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Breakthrough wireless security system causes industry uproar...

Advanced 360° passive infrared alarm system offers features not found even in systems costing five times as much.

by John Lindner

If the predictions are true, the days could be numbered for traditional alarm systems. In a development which shocked industry insiders, Guardtech unveiled a new wireless security system which challenges even the most sophisticated alarms.

The system, called the Snitch, uses portable infrared motion detectors in conjunction with a base console and key chain remote to offer features never before available—even in systems costing thousands of dollars.

Ultimate protection.

The Snitch's microchip technology gives it the ability to provide superior security without the installation nightmare of traditional alarms. The three components of the Snitch communicate with each other using radio waves, so there are no cumbersome wires to bother with. The whole system can be installed by you in just minutes. What's more, the Snitch gives you the option of linking to a monitoring service—the same one used by systems costing up to \$10,000—for ultimate security.

Total flexibility. The Snitch covers up to 1,400 square feet. You can add up to three additional motion detectors for up to 6,000 square feet of protection. Plus, only the Snitch lets you adjust the scope of the infrared detection.

Using special blockers, you can adjust the area from 360° down to as low as 90°. The detector also has a built-in height adjustment.

Easy to use. The Snitch is one of the easiest systems to install and operate available. Simply plug it in and follow simple instructions—it sets up in minutes. Then you can arm or disarm by pushing a button on the key chain remote. No more dashing in and out before the alarm is activated—with the Snitch, you can turn it on or off from up to 100 feet, even through walls!

Complete security.

The Snitch also gives you the option of activating a 24-hour, professional monitoring service that will dispatch help when the alarm is tripped. The service is just \$12.95 a month with no long-term commitment.

HOW DOES THE SNITCH WORK?



The Snitch system consists of a passive infrared motion detector, a key chain remote and a base console. The motion detector picks up movement within a 1,400-square-

foot area and instantly reports to the base console. The base console sounds a loud siren, notifying you of the intrusion. It also has the option of triggering a call to a professional monitoring service. The alarm can be armed or disarmed with the push of a button on the remote, which has a 100-foot range. It can even transmit signals through walls so you can arm and disarm the system before you even step inside the door.

THE SNITCH

- World's first 360° portable motion detector.
- Use up to four motion detectors and eight remotes for 6,000 square feet of protection.
- Uses same monitoring services as systems that cost \$10,000.
- Arm, disarm and trip a panic alarm from up to 100 feet away.



THE SNITCH

VS. OTHER ALARMS

Compare the Snitch to other alarms. You'll find many advantages in addition to its portability and convenient operation.



Installation

- You can install the Snitch in just minutes.
- Security companies often charge high fees.

Value

- The Snitch is available at a very low price.
- The average alarm system costs \$1,385.

Monitoring expense

- Monitoring is \$12.95 with the Snitch with no long-term commitment.
- Monitoring averages \$22.95 and requires a long-term agreement.

Protection

- The Snitch's 360° passive infrared motion detector can be placed anywhere—even the room you are sleeping in.
- Most motion detectors have 90° passive infrared detection that must be turned off in the room you sleep in.

Ability to expand

- With the Snitch, use up to four motion detectors and eight remotes with one base console.
- Traditional alarms require professional installation to expand their coverage.

Try it risk-free. The Snitch is backed by Comtrad's exclusive risk-free home trial. Try it and if you're not totally satisfied, return it within 30 days for a full "No Questions Asked" refund. It also comes with a one-year manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

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MAY 1995

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In today's economic environment, saving money is more important than ever. And the state of the world's ecological environment makes conserving energy another important consideration. You can save money and protect the environment at the same time by choosing and using "green" computers and peripherals. The Environmental Protection Agency (EPA) estimates that PC systems now account for more than 5% of total U.S. electrical power consumption, and that figure continues to increase rapidly. Computer manufacturers have tried to stem the tide, not by selling fewer systems, of course, but by creating energy-saving computer systems that use little or no power when not in active use. PCs and peripherals that meet the EPA's Energy Star guidelines can save you money, and are more ecologically sound than traditional equipment. Here's a close-up look at those guidelines, and what goes into a green PC.

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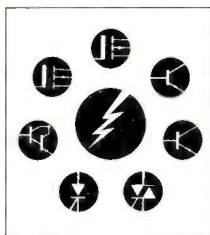
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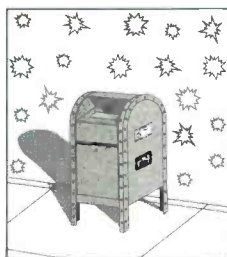
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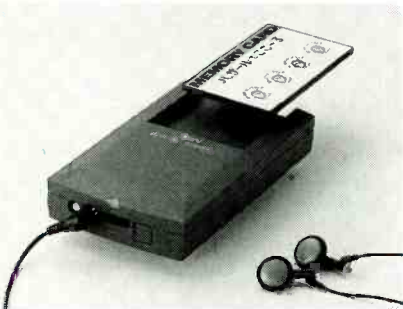


A review of the latest happenings in electronics.

Silicon audio player

NEC Corporation has developed a portable music player that reproduces compact disc-quality sound with instant random access from audio data stored on a semiconductor flash-memory card. Silicon Audio is more compact and weighs less than standard cassettes or digital audio tape, and it requires no moving parts to be played. That eliminates unwanted vibrations and jumping problems that plague compact disc, and tape playback systems.

The memory cards are the size of credit cards. The prototype unit can compress a 20-kHz, 770-kilobyte-per-second audio signal to one-eighth of its uncompressed length. This permits 24 minutes of recording from a 23-megabyte memory card.



A SOLID-STATE AUDIO PLAYER based on flash memory cards from NEC will store and play back audio with the quality of a compact disc.

After encoding and compressing the audio signals, the Silicon Audio player records the signals on semiconductor memory chips on the memory card. Data decoding and playback are in real time.

Silicon Audio combines Moving Picture Experts Group (MPEG) and audio-decoding large-scale ICs, developed by NEC, with standard memory card ICs to achieve what NEC claims is superior wideband audio-signal compression and reproduction that will match the quality of CD sound.

According to NEC, the semiconductor memory card can also store text, still pictures, and moving images. NEC plans to introduce the Silicon Audio player within two years.

Approaching world's most powerful magnet

Researchers at Los Alamos National Laboratory in New Mexico have successfully tested two of nine coils of a multiton magnet. When completed later this year, the magnet will be the most powerful magnet of its kind in the world. Recent tests by the laboratory have validated the magnet coil design and manufacturing procedures.

The tests also demonstrated that the coil material will reliably and safely withstand the electrical and mechanical stresses of the new 60-tesla magnet. A 60-tesla magnetic field is 1.2 million times the strength of the Earth's magnetic field. This value is nearly one-and-a-half times stronger than the field of its closest rival, a magnet at the University of Amsterdam.

The 60-tesla magnet will be an important resource at the new National High Magnetic Field Laboratory, located at Florida State University in Tallahassee. The laboratory is sponsored by a consortium made up of Florida State University, the University of Florida, and Los Alamos National Laboratory. It is financed by the National Science Foundation.

Scientists make use of high magnetic fields to reveal the fundamental electronic and optical properties of matter, learn how materials behave in high magnetic fields, and study the makeup of atomic and molecular material. Higher magnetic fields lead to more comprehensive data.

The magnet will become a research tool that will fill the void between two existing extreme magnetic field conditions: large fields

that last only microseconds or smaller fields that can be sustained for days. The new magnet will be able to produce a steady 60 tesla for a tenth of a second; it will also be able to produce pulsed and variable fields.

The magnet, designed by Los Alamos scientists, consists of nine nested coils that are mechanically independent. The copper-alloy coils not only are improvements on previous magnetic coils, but they have also solved earlier insulation and heat dissipation problems that have occurred in high-field, pulsed magnets.

The coils are combined electrically into three groups and will be pulsed sequentially to reduce heating and allow rapid cooling and turnaround time. This configuration will allow researchers to pulse the magnet again in less than an hour after it has been a pulsed.

The magnetic field behavior can be customized and optimized for different experiments. The designers report that their design concept can be expanded to generate 100 tesla without having the magnet destroy itself.

The longer high-field pulse length and relatively large sample chamber require high energy—more power than can be supplied by a commercial power grid. A 1.4-billion-watt electrical generator, intended for a nuclear power plant in Tennessee that was canceled, will power the magnet.

IBM sets patent record

IBM was issued more U.S. patents in 1994 than any single company has ever received in a calendar year. According to IFI/Plenum Data Corporation, IBM received 1298 patents in 1994, topping its closest competitor, Canon of Japan, by 199 patents. IBM also ranked first in U.S. patents awarded in 1993, the first year since 1985

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VIDEO NEWS

What's new in the fast-changing video industry.

DAVID LACHENBRUCH

• **DVD coup.** Sony and Philips, proprietors of basic patents on the compact disc and its variations, including CD-ROM, were shocked by an apparent coup d'etat when major Hollywood and consumer-electronics interests backed a competing proposal for a digital video disc (DVD) system over their proposal, which had generally been considered the favorite. Working quietly behind the scenes, Toshiba and Time-Warner mustered the support of MCA, MGM/UA, and Turner Home Entertainment (in addition to Warner Brothers) from the movie-making community, and Matsushita (Panasonic), Thomson Consumer Electronics (RCA and GE), Pioneer, Hitachi, JVC, and Nippon Columbia (Denon) from among consumer-electronics manufacturers—in addition, of course, to Toshiba.

Both the Sony-Philips and the Toshiba-Time Warner systems were designed to extend the capabilities of the 5-inch compact disc to accommodate full-length movies in digital storage with quality exceeding that of the laserdisc. Both formats were carefully screened by Hollywood studios as the potential successor to tape as the chosen format for prerecorded entertainment—particularly movies. However, the chosen format also has implications for other types of storage, particularly as a CD-ROM with five to seven times the capacity of today's version. As reported here (*Electronics Now*, March 1995), the Sony-Philips proposal envisioned a single-sided, high-density disc, 1.2 mm thick, capable of storing 3.7 gigabytes of data and claimed to be capable of holding a 135-minute movie. There is the possibility of doubling the capacity some time in the future by switching to a dual-layer disc, using a reflective-transparent coating for the top layer, with the focus of the playback laser variable to read either the top layer or the bottom layer recording.

The Winner? Sony admittedly



The single-sided Sony-Philips digital video disc (DVD), pictured above, faces stiff competition from the recently unveiled Toshiba-Time Warner double-sided version.

was taken by surprise when the competitive system was presented—at simultaneous news conferences in Los Angeles, Tokyo, and Osaka. The Toshiba-Time Warner disc demonstrated at all three locations was a double-sided disc. Its two 0.6mm sides, laminated together, had a data capacity of five gigabytes per side, for a total of ten gigabytes, designed to hold a 135-minute movie on each side, or various combinations—for example, a movie on one side, a video game based on the movie on the other side.

Taken aback, Sony first said the system was more difficult to produce than the 1.2mm disc. However, Warner said that it had already produced 50,000 discs in trial runs at its CD-pressing facility, and the estimated cost in mass production would be about 25% higher than an audio CD. Toshiba and Time Warner said that the additional capacity of their disc over the Sony-Philips version would make possible higher quality recordings, particularly of movies that are difficult to digitize because of rapid scene changes and fast action.

The Toshiba disc has an average playback rate of 4.94 megabits per

second (Mbps) for a 135-minute movie. That can be extended to 142 minutes at a lower rate of 4.69 Mbps. In either case, it can accommodate Dolby AC-3 digital audio, three language channels, and four subtitle channels. As demonstrated at the news conferences side-by-side with laserdisc, the DVD images were noticeably better—sharper, with more subtle texture gradations and far better color. As shown alongside the same movie played back from a digital D-1 broadcast videotape recorder, the difference was indistinguishable to observers.

Warner says that it will produce movies on the new format for sale at the same price as it does videocassette movies, and both Matsushita and Thomson said that they plan to introduce players in the second half of 1996 to retail at about \$500. The players will be "backward compatible" with audio CDs—that is, they will be able to play audio CDs, but the digital video discs will not be playable on today's CD players. Movie interests forecast that the launch will be accompanied by 250 movie titles.

The system obviously can't be a
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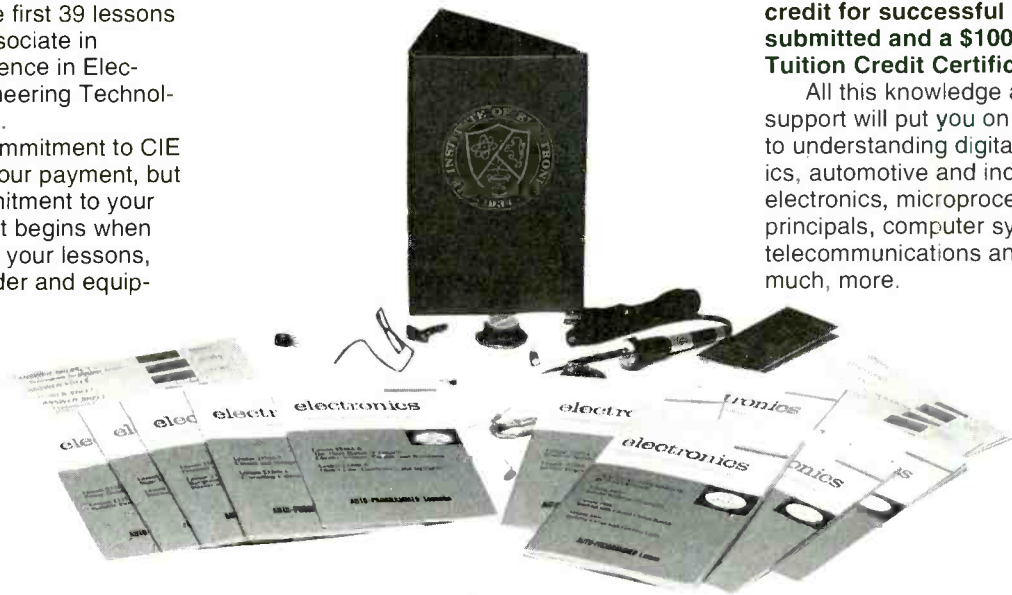
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Q & A

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ONE FOR THE BIRDS?

I want to build an incubator for hatching birds' eggs. This requires that the eggs be gently moved about once an hour. I have a reversible AC motor, geared down to 1 rpm. I need a circuit to run the motor forward for 10 seconds, wait an hour, run it backward for 10 seconds, wait, run it forward again, and so on. Can you help?—R. Weaver, Albuquerque NM.

Actually, this sounds like a job for a stepper motor and a micro-controller, but since you already have the reversible AC motor installed, try the circuit in Fig. 1.

One cycle every two hours is much too slow for an ordinary RC oscillator; it would require an enormous (and unstable) capacitor. Accordingly, the circuit has a 4060 CMOS long-period timer, which consists of an oscillator plus a series of binary counters that divide the frequency by 2, 4, 8, and so on up to 16,384. The oscillator runs at a comfortable 2 hertz (2 cycles per second), controlled by a capacitor and two resistors, and the binary counter divides this down to produce a square wave that has only one cycle every 2 hours, as well as another one that oscillates twice as fast (see Fig. 2).

The faster of the two square

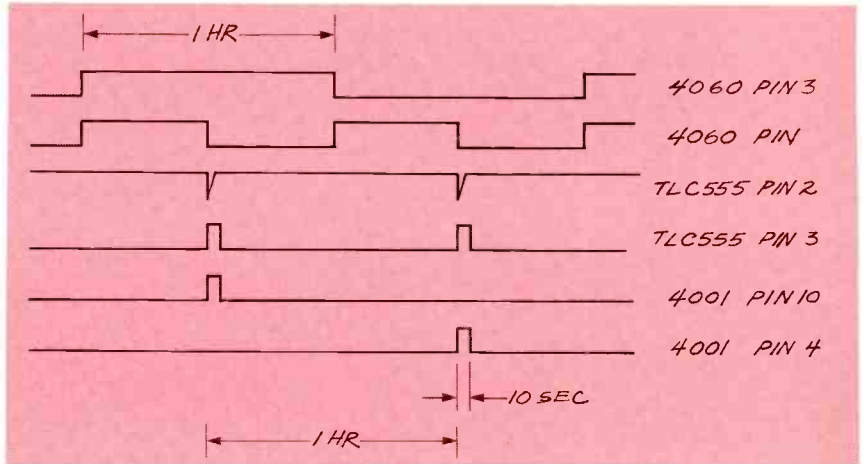


FIG. 2—WAVEFORMS in the circuit of Fig. 1 (not to scale).

waves determines when the motor runs, and the slower one determines its direction. Here's how it's done: First, the faster square wave goes through a capacitor, resistor, and diode, which convert it into a narrow negative-going pulse that occurs once per hour. Then the 555, connected as a monostable, stretches the short pulse so that it is 10 seconds long (the length of time the motor should run). Logic gates then steer that pulse to one of two relays so that the motor runs either forward or backward, depending on which state the slow square wave is in at the time. Because the forward and reverse pulses are generated by the same 555 circuit, they are the same

length—important so that the reverse cycle will exactly undo the motion of the forward cycle. Wiring the relays to the motor is left up to you. Good luck with your eggs.

TONE DECODER

I am hoping that you or one of your readers may have a cross reference and/or pin assignment for an SSI 20C90 DTMF chip.—J. Lubben, Deer Park, TX.

DTMF (dual tone multi frequency) signals are the tones used for telephone dialing; they are also used for other purposes, such as control of ham radio repeaters. Each tone consists of two sinewaves transmitted simultaneously, one indicating the row on the keypad and one indi-

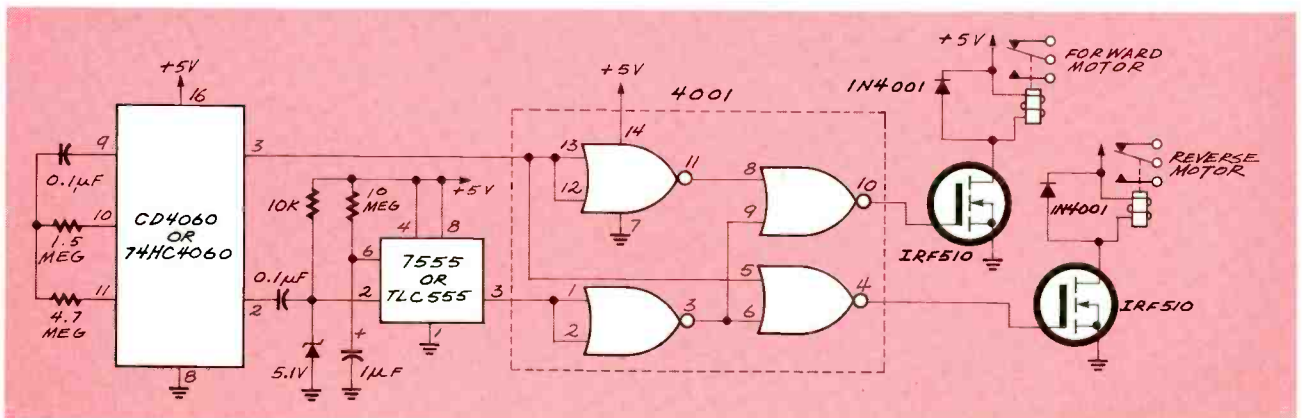


FIG. 1—CIRCUIT CONTROLS FORWARD AND REVERSE MOTORS to rock eggs in incubator. Every hour, one motor runs for 10 seconds.

1209 Hz	1336 Hz	1477 Hz	1633 Hz	
1	2	3	A	697 Hz
4	5	6	B	770 Hz
7	8	9	C	852 Hz
*	0	#	D	941 Hz

FIG. 3—EACH DTMF SIGNAL consists of two sinewaves transmitted simultaneously, one indicating the row on the keypad and one indicating the column.

cating the column, as shown in Fig. 3. For example, the digit 5 is transmitted as 770 Hz and 1336 Hz. The codes in the rightmost column (A, B, C, and D) are not normally available on consumer equipment.

SSI (Silicon Systems, Inc.) makes ICs that recognize and decode DTMF tones. Several SSI chips (though not this particular one) are described in *The ARRL Handbook for Radio Amateurs*, published by the American Radio Relay League, Newington, CT 06111—a book every electronic tinkerer should have. For data on the 20C90, you can write to SSI at 14351 Myford Road, Tustin, CA 92680.

ELECTRONIC CLOCKWORK?

In 1977 I assembled a 6-digit LED clock kit. Now, 17 years later, the clock has failed, and I can't get a replacement for its CT7001 clock chip. Could you direct me to plans for a similar clock kit that is still available?—P. Smith, Thousand Oaks, CA.

Certainly. LED clock kits and parts are available from Jameco, 1355 Shoreway Road, Belmont, CA 94002-4100. Although their catalog does not list a CT7001, they'll know of a replacement if one exists.

METER SHUNTS

What type of shunt do I need to measure 50 amperes on a 50-microampere meter, and where can I get one?—Steve Baumfalk, Norfolk, NE.

A shunt is a small resistor connected across a current meter to

make it read a higher range of current than it normally could. For example, a 1-milliamperere meter can read 100 milliamperes full scale with the proper shunt (see Fig. 4).

To calculate the resistance of the shunt, you have to know the resistance of the meter. You can measure this with an ohmmeter, but make sure the ohmmeter doesn't send too much current through the

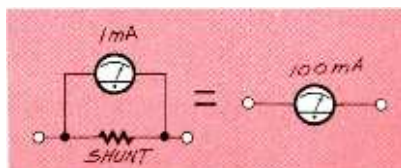


FIG. 4—A SHUNT is a resistor connected across a current meter to make it read a higher range of current than it normally could.

meter movement that you're testing. For best results, use a digital multimeter (DMM) set to its 20-kilohm or higher range, and switch to lower ranges only if necessary. You'll find that the resistance of your 50-microampere meter is probably a few thousand ohms. Then you can find the shunt resistance:

$$R_{\text{SHUNT}} = (R_{\text{METER}} \times I_{\text{METER}}) / (I_{\text{TOTAL}} - I_{\text{METER}})$$

The current can be in amperes, milliamperes, or microamperes, as long as you use the same units in all three places in the formula. For example, if you had a 1-milliamperere meter with a resistance of 1000 ohms, and you wanted to make it read 100 milliamperes full-scale, you'd plug in the following values:

$$\begin{aligned} R_{\text{SHUNT}} &= (1000 \Omega \times 1 \text{ mA}) / (100 \text{ mA} - 1 \text{ mA}) \\ &= 1000/99 \\ &= 10.1 \text{ ohms} \end{aligned}$$

A 10-ohm resistor will do just fine; in general, it's sufficient to get within a few percent of the correct value.

Now back to your problem. Yours is a special case because you want a million-to-one change of scale (50 amps to 50 microamps). Suppose the resistance of your meter turns out to be 6000 ohms. Then you'll calculate as follows:

$$\begin{aligned} R_{\text{SHUNT}} &= (1000 \Omega \times 50 \mu\text{A}) / (50,000,000 \mu\text{A} - 50 \mu\text{A}) \\ &= 50,000/49,999,950 \\ &= 0.001 \text{ ohm} \end{aligned}$$

They don't make resistors that

Continued on page 93

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LETTERS

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MILLIOHM TESTER MODIFICATIONS

I read the article "Build this Milliohm Tester" (*Electronics Now*, February 1995) and I found some possible problems with the circuit and would like to suggest ways to simplify it.

Approximating a current source with a voltage source in series with a resistor will allow the current through the resistor under test to vary as a function of the unknown resistor's value. Although that reference current error will be small for small values of R_x , I would suggest a three-terminal voltage regulator as a current source, as shown in Fig. 1.

IC1 is an ECG956 (or equivalent) positive adjustable voltage regulator that has a 1.2 voltage reference between its OUT and ADJ terminals. A 12-ohm resistance (R_1 and R_2) connected between IC1's OUT and ADJ terminals sets the regulator's output current to 100 milliamperes. To calibrate the circuit, connect a digital ammeter in place of R_x and adjust R_2 to get a current of 100 milliamperes.

I have another criticism of the article's circuit: Never connect the current source and voltage measurement leads together before con-

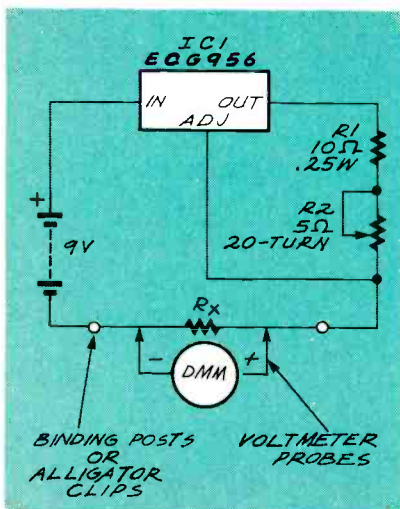


FIG. 1.—A THREE-TERMINAL voltage regulator acts as a current source in this circuit.

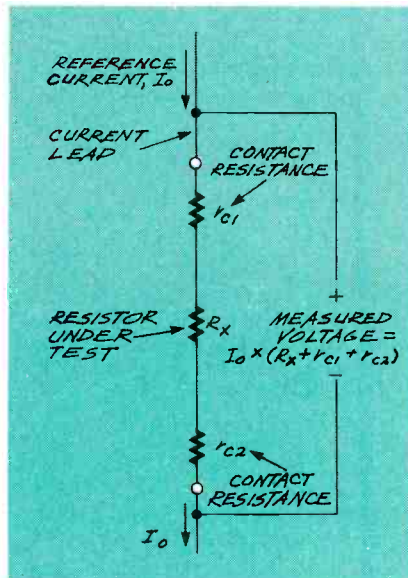


FIG. 2—TYING THE VOLTAGE and current leads together adds contact resistance to the measurement.

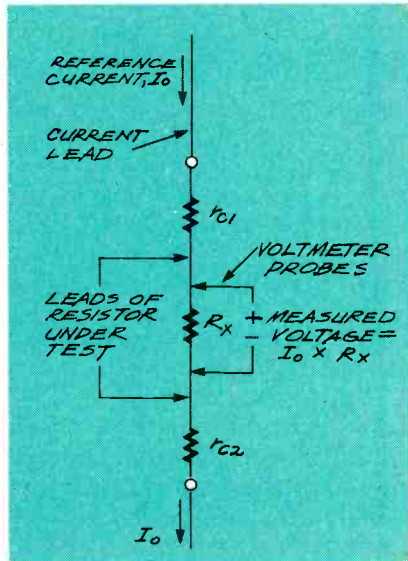


FIG. 3—A TRUE FOUR-WIRE resistance measurement hookup.

necting any device under test in any kind of four-wire resistance measurement. If you do, you'll be measuring the resistances of the contacts between the current leads as well as the resistance under test. This is shown in Fig. 2.

Instead, connect the current source and voltage measurement

leads separately to the leads of the resistor under test, as shown in Fig. 1. That avoids measuring the voltage drop across the current lead's contact resistance, as shown in Fig. 3. (Contact resistance of the voltmeter probes is not measured because a digital multimeter draws no current.)

Note also that the circuit shown in Fig. 1 requires fewer parts than that in the published article. Moreover, a power switch is not needed because the Fig. 1 circuit draws no current when there is no R_x connected.

GARY TONG
White Deer, PA

SIGNAL THEFT

Thank you for publishing a fine electronics magazine. I enjoy the wide editorial coverage of the electronics industry.

I'm writing in response to the "Signal Theft" article (January 1995). Scrambling and descrambling techniques are of great interest to me. Although the article was good, I believe that there are many sides to the issue.

First, consider cable TV as a utility; it is a monopolistic one at that. I pay my local cable-TV provider to deliver non-premium service to a terminal on the back of my house. Their only obligation beyond that is to deliver a clear signal.

Second, look at the other utilities that service my house: electric, water, and telephone. The electricity and water are metered and I pay for the quantity I use. However, once all three of these services are installed in my house, I can do whatever I want with them as long as I don't interfere with their delivery. I can even choose not to use any of them and seek alternative sources.

For example, I can use the electricity as is, transform it up or down, rectify it or connect a wire so my neighbor can use it. Similarly, I can use the water just as it enters the house or I can heat it, cool it, freeze

it, or give it away. As for the telephone service, I can speak over the phone or send data over it with a modem or fax. I can even add extra phones or answering machines.

The point is, if I have paid for a service to be delivered to my house, I believe that I should be able to do whatever I please with that service in the confines of my home, as long as it doesn't interfere with the service's distribution.

I don't think of cable-TV signals as different from these other services. If the cable company does not take steps to limit or control the incoming signal with its equipment, I should be able to do whatever I want with the signal in my home. Yes, even descramble it if I had the equipment and were inclined to do so.

Satellite program services have taken a similar approach; they have added some sophisticated techniques to their VideoCypher scrambling method. No "pirates" have been successful in breaking the VCRS board to receive the television audio from it without subscribing, and satellite piracy has been virtually eliminated. If cable-TV distributors are to achieve the same kind of control, extensive equipment upgrades will be required.

I do not think that we will see that happen as the competitive threat of the small-dish TVRO industry continues to grow. Programming bargains are becoming more widely available as the competition heats up. That will benefit us TVRO owners. (Yes, I have both cable and a satellite dish.)

The cable TV companies will receive their comeuppance for their lousy service, poor quality signal, and indiscriminate and frequent rate increases when the TVRO industry increases its offerings.

The operative word in my examples is *ownership*. Once a service enters my home, ownership is transferred to me so that I can use that service as I please. That includes altering the state of the service or product to my preferences. After all, who would want to take a cold shower in the dark and have the only phone in the house ringing in another room?

J. DARRELL GAMMON
Cary, NC

TV-SERVICE TIP

I service television sets for a living, and I've found a way to check for open electrolytic capacitors.

My oscilloscope has a 1-kHz squarewave output jack for calibration. Because it has an output impedance of about 1500 ohms, a capacitor connected between it and ground will cause integrate the signal, depending on the value of the capacitor.

I connect my oscilloscope probe to the jack and use several test

leads, one from the jack and one from ground to find defective electrolytic capacitors. Any capacitor with a value above about 10 μ F will show up as a straight line trace (as will a short circuit, so be careful).

A good 1- to 10- μ F capacitor will show up as a triangle waveform. An open capacitor will, however, not show any pattern, just add noise to the square wave, or give a reduced amplitude squarewave, depending on the resistance in parallel with the capacitor.



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While this method is not infallible, it can save you the trouble of removing capacitors from a circuit and testing them individually.

ARDELL FAUL
Spokane, WA

IN DEFENSE OF CSICOP

The letter from Benson Boss (*Electronics Now*, January 1995) condemning the Committee for the Scientific Investigation of Claims of the Paranormal (CSICOP) requires an answer. I will take on his points one by one:

1. He says that CSICOP condemns before investigating. Can he give me an example of that? CSICOP has investigated countless claims of paranormal events. In many cases, the claims have absolutely nothing but anecdotal evidence to support them.

Plenty of television talk shows provide a large audience for people who want to make fantastic claims. I certainly don't want CSICOP to join that parade. Just remember that the second and third words in CSICOP's title are "scientific investigation."

Mr. Boss claims that the committee picks on weak, absurd, and vulnerable reports of the paranormal. That probably represents most paranormal claims. Does he know about any paranormal event that CSICOP refuses to explore be-

cause that event could possibly be real? I'm sure CSICOP will pay particular attention to any paranormal claim that seems to be truly remarkable.

Mr. Boss condemns CSICOP for demanding physical evidence to substantiate claims. No one who believes in the scientific method should ever settle for less. Anyone can make up a fantastic story. No organization could possibly investigate every idiotic claim made in a world that does not seem to have a shortage of crackpots.

Finally, Mr. Boss believes that it is professors, intellectuals, and scientists (the sort of people who make up CSICOP) who prevent the introduction of any fundamentally new ideas in politics, religion, medicine, and science. Well, just who *has* made the major contributions in those areas?

The readers of *Electronics Now* are interested in electronics. There is no doubt that the incredible advances being made in that field are being made by just the kind of people Mr. Boss thinks are too narrow-minded to achieve such accomplishments.

Everyone interested in learning about CSICOP should read its journal, *Skeptical Inquirer*.

RICHARD W. STICKA
Yorkville, IL

Continued on page 93

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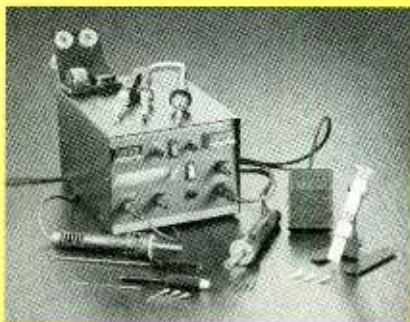


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The soldering iron is perhaps the most important tool for assembly and repair work in electronics. The basic soldering iron can tackle nearly any job involving common leaded components—not only assembly and installation work, but disassembly and repair work as well.

In skilled hands, no work with leaded components is too delicate for an ordinary soldering iron. But experience is the only way to learn how long to hold an iron in place and how much solder is sufficient.

Disassembly work can also be done with a soldering iron and either a plunger-type "solder sucker" or a piece of desolder braid. Most hobbyists are familiar with the manually operated plunger-type solder suckers that must be cocked before use. After a solder joint is melted with an iron, the sucker is placed over the joint, and a trigger is pressed that releases the spring-loaded plunger and, if everything goes right, the solder is sucked out of the joint.

Because solder suckers are difficult to operate effectively, many people prefer to use desoldering braid. Desoldering braid is placed over a solder joint, and is heated along with the solder. As the solder melts, the braid soaks it up. After the solder has been removed from all of an IC's pins, the part can usually be removed from the board fairly easily.

Unlike through-hole compo-

nents, surface-mounted components usually require specialized tools. Some surface-mount work can be done with a regular soldering iron, but not much. For example, disassembly or repair work on surface-mount components is next to impossible with a regular iron, because surface-mount components must be removed by simultaneously melting all solder joints and lifting the part off the board. There is no way to effectively heat all of an IC's pins at once with an ordinary soldering iron.

Surface-mount assembly and repair work requires special tools: tools to dispense special solder, others to melt it, and yet others to remove a part already soldered in place.

The SMD-250

The *SMD-250* from Automated Production Equipment Corporation (A.P.E., 142 Peconic Avenue, Medford, NY 11763, 516-654-1197) could be the last piece of soldering equipment you'll ever need. The SMD-250 is a professional-quality tool that includes all of the features normally required for working with both through-hole and surface-mount components.

The unit is somewhat like an erector set in that many different tips and attachments can be interchanged to perform any soldering or desoldering task. All tips are sensor-driven so that the unit can display the actual tip temperature.

The SMD-250's thermal quad-pack tweezer with interchangeable tips allows the quick removal of all kinds of surface-mount devices. The tweezer handle is basically two soldering irons joined at a hinge that allows a surface mount device to be grabbed, heated, and removed from the board with one hand. Tips for the tweezer handle range from simple chopstick-like ones that can grasp a surface-mount capacitor or resistor, to square-shaped tips of different sizes that can slip over a PLCC (plastic leaded chip carrier). The tips tighten when the handle is squeezed, and heat all the pins at once—the part then lifts right off the board. Precise temperature control targets the heat to the leads without damaging the part or the board.

A static-dissipative solder extractor can remove solder from leaded components. The solder extractor is basically a soldering iron with a hollow tip. The tip is pressed over the end of a lead on the solder side of a PC board. Once the solder melts, the user can press a trigger that activates a vacuum pump within the SMD-250. That sucks the solder out of the joint, freeing the lead. The procedure must be repeated for each pin of a conventional IC before the part can be removed. The solder extractor can be used to remove any type of leaded component from a PC board. The sensitive tip responds to changes in temperature quickly, even when it is used on multilayer boards.

The SMD-250 also contains a high-efficiency lightweight soldering iron for use with both through-hole and surface-mount applications. The iron is temperature-controlled. A variety of interchangeable tips are included with the iron.

The SMD-250 also has a built-in epoxy/solder paste dispenser that can apply consistent deposits of the paste. Paste is pumped out of a dis-

Continued on page 92

New device turns any electrical outlet into a phone jack

Engineering breakthrough gives you unlimited phone extensions without wires or expensive installation fees



By Charles Anton

You don't have to have a teenager to appreciate having extra phone jacks. Almost everyone wishes they had more phone jacks around the house.

When I decided to put an office in my home, I called the phone company to find out how much it would cost to add extra phone jacks. Would you believe it was \$158?

No more excuses.

Today, there are a thousand reasons to get an extra phone jack and a thousand excuses not to get one. Now an engineering breakthrough allows you to add a jack anywhere you have an electrical outlet. Without the hassle. Without the expense. And without the miles of wires.

Like plugging in an appliance.

Now you can add extensions with a remarkable new device called the Wireless Phone Jack. It allows you to convert your phone signal into an FM signal and then broadcast it over your home's existing electrical wiring.

Just plug the transmitter into a phone jack and an electrical outlet. You can then insert a receiver into any outlet anywhere in your house. You'll be

able to move your phone to rooms or areas that have never had jacks before.

Clear reception at any distance. The Wireless Phone Jack uses your home's existing electrical wiring to transmit signals. This gives you sound quality that far exceeds cordless phones. It even exceeds the quality of previous devices. In fact, the Wireless Phone Jack has ten times the power of its predecessor.

Your range extends as far as you have electrical outlets: five feet or five hundred feet. If you have an outlet, you can turn it into a phone jack—no matter how far away it is. The Wireless Phone Jack's advanced companding noise reduction features guarantee you crystal-clear reception throughout even the largest home.

Privacy guarantee.

You can use The Wireless Phone Jack in any electrical outlet in or around your home, even if it's on a different circuit than the transmitter. Each Wireless Phone Jack uses one of 65,000 different security codes. You can be assured that only your receiver will be able to pick up transmissions from your transmitter.

Is the Wireless Phone Jack right for you?

The Wireless Phone Jack works with any single-line phone device. Almost anyone could use it, especially if...

- **Few jacks.** You want more phone extensions without the hassle and expense of calling the phone company.
- **Bad location.** You have jacks, but not where you need them most, like in the kitchen, garage, home office or outside on the deck.
- **Renting.** You want to add extensions, but you don't want to pay each time you move.
- **Other phone devices.** You have an answering machine, modem or fax machine you want to move to a more convenient place.

The Wireless Phone Jack System

consists of a transmitter (right) and a receiver (left). One transmitter will operate an unlimited number of receivers.



Unlimited extensions—no monthly charge. Most phone lines can only handle up to five extensions with regular phone jacks. Not with the Wireless Phone Jack. All you need is one transmitter, and you can add as many receivers as you want. Six, ten, there's no limit. And with the Wireless Phone Jack, you'll never get a monthly charge for the extra receivers.

Works with any phone device.

This breakthrough technology will fulfill all of your single-line phone needs. It has a special digital interface for use with your fax machine or modem. You can even use it with your answering machine just by plugging it into the Wireless Phone Jack receiver.

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To introduce this new technology, we are offering a special factory-direct package. For a limited time, the transmitter is only \$49. One transmitter works an unlimited number of receivers priced at \$49 for the first one and \$39 for each additional receiver. Plus, with any Wireless Phone Jack purchase, we'll throw in a phone card with 30 minutes of long distance (a \$30 value) for only \$9.95!

Try it risk-free. The Wireless Phone Jack is backed by Comtrad's exclusive 30-day risk-free home trial. If you're not completely satisfied, return it for a full "No Questions Asked" refund. It is also backed by a one-year manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

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The Wireless Phone Jack lets you add a phone, modem, fax machine or answering machine almost anywhere.

May 1995, Electronics Now

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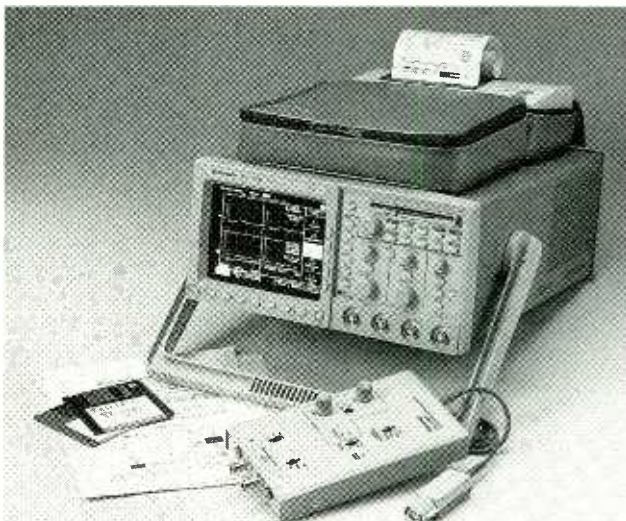
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The TDS 400A series of three digitizing storage oscilloscopes from Tektronix offer operating bandwidths from 200 to 400 MHz and sampling rates from 2.5 samples per second to 100 megasamples per second. The oscilloscopes are capable of making the electrical and physical measurements required for a range of applications from biophysical research, medical research, and mechanical analysis to high-voltage equipment.

Signal conditioning with 1.5 % accuracy is offered. An extended record length of 120 kilobits per channel allows researchers to capture hours of complex, slow-varying waveforms. When teamed with the ADA400A differential preamplifier, the instruments' 10-microvolt sensitivity can analyze extremely small amplitude signals. A HiRes mode extends vertical dynamic resolution to 12 bits, even on its single-shot signals.

Both TDS400A instruments feature an easy-to-use graphical user interface (GUI) and waveform zoom functions for efficient handling, viewing, and management of complex waveform data. The GUI



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and 25 automatic measurements are standard. A Fast Fourier Transform (FFT)/math option permits the harmonic analysis of signals in the frequency domain. An optional floppy-disk drive permits data and waveforms to be saved for further processing to document the results of acquired measurements.

Specialized signal-conditioning accessories supplement the personal lab scopes' capabilities. The ADA400A differential preamplifier makes 10-microvolt sensitivity possible and the P5200 high-voltage differential probe permits a TDS 400A to make safe and accurate measure-

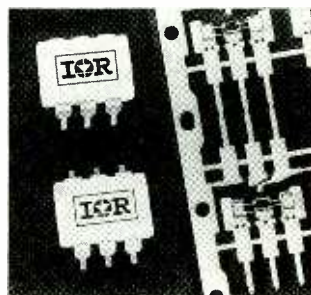
ments at voltage levels up to 1300 volts.

The TDS 410A two-channel model has a base price of \$4950. There are two four-channel models: the 200-MHz TDS 420A has a base price of \$6295, and the 400-MHz TDS 460A has a base price of \$7685. The ADA 400A differential input preamplifier is priced at \$895, and the P5200 high-voltage differential probe is priced at \$399.

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example, the PVT412L includes an active, current-limiting circuit conforming to FCC Part 68 and other regulatory agency current-surge requirements when overvoltage protection is provided. The PVT412 does not include current-limiting circuitry, but offers lower on-state resistance. The relays permit ± 400 -volt AC peak or DC switching at up to 140 milliamperes in AC mode and 210 milliamperes in DC mode.



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Series PVT412 relays are packaged in six-pin, molded DIP packages with either thru-hole or "gull-wing" surface-mount terminals. They are available in standard (50-count) plastic shipping tubes or on tape-and-reel, priced at \$1.40 each in 25,000 quantities. **International Rectifier**
233 Kansas Street
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Phone: 831-322-3331
Fax: 310-322-3332

PHOTOVOLTAIC RELAY. The PVT412 Series of photovoltaic relays from International Rectifier are single-pole, normally open, solid-state relays that can replace electromechanical relays in many applications.

Each includes a power MOSFET (HEXFET) output switch, driven by an integrated circuit photovoltaic generator. The output switch is controlled by radiation from a GaAlAs light-emitting diode, which is op-

tically isolated from the photovoltaic generator.

The relays, intended for telecommunications applications, are designed for on-off hook switching, dial pulsing, ringer injection, and general switching. For

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The Optobus optical link from Motorola is a 10-bit wide bidirectional data interconnect assembly that will link computer systems over distances of up to 30 meters. The optical link

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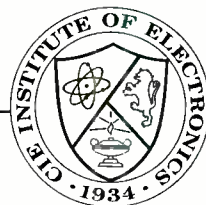
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consists of two identical transmitter and receiver modules at the ends of a pair of connector-terminated and detachable 10-fiber ribbon cables. Optobus can transfer parallel data at 1.5-billion bits per second (1.5 Gb/s) in each direction, making it suitable for the higher transfer rates offered by the latest image, text, video, and voice data systems.

Optobus offers a data-transfer rate of 150 megabits per second (MB/s) per channel and provides 20 channels—10 transmit and 10 receive. Data is transferred over fiber ribbon cable. The assembly's bandwidth and functionality can be upgraded by replacing modules, and it is powered by a five-volt supply. In common with other fiber-optic systems, the data is secure and not affected by EMI and RFI.

The two transmitter and receiver subsystems share a common substrate, but they do not share a common power or ground. The module uses a form of low-voltage differential I/O (current-mode logic). The transmitter subsection consists of 10 differential electrical inputs and 10 optical output channels, which the order is reversed in the receiver subsection.

The optical interface of each module consists of a waveguide unit combined with an optical connector (MT) and 10-channel fiber ribbon. The transceiver module contains 10 laser-diode output ports, and the

laser wavelength is nominally 850 nanometers.

Applications for Optobus are seen in high-performance PCs, workstations, multimedia environments, parallel computers, high-end graphics, and video systems including interactive video.

An Optobus evaluation kit containing an evaluation board, one bidirectional module, one fiber-optic ribbon cable, and complete documentation is priced at \$1500. Sample Optobus links consisting of two bidirectional modules and 10 meters of bidirectional fiber cable are priced at \$5000, with discounts available.

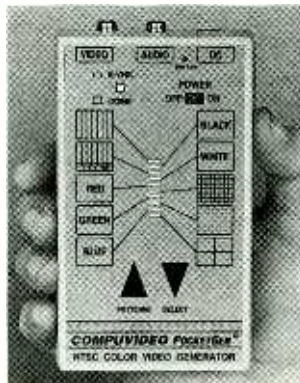
Optobus Marketing

Motorola, Inc., MD M526
2200 West Broadway
Mesa, AZ 85202
Phone: 602-655-2967
Fax: 602-655-5020

COMPOSITE VIDEO/AUDIO GENERATOR.

PocketGen is a handheld, composite video/audio generator from Compuvideo for editing studios, TV broadcast studios and post-production and video services. It is available in either NTSC or PAL versions.

The video/audio generator provides 10 patterns, including full field bars, SMPTE bars, rasters (red, green, blue, white, and black), crosshatching,



CIRCLE 23 ON FREE INFORMATION CARD

dots, and center crosses. It can record SMPTE color bars with a tone at the beginning of a tape, and is switchable to black burst for blacking tapes. PocketGen will also "genlock" video equipment with a black burst. It can operate for more than 40 hours on four AA batteries, or be powered from the wall-outlet AC adapter included.

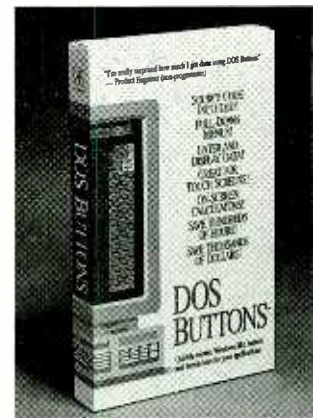
The PocketGen video/audio generator is priced at \$399.00

Compuvideo, Inc.

3861 Oceanview Avenue
Brooklyn, NY 11224
Phone: 718-714-9873
Fax: 718-267-0234

GUI DESIGNER.

DOS Buttons from Annabooks allows designers of embedded systems to create a graphical user interface (GUI) for DOS applications that works with any pointing device, such as a



CIRCLE 24 ON FREE INFORMATION CARD

mouse, pen, or touch screen. A custom GUI can be designed on a personal computer with the program's built-in toolsets. It is possible to create labeled pushbuttons of any size in a range of colors. They can have single- or dual-positions, and they can be in arrays or alone.

Each button can activate functions when pressed or released, or it can bring up

windows containing more buttons. The designer can create on-screen calculators and keyboards or groups of latching pushbuttons that disable one button when another has been selected.

Analog bars can be created for either input or output data. To input data, the user points to the graduations on the bar, and the indicator moves to that position to show the value at the bottom of the bar. The value can be interpolated between the preset lower and upper values labeled on the bar. When transmitting data, the bar shows the selected position, and the data value appears at the bottom.

DOS Buttons also includes simple drawing tools. Several type fonts can be used to format the screens and windows, label the buttons and bars, and group similar buttons together under a common label.

DOS Buttons with its source code is on disk. With a manual it is priced at \$249.00. The run-time royalty is \$1.00 and the first 100 licenses are included in the purchase price.

Annabooks

11848 Bernardo Plaza Court
Suite 110
San Diego, CA 92128
Phone: 619-673-0870 or 800-642-1042
Fax: 619-673-1432

ELECTROMAGNETIC FIELD METER.

The FieldProbe PY-17 is a new handheld electromagnetic field meter from Amprobe Instrument. It will measure 60-Hz electromagnetic field radiation generated by transformers, power lines, electrical distribution equipment, home appliances, and other sources.

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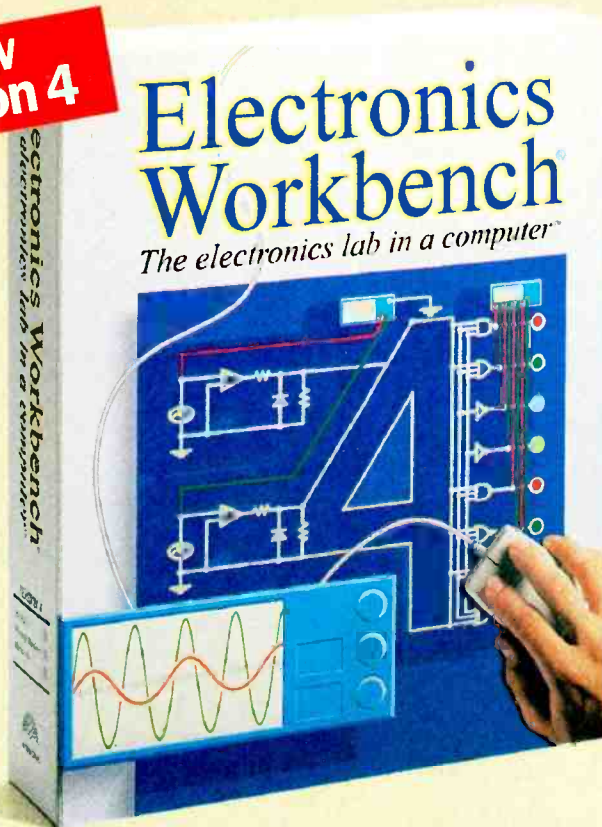
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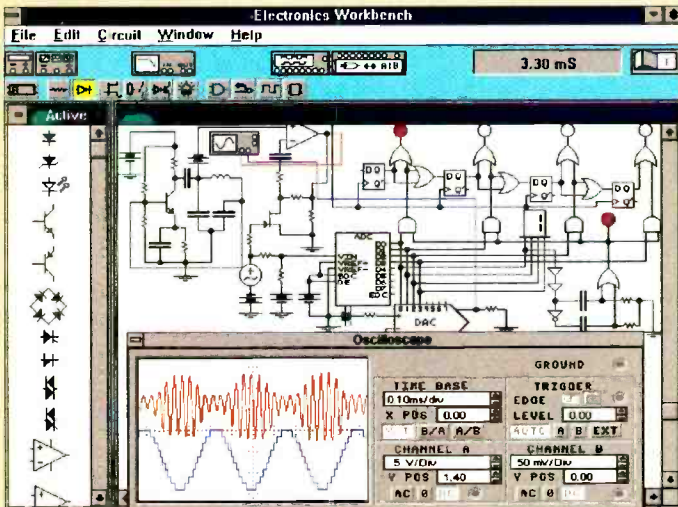
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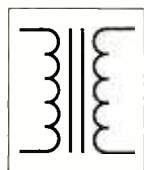
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ject that generates electromagnetic fields, the PY-17 displays EMF levels to determine if they pose a potential health hazard. The meter measures fields from 1 to 800 milliGauss (mG). It is powered by a 9-volt battery (not included).

The *FieldProbe PY-17* EMF meter has price of \$29.85.

Amprobe Instrument
630 Merrick Road
P. O. Box 329
Lynbrook, NY 11563
Phone: 516-593-5600 or 800-477-VOLT
Fax: 516-593-5682

PRECISION FUNCTION GENERATOR. The MAX038 is a high-speed, precision function generator from Maxim Integrated Products. It produces accurate, high-frequency sine, square, triangle, sawtooth, and pulse waveforms with several external components. Its output frequency can be controlled over a range of 0.1 Hz to 20 MHz by an internal 2.5-volt bandgap voltage reference and an external resistor and a suitable capacitor.

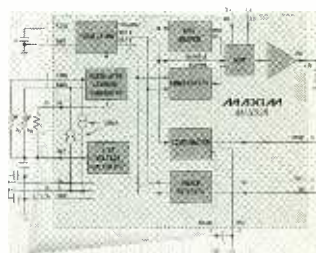
The duty cycle of the output signal can be varied over a wide range by applying a ± 2.3 -volt control sig-

nal. This permits pulse-width modulation (PWM) and the generation of sawtooth waveforms.

Frequency modulation and frequency sweeping are achieved in the same way. The duty cycle and frequency controls are independent of each other.

Sine, square, or triangle waveforms can be selected at the output by setting the appropriate two-bit digital code at two TTL-compatible select pins.

The output signal for all waveforms is a 2-volt peak-to-peak signal that is symmetrical around ground. The low-impedance output can drive up to ± 20 milliamperes.



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The TTL-compatible sync output from the internal oscillator maintains a 50% duty cycle—regardless of the duty cycle of the other waveforms—to synchronize other devices in the system. An internal phase detector allows the oscillator to be synchronized to an external TTL clock.

The MAX038 is available in a 20-pin DIP or wide-small outline package with two temperature ranges: 0 to 70°C and -40°C to +85°C. Prices start at \$9.50 each in quantities of 1000.

Maxim Integrated Products
120 San Gabriel Drive
Sunnyvale, CA 94086
Phone: 800-998-8800 or 408-737-7600, extension 6087

HIGH-SPEED, LOW-POWER OP-AMP. The OPA658 is a new ultra-wideband, low-power, current-feedback operational amplifier from Burr-Brown. It features a high slew rate and low differential gain/phase error. Its low (50-milliwatt) power dissipation combined with its high (900-MHz) bandwidth make the device suitable for video, medical imaging, communications, and digital-to-analog conversion applications.



