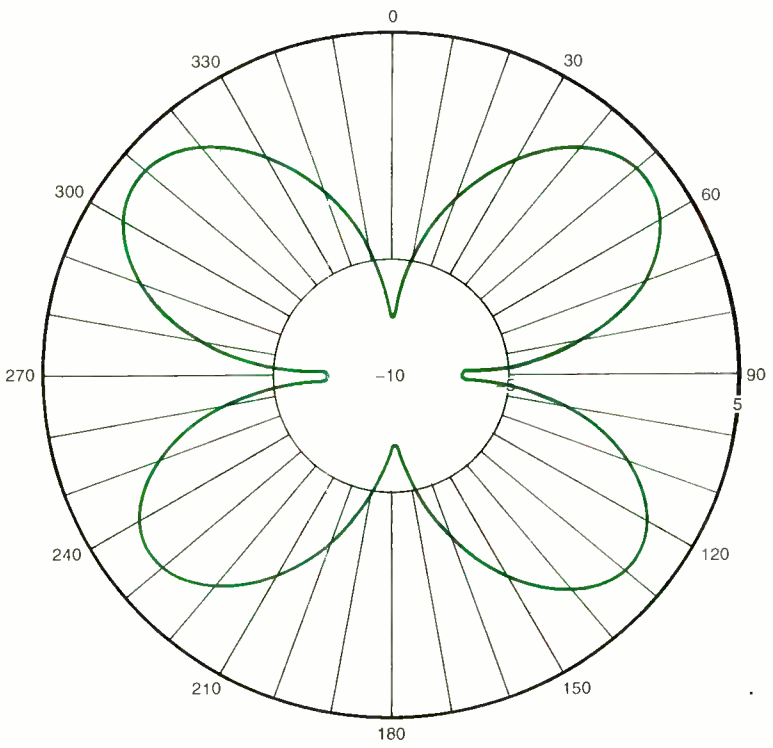

Fig. 3. 7-MHz pattern (1λ wavelength long).

TOOLS AND WHERE TO FIND THEM

A number of times in my electronics project-building career I've needed special size or shaped boxes that were not easily available on the market. In other cases, I've needed shielding materials between sections of a box, or between sensitive sections of a printed-circuit board. The problem is that the normal ham and electronic hobby stores don't carry what I need.

If you go to the type of hobby shops that cater to model builders, you will often find a display of brass sheet metal strips, solid rods, and hollow tubing. These can be formed into squares, rectangles, or other shapes using ordinary tools, and used for shielding or to make custom boxes. Bending can be done on a bench vise, or using pliers.

If you have access to a jeweler's supply store (or lapidary and rock shop), then you also have access to a number of special tools that are also of use to amateur-radio constructors. These tools are used by amateur and professional silversmiths. A jeweler's saw, for example, is a kind of jig saw that can be used to make very intricate cuts, as well as standard straight-across cuts. If you buy one of these saws, I also recommend you buy a book on making silver jewelry in order to learn how to use the saw. Otherwise, you will break a lot of blades learning on your own.

Jewelry supply stores also have tiny drills that can be used to drill fine holes in printed-circuit boards or metal chassis. I've used both the Fordham *Flex-Tool* and the Dremel *MotoTool* for both jewelry and radio constructing. The Dremel (which I actually own) has a large number of accessories that can drill, burnish, grind, cut (you've seen the TV ad—it'll do anything but hammer).

Another little-known, but terribly

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useful tool used by jewelers, is the "parallel-jaw pliers." These pliers look like ordinary heavy-duty flat-jaw pliers, except that the planes on the inside of the jaws remain parallel as the handle is squeezed. If you try to make a bend in a piece of sheet metal with ordinary pliers, then you will find that it is skewed to one side because of the changing angle of the jaws as they close. The parallel-jaw pliers eliminate this problem.

I've also used hobby shops to purchase copper foil. This material can be used to shield small loop antennas, or to form ground planes on perf-board projects, or to form shielding on printed-circuit and perf-boards. I've also used it to make a common ground point for my transceiver and other accessories. The shops that carry copper foil are those that cater to doll-house builders. They use the copper foil to simulate copper roofs on nineteenth-century houses. Most of the type of foil sold by these sources is either straight copper foil in 36- to 40- gauge size, or copper foil backed with paper. In either case, it can be worked with ordinary scissors.

You can also buy copper at metal distributors, but they usually only carry the heavier stuff. I've bought 1-lb/ft^2 copper and used it for the station ground. The copper was mounted as a seven-inch wide strip along the back of the operating desk. A heavy-duty tinned copper braid was then soldered to the copper sheet and routed to the eight-foot ground rod. This type of copper requires large "tin snip" tools to work.

SUMMER ACTIVITIES

If you are working on things like single-band "Worked All States" awards, then summer offers some interesting possibilities. During the summertime, we see an odd mixture of long and short skip on the upper bands. Both 10-meters and 15-meters will show long skip (transcontinental and intercontinental) at times, and short skip (200-500 miles) at others. I live in northern Virginia, near Washington, D.C. During the summer months I can work Pennsylvania and North Carolina on 10-meters. At other times of the year, 10-meters gives me either local activity (a few miles) or South America—North Carolina is out of the question. Indeed, I've seen a case on 15-meters where a ham in Lima, Peru had to relay between myself and a buddy in South Carolina. We were only about 450-500 miles apart, but needed a station thousands of miles distant to make the connection between us.

NEW BOOK ON RADIO-SCIENCE OBSERVING

Several years ago I started writing about subjects like radio astronomy, propagation studies, whistler and

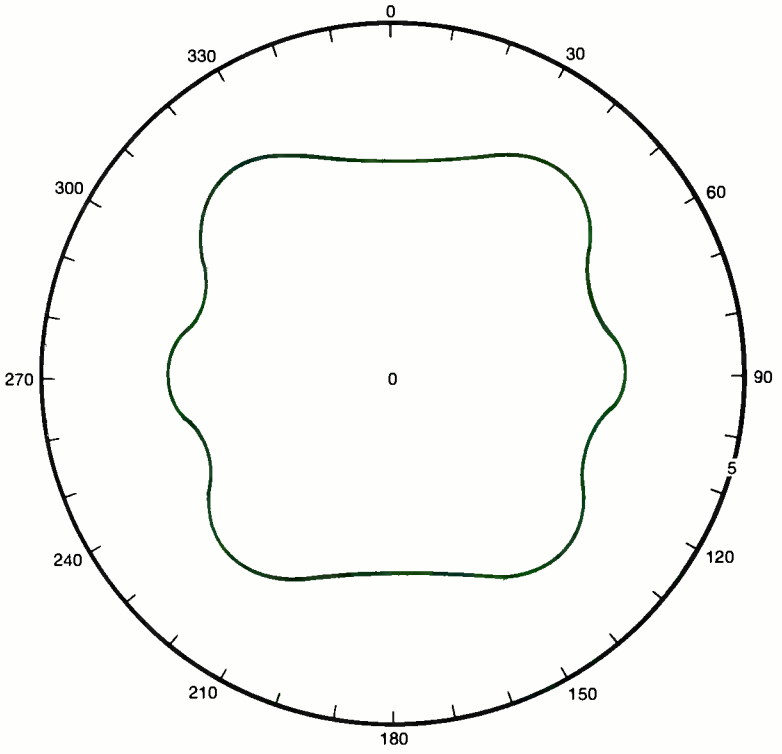

Fig. 4. 10.1-MHz pattern (1.44λ wavelength long).

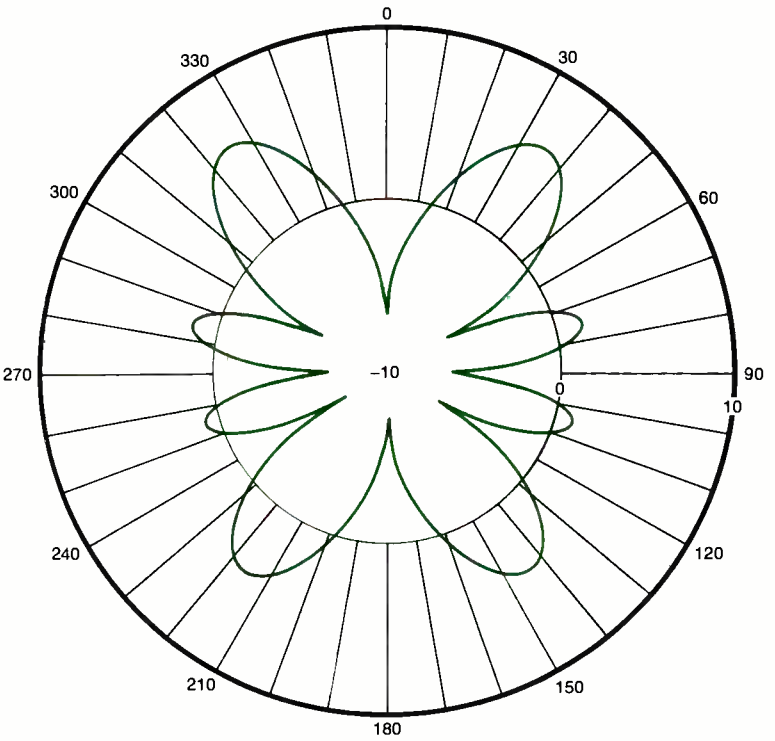

Fig. 5. 14-MHz pattern (2λ wavelengths long).

