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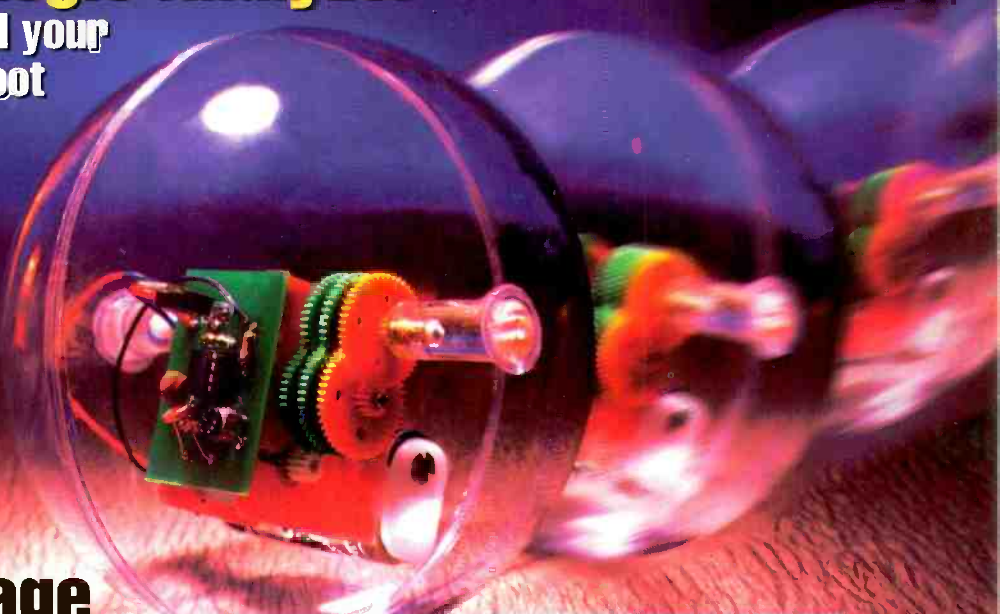

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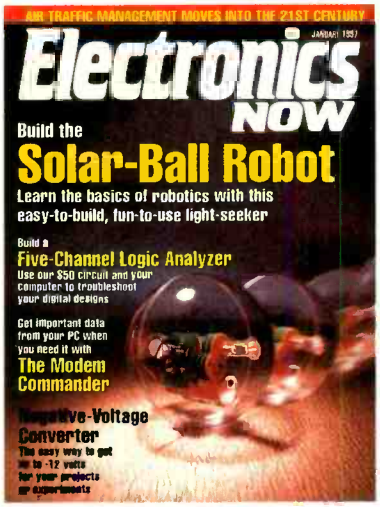

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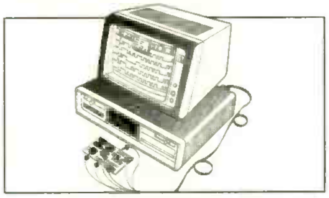

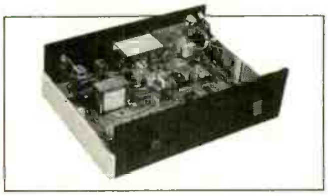

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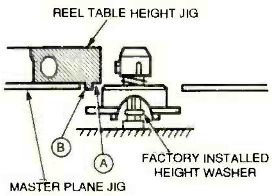

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EDITORIAL

Net Abuse

The Internet is a wonderful place. The Internet is a horrible and evil place. Both of those statements are true; they are also both false.

Actually, the Internet is what you make it and how you use it. Think of it as a tool. Used properly, a tool makes completing a job easier. Used improperly, it makes completing a job harder. And used maliciously, it can turn into a weapon of destruction.

The different faces of the Internet are easy to see. Consider just one facet of the Internet—Usenet newsgroups. In the various sci.electronics newsgroups, there is a cadre of dedicated hobbyists and professionals exchanging ideas and tips freely with each other. It's a great place to turn to for help.

But there is a peril. The information exchanged is unmoderated and unverified. It is not unusual for a request for help to be answered with an inaccurate or impractical suggestion. The respondents in those cases are well-meaning, but misinformed. Generally, subsequent responses will supply the correct information.

Unfortunately, there is another creature that prowls the Net. The one with an ax to grind or who just enjoys spreading rumor, innuendo, or worse. The problem is not that bad on the sci.electronics newsgroups, but can be incredible elsewhere. Add to that the unsolicited and off-topic "spams," and the signal-to-noise ratio can quickly become overwhelming.

Does that make newsgroups unusable? Nothing could be further from the truth. However, it does mean that you have to take most things you read with at least a grain of salt. If you obtain electronics or other information from the Net, make sure you verify it before putting it to use.

As with any tool, you need to practice common sense. It can make the difference between a pleasant experience, and one you'd sooner not talk about.

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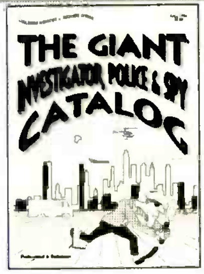

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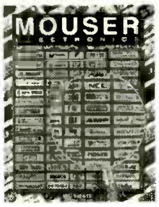

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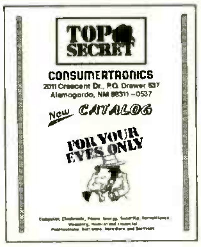

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WHAT'S NEWS

A REVIEW OF THE LATEST HAPPENINGS IN ELECTRONICS

Security Engineering Courses

Open any newspaper and you'll see evidence of intentionally caused tragedies—bombings of office buildings in New York and Oklahoma City, planes blown out of the sky, disgruntled employees shooting up their work sites. Such incidents underscore the need for individuals trained in high-tech security.

Sandia National Laboratories (Albuquerque, NM), New Mexico State University (NMSU) in Las Cruces, and the New Mexico Institute of Mining and Technology (NMIMT) have joined forces to offer the first undergraduate curriculum in the United States to focus on security engineering. The three organizations have formed the Southwest Surety Institute to provide education in security and to conduct security-systems research and development. With an eye toward providing U.S. government and private industry with a pool of ready expertise, the Institute will focus on teaching students the methods and principles of security-systems design and implementation.

"The Institute represents a unique alignment of technology, education, and research and development," said Mary Lynn Garcia of Sandia's Security Systems and Technology Center. "This curriculum will combine elements from different disciplines—safety, engineering, criminal justice—in order to produce individuals who will be able to design security systems to address issues of concern to all of us—workplace violence, terrorism, and theft, for example."

For more than 30 years, Sandia's nuclear security work has focused on anticipating and preventing tragedies caused by human intent. That experience in designing and developing security technologies for the Department of Energy will be applied to the new program. Sandia security experts will lecture on various security technologies, including sensors, video assessment and display, access delay, and communications.

To electronically bring Sandia's experts into the classrooms and to maximize each other's programs and capabilities, NMSU and NMIMT will use distance learning technology, already in place at both schools. As of the 1996 fall term, NMSU had linked its criminal-justice and engineering-technology programs to provide an academic minor in security technology. The university plans to establish an undergraduate degree in security technology in the future.

"The field of private and public security is a growing one," said George Alexander, head of NMSU's Engineering Technology Department. "People are concerned about terrorism, industrial security, and being able to safeguard people and information. Students going through this program will be credible additions to this line of work."

Sandia's long-term goal is to develop an advanced degree program in surety—the field of making something safe, secure, and reliable—at interested universities across the country.

Fire-Fighting Home-Robot Contest

Trinity College in Hartford, Connecticut is sponsoring its annual Fire-Fighting Home-Robot contest, to be held on its campus on April 20, 1997. As the largest public robotics competition held in the U.S. and open to entrants of any age and experience level, the event draws people from all over the U.S., Canada, and Europe. Besides the competition, the event includes a robotics seminar, a robotics exposition, and a movie with a robotics theme.

The goal of the contest is to build a robot that can find and extinguish a fire in a house. The challenge is to build a computerized (not radio-controlled) robotic device that can move through a model of a single floor of a house, detect the flame of a lit candle, and then extinguish it. Robots that can accomplish the task in the shortest amount of time win the contest.

The weekend-long event will culminate months of work on the part of robotics enthusiasts of all ages. Last year's contest drew interest from people in all 50 states and 19 countries, with participants ranging from elementary-school students to college professors and engineers.

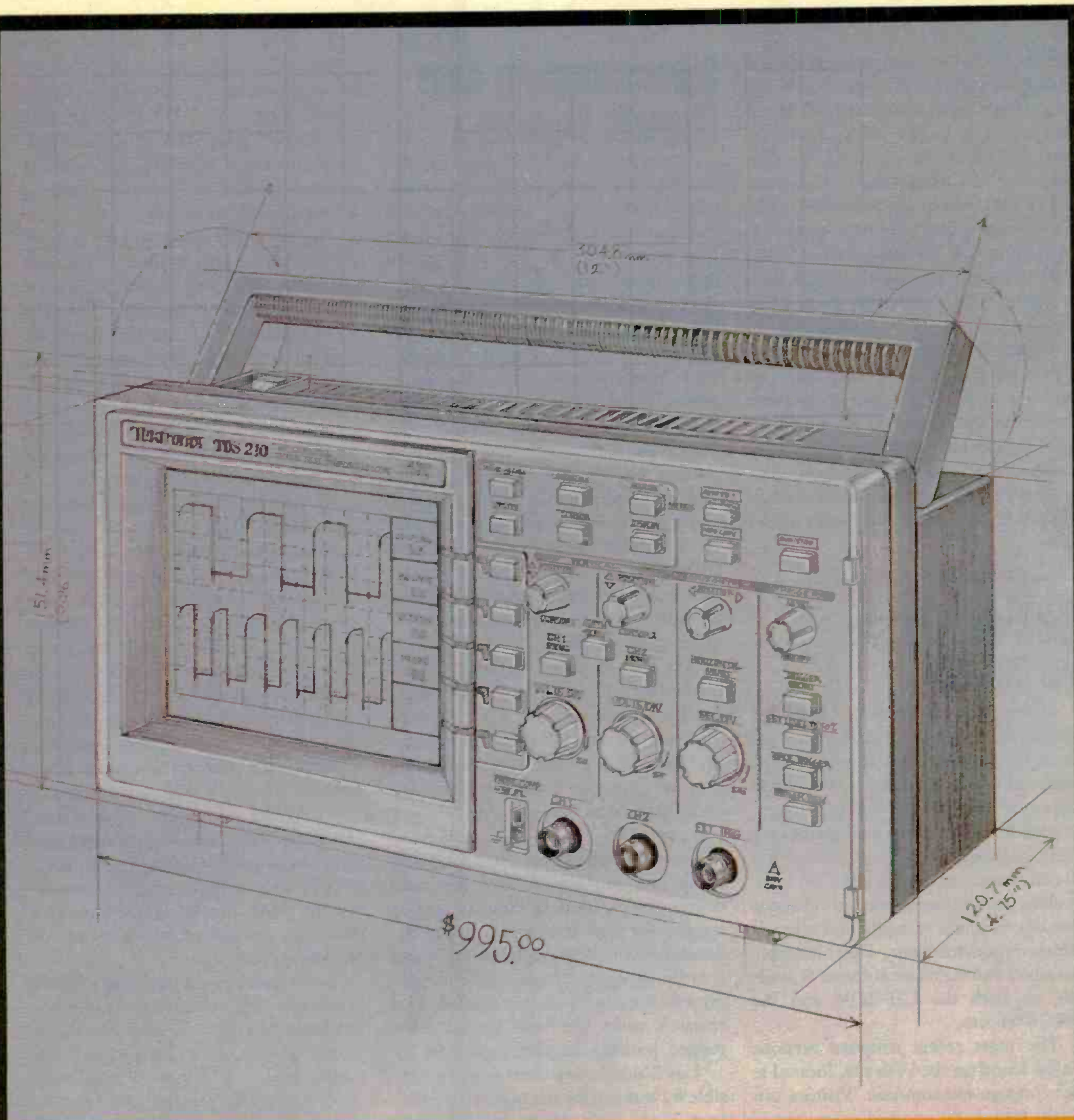
There are two divisions: a Junior division for those in high school and younger, and a Senior division for everyone else. There will be a $1000 prize awarded to the top winner, and additional prizes to other winners.

To receive a copy of the updated rules for the 1997 contest, please send $3 (checks or money orders payable to Trinity College) to the attention of Jake Mendelssohn, 190 Mohegan Drive, West Hartford, CT 06117, or download the information from the contest home page at http://www.shakti.trincoll.edu/~jhough/fire_robot/comp.html.

Next-Generation TV Sets

Move over, cathode ray tubes. Make way for what some are predicting will be the next wave in TV—large-screen plasma-display sets. Plasma-display technology, which also has applications in computer monitors and multimedia-presentation equipment, will allow the manufacture of television sets that are thin enough to hang on a wall. Even big-screen sets will be just a few inches wide.

Two major Japanese manufacturers have announced their intention to market plasma-display-panel (PDP) sets in Japan. As we go to press, NEC was scheduled to begin mass producing a 33-inch set with a 4:3 aspect ratio and to start construction on a manufacturing facility dedicated to plasma sets. The



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plant is due to be completed next fall and be fully operational by April of 1998. No prices have been announced. At about the same time, Fujitsu will start production of a 42-inch plasma display set, with plans to build 10,000 units per month, and 100,000 sets by the year 2000. At its introduction, the 42-inch model is expected to cost the equivalent of $9300 U.S., although that figure should drop by about 50% once full production begins.

Fujitsu hopes to begin selling plasma-display sets in the United States in the next year or so, priced between $6000 and $8000, and to hit the $3000 price tag within three years. Industry insiders expect plasma-display technology to boost the television sales market, which has been relatively flat in recent years.

Motorola Web Site and CD-ROM

Motorola's Customer Specified Integrated Circuits (CSIC) Microcontroller Division has announced the release of a CD-ROM and a Web site to support its new 68HC08 family of microcontrollers as well as the well-established 68HC05 family. The CD-ROM contains 50 new documents on the 68HC08 family, along with hypertext-linked reference manuals, technical manuals, and general-release specifications. Downloadable assembler and simulator software is available on both the CD-ROM and the CSIC Web site.

The most recent software versions can be found on the Web site, located at http://design-net.com/csic. Visitors can obtain frequently updated overviews of Motorola products, markets, and development tools, as well as the company's latest news and media releases. The Web site offers access to online microcontroller and development tool-selector guides, as well as data sheets and application notes. Also included are upgrades to development-tool software, free applications and development software, on-line technical support, and information about third-party development tools.

You can obtain the UNIX-, Macintosh, or Windows-compatible CD-ROM (CDCSIC2/D) free of charge by calling 1-800-765-7795, extension 858, or by faxing 512-891-3236.

Superconductivity Helps Magnetic Separators

By applying their expertise in superconductivity to magnetic separators, researchers at Los Alamos National Laboratories (Los Alamos, NM) believe they have taken the first step toward more cost-effective papermaking, high-volume water-purification systems, and powerful portable separator units that could clean up contaminated soil on site. The work is part of a cooperative research and development agreement between Los Alamos and Eriez Magnetics (Erie, PA). The superconducting magnet—one of the most powerful high-temperature superconducting magnets ever—was developed and built by American Superconductor Corp (Westborough, MA). The magnet is made of the superconducting ceramic bismuth-strontium-calcium-copper-oxide, known as BSCCO.

At the biennial Applied Superconductivity Conference in Pittsburgh, Mark Daugherty of Los Alamos' Superconductivity Technology Center explained, "Since large superconducting magnets can produce much greater magnetic fields than conventional magnets, you can move a much larger volume of material through the separator at a much faster rate and still achieve the same degree of separation. In addition, cooling systems for high-temperature superconductors are simple enough that you could actually transport a large magnetic separator to the site where it is needed. This research paves the way toward more rugged, portable magnetic separators."

Los Alamos researchers were responsible for integrating the magnet and current leads (also made by American Superconductor) with the cooling environment, or cryogenics, of the system. Los Alamos-patented heat pipes were crucial to the research. Heat pipes are tubes that contain a liquid, in this case, nitrogen. As heat travels in to the pipe, the liquid nitrogen vaporizes, rises in the pipe, cools, and condenses, thus removing heat from the system. With no moving parts, the heat pipe is very reliable, and it can regulate temperatures to within a desired range.

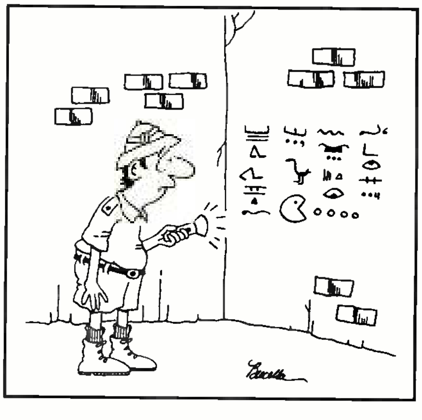
The superconducting magnet must be cooled to about minus 400-degrees F to work. Because the electrical current leads and wiring that bring power to the magnet are at room temperature or higher, the current leads—which bridge the gap between hot and cold environments—must be cooled to ensure that the magnet's temperature isn't increased through contact. The heat pipes prevent most of the heat leakage from reaching the superconducting magnet.

"So far in the laboratory we've been able to get a magnetic field of two tesla out of the magnet at around minus 400-degrees F," said Daugherty. "That's a significant field." (The earth's magnetic field is less than one ten-thousandth of a tesla.) For magnetic-separation applications, a high magnetic field means that more material can be passed through the separator faster, while still achieving maximum separation of materials.

In addition to removing impurities from kaolin clay, a substance used to coat high-quality paper, magnetic separation could be used to remove strongly and weakly magnetic materials from gases and liquids. Therefore, smaller and more powerful portable separators show great promise for cleaning up contaminated soils and liquids throughout the Department of Energy defense complex. A number of DOE sites are contaminated with radioactive actinide components, which are slightly magnetic.

In terms of water purification, Daugherty said, "Since viruses and bacteria can be made to cling to iron compounds, it's possible to add ferrous materials to water, run the water through a separator, and get rid of the metal and biological contaminants."

Los Alamos researchers have built a bench-top high-temperature superconducting separator for demonstrations. About the size of an old-fashioned ice-cream maker, it houses a cylindrical superconducting magnet that is about six inches in diameter and six inches tall. The magnet in a full-size clay separator would be 8 to 12 feet in diameter and about 20 inches thick. EN



Q & A

READERS' QUESTIONS, EDITORS' ANSWERS

Five Minutes Of Power

Q *To make timers for my kinetic sculptures, I have been using 2N4891 UJTs but can no longer find them. Can you recommend a substitute UJT or a different circuit? The timer is powered by 120-volts AC and must be small and lightweight (no transformer). The sculpture, with lights and motors, plugs into the timer, which supplies power for 1 to 5 minutes at the touch of a button.—I. A., Highland Park, IL*

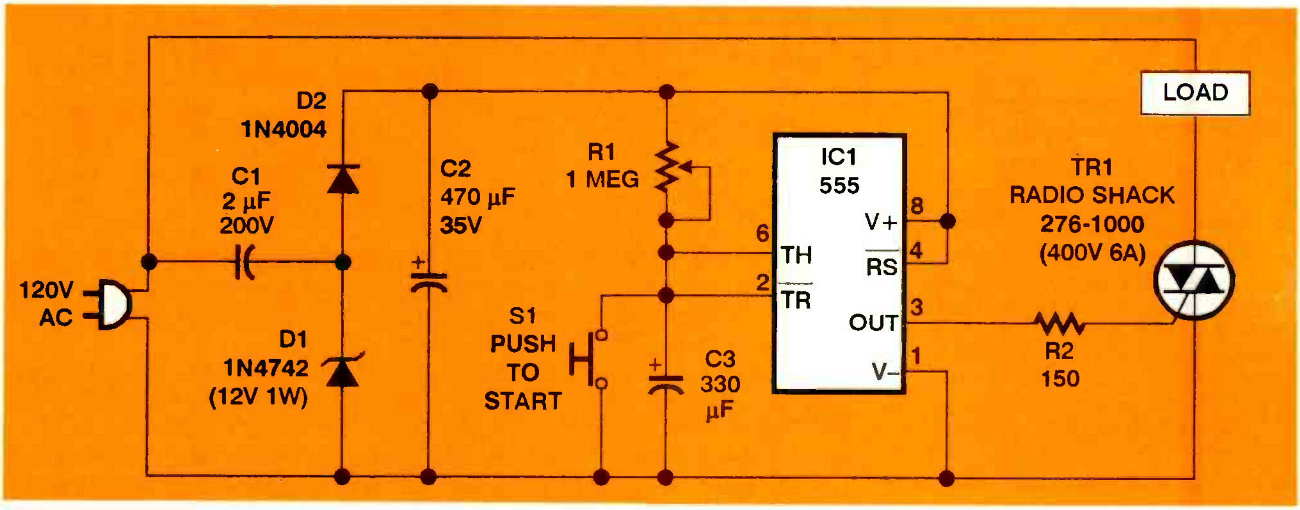


FIG. 1—THIS 555-BASED CIRCUIT will power a load for up to 5 minutes depending on the setting of R1. Note the transformerless power supply made up of C1, C2, D1, and D2.

A If you still want to use UJTs (unijunction transistors), the ECG6409 and NTE6409 are currently available substitutes for the 2N4891. But the main reason you no longer see UJTs is that ICs such as the 555 do a much better job at the same tasks.

A unijunction transistor is a trigger device—that is, it "turns on" suddenly when a voltage reaches a particular level. The 555 timer does the same thing, but with a difference: Instead of tripping at a fixed voltage, it trips at exactly 2/3 of the supply voltage, whatever that may be. As a result, timers built with the 555 are not very sensitive to supply variations. Also, all 555s are alike, whereas different UJTs of the same type will trigger at slightly different voltages.

Figure 1 shows a timer you can try; it covers zero to five minutes, or a little more, by measuring the time needed to charge C3 through R1, which is adjustable. To switch the AC power to the load, it uses a Triac (a solid-state AC switch) instead of a relay.

The hardest part of the circuit design was the transformerless power supply. We simulated it with Electronics Workbench before breadboarding, to reduce the risk of mishaps with dangerously high voltages and currents.

In the power supply, the capacitive reactance of C1 limits the current without generating heat. You must use a metal-film capacitor for C1, not an electrolytic; you can use two 1-µF capacitors in parallel or one 2.2-µF unit. Be sure to observe the voltage rating—use a capacitor rated for at least 200, and preferably 600 volts. Zener diode D1 limits the voltage, and D2 and C2 are the rectifier and filter.

With a smaller value of C3, this circuit would make a good, cheap enlarging timer for photographers.

Imitation Heartbeat

Q *I made a cradle 20 years ago that calms the baby with the sound of the mother's heartbeat. To produce the sound, I used a cassette player. Now I'm modernizing it. Can I produce the heartbeat sound with an IC?—H. S. M., Mashhad, Iran*

A Figure 2 shows a circuit that makes a reasonably authentic heartbeat sound with just a few components. For best results, use an 8-ohm speaker that's at least 4 inches in diameter in order to get good bass response. The capacitors and resistors at the output shape the waveform so that the sound is "thump-thump" rather than "click-click."

You may have to experiment with component values to get the sound that you want. If the volume is too low, reduce or eliminate the second 47-ohm resistor.

Making Printed Circuits

Q *I've suffered through the messy, tedious process of copying a printed-circuit board design onto a board free-hand with a resist*

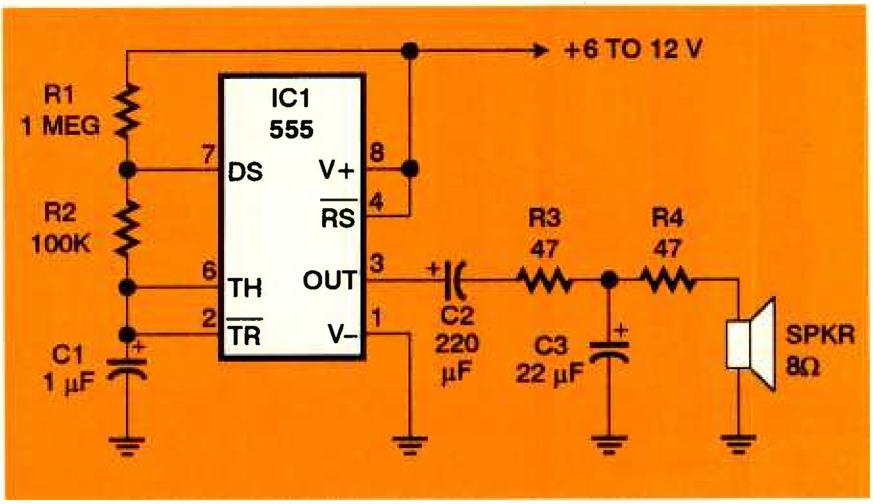


FIG. 2—THIS OSCILLATOR CIRCUIT imitates the sound of a heartbeat. Use a 4-inch or larger speaker to get good bass response.

pen and then etching the board in a liquid that dissolves the copper where it is not coated with ink. Is there an easier way?—M. M, Denver, CO

A If you have a big enough budget, you can get a machine that grinds away the copper under computer control, so that you don't have to handle etching chemicals. Those machines aren't quite in the hobbyist price range yet, though.

But at least you can avoid the free-hand drawing. One way to do this is to make a photographic negative and then contact-print it onto photosensitive resist. Unfortunately, that involves even more chemicals than the process you want to get away from.

The other way is to transfer the image from a laser printer or copy machine. Those images are made of toner, which consists of tiny particles of black plastic that are attached to the paper by melting them. You can melt the toner again and transfer it to another surface.

The catch is that plain paper isn't suitable because it doesn't give up its toner easily enough. Glossy inkjet-printer paper works better, but we have had best results with "PnP Blue" plastic sheets available from All Electronics Corporation (P.O. Box 567, Van Nuys, CA 91408, Tel: 818-904-0524). Here's how it's done:

(1) Create a mirror-imaged version of the PC board pattern. With a copy machine, you can do that by copying it onto clear plastic, then flipping the plastic over and copying it again. With a scanner and laser printer, scan the image in and flip it in your graphics program.

(2) Print the mirror-imaged pattern onto the matte side of the PnP Blue sheet. To save materials, don't use a full sheet; a quarter sheet will feed fine in most laser printers. If the image is small, print several copies side by side to avoid wasting space.

(3) Clean the copper surface of the unetched board very carefully, give it a final rinse with alcohol, and don't let fingers or other objects touch it.

(4) Heat the board to about 200° F with a clothes iron. Keep careful notes on how you do that so you can refine your technique; different irons and different kinds of toner require different settings. The printer darkness may also require adjustment.

(5) Lay the printed side of the PnP Blue sheet down on the hot copper surface and immediately press it into place with a rubber roller. Let it cool and carefully peel up the PnP Blue; the toner will stay on the copper.

(6) Etch the board. The toner serves as resist and can be cleaned off afterward with a steel-wool pad (the usual resist solvents don't work).

Microprocessor Questions

Q *I'm having trouble understanding some microprocessors. I know some of them can be programmed, and some of them have RAM and ROM built in. How do you program microprocessors? Can you refer me to a book that has general information on how they work?—D. S., Gary, IN*

A Let's back up a moment and define some terms. Every computer, large or small, has the basic parts shown in Figure 3. As you know, RAM (random-access memory) is where the computer holds the program and data that it's working on, and ROM (read-only memory) contains code that tells the computer what to do when power is first applied, before anything else has been read in. The computing itself is done by the CPU (central processing unit), which spends its time fetching instructions from memory and executing them, one by one. All the parts of the computer communicate through the bus, which is a set of wires or printed-circuit traces running in parallel.

A microprocessor is a CPU that fits on a single IC. Examples include the Intel Pentium in present-day PCs, the 8088 in the original IBM PC, and the Z80 in earlier personal computers. A microprocessor needs external RAM and ROM in order to work.

A microcontroller is a single IC that contains not only a CPU, but also some RAM, ROM, a clock generator (so that all you add is the crystal) and possibly some input-output devices. It's designed to function as a tiny computer, controlling other kinds of equipment, such as microwave ovens, automobile engines, VCRs, or clock radios. Usually the microcontroller CPU is not especially fast or sophisticated; the emphasis is on making it cheap, not powerful. The important thing is that a complete, running computer fits on one chip and costs only a few dollars.

To program a microcontroller, you use a cross-assembler or cross-compiler—that is, you run an assembler or compiler on your PC which generates code for the microcontroller. Then you store the code in the microcontroller's PROM area. Methods of doing that differ from chip to chip. For example, the Intel 87C51 can be programmed in most EPROM programmers, but its close relative the Philips 87C750 requires a special programming circuit. At the other end of the spectrum, Philips' new 87C576 can be programmed by hooking it up to your PC's serial port and downloading the code.

To learn more, start with the chapter on microprocessors in Horowitz and Hill's *The Art of Electronics* (published by Cambridge University Press). Then move on to books about the specific type of microcontroller you've chosen to work with. It may save time in the long run if you learn assembly language on your PC, where it's easy to experiment,

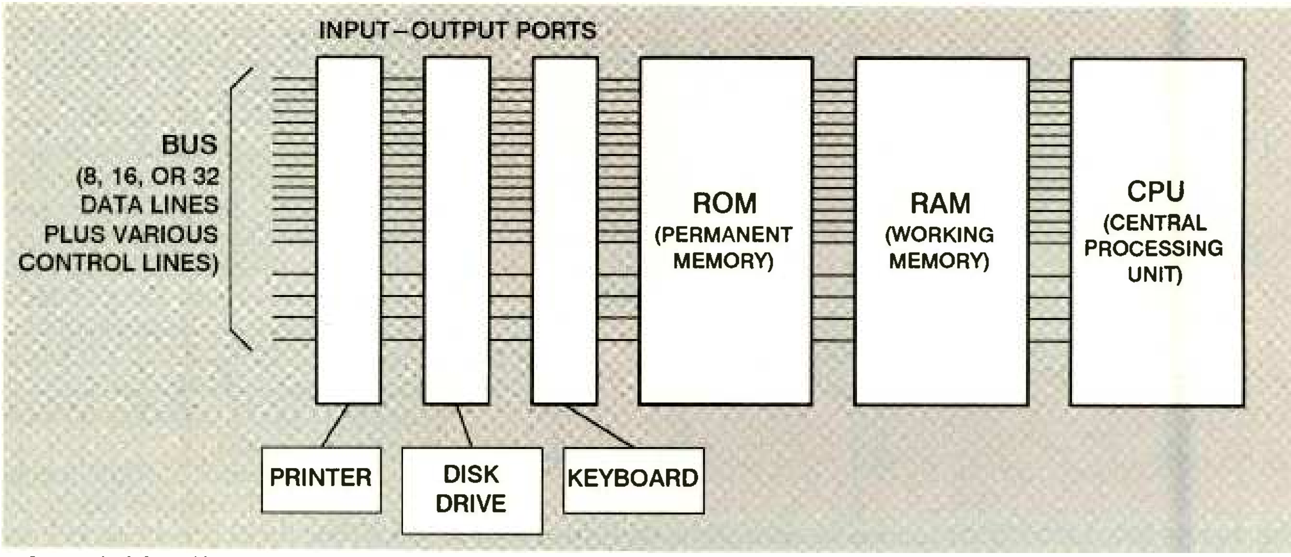


FIG. 3—A COMPUTER IS MADE UP of these basic parts. A microcontroller has the CPU, RAM, ROM, and possibly some I/O devices all on one integrated circuit.

before tackling the assembly language of a more specialized processor.

Signaling By Radio

Q *The project I'm working on requires a simple radio transmitter and receiver capable of activating a relay with a range of about 30 feet. Can you help me with wiring diagrams of both or possibly a book referral?—E. J. H., Pomona, CA*

A Getting good performance from a wireless communication system while staying within FCC regulations can be tricky. Fortunately, good transmitters and receivers are available as ready-made modules that you can embed into other projects.

For example, Holtek makes transmitters and receivers for 1200-baud serial data that operate in the 310-MHz license-free band and cost under $12 each. They also make other interesting products, including a transmitter that can be hung on a keychain. Holtek products and data books are available from Digi-Key (P.O. Box 677, Thief River Falls, MN 56701-0677, Tel: 800-344-4539).

Another line of modular transmitters, made by Ming, is available from Marlin P. Jones (P.O. Box 12685, Lake Park, FL 33403, Tel: 407-848-8236).

Acoustic Cancellation

Q *I need to cancel a horrendous level of road noise at our residence. My theory is to pick up the offending traffic sounds with a microphone, then invert the signal while staying in phase and then amplify the result to the required level and output it to a speaker. I remember that one or more of the big three auto manufacturers were exhibiting such a device as an alternative to conventional vehicle mufflers a couple of years ago, but now I can't find any more information. Any assistance you might offer is greatly appreciated.—J. D., Durango, CO.*

A The idea here is to eliminate a sound wave by emitting a second sound wave that vibrates the air in exactly the opposite way. Together, the two sound waves should add up to zero.

You can invert a sound wave by swapping the two wires that go to the speaker, but that, by itself, won't do the job of canceling noise. The reason is that the waves from your speaker don't originate in the same place as the waves you're trying to cancel. As a result, at any particular location they will not be traveling in the same direction, nor will they have been traveling the same length of time. Although the two waves might match up and cancel at one particular point, they will be mismatched everywhere else.

Acoustic noise cancellation works reasonably well in small enclosed spaces, especially inside headphones, and maybe even inside cars. It apparently won't work in a house or large room with noise coming in from several directions. For further information see "Hardware Hacker" in our June, 1995, issue, and "Letters," November, 1995.

By the way, the traffic noise is probably getting inside your house through or around the windows. Check that the caulking is intact and consider adding storm windows. A hedge of thick shrubbery may also help.

TV Signal Level Meter

Q *When I work on a distribution system with multiple TV-set hookups, having a portable signal-level meter available would sure help things along. Can I build a meter using tuners salvaged from a solid-state color receiver?—E. E., Lehighton, PA*

A Yes, probably, but it would be better to use a whole TV set. Get a small, cheap portable TV and tap into the AGC voltage that is fed into the tuner. You could add a digital panel meter to display the AGC voltage or a pair of pin jacks where you can plug in your voltmeter. The AGC voltage will tell you the relative signal strength. By using a complete TV, you'll be able to see what you're measuring.

Writing to Q&A

We welcome your questions. The most interesting ones are answered in print. Please be sure to include plenty of background information (we'll shorten your letter for publication). If you are asking about a circuit, please include a complete diagram. We regret that we cannot give personal replies. EN

VIDEO NEWS

WHATS NEW IN THE FAST-CHANGING VIDEO INDUSTRY

BY DAVID LACHENBRUCH

Plasma vs. Plasmatron

Large-screen flat-panel TVs are now on the market—in Japan, that is. Priced at $8000 and up, they're not exactly an impulse purchase. Fujitsu, NEC, and several other manufacturers are now offering TV sets with plasma display panels (PDPs) with 42-inch diagonal displays. The sets are about five inches deep and can be hung on the wall. Plasma displays are gas-discharge tubes; they operate somewhat like fluorescent-light tubes, with the gas actually creating the colored light within the tube.

On the other hand, Sony's Plasmatron technically is a plasma-addressed liquid crystal (PALC) display, based on development work by Tektronix in the United States. It was first shown by Sony in June 1995 and put on the market in Japan last October. The PALC tube makes use of the gas discharge as an on-off switch, triggering individual pixels in an externally lighted liquid-crystal display. Sony's Plasmatron has a horizontal plasma channel for each scanning line in the TV picture. Each line is activated instantaneously, and remains illuminated until refreshed, eliminating flicker. Sony says that the system is simple and economical for large displays.

Sony's first Plasmatron has a 25-inch picture, is just over five inches deep, and costs about $8000, available by "special order." Obviously, Sony is aiming at displays larger than that, and its 25-incher is only an interim product. Because the LCD is a key component in the PALC display, Sony has united with the major producer in LCDs—Sharp—and the two companies have signed an agreement to develop PALC displays with wide viewing angles and pictures as large as 50 inches. The first samples of PALC displays in the 40-inch range are scheduled for next fall, with production quantities targeted for 1998.

Meanwhile, in a separate but related development, Sharp announced that it has made what it calls the "world's largest color TFT LCD." The 40-inch panel was made in a trial run by seamlessly joining two 29-inch panels with SVGA resolution. Sharp says that it is the forerunner of even larger LCD panels, based on its seamless technology, and predicts that the panels will be used in multimedia computer monitors and high-definition TV.

THE RCA GENIUS THEATER HOME-ENTERTAINMENT CONCEPT combines a large-screen TV with the power of a computer, allowing a whole family to surf the 'Net together in the comfort of their living room.

Surfing the Box

Although the jury is still out, TV and computer manufacturers are rushing to add big-screen TVs with Web-browsing and e-mail capabilities to their product lines. As reported here (**Electronics Now**, November 1996), both Sony and Philips (the latter via its Magnavox brand) have introduced set-top boxes containing proprietary circuitry developed by WebTV Networks. Both boxes are now on the market at suggested list prices of $349 and $329, respectively. WebTV Network service, priced at $19.95 monthly, is required to operate them.

Toshiba was among the first to offer Web-browsing TVs via its "TIMM" (Toshiba Interactive Multimedia Monitor) series, while RCA is working with Compaq on a 36-inch "Genius Home Theater" combining high-end television with computing capabilities. Zenith and Samsung have licensed Web-browsing TV capability developed by Diba, and Zenith's sets are now on the market here. Hitachi, JVC, Mitsubishi, Sanyo, and Sharp all have announced that they'll have Internet TVs. Among computer manufacturers, Gateway 2000 and NetTV are offering large-screen TVs combined with computers, priced at $3000 and up. Sega is offering a combination Web browser and video-game attachment for the family TV.