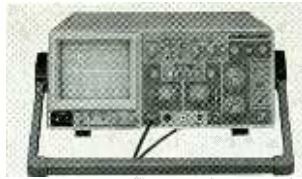
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The current feedback of the OPA658 allows large signal bandwidth at high gains. Internally compensated for unity-gain stability, it operates from a ± 5 -volt power supply. It is packaged in eight-pin DIP and SOIC cases.

The OPA658 operational amplifier is priced at \$2.25 each in quantities of 1000. **Burr-Brown Corporation**
P. O. Box 11400
Tucson, AZ 85734
Phone: 800-548-6132

DUAL TIME-BASE OSCILLOSCOPE. The Model 2260 oscilloscope from B+K Precision has a 60-MHz bandwidth and 1-millivolt per division vertical sensitivity. V-mode triggering permits viewing two signals unrelated in frequency. Other features are main and delayed time bases and a built-in component tester for checking resistors, capacitors, coils, diodes, and other semiconductor devices.

The oscilloscope's dig-



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ital readout displays volts per division (either channel), seconds per division, and important operating mode information. Cursors can be set for measuring voltage and time differences and frequency.

There are 23 user-selectable calibrated sweep time ranges on the main timebase and 19 user-selectable calibrated ranges on the delayed-sweep timebase. Each sweep time range is fully adjustable between calibrated ranges. A times 10 magnifier allows closer examination of waveforms without disturbing the oscilloscope's display calibration.

The 2260 dual time-base oscilloscope with two 10:1 probes, instruction manual, and schematic diagram is priced at \$1399.00.

B + K Precision
6470 West Cortland Street
Chicago, IL 60635
Phone: 312-889-1448 Ω



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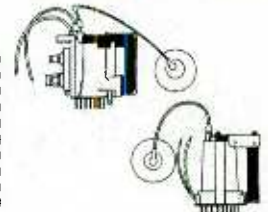
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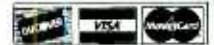
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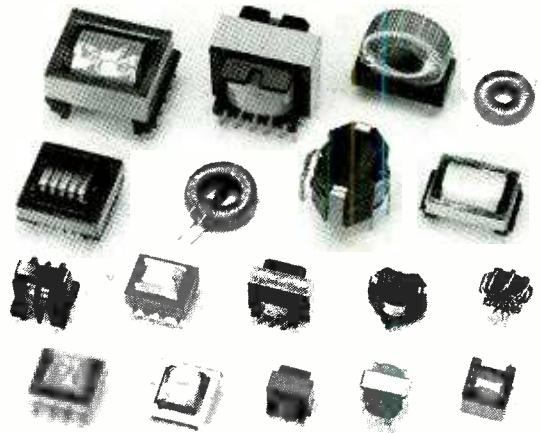
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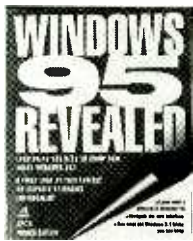
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Windows 95 Revealed; by Jack Nimersheim. Random House Electronic Publishing, 201 East 50th Street, New York, NY 10022; Phone: 800-733-3000; CompuServe: GO RANDOM; \$19.00

Microsoft's Windows 95 differs significantly from its predecessor Windows 3.1. It has a radically new interface design, and it handles DOS differently, nevertheless, many new features to help Windows users work more effectively with their personal computers.



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Nimersheim's book cuts through the Windows 95 promo about such subjects as the 32-bit environment and plug-and-play. It will help the reader to decide whether or not to upgrade to Windows 95 because of its comprehensive information on this new operating system.

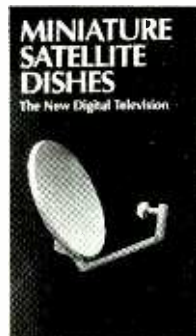
The topics covered include how to: navigate and configure the user interface; use the new folders feature to hold documents and applications; set up peripherals, such as printers and modems; and install popular software programs in computers.

The book also explains how to use the Explorer, the improved version of

Windows 3.1's File Manager. It explains how to access DOS (and why it's still necessary). And the reader will learn how to access frequently used files and programs rapidly with shortcuts and time-saving tips.

Miniature Satellite Dishes: The New Digital Television; by Dr. Frank Baylin. Baylin Publications, 1905 Mariposa, Boulder, CO 80302; Phone: 303-449-4551; Fax: 303-939-8720; \$20.00 plus \$4.00 S&H.

The introduction of high-power, direct-broadcast satellites (DBS) has made possible reception with miniature parabolic-dish antennas only 18 inches in diameter. This book gives the fundamentals of both large- and small-dish digital satellite television systems, and it provides a technical background in both DBS and large-dish television receive only (TVRO) systems.



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The author explains how both systems work, how to install them, and how to upgrade TVROs to dual-band, DBS/TVRO receiving systems economically. The

book lists major component, system, and satellite manufacturers and includes descriptions of their products, systems, and available services.

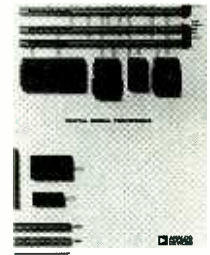
Competing programming packages are compared and their security encryption systems are explained. The book also describes how to connect DBS to existing home-entertainment systems. The text is accompanied by detailed circuit diagrams for connecting DBS television receivers and video cassette recorders. The author also forecasts the future of satellite TV.

Digital Signal Processing Brochure (Publication Number G1633a). Analog Devices, Inc., DSP Market Development, Norwood, MA 02062; 24 pages; Phone: 617-461-3881; Fax: 617-821-4273; free.

Analog Devices' latest fixed- and floating-point DSPs (digital signal processors) and 16-bit codecs are described in this brochure. Also included are chipset solutions for sound, fax/modem, and combination sound/modem designs.

An overview of DSP architectures includes the new SHARC (Super Harvard Architecture Computer) DSP with a 4-megabit on-chip SRAM and "glueless" interface for multiprocessors. A second member of the SHARC family offers 2 megabits of memory.

The brochure includes an overview of the company's software and hardware



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tools for application development. They include GNU C compilers and C debuggers; FFT benchmarks are provided to measure performance for routing DSP functions. Mixed-signal processors with DSP, codec, and all data and program memory on a single IC are discussed.

Mastering Laser Printer Repair; by Don Thompson. Diversified TechniGraphics, Inc., 6 Morgan, Suite 112, Irvine, CA 92718; Phone: 1-800-457-5776 or 714-855-3838; Fax: 714-855-3959; \$395 plus \$10.00 S&H (U.S.).

This book will help technicians at all experience levels diagnose and fix laser printers. It covers such popular products based on Canon printer engines as Hewlett-Packard LaserJets and Apple LaserWriters.



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Thompson's book begins with an overview of laser printers and discusses their principles and technology. It then explains why servicing them can be profitable, and how to start and expand a laser-printer service company.

With the Canon SX engine as a model, the other printers are compared. The book discusses faults that are common to the four most popular Canon printer engines. The frequency of occurrence of those faults is explained with probability charts.

One chapter covers print defects. Each page gives an example of a defect accompanied by explanations of its cause and cure. Preventative maintenance procedures are discussed and service procedures developed by experienced professionals are presented. The basic electrical and mechanical troubleshooting techniques are given.

The Robotics Practitioner: The Journal for Robot Builders. Footfalls Ltd., 483 South Kirkwood Road, Suite 130, Kirkwood, MO 63122; E-mail: TRPSAKFootfalls.com; special first-year (four-issue) subscription rate for Electronics Now readers: \$29.00

This new quarterly magazine will cover the design, development, and performance of robots, with its focus on the robot hobbyist, students, educators and inventors.

The contributed articles will be written by robot builders about their projects. They will cover the wide variety of software and hardware issues raised in robotics technology. Construction articles will take readers step-by-step through the construction of working robots designed to



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be built from readily available components.

Regular columns will list robot clubs, provide a calendar of robot events, and give electronic addresses for robot builders' bulletin boards.

Looking Good with QuarkXPress: The Designer's Companion for Mac & Windows; by Joe Grossman. Ventana Press, P. O. Box 2468, Chapel Hill, NC 27515; Phone: 919-942-0220; Fax: 919-942-1140; \$34.95, including a CD-ROM.

This book on QuarkXPress is a guide for those who use or want to use that software in the design and production of brochures, newsletters, advertising matter and other publications. The latest versions QuarkXPress have cor-



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rected the interface quirks in the original software that made it difficult to use.

To help readers take advantage of QuarkXPress' array of tools, this book contains illustrations, backed-up by practical advice and insider tips. Coverage includes a brief overview of the tools, techniques, basic design con-

cepts, and the design development process.

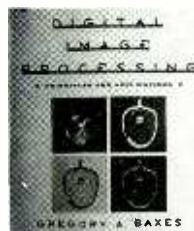
The reader will learn how to use dialog boxes and palettes to create page designs, headlines, photo arrangements, and color effects. Actual XPress creations, including 40 pages of color examples, are analyzed.

The companion CD-ROM disk contains 45 design templates that serve as models for the readers' page designs. Included are backgrounds, special picture boxes, fonts, and clip art.

Digital Image Processing: Principles and Applications; by Gregory A. Baxes. John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Phone: 1-800-CALL-WILEY; \$39.95, including an instructional floppy disk.

This book discusses the principals and applications of digital image processing at a level that will be comprehensible to a wide range of readers. Baxes has written in clear, jargon-free language to attract those readers who have a need to know but may have neither the time nor opportunity to take a formal course in the subject.

Step-by-step lessons are given in digital image processing principles, techniques, and technologies. The author provides detailed explanations of the most commonly used digital image-processing operations.



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The book also includes a comprehensive listing of available hardware, and an explanation of the best methods for acquiring, displaying, and processing digital images. The text is backed-up by a digital image-processing program on a floppy disk that is included with the book.

PC Instrumentation and Data Acquisition Catalog. Global Specialties, 70 Fulton Terrace, New Haven, CT 06512; Phone: 800-572-1028; Fax: 203-468-0060; 16 pages; free.

This is Global Specialties latest catalog on personal computer instrumentation and data acquisition products. It includes virtual instruments on a card and analog and digital I/O cards for IBM-PC or compatible personal computers.



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The plug-in boards include A/D combination cards, opto-isolated Darlington output cards, a 48-channel PIO card, a thermocouple input card, and two virtual instrument boards.

The virtual instruments include those for simulating a digital multimeter with chart recording and data-logging functions, and a combination function generator, pulse generator, waveform generator, and universal counter-timer. Each virtual instrument includes the card and a software graphics package. Ω

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what was to be an embassy and private residence into the most sophisticated recording studio the world had ever known. The building had to be torn down in order to remove all the bugs.

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The professional discussions seen on the TV screen in your home reveals how to detect and disable wiretaps, midget radio-frequency transmitters, and other bugs, plus when to use disinformation to confuse the unwanted listener, and the technique of voice scrambling telephone communications. In fact, do you know how to look for a bug, where to look for a bug, and what to do when you find it?

Bugs of a very small size are easy to build and they can be placed quickly in a matter of seconds, in any object or room. Today you may have used a telephone handset that was bugged. It probably contained three bugs. One was a phony bug to fool you into believing you found a bug and secured the telephone. The second bug placates the investigator when he finds the real thing! And the third bug is found only by the professional, who continued to search just in case there were more bugs.

The professional is not without his tools. Special equipment has been designed so that the professional can sweep a room so that he can detect voice-activated (VOX) and remote-activated bugs. Some of this equipment can be operated by novices, others require a trained countersurveillance professional.

The professionals viewed on your television screen reveal information on the latest technological advances like laser-beam snoopers that are installed hundreds of feet away from the room they snoop on. The professionals disclose that computers yield information too easily.

This advertisement was not written by a countersurveillance professional, but by a beginner whose only experience came from viewing the video tape in the privacy of his home. After you review the video carefully and understand its contents, you have taken the first important step in either acquiring professional help with your surveillance problems, or you may very well consider a career as a countersurveillance professional.

The Dollars You Save

To obtain the information contained in the video VHS cassette, you would attend a professional seminar costing \$350-750 and possibly pay hundreds of dollars more if you had to travel to a distant city to attend. Now, for only \$49.95 (plus \$4.00 P&H) you can view *Countersurveillance Techniques* at home and take refresher views often. To obtain your copy, complete the coupon or call.

COMPUTER CONNECTIONS

Retreat of the barbarians.

JEFF HOLTZMAN

Growing up can be bittersweet. On one hand, you get to learn the truth concerning many things you were curious about. On the other, you do learn the truth.

Borland is the company that never grew up. Throughout the first decade of its existence, Borland prided itself on being different. It shunned traditional corporate culture. It emphasized product performance and originality. Based on an underlying faith in excellence, it thumbed its nose at hard-nosed business practices, preferring instead what it called a "barbarian" style of marketing.

Its barbarian style worked, for awhile. Throughout the 80's, when the computer industry was much more fragmented, when products with original ideas sprouted like weeds overnight—and often disappeared just as quickly—Borland was a mainstay in that environment. Turbo Pascal, SideKick, Turbo C... then what?

There were brief flings with various products, including a Prolog development system, a text editing/formatting system, a massive upgrade of SideKick that substituted mere heft for magic, and an OS/2 version that went nowhere. (For you youngsters: SideKick was the original TSR and the original PIM (personal information manager); but Borland never even tried to make SideKick desirable to the PIM market. Yes, Borland did eventually (in the fall of '94) release a version of SideKick for Windows, but it was much too little, way too late. In fact, SideKick for Windows was one of the first products jettisoned in the company's recent reorganization.)

Then Borland bought Ashton-Tate, to gain control of dBase database software. dBase? Borland had already bought Paradox, considered technically superior to dBase. dBase had been in technical

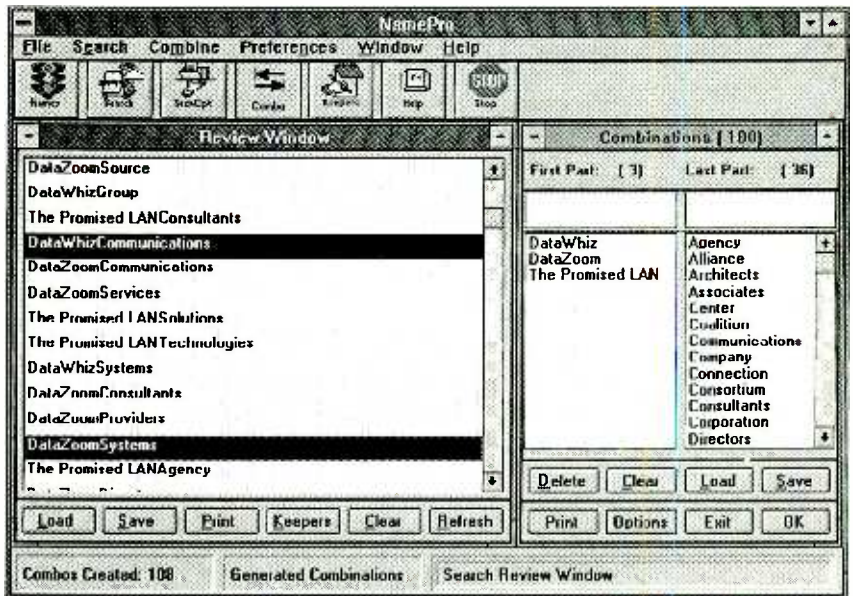


FIG. 1—NAMEPRO helps create names for new products and companies using several databases and combinatorial techniques.

trouble at Ashton-Tate, and Borland quickly found out that resolving those difficulties was going to be difficult and time-consuming. The protracted period during which Borland fought to overcome those difficulties gave Microsoft a tremendous head-start in the just-emerging Windows market. Borland was taken off-guard by the success of Microsoft's Access database for Windows. Despite years of development, Microsoft had never even introduced its DOS-based database, known internally as Cirrus, which was eventually re-architected for Windows and released as Access. (The header of one appendix of the user manual for Access 1.0 actually refers to the product as Cirrus.)

Throughout that period, Borland was busy building fancy new office space and providing a musical outlet for saxophone-playing founder and charismatic chairman of the board, Philippe Kahn.

Hard-nosed business practices eventually caught up with Kahn. In early January of this year, he re-

signed his roles as President and CEO of Borland. Although he retains chairmanship, Gary Wetsel has assumed the roles of President and CEO. One of Wetsel's first actions was to lay off 40% of the company. That came on the heels of a decision by the board to divest Borland of its consumer product line, which consisted only of SideKick for Windows and a nice Windows shell originally written by Hewlett Packard called DashBoard.

The new Borland intends to focus on programming tools, including its C/C++ compilers, dBase and Paradox, and a new entry currently known as Delphi, expected for release around the time you read this. I find the C/C++ market rather ho-hum, but Delphi sounds hot.

The oracle and the barbarian

In many ways, Delphi represents Borland's last best hope for survival. Delphi reaches back to Borland's earliest roots in Pascal, but in an up-to-date, object-oriented visual development environment. Delphi is intended to be a Visual Basic (VB)

killer. Delphi is intended to make up for many of VB's deficiencies.

Whereas VB is based on relatively slow technology that interprets an intermediate "p-code" at run-time, Delphi produces fully compiled applications. One reason for VB's immense popularity is its extensibility via what are called VBXs (Visual Basic Extensions). An entire subindustry now exists to supply VBXs of all sizes, shapes, and colors. Ironically, though, VB itself cannot be used to produce VBXs; a Windows C compiler is required. Delphi, by contrast, can create its own custom extensions. Delphi can also run VBXs.

Visual Basic, in its attempt to simplify Windows programming, restricts direct programmer access to numerous properties, functions, and messages; Delphi will by contrast make these features visible. Another feature worth mentioning is run-time support. Visual Basic requires a 400K dynamic link library (DLL), whereas Delphi can produce complete applications with everything bound into a single file.

Delphi is based on Pascal. There is no internationally sanctioned standard for Pascal; over the years, whatever Borland has done has defined a de facto, albeit single-sourced, standard. Delphi will do nothing to change that. In addition, from what I've heard so far, it appears that Delphi will have no cross-platform support. On the other hand, the Visual Basic language conforms to no standard either; nor is it available on any other platform.

Another issue is that there are lots of Basic programmers out there, and lots of C/C++ programmers. But Pascal programmers? Is Pascal still commercially viable? I love Pascal as a language. I find it infinitely more elegant than either Basic or C. But I know that's a minority opinion.

In the meantime, Microsoft has been working on version 4.0 of Visual Basic. The product was originally targeted for release early this year, but Microsoft seems to be holding off to coordinate its release with Chicago. That may give Borland a six-month lead, or it may force buyers to hold off for six months.

Can Borland survive? Can Delphi save Borland? I don't know, but I would hate for the industry to lose Borland—it needs more than one vendor of programming tools.

Growing up can be hard. But the mistakes of youth can make us stronger adults. Let's hope Borland has learned its lesson. We need barbarians to keep the big guys honest.

Product cameos

I used to review lots of products. Due in part to evolution of my interests, but also due in part to a slow-down in innovation in the computer industry, product reviews have become less and less a part of what I do.

Nonetheless, I am always on the lookout for new and innovative products, especially those produced by small, out-of-the-mainstream companies. If you know of computer products in this category that you believe other readers would find interesting, send me E-mail with a brief description of the product, what you find intriguing about it, and contact information. I'll see what I can do.

In that spirit, I'd like to discuss briefly one such product, NamePro, along with one very much in-the-mainstream product, Microsoft Office Professional & Bookshelf.

NamePro. How do you name a new product? There are two major tasks, one creative, the other administrative. The creative part involves coming up with a name that concisely expresses something about the nature of your product. The administrative part involves verifying that the name is not already in use.

NamePro can help in both regards. The creative part consists of several databases of words, along with an interactive Windows-based component that allows you to combine them in various ways, based on the connotation you'd like the name to have. The administrative part consists of a database of existing trademarked names against which you can compare candidate names.

For example, if you wanted to start a company dealing with networks and databases, you might find the following prebuilt names in

NamePro's database: The Promised LAN, DataZoom, and DataWhiz. Then you could load a word-part database dealing with company names, and automatically combine them, in all permutations, with the prebuilt names, as shown in Fig. 1.

By itself, NamePro might or might not lead you to the perfect name. But its numerous databases and combinations can help you get into the right frame of mind.

Microsoft Office Professional & Bookshelf. Someday we will look back at this massive cantankerous lumbering collection of applications as, in the evolutionary sense, a dinosaur. But right now, it's the best dinosaur we've got, particularly Word for Windows and Access. And more and more new PCs come with this package pre-installed. I was curious to see how the integrated installation and documentation function. Let's say I wasn't overly impressed.

This "Office Suite with Integrated CD-ROM Library" comes on a pair of CD-ROMs. One contains all the programs (primarily Word, Excel, PowerPoint, and Access; a license (but not the code) for Microsoft Mail; and a set of mini-applications, some of which (e.g., a scanning utility and an organization chart utility) appear to be brand new but unadvertised. The other CD contains an extensive set of on-line documentation and BookShelf, a collection of reference works, including dictionary, thesaurus, encyclopedia, quotations, almanac, and more. Interesting points about the package:

- The basic package does not include printed documentation; if you want it, you must purchase a set of manuals separately for about \$130.
- A complete installation of everything (less the BookShelf database and on-line documentation) requires only about 90 megabytes of disk space.
- The installation routine is buggy, as it repeatedly reports errors after installing some icons into Program Manager.
- An installation frustration is that it asks where you want to install files, and then proceeds to stick a nice little 12-megabyte chunk where it wants.
- The overall installation process is

awkward. You can't just set of bunch of options on a screen or two and go away. Instead, you're presented with dialog after dialog, redundant checks for available disk space, and other time wasters.

Once you get through the installation, everything pretty much works as advertised. The package also includes a couple of "always-on-top" button bars (to which you can add your own buttons) that keep you never more than a click away from any of the Office applications and Bookshelf references.

E-mail

My column on Conceptual Documentation is still generating responses. G. Lundy thoughtfully writes, "As an engineer who dreamt of being an engineer, not a technical writer, I drifted into the technical writing field, where I have seemingly been enslaved for the past ten years. . . . Each of six writers here is a degreed engineer (EE, ME, CS, other).

The common problem faced is not just a standard methodology for writing, but getting project managers to fit within the scope of their respective projects the need to plan document development in parallel with engineering. Far too often the document is the last thing to be scheduled. This leads to writing garbage-in-garbage-out-type technobabble, and rushing to put out anything that can meet the terms of the contract." Yup. I hear you. I've been there.

Also, for you die-hards out there, Chris Courson operates a free BBS that supports 8-bit computers and public domain software. The number is (813) 238-8076.

As always, comments are welcome. Send them to my Internet address jkh@acm.org.

PRODUCTS DISCUSSED

- NamePro (\$495), The NameStormers, 4347 West Northwest Highway, Suite 1040, Dallas, TX 75220-3864. (214) 350-6214.
- Microsoft Office Professional & Bookshelf, Microsoft Corporation, One Redmond Way, Redmond, WA 98052. (206) 882-8080.

WHAT'S NEWS

continued from page 4

that a U.S.-based company topped the list.

Most of the IBM patents were in the field of information processing, but IBM continued to hold its lead in patenting software-related inventions. The patents issued include one for a method for encrypting and decrypting software on a CD-ROM. It allows a buyer to use only the software he has purchased and for which he has a software "key." The invention will allow several different software packages to be recorded and distributed on a single CD-ROM.

Patents also were issued for processes that make possible for the speedy and efficient transmission of multimedia data—audio, video, graphics, and text—over a network. The patented technology, called asynchronous transfer mode or ATM, allows computers to send and receive a combination of multimedia information simultaneously over a network.

Related patents covered methods for bundling different packets of information and "traffic cop" techniques for directing the information around a network without overloading it.

Another patent was issued for a high-quality semiconductor material production method that combines silicon with germanium. The material is intended to allow IBM to build super-fast transistors. Those transistors, which can be produced on existing wafer fabrication lines, could lead to improved consumer-electronics products, better medical equipment, and higher-speed computers. Ω



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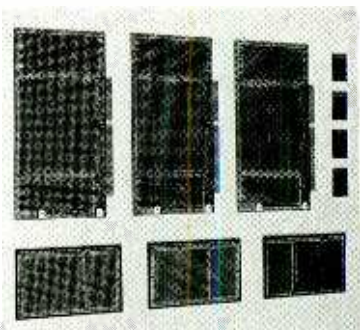
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TJ BYERS

EVERYONE WANTS TO SAVE MONEY, AND MOST people want to improve the well-being of our planet. Well, you can do both by simply using such energy-saving computer products as "green" PCs and other Energy Star peripherals.

Recent studies conducted by the Environmental Protection Agency (EPA) conclude that personal computer systems account for more than five percent of all electrical power consumption in the U.S. That consumption is increasing rapidly because home and office computer equipment has become the fastest growing segment of the consumer-electronics market. That booming growth not only threatens to increase energy costs, but also to damage the environment as power companies scramble to meet the need by building new facilities.

In an effort to stem this rising tide, Phoenix Technologies and Intel conceived of the concept of the "green" PC: one that draws little or no power when it is idle. The green concept was later expanded to include PC peripherals and energy-smart software. These energy-saving products cut energy consumption by switching the device to a low-power state when it is idle or not in use. As an added benefit, powering down these devices can often extend their life.

Even if you are not concerned about saving money or the planet, it's virtually impossible to avoid the green movement. Many PCs and peripherals sold today—which include everything from monitors to printers to modems—include energy-saving features.



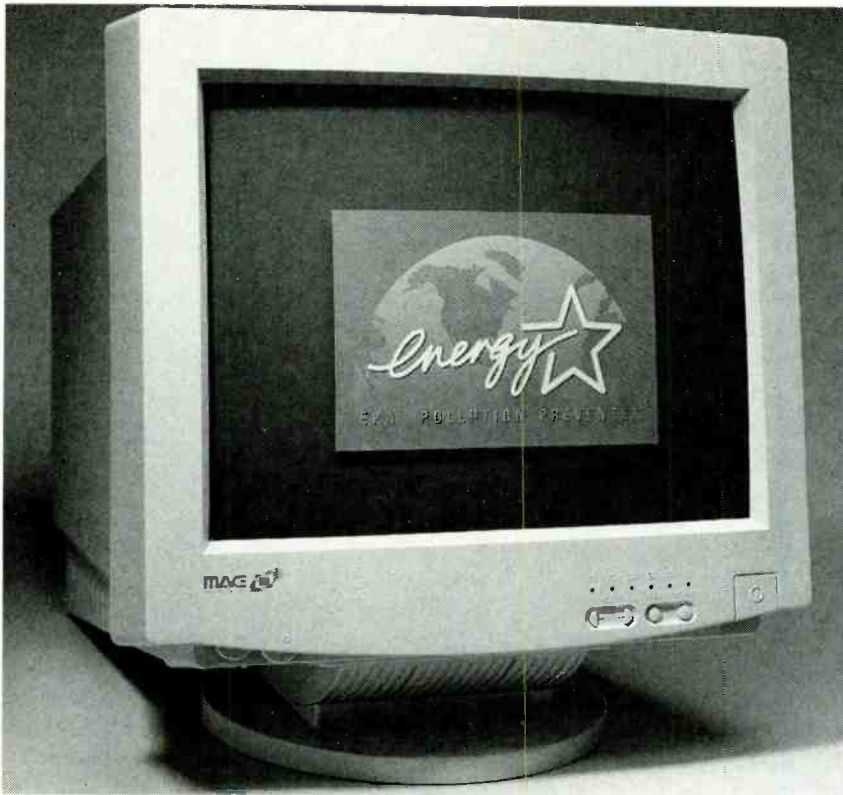


FIG. 1—ENERGY STAR IS A SELF-POLICING PROGRAM that lets the vendors test their own products for compliance. The EPA grants the Energy Star logo shown on the Mag Innovation screen above to PCs, monitors, and printers that use 30 watts or less when idle.

TABLE 1—ENERGY-SAVING RECOMMENDATIONS

	Normal	Standby	Suspend	Off
Energy Star	100%	Not defined	<30 watts	Not defined
NUTEK/TCO	100%	<30 watts; <15 watts recommended	<8 watts; <5watts recommended	<1 watt ultimate goal

Energy Star

In late 1992, the EPA proposed a set of power-management guidelines for energy-efficient computer equipment. The program, called Energy Star, is not a government mandate; therefore participation is not a requirement for computer and peripheral manufacturers.

Energy Star guidelines recognize two levels of operation: a full power mode and an inactive, or sleep, mode. To garner an Energy Star rating, a device cannot draw more than 30 watts of power when it is idle. However, Energy Star guidelines say nothing about the length of time the device has to be inactive before it powers down, or how the power-down is accomplished. All of those de-

tails are left up to the individual manufacturer.

Computer products that comply with the Energy Star guidelines are distinguished by an Energy Star logo (see Fig. 1) that the vendor can proudly display in advertisements, publications, and on the product itself. To encourage participation in the program, President Clinton issued an Executive Order on April 21, 1993, Earth Day, that directs all government agencies to purchase only equipment that meets the Energy Star guidelines.

NUTEK/TCO

Of course, Energy Star isn't the last word in energy conservation, and many consider the guidelines to be much too

lenient. A stricter version comes from Sweden's Department of Energy Efficiency, NUTEK, which has teamed up with TCO, a trade union, to create an energy-saving standard known simply as NUTEK/TCO for use throughout Europe.

The NUTEK/TCO recommendation defines three power levels of operation: full power, automatic standby, and automatic power down (see Table 1). The automatic standby mode, the first step down from full power, limits power consumption to 30 watts (which matches Energy Star's recommendation) but suggests a 15-watt ceiling. The automatic power-down mode, for which there isn't an Energy Star equivalent, specifies 8 watts as the highest acceptable energy consumption level, with a desired figure of 5 watts or less. NUTEK/TCO's ultimate goal for power-down is 1-watt total power consumption, which would occur when everything but the power-controller circuit is turned off.

Both shut-down modes are activated by a timer. If no user or communications (modem or network) activity is detected within a period of five minutes to one hour (the length of the period determined by the user) the energy-saving gears are set into motion. Note, though, that the timers run concurrently. For example, if the standby mode is set to kick in at 30 minutes and the power down mode is set for 40 minutes, the device will reduce power to standby status in 30 minutes and go into the power down mode 10 minutes after that.

Green PCs

Although the concept of powering down idle devices seems simple enough, the process itself can get quite complex. In a green PC, the microprocessor or CPU, its associated chip set, and the BIOS (basic input/output system) are all involved. Basically, it's the job of the BIOS and chip set to monitor system activity and determine when it's appropriate to shut down the various subsystems. The priority of device

shutdown depends on its power consumption and typical use cycle (see Fig. 2).

Processors

The microprocessor is a major power consumer. Pentium processors can draw up to 15 watts under full load, and the 80486DX2 can easily consume 5 watts, even while doing absolutely nothing. The amount of power a microprocessor consumes is directly proportional to its operating frequency, as described by the equation:

$$P = CV^2f$$

where C is the device's capacitance, V is the voltage difference between its high and low logic levels (1.6 volts for 5-volt logic, and 0.6 volts for 3.3-volt logic), and f is the clock frequency (see Table 2).

An obvious way to reduce power consumption is to slow down the microprocessor's clock speed. The speed of the clock can be dropped to 8 MHz during periods of inactivity for most 486 processors without adversely affecting system performance. Slowing the clock was a popular method of energy conservation a couple of years ago, but it has largely given way to suspend- and stop-clock power reduction. However, the microprocessor must be a static device for the stop-clock mode to work; that is, it must be able to retain its data even with the clock stalled. All Pentium and all 486 microprocessors (except those made by AMD) are static devices.

In most microprocessors, the

TABLE 2—MICROPROCESSOR POWER CONSUMPTION

Processor	Frequency	Power (W) active	Power (W) suspend	Power (W) stop clock
Intel Pentium	100	10.1	1.55	0.090
Cyrix Cx486DX2	66	6.6	0.17	0.005
AMD 486DXL2	80	7.5	1.17 (1)	n/a (2)
Intel 486DX2	50	5.7	0.45	0.100
Cyrix Cx486DX2-V	80	5.2	0.15	0.040
AMD 486DX4	100	5.0	0.14(1)	n/a(2)
Intel 486DX	33	4.5	0.50	0.010
Cyrix Cx486DX2-V	66	4.4	0.13	0.038
Intel 486DX4	100	4.3	0.33	0.003
Intel 486SX	33	3.2	0.40	0.010
Cyrix Cx486DX2-V	50	2.9	0.09	0.034

suspend state is accomplished by stopping the clock to the bulk of the circuits, while keeping the memory, cache control, and external-bus control alive. A halt instruction causes all 486 and Pentium processors (except AMD's 5-volt 486 series) to enter their suspend states.

In the suspend mode, the microprocessor still responds to interprocessor and external snoop requests. For example, an interrupt request (INTR), non-maskable interrupt (NMI), or signal-managing interrupt (SMI) will terminate the suspend mode and bring the microprocessor back to full power.

In the clock-stop mode, clock signals to all microprocessor logic, except that needed to awaken the processor, are stopped. In this mode, power consumption is typically less than 1/10th watt; the clock is restored when the "clock-stop" reset line is strobed.

The mechanism normally used to control power management is system-management mode (SMM), a set of special in-

structions that was first available on Intel's SL processors. The SMM software, which is stored in a separate memory space called system-management RAM (SM-RAM), controls microprocessor power without requiring that the existing operating system be rewritten or modified.

Storing the system-management code at a specific memory address allows the SMM to operate without interrupting normal microprocessor operation or system memory. System-management code is entered via the signal-management hardware interrupt. An SMI signal is generated by any one of the many system interrupts that monitor for system activity or inactivity. When an SMI is detected, the processor saves its state to a fixed location within the SM-RAM, and then runs the SMM code. The code's message determines the level and depth of power management. Normal microprocessor operations are restored by entering an SMM instruction called Resume Normal Mode (RSM).

Green chip sets and BIOS

If you think of the microprocessor as the muscle of a power-management system, then the chip set represents the nervous system, and the BIOS is the brains. The chip set is a collection of signaling devices that link the microprocessor to its peripherals. A green chip set must also provide the signals necessary to power-down and reactivate the microprocessor and peripherals. At the simplest level, a green chip set provides

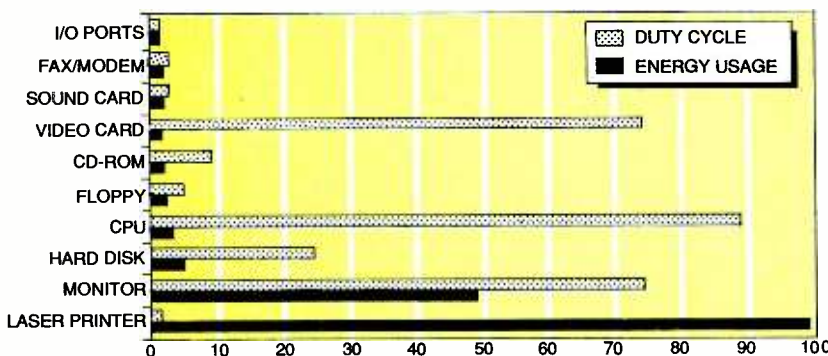
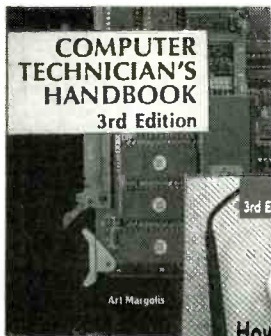
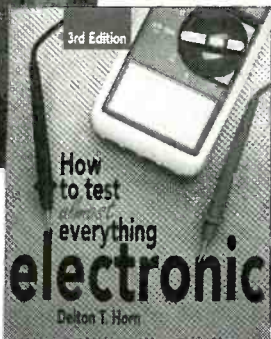


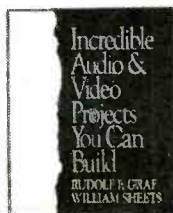
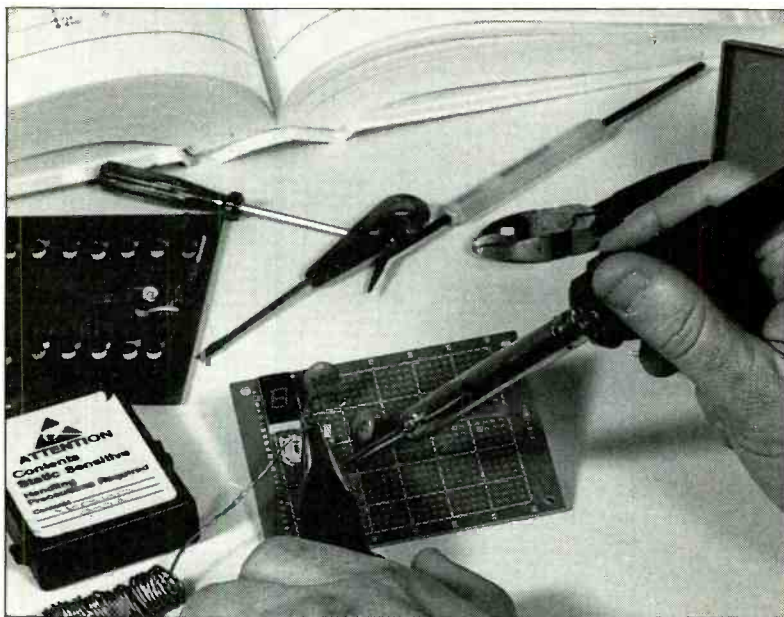
FIG. 2—WHILE IT'S ADVANTAGEOUS TO SHUT DOWN power hogs as quickly as possible, it's not always practical. As much power savings can be gained by paying close attention to spinning the hard disk up and down as to blanking the monitor.



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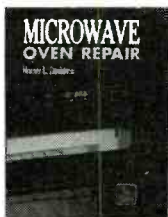
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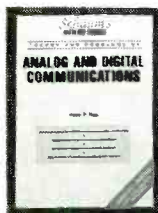
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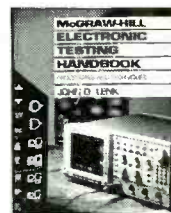
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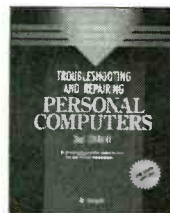
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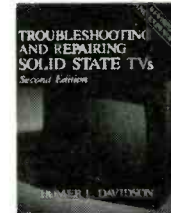
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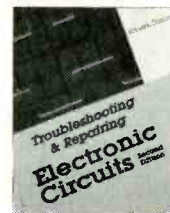
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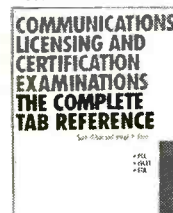
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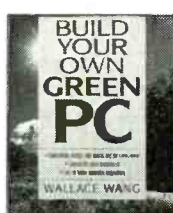
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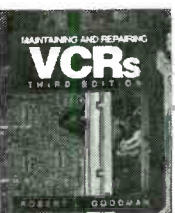
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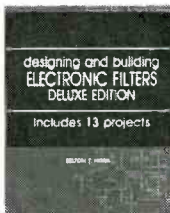
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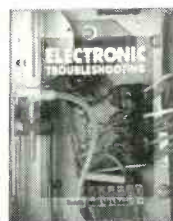
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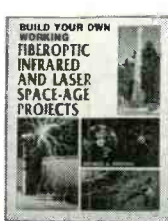
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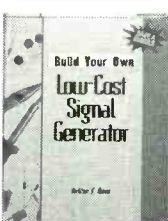
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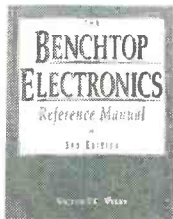
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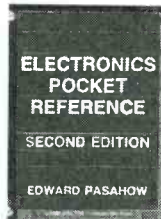
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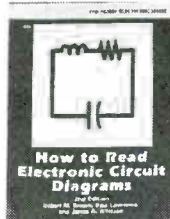
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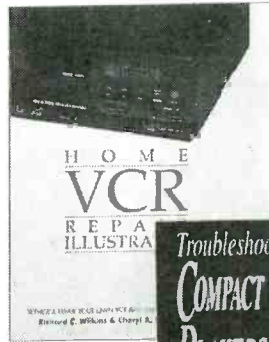
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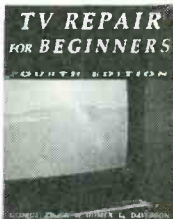
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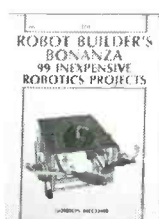
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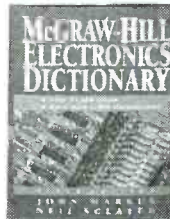
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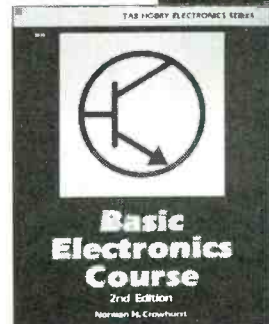
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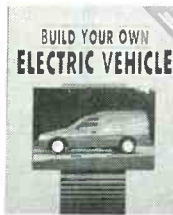
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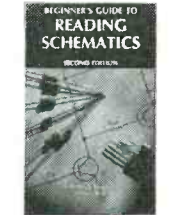
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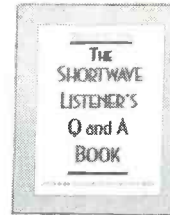
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TABLE 3—VESA MONITOR POWER STATES

	Normal	Standby	Suspend	Off
H-sync	On	Off	On	Off
V-sync	On	On	Off	Off
Power level	100%	80%	<30 watts	<8 watts
Mitsubishi Diamond Scan 17FS—power usage	106 watts	78 watts	10 watts	5 watts

SMI, stop-clock, and suspend power-management signals to the microprocessor. But virtually all green chip sets also include SMM support for Intel's SMI power-management scheme, and most support AMD's and Cyrix's power management routines.

All chip sets have one or more timers to monitor system activity and provide signal-management (or equivalent) interrupts as subsystems and peripherals time out. These interrupts trigger on the activity or inactivity of video, floppy- and hard-disk drives, I/O ports, keyboard, DMA (direct memory access), and system memory. The BIOS dictates when a timer will time out and generate an interrupt signal.

For example, consider the typical duty cycle of a hard-disk drive—the second largest energy consumer in a desktop PC. When the computer system is booted (started), the BIOS loads the hard-disk drive timer with a time-out value. That value may be user supplied or a system default, and typically ranges from 2 to 15 minutes. The chip set monitors the hard disk's activity, and resets the timer every time a read/write operation is performed. If a read or write isn't detected within the specified period, the timer times out, and the chip set generates an SMI, forcing the microprocessor to run the SMM code that shuts off power to the hard disk.

Advanced Power Management

So far, only power management at the hardware level—where hardware timers determine the sequence of power-down events—has been discussed. However, greater power saving can be achieved if the

software, which can determine exactly what components are needed and when, takes an active role in defining the power-management profile.

Advanced Power Management (APM) is a layered approach to software power management. It allows applications, operating systems, and the system BIOS to work together to reduce power consumption. As the program runs, it constantly feeds the BIOS with updated information, dynamically changing the system's power-management parameters to match those of the application. The BIOS, in turn, programs the chip set in real-time as it writes special SMM code to the SM-RAM that's in step with changing software demands. When necessary or requested, the chip set generates an SMI to the microprocessor, causing it to enter SMM. Originally designed

for use in notebook computers, the APM standard is finding widespread acceptance in green desktop computing. (See Advanced Power Management: Power-Saving Protocol for Mobile PCs for details.)

Monitors

It used to be that the motherboard was the biggest consumer of electric power in a computer system. That's no longer true because computer users are replacing their small-screen 14-inch monitors with large-screen 17-inch displays—which can consume 100 watts and more. That's about 50% more power than used by a typical 486SX multimedia PC system. That's why a lot of effort has gone into reducing monitor power consumption.

Buying a green monitor is only half the battle, however. Few monitors are smart enough to know when they're needed and when they're not. They have to be told when to be awake and when to go to sleep. There are no set rules on how to do this—each monitor manufacturer can create its own power-management scheme. At present, the two methods most commonly implemented are the Video Electronics Standards Association

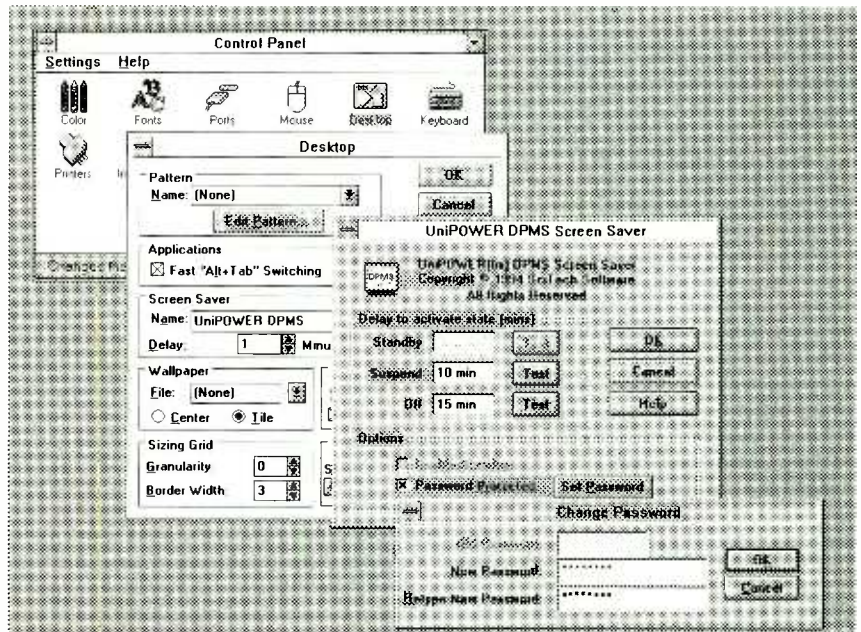


FIG. 3—SPECIAL TSR SOFTWARE, like SciTech Software's UniVBE/Pro 5.0 shareware above, can make an ordinary VGA or superVGA video controller behave like an energy-saving DPMS controller. This program, named UNIVBE50.ZIP, can be found on the Gernsback BBS.



FIG. 4—TO INSTALL THE WATTLISS, unplug your keyboard, plug it into the Wattless, and then plug the Wattless keyboard cable into your PC. If you have a mouse, you can use a special cable with a bifurcated cord that allows you to plug it in as well.

(VESA) standard and video-blanking signaling.

The VESA Standard

The most popular method is the VESA standard, which incorporates a four-step program called display-power management signaling (DPMS). DPMS sends a binary code to the monitor via the horizontal and vertical sync signals. The monitor, in turn, decodes the message and shifts its circuits into the appropriate power-saving mode (see Table 3).

Step one is the full-power, normal mode where the

monitor is active and receiving both horizontal and vertical sync signals. The next step is called standby, which is activated by disabling the horizontal sync while maintaining the vertical sync. At this level, the power is reduced by a mere 20%, which is usually achieved by simply blanking the screen.

The third step is the suspend mode, in which the horizontal sync becomes active and the vertical sync shuts off. VESA specifies that the monitor consume no more than 30 watts at this level. While each vendor does it

differently, the typical game plan is to turn off the high voltage (flyback circuit) and video drivers, while maintaining full power to the filaments. Recovery time to full screen brightness is typically 5 seconds or less.

The final stage is the off mode where both the horizontal and vertical sync are disabled. This tells the monitor to shut off all circuits—including the CRT's filament. The only thing kept alive is a watchdog circuit that looks for any sync activity which will awaken the display. Although DPMS dictates that the off-power consumption cannot exceed 8 watts, many DPMS-compliant monitors con-

Advanced Power Management: Power-Saving Protocol for Mobile PCs

Advanced Power Management (APM) is a layered approach to software power management that allows applications, operating systems, and the system BIOS to work together toward the goal of reducing power consumption. APM defines four power states: ready, standby, suspend, and off.

Ready. In the ready mode, the system or device is fully powered up and ready for use. No distinction is made between active and idle conditions.

Standby. Standby is an intermediate state that attempts to conserve power by using the chip set's timers to disable inactive devices. The difference between the BIOS default standby settings and APM is that APM-aware software can change the timer values as the application changes phases, resulting in more precise power management. The system can recover from standby mode by a device hardware interrupt (as happens when the device asks permission for microprocessor or memory access) or a CPU call to the device. All data and operational parameters are preserved when the system is in the standby mode.

Suspend The suspend state is a special low-power condition that applies only to the system itself, and not its individual parts. The suspend mode is the lowest level of power consumption that guarantees to preserve operational data and parameters. The suspend state can be initiated by either the system BIOS or the application software. When the system is in the suspend mode, computation will not be performed until normal activity is resumed.

Off In the off state, the system or device is powered down and inactive. Data and operational parameters may or may not be preserved, depending on the BIOS.



FIG. 5—MONITORMISER AND LASERMISER from EMPAC are companion energy savers that need no software to work. Both have DIP switches for setting their programming values. MonitorMiser uses a simple keyboard-sensing circuit to monitor PC activity. LaserMiser uses a microprocessor that analyzes and remembers your printing habits to power down a laser printer based on consumption.

sume less than 5 watts. In the off mode, recovery time is the same as it would be from a cold start, which can take up to 20 seconds and longer.

For display power management signaling to be effective, both the monitor and the video controller card must be DPMS-aware. The video controller must be able to interpret instructions from the DPMS software and process them to turn the sync signals on and off properly. While most of today's video controllers are DPMS compatible, there's a large base of existing video controllers, both on adapter cards and built into the motherboard, that aren't.

Fortunately, there are several TSR (terminate and stay resident) programs that allow video controllers built before the DPMS standard was accepted to signal a DPMS-compatible monitor properly (see Fig. 3). The programs work by accessing an unassigned video BIOS call that controls the horizontal sync and vertical sync signals.

Video-blanking signaling

Not all PCs are capable of DPMS signaling. Therefore, some monitors instead incorporate the video-blanking signaling method. The power-saving mode is triggered by a blank screen created by a screen saver, such as those in After Dark or Windows.

A blank screen is an all-black screen which has both the horizontal and vertical synch signals, but no red, green, or blue video information. By itself, a blank screen will reduce power consumption by 20% to 25% because the electron guns don't have to supply current to the screen.

When a video-blanking monitor detects a blanked screen and enters its power-saving modes, it takes control of the power-management process without help or instruction from the video controller. The power-down modes are controlled by an EEPROM built into the monitor. Typically, the power-down routine is similar

to that established by VESA, but some monitors provide only the two-step power-down sequence suggested by Energy Star. The amount of time the monitor waits before acting on a blanked screen and the time intervals between the different power modes is usually user-programmable.

Printers

The laser printer has no peer as an energy hog. At full speed, a laser printer can easily consume 500 watts of power or more. Even in the idle state, some printers can waste 100 watts just keeping warm. That's why more and more printers feature a low-energy sleep mode that kicks in after a set period of inactivity. This mode trims the cost of running the printer. It also reduces wear and tear on the machine and cuts your office cooling costs.

Like systems and monitors, Energy Star printers must consume 30 watts or less when idle. And again like systems and monitors, not all Energy Star printers are created equal. The LaserJet 4L, for example, consumes five watts when asleep, yet it can respond instantly to a print request. Some other printer models consume 20 watts or more when asleep, and can take as long as 10 minutes to wake up and begin printing.

The HP LaserJet 4L is a good example of the type of laser printer that is common in home offices. It's light on price, about \$599 on the street, and light on

TABLE A—RETROFIT HARDWARE

	Green Keeper	LaserMiser	Monitor Manager	MonitorMiser	PC Ener-g Saver	Wattless VDU Power Saver
Price	\$69.95	\$149.00	\$25.00	\$49.95	\$79.95	\$57.00
Manufacturer	B&B Electronics	EMPAC Int'l	Alpha Micro Technology	EMPAC Int'l	NEI	Ergonomics
AC operating voltage	90-130	90-140	110-240	100-240	90-130	100-250
Switch current, amperes	10	10	4	5	8	3
Surge current, amperes	20	20	10	10	10	90
Operating power, milliwatt	410	3000	100	500	320	n/a
Software programmable	Y	N	Y	N	Y	N
Hardware programmable	N	Y	Y	Y	N	Y
Warranty	3 yrs	3 yrs	90 days	3 yrs	5 yrs	2 yrs

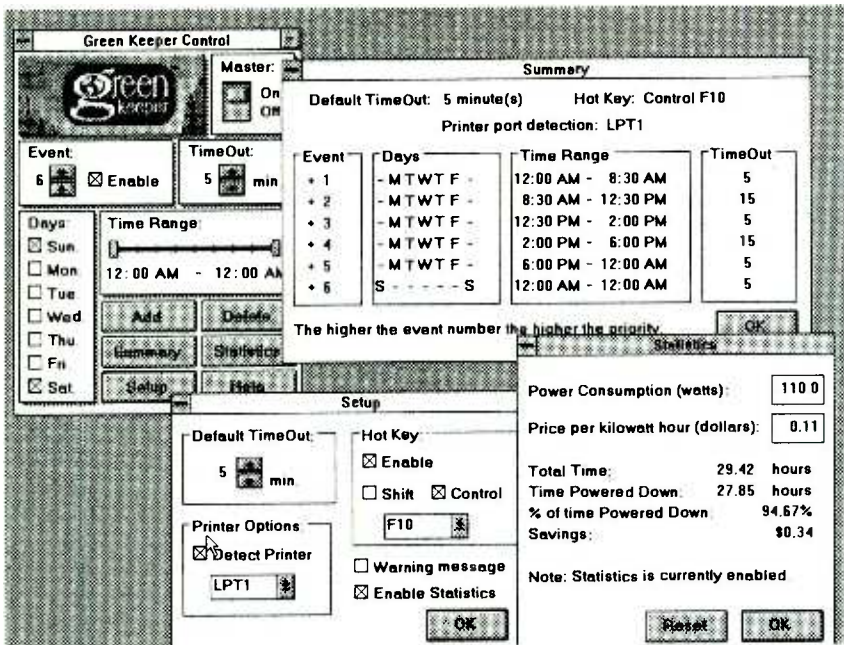


FIG. 6—ALTHOUGH GREEN KEEPER HAS JUST ONE OUTLET, its 10-ampere load rating is enough to control a monitor, printer, and desk lamp simultaneously. Green Keeper has a dynamite software interface that lets you create up to nine different time-out events, and it generates a report of user activity and cost saved.

power consumption. In the print mode, it soaks up a fairly decent 120 watts of power—about as much as a large-screen monitor. But give it 15 minutes of rest, and it goes to sleep to the tune of just 5 watts. Power-up is described as “instantaneous,” in that the fuser drum reaches its operating temperature well before most software can time out and display a print-error message.