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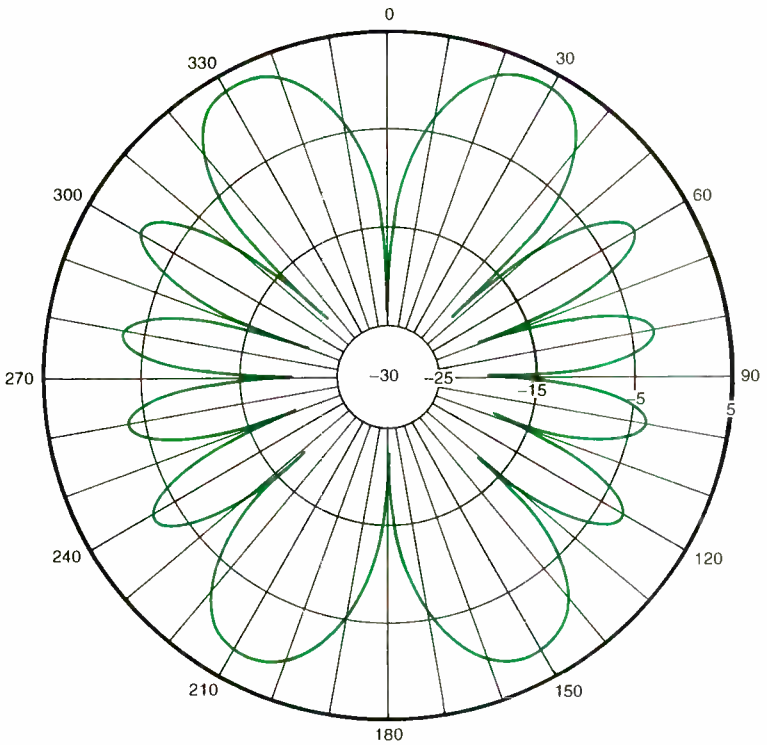
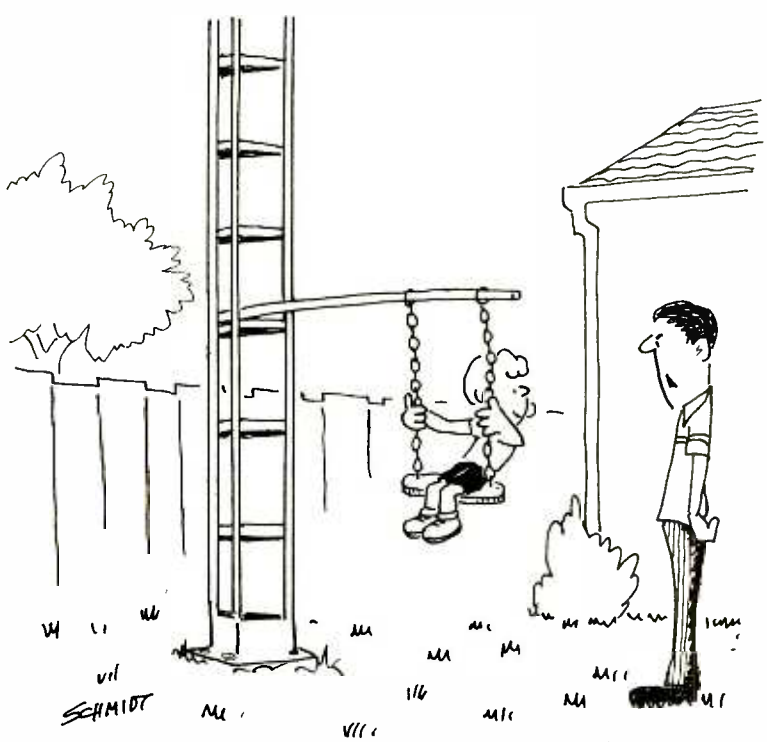


Fig. 6. 21-MHz pattern (3λ wavelengths long).

spheric hunting, VLF SID hunting, reception of Jupiter's natural radio signals, and so forth. I coined the term "radioscience observing" to cover all such activities. My new book on these topics is now out. Howard W. Sams/PROMPT Publishing (Tel. 800-428-7267) has released *RadioScience Observing-Volume 1* (ISBN 0-7906-1127-9, $29.95). The book includes a CD-ROM software program that performs antenna dimensions calculations, plus gives examples of natural radio sounds (not to mention some original music composed by my wife, Bonnie, that incorporates whistler and pulsar sounds).

Comments? I can be reached by snail mail at P.O. Box 1099, Falls Church, VA, 22041, or by E-mail at carrjj @aol.com. ■



"I don't care what Mommy said—down you go!"

ANTIQUE RADIO

(continued from page 51)

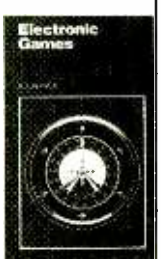
mentioning that several familiar 6-volt civilian tubes were re-released with 12-volt heaters more compatible with the electrical systems of military vehicles and aircraft. Examples include the 12K8 converter and 12SR7 diode/triode. A whole new range of 12-volt Loctal tubes also emerged to meet military needs. The designations of these tubes began with the number 14 (example: 14C7), which is consistent with the "7" used in the designation of the original Loctal tubes having half the heater voltage.

AFTER THE WAR

The coverage of this article really stops with the war years, which closed the "classic radio" era. However, a few general trends could be mentioned. The seven-pin miniature family, later joined by a 9-pin style, would be expanded to include 6-volt types as well as the higher-voltage versions needed for AC-DC sets. Eventually, these miniatures would almost totally replace octal and loctal tubes.

More 12-volt types would be developed for use on the new 12-volt auto electrical systems. And the coming of TV would bring multiple-tube series-string sets with heaters operating from voltages never seen before, such as the 8BM11, 9A8, 10JY8, and 11MS8. ■

ELECTRONIC GAMES



BP69—A number of interesting electronic game projects using IC's are presented. Includes 19 different projects ranging from a simple coin flipper, to a competitive reaction game, to electronic roulette, a combination lock game, a game timer and more. To order BP69 send **$8.00 (includes s&h)** in the US and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.** US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. MA07

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Electronics Library

WINDOWS 95 EXPLAINED

by P.R.M. Oliver & N. Kantaris

Written with the non-expert, busy person in mind, this book is designed to help you get your Windows 95 operating system up and running as soon as possible. It explains the hardware you need to run Windows 95 successfully, as well as how to install and optimize your resources. An overview of the Windows 95 environment is also presented.

The material is organized on a "what you need to know first, appears first" basis, although readers don't have to start at the beginning and go through right to the end. Each section is self-contained, so the more experienced user can start anywhere.

Later chapters cover how to work with programs, folders, and documents; how to control Windows 95 and use the many accessories that come with it; how to use DOS programs and, if necessary, DOS commands; and how to communicate with the rest of the electronic world.

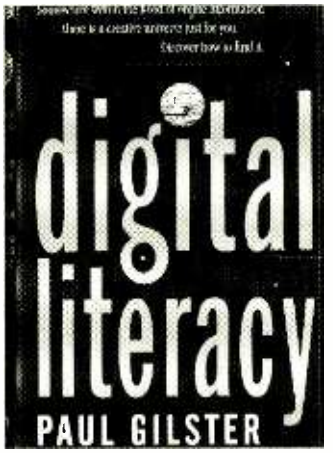
Windows 95 Explained (Order No. BP400) costs $10.99 plus $3.00 shipping and handling and is published by Electronic Technology Today, P.O. Box 240, Massapequa Park, NY 11762-0240.

CIRCLE 90 ON FREE INFORMATION CARD

DIGITAL LITERACY

by Paul Gilster

The Internet is easier to use than ever, but using it requires a different way of thinking according to the author. He calls this new mindset digital literacy. Without these new thinking skills, Internet users may not be able to take full advantage of this medium. The book provides Internet novices with the basic thinking skills to thrive in an interactive environment that differs radically from passive media such as television or print.



Readers are shown how to evaluate sources of information found in news groups, bulletin boards, and other online sources, as well as how to focus search strategies. The book leads you through hypertext and hypermedia tools, explaining methods to map a path through the wealth of information found on the Internet.

Questions to be asked when viewing a Web site are discussed, as are ways of separating form from content. Other topics covered are how to integrate the Web's massive flow of information into one's every day business and personal life, and a brief glimpse of the future of digital literacy.

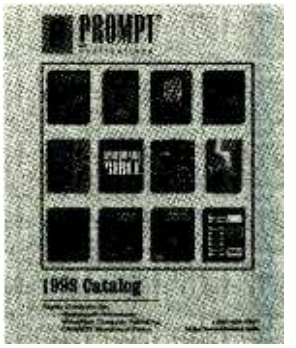
Digital Literacy costs $22.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-225-5945: Web: www.wiley.com.

CIRCLE 91 ON FREE INFORMATION CARD

1998 PUBLICATIONS CATALOG

from Prompt Publications

Hundreds of best-selling titles from Prompt Publications, Butterworth-Heinemann, Macmillan Computer Publishing, and UCANDO Educational Videos are presented in this catalog. Aimed at hobbyists, students, and professional technicians, some of the new publications coming out in 1998 are *Complete Guide to Audio* from Prompt, *Laser Technology*—an educational video from UCANDO, and *Surface Mount Technology Terms & Concepts* from Butterworth-Heinemann. Along with many new books, there are updated editions—second editions of *Real-World Interfacing with Your PC* and of *Power Supplies*, as well as the sixth edition of *Modern Dictionary of Electronics* and the eighth edition of Macmillan's *Upgrading and Repairing PCs.*



Concentrating on technical books for both the novice and the experienced electronics technician, Prompt has published more than 100 books in its first seven years, and has another 30 scheduled for 1998. Prompt's Web site provides complete book summaries, new release dates, and other information.

The 1998 Publications Catalog is free upon request and is published by Prompt Publications, Howard W. Sams & Company, 2647 Waterfront Parkway, East Drive, Indianapolis, IN 46214-2041; Tel. 800-428-7267 or 317-298-5400; Fax: 317-298-5604; Web: www.hwsams.com. ■

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NEW PRODUCTS

LCD PROJECTOR

Designed specifically for field sales forces and corporate training, the latest addition to *Sharp's* line of portable, multimedia LCD projectors, the *NoteVision2* (*XG-NV2U*) incorporates many enhancements not found in the first generation of Notevisions. The XG-NV2U features XGA compression, as well as global compatibility with its international power supply and tri-standard video input (NTSC/PAL/SECAM).

Users can display images on screen sizes up to 300-inches diagonal, even in less than ideal lighting conditions, because of the unit's 500 ANSI lumens brightness. Since the user-replaceable UHP lamp requires less power and cooling, the projector has a smaller footprint, a reduced weight (under 13 pounds), longer life, and less fan noise.

For greater flexibility, Notevision2 has two separate computer and video inputs, a built-in stereo audio system, a 1:1.6 zoom lens, and an integrated presentation remote with built-in wireless mouse and laser pointer.

The XG-NV2U NoteVision projector has a suggested list price of $7495. For more information, contact Sharp Electronics Corporation, Professional LCD Products Division, Sharp Plaza, Mahwah, NJ 07430-2135; Tel. 888-523-7427; Fax: 201-529-9636; E-mail: ProLCD@SharpSEC.com; Web: *www.sharp.usa.com.*

CIRCLE 80 ON FREE INFORMATION CARD

STEREO NOISE FILTER AND COMPRESSOR

An advanced stereo dynamic noise filter and compressor, the *Model SSM2000* reduces noise by a combination of variable dynamic frequency filtering plus a downward expansion to achieve a signal-to-noise ratio improvement of 25 dB from any line-level source material: disc, FM, AM, TV, tape, CD and PC multimedia. The downward expander uses a Voltage-Controlled Amplifier (VCA) to force amplifier gain to fall off at an increasing rate below a threshold value. This technique reduces noise during fadeouts or low signal passages to maintain the noise floor well below the program material. The dynamic noise filter also uses a Voltage-Controlled Filter (VCF) to adjust the amplifier bandwidth to further reduce the noise floor. In addition, the amplitude of the noise floor is detected to automatically adapt the VCA and VCF threshold without fumbling with the setting of user controls.