The breakneck rush to bring the Web into the living room is surprising when you consider that nobody really knows whether people want to surf the net from their easy chairs with the family looking on. Philips says that it's bringing the Internet to the 60% of American families who don't own or want computers. Of course, the corollary to that statement could well be that they don't want the Internet, either. Then there are problems with legibility of many 'Net pages when viewed from across the room on TVs.

An additional unfathomed question is whether the consumer will be willing to pay the freight to add the Internet to the TV. The $300 to $400 being sought for black-box attachments is more than the cost of many TVs themselves.

And the cost of the box could be only the beginning of the investment in TV Web-browsing and e-mail. Most of the proposed systems so far use an on-screen "keyboard," operated laboriously through the set's wireless remote control. That is inadequate for any serious attempt at originating e-mail—which generally requires the addition of a keyboard, at extra cost.

Desensitizing Camcorders

The camcorder you buy today with "one-lux light sensitivity" might turn out to have only four or five lux in the future. That is because there finally is a U.S. standard for measuring the usable light sensitivity of camcorders.

For years, manufacturers have advertised sensitivity of camcorders in "lux," without ever specifying exactly what is measured. The lux is a standard measurement of illuminance units—the metric analogy to the foot-candle—actually lumens per square meter (one lux = 9.29×10^{-2} foot-candles).

However, in the past, there has been no standard way of measuring usable brightness because sensitivity is not meaningful if the picture washes out or the color disappears. The figures selected individually by manufacturers could best be described as arbitrary. Now, the Consumer Electronics Manufacturers Association (CEMA), a sector of the Electronics Industry Association (EIA), has developed a standard method of measuring for camcorder light sensitivity—one that takes into consideration luminance level, black level, signal-to-noise ratio, chroma level, and resolution. The measurement system was approved by camcorder manufacturers in CEMA and as a national standard by ANSI.

Nevertheless, few manufacturers are using the new standard. The problem is that camcorders that once claimed sensitivity as low as one lux are now measuring as high as five to six lux. In the competitive consumer-electronics industry, manufacturers have been shying away from that apparent disadvantage—at least until everybody else adopts the new system. However, Thomson Consumer Electronics, which markets RCA- and GE-brand camcorders, is using the new measurements on all its newly introduced models and Panasonic promises to do the same thing. But other brands hadn't yet made any kind of commitment at our press time.

When you shop for a camcorder, it's easy to tell whether its light sensitivity has been measured by the old arbitrary method or the new standard. Measurements made under the new standard are identified as "measured by EIA method." EN

LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

Hobby Spectrum Analyzer Shortcut

I'm writing in reference to Part II of my article, "Build a Hobby Spectrum Analyzer" (**Electronics Now**, October 1996). I'd like to suggest that Figure 9, the RF assembly drawing which appears on page 59, can be used as an actual size drilling template by enlarging it 170% on a standard photocopy machine.

Since photocopiers are not precision instruments, measure your enlargement to make sure it fits the board specifications, *i.e.*, 1¾-inches wide by 5.0-inches long. If it is off, adjust the magnification as needed. The enlarged drawing, when cut out and overlaid on the blank double-sided circuit board material, can be used to center punch all the holes indicated, and locate all the parts shown. That should be a great aid to the assembly process. In fact, while it was not documented in my article, the original was done using just such a "full-size" layout drawing.

BOB KOPSKI

Another Face

Thank you for your mention of Visual Designer from Intelligent Instrumentation in the article, "A Visit to Virtual Instrumentation" (**Electronics Now**, October 1996). As a point of interest, Fig. 1 here shows an application screen that could be created using the block diagram shown in the article's sidebar on page 37 ("The Many Faces of Virtual Instrumentation").

BOB WINKLER,
PRODUCT MANAGER
Intelligent Instrumentation

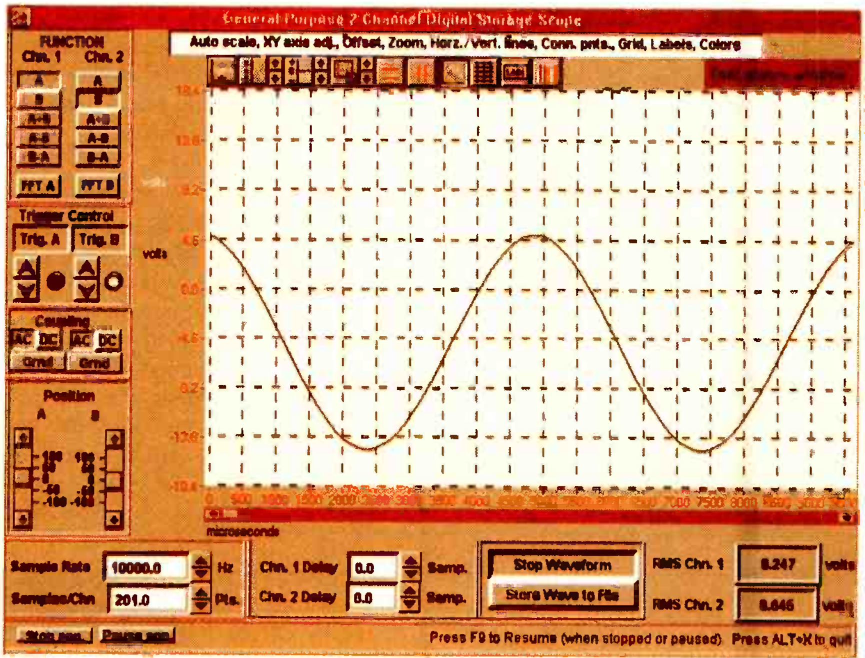


FIG. 1

Laser Experimenting Slip-Ups

I was reading Carl Bergquist's laser light column in the October issue of **Electronics Now** when I found a circuit that will solve a problem I have. I began to look it over to see what I needed and came to the conclusion that it would not work as presented.

The first error that I saw is the statement that "Q1 to Q4 act as amplifiers for the digital drivers to keep the display at full illumination." If you refer to the diagram in Figure 5, then Q2 to Q5 are switching transistors that strobe or turn on the back plane of each digit in turn. If the display is too dim, the only way to brighten it would be to reduce the value of the 220-ohm resistors (R1 to R7), but you would have to be careful not to increase the current too much.

The next error concerns VCC. I believe that in Fig. 5, a dot should be placed at the junction of the line from pin 16 of the IC to the collector of Q1, and the line from +V to the collector of Q6. That would put supply voltage on pin 16 (VCC) of the IC where it belongs, and on the collector of the clock pulse transistor.

The third error concerns Q6. I would think that the author meant to use a light sensitive transistor, not drill a hole in the case of a 2N3904.

If I am right in my assumptions, I do not know how you missed those errors. You people are usually pretty good at proof-checking your articles.

KEN OWEN
Instrumentation Technician
Freelton, Ontario, Canada

You are correct on all of the above points. We were undergoing some staffing changes, and this got by us in the process. We apologize for any inconvenience that has been caused.—Editor EN

Write To:
Letters,
Electronics Now Magazine,
500 Bi-County Blvd.,
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

EQUIPMENT REPORTS

VOICE-RECOGNITION SOFTWARE FROM KURZWEIL APPLIED INTELLIGENCE

Tell your computer what to do with Kurzweil Voice 2.0 voice-recognition software for your PC.

Star Trek fans are sure to remember the movie, *Star Trek: The Voyage Home*. In it, the crew of the Enterprise traveled back to the late 20th Century on yet another mission to save "mankind." Much of the charm and humor of that film centered on the crew's difficulty in adjusting to the culture and technology of the times.

One of the film's funnier moments occurred when Chief Engineer Montgomery Scott, better known as "Scotty," went to a computer to demonstrate a principle to a 20th Century scientist. Sitting in front of the screen, he simply addressed the machine, saying "computer" as he always had. When directed to use the keyboard instead, he cracked his knuckles and replied, "Keyboard, how quaint."

Well, thanks to a new software product, *Kurzweil Voice 2.0*, we might not have to wait until the 23rd Century to relegate the keyboard to the local antique shop. Kurzweil Voice 2.0 (Kurzweil Applied Intelligence, Inc., 411 Waverley Oaks Road, Waltham, MA 02154, Tel: 800-380-1234) is voice-recognition software on a large scale for a PC. It lets you navigate and dictate through Windows and many popular Windows programs. While it's best suited for a Pentium running Windows 95, you can run it on a 486 DX4/75 or faster. The software turns someone who can't type into someone who can, and at a very reasonable speed. Fast typists can still beat out the software, though.

Be aware that Kurzweil Voice is a resource hog—in addition to recommending a Pentium, the program requires 35MB of disk space and 16MB of RAM for a 30,000-word vocabulary, or 24MB of RAM for a 60,000-word vocabulary. (Actually Kurzweil Voice needs 8 or 16 MB of memory for itself, and then you need the extra 8 MB to run Windows.) To give the benefit of the doubt to Kurzweil Voice, we tested the software on a Pentium 200 with 24 MB of RAM and Sound Blaster sound.

Supposedly the program will work with only one of two microphones. One, the Telex Nomad, is included with Kurzweil Voice. The Telex Nomad is a comfortable, adjustable, combination earpiece and microphone that's hands-free and easy to use.

Using your voice is the easiest way to communicate, so it makes sense to use it with your computer. You can forget about typing, and never worry about spelling with voice-dictation software. This new release works with virtually all Windows-compatible sound cards, and its continuous digit recognizer lets you input numbers, which is nice for spreadsheets. There is one drawback: the software isn't cheap. It costs $695 for new customers, or $295 to upgrade from an earlier version.

Using Kurzweil

Once you install the software, you can put on the headset and begin talking. However, it's best if you first train the program to recognize your particular speech. Kurzweil Voice starts an enrollment session for a new user with a volume check on background noise and voice level. Then you pronounce hundreds of simple words and a series of numbers in a process that takes about half an hour. The software gets better and better at recognizing what you say after that, learning more and more as you go. It gets noticeably better even while writing—or speaking—a single document or article.

To use Kurzweil Voice with an application, you first run Kurzweil, then the application. Or, once running, you can even tell Kurzweil to launch the application. The microphone is toggled on and off in any of three ways: by pressing Ctrl and Alt on the keyboard, by clicking on the microphone button, or by saying "Stop listening." The last command doesn't really turn off the software; it just stops responding to your speech until you say "Listen to me." It then returns to voice control. You can also press Ctrl and Alt on the keyboard or click on the microphone button to turn it back on.

There are basically two dictation styles. You give system commands using continuous dictation, saying commands without pauses between words. You say things as one word, like "Filemenu," "Saveas," and so on. To dictate text you add a sharp pause between each word, saying them as if you were reading printed words separated by periods. You only need about a one-sixth-second pause between words. With a fast computer you can dictate as fast as you can speak, as long as you pronounce each word clearly and produce the pause between each.

Kurzweil voice displays your words in a small window as you speak. If it gets a word wrong, or if you say something unintended, you simply say "Correct That" or "Delete That" as necessary. It offers a list of numbered suggestions for words it doesn't understand, and you select words from the list by saying

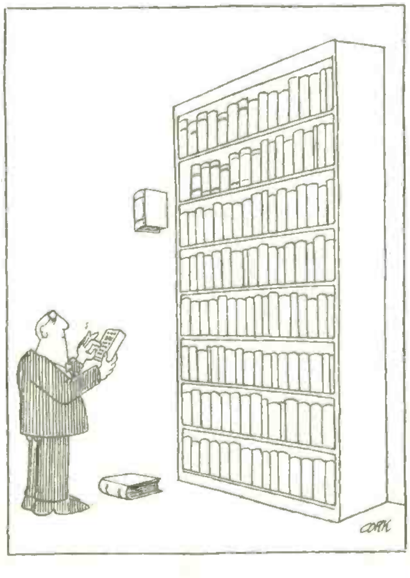
"Take 2" to accept the second choice, "Take 3" for the third, and so on. If the program doesn't suggest the proper word, you can type it in yourself. The software then stores the sounds that correspond to words you've taught it.

Punctuation marks are spoken in by saying "period," "comma," and so forth. You can dictate numbers quickly, including a decimal point, by saying, for example, three point one four one seven. Individual letters are entered in a special mode by saying Alpha, Bravo, Charlie, *etc.* The program does recognize common letter combinations and acronyms, such as AC, DC, SCSI, and so on.

Commands can also simulate keys that let you move around in an application. The Enter key, arrow keys, page up and down, and others all work as they always do. "Open Word" will start Word and open a new document.

It is only fair to point out that the software is not fool-proof. Sometimes it responds when you don't want it to, say if you cough. And anything could happen depending on what word it thinks your cough was. Sometimes the microphone picks up keyboard clicks when you're filling something in manually and it will insert characters on its own.

While it takes some getting used to, Kurzweil Voice 2.0 is a product of the future that's here today. If you do a lot of typing and aren't very good at it, then you will definitely appreciate this software. Anyone who can talk, can now type, and with great accuracy and speed. All you need is money—$695 for the software and a couple grand for a powerful Pentium. EN



NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Advanced Logic Probe

HEWLETT-PACKARD'S HP *LOGICDART* advanced logic probe is designed to give engineers a head start on troubleshooting fine-pitch digital circuitry. More than a standard logic probe, the LogicDart incorporates a 100 MSa/s timing analyzer, a logic monitor, a DC voltmeter, and a continuity tester. It provides data to the user audibly, with different beeper tones for high and low conditions, and visually, with graphic timing displays and blinking LEDs.

Fast and easy to use, the probe has a particularly sharp point and thin profile to make working with today's small topologies easier and more precise. It has the ability to detect high, low, and tri-state conditions.

For analyzing signal timing, the LogicDart has three separate input channels. It can display all three simultaneously with up to 10-ns resolution and can store up to 10 2048-sample waveforms. Each channel has independent triggering, and all three channels can be set up for edge, pattern, and edge/pattern-combination triggering. The logic probe also has pan and zoom capabilities that allow the engineer to use cursors on the graphical display to make precise delta-time measurements.

CIRCLE 20 ON FREE INFORMATION CARD

With 3.5-digit resolution, the DC voltage measurement function allows the user to verify voltage buses, look for loading problems, and check logic thresholds. The continuity-measurement function allows users to verify that connections on the circuit board match the original schematic design, even before power is applied to the circuit.

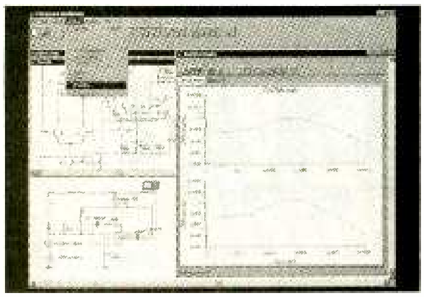
The battery-operated LogicDart includes an AC adapter for bench operation. The probe is preset for TTL, ECL, and CMOS, but it also can handle custom logic functions. Hard copies of measurement and screen results can be printed via an infrared link to a thermal printer. Help screens and other onscreen information are available in five languages.

The HP LogicDart (HP E2310A), complete with a full set of probes, a carrying case, a user manual, batteries, and AC adapter, costs $695. The HP 82240B thermal printer costs $135.

HEWLETT-PACKARD COMPANY
Direct Market Organization
P.O. Box 58059, MS51L-SJ
Santa Clara, CA 95051-8059
Tel: 1-800-452-4844 ext. 1893
Web site: http://www.tmo.hp.com

Electronics Workbench Version 5.0

Version 5.0 of Interactive Image Technologies' *Electronics Workbench* Spice-based simulation tool offers more functionality and speed than the Version 4.1 Engineer's Pack product. The latest version provides a powerful simulation engine that is more than ten times faster than previous versions, and also provides six analyses that allow users to investi-



CIRCLE 21 ON FREE INFORMATION CARD

gate more comprehensively the behavior of their circuits. The software offers more than 1000 analog components with over 4000 device models and over 200 digital components and ICs.

The distortion analysis feature calculates the magnitude of the harmonic components, allowing the user to observe the AC spectral distortion at any point in the circuit. Fourier analysis calculates the spectral components of the transient response, including magnitude and phase. That produces useful data for analyzing networks and other frequency-dependent systems. Four other analyses—transient, AC sweep, DC operating point, and noise analysis—provide similar benefits.

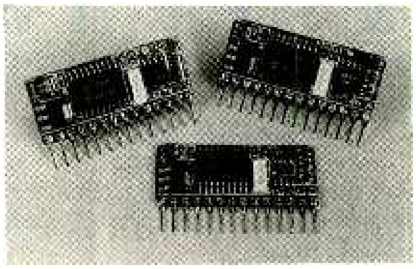
Electronics Workbench 5.0 also features click-and-drag schematic editing and scrollable waveforms and autoscaling graphs. It allows export to standard PCB-layout packages and the import and export of standard Spice netlists.

Electronics Workbench 5.0 for Windows 95/NT/3.1 and (as of first quarter 1997) Macintosh costs $299. Users of Version 4.1 can receive an upgrade to Version 5.0 for $79. Users requiring 4000 additional models and eight additional analyses including Monte Carlo can upgrade to Electronics Workbench EDA for $399.

INTERACTIVE IMAGE TECHNOLOGIES LTD.
111 Peter Street, Suite 801
Toronto, Ontario
Canada M5V 2H1
Tel: 1-800-263-5552 or 416-977-5550
Fax: 416-977-1818
Web site: http://www.interactive.com.

Subminiature Control Computer

Micromint's *PicStic* is an industrially-oriented controller on a 14-pin SIP and an enhanced pin-compatible replacement for the Parallax BASIC stamp. Including options, the PicStic features digital inputs and outputs, analog inputs, real-time monitoring, power input regulation, and serial communications in a 0.85-square-inch module.



CIRCLE 22 ON FREE INFORMATION CARD

PicStics use a reprogrammable PIC16C84 processor and a choice of languages. They can be programmed in compiled BASIC, C, or directly in PIC assembly language. Using the Micromint PBASIC compiler, PicStics are 100% compatible with Stamp I software, have twice the available program space, and execute programs at least 15 times faster for the same crystal speed.

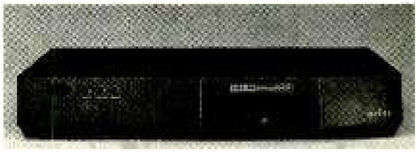
Three varieties of PicStics are available. PicStic1 is a straight one-for-one faster replacement for the Stamp I, with two extra I/O lines. PicStic2 has all the features of PicStic1 plus a battery-backed, real-time clock/calendar that keeps time in terms of year, month, date, day of week, hour, minute, and second. PicStic3 has all the features of PicStic1 plus a two-channel, 12-bit ADC. The compilers contain library routines for serial communication up to 9600 bps, reading the ADC and real-time clock, and dealing with the extra I/O lines.

The single-quantity prices of PicStic is $29; PicStic2 and PicStic3 cost $39 each in single quantities. A development system that consists of either a PC-compatible PBASIC or a C compiler, and a PicStic programmer is $149.

MICROMINT INC.
4 Park Street
Vernon, CT 06066
Tel: 860-871-6170
Fax: 860-872-2204
Web site: http://www.micromint.com

TV Internet Access

Aimed at consumers who want Internet access without investing in a home computer and families who want to experience the Internet from their living rooms, Philips Consumer Electronics Company calls its Magnavox *WebTV* "Internet for the rest of us." The set-top WebTV box, with a subscription to the WebTV Network online service, makes Net access as simple as connecting the unit to the family TV and a standard phone line and then pushing one button on the remote control. Users can surf the Net for online shopping or travel information as easily as they change television channels.



CIRCLE 23 ON FREE INFORMATION CARD

WebTV's built-in parental control feature allows parents to limit access to Web pages they deem inappropriate for children. A "Kids" icon, connection to interactive "field trips," reference resources, and other youth-oriented features make it fun and easy for children to use the Internet for learning and for fun activities.

WebTV features a 33.6-Kbps V.34 modem with patent-pending "Lineshare" technology, which allows incoming calls while WebTV is used on a phone line equipped with call waiting, and prevents WebTV activation when an extension phone is in use. TVLens image-enhancing technology eliminates interlace flicker without blurring, while perceptually enhancing image detail. PhosphoRam on-the-fly image-decompression technology minimizes memory consumption. WebTV offers CD-quality sound, a universal remote control with "One Thumb Browsing," and a PC-compatible keyboard port.

WebTV Browser software is compatible with HTTP, MIME, HTML 3.0, and virtually all Netscape Navigator 3.0 and Microsoft Internet Explorer 3.0 extensions. The WebTV user interface features an on-screen options bar to make common functions easily accessible. A Guided Tour and Help system are built in, and automatic URL completion makes entry simple.

The Magnavox WebTV set-top box costs $329.

PHILIPS CONSUMER ELECTRONICS COMPANY
One Philips Drive
Knoxville, TN 37914-1810
Tel: 423-521-4316
Web site: http://www.Magnavox.com

NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Modern CMOS Circuits Manual

by R.M. Marston
Butterworth-Heinemann
225 Wildwood Avenue, Unit B
P. O. Box 4500
Woburn, MA 01801
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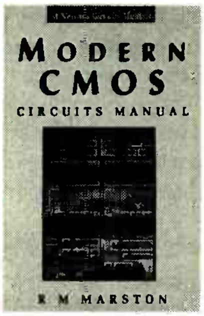

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McGraw-Hill Circuit Encyclopedia & Troubleshooting Guide, Volume 3

by John D. Lenk
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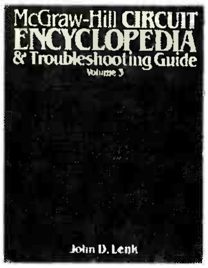

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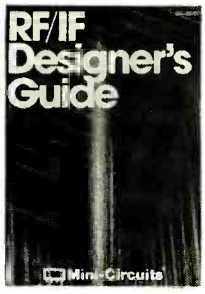

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Designing 3D Graphics: How to Create Real-Time 3D Models for Games and Virtual Reality

by Josh White
John Wiley & Sons, Inc.
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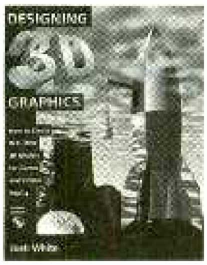
This guide to creating cool three-dimensional graphics contains every-



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A Technical Introduction to Digital Video

by Charles A. Poynton
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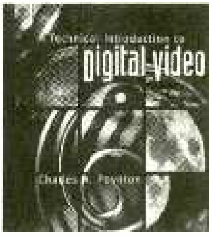

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BUILD THE SOLAR-BALL ROBOT

Here's a project that's educational, entertaining, and fun to build: a ball-shaped robot that rolls around in search of light.

JOHN IOVINE

From the clockwork-driven automata of the 16th and 17th Centuries to the latest industrial robots and movie "droids" of today, robots in one form or another have fascinated us down through the ages. Experimental and toy robots today come in many different shapes, sizes, and capabilities. Some have no form of on-board intelligence and rely on remote control from a human operator for guidance and action. Others have sophisticated computers inside them that can be pre-programmed to carry out specific tasks. Another variety has either a simple microcontroller or some form of simple circuitry that allows the robot to perform a simple task or demonstrate a particular type of behavior in response to its environment. It is that last category that the *Solar Ball Robot* falls into.

The inspiration for the Solar Ball Robot originally came from Richard Weait of Toronto, Ontario. He created a light-seeking robot housed in a transparent globe. More recently, Dave Hrynkiw of Calgary, Alberta, picked up the ball (so to speak) and developed a series of light-seeking, mobile ball-shaped robots.

Designing A Ball-Shaped Robot. There are two features of the Solar Ball Robot that are interesting. First is the method the robot uses to move around. Inside the globe is a gear box. The gear box shafts are secured and locked to opposite sides on the inner surface of the transparent globe. That prevents the shafts from rotating, forcing the gear box itself to rotate. Normally, the weight of the gear box keeps it hanging down towards the bottom of the globe. That off-balance weight keeps the ball from rolling. When the motor runs, the gear box begins to rotate inside the globe. That moves the center of gravity of the ball forward, causing the ball to roll forward.

The second feature relates to the power supply for the gear box. The original Canadian design used a photovoltaic or solar-cell power supply that provided intermittent power to the gearbox. When exposed to sunlight, the solar cell would start charging up a capacitor. When the capacitor reached a certain voltage, a trigger circuit dumped the stored energy into a high-efficiency motor/gearbox assembly, which caused the robot to move forward a little. The general circuit was similar to that of a strobe flash used in photography.

The Solar Ball Robot uses a motor/gearbox arrangement that is similar to the Canadian design, but uses a pair of AA batteries instead of a photovoltaic cell. The batteries must be replaced when they run down, but they supply continuous power to the robot, making it much easier to study the robot's behavior, locomotion, and mobility. The original photovoltaic version required the use of time-lapse photography to study the robot's characteristics. The capacitor took a few minutes to charge up, with the exact time depending upon the intensity of sunlight. Because we've done away with that charging time, 10 hours of motion with the original design can be compressed into a few minutes of study with the robot presented here.

While the Solar Ball Robot doesn't incorporate the electronics for an on-board photovoltaic power supply, it still uses a light trigger. The circuit reads the level of illumination that falls on the robot. If the light level is high enough, the motor is turned on, moving the robot by shifting the center of gravity.

Circuit Description. The electronic circuit for the Solar Ball Robot is a basic light-activated on-off switch for the motor. The schematic diagram in Fig. 1 shows how straightforward the circuit is.

A CMOS op-amp (IC1) is used as a voltage comparator. An ALD1702, manufactured by Advanced Linear Devices, was chosen for its low power consumption, low supply-voltage requirements, and the ability to run on a single-voltage supply instead of the more common dual (or split) voltage supply. That puts less strain on the batteries, leaving more current available for running the motor. The comparator monitors the levels of two input voltages and switches its output on or off depending on which input voltage is greater. The input on pin 2 is set to a reference voltage of about half the supply voltage by R3 and R4. The input on pin 3 is also connected to a voltage divider made up of a cadmium-sulfide photocell (R1) and potentiometer R2. The resistance of a photocell changes depending upon the amount of light shining on it, so the intensity of light is indicated by the voltage on pin 3 of IC1. The light level at which the circuit turns on is adjusted by R2. When the voltage on pin 3 of IC1 is greater than pin 2, the output (pin 6) turns on. Of course, when the voltage on pin 3 drops back down below the voltage on pin 2, the output turns off.

Since the op-amp is being used as a comparator, no feedback resistor has been placed between the output (pin 6) and either of the inputs (pins 2 and 3). That forces the op-amp to operate at its open-loop gain. Like a comparator, when one input voltage exceeds the other, the output "snaps" from one state to the other.

The output of IC1 drives Q1 directly. That transistor acts like a current amplifier for the op-amp. The transistor switches the motor on and off.

The Gear Box. Before we get into the construction of the robot itself, let's first look at the gear box. There are two types of gearboxes available from the source given in the Parts List. If you wish, you could also purchase a suitable gearbox from a local hobby shop or a mail-order supplier that carries gearboxes and related items or design and build your own.

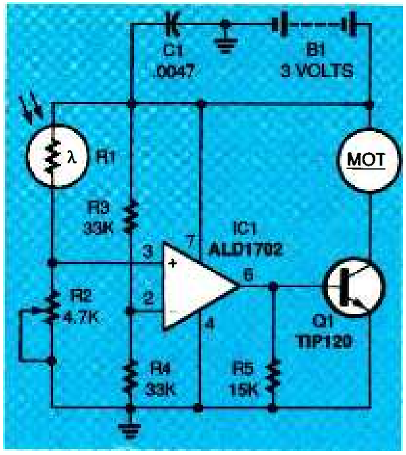


Fig. 1. The circuit for the Solar Ball Robot is designed to do one task: wake up and run the motor when the light shining on the photoresistor is bright enough. Light sensitivity is adjusted with R2.

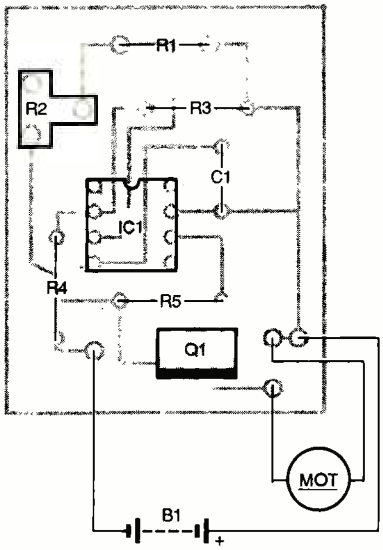
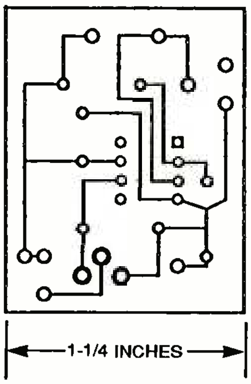


Fig. 2. If you use the recommended PC board, this diagram shows the correct locations for the various components. You can leave the photoresistor sticking up off the board if you want.



Here's the foil pattern for the Solar Ball Robot. The circuit is simple enough to use a single-sided PC board.

If you build your own gearbox, or buy one from another source, there are several important things to keep in mind. The gearbox should be small enough to fit inside the transparent sphere along with the PC board and a pair of AA batteries. The motor you use should be rated at 3-volts DC and should not draw a lot of current (to avoid having to change the batteries too frequently). Finally, the output shaft should turn at about 7 rpm.

The PC Board. There is nothing critical about the electronic circuit. If you make the PC board from the foil pattern, or buy one from the source given in the Parts List, follow the parts-placement diagram in Fig. 2 for the proper placement of the components. If you do not wish to purchase or make the PC board, the circuit may be wired and assembled on a standard perfboard. When mounting R1, you may leave it sitting off the board up to about a height of ½ inch. If you have difficulty locating a source for IC1, you can substitute a Texas Instruments TLC271, which is a direct replacement for the Advanced Linear Devices component. The Texas Instruments chip can be special ordered through any Radio Shack store. After you have soldered all the components onto the board, solder the wires from the 9-volt battery clip and the gearbox motor to the appropriate pads on the board.

Once the PC board is complete, you are ready to put the gearbox assembly together. Glue the AA battery pack to the back of the gear box. The battery pack should have a 9-volt-style battery snap for easy disconnection and reconnection of power. Be careful that no glue comes into contact with any of the gears. The PC board is glued to the front of the gear box. Again, make sure none of the glue touches any of the gears.

Once the circuit is complete you will need to adjust the light level that will activate the circuit. Place a fresh pair of AA batteries in the battery pack and connect the battery snap. The level adjustment is made by turning R2 until the motor starts running. When making the light level adjustment, use a low level of light. If the light level is set too high, the robot will stop every time it passes under a shadow. Disconnect the batteries when you're done calibrating the sensor.

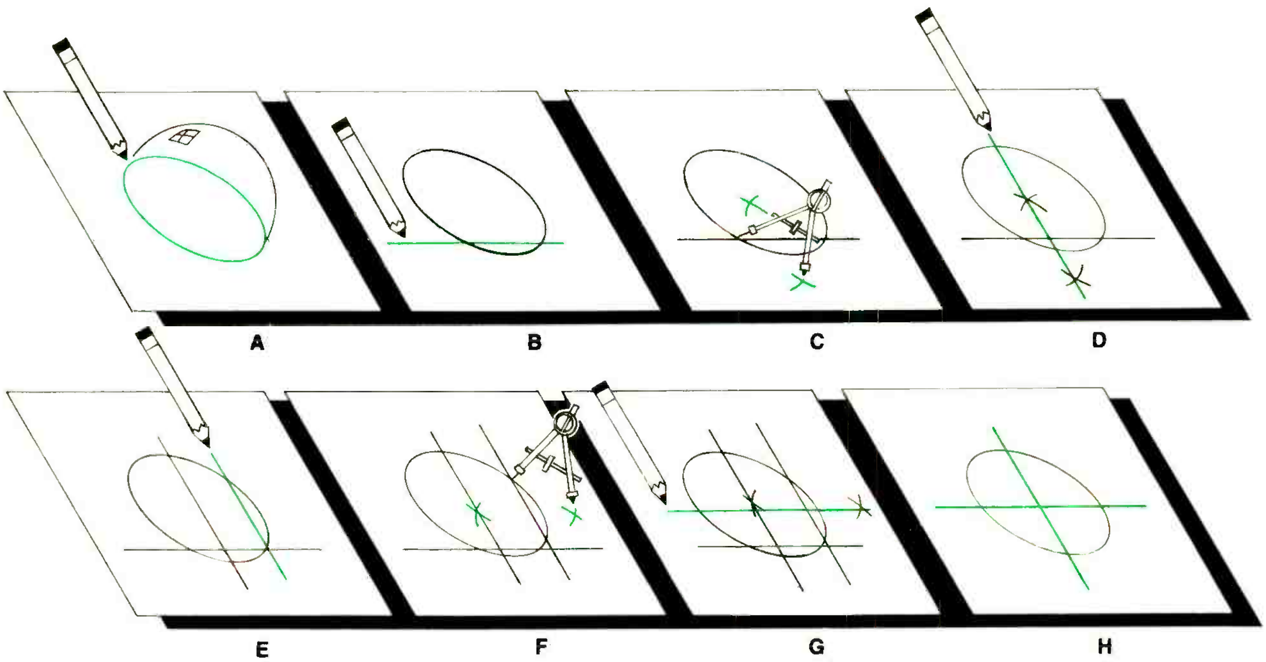


Fig. 3. Finding the center of the Solar Ball Robot's sphere halves is easy if you use some basic high-school geometry. Start by tracing the sphere on a sheet of paper (A). Draw a chord on the circle (B). Bisect the chord with a compass (C). The bisecting line is a diameter (D). Repeat the process at a right angle with a second chord (E), bisect it (F), and draw a second diameter line (G). Where they meet is the circle's center (H).

Robot Construction. We'll start the actual Solar Ball Robot construction from the outside in. The shell must be transparent so light can fall on the photocell, and it must be large enough to hold the gear box and electronics. A good choice are transparent spheres available in many hobby and craft stores. Those snap-together globes are about 5½ inches in diameter, and are usually used to enclose holiday ornaments. If you can not find a suitable shell locally, you can purchase one from the source given in the Parts List.

The first step is to locate the center of each half sphere. That is where the shafts of the gear box will be connected. At first, locating the center appears much easier than it actually is. One method for finding the center is shown in Fig. 3. Trace the diameter of a sphere half onto a large piece of white paper (Fig. 3A). Draw a chord on the circle (Fig. 3B). With a compass drawing tool opened to slightly greater than half the length of the chord line, mark a series of arcs on each side of the chord using the point at which the chord meets the circle as a center (Fig. 3C). You will find that the arcs will cross each other on both sides of the chord line. Drawing a line through those crosses will mark a line that is perpendicular the chord line and crosses it in its exact center (Fig. 3D). That line will be a diameter of the circle.

Draw another chord line at a right angle to the first chord (Fig. 3E). Again, bisect the chord in the same way as before by marking the arcs with a compass (Fig. 3F) and connecting those crosses, which draws a second diameter (Fig. 3G). The point where the two diameters meet will be the center of the circle (Fig. 3H).

The more difficult part is to transfer that center point onto the sphere half itself. Placing the sphere over the drawing and trying to mark the point by eye will probably result in somewhat less than ideal results.

A more accurate method would be to use two small carpenter's squares. Figure 4A shows that method. Place the squares on opposite sides of the sphere half's diameter. Hold a straightedge ruler between them and mark two points on the sphere surface. Connect those points with a line, and repeat the process on the other diameter line. You should end up with an "X" on the sphere half that marks its center. Yet another method would be to cut a length of wooden dowel

PARTS LIST FOR THE SOLAR-BALL ROBOT

RESISTORS

(All resistors are ¼-watt, 5% units, unless otherwise noted.)
R1—Cadmium sulfide photoresistor
R2—4700-ohm, variable
R3, R4—33,000-ohm
R5—15,000-ohm

SEMICONDUCTORS

IC1—ALD1702 (Advanced Linear) or TLC271 (Texas Instruments) 5-volt CMOS op-amp or similar (see text)
Q1—TIP120 NPN transistor

ADDITIONAL PARTS AND MATERIALS

C1—0.0047 µF capacitor, ceramic-disc
B1—3-volt battery, type AA (2)
PC board, 9-volt battery snap, battery holder, gearbox, 5½-inch diameter transparent plastic globe (see text), 6-inch length of ½-inch diameter solid plastic rod, 3-inch length of ⅝-inch o.d. × ½-inch i.d. plastic tubing, 1-inch length of ½-inch diameter half-round plastic rod, 2-part epoxy, plastic adhesive, etc.

Note: A kit of all the above components is available for $45.00 plus $7.50 UPS ground shipping from: Images Company, PO Box 140742, Staten Island NY 10314; Tel: 718-698-8305. NY residents must add 8.25% sales tax. All major credit cards are also accepted.