A bigger, faster brother of the HP LaserJet 4 is the LaserJet 4 Plus, which has a throughput of 12 pages per minute (ppm). At full speed, it consumes a healthy 180 watts—twice the energy of a 15-inch monitor. Fortunately, it slows down to a cool 10 watts in the power-saving mode. The power-down interval is user-programmable in steps of 5, 15, 30, and 60 minutes. However, the LaserJet 4 Plus has a large transfer drum that can take up to 30 seconds to warm up to operating temperature. During this period, the 4-Plus's built-in 2-megabyte RAM buffers the data to emulate normal operation. Thus, the software application that is sending print data doesn't realize that the printer is just warming up and not ready to print.

Green retrofits: a buyer's guide

Yes, it's great news that new computer equipment is finally energy efficient. But what about the millions of existing devices—older PCs, monitors, and printers—out there that were made before Energy Star that continue to suck up power and greenbacks at an alarming rate? Fortunately, there is a good selection of add-on products that can turn your system into a lean, green machine. These power controllers generally are connected in the line between the AC outlet and the monitor or printer. They interrupt the flow of current (which is the same thing as flipping the on/off switch) when the device is idle. All perform as promised, shutting down equipment to save power, but each goes about it in different ways. Some are specifically designed for monitors, while others target printers; some do both. Here's a look at six such energy savers.

Wattless VDU Power Saver

Wattless is a small unit designed to power-down the video display by monitoring keyboard and/or mouse activity (see Fig. 4). It is supplied with cables that you hook to your PC, monitor,

mouse, and keyboard. Thanks to a design that needs no software, the Wattless is the fastest and easiest of all power savers to install. A single slide switch located on the side of the case lets you choose a sleep time of 15, 30, or 60 minutes. If the Wattless doesn't detect any keyboard or mouse activity before the defined time expires, it shuts off power to its single AC outlet.

Unlike other power-saver controllers, which use a mechanical relay to switch the AC power on and off, the Wattless has a semiconductor relay built around a triac. The advantages are an inrush surge current of 90 amperes and zero-crossing switching that all but eliminates radio-frequency interference (RFI). However, the solid-state relay's continuous-current rating of three amperes is too low to handle a large-screen monitor and laser printer, too. A nice safety feature is a lamp on the side of the case that warns you if you have the polarity of the monitor's power cord reversed. The Wattless is priced at \$57, but is less with substantial discounts for volume buyers.

MonitorMiser

Like the Wattless, MonitorMiser is a hardware-programmable monitor controller that's extremely easy to install. The MonitorMiser sits in-line between the keyboard, PC, monitor, and AC outlet, and requires no tools or software to install. Power-down times of 10, 18, 26, or 42 minutes can be switch-selected. Power is restored to the monitor within moments of touching any key on the keyboard. While the MonitorMiser doesn't connect directly to the mouse or mouse port, it can detect mouse activity for the PS/2 mouse that is supplied with most Compaq computer systems and many PC clones. However, it can't trigger off a serial mouse. The unit can supply five amperes of continuous current, enough for the largest monitor plus a desktop laser printer. It is fuse-protected and priced at \$49.95.



WHERE TO BUY

After Dark
Berkeley Systems, Inc.
2095 Rose St.
Berkeley, CA 94709(510) 540-5535

Green Card
Micro Express
1801 Carnegie Ave.
Santa Ana, CA 92705
(800) 989-9900

Green Keeper
B&B Electronics
4000 Baker Rd.
Ottawa, IL 61350
(800) 346-3119

Hewlett-Packard Co.
DMO Organization
PO Box 58059
MS 511L-SJ
Santa Clara, CA 95051-8059
(800) 752-0900

LaserMiser
MonitorMiser
EMPAC Int'l Corp.
47560 Seabridge Dr.
Fremont, CA 94538
(510) 683-8600

MonitorManager
Alpha Micro Technologies
275 Lirac Ct.
Alpharetta, GA 30202
(404) 772-0707

PC Ener-g Saver
NEI
23052 Alicia Pkwy. H455
Mission Viejo, CA 92692
(800) 832-4007

Wattless VDU Power Save
Ergonomics Inc.
PO Box 964
Southampton, PA 18966
(800) 862-0102

FIG. 7—PC ENER-G SAVER INCLUDES A POWER STRIP specially designed to control the monitor and a laser printer independently. PC Ener-g Saver's software take only a couple minutes to install, and operates under DOS as a TSR utility or in Windows as a startup application.

LaserMiser

The companion to the MonitorMiser is the LaserMiser. The LaserMiser is a micro-processor-based energy-saving controller that saves electrical power by automatically switching laser printers on and off. By monitoring and analyzing the data stream passed from the PC to the printer, the LaserMiser learns your consumption patterns and uses it to shut down the printer intelligently. For example, if you typically print intensively for 15 minutes and don't print for several hours afterward, LaserMiser will remember this pattern and shut down the printer immediately after hard-copy printing is complete. If you tend to do a lot of randomly-timed screen printouts, on the other hand, LaserMiser remembers this pattern too, and waits a few minutes before powering down the printer. When the printer is off or powering up, the LaserMiser buffers data in its built-in RAM.

The LaserMiser is installed between a parallel port and a compatible laser printer, including stand-alone printers and networked print servers. Serial connections to the PC are made through an external adapter. LaserMiser requires no special tools or software to install. All time-out settings and options are entered with four DIP switches located on the front panel (see Fig. 5). Although pricey at \$149, LaserMiser is a

Is It Light or Dark Green?

As with most green terminology, there's some confusion about what constitutes a light green and a dark green machine. Actually, the answer depends on which part of the green process you're talking about. Inside the PC, light green refers to systems that rely strictly on the keyboard or mouse to wake them. Dark green PCs can wake up on any I/O activity that generates a signal-management interrupt, as would be the case if the modem received an incoming message.

The other light/dark term refers to the environmentally-sound steps taken during the manufacturing process. Some manufacturers define light green PC's as those with built-in power management, and dark green systems as those that are manufactured without the use of toxic or ozone-depleting chemicals. Whichever shade of green you use is not as important as thinking green and putting it into practice.

master at curbing the high cost of keeping a laser printer on call 24 hours a day, 365 days a year.

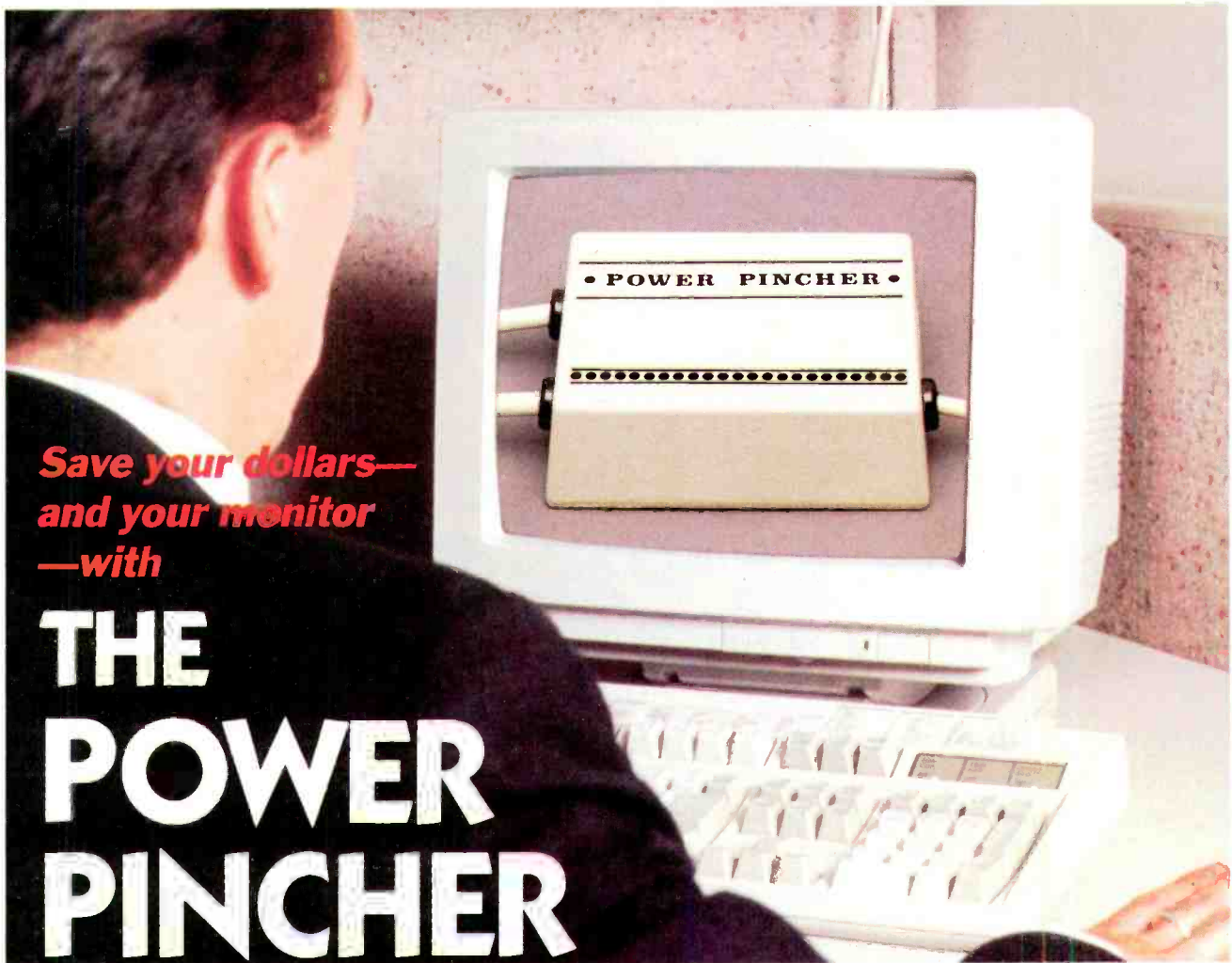
MonitorManager

If it's lowest cost you're looking for, there's no beating Alpha Micro Technologies' \$25 MonitorManager. Low cost doesn't mean low performance, here. Unlike many power savers, the MonitorManager works with or without a software driver—you decide. With the supplied software installed, the MonitorManager shuts down your monitor in two stages. If there is no keyboard activity within a defined time period of 1 to 9 minutes (5 minutes is de-

fault), MonitorManager first activates a screen saver. Three minutes after that, it shuts off power to the monitor. Without a software driver, MonitorManager shuts off AC power after 3 minutes.

Should you opt not to use MonitorManager's software driver, the unit will only monitor for keyboard activity. With the driver installed, it will trigger on both the mouse and the keyboard. Current output to the single AC outlet is 4 amperes, enough to handle a monitor and inkjet or dot-matrix printer, but insufficient for controlling a large-screen monitor plus office-quality laser printer.

Continued on page 48



**Save your dollars—
and your monitor
—with**

THE POWER PINCHER

WHETHER ELECTRIC POWER IS GENERATED by nuclear, hydroelectric, natural-gas, or coal-powered generators, one thing is for certain: it costs more today than it did yesterday. You can bet that it will cost more tomorrow than it does today.

If the thought of wasted electricity bothers you, you'll want to build the Power Pincher. It's a simple device that can monitor keyboard activity on an IBM-compatible personal computer. If no keys are pressed after a predetermined amount of time, the Power Pincher will cut off power to your monitor. Many new monitors and computer systems have this kind of power-down feature built right in. (See "Green PCs" on page 31 of this issue.) Power Pincher will give the same capability to an older system.

The complete Power Pincher circuit details, including foil

MICHAEL A. LASHANSKY

patterns for the PC board, are presented here. In addition, a complete kit of parts is available at reasonable cost. (See the Parts List.) Power Pincher can actually pay for itself in less than a year, and it might prolong the life of your monitor, too.

How it works

Figure 1 is a block diagram of the circuit, in which a low-frequency oscillator continually drives the input of a multistage binary counter. Whenever the count reaches the setting selected by DIP switch S1, the circuit turns triac Q3 off, thereby interrupting the flow of 120-volt AC current to the monitor.

A keyboard-monitoring circuit keeps the video monitor powered up during active use by resetting the counter every time

a key is pressed. As long as a key-press occurs before the time delay expires, the counter keeps resetting. Hence it never times out, and the monitor continues to receive power.

When the computer turns on, a routine in its basic input/output system (BIOS) polls the keyboard. The keyboard, in turn, sends a series of data pulses back to the microprocessor to indicate its status. The data line is normally high (+5 volts), and the pulses are low-going transitions. The first stage of the Power Pincher inverts the sense of the logic to normally low with high-going transitions.

Circuit description

The full Power Pincher circuit schematic is shown in Fig. 2. It consists of an input buffer (IC1-d), a peak detector (IC2 and Q1), a buffer stage (IC1-b and IC1-c), a programmable 24-stage bin-

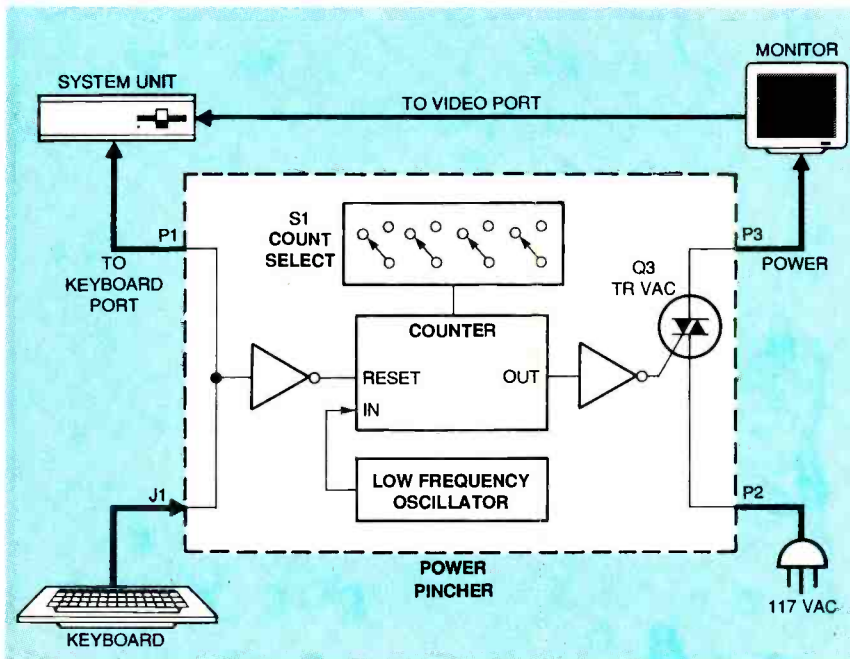


FIG. 1—BLOCK DIAGRAM OF THE POWER PINCHER: When the counter times out, the triac turns off and removes power from the monitor. The keyboard resets the counter every time a key is pressed, thus keeping the monitor powered up.

ary ripple counter (IC4), a triac (Q3), and an optoisolated driver (IC3).

The circuit monitors PC keyboard activity through five-pin

DIN connector J1. When the user presses a key, the keyboard sends a series of negative-going pulses on pin 3. Capacitor C2 couples the signal to NAND gate

IC1-d, which buffers it for use by op-amp IC2. In conjunction with Q1 and C3, the op-amp essentially functions as an integrator, which stretches the continually varying periods of the input pulses to a relatively constant period with a higher average DC value.

Inverters IC1-c and IC1-b buffer the peak detector's output to trigger IC4, an MC14536B programmable timer. Understanding the timer's operation is key to understanding the circuit; its block diagram is shown in Fig. 3.

The MC14536B

The MC14536B has two sets of dividers: an eight-stage block and a 16-stage block. The eight-stage block can be bypassed by setting pin 6 (8-BYPASS) high. The four binary inputs (A-D, pins 9 to 12) allow the user to specify which of the 16 counter stages then provides a monostable output via pin 13. (Table 1 shows the switch settings and corresponding output stages.) When the specified count oc-

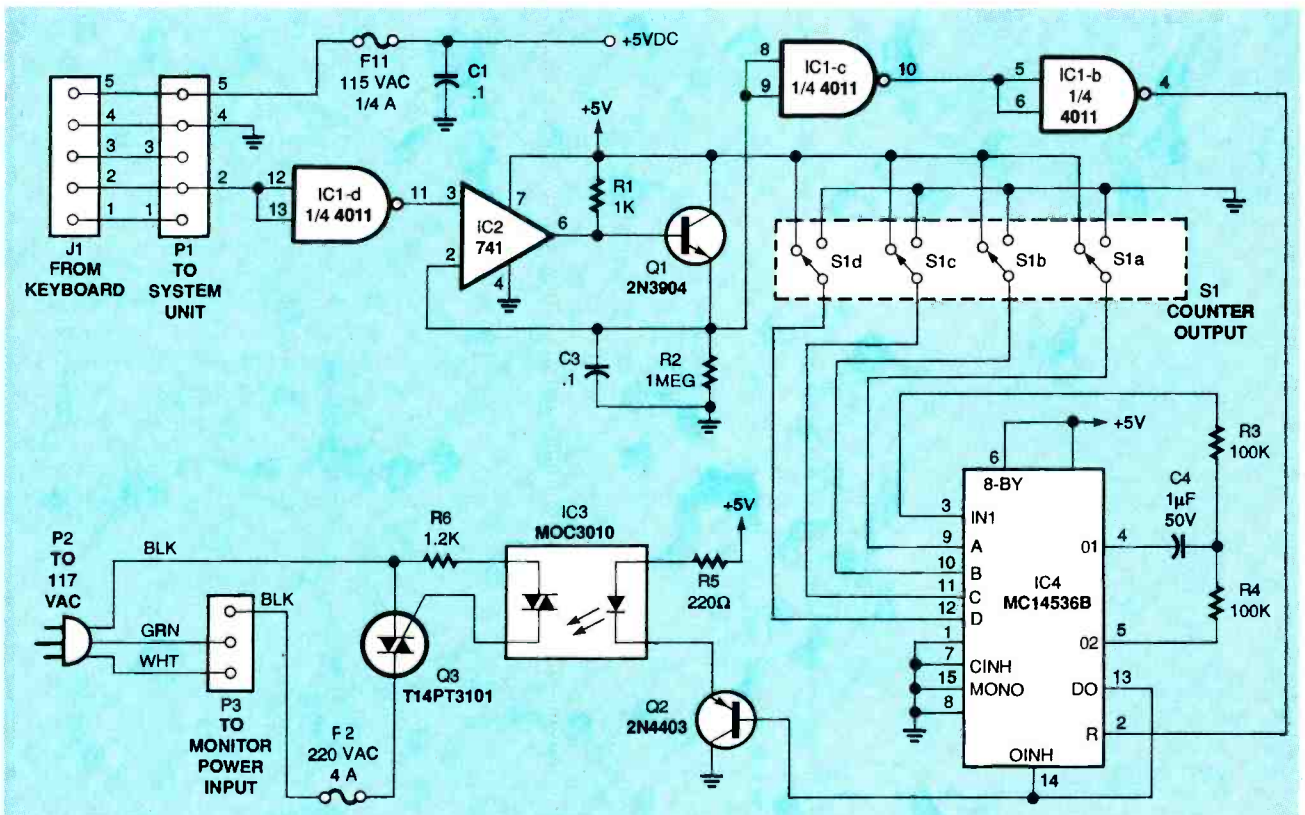


FIG. 2—COMPLETE SCHEMATIC: The circuit is built around an MC14536B, a 24-stage programmable counter.

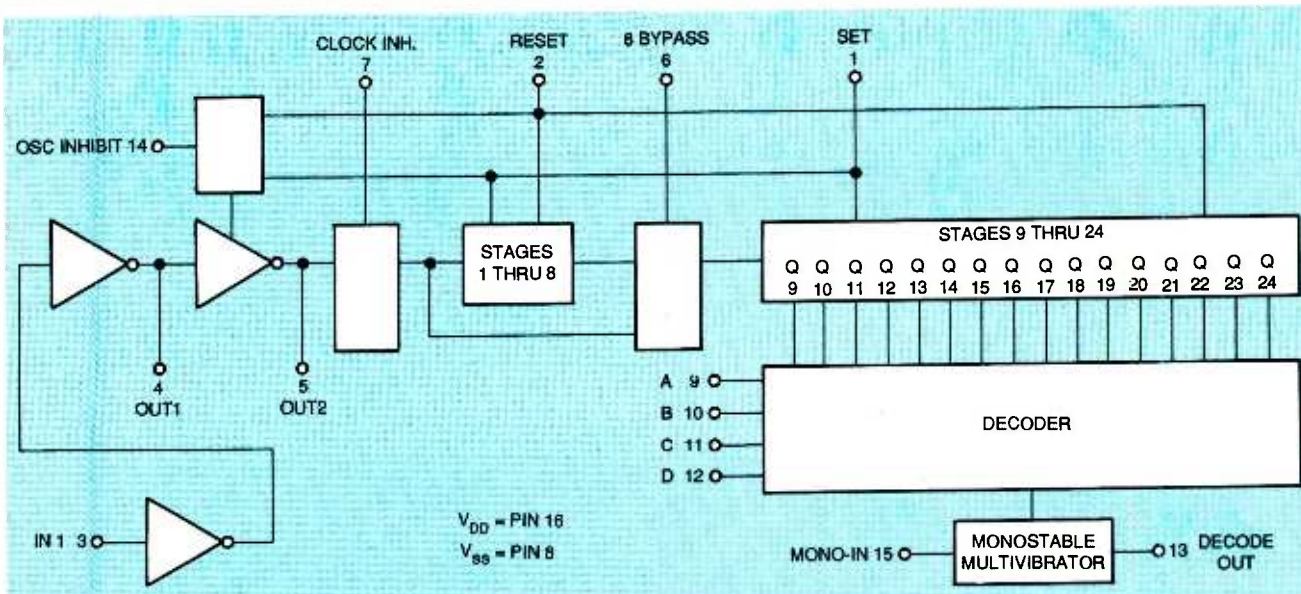


FIG. 3—BLOCK DIAGRAM OF THE MC14536B. Tie pin 6 high to bypass the first eight stages of the counter.

TABLE 1—MC14536B OUTPUTS AND SWITCH SETTINGS

DCBA	8-Bypass	Output	8-Bypass	Output
0000	1	1	0	9
0001	1	2	0	10
0010	1	3	0	11
0011	1	4	0	12
0100	1	5	0	13
0101	1	6	0	14
0110	1	7	0	15
0111	1	8	0	16
1000	1	9	0	17
1001	1	10	0	18
1010	1	11	0	19
1011	1	12*	0	20
1100	1	13*	0	21
1101	1	14*	0	22
1110	1	15*	0	23
1111	1	16	0	24

* = Recommended Settings

curs, pin 13 goes high, where it remains until the IC's RESET input (pin 2) goes from high to low, which in turn restarts the count cycle.

Input to the device can come from two sources: an external clock or an RC oscillator configured using the first few inverters in the MC14536B. The Power Pincher circuit uses the latter configuration. Returning to Fig. 2, the output frequency of the oscillator is given by the following equation:

$$f_O \approx 1 \div (2.3 \times R4 \times C4),$$

where f_O is in hertz, R4 is in ohms, and C4 is in farads. With the values specified, the circuit

provides a base frequency of about 4.4 Hz. The 4.4-Hz signal can then be divided down as many as 24 times, theoretically giving delays as long as about 16 hours. Table 2 shows approximate delay times for the first 16 stages.

The time delays produced by the circuit depend on the accuracy of R3, R4, and C4. For that reason, all times given in this article are approximate. If an accurate delay time is important to you, you could tweak the value of one or more of the timing components while monitoring the circuit's output frequency at pin 5 of IC4.

On power-up, the monostable output (DECODE OUT, pin 13) goes high. The Power Pincher circuit ties that output to the INHIBIT input (pin 14), which puts the device in a low-current standby mode. The rising edge of the reset pulse then causes the output to go low, thereby disabling the inhibit function.

The monostable output of the MC14536B drives PNP transistor Q2. As long as pin 13 is low, Q2 conducts and, in turn, drives optoisolator IC4. That device contains a complete Triac driver. When the triac is on, AC current is available to power a monitor. On the other hand, when pin 13 goes high, Q3 goes off, so does the optoisolator, so does the triac, and so does the monitor.

In addition to monitoring the keyboard's data line, Power Pincher taps power and ground through the keyboard connector, hence no dedicated power supply is needed. A fuse (F1) in series with the +5-volt supply line provides protection for the host PC. Another fuse, F2, protects the monitor from line surges.

Construction

Construction of the Power Pincher is straightforward. No special construction procedures are required, but building the circuit on a PC board is recommended. Foil patterns are

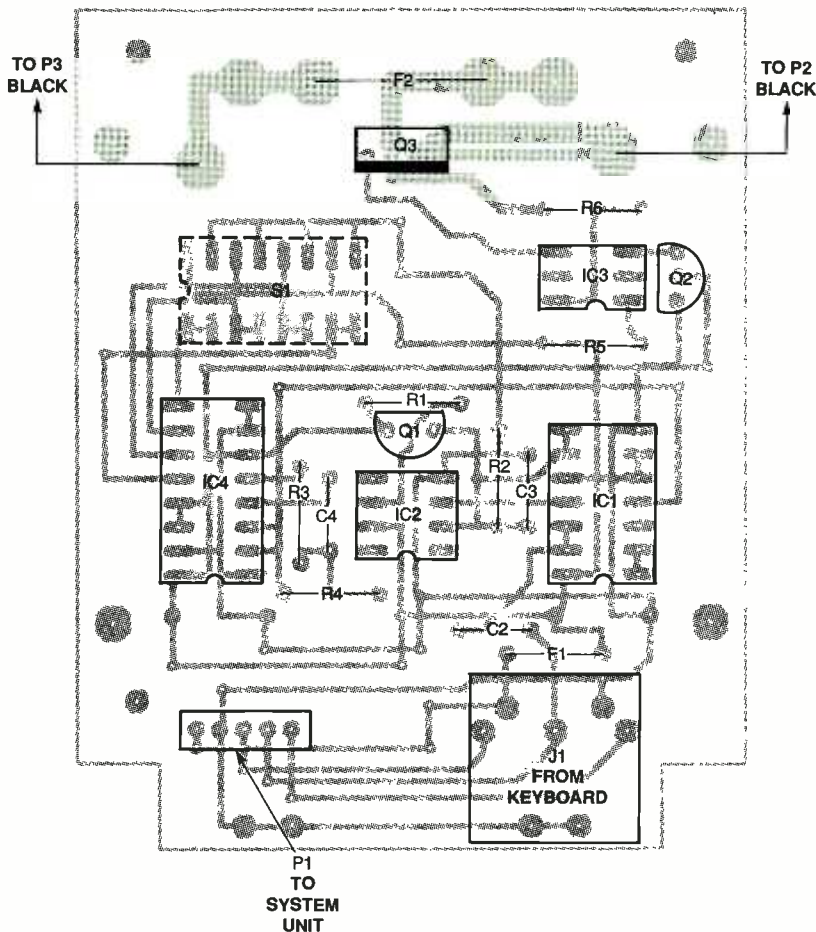


FIG. 4—MOUNT ALL COMPONENTS as shown here. Note that DIP switch S1 mounts on the foil side of the board.

shown here; you may also purchase a board from the source mentioned in the Parts List.

Start by mounting and soldering the lowest profile components first, gradually working your way up to the DIN connector J1 and the fuse holder for F2. The board provides two pad spacings to allow for standard fuse sizes. IC sockets are optional; unless you use premium-quality sockets, their installation is not recommended.

Make sure you mount Q3 in a vertical position; do not allow it to be bent over and accidentally apply 120 volts AC to the digital circuit! Unless you are pumping more than five amps through the triac, you won't need to use a heat sink. For the prototype, as shown in Fig. 4, board-mounted, noninsulated spade connectors were used to connect the black wires from the two power cables to the board.

Alternatively, you could solder the power wires directly to the board.

One line cord is terminated with a three-prong plug, the other with a three-pin socket, to mate with typical monitor power connectors. You might have to customize the P3 connector to match your monitor. Connect the ground (green) and neutral (white) wires of the two cables directly, or with insulated spades. Then connect the black wires to the PC board.

In the prototype, the keyboard was attached to a five-pin header block and matching connector. You could also solder those wires directly to the board.

You may have noticed a three-pin jumper in the photo. The jumper in the prototype ensured compatibility with older XT-class PC's. Because of the rarity of that type of machine these days, the jumper was eliminated from the final design.

One final construction note: Be sure to mount the DIP switch on the foil side of the board so that it can protrude through the hole in the case supplied with the Power Pincher kit.

PARTS LIST

All resistors are ¼-Watt, 5%, unless otherwise noted.

- R1—1000 ohms
- R2—1 megohm
- R3, R4—100,000 ohms
- R5—220 ohms
- R6—1200 ohms

Capacitors

- C1, C3—0.1 uF, 50 volts
- C2—100 pF, 50 volts
- C4—1 uF, ceramic

Semiconductors

- IC1—CB4011B quad NAND gate
- IC2—741 op-amp
- IC3—MOC3010 optoisolated triac driver, Motorola or equivalent
- IC4—MC14536B 24-stage binary counter, Motorola or equivalent
- Q1—2N3904 NPN
- Q2—2N4403 PNP
- Q3—T14PT3101 triac, Texas Instruments or equivalent

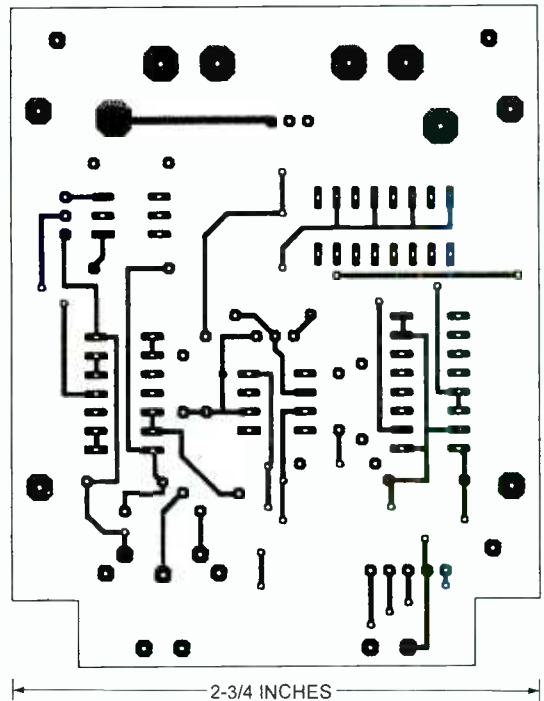
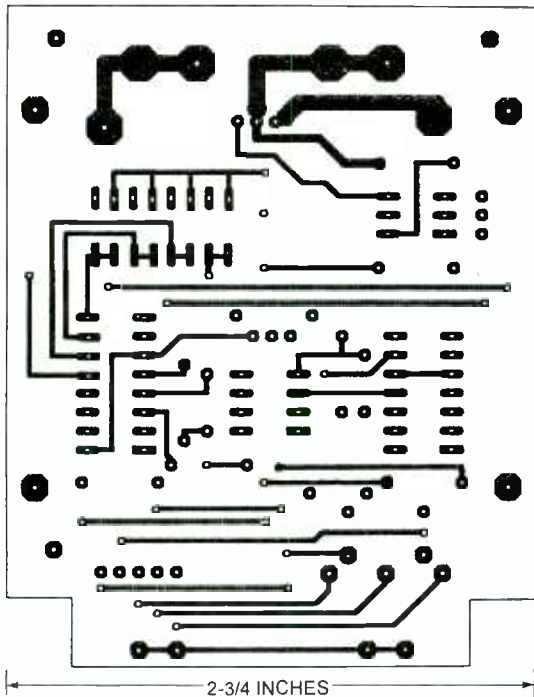
Other components

- S1—4-pole SPDT DIP switch
- F1—115 VAC, 250 mA, (Pico Fuse 251.250 or equiv.)

- F2—4A slow blow fuse
- J1—5-pin DIN jack for IBM compatible keyboard
- P1—IBM keyboard cable with 5-pin DIN connector on one end
- P2—AC line cord with male end
- P3—AC line cord with female end (or as required to match your monitor)
- Other—Fuse holder (2), 5-pin header with 0.1" spacing and mating connector, insulated male Panduit spade (2), insulated female Panduit spade (2), noninsulated male Panduit spade (2), strain reliefs (3), case (Unibox 01 or equiv.), pc board, mini DIN adapter, wire, solder, etc.

ORDERING INFORMATION

The following items are available from Eikim Electronics, 4142 Old Almonte Road, RR#4, Almonte, Ontario, Canada, K0A 1A0. (613) 256-0224. Kit of all parts listed above (\$45). Check or money order. Commercial orders welcome; quantity discounts available for assembled and tested units.



POWER PINCHER COMPONENT SIDE FOIL PATTERN.

SOLDER SIDE FOIL PATTERN.

TABLE 2—DELAYS PRODUCED BY STAGE

Stage	Hz	Seconds	Minutes	Hours
1	4.4	0	0	0
2	2.2	0	0	0
3	1.1	0	0	0
4	0.55	1	0	0
5	0.275	3	0	0
6	0.1375	7	0	0
7	0.06875	14	0	0
8	0.034375	29	0	0
9	0.017187	58	1	0
10	0.008593	116	2	0
11	0.004296	232	4	0
12	0.002148	465	8	0
13	0.001074	930	16	0
14	0.000537	1861	32	0
15	0.000268	3723	64	1
16	0.000134	7447	128	2

Why bother?

Consumers, the government, and industry, are all being forced to take a long, hard look at energy consumption patterns. Take your average computer monitor for example. If left running continuously for 24 hours a day, seven days a week, the yearly cost to run that monitor would be about \$145.

The chances are, however, that the monitor is used only sporadically throughout that period. If you assume that the monitor consumed energy only when it is really needed—about 15 hours per week—the cost would be reduced to only about \$15 yearly. On an individual basis, that's quite a cost reduction. When you scale those numbers to cover corporate and government use, savings mount up even more dramatically. For example, 100 continuously running monitors translates into \$13,000 of wasted power, and 1000 monitors wastes \$130,000 worth of electricity. Furthermore, those calculations include only direct operating costs, and ignore additional costs of air conditioning required to offset heat generated by the monitors. The U.S. Government considers wasted power to be of such concern that it has legislated that all computer monitors sold in the U.S. after 1998 must have an automatic shutdown feature. The Power Pincher can retrofit any PC clone computer to achieve those goals.

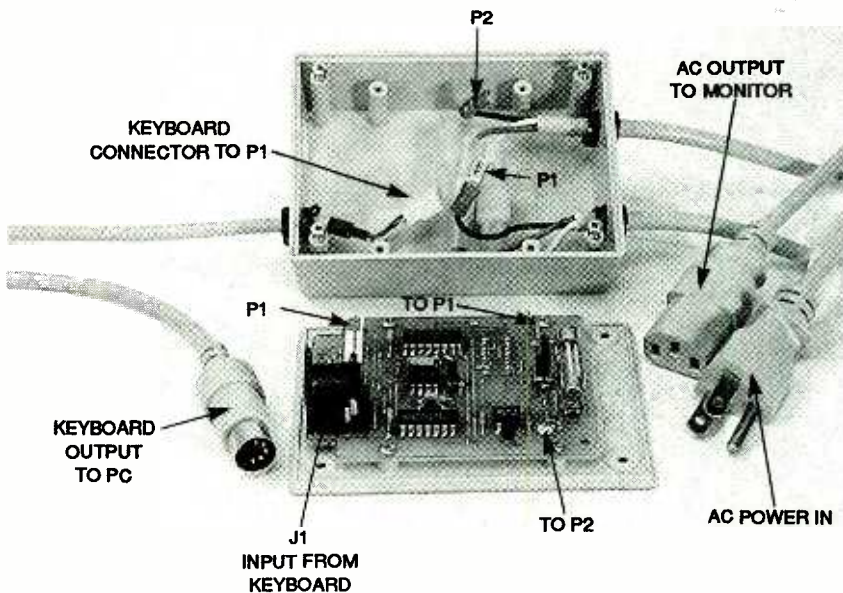
An additional benefit is that use of the Power Pincher can actually extend monitor life by decreasing the usage rate of CRT phosphors.

Checkout and calibration

After building the circuit, make sure that every component is mounted in the right place and with the correct orientation. Also check that all of your solder joints are perfect before you try to verify the Power Pincher's operation. Before you plug in the line cord, put the circuit into an insulated case. Because the circuit has 120 volts AC present at various points, it is easy to destroy the Power Pincher, your computer, or injure yourself if you are not careful.

Turn your computer off and plug its keyboard into J1. Then insert P1 into the keyboard port on your PC. (The kit of parts includes an adapter for the mini-DIN PS/2 style plug; use it if necessary). Next, unplug the monitor's line cord, plug the Power Pincher's female end into the back of the monitor, and the male end into the wall outlet. Leave your monitor switch in the on position.

Using Table 2 as a guide, set S1 for a short delay, say, 8 or 16 seconds. Then turn on the computer. The monitor should come



THE POWER PINCHER PROTOTYPE. Connectors installed on the PC board simplify connections to the keyboard and power cables.

on shortly after your keyboard is polled, and turn off shortly thereafter. Press a key; the monitor should come back on and begin a new delay. Repeat the process several times to verify that the Power Pincher is operating properly. Then set S1 for the desired delay. The author found the eight-minute setting most suitable.

Further notes

One concern that many people have about this kind of circuit is the effect of increased power cycling on a monitor's working life. Hence we contacted several major monitor manufacturers to get their recommendations.

The consensus is that all UL/CSA listed monitors have built-

in circuitry to dampen the effects of surges that occur when power is applied or removed. In general, monitors are rated to withstand 100,000 on/off sequences. If you assume that a monitor turns on and off a total of 10 times per day, five days per week, 50 weeks per year, that amounts to a 40-year life span. Thus the monitor will likely be obsolete before it is damaged from power cycling.

Another interesting fact surfaced: The Power Pincher will probably extend the useful life of the average monitor. The reason is that monitors become less efficient (they lose crispness, brightness, and focus) as the CRT phosphor is depleted. In simple terms, the longer electrons continue hitting the phosphor, the faster it will be affected. Screen-saver software can protect against image burn-in, but it does nothing to stop wear and tear on the phosphor. Thus, the only way to extend CRT lifespan is to remove power. In fact, a study done for the Canadian government revealed that useful monitor life could be increased from three to at least five years through the use of automatic power-down devices. Ω

GREEN PC'S

continued from page 42

Green Keeper

The most ambitious stand-alone power controller is Green Keeper from B&B Electronics. Green Keeper is completely software driven (there are no hardware defaults), which adds extra steps and time to the installation process. The software communicates with the Green Keeper unit via the keyboard cable to turn off the monitor after a user specified time. The software lets you create up to nine different shutdown scenarios. For example, you can program it to shut down after 15 minutes of inactivity between 8 AM and 12 noon. During your lunch break, a second event timer would kick in to turn your monitor off after

just one minute of inactivity. After that, a third timer would reset the time-out value back to 15 minutes for the rest of your workday. You can also set different time outs on different days (see Fig. 6).

In addition to monitoring the keyboard and mouse for activity, Green Keeper keeps an eye on your printer's activities. This prevents it from shutting down during times when the printer is active and the keyboard and mouse aren't. Green Keeper's 10-ampere load rating is robust enough to control a monitor, laser printer, and a desk lamp when used with a power strip. Its price is \$69.95, with price breaks on quantity purchases.

PC Ener-g Saver

Like the Green Keeper, NEI's PC Ener-g Saver is a software-

driven stand-alone power controller that monitors keyboard, mouse, and printer activity. However, PC Ener-g Saver takes power control one step further by providing separately switched outlets for the monitor and printer. The outlets are controlled by independent timers; this means that the printer can be shut off while the monitor is powered up, and visa versa. Users can select printer ports and printer warm-up time, and schedule the monitor and printer to turn off at the end of the day. PC Ener-g Saver also features a management report that audits energy use and costs. Total switching current is eight amperes, and the unit is fuse-protected. It's moderately priced at \$79.95. Like the other products mentioned here, PC Ener-g Saver will save you money in the long run. Ω

*Add text overlays to your home video
with this handy device.*



**BUILD THIS
VIDEO TITLER**

TEXT OVERLAYS CAN MAKE ANY VIDEO recording more valuable and informative. Now you can build a video titler to create your own text overlays or titles and add them to your home recordings. The video titler is a small, handheld device that can overlay black or white text on any composite video source. The overlay area consists of 12 rows of 24 characters per row or 6 rows of 12 characters per row of double-size characters. A maximum of 110 normal-size characters, including line feeds, can appear on the display at any one time, and a maximum of 72 double-size characters can appear.

To input text, any one of three interfaces can be used, all connected through a female DB9 connector. First, an IBM PC/AT type keyboard can be attached, allowing a user to type in overlays. Second, commands can be

DAN MICHELSON

input from an interactive RS-232 interface. Last, an RS-485 network-type interface is provided. The RS-485 interface conforms to the HCSII protocol used in the Circuit Cellar Home Control System Network.

Overlay text is stored and recalled from a 1024-bit EEPROM with non-volatile data storage. Character intensity and outline can be individually adjusted via software-controlled potentiometers (EEPOTs). The device is small in size, measuring only about 3 $\frac{3}{4}$ inches long, 2 $\frac{3}{8}$ inches wide, and 1 inch high.

The 87C055

The 87C055 microcontroller for television and video from Philips Semiconductor is the heart of the Video Titler. It is a derivative of the industry-stan-

dard 80C51 microcontroller. The 87C055's features include:

- 16K \times 8 one-time-programmable (OTP) EPROM
- 256 \times 8 RAM
- On-screen display (OSD) controller IC
- 128 \times 10 display RAM
- 60 \times 18 \times 14 character generator OTP EPROM
- Eight 6-bit pulse width modulators ICs
- One 14-bit pulse width modulator IC
- Two 16-bit timer/counters
- D/A converter/comparator with 3-input multiplexer
- Four high-current open-drain outputs
- Twelve high-voltage (+12V) open-drain outputs

Many of those resources are not used in the video titler circuit, but they could be useful to readers who can write their own software.

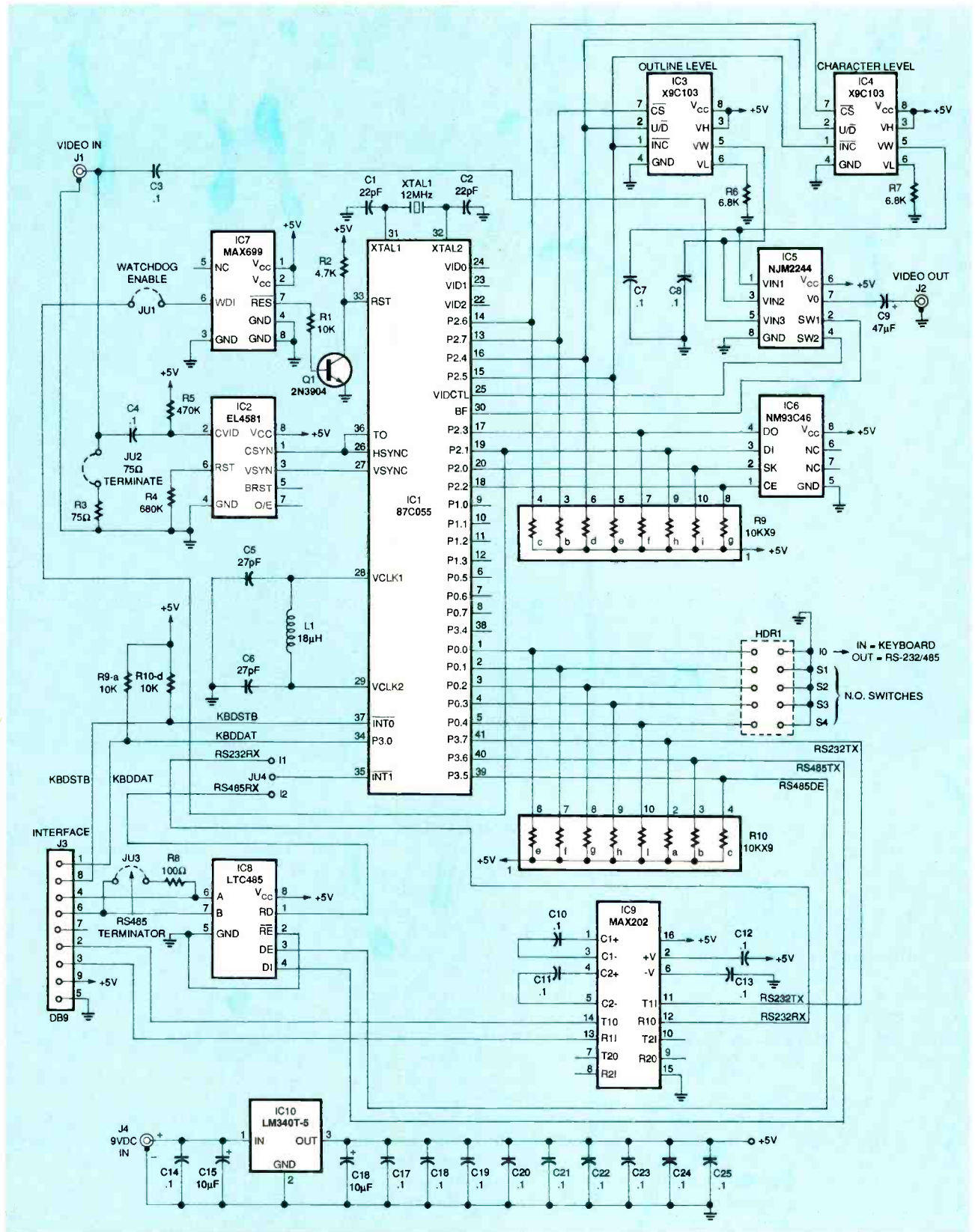


FIG. 1—SCHEMATIC OF THE VIDEO TITLER CIRCUIT. The power-on reset function is generated by IC7, a MAX699. That device supplies a reset pulse of 140–500 milliseconds at power-up.

erated by IC7, a Maxim MAX699 reset and watchdog pulse generator. That device supplies a reset pulse of 140–500 milliseconds at power-up. The watch-

Circuit description

Figure 1 shows the schematic

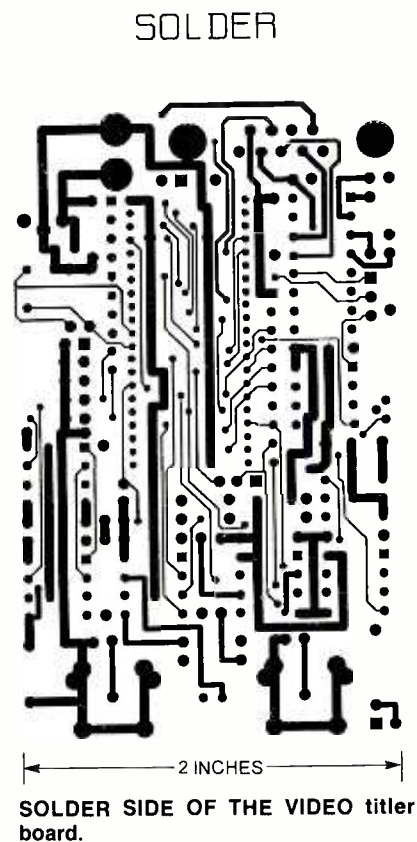
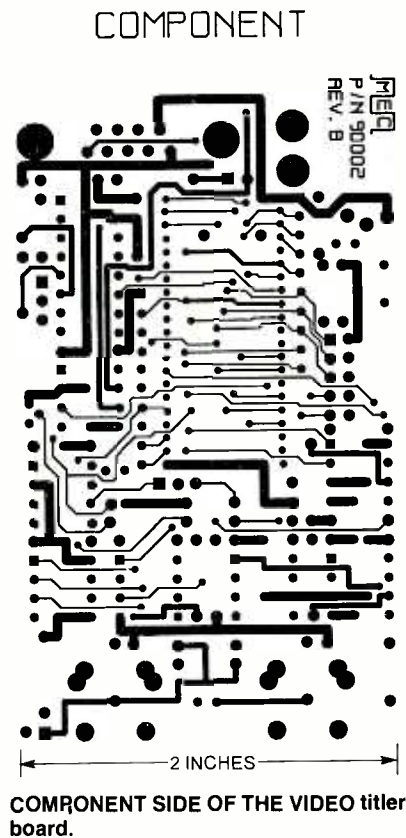
of the video titler circuit. The power-on reset function is gen-

dog function is enabled by tying the wdi input at pin 6 to a logic high or low; if the pin is left floating, the function is disabled. Therefore, if jumper JU1 is inserted, the watchdog function is enabled. This pin must be toggled a minimum of once a second, or the watchdog will time out and generate a reset to the processor. The reset from IC7 is inverted by transistor Q1 because microprocessor IC1 requires an active-high reset.

The overlay text must be synchronized, or *genlocked* to the input video. Genlocking is simply the synchronization of two video sources by locking horizontal and vertical timing together. This is accomplished with some external parts as well as the OSD controller in IC1. First, the horizontal and vertical sync from the composite video input is detected by IC2, which is set for NTSC specification horizontal and vertical synchronization timing via resistor R4.

The detected horizontal and vertical sync is fed to IC1. The OSD controller in IC1 uses these signals to internally synchronize the overlay text to the incoming video. The frequency of the dot clock is controlled by components L1, C5, and C6. Text is overlaid by video multiplexer IC5 which is controlled by IC1. This device has onboard input clamps and a 75-ohm output driver. The video input can be terminated to 75 ohms by shorting jumper JU2.

The overlay character outline and intensity are controlled via solid-state potentiometers IC3 and IC4 respectively. The solid-state potentiometers allow the microcontroller to control the position of their wipers and store the settings in an onboard EEPROM. This provides a self-contained, non-volatile, software-controlled potentiometer. The microcontroller's OSD logic controls the multiplexer timing from the BF (IC1, pin 30) and VIDCTL (IC1 pin 25) signals. The BF signal switches the video multiplexer between character and character-outline video, and VIDCTL switches the multiplexer between the input video



and the overlay video from IC1. The DC levels from IC3 and IC4 set the character and outline in-

tensity, and these levels are fed to video multiplexer IC5. The output of IC5's internal multiplexer is fed to an internal 75-ohm output driver and then output at pin 7.

The video titler can store and recall text from EEPROM IC6, which has enough capacity to store one overlay screen and other required data such as network address, horizontal and vertical overlay fine position, and type of interface.

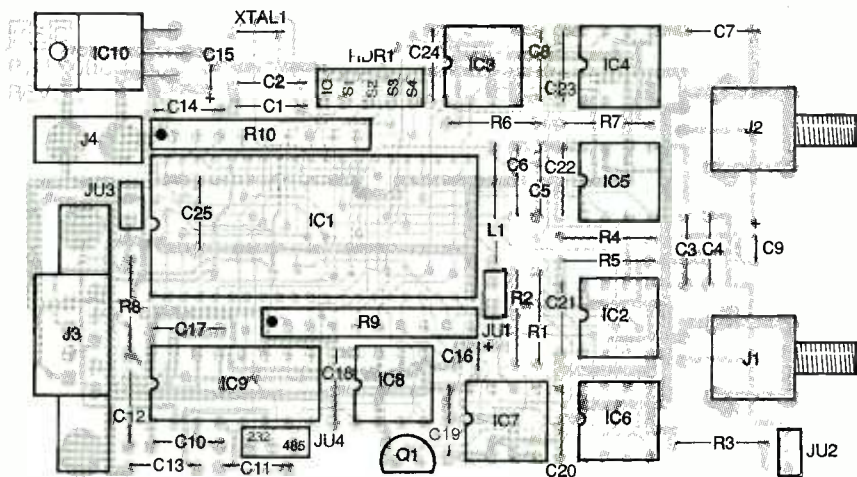
The RS-232 interface is provided by a MAX202 transceiver which contains two line drivers and two receivers. The device also contains a charge pump that allows it to generate +10-volt and -10-volt sources for the RS-232 interface from a single +5-volt supply. The RS-485 interface is provided by an LTC485 transceiver that provides both transmit and receive functions. The keyboard interface is basically a direct connection to the microprocessor. All three interfaces are attached through DB9 connector J3.

Construction

For best results, this project should be assembled on a printed circuit board. The microprocessor has pins on 0.070-inch centers. That makes the use of standard perforated construction board with 0.1-inch centers very difficult. You can make your own PC board from the foil patterns provided here, or you can buy one from the source given in the Parts List. A programmed microprocessor (IC1) is also available.

The binary code for IC1 is available as part of a ZIP file called VIDTITE.ZIP on the Gernsback BBS (516-293-2283, v.32, v.42bis) for those with access to a programmer. Because this is a one-time programmable (OTP) device, you get only one shot at programming it. Unless you have an emulator for the processor to debug your own code, the code from the BBS should be used. The code provides a flexible user interface.

The parts placement diagram is shown in Fig. 2. Insert all resistors, capacitors, and induc-



PARTS LIST

All resistors are 1/4-watt, 5%

- R1—10,000 ohms
- R2—4700 ohms
- R3—75 ohms
- R4—680,000 ohms
- R5—470,000 ohms
- R6, R7—6800 ohms
- R8—100 ohms
- R9, R10—10,000 ohms, SIP

Capacitors

- C1, C2—22 pF, ceramic
- C5, C6—27 pF ceramic
- C3, C4, C7, C8, C10—C14, C17—C25—0.1 μ F, ceramic
- C9—47 μ F, 16 volts, electrolytic
- C15, C16—10 μ F, 35 volts, radial electrolytic

Semiconductors

- IC1—P87C055BBPNB microcontroller (Philips—unprogrammed part available from Marshall or Hamilton Hallmark)
- IC2—EL4581CN video sync separator (Elantec—available from Marshall)
- IC3, IC4—X9C103P, 10K EEPROM (Xicor—available from Marshall or Hamilton-Hallmark)
- IC5—NJM2244D video multiplexer (NJRC—available from MEC)
- IC6—NM93C46N 1024-bit EEPROM (National—available from Digi-Key)
- IC7—MAX699CPA watchdog (Maxim—available from Digi-Key)
- IC8—LTC485CN8 RS485 transceiver (LTC—available from Digi-Key)
- IC9—MAX202CPE RS-232 transceiver (Maxim—available from Digi-Key)
- IC10—LM340T-5 voltage regulator, 5 volts, 1.5-amp
- Q1—2N3904 NPN transistor

FIG. 2—PARTS PLACEMENT DIAGRAM. Capacitor C24 is a tight fit, and must be offset slightly. One of the pins on jack J4 must be clipped off before mounting, and IC10 should be mounted flat against the board.