The Compressor attenuates larger amplitude signals above a user-defined threshold to level the volume of the processed material. Attenuation of loud TV commercials and loud program material are some applications where this feature is particularly useful.

Front-panel controls consist of three switches: a slide compressor Threshold level with a separate Enable switch and LED indicator; a TV, FM, or Audio Filter switch; and an A/B comparison switch. It also contains an LED bargraph of the VCF response to indicate the instantaneous bandwidth and normal operation.

The SSM2000 should be installed after any signal preamplifiers and before any volume controls, tone controls, or equalizers. It is designed to handle line-level signals from 100 mV_{rms} to 1 V_{rms}. Housed in a black case ($5^1/_4$- by 5- by $1^1/_2$- inches), the unit is priced at $125, plus $5 for shipping in the U.S. and Canada. Illinois residents, please add 7.5% sales tax. For more information, contact Vista, Box 1425, Bolingbrook, IL 60440; Tel.630-378-5534.

CIRCLE 81 ON FREE INFORMATION CARD

CLAMP-ON MULTIMETER

The advanced Hall-Effect technology enables the *AC68* multimeter from *Wavetek* to measure both AC and DC current, as well as frequency, through its jaws. The non-invasive clamp method allows for quicker and safer current measuring without disruption of circuitry or service interruption.

A full digital multimeter, it is suitable for electronics professionals, such as electricians, electrical contractors, and plant and maintenance staff. Ideal for numerous work environments, including the electrical shop in industrial and commercial establishments, the *AC68* is invaluable for installing and servicing a broad range of AC/DC systems.

Measurement capabilities of the clamp-on multimeter include AC/DC current to 600A, AC/DC voltage to 600V, frequency to 20kHz, resistance to 4000 ohms, and continuity and diode tests. It features data hold, AC peak hold, DC zeroing, and thirty-minute auto-off. The unit comes equipped with carrying case, premium

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test leads, and 9V battery.

The AC-68 Clamp-On Multimeter is priced at $199. For more information, contact Wavetek Corp., Instruments Division, 9405 Balboa Avenue, San Diego, CA 92123; Tel. *800-854-2708 or* 619-279-2200; Fax: 619-565-9558; *Web: www.wavetek.com.*

CIRCLE 82 ON FREE INFORMATION CARD

PALM-SIZE HANDHELD TRANSCEIVER

With a height of about four inches, the palm-size *IC-T7AHP Dual-Band FM Transceiver* from *ICOM America* is designed for convenience and easy operation. The well-spaced keyboard comes with a "thumb touch" lock switch and "single push action" feature selection. Push once for the primary function; push again for the secondary function. Change bands by depressing the band key to toggle between two meters and 440 MHz.

Storing up to 70 channels in any combination of VHF or UHF frequencies, this handheld has nine DTMF memories for auto dialing. The IC-T7AHP also provides 50 separate encode and decode frequencies as well as a tone-scan function for easy sub-audible tone selection. The large alphanumeric display offers easy access to information such as remaining battery voltage. It comes standard with a BP-173 battery pack enabling it to have four watts of output power.

The IC-T7AHP Dual-Band FM *Transceiver* has a suggested list price of $330. For more information, contact ICOM America, Inc., 2380 116th Avenue NE, Bellevue, WA 98004; Tel. 425-454-8155; Web: *www.icomamerica.com.*

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COMPUTER BITS

(continued from page 45)

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Atmel Corporation
2325 Orchard Parkway
San Jose, CA **95131**
Tel. 408-441-0311
Web: *www.atmel.com.*

MVS
Box 850
Merrimack, NH 03054
Tel. 508-792-9507
Web: *www.star.net/people/~mvs*

LISTING 1—MV1200 TEST PROGRAM

```
a=0
b=0
10 inp a
b=b+128
a=a+b
parout a
sleep 32
goto 10
```

You write MVS BASIC programs using an ASCII text editor. Then you "compile" that file using a program called BTOKE. BTOKE both compiles your program and downloads it to an *MV1200.* BTOKE is not a true compiler. According to the documentation, it produces tokenized code that the on-chip interpreter interprets and executes. BTOKE is an annoying beast. For one, it won't run under NT. Second, it appears to have no concept whatsoever of diagnostic or error messages. So, debugging MVS BASIC programs can be challenging.

Table 1 summarizes MVS BASIC commands. The columns labeled A and B indicate to which architecture each command applies: the bit-level hardware of Fig. 1A or the virtual ports of Fig. 1B.

Incidentally, the table presented here corrects several errors in MVS's documentation. In particular, the *if* conditional statement doesn't actually use the *goto* keyword. The documentation says to use it, but if you do, the code doesn't work—and the compiler doesn't complain.

Note that MVS basic supports 8-bit unsigned integer arithmetic, has no multiply or divide functions, has no support for strings, no conversion functions (*e.g.*, CHR or ASC), and supports only eight 8-bit variables, labeled A—H. Also, because the serial ports are implemented in software, bit rate is limited to 19.2K maximum. And BASIC provides no direct support for the built-in A/D hardware.

Internally, the BASIC interpreter uses all the FLASH memory; user programs are downloaded to the 64-byte EEPROM. BASIC tokens are four-bits wide, so there is a theoretical maximum of 128 instructions, although the practical limit is more like 100. BASIC program execution is going to be slow, regardless of the speed the IC actually runs at, because accessing EEPROM takes several instructions per location. However, even given all those limitations, it is possible to do some interesting things with the *MV1200.*

Listing 1 shows a simple test program you can use to verify basic I/O functionality of the chip. The program uses the circuit of Fig. 3. Basically, the program just reads the contents of Port D and writes the corresponding value to Port B, waits half a second, and loops. By toggling the switches, you should be able to change the state of the first seven (bits 0–6) LEDs. The eighth LED changes state by itself. (How? Hint: what does variable B do in the program?)

Here's an exercise for the reader: Reverse the connections, so that the switches are connected to Port B, and the LEDs are connected to Port D—then rewrite the program to function similarly. Got that? See you next time or contact me at jeff@ingeninc.com. ■

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CIRCUIT CIRCUS

Keying Circuits

CHARLES D. RAKES

Hello Circuiteers! This visit we're going to look at a number of simple, and useful, electronic keying circuits. But before we get into the circuitry, I would like to give out my e-mail address so you can send me your comments and circuit suggestions—e-mail me at cdrakes@ipa.net. Of course you can still send snail-mail to me at **Popular Electronics**, *Circuit Circus*, 500 Bi-County Blvd., Farmingdale, NY 11735.

Electronic keying is used in many circuit applications to turn on, or off, associated circuitry. In some applications, the keying circuit is tailored to produce a soft- or hard-keyed output. For example, in a modern transceiver, the microphone push-to-talk or voice-operated (VOX) break-in switch, or the CW key in amateur radio equipment, controls numerous circuits, both in the transmitter and receiver simultaneously. Computer keyboards, telephones, calculators, remote controls, radios, TVs, and just about anything else that uses electronics, has a key pad input. That's how we interact with the electronic world.

KEYING CIRCUIT WITH SHAPING COMPONENTS

Our first keying circuit, see Fig.1, uses a single 2N2222A general-purpose NPN transistor as a solid-state switch. Transistor Q1's collector takes the connected circuitry to ground when the key is closed. The RC network at the base of the transistor "softens" the switching effect of the transistor action. This softening effect essentially shapes the sharp envelope of the turn-on waveform by increasing its rise time.

Closing the key sends current through R1 to the base of Q1. But before Q1 can turn on, C1 must charge up to approximately 0.6 volts. The charging time is determined by the values of R1 and C1, and the discharge time by the values of C1, C2, R1, and R2. To extend the soft turn-on time, increase the value of C1. The soft turn-off time will also be increased with the larger value of C1. To shape the turn-off characteristics, without affecting the turn-on function, increase the value of C2. The more energy that C2 contains, the longer Q1 will remain on after the key is returned to the up position. The soft turn-on feature occurs when the transistor is going from the off condition to the on condition, in the linear portion of the gain curve. The soft turn-off feature occurs when the transistor is going through the linear portion of its gain curve near its turn-off point.

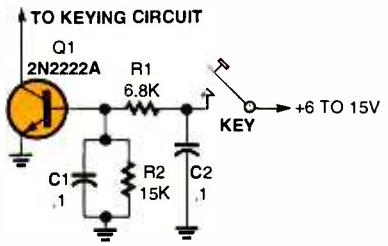

Fig. 1. When the key is closed, this simple circuit switches the keying circuit to ground. The RC values are chosen to provide the proper shaping of the switched waveform.

PARTS LIST FOR KEYING CIRCUIT WITH SHAPING COMPONENTS (FIG. 1)

C1, C2—0.1-μF, 50-WVDC, ceramic-disc capacitor
Q1—2N2222A NPN general-purpose transistor (NTE123A, SK3444, or equivalent)
R1—6800-ohm, 1/4-watt, 5% resistor
R2—15,000-ohm, 1/4-watt, 5% resistor
Key—Any type of single-pole switch, *etc.*

This type of on-off keying circuit is used in low-power amateur radio CW transmitter circuits to shape the RF output waveform for a pleasant-sounding signal at the receiving end. With no shaping, the sharp rise time ("make") and fall time ("break") of the transmitted signal may generate unwanted sidebands around the carrier signal, or "key clicks," since such sidebands sound like clicks to a station listening away from the signal frequency, and can cause objectionable interference to other stations.

The circuit in Fig. 1 can handle current levels up to 100 mA or more, as long as the transistor's linear switching time is not too long. Adding a heat sink to Q1 will help keep things cool at higher current levels. If more output current capacity is required, select a higher current transistor. If a power transistor is used in place of Q1, be sure to adjust the value of R1 to supply sufficient base current needed for the new output current level.