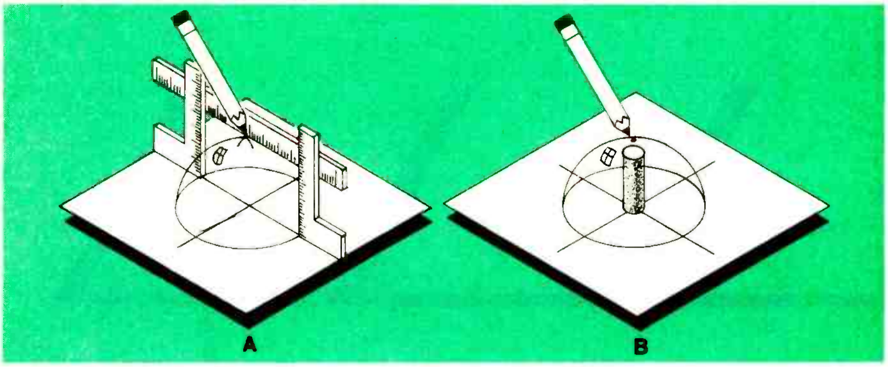


Fig. 4. Projecting the center of a circle onto the sphere half is not that easy. One way to do that is by "lifting" the diameter lines with a pair of small carpenter's squares and a straightedge ruler (A). You might use alligator clips to hold the straightedge and squares together. A wooden dowel that stands up on the paper at perfect right angles will also work (B).

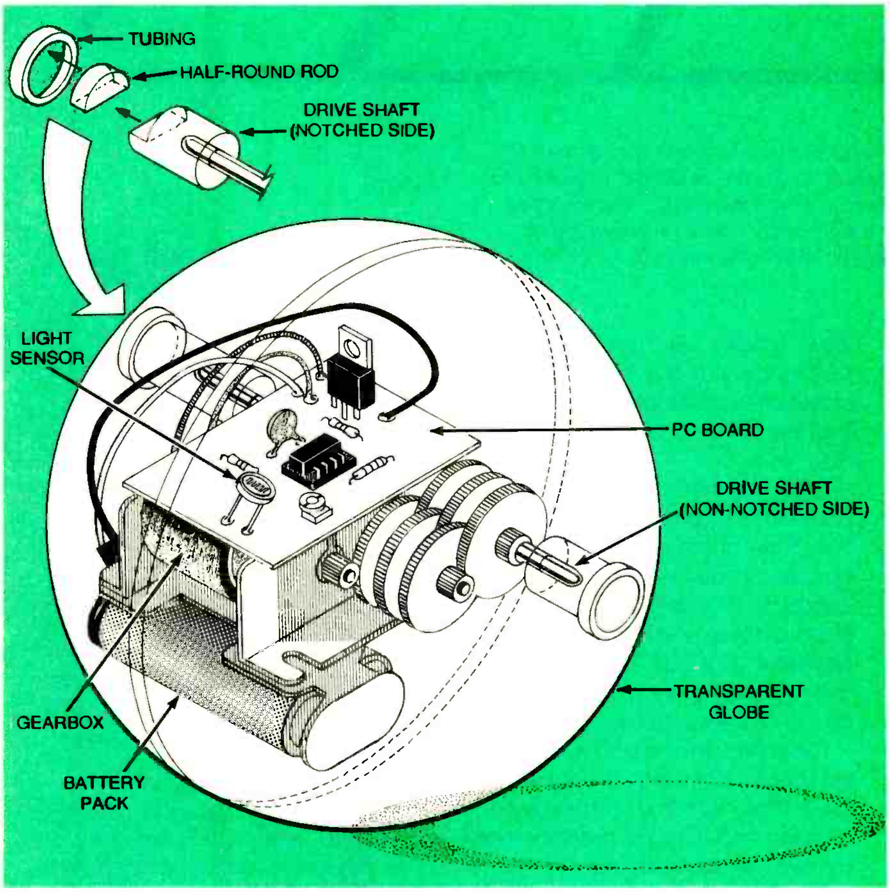


Fig. 5. The Solar Ball Robot's gearbox assembly is suspended in the center of the globe. When the motor runs, the gearbox rotates around the axle, rolling the robot along. The gearbox is held inside the Solar Ball Robot with pieces of tubing and rod. Although you can use wood or brass for the tubing and rod, clear plastic is easier to work with, and looks more interesting.

about 2 to 2½ inches long. Stand the dowel upright on the center mark of the drawing, making sure the dowel stands perfectly upright and at right angles to the drawing. Place the half sphere over the dowel as in Fig. 4B. Mark the location of the center of the dowel on the sphere. No matter what method you use, mark the center of the second sphere half in the same way.

The next step is to make a receptacle that will lock the driveshaft of the gearbox in the sphere. If the shaft cannot spin, the gearbox will rotate around the shaft, shifting the robot's center of gravity and causing it to roll. The shaft locks must also let the sphere be opened and closed easily. The method used is shown in the detail illustration of Fig.5. Although the drive components in the prototype were made from transparent plastic, you can use any suitable material you want to, including brass or wood.

Cut two pieces of ½-inch i.d. tubing and one piece of ½-inch diameter half-round rod to a length of about ⅜-inch. If you are using plastic tubing, the outside diameter of the tubing can be about ⅝ inch. Glue the half-round rod to the inside of one of the tube pieces, and glue that assembly to the inside of one of the sphere halves at the center point you previously marked. If you want, you could glue the tube to the sphere half first, and add the half-round rod separately.

Take a piece of ½-inch-diameter solid rod and cut a half-round notch in one end. Using a hacksaw or a coping saw, cut a slit down the center of the rod to a depth of about ⅜ inch, then make a horizontal cut to remove the half-round section. The rod end should now fit smoothly into the tube piece glued onto the sphere half. If it doesn't, file and trim the rod as needed until the rod fits into the tube piece easily. The length of the rod will depend on the size of the gearbox you'll be using and the diameter of the sphere. Measure the inside diameter of the sphere, subtract the width of the gearbox at the driveshaft, and divide that result by 2. Cut the rod a bit shorter than that to allow for clearance. You may also need to adjust the length of the rod if your gearbox is heavier on one side. If possible, the gearbox's center of gravity along the driveshaft should be at the center of the sphere. If the gearbox cannot be balanced side-to-side, the robot will tend to travel in a wide arc toward the heavier side. Balancing the gearbox along the driveshaft might not be possible, depending on the size of the gearbox and the diameter of the sphere. Centering the gearbox within the sphere will make sure that there is enough clearance for the gearbox within the sphere. Once you have cut the rod to length, drill a hole down the center of the rod at the end opposite the notch. The hole should fit the gearbox's drive shaft.

The robot will roll quite nicely with only one axle notched. If you want, you may certainly notch both shafts, but it is not necessary. If you don't notch the shaft, the other sphere half is easier to finish. Glue the other piece of ½ inch i.d. tubing to the center of the half sphere in the same way you did the first, only omit the half-round piece. Cut a small length of ½-inch diameter solid rod. Again, the length of the solid rod will depend on the size of your gearbox and sphere. Check to make sure the shaft fits easily into the tubing. If not, a small piece of 100-grit sandpaper wrapped around the end of the shaft can be used to sand down the diameter of the rod until the end of the shaft fits easily into the tube piece. Drill a hole that will fit the driveshaft from the gear box down the center of the unsanded end.

Place one of the rods on one of the driveshafts of the gearbox. Place the rod and gearbox in the appropriate half sphere of the globe. Position the gear-box so that it will lie in the center. Mark the depth the gear box shaft must go into the rod on the gearbox driveshaft. Remove the rod from the driveshaft. Mix a small amount of 2-part epoxy. Coat the driveshaft with the epoxy, and insert it into the plastic rod. Let the epoxy set before proceeding.

Once the glue has dried on the first shaft, we must glue the other rod on the opposite shaft. Position the glued rod into the half sphere. Place the other rod on the opposite shaft. Place the other half sphere together with the first. Gauge the depth the gear box shaft must be inserted in the plastic rod, then add another ⅛-inch of depth for error. Glue the second rod like the first one and let it set. Check your work while the glue is setting on the second shaft to insure that you can close the sphere properly.

Putting It All Together. Install the batteries and connect the battery clip on the gearbox assembly to the battery holder. The gear box will probably start turning if the light level in the room is high enough. To load the mechanism inside the robot, bring all the parts into a room dark enough that the motor doesn't run, but bright enough to see what you are doing. Load the gearbox assembly inside the sphere and close the two halves of the sphere together. Figure 5 shows how the completed robot will look based on components bought from the source given in the Parts List.

Take the robot out into the light. The gear box should start running. Place the robot on the floor. The robot should travel toward the direction of light. If the robot moves away from the light, stop the robot, remove the gear-box assembly, and reverse the wires leading to the motor.

Locomotion. If you think the Solar Ball Robot might become trapped easily, you will be amazed the first time you see it roll into a corner. When the robot gets stuck in a corner, the gear-box assembly continues to swing all the way up and over. Shifting its center of gravity over the top dead center of the driveshaft will roll the robot out of the corner and face it in another direction. Remember, the plastic shell is fragile. Do not have your robot try to climb or fall down stairs.

Options And Other Design Ideas. A good area for advanced research is a form of steering, rather than depending on any obstacles or the slope of the ground to guide the Solar Ball Robot. With an advanced steering mechanism, an advanced insect-like intelligence could be modeled with a second light-sensing circuit. The robot could be set up to always head toward a light source (moth), or to scurry away from a light source (cockroach). The robot starts running when a certain level of light shines on it. If a second circuit and several photovoltaic cells are added, we can add a "feeding" behavior. The second comparator circuit would be set to shut the motor down when the light level becomes high enough to let the photovoltaic cells recharge the batteries. With that option, the batteries will have to be of the NiCd type. If you want to try that, keep track of the current drain of the comparator circuits. It must not exceed the current supplied by the solar cells.

The Solar Ball Robot is an entertaining and educational project. We hope your imagination will run wild with modifications and additions. If you would like to share your ideas with the author, please feel free to send a letter with your thoughts c/o **Electronics Now**. Have a ball! Ω

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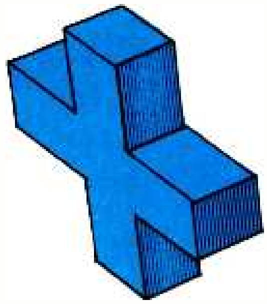
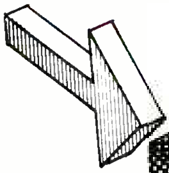
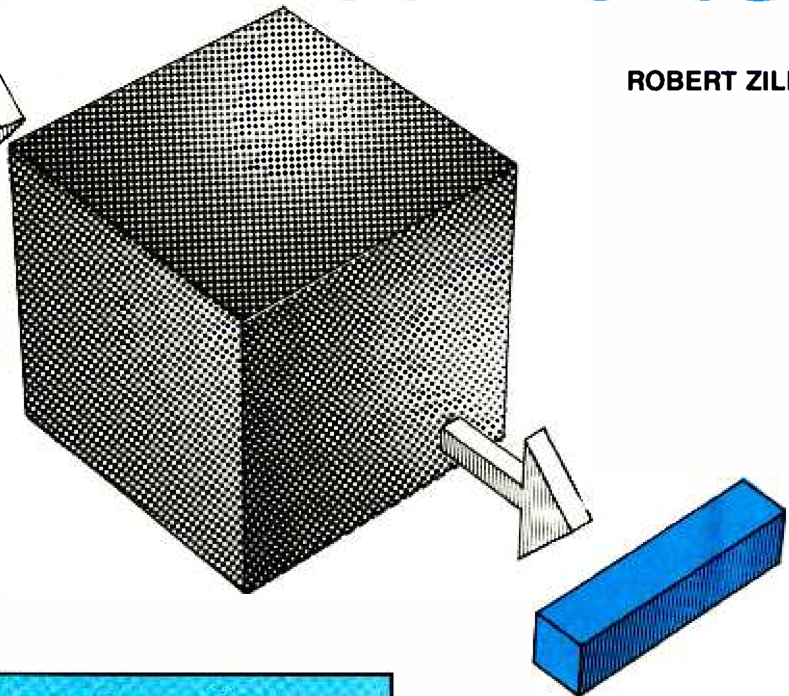


BUILD THIS Negative Voltage Converter





ROBERT ZILLER

Build a negative voltage supply from a CMOS voltage converter IC, and obtain up to −12 volts the easy way for your projects and experiments.

THE REQUIREMENT FOR NEGATIVE voltage in some projects can be annoying because it adds components that you'd like to avoid. In personal computers, for example, there might be a requirement for 20 amperes of +5 volts, but only 0.3 amperes of −5 volts, and a similar relationship holds for many electronic projects. The positive supply powers the digital and analog circuitry, but typically only a few negative milliamperes are needed to power operational amplifiers, digital-to-analog converters, or RS-232C interfaces.

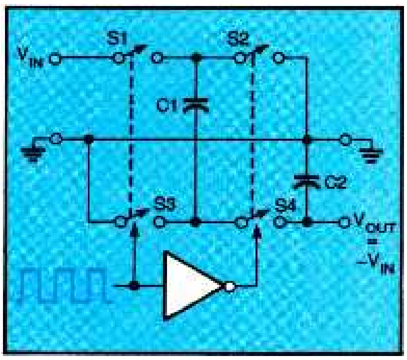


FIG. 1—SIMPLIFIED DIAGRAM OF A CHARGE PUMP that functions as a negative voltage converter.

The charge pump

A simple method for obtaining negative voltages is with the charge pump or negative voltage converter, diagrammed in Fig. 1. Capacitor C1 charges to the input voltage during the half cycle when switches S1 and S3 are closed. (Switches S2 and S4 are open during that half cycle.) During the second half cycle, switches S2 and S4 are closed and switches S1 and S3 are open. Charge is then transferred from C1 to C2 through ten charging (pumping) cycles until the voltage on C2 reaches a negative voltage value equal to the positive input voltage value.

Monolithic charge pumps

The 7660 industry standard monolithic CMOS voltage converter includes the components needed to make a discrete charge pump, saving board space and construction time. It offers an output of −5 volts from a +5-volt source. These devices are still available, but they are not recommended for new designs. The 7660 has been superseded by the improved 7660—the ICL7660S CMOS super voltage converter made by Harris Semiconductor. It can provide negative voltages for an input range of 1.5 to 12 volts.

Figure 2 applies to both versions except that the RC oscillator of the ICL7660S has a BOOST pin for higher switching efficiency. Both contain a series DC power supply regulator, an RC oscillator, a voltage-level translator, and four output power MOS switches. Switch S1 is a P-channel device, and switches S2, S3, and S4 are N-channel devices. A logic network senses the most negative voltage in the device and ensures that the output N-channel MOS switch source substrate junctions are not forward biased. This feature prevents

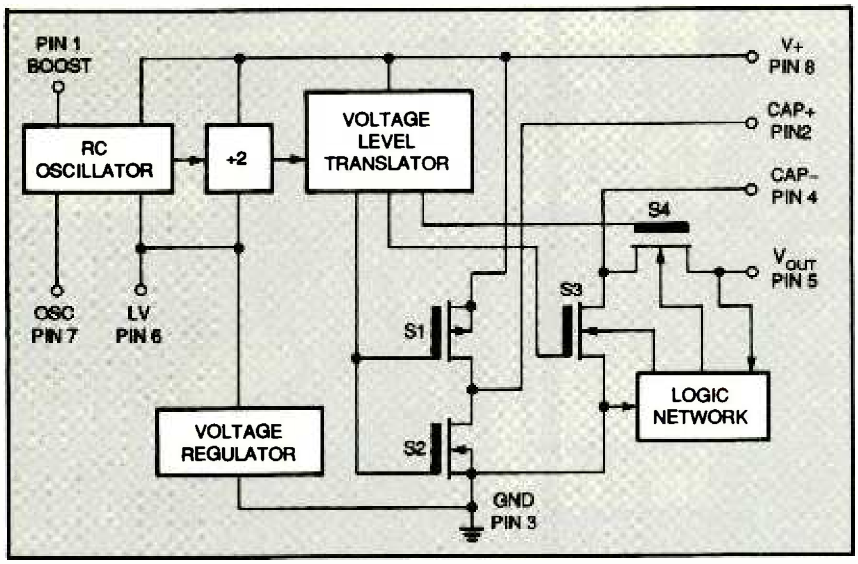


FIG. 2—BLOCK DIAGRAM FOR 7660-type CMOS voltage converters. Pin 1 in the 7006 is NC, but in the ICL7660S it is the BOOST pin for increasing switching frequency.

latchup. The RC oscillators of both versions, when unloaded, oscillate at a nominal frequency of about 10 kHz when the input supply is 5 volts.

The ICL7660S converts positive to negative voltage for an input range of +1.5 volts to +12 volts. This conversion produces negative output voltages of −1.5 volts to −12.0 volts. Only two non-critical external capacitors are needed for the charge pump and charge reservoir. These can be 10 μF aluminum electrolytic capacitors. Both 7660s can also function as voltage doublers, and the ICL7660S will generate output voltages up to +22.8 volts with a +12-volt input. Both versions can approach 100% conversion efficiency.

Putting it to work

Looking back at Fig. 1, when the 7660 is connected to a load, the load takes some of the charge from capacitor C2 which is partially replaced by capacitor C1. This replacement action results in voltage ripple at the switching frequency and a slightly reduced output negative voltage. If this ripple will create problems in the host circuit, the output of the 7660 can be connected to a voltage regulator or larger capacitors. Because the output of a 7660 is unregulated, a +5-volt input will produce only about a −4.5-volt output into a 10 milliampere load.

PARTS LIST

IC1—ICL7660S CMOS monolithic voltage converter, integrated circuit
C1, C2—10μF, 35 WVDC electrolytic capacitor
Wire, solder, circuit-board materials, etc.

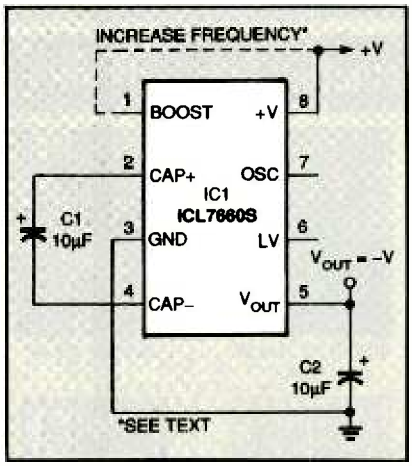


FIG. 3—SIMPLE NEGATIVE voltage converter circuit with its external capacitors. Negative voltage up to −12 volts can be obtained from output pin 8.

Figure 3 is a simple charge pump schematic based on the ICL7660S. Capacitors C1 and C2 have values of 10 μF. This three-component circuit is as simple as a standard IC voltage regulator circuit, and a lot simpler than a full-fledged negative power supply.

The 10-kHz frequency of the 7660S can be increased 3.5 times by tying BOOST pin 1 to +V (pin 8). It can be lowered by adding an external capacitor to the OSC terminal. The oscillator frequency can also be increased by overdriving it from an external clock. Refer to the manufacturer's data sheet to find out how to do this. The low voltage LV terminal can be tied to ground to bypass the internal series regulator to improve low-voltage operation. At medium to high voltages (+3.5 to +12.0 volts) the LV pin is left floating to prevent latchup.

Do's and don'ts

Here are some recommendations to assure that your negative voltage converter works correctly:

1. Do not connect the LV pin 6 to ground for supply voltages greater than 3.5 volts.
2. Do not short circuit the output to the +V supply for supply voltages greater than 5.5 volts for extended periods.
3. When using polarized capacitors, the + terminal of C1 must be connected to pin 2 of the 7660, and the + terminal of C2 must be connected to ground.
4. Do not allow the output at pin 5 to go more positive than GROUND pin 3 or the device will latch up. A 1N914 or equivalent silicon diode in parallel with C2 will prevent latchup under these conditions. Connect the anode to output (V_{OUT}) pin 5 and the cathode to LV pin 6. Ω

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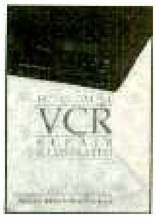

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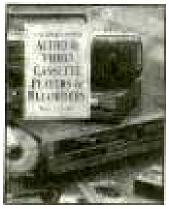

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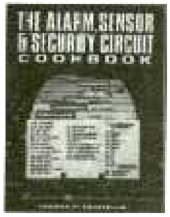

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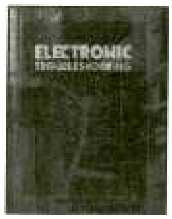

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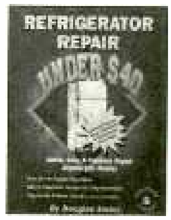

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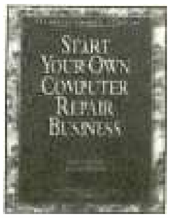

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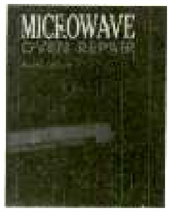

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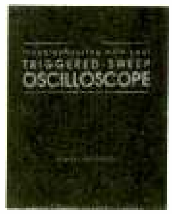

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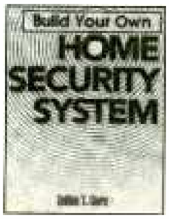

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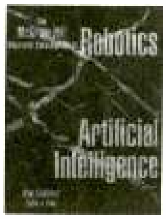

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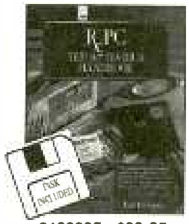

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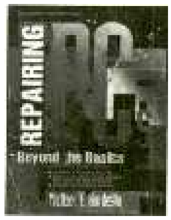

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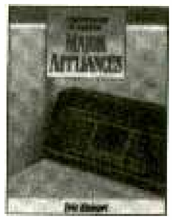

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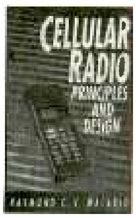

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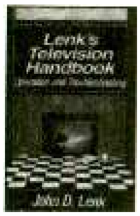

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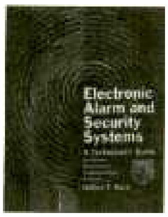

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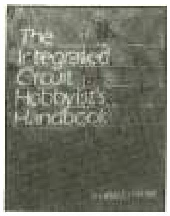

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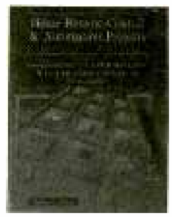

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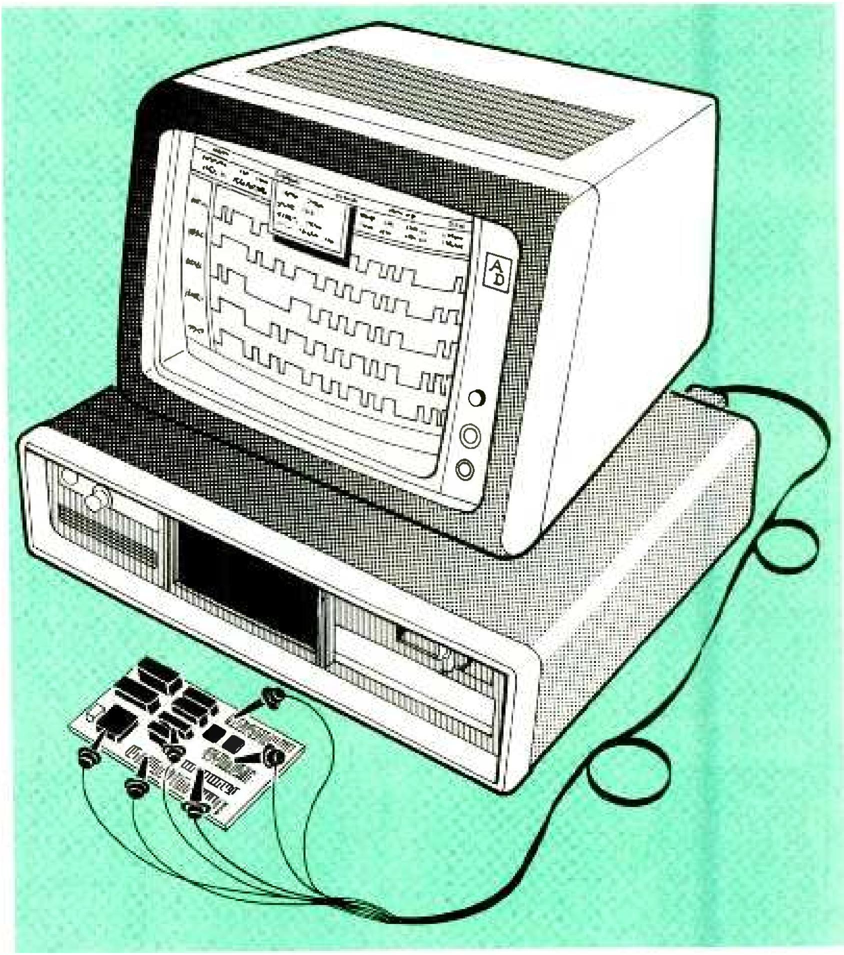


BUILD A FIVE-CHANNEL LOGIC ANALYZER FOR $50.00

Your latest digital circuit is perfect on paper and in the simulator software, but the actual prototype doesn't work as it should. Don't despair—our low-cost logic analyzer will come to the rescue!

WAYNE WHITWORTH

Soon after the first appearance of digital-logic circuits, it was found that the more complex a circuit design was, the more difficult it became to troubleshoot that circuit from both an engineer's and a repair technician's point of view. Always the inventor of tools to wield, Man soon solved that predicament by developing the right tool for the job: the logic analyzer.

Logic analyzers capture and display digital waveforms produced by modems, serial ports, remote controls, microprocessors, and other digital circuitry. Unfortunately, like most pieces of useful test equipment, a decent logic analyzer can be quite expensive. Let's take a closer look at logic analyzers and how they work. With that knowledge, we should be able to design a low-cost analyzer that we can easily build.

How They Work. A logic analyzer is very much like a multi-channel storage oscilloscope. The big difference is that it only understands two types of input voltages: on and off, or in binary language, one and zero.

The secret of a logic analyzer's success is in its ability to record the exact time those ones and zeros change. What's interesting is that while the signals we are interested in are digital, their timing is somewhat analog in nature; we need to digitize the timing of a digital circuit. That is done by reading the state of a digital signal we're interested in at a set time interval. Any changes in the digital signal won't be recorded until the next time interval. If you want to increase a logic analyzer's timing accuracy, you have to increase the number of samples per second the analyzer takes. Better analyzers can record more samples per second.

Recording, or "sampling", the digital data begins with some sort of triggering condition. That can be anything from a complex combination of signals on the monitored input channels to a simple pushbutton that you press. The state of each input channel is read and stored at repeating time intervals until a set number of samples has been taken or the analyzer has run out of storage space for the data. That data is then displayed as a logic state on the vertical axis, and time on the horizontal axis.

Design. When reduced to their basics, logic analyzers are very simple devices. The two main concerns in designing one are a stable and accurate clock to control the sampling rate, and suitable memory to store the collected data. With what we now know about logic analyzers, let's see if we can design an analyzer that has several input channels, a decent sampling rate, and is lower in cost than units already on the market.

If we can find a device that already has some of the features of a logic analyzer, we can base our design around it rather than trying to build a complete analyzer from the ground up. Since an analyzer stores and displays digital information, we don't have to look any further than the IBM-compatible computer sitting on our desktop. We can use the printer port to get data into the computer. Even the most basic type of printer port has five input pins for reading status information from the printer, so we can create an interface that will read five input channels. Another trick we can use to help keep the cost of the project down is to power the interface circuit from the printer port itself. We can take all of the unused output pins and set them to a logic "high" state. Those pins will be supplying a positive voltage which can be tied together to form a power supply. Since the output pins are only TTL compatible, the supply voltage will not be a full 5 volts. In fact, the supply voltage is not really guaranteed to be much over 2.4 volts (the minimum guaranteed voltage for a high TTL-logic output), although the voltage level is usually a bit higher than the minimum. We can compensate for that by using a CMOS logic family for the interface circuit that both runs on a supply voltage as low as 2 volts and has TTL-compatible inputs and outputs at those lower supply voltages.

So far, we've got the makings of a logic analyzer that's low-cost (at least for the interface) and capable of multiple input channels (five to be exact). The difficulty in using a PC as a logic analyzer is in achieving a decent and stable sampling rate. Different models of PCs run at different clock speeds, and even their internal clock/calendar chips differ between computer manufacturers. To get around that, a crystal-controlled time base on the interface board can be used to generate a stable signal that the software can read. That lets the software calibrate itself to different computers. The result is greater accuracy and reliability for the logic analyzer, as well as the flexibility to run on computers of different capabilities using the same hardware and software.

Since the logic analyzer is being designed around an IBM or compatible computer, the user interface, logic display, and many other functions are run by software. The program has been posted on the **Electronics Now** ftp site (ftp://ftp.gernsback.com/pub/EN/logprobe.zip).

Circuit Description. A complete schematic of the interface module appears in Fig. 1. All IBM-compatible printer ports have a data ready signal on pin 1, and data outputs on pins 2 through 9, and printer status inputs on pins 10, 11, 12, 13, and 15. Output pins 2–6 are set high by the software when it is first loaded. Those pins are connected to resistor network RN1. The resistor network and filter capacitor C1 generate the supply voltage for the interface circuit.

The time base consists of IC1 (a CMOS 14-stage oscillator and divider), C2, C3, XTAL1, and R1. When the software first initializes, pin 12 (reset) of IC1 is set low. That enables the oscillator and produces a 4950-Hz squarewave on pin 15. That squarewave is routed to pin 12 of the printer port (PL1) through D2 and one of the inverter gates in IC2. The squarewave is used as a time base by the software to figure out what the sample rate should be, based on how fast the computer is able to execute instructions.

The rest of the components surrounding the squarewave path (D1, D2, RN2-a and R2) serve as a switch to select either the time-base squarewave while initializing, or the input signal from the input probe labeled "GRN" during normal operation. When the software is initializing itself, pin 8 of PL1 is set low. The resulting

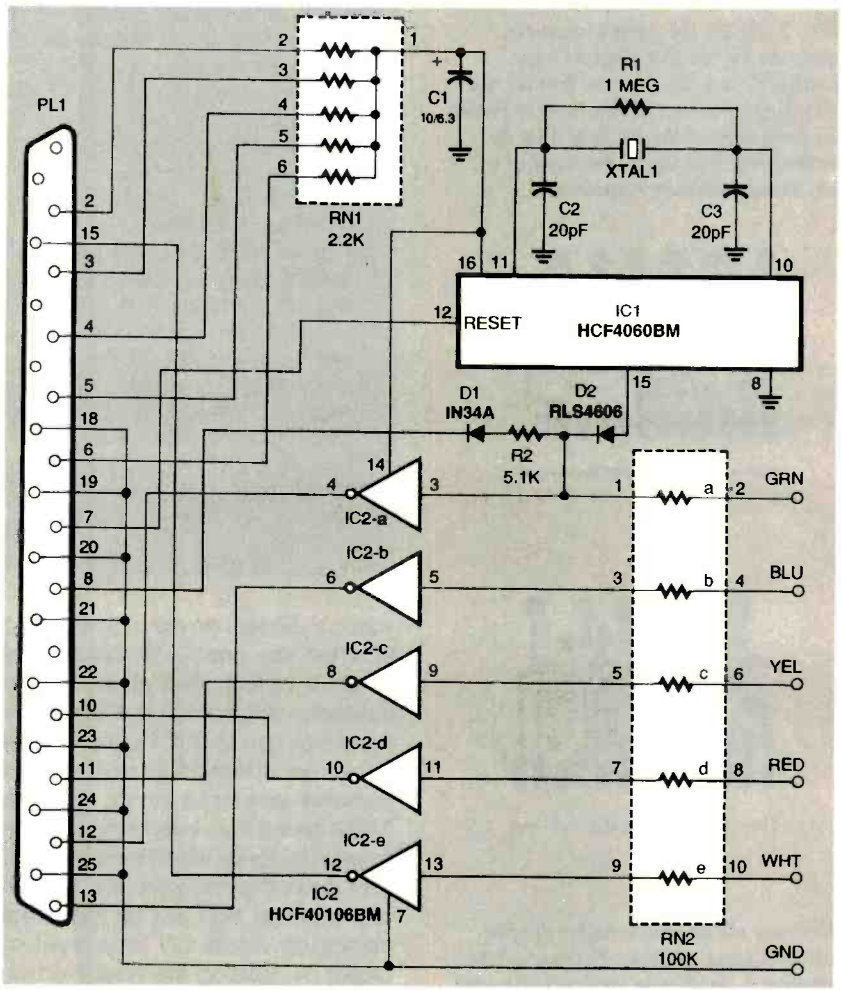


Fig. 1. The interface circuit for the five-channel logic analyzer is very simple. Low-power CMOS technology allows the printer port itself to power the circuit. An on-board time-base circuit lets the interface work with any speed IBM or compatible computer with the same level of accuracy.

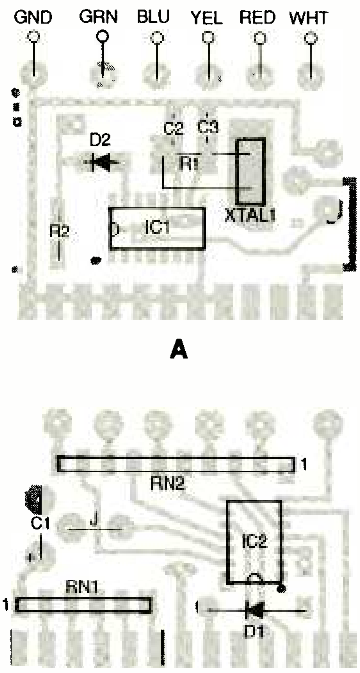
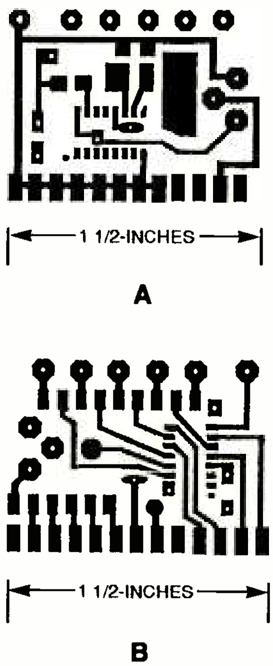


Fig. 2. Here's the parts-placement diagram for the five-channel logic analyzer's top side (A) and bottom side (B). Surface mount components mounted on both sides of the PC board let the entire project fit inside the hood of a 25-pin D-subminiature connector.



Here are the foil patterns for the five-channel logic analyzer. Because of the small size, be careful when aligning the top side (A) and bottom side (B) patterns. The circuit board should be cut small enough to fit into a 25-pin connector hood.

PARTS LIST FOR THE FIVE-CHANNEL LOGIC ANALYZER

SEMICONDUCTORS

D1—1N34A diode
D2—RLS4606 diode, surface-mount
IC1—HCF4060BM CMOS 14-stage oscillator-divider, surface-mount
IC2—HCF40106BM, CMOS hex Schmitt Trigger, surface-mount

RESISTORS

(All resistors are ⅛-watt, 10%, units.)
R1—1-megohm, surface-mount
R2—5100-ohm, surface-mount
RN1—2200-ohm × 5, bused, SIP resistor network
RN2—100,000-ohm × 5, isolated, SIP resistor network

CAPACITORS

C1—10-µF, 6.3-WVDC, tantalum
C2, C3—20-pF, surface-mount

ADDITIONAL PARTS AND MATERIALS

XTAL1—5.0688-MHz parallel-resonant crystal, HC-49US case
PL1—25-pin male D-type connector
TT-series hood for PL1, 6-conductor cable, test clips

Note: The following items are available from: American MicroTech, Inc., P.O. Box 8304, Fort Wayne, IN 46825, Tel: 219-482-3896: Double-sided PC board $15.00; test clips & cable $20.00; remaining parts $15.00; complete parts kit: $50.00; fully assembled unit $65.00. No shipping charges within USA. IN residents must add sales tax. Fully assembled unit includes current version of LOGIC PROBE program provided on disk, software updates, and technical support.

voltage divider formed by RN2-a and R2 attenuate any "GRN" input signal at pin 3 of IC2. Since there are no resistors in the path of the time-base signal from pin 15 of IC1 to the input of IC2-a, no attenuation occurs. That prevents any input signal from the "GRN" probe from interfering with the time-base signal. When the logic analyzer is running normally, pins 7 and 8 of the printer port are set high. That operation resets IC1 and reverse-biases D1. Holding the reset high on IC1 disables the time-base oscillator, which sets pin 15 of IC1 low. When D1 is reverse biased, the voltage divider formed by R2 and RN2-a is disabled. That allows any signal from the "GRN" input probe to be routed to the printer port.

Some of the printer-status inputs on the printer port are edge triggered while others are level triggered. That would normally result in uneven trigger thresholds among the five channels. Schmitt trigger IC2 is placed in the path of the input signals to eliminate those uneven trigger thresholds; it also removes noise and provides protection to the printer-port circuitry. Resistor network RN2 and the internal clamping diodes of IC2 protect the interface circuit and the printer port from transient voltages as large as 75 volts.

Building The Logic Analyzer. By using surface-mount components, the interface circuit can be made small enough to fit in the connector housing for PL1. The interface circuit can be built in less than an hour. However, the surface-mount components require a good eye and a steady hand to solder properly.

Refer to Fig. 2 for component locations on the top side (A) and bottom side (B) of the circuit board. Use a low wattage soldering iron (about 25 watts) and a fine tip to solder the parts.

Start by soldering the DB-25 connector to the edge of the circuit board. Align the connector pins to the pads on the circuit board carefully. There are 12 pins on the top side of the board and 13 pins on the bottom. If you don't have a suitable vice in which to clamp the circuit board during soldering, you can use the flanges at the end of the connector to hold the circuit board in place while soldering the remaining parts to the board. One way to do that is by using needle-nose pliers with a rubber band stretched over the hand grips to hold the connector in place. That way, the needle-nose pliers act like spring-loaded clamps.