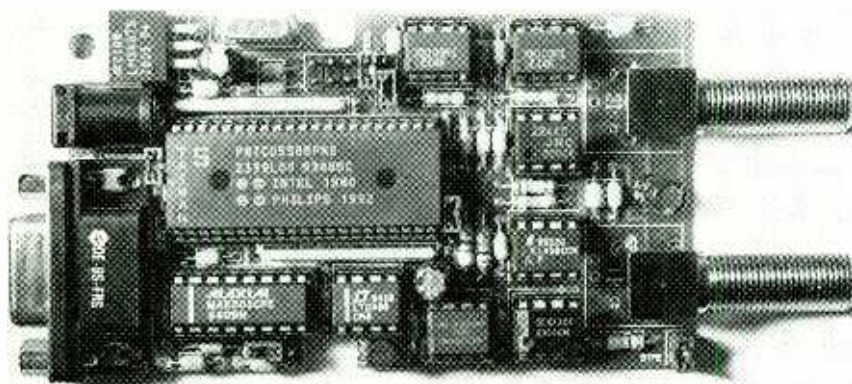


FIG. 3—THE COMPLETED BOARD. The leads should be trimmed to the length of the IC socket pins to allow the board to sit flat at the proper height in the enclosure.

tors first. Note that C24 is a tight fit, and must be offset slightly. Mount the parts as close to the circuit board as possible. Next, mount all of the IC sockets. Finish by mounting the rest of the parts. Note that one of the pins on jack J4 must be clipped off before mounting. Voltage regulator IC10 should be mounted flat against the board with its leads bent at 90 degrees. Figure 3 shows the completed board.

When all components have been soldered in place, the leads should be trimmed to the length of the IC socket pins to allow the board to sit flat at the proper height in the enclosure. If a stock enclosure is purchased instead of the pre-drilled one available with the kit, it must be modified before the input and output jacks can be installed.

For simplicity, the reader may wish to make the cutout for the DB9 rectangular rather than the DB9 shape. The pre-drilled enclosure from has the DB9 shaped cutout. Before installing the ICs, check power at each socket. When everything checks out, the ICs can be installed.

Cables

There are three possible interfaces and therefore three different cables. All three terminate in a female DB9 connector, J3. Figure 4 shows how to wire the three different cables.

Serial RS-232—The RS-232 serial cable is simply a one-to-one male-female DB9 cable that ties pins 2, 3, and 5 together. Only pins 2, 3, and 5 must be connected. Any RS-232 signals driven into other pins can cause damage. (See Fig. 4-a.)

PC/AT keyboard—Rather than make this cable from scratch, a readily available PC/AT keyboard extension cable be purchased and modified. Just about any computer supply store stocks these cables. By cutting off the male end (the one that does not mate with the keyboard) and installing a DB9 male connector, this cable can be assembled quickly. After cutting off the connector, the wires will have to be tested for con-

Other components

L1—22 μ H inductor, 5%
 J1, J2—right-angle female F connector

J3—DB9 right angle female J4—2 mm right angle power jack
 XTAL1—12 MHz crystal
 T1—9-volt DC, 200 mA adapter
 JU1—JU3—2 pin, 0.1-inch header
 JU4—3 pin, 0.1-inch header
 HDR1—10-pin, 5-position, 0.1-inch header

Miscellaneous: Seven 8-pin DIP sockets, one 16-pin DIP socket, one 42-pin shrink DIP socket for IC1, six shorting jumpers for I0—I2 and STP1—STP3, Enclosure (Pactec Model HM drilled for fit), PC board, two male "F" connector to RCA female phono jack adapter, RCA video cables.

Note: The following items are available from MEC, 1036 Marshall Drive, Des Plaines, IL 60016:

- Printed Circuit Board and full assembly documentation (VTKIT 1)—\$25.00
- Programmed 87C055 Microprocessor, Printed Circuit Board, and full assembly documentation (VTKIT 2)—\$65.00
- Partial kit (contains PC board, programmed microprocessor, all parts that mount on the PC board, and full assembly documentation (VTKIT 3)—\$159.00
- Complete kit (contains PC board, programmed microprocessor, all parts that mount on the PC board, pre-drilled enclosure, wall transformer, and full assembly documentation (VTKIT 4)—\$179.00

Check or Money orders only. Illinois residents add 8.25% sales tax. Add \$4.00 to all orders for shipping and handling.

tinuity to determine which pin goes to which wire. (See Fig. 4-b.)

RS-485—RS-485 generally involves connecting network wires to a terminal block. Since the board space did not make this practical, the RS-485 connections were assigned two pins on the female DB9 connector J3. The reader can connect these in any manner that makes sense in the chosen network environment. (See Fig.

4-c.) Details on RS-485 operation are contained in the ZIP file available on the Gernsback BBS (516-293-2283, v.32, v.42bis).

The first power-up

On first power-up, the software will initialize the EEPROM (IC6) checksum, set the EEPROMs (IC3 and IC4) to default intensities, and overlay the video titler character set on the display. Connect a noise-free composite video source such as that from a video camera to the video input connector J1. Next, connect video output J2 to a com-

posite video monitor or the video input of a VCR whose output is connected to a TV. Install jumpers for JU1—JU4 and HDR1 as needed for the type of interface you are using (see Fig. 5). For the first power-up, a serial RS-232 or keyboard interface should be used.

The cable for the chosen interface should be attached to J3 and connected to the keyboard or RS-232 serial device (a "dumb" terminal or PC running a terminal-emulation program) Plug the wall-mount adapter into an outlet and insert its DC

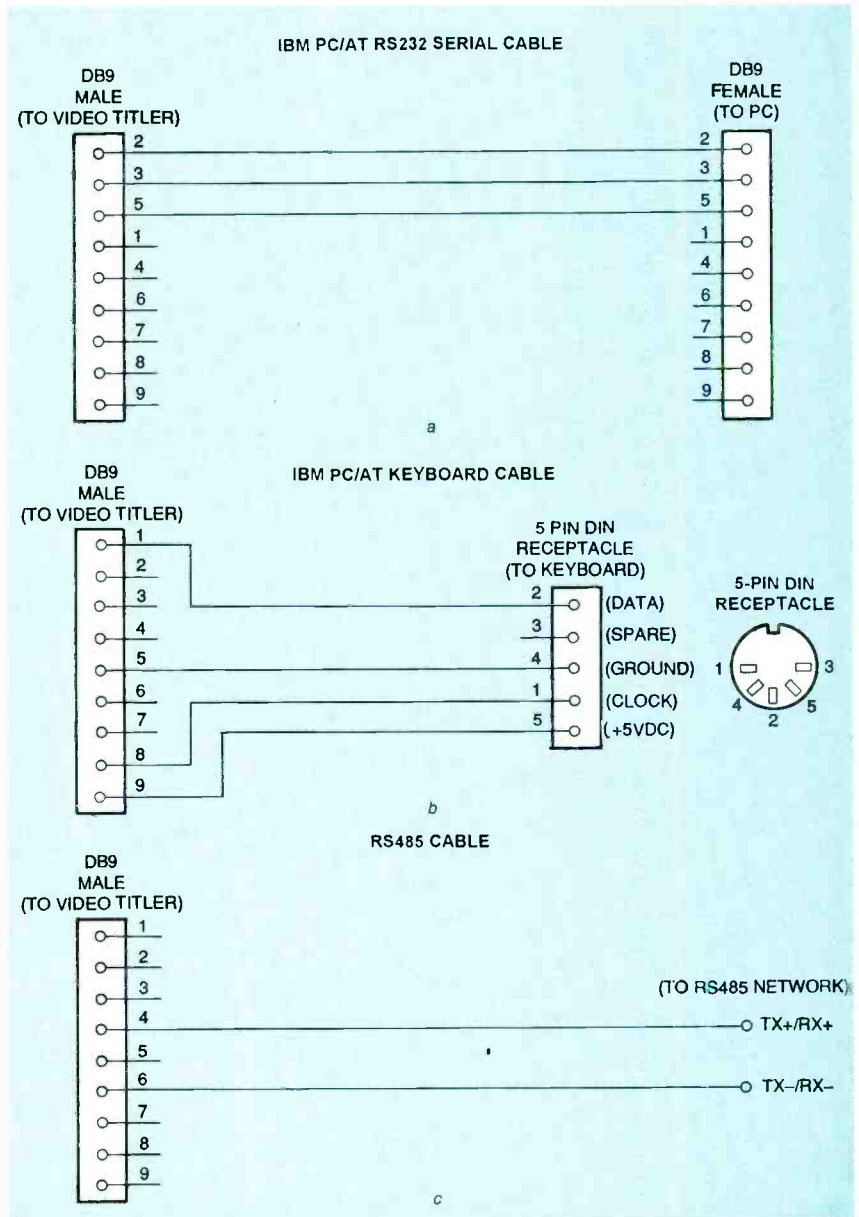


FIG. 4—THERE IS A DIFFERENT CABLE for each interface. The RS-232 serial cable is shown in a, the PC/AT keyboard cable is shown in b, and the RS-485 cable is shown in c.

TABLE 1—CONTROL-KEY FUNCTIONS



Enter Edit Mode

Automatically clears the screen and places the cursor at line 1, column 1. Once in the Edit mode, overlay text can be entered.



Exit Edit Mode With No Overlay Save

Exits the Edit mode and no further editing of characters on the screen can occur. No Overlay data is saved.



Exit Edit Mode and Save Overlay

Exits the Edit mode and saves the current overlay data. This includes the fine horizontal and vertical position.



Recall Overlay

Recalls the stored overlay data and puts it on the screen. This function is not available in Edit mode.



Clear Overlay

Removes all overlay data from the screen.



Increment Character Intensity

Increases the intensity of the overlay character video. The increments are small, so many keystrokes may be required. The key can be held down for a repeat increment. Each new setting is stored.



Decrement Character Intensity



Increment Character Outline Intensity



Decrement Character Outline Intensity



Turn Overlay Display Off



Turn Overlay Display On



Display Character Set

This function is not available in Edit mode.



Wipe On Effect From Top to Bottom

The current overlay is turned off, and then repainted from the top to the bottom of the screen. This has the same effect as turning on the overlay display (F11). The presentation is the only difference.



Wipe On Effect From Bottom to Top

The current overlay is turned off, and then repainted from the bottom to the top of the screen. This has the same effect as turning on the overlay display (F11).



Wipe Off Effect From Top to Bottom

The screen will redisplay the current overlay if it is off, then it will begin removing the overlay from the top to the bottom of the screen. This has the same effect as turning off the overlay display (F10).



Wipe Off Effect From Bottom to Top

The screen will redisplay the current overlay if it is off, then it will begin removing the overlay from the bottom to the top of the screen.



Set Double Size Character Height/Width

Characters are set to double height/width, allowing 6 rows of 12 characters per row. If the screen already has more than 6 rows or 12 characters in a row, this key sequence will cause distortion on the display. (This is a limitation of the video controller.) The screen must either be in a 12-character-per-row, 6-line format, or must be cleared before using this key sequence.



Set Normal Size Character Height/Width

Sets characters to the normal size, allowing 12 rows of 24 characters per row. This function is not available in Edit mode.



Overlay Display Blink On

The overlay display will begin blinking.



Overlay Display Blink Of

The overlay display will stop blinking if it is currently doing so. The overlay display will be left in the on state.



Go to New Line

Move to the first column of the next line on the display. If Edit mode is not active, this key is ignored.



(Back Space) Move Cursor Left and Erase

If the cursor is in column 1 when the keystroke is received, it will move up to the end of the preceding line. If Edit mode is not active, this key is ignored.



Move Overlay Screen Position Left

Moves the entire overlay screen to the left by 4 character dots. This is used for fine horizontal positioning of the overlay characters.



Move Overlay Screen Position Right

Moves the entire overlay screen to the right by 4 character dots.



Move Overlay Screen Position Up

Moves the entire overlay screen up by 4 horizontal lines. This is used for fine vertical positioning of the overlay characters.



Move Overly Screen Position Down

Moves the entire screen down by 4 horizontal lines.

power connector into J4. The display should initialize to the power-up default overlay screen which displays the titler's character set.

The character set is programmed into the 87C055 microprocessor's EPROM. The set contains alpha-numeric as well as some special characters. The characters can range from white with a black outline to black with a white outline. The characters are not reprogrammable. Once the characters are programmed in the EPROM of the microcontroller, they are fixed.

If a keyboard was chosen as the interface, it should be functional at this point. If a serial RS-232 interface was chosen, a banner should appear on the display of the connected terminal or PC.

Interfaces

With an IBM PC/AT keyboard attached, the user can simply type-in overlays and manipulate them in various ways. An interactive RS-232 interface provides a prompt that allows the entry of commands.

When using the keyboard interface, in addition to the standard alphanumeric keys, certain function keys are recognized. The function keys are outlined in Table 1. If you press the F1 key, the video titler will respond by clearing any overlay present and put a cursor in the upper left corner of the display in row 1, column 1. At this point, any of the character set keys shown in Table 2 can be typed.

When column 24 of any line is reached, the next character will roll to the next line in the column 1 position. When the cursor is at column 1, the backspace key will move the cursor back to column 24 of the previous line.

RS-232 serial interface

The RS-232 interface can be used in a Network or Interactive mode. It is, however, mainly meant to be used with the Interactive mode.

In the Interactive mode (NO), a "dumb" terminal can be at-

INTERFACE SELECTION

HDR1	JU4		Interface
	I0	I1 I2	
In	X	X	Keyboard
Out	In	Out	RS232
Out	Out	In	RS485

X = DON'T CARE

WATCHDOG GENERATION

JU1	Function		
In	Watchdog	Timer	Enabled
Out	Watchdog	Timer	Disabled

VIDEO ENPUT TERMINATION

JU2	Function
In	Video Input Terminated To 75 Ohms
Out	No Video Input Termination

RS485 TERMINATION

JU3	Function
In	RS485 Terminated To 100 Ohms
Out	RS485 Not Terminated

FIG. 5—JUMPERS MUST BE INSTALLED for JU1–JU4 and HDR1 according to the type of interface you are using.

- 1) Pkut the Titler in Edit mode
 - 2) Send: "THIS IS A TEST" "
 - " OF THE VIDEO "
 - " TITLER "
 - 3) Exit the edit mode.
- ```
TERMO >S=AOTHIS_IS_A_TEST\O_OF_THE_VIDEO\O__TITLER\A1<CRET>
KEYS ENTERED
```

PROMPT  
FROM TITLER

- 1) Turn off the overlay display
  - 2) Put the Titler in Edit mode
  - 3) Send: " HELLO WORLD" "
  - " THIS IS A TEST "
  - 4) Exit the edit mode
  - 5) Wipe the message onto the screen from top to bottom
  - 6) Start the message flashing
- ```
TERMO >S=VO\AO ____HELLO_WORLD\O__THIS_IS_A_TEST\A1\KO\NO<CRET>
KEYS ENTERED
```

PROMPT
FROM TITLER

FIG. 6—THE INTERACTIVE MODE is the easiest way to set up the Titler. Some examples in the RS-232 Interactive mode are shown here.

TABLE 2—CHARACTER SET

Hex Value	ASCII Char.	Titler Function	Hex Value	ASCII Char.	Titler Function
00	NUL	Not Used	40	@	@
01	SOH	Not Used	41	A	A
02	STX	Not Used	42	B	B
03	ETX	Not Used	43	C	C
04	EOT	Not Used	44	D	D
05	ENQ	Not Used	45	E	E
06	ACK	Not Used	46	F	F
07	BEL	Not Used	47	G	G
08	BS	Not Used	48	H	H
09	HT	Not Used	49	I	I
0A	LF	Not Used	4A	J	J
0B	VT	Not Used	4B	K	K
0C	FF	Not Used	4C	L	L
0D	CR	Reserved in Serial	4D	M	M
0E	SO	Not Used	4E	N	N
0F	SI	Not Used	4F	O	O
10	DLE	Not Used	50	P	P
11	DC1	Not Used	51	Q	Q
12	DC2	Not Used	52	R	R
13	DC3	Not Used	53	S	S
14	DC4	Not Used	54	T	T
15	NAK	Not Used	55	U	U
16	SYN	Not Used	56	V	V
17	ETB	Not Used	57	W	W
18	CAN	Not Used	58	X	X
19	EM	Not Used	59	Y	Y
1A	SUB	Not Used	5A	Z	Z
1B	ESC	Not Used	5B	[Not Used
1C	FS	Not Used	5C	\	Reserved in Serial
1D	GS	Not Used	5D]	Not Used
1E	RS	Not Used	5E	^	Not Used
1F	US	Not Used	5F	_	Not Used
20	SP	Space	60	`	Not Used
21	!	Reserved in Serial	61	a	A
22	"	Reserved in Serial	62	b	B
23	#	Reserved in Serial	63	c	C
24	\$	\$	64	d	D
25	%	%	65	e	E
26	&	&	66	f	F
27	.	.	67	g	G
28	((68	h	H
29))	69	i	I
2A	*	*	6A	j	J
2B	+	+	6B	k	K
2C	,	,	6C	l	L
2D	-	-	6D	m	M
2E	.	.	6E	n	N
2F	/	/	6F	o	O
30	0	0	70	p	P
31	1	1	71	q	Q
32	2	2	72	r	R
33	3	3	73	s	S
34	4	4	74	t	T
35	5	5	75	u	U
36	6	6	76	v	V
37	7	7	77	w	W
38	8	8	78	x	X
39	9	9	79	y	Y
3A	:	:	7A	z	Z
3B	;	;	7B	{	Not Used
3C	<	<	7C		Not Used
3D	=	=	7D	}	Not Used
3E	>	>	7E	~	Not Used
3F	?	?	7F	DEL	Not Used

tached and commands can be given. In either case, jumpers must be installed on the board in the proper positions for the RS-232 interface selection (see Fig. 5 for details on setting the jumpers).

The pins on Header 1 (HDR1) marked S1–S4 are for connecting jumpers or external switches to activate certain functions. If external switches are going to be used, they should be of the normally open SPST-type. The switch inputs are read via the "Q" command from the serial interface. Only switch closures since the last Q command are reported.

The Interactive mode can be selected at power-up by closing the S2 contacts. It can also be selected from the Network mode by generating command NO. The interface can then be changed to RS-232 via jumpers and a "dumb" terminal can be attached.

When used in the Network mode, the address and optional checksum portion of the command string is required. If the Interactive mode is selected, the address and optional checksum are omitted. When the Interactive mode is selected, a sign-on screen will be sent to the terminal along with a prompt that indicates the Network address. The address defaults to TERMO at the first power-up. The Interactive mode is the easiest way to set up the Titler. Some examples in the RS-232 Interactive mode are shown in Fig. 6.

Power-up overrides

At power-up, certain override functions can be performed by closing S1 and S2. If S1 is closed at power-up, the titler will force all parameters to their defaults. This will put the video titler's default character set on the display, set the address of the unit to TERMO, and the mode of the unit will be Interactive. This is a good way of forcing a start from a defined point if everything else you try fails. If S2 is closed at power-up, the titler will assume Interactive mode of operation. This is equivalent to entering the "NO" command from the Network mode.

POWER SEMICONDUCTORS

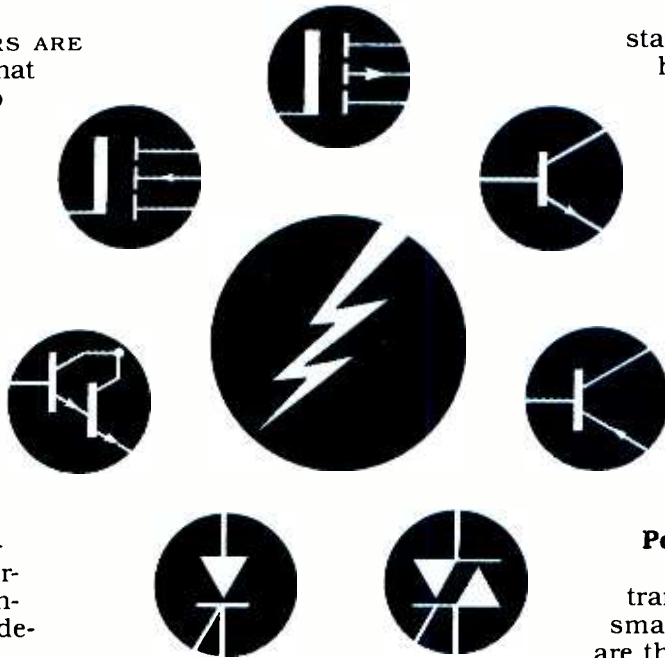
POWER SEMICONDUCTORS ARE semiconductor devices that have been designed to handle or switch power. They include bipolar and field-effect transistors, thyristors, solid-state relays and a fairly new class of device called the power ICs.

There is no industry-accepted definition that will apply to all power semiconductors. However, most should be capable of passing at least 1 ampere of current or handling 1 watt of power during normal operation without being damaged or destroyed.

Some semiconductor devices are rated for handling voltages and currents that are far beyond those normally encountered in electronics. They are more properly classed as electrical power and distribution components, but there is no agreement on the boundaries between those classifications. They are best determined by their applications.

Many people think of power semiconductors as components found only in automotive, industrial, and military circuits, but they are now found in many consumer appliances, entertainment products, and business machines. Not so long ago it was easy to distinguish a power semiconductor device from a small-signal device—they were in metal cases.

Today, a surprisingly large number of mid- and low-range power devices are packaged in plastic cases because of the development of improved, low-cost plastic cases that will with-



NEIL SCLATER

Semiconductors from transistors and thyristors to solid-state relays and integrated circuits have been designed to switch high currents and voltages, making them power devices.

stand thermal stress. Some have metal tabs that function both as heat-sinks and mounting surfaces.

Power transistors

Three types of discrete transistors qualify as power transistors: power bipolar junction transistors (BJT), power bipolar Darlington transistors, and power MOSFETs.

Power bipolar transistors

Power bipolar junction transistors (BJT), like their small-signal counterparts, are three-layer, three-terminal devices formed by adding a second junction to a two-layer diode chip. Figure 1 is the schematic symbol for an NPN BJT; it is the same symbol as that for a small-signal BJT. Power BJTs also have emitter, base, and collector terminals. In normal operation, the emitter-to-base junction is biased in the forward direction, while the collector-to-base junction is reverse-biased.

Electrons flow from the emitter to the collector in all BJTs (opposite the flow of conventional current). However, the outward-pointing arrowhead in Fig. 1 shows the direction of conventional current. Figure 2 is the schematic symbol for a power PNP BJT. Here electron flow and conventional current are reversed. This can be seen from the inward direction of the arrowhead. (For more information on all BJTs refer to the September 1993 *Electronics Now*, page 57.)

Both kinds of power BJTs are

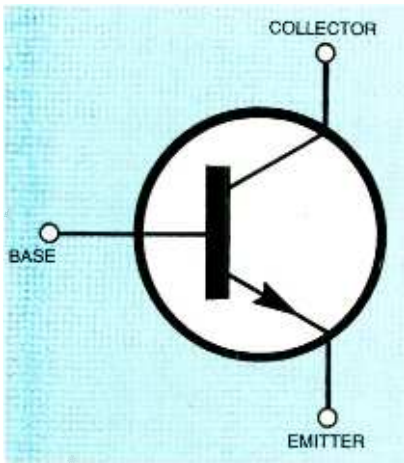


FIG. 1—SCHEMATIC SYMBOL for an NPN power bipolar junction transistor (BJT).

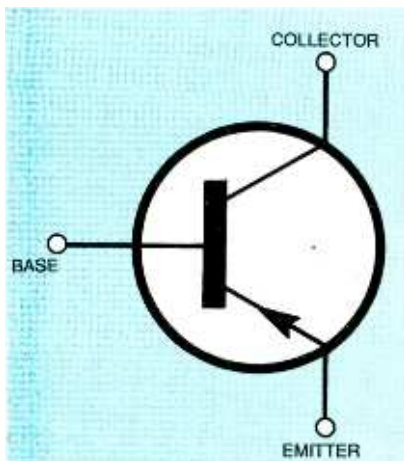


FIG. 2—SCHEMATIC SYMBOL for a PNP power bipolar junction transistor (BJT).

made as two parallel PN junctions with controlled spacing between their junctions and controlled impurity levels on both sides of each junction. This is shown in Fig. 3, the functional diagram for an NPN showing the polarities for conventional operation.

In power BJTs, *structure* refers to the junction depth, the concentration and profile of the impurities (doping), and the spacing of the various levels of the device. Figure 4 is a cross-section view of an NPN BJT formed as a vertical silicon structure. The collector terminal is at the base of the chip, but both the base and emitter terminals are on the top.

The term *geometry* refers to the topography of the transistor, that is, the way the various doped parts of the tran-

sistor are formed on the silicon chip or die.

The applications for power BJTs are influenced by their structure, geometry, and packaging. When selecting a power BJT, the circuit designer must consider gain, frequency, voltage, current, and the heat dissipation characteristics of the device.

BJT structures

Various power transistor structures have been developed to provide different electrical and thermal characteristics at different price levels. Each has advantages and disadvantages or compromises. BJT structures can be classified in terms of the number of diffused layers, the use of an epitaxial base, or combinations of these.

Some power BJTs have a *mesa* structure and others have a *planar* structure. In text-

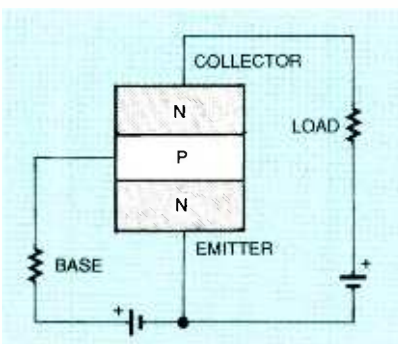


FIG. 3—FUNCTIONAL DIAGRAM of an NPN power bipolar junction transistor (BJT).

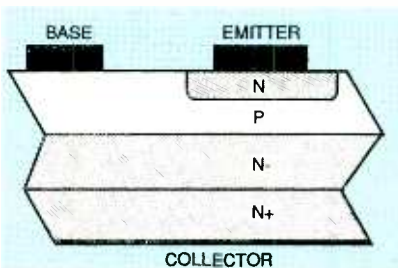


FIG. 4—SECTION VIEW of an NPN power bipolar junction transistor (BJT) with a vertical structure.

books and manufacturers' data books you will see references to specific structures:

1. Single-diffused (hometaxial)
2. Double-diffused (mesa, planar, epitaxial mesa, planar mesa, and multiple epitaxial mesa)

3. Triple-diffused (mesa and planar)

4. Epitaxial-base (mesa)

5. Multiple-epitaxial base (mesa)

A discussion of these structures and how they are formed is beyond the scope of this article. However, each of these structures has its own set of characteristics that make them suitable for handling high voltages, current, and power. Some structures are best suited for power switching while others function better as large-signal amplifiers including radio frequency (RF) amplification.

There also economic considerations. Some structures cost more to manufacture than others and this is reflected in their pricing. If a metal case is required, or a wider operating temperature is needed, expect to pay more for the device.

Power BJTs are specified in terms of the following parameters:

1. Voltage rating, collector-to-emitter.
2. Current rating of the collector.
3. Power rating.
4. Switching speed.
5. Direct-current gain.
6. Gain-bandwidth product.
7. Rise and fall times.
8. Safe operating area (SOA).
9. Thermal properties.

Power switching BJTs

The popularity of the switching or switchmode power supply has created a heavy demand

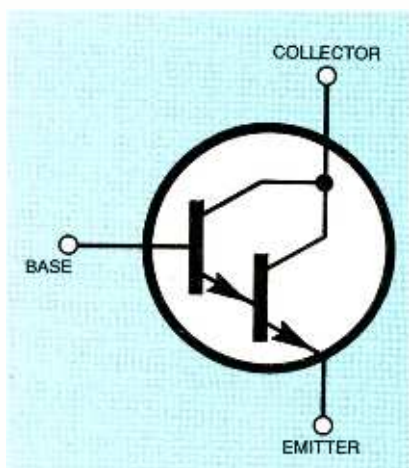


FIG. 5—SCHEMATIC SYMBOL for a power Darlington transistor.

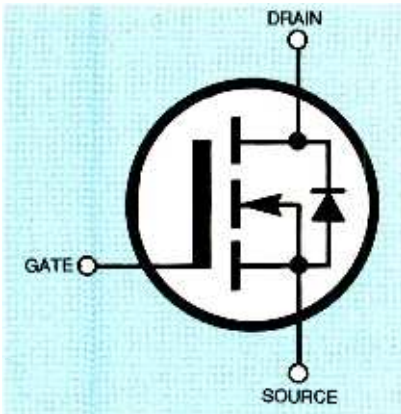


FIG. 6—SCHEMATIC SYMBOL for an N-channel power MOSFET.

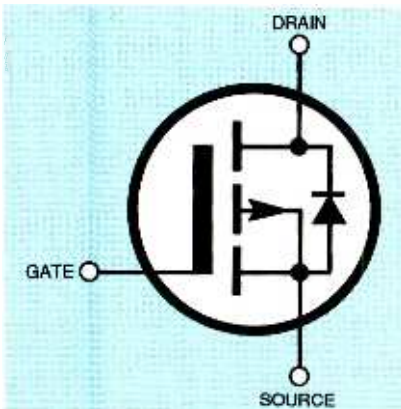


FIG. 7—SCHEMATIC SYMBOL for a P-channel, enhancement-mode power MOSFET.

for power BJTs that are capable of switching at frequencies greater than 10 kHz. To qualify for switchmode power supplies, the power BJT must be able to withstand voltage that is typically twice the input voltage.

The BJT must have a collector current rating and safe operating area (SOA) that are high enough to prevent the device from being damaged or destroyed in its intended application. The SOA quantifies the ability of the power BJT to handle high currents and voltages simultaneously.

A power BJT operated at high power densities can fail due to second breakdown. This occurs when current concentrates in a small area of the chip, causing its temperature to rise rapidly. The emitter-collector voltage could drop more than 10 volts. Input power must be shut down quickly when second breakdown occurs to prevent the BJT from being damaged or destroyed.

Darlington power transistor

Figure 5 is the schematic symbol for a Darlington power transistor. A Darlington power transistor consists of two bipolar power transistors on a single chip that are DC coupled internally as emitter followers. Because they are packaged in discrete cases with three pins, they look like conventional power BJTs. Power Darlington offers higher input resistance and current gain than individual BJTs.

Power MOSFETS

Power MOSFETs are metal-oxide semiconductor field-effect transistors made to handle higher current and power than small-signal MOSFETs. Like small-signal MOSFETs, power MOSFETs are voltage-controlled devices; they have the same three electrodes: source, gate, and drain.

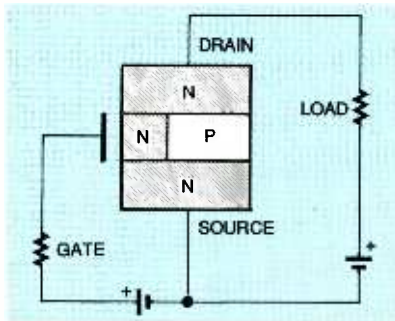


FIG. 8—FUNCTIONAL DIAGRAM of an N-channel, enhancement-mode power MOSFET

Figure 6 is the schematic symbol for an N-channel, enhancement-mode MOSFET power transistor. This schematic symbol differs from the small-signal MOSFET symbol in that it has a diode connected between its source and drain.

However, as in the small-signal MOSFET symbol, the direction of the arrow indicates the direction of conventional current flow. The broken lines representing the source to drain channel indicate that it is an enhancement-mode device. This means that it is a "normally off" device. Electrons flow from the source to the drain in an NPN MOSFET when the channel is enhanced or correctly biased.

Figure 7 is the schematic symbol for a P-channel, enhancement-mode power MOSFET. Again, as in the NPN transistors, the flow of electrons and the flow of conventional current are reversed. This can be seen from the direction of the arrowhead representing conventional current flow. (For more information on MOSFETs, both enhancement- and depletion mode, see the May 1993 *Electronics Now*, page 59.)

Figure 8 is a functional diagram for a N-channel, enhancement-mode MOSFET that is better for explaining the operation of the device. Voltage applied across the gate and source causes current to flow to the drain. The gate, as in all MOSFETs, is isolated from the source by a layer of insulating silicon oxide. With no voltage between the gate and source electrodes, the impedance between the gate and source is high and no current flows.

Figure 9 is a simplified section view of the structure of a typical power MOSFET. Unlike the planar structure of small-signal MOSFETs, most power MOSFETs today are made as vertical structures. The drain is the substrate body and its terminal is a metallized layer on the bottom. The gate and source are deposited on top of the drain structure like icing on a cake.

Most power MOSFETs today are made by the double-diffused vertical DMOS process. (It is a MOS manufacturing process involving two-stage diffusion of impurities through a single mask opening.) This geometry

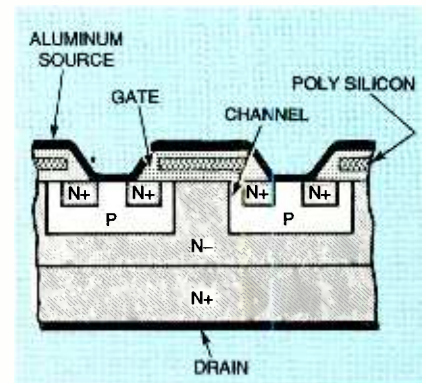


FIG. 9—CROSS-SECTION of the structure of an N-channel power MOSFET.

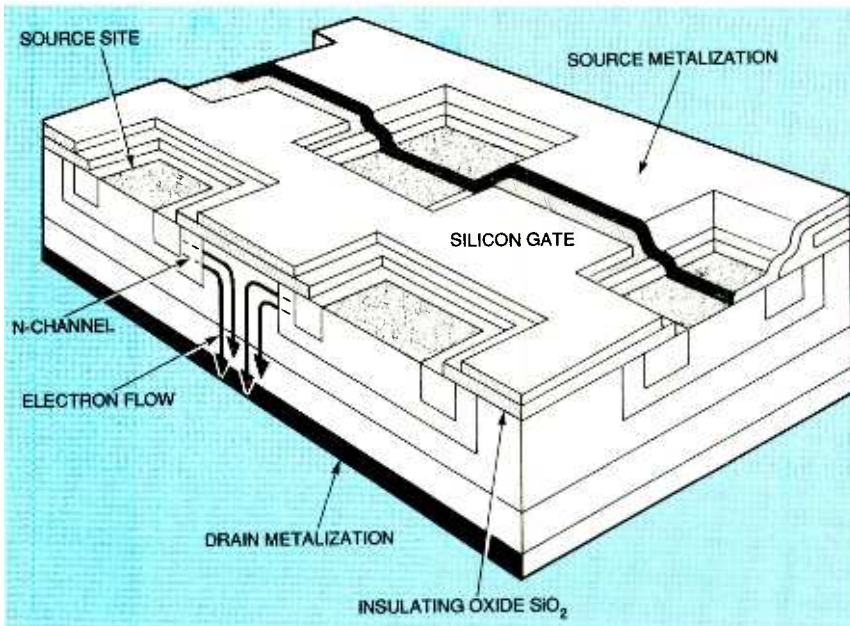


FIG. 10—CUTAWAY VIEW OF A DMOS power MOSFET. The current flows vertically from the drain to the source.

and structure has replaced the V-groove or VMOS process widely used in the 1970s.

The term vertical refers to the vertical flow of current between the drain and source as opposed to the flow of current in horizontal channels in small-signal MOSFETs and CMOS ICs.

Power MOSFET geometry.

To gain more uniform current distribution throughout the power MOSFET chip, manufacturers have developed various mesh or honeycomb gate and source structures for the upper surfaces of the chip. They define the multiple gates and sources. Figure 10 is a cutaway view of a typical power MOSFET made by the DMOS process.

The source cells consist of closed rectangular or hexagonal channels which separate a source region from the substrate drain body. The source cells are formed by an deposition process and some power MOSFETs have a density of more than a half-million cells per square inch.

Channels are formed by double diffusion at the periphery of each source cell, as shown in Figs. 9 and 10. An insulating layer of silicon dioxide is then deposited over all of the channels. A polysilicon gate pattern

is deposited on top of both the insulating oxide and channel.

The silicon gate is then insulated from the source by another silicon oxide layer. All of the source cells are then connected in parallel by a continuous deposition of aluminum that forms the source terminal.

MOSFET conduction occurs when a voltage is applied between the gate and source terminals; it modulates the conductivity between the source and drain. Electrons flow from a source cell through the channel around the outside of the cell and then into the drain body.

The lower metallized surface of the drain substrate forms a conductive electrical and thermal contact with the header or mounting surface within in the device case.

International Rectifier Corp.,(IRC) developed power MOSFETs with hexagonal gate cells that HEXFETs to highlight the manufacturing process. However, Motorola Semiconductor developed rectangular gate cells, but its MOSFETs are called TMOS, a name that suggests the T-shaped flow of current in the device. This is seen in Fig. 10. Other manufacturers refer to their power MOSFETs by their own proprietary names.

Typical applications for power MOSFETs are in high-frequen-

cy switching power supplies, chopper and inverter systems for DC and AC motor speed control, high-frequency generators for induction heating, ultrasonic generators, audio amplifiers and radio-frequency transmitters.

Power MOSFETs have certain advantages over power BJTs, but these are most significant when the MOSFET is switched at high frequencies that might be 40 kHz or more. Those advantages are:

- 1) Faster switching speed and lower switching losses.
- 2) Absence of second breakdown.
- 3) Wider safe operating area.
- 4) Higher input impedance.
- 5) Generally higher gain.
- 6) Faster rise and fall times
- 7) Simpler drive circuitry

Power MOSFETs are priced higher than comparable power BJTs. They also have higher static drain-to-source, on-state resistance values ($R_{DS(ON)}$) that cause power losses in switching power supplies. Manufacturers have made considerable progress in reducing these values by improving their manufacturing techniques.

Power transistor packages

As in other power devices, the packaging of power transistors is influenced by the device's current ratings. The most popular case for all power transistors rated 15 amperes or less is the plastic TO-220 package. Power transistors with higher rating are packaged in metal TO-3 and TO213 metal cases among others. More recently, power transistors have been packaged in various small-outline, surface-mount cases such as the SO-8.

Thyristors defined

Thyristors are a class of gate-controlled semiconductor power rectifiers formed from four or more alternate layers of P- and N-doped silicon. The most familiar thyristors are the silicon controlled rectifier (SCR) and the bidirectional triode thyristor or triac. Less familiar are the GTO and diac.

All of these devices behave

like conventional PN rectifiers in the presence of current passing in the reverse direction and as combination switch/rectifiers in the presence of current in the forward direction.

Controlled rectifier

The silicon controlled rectifier (SCR) is a four-layer PNPN thyristor that switches load currents in one direction only. This makes it useful for switching DC as well as half-wave and full-wave AC power. Figure 11-a shows the schematic symbol for the SCR and Fig. 11-b is a sectional view of its layered structure. The SCR has three junctions and three terminals: anode, cathode, and gate.

The SCR is fundamentally a rectifier diode with a control element called the gate. The anode-to-cathode voltage at which the SCR starts to conduct is determined by the current flowing in the gate electrode. The gate bias can hold the SCR off, or it can permit conduction to begin at any point in the forward half cycle of AC across the anode and cathode terminals.

The SCR anode voltage must be positive for conventional forward-biased operation. The SCR is turned on by placing a positive voltage on the gate electrode. Once it is turned on, the SCR remains on—even if its gate voltage is cut-off or made negative.

The anode-to-cathode voltage must be reduced to the threshold level or the forward current must be reversed. Also, if the SCR is switching AC, the AC must cross the zero level.

In most applications, the SCR switches currents in only one direction. SCRs can also function as controlled rectifiers in high-power bridges. Heavy-duty SCRs can handle hundreds of amperes and peak voltages as high as 1500 volts with triggering currents of a few milliamperes.

Most SCRs specified for electronics circuits are rated for 40 amperes or less. Those with higher ratings typically serve in electrical power generation, distribution, and control applications.

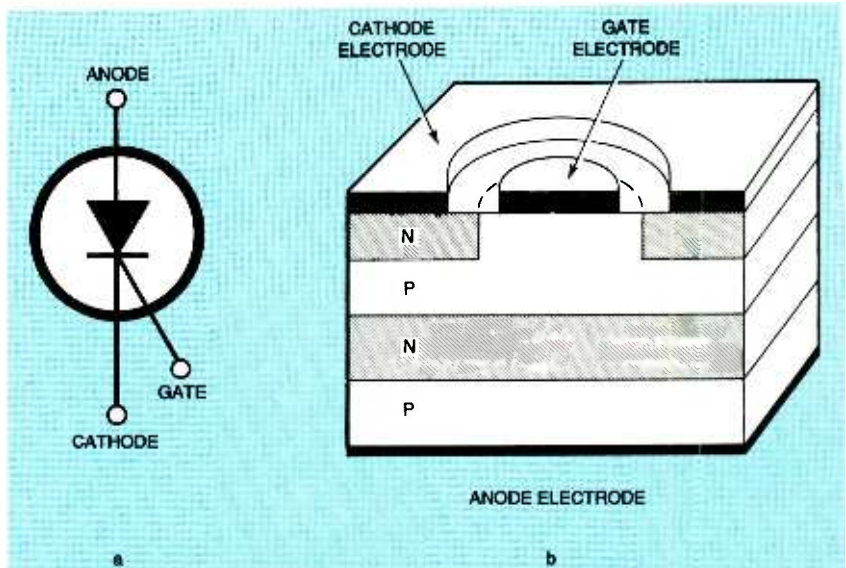


FIG. 11—SCHEMATIC SYMBOL for a silicon controlled rectifier (a), and a sectional view of an SCR chip (b).

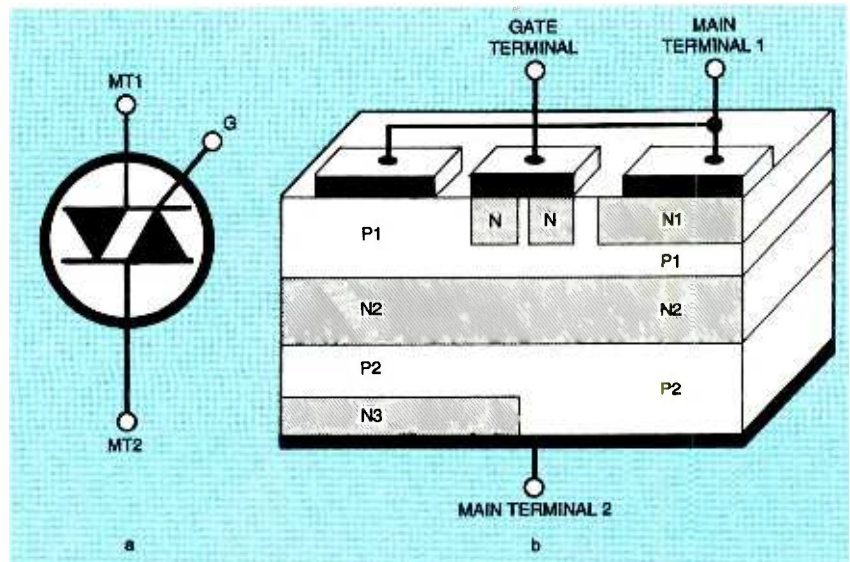


FIG. 12—SCHEMATIC SYMBOL for a triac (a), and a sectional view of a triac chip.

The gate turn-off rectifier (GTO) is a variation on the SCR. It can be turned off with a negative bias applied to its gate terminal.

Bidirectional thyristors

A triac is a bidirectional thyristor that can be turned on for load current in either direction. Figure 12-a is the schematic symbol for a triac and Fig. 12-b is a diagram of the triac's five-layer, four junction NPNPN structure. It acts like two inverse-parallel connected SCRs. A single-gate electrode turns the device on for current in both directions.

A triac is also called a gated symmetrical switch. Because triacs are bidirectional, they are widely specified for switching AC. Unlike an SCR, a triac need not be preceded by a bridge rectifier to switch full-wave AC. The electrodes of the triac are the main terminals 1 and 2, and the gate.

When a positive voltage is applied across the main terminals, a positive pulse at the gate will trigger the device into forward conduction; when a negative voltage is applied, a negative gate pulse will trigger the device into reverse conduction. Once a triac is turned

on, the gate loses control and the device remains in its on-state until the AC voltage across its terminals falls to the triac's sustaining value or passes through the zero value.

Some triacs can switch up to 1500 volts and others can switch currents up to about 40 amperes. The restriction on current is imposed because a single silicon triac chip carries current in opposite directions. If the current is excessive, it will cause the chip to break down and be destroyed.

A diac is a variation of the triac without a gate terminal. Figure 13 is the schematic symbol for a diac. The device is switched on by raising the applied voltage to the breakover voltage.

Triacs are found in consumer products including power switches, lamp dimmers, appliance motor speed controls, microwave ovens, and space heaters. In addition, they are widely used as power switches in industrial and commercial solid-state relays and AC output modules.

Thyristor packaging

Thyristors are packaged in the same kinds of cases as power transistors. Thyristors rated for more than 1 ampere are typically packaged in TO-220 plastic cases and those rated for 15 to 40 amperes are typically packaged in one of the popular metal cases.

Optocouplers

An optocoupler, also known as an optoisolator is a semiconductor device consisting of a photoemitter, a short optical transmission path and a photodetector in the same package, typically a DIP. Optocouplers are capable of converting an electrical input signal to modulated light and restoring it to an electrical signal.

The only optocouplers discussed here are those with thyristor drivers. (For more complete information on optocouplers, see the August 1992 *Electronics Now*, page 44.)

All optocouplers provide electrical isolation between the input and output circuits and are

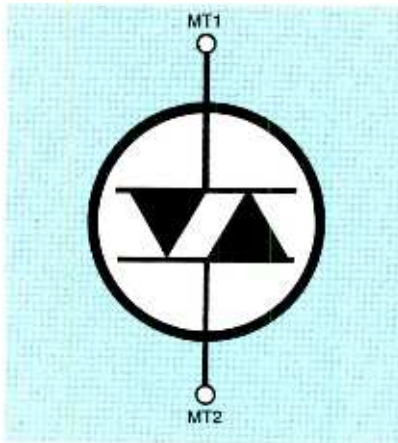


FIG. 13—SCHEMATIC SYMBOL for a diac.

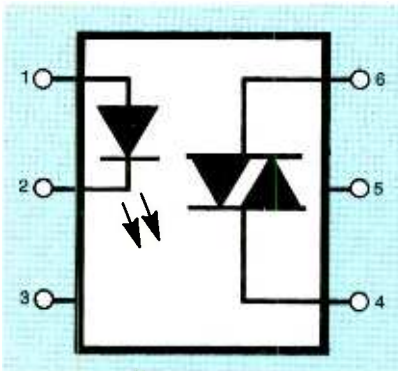


FIG. 14—SCHEMATIC FOR AN OPTOCOUPLER with a random phase phototriac driver.

able to protect the output circuit against damaging or destructive voltage transients or surge currents in the input circuit.

The photoemitters in power optocouplers are infrared-emitting diodes (IRED) and the photodetectors can be photoSCRs or phototriacs. As in other couplers, these optothyristors are matched to the output of the IRED. The photoSCR can switch direct current and the phototriac can switch alternating current.

Figure 14 is the schematic for an optocoupler with a triac driver and Fig. 15 is the schematic for an optocoupler with a zero crossing triac driver. When not receiving an electrical input, the IRED and photothyristor are normally "off." The input signal across the IRED terminals causes it to emit infrared energy that is transmitted through a short glass or plastic waveguide to the pho-

tothyristor.

Light energy incident on the photoSCR or phototriac causes it to generate an electrical output. Both photothyristors responds to input signals that might be short pulses. The internal zero-crossing circuit switches the triac only at zero crossings of the AC.

Optocoupler packaging.

All optocouplers are packaged in opaque cases to prevent the entry of extraneous light that could interfere with signal transmission. The most popular commercial/industrial optocouplers are packaged in standard six-pin dual-in-line (DIP) packages, but there is increasing demand for surface-mountable, gull-wing lead cases.

The accepted industry standard for electrical isolation (V_{ISO}) is about 5000 volts AC peak, but Motorola offer optoisolators with ratings of 7500 volts. Most manufacturers seek the UL recognition as well as approval by CSA, VDE, DIN and other regulatory agencies for their products because they can switch AC line power.

Solid-state relays

A solid-state relay (SSR) is an electronic circuit that includes a signal-level trigger circuit coupled to a power semiconductor switch, either a transistor or thyristor. The term SSR is widely understood to mean a factory-made and tested product rather than a solid-state relay function built from separate components on a PC board by the user.

The SSR differs significantly in both structure and operation from the coil-and-contact electromagnetic relay (EMR). However, both provide power gain. The input circuit of an SSR might be an optocoupler, reed relay, or transformer. It is analogous to the "coil" of an EMR, and it is electrically isolated from the power semiconductor switch that acts as the "contact." SSRs require only relatively low energy control circuits to switch the output power.

SSRs for switching alternating current require either two

inverse-parallel (back-to-back) silicon controlled rectifiers (SCR) or an electrically equivalent triac. However, if direct current is to be switched, the switching device is either a bipolar or MOSFET transistor.

The classification of an SSR is based on its input circuit or method for achieving input-output (I/O) isolation. True SSRs achieve electrical isolation between the input and output circuits with optocouplers. Figure 16 is the block diagram of an optically-coupled, solid-state relay with zero-voltage triggering of a triac for switching an AC load. However, hybrid solid-state relays for have reed relays or transformers for isolation.

Solid-state relays have many advantages over electromechanical relays. These advantages include:

1. Longer life and higher reliability.
2. Ease in matching logic-level circuits.
3. Higher-speed switching.
4. High resistance to shock and vibration.

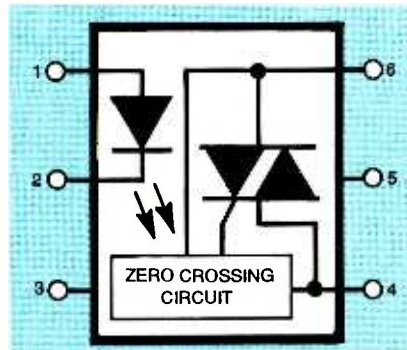


FIG. 15—SCHEMATIC FOR AN OPTOCOUPLER with a zero-crossing triac driver.

5. Absence of mechanical contacts.

The absence of mechanical contacts eliminates: contact bounce, arcing due to contact opening, electromagnetic interference (EMI), and fire or explosion hazards that would be caused by contact arcing in the presence of explosive or flammable gases, liquids or solids.

However, electromechanical relays are more cost effective in many applications that do not call for high-speed switching or operation in a hazardous environment. Many small sensitive electromechanical relays can be switched at TTL logic level.

Solid-state relays can be classified in five general groups:

1. AC power relays capable of switching 24 to 530 volts AC at 2 to 75 amperes with DC input (typically 3 to 32 volts) or AC input (typically 90 to 280 volts) with triacs or dual, back-to-back SCRs.
2. DC power relays, capable of switching 100 to 500 volts at 7 to 40 amperes under DC control with power transistors.
3. AC low-power relays, for PC-board mounting, capable of switching 60 to 240 volts at 0.3 to 4 amperes with triacs.
4. DC low-power relays, for PC-board mounting, capable of switching up to 60 volts at 3 amperes with power transistors.
5. Input-output modules, specialized miniature low-power AC and DC relays for PC-board mounting. They are widely used for interfacing computer systems and industrial controls with external sensors and actuators.

AC solid-state relays

The most popular AC power relays with ratings of 2 to 75 amperes are packaged in four-terminal, rectangular flatpacks suitable for panel or heatsink mounting. They have three functional sections as shown in Fig. 16: an optoisolator, a zero-voltage detector and a triac.

The zero-voltage detector assures that the thyristor will be triggered only when the AC voltage crosses the zero reference (in either the negative or positive direction) to minimize the effect of surge currents at the time the thyristor is switched.

Surge currents can result from switching tungsten-filament incandescent lamps and capacitive loads. For example, the cold resistance of a tungsten lamp is less than 10 % of its illuminated resistance.

If the SSR is turned on when the voltage is not at a zero crossing, the high instantaneous load current drawn by the lamp could destroy the SSR. The thyristor, once triggered, will not stop conducting until the load current it is conducting falls to zero.

A resistor and capacitor in series, called a snubber, bypasses voltage transients that occur with inductive loads when current and voltage are out of phase. Triacs are the thyristor of choice in general purpose AC relays for ratings up to 10 amperes at 120 to 240 volts. Dual SCRs are capable of switching AC power loads in excess of 40 kilowatts.

Important specifications for AC SSRs include:

1. Isolation voltage.
2. Operating temperature range.
3. Control signal range.
4. Must-operate voltage.
5. Must-release voltage.
- 6) Input current.

UL recognition and CSA approval are commonly obtained for all factory-made power SSRs for use in the United States and Canada. But there is an increasing demand for SSRs made by North American manufacturers that meet the European VDE and DIN standards so that they

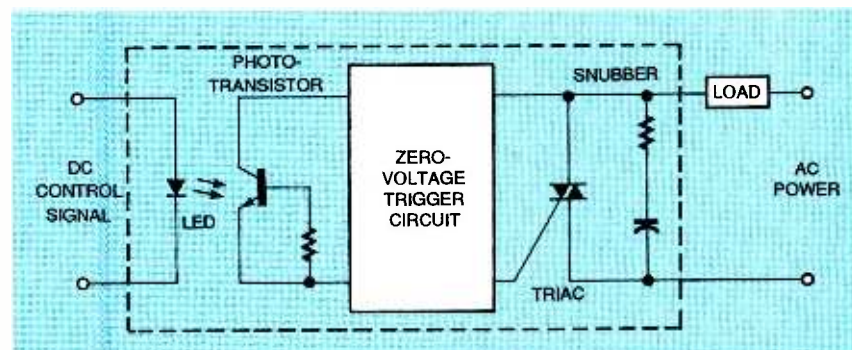


FIG. 16 —SCHEMATIC OF A SOLID-STATE AC RELAY with zero-crossing. The triac permits the relay to switch AC directly.



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will meet European requirements as components or when installed in American-made equipment.

SS relay packaging.

The standard industry-accepted package for AC SSRs worldwide rated 2 to 40 amperes is a rectangular flatpack that measures $2\frac{1}{4} \times 1\frac{3}{4}$ -in $\times 0.9$ -inches. Its four screw terminals permit the relay to be installed (or replaced) in the field by forming hooks in the ends of the connecting wires and clamping the wires tightly with the screws.