POSITIVE-VOLTAGE KEYING CIRCUIT—USING PNP TRANSISTOR

Our next keying circuit, see Fig. 2, supplies a positive voltage to the output when the key is closed. Q1, a 2N3906 general-purpose PNP transistor, is connected in series with the positive DC source and the connected circuitry to be keyed. With the key open, no base current flows, and the transistor switch is like an open circuit. Closing the key supplies base current, which switches Q1 on, connecting the positive supply voltage to the output. This circuit produces a hard-keyed output. To soften the output, capacitors may be added between Q1's base and

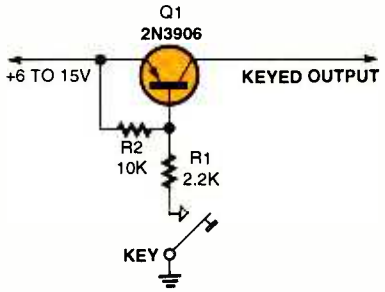

Fig. 2. This circuit drives the keyed output circuitry to the positive supply voltage when the key is closed.

PARTS LIST FOR POSITIVE-VOLTAGE KEYING CIRCUIT—USING PNP TRANSISTOR (FIG. 2)

Q1—2N3906 PNP general-purpose transistor (NTE159, SK3466)
R1—2200-ohm, 1/4-watt, 5% resistor
R2—10,000-ohm, 1/4-watt, 5% resistor
Key—Any type of single-pole switch, *etc.*

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emitter, and across the key. Same rules apply here on shaping factors, delays and component values as on our first circuit.

POSITIVE-VOLTAGE KEYING CIRCUIT—USING NPN TRANSISTOR

Another positive keying circuit is shown in Fig. 3. A 2N2222A general-purpose NPN transistor transfers power to the output, when the key is closed. Both keying circuits in Figs. 2 and 3 can be modified to transfer more power to the output load by changing Q1 to a medium or high-power transistor.

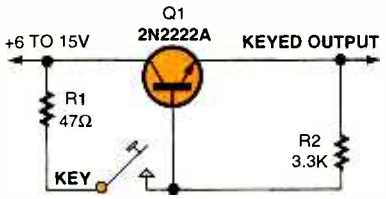

Fig. 3. Similar to Fig. 2, this is a positive-voltage keying circuit, but using a NPN transistor as the switch.

PARTS LIST FOR POSITIVE-VOLTAGE KEYING CIRCUIT—USING NPN TRANSISTOR (FIG. 3)

Q1—2N2222A NPN general-purpose transistor (NTE123A, SK3444, or equivalent)
R1—47-ohm, 1/4-watt, 5% resistor
R2—3300-ohm, 1/4-watt, 5% resistor
Key—Any type of single-pole switch, *etc.*

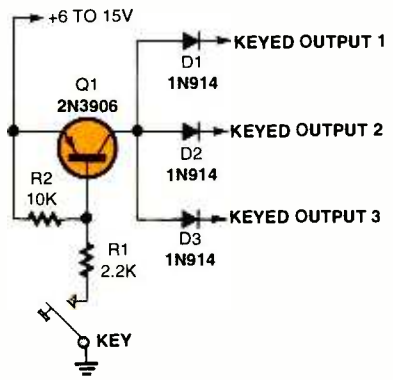

Fig. 4. Three isolated keyed outputs are provided using this circuit when the key is closed.

MULTIPLE-OUTPUT KEYING CIRCUIT

The keying circuit, in Fig. 4, is basically the same as the circuit in Fig. 2, but with isolated multiple outputs. Often a keying circuit must be able to key several different circuits simultaneously and not have interaction between any of the keyed circuits. Adding 1N914 switching diodes to the basic circuit of Fig. 2 allows the three circuits to have power applied at the same time, yet remain isolated from one another. The circuit can be modified to handle higher power loads by changing Q1 to a power transistor and D1–D3 to higher current diodes.

PARTS LIST OF MULTIPLE-OUTPUT KEYING CIRCUIT (FIG. 4)

D1–D3—1N914 silicon-switching diode
Q1—2N3906 PNP general-purpose transistor (NTE159, SK3466, or equivalent)
R1—2200-ohm, 1/4-watt, 5% resistor
R2—10,000-ohm, 1/4-watt, 5% resistor
Key—Any type of single-pole switch, *etc.*

GROUNDING ONE SIDE OF THE KEY

In some circuits, the actual key must, for either circuit requirements or safety reasons, always have one side tied to circuit ground. The circuit in Fig. 5 is a modification of the circuit in Fig. 1, which allows one element of the key to be tied to ground. Transistor Q1, with the key open, is biased on with its collector at near-ground level.

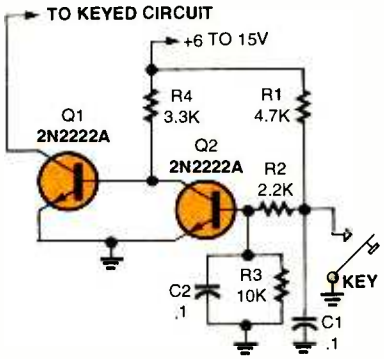

Fig. 5. Need to have one side of the key always tied to ground? Use this switching circuit to key the output.

PARTS LIST FOR GROUNDING ONE SIDE OF THE KEY (FIG. 5)

C1, C2—0.1-µF, 50-WVDC, ceramic-disc capacitor
Q1, Q2—2N2222A NPN general-purpose transistor (NTE123A, SK3444, or equivalent)
R1—4700-ohm, 1/4-watt, 5% resistor
R2—2200-ohm, 1/4-watt, 5% resistor
R3—10,000-ohm, 1/4-watt, 5% resistor
R4—3300-ohm, 1/4-watt, 5% resistor
Key—Any type of single-pole switch, *etc.*

The base of Q2 is also near ground, and no collector current flows. Closing the key to ground removes the bias from Q2, allowing all of the current through R4 to flow into the base-emitter junction of Q2, turning it on and pulling the keying circuit to ground. Shaping of the output keying has also been included in this circuit.

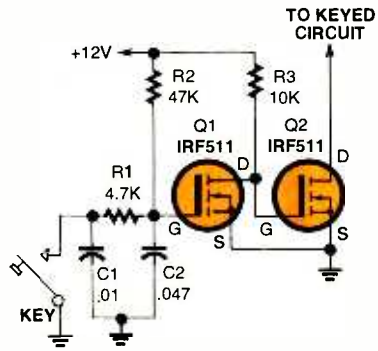

Fig. 6. This keying circuit uses high-power MOSFETs to switch higher current levels in the keyed circuit.

PARTS LIST FOR HIGH-POWER KEYER CIRCUIT (FIG. 6)

C1—0.01-µF, 50-WVDC, mylar capacitor
C2—0.047-µF, 50-WVDC, mylar capacitor
Q1, Q2—IRF511 N-channel MOSFET transistor (NTE66, SK9165, or equivalent)
R1—4700-ohm, 1/4-watt, 5% resistor
R2—47,000-ohm, 1/4-watt, 5% resistor
R3—10,000-ohm, 1/4-watt, 5% resistor
Key—Any type of single-pole switch, *etc.*

HIGH-POWER KEYER CIRCUIT

A high-power MOSFET keyed circuit is shown in Fig. 6. This circuit is similar to our previous grounded keying circuit, but can handle higher current levels without requiring large base currents, as would be required when using power transistors. The timing of the soft-keying feature of this circuit may be varied by changing the values of C1 and C2. Increasing the value of C1 and/or C2 adds delay to the turn-on time as well as the turn-off time. The best way to vary the soft-keying action is to leave C1 at its stated value, and vary with the selection of C2. Also R3 can be varied to change the timing feature. Use higher resistance values for longer delays and lower values for shorter delays. Keep the values of R2 between 10k and 1 megohm.

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OPTICALLY-COUPLED KEYING CIRCUIT

On occasion you'll come across a circuit that requires the keying circuit to be electrically isolated from the circuit it controls. Isolation between power sources is one place this type of keying circuit is used. One method that works well is to use an optocoupler as the isolating device between the keying circuit and the circuit it controls. The circuit in Fig. 7 uses a 4N25 NPN transistor-output optocoupler to separate the key from the control circuitry. A 4N35 is another optocoupler that works just as well and can handle a little more power.

When the key is closed, the optocoupler's LED turns on, causing the optocoupler to conduct and supply bias for the transistor. Transistor Q1 switches on, pulling the connected circuitry to ground. This type of keying circuit can be used to control AC circuits by using an optocoupler with an SCR or triac output.

As in the other keying circuits, this one can be modified to handle higher current loads using a power transistor or, better yet, switching to an IRF511 MOSFET. The MOSFET can replace Q1 without any circuit component changes. Just connect the MOSFET's gate to pin 4 of Q1, its drain to the positive key circuit (output), and the source to circuit ground. To control even higher current, or higher voltage loads, choose a MOSFET to match the load requirements.

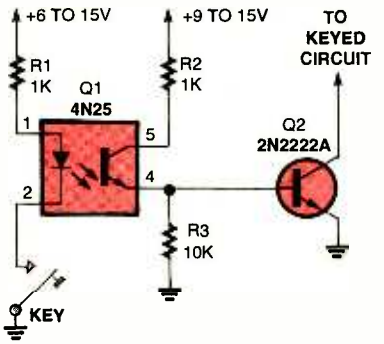

Fig. 7. For complete isolation between the key and keyed circuit, this circuit features an optocoupler to drive the 2N2222A switching transistor.

PARTS LIST FOR OPTICALLY-COUPLED KEYING CIRCUIT (FIG. 7)

Q1—4N25 optocoupler IC (NTE3040, SK2040, or equivalent)
Q2—2N2222A NPN general-purpose transistor (NTE 123A, SK3444, or equivalent)
R1, R2—1000-ohm, 1/4-watt, 5% resistor
R3—10,000-ohm, 1/4-watt, 5% resistor
Key—Any type of single-pole switch, *etc.*

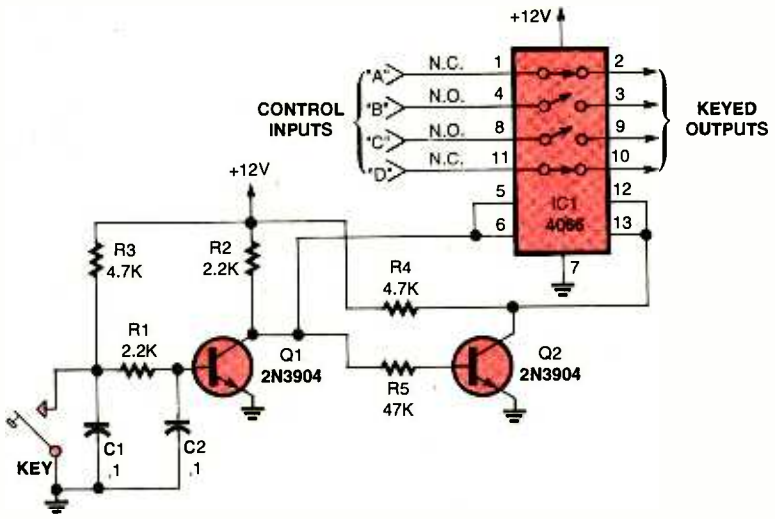

Fig. 8. This circuit uses the 4066 quad bilateral switch IC to control four different AC signals simultaneously. Lines "A" and "D" are switched through the IC when the key is open. Closing the key opens the "A" and "D" paths and closes the "B" and "C" paths between the inputs and the keyed output circuits.