After the PC board is soldered to the connector, solder IC1 to the top side and IC2 to the bottom side of the circuit board. Double check the orientation of those polarized components before you solder them to the circuit board. Pin 1 on IC1 and IC2 is located at the far left side of the IC with its beveled edge facing you. Solder D1

(Continued on page 54)

AIR TRAFFIC MANAGEMENT MOVES INTO THE 21ST CENTURY

Learn about the major changes in concepts and technology that will soon make flying safer and more economical.

BILL SIURU

By the year 2005, the number of commercial passengers flying in the U.S. will increase by almost 45%—from about 625 to some 900 million annually. To meet that increased demand, as well as to modernize equipment that often dates back to the 1960s and, in some cases, even the 1950s, the Federal Aviation Administration (FAA) will be making major changes in the Air Traffic Management system.

The Air Traffic Management (ATM) system is designed to ensure the safe and efficient flight of aircraft flying under instrument flight rules (IFR). It is responsible for the aircraft's safety from takeoff to landing. That responsibility is divided into three controlled airspaces—airport, terminal, and en route (see Fig. 1). At the busiest airports, the airport airspace as well as the airport's surface traffic is supervised by the control tower. Beyond the airport airspace, while flying in terminal airspace, aircraft are supervised by Terminal Radar Approach Control (TRACON). The en route airspace, where aircraft spend most of their flying time, is supervised by an Air Route Traffic Control Center(ARTCC). ATM modernization will affect all aspects of the IFR flight—communications, navigation, surveillance and ATM automation.

Communications. Currently, air-ground communications uses mostly voice on the VHF and HF bands, and is pretty much limited to flight-plan changes, aircraft separation and sequence instructions, weather, and advisories on other aircraft flying under visual flight rules (VFR) in the area. Communications between adjacent air-traffic service locations is by landline (telephone) using voice and a limited amount of data transmission.

One example of modernization already underway is the Voice Switching and Control System (VSCS) to replace 1950s electromechanical

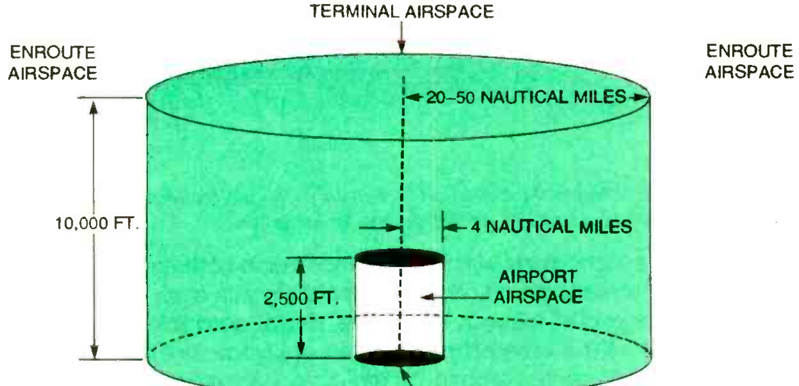


Fig. 1. The airspace over the U.S. is divided into three regions—airport, terminal, and en route. Most of an aircraft's flight occurs in the en route region.

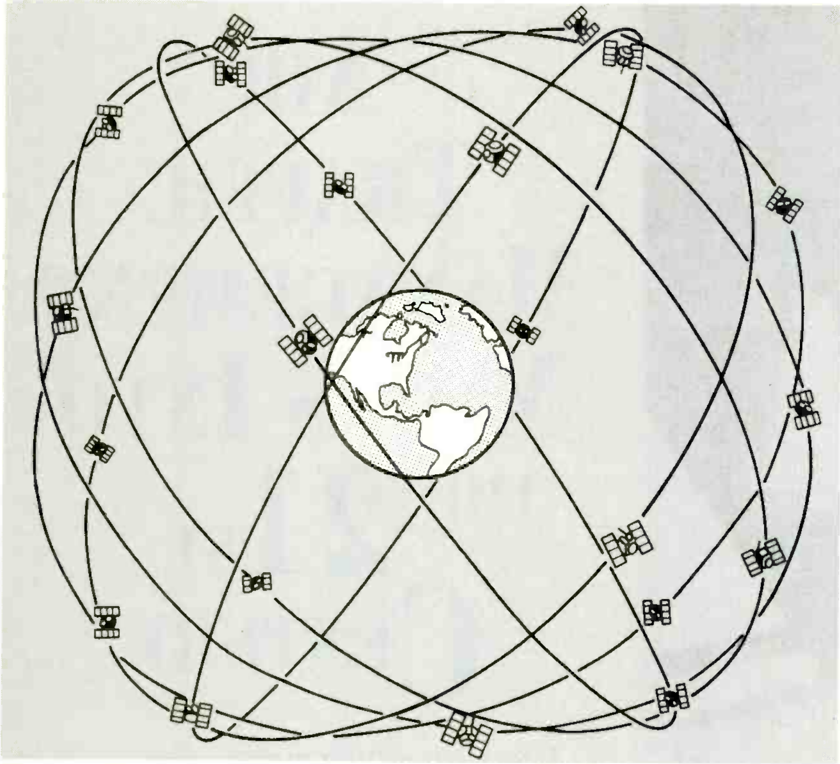


Fig. 2. Each of the 24 GPS satellite are placed in an orbit where they circle the earth every 12 hours. Four GPS satellites are located in each of six orbital planes inclined at 55 degrees to the equator.

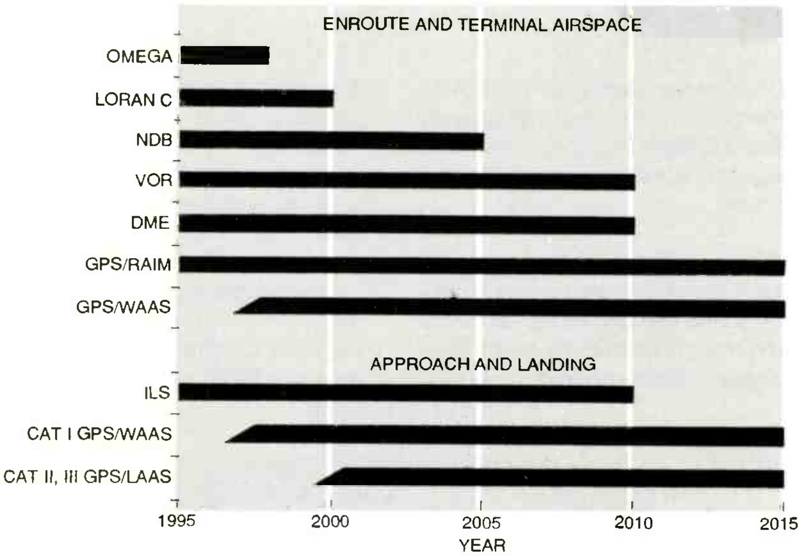


Fig. 3. This chart illustrates the transition from traditional navigational systems such as Loran C to ones based on GPS and other new technologies.

and vacuum-tube technology with fiber-optics, touch screens, and digital electronics. By the end of this year, a total of 21 VSCSs will be installed at ATC (air-traffic control) centers around the country. VSCS virtually eliminates delays and allows controllers to adjust their communications system to meet the changing traffic volume, weather conditions, and workload.

Since voice communications is not compatible with automated ATM systems, digital data links that let computers easily talk to other computers are a must. For example, future communications will also take place using two-way, high-speed Gatelink data communications links while a plane is parked on the ground, and communication satellites while in the air. Voice communications will still be available for backup and for emergencies and problem resolution.

Navigation. Over the next few years, systems such as Omega, Loran C, NDB (non-directional beacons), VOR-DME (VHF omnidirectional range distance-measuring equipment), and ILS (instrument-landing systems) so familiar to pilots will be retired (see Fig. 3). Thousands of those ground-based systems, some dating back a half century, will be replaced by Global Positioning System (GPS) navigation satellites, communication satellites, and far fewer ground sites.

Radio navigation requires four qualities—accuracy, integrity, availability, and continuity of service. *Accuracy,* expressed in statistical terms such as 100 meters 95% of the time, indicates the maximum difference between the estimated and actual position. *Integrity* refers to the ability to provide a timely warning when the GPS signal is not accurate and should not be used. *Availability* means there is a sufficient number of GPS signals for accurate position determination. *Continuity of service* is the ability to provide enough GPS signals over a specified period of time without interruption.

Civilian GPS users can pinpoint their location with an accuracy of 100 meters horizontally and 156 meters vertically 95% of the time. In most cases that is not quite sufficient for aviation and must be augmented by other techniques. The increased accuracy available to the military—22 meters horizontally and 28 meters vertically with 95% confidence—is not available to civilian users since the U.S. logically wants to deny that accuracy to an enemy.

The 24 Global Position System satellites (see Fig. 2) represent just the first phase of the Global Navigation Satellite System (GNSS), an international system that will also include 24 Russian navigation satellites, known as the GLONASS series. With 19 of the satellites already launched at the time this was written, that 24-satellite constellation should be complete shortly.

Because of low traffic density on routes over the Atlantic and Pacific oceans, the information from the basic Global Positioning system only requires augmentation with Receiver

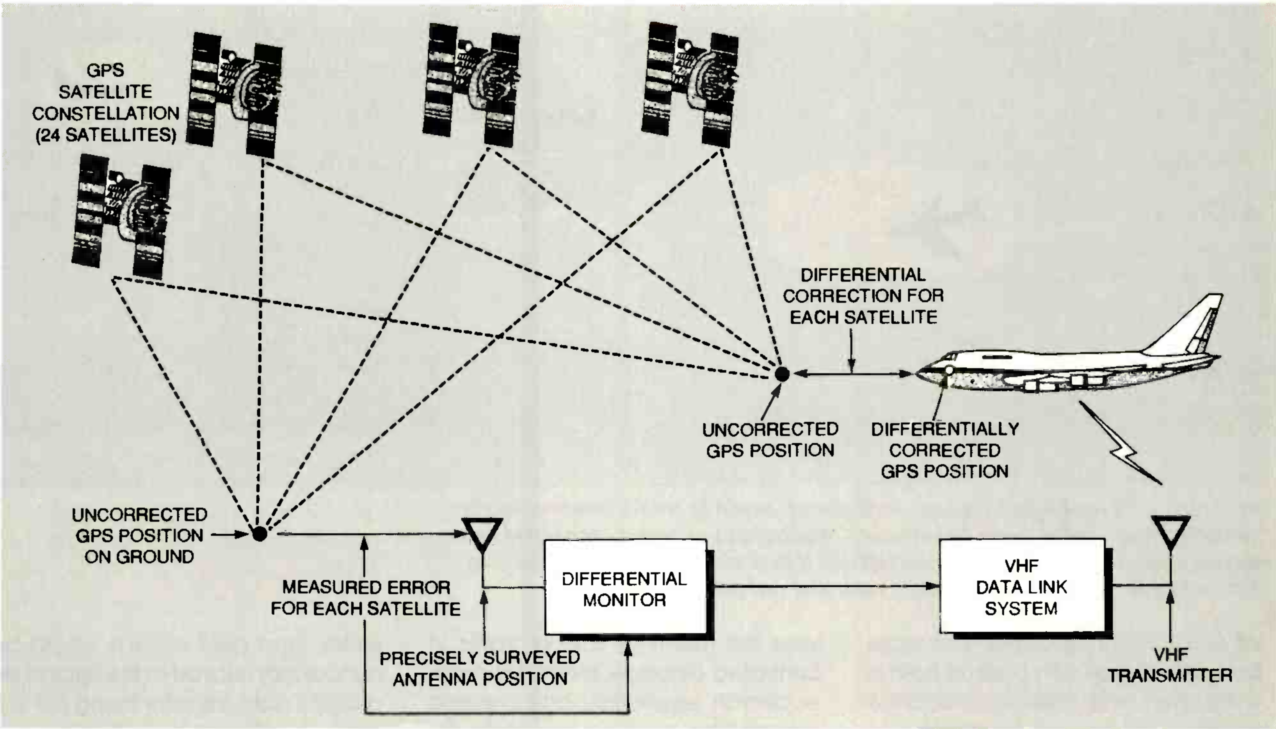


Fig. 4. The differential GPS correction is computed from signals received by a precisely located ground receiver and then transmitted to the aircraft so the same correction can be made there as well.

Autonomous Integrity Monitoring (RAIM), which is incorporated into the aircraft's GPS receiver. By continuously monitoring the integrity of the received GPS signals, RAIM informs the flight crew as to whether or not they can reply on the GPS signal. With the forecasted wide-spread use of GPS, the U.S. plans to discontinue supporting the ground-based Omega and Loran C radio navigation systems.

The much higher traffic density in the en route and terminal airspace over the U.S. mainland requires greater capability than provided by GPS/RAIM. That requirement will be fulfilled by the Wide Area Augmentation System (WAAS), which will use 20–30 ground stations, GPS, and several communication satellites in geostationary orbit. The ground sites will monitor the radio navigation signals transmitted by GPS, and that data will be relayed to an aircraft via a communications satellite. When in operation in late 1997 or early 1998, WAAS coverage will extend over the entire U.S., as well as the U.S.-managed airspace over the Atlantic and Pacific oceans. Current plans call for an eventual phase out of non-directional beacons and VHF omnidirectional range distance-measuring equipment ground sites now in use.

WAAS will also be used for non-precision and Category I (more on that in a moment) ILS approaches and landings, starting at some airports in late 1997 or early 1998. One of the most challenging tasks for GPS will be using it during precision approaches and landings under poor visibility conditions.

There are three categories of precision landings—Category I, II and III—each with decreasing visibility and thus tighter requirements on accuracy. Precision approaches now use a three-dimensional (horizontal and vertical) glide path provided by an ILS. That enables the aircraft both to align itself with a runway and to fly along a 3-degree glide path with respect to the runway surface.

A second GPS-based system, Local Area Augmentation System (LAAS) will be used for Category I approaches at a few airports without WAAS coverage. More significant, LAAS will replace ILS for Category II and III precision approaches, and thus ILS could be entirely gone by 2010.

The disadvantage of LAAS over WAAS is that LAAS provides coverage in the airspace only in the immediate vicinity of a single airport. That means far more ground sites, so LAAS is more expensive to build and operate. While LAAS performs with the same level of capability as ILS, a single LAAS can provide assistance for several runways at an airport. An ILS has to be placed at the end of each runway.

While the basic civil version of GPS has sufficient accuracy for en route and terminal airspace navigation, it is not sufficiently accurate for precision approaches and landings. Therefore Differential GPS has been developed to increase accuracies to about one meter.

Differential GPS (see Fig. 4) uses a ground receiver whose fixed location is precisely known. That ground unit receives the radio navigation signals from the same GPS satellites as the aircraft. Since that ground receiver's location is precisely known, the difference, or correction, between the exact location and the location computed from GPS signals can be determined. That correction is instantaneously transmitted to the aircraft so the same correction can be made aboard it.

Surveillance. While control-tower personnel usually observe the aircraft they are controlling, at the busier airports they also have radar displays for poor visibility conditions. Controllers manage both the minimum horizon-

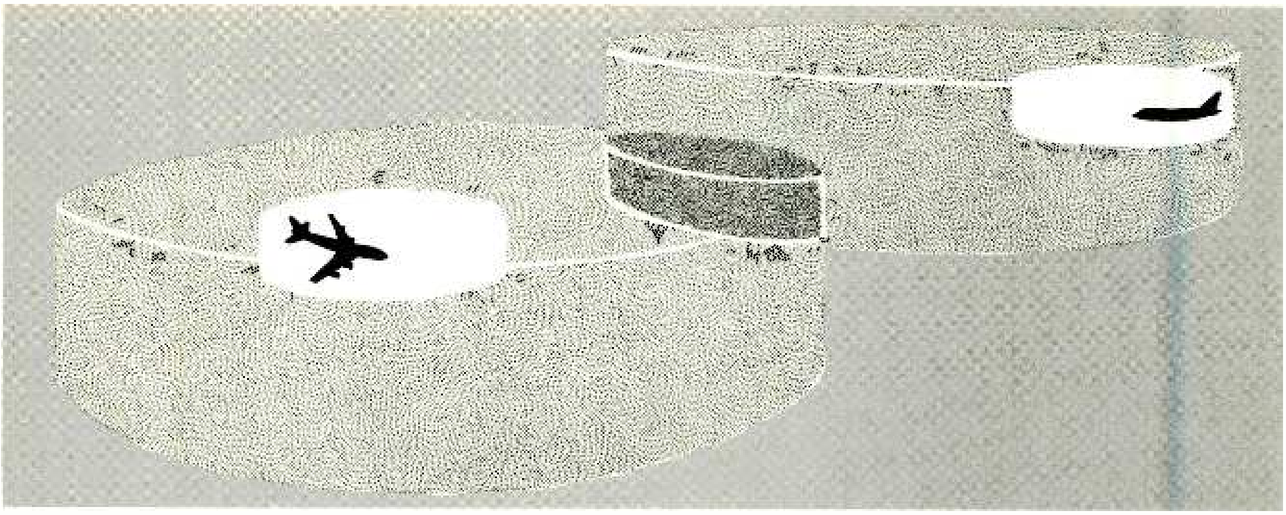


Fig. 5. In the "Free Flight" concept, each aircraft would fly within zones—a smaller "protected zone" and a larger "alert zone." An aircraft's protected zone would never meet the protected zone of another aircraft and if their alert zones make contact, an alert calling for action by the air-traffic controller and pilot is signaled.

tal and vertical separation distances between aircraft with backup from a traffic alert and collision avoidance system found now on virtually all carrier aircraft. TRACONs (terminal radar-approach control) or ARTCCs (air-route traffic control center) currently use a combination of primary and secondary radars to locate and track aircraft flying IFR in terminal and en route airspace. Primary radars, also called search radars, use passive electromagnetic reflections from the aircraft to monitor their location a horizontal plane. Secondary radars actively interrogate aircraft equipped with beacon transponders to determine their horizontal position as well as their altitude and identity.

By the turn of the century, primary radars used to keep track of aircraft in en route will be phased out and their function replaced by Automatic Dependent Surveillance (ADS). By 2011, ADS will provide aircraft position data now provided by both primary and secondary radars in en route and terminal airspace. Rather than being tracked by ground-based radar, with ADS, each aircraft's navigation system transmits its position determined from the GPS every few seconds via a digital data link to the appropriate ATC facility. Terminal primary radars and all secondary radars would still be retained as a backup to ADS.

ATM Automation. The ATM mission consists of tactical air-traffic control and strategic traffic-flow management (TFM). Air-traffic control supervises the real-time flow of traffic in controlled airspace, maintains proper aircraft separation, and prevents aircraft from crashing into obstacles or the ground. Traffic-flow management is responsible for the optimal, smooth flow of all IFR air traffic around major airports and in high-density controlled airspace. The ATC System Command Center (ATCSCC) located near Washington, D.C. manages the overall flow of IFR aircraft over the continental U.S.

By 2011 the FAA will have upgraded or replaced the existing ATM software, automation equipment, and displays throughout the entire system, including ARTCCs, TRACONs, and the ATCSCC. Automation is required to handle the huge increase in air traffic while maintaining, or, hopefully, improving safety. Automation coupled with data-link communications will also allow a "control by exception" philosophy. Controllers would take action only if an aircraft is in conflict with another aircraft, diverting from its flight plan, or in emergency and abnormal situations. Otherwise, routine flights will occur automatically with little input from controllers. Control by exception is the basis of the "Free Flight" concept, which we will discuss in a moment.

One example of future automation is where crews could monitor the weather continually on cockpit displays while en route. The weather data from the National Weather Service and the FAA from ground-based observations, weather radars and satellites, and pilot reports would be periodically relayed to the aircraft via a digital data link after being put In a easily used format to be displayed on a graphic cockpit display.

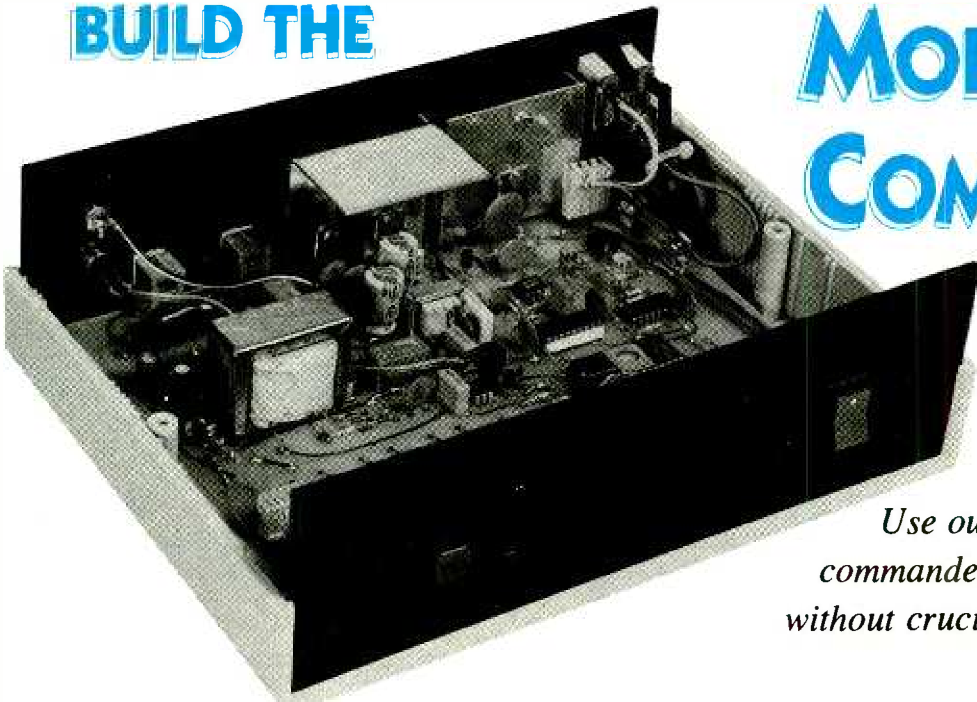
Free Flight. Most air traffic in the U.S. is general-aviation aircraft flying VFR below 18,000 feet. They fly wherever and whenever they want, weather permitting, as long as they do not fly into airspace reserved for IFR aircraft or special-use airspace such as that reserved for the military. Free Flight, as being developed by the FAA in collaboration with the airline and aviation communities, means almost as much flexibility for aircraft flying IFR.

With Free Flight, two zones would encircle each IFR aircraft (see Fig. 5). The size would depend on the aircraft's speed and performance, as well as the capability of its onboard CNS (communications, navigation, surveillance) equipment. The greater the capability, the larger the zone. The smaller "protected zone" of one aircraft can never intersect the protected zone of another aircraft. The significantly larger "alert zone" extends beyond the protected zone. Aircraft maneuver at will until one aircraft's alert zone contacts another's alert zone. That sets off a "control-by-exception" situation requiring action such as the air-traffic controller providing one or both pilots with course corrections or restrictions to ensure separation.

Currently, IFR pilots must get pre-ap-

(Continued on page 54)

BUILD THE MODEM COMMANDER



RAYMOND C. BUCK

Use our remote-booting modem commander to avoid getting caught without crucial data.

Common practice these days is to bring office work home and do it on your PC at night. People often do that by using a floppy disk to transfer files. Unfortunately, even with careful planning, it's easy to forget an important file.

Of course, there are numerous remote-access telecommunications programs that give you the ability to access a computer from another location. However, to do so, you must leave the remote computer turned on all the time, which consumes unnecessary power, and can expose the computer to possible damage from thunderstorms. What is needed, then, is a way to turn the remote computer on when you need access, and automatically shut it off when you're through. And that is exactly what the Modem Commander (ModCom) described in this article does.

With ModCom connected to your computer and a telephone line, you can dial into the unit and enter a four-digit security code. ModCom then turns the computer on, allows time for it to boot, rings the computer's modem, and then connects it to the telephone line. Then normal modem communications can take place. When your communications session terminates, or in the event of an accidental disconnect, the unit automatically shuts the computer off after a preset time. A special bypass switch allows you to keep the attached device powered continuously, if desired. A set of DIP switches allows you to set a four-digit security code, the number of rings (between 1 and 15) before the unit answers, the ring-burst interval (discussed later), the period of time between disconnect and shutdown, and whether or not you can call back into the computer before it completes its shutdown cycle.

The heart of the ModCom is Motorola's 68705 single-chip microprocessor. The device is readily available, easy to work with, and ideally suited to the type of application described here. Complete and partial kits of parts are available, including preprogrammed microprocessors and PC boards. For those who like to "do it themselves," the program is also available on the Gernsback FTP site (ftp.gernsback.com/pub/EN).

Circuit description. As shown in Fig. 1, the circuit consists of three major sections:

- Telephone line interface (left)
- DIP-switch scanning matrix (center)
- Power-line interface (right)

Let's now discuss each of those.

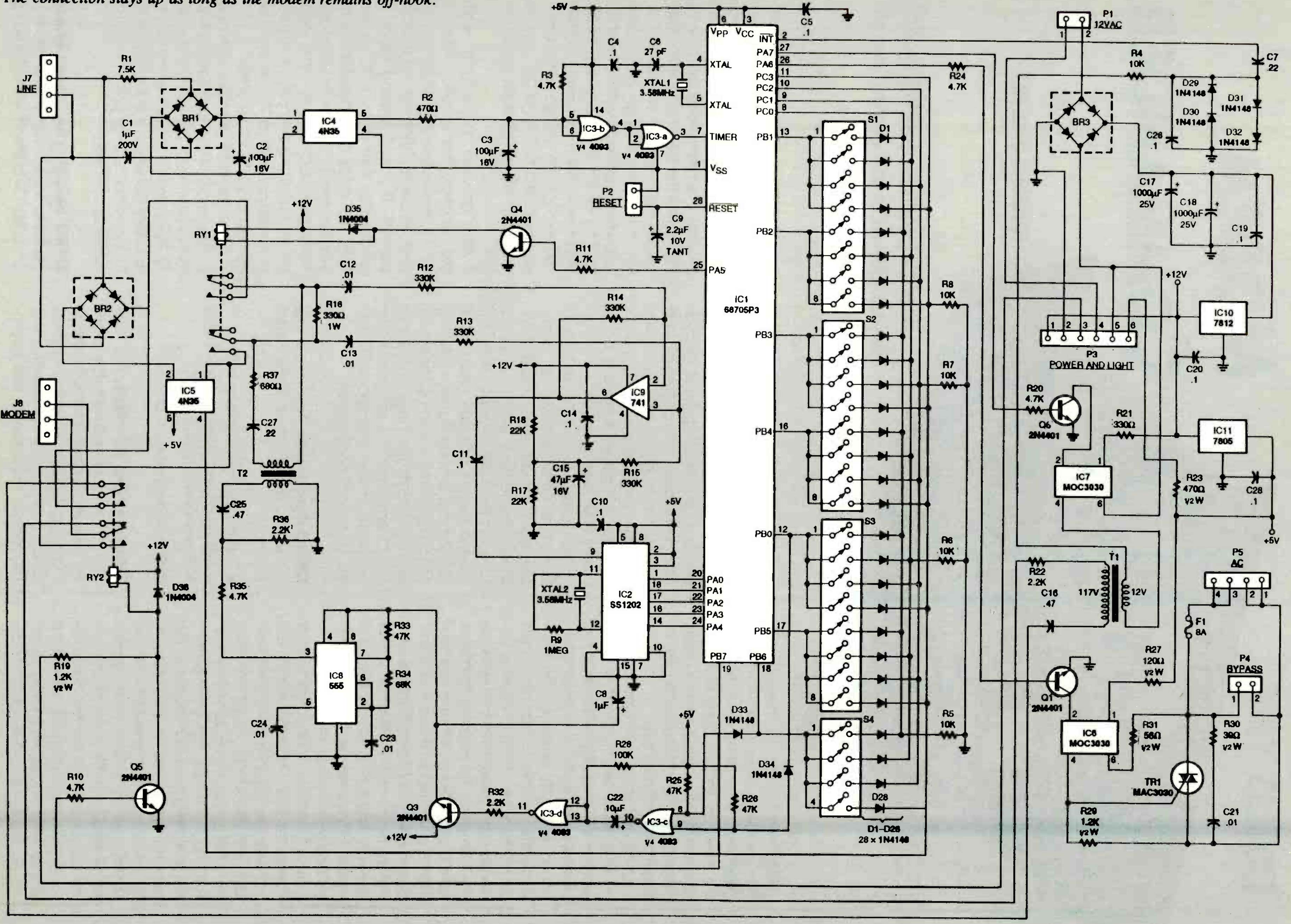
Telephone-line interface. The telephone line is connected to the circuit via jack J4. Optocoupler IC4 detects incoming ring signals, which it passes to IC3-b and IC3-a for conditioning. The signal then feeds the microprocessor's TIMER input. Software configures that input to be an event counter. When the number of rings reaches the preset value, the microprocessor activates relay RY1, placing R16 across the telephone line, which causes the line to be answered. Current then flows through optoisolator IC5, which applies 5 volts to port C3 (pin 11) of IC1. If for any reason the telephone line disconnects, current flow through IC5 will cease, the signal will disappear from port C3, and the ModCom will start the shutdown cycle.

After answering, ModCom waits two seconds, then applies a 650-Hz tone to the telephone line for 1.5 seconds to confirm that the unit has answered. The two-second delay is required by Part 68 of FCC regulations; the delay gives network signaling equipment time to operate. Although ModCom is not FCC registered, including the delay ensures compliance should registration be desired at some future date.

A standard 555 oscillator, IC8, generates the 650-Hz tone, and couples it to the telephone line via transformer T2. Power to the 555 comes by way of transistor Q3, which is in turn driven by IC3-c and IC3-d under microprocessor control.

DTMF decoding and power-line interface. When the line is off-hook, op-amp IC9 buffers the incoming sig-

Fig. 1. Here's the complete schematic of the ModCom. The microprocessor monitors the power line, answers after a number of rings preset by S3, then connects J8 to J7. The connection stays up as long as the modem remains off-hook.



nal, then feeds it to a DTMF (dual-tone multi-frequency) decoder chip, IC2, which in turn feeds decoded digits to the microprocessor. After reading four digits, the microprocessor performs a comparison to see whether they match the codes set by switches S1 and S2. If the digits do not match, the microprocessor watches for four more digits, and another comparison occurs. The cycle repeats until a correct code appears or a 60-second time-out occurs, in which case ModCom disconnects the telephone line and resets to wait for another call.

When a correct security code does appear, port A6 of IC1 (pin 26) goes high, which activates transistor Q1, which in turn activates optocoupler IC6. The optocoupler supplies gate current to Triac TR1, which turns on and applies AC power to plug P5. The remote computer, whose power switch must remain in the on position, plugs into P5 via J6, as shown in Fig. 2. When power is applied to J6, the remote computer powers up and starts its boot process.

After the delay set by S3-b expires, ModCom again applies the 650-Hz tone to the telephone line for 1.5 seconds to alert you that the modem is ready to be connected to the line. If you use manual mode to activate your local modem, you should turn the modem on at this time. After the tone ceases, port A7 goes high, activating IC7 and applying 12 volts to transformer T1. The transformer steps that signal up to approximately 90 volts, which subsequently drives modem jack J8 for 1.5 seconds. That signal in turn triggers the modem into answering, at which point relay RY2 latches, connecting the modem to the telephone line. After another 1.5-second delay, the microprocessor releases RY1, thereby disconnecting the answering and DTMF-decoding circuits. With the modem now connected, current will continue to flow through IC5, which will keep the computer powered up.

From that point on, all ModCom does is monitor the telephone line for a disconnect. It knows the line has been disconnected if loop current ceases to flow through IC5, because, as described above, port C3 of IC1 will go low and the unit will begin the shutdown cycle. When the shutdown period set by S4 has expired, the unit

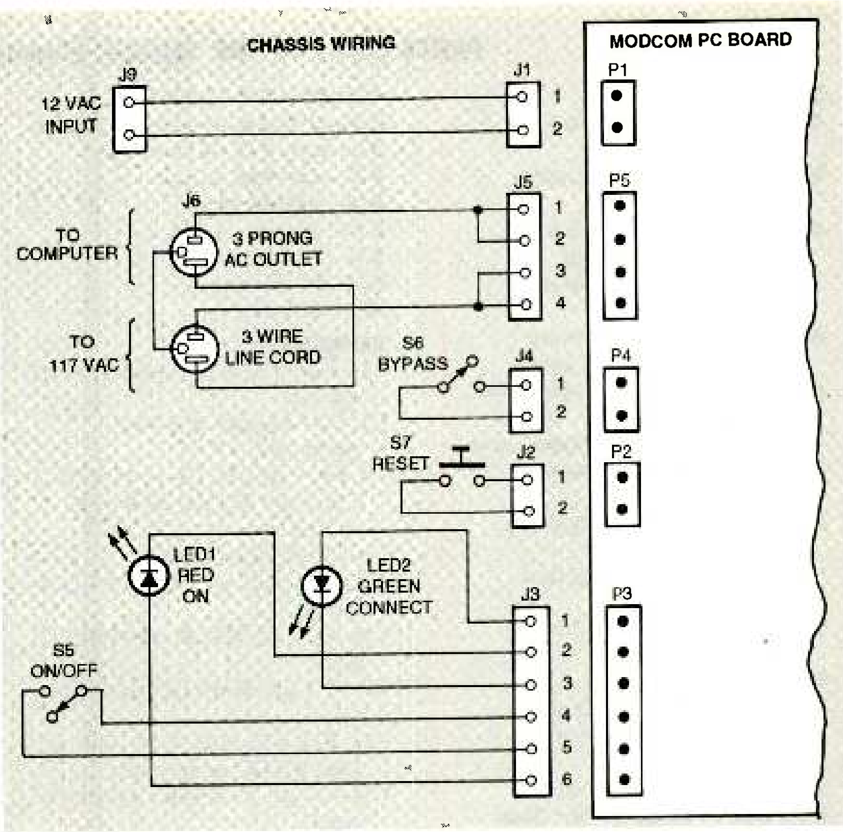


Fig. 2. All front and rear panel controls connect to the PC board via header-pin connectors.

TABLE 1—DIP SWITCH SETTINGS

Switch	Function
S1, low nibble	Security code digit 1 (hex 0–C)
S1, high nibble	Security code digit 2 (hex 0–C)
S2, low nibble	Security code digit 3 (hex 0–C)
S2, high nibble	Security code digit 4 (hex 0–C)
S3, low nibble	Number of rings (1–15) before ModCom answers.
S3, high nibble	Delay from code entry to modem ring. Set in 30-second intervals to five-minute maximum.
S4, bit 1	Whether you can call back into computer before it completes the shutdown cycle (Off=Yes).
S4, bits 2–4	Time from modem disconnect to shutdown, set in one-minute intervals, to seven-minute maximum.

removes AC power from J6, re-initializes all circuits, and then waits to receive the next call.

Most of ModCom's timing functions derive from the 60-Hz power line. Resistor R4, diodes D29-D32, and capacitors C7 and C26 feed the microprocessor's interrupt pin 60 times per second. The software's interrupt service routine increments and decrements certain memory locations to keep track of timing cycles. Since some timing functions need to be precise, ModCom uses a crystal for its primary timebase, instead of operating in the free-running mode.

Switch settings. DIP switches S1–S4 form a 7 × 4 matrix that provides 28 discrete positions. Diodes D1-D28 isolate the individual switches from one another. The microprocessor, IC1, scans the keyboard matrix to read the switches in four circumstances:

1) Whenever the unit powers up,
2) Whenever the unit resets,
3) Whenever the telephone line disconnects, and
4) Whenever a power-down sequence completes. All timing func-

PARTS LIST FOR THE MODEM COMMANDER

SEMICONDUCTORS

IC1—68705P3S microprocessor, integrated circuit
IC2—SSI202P DTMF decoder, integrated circuit
IC3—4093 CMOS quad Schmitt trigger, integrated circuit
IC4, IC5—4N35 optoisolator, integrated circuit
IC6—MOC3030 zero-crossing optoisolator, integrated circuit
IC7—MOC3010 TRIAC optoisolator, integrated circuit
IC8—LM555 timer, integrated circuit
IC9—LM741 op-amp, integrated circuit
IC10—LM7812 12-volt regulator, integrated circuit
IC11—LM7805 5-volt regulator, integrated circuit
Q1, Q3–Q6—2N4401 or 2N2222, NPN transistor
Q2—Not used
TR1—15-amp, 400-volt Triac, Motorola MAC3030-15 or equivalent
D1–D34—1N4148 signal diode
D35, D36—1N4004 rectifier diode
BR1–BR3—Bridge rectifier, 1.5-amp, 20-volt
LED1—Red light-emitting diode
LED2—Green light-emitting diode

RESISTORS

(All resistors are ¼-watt, 5%, unless otherwise noted.)
R1—7500-ohm
R2—470-ohm
R3, R10, R11, R20, R24, R35—4700-ohm
R4–R8—10,000-ohm
R9—1-megohm
R12–R15—330,000-ohm
R16—330-ohm, 1-watt
R17, R18—22,000-ohm
R19, R29—1200-ohm, ½-watt
R21—330-ohm
R22, R32, R36—2200-ohm
R23—470-ohm, ½-watt
R25, R26, R33—47,000-ohm
R27—120-ohm, ½ watt
R28—100,000-ohm
R30—39-ohm, ½ watt
R31—56-ohm, ½ watt
R34—68,000-ohm
R37—680-ohm

CAPACITORS

C1—1-µF, 200-volts, Mylar, 1.1-inch spacing
C2, C3—100-µF, 16-WVDC, electrolytic
C4, C5, C10, C11, C14, C19, C20, C26, C28—0.1-µF, 50-WVDC, ceramic-disc
C6—27-pF, ceramic-disc
C7, C27—0.22-µF, Mylar, 0.4-inch spacing
C8—1-µF, 50-WVDC, electrolytic, radial
C9—2.2-µF, 10-WVDC, tantalum, radial
C12, C13, C21, C23, C24—0.01-µF, 2000-WVDC ceramic-disc
C15—47-µF, 16-WVDC, electrolytic, radial
C16, C25—0.47-µF, Mylar, 0.6-inch spacing
C17, C18—1000-µF, 25-WVDC, electrolytic, radial
C22—10-µF, 16-WVDC, electrolytic, radial

ADDITIONAL PARTS AND MATERIALS

XTAL1, XTAL2—3.58-MHz color-burst crystal
RY1, RY2—12-volt DPDT relay
S1–S3—8-position DIP switch
S4—4-position DIP switch
S5—SPST push-on/push-off switch
S6—SPST rocker switch, 6-amp contacts
S7—SPST momentary pushbutton switch, normally open
F1—8-amp fast-acting fuse
J1, J2—2-pin 0.1-inch male header connector
J3—6-pin 0.1-inch male header connector
J4—2-pin 0.156-inch male header connector
J5—4-pin 0.156-inch male header connector
J6—3-wire 117-volt AC receptacle
J7, J8—PC-mount modular telephone jack
J9—0.125-inch panel jack
P1, P2—2-pin 0.1-inch female header connector
P3—6-pin 0.1-inch female header connector
P4—2-pin 0.156-inch female header connector
P5—4-pin 0.156-inch female header connector
T1—12-volt power transformer, PC mount
T2—600-ohm to 600-ohm line transformer
PC mount fuse clips; case (Jameco H2507 or equivalent); 3-wire AC power cord; heatsinks for TR1, IC10, IC11; 12-volt, 200-mA wall-plug transformer; IC sockets; PC board; solder wire; etc.