SSR for switching direct current include optocouplers for isolation and power MOSFET drivers. They are also packaged in the flatpack cases but there is no real standardization of DC SSR package style.

Power integrated circuits

A power integrated circuit is a monolithic IC with signal-level analog circuitry or digital logic circuitry on the same chip with one or more power transistors. These ICs are capable of handling 2 amperes or 2 watts. The first commercial power ICs were drivers for high-voltage neon gas-discharge seven-segment displays. They combined bipolar digital logic with a bipolar power transistor on the same chip.

Later power ICs were made with mixed bipolar and metal-oxide semiconductor (MOS) technologies, and analog circuitry was added. CMOS logic was combined with bipolar transistors in a fabrication process called BIMOS technology. Then CMOS logic was combined with DMOS MOSFETs in a technology called CMOS/DMOS.

BIMOS technology is suitable for medium voltage and current devices. Motor controller, solenoid switcher, pulse-width modulators, and voltage regulator ICs have been made with this technology.

By contrast, CMOS/DMOS technology is suitable for applications involving either low-voltage, high-current, fast-switching or high-voltage, low-

current, fast-switching ICs. Display drivers have been fabricated with CMOS/DMOS technology.

Three different techniques are used to isolate the control circuitry from the power device on the monolithic IC chip to prevent interference and electrical breakdown of the device. These are:

1. Self-isolation, an extension of CMOS technology. The reverse-biased junction is located between the source and the drain region. This technique is usually limited to devices drawing less than 2 amperes, but voltage can be as high as 500 volts.

2. Dielectric isolation (DI) employs single-crystal islands or "tubs" grown on a polysilicon substrate for locating the IC functions. Because current must be brought out of the top of the circuits within the tub, the voltage levels are limited. It is said to produce the lowest parasitic capacitance and permit full isolation on the chip.

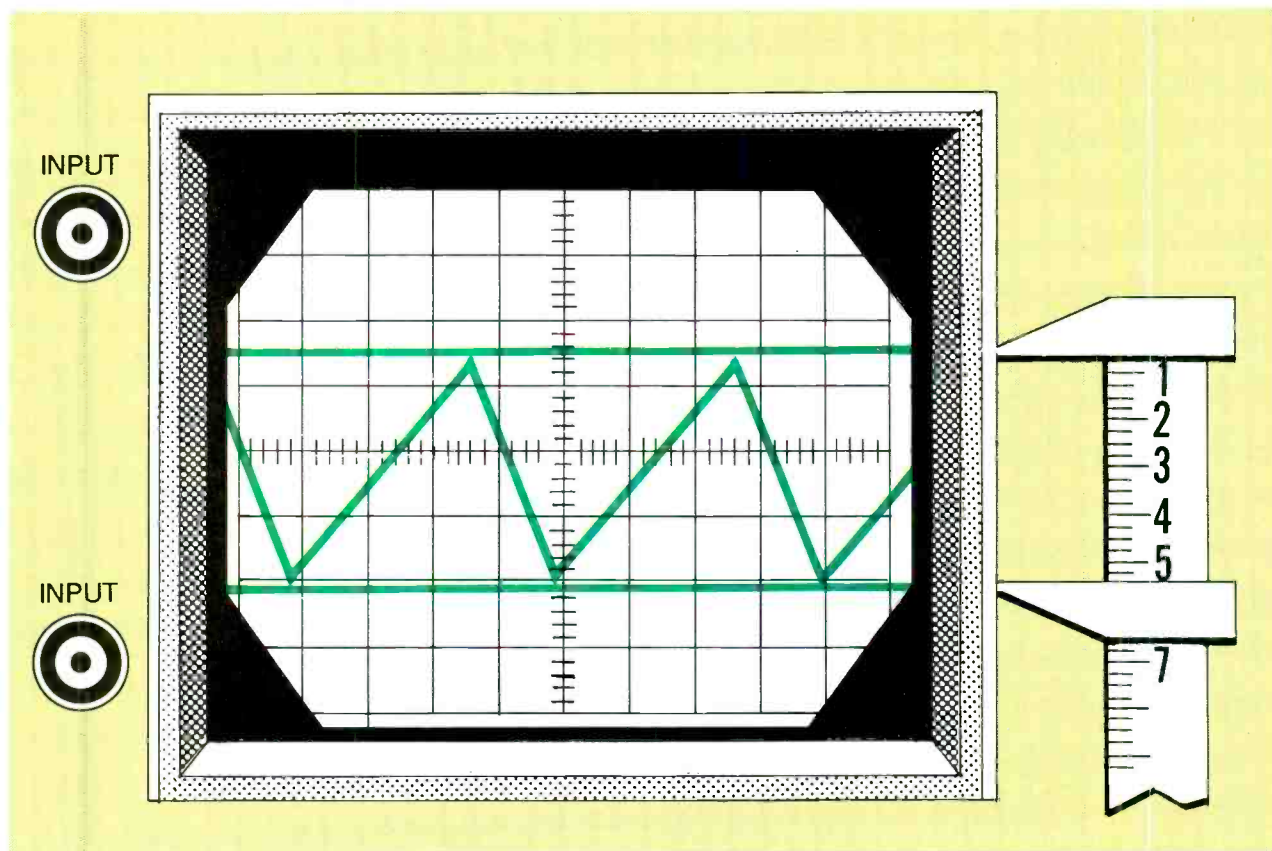
3. Junction isolation (JI) permits the formation of both lateral and vertical ICs. An epitaxial layer is formed on the substrate and deep junctions are diffused to obtain isolated areas. Current flow is similar to that in discrete power devices.

Power IC packaging

Power ICs are being packaged in many of the same style cases as conventional ICs. However, more attention is being given to keeping junction temperatures below set limits. These include DIP cases with 8 to 28 pins and small outline (SO) cases where dissipated power is less than 2 watts.

More complex parts are being packaged in single-in-line (SIP) cases with from 11 to 23 leads. Plastic TO-220-style cases are used for power ICs that dissipate from 5 to 10 watts. Some power ICs are being packaged in plastic leaded chip carriers (PLCCs).

Power semiconductors are used in a wide variety of practical power control circuits, from simple switches to thermostatically controlled heaters. Ω



VOLTAGE CURSOR ADAPTER

Measure the voltage values of waveforms accurately and easily on your oscilloscope with the Voltage Cursor Adapter.

HAVE YOU EVER HAD TROUBLE MEASURING the voltage value of a waveform on an oscilloscope screen? Are you tired of counting graticule squares and "guesstimating" those values? If so, you need the Voltage Cursor Adapter. It superimposes horizontal cursor lines on the top and bottom of the waveform—a kind of electronic calipers—to permit direct readout of the voltage value. The cursor lines extend across the entire screen.

The lower cursor (think of it as the floor) is the *zero-volt cursor* and the upper cursor (think of it as the ceiling) is the precision DC *reference voltage*. The cursors can be placed on any parts of the waveform that you want to measure, and the volt-

SKIP CAMPISI



THE CURSOR ADAPTER superimposes horizontal cursor lines on the top and bottom of a waveform.

age can be read directly from a turns counter coupled to a precision potentiometer.

Figure 1 is the schematic diagram for the voltage cursor adaptor. The required 15 to 25-volt power to the circuit can be supplied either by batteries or a wall-mounted AC to 15-volt DC adapter. The author's prototype has a jack that will accept a plug from either the adapter or a battery pack consisting of two 9-volt batteries taped together.

The MC78L12 voltage regulator (IC1) supplies regulated 12-volts DC to the rest of the circuit. The ICM7555 timer (IC2), a CMOS version of the industry-standard 555, drives the CD4066B, a CMOS bilateral switch (IC3). This drive frequency can either be a normal

frequency (NORM) of 100 Hz or a low-frequency (LO-F) of 10 kHz, depending on the setting of switch S1. Set S1 to LO-F for inputs below 500 Hz.

The DC reference voltage supplied to pin 3 of IC3 is set by R3, a 10-turn, 5000-ohm precision potentiometer. The voltage can be read directly from a turns counter dial coupled directly to the potentiometer's wiper. The accuracy of this reading can be 1% or better. Trimmer potentiometer R1 permits the voltage to R3 to be calibrated to precisely 10 volts.

The circuit is calibrated by setting the digital reading on the turns counter of R3 to the

full clockwise position and adjusting R1 for a reading of 10 volts at the wiper of R3 with a digital voltmeter.

Bilateral switch IC3 converts the DC reference to a square-wave with exactly the same wiper amplitude. The square-wave output appears on the common pins 4, 9, and 10 of IC3 and coaxial plug PL1.

Building the adapter

The circuitry is simple enough to be built on an approximately 2 x 3-inch stock predrilled perforated board by point-to-point wiring methods. (The prototype circuit was built on a multipurpose board from

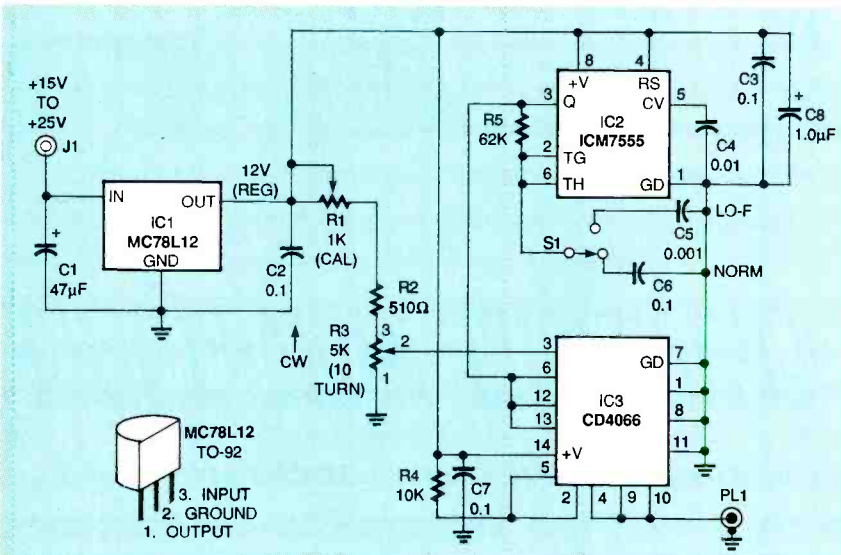


FIG. 1—SCHEMATIC DIAGRAM for the voltage cursor adapter. Power can be supplied by batteries or an AC adapter.

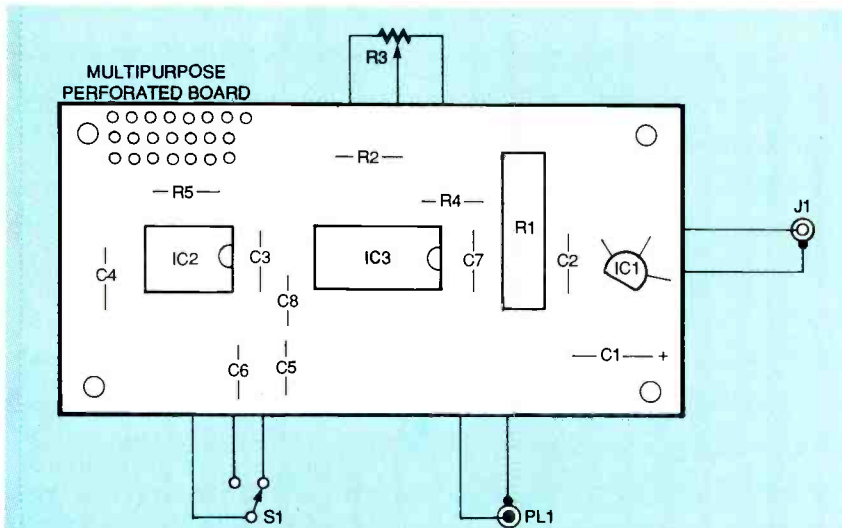


FIG. 2—USE THIS AS A GUIDE for positioning the parts on the perforated construction board.

PARTS LIST

Resistors: all fixed are ¼-watt, 5%

R1—1000-ohm multiturn trimmer potentiometer, Bourns 3005P 101 or equiv.

R2—510 ohms

R3—5000-ohm, 7/8-in. precision potentiometer, ten-turn with matching multiturn dial, Clarostat 73JB with a 15-turn dial or equiv. (See text)

R4—10,000 ohms

R5—62,000 ohms

Capacitors

C1—47µF, aluminum electrolytic, 35 VDC

C2, C3, C6, C7—0.1µF, ceramic

C6—0.1µF, polyester

C4—0.01µF, ceramic

C5—0.001µF, polyester

C8—1.0µF, solid tantalum dipped

Semiconductors

IC1—MC78L12 12-volt voltage regulator, Motorola or equiv.

IC2—ICM7555 CMOS timer, Harris or equiv.

IC3—CD4066B CMOS quad-bilateral switch, Harris or equiv.

Other components

S1—SPDT switch, miniature, panel-mounted, 3A

J1—coaxial jack, panel-mounted (to mate with power plug)

PL1—panel-mounted phone plug 1/8-inch dia.

Miscellaneous: multipurpose perforated board 1²⁷/₃₂ x 2²⁷/₃₂ (Radio Shack 276-150 or equiv.); project case, aluminum, 4 x 2 1/2- 1 5/8-in. (Radio Shack 270-239 or equiv.); one 8 pin DIP socket and one 14-pin DIP socket; four standoffs with screws, 1/16 inch; two 9-volt batteries with two snap connectors and attached plug or wall-mounted line AC to 15-VDC adapter, 50 mA; insulated hookup wire; solder; screws.

Radio Shack.) There is nothing critical about component selection or placement. Figure 2 is a guide for positioning components on the circuit board.

The prototype was mounted in a two-part aluminum case that measured approximately 4 by 2 by 1 5/8 inches. If you intend to put the circuit in similar project case, use the blank circuit board as a pattern and mark the hole locations on that part of the case with the ends folded up.

It is recommended that both

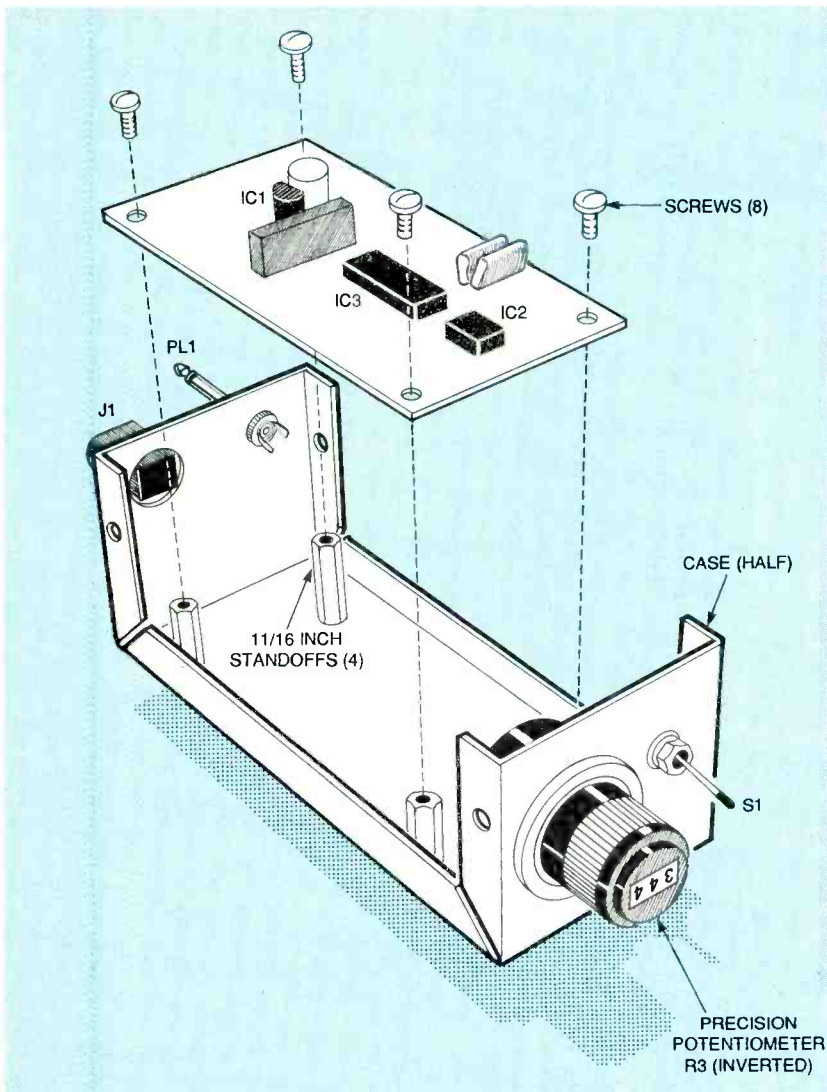
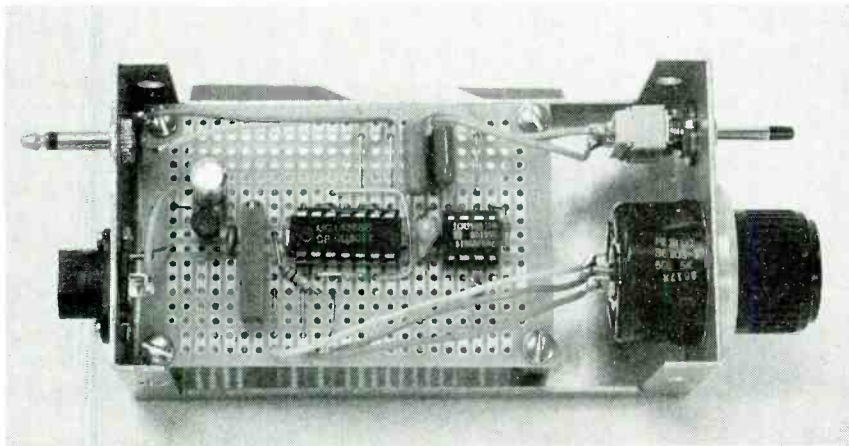


FIG. 3—HERE'S HOW EVERYTHING MOUNTS inside the case.



EVERYTHING FITS EASILY inside the case.

IC2 and IC3 be inserted in sockets. Insert and solder an 8-pin socket for IC2 and a 14-pin socket for IC3, as shown in Fig. 2. Insert and solder all other on-

board leaded components in the positions shown, but do not trim any leads at this time.

Set the circuit board aside. Refer to Fig. 3, the mechanical

assembly diagram, and drill the holes that you marked on the case half for mounting the $\frac{3}{4}$ -inch standoffs. Then drill the holes for mounting jacks J1 and J2, precision potentiometer R3 with counter and switch S1 in the case end surfaces.

Mount the jacks, potentiometer and switch on the case half. Cut 3- to 4-inch lengths of No. 22 AWG stranded, insulated, hookup wires for making all connections to the board-mounted components, as shown in Fig. 2. Note: A lower cost counter can be substituted for the digital readout dial used in the author's prototype.

Solder one end of the wires from the jacks, potentiometer and switch and the other ends to the assigned terminal pads on the circuit board, leaving enough slack in the hookup wires to permit inverting the board and fastening it to the case half.

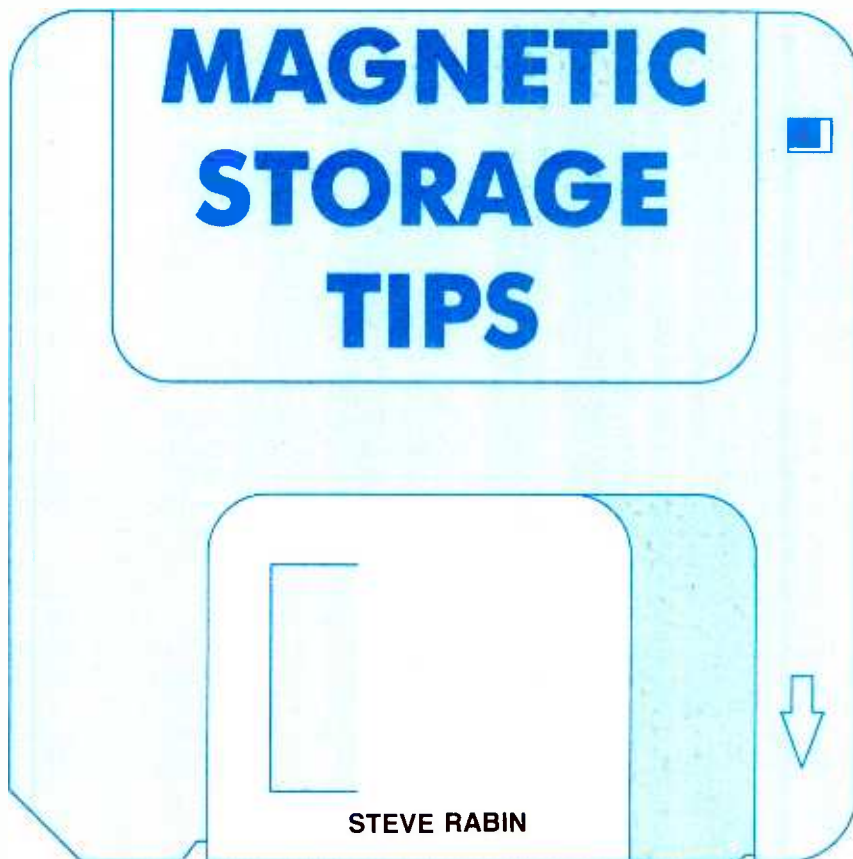
Carefully check all solder joints to be sure they are free of inadvertent bridges or cold soldering. Check IC1 to be sure that the three pins are identified and soldered correctly. Insert IC2 and IC3 in their sockets, observing the correct pin locations. After the Voltage Cursor Adapter is completely assembled it is ready for testing.

Connect the times 10 probe from the channel B input of your oscilloscope to the output jack of the Voltage Cursor Adapter.

Measuring waveform voltage

Display the signal whose voltage you want to measure by plugging a lead from the signal source into the channel A vertical amplifier jack of your oscilloscope. Set the triggering on channel A. The output is variable from 0 to 10 volts.

Set your oscilloscope's attenuators to accommodate the 0 to 10-volt range. Using the CHOPPED/ALTERNATE mode, position in the zero cursor with the channel B vertical position control. Then adjust potentiometer R3 to position the *reference voltage cursor* at the correct level on the signal waveform you want to measure. Ω



You can tame magnetic storage gremlins with these helpful hints.

MAGNETIC-TAPE AND FLOPPY-DISK storage are based on reliable technologies that have been proven over many years for storing analog audio and video as well as digital computer data. However there are a few actions that you can take to improve the quality, lifetime, and interchangeability of your magnetic recordings.

Bulk-erase your media. When a magnetic head overwrites new data on previously recorded media, it will write precisely at the same track location or recording depth. Therefore a portion of the previously recorded signal will remain on the media as a noise signal.

Bulk erasing is the best way to completely erase most magnetic media. Handheld bulk erasers are low-cost, widely available devices that can improve the quality of your recordings. Unlike an overwriting magnetic head, a bulk eraser

can erase the media at all recording depths, without regard to track alignment.

Limit interchange. The best quality is obtained when formatting, recording, appending and retrieval all take place on the same unit.

Every tape or disk drive will have slight variations in track locations, head-azimuth adjustments, media speed and other critical tolerances. Although each variation may be within specification, the combination of variations can cause immediate problems or reduce the storage life of the data.

Pre-formatted media adds an additional stage of interchange (because, by definition, they are recorded on a different machine). That can be compensated for by reformatting the media in the same recording unit that will be used to read, write and append data.

Select high quality media.

Magnetic media contains lubricants to reduce friction, and abrasives to prevent head clog. Too much lubricant can clog the magnetic head or gum up moving parts. Too much abrasive will wear out a head prematurely. It is essential to follow manufacturer's media recommendations to avoid "sand papering" your magnetic head.

Brand new tapes are much more abrasive than tapes that have been 'burnished' by several passes across a recording head. Using a drive primarily to record brand new media will reduce its magnetic-head life below the nominal specification.

Control media storage environment. Media storage should be at the media vendor's environmental specification. Long-term storage, especially at high temperature, can result in the spreading apart of magnetic transitions, or print-through, a condition where data is unintentionally transferred between adjacent layers of tape packed on a spool.

Annual retention passes on tapes in long term storage will help prevent print through. Multiple passes across a recording head can correct a print through condition by scraping away the surface layers of the tape. Do not store media near magnetized screwdrivers, magnets, motors, audio speakers, power supplies or other equipment producing strong magnetic fields.

Retention tapes. Tape media should be occasionally retensioned by performing one complete end to end pass to prevent loose or uneven packing of tape around the cartridge hub. This should be done after each insertion into the drive, after prolonged operation over a limited area of tape, after each hour of start-stop or shuffle operations, and after exposure to a temperature change.

Tape cartridges that develop loose packs in storage should be tightened manually, if possible, before the cartridge is inserted into a drive.

Maintain equipment properly. Do not place a magnet or

Continued on page 92

The PROCAR SECURITY SYSTEM

This is the third part of a series of articles about building ProCar, an automobile alarm, anti-theft, and anti-carjacking system.

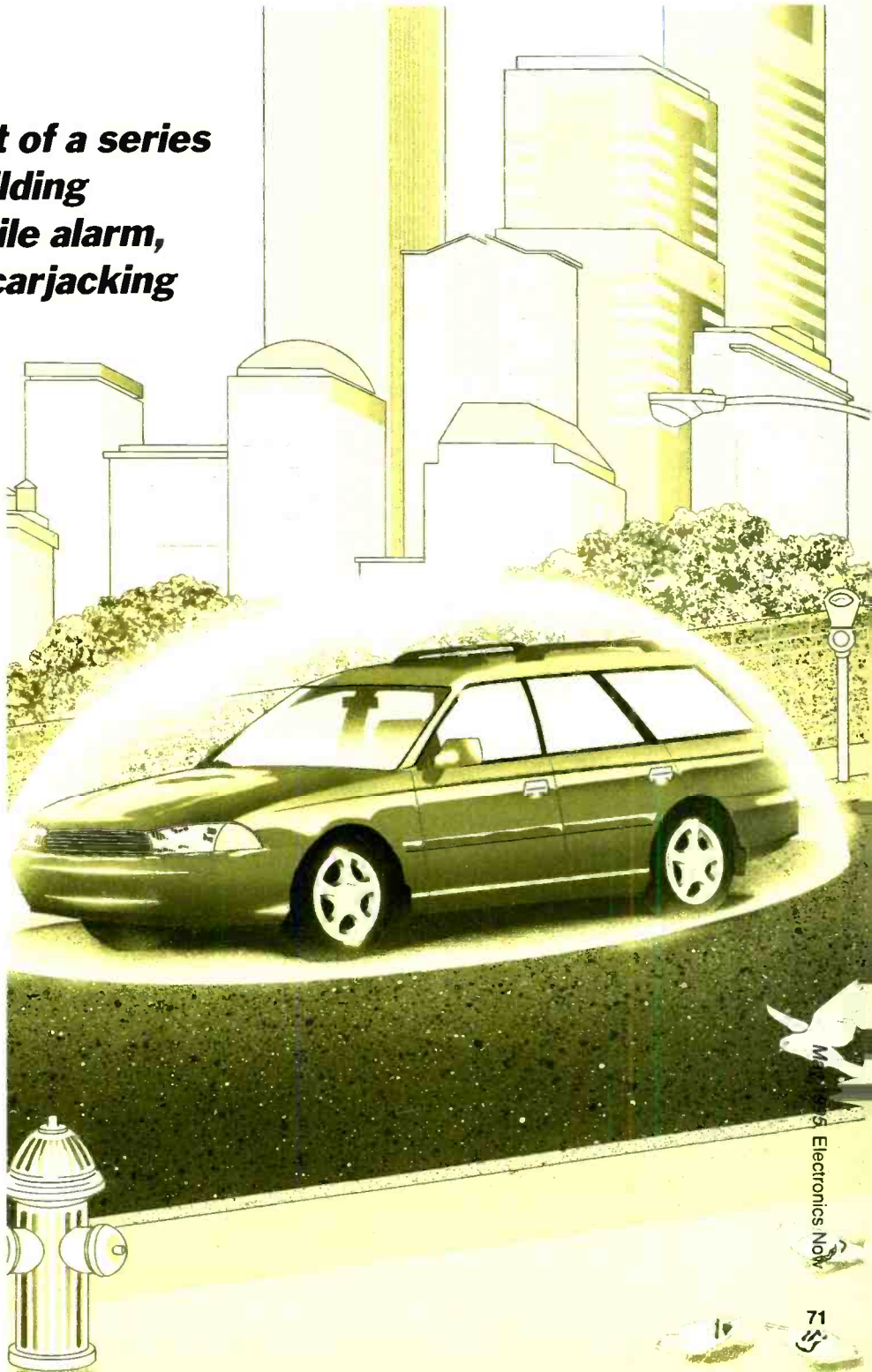
DAVID T. MIGA

THE SECOND PART OF THIS ARTICLE (*Electronics Now*, March 1995, page 65) picked up on the discussion of ProCar's Power Module and went on to describe the assembly of the Main Alarm, Voice/Options, and Power Module circuits. The Logic Module consists of the Main Alarm and Voice/Options circuits.

The wiring of the Power Module board and its assembly to the aluminum case and inter-board wiring were discussed. In addition, the formation of the wiring harnesses and the packaging of the Logic Module were explained.

Wiring harness assembly

ProCar has two wiring harnesses: A main 15-wire harness connects plug PL1 from the Logic Module to the battery, radio, door lock motor, stereo amplifier, siren, door switches, and other functions, as shown in Fig. 17. A three-wire cable from the logic module is terminated by indicator LED1, the system's only visual indicator. Four wires from the logic module connect to the optional remote radio-frequency receiver, and an antenna wire extends from the radio-frequency module.



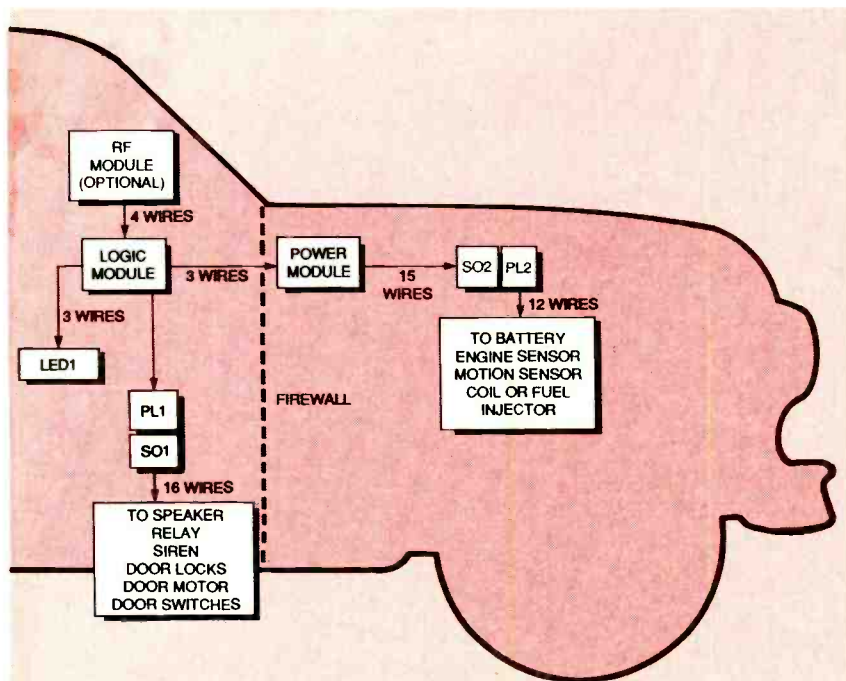


FIG. 17—BLOCK DIAGRAM OF THE PROCAR system wiring. Only three wires from the Logic Module pass through the firewall to the Logic Module.

A second wiring harness connects socket SO2 from the Power Module to the battery, air flow or throttle position sensor, hood pin switches, and other functions as shown in Fig. 17.

Table 2 lists the symbols, pins, colors, and functions on the wiring harness from the Logic Module socket SO1, which plugs into plug PL1. (The pin arrangement of plug PL1 is shown in Fig. 14, March 1995 *Electronics Now*, page 77.) Figure 18 is a schematic diagram for the external wiring from the Logic Module.

Logic Module connections

Refer to Table 2, Logic Module Pin Functions and Fig. 17 showing the wiring from the Logic Module. (Also see Fig. 13, Logic Module Wiring Harness, March 1995 *Electronics Now*, page 74.) The following comments are specific to colored wire connections to the pins from socket SO1:

- Red to pin 1 (+12 V): Verify that the supply can produce at least 10 amperes. (Connect this positive wire to the 12-volt battery last.
- Black to pin 2 (Negative ground)
- Orange to pin 3 (Ignition accessory): Connect to the radio

accessory power "ignition on" wire.

- Yellow to pin 5 (+ Disarm from OEM keyless entry): This is the positive input disarm wire from car's factory-installed digital (keyless) entry.
- Blue to pin 6 (Secret switch): The owner must identify himself with the proper sequence of switch closings. The switch permits the selection of such features as *high security*, *valet*, *disarm/service*, or *panic*. Obtain momentary voltage from door-lock switch, window-up switch, windshield washer

lever, or "high-beam" light switch.

- Red to pin 7 (Speaker relay positive); green to pin 8 (Speaker negative), and white to pin 9 (speaker, positive): The three wires of this cable connect to the speaker relay for switching the left front speaker from the stereo system to the voice module. (A fourth wire enters from pin 2.) **Caution:** the speaker wires must float electrically. Relay negative connects to ground.

Two wires connect the car's stereo amplifier to the relay: a yellow positive amplifier and a blue negative amplifier output.

Two wires connect the car's front left speaker to the relay: a green negative speaker and a white positive speaker.

If you do not want to include the car's speaker system, install a dedicated speaker wired to green negative and white positive wires.

- White to pin 10 (Internal siren): This is a positive wire to the piezoelectric siren. Ground the siren's negative lead.
- Brown to pin 11 (Driver door): Open the Logic Module and select the positive or negative door switches at their headers. (see the specific directions for doing this further on in this article).
- Gray to pin 12 (Passenger Doors): This wire is accessible in the driver's side door. Select positive or negative door switching. (See specific directions further on in this article).

TABLE 2
LOGIC MODULE PIN FUNCTIONS

Symbol	Pin	Color	Function
+12	1	red	+12V
GND	2	black	GROUND
A	3	orange	Ignition accessory
—	4	—	Open
D	5	yellow	+Disarm from OEM keyless entry
S	6	blue	Secret switch
R+	7	red	Speaker relay +
SP	8	green	Speaker -
SP	9	white	Speaker +
I	10	white	Internal siren
DRI	11	brown	Driver door
PAS	12	gray	Passenger doors
T	13	red	Trigger
R	14	green	Armed
H	15	black	Hood/sensor

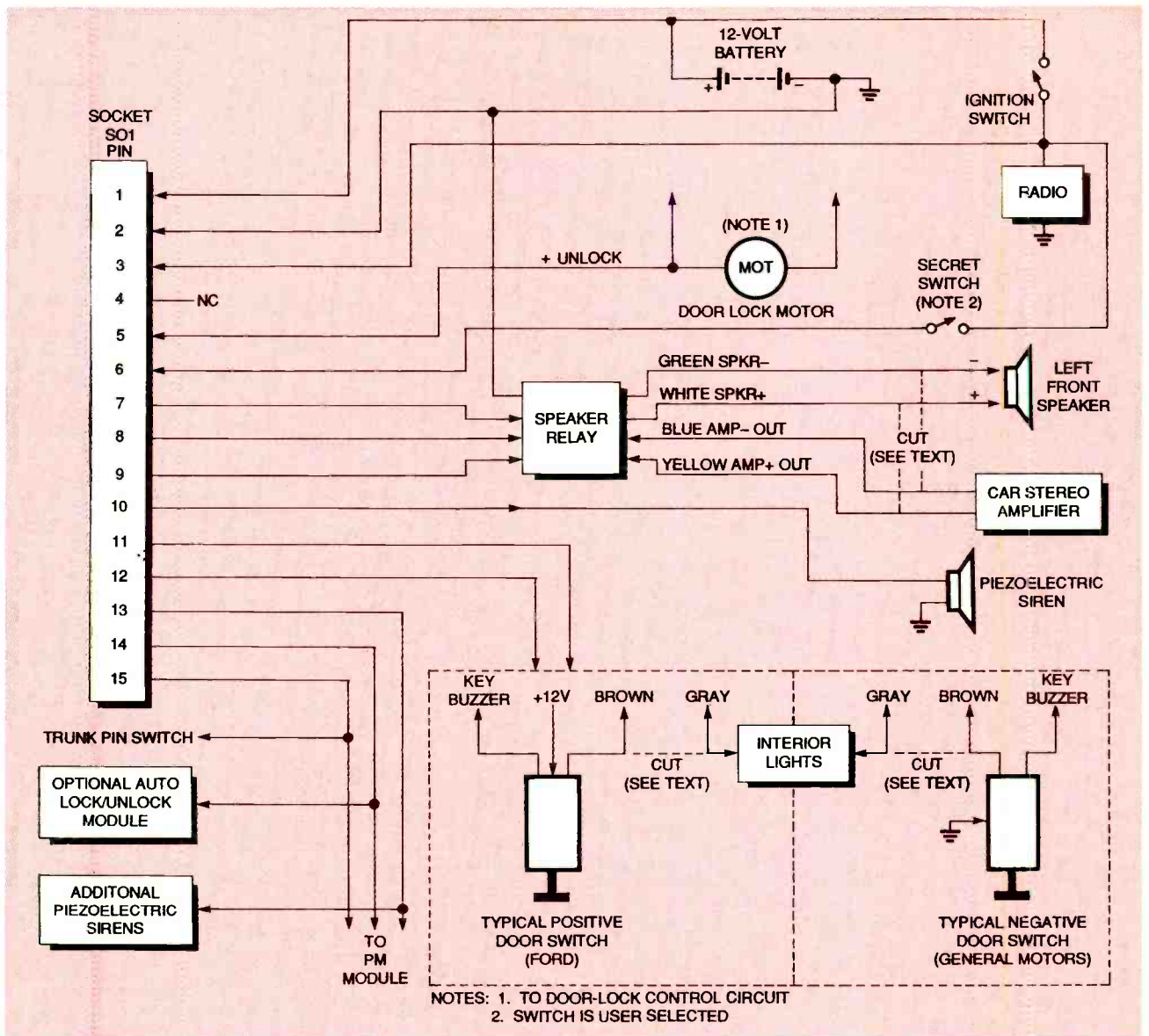


FIG. 18—WIRING FROM THE LOGIC MODULE via socket SO1 to the speaker relay, siren, door locks, motors, and switches and other under dashboard functions.

- Red to pin 13 (Trigger), green to pin 14 (Armed) and black to pin 15 (Hood sensor): Pass the cable containing these three wires through the car's firewall to the Power Module. The connections of these wires are:
- Red, positive output to Power Module for external siren power. (This wire can power other sirens or relays if their current drain is less than 1 ampere.)
- Green: becomes positive when the system is armed to cut out the engine. This wire also signals the optional automatic door-locking and unlocking relays.
- Black: hood switch and motion sensor from the Power

Module. Connect special sensors, such as microwave field sensors to this wire. (standard grounded switching.) There is no limit to the number of switches that can be connected to this wire.

Cut appropriate six-foot lengths of red and black No. 16 AWG stranded, insulated, hookup wire. The red wire will connect from pin 1 of the socket SO1 to the battery and ignition switch, and the black wire will connect pin 2 of SO1 to the negative side of the battery and ground.

Cut approximately six-foot lengths of the appropriately colored No. 18 AWG stranded,

insulated hookup wire for pin 3 (to ignition accessory); pin 5 (+ Disarm) to the door-lock motor; pin 6 (to secret switch); pin 10 (to the internal piezoelectric siren); pin 11 (to driver's side door switch); and pin 12 (to the passenger door switches). Crimp the ends of the wires to AMP A1441 socket sleeves and insert them in the 15-pin socket SO1 (AMP A14630).

Cut a 10-foot length of three-conductor cable that will pass through the car's firewall to the Power Module to be located in the engine compartment. Crimp and connect the wires to SO1 socket pins 13 through 15. The wire from pin 13 also goes to additional

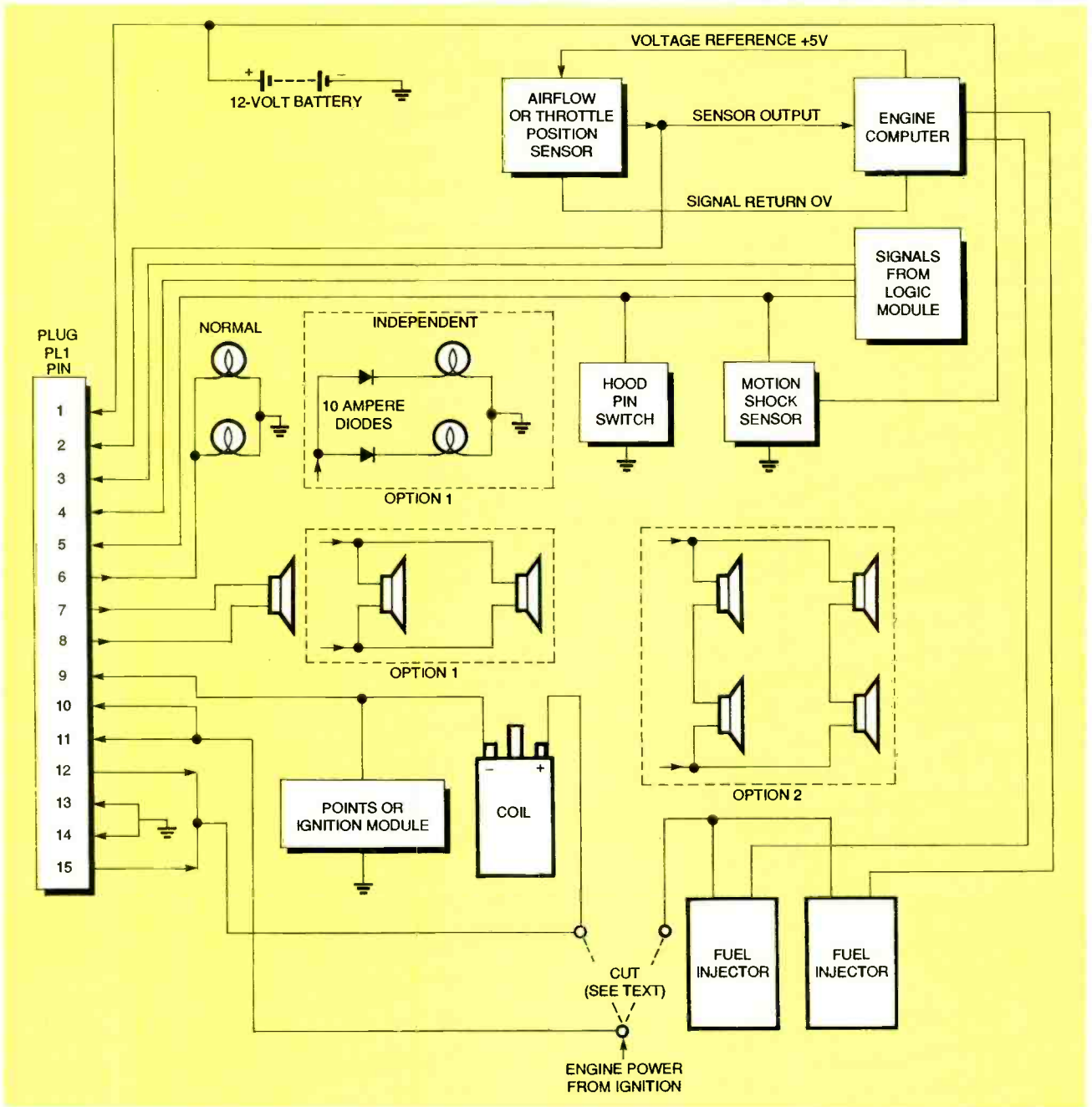


FIG. 19—WIRING FROM THE POWER MODULE via plug PL2 to the battery, engine sensor, motion sensor, coil or fuel injector sensors and other engine compartment functions

Installation

Mount the Logic Module high up under the car's dashboard behind the center console with appropriate fasteners.

When you wire the Logic Module harness to its intended speakers, switches and other destinations, the red battery power wire (pin 1, +12V) must be the last one connected because ProCar will auto-arm when a positive voltage is on the red wire.

Mount the three-color LED on the end of the cable through any flat surface on the automobile's

dashboard that is less than $\frac{3}{16}$ -inch thick. Drill a $\frac{3}{16}$ -inch hole, then carefully ream it so that the reflector of LED1 fits securely in position.

Power Module wiring

The Power Module contains the circuits for flashing lights, sounding the siren, powering the fuel-injection system and performing other functions. It has a 15 pin socket SO2 (See Fig. 19 and Table 3 and Fig. 10 (March 1995 *Electronics Now*). Select the wire sizes following the guidelines given for the Logic Module harness. The wires to the mating plug are as follows:

- Red to pin 1 (+12V): Battery positive for light flasher power. It must be able to supply up to 15 amperes.
- Brown to pin 2 (Engine sensor defeat-ESD): This defeat wire intermittently grounds the output from the airflow sensors (AFS) or throttle-position sensors (TPS) through a protective resistor. It simulates engine problems to a carjacker.
- Red to pin 3 (Trigger), green to pin 4 (Armed) and black to pin 5 (Hood/shakes): the three wires form a cable. Connect the black wire from pin 5 to the motion sensor and the hood pin switch. There is no restriction on the number or type of motion sensors or pin switches that can be connected to that black wire.
- White pin 6 (Light/flasher) is a positive output wire to the parking lights. Its maximum load of 15 amperes is protected by a 10-ampere automatic-reset circuit breaker CB1.
- Silver to pin 7 (Speaker) and gold to pin 8 (Speaker): This pair of wires can connect up to four four-ohm horn speakers to the siren module. Both wires should "float" electrically
- Green to pin 9 (Coil negative): This wire intermittently short-circuits the points or ignition module and negative side of the coil to ground when the siren is activated.
- Orange to pin 10 (Engine power, input 1) and orange to pin 11 (Engine power, input 2). Connect both orange wires. (The second wire is a backup wire.) The paired wires are con-

nected to the wire that normally provides power to the fuel injectors or ignition coil.

● Yellow to pin 12 (Engine power, output 1) and yellow pin 14 (Engine power, output 2). The Power Module routes (or interrupts) the power input on pins 10 and 11 to pins 12 and 15. The output of pins 12 and 15 is fed to *either* the fuel injectors or the positive side of the coil. The paired yellow and orange wires will supply up to 20 amperes.

Note: The connection at the junction between the pairs of orange and yellow wires is broken as soon as ProCar is armed. This does not occur for the green (Coil negative) or brown (Engine sensor defeat) wires which are only activated simultaneously with the siren.

● Black to pin 13 (Ground) and black to pin 14 (ground): Ground both of these wires.

Power Module installation

The Power Module contains circuitry for flashing the lights, powering the external siren speakers, the fuel system, ignition shutoff, and engine shutdown circuits. Mount the module in the engine compartment high enough up to be in a dry location and away from the exhaust manifold so that air can circulate freely around it.

Light flasher

After mounting the power module, connect the wire from the vehicle's parking light on the same side of the vehicle as the power module. (Identify this parking light power wire by turning on the parking lights and finding the live wire.) **Caution:** Do not use the headlight wires.

Connect the power wire to the white wire from pin 6 (Light/flasher) of the power module. If ProCar lights the driver's side parking lamps when activated, install 10-ampere diodes to isolate the driver's side and passenger light circuits, as shown in Fig. 19.

Ignition cutoff

The green wire from pin 9 (Coil negative) of the Power Module will intermittently short circuit the negative side of the ignition coil to ground through an internal ballast resistor only when the siren is activated. This will simulate intermittent engine trouble. The wire was intended for typical, single-coil ignition systems, but it can be wired to one of the coils of a multicoil system.

Caution: If the green pin 9 wire is used, do not connect the brown engine sensor defeat (ESD) wire from pin 2.

TABLE 3—POWER MODULE PIN FUNCTIONS

Symbol	Pin	Color	Function
+	1	red	+12V
E	2	brown	Engine sensor defeat (ESD)
T	3*	red	Trigger
R	4*	green	Armed
H	5*	black	Hood/speaker
L	6	white	Light/flasher
S	7*	silver	Speaker
S	8*	gold	Speaker
P	9	green	Coil negative
I	10*	orange	Engine power (Input 1)
I	11*	orange	Engine power (Input 2)
C	12*	yellow	Engine power (Output 1)
G	13*	black	Ground
G	14*	black	Ground
C	15*	yellow	Engine Power (Output 2)

*Denotes functional pairs or cable

Locate the coil if the car has a coil and a distributor. Expect to see two or more small wires leading to the coil. Ignore the high-voltage distributor wire. Start the car and measure the voltage at the terminations of the small wires.

The voltage on one wire will be +12 volts. The second wire (or wires) are switching wires to the ignition amplifier module (or the points on older model cars). A voltage lower than +12 volts that varies with engine revolution per minute should appear on those wires.

If you make the measurement with an oscilloscope, expect to see a voltage squarewave as the coil discharges. If this is seen, the correct wire to join to the green wire from pin 9 of the Power Module has been correctly identified.

Disabling sensors

Some late model cars do not have an ignition coil system. The brown (Engine sensor defeat—ESD) wire from pin 2 of the Power Module can be wired to many different kinds of sensors on a fuel-injected engine to cause the engine to sputter and stall without damaging it. Two examples are the airflow sensor (AFS) or throttle-position sensor (TPS).

The output voltages of those sensors vary with engine acceleration. Each sensor has two or three wires. The voltage on one wire will vary directly with engine revolutions per minute. Connect that wire to the brown engine sensor defeat (ESD wire, pin 2 from the Power Module).

Caution: The car's engine electronics will not be damaged if *only* the wire carrying the changing voltage is connected to the brown ESD) wire. If the brown wire is connected, *do not* connect the green (Coil negative) wire from pin 9.

Power cutoff circuit

If the engines of cars with automatic transmissions are shut off, the power steering and braking functions will be disabled. Therefore, the orange engine power input 1 wire from pin 10 and the yellow engine

power input 2 wire from pin 11 should not be connected to shut off the fuel system. Instead, the green coil negative wire from pin 9 or the brown ESD wires will ground pulsed signals. Those signals stall the car intermittently and slow it down, rendering it virtually undrivable. However, the pulse signals will not cause the driver to lose control of the car.

The direct link between the engine and transmission on cars with standard transmissions will allow the engine crankshaft to turn as the car decelerates. Although the ignition is shut off, the car's brakes and steering function will remain unaffected.

Power cutoff to fuel

Cars with fuel-injection have an electric fuel pump, fuel injectors, and a fuel-control relay. The two orange engine power input 1 and 2 wires from pins 10 and 11 and the two yellow engine power output 1 and 2 wires from pins 12 and 15 of the Power Module can be connected to act as a normally closed switch. The "switch" opens when Logic Module directs the Power Module to shut down the engine.

ProCar includes two identical switches, wired in parallel for failsafe operation. Be sure to install both pairs of orange and yellow wires.

The best way to cut off fuel is to wire ProCar to the fuel relay if you car has one. The fuel relay is usually in the engine compartment and it draws low current. As another person turns the ignition key on and off, listen in the engine compartment for the sound of the fuel relay contacts clicking.

Find the wire to the fuel relay coil and cut it. Wire the orange engine power input wires from pins 10 and 11 of the Power Module to the power source and the yellow wires from pins 12 and 15 to the relay coil. **Warning:** *It is important that the orange wires receive the voltage and the yellow wires deliver the power to the load. The circuit MOSFETS are unidirectional, so if the wires are reversed, the power module will be*

damaged.

The second alternative is to cut power to the fuel injectors. The injectors are wired together with the wire bundle terminating at a multipin connector. Measure the voltage at each wire as the engine is running. Only one wire will carry a constant 12 volts. The voltage on the others will be lower.

Accelerate the engine to obtain a better reading. The injector wire voltage drops as engine revolutions per minute are increased. An oscilloscope screen will show a narrow negative pulse imposed on the 12-volt level at the injector wires. Wire a connection into the constant power wire that supplies all of the injectors.

Cut the constant 12-volt wire to all injectors. Connect the 12-volt wire to the two orange (engine power input 1 and 2) wires from pins 10 and 11 of the Power Module. Connect the other end of the cut wire (to the injectors) to the two yellow engine power output 1 and 2 wires from pins 12 and 15 of the Power Module. **Caution:** *Reversing these wires will damage the Power Module.*

Another alternative is to use the fuel power cutoff circuit as a starter interrupter. A thief or carjacker might panic if the engine shuts down completely within seconds after an attempted carjacking, especially if the vehicle has an automatic transmission.

To delay engine shutdown, cut the small start wire from the ignition key to the starter solenoid and wire the power source to the orange engine power input wires, and the solenoid wire to the yellow engine power output wires.

Mechanical fuel systems

On cars that do not have fuel injectors, the power cutoff circuit can cut power to the ignition coil. Follow the instructions for wiring the ignition cutout circuit given earlier. The ignition input to both the coil and the points or ignition module is 12 volts.

If the green coil negative wire from pin 9 to the points or igni-

tion module has been connected, cut the 12-volt ignition power to the coil positive and wire the orange engine power input wires to the power source, and the yellow engine power output wires to the coil power input.

The power cutoff circuit can also disable the starter in those cars instead of removing ignition power. Alternatively, an electric fuel cutoff solenoid (a standard part available at most automotive supply stores) can be installed.

Caution: *If the power cutoff circuit is installed to cutoff power to the fuel or ignition system, the engine will be shut down completely 10 seconds after the voice warning.*

Motion sensor

Mount the motion sensor on a vertical metal surface within the engine compartment (*avoid plastic surfaces*) on the driver's side as close to the firewall as possible so that sound vibrations will be conducted effectively. Connect the black hood shaker wire from pin 5 of the Power Module to the motion shock sensor.

Connect the red +12V power wire from pin 1 of the Power Module to the motion sensor and ground the two black wires from pins 13 and 14 of the Power Module.

When adjusting the motion sensor, temporarily disconnect any plunger or pin switches. Adjust the motion/shock sensor so that it requires at least a heavy impact through a distance of about one foot directed at either the front or rear bumpers to respond.

Pin/plunger switches

There is no limit to the number of grounded pin or plunger switches that can be connected to the black hood/shaker wire from pin 5 of the Power Module.