PARTS LIST FOR QUAD-KEYED CIRCUIT (FIG. 8)

C1, C2—0.1-µF, 50-WVDC, mylar, or similar capacitor
IC1—4066 quad bilateral switch IC (NTE4066B, SK4066B, or equivalent)
Q1, Q2—2N3904 NPN general-purpose transistor (NTE 123AP, SK3854, or equivalent)
R1, R2—2200-ohm, 1/4-watt, 5% resistor
R3, R4—4700-ohm, 1/4-watt, 5% resistor
Key—Any type of single-pole switch, *etc.*

QUAD-KEYED CIRCUIT

Our last keying circuit is shown in Fig. 8. This keyer is similar to the basic keying circuit in Fig. 5, with the addition of a quad bilateral switch IC. Using the versatile 4066 quad electronic switch allows the keying circuit to control four different AC signals simultaneously. The circuit, with the key up, has Q1 biased on with its collector at near ground level. IC1's control pins 5 and 6 are low, keeping switches "B" and "C" of IC1 open. Q2's collector is near 12 volts and IC1's control pins 12 and 13 are high, thereby closing switches "A" and "D." Closing the key reverses the position of the four switches, with "B" and "C" closing and "A" and "D" opening.

These simple keying circuits are build-block circuits that, hopefully, will find a way into one of your future projects. Looks like it's time to key-off for now. Good circuitry until we meet here again next month. ■

NET WATCH

(continued from page 16)

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Another neat feature is that each of the programs is rated with a duck scale. The more little ducks you see, the better a product is, kind of like the star rating used for motion pictures. But even if they didn't have the duck rating, I wouldn't complain. Let's not be too picky; after all, these programs are free.

As always, if you've got a question or comment, feel free to e-mail me at netwatch@comports.com, or send a good-old USPS letter (yes, I'll read those too) to Net Watch, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

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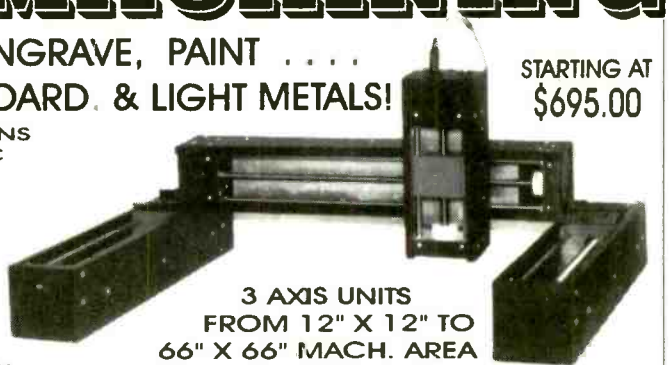

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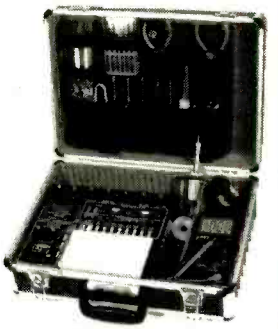

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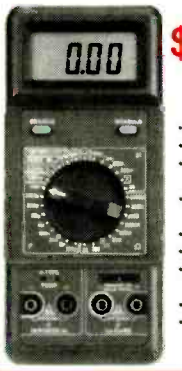

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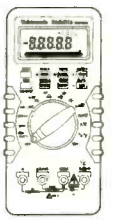

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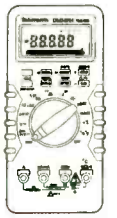

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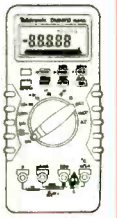

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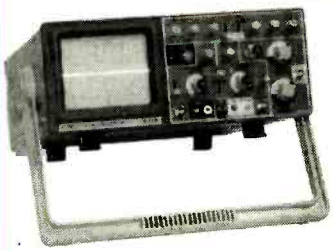

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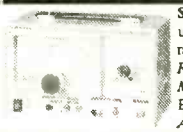

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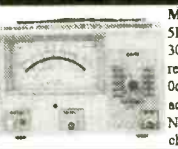
AC MILLIVOLT METER



MV-3100A $159.95 wide band 5Hz~1MHz; 3 scales, mV, dB &dBm; 300μV~100V in 12 ranges, 10μV resolution; -70~40dB in 12 ranges, 0dB=1Vrms,0dBm=0.755V); ±3% accuracy, Input impedance 10MΩ; Noise <2%. **MV-3201B $309.95** dual channels, simultaneous measurement.

OSCILLOSCOPES

OS-7305B $249.00 DC~7MHz, 3" CRT; *Horz:* .25V/div, 10Hz~100KHz in 4 ranges; *Vert:* 10mV/div, Int. & Ext. Sync.; *Input:* 1MΩ/35pF.
OS-7010A $299.95 10MHz, 5"CRT, *Horz:* .2V/div, *Vert:*10mV~10V /div.
OS-622G $389.95 20MHz, 2 CH/X-Y Alt trigger, trigger lock, hold OFF, TV syn., 8x10 div., 1mV/div., *Horz:* .2μs~.5s/div; *Vert:* 1mV~5V/div.
OS-653G $699.95 50MHz, 2 CH/delay sweep, Alt trigger, TV syn.
OS-6101G $1499.95 100MHz, 4ch/8 traces, delay sweep, cursor readout. *2 years warranty for OS-622G, OS-653G, & OS-6101G.*

UHF ATTENUATORS

RT-8815U (50Ω) $299.00 / RT-8817U (75Ω) $299.00, 950MHz, 81dB, 0.5W max.; *Steps:* 1/2/3/5/10/20/20/20, 8 switches.
085E-2 (50Ω) $399.00 / 087E-2 (75Ω) $399.00, 950MHz, 81dB, 0.5W max.; *Steps:* 10dB+7.1dBx10, Electronic adjustment knob.

MICROPROCESSOR TRAINER

BGC-8088 $699.00, learn computer theory. Excellent for school & individual who want to learn about ROM, RAM, I/O ports, programming, & run a 8088 Microprocessor. An easy to understand step-by-step manual guides you to achieve your goal. 56-key keyboard, LCD display, RS-232, UART.

GRID DIP METER

DM-4061 $89.95 1.5-250MHz, 6 bands; 6 plug-in coils, 2 transistor, and 1 diode.
Modulation: ≈ 2KHz Sinewave.
Crystal Oscillator: 1-15MHz.
Wave absorption meter. 9VDC battery.

FREQUENCY COUNTER

FC-5250C $119.95 10Hz-220MHz. (HF)10Hz-20MHz, (VHF)10-200MHz. *GateTime:* .1, 1sec. *Max. Input:* $10V_{p.p.}$ *Input Sensitivity:* 35mV/10Hz-200MHz *Input Imped.:* 1MΩ(HF), 50Ω(VHF). *Display:* 7-digit LEDs; 9V adapter ($6)

FC-5260A $129.95
10Hz-600MHz. 7-digit LEDs.
FC-5270 $149.95
10Hz-1.2GHz, 8-digit LEDs.
FC-5600B $229.95
10Hz-600MHz; 10-digit LEDs.
FC-5700 $299.95 10Hz~1.3GHz; 10-digit LEDs. Period measure.

SIGNAL TRACER/INJECTOR

($ Reduction!) SE-6100 ~~$134.95~~ $89.95
TRACER: Gain 60 dB maximum. *Attentuation:* 0/20/40/60dB
Input Imped: 100KΩ; *Meter:* Vu 100μA
Output Imped: 600Ω; *Speaker:* 8Ω
INJECTOR: =1KHz Squarewave;
Output Level: Variable 0~$4.5V_{p.p}$; 9V battery or adapter ($6.00)

LCR METERS

MIC-4070D $179.95, *Induct.*: 0.1μ~200H, *Capacit.*: 0.1p~20mF, *Resist.*: 1mΩ~20MΩ, 2Ω range, Dissipation factor measurement, Zero adjust, Surface mount device (SMD) test probe: **LT-06 $21.95**

DIGITAL MULTIMETER

DMM-120 $24.95, 3½ digit, 600VDC, 2ADC 500VAC, 2MΩ, hFE/diode/continuity test; 1.2%
DMM-123+Capacitance $44.95, 3½ digit, 600VDC/600VAC, 10ADC/AC, 2GΩ, 20μF, hFE/diode test, continuity beeper; 0.8% accuracy
DMM-124+Cap.+Temp.+Freq. $69.95, 3½ dig. 600VDC/500VAC, -58~752°F, 2GΩ, 20mF, 200KHz, 3φ phase/diode/continuity test; 1.2%.
DMM-125 $54.95, Autorange/Bargraph, 32 MΩ, 600VDC/AC, 10ADC/AC, diode/continuity test.
MIC-35 $59.95, Autorange, 3½ LCD, 20MΩ, 1000VDC/750VAC, 20ADC/AC, data hold, diode/continuity test, free holster; 0.5% accuracy
MIC-39 $129.95, Autorange/Bargraph, True RMS, 3¼ LCD, 40μF, 40MΩ, 1000VDC/750VAC, 20ADC/AC, 600KHz freq. cntr., data hold, sleep mode, memory, read functions, holster; 0.3% accuracy.

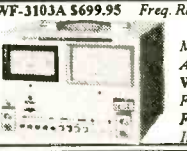
AUTO. CAPACITANCE METER

CM3300A $139.00 10 ranges, 99.9pF ~ 99.9mF, fully automatic.
Resolution: 0.1pF lowest, 0.1% full scale.
Accuracy:
0.5% of full scale ±1 digit to 99.9μF,
1% of full scale ±1 digit to 99.9μF.
Display: 3 digit LED.
Unit: pF, nF, μF, mF, Overrange indicators.