Note: The following items are available from ATC Electronics, PO Box 14091, Scottsdale, AZ 85260; e-mail 103463.301@compuserve.com: Programmed MC68705P3S, $15.95; SSI202P DTMF decoder, $6.50; Double-sided PC board, $15; Complete kit of parts less case, $85; Fully assembled and tested unit, $135. Add $3.50 for shipping and handling. Add an additional $4.00 for COD orders. AZ residents add appropriate sales tax. Check or money order only.

tions and options are preset by DIP switches located inside the unit, as shown in Table 1.

The microprocessor reads the settings for switches 1–3 as two pseudo-BCD values per switch. The value of each security-code digit may vary from 0 to 12, where 12 would be encoded as a hexadecimal C (1100).

The upper half of S3 sets the number of rings that the unit receives before it answers. The lower half of S3 determines the ring-burst interval, the time after a correct security code has been entered and before ModCom rings the modem. The ring-burst interval is set in 30-second increments to a maximum of five minutes. The software reduces any switch setting greater than 10 (hex A) to a value of 10, which should be more than enough time for any boot up sequence to be completed.

Switch S4 provides two functions. Position 1 of the switch determines whether ModCom may be called back once it has started its shutdown cycle. If position 1 is on, you will not be able to call back until after the computer turns off. If position 1 is off, you can call back and the unit will answer. Then, following entry of a correct security code, ModCom will immediately ring the modem, without having to go through the ring-burst delay. Positions 2–4 of S4 set the shutdown time delay. Because bit 1 has been used, the set routine simply ignores it. Thus, shutdown intervals occur in one-minute increments. For example, bits 2 and 3 on (011x) would be interpreted as a value of 6 (bit 1 is ignored), which would give a shutdown delay of three (6 × 30) minutes.

Software. The complete software listing is too long to present here; however, as mentioned earlier, it is posted

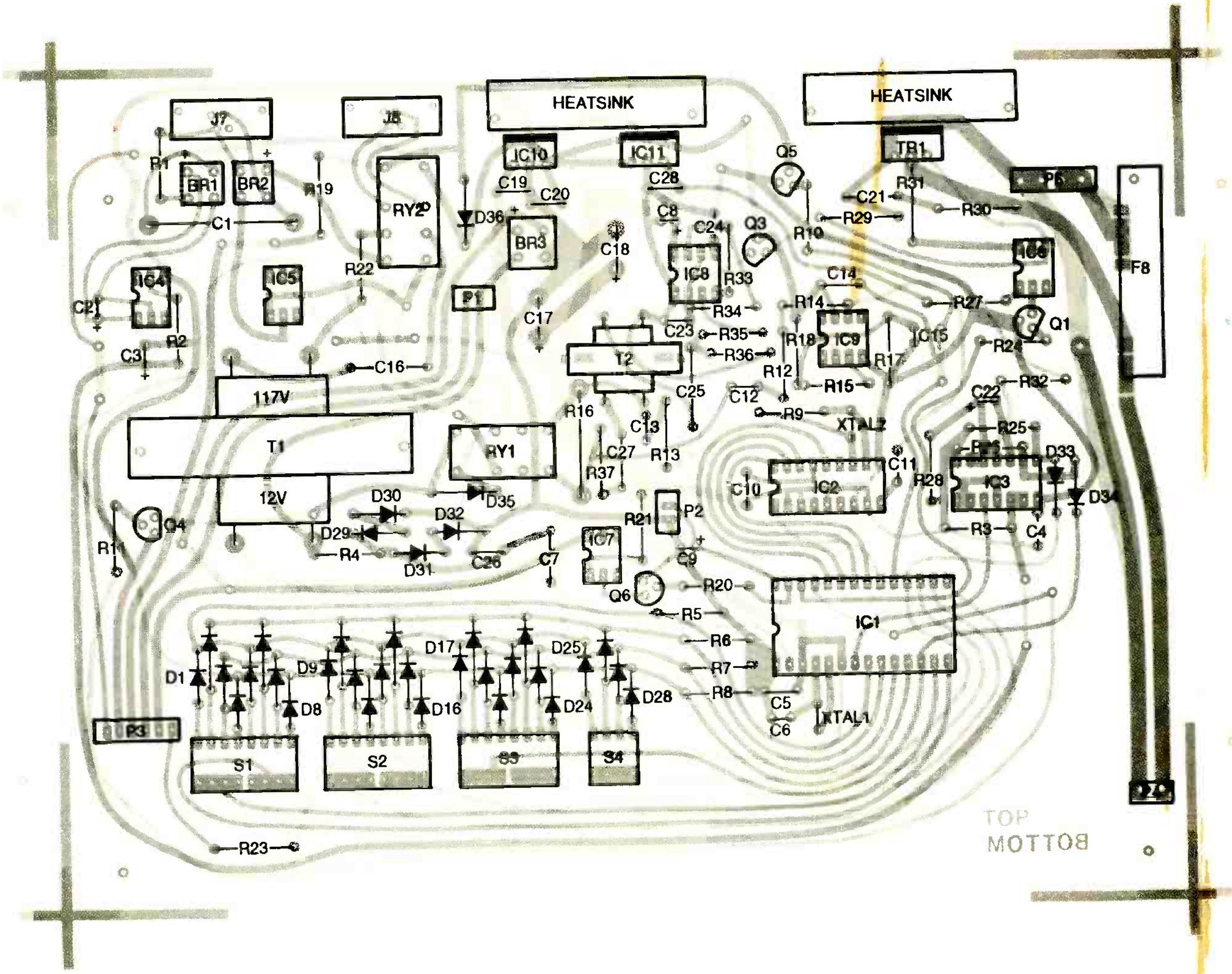


Fig. 3. Mount all components as shown here. The heatsinks are simple L-brackets attached with short 6-32 machine screws and nuts. Use heatsink grease to attach the regulators and Triac.

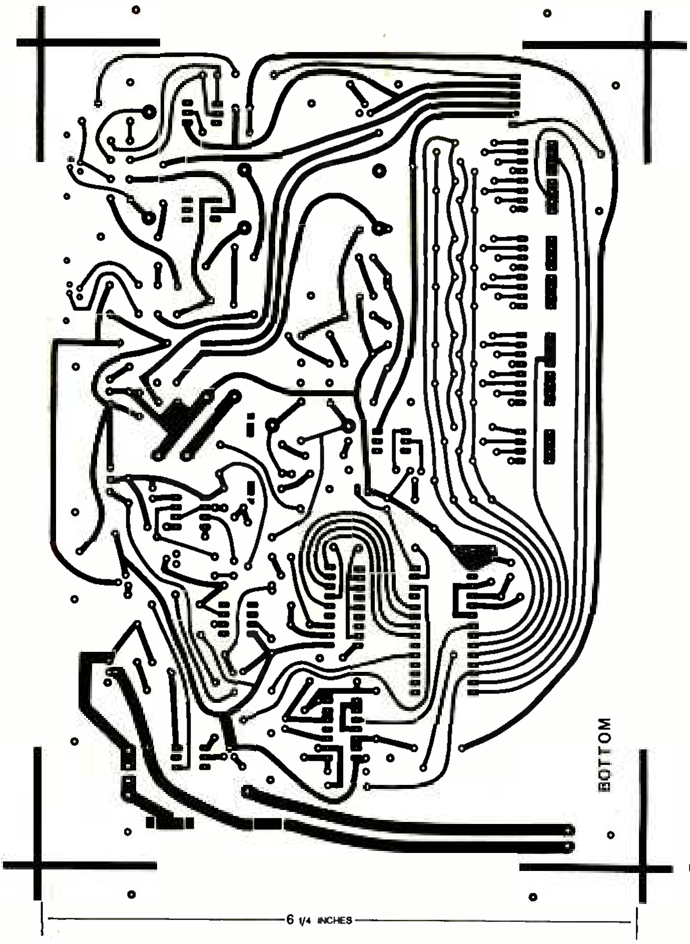
TABLE 2—SOFTWARE ROUTINES

0100–016C	Read switches and configure I/O ports.
016D–01A3	Monitor incoming rings.
01A4–0225	Handle DTMF decoding functions for security code verification.
0226–0246, 02C0–02CE, 0251–025A	Ring modem, connect it to telephone line, disconnect answer and DTMF circuits.
025C–0263	After modem is connected, monitor telephone line for disconnect.
0500–0544	On disconnect, controls remote computer shutdown.
0560–0581	Disconnect routine activated if correct security code not entered within 60 seconds.
0287–0296	Tone generation routine.
0380–03A5	Timing loop produces either one- or two-second delay, depending on value at 0021 (must be set by calling routine).
02A0–02BC	Timing loop, 1.5-second delay.
0300	External interrupt routine.
0340	Timer interrupt routine.
0560	Startup routine, pointed to by reset vector at 07FE.

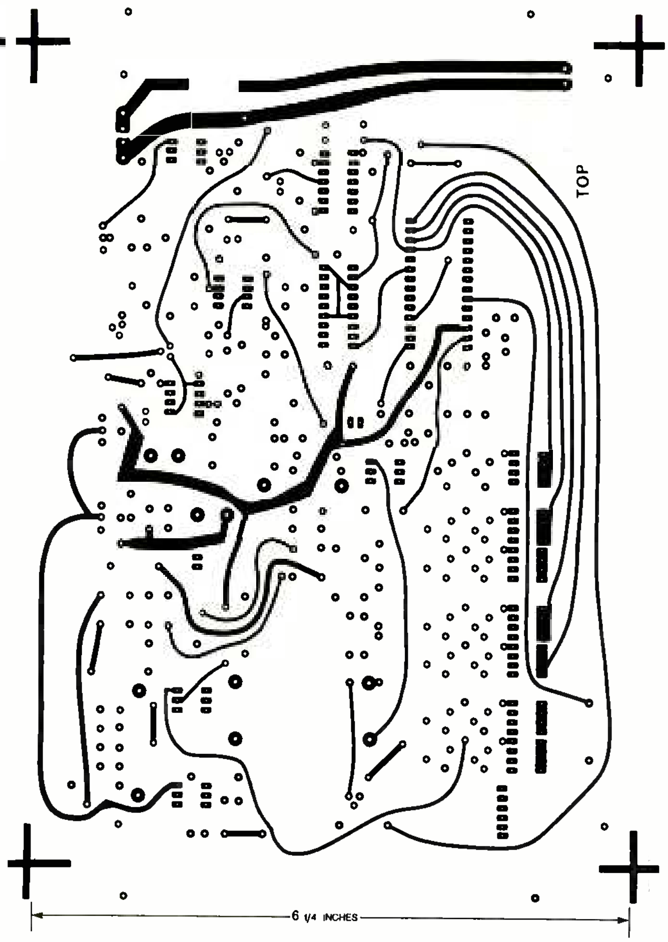
on the Gernsback FTP site as file MODCOM.ZIP. You can also receive a listing by sending an SASE to the address given in the Parts List. To give you an idea of what happens where, Table 2 lists major software routines and their corresponding hex addresses.

Note the last value in the table. The microprocessor's reset vector points to address 0560, which is where program execution begins each time the microprocessor resets. That location performs a 1.5-second delay, then jumps to the main startup routine at 0100. Initial testing of the ModCom revealed that the delay is necessary because DIP switch values were not always read correctly on power up or after a disconnect. The problem turned out to be port C3, which did not have enough time to settle completely to its normally low state, due to residual current from the output of IC5. The 1.5 second delay solves the problem.

Construction. ModCom con-



Here's the component side of the board. For space reasons, it is shown half size.



Here's the solder side of the double-sided ModCom PC board. Again, it is shown half size.

struction is best performed using a printed-circuit board. Patterns are shown here, though for space reasons they are shown at half size; you can also purchase the board from the source mentioned in the Parts List. Use sockets for all ICs, particularly IC1 and IC2.

Using the component placement guide shown in Fig. 3, mount all low-profile components first. Then mount the voltage regulators and their heatsinks. Install all ICs except IC1 and IC2, and mount transformer T1. If you use the case specified in the Parts List, the mounting holes in the circuit board mate directly with the bosses in the case. Make cutouts for the switches, LEDs, connectors, and modular jacks in the front and back panels. The cutouts for the AC power connector and the modular jacks are fairly critical, so exercise care in marking their locations prior to cutting the holes. Mount the PC board in the case, and attach all switches and connectors to the correct header pins.

Testing. *Do not plug the 117-volt line cord in at this time.* Plug the 12-volt AC power adapter into J9 on the back of the ModCom, and plug the adapter into a wall socket. Then apply power to ModCom by pressing S5. The red power indicator (LED1) should come on, indicating that the power supplies are functioning properly. Check the voltages at the output pins of the 5- and 12-volt regulators. If both voltages are correct, remove power and install IC1 and IC2. ModCom is now ready for final testing.

Temporarily set the switches for two rings, a 30-second ring burst, and a 1-minute shutdown time. Also, set a security code of your choice using S1 and S2. Plug the 117-volt line cord into an AC outlet, and plug a table lamp into 3-wire AC outlet J6. Next turn ModCom on and make sure switch S6 (BYPASS) is not on. Connect your telephone line to jack J7 and your modem to jack J8.

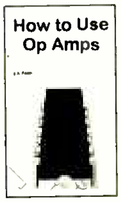
Now have a friend dial your number and enter the security code upon hearing the confirmation tone. The lamp should turn on, and 30 seconds later your modem should squeal, indicating that it has answered. In addition, LED2 (green) should come on to indicate that the modem is connected to the telephone line. Since the modem will not receive reply tones from the caller, it should time out. One minute after it times out, the lamp should go off, because the shutdown timer will have expired. If all tests are successful, the unit is now ready for operation.

Remember that whenever you change any switch settings, reset ModCom either by pressing S7 or by turning power off and back on.

Operation. During normal computer operation, leave S5 (POWER) off, and S4 (BYPASS) on. That prevents ModCom from interfering with either telephone-line or computer functions. When you want to set the computer up for remote access, turn S5 on and S6 off. Be

(Continued on page 71)

Electronics Paperback Books



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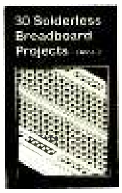

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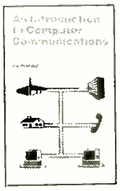

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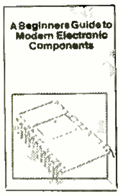

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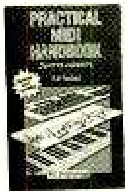

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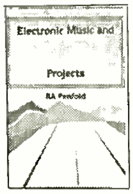

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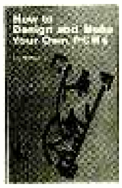

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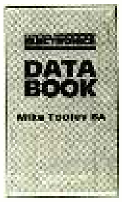

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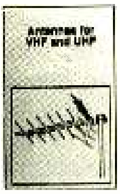

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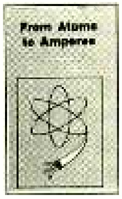

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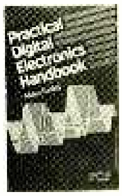

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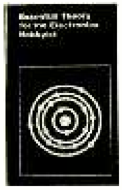

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AIR TRAFFIC MANAGEMENT

(Continued from page 46)

proval from the air-traffic controller for deviations from their flight plans. With Free Flight, the pilot will choose the route, speed, and altitude in real time and then notify the air controller of the plan. The pilot's flexibility will be restricted only as needed to ensure separation and safety, prevent entry into special-use airspace, or when traffic density at busy airports or in congested airspace precludes flying under Free Flight rules. For the bulk of an IFR flight, pilots would have the same freedom as a pilot flying VFR in terms of course, speed, and altitude selection.

The FAA would continue to monitor congested airspace and major airports operating near their capacity to ensure aircraft density does not exceed a safe level. When capacity is approached, Free Flight rules would be temporarily suspended and more structured traffic flow of would be imposed. To better anticipate where and when traffic density would exceed safe Free Flight levels, a historical database on hourly, daily, and monthly airspace-density patterns would be developed.

With Free Flight, aircraft could fly more direct and efficient routes, minimizing time aloft. That could result in significant operating cost savings to airlines and time savings to passengers. Modern airliners are designed to operate much more efficiently than permitted under current ATM procedures. There are quite differing estimates of the dollar savings, but NASA, for example, estimates savings from using more optimum fuel-burn rates and decreased flight times could be $1.47 billion annually by 2005.

While full implementation of Free Flight is still about 10 years in future, transition to the Free-Flight concept is already underway with efforts like the expanded National Route Program (NRP), a phased approach to eventually allow aircraft flying above 29,000 feet to select their own routes rather than the published preferred IFR routes. As of March 1996, the expanded NRP encompasses all flights above 33,000 feet and flights above 31,000 feet in the Western U.S. Ω

LOGIC ANALYZER

(Continued from page 42)

onto the bottom side of the board next. The cathode lead (marked with a band) is clipped short and surface-mounted to the PC board pad. Be sure the anode lead goes all the way through the board and solder it on both the top and bottom sides of the circuit board.

Bend the leads of pins 2–10 (do not disturb pin 1) of RN2 at the base of the component to form a right angle. Cut the ends of those leads so that you leave a "foot" about 0.1-inch long. Place RN2 onto the bottom side of the board, making sure to push pin 1 through the board. Solder pin 1 on both sides of the board. Solder the remaining pins on the bottom side of the board. Solder a piece of insulated wire where jumper "J" is indicated on Fig. 2B. Be sure that the pad closest to C1 is soldered on both the top and bottom sides of the board.

Solder all the remaining components (except C1 and XTAL1) to the board. Solder C1 into the circuit with the positive lead next to the "+" sign. That lead also needs to be soldered on both sides of the board. Solder XTAL1 onto the board by first laying it in place with its leads facing away from the board. Solder the case of XTAL1 to the board. Place insulation over the bare leads. Solder the leads of XTAL1 to each side of R1.

Remove the outer jacket from both ends of the length of modular telephone cable, leaving 1 inch of insulated wire on one end and 8 inches on the other. Strip ⅛ inch of insulation from all the wires on both ends of the cable. Solder all 6 of the 1-inch long wire ends to the circuit board pads opposite the end of the DB-25 connector. Only the top side of the circuit needs soldering for all wires except ground. The ground lead must be soldered on both sides. Solder the test clips to the other end of the modular cable. Be sure to match the colors of the connectors to the appropriate color designators GRN (Green), BLU(e), YEL(low), RED, and WHT (white) on the PC board.

Testing. Download the software application from the **Electronics Now** ftp site (ftp.gernsback.com/pub/EN/logprobe.zip). To run the program, you will need an IBM-compatible 286 or higher running MS-DOS, an EGA or VGA graphics card, 512 Kbytes minimum memory, and one printer port.

Plug the interface into any available printer port. Place a copy of the MS-DOS utilities GRAPHICS.COM and GRAPHICS.PRO in the directory with LOGIC PROBE. Those files might be found in your DOS directory. Type LP to start the program. A blue display with the heading LOGIC PROBE should appear. If that display is not present, check that the graphics card is properly installed. Press any key to continue the program. If the interface is not operating, the error message "Unable to calibrate with no module installed" will appear. Should that happen, carefully look over the top and bottom of the PC board. Check for shorts and unsoldered connections. Also, make sure that all points where the pads need to be connected to both sides of the board are soldered on both top and bottom. This includes the positive lead of C1, the anode of D1, pin 1 of RN2, the GND pad for the probes, and the jumper.

When LOGIC PROBE is able to complete its calibration, the main menu will be displayed. If the time base is correct, the sample rate should be between 0.8 and 7 µs. That sample rate is located in the upper left corner of the main menu.

Verify that all channels are working by testing each channel with a known frequency source that has a 5-volt swing. When testing each channel, ground the unused leads to prevent cross talk on the cable. If the sample-rate error is acceptable (less than 5% or +/− one sample period) and all channels are working, you are ready to familiarize yourself with your new logic analyzer.

Using The Logic Analyzer. To learn more about the logic-analyzer software, enter the Help menu by holding down the "Alt" key while pressing the "H" key. Press the enter key to view the help file. Detailed information on using LOGIC PROBE is contained in the help file. Contained in the zip file is a text file named README.TXT. That text file for the most part repeats the contents of the help file, and can be printed out if you find it easier to work with a printed copy. Ω

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BY DON LANCASTER

Debunking Techno-Myths, Linear-Phase Digital Filters, and More

THERE HAVE BEEN SEVERAL MEDIA REFERENCES RECENTLY TO THE TERM "*TECHNO-MYTH*." TECHNO-MYTHS ARE SIMPLY URBAN LORE WITH A TECHNICAL BENT. EXAMPLES OF THAT INCLUDE SUCH THINGS AS THE ONE-THOUSAND MILE-PER-GALLON carburetor that the Detroit conspiracy is suppressing, or the alien commune the Air Force has secretly stashed. Another is the one about the lone industry outsider who got his untested and unproven idea effortlessly patented, and instantly became filthy rich.

Techno-myths are also what some might politely term *that which is not so.* The myths are, in fact, easily separated from reality—all you have to do is ask some fundamental and very pointed questions. For instance: "Are there *several* independent and *personally verifiable* primary sources?" "Where is the hard evidence?" "Do any peer-reviewed publications exist?" "Is there an unambiguous experiment that will clearly cause the effect to reveal itself?" "Does the claimant possess enough theoretical and math background to even understand the problem?" "Is this the simplest and the most probable explanation for the observed effect?"

I have long been a fan of all these techno-myths. Especially those that involve pseudoscience or any patent scams. Most of those works of fiction are wondrously bizarre reading. As I've mentioned a time or two before, a goal around here is to heap all of this stuff on center stage, then shine a bright light on it, and get you to independently conclude: "Yup—That really is a big pile!"

I have expanded the pseudoscience section of my *www.tinaja.com.* We've now got new links to everybody, including, *Saucer Smear*, *Skeptical Enquirer*, and *KeelyNet*. In fact, KeelyNet has made me their resident skeptic, whatever that means. You'll find more on patent myths in my *Case Against Patents* package, or the *www.tinaja.com* patent shelf.

Tell you what, let's make a contest out of this: Simply tell me about any techno-myth that I've not heard of yet, or a different slant on one I have. There'll be a dozen or so of my *Incredible Secret Money Machine II* books going to the better entries, along with an all-expense-paid (FOB Thatcher AZ) *tinaja quest* for two going to the best submission of all. As usual, *written* and *snail-mailed* entries only. Be sure to send them to me at *Synergetics* (the address can be found elsewhere in this column), rather than to the **Electronics Now** editorial offices.

And hey, no complaints about no e-mail entries. (A) It is my contest, so I'll make any rules I want. (B) I need a hard-copy audit trail of the entries. (C) Snail-mail dramatically *increases* your odds of winning. And, of course, (D) the purpose of my contest is to encourage creative thought. A single e-mail message ruthlessly demolishes any and all creative thought within a six block radius.

Linear Phase Digital Filters

After our digital filter coverage in the past few columns, I've had lots of requests for exact details on how you design a "real" digital filter. As it turns out, that's a lot easier than you'd first suspect. Designing digital filters simply involves finding some magic numbers called *coefficients.* Those coefficients can be found by solving the linear equations we looked at last month—just plug the desired amplitudes and frequencies into those equations, and crank out your answers.

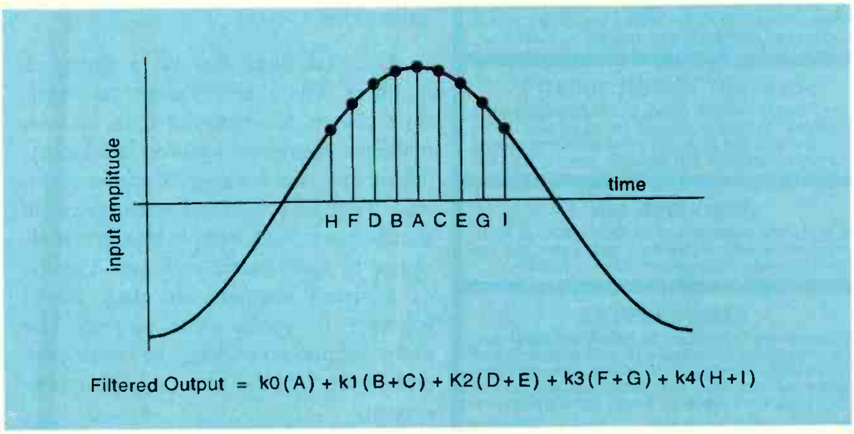

FIG. 1—A LINEAR-PHASE DIGITAL FILTER gets created by taking some chosen number of evenly spaced samples. The samples are then added into pairs and multiplied by carefully chosen coefficients. Finally, all of the paired and scaled values are summed into a single output result.

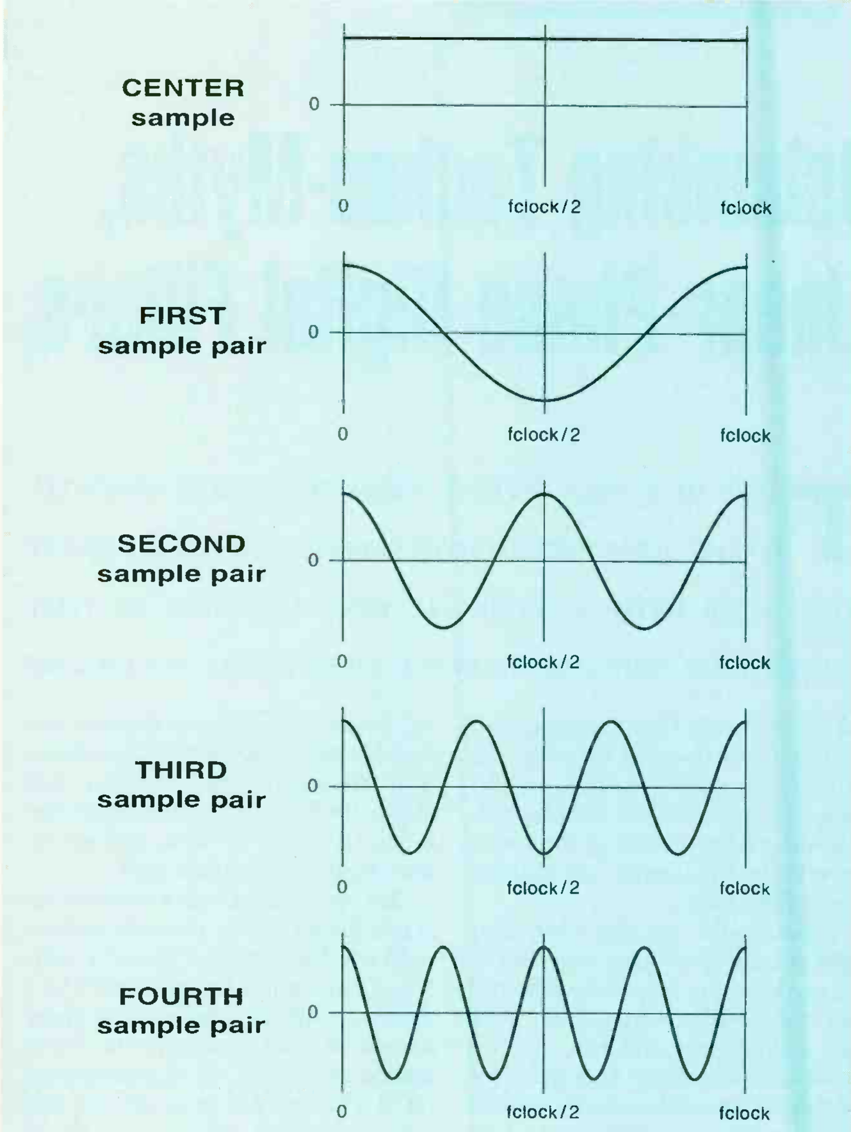

FIG. 2—EACH FILTER TAP PAIR is independent and responds differently as your frequency changes. Each pair can be scaled to any size or to either polarity by multiplying by a chosen coefficient. Thus, any two of the scaled pairs can force any two frequencies to have any two selected amplitudes. Any n pairs can force n frequencies to have n selected amplitudes.

A digital filter acts on a group of numbers. The numbers might be a real-time stream of incoming data, or non real-time data already stored in memory. Those numbers are *sampled* at some constant rate (or a constant spacing) called the *clock rate*. Each sample first gets multiplied by some magic *coefficient*. A group of adjusted samples are then added together to create your output. The more samples you select, the better your end result, but the more complex your system.

Figure 1 shows us a special type of digital filter known as a *constant-phase* filter. Constant-phase filters can magically search both *forward* and *backward* in time. All of the signal's harmonics stay in perfect step with each other. In contrast, most analog filters often introduce unavoidable delays with capacitor or inductor energy storage.

One major advantage of constant-phase filters is that they are usually "distortionless," which is extremely important in data communications applications. Their disadvantage is that their response shapes are somewhat limited, and more time and effort might be needed to get a desired result.

A linear-phase filter consists of a single *center* sample, combined with one or more pairings of identically scaled "outrigger" samples. The first sample pair is made one clock earlier and one clock later than "now." Your second sample pair will end

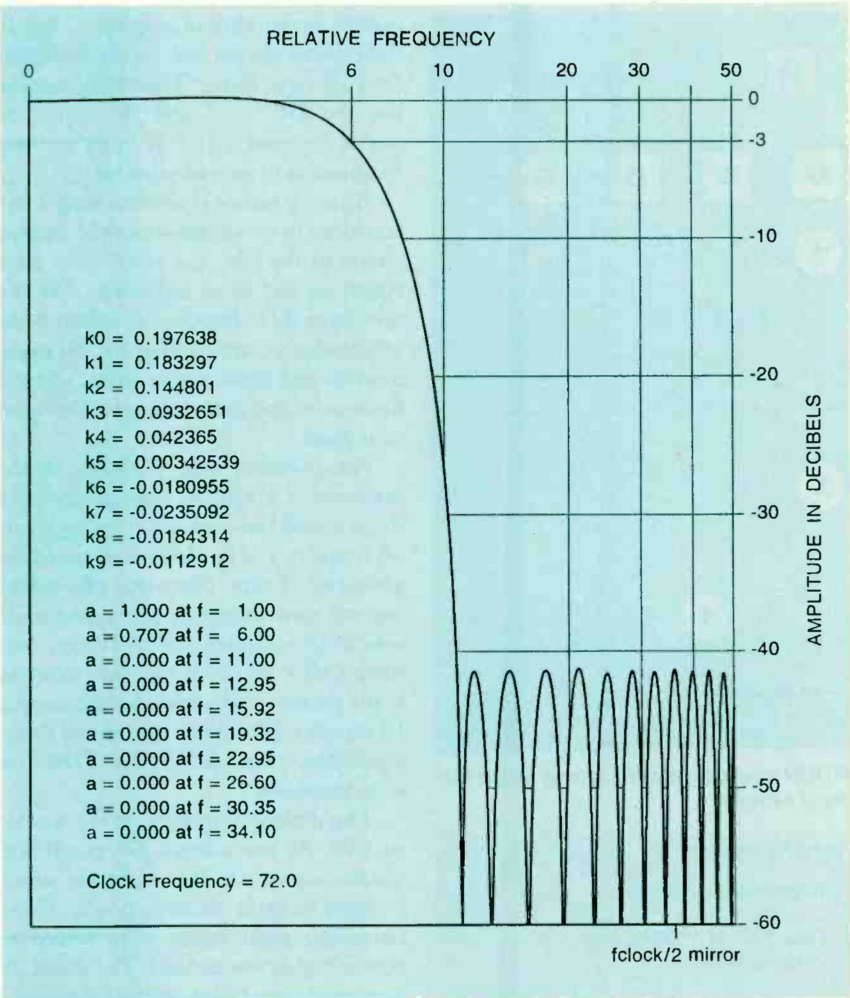

FIG. 3—THE FREQUENCY RESPONSE of a typical 19-tap linear-phase low-pass filter. Ten desired amplitudes and frequencies are sent to LINEAREQ.PS, which then calculates the coefficients and plots the results.

up two clocks earlier and two clocks later than "now." And so on. As many sample pairs get used as are needed to do the job. In general, a digital filter begins to pick up power when you use the center and three or more sample pairs.

Your clock sets your sample rate, and therefore your *time interval* between samples. At any desired frequency, another name for a time interval is a *phase delay*.

Let's assume a clock frequency of 72 samples-per-cycle for your lowest (f=1) frequency of interest. There's 360 degrees in one frequency cycle. Last time I checked, 360/72 = 5. So there are five degrees of phase shift per sample at the f=1 fundamental.

Since digital filters are linear, we can analyze them by using carefully chosen frequencies and phases. By a process of *superposition*, the chosen selections should predict the exact, final real-world filter response where lots of frequencies and phases are present all at once.

Because we are linear, we can also apply a *normalization*. That is, you initially assume your fundamental frequency is 1.0. And in our current case, your clock frequency is 72. Later you can adjust your clock to reach the desired frequency-response range. We will also normalize our input to one volt. That simplifies the math and is easily scaled later. Additional details on scaling and normalization are found in my *Active Filter Cookbook*.

Building a Response

First, let's look at the fundamental. Because any old phase will do for our analysis, let's use cosines, otherwise known as a ninety degree phase shift. Your center sample simply measures how big your fundamental is. The first sample pair measures the amplitudes at (in this case) plus-and-minus five degrees of phase. The second sample pair measures it at plus-and-minus ten degrees of phase shift. The third sample pair measures it at plus-or-minus fifteen degrees from the center peak.

Next, look at your (f=2) second harmonic. The center sample stays on your peak. But your first sample pair now measures at-plus or-minus ten degrees. Your second sample pair is at twenty degrees. Similarly, at your third harmonic, your center sample still stays in the center. But the first sample pair is at plus-or-minus fifteen degrees from peak.

How do those sample pairs behave as we change frequency? Figure 2 shows us the amazing results. Your center sample is just your amplitude, telling us "how big" this frequency is. Therefore, the center sample plots as a constant with frequency; that is, a straight horizontal line. Your first sample pair plots as a cosine in amplitude-frequency space. Why? At rather low frequencies, the samples are all so close together that they are nearly identical. As you raise frequency, the sample pairs move further and further away from the peak. At one-quarter of the clock frequency, both samples will sit on a zero crossing, giving you a zero result. At one-half of the sample frequency, both samples will hit on negative peaks. The result will go back to zero at three-quarters of your sample frequency, and to maximum at your actual sample frequency. Note that at your clock frequency, your sample phase shift is plus-or-minus 360 degrees, and they are sitting on the peaks of the next and the previous cycle from where you are "now."

Your second sample pair is easily shown to be a cosine which will repeat twice in the sample space. Your third sample pair will repeat three times, and so on. Taken together in the real world, I believe this neat-o pile of cosines is called a *Chebycheff Polynomial*. I will offer a free ISMM II to the first math freak that can set me straight on the correct terminology.

Finding Coefficients

Let us see what we can do with all those magic cosines. A center sample can be thought of as a "DC level" or zero-frequency cosine. We can adjust that amplitude any way we like. We could also make it positive or negative. Therefore, with our zero-frequency cosine, we can force any one frequency to have one chosen amplitude.