The ProCar circuit will operate reliably even if any of the pin/plunger switches connected to the black wire are filled with water or have mildly corroded contacts. The resistance across a pin switch should be zero

ohms when actuated and have an infinite value when open. The ProCar circuit considers any resistance value less than 400 ohms to be equivalent to zero ohms and any value more than 400 ohms to be infinite.

The voltage reading should be 11 volts when all entry points are closed (The system need not be armed to make this measurement.) If the voltage measurement is lower than 10 volts, examine all pin switch or the motion/shock sensor for defects. If both sirens are activated immediately after the system arms itself, the fault is probably a defective or intermittent pin switch or sensor.

Any "stuck" sensor that causes the voltage to drop to zero will prevent the system from arming itself, and status indicator LED1 will stay green. Install only pin/plunger switches with plastic rather than steel bodies to eliminate false alarms due to moisture condensing on the switch contacts.

Keyless-entry system

The logic module can be wired into any vehicle with a digital (keyless) entry system that provides a positive pulse from the door lock solenoid. Refer to Table 2 and Fig. 17. The yellow wire from pin 5 (+ Disarm from

OEM keyless entry) will disarm ProCar with a positive pulse. To integrate ProCar into a vehicle's factory-installed remote control or keyless-entry system, tap into the wire on the car's door-lock motor that becomes positive when opened.

If the high security level is selected, the keyless entry will only unlock the doors. The ProCar system will let the driver in, but the alarm will sound if the system does not receive the secret signal within 15 seconds.

Four-function remote

If you plan to install the optional remote radio-frequency receiver, mount it high enough

TABLE 4
LOCK-CONTROL
WIRE IDENTIFICATION

Color	Function
Red	+12 V Battery
Black	Negative ground
Orange	Positive switch lock
Yellow	Negative switch lock
Green	Driver door motor +Unlock
Blue	Driver door motor +Lock
White	Driver OEM wire +Unlock
Brown	Driver OEM wire +Lock
Gray	Ford lock switch

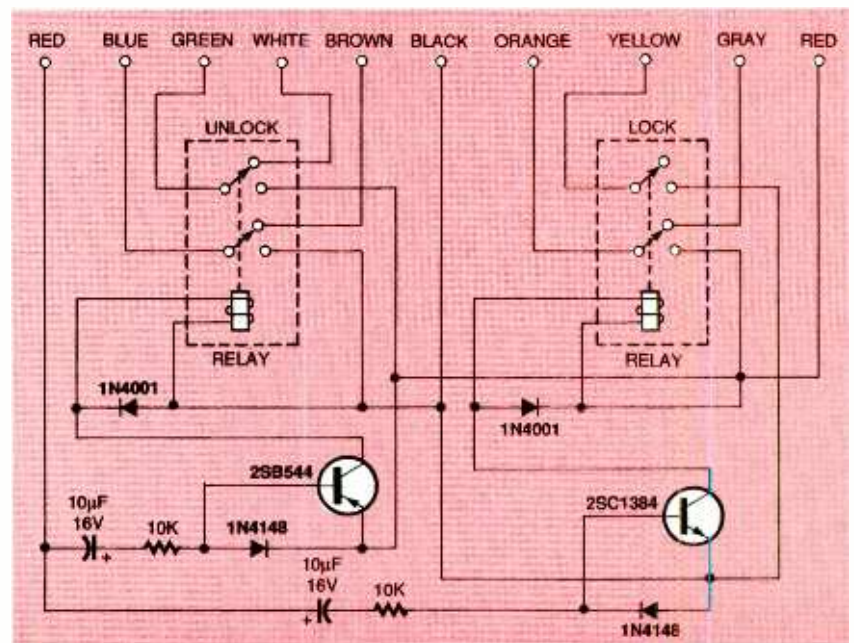


FIG. 20—WIRING FOR AUTOMOBILE DOOR LOCKS.

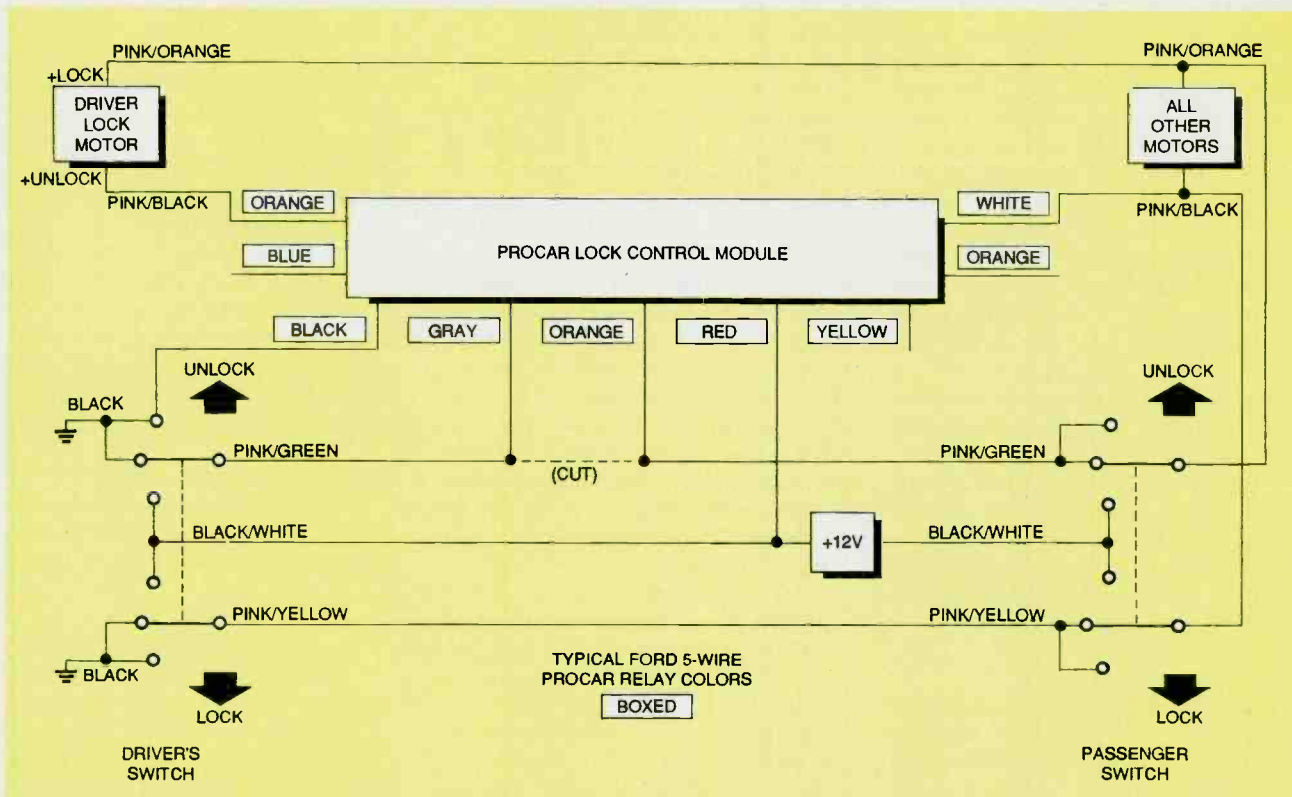


FIG. 21—TYPICAL DOOR LOCK INSTALLATION WIRING for positive switching in Ford cars.

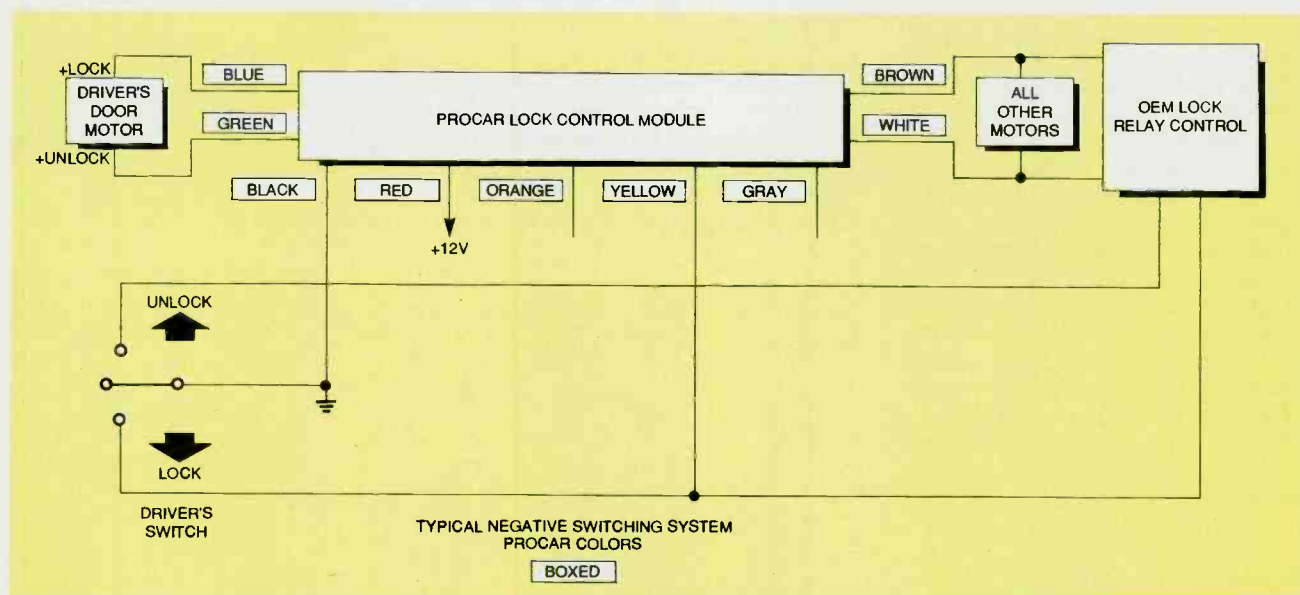


FIG. 22—TYPICAL DOOR LOCK INSTALLATION WIRING for negative switching in foreign cars.

under the dashboard so that its antenna wire can be fastened close to the windshield. Terminate the four wires from the Logic Module (see Fig. 13, page 74 March 1995 *Electronics Now* with the flat plug provided. Plug in the receiver *after* the red power wire has been connected. If power is applied after the sys-

tem is wired, ProCar will arm and the remote receiver could then enter the panic mode immediately.

Identify the antenna wire from the module and attach its end as high as possible under the dashboard with a sheet metal screw. The range of the antenna depends on the height of the

radio-frequency receiver and antenna under the dashboard.

If the vehicle is started as soon as the red wire is attached, ProCar will auto-arm, and the remote receiver could enter the panic mode immediately. If the sirens and light flasher are activated immediately after the red wire to the logic module is hooked up, push the No. 1 panic button on the remote control, then

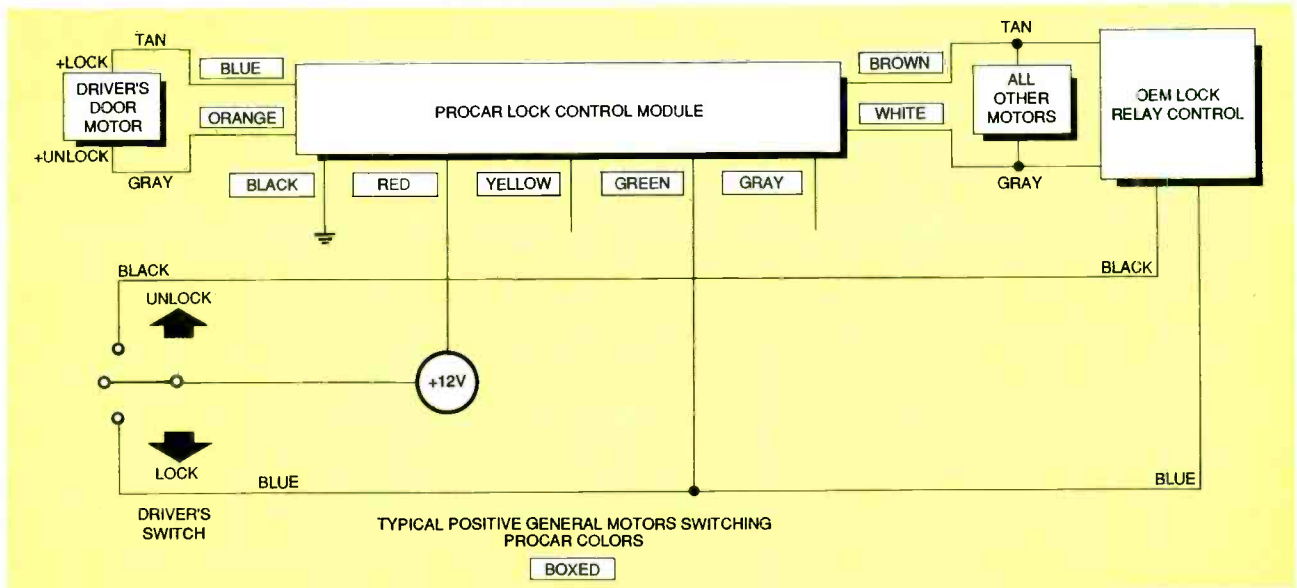


FIG. 23—TYPICAL DOOR LOCK INSTALLATION WIRING for positive switching in General Motors cars.

disarm the system by holding the No. 2 button for 3 seconds.

Automatic door locking/unlocking

Refer to Table 2 and Fig. 18. This feature allows the original power door locks to be synchronized with ProCar. Connect the optional auto lock/unlock module to the green Armed wire from pin 14 of the Logic Module. This circuit will lock all door locks as ProCar arms, and the unlocking relay will unlock the driver's side door only when ProCar disarms.

The locking feature will lock the keys inside the car if they are left in the ignition switch and all car doors are closed. However, ProCar allows a delay and sounds an audible warning before it arms and locks. If the driver has the remote control, he or she can unlock the driver's side door while simultaneously disarming ProCar.

If you want ProCar to lock the doors automatically after you leave the vehicle, or if you want to use the remote control and want ProCar to unlock the driver's side door as you disarm the system, wire the circuit shown in Fig. 20, the door lock control schematic. The lock and unlock circuits are shown separately. Table 4 identifies the functions of the colored wires in Fig. 20. Solder the components directly

to the relay terminals.

The door-lock control is designed to be universal for any vehicle, whether positive-switching, ground-switching, or five-wire switching.

Figure 21 is a diagram of a

Ordering Information

The following three complete circuit boards are offered:

- Main Alarm Board, double-sided—\$14.00
- Voice/Options board, double-sided—\$14.00
- Power Module board, single-sided—\$8.00

The following kits of components with PC boards are offered:

- Main Alarm circuit, less case—\$69.00
- Voice/options circuit, less case—\$79.00
- Logic Module: includes alarm and voice option boards, all components, case, LED1, wiring harness, connectors, speaker relay RY1—\$199.00
- Power Module: power module board, all components, case, wiring harness, connectors, and hardware—\$89.00

Other system components available are:

- Programmed ISD1016 voice record/playback device—\$18.00
- Radio-frequency receiver and two remote control (two-key) transmitters (modified and assembled)—\$59.00

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typical Ford automotive five-wire switching system, Fig. 22 is a diagram of a typical foreign car negative switching system; and Fig. 23 is a diagram of a typical General Motors positive switching system. The colors of the wires from the ProCar system are enclosed in boxes in these figures.

Door-monitoring circuits

The door switches on modern cars are set up in one of two different ways. They can either switch positive voltage to the dome lamps, or with positive on one side of the lamps, switch negative, or ground to the other side of the lamp. General Motors vehicles typically have negative switching while Ford vehicles have positive switching.

ProCar monitors the doors individually, but the system has been designed so that the installer need only gain access to the wiring of the switch in the driver's side door. ProCar circuitry will connect the car's electrical system to light interior dome lights when any door is opened. Nevertheless, it will discriminate between the different doors.

Positive switches

Locate the door-light switching wire. Verify that all of the passenger doors, hatch or trunk are closed. Open the driver's side door, and remove the

Continued on page 94

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DON LANCASTER

Way back in the seventh grade, I had a brilliant idea on how to "improve" VHF radio vacuum tubes by *eliminating* all of their internal interelectrode capacitances. That would be achieved by arranging the cathode and plate planar beside each other, and then placing the grid at right angles to them. I reasoned that there would be zero capacitance among the three. I vaguely remember assigning magnets to somehow bend the electron beam from cathode through the grid to the plate. I even sent this idea to RCA.

Sorry, but electrical capacitance *always* exists *everywhere*. Separate a conducting point from another with an insulator, and you've got a capacitor. Period. All that my scheme did was reduce the capacitance slightly. Obviously, I had never heard of *transit time*, *electron ballistics*, or *parasitics*. Or any of the other crucial gotchas important for any high-frequency design.

Naturally, it never dawned on me for an instant that similar ideas might have occurred to RCA's hired help. History seems to be repeating itself among my helpline callers, so we need to talk about...

"Too good to be true" results

Let's see. One caller has a zero-inductance scheme that is remarkably similar to my zero capacitance one. Of course, there are all of the usual motors and magnets perpetual-motion folks. Another caller has information traveling faster than the speed of light. One believes that a ridiculous amount of spark advance is all you need for a super efficient gas engine. Yet another claims to have developed an ultra small satellite antenna system.

I would really like to reply to all of these people "You are wrong." The outcome is not now and never was

0. They are.

1. The primary cause of an outrageous result is an outrageous mistake.

2. The secondary cause of an outrageous result is not having enough tools and skills to understand the problem.

3. Outrageous results *demand* that you make heroic efforts to thoroughly *disprove* them.

4. It is trivially easy to be "not even wrong".

5. Have others ever thought about this problem? When? How?

6. Have you completed a thorough DIALOG search? Do you personally subscribe to most of the industry trade journals? Are you aggressively using online resources?

7. What do you know that "they" do not?

8. What are you bringing to the table that is genuinely new?

9. Is hubris a factor?

10. Extreme paranoid secrecy or obsessions with patent "protection" are *certain* to cost you dearly in the long run.

11. If the result *still* looks legit, reduce the effect to its most fundamental terms. Then create a simple and reproducible experiment that some disinterested outsider can verify or disprove.

FIG. 1—MY GUIDELINES FOR dealing with "too good to be true" results.

in doubt. All that remains is deciding whether you want to find out *how* or *why* you made your error. Figure 1 shows my guidelines for dealing with "too good to be true" results.

If you have *any* conductor routed between two points in space, you *do* have inductance. Period. All that a non-inductive winding does is make the inductor physically *larger* in size.

Nobody who has ever stayed awake during Physics 101 lectures would even dream of trying to achieve perpetual motion. Without exception, *each* and *every* attempt to date has failed spectacularly. There is not one shred of evidence that such a thing is even remotely possible.

On extreme spark advance: there are few dead horses that haven't been whipped as thoroughly as this one. Try the *SAE Library* for more information.

I got the impression the antenna

person never even heard of "Doctor Maxwell's silver hammer," nor read chapter twelve of H. Jasik's *Antenna Engineering Handbook*. Nor has he appreciated the zillions of small antenna failures and outright scams littering all of satellite TV history.

An antenna has an *effective area*. There is a specified amount of input energy flux going into that area. You can do no better than grab it all. But even *trying* to grab it all will cause ugly *sidelobes*.

If you want a smaller antenna, raise the frequency and the transmit power. That's how the direct broadcast satellite (DBS) folks do it for their new services.

I like to encourage people to think about things and then come up with new ways of looking at problems. And, yes, new or improved antennas are certainly possible. But results that seem to be "too good" are *always* suspect.

New BASIC stamps

Lance Wally of *Parallax* just sent me a few samples of his brand new BS1-1C BASIC Stamp Module. This \$29 module is an *entire* computer measuring 0.4 by 1.4 inches. Figure 2 shows the stamp's actual size. The schematic for the new stamp is shown in Fig. 3.

Just in case you've come in late, there's a new microcontroller on the block called a PIC chip from Microchip Technology, Inc. These are clearly *the* hacker component of the decade. They cost under one dollar in large quantities. Dozens of PIC projects already have appeared in print, and hundreds more are on the way.

Thanks to an unusual architecture and a minimal RISC instruction set, PICs blow away *all* of the earlier microcontrollers, usually with three times the performance or more. The same unusual architecture makes it possible to distribute any problem among two or more PIC chips.

The PIC chips are far easier to use than, say, a 555 timer. And lead to *far* lower cost products. If your circuit contains eight or more parts and if one of them is an active de-

vice, then you most likely should use a PIC instead.

As we saw last month, you can easily perform such PIC tricks as creating complete digital sinewave generator with only six bytes of code. But the really great thing about PICs is that they are simple and fun to use. *None* of the traditional microprocessor hassles remain.

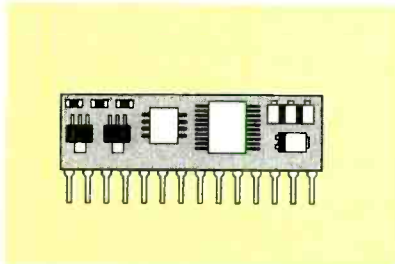


FIG. 2—NEW \$29 BASIC STAMP is an incredibly versatile microcontroller. It is shown here full size.

You can easily code these by hand without ever going near an assembler or an emulator. In fact, I strongly recommend that you write at least your first 1200 lines of PIC code by hand.

For those of you that don't want to jump in with both feet, the BASIC stamps make becoming microcontroller-literate quite easy. After a few of the stamp projects, you can step up to "real" PIC projects with blazing speed.

No matter where you look in the PIC universe, amazing and elegant hacks show up. Note the apparent misprint in Fig. 3, where a logic output becomes the supply pin for another chip. This is in fact a cute power-saving trick. If you aren't immediately using a chip, disconnect it.

I'll get into these a lot more in future columns. But for now, you get started by picking up the free catalog from *Parallax*, the "must have" free *Microcontroller Handbook* and *PIC Applications Manual* from *Microchip Technology*, and the really unique *PIC Tools* and *Stamp Extenders* from *Scott Edwards Electronics*.

As our resource sidebar for this month, I've listed several more key sources for PIC information and applications support. Don't miss this one!

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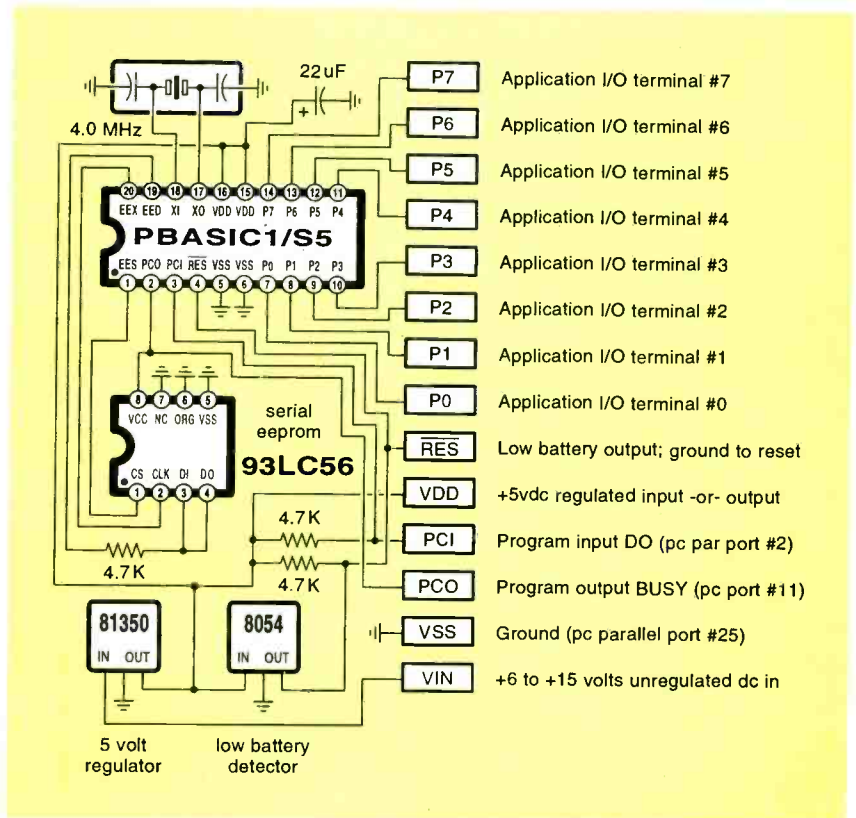


FIG. 3—BS1-1C BASIC STAMP schematic. This is the first microcomputer that is easier to use than a 555 timer.

AC motor drives

Induction-motor speed controls and electric auto drives are both of major hacker interest these days. In both cases, the key is to come up with a variable voltage and a variable frequency power sinewave cheaply and conveniently.

Sadly, a plain old linear amplifier will not hack it. That's because there's no known linear amplifier that offers any decent efficiency. Instead, you might want to go to one of the routes of Fig. 4. A DC power supply is connected to one winding of an AC motor through a pair of switches. The switches are often called a *bridge drive*.

The trick is to flip the switches just right so that the motor thinks it is seeing a variable voltage and variable frequency pure sinewave. What gets hairy fast is that you'll want to minimize motor *harmonics* because harmonics cause power loss, whine, cogging, and even instability. You'll also want to flip the switches as *few* times as possible per cycle because each flip costs you dearly in *transition losses*.

A classic method of dealing with power sinewaves is known as PWM, short for *pulse width modulation*. A high-frequency carrier becomes duty-cycle modulated with the sinewave. The fundamental is *not* present at first. It appears only after the PWM waveform has been *summed*, or *integrated*. Fortunately, the inductance of the motor winding forms a low-pass filter that doubles as an integrator, thus converting the duty cycle variations into a fundamental sinewave. There will be no low harmonics if the carrier frequency is high enough.

But PWM does have some nasty habits. Nonlinearities, quantization, and DC offset in the modulation shows up as output distortion. And the high-frequency carrier amplitude is *always* larger than the fundamental—gruesomely so for low-amplitude fundamentals. And there is all that higher frequency energy to contend with. Also ugly is the high number of transitions per cycle.

By using the *magic code* method, you come up with a switch flipping pattern that looks like a fundamental sinewave. The waveform shown is one of the simplest you can build

that has a strong fundamental, zero even harmonics, and a zero third harmonic. It has very few transitions per cycle. On the other hand, there's only one value available, and it has fairly strong fifth and seventh harmonics.

Note that classic PWM changes *both* sides of the bridge at the same time. Even for a comparable number of transitions per cycle, PWM has *twice* or more the losses.

In the simple example shown, the magic code requires only *four* single transitions per cycle. PWM would require *twenty-four* double transitions. While I can't claim this is "twelve times more efficient," I might say that those high-frequency transition losses are only $\frac{1}{12}$ th as much. And PWM often uses *much* higher frequencies for even worse performance.

Fewer losses, of course, let cheaper drivers be used, with lower temperatures and smaller heat-sinks. Thus, the magic waveform method would seem to be better if you could locate some having lots of different amplitudes and low harmonics.

We saw last month that a magic half waveform of 00101111111010 has no DC term, no even harmonics, no third and fifth harmonic, and a fairly weak seventh. To pick up the other half, use a code of 00-10-1-1-1-1-1-1-10-10. Do this by reversing the bridge to run the current *backward* through the motor winding.

Go through the 30-bit math, and you'll also find that the waveform 000110111101100 has an amplitude of about 83 percent and that 000101011010100 has an amplitude of about 62 percent. That's equal to 69 and 38 percent power, while still keeping a zero third and fifth harmonic. Plus, of course, there's the good old trivial 0000000000000000 waveform for the zero amplitude.

This gives us four amplitudes to work with at 30 bits. For many applications, you'll want a lot more than this. The obvious thing to do is increase the number of bits in the word. It turns out that words that are *products* of low harmonics can force all of those harmonics to zero.

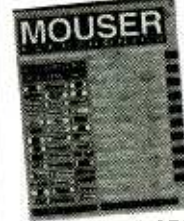
The most obvious next stopping point is a 105-bit half word because

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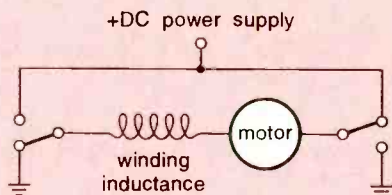
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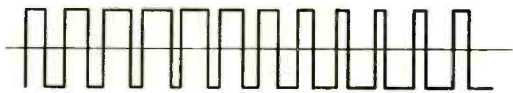
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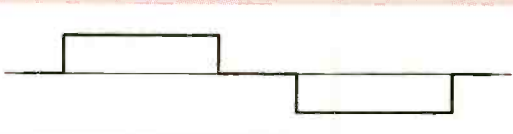
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(A) The object of the game is to flip the switches as few times per cycle as possible, while still convincing the motor it is seeing a clean sinewave having the desired alternating current frequency and amplitude.



(B) With the "PWM" method, a high frequency carrier gets integrated by the motor's inductance to produce the desired waveshape. While amplitude is easy to adjust, there are many efficiency degrading transitions.



(C) With the "magic waveform" method, a shape having a desired fundamental and acceptable harmonics gets used. This example has no third or even harmonics. The transitions are few, but it is tricky to find useful values.

FIG. 4—TWO APPROACHES to high power variable amplitude sinewaves.

$3 \times 5 \times 7$ equals 105. Now, there are a *lot* of possible 105-bit words. But it turns out that only a mere 2219 or so of them end up with zero third, fifth, and seventh harmonics. These also have zero ninth, fifteenth, and twenty-first harmonics, with no DC term and no even harmonics. This means that harmonics 0, 2–10, 12, 14–16, 18, 20, 21, and 22 are all zero—not half bad.

Some of the magic sinewaves will have too much distortion. Others will have too many transitions. And yet others won't hit the amplitudes we want, or might cause amplitude jitter.

But if you go through the list, you can pick out 103 or so magic sinewaves from the list in Fig. 5. These give you roughly one percent amplitude control. And they have far fewer losses than PWM.

To use this list, you "unfold" the strings to get magic words of length 210. You then stash these in a table lookup memory somewhere. Pick a

magic word for an amplitude. Pick a selected delay for a frequency. And that's all there is to it. If really needed, the few "missing" words in Fig. 5 can be calculated by going to 420 bits.

I do this with PostScript and an Apple IIe. How else are you going to exhaustively explore all possible 210-bit binary words? As always, I've found PostScript's friendly interactivity to be *the way* to solve a seemingly sticky problem.

As with all sticky problems, once you get inside, things simplify a lot. For instance, to end up with zero even harmonics, you must have half-wave symmetry, which means that you really are starting with 105-bit words. Quarter-wave symmetry makes for easy analysis because it results in sine terms only. Thus, you are down to $52\frac{1}{2}$ bit words. Always deal with the half bit by splitting a zero.

A 52-bit word results—a mere 4,503,599,627,370,496 states to

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run a full Fourier series on. All in all, this still might make for a fairly long Postscript evening. But wait. You can easily write 17 equations that

force a zero third harmonic, and 10 equations for a zero fifth harmonic, and seven for a zero seventh harmonic. Thirty four equations in 52 unknowns should, in theory, reduce to one equation in 18 unknowns—262,144 states or so.

However, these are *general* equations. But *all* of our inputs and *all* solutions have to end up *binary* ones and zeros. You can thus eliminate some of these 52-bit words immediately and test for the rest. That quickly generates all 2219 possible candidates. You then run your Fourier Series only on the good ones, leaving you with a few hours work at most.

Full details appear on *GENIE* PSRT in *FOURIER.PS*, *ZEROHARM.PS*, and *SN210CAT.PS*. Plus a few others.

Many thanks to math genius Jim Fitzsimons for his valuable input on all this. Consulting services are available for this exciting new

hacker topic. A kit or two may also be in the works. Surely others have plowed some of this ground before. If you know of any technical papers on power waveform harmonics, please send them to me for a free copy of my *Incredible Secret Money Machine II* book.

Now, the real challenge is to find the improved 440-bit magic word list. That should give us fewer losses, lower distortion, and more choices, yet still keep reasonable 26.4 kHz switching frequencies. This one might take a tad longer, though...

New tech lit

Sony has published new data books, including *Multimedia Computer Audio/Video*, *CCD Area Sensors*, *CCD Linear Sensors*, and *Radio Communications ICs*.

Motorola has a new *Rectifier Applications Handbook*. It includes some mind numbingly obsolete fil-

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This table of "magic" values can be used to generate efficient digital power sinewaves having very low distortions and minimum state transitions. Important uses include induction motor speed controls and electric automobiles...

00 - 000	50 - 0000100000000011000010001000011100110001100001110
01 - Not available yet	51 - 00000000010001000000011110000000111100000011110000
02 - Not available yet	52 - 000100000000000111000000110111000001111010000111
03 - Not available yet	53 - 00000010000000011000010000111010000101000011110000
04 - Not available yet	54 - 000000000100000110010000010011110000011110000111
05 - Not available yet	55 - 0110000000001001000001100001110000011100111000011100
06 - Not available yet	56 - 0000000001000000000111110000001111000001111110000
07 - Not available yet	57 - 0000000010000010000111010000011000110000111000001110
08 - Not available yet	58 - 00100000000010000110000010110000111000011100001110000
09 - Not available yet	59 - 0011000000000111000000111001100000111100011001111100
10 - 001000000000000000000001000000000000100000000100000	60 - 00000000001100000001100100011100000111100111001110
11 - Not available yet	61 - 000100000100000100000111001100000111100000011110000
12 - 00000000000000010000000000010000010000000000001	62 - 0111000000000110000001110011100000111001100111100
13 - Not available yet	63 - 00000000100010001000101110000001111110000011111000
14 - Not available yet	64 - 000001100000000000110001110000110100011110001110
15 - Not available yet	65 - 0000000110000000010011110001001110110001101110001
16 - Not available yet	66 - 000000001000001010010000011110100010111100001111
17 - Not available yet	67 - 0010000000000111000000101111000010101111000011110
18 - Not available yet	68 - 0000000110000001100001111000001111100001111100001
19 - 0000100000000000000001000100000000100010000010001000	69 - 01000000011000000111000001111000011110001011110010
20 - Not available yet	70 - 0110000000001101000001100111000111011100110011111
21 - 00000000000000010000010000000000011100000000001100	71 - 0111000000001001000001110000011100110000111100001
22 - 00010000000000001000001000000000011000000000001	72 - 000000000001000110000100111001110001110011100111100
23 - 00000100000000000000010000010010000000001100100000100	73 - 011000000100000110011000001111000011110010011111
24 - 000000000010000000000100100000100001100000101100000	74 - 000001000000101000000111110000111100001111000111110
25 - 010000000000000010000010000001000011000010000001100	75 - 000000000001001100000110011000111110001101110001
26 - Not available yet	76 - 0001000000000101100010000111110010101111100001111
27 - 01000000000000010001000000001100000100110000000110	77 - 0111000000010001000101110001111000011111100111110
28 - 0000100000000000100000000111000100000000011000110000	78 - 00100010000001100000011110100011100111110101111
29 - 00000000100000000000011000001000001010000011000011000	79 - 0110000001100000001111000011110001111100111110111
30 - 00000000001000000100000100001100000011000011000010	80 - 0000000110000001001100011100111001100110011111100011
31 - 0010000000000001000001010000000001111000000000101100	81 - 00000000001100100001100110001110011000011110000111110
32 - 000000010000000001000001100000100010001001010100000	82 - 00001000011000000001110001110110001111111011011110
33 - 000000000100000000011000000011000000010010000110010000	83 - 01110000000001000100001100111100000111111011011110
34 - 001000000000000110000001000011000001011000010000010	84 - 0000000011000001100110000111110001111100011111000111
35 - 00000100000000000010001000001100100000100111000001001	85 - 01000000100001000011100101111000111110101111110
36 - 0000000001000000011000000011100000001100010000110	86 - 0000010000001011000001111000001111000111111001111110
37 - 010000000001000000010100001000000100011000011000011000	87 - 00000000001010000110100001111101011111001111110111
38 - 000000010000000100000001001101000001000001110100100	88 - 00100010000001100000111100100011110111101111110111
39 - 0000000000001000000001100100000111000001011010100	89 - 0000000010110000000111100101111010101111111111110
40 - 0010000000010000010000011000011000001011000011100001	90 - 0010010000001111000001111101010111101111110101111
41 - 000100000000000110000001100001010000011100110000011	91 - 0000011000000001011001010111100001111100001111101111
42 - 00000000000100000101000001000011100000111000011000011	92 - 01000100000100011100010011110111001111111101111101111
43 - 0100000000100000000111000001000100011100010001111000	93 - 000000000001001100001100110011100111111111001111111
44 - 00000001000000000111000000011100010001110000000111	94 - 0000010010010000001111001010110101111110111111011111
45 - 010000100000000001000110000000011001100100001100011	95 - 001100000000011010100001011011000111111111011111111
46 - 0110000000010000000111000000110000110011100000011100	96 - 00001000000110001100011011011001111111101111110111111
47 - 0000010000000001100011000000110011000100011001001000	97 - 000001001001000001011110100101111111011111110111111
48 - 00000000000100001000000010001100000111000011000011000	98 - 0000100000000101101000010111010011111111011111101111
49 - 0010000000000100000000011100100000111000010011111000	99 - 0000000001001010100011101110101111101111110111111111
100 - Not available yet	
101 - 000000011000000111110001111110111111111111111111	
102 - 00001001000001000110101110100111111111111111111111	

210-bit values shown in approximate one percent steps. Each listing consists of a zero followed by 52 active bits. To form the first half cycle, MIRROR the listing and REMOVE THE FINAL ZERO, giving a 105 bit half word.

To form the second half cycle, duplicate the first half, replacing each 1 with a -, completing the 210 bit word. Do NOT mirror the second half!

To use, stash the words in a table lookup memory and pick the one you want.

More details (including full spectral analysis) in MAGIC210.PS, FOURIER.PS, ZEROHARM.PS and SNCAT420.PS on GENIE PSRT.

FIG. 5—103 MAGIC POWER SINEWAVES shown as one percent amplitude steps. Harmonics 2–10, 12, 14–16, 18, 20, 21, and 22 are zero. Harmonics 11 and 13 are tame. Minimum transitions are used for superb efficiency.

ter design information. Motorola completely missed the fact that you can *instantly* design any 60-hertz full-wave filter capacitor simply by memorizing this fact: In an 8300-microfarad capacitor, the volts of ripple equals the amps of current.

Marvin Simon's *Spread Spectrum Communications Handbook* offered by McGraw Hill does seem to be the definitive tome on the subject—all 1228 pages of it. This textbook clearly shows the military jamming heritage of spread spec-

trum communication, for it takes until page 1186 or so to get around to mentioning that there *might* be some commercial uses for this stuff. For a totally different approach to the same subject, check out Randy Robert's *Spread Spectrum Scene*.

Dave Strom has written a new *Power Up* book on making battery adapters for military surplus radios. It's published by CRB Research.

Scientific American, January 1995, has a great project on sonoluminescence in the *Amateur Scientist* section. Costs are in the hundred dollar range. Useful results should be obtainable in any fairly advanced home lab.

The fusion energy potential for sonoluminescence is talked about in *Science*, December 16, 1994, p. 1804. Sonoluminescence can routinely produce temperatures of a million degrees C and pressures of a 100 million atmospheres. All in a flask! Of course, I did tell you all about sonoluminescence long ago. More in HACK73.PS on GENIE PSRT.

Lots of information on *bright* blue light emitting diodes appears in the January 6, 1995 *Science* on pages 51–55. Few people are aware that LEDs are potentially five to ten times more efficient than an incandescent lamp. As auto taillights, LEDs are also *much* safer. That quarter second or so turn on risetime of an incandescent lamp translates to *twenty feet* of delayed warning at thruway speeds!

For information on speech synthesis and recognition, check into the AVIOS, or *American Voice I/O Society*. Its next applications conference will be September 12–14 in San Jose, CA. Journals, proceedings, and vendor's directories are also offered.

The *Electric Spacecraft Journal* is one interesting pseudoscience publication. There is also an *Anomalous BBS* on related off-the-wall topics.

Historically Brewed is that unique magazine offered from the *Historical Computer Society*. Trial issues are available for \$3.

Free P-Nut connector samples are available through *Kleinhuus North America*. These are a long overdue improvement to wire nuts.

AMAZING

Electronic and Scientific Products

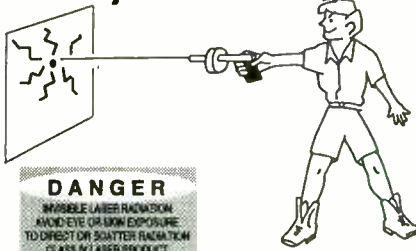
Mystery Levitating Device!



Remember War of the World? Objects float in air and move to the touch. Defies gravity, amazing gift, conversation piece, magic trick or great science project.

ANT1K Easy to Assemble Kit / Plans \$19.50

Laser Ray Gun



DANGER
VISIBLE LASER RADIATION
AVOID EYE OR SKIN EXPOSURE
TO DIRECT OR SCATTER RADIATION
CLASS IV LASER PRODUCT

Advanced project produces a burst of light energy capable of burning holes in most materials. Hand-held device uses rechargeable batteries. 500 joules of flash energy excite either a neodymium glass, yag or other suitable 3" laser rod. This is a dangerous CLASS IV product (individual parts/assemblies available). LAGUN1 Plans \$20.00
LAGUN1K Kit / Plans Price on Request

Extended Play



Telephone Recording System

READY TO USE! Automatically controls and records on our X-4 extended play recorder, taping both sides of a telephone conversation. Intended for order entry verification. Check your local laws as some states may require an alerting beeper. TAP20X Ready to Use System \$129.50



Shocker Force Field/ Vehicle Electrifier

Neat little device allows you to make hand and shock balls, shock wands and electrify objects, charge capacitors. Great payback for those wise guys who have wronged you!

SHK1KM Easy to Assemble Electronic Kit \$24.50

Electric Charge Gun

All New Technology!



Stuns/immobilizes attackers up to 15 feet away!
*Legal in most state (not in NY, NJ, MA, WI) • More knock-down power than most handguns • No permanent injury • ID coded • Free 80KV stun gun with every purchase.
ECG1 Data Packet, Creditable toward purchase \$10.00
ECG10 Charge Gun, Ready to Use, w/Free 80KV Gun \$249.50

Homing / Tracking Transmitter

Beeper device, 3 mile range.
HOD1 Plans \$10.00 HOD1K Kit / Plans \$49.50

Listen Through Walls, Floors

Highly sensitive stethoscope mike.
STETH1 Plans \$0.00 STETH1K Kit/Plans \$44.50

Infinity Transmitter ++



Telephone Line Grabber/ Room Monitor / Controller

All New - The Ultimate in Home/Office Security & Safety!
Simple to use! Call your home or office, push a secret tone on your telephone keyed to access: • On premises sounds and voices • Ongoing phone conversation w/break-in capability • Up to 10 external electrical functions, lights, TV, alarms, coffee pots, heater, etc. CAUTION! Check legality with your state's attorney general's office before use for monitoring of voices.

TELECOM2 Kit, includes PC Board \$149.50
TELECOM2 Ready to Use \$199.50

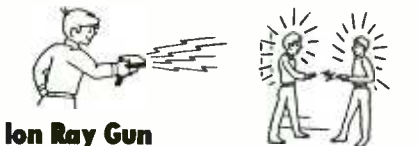
Visible Beam Laser

Easy to build, RED Beam, visible for miles. Use for light shows, window bounce holography, cloud illumination and much more! LAS1KM Kit w/1mw Laser Tube, Class II \$69.50
LAS3KM Kit w/2.5mw Laser Tube, Class IIIA \$99.50

Life is Precious -

Protect It!

Hard hitting 200,000 volts of crackling, sizzling plasma. Stuns and immobilizes most attackers
STUN40 Ready to Use \$69.50
STUN10 Smaller Unit \$39.50



Ion Ray Gun

Projects charged ions that induce shocks in people and objects without any connection! Great science project as well as a high tech party prank. IOG3 Plans \$8.00
IOG3K Kit/Plans \$69.50

Invisible Pain Field Generator

Shirt pocket size electronic device produces time variant complex shock waves of intense directional acoustic energy, capable of warding off aggressive animals, etc.
IPG7 Plans \$8.00 IPG7K Kit/Plans \$49.50
IPG70 Assembled \$74.50

1000 Ft++ Potato Cannon

NOT A TOY. Uses electronic or piezo ignition. CAUTION REQUIRED!
POT1 Plans \$10.00
(Dangerous Product)

FireBall Gun

Shoots flaming ball - two shot capacity
Great for special effects and remote fire starting. CAUTION REQUIRED!
FIREBALL Plans (Dangerous Product) \$10.00



TV & FM Joker / Jammer

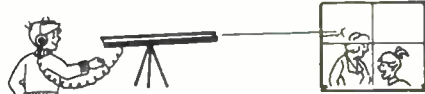
Shirt pocket device allows you to totally control and remotely disrupt TV or radio reception. Great gag to play on family or friends. Discretion required.

EJK1KM Easy to Assemble Electronic Kit \$24.50

ATTENTION: High Voltage Fans!

4,000 volts in the palm of your hand! Experiment with anti-gravity, hovercraft, ion guns, force fields, plasma guns, shock devices, wireless energy and electrical pyrotechnics. Input: 9-14VDC.

MINMAX4 Ready to Use \$19.50



"Laser Bounce" Listener System

NEW - Latest Technology! Allows you to hear sounds from a premises without gaining access. Aim at room window and listen to sounds from within via reflected laser light. Not for illegal use. Requires video tripods.

LWB3K 5mw Laser and Receiver Kit \$149.50
LWB30 Ready to Use, includes Laser Gun Sight \$199.50

5mw Visible Red Pocket Laser

Utilizes our touch power control!
VRL5KM Kit / Plans \$74.50

Electronic Hypnotism

Puts subjects under control using highly effective electronic stimuli. Intended for parties and entertainment but must be used with caution. Includes valuable text book reference and plans.
EH2 Plans and Text Book \$19.50

Automotive NEON!



Easy-to-Install
4-Tube Kit
for Cars, Trucks, Vans!
Available in Pink, Purple, Blue or Green
- please specify color when ordering.
RG4K (Specify Color) \$129.50
License Frame Kit (Specify Color)
LIC1K \$24.50
Flash-To-Music Option for above
kit FMU1 \$29.50

3 MI FM Wireless Microphone

Subminiature! Crystal clear, ultra sensitive pickup transmits voices and sounds to FM radio. Excellent for security, monitoring of children or invalids. Become the neighborhood disk jockey!
FMV1 Plans \$7.00 FMV1K Kit and Plans \$39.50

Telephone Transmitter - 3 Mi

Automatically transmits both sides of a telephone conversation to an FM radio. • Tunable Frequency • Undetectable on Phone • Easy to Build and Use • Up to 3 Mile Range • Only transmits during phone use. VWPM7 Plans \$7.00
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It started in America!

The creators are the masters in manufacturing the finest video products...

You probably don't associate VCR's with American technology. Fact is, video recording has its origins in America and it was 3M that brought video recording out of the lab and into your living room. Today, 3M video tape is the choice of all the major networks. No other tape company has ever won an Oscar or an Emmy. 3M Black Watch tape follows in this tradition—service and quality go hand in hand. Here are three Black Watch products you should be using at home!

Clean up! With constant playing and using of degrading dry or wet cleaners, the output of your video tapes has slowly diminished to an unacceptable level and the VCR plays as if it has a head cold! The culprit is most likely clogged and dirty video and/or audio heads. The 3M Black Watch™ Head Cleaner Videocassette uses a patented magnetic tape-based cleaning formation to remove head clogging debris. No foreign substances such as cloth, plastics or messy liquids and no harsh abrasive materials are present. The cleaner's usable life is 400 cleanings or more!

It's easy to use. Place the 3M Black Watch™ Head Cleaner Videocassette in the VCR and press the Play button. A pre-recorded message will appear clearly on your screen and an audible tone is heard, telling you that the cleaning process is now completed. No guess work; you never over clean! Priced at \$19.95.

For the VCR! Once your VCR's record and playback heads are cured, and the unit plays like new, consider using the finest videocassette you can buy—the 3M Black Watch™ T120 Hi Pro VHS 4410 Videocassette. The 4410 is the highest performing videocassette available today for use with all standard format VHS recording hardware!

Here's what you hear and see....A sharp, clear picture—brightest ever colors—freedom from streaks, flashes and snow—outstanding high-fidelity audio reproduction—optimum camcorder performance—maintains recording integrity. 3M Black Watch™ video tape is 100% laser inspected to guarantee surface smoothness and drop-out free performance. Priced at \$8.00

You saw it here first! 3M Black Watch™ 0900 8mm video tape cassette loaded into your Hi Band camcorder delivers the finest picture and sound possible in the 8mm format. Extremely fine particles of pure iron alloyed with nickel and cobalt deliver a video performance exceeding 400 lines of horizontal resolution. You get the advantage of an exceptional video image with superior audio re-



production. This means your Hi 8 format camcorder will produce the best video and audio definition possible. With the 3M Black Watch™ 8mm cassette, the recording capability and performance of your camcorder will be significantly enhanced. Priced at \$14.95.

Clagg Inc. — 3M VHS Special Offer
P.O. Box 4099,
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Yes, I like your offer and here is my order for 3M Black Watch™ products!

- ___ 3M Black Watch™ 0900 Hi Band-120 8mm Cassette \$ _____
 (\$14.95 each)
- ___ 3M Black Watch™ T120 Hi Pro VHS 4410 Videocassette \$ _____
 (\$8.00 each)
- ___ 3M Black Watch™ Head Cleaner Videocassette \$ _____
 (\$19.95 each)

Shipping and handling per order **\$4.00**

Total Amount in U.S. Funds only \$ _____

New York residents add local sales tax. Canadians **add \$6.00** per order. No foreign orders. Do not send cash.

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For most hardware hackers most of the time, patents are an utter and total waste that is *guaranteed* to cause you a net loss of time and money. The reasons behind this, along with fully tested and proven real-world alternatives, now appear in my *Case Against Patents* package. That also *includes* my *Incredible Secret Money Machine*. Details are found in my nearby *Synergetics* ad.

A reminder that unique downloads, freebie insider secrets, catalogs, and technical help are available on my *GENIE* PSRT. A 10-hour free trial time is available per the *Need Help?* box. A credit card is required to register.

As usual, the resources I've mentioned appear in either the *Names & Numbers* or *PIC Resources* sidebars. Be sure to check there first before calling our no-charge technical helpline. Let's hear from you. Ω

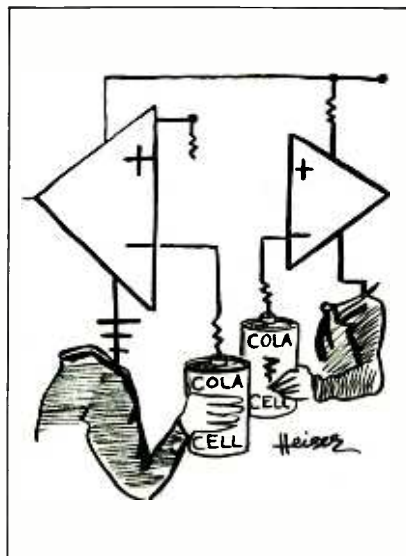
NEED HELP?

Phone or write your Hardware Hacker questions to:

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 Box 809-EN
 Thatcher, AZ, 85552
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For fast PSRT access, modem (800) 638-8369. On prompt, enter JOINGENIE. When asked for the keyword, enter DMD524.

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AUDIO UPDATE

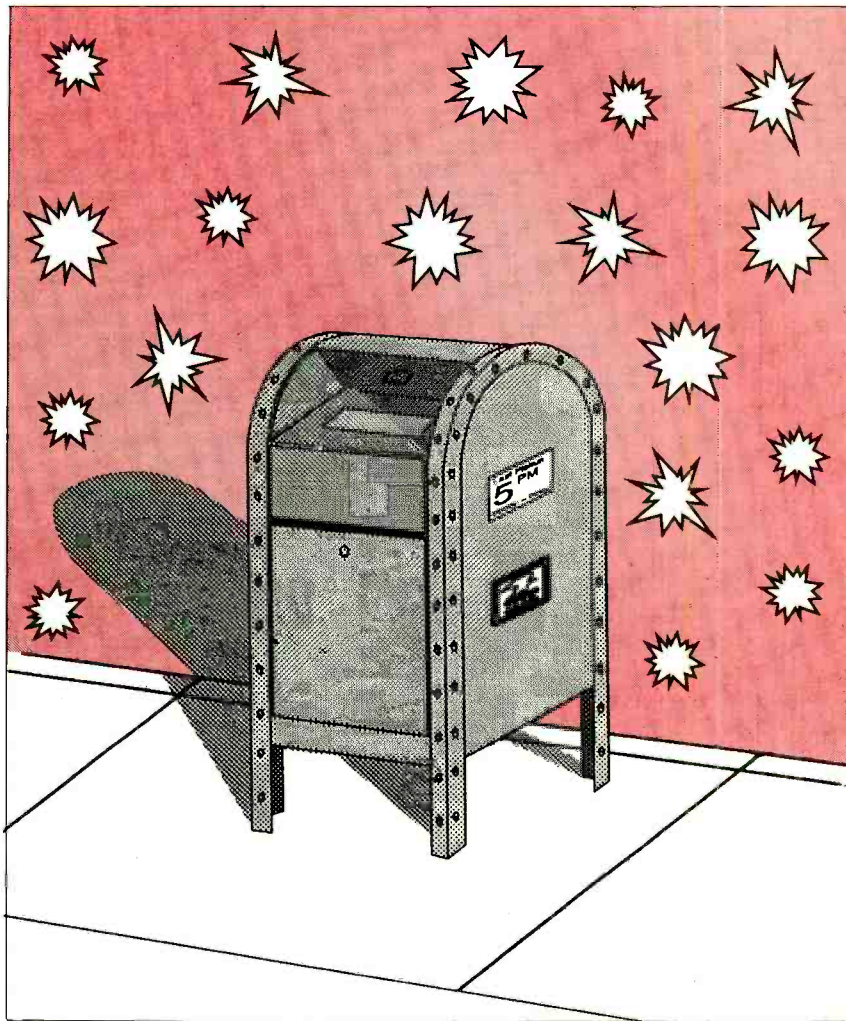
Letters: Bouquets and Brickbats

LARRY KLEIN

As regular readers may have noticed, one of my favorite critical targets is the publications that cater to the high-end audiophile purist crowd. And, not surprisingly, most of my *Electronics Now* mail is in response to those potshots. At present, I'm pleased to note, such mail is running about 3 to 1 in my favor—which testifies to the good sense of most of this magazine's readership.