AUTO DISTORTION METER

DM-3104A $799.95
DISTORTION MEASURE
Range: 0.01% to 30%, 0.1/0.3/1/3/10/30% 6 ranges.
Freq: 400Hz±10%, 1KHz±10%(HPF).
Input: 3mV-100V; Ratio measure 20dB.
Auto. Freq. Switching Ranges:
Fundamental Freq. = (fo)±10%;
Fund. Rejection: >-80dB at (fo)±5%; >-70dB at (fo)±10%.
Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.
LEVEL MEASURE *Range:* 0 to 100V in .03/.1/.3/1/3/10/30/100V
Freq Response: ±0.5dB/20~50kHz; ±1dB/20~100kHz.
DM-3204 $1,599.00 dual channels, Spec see DM-3104A.

WOW-FLUTTER METER



WF-3103A $699.95 *Freq. Range:* 3KHz±10% JIS/CC1R; 3.15KHz±10% DIN.
Measuremt: .03/.1/.3/1/3% full scale.
Accuracy: ±5% of full scall.
WF-3105A $799.95, digital display,
Function: LIN/WOW/Flutter/WTD.
Freq Counter: 10Hz-9.99MHz.
Indication: CCIR/DIN/JIS.

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Antenna Rotator

Ideal for use with most TV antennas as well as smaller UHF and VHF Ham antennas. Adjustable mounting clamp accommodates masts up to 1½". Requires three conductor rotor cable (not included).

Order #	Description	(ea.)
30-1100	Rotator and control box	$39.95
30-1025	100' three conductor cable	12.95

Universal Desktop Rapid Battery Charger

Unique charge contacts accommodate nearly any type of Ni–Cad or NiMH battery. Ideal for Amateur Radio HTs, computer laptop, camcorder, cellular phone and many other batteries. Supports 4.8V, 6V, 7.2V, 8.4V, 9.6V and 12V charging. AC adaptor and automobile cigarette lighter included. Charge rate: 650/40mA. Discharge rate 400mA.

Order #	(ea.)
111-2801	$49.95

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Digital Laboratory Power Supply

Precision power supply is ideal for any service bench. Output voltage is variable from 0~30VDC, with adjustable current limiter from 0~3A. Switchable digital readout shows either current or voltage output. Coarse and fine adjustments provide precise adjustment.

Order #	Reg.	
72-2075	~~$249.00~~	$199.00

Remote Control A/B/C/D Switch

Four input remote controlled RF switch allows selection from up to four sources for output to TV or VCR, via infrared remote. Electronic switcher eliminates possibility of contact failure. Frequency range: 5MHz~2050MHz. Output and inputs are 75ohm "F" type connections. Remote requires two "AA" batteries not included (#290-070).

Order #	Reg.	
32-5190	~~$51.25~~	$39.95

Remote Control A/B Switch

Remote controlled RF switch allows selection from two sources for output to TV or VCR, via infrared remote. Electronic switcher eliminates possibility of contact failure. Frequency range: 5MHz~8900MHz. Output and inputs are 75ohm "F" type connections. Remote requires two "AA" batteries not included (#290-070).

Order #	Reg.	
32-4425	~~$25.75~~	$19.95

30 Piece Security Tool Set

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22-1475	~~$39.99~~	$19.95

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Order #	Reg.	
29-1910	~~$19.95~~	$14.95

AC Wall Adaptor

This 13.5VDC, 1 amp AC adaptor is perfect for use as a battery charger or to power projects.

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58-3330	$3.99

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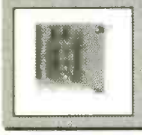

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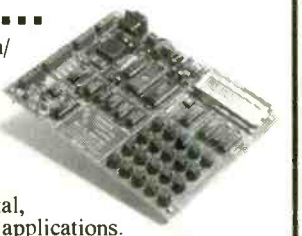

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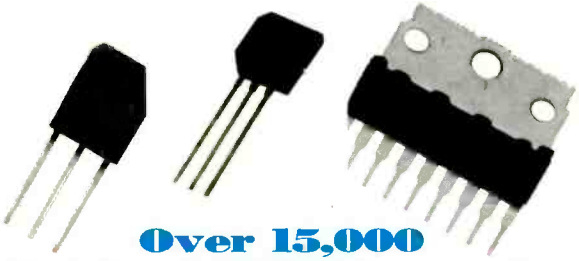

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General — ***Rubber Boot Included***

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 o 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

Positive Photofabrication Kit

Make your own PCB's

Kit includes the basic items needed to fabricate pre-sensitized printed circuit boards (does not include artwork). Also included is a basic process guide to assist the user in the basics of exposing, developing and etching a PCB. All items fit conveniently in the plastic development tray, and a tight fitting lid is included for handy storage. Additional recommended supplies for fabricating PCB's are: exposure bulb, etchant tank, eye protection, art-work, paper towels.

Kit Includes

- 1 each 3"x5" pre-sensitized single sided PCB
- 1 each 4"x6" pre-sensitized single sided PCB
- 1 each 6"x6" pre-sensitized single sided PCB
- 1 each 500ml developer liquid
- 1 each 500ml ferric chloride etching liquid
- 2 each foam brushes
- 1 each plastic development tray
- 1 each rubber gloves
- 1 each instruction sheet

new!

CAT NO	DESCRIPTION	PRICE
416-K	Photofabrication Kit	**$27.95**

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	1	PRICE EACH 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	1	PRICE EACH 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	1	PRICE EACH 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

Exposure System

Just place your presensitized board and artwork centered under the exposure fixture. Place the convenient acrylic sheet over the board and artwork to hold everything in place. Turn on light. Voila! Exposure takes about 5 minutes. Kit includes one fluorescent tube, stand and acrylic weight.

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Features

- Exposes boards in about 5 minutes!
- Convenient acrylic sheet to hold board in place during exposure (12.5" x 8.5")
- Fluorescent light fixture with plastic cover designed to aid in proper light refractions for even exposure

CAT NO	DESCRIPTION	PRICE
416-X	Fluorescent Exposure System	**$31.95**
416-B	Extra Replacement Fluorescent Tube	**16.95**

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

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

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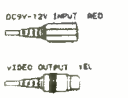
Image Sensor:	Interline transfer CCD 1/3" format
Effective Pixel:	512(H)x492(V) pixels/NTSC 512(H)x582(V) pixels/PAL
Scanning System:	2 : 1 interlaced
Sync System:	Internal sync
Sync Pulse:	15.734KHz +1%(H),15.625KHz +1%(H) 59.94Hz +1%(V)/ 50Hz +1%(V) Sub-Carrier 3.57 MHz +30ppm
Resolution:	400 TV lines (H)
S/N Ratio:	More than 46dB (typ)
Gamma Characteristics:	0.45
Min. Illumination:	1 LUX (F1.2 10 IRE)
Video Out:	Composite video signal : 1.0Vp-p
White Balance:	Auto white balance
Electronic Shutter:	1/60 - 1/100,000 SEC(N) 1/50 - 1/100,000 SEC (P)
Power Supply:	DC 12V + 10%
Power Consumption:	240mA (typ)
Lens:	4mm (78 or 92 degree) F : 2.0
Ambient Operating Temp:	-5 deg. C +40 Deg. C
Ambient Storage Temp:	-10 Deg. C+50 Deg. C RH 95% MAX
Dimension:	2 1/8" (L) x 1 1/4" (D)
Weight:	3 oz.



CAT NO	DESCRIPTION	PRICE EACH 1	5
WDB-5407S	Color Water Tight Bullet Camera	$299.00	$269.00

(water tight for outdoor use, not suitable for sustained underwater use)

CCD Bullet Cameras

new!

Available with standard or pinhole lens. Virtually indestructible bullet shaped casing. This sleek B&W camera can be mounted on walls or ceilings along narrow corridors or virtually any location for virtually any surveillance application. 0.5 lux minimum illumination with 380 lines of resolution. Even includes a built-in electronic iris for automatic light compensation.

Features

- Extremely low power consumption
- No blooming, no burning
- 0.5 LUX minimum illumination
- CCD area image sensor for long camera life
- Ultra small size allows for simple application and installation
- Built-in electronic auto iris for automatic light compensation
- Ultra compact camera

Specifications

Image Pick-Up Device:	1/3" CCD area sensor
No. of Pixels:	EIA = 512(H) x 492(V)
Pixel Pitch:	EIA = 9.6uM(H) x 7.5uM
Scanning System:	EIA=525 lines, 60 field/sec
Sync System:	Internal sync
H. Resolution:	430 TV line
V. Resolution:	400 TV line
Usable Illumination:	0.5 Lux F1.6
S/N Ratio:	More than 48dB
Gamma Characteristic:	0.45
Video Output:	1.0 - 1.1 up-p 75 Ohm
Electronic Shutter Time:	EIA=1/60 - 1/50,000 sec
Lens F No. Focal Length:	STD : 1.6 Open / 4.3mm(78 deg) Pinhole: 4.3 fixed/ 2.8mm(91.4 deg)
Power Consumption:	DC 9V (8-10V), 110mA
Operational Temp.:	-10 deg - +50 deg C RH95% max
Storage Temp:	-20 deg - +60 deg C RH95% max
Dimensions:	STD : 22mm(W) x 22mm(H) x 38mm(D) Pinhole: 22mm(W) x 22mm(H) x 30mm(D)
Weight:	35g max

CAT NO	DESCRIPTION	PRICE EACH 1	5
WDB-07S	Standard Lens Version	$144.00	$129.00
WDB-07P	Pinhole Lens Version	144.00	129.00
WDP-07S/water	Standard Lens Weather Proof	169.00	152.00
WDP-07P/water	Pinhole Lens, Weather Proof	169.00	152.00

CCD Dome Camera with Audio

B&W DOME camera with integrated microphone. Ideal security system application. 12 VDC operation.

new!