Similarly, by using our one-cycle cosine, we are able to force any one fre-

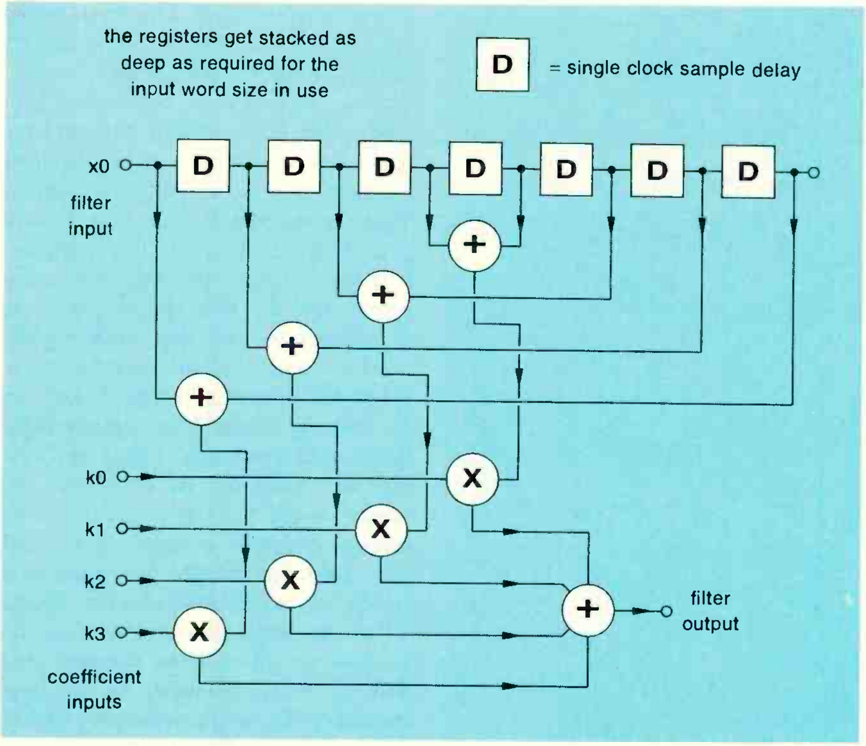

FIG. 4—THE SYMMETRIC DIGITAL FILTER OPTION uses tap pairs. Response shape can end up better, but the output falls between the input samples.

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quency to one chosen amplitude. But all these wave shapes are totally independent of each other. Therefore, we can use the DC level and the one-cycle cosine together to let us force any two frequencies to two amplitudes.

By using plain old algebra, we get two equations in two unknowns. Add another cosine to the pile, and you'll have three equations and three unknowns. We can now force three frequencies to match the amplitudes we are looking for. By going to more and more cosine terms, you can force more and more frequencies to meet your goals.

For instance, Fig. 3 shows us the response of a specific example called a sharp-cutoff low-pass filter having a cutoff frequency of six. It uses 10 terms for a total of 19 taps. Note that one center tap and nine outrigger pair taps should sum to 10 variables. and to 19 taps. You solve a 10 × 10 linear equation to arrive at the correct coefficients for the needed 19 samples. (For more on solving linear equations, see MUSE106.PDF on *www.tinaja.com.)*

The desired amplitude at f=1 was set to 1.00. At our wanted f=6 cutoff frequency, we set a 0.707 amplitude, which is equal to three decibels down. Those remaining eight terms were forced to zero at higher frequencies. The initial try bounced around a lot, so the frequencies were adjusted to give the uniform humps shown. More design details appear in file LINEAREQ.PS on *www.tinaja.com.*

You can easily design your own digital filters just by punching frequencies and amplitudes into this routine.

Some Options

Remember that there is a "mirror" on any digital filter at one-half the sample frequency. Therefore, the response in Fig. 3 starts going back up at around a frequency of 62, and gets back to unity at 72. That is why you *must* prefilter all digital filters to prevent significant energy beyond half the clock.

When you force some frequencies to provide the amplitudes you desire, others may end up wildly wrong. For instance, a linear-phase filter seems to want to "bounce" in the stopband. Force the smooth stopband response and it won't end up as good. If your response misbehaves, try shifting your set frequencies around some. If that fails, you could go to additional taps. Don't be afraid to experiment.

A symmetrical approach to digital fil-

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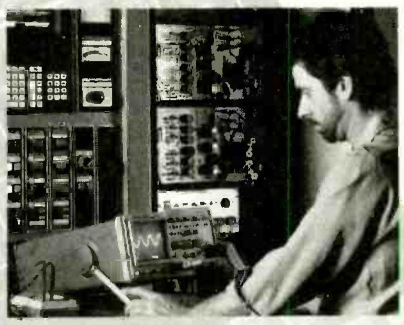

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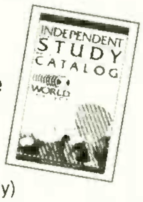

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ters is shown in Fig. 4. Instead of the center sample we used before, all samples are paired. Symmetrical filters have somewhat improved shapes for a given number of samples, but your output result is "centered" between input samples—a feature that caused problems for my magic sinewave research.

You can also unpair your samples. Each can independently contribute to your response shape. You will get lots more shape options, but you will lose the "distortionless" property of linear-phase filters.

Home Theater Resources

In the future, the information presented here might be considered akin to a 1902 book on aviation, but a preliminary listing of home-theater resources shows up as this month's sidebar. The new home theater field is now about to explode, offering lots of unique opportunities to more savvy tech folk. There is absolutely no reason why home video displays can not shortly *exceed* those of theaters in terms of quality, brightness, and resolution.

Among other things, those new DVD disks and players should start to hit the retailers soon, though politics has delayed their debut for the time being. DVDs (digital versatile discs) are the first media that are obviously able to offer full theater quality, and still be flexible enough to adapt to even better future display or compression formats.

If you search the web, you'll find over 200,000 listings on *Alta Vista* alone for *home +theater*. Such as the new *Secrets of Home Theater and High Fidelity* e-zine at *www.sdinfo.com/about.index.html.*

Let me know if there are some additional home-theater resources we should have listed here. A free ISMM II is offered for your input.

New Tech Lit

Government surplus electronics has gotten a lot easier to deal with. There are now walk-in "fed"-run "retail" stores in certain areas. Also, new online listings are available, and plastic is now acceptable as payment. To get started, call (800) GOVT BUY for a free catalog, or visit their website at *www.drms.dla.mil.*

Also new this month, a CD full of data sheets and applications notes from *Linear Technology*. From *National Semiconductor*, comes a new *sidewinder* plug and play chip known as the PC87308VUL. That chip includes a floppy disk controller, a keyboard interface, a real time clock, a pair of UART's, infrared support, and a fast two-way parallel port (apparently they are saving the cow-milking option for revision 2.0 of the chip!). For some strange reason, it comes in a 160 pin package.

From *C&H Sales*, there's a new catalog on surplus motors, pneumatics, steppers, transformers, and for similar "heavy iron." All appear great for robotics or home-brew "flutterwumpers."

Lindsay Publishing is continuing their re-release of "new" older books. Some of those include 1904 *Amateur Work* reprints, a 1921 book on *Graduating, Etching, & Engraving*, and a hard bound 1910 *Elements of Machine Work.*

From *Don Thompson* comes a new book on easy laser-printer module repairs, especially the popular Canon SX and LX engines. And don't forget the revised *Battery Reference Handbook* retailed by *Butterworth-Heinemann.*

For the fundamentals of your own homebrew self-publishing, check into my *Book-on-demand* publishing kit per my nearby *Synergetics* ad. Also I just picked up a few newer surplus items, including several more mint *Tektronix* 1230 logic analyzers. Give me a call for full details. A reminder that nearly all of the mentioned resources appear in the *Names & Numbers* or *Home Theater* sidebars. Always check there first, then visit my web site at *www.tinaja.com.* I also offer a no-fee U.S. technical helpline per the *Need Help* box, as well as U.S. e-mail support. **EN**

NEED HELP?

Phone or write all your US Tech Musings questions to:

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US email: don@tinaja.com
Web page: http://www.tinaja.com

BY JEFF HOLTZMAN

NT 4.0 and the Small-Office Network

RECENTLY I RECONFIGURED MY OFFICE NETWORK TO USE WINDOWS NT 4.0 AS THE PRIMARY SERVER, AND I'M MOSTLY PLEASED WITH THE RESULTS. FORMERLY, I USED AN OLD 386-BASED MACHINE AS A PRINT AND COMMUNICATIONS SERVER.

It ran Win95, and primarily provided dial-in, dial-out, fax-out, and printer sharing. File serving and backup services were provided by what had been the largest machine—a Pentium P60 with 24 MB of RAM, a 3-GB hard drive, a 4X CD-ROM drive, and a 4-mm DAT drive (all SCSI based).

The P60 also ran Macintosh file- and print-sharing services provided by a third-party package. In addition, the P60 served as my primary workstation. With all that going on, occasionally it got bogged down, depending on network traffic.

As for other office components, the laser printer has a built-in fax-receive module, so faxes print directly on plain paper. All faxes and modems connect to a single telephone line through a line-sharing device that automatically routes incoming calls by type, and outgoing calls by the port to which a device attaches. There is a separate voice line.

The new configuration includes a brand-new, ripping fast P166 with 64 MB of RAM, an Adaptec Ultra Wide SCSI controller with a wide 1-GB drive and an 8X CD-ROM, and a Matrox Millennium video adapter. That serves as my primary workstation, which no longer provides any network services. Its hard drive is divided into four partitions of about 256 MB each, which provides a good balance between cluster size and drive-letter manageability. I plan to keep that machine lightly loaded, running only the necessities, which includes things like MS Office, Norton Utilities, Mcafee Virus Shield/Scan, MicroHelp's fantastic PowerDesk, and the development environment(s) for whatever my current project happens to be. That machine currently runs Win95, although NT Workstation is looking better and better all the time.

I retired the 386 from server duties. In its place, the P60 now runs NT Server 4.0; it now concentrates (or soon will) all network services. Currently that includes domain security, Macintosh file and print sharing, PC file and print sharing, fully automated and reliable backup (finally!), an HTTP server for development and testing, and dial-in services using Windows' Remote Access Service (RAS).

Unfortunately, the initial release of NT 4.0 does not include a fax service, even though fax-sharing is a standard part of Win95. However, Microsoft has stated that it will rectify that shortcoming within the next few months. In the meantime, I am experimenting with several different shareware packages. I am also looking into modem-sharing software, so the same port can be used (not at the same time, of course) for both RAS and fax. (I'll have more on the

NT SERVER 4.0 adopts the Win95 user interface and provides a robust and stable environment for use in a small software-development firm. However, be prepared to spend some time configuring resource sharing, TCP/IP addressing, and user security.

modem and fax packages next time.)

I had several questions about that configuration before I would commit to it. The biggest question was the NT vs. Win95 tradeoff: For a small office, is the extra cost of NT Server justified? Does it provide any significant advantages? Does it provide any significant disadvantages? Also, I had serious doubts about whether a low-end machine could function effectively as a file server. To resolve the latter, the answer is yes. In fact, I can load applications across the network (to the P166) faster than from the local machine.

The Win95 vs. NT tradeoff is more complex. Win95 has built-in RAS and fax services, but no Macintosh support. NT offers multi-user RAS, Mac support, but currently no fax service. Neither OS by itself can share a modem among applications. Win95's backup support is pathetic; NT's is entirely adequate for a small-office network. NT includes a built-in scheduler, to run things like automated, unattended backup. Win95 relies on the System Agent available as part of the Plus pack.

NT has several capabilities that have no Win95 equivalents. A major one is intelligent disk-cluster support when using the NTFS (NT File System) format. This means you don't have to waste hundreds of megabytes of space when partitioning a large drive. NTFS also supports a range of compression options, including individual files, directories, and entire drives.

Then there's security, and that's where you'll spend your time, doing things like setting up users and groups, giving them the proper permissions for access to resources, and defining their home directories and login scripts. You'll also have to spend time setting up the client (Win95) machines.

Is It Worth It?

You have to undergo lots of time-consuming tests and reboots to get an NT Server and the client machines configured properly. Even experienced network administrators will undergo a learning curve, especially if you're a TCP/IP newbie.

So, is NT Server 4.0 it worth it for a very small business? Comparing prices, NT Server costs twice what a Win95 installation costs, even after counting the extra-cost add-ins. NT is also more expensive than Win95 in terms of initial setup time, though, once you get the hang of it, ongoing maintenance should be no more expensive than with Win95. Even so, Win95 wins on a simple cost basis.

However, NT gives me a much safer feeling than Win95. I have more (though not perfect) confidence in NT than in Win95. I could get by with a Win95 server, and save some time and money, although not a lot. But I would still have to integrate third-party products, most significantly a robust backup package for DAT drives. The bottom line is that NT is worth it as a server solution for a very small business, but only if you don't mind scaling an OS administration learning curve.

Delphi Books

My love affair with Delphi continues. There is no faster way to get high-performance apps up and running on a Win32 platform (NT or Win95) than with Delphi. It strikes the perfect balance between rapid-development environments (like Visual Basic) and down-and-dirty C/C++ coding.

You can create user interfaces using the "drawing" method made famous by Visual Basic, but you can also get down and dirty when you need to. Delphi programs compile to a single executable, so distribution and configuration management are greatly simplified over the Visual Basic model. And the compiled file is native machine code, not 'p' code that is subsequently interpreted at runtime, as with Visual Basic. Delphi apps in general have a much snappier feel than Visual Basic apps.

The single biggest problem with Delphi is the documentation. There is extensive reference material (both print and on-line), and a good primer on Object Pascal. What's missing is information on intermediate and advanced topics.

Numerous third-party books have been published trying to fill that gap. Unfortunately, I have not as yet found a single volume that covers Delphi's breadth of possibilities consistently. However, I have found several volumes that individually provide worthwhile information on one or more topics. The irony here is that you could easily end up spending more on third-party books than for Delphi itself!

The Revolutionary Guide to Delphi 2 (Various authors, Wrox Press, Chicago. ISBN: 1-874416-67-2) is a quickly remodeled version of a corresponding tome for Delphi 1. Each chapter is written by a different author (nine authors covering eighteen chapters), so there is some inconsistency in style and depth. Even so, the writing style in the book is much livelier than in typical programming books. The book provides lots of good working code and discussions of Delphi's internal workings. It includes a CD with the complete text in searchable format (a practice I really wish all publishers would follow), as well as sample components and other code.

If you happen to need information covered by a chapter in this book, you'll likely not be disappointed. For example, I found information on dynamic function pointers extremely helpful in designing a component that iterates over a custom object hierarchy, calling different routines (as passed in to the iterator) depending on the type of object or level of the hierarchy. Is there any way that you can do that in Visual Basic? Only in your dreams!

Delphi 2 Developers Guide (Borland Press, Sams Publishing, Indianapolis. ISBN: 0-672-30914-9) was written by Borland employees Xavier Pacheco and Steve Teixeira, and the access to inside information shows. At this point, the book is the closest thing to the missing user documentation required by Delphi. For example, I found a chapter on Win32 memory-mapped file I/O helpful. There is a good chapter on building DLLs with Delphi, and another, called "Hard-Core Techniques," that discusses topics like writing custom Window procedures, using Delphi's built-in x86 assembler, creating Windows hooks, thunking, and more.

One thing about that book gives me mixed emotions: Most code samples are printed twice—once as part of a complete listing, and once in a separate section as each routine is discussed. Is that an attempt to pad the page count? Are the authors legitimately trying to break complex items down into manageable chunks? Whatever the reason, once is enough, methinks.

Another decent book is *Delphi 2 Unleashed* (Borland Press, Sams Publish-

continued on page 71

PRODUCT INFORMATION

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BY ROBERT EPPERSON*

VCR Tape-Transport Adjustments

BACK IN NOVEMBER, WE LOOKED AT THE TAPE PATH IN A TYPICAL VCR, WHAT COULD GO WRONG, AND WHAT ADJUSTMENTS ARE AVAILABLE WHEN THINGS DO GO WRONG. THIS TIME, WE'LL LOOK AT HOW TO PERFORM THREE OF THE most common of those adjustments. Those are:

- **Reel-table height adjustment**—sets the table to a specific height to regulate the height of the tape.
- **Tape tension and tension-arm pole adjustments**—assures proper video-head to tape contact for interchangeability of tapes between VCRs.
- **Guide roller adjustments**—regulates the height of the tape so the video heads start scanning the tape at the proper point when the tape is entering and exiting the drum assembly. There are two of those adjustments: coarse and fine.

While the procedures shown here are for Hitachi VCRs, they are common to many brands of VCRs that have been manufactured in the past several years. You should have little problem applying them to your particular machine.

Tools You Will Need

In addition to ordinary hand tools and electronic instruments, there are a few special tools that you will need if you are going to make the adjustments described in this article. Specifically, those are a master plane, a reel table height jig, an alignment tape, and a back-tension meter. Three of those are shown in Fig. 1. For Hitachi equipment check with Hitachi Home Electronics (America), Inc., at 675 Old Peachtree Road, Suwanee, GA 30174. For other brands, contact the specific manufacturer for more information.

*From Hitachi HiLite. Hitachi Home Electronics (America) Inc., Suwanee, GA

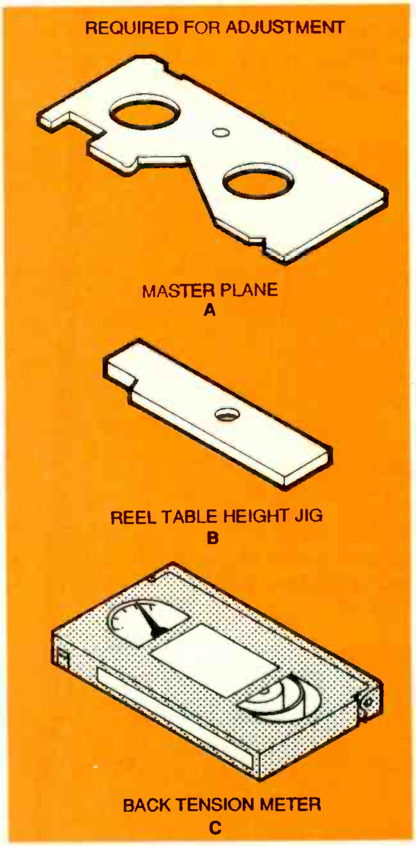

FIG. 1—YOU NEED THESE SPECIAL TOOLS along with a VCR alignment tape and a dual-channel oscilloscope to perform the adjustments described in this column.

VCRs are delicate electronic devices. Misadjusting a VCR will result in improper operation and damage to the heads. Gross misadjustments can also damage the tape in your VHS cassette. If you are not familiar with working on

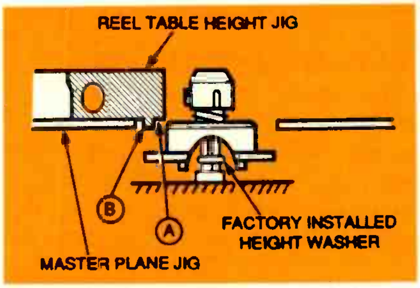

FIG. 2—HOW TO SET the reel-table height. Proper adjustment means that the reel-table height falls between points A and B.

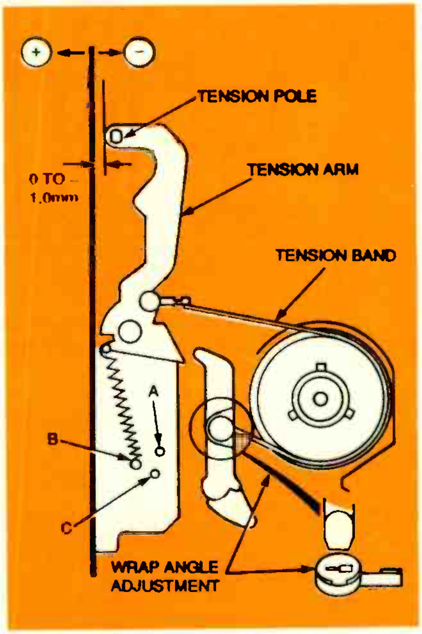

FIG. 3—WHERE TO FIND the wrap-angle screw. Note that there are three possible spring settings.

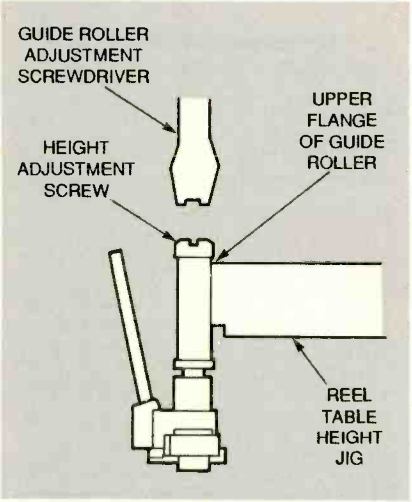

FIG. 4—FOLLOW THIS DIAGRAM when setting up the guide rollers.

VCRs, and you think the kind of adjustments described here are needed, you might want to take your equipment to a professional service center.

Reel-Table Height Adjustment

First remove the cassette housing assembly and place the master plane over the reel table as shown in Fig. 2. Then check to be sure that the reel-table height is between points A and B of the reel-table height jig. If the height is not within those specifications, remove the reel table and add a 0.5-mm thick washer underneath the already installed factory washer as shown. Reassemble, and check again to see if reel-table height is now within specifications.

Tape Tension and Tension-Arm Adjustments

While the cassette-housing assembly is still off (remember, you removed it when you checked the reel-table height adjustment), set the VCR to its loaded state without a tape. To do that, unplug the VCR and cover the end sensors that tell the machine that a tape has been inserted. Then plug the VCR in and turn the power switch on. Now you can adjust the tension pole.

Figure 3 shows the location of the wrap-angle adjustment screw. Set that screw so that the top tip of the tension arm is positioned between 0.0 and 1.0 mm from the edge of the chassis.

After making that adjustment, reinstall the cassette-housing assembly and insert and play the back-tension meter cassette. Set the position of the spring at either point A, B, or C. Select the position that gives you a back-tension reading of between 25 and 32 g-cm.

Guide-Roller Adjustments

As we mentioned earlier, there are two guide-roller adjustments—coarse and fine. The coarse adjustment must be made first. To perform it, remove the cassette housing assembly and place the master-plane jig over the reel tables. Then, using the reel-table height jig (as shown in Fig. 4), turn the guide roller using a guide-roller adjustment screwdriver until the bottom of the guide roller's upper flange is flush with the top of the reel-table height jig.

Now play a blank tape and check to see if the tape rides correctly on the tape-guide ledge of the lower cylinder. If it does not, adjust the guides so that the tape enters and exits the drum assembly on that guide ledge. It may be necessary to alternate from one guide-roller adjustment to the other as they do interact.

Once the coarse adjustment is completed you can move on to the fine adjustment. Now you will need a dual-channel oscilloscope to adequately reproduce and synchronize the FM envelope (used for tracking adjustments) and the X-value, commonly called the "Interchangeability" adjustment.

Connect one scope probe to the FM envelope test point and the other to a point where you can observe the unit's

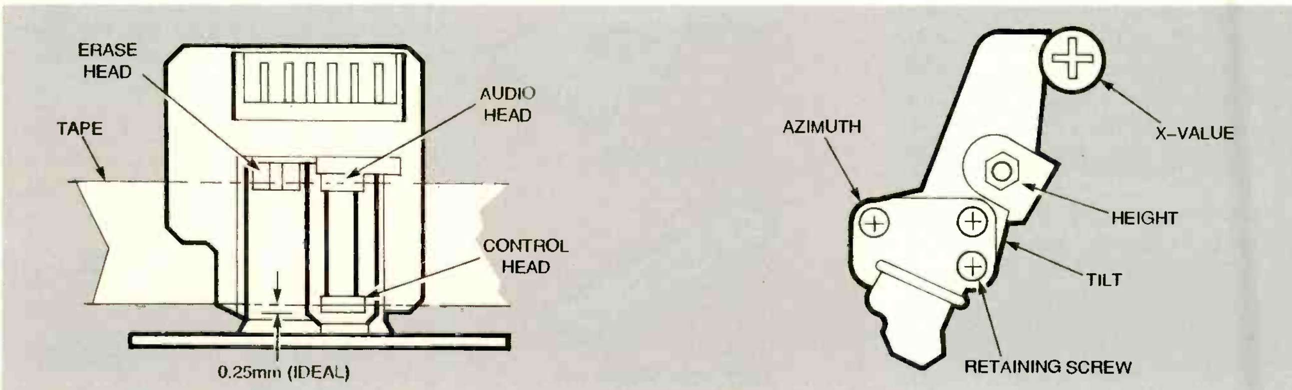

FIG. 5—THE HEIGHT OF THE audio-head guide post is ideal when the bottom edge of the tape is 0.25 mm from the bottom edge of the control head's core (left). The locations of the various audio-head adjustments are shown on the right.

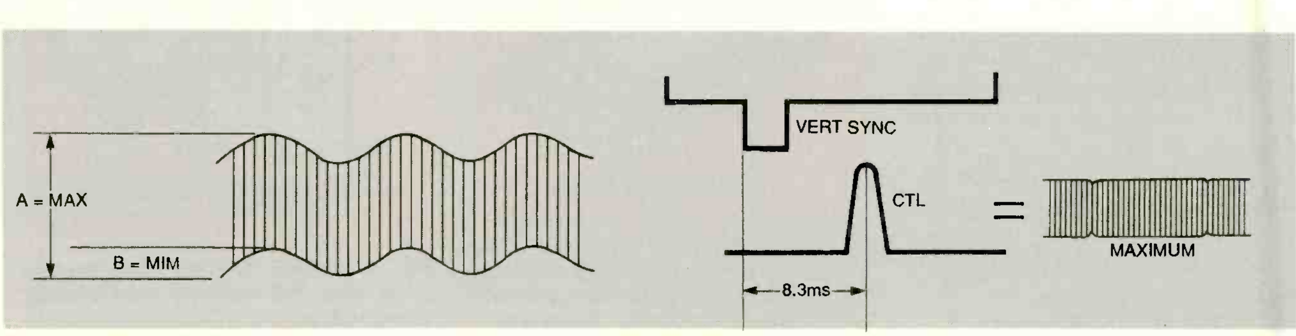

FIG. 6—THE FM ENVELOPE (left) is at its maximum when the CTL and vertical-sync signals have the correct phase relationship (right).

head-switching signal. To locate those points you will need the manufacturer's schematic of the VCR you are working on. Synchronize the scope to the head-switching signal. Now play the color-bar section of the alignment tape and adjust the manual tracking for maximum FM envelope.

The next step is do a linearity test, making sure that when the tracking controls move from one extreme to the other, that the FM envelope is uniform when collapsing and rising. Once that is done, it is time to move on to the audio-head adjustments.

Audio-Head Adjustments

Connect the scope probe for channel one of your dual-trace scope to the audio output of the VCR. Then playback the stair-step section of the alignment tape. While it is playing, adjust the tilt hexagonal screw so that no curling appears at the take-up guide post. The height of the guide post is ideal when the bottom edge of the tape is 0.25 mm from the bottom edge of the control head's core (see Fig. 5). Adjust the azimuth adjustment screw, height-adjustment nut, and the tilt adjustment hexagonal screw to maximize the audio waveform with minimum fluctuations (ripple) as shown in Fig. 6.

Next, connect the scope's channel-one probe to the CTL test point (again, you'll need a schematic for this) and the channel-two probe to the video out. Play the alignment tape. While the tape is playing, adjust the VCR's tracking control until the phase of the CTL pulse is leading the vertical sync signal by 8.3 ms as in Fig. 6. Now move the channel-two probe to the FM envelope test point. Adjust the X-value screw for maximum FM envelope output. Repeat the entire procedure to verify that the FM envelope is indeed at its maximum when the CTL and vertical-sync signals have the correct phase relationship.

Closing Comments

This troubleshooting column has been a bit more nitty-gritty than most, but it does deal with a relatively common VCR problem that is frequently ignored. Take the time and effort to get the VCR's tape transport set up right and you will make video recordings that always play back properly on other machines. You'll also protect and extend the useful lives of both your tapes and your VCR. EN

COMPUTER CONNECTIONS

continued from page 68

ing, Indianapolis. ISBN:0-672-30858-4), by another Borland employee, Charles Calvert. The author's personal interjections sometimes get on my nerves, but I am willing to overlook that because there is lots of in-depth discussion. One strength is its coverage of Microsoft's OLE and COM models, and how to use them within Delphi.

Wrapping Up

That's about it for this month. Before signing off: Have you noticed how the price of 100-Mbps Ethernet cards has plummeted recently? Name-brand cards are available for just a little over $100. The problem is that the hubs required by those fast cards still cost 10-20 times what standard 10-Mbps units cost. What's wrong with that picture?

Until next month, you can stay in touch by e-mail at jkh@acm.org, or by snail-mail at **Electronics Now** 500 Bi-County Blvd., Farmingdale, NY 11735. EN

MODEM COMMANDER

(Continued from page 52)

sure to leave the computer's power switch turned on!

You'll also have to configure your computer to boot into a telecommunications program in auto-answer mode. Before actually attempting to use your computer remotely, measure how long it takes to boot and set switch S3 accordingly. In addition, you will have to set communications program at the remote computer so that its "wait for carrier" time exceeds the total time required to call and boot the remote computer. Otherwise, the remote modem will time out and disconnect before the computer has a chance to go on-line. You should be able to make all these settings using the scripting or setup capabilities of your telecom program. Ω

BY FRANKLIN J. MILLER

Solving Microphone-Splitting Problems

LAST TIME, I INTRODUCED YOU TO THE BASIC PROBLEMS RAISED BY MICROPHONE SPLITTING. THIS TIME, WE WILL LOOK AT HOW TO OVERCOME THOSE PROBLEMS. PROPER MICROPHONE SPLITTING IS FAIRLY EASY TO DO, BUT IT DOES REQUIRE an audio transformer that has at least three equal windings designed to match modern-day microphones. The problem is, most such audio transformers are designed to optimize line level signals, so they don't work very well with microphone circuits. Let's look at why.

Designing a Transformer

Most modern microphones produce a small output signal—typically 5-mV from a normal speaking voice. However, in rock-concert environments, musicians can be literally screaming into their microphone, causing it to produce several hundred millivolts of signal. And while the frequency range of the voice range is limited to about 100-Hz to 10-kHz, the frequency response of the transformer has to be much higher (20-Hz to 20-kHz) to handle musical instruments. In short, what is needed is an audio transformer that offers broad frequency response, low THD, low noise, and the ability to operate over a range of 5-mV to 500-mV, or 40-dB.

Since such a unit was not available, designers set out to make one. A great help in that process was the design philosophy of how the audio transformers and microphones were to act. In the early years of PA sound systems, the electronic part of the solution was handled by vacuum-tube equipment. Because of certain design considerations when using tube circuits, the audio transformers had to be terminated as shown in Fig. 1. But when an audio transformer is terminated like that, there are signal losses, as well as coloring of the sound. Figure 2 shows the effects of improper termination on the audio signal.

However, with the advent of transistors and op-amps, engineers concentrated their efforts on voltage rather than power transfers. The results were designs where the audio transformer was not being terminated on either the primary or secondary sides. That's a definite plus in microphone splitting as otherwise we could have a signal loss of 6 to 10 dB in the split. That would have made a real difference in the signal-to-noise ratio.

Other factors helped simplify the transformer-design process. Microphones were at one time thought of as having an impedance of 150 to 200 ohms. Therefore, the input transformers in microphone preamps had to have input impedances of 150 to 200 ohms, and a 60,000-ohm output impedance. The idea was that the designer had to match the impedances then found in tube amplifiers. Figure 3 shows the schematic for that kind of transformer.

The engineers soon discovered that bridging the 150- to 200-ohm output impedance of the microphone by 10 times—*i.e.* 500 to 2000 ohms—made the microphone sound better. What an idea! The audio quality could be improved by just a little juggling of some numbers in a design formula. Engineers *can* be useful to the musical community in their design efforts! Now we could have a transformer that had three equal windings. And best of all, it was designed to transfer voltages and have no apparent loss in this application.

That solved the problem of how to get proper sound from the monitor for the performer to hear. Along with that

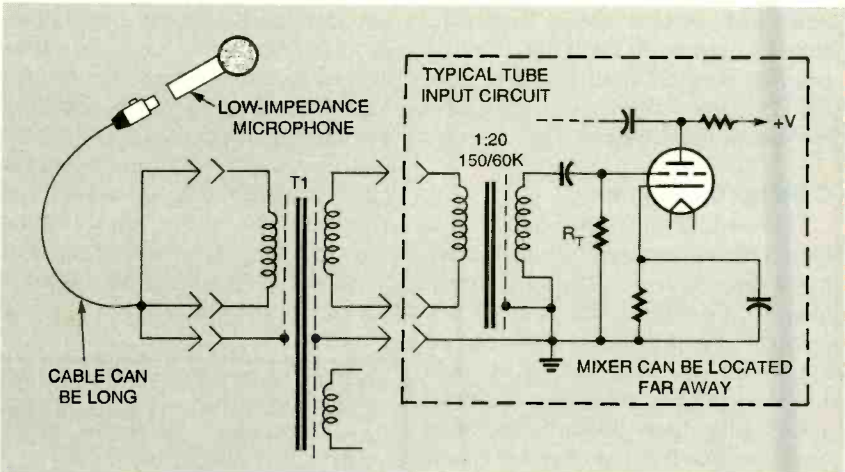

FIG. 1—WHEN AUDIO TRANSFORMERS are connected to tube circuits, the transformers had to be terminated as shown here.

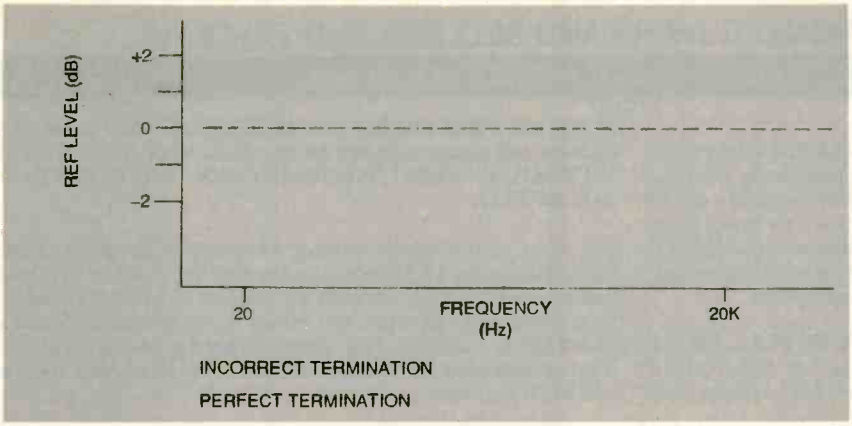

FIG. 2—TERMINATING AN AUDIO TRANSFORMER incorrectly can introduce signal losses and may color the audio signal.

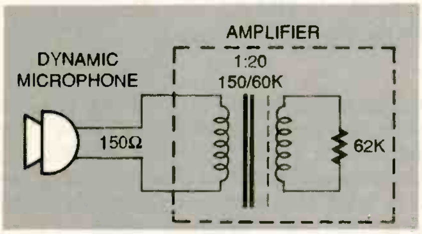

FIG. 3—INPUT TRANSFORMERS in microphone preamps were at one time designed to match the impedances found in tube amplifiers.

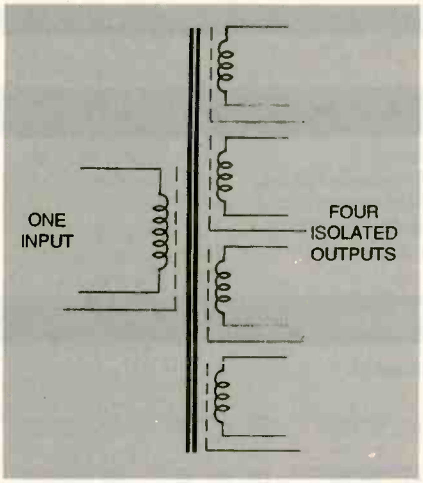

FIG. 4—THIS MICROPHONE-SPLITTING transformer provides four isolated output to meet the audio needs of today's live-music world.

success, people asked us to give them another output so that a recording could be made at the same time the live performance was taking place. Eventually I designed a microphone-splitting transformer with four separate outputs. It is shown in Fig. 4. The splits provided one output for the house PA, one for monitor sound, one for TV/radio, and the last for recording. I must admit that this is not the most common application of microphone-splitting transformers, but Sescom (my company) has produced more than 25,000 units since the original design was created.

Changing Technology

As the years progressed, microphone technology improved. For example, dynamic microphones became more sensitive; their output voltage and dynamic range increased. Also, the electret condenser microphone became popular in the music world. Its average output level is greater than that of the dynamic type—it can produce more than 1 volt of signal under certain circumstances. Needless to say, the microphone-splitting transformer had to be improved to keep up with changing technologies and trends. As a result, a third generation of microphone-splitting transformers was designed to meet that need.

That new generation would allow the user to have microphones that could generate levels up to +4 dBV without distortion in the transformer. Of course, that would be difficult for the microphone-input stages of many amps to handle, but input pads on the microphone preamps could be used to compensate.

The dynamic range of that series of splitting transformers was over 60 dB. That means that it could handle a 1000:1 ratio of input signals. It is very difficult to maintain linearity over that very large range, but it was my goal to make sure that the microphone-splitting transformer was not the weak link in the chain. EN

FOR MORE INFORMATION

For a copy of a complete 32-page booklet on *Mic-Splitting Demystified* send $5 to Franklin J. Miller, 2100 Ward Drive, Henderson, NV 89015-4249. Price includes shipping. NV residents must add sales tax.