In general, I don't think the purist (I-can-hear-it-even-if-you-can't) publications do grievous harm—other than encouraging those seeking quality reproduction to spend far more than necessary and engendering, by example, an anti-science dumbing down of their readers. Some favorite examples of their recommended, but scientifically implausible, products come to mind: the metal brick that when placed atop an amplifier improves its sound; the adhesive-backed, 1-inch, fuzzy discs that when cemented randomly to the walls of a listening room enhance its acoustic qualities; and a dozen or so brands of speaker cables that magically embellish an audio system's spatial coherence, resolution, speed, and/or harmonic integrity (if not convergence). None of those products appear to employ known laws of physics, acoustics, or electronics to perform its wonders—which opens the question of which alternate physical (or psychological) dimension it or its admirers operate in.

In any case, my generally good-humored attacks on the purveyors of audio excess have generated both bouquets and brickbats (in a 3:1 ratio, as I've noted). Herewith is an interesting sample brickbat from reader Vincent Knoll of Seattle, WA. Mr. Knoll is annoyed at my dismissal of *Stereophile's* concerns about the adoption of Dolby's AC-3 digital audio system for digital TV. His letter



has been edited for space while (hopefully) preserving its tone and major points. Since the issues raised deserve replies, I've keyed my responses to his letter.

Mr. Knoll writes:

(1) Larry Klein's latest attack on *Stereophile* [Dec. 1994] was unnecessary to say the least.

(2) Far from being an exercise in arrogance, *Stereophile's* letter to Pioneer [on the AC-3 system] was one of valid concern.

(3) Do we really fail to hear those soft sounds buried under the louder ones? Maybe they do have some

influence.

(4) Klein says he is more amused than upset [by *Stereophile's* open letter]. Really? I wonder, since his comments on *Stereophile* [to use his term] are becoming "prolix"! What?! I read an electronics magazine and improve my vocabulary too. Such a deal!

(5) Before Mr. Klein's obsession with *Stereophile* goes beyond prolix—he'll have to help me out here, I don't know a word for that concept—maybe you could persuade him to be more technical and less editorial.

(6) I enjoy both *Stereophile* and *Electronics Now*. *Stereophile* doesn't single out *Electronics Now* by name for repeated attacks. Please make the courtesy reciprocal.

My response.

(1) Unnecessary? As long as publications such as *Stereophile* continue to push bad science, bad logic, and unsubstantiated evaluations, I feel I'm doing a small but helpful service by pointing out the absurdity of much of their buying advice and recommendations.

(2) Perhaps. I receive a monthly self-promotional "news release" from *Stereophile* extolling their latest editorial content and achievements. Their "open-letter" objections were simply an opportunity for them to promote their publication to the press and their advertisers. In my day, we did the same thing at *Stereo Review*, but I tried to stick with substantive issues, e.g., the quality problems of records and pre-recorded tapes, the audio industry's hanky-panky on power ratings, the FTC's irrational power rulings, etc.

(3) As I said in my original article, we know a lot about psychological masking and how to manipulate it to desirable ends. And psycho-acoustic studies are ongoing, not only among the equipment manufacturers but in the electronics and psychology departments in universities throughout the world. (The preliminary program of the 98th Audio Engineering Society Convention, taking place in Paris this February, schedules no less than 11 separate papers on audio data reduction and its subjective evaluation.) To disregard the results of those ongoing studies, trials, and controlled listening tests on the basis of speculative "maybes" (and the unreliable opinions of self-anointed golden ears) is not how science works.

(4) I've been known to do so. But exactly what is your objection to expanding your vocabulary? If by reading my column you can incorporate dual avians with a single lithic formation, why not?

(5) "Logorrhea" is the word you want. I do try to maintain a balance between the technical and the "editorial." At least two-thirds of the col-

umn you complain about was "technical," but in any case, I don't see myself as a reporter, but rather as a commentator. Electronics news is handled very ably in other areas of *Electronics Now*.

(6) I refer you to response (1). I don't know how much "courtesy" is owed, for example, to a snake-oil salesman selling a fraudulent product, or when pointing out a publication's off-the-wall product evaluations.

Incidentally, I don't mean to leave readers with the impression that there is no worthwhile editorial content in *Stereophile* and *The Absolute Sound*, but technical silliness continues to sully both publications.

A final point on the Dolby AC-3 digital audio system that started all this: The Advanced Television Systems Committee (ATSC) has voted to accept the AC-3 system as part of the proposal on digital TV to be forwarded to the FCC for approval. The ATSC includes more than 50 companies, associations, and educational institutions involved in delivering television to the U.S. public. These include television networks, broadcasters, cable operators, motion picture companies—and equipment manufacturers for all of the above. An official count of the six-week mail ballot conducted by the ATSC last November showed 40 members in favor of the Dolby AC-3 audio system and one against. Enough said.

Bouquet department

I received a wonderful, but too-long-to-print, letter from Haynes Davis of MCP DaviSound of Newberry, South Carolina. Mr. Davis, who is a professional audio design engineer, tells an interesting tale of two prototype preamps, one of which received raves from a high-end reviewer for its "well-defined low end," "high degree of imaging," "silky smooth high end that reproduces the 'velvety' characteristics of the string section," etc. and so forth. The unfortunate other unit was judged to suffer from a variety of sonic inadequacies and nasties that clearly disqualified it as a truly hi-fi product. The kicker is that they were both primarily off-the-shelf bi-fet op-amp designs from the

same textbook circuits using the same high-grade parts and layouts. True, the two units did use different face plates. Perhaps the prettier face won the sonic beauty contest?

Mr. Davis closes with a request that I "continue to educate the masses along these lines from time to time via your column and may logic prevail." Pleased to comply!

Another reader, Professor Gerald L. Park from the Department of Engineering at Michigan State University, recounts some of his past experiences building kits (prompted by my column on the subject) and laments the fact that the reduction in experimentation and building is very noticeable among his engineering students. He suggests that I "keep the good words flowing and don't be afraid to offend the gurus of dollar-fi—the modern version of hi-fi wherein high cost is a positive performance parameter."

Professor Park concluded with an interesting speaker-cable suggestion: "You might suggest to your readers that they consider SO type extension cord cable used for boats (yellow jacket) or in industry (black jacket). They often use #8 gauge stranded wire and differ very little from higher-priced oxygen-free [?] hi-fi cables. A few measurements with an audio-spectrum analyzer [HP 3561A] confirmed that conclusion."

Thank you, Professor Park, and all the others who have taken the time to write and let me know your thoughts. I appreciate your comments, whether we agree with each other or not. Ω



JOHN W. SWANCARA

THE REQUIREMENTS FOR THIS project were determined when our club historian assembled a slide show to run during an upcoming banquet. Everyone wanted to eat, and no one wanted the responsibility of operating the slide projector and advancing the slides. Unfortunately a slide projector that would sequence them automatically was not available. The circuit described here solved the problem by adapting a standard carousel slide projector for automatic operation. Only the remote control cable that plugs into the slide projector must be modified—the projector is left in its original form.

The circuit for the unmodified remote control of the Kodak carousel projector is shown in Fig. 1. The remote originally provided forward and reverse advancing of the slides. It was replaced by a variable timer and a relay that simulated the remote's forward switch and controlled the projector.

Theory of operation

The timer circuit is shown in Fig. 2. A 555 timer, IC1, is the heart of the circuit. The value of resistor R3 determines a minimum time delay, and potentiometer R4 sets the maximum delay. The values indicated provide a time delay that is variable from 1 to 15 seconds. If only one time delay is required, R3 and R4 may be replaced with one

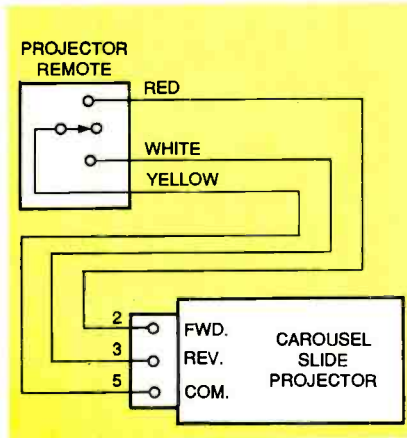
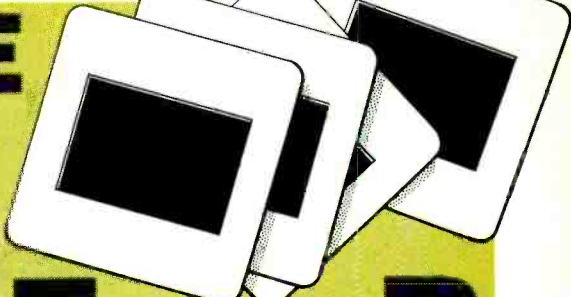


FIG. 1—ORIGINAL CONFIGURATION of the slide projector's remote control.

S THE L I D E S T E P P E R



Put on an automatic slide show with this simple stepper circuit.

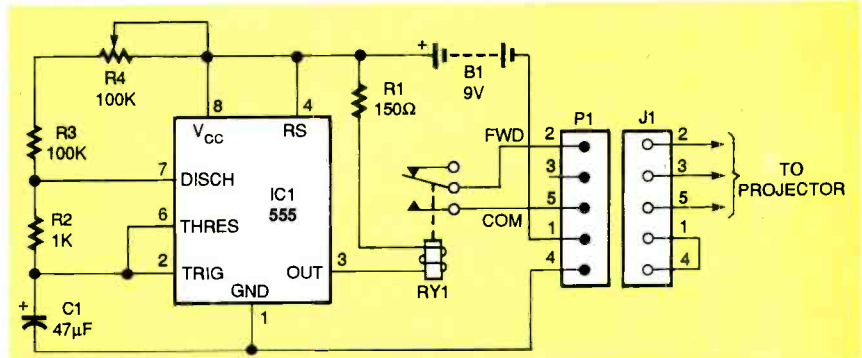


FIG. 2—SCHEMATIC DIAGRAM. The stepper circuit replaces the remote and will automatically advance the slides with a variable time delay.

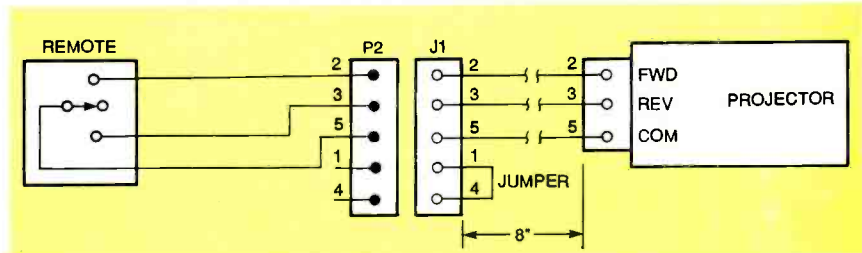


FIG. 3—CABLE MODIFICATION. This will allow the remote and the stepper circuit to be swapped easily.

equivalent fixed resistor. The reset time of IC1 is sufficient to energize relay RY1 for a duration roughly equivalent to a person momentarily depressing the forward button on the original remote control. Resistor R1 provides current limiting for the 5-volt reed relay, also extending the life of the battery.

No power switch is required. Power is supplied by a 9-volt battery (B1) and it is switched on when pins 1 and 4 of DIN plug P1 are shorted by DIN jack J1 as shown. The circuit works only when connected to the projector. This saves parts and labor and eliminates the chance of forgetting to turn off power

when the stepper is not being used.

Construction

The parts can be assembled on perforated construction board using point-to-point wiring. All connections to the board are made to 5-pin DIN plug P1. The positive lead of the battery connector connects to the circuit board, while the negative lead connects to pin 1 of plug P1. The board can be installed in any suitable case, as long as there's room for the 9-volt battery, too.

PARTS LIST

All resistors are 1/4-watt, 5%.

R1—150 ohms

R2—1000 ohms

R3—100,000 ohms

R4—100,000 ohms, potentiometer

Capacitors

C1—47 μ F, electrolytic

Semiconductors

IC1—TLC555 timer

Other components

J1—5-pin DIN jack (or equivalent connector)

P1, P2—5-pin DIN plug (or equivalent connector)

B1—9-volt battery

RY1—5-volt, SPST relay

Miscellaneous: 9-volt battery clip, circuit board, case, one 8-pin IC socket

The projector's remote control cable must be modified to work with the timer circuit. Cut the cable approximately 8 inches from the projector connector end. Reconnect the remote end to DIN plug P2, and the projector end to DIN jack J1. This will allow the remote and the stepper circuit to be swapped easily.

Connect the modified remote control cable to the projector and make sure that the forward and reverse functions of the remote control still work. With the projector turned off, disconnect the remote from J1 and connect the stepper circuit. You should hear the relay click with a steady time delay. Potentiometer R4 should vary the time delay. Now you can turn on the projector, set the advance delay, and join the party. Ω

MAGNETIC STORAGE

continued from page 68

magnetized screwdriver near magnetic heads. Magnetic heads should be cleaned and demagnetized according to manufacturers' specifications.

The effect of a dirty head varies greatly in different storage technologies. Floppy disk drives rarely fail due to dirty heads, whereas many tape drive failures can be corrected simply by cleaning the heads.

Laboratory-grade alcohol and a cotton swab will clean most recording heads and tape paths. Special cleaning and demagnetizing kits are available for the various media. These kits use alcohol substitutes due to regulation of shipment of flammable substances. Avoid using rubbing alcohols containing oily lubricants that can foul or prematurely age drive components.

Maintain proper operating environment. Severe line power problems such as brownout or surges can result in momentary loss of recording quality in an open-loop recording system such as analog audio tape. This can be caused by heavy switched loads such as a refrigerator or certain models of laser printer sharing a circuit with recording equipment.

In dry climates static buildup on your body or inside recording equipment can cause problems. Some equipment is not specified to work below 20% humidity. Review your equipment's specifications. Monitor your humidity. Purchase humidifiers or employ anti-static carpeting and handling procedures as indicated. Discharge your body before handling magnetic media.

Park your media. Tape media should be parked at the beginning of tape position or at the end of tape position before being removed from the drive.

Long term storage of a cartridge in a drive can cause the drive or cartridge roller hubs to deform. This deformation can be repaired by performing multiple retension passes. Ω

EQUIPMENT REPORTS

continued from page 14

penser tube under precisely controlled air pressure. The amount of time that the air pressure is applied to the dispenser is also precisely controlled and can be varied to adjust the amount of solder paste deposited on a board.

Surface-mount components are difficult to handle, and conductive tools such as tweezers can damage parts that are sensitive to electrostatic discharge or ESD. An SMD (surface-mount device) vacuum handling tool is also included with the SMD-250 to eliminate the danger of ESD damage. Interchangeable vacuum tips are used to pick up and place all kinds of surface-mount parts. Vacuum is applied to pick up and place the part, and when the part is in position, the vacuum is released and the part stays put.

A hot thermal jet-flow attachment allows a temperature-controlled blast of air to be directed at SMD parts to melt the solder paste. This allows surface-mount parts to be replaced without heating the entire board.

Holder assemblies mount on the top of the SMD-250 to hold the accessories when they are hot. A wet and dry tip maintenance kit is also included that mounts on top of the unit to keep all kinds of tips clean and ready for use.

The front panel of the SMD-250 contains most of the unit's controls and displays. A lighted on/off switch indicates when power is on. Two separate temperature displays can show the exact temperature of any two attachments. Pushbuttons allow exact temperatures to be set by the user.

With a list price of \$1995, the SMD-250 is competitively priced. Anyone who is running a modern electronics repair shop will undoubtedly need the capabilities of this machine.

Repairing PC boards with the wrong equipment can end up causing more damage than one set out to repair in the first place, and so the SMD-250 could pay for itself in time saved and in damage not done. Ω

LETTERS

continued from page 12

POWER CONTROLLER SAFETY CONCERNS

I read with interest Richard Roane's "Power Controller" article (*Electronics Now*, January 1995). It is a clever microprocessor-based board for controlling eight channels of 120-volt loads at various power levels. However, as a licensed industrial electrician, I'd like to point out a few safety considerations with regard to projects powered from the 120-volt AC line.

First, unless 14-gauge wiring is used throughout, an appropriately rated fuse should be added to protect the wires from overheating and from accidental overcurrents. In any case, an 18-gauge wire is the minimum wire size that should be used.

Second, the "neutral" wire must be identified. It must be distinguishable from the "hot" wire. This can be done by color-coding the wires. The neutral wire should always be white and the ground wire should always

be green, but the hot wire can be any color except white or green.

That color coding should be clearly marked on the schematic as well. If it is ever necessary to troubleshoot the board, you'll appreciate the coding. It always helps to know what's on a board before you start building a circuit.

The hot wire should go to the main terminals (MT1) of the triacs. The neutral wire should go to J2, for connecting to the various loads. That was correct in the Power Controller schematic but wrong on the foil pattern. Confusion like that always stems from not identifying the wires in the first place.

Third, the article does not mention enclosures. I've seen far too many circuits like this one that are either put in a flimsy wooden box of some sort, or they are not put in any enclosure. The electrical code is very clear on this: An enclosure must be provided. The enclosure can be made of any material as long as it is not flammable. That means that wood is unacceptable, as are many plastics. Metal is best.

If you are considering the use of a plastic enclosure and don't know if it's flammable or not, shave off a thin strip from it with a knife put it in a match flame. If the strip burns, don't use that enclosure.

Fourth, the ground wiring from the Power Controller's input power cord need not go to the PC board, as the schematic indicates. It is earth ground, not circuit ground. Its purpose is to connect metal parts of your equipment to the earth. If a metal enclosure is used, then you would ground it. If your enclosure is plastic, leave a lug so the ground wire is available if it's needed for light fixtures or other equipment that connects to your circuit.

These pointers are not meant to discourage electronics enthusiasts. However, a sense of responsibility and attention to detail will help in making your project safe. This will not only benefit yourself, but the people around you—members of your family, and others you care about.

JIM STEINMAN

Kitchener, Ontario, Canada

Ω

Q & A

continued from page 9

small, but you can use 1/4 inches of ordinary No. 20 copper wire, which has a resistance of 0.0008 ohm per inch. Be sure to make excellent solder joints. For best results, place the shunt a few inches away from the meter, and run wires to the meter from it; the reason is that when 50 amperes flow through the shunt, there will be an appreciable magnetic field, which could make the meter read wrong. Also, make measurements only momentarily, because the shunt will get hot.

SCANNER MODS WANTED

I'm using a Realistic Pro-57 programmable scanner which has several bands of frequencies that are blocked off, including FM broadcast stations, TV broadcasts, VHF airline and military frequencies, and cellular phones. Could you suggest an easy way to modify this receiver so that there are no blocked fre-

quencies within its desired range?—T. Rozzi, Norwalk, CT

There are two reasons why a digitally controlled receiver may not get a particular range of frequencies: either its front end isn't designed to let them in, or its microcontroller isn't programmed to tune to them.

Federal regulations require cellular phone frequencies to be blocked out by programming the microcontroller not to tune to them, even though the front end and the rest of the radio may work just fine on those frequencies. By law, this "blockout" must not be easy to undo. As you should know, listening to cellular phone calls is illegal in the United States.

FM and TV signals are blocked out because they're too strong! A well-designed scanner will have a front end that rejects these frequencies so that it doesn't go haywire when you get near a high-power TV station. FM broadcast and TV sound signals are much wider in bandwidth than the signals your radio is designed to demodulate. Similarly, VHF aviation signals are AM

and your radio would not demodulate them.

INTERMITTENT RECORD PLAYER

I have a 22-year-old stereo system. The sound from the radio portion is fine, but when I play a record, the sound is uneven, often alternating between two speakers or coming out of only one speaker. How can I correct this problem?—E. Chambers, Jr., Pittsburgh, PA.

Look for loose connections in the cabling from the phono cartridge to the amplifier. It may be as simple as a plug loose in its socket—but more likely, there is a break in the thin wires inside the tone arm. After all, they move around every time you play a record. Another possibility is a defective cartridge or stylus (needle). Still another possibility is that the selector switch might not be making good contact when you switch from radio to phono. Try turning it back and forth a few dozen times; if the problem diminishes, the switch should be cleaned or replaced.

Ω

PROCAR SYSTEM

continued from page 79

door switch. Ford, and other car makes with positive switching, have three wires. One wire is connected to the positive side of the battery, the second is typically to a "key-in-the-ignition" buzzer, and the third is for lights.

Check out each wire with a test light. With the door switch depressed, turn the dashboard dome light switch on and off, observing which wire from the switch turns on the light. After identifying the door wire, turn off the dashboard dome light switch and release the door switch so the dome light remains on.

Cut the wire about two inches from the switch; the dome light should go out. Connect the short wire from the switch to the brown wire from pin 11 (DRI, Driver door) of the Logic

Module. Connect the other end to the gray wire to pin 12 (PAS, passenger door) from pin 12 of the Logic Module.

The Logic Module must be programmed for the specific host vehicle. Remove the four screws and cover from the Logic Module to expose its circuit boards. There are header pins on the Alarm board for the driver's side and passenger doors for (+) and (-) switching. Then program both doors for + switching.

Negative switching

Identify the door light switching wire. Verify that all car doors and hatch or trunk are closed. Open the driver's side door, and remove the door switch. On General Motors and other cars with negative switching, there will be two wires to the switch. One will be for the "key-in-ignition" buzzer, and the other will be for the dome lights. With the switch removed, the dome light

will be out.

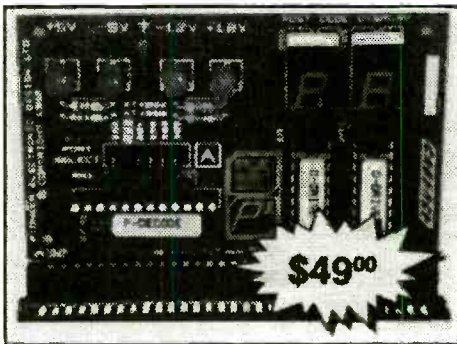
Touch one wire and then the other to ground. Cut the wire that turns the light on about two inches from the switch. The short wire from the switch connects to the brown driver's side door wire from pin 11 of the Logic Module. Connect the other end to the gray passenger side door wire from pin 12 of the Logic Module.

Test and checkout

The fourth installment of this article will include a 29-step test and checkout procedure to determine the fitness of your completed ProCar system. It will also contain an "instruction manual."

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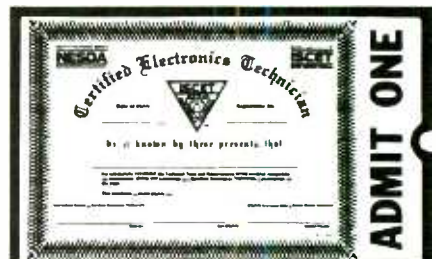
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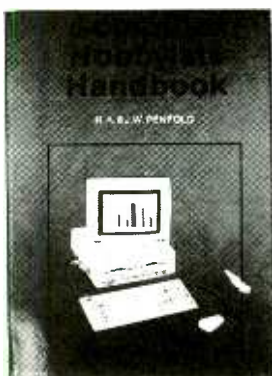
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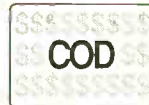


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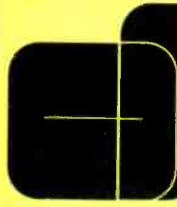
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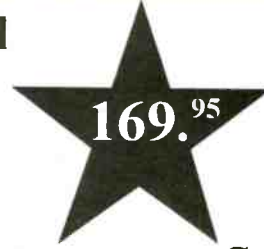
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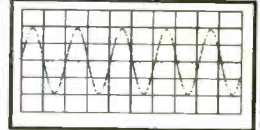
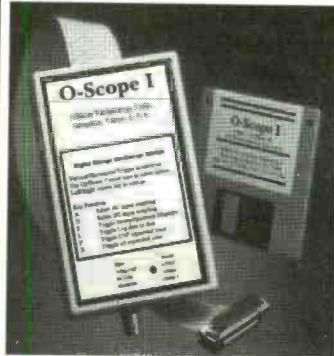


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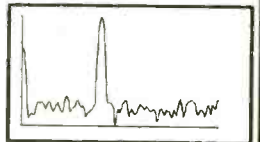
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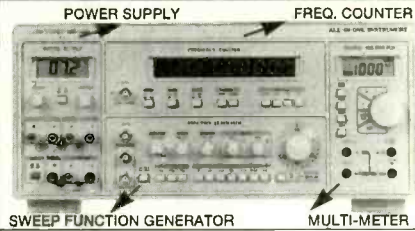
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2MHz Sweep Function Gen. w/Freq. Counter

FG-150
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Deluxe O'scopes w/Phillips CRT. 2 yr. Parts/Labor Warranty

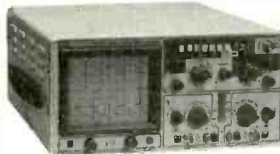
OS-3304
Reg. \$499. **\$339.00**



OS-3304 25MHz, Dual Trace

- DC to 25 MHz. Dual Channel
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 14n Sec. or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 2kV
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

OS-3315
40MHz, Dual Trace Sweep Delayed
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- DC to 40 MHz. Dual Channel
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- Full TV Trigger for TV-V & TV-H
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- 16ns - 1.0s Time Base
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- Power: 115/230V AC

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- OS-3304
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- Function Generator 0.02 Hz to 2.0 MHz

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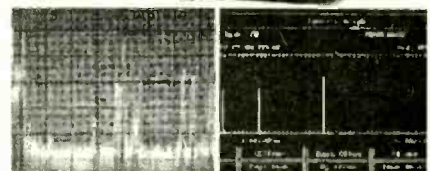
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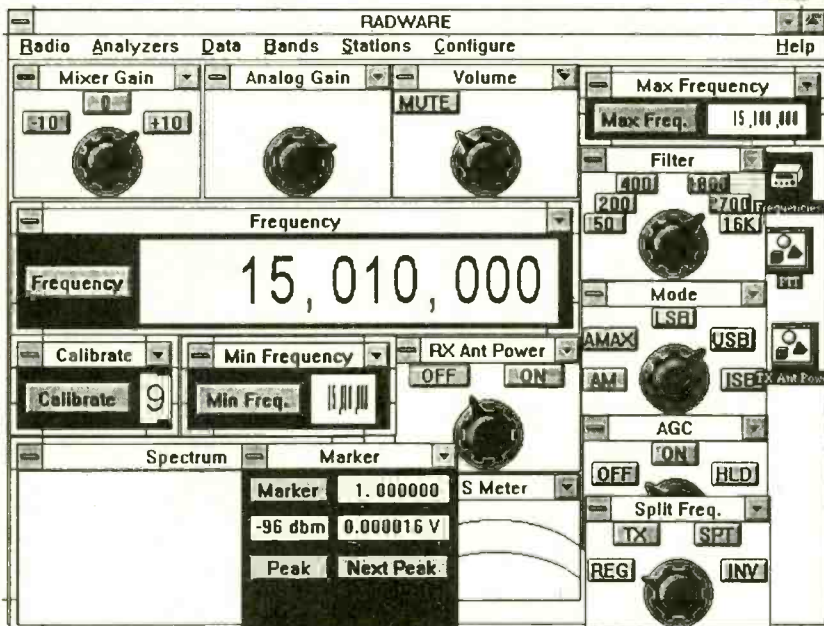
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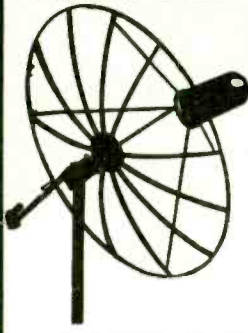


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1514002	8.3'	SX-8.5	Polar/Spin	49 (S&H)	319
1514004	10.0'	SX-10	Polar/Spin	63 (S&H)	449
1514005	11.7'	SX-12	Polar/Spin	84 (S&H)	649

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900038	Pico Peaker	S&H \$5	\$89.95
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Superjack Actuators

Is your actuator no longer doing its job because of wear and tear? As the hardest working part of your satellite system, the actuator must move your dish from east to west across the entire satellite belt. Each time you change satellites, your actuator sends pulses to the receiver telling the receiver when to stop moving the dish. Most older actuators sent only 10-16 pulses for each inch of travel, which may not be enough to stop the dish at the maximum signal strength. Today's new heavy duty actuators with high resolution reed sensors send 48 pulses per inch of arm travel. So if your old actuator is getting tired, let a new SuperJack insure the finest picture possible.

18" arm	1019018	S&H \$15	\$ 89
24" arm	1019026	S&H \$16	139

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Ultra

The Ultra is Uniden's newest, smallest fully-integrated C/KU receiver ever. This unit includes the ability to control dish movement and is ready for an optional internal program decoder. The Ultra comes preprogrammed for 49 satellite positions and allows you to add satellites as they are launched. Move directly to the satellite by entering the abbreviation from the included infrared remote control. Forty programmable favorite channels can be accessed immediately from your easy chair. Run across something you don't want your kids to see? Just touch a button and eliminate that channel from their access. A complete variety of color menus allow you to control everything from your remote control. The Uniden Ultra is an ideal receiver to get you started in Direct-To-Home Satellite TV.

4527008	Ultra	S&H \$22	\$379.00
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uniden

The UST 4600 sets a standard in value and performance for home satellite receivers. This unit features automatic satellite programming, 160 favorite channels can be instantly recalled for easy access. All 160 can be changed or updated at any time. This IRD features a stereo processor, enabling you to tune both left and right channels for a full stereo effect from over 100 radio stations found in satellite. The QuikTune feature quickly optimizes the satellite picture for the sharpest image. The 4600 offers other features including IR/UHF remote, 55 satellite position memory and direct satellite access. The versatility makes this an excellent choice.



UST 4600

4527009	UST4600	S&H \$22	\$499.00
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UST 4900

The Uniden UST 4900 is one of the most sophisticated satellite television receiver systems available today. This receiver will open your home to the universe of satellite viewing and is designed to be one of the most user-friendly IRDs available anywhere. Sophisticated microcomputer technology brings in crystal clear audio and video broadcasts with a minimum of user effort. The UST 4900 front display features easy-to-read icons that show you vital information including satellite, channel, polarity, timer status, antenna position and much more. This receiver is capable of storing the positions of the satellites, as well as the tuning details for each channel. The picture-in-picture feature allows you to view two video sources at the same time. You can have it all, including advanced technology and lasting quality, with the UST 4900.

4527010	UST4900	S&H \$22	\$689.00
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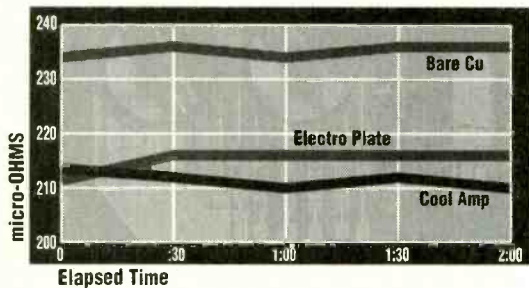
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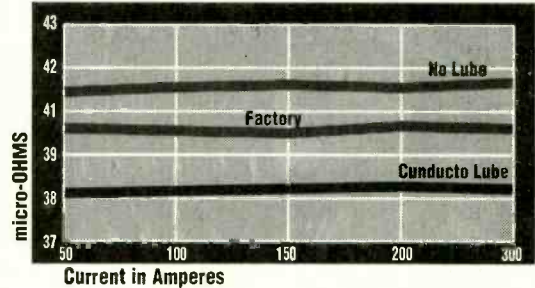
In recent independent tests Cool-Amp is proven better than electroplating.

(For 50 years we've said Cool-Amp is "equal to" electroplating in performance. It is better.)

Cool-Amp



Conducto-Lube



From the report:

"...compare the conducting properties of Cool-Amp silver plating compound with factory silver electro-plated bus and bare copper bus.

"The test results indicated that the contact resistance of the Cool-Amp plated bus connection was slightly lower than that of the electro-plated bus connection and much lower than that of the bare copper bus connection. The final temperature at temperature equilibrium of the bus connection employing Cool-Amp was slightly lower than that of the electro-plated bus connection and the bare copper bus connection..."

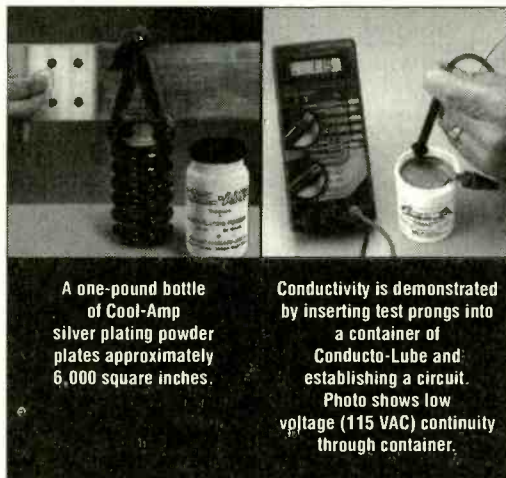
From the report:

"...compare the conducting properties of Conducto-Lube lubricant with factory lubrication and non-lubricated connections on an air switch. Identical test setups and procedures were used for each test so that comparative data could be collected and the relative performance of each type of connection could be quantified.

"The test results indicated that the contact resistance of the switch employing Conducto-Lube was generally lower than that of the factory lubricated switch and the switch that used no lubricant."

Cool-Amp How it works:

- Applies *on the job*. Application is simple. Yet Cool-Amp adheres permanently. As tests show, it is better than electroplating.
- Minimizes overheating and power loss by silver plating high amperage connections.
- Saves time, reduces maintenance. Cool-Amp is so simple to apply on the job. It assures maximum conductivity for copper, brass, or bronze contacts and prevents losses due to oxidation.



A one-pound bottle of Cool-Amp silver plating powder plates approximately 6,000 square inches.

Conductivity is demonstrated by inserting test prongs into a container of Conducto-Lube and establishing a circuit. Photo shows low voltage (115 VAC) continuity through container.

Conducto-Lube How it works:

- This is *the* conductive lubricant; highly conductive because it contains pure silver.
- Originally developed to lubricate switches, to the point tension can be adjusted to factory specs allowing full rated capacity of the switch to be maintained at all times.
- Uses have continued to expand—from switches and breakers—to any application where a conductive lubricant is needed.

*Various tests were performed on both products in the Electro-Test, Inc. facilities in Portland, Oregon during January-March, 1994. Evaluation of plating thickness of Cool-Amp was performed by Surface Science Laboratories of Mountain View, California.

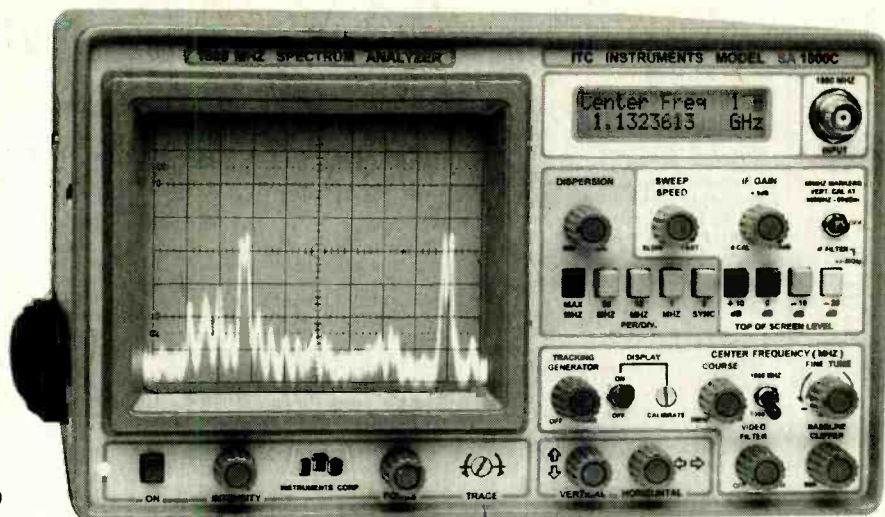
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Conducto-Lube

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ALL NEW SPECTRUM DISPLAY MONITOR PLUS FULL FUNCTION SPECTRUM ANALYZER

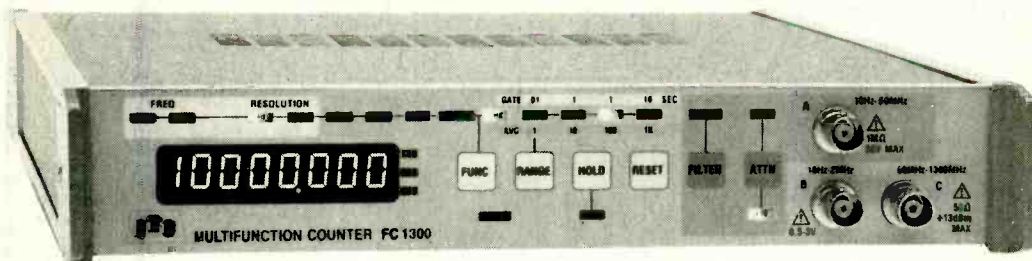
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The SA500A easily attaches to any receiver IF output jack. Providing a panoramic signal display of your 1-30 MHz and 30 to 2000 MHz scanner or communication receiver. The SA500A is a Professional Spectrum Surveillance Technology Monitor. A Full Function Spectrum Analyzer with +/- 5KHz Narrow Band Filter, Center Freq. Display, 50 MHz Marker Generator. Capable of Tuning Duplexes, Amps, Filters Receivers, Transmitters & Perform EMI, RFI, FCC, Testing. SA500A First affordable Professional Spectrum Monitor/Analyzer for all serious Ham Radio and Radio Monitoring Operators. just \$895.00

.2-1.3GHz SA1300B THE ULTIMATE LOW COST ANALYZER

Quality & Performance that's what ITC Spectrum Analyzers are known for. 80 dB on Screen, -110 dBm Sensitivity, Center Frequency Display, +/- 5KHz Narrow Band Filter (for 5KHz resolution band width) 50 MHz Marker. DISPERSION ZOOM, Baseline Clipper, Sweep Speed, Adjustable Video Filter, 40dB of Input Attenuation. Standard on all ADVANTAGE Spectrum Analyzer specials. The SA1300B and SA1800C provide Laboratory Performance at a fraction of the normal cost. The SA1300B \$1895.00 -SA1800C .2-1.3GHz & 8-1.8GHz \$2295.00. Add a 1.3GHz Tracking Generator to any unit

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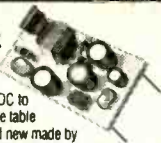
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Power Table		
Voltage Input DC	Voltage Output DC	Current Output
0.5VDC (solar)	3V	1mA
1.5VDC	9V	15mA
3VDC	9V	40mA

G6344 \$3.98

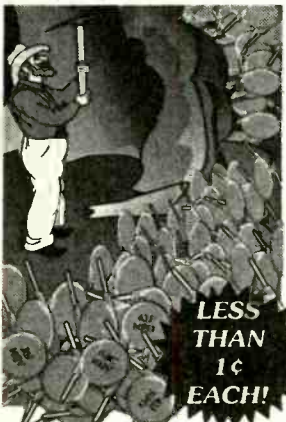
TDK VOLTAGE CONVERTER

Brand new voltage converter converts 3VDC to 9VDC. Size only 1 7/8" x 1 3/16" x 1/4". Made by TDK for a major manufacturer. Output current is 60 ma at 9VDC. Use 2 penlight batteries to operate transistor radios, calculators, etc. or any electronic device that can operate on 9VDC at up to 60ma. With hookup diagram (only 3 leads are used).



G6546 \$2.00

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TINY TRACKBALL



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G5514 \$1.95 10/\$15.00

MAGIC SOUND SWITCH

Small circuit board triggers a scr from a built in microphone circuit. Turn on low voltage lamps, motors, relays etc. Operates from 3VDC. Comes with schematic. Size only about 2" square.

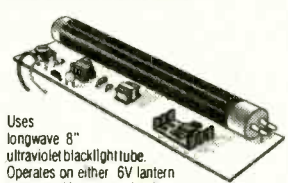
G5554 \$1.00

ULTRABRIGHT SMD RED LED

Very intense clear lens tiny SMD ultrabright red LED made by Panasonic. Type LN1261CAL Prime-on tape and reel.

G6447 4/\$1.00

PORTABLE FILTERED BLACKLIGHT KIT



Uses longwave 8" ultraviolet blacklight tube. Operates on either 6V lantern battery or 4D cell batteries (batteries and holder not included). Skill level 2.

C6471 \$23.95

ELECTRONIC CRICKET KIT



This electronic cricket starts "chirping" every time it gets dark. Of course, if you turn on the lights to look for the "cricket" it becomes silent again. Loads of fun. Uses 9V battery (not included). Skill level 1.

C6707 \$5.30

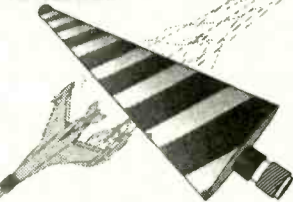
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This ultra sensitive 2 Channel Color Organ produces brilliant flashes of light (from any incandescent lamps of your choice - up to 200W) in response to music or other sounds. This is probably the best and brightest color organ we have ever seen. It is fully assembled (except for line cord and outlets) and features 2 response controls, on/off switch, sensitive FET microphone (no hookup to stereo needed) and 3 transistor, 2 SCR circuitry. Operates from standard 120VAC and requires only that you solder your line cord and 2 outlets (for your lamps) to the board. We strongly recommend that you install the color organ in an insulated case for safety reasons as it operates from the AC line. Connect up a couple of your brightest, colorful lamps and watch the fireworks with each beat of the music! Great for DJ's as there is no connection to the sound source. Size of board: 3 3/4" x 4 1/4". Color organ board only - you supply lamps, line cord, knobs, case and outlets. Hurry, these will sell very fast!

G3319 WAS \$5.95 SALE ONLY \$4.95!

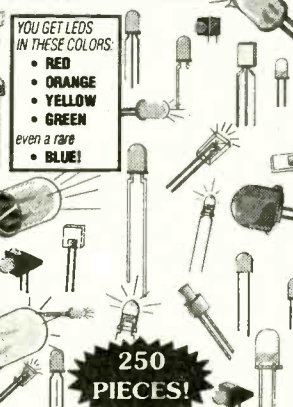
A7 JET COUNTERMEASURES ANTENNA



We were told that these were made for Navy A7 jets. They are brand new (part # 23473 G2) and are in sealed military packaging. The antenna looks like a 5 1/4" ice cream cone with 2 foil spirals. At the base of the cone is a TNC female connector. We used an adaptor to connect this antenna to a scanner and the increase in sensitivity of the scanner to frequencies above 800MHz was amazing! Antenna is encapsulated for rugged use, very high quality and if nothing else, makes a great conversation piece. Can you imagine what the Navy must have paid for these things? Own a piece of high tech military history before we run out!

G6662 \$8.00

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YOU GET LEADS IN THESE COLORS:
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even a rare
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Assortment of all types, colors, sizes and shapes of prime high quality LEDs. This large assortment even contains a clear LED that lights up blue! Our largest and most spectacular assortment contains 250 pieces.

G6554 \$10.00

HEAVY DUTY 12VDC MOTOR WITH REGULATOR

Precision 17/16" Dia. motor has a 3 transistor regulator board attached. We don't have the hookup diagram on these, but they look like sophisticated electronic regulator boards. Size of board: 1 1/2" x 2 1/8". Size of motor: 1 7/16" Dia. x 1 7/8" L. The shaft is a "D" type and 1/2" long. Brand new - no other info available except that these were made by Sonar Radio Corp., part # 27-030-008.

G6540 \$1.50

HEAVY DUTY 12VDC MOTOR

Made by Barber Coleman, these high quality 12VDC motors have a separate set of leads that put out an AC voltage in proportion to the shaft speed which can be measured on a meter. The part # is FYQM-33560-4. New, high quality with great torque. Use in robots or hundreds of other applications. Size: 1 7/8" L x 1 1/4" Dia. with 5/8" long shaft.

G6539 \$2.95

CONTROL PANEL KEYBOARD

Keyboard with 6 LEDs and ribbon cable. Make take alarms as this is the same unit found on the front door control panels for many professional home alarms. Size: 4 9/16" sq.

G2904 WAS \$3.00 SALE ONLY \$2.75! 10/\$23.00

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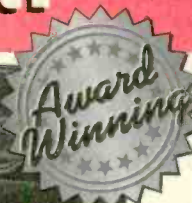
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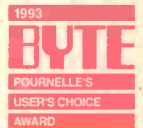
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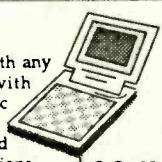
These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 MHz below those frequencies. A digital 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 are available.

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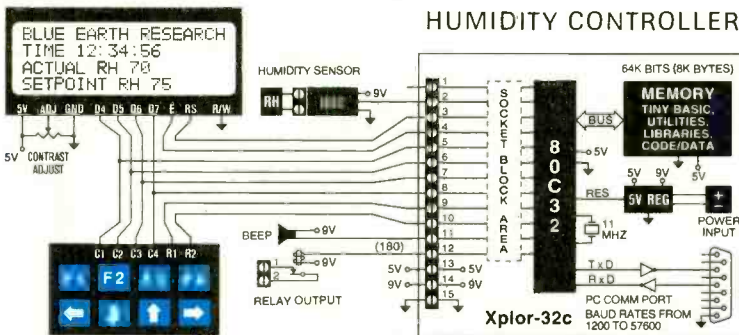
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ALL YOU NEED IS A PC and a Terminal Program (Or Xplor Starter Package)

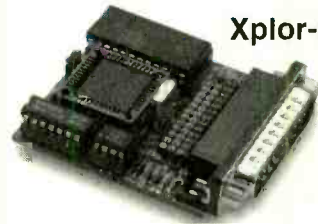
No Other Programming Equipment Required!

```

10 CALL 8132 (LIBRARY FUNC: Initialize LCD)
20 ONTIME 200 (Initialize 1 second interrupt)
30 PRINT "BLUE EARTH RESEARCH"; (Display sign-on message)
40 PRINT "\\ ACTUAL RH "; FREQ 0; (Display actual sensor frequency)
50 PRINT "\\ SETPOINT RH "; S; (Display desired setpoint value)
60 CALL 8140 (LIBRARY FUNC: Get keypad input)
70 IF DBY 27=6 THEN S=S - 1 (Decrement setpoint if down arrow)
80 IF DBY 27=7 THEN S=S + 1 (Increment setpoint if up arrow)
100 IF FREQ 0<S THEN BIT 180=1 (If actual < setpoint then relay on)
110 IF FREQ 0>S THEN BIT 180=0 (If actual > setpoint then relay off)
120 GOTO 40 (Loop back to repeat program)

200 PRINT "\TIME "; DBY 51; " "; (This 1 second interrupt routine)
210 PRINT DBY 50; " "; DBY 49; " ; IRET (refreshes LCD with current time.)
    
```

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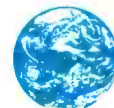
All Xplor PDCs are available in starter packages that include the Xplor board, screw terminal blocks, RS-232 cable, 9V power supply, users manual, application notes, and MSDOS format disk. The disk includes sample BASIC programs, library source code, BXA-51 and TB-QComm. The BXA-51 assembler can be used for making library changes or other assembly language programming. TB-QComm is a communications utility that allows you to load HEX files and load, edit, or save BASIC programs.



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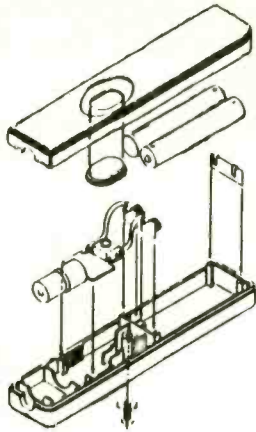
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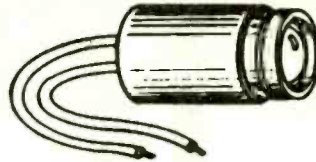
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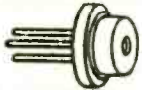


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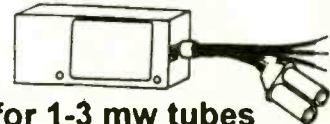


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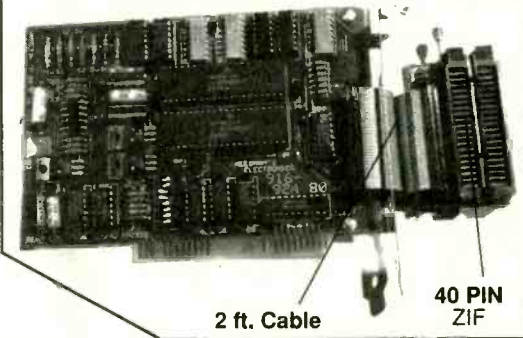
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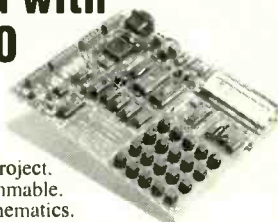
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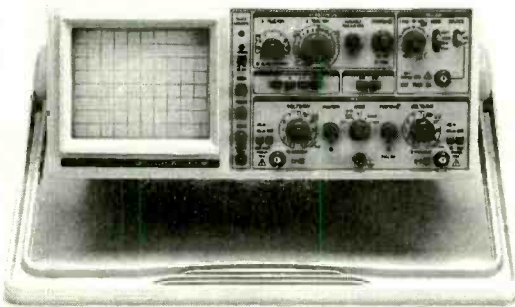
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GoldStar Precision

New Oscilloscope Specials



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Full 100 MHz Bandwidth!

SUPER SALE! \$999.00

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On-Screen Measuring Cursors & Readout!

40 MHz Bandwidth \$699.00

- TV Synchronization Trigger
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- Calibrated Delayed Sweep
- Two Probes included
- 2 Year Warranty

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Tektronix 475	200 MHz	\$749.00
Tektronix 475A	250 MHz	\$849.00

- Professionally Refurbished
- Calibrated to Original Specifications
- Dual Channel, Calibrated Delayed Sweep
- 90 Day Warranty



Professional Quality DMM's at Affordable Prices!