Specifications

Image Device:	1/3" interline transfer CCD
Picture Elements:	EIA=542(H)x492(V)
Scanning System:	2:1 Interlace
Synchronization System:	Internal
Horizontal Resolution:	380 TV Lines
Sensitivity:	Under 0.3 LUX
Electronic Iris (linear):	EIA = 1/60~1/100,000 sec
Video Output:	1.0vp-p, 75 ohm
S/N Ratio:	More than 50dB
Power Supply:	12V DC (±20%)
Gamma:	r=1
Power Consumption:	110 mA max
Operating Temp.:	-10°C ~ +50° C
Operating Humidity:	RH 95% Max
Weight:	100g
Applied Lens:	3.6mm -92°, 4.3mm -78°
AI/EE/Flicker Less/Mirror Image:	Jump soldering selection
Audio Pick-up Sensitivity:	-60dB (0dB=1V/ubar)
Audio Frequency Range:	20 Hz ~ 20 kHz
Audio S/N Ratio:	More than 40dB
Audio Output Level:	1Vp-p/600 ohm
Dimensions:	87 x 55.5mm

CAT NO	DESCRIPTION	PRICE EACH 1	5
WDDB-6500	B&W Dome Camera	$144.00	$129.00

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

WDP-2000

WDS-2005

WDI-4000

Dimensions

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

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
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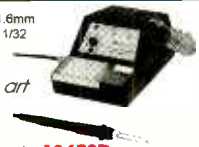

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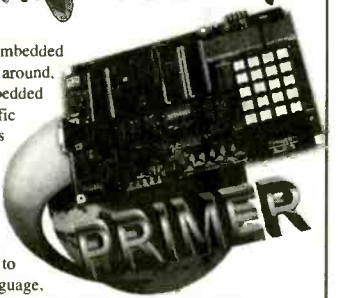

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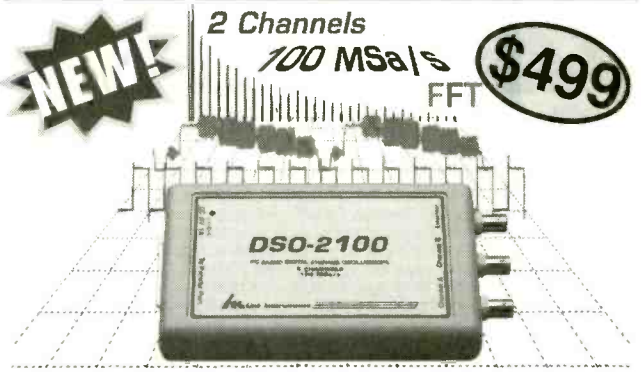

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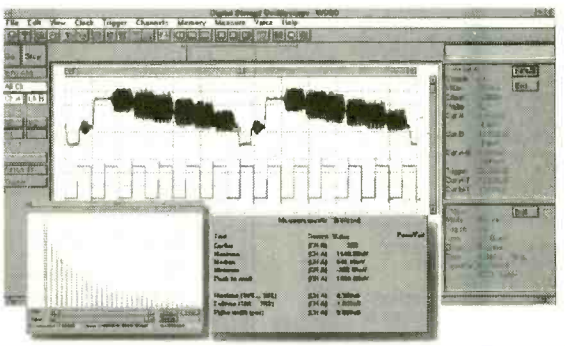

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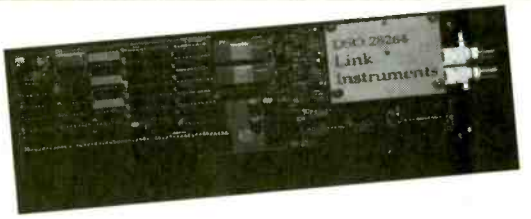

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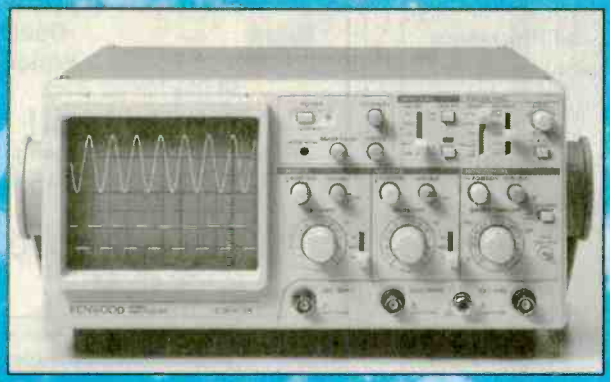

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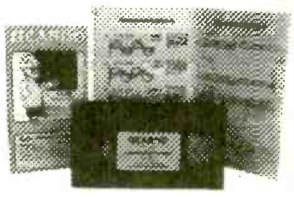

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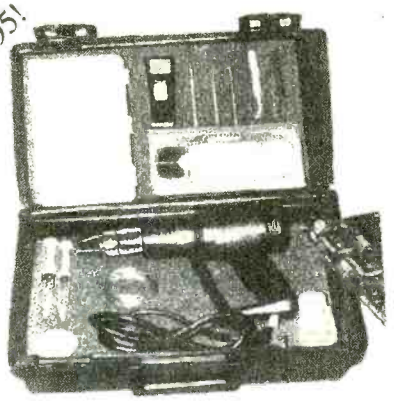

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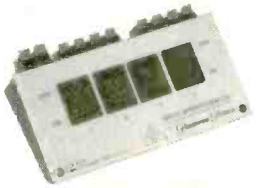

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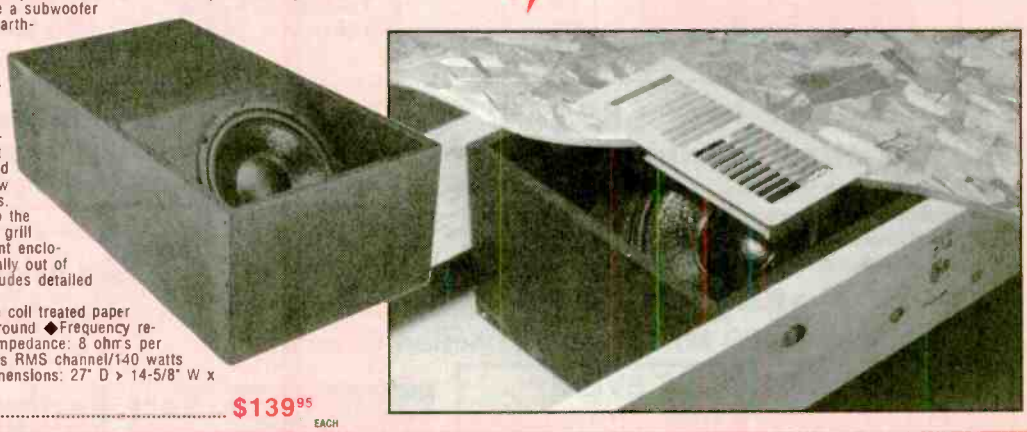

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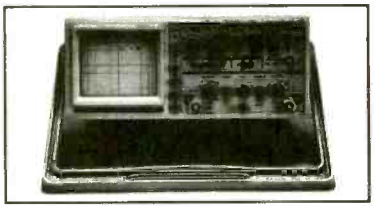

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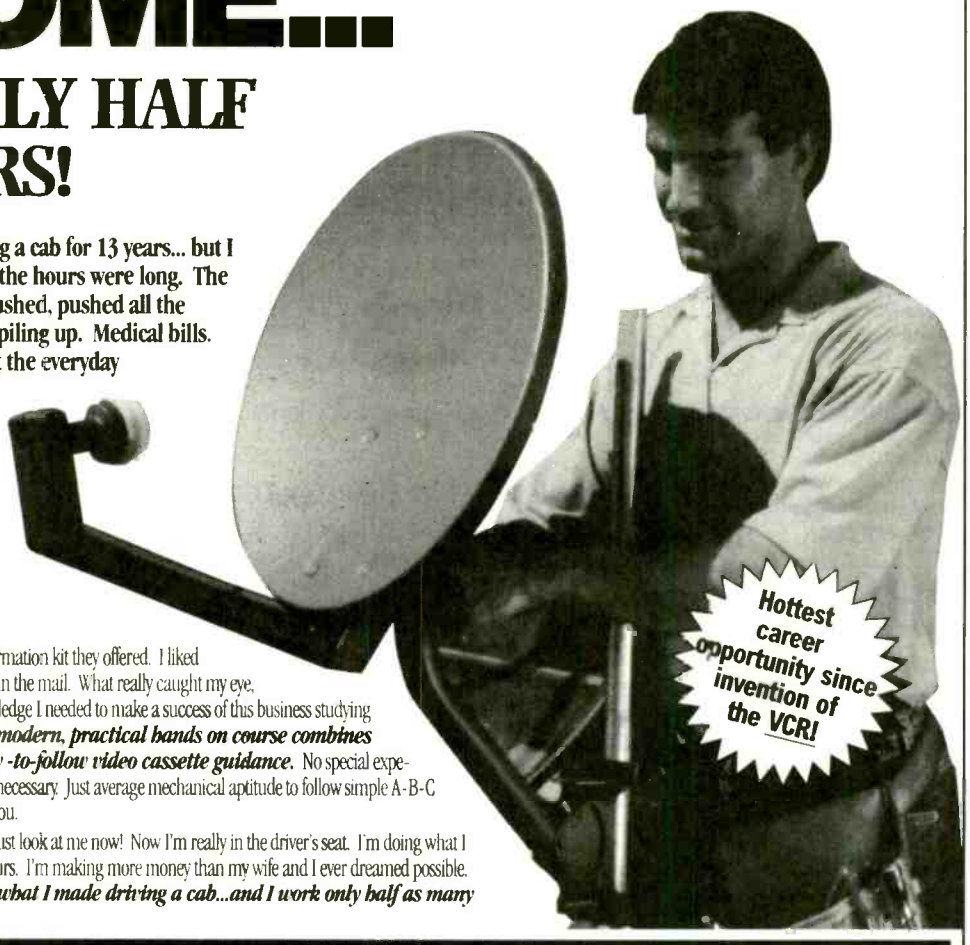

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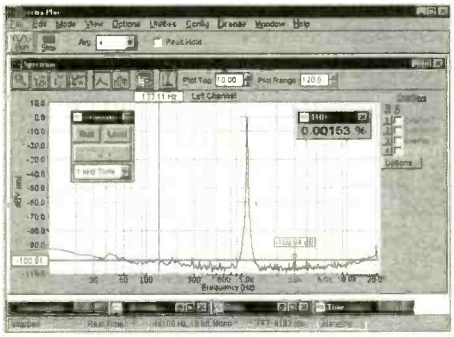

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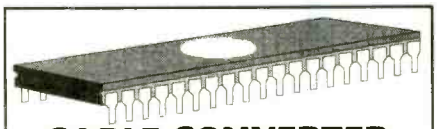

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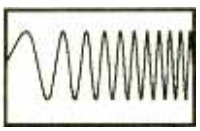

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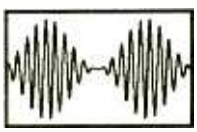