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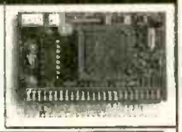

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EL34	9.00	8.40	7.80
ECC83/12AX7	5.90	5.60	5.25
EL84/6BQ5	5.70	4.95	4.40

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6CA7 "big bulb"	$11.50	$10.50	9.50
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12AX7/ECC83	4.50	3.60	2.90
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12DW7/7247	7.90	6.90	5.90
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Vertical deflection: • Bandwidth :DC coupled (DC to 20MHz normal), AC coupled :(10Hz to 20MHz normal) • Deflection factor: 5mV/div to 5V/div in 10 calibrated steps of 1-2-5 sequence • Rise time: 17.5nS or less
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STRD-1005	SANKEN	1	4.15
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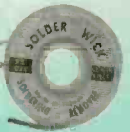

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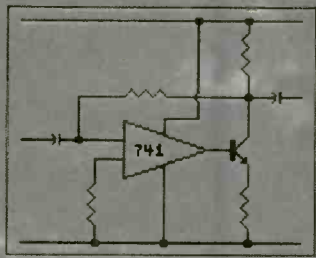

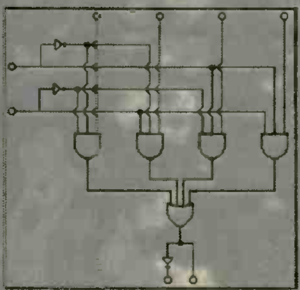

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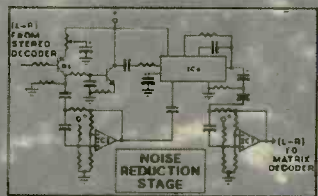
VT102	Intro to VCR Repair: This video is designed for the serious technician. (workbook not available). 84 Minutes	44.95	39.95
VT103	Learn How To Clean Your Own VCR: This video is not technical, but will save you money. (workbook not available). 32 Minutes	29.95	25.95



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OPTREX. DMF5005 *(non back-lit)* $69.⁰⁰ or 2 for $129.⁰⁰
20 character x 8 line 7⅛L x 2½H
The built-in controller allows you to do text and graphics.

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5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • *Certain models are backlit, call for more info.*

Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	$35.00	480x128	Hitachi	$15.00
640x400 (backlit)	Panasonic	$25.00	256x128	Epson	$20.00
640x200	Toshiba	$15.00	240x128 (backlit)	Optrex	$20.00
480x128 (backlit)	ALPS	$15.00	240x64	Epson	$20.00
			160x128	Optrex	$15.00

6" VGA LCD 640X480, Sanyo LMDK55-22 **$35⁰⁰**

LASER PRODUCTS

HeNe Laser Head (10Mw max. output) TEMOO, 15.5" long MFG: NEC **$99.⁰⁰**
Laser Power Supply (for HeNe tube) $89.⁰⁰

LASER SCANNER ASSEMBLY $29.⁰⁰
Assembly intended for a laser printer. Includes laser diode, polygon motor (6 sided) and misc. optics and lenses.

LASER DIODE (5mW) with collimator $20.⁰⁰

VISIBLE LASER DIODE: 5mw at 670nm **$15.⁰⁰**
Index guided. Threshold current 40 ma typical.

3 and 4mW, 1,300nm LASER DIODES, 5.6mm package, $35⁰⁰
Mitsubishi Electric part number ML701BIR-E21A, General specs are:
1. Vop=1.25, Beam Divergence 25.6° x 28.6°; 2. Tc=24°C, Iop=19 to 20mA, ITH=10.7mA; 3. Wavelength range between 1,280nm and 1,330 nm

POLYGON MOTOR UNIT & DRIVER $79⁰⁰
Ten-sided first surface mirror mounted on an armature that spins at 125 revolutions per second yielding a beam sweep rate of 1250 sweeps per second. The driver for the polygon unit requires 24 volts and plus and minus 12 volts to operate. There is also an f-theta lens in front of the polygon scanning mechanism with a three inch diameter. Great for optical experiments, etc. Very high quality units. (MFR: JAPAN ELECTRONICS)

NETWORK

Proteon ProNet-4 Model p1347 Token Ring Board $49.⁰⁰
16 bit • 4 Mbps • IEEE 802.2 and 802.5 compatible • twisted pair • interoperable with IBM Token Ring network

POS & BAR CODE

MAGNETIC CARD READER $25.⁰⁰
Includes: • 20 character dot matrix display with full alpha-numeric capability • keypanel with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.

HP bar code wand (HBCS 2300)......................$25.00

POWER SUPPLYS

SWITCHING POWER SUPPLYS $12.00 or 2 for $20.00 115/230 Volts
73 WATT (2) 4 pin power connectors attached • Dim: 8.5" L x 4.5" W x 2" H
Output: +5V @ 2-9.75, A, +12V @ 0-1.5 A, -5V @ 0-0.4 A, -12V @ 0-0.5 A
68 WATT Dim: 5.5" L x 3.2" W x 1.7" H • Output: 5V @ 4 A, 12V @ 4A
60 WATT Dim: 8¾ x 4¼ x 3 • Output:5V @ 6A + 12V @ 1A · 5V @ 1A · 12V @ 1A

CHARGE COUPLED DEVICES

"The Spy In The Sky" $79.⁰⁰ — **MATRIX TYPE**

Thomson 576X550 pixel CCD
400-1,100nm resolution and responsivity. **$500⁰⁰ Original cost device**

Sony CCD Imager - designed for black and white composite video cameras. Picture elements: 384 (H) x 491 (V) $29⁰⁰
Chip size 10.7 (H) x 9.3 (V) mm² • Unit cell size 23.0 (H) x 13.4 (V) um². Ceramic 24 pin DIP package • Mfr: Sony, Part# 016AL

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4096 element CCD $19.00
1024 element CCD $15.00
2048 element CCD $15.00 • 1728 element CCD $15.00

MONITORS

Non-Enclosed TTL
Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15Khz. • Ability to do 40 and 80 column.
5 inch Amber $29.00 • 7 inch Amber $39.00
9 inch Amber or Green $29.95

5" COLOR MONITOR $49.⁰⁰

• Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
• 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
• Open Frame Construction • Standard Interface Connector • Degaussing Coil included • Mfr. Samtron

9" monochrome SVGA MONITOR $99.⁰⁰
Tilt and swivel type. **Mfr: WEN**

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IBM 370 option XT and AT emulation boards $35⁰⁰

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POINT OF SALE BANK TERMINAL $49⁰⁰ or 2 for $89⁰⁰
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Note: We have not been able to bypass an access code in the software. Thus, while time of day and other introductory things are displayed on LCD, the full original capabilities of this unit cannot be guaranteed. Also, we do not have a source for the smart cards that were to go in the PCM CIA sockets. Requires 12 volt adapter for power. (Not included) Dimensions: 9-1/2L x 6-1/4W x 2-1/2 D • Original cost over $450.00

CAMERA BLOCK $149⁰⁰ or 2 for $199⁰⁰
FOR ROBOTICS AND EVERYTHING ELSE
Unit is for Hi Band 8mm CamCorders, includes 8X zoom lenses, D/D converters, built-in CCD 2/3 in, 420 thousand picture elements, complementary mosaic filters. Excellent performance. High resolution, high sensitivity, low lag, low smear, good color reproduction, no distortion, 1/60-1/10000sec variable speed digital shutters, TTL auto focus, auto white balance, one-push auto white balance, auto/manual iris and gain up switch. Can be controlled by a 4bit micro computer. Remote controlling is possible for zoom and focusing. **NOTE:** We have Composit or PAL (European Standard) Units. **MFR: SONY**

CELL SITE TRANSCEIVER $79⁰⁰ 2 for $149⁰⁰
These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 HMz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier, channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

Encased Black & White Composite CCD Camera with Adapter
IR viewing to 1000 nm 7 ½ L x 2 ¾ W x 1 ¾ H
Comes complete with CCD camera, mounting nut on bottom of casing, 12VDC power supply. Excellent low light capability, standard RCA NTSC video out. **$89.00**
Great for: entryway security/remote monitoring, video conferencing/desktop video conferencing **2 for $159.00**
This miniature camera is perfect for multimedia computer applications as well as security and surveillance. NTSC output allows use with all popular video digitizing boards for Apple Macintosh and Microsoft video for Windows. Connects directly to any composite monitor or VCR with "video" input. Its razor-sharp wide-angle lens focuses from two inches to infinity and its state-of-the-art CCD technology accurately captures 16 level grayscale images for Quick Time movies and still pictures. Records at 30 frames per second and 260 lines resolution with excellent low light capability. Uses 12VDC (adapter supplied) and standard RCA cable.

US made Micronics 486 VLB ALL in ONE $99⁰⁰
motherboard, supports 3.4 or 5V CPU, at either 25 or 33 mhz basic clock. Can use AMD or Intel from 4865X25 thru 486DX4-100 to HOT new AMD 5X86-133 cpu. On board 2 serial ports, 1 printer port, floppy and IDE hard drive controller. On board 256K cache. Uses 72 pin simm memory.

Board will not fit standard All in One case because of non standard location of riser board. VLB riser board is included with motherboard.

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Cable TV Stereo Decoder
When used in conjunction with a cable TV converter or cable ready VCR, this handy device allows you to feed the cable TV stereo signal into your home sound system for superb audio reproduction of your favorite shows, movies, and sporting events.
#EN-189-110 .... $19.90
Digital Video Stabilizer
The digital video stabilizer will eliminate the constant picture distortion caused by the copyright protection on movie videotapes. This unit is fully automatic and operates on one 9V battery which is included.
#EN-180-320 .... $17.95
Decoy Cameras
These 1/3" CCD cameras offer a clever means of disguise. Both feature a 3.6mm wide angle lens, built-in electronic shutter, and a 12 VDC power supply. Minimum illumination: 0.3 lux. 400 line resolution. Smoke detector decoy camera includes an audio output.
AFFORDABLE HIGH TECH SURVEILLANCE!
Microphone
Camera Lens
Part # | Description | Price
EN-335-535 | Smoke detector decoy | $249.50
EN-335-540 | Decoy clock camera | 299.95
"The Sound Bridge" FM Stereo Wireless Transmitter
The Sound Bridge is a mini FM wireless transmitter that can be used to broadcast stereo sound from any audio source like portable CD players, TVs, electronic games, CD-ROM, even computer soundcards, to your home stereo receiver! Adjustable from 89 to 95.5 MHz.
HOT NEW ITEM!
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Portasol/Weller Butane Soldering Tool
NO CORDS, NO BATTERIES!
This cordless, refillable, butane powered soldering tool is ideal for any on-site soldering job. Provides up to 35 watts with a temperature range up to 700 degrees F. Includes flint ignitor in plastic case, safety cut off switch, and C-2 chisel tip.
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Deluxe probe kit features a modular design for longer life, switchable 10:1 probe with 150 MHz bandwidth, 2.8 ns rise time, and adjustable capacitance from 10-35 pF. 60" in length.
GREAT VALUE!
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5" Sealed Back Midrange
5" heavy duty sealed back midrange with deluxe mesh grill. 1" aluminum voice coil. Popular midrange for auto sound installations. •Power handling: 35 watts RMS/50 watts max •Voice coil diameter: 1 inch •Impedance: 8 ohms •Frequency response: 800-10,000 Hz.
#EN-280-030 .... $7.50
3 Channel Color Organ Kit
This sound to light unit features three separate outputs, which can be controlled independently. Each output reacts to three different bands of the musical spectrum: bass, midrange, and treble. Has built-in microphone, so no connection is required to music source, but a line input is provided.
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Features a ferro fluid cooled Kapton voice coil and a rubber surround. Very natural sounding high frequency reproduction with extended response to 30KHz.
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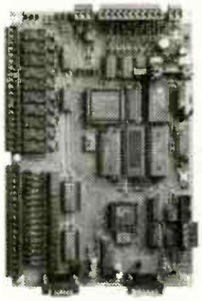

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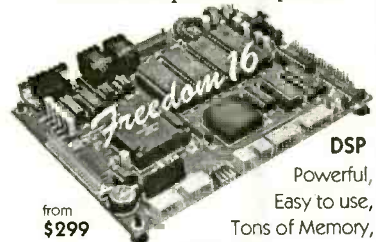

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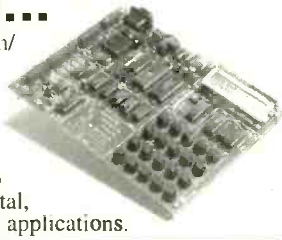

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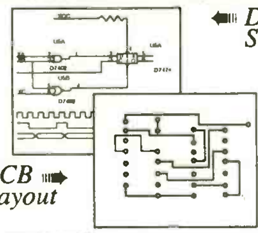

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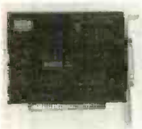

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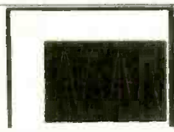

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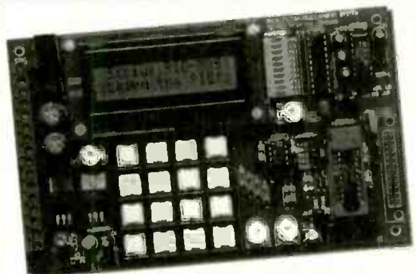

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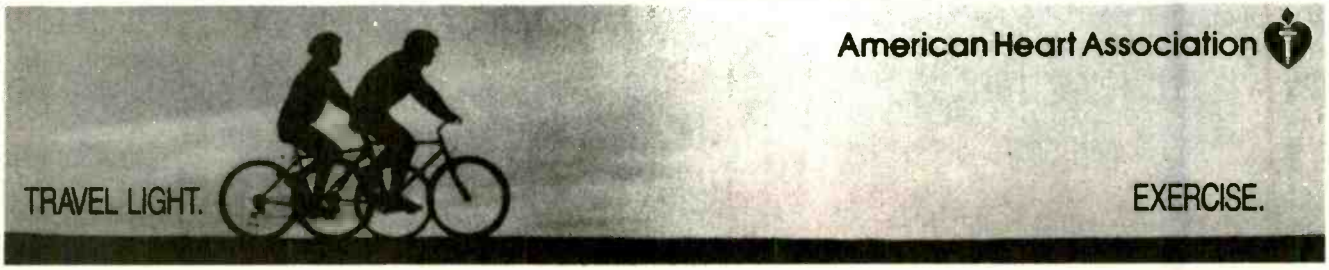

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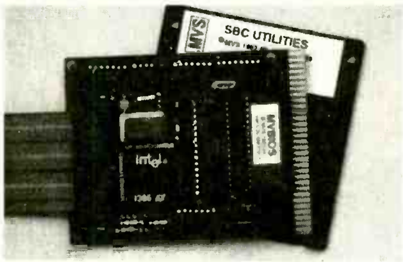

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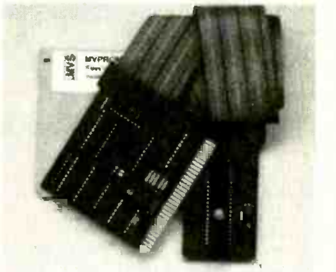

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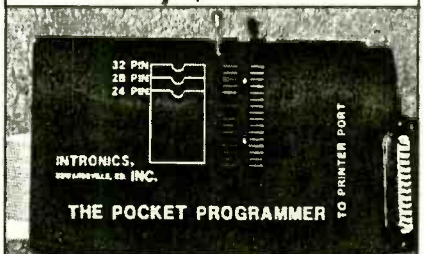

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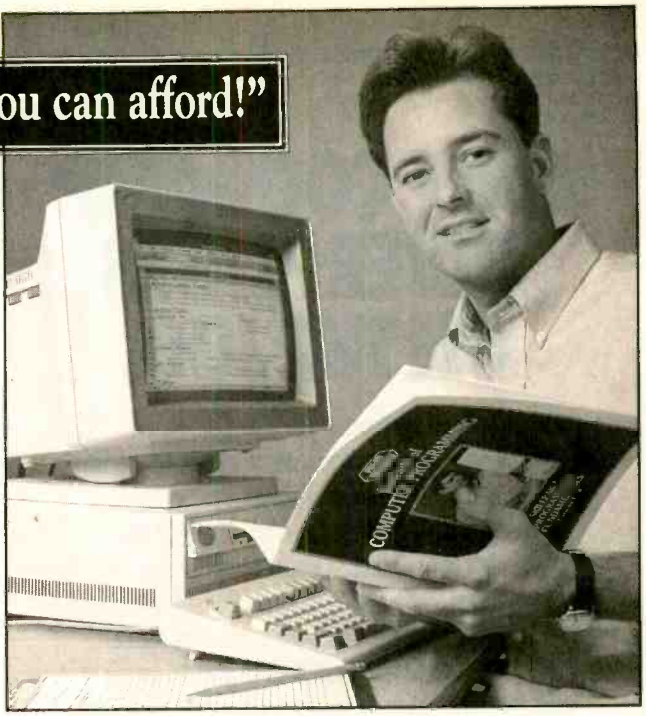

Cash in on the explosion of opportunities. Start your new career or even open a business of your own as a highly-paid computer programmer.

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Look at some of the things professional computer programmers do. "Wrote a C program to clean up a WordPerfect file; edited the resulting file as data errors were found." This work would take a trained programmer less than five hours to complete, and they could make over $200 for the work. That's money you could be making — and soon — with training from the Foley–Belsaw Institute of Computer Programming.

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Other schools force you to buy a complete computer package as part of their training program. At Foley–Belsaw we understand that your needs as a programmer may not fit into a "one size fits all" approach. Why should you pay hundreds of dollars for a computer system that you may not need?

We'll tell you what you need to know so that when you're ready to buy your own computer, you can get the machine that fits your needs at the lowest possible price. That's the Foley–Belsaw way.

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Whether you want to change careers, have a profitable part-time job or start your own business, Foley-Belsaw Institute's new computer programming course is the first step. A profitable future in computer programming can be yours. Call or write today for a fact-filled information kit including a free copy of *Computer Programming — A Profitable Career In Your Spare Time*. See how easy it is to begin a money-making career as a sought-after computer programmer. Our free full-color information kit outlines the steps of the computer programming course and shows you everything you will receive as part of your training.

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❑ TV/Satellite Dish Repair, Dept. 31350
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❑ Woodworking, Dept. 43635
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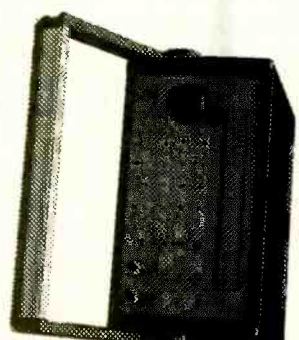

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Our Best Offer Ever on a High Quality Full Sized DMM

General

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

$19.00 any qty

DC Voltage (DCV)

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

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

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

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

AC Voltage (ACV)

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

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

Resistance (Ω)

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

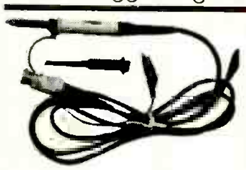
Maximum Open Circuit Voltage: 2.8V

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

hFE Test
Measures transistor hFE.

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

Switchable Scope Probe Sets



(Selectable X1/Ref/X10) These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP9060) or 150MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

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

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

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

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

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 185mm/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

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

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
GS114	114mm x 185mm/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

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

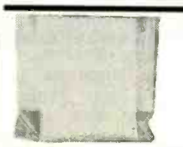
CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114	114mm x 185mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30

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

Developer



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

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

Etching Tank

This handy etching system will handle PC boards up to 8"x9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!

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

Desoldering Pumps

These powerful plastic body desoldering pumps are designed for easy one hand operation for fast, efficient desoldering. Double O-ring piston seals for maximum suction.

CAT NO	DESCRIPTION	PRICE EACH 1	5	10
08-366S	Large Desoldering Pump	$15.89	$13.49	$11.95
08-366E	Regular Desoldering Pump	10.89	8.59	7.39
08-366TIP	Replacement Tip	1.95	1.95	1.95

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Electronic Soldering System

Here's the ideal solution when **Temperature Control** is required. Easy to use slide control allows user to set system from 300°F to 840°F. Voltage to iron from control unit is 24V Iron heating power is 48W. Replaceable 5.3mm tip is standard. Replacement irons and tips are available.

AS LOW AS $50⁰⁰

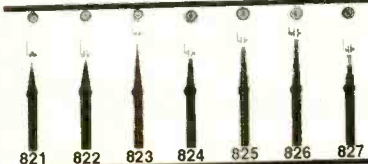
CAT NO	DESCRIPTION	PRICE EACH 1	5
SL10	Temp Controlled Soldering Iron	$56.00	$50.00
SL24V	Spare 24V Soldering Iron	10.50	7.50

Electronic Soldering System with LED Display

Deluxe temperature controlled system with LED display for maximum accuracy. Temperature is adjustable from 160°-480°C (320°-900°F). Iron heating power is 48 Watts. Runs on 24V from controller unit. Replacement irons and tips are available. Tip size is 5.3mm.

CAT NO	DESCRIPTION	PRICE EACH 1	5
SL30	Deluxe Soldering System w/LED	$86.00	$75.00
SL24V	Spare 24V Soldering Iron for SL10 or SL30	10.50	7.50

AS LOW AS $75

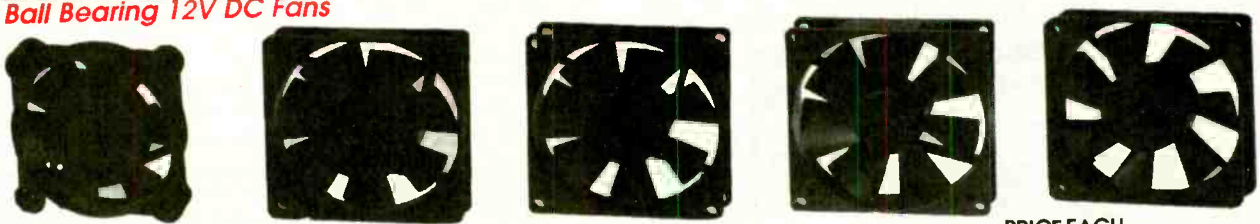


Replacement Tips for SL10/SL30

We now offer a variety of replacement tips for the SL10/SL30 soldering stations.

CAT NO	DESCRIPTION	PRICE EACH 1	5
821	1/32" Pencil Tip	$1.39	$1.19
822	1/32" Pencil Tip	1.39	1.19
823	1/64" Pencil Tip	1.39	1.19
824	1/16" Chisel Tip	1.49	1.29
825	1/8" Chisel Tip	$1.49	$1.29
826	3/64" Chisel Tip	1.49	1.29
827	3/64" Pencil Tip	1.59	1.39

Ball Bearing 12V DC Fans



These High Quality Fans feature Ball Bearings and Brushless DC Motors. All of them are designed to meet UL, CSA & VDE Standards. Design these fans into power supplies, computers or other equipment requiring additional air flows for heat removal. These fans are regular Circuit Specialists stock items — they are not surplus.

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CAT NO	PRICE EACH 1	10	25	100
CSD 4010-12	$ 9.88	$ 6.38	$5.48	$4.87
CSD 6025-12	9.38	5.91	5.41	4.71
CSD 8025-12	8.88	5.85	5.19	4.49
CSD 9225-12	8.95	6.14	5.29	4.59
CSD 1225-12	11.45	8.96	7.82	6.85

Specifications

CAT NO	DIMENSIONS (MM)	RATED VOLTAGE (V)	START VOLTAGE (V)	INPUT CURRENT (A)	AIR FLOW (CFM)	STATIC PRESSURE (INCH-H_2O)	SPEED (RPM)	NOISE LEVEL (dB)	WEIGHT (g)
CSD 4010-12	40x40x10mm	12	7	0.06	5.1	0.19	5,500	26	20
CSD 6025-12	60x60x25mm	12	5	0.13	13.7	0.165	4,500	28	65
CSD 8025-12	80x80x25mm	12	5	0.16	37.8	0.177	3,000	31	80
CSD 9225-12	92x92x25mm	12	5	0.32	42	0.18	2,800	37	95
CSD 1225-12	120x120x25mm	12	5	0.35	62	0.180	2,500	42	135

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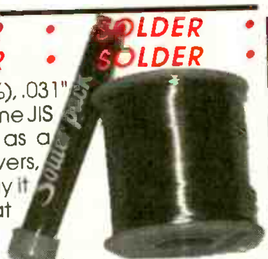

We stock high quality 60/40(Sn%/Pb%), .031" and 63/37, .031" diameter. This is prime JIS certified solder that we maintain as a regular stock item (It is not "Left-overs, Rejects or Surplus") and you can buy it from us at a fraction of the price that you are used to.

Tired of Paying Inflated Prices for Solder?

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
RH60-1	1-lb. Spool, .031", 60/40	$ 6.90	$ 5.96	$ 5.30
RH63-1	1-lb. Spool, .031", 63/37	6.95	6.10	5.41
RH60-4	4.4-lb. Spool, .031", 60/40	24.00	21.90	17.92
RH60-TUBE	6-oz. Tube, .031", 60/40	.99	.89	.79

CCD Camera - IR Responsive

As Low As $109!!

This black and white monochrome CCD Camera is totally contained on a PCB (70mm x 46mm). The lens is the tallest component on the board (27mm high from the back of the PCB) and it works with light as low as 0.1 lux. It is IR Responsive for use in total darkness. It comes with six IR LED's on board. It connects to any standard monitor, AUX or video input on a VCR or through a video modulator to a TV. Works with a REGULATED 12V power supply (11V-13V). Hooks up by connecting three wires: red to 12V, black to ground (power & video) and brown to video signal output.

CAT NO	DESCRIPTION	PRICE EACH 1	5
CA-H34A	PCB Mounted IRCCD Camera	$125.00	$109.00

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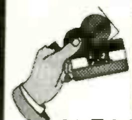

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Regal CR-83	45	39	35
* New, Panasonic TZPC 145	75	69	65
DQN-5 (2 or 3) (unmodified)	45	39	35
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DRX-3 PJ (unmodified) 60 Channel Plain	32	30	27

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Panasonic: Call for model #	7.50	7.00	6.50
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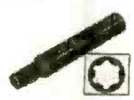

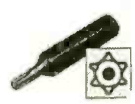

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Calibrator for analog and digital multimeters up to 4.5 digits, five functions: direct or alternating voltage or current plus resistance. Opt 03, 05.

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Fluke 5101B Calibrator

Similar to 5100B but has procedure storage feature. Opt Y5000 interface buffer for 5205A, 5215A and 5220A.

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Fluke 335D

Dc Standard Null Detector, 1 μV to 1000 Vdc with .001% accuracy.

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ESI RV622A Dekavider

Decade voltage divider, 6 dial, 10,000 Ω.

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Selective Level Meter, 50 Hz to 30 MHz frequency range, provides highly accurate measurement of signal levels with accuracy and stability needed to manufacture, maintain and install FDM systems. Opt 31, new boxed.

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ENI 403LA Power Amplifier

37 dB, .15 to 300 MHz, input 1 V max.

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General purpose amplifier that will boost the output of any signal source by 27 dB and provide more than 300 mW of power from 2 to 500 MHz.

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ENI 500LA RF Power Amplifier

1.5 to 520 MHz, 27 dB, input 1 V max.

$500.00

ENI 503L RF Power Amplifier

2 to 510 MHz, outputs 3 linear watts, input and output 50Ω with a max input SWR of 1.5 and a max output of SWR 2.5, gain is 40 dB.

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Fluke 931B

True RMS Voltmeter, measures .01 to 1100 V in 5 ranges over 2 Hz to 1 MHz frequency range.

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Fluke 8012A

Digital Multimeter, 3.5 digits, seven functions, 0.1% basic dc accuracy, true RMS ac, from 45 Hz to 50 kHz, 2Ω and 20Ω range.

$325.00

Cal Instruments 1201WF

Frequency Changer, output voltage is adjustable from 0 to 260 volts at frequencies of 47 to 500 Hz. Digital display, internal jumpers allow operation at either 115 or 230 VAC. New.

$1950.00

Hewlett-Packard 5335A

Universal Counter, high performance 200 MHz counter, automatic rise time, duty cycle, pulse width, slew rate, and phase measurements.

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Tektronix 1741

Waveform/Vector Monitor, PAL applications, call for complete specs. Option 16.

$1650.00

Tektronix 1751

Waveform/Vector Monitor, SCH monitoring and measurement, PAL applications, call for complete specs.

$1950.00

Tektronix 2246

100 MHz Oscilloscope, four independent channels, 2ns/div time base, flexible triggering, displays voltage on screen, includes 2 probes.

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Wavetek 172B

Programmable Signal Source, .0001 Hz to 13 MHz, 500 settings per second, functions as a synthesizer, waveform generator, oscillator and pulse generator. Options 001, 002.

$3500.00

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Universal Counter, 12 digit, 225 MHz, 20 to 40 mV sensitivity, 150 ps time-interval res., HP-IB.

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Hewlett-Packard 214B

Pulse Generator, high power 100 V, 2 A output into 50Ω, 10 MHz repetition rate, constant duty cycle.

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Hewlett-Packard 8553B

Spectrum Analyzer RF Section, 1 kHz to 110 MHz, resolution bw range from 300 kHz to 10 Hz.

Special $575.00

Hewlett-Packard 5328B

Universal Counter, 100 MHz, 10 ns time interval, resolution, 10 ps with averaging, HP-IB. Has option 21, high performance DVM.

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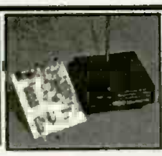
Synthesized FM Stereo Transmitter



Microprocessor controlled for easy freq programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit........$129.95

Tunable FM Stereo Transmitter

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC, or optional 120 VAC adapter. Add our matching case and whip antenna set for a nice finished look.

FM-10A, Tunable FM Stereo Transmitter Kit............$34.95
CFM, Matching Case and Antenna Set................$14.95

RF Power Booster Amplifier

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Power required: 12 to 15 volts DC at 250mA, gain of 38dB at 10 MHz, 10 dB at 1000 MHz. For a neat, professionally finished look, add the optional matching case set.

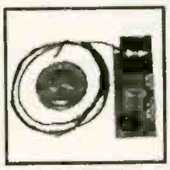
LPA-1, Power Booster Amplifier Kit..................$39.95
CLPA, Matching Case Set for LPA-1 Kit...............$14.95
LPA-1WT, Fully Wired LPA-1 with Case...............$99.95

Micro FM Wireless Mike

World's smallest FM transmitter. Size of a sugar cube! Uses SMT (Surface Mount Technology) devices and mini electret condenser microphone, even the battery is included. We give you two complete sets of SMT parts to allow for any errors or mishaps-build it carefully and you've got extra SMT parts to build another! Audio quality and pick-up is unbelievable, transmission range up to 300 feet, tunable to anywhere in standard FM band 88 to108 MHz. 7/8"w x 3/8"h x 3/4"h.

FM-5 Micro FM Wireless Mike Kit...................$19.95

Crystal Controlled Wireless Mike



Super stable, drift free, not affected by temperature, metal or your body! Frequency is set by a crystal in the 2 meter Ham band of 146.535 MHz, easily picked up on any scanner radio or 2 meter rig. Changing the crystal to put frequency anywhere in the 140 to 160 MHz range-crystals cost only five or six dollars. Sensitive electret condensor mike picks up whispers anywhere in a room and transmit up to 1/4 mile. Powered by 3 volt Lithium or pair of watch batteries which are included. Uses the latest in SMT surface mount parts and we even include a few extras in case you sneeze and loose a part!

FM-6, Crystal Controlled FM Wireless Mike Kit.........$39.95
FM-6WT Fully Wired FM-6 ....$69.95

Call for our Free Catalog !

Super Pro FM Stereo Radio Transmitter

A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes sharp looking metal cabinet, whip antenna and 120 volt AC adapter. Also runs on 12 volts DC.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Professional FM Stereo Transmitter Kit.......$299.95
FM-100WT, Fully Wired High Power FM-100...........$429.95

Speech Descrambler Scrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. The technology used is known as speech inversion which is compatible with most cordless phones and many police department systems, hook it up to scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC, RCA phono type jacks. Our matching case set adds a super nice professional look to your kit.

SS-70A, Speech Descrambler/Scrambler Kit...........$39.95
CSS, Custom Matching Case and Knob Set $14.95
SS-70AWT, Fully Wired SS-70A with Case.............$79.95
AC12-5, 12 Volt DC Wall Plug Adapter.................$9.95

Tone-Grabber Touch Tone Decoder / Reader

Dialed phone numbers, repeater codes, control codes, anywhere touch-tones are used, your TG-1 will decode and store any number it hears. A simple hook-up to any radio speaker or phone line is all that is required, and since the TG-1 uses a central office quality decoder and microprocessor, it will decode digits at virtually any speed! A 256 digit non-volatile memory stores numbers for 100 years - even with the power turned off, and an 8 digit LED display allows you to scroll through anywhere in memory. To make it easy to pick out numbers and codes, a dash is inserted between any group or set of numbers that were decoded more than 2 seconds apart. The TG-1 runs from any 7 to 15 volt DC power source and is both voltage regulated and crystal controlled for the ultimate in stability. For stand-alone use add our matching case set for a clean, professionally finished project. We have a TG-1 connected up here at the Ramsey factory on the FM radio. It's fun to see the phone numbers that are dialed on the morning radio show! Although the TG-1 requires less than an evening to assemble (and is fun to build, too!), we offer the TG-1 fully wired and tested in matching case for a special price.

TG-1, Tone Grabber Kit.................................$99.95
CTG, Matching Case Set for TG-1 Kit..................$14.95
TG-1WT, Fully Wired Tone Grabber with Case.........$149.95
AC12-5, 12 Volt DC Wall Plug Adapter.................$9.95

Mini-Peeper Micro Video Camera

Super small, high quality fully assembled B & W CCD TV camera the size of an ice cube! Provides excellent pictures in low light (2 lux), or use our IR-1 Infra-Red light source to invisibly illuminate an entire room on a pitch black night! Imagine the possibilities... build it into a smoke detector, wall clock, lamp, book, radio. Exact same camera that's in big buck detective catalogues and stores. Kit includes: fully assembled CCD camera module, connectors, interface PC board kit with proper voltage regulation and filtering, hook-up details, even a mini microphone for sensitive sound! Two models available: Wide Angle Lens 3.6mm/f2, adjustable focus lens, 92 degree view; Pinhole Lens 5.5mm/f4.5, 60 degree view. The Pinhole Lens is physically much flatter and provides even greater depth of focus. The camera itself is 1.2" square. The Wide Angle Lens is about 1" long, Pinhole Lens about 1/2", interface PC board is 1" x 2" and uses RCA jacks for easy hook-up to VCRs, TVs or cable runs. Power required is 9 to 14 VDC @ 150 mA. Resolution: 380 x 350 lines. Instruction manual contains ideas on mounting and disguising the Mini-Peeper along with info on adding one of our TV Transmitter kits (such as the MTV-7 unit below) for wireless transmission!

MP-1, Wide Angle Lens CCD TV Camera Outfit........$169.95
MP-1PH, Pin-Hole Lens CCD TV Camera Outfit........$189.95

MicroStation Synthesized UHF TV Transmitter

Now you can be in the same league as James Bond. This transmitter is so small that it can fit into a pack of cigarettes - even including a CCD TV camera and battery! Model airplane enthusiasts put the MTV-7A into airplanes for a dynamite view from the cockpit, and the MTV-7A is the transmitter of choice for balloon launches. Transmitter features synthesized, crystal controlled operation for drift-free transmission of both audio and video on your choice of frequencies: Standard UHF TV Channel 52 (which should only be used outside of the USA to avoid violating FCC rules), and 439.25 MHz or 911.25 MHz which are in the amateur ham bands. The 439.25 MHz unit has the nifty advantage of being able to be received on a regular 'cable-ready' TV set tuned to Cable channel 68, or use our ATV-74 converter and receive it on regular TV channel 3. The 911.25 MHz unit is suited for applications where reception on a regular TV is not desired, an ATV-79 must be used for operation. The MTV-7A's output power is almost 100 mW, so transmitting range is pretty much 'line-of-sight' which can mean many miles! The MTV-7A accepts standard black and white or color video and has its own, on-board, sensitive electret micorphone. The MTV-7A is available in kit form or fully wired and tested. Since the latest in SMT (Surface Mount Technology) is used to provide for the smallest possible size, the kit version is recommended for experienced builders only. Runs on 12 VDC @ 150 mA and includes a regulated power source for a CCD camera.

MTV-7A, UHF TV Channel 52 Transmitter Kit..........$159.95
MTV-7AWT, Fully Wired Channel 52 Transmitter $249.95
MTV-7A4, 439.25 MHz TV Transmitter Kit.............$159.95
MTV-7A4WT, Fully Wired 439.25 MHz Transmitter $249.95
MTV-7A9, 911.25 MHz TV Transmitter Kit.............$179.95
MTV-7A9WT, Fully Wired 911.25 MHz Transmitter $269.95
ATV-74, 439.25 MHz Converter Kit $159.95
ATV-74WT, Fully Wired 439.25 MHz Converter.........$249.95
ATV-79, 911.25 MHz Converter Kit $179.95
ATV-79WT, Fully Wired 911.25 MHz Converter.........$269.95

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Mike Murphy - Service Center -Van Nuys CA 818-785-7805
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Bob Monroe - M.A.R.C. Electronics - Virginia Beach VA 804-468-3932
Best investment we've made. Saves time, especially with multi-sided PCB's. Extremely pleased with warranty. Failed within 6 months and replaced by DEN-ON overnight.

Dick Manning - Dicks Electronics - Hartland WI 414-367-8339
The ease & speed of component removal greatly increases productive time. The SMD kit makes SMD removal a breeze, even for inexperienced Techs.

Bob Sorrels CET/CSM Polytronics Microcomputer - Shreveport LA
We've used our SC7000 almost every day for about three years with virtually no problems. Just clean it before you turn it off for the day.