Model DM-334 \$99.00

- 3.75 Digits, 4000 Count, Auto Range
- DC/AC Volts (1000/750V)
- DC/AC Current (10 A)
- Resistance (40 Meg Ohm)
- Bar Graph, Min/Max, Data Hold
- Frequency Counter (1 MHz)
- Safety Holster & Test Leads Included
- 1 year Warranty

Model FG-2002C, Sweep/Function Generator \$299.00 with Built-In Frequency Counter

- Wide .02 Hz - 2 MHz Frequency Output, 20 Vp-p (open circuit)
- Sine, Triangle, Square, Ramp, Pulse, & Sawtooth
- Built-In 4 MHz Frequency Counter, Bright 4 Digit Display
- Switchable 50 or 600 ohm Output Impedance
- TTL/CMOS Output
- 1 Year Warranty

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20 reference impedances
True RMS
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Capacitance: 1pF-50,000μF
Measure AC volt to 20kHz
5000 counts, 0.1% accuracy
Auto/manual range, fast bar graph
Min/Max/Ave/DH/Relative/Zoom
Auto power off
Input warning
Splash proof
Volt, amp, ohm, logic, diode, continuity
Ruggedized case
Rubber holster included



DMM 2360 \$119.95
DMM+LCR Meter
Very Versatile DMM
Inductance: 1μH-40H
Capacitance: 1pF-40μF
Frequency: 1Hz - 4MHz
Temperature: -40-302 °F
TTL Logic Test: 20MHz
Diode, Continuity
Volt, Amp, Ohm
3999 count display
Peak Hold
Auto power off
Ruggedized case.
Temperature probe included
Rubber Holster \$8.00



DMM 20 \$74.95
Inductance: 1μH-40H
Capacitance: 1pF-200μF
Frequency: 1Hz-20MHz
Volt, amp, ohm, diode,
20 Amp AC/DC current
Transistor HFE
Continuity, duty %
Peak hold/Max
Ruggedized case
Rubber holster \$8.00

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ruggedized, solar cell,
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Fluke Multimeter
Fluke 12 \$84.95
Holster C-10 \$10
Fluke 70 II \$67.5
Fluke 73 II \$94
Fluke 75 II \$129
Holster C-70 \$16
Fluke 77 II \$149
Fluke 79 II \$169
Fluke 29 II \$169

Fluke 83 \$225
Fluke 85 \$259
Fluke 87 \$287

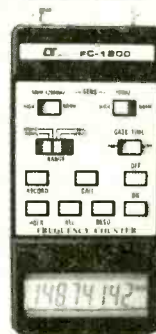
Fluke 97
Scope Meter \$1785



LCR Meter 131D \$229.95
Most Advanced LCR
Dual display: L/Q or C/D
Inductance: 0.1μH-1000H
Capacitance: 0.1pF-10,000μF
Impedance: 1mΩ-10MΩ
0.7% basic accuracy
Auto/manual range
Dissipation factor & Q factor
Serial & parallel mode
Relative mode for comparison
and to remove parasitics
Statistics, tolerance,
Best for design, incoming
testing & production
SMD and chip component
test probe \$25.00

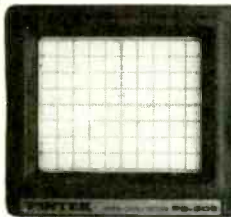


LCR Meter 814 \$189.95
Best Resolution LCR
Inductance: 0.1μH-200H
Capacitance: 0.1pF-20,000μF
Resistance: 1mΩ-20MΩ
1% basic accuracy
Dissipation factor indicates leakage
in capacitor and Q factor in inductor
Zero adjustment to reduce parasitics
Best for high frequency RF
SMD and chip component test probe
\$25.00
LIMITED QUANTITY SPECIAL
DIGITAL LCR METER \$74.95
0.1pF, 1μH, 10mΩ resolution



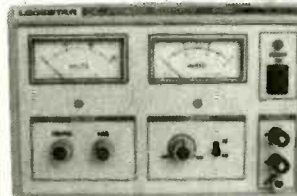
Frequency Counter FC-1200 \$129.95
Frequency: 0.1Hz-1.25GHz
Display: 8 digit LCD
Period: 0.1us-0.1s
Records Max/Min/Average
Data hold, relative mode
Telescoping antenna \$8.00
Deluxe case \$5.00

Also Available:
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voltage probe, Digital calliper
Anemometer, Electronic scale,
Force gauge, Tachometer,
Stroboscope, Humidity & EMF
adapter, Sound level meter,
Frequency counter, SWR/field
strength/power meter, Dip meter

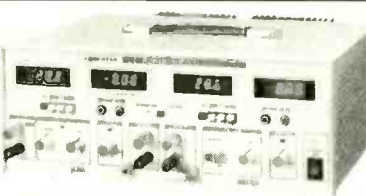


20 MHz Oscilloscope with Delay Sweep PS-205 \$429.95
Dual Trace, Component test, 8" CRT, X-Y Operation, TV Sync, Z-Modulation, CH2 Output, Graticule Illum, 2 probes each has x1, x10 switch. Best price with delay sweep.
PS-200 20 MHz DUAL TRACE \$339.95
PS-400 40 MHz DUAL TRACE \$494.95
PS-405 40 MHz DELAY SWEEP \$589.95
PS-605 60 MHz DELAY SWEEP \$789.95
Scope Probe: 60MHz x1, x10 \$15, 100MHz x1, x10 \$22, 250MHz x1, x10 \$29, 250MHz x100 \$39

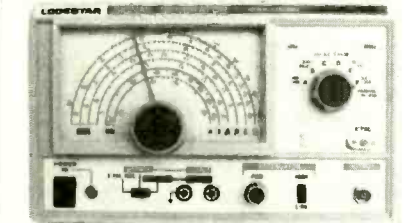
Digital Storage Scope
DS-203 20MHz, 10M Sample/sec \$729.95
DS-303 30MHz, 20M Sample/sec \$849.95
DS-303P with RS-232 Interface \$1,049.95
Switchable between digital and analog modes
2 K word per channel storage
8 bit vertical resolution (25 Level/div)
Expanded Timebase 10ms/div - 0.5 s/div
Refresh, Roll, Save all, Save CH2, Pre-Trig
Plotter control



DC Power Supply PS-303 \$159.00
0-30 VDC, 0-3A output
Constant voltage & constant current mode
0.02% + 2mV line regulation
0.02% + 3mV load regulation
1 mVrms noise and ripple
Short circuit and overload protected
PS-8200 with digital voltmeter \$179.00
Also available: 30V/5A, 60V/3A, 60V/5A
16V/10A, 30V/10A



DC Power Supply Triple Output PS-8202 \$499.95
Two 0-30 VDC, 0-3A outputs
One fixed 5VDC, 3A output
Capable of independent or tracking operation
Constant voltage and constant current mode
Four digital meters for volt and current display
Excellent regulation and low ripple
Short circuit and overload protected
Also available: 30V/5A, triple output \$549.95
Dual tracking 30V/3A, 30V/5A, 60V/3A, 60V/5A



RF SIGNAL GENERATOR SG-4160B \$119.00
100 kHz-150MHz sinewave in 6 ranges
RF Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz
AM modulation
Audio output 1 kHz, 1 Vrms

AUDIO GENERATOR AG-2601A \$119.00
10Hz - 1MHz in 5 ranges
Output: 0-8Vrms sinewave
0-10Vp-p squarewave
Synchronization: ±3% of oscillation frequency per Vrms
Output distortion:
0.05% 500Hz - 50kHz
0.5% 50Hz - 500kHz
Output impedance: 600 ohm

FUNCTION GENERATOR FG-2100A \$169.95
0.2 Hz - 2 MHz in 7 ranges
Sine, square, triangle, pulse and ramp
Output: 5mV-20Vp-p
1% distortion, DC offset ± 10V
VCF: 0-10V control frequency to 1000:1



RF SIGNAL GEN./COUNTER SG-4162 AD \$229.95
Generates RF signal same as SG-4160B
8 digit frequency counter 1Hz - 150 MHz for internal and external source Sensitivity <50mV

AUDIO GEN./COUNTER AG-2603AD \$229.95
Generates audio signal same as AG-2601A
8 digit frequency counter 1Hz - 150MHz for internal and external sources Sensitivity <50mV

FUNCTION GEN./COUNTER FG-2102AD \$229.95
Generates signal same as FG-2100A
Frequency counter 4 digits
Feature TTL and CMOS output

SWEEP FUNCTION GEN./COUNTER \$329.95
0.5Hz to 5 MHz in 7 ranges
Sweep: Linear 10:1/Log 10:1 20ms to 2s
AM Modulation
Gated Burst, Voltage Control Generator
Generator Control Voltage & 8 digit counter
1Hz-10MHz for internal & external sources

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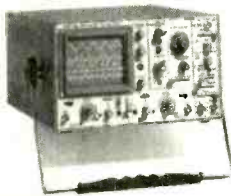
Electronics Now, May 1995

100 MHz Cursor Readout Scope 4 ch, 8 traces OS-6101 \$1,499.95



- * 4 independent channels, 8 traces
- * Time /Voltage cursor measurement
- * ALT triggering function for 4 ch.
- * Sweeps to 2ns/div, Delayed Sweep
- * TV Sync., Ch. 1 output, Z-axis input
- * 2 probes(x1, x10)

100 MHz Scope, 4ch. 8 traces Best value all purpose scope OS-6100B \$1,329.95



- * 4 channels, 8 traces
- * High sensitivity 500µV/div
- * Sweeps to 2ns/div, Delayed sweep
- * 20 kV accelerating voltage
- * TV sync., Z-axis input
- * A and B gate output
- * Best price 100 MHz scope
- * 2 probes(x1, x10)

50 MHz Triggering Oscilloscope OS-653 \$699.95



- * Dual Channel
- * Hold Off Function
- * Delayed Sweep
- * Built-in Delay Line
- * TV Sync
- * ALT Triggering
- * High sensitivity 1 mV/div
- * Trigger level lock function
- * Z-axis input, CH1 output
- * 2 probes(x1, x10)

20 MHz Oscilloscope OS-622B \$344.95



- * Dual trace, X-Y operation
- * TV Sync., Z-axis input, CH 1 output
- * High sensitivity 1 mV/div
- * Trigger level lock
- * 2 probes (x1, x10)
- OS-645B - 40 MHz Cursor readout.....\$ 734.95
- OS-625B - 20 MHz Cursor readout.....\$ 549.95
- OS-623B - 20 MHz w/Delayed Sweep.....\$ 449.95
- OS-935 - 5 MHz One channel.....\$ 209.95

DC Linear Power Supplies Single Output



- * Constant voltage and constant current mode
- * Voltage regulation ≤0.01%
- * Current regulation ≤0.2%
- * Low ripple and noise
- * Overload and reverse polarity protection
- * Features 2 analog or 1 digital meter(PS series)
2 analog or 2 digital meters(PR series)

PS-1830 : (0-18V, 0-3A).....	\$209.95
PS-1830D : Digital Display.....	\$219.95
PS-1850 : (0-18V, 0-5A).....	\$244.95
PS-1850D : Digital Display.....	\$224.95
PS-3030 : (0-30V, 0-3A).....	\$254.95
PS-3030D : Digital display.....	\$209.95
PS-6010 : (0-60V, 0-1A).....	\$349.95
PR-1810H : (0-18V, 0-10A).....	\$314.95
PR-3060 : (0-30V, 0-6A).....	\$299.95
PR-6030 : (0-60V, 0-3A).....	\$399.95
PR-6030D : Digital Display.....	

Triple Output DC Power Supplies



- * Two variable 0-30VDC, 0-3A outputs
- * One fixed 5VDC, 3A output
- * Auto tracking
- * Auto serial and parallel operation
- * Constant voltage and constant current mode
- * Continuous/dynamic load can be selected
- * Features 4 analog or 2 digital displays

PC-3030 : (0-30V, 0-3Ax2).....	\$499.95
PC-3030D : Digital display.....	\$549.95

Programmable DC Power Supplies



- * High stability, low drift, 4 digit display
- * Front/rear output-sense switch selectable
- * Auto step running w/timer settings
- * 100 point programmability (PPS series)
- * 50 point programmability (PPT series)
- * Auto serial and parallel operation (PPT series)
- * Auto tracking (PPT series), IEEE 488.2 and SCPI compatible command set (optional)
- PPS-1860G: (0-18V, 0-6A).....\$1099.95
- PPS-3635G: (0-36V, 0-3.5A).....\$1099.95
- PPS-6020G: (0-60V, 0-2A).....\$1099.95
- PPT-1830G: (0-18V, 0-3Ax2, 0-6V, 0-5A).....\$1399.95
- PPT-3615G: (0-36V, 0-1.5Ax2, 0-6V, 0-3A).....\$1399.95

Digital Display Function Generator FG-8016G \$239.95



- * Frequency Range: 0.02Hz to 2MHz
- * Three Instruments in one: Function generator, Pulse generator & Frequency counter.
- * Sine, Triangle, Square, TTL Pulse and CMOS output
- * Built-in 6 digit counter with INT/EXT function
- * 1000:1 tuning range
- * Variable DC offset control

FG-8015 Function Generator	
* 0.02Hz-2MHz (No Counter).....	\$189.95
FC-8131 Intelligent Counter 1.3GHz.....	\$469.95
FC-8270 Intelligent Counter 2.7GHz.....	\$629.95
UC-2010G Universal Counter.....	\$294.95

Digital Multimeter & C Meter DM-8034(3½ digits) \$179.95



- * 8 Function, AC/DC voltage, AC/DC current, resistance
- * Built-in C meter, diode test and audible continuity check
- * High voltage 1000V and 20A range
- * 0.5% basic accuracy
- DM-8040 (3½ Digits, True RMS)
- * Measures ACV to 50 kHz.....\$339.95
- DM-8055 (5½ Digits).....\$649.95
- * 0.006% basic accuracy
- * 1µV, 1mΩ, 1nA resolution
- * dBm measurement
- * Auto range, relative mode, Max/Min
- DM-8055G(5½ Digits, GPIB).....\$889.95

Model DM-392 (3½ digits) \$109.95



- * Auto/Manual ranging(38 ranges)
- * 42 Segment analog bar graph
- * Data Hold/Min-Max memory /Relative mode
- * Auto power off
- * Overload protection
- * Audible continuity check /diode test
- * Capacitance: 1pF-40µF
- * Frequency: 0.1Hz-1MHz
- * 20 Amp range
- * Double high energy fused (1A, 20A)
- * 0.3% DCV accuracy
- * AC True RMS (DM-394 only)

DM-351 : 3½ Digits w/Continuity, Auto Off.....	\$54.95
DM-352 : 3½ Digits, Cap. Freq. hFE, 20 Amp.....	\$79.95
DM-353 : 3½ Digits, Cap. Freq. Temp. hFE.....	\$84.95
DM-391 : 3½ Digits, Auto. Cap. Freq. Min/Max.....	\$99.95
DM-392 : 3½ Digits, Hold, Min/Max 20Amp.....	\$109.95
DM-393 : 3½ Digits, Peak Logic, hFE, Freq.....	\$119.95
DM-394 : 3½ Digits, TRMS, Same as DM 392.....	\$129.95

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- Tunes 88-108 MHz.
- Powerful 2 stage audio amplifier.
- Sensitive, picks up sounds at the level of a whisper.
- Up to 1 mile range.
- Requires 9V battery. (Not incl.)



SUPER-MINIATURE FM TRANSMITTER
Super small FM transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip (SMT) parts are pre-assembled to the circuit board.

XST500 (E-Z) Kit \$44.95

- Miniature photo battery mounts right on circuit board. (Included)
- Tunes 88-108 MHz.
- Up to 1/2 mile range.
- Sensitive 2 stage audio amplifier, picks up sounds at the level of a whisper.



MICRO-MINIATURE FM TRANSMITTER
Including the battery, this is the Worlds smallest FM transmitter. Use with any FM broadcast receiver. Easy to assemble, uses pre-assembled circuit board.

XWB1000 E-Z KIT \$49.95

- Transmits at 143 MHz
- Up to 1 mile range.
- Miniature photo battery mounts right on circuit board. (Included)
- Amazing audio sensitivity, picks up sounds at the level of a whisper.



CRYSTAL CONTROLLED FM TRANSMITTER
Including the battery, this is the Worlds smallest crystal controlled FM transmitter. Transmits to any scanner type receiver. Easy to assemble, uses pre-assembled circuit board.

XTL1000 E-Z KIT \$69.95

- Smallest Phone transmitter anywhere!
- Tunes 88-108 MHz.
- No batteries required, powered by phone line.
- Up to 1/4 mile range.
- Attach to phone line anywhere in house, even inside phone.



SUPER-MINIATURE PHONE TRANSMITTER
Worlds smallest FM phone transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip components are pre-assembled to the circuit board.

XSP250 (E-Z) Kit \$34.95

- Dial your phone from anywhere and listen to the sounds inside your home.
- Two digit Touch Tone code for secure operation.



TELEPHONE SNOOP

The latest in home or office security. Call home from anywhere, enter a two digit security code, and hear the sounds in your home. Automatically turns on without ringing the phone, verifies code, then activates for one and a half minutes.

XPS1000 (C) KIT \$13.95

- Transmits a continuous beeping tone.
- Adjustable from 88 to 108 MHz.
- Up to 1 mile range.
- Works with any FM broadcast receiver.



TRACKING TRANSMITTER

Only 0.7 by 2.4 inches, the XTR100 operates at voltages of 3 to 18 Volts and is ideal for use in locating lost model rockets, bicycles, automobiles, games of hide and seek, and contests.

XTR100 (C) KIT \$33.95

- Uses sensitive microwave transistor amplifier.
- Covers 1 to 2,000 MHz.
- Compact hand held unit.
- Includes miniature loud speaker for audio indication of detected signals.



SUPER SENSITIVE BUG DETECTOR

Including the battery, this is the Worlds smallest crystal controlled FM transmitter. Transmits to any scanner type receiver. Easy to assemble, uses pre-assembled circuit board.

XBD200 (C) Kit \$49.95

- Use with any FM broadcast receiver.
- Hear every sound in an entire house!
- Up to 1 mile range.
- Powerful 2 stage audio amplifier.



MINIATURE FM TRANSMITTER

The XFM100 has a super sensitive microphone and is capable of picking up sounds at the level of a whisper and transmitting them to any FM broadcast receiver.

XFM100 (C) Kit \$32.95

- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Anonymity on any call.
- Button for normal operation.
- 16 levels of voice masking.



VOICE CHANGING TELEPHONE

STOP THOSE ANNOYING TELEPHONE CALLS! Sound older and tougher when you want to. Not a kit. Fully assembled. Single phone operation only.

TRANSITION 2000 \$89.95

- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Use with any modular phone.
- 16 levels of voice masking.
- Connects between handset and phone.



VOICE CHANGING ACCESSORY

STOP THOSE ANNOYING TELEPHONE CALLS! Sound older and tougher when you want to. Not a kit. Fully assembled. Use with single or multi-line phones.

TRANSITION 2001 \$59.95

- Uninterrupted coverage of 800 to 950 MHz.
- Works with any scanner that can receive 400 to 550 MHz.



800-950 MHz SCANNER CONVERTER KIT

If your scanner can receive 400-550 MHz, just add the XLC900 for uninterrupted 800-950 MHz coverage. It converts all 800-950 MHz signals down to 400-550 MHz so your scanner can receive them! Add our custom case kit for that "Professional" look.

XLC-CASE KIT \$13.95

XLC900 (C) KIT \$49.95

- Transmit high quality stereo to any FM stereo receiver.
- Built-in output level monitor for quick and easy tuning.
- Ideal for use with personal CD player.



FM STEREO TRANSMITTER

Transmit full-bodied Hi-Fi stereo to any FM stereo receiver. Separate left and right inputs and gain controls. Includes an output booster stage for greater range.

XFS-CASE KIT \$13.95

XFS108 (C) KIT \$41.95



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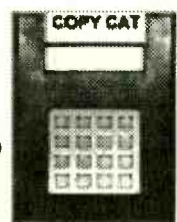
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 10 Amp

FREQ COUNTER
 up to 20MHz
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 with 3200 counts
AC CURRENT
DC CURRENT
ANALOG BAR
 10 Amp

INDUCTANCE
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FREQ COUNTER
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DUTY %
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- RESISTANCE
- 3 1/2 Digit LCD
- CONTINUITY TEST
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Designed to meet IEC-348 & UL-1244 safety specifications.

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The Ultimate Meter

TRUE RMS - LCR - Hz - dBm

Popular Electronics (Reviewed - May 1993)

"Not only does the Kelvin 94 boast alot of features ... the features go the extra distance."

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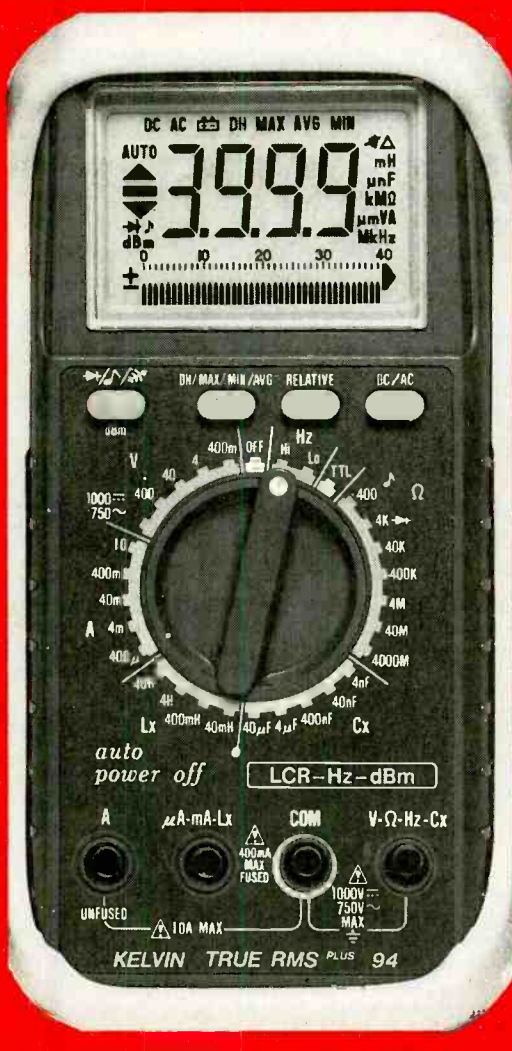
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Freq Counter to 20 MHz

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The TriField™ meter reads all three types of fields numerically and with a SAFE/BORDERLINE/HIGH SCALE, weighted proportional to effect on the body. Thresholds are based on epidemiological and laboratory studies. (While no absolute hazard thresholds have been established, reduction of relative exposure is prudent.)

The TriField™ meter comes ready-to-use with battery, instructions, and one-year limited warranty. The cost is \$144.50 postpaid.

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VIDEO NEWS

continued from page 6

substitute for the VCR, because it won't record. There was talk, however, of a recordable version in 1998 or 1999, when blue lasers are in mass production.

One of the most intriguing features of the DVD—presumably both the Toshiba and the Sony versions—is its extreme flexibility, allowing a single disc to suffice for many purposes, thereby reducing dealers' inventory requirements. Multiple soundtracks on a single disc can appeal to various language groups in a single country or in sev-

eral countries. The same disc can satisfy different types of TV receivers and viewing preferences, supply a letterboxed picture (for viewing on a standard set with black bands above and below), a full-resolution 16:9 picture (for viewing on a widescreen set), or a standard 4:3 pan-and-scan version. By the same token, a single movie can be viewed in the original theatrical release version, or in an abridged version with the "adult" scenes eliminated to protect kiddie viewers.

The Sony-Philips reaction to the Toshiba-Time Warner announcements and demonstrations was rather confusing. While publicly favoring a single standard to avoid a

repetition of the Beta/VHS standards war, Sony first announced that it planned to go ahead with its system anyway. Later, it hinted that it was open to talks with the rival camp, possibly to develop a compromise version. However, at our press time, no formal talks were going on.

Although the odds now appear to favor the Toshiba-Time Warner proposal, a compromise—or even a reversal—can't be ruled out at this time.

No matter which side wins, or if the two systems are combined into a single one, we should have a new—and superior—home video system in a year or so. Ω

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The "Checker 12" is a hand held, battery/AC operated computer color monitor pattern generator.

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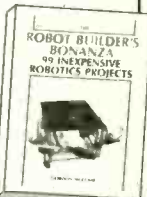
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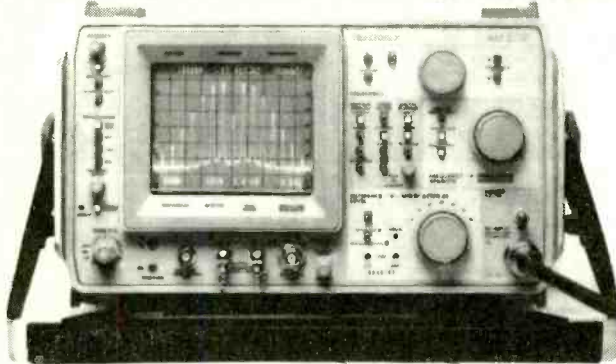
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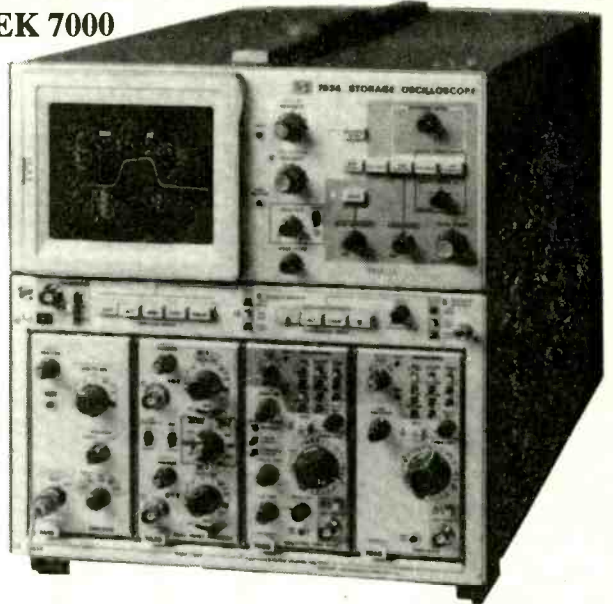
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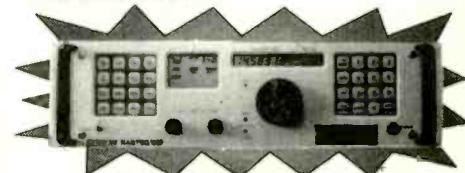
COLLINS KWM-2A TRANSCIVER

A classic HAM 100w tranceiver. These units are true to the classic collins style and quality, built to last more than a lifetime. Limited quantity !!!

Price: \$595.00 with piggyback pwr-supply.
: \$445.00 complete as-is w/pwr supply.

**All Prices in U.S. Dollars
Please include telephone/fax
number with mail-in orders.
Orders must be prepaid by
guaranteed instrument.**

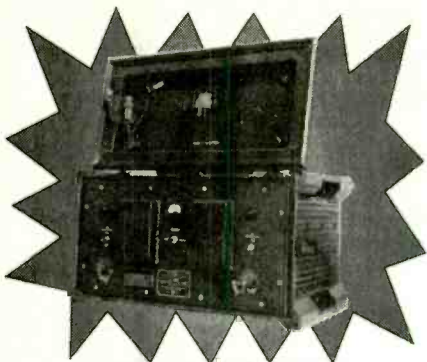
Manuals available at extra cost



RACAL RECEIVER RA 6790/GM

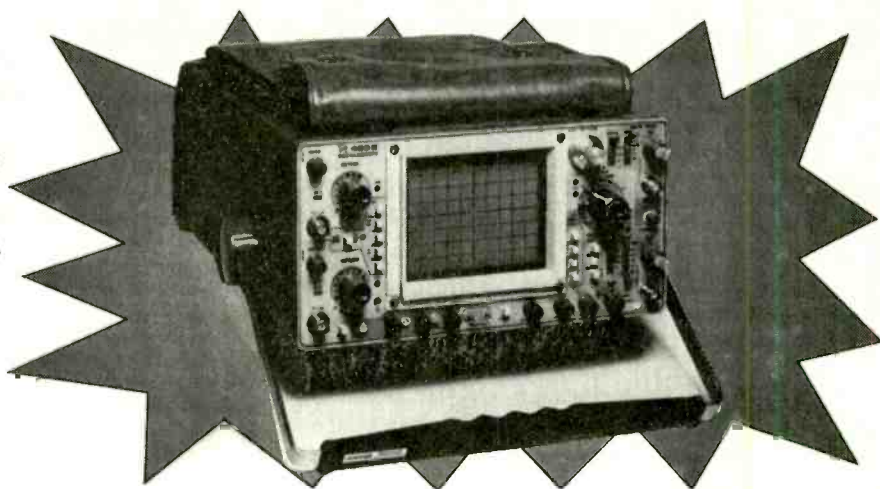
Superior quality and design are standard in this 500KHz-30Mhz general coverage receiver. Modes of operation are AM,FM, CW,U/LSB,ISB -optional, with room for seven bandpass filters. The illuminated LCD display features large readable digits for frequency and mode status as well as AF or RF signal strength.Tuning can be directly entered via keypad or with a tuning knob. Three different gain modes are Manual, Automatic, and Automatic with selectable threshold. Fully Checked & Operational.
Price: \$995.00 Radio only-less filters.
Bandpass Filters: 400Hz/1.2KHz/2KHz/6.8KHz 16KHz / USB/LSB are \$65.00 ea. max 4 per unit.

** NOTE: if there are specific items you are looking for regardless of whether or not they appear in this ad, we would be happy to provide you with a quote including, availability, pricing information and shipping details.



STATIC FREQUENCY CONVERTER

Finally a simple way to power up all that 400 cycle stuff. This is a completely self contained solid state converter that just plugs in to any 115vac 60 Hz power source and provides easy instant 400Hz single phase 115vac output @500 watts. Price: \$275.00 ea. New in Original Carton Dim=L21"xW12"xH15" Weight=99lbs



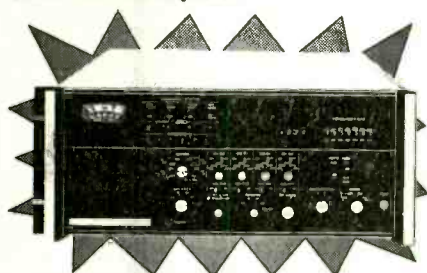
TEKTRONIX 465B

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 "465B". 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 rarely permits. Fortunately, we were recently able to acquire a limited supply of 465B-s in nearly new condition. Our LOW PRICES will likely permit "you" to own one of the best scopes anywhere in the country. If your needs are current and action *swift* you too will be a member of a growing club!!!

SELECTED EXCELLENT COND.....\$849.00

VERY GOOD CONDITION.....\$695.00

These instruments are fully checked out and calibrated. They are supplied with an original front panel cover and complete service manual. Original TEK Probes are \$75.00 each with each purchase.



ROCKWELL / COLLINS HF8054A

Four channel HF receiver.

"Top of the Heap" certainly describes this commercial communications receiver. Produced by what most folks consider the best and most desirable manufacturer in North America. There's nothing like a Rockwell/Collins HF80 series receiver, and to "top that", OUR's are factory new in the orig. carton from the Toronto mfg. facility. These units are loaded with the following options. - 10Hz tuning resolution, -remote control, high stability txc., -four chan. audio output, and completed with 6 bandpass filters. The bonus? "no scratches". Price: \$3,700.00

Just Arrived- \$39.00

8-DAY AIRCRAFT CLOCK

1-7/8" dial

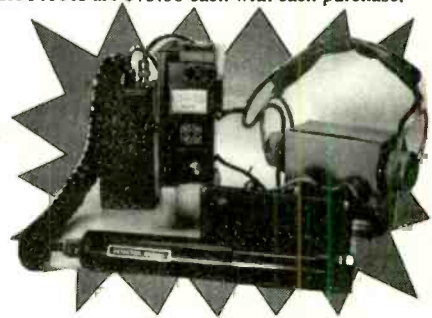
Great collectors item for the ham shack, fifties vintage funct/chkd.



MARCONI SYNTHESIZED SIGNAL GENERATOR

Model 2018

Freq range 80Khz-520Mhz with calibrated output levels from -127 dBm to +13dBm. Resolution 10Hz. It can be freq, phase or amplitude modulated from ext or int modulation sources. RF output resolution is 0.1dB. reversepower 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



PDR-63 PORTABLE RADIAC METER

This portable radiac set is loaded with all kinds of extras featuring six ranges of sensitivity for both Gamma or Beta radation measurements. The 1st scale 0-1 rad/hr up to 0-5000 rad/hr. The unit comes supplied with headset & bat/charger. Req's only 4 AA Batteries. Price: \$149.95

-HP 3551A TRANSMISSION TEST SET	\$ 950.00
-HP 3581A WAVE ANALYZER	\$1,295.00
-HP 4260A LCR BRIDGE	\$ 385.00
-HP 5006A SIGNATURE ANALYZER	\$ 450.00
-HP 54111D COLOR DIGITAL STORAGE SCOPE	\$8,500.00
-HP 8160A OPT-20 PROG PULSE GEN	\$3,995.00
-HP 8505 NETWORK ANALYZER SYSTEM	\$6,000.00
-HP 8160A OPT-20 PROG PULSE GEN	\$2,750.00
-HP 8558A SPEC ANALYZER .01-1.5GHz	\$4,995.00
-TEK FG504 FUNCTION GENERATOR (40MHz)	\$ 875.00
-TEK 520 VECTORSCOPE	\$1,200.00
-TEK 577D1/177 CURVE TRACER	\$2,000.00
-TEK 1502 TDR w/CHART REC	\$2,200.00
-TEK OF150 MULTIMODE FIBRE OPTIC TDR	\$4,750.00
-TEK AA5001 PROG, DIST-ANA /w/TMS003 MF	\$1,790.00

-EIP 351D 18 GHz FREQ COUNTER	\$ 950.00
-ENI MOD 310L 250KHz-110MHz @ 50db GAIN	\$ 765.00
-ENI MOD 406L 150 KHz-250MHz @ 40db GAIN	\$ 850.00
-GOULD 220 CHART RECORDER	\$ 950.00
-GOULD RS 3800 PROGRAMABLE CHART RECORDER/w MOD 5900 SIG CONDITIONER & DC AMPS (NEW)	\$6,500.00
-IFI MOD 404 WIDEBAND LABORATORY POWER AMP - .01-250MHz @ 2.5Kw POWER OUTPUT	\$ CALL
-MARCONI MOD 2019 SYNTHESIZER 1024MHz	\$2,800.00
-ROHDE & SCHWARZ SIG GENERATOR .4-484MHz @ 500.00	\$ 500.00
-SOUND TECHNOLOGIES DIS MEAS SYSTEM	\$1,200.00
-SCHENCK DYNAMIC BALANCING MACHINE MOD CAB570 WITH- BED, SENSORS & MANUAL	\$4,500.00
-WILTRON 6647A-40 PROG. SWEEP GEN. 10MHz-18.6GHz	\$8,500.00

-ANRITSU MS420K NETWK SPEC. AN.10Hz-30MHz ..	\$1,800.00
-EATON NM-17/27A EMI FIELD INT. METER	\$1,500.00
-FLUKE 5100A CALIBRATOR	\$3,800.00
-FLUKE 6039A FREQUENCY SYNTHESIZER	\$ 500.00
-WAVETEK 3002 RF SIG. GENERATOR	\$ 795.00
-BOONTON 82AD AM/FM MOD-METER	\$1,275.00
-BOONTON 102F SIG. GEN. 1040MHz	\$1,295.00
-COLLINS 516-F2 PWR SUPPLY(USED)	\$ 85.00
-COLLINS 651S-1 RECEIVER	\$1,250.00
-R392 RECEIVER .5-30MHz	\$ 165.00
-T195 100w COMPANION XMTR TO 392	\$ 85.00
-GRT-22 UHF POWER AMPLIFIER	\$ 200.00
-HARRIS RF280 HF/TACTICAL TRANSCEIVER	\$1,500.00
-LEXEL MOD 75 HIGH POWER ARGON LASER	\$1,500.00
-HP 8640A SIGNAL GENERATOR (512MHz)	\$ 995.00

USE ELECTRONIC SHOPPER CLASSIFIEDS READ BY MORE THAN 100,000 ELECTRONICS BUYERS AND SELLERS AND TRADERS

INSTRUCTION FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or **PRINT** your classified ad copy **CLEARLY** (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is \$1.25 per word. Minimum charge is

\$18.75 per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT

All classified advertising in the **Electronic Shopper** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by April 1 will appear in the July, 1995 issue that is on sale in June 1. Shopper ads will appear Jan., Mar., May etc. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. **NO RE-FUNDS**, advertising credit only. No phone orders.

AD RATES: \$1.25 per word, Minimum \$18.75.

Send your ads with payment to:

Electronic SHOPPER, 500-B BI-County Blvd. Farmingdale, NY 11735

CATEGORIES

100 — Antique Electronics	270 — Computer Equipment Wanted	450 — Ham Gear Wanted	630 — Repairs-Services
130 — Audio-Video-Lasers	300 — Computer Hardware	480 — Miscellaneous Electronics For Sale	660 — Satellite Equipment
160 — Business Opportunities	330 — Computer Software	510 — Miscellaneous Electronics Wanted	690 — Security
190 — Cable TV	360 — Education	540 — Music & Accessories	710 — Telephone
210 — CB-Scanners	390 — FAX	570 — Plans-Kits-Schematics	720 — Test Equipment
240 — Components	420 — Ham Gear For Sale	600 — Publications	

CLASSIFIED AD COPY ORDER FORM

Ad No. 1—Place this ad in Category # _____

1 - \$18.75	2 - \$18.75	3 - \$18.75	4 - \$18.75
5 - \$18.75	6 - \$18.75	7 - \$18.75	8 - \$18.75
9 - \$18.75	10 - \$18.75	11 - \$18.75	12 - \$18.75
13 - \$18.75	14 - \$18.75	15 - \$18.75	16 - \$20.00
17 - \$21.25	18 - \$22.50	19 - \$23.75	20 - \$25.00
21 - \$26.25	22 - \$27.50	23 - \$28.75	24 - \$30.00
25 - \$31.25	26 - \$32.50	27 - \$33.75	28 - \$35.00

29 - \$36.25	30 - \$37.50	31 - \$38.75	32 - \$40.00
33 - \$41.25	34 - \$42.50	35 - \$43.75	36 - \$45.00
37 - \$46.25	38 - \$47.50	39 - \$48.75	40 - \$50.00

Ad No 1—Total words _____ x \$1.25 per word = \$ _____
 All Caps words _____ x .20 per word = \$ _____
 Bold words _____ x .20 per word = \$ _____
 Bold Cap words _____ x .40 per word = \$ _____
TOTAL COST OF AD No. 1 \$ _____

Card # _____
 Expiration Date ____ / ____
 Signature _____

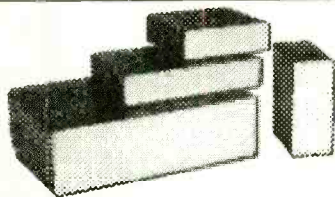
Total classified ad Payment \$ _____ enclosed.
 Check Mastercard Visa (\$18.75 minimum credit card order)

Name _____ Phone _____
 126 Address _____ City State Zip _____



BROW MOUNTED BINOCULAR MAGNIFIER

Wear this handy magnifier with its velcro clasp. One size fits all so it's always comfortable. Magnifier assembly tilts up out of the way when not needed. Fixed lens gives 1.8X magnification for most close-up activity. For a closer look a second binocular lens tilts down from inside visor. For turbo pep mode, swivel the loupe in front of the right eye. Combinations are 1.8X, 2.3X, 3.7X and 4.8X. (MP242) **\$23.95 each**



STEEL ENCLOSURES

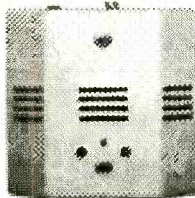
Features include ventilation holes, self-adhesive rubber feet. Front and rear panels are 0.05" aluminum alodine painted white. Top and bottom covers are 0.04" phosphated steel painted black.

- CG3119A (2.5" x 6" x 7") **\$14.00**
- CG3119B (2.5" x 12" x 7") **17.00**
- CG3119F (2.5" x 17" x 11") **21.00**
- CG3119G (3.5" x 8" x 7") **15.00**
- CG3119K (3.5" x 17" x 11") **26.00**
- CG3114P (5.2" x 17" x 11") **33.00**
- CG3119K (3.5" x 17" x 11") **26.00**
- CG3114P (5.2" x 17" x 11") **33.00**



SNIP²

This was designed to be a thread nipper, but in reality it is a spring-loaded stainless steel cutalottastuff tool. The handy eyering allows you to dangle it from your pinky between ops on repetitive work. (SC123) **\$8.85 each**



ULTRASONIC LIGHT SWITCH

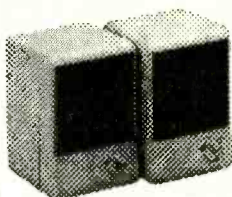
Replace your light switch with this motion detector. Turns lights on when you enter a room and turns them off when you leave. Has sensitivity and delay adjustments. Specs and instructions included. (95U002) **\$9.95 each**

ALLTRONICS

2300 Zanker Road - San Jose, CA 95131
(408) 943-9773 - Fax (408) 943-9776

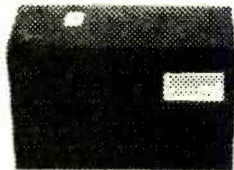
24-Hour BBS
(408) 943-0622

9600 Baud - N-8-1



AMPLIFIED SPEAKER PAIR

These units have excellent audio for their small size (approx. 3" x 3" x 5") and are loud enough, too. A 3.5mm stereo plug brings the audio in, and each speaker has its own volume control. They run on 6VDC (four "C" batteries) or an external 6VDC wall transformer. (94V007) **\$9.95/pair**



SEALED LEAD-ACID BATTERIES

Five different new, rechargeable units operate in any position. Charge at 10% of AH capacity for 14 hours, less if partially discharged. (Limit charge voltage to 14.5V for 12V units, 7.25V for 6V units.) Sizes given are approximate.

- 12V, 4AH, 2.75" x 4.25" x 3.5". (95E003) **\$6.95 each**
- 6V, 10AH, 1.875" x 3.75" x 5.875". (95E004) **\$7.95 each**
- 6V, 6.5AH, 1.875" x 3.75" x 5.875". (95E005) **\$4.95 each**
- 6V, 3AH, 1.875" x 2.375" x 5.25". (95E006) **\$2.95 each**

SHRINK TUBING ASSORTMENT

Stock up on a good supply of four-foot lengths of popular sizes ranging from 0.125" to 1.5" in various colors. Compare at \$70.00. (92Z042) **Twenty 4' Pieces for \$8.95**

USED TUBES

\$1.00 each

Your choice, Pulls, test OK.

- | | | | |
|-------|-------|-------|-------|
| 12AX4 | 12BE6 | 13FD7 | 17DQ6 |
| 12AX7 | 12DQ6 | 13FG7 | 50L6 |
| 12BA6 | 12SA7 | 17AX4 | 117Z6 |
| 12BY7 | 12L6 | 17AY3 | 5814 |

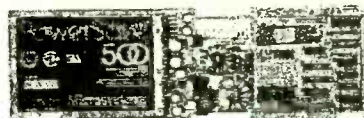
Prices good through 5/31/95.

RESISTOR RIOT

1/8, 1/4, 1/2 Watt, power, precision, fixed, adjustable, etc. Thousands of pieces. (92P023) **5 Lbs. for \$4.95**

100° LOW NOISE AMPLIFIER

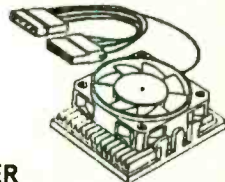
For TVRO applications. 3.8-4.2GHz input, 950-1450 mHz output. Amplica P/N MTI-AG1021. (95G002) **\$9.95 each**



PowerSave 500 UNINTERRUPTIBLE POWER SUPPLY

We have just received a quantity of these internally mounted battery backup units for PC's and PC clones. They use one full-size slot in your PC and monitor the power supply for hiccups or outages. When the power goes out:

- 0-2 seconds: PowerSave provides system power to "ride through" short power interruptions without any effect on the user.
- 2-20 seconds: PowerSave initiates a complete system data backup to the hard drive, and returns to user when AC returns.
- 20+ seconds: PowerSave completes system backup and shuts PC off after completion. Application is restored whenever PC power is restored. Application restoration may be automatic or manual, returning you to exactly where you were just before power loss. Cool unit! (95C004) **\$49.95 each**



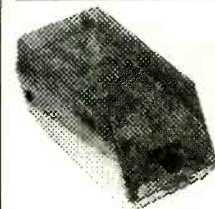
'486 CPU COOLER

Fan and heatsink with a state-of-the-art peltier junction attached to keep your '486 CPU ice cold. (95C007) **\$44.95 each**



3.5" HIGH DENSITY DISKETTES

Box of ten brand new diskettes. (95C009) **\$5.95/box**



3.5" DISK STORAGE FILE WITH LOCK

Holds 48 disks. Perfect Micro P/N PM-48L. (95C008) **\$4.95 each**

AT MFM HARD/FLOPPY CONTROLLER

2 Hard drives, 2 floppies, 3:1 interleave. (92C071) **\$24.95 each**

DENTAL DRILL MOTOR CONTROLLER

Features reversible DC outputs in two speed ranges (8V and 12V DC), sonalert, switches, power supply and other goodies inside. (94M010) **\$14.95 each**

VISA, MC, Amex cards accepted.
Minimum order \$15.00.
California residents add sales tax.
Shipping additional on all orders.



030595

May 1995, Electronics Now

The Next Generation Contact Cleaners, Conditioners and Preservatives

Even the finest equipment cannot guarantee noise-free operation. One "dirty" connection anywhere in the signal path can cause unwanted noise, distortion and signal loss. Considering the hundreds (if not thousands) of connections in electronic equipment today, it is only a matter of time before they begin to fail.

ProGold and **DeoxIT** increase the performance and reliability of electrical components and equipment. They provide long-lasting protection, reducing the expense of repeated cleaning with expensive ozone-depleting solvents. As a general rule, use **ProGold** for best performance and protection on plated surfaces and **DeoxIT** as a general purpose treatment.

ProGold™ Conditioner & Preservative

ProGold outperforms all other contact cleaners, enhancers and lubricants. Due to its unique properties, not only does it deoxidize and clean surface contamination, but it penetrates plated surfaces and molecularly bonds to the base metals. This increases conductivity and contact surface area and reduces arcing, RFI, wear and abrasion - the major cause of intermittent signals, distortion and signal loss. **ProGold** is the only product that conditions & protects plated surfaces and their base metals.



DeoxIT™ & PreservIT™

Deoxidizes, Seals & Protects Electrical Connections

DeoxIT is a fast-acting, deoxidizing solution that cleans, preserves, lubricates & improves conductivity on all metal surfaces. Use as a general treatment for connectors, contacts & other metal surfaces.



PreservIT seals, lubricates and preserves metal surfaces for protection from oxidation and contamination. For use on clean/new surfaces or those pre-cleaned with **DeoxIT**.

Both have excellent migration properties that coat the surfaces and protect them from future oxidation & contamination. These formulas contain improved deoxidizers, preservatives, conductivity enhancers, anti-tarnishing compounds, arcing & RFI inhibitors and provide extended temperature range.



OpticALL™ StaticALL™

OpticALL cleans, polishes and eliminates static electricity on optical viewing surfaces. **OpticALL** is also recommended as a general purpose antistatic cleaner on plastic, glass and metal surfaces. **StaticALL** neutralizes static build-up caused by friction & low humidity conditions. Use on carpets, floors, clothing & other static generating surfaces.



DustALL™ FreezALL™

DustALL quickly & safely removes dust, lint & particles from sensitive electronic equipment, computers, lab equip., optical grade surfaces & other mechanisms & equipment. **FreezALL** quickly and safely cools circuits to -54°C. Locates intermittent components due to heat failure and hairline cracks on PCBs.



MechanicALL™

High Penetrating Anti-Corrosive Anti-Tarnishing Cleaner & Lubricant. Lubricates & Protects, Displaces Moisture, Stops Squeaks, Migrates & Coats Entire Surface.



ElectricALL™

Rejuvenating Solution For All Electrical Applications. Cleans, Preserves, Improves & Protects Connections, Removes Corrosion & Oxidation, Reduces Wear, Abrasion, Arcing & RFI.



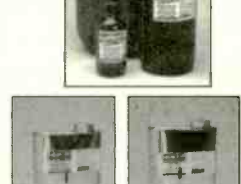
CaiKleen 41

Approved Freon TF replacement. Cleaning solvent for equipment and parts. Harmless to metal and most plastics & elastomeric parts. No residue, non-flammable, HCFC blend.



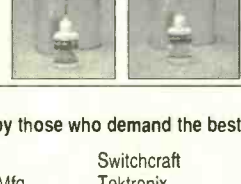
CaiKleen TRP

For degreasing, cleaning & defluxing equipment and parts. Removes oil, grease, dirt and contaminants including rosin flux from PCBs, components and metal parts. Biodegradable.



CaiKleen IPA

Ultra-pure isopropyl alcohol. Cleaning & degreasing solvent for removal of oil, grease & dirt from instruments, equipment & parts. Use on tape heads, discs, guides, switches, connectors, relays, and other parts for general cleaning.

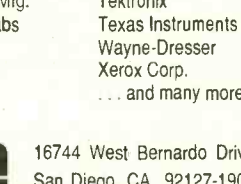


CaiLube 360

Finest quality cutting and lubricating oil for use on various materials; cast-iron, stainless, titanium, gold, platinum, non-ferrous metals, synthetics, etc.

CaiLube X-10S Instrument Oil

Contains silicone. Finest quality Instrument oil for use on rubber, plastics and metals. Non-gumming, rust-inhibiting, long lasting lubrication.



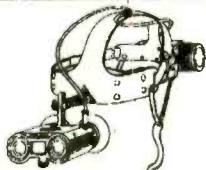
CAIG Products ... used by those who demand the best!

Boeing
 Dolby Laboratories
 E.I. Dupont
 Federal Express
 General Electric
 Hewlett Packard

Honeywell
 John Fluke Mfg.
 McIntosh Labs
 Motorola
 Nakamichi
 RCA

Switchcraft
 Tektronix
 Texas Instruments
 Wayne-Dresser
 Xerox Corp.
 ... and many more!

THE TOTAL COST FOR SHIPPING MOST MIXED ORDERS FROM THIS ADVERTISEMENT BY FEDERAL EXPRESS IS \$15 - \$25 ALL PRICES ARE IN US DOLLARS.



HEAD MOUNTED IR BINOCULARS

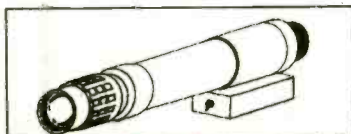
These lightweight USSR made binoculars will produce good vision with 1/4 moonlight illumination, but can also be IR assisted at lower light levels: Work well with our \$11 IR filter. Powered by 4 AAA batteries (6V), 1 X magnification, angle of vision 28 deg., focuses from 2' to infinity.

\$380

VISIBLE LASER DIODE KIT

Just the basics: A 5mW / 670nm visible laser diode plus a collimating lens, plus an APC driver kit UNBELIEVABLE PRICE:

\$26

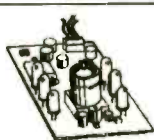


INTENSIFIED NIGHT VIEWER KIT

See in the dark! Make your own night scope that will produce good vision in sub-starlight illumination! We supply a three stage fibre optically coupled image intensifier tube, EHT power supply kit, and sufficient plastics to make a monocular scope. The three tubes are supplied already wired and bonded together.

**\$200 for the 25mm version
\$280 for the 40mm version**

We can also supply the lens (100mm f2: \$50) and the eyepiece (\$12) which would be everything that is necessary to make an incredible viewer!



CCD CAMERA

Monochrome CCD Camera which is totally assembled on a small PCB and includes an Auto Iris lens. 9-12V DC operation. It can work with illumination of as little as 0.1Lux, and is IR responsive: Can be used in total darkness with Infra Red illumination. A suitable illuminator is our HIGH POWER LED IR ILLUMINATOR kit. Overall dimensions of camera are 24 X 46 X 70mm and it weighs less than 40 grams! Can be connected to any standard monitor or the video input on a Video cassette recorder: EIA (US - NTSC) compatible.

\$145



FIBRE OPTIC TUBES

These US made tubes are "pulls" from equipment, in excellent condition. Have 25 / 40 mm diameter, fibre - optically coupled input and output windows. The 25mm tube has an overall diameter of 57mm and is 60 mm long, the 40mm tube has an overall diameter of 80mm and is 92mm long. The gain of these is such that they would produce a good image in approximately 1/2 moon illumination, when used with suitable "fast" lens, but they can also be IR assisted to see in total darkness. Our \$11 IR filter is suitable for use with these tubes. Suitable for low light video preamplifiers, wild life observation, etc. Each of the tubes is supplied with an 9V - EHT power supply kit. REDUCED PRICES:

\$75For the 25mm intensifier tube and supply kit.

\$110For the 40mm intensifier tube and supply kit.

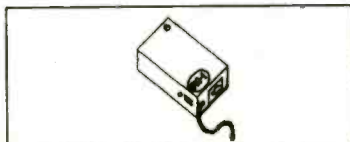
We also have a good supply of the same tubes that may have a blemish which is not in the central viewing area! Satisfaction guaranteed! IION SPECIAL!! \$40For a blemished 25 or 40mm (Specify preference) image intensifier tube and supply kit. Matching good quality eyepiece lens only, \$6 *Extra! That's almost a complete night viewer kit for \$46.*



IR TUBE AND SUPPLY

A tube and supply combination that can be used as the basis of making a very sensitive IR responsive viewer. The tube employed is probably the most sensitive IR responsive tube we ever supplied, and the EHT supply kit enables the tube to be operated from a small 9V battery. Basic instructions provided.

\$80



MINIATURE FM TRANSMITTER

Not a kit, but a very small ready made self contained FM transmitter enclosed in a small black metal case. It is powered by a single small 1.5V silver oxide battery, and has an inbuilt electret microphone. SPECIFICATIONS: Tuning range: 88 - 108MHz, Antenna: Wire antenna - attached, Microphone: Electret condenser, Battery: One 1.5V silver oxide LR44 / G13, Battery life: 60 hours, Weight: 15g, Dimensions: 1.3" X 0.9" X 0.4".

\$25

SECOND GENERATION TUBES

WE SHOULD HAVE A REGULAR SUPPLY OF SOME NEW USSR MADE 18mm 2ND. GEN. FIBRE OPTICALLY COUPLED IMAGE INTENSIFIER TUBES @ APPROX. \$500.



INFRA RED FILTER

Very high quality IR filter and a RUBBER lens cover that would fit over most torches including MAGLITE's, and convert them to a good source of IR. Suitable for use with passive and active viewers.

\$11

For the filter and the rubber lens cover.

GLASS PRISMS

Precision 90 deg. glass prisms with a mirrored backing. We have a limited quantity of these prisms

\$10

For the smaller prism: Approximately 18 X 18 X 24 X 64mm.

\$20

For the larger prism: Approximately 18 X 18 X 24 X 127mm.



PASSIVE NIGHT VIEWER KIT

See Electronics Now Oct. 94. This kit is based on a BRAND NEW passive night vision scope, which is completely assembled and has an EHT coaxial cable connected. This assembly employs a high gain passive tube which is made in Russia. It has a very high luminous gain, and the resultant viewer will produce useful pictures with starlight illumination. It needs an EHT power supply to make it functional, and we supply a suitable supply and it's casing in kit form.

\$220

MISCELLANEOUS ITEMS COMPONENTS AND KITS

- FM TRANSMITTER KIT - MKII:\$8
- SINGLE CHANNEL UHF REMOTE CONTROL KIT: One transmitter and one receiver: \$32 additional transmitter \$11
- 4 CHANNEL UHF REMOTE CONTROL KIT: Two transmitters and one receiver: \$68
- ELECTRIC FENCE KIT: PCB and components\$28
- GARAGE - DOOR - GATE REMOTE CONTROL KIT: ..Tx \$13 ..Rx \$56
- LASER BEAM COMMUNICATOR KIT: Tx. Rx. plus IR Laser\$39
- PLASMA BALL KIT: PCB and components kit, needs any bulb\$18
- HIGH POWER IR LED's - 880nm / 30mW / 12deg. @ 100mA .10 for \$6

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LM324	45¢
LM339	45¢
LM358	45¢
NE555	40¢
NE556	45¢
LM741	45¢

Deal 'U3': 12 pcs total, (2pcs of each).....\$5

POPULAR CMOS

CD4001B	25¢
CD4011B	25¢
CD4013B	35¢
CD4017B	35¢
CD4028B	35¢
CD4066B	35¢
CD4069B	35¢

Deal 'V2': 14 pcs total, (2pcs of each).....\$4

1 AMP SCHOTTKY

1N5817	1A/20V	20¢
1N5818	1A/30V	23¢
1N5819	1A/40V	24¢

Deal 'Y4': 9 pcs total, (3pcs of each).....\$2

5mm (T1 3/4) Diffused LEDs

Red	7¢
Green	8¢
Yellow	9¢

Deal 'L3': 30 pcs total, (10pcs of each).....\$2.50

3mm (T1) Diffused LEDs

Red	7¢
Green	8¢
Yellow	9¢

Deal 'L6': 30 pcs total, (10pcs of each).....\$2.50

Germanium Diodes

1N34A	12¢
1N60	12¢
1N270	18¢

Deal 'G5': 18 pcs total, (6pcs of each).....\$2.50

RADIAL 'LYTICS'

1uF/50V	5¢
2.2uF/50V	5¢
3.3uF/50V	5¢
4.7uF/50V	5¢
10uF/25V	5¢
22uF/25V	5¢
33uF/25V	6¢
47uF/25V	7¢
100uF/25V	8¢
220uF/25V	9¢
330uF/25V	10¢
470uF/25V	11¢

Deal 'A9': 60 pcs total, (5pcs of each).....\$5

Voltage Regulators

7805	47¢
7808	47¢
7812	47¢
7815	47¢
7818	47¢
7824	47¢
7905	50¢
7908	50¢
7912	50¢
7915	50¢
7918	50¢
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Deal 'J1': 10pcs (5ea of 78L05 & 78L12).....\$3.50

3 AMP SCHOTTKY

1N5820	3A/20V	32¢
1N5821	3A/30V	36¢
1N5822	3A/40V	40¢

Deal 'Y9': 9 pcs total, (3pcs of each).....\$3

CERAMIC DISC (All caps rated 50V)

10pF	5¢
22pF	5¢
27pF	5¢
33pF	5¢
47pF	5¢
100pF	5¢
150pF	5¢
220pF	5¢

Deal 'R4': 40 pcs total, (5pcs of each).....\$2.50

More Ceramic Caps (All caps rated 50V)

270pF	5¢
330pF	5¢
470pF	5¢
.001uF	5¢
.01uF	5¢
.022uF	5¢
.047uF	6¢
.1uF	6¢

Deal 'R7': 40 pcs total, (5pcs of each).....\$2.50

TRANSISTORS

PN2222A	6¢
PN2907A	6¢
2N3904	6¢
2N3906	6¢
2N3401	6¢