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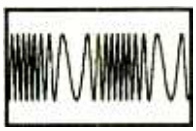

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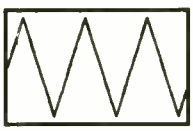

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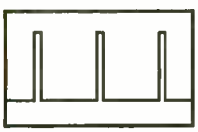

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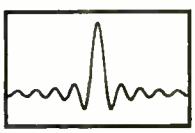

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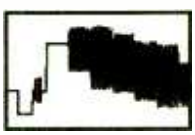

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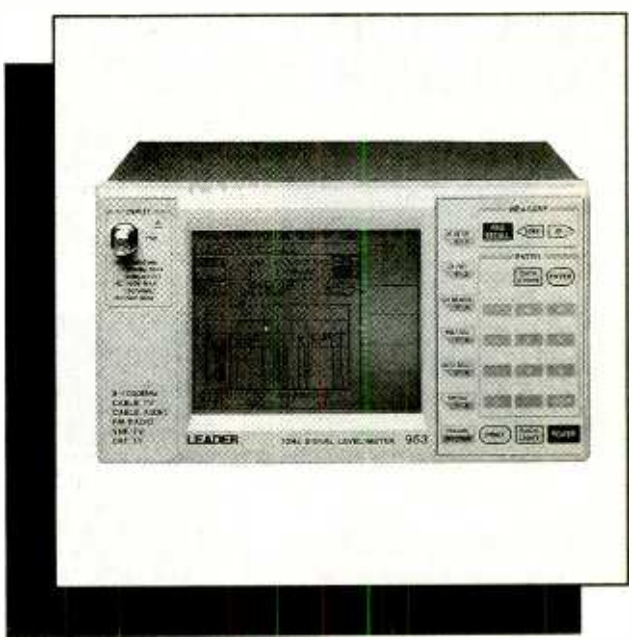

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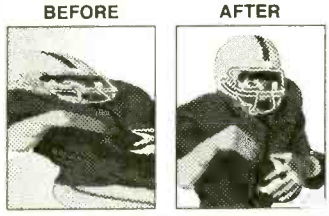

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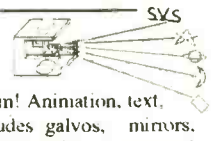

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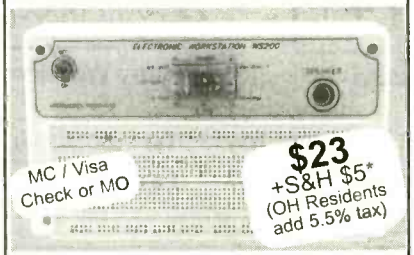

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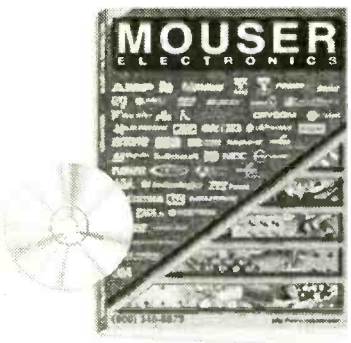

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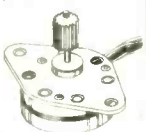

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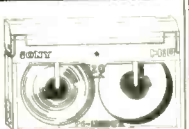

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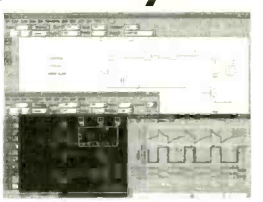

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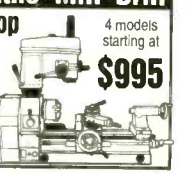

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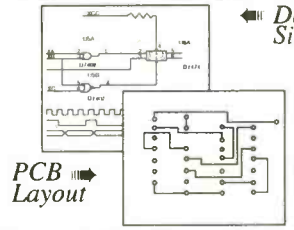

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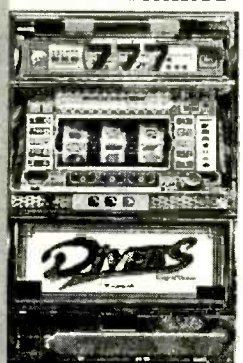
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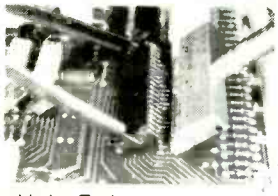
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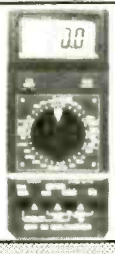

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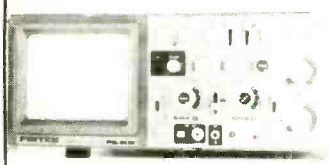

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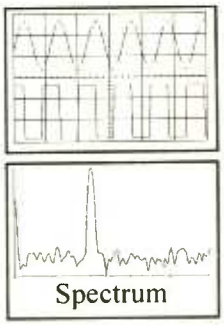

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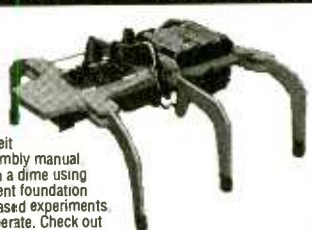

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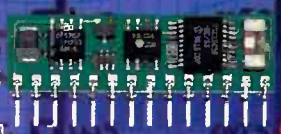

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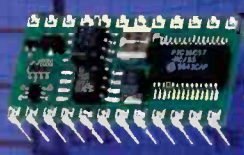

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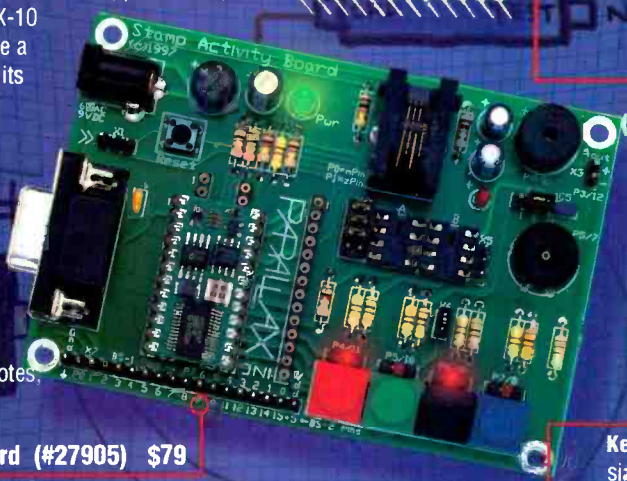

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Kevin Kelm is an anthropomorphic enthusiast in Denver, CO. "Sir Karl" is a full size knight costume that uses a BASIC Stamp module to control ear, eye, and facial movements. See Sir Karl's construction and PBASIC code at http://www.xvt.com/users/kevink/furry/build.html

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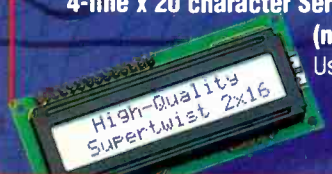

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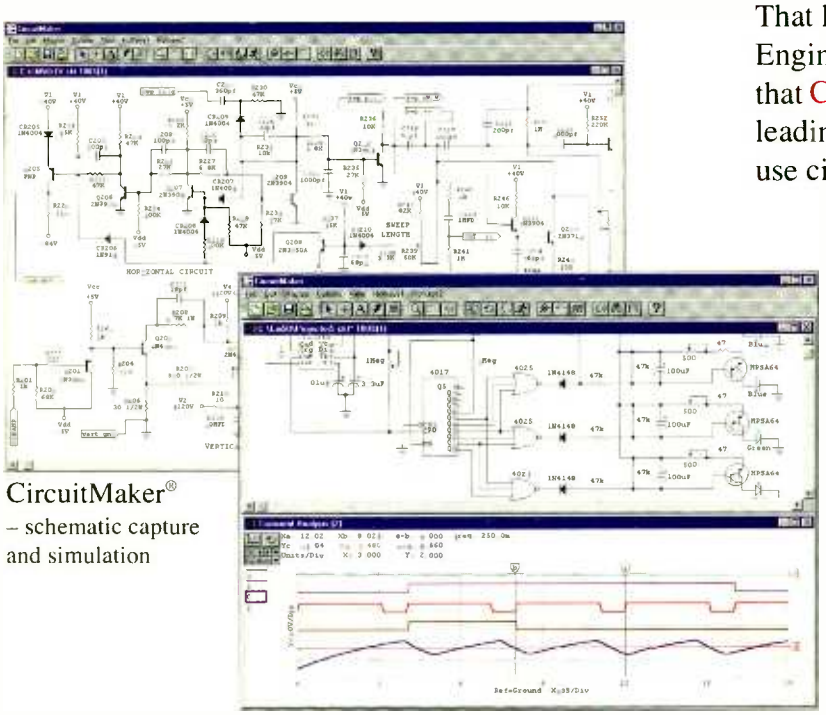

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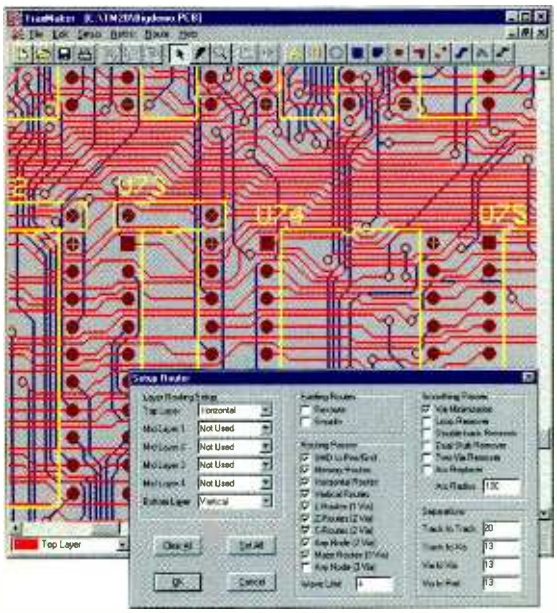
TraxMaker® – PCB layout and autorouting



TAKE MEASUREMENTS at any point in the circuit with a click of the Probe tool. Results appear immediately on virtual instruments like the Digital Oscilloscope, Curve Tracer, Digital Multimeter and Bode Plotter. No other simulator lets you take measurements as quickly and easily as CircuitMaker.

COMPLETE the design process with TraxMaker, a professional printed circuit board layout program with built-in autorouter. Import netlists from CircuitMaker and other schematic programs, or design boards from scratch.

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