George Hefner - Hefner Electronics - Coleridge NE 402-283-4333
Being a one-men service center, I hesitated to spend the money on a desoldering tool, however all that changed when I nearly ruined a $400 computer logic board. It has cut my desoldering time by 50%.

Don Cressin - Certified Electronics Serv ice - Ellicott City MD 301-461-8008
We have obtained excellent results with the SC7000 including repairing high density U/V tuners. It is one of the best purchases we have made.

Doug Pettit - LuRay Electronics - LuRay VA 703-743-5400
We found that the SC7000 not only saves money vs. wick, but saves valuable time in troubleshooting. It allows you to be more accurate in removing SMD's.

Randy Whitehead - Service West - Salt Lake City UT 801-262-4069
My techs thought it would be a waste. I bought one anyway after a demo. My techs then fought over it. Now we have three. It is the Best desoldering tool we have ever used.

Timothy Kraft - Monikraft, Inc. - Cherry Hill NJ 609-751-3252
We replaced all our existing desoldering stations with the SC7000. Our technicians are very pleased with the improved performance, portability, and reliability over our previous higher priced equipment.

Alan P. Dunasky - Al's TV, VCR, & Computer Service -Cleveland, OH 216-631-8132 One of my most valuable tools in the shop. I would be lost without it.

Bill Warren CET/CSM - Warrens Audio & Video - Knoxville TN - 423-546-1128 We have been extremely satisfied with the quality and durability of the DEN-ON SC7000 as well as with after the sale support.

Ray Wurmnest - Ray's Electronics, Inc.- Bloomington IL 309-829-3238 The SC7000 saves time when changing out parts in the home or in the Service Center — Worth every penny we spent.

James Dietrich - Dietrich Electronics - Monroe NY
Look mom, one hand, & I can go three times faster without breaking a sweat. I'll recommend anyone to DEN-ON Tools.

Don Scott - LAV Electronics Healeah-Miami Lakes FL
I am a constant user of the SC7000 Desoldering Tool and for quick component removal, this unit has no equal. It also comes with excellent company support. I am very satisfied and highly recommend it to anyone in the servicing field.

Gale TV, Inc. Gale Holloway Virginia Beach VA 804-486-3562
Desoldering has never been easier with the SC7000. We use the desoldering tool daily and are fully satisfied with this product.

Daryl Baker Servus Electronics Wichita KS
The SC7000 is a better product than advertised. It has more than paid for the initial investment. We highly recommend the SC7000 Desoldering Tool.

Steve Hall Telco Electronics, Inc. Boise ID 208-322-3304
My first mistake in purchasing the SC7000 was buying only one. My Techs. were so pleased with this tool and it's usefulness they begged for more. They raved about it and even fought over it. I intend to purchase one SC7000 for each workstation.

DEN-ON SC7000

Features

- Totally Self Contained diaphragm vacuum pump and AC motor for high vacuum suction or reversible hot air blow for SMD removal.
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- Unique patented long lasting filter cartridge design. Solder builds up on easily cleaned baffle, while air flows around the outside of baffle.
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- **Power Consumption** —— 120W
- **Pump** —— Diaphragm Type
- **Motor Output** —— 2W
- **Vacuum Attained** —— 600mmHg
- **Temperature Range** —— 300°C—400°C (572°F—842°F)
- **Air Flow Rate** —— 15 Liter/Minute (Open)
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- **Control System** —— Feed Back Zero Cross-over Type
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XTL3000 E-Z
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Sensitive built in microphone with amazing audio sensitivity. Picks up sounds at the level of a whisper. With a range of up to 1 mile, this is our longest range transmitter. Custom frequencies available. 3 Volt photo battery included.

XTL1000 E-Z
TRANSMITTER KIT
Sensitive built in microphone with amazing audio sensitivity. Picks up sounds at the level of a whisper. Up to 1/2 mile range. Custom frequencies available. 3 Volt photo battery included.

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XTR 100 Combo $29.95 E-Z $46.95
XTT 100 Combo $19.95 E-Z $36.95

XST 500 Voice transmitter. Range up to 1 mile. Supersensitive mic. Uses 9 volt battery. Uses surface mount components.
XWB 1000 Voice transmitter. Range up to 1/2 mile. Includes mic and battery on circuit board. Uses surface mount components.
XFM 100 Voice transmitter. Range up to 1 mile. 9 v battery and leaded components.
XSP 250 Super-miniature telephone transmitter. Range 1/4 mile. Powered by phone line. Uses surface mount components.
XTR 100 Tracking transmitter. Range up to 1 mile. Uses 9 volt battery. Transmits a BEEP - BEEP - BEEP tone
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Elenco's advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square wave forms.
1560 tie point breadboard area.

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Assembled and Tested
$169.95

XK-550K - Kit
$139.95

Tools and meter shown optional

TK-3000
$89.95

Tools Included:
- SR-2 - Deluxe Soldering Iron
- SH-1 - Soldering Iron Stand
- ST-1 - Diagonal Pliers
- ST-2 - Long Nose Pliers
- ST-30 - Deluxe Wire Stripper
- SE-1 - Solder Ease Kit
- ND-3 - 3 pc. Nut Driver Set
- TL-8 - Precision Screw Drivers
- ST-5 - Screw Driver Slotted 3/16"
- ST-6 - Screw Driver #1 Phillips
- ET-10 - IC Puller
- SP-2 - Solder Pump
- ST-20 - Safety Goggles
- ST-9 - Pocket Screw Driver
- ST-4 - Solder Tube
- SW-3 - Solder Wick

A professional technician service tool kit in a metal reinforced tool case with heavy-duty handle and locks. A removable pallet handles most of the tools listed with more room for tools and parts in the lower half.

GF-8026 w/ Frequency
- Linear and Log Sweep
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- 4 Digit Display

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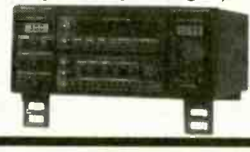
MX-9300 Four Functions in One
- One instrument with four test and measuring systems: 1.3GHz Frequency Counter • 2MHz Sweep Function Generator Digital Multimeter • Digital Triple Power Supply (0-30V @ 3A, 15V @ 1A, 5V @ 2A)



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Model XP-581
4 Fully Regulated DC Power Supplies In One Unit
4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

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DMM w/ Bar Graph Model EDM-163
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7 Functions with data hold
Compares to Fluke Model 77II

Digital Multimeter Model M-1700
$39.95

11 functions including freq to 20MHz, cap to 20µF. Meets UL-1244 safety specs.

Fluke Multimeters

70 Series		80 Series	
Model 70II	$69.95	Model 83	$235.00
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Model 75II	$135.00	Model 87	$289.00
Model 77II	$154.95		
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B&K Precision Multimeters

Model 391	$159.00	Model 388A	$99.00
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over 100 kits available

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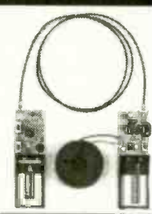
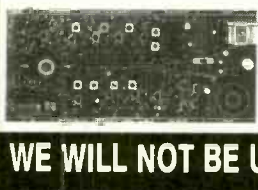


Model AM/FM-108K Transistor Radio Kit



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Compact Multimeter Kit
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Programmable DMM
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60MHz ANALOG WITH DIGITAL STORAGE

Model 2560

- Cursors and readouts
- RS-232 port
- 20MS/s real time sampling
- 1GHz equivalent time sampling (at 0.1μs/div.)
- Prints via RS-232 port to any HP-GL plotter

$1995

20MHz ANALOG WITH DIGITAL STORAGE

Model 2522A

- 20MHz analog bandwidth
- 20MS/s sampling rate
- 2K memory per channel
- 300MHz equivalent time sampling
- Pre-trigger capture

$869.95

100MHz THREE-TRACE

Model 2190A

- 1mV/division sensitivity
- Sweeps to 5ns/division
- Dual time base
- Signal delay line
- 15KV accelerating voltage

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60MHz DUAL-TRACE

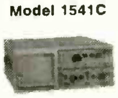
Model 2160A

- 1mV/division sensitivity
- Sweeps to 5ns/division
- Dual time base
- Signal delay line
- V mode-displays two signals unrelated in frequency.
- Component tester

$949.95

40MHz DUAL-TRACE

Model 1541C

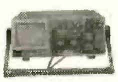


- 1mV/division sensitivity
- Video sync separators
- Z-axis input
- Single Sweep
- V mode displays two signals unrelated in frequency
- Component tester

$695

60MHz, CURSORS & READOUTS, DUAL TIME BASE

Model 2260



- Cursors and readouts
- 1mV/div sensitivity
- 23 calibrated ranges - main time base
- 19 calibrated ranges - delayed time base
- Signal delay time
- V-mode - displays 2 signals unrelated in frequency.
- Component tester
- Z-axis input
- Single sweep

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Model 2120 - 2 Year Warranty

Special $389.95

Model 2125 with delayed sweep

$539.95

- 1mV/division sensitivity
- AUTO/NORM triggered sweep operation
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- Compact low-profile design

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- 20MS/s Sampling Rate

S-1360 $749
- Analog with Delayed Sweep

40MHz

S-1345 $569
- Analog with Delayed Sweep

S-1340 $475
- Analog

2 Year Warranty

25/30MHz

DS-303 $1095
- Analog / Digital Storage

S-1330 $439
- 25MHz Analog
- Delayed Sweep

S-1325 $325
- 25MHz Analog

OSCILLOSCOPE SELECTION CHART

ANALOG

Model	Bandwidth MHz	Sensitivity (max)	No. of Channels	Sweep Rate Max ns/div	Delayed Sweep	Video Sync	Component Tester	Beam Find	Time Base
S-1360	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1345	40	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1340	40	1mV/div	2	10ns/div	No	Yes	No	No	1
S-1330	25	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1325	25	1mV/div	2	10ns/div	No	Yes	No	No	1

DIGITAL STORAGE

Model	Bandwidth MHz	Analog Sen (max)	No. of Channels	Sampling Rate	Memory Channel	Internally Backed Up	Pretrigger %	Output
DS-303	30	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232
DS-603	60	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232

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500MHz Series

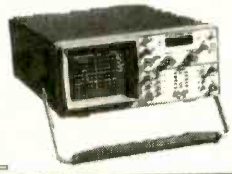
Model 2615 - $1595

Model 2620 w/ tracking generator - $1895

1.05GHz Series

Model 2625 - $2395

Model 2630 w/ tracking generator - $2995



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96B **$1695**

97 ...... **$1795**

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(All caps rated 50V)
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Miniature size 1/4" Panel hole
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1N5408 ...3A/1kV ... 12¢
6A10 .....6A/100V.. 32¢
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33uF/25V .... 8¢
47uF/25V .... 9¢
100uF/25V.. 10¢
220uF/25V.. 12¢
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Deal A7: 40 pcs total, (5pcs of each)....$4.00

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(All caps rated 50V)
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330pF .... 7¢
470pF .... 7¢
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.01uF .... 7¢
.022uF .... 7¢
.047uF .... 9¢
.1uF .... 10¢
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1N5817 ... 1A/20V .. 22¢
1N5818 ... 1A/30V .. 23¢
1N5819 ... 1A/40V .. 24¢
Deal Y8: 9 pcs total, (3pcs of each)....$2.00

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DF04M ....DIP ..... 40¢
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KBL04 ......In-line ... 89¢
Deal X8: 6pcs total, (2pcs of each)....$3.00

DEAL J1.....$3.50
78L05
78L12
10 pcs total (5pcs of each)

Crystals.....99¢ea
3.5795MHz, 4.000MHz
11.0MHz, 11.0592MHz

Mono Caps....9¢ea
.01uF/50V .047uF/50V
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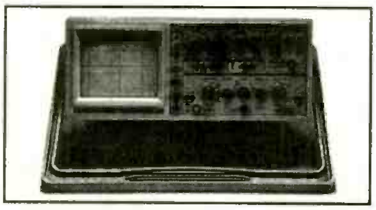

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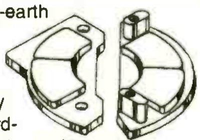
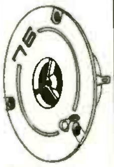


Four neodymium, rare-earth magnets mounted on two metal plates separated by 0.35" spacers. Probably originally part of a computer hard-drive assembly. Magnets are trapezoidal in shape, approximately 0.7" on two sides, 0.55" and 0.9" on the other two sides and 0.115" thick. Quite powerful for their size.

CAT# MAG-20 $3.50 each

POLYMER DOME TWEETER



Infinity SL
3.7" diameter polymer face plate. 8 ohm impedance. No specs available. Made for Infinity speaker systems.

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STEREO 3.5 MM EXTENSION CABLE

6' shielded cable with stereo 3.5 mm mini-phone plug one end, 3.5 mm jack on other end.

$1.25 each **CAT# CB-357**

10 for $10.00

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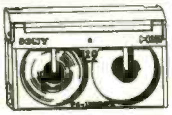

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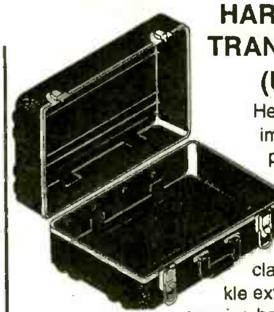
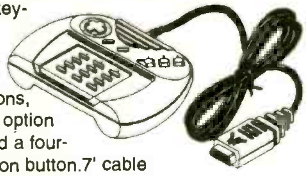


HARD SHELL TRANSIT CASE (USED)

Heavy-duty, impact resistant plastic transit case with aluminum hinges and trim and metal clasps. Black crinkle exterior and black carrying handle. These cases were used slightly for moving medical equipment. They are in excellent condition. Exterior dimensions: 18.5" x 14" x 7.5".

CAT# CSE-9 $19.50 each

ATARI "JAGUAR" CONTROLLER/KEYPAD



Cool-looking game controller for the Atari Jaguar system. Erogonomically designed black box has 12 button keypad (0-9, * and #), separate A,B,C buttons, pause and option buttons and a four-way direction button.7' cable terminated with hi-density DB-15 connector. 6.5" X 5" X 1.65"

CAT # EX-18 $2.50 each

10 for $20.00

SPECIAL PRICE BI-COLOR LED

RED/ GREEN diffused.
T 1 3/4 (5mm) Three Legs
Center cathode.

CAT# LED-63 35¢ each

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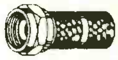
SPECIAL PRICE! TWIST ON F-56 CONNECTOR



We recently made a large purchase of this twist-on co-ax connector for RG-6 cable. Special pricing while the supply lasts.

CAT #FTO-56R

100 for $15.00
500 for $50.00
1000 for $70.00

THERMOELECTRIC COOLER PELTIER JUNCTIONS

These incredible miniature solid state heat pumps raise or lower temperature in a small area almost instantly. Utilizing the Peltier effect these modules perform the same cooling or heating functions as freon based refrigerators but they do it with no moving parts, and are very reliable. Current applied to the device will produce heat on one side and cold on the other side, up to 68° C difference between the two sides. Modules can be mounted in parallel to increase the heat transfer effect or can be stacked to achieve high differential temperatures. 127 thermocouples per device. Operates on 3-12 Vdc. Requires a heatsink to prevent overheating.

1.18" (30 mm) square X 0.15" (3.8 mm) thick.
$17.00 each **CAT# PJT-1** 5 for $75.00

1.57" (40 mm) square X 0.15" (3.8 mm) thick.
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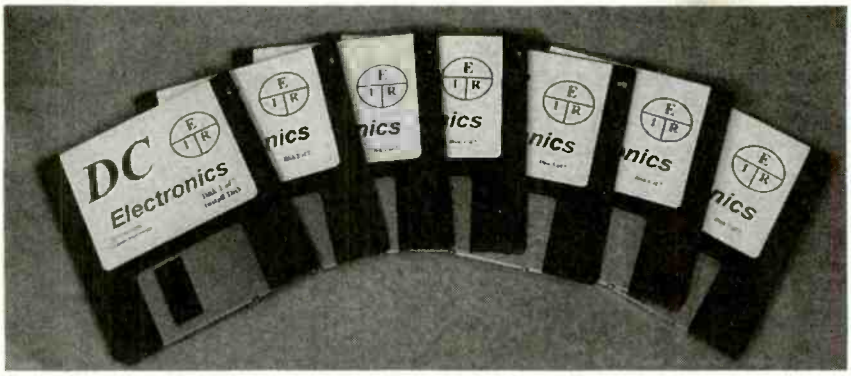

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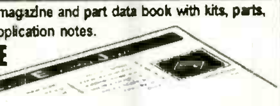

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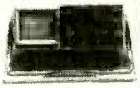
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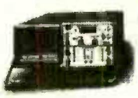
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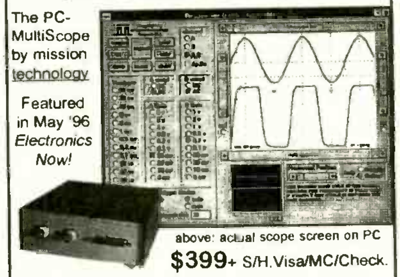

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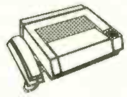

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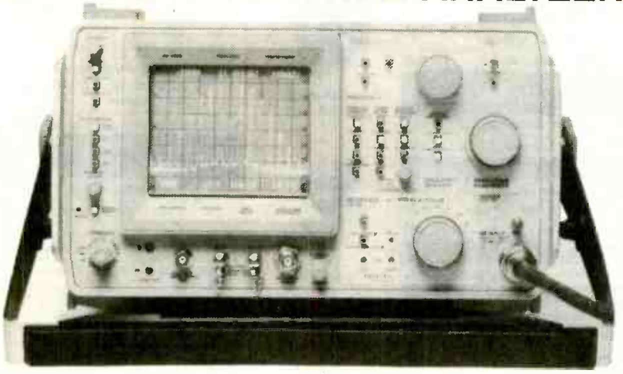

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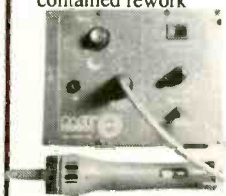

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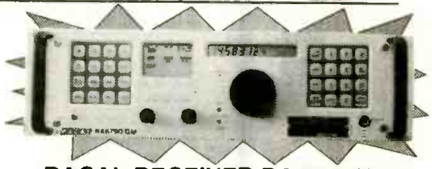

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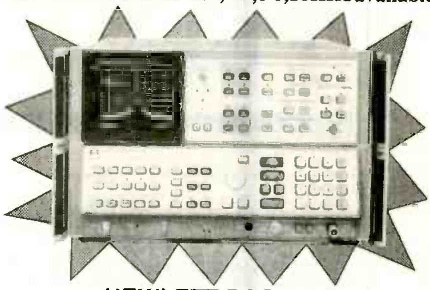

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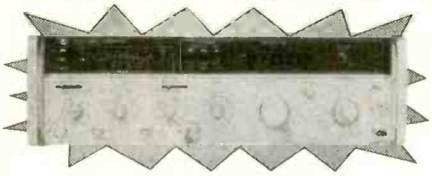

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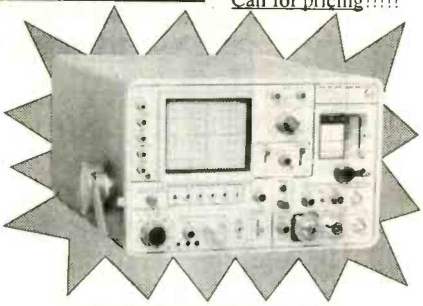

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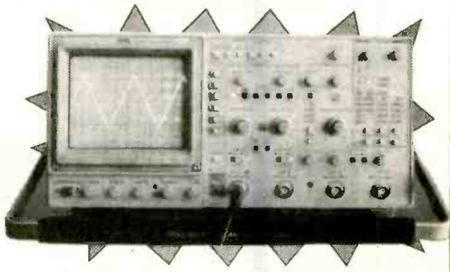
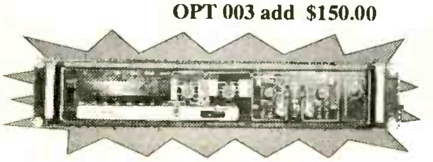


TEK 2246 OSCILLOSCOPE

This user friendly oscilloscope features, 100MHz bandwidth on four channels, on screen scale factors, versatile triggering, 2mV/Div vertical sensitivity, delayed sweep, hands-off voltmeter and smart cursors.
Looks very clean. **Price: $1,950.00**



RACAL DANA UNIVERSAL COUNTER/TIMER

DC - 100Mhz. Fully automatic measurement capability of frequency, period, time interval, frequency ratio and totalize. High speed operation allows for burst mode measurements and 2 nanosecond single shot time interval. Temperature stabilized internal frequency standard, 9 digit display and GPIB IEEE-488 make this microprocessor-based unit excellent value.
Price: Untested $99.00

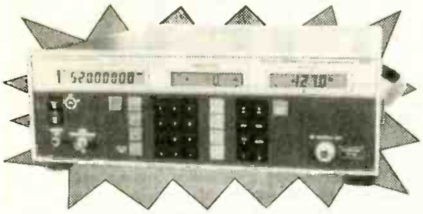
All Prices in U.S. $
Please include telephone/fax # with mail-in orders. Orders must be prepaid by guaranteed instrument.
Prices do not include shipping.
Please call us if you have any questions

(No catalog available yet!)

Manuals available at extra cost

Jan. 97

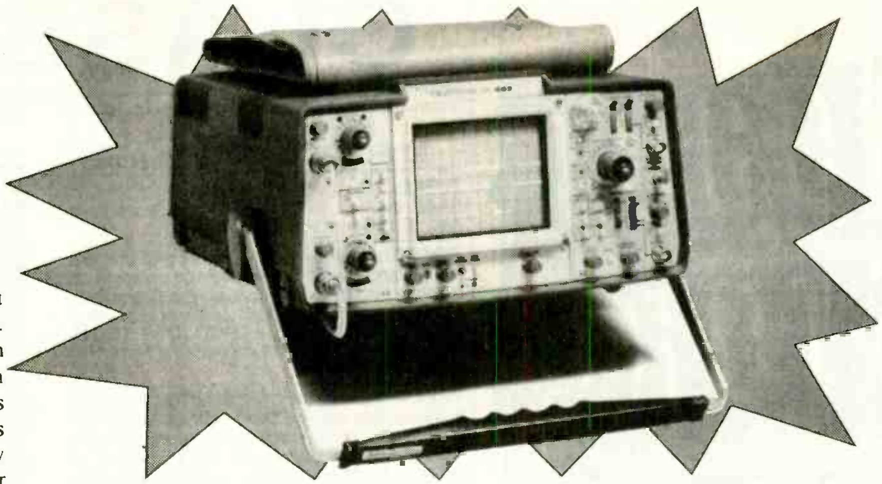
CIRCLE 312 ON FREE INFORMATION CARD



MARCONI SYNTHESIZED SIGNAL GENERATOR Model 2018

Freq. range 80Khz-520Mhz with calibrated output levels from -127dBm to +13dBm. Resolution 10Hz. It can be freq., phase or amplitude modulated from ext. or int. modulation sources. RF output resolution is 0.1dB, reverse power protection of up to 50W is possible without damage to the instrument. This instrument is microprocessor controlled and very easy to use, a must for any serious repair or development lab.

Price : $1750.00 Checked



TEKTRONIX 465M

Proof is in the pudding when it comes to this instrument's track record. There's no doubt, that popularity speaks many languages when speaking of the "465M". This excellent instrument continues the tradition of the standard 465 oscilloscope by adding useful features such as CH-1, CH-2 sum or difference, trigger view in any combination, alternate sweep and trace selection versatility. Many technicians dream of owning a quality 100-MHz oscilloscope, but funding rairly permits. Fortunately, we were recently able to aquire a limited supply of 465M-s in very good condition. Our LOW PRICES will likely permit "you" to own one of the best scopes anywhere the country. If your needs are current and action *swift* you too will be a member of a growing club!!!

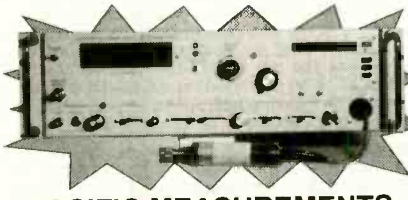
VERY GOOD CONDITION................$695.00

These instruments are fully checked. They are supplied with an original front panel cover and complete service manual.

MILITARY STANDARD D.C. GENERATOR

Superior QUALITY plus rugged design are features of this deluxe 2 cylinder 4 stroke gasoline generator. The control panel contains meters for voltage & current indication, main circuit breaker and voltage adjustment. Shielded wires and plugs comprise the RFI suppression ignition system eliminating most radio noise. These units are "new" in the original carton complete with operators manual and only require fuel and oil for operation; output voltage is adjustable approx. 10-32v (28v nom) @ 53.3A (1.5Kw) continuous duty load.

Price: $379.00 New in Orig. Carton.
You will be impressed!!!



PACIFIC MEASUREMENTS LOG/LIN RF PEAK POWER METER MOD 1018B

This rackmount digital meter measures RF power from 10 uW to 10 mW (-20 to +10 dBm). It covers the freq range of 0.1 to 18GHz. Maximum peak power input is 50mW, measurable pulse width from 0.35usec to CW. Frequency response of +/- 0.5 db from 100 MHz to 18 GHz. These units include opt 5 (IEEE-488) interface.

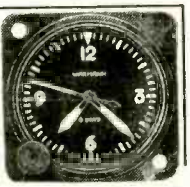
Price fully checked $1,285.00

Includes power head and internal calibrator.

PRC 25 - MILITARY TACTICAL TRANSCEIVER

Fabulous quality and design are standard in this 30Mhz-75.95 Mhz tactical transceiver.
Output power level from 1.1 - 2 watts, 150Hz squelch. The units we just received are reconditioned (newly painted) ready for issue and include the battery box. **Price: $245.00**

COLLECTOR ALERT - $39.00
8-DAY AIRCRAFT
CLOCK
1-7/8" dial



Great collectors item for the ham shack, fifties vintage funct/chkd.

-CROWN MODEL 7560 1KW PWR AMP. DC - 40KHz	$1,800.00
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-ROHDE & SCHWARZ SIG GENERATOR .4-484MHz	$ 750.00
-TEK FG504 FUNCTION GENERATOR (40MHz)	$ 875.00
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-TEK 465B 100mHz OSCILLOSCOPE	$ 895.00
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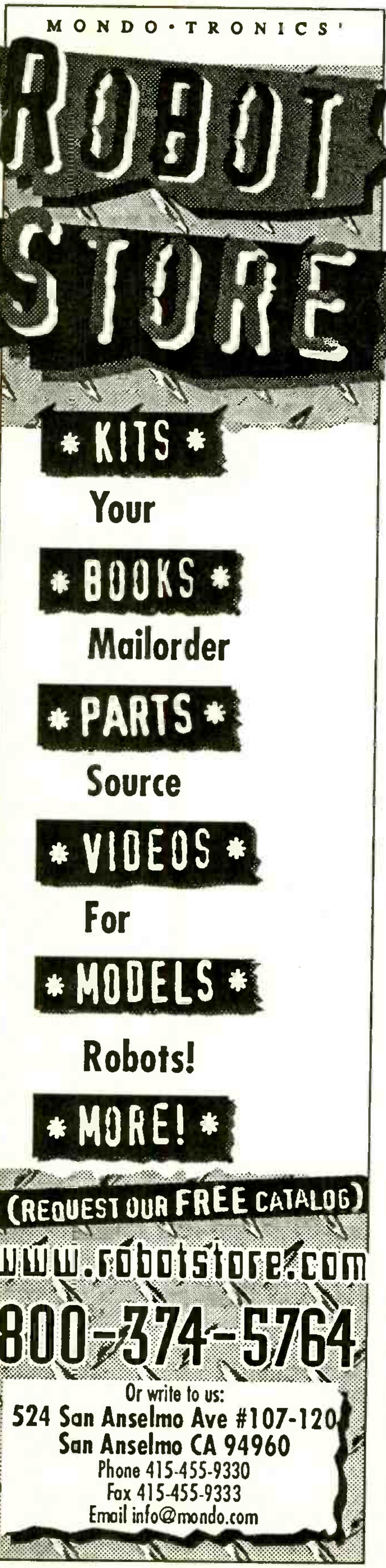

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MISCELLANEOUS ELECTRONICS FOR SALE

TUBES: "oldest", "latest". Parts and schematics. SASE for lists. **STEINMETZ,** 7519 Maplewood Ave., EN, Hammond, IN 46324.

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CABLE TV TURN-ON CHIPS

SUPER Cable TV "Test Chips". Provides full service activation. Excellent; Instructions & illustrations. **Jerrold Starcom:** DP(V)5..DP(V)7.. DPBB7..CFT-2000..CFT-2200 Series. **Pioneer:** BA-5000 thru BA-6700. **Pioneer: Custom Programmer** (Clears E2 & rewrites new I.D. codes). **Scientific Atlanta:** 8500 thru 8600. **Tocom:** 5503-VIP..5507. **Zenith:** ST-1000 thru ST-5612. **Call Now!! MASTER COMPONENTS. 1 (800) 233-0570.**

THE CABLE TV SUPER CUBE

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ATTN, cable box owners. Order your ID signal and bullet stopper before it's too late. Send $23.00 to **R.R. ENTERPRISE,** Box 3532, Easton, PA 18043.

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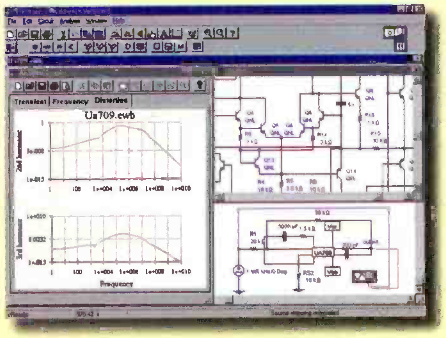

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PRO SCHEMATIC EDITOR	YES
HIERARCHICAL CIRCUITS	YES
VIRTUAL INSTRUMENTS	YES
ON-SCREEN GRAPHS	YES
ANALOG COMPONENTS	OVER 100
DIGITAL COMPONENTS	OVER 200
DEVICE MODELS	OVER 4,000
MONEY-BACK GUARANTEE	30-DAY
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DC OPERATING POINT	YES
AC FREQUENCY	YES
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FOURIER	YES
NOISE	YES
DISTORTION	YES

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Integrated Tool: Fully integrated schematic editing, SPICE simulation and waveform generation and analysis. Supports modifications to the circuit during simulation. Circuit analysis through virtual test instruments, or 6 analyses listed below.

Simulation Engine: Interactive 32-bit SPICE 3F5, enhanced with native-mode digital and mixed analog/digital support. Automatic insertion of signal translation interface. Supports multiple reuse of hierarchical blocks. GMIN stepping for better convergence. No preset limits on circuit size or complexity.

Schematic Capture: Click-and-drag interface, hierarchical workspace, automatic wire routing with [illegible] automatic reference designation [illegible] schematic size.

[illegible] instruments for quick and simple analysis. Six analyses for on-screen graphs and more [illegible] described below).

[illegible] All design information, including [illegible] configuration, SPICE parameters, setup and [illegible] of all models [illegible] a design file to [illegible] and reuse.

[illegible] export standard SPICE [illegible] with other simulators or to reuse existing design elements. Imports manufacturers models and netlists into reusable Electronics Workbench components. Exports to standard PCB layout packages such as OrCAD, Protel and Tango.

ANALYSES

DC Operating Point: Calculates DC operating point and reports voltage at each node.

Transient: Circuit voltages and currents over time at any number of nodes. Specify start and stop times.

AC Frequency Sweep: Small-signal gain and phase over range of AC frequencies at any number of nodes. Specify range, type (decade, octave or linear) and resolution (number of steps) of frequency sweep.

Fourier: Magnitude and phase of DC and Fourier spectral components of transient response. Specify fundamental frequency and an unlimited number of harmonics.

Noise: Resistor and semiconductor noise contribution reported as RMS sum. Specify device of interest, output and reference nodes, and range, type and resolution of frequency sweep.

Distortion: Small-signal steady-state harmonic and intermodulation products over a range of frequencies. Specify any number of nodes and sweep range, type and resolution. Optionally exclude devices on an individual basis.

VIRTUAL TEST INSTRUMENTS

Digital [illegible] AC [illegible] bel loss [illegible] d [illegible] Hz [illegible] Adjustable duty cycle, amplitude and DC offset. [illegible] through time [illegible] two digital cursors. Save data to ASCII file.

Bode Plotter: Plots magnitude and phase for a frequency sweep. Supports frequencies from mHz to GHz. Log or linear scales.

Word Generator: Acts as a digital stimulus editor to drive a circuit with up to 32K 16-bit words. Display and edit data as ASCII, binary or hex. Load, save, cut and paste words. Supports breakpoints and single step, burst and continuous modes. External trigger and data ready indicator for syncronization.

Logic Analyzer: Supports pre- and post-trigger. Internal or external clock, negative or positive edge. Clock qualifier to synchronize data. User-defined trigger patterns and trigger qualifier.

Logic Converter: Converts among gate, truth table and Boolean logic representations.

COMPONENTS

Sources: DC Voltage, DC Current, AC Voltage, AC Current, Voltage-Controlled Voltage, Voltage-Controlled Current, Current-Controlled Voltage, Current-Controlled Current, AM, FM, Vcc, Clock, Pulse-Width Modulated, Frequency-Shift Keying, Polynomial, Piece-Wise Linear Controlled, Voltage-Controlled Oscillator and Nonlinear Dependent

Basic: Resistor, Capacitor, Inductor, Transformer, Relay, Switch, Time-Delay Switch, Voltage-Controlled Switch, Current-Controlled Switch, Pull-Up Resistor, Variable Resistor, Resistor Pack, Polarized Capacitor, Variable Capacitor, Variable Inductor, Coupled Inductor and Nonlinear Transformer

Diodes: Diode, Zener Diode, LED, Shockley Diode, Diac, SCR, Triac and Full-Wave Bridge Rectifier

Transistors: NPN and PNP BJTs, N- and P-Channel JFETs, 3- and 4-Terminal Enhancement and Depletion N- and P-Channel MOSFETs

Analog ICs: 3- and 5-Terminal Opamps, Comparator and Voltage Regulator

Mixed ICs: A-to-D Converter, D-to-A Voltage and Current Converters, 555 Timer and Monostable

Logic Gates: AND, OR, NOT, NOR, NAND, XOR, XNOR, Tristate Buffer, Buffer and Schmitt Trigger

Digital: RS, JK, JK', D and D' Flip-Flops, Half and Full Adders, Multiplexer, Demultiplexer, Encoder and Decoder

Indicators: Bulb, Voltmeter, Ammeter, Probe, Raw and Decoded 7-Segment Display, Buzzer and Raw and Decoded Bargraph

Controls: Differentiator, Integrator, Gain Block, Transfer Function, Limiter, Multiplier, Divider and Summer

Other: Fuse, Lossy and Lossless Transmission Lines, Crystal, DC motor, Vacuum Tube and Buck and Boost Converter

74xx ICs: 7400, 7402, 7404, 7405, 7406, 7407, 7408, 7409, 7410, 7411, 7412, 7415, 7420, 7421, 7422, 7425, 7426, 7427, 7428, 7430, 7432, 7433, 7437, 7439, 7440, 7442, 7445, 7447, 7451, 7454, 7455, 7469, 7472, 7473, 7474, 7475, 7476, 7477, 7478, 7486, 7490, 7491, 7492, 7493

74xxx ICs: 74107, 74109, 74112, 74113, 74114, 74116, 74125, 74126, 74133, 74134, 74138, 74139, 74145, 74147, 74148, 74151, 74153, 74154, 74155, 74156, 74157, 74158, 74159, 74160, 74162, 74163, 74164, 74165, 74166, 74169, 4173, 74174, 74175, 74181, 74190, 74191, 74192, 74194, 74195, 74198, 74199, 74238, 74240, 74241, 74244, 74251, 74253, 74257, 74258, 74273, 74280, 74290, 74293, 74298, 74350, 74352, 74353, 74365, 74367, 74368, 74373, 74374, 74375, 74377, 74378, 74379, 74393, 74395, 74445, 74465, [illegible]

4[illegible] ICs: [illegible] 4008, 4011, 4012, [illegible] 4028, 4030, 4040, [illegible] 4069, 4070, 4071, 4073, 4081, 4085, 4086, 4107, 4019, 4024, 4027, [illegible] 4050, 4069, 4072, 4075, 4077, 4078, [illegible] 4503, 4512, 4516, 40103

MODELS

Digital: Models for ICs, Gates and Flip-Flops in HC totem-pole, HC buffer, HC open-drain, LS totem-pole, LS buffer, LS open-collector and LS open-collector buffer configurations

Diodes: Over 1,300 models for Diodes, Zener Diodes, LEDs, Shockley Diodes and Diacs from Motorola, General Instruments, International Rectifier, Zetex and Phillips

Transistors: Over 1,400 models for NPN and PNP BJTs, JFETs, MOSFETs, SCRs, Triacs and IGBTs from Motorola, National Semiconductor, International Rectifier, Toshiba, Harris and Phillips

Analog ICs: Over 1,200 models for Opamps, Comparators and Voltage Regulators from Motorola, Texas Instruments, Maxim, Elantec, Analog Devices, Zetex, Burr-Brown and Linear Technology

Other Models: a variety of Relays, Transformers, Vacuum Tubes, Transmission Lines and Crystals.

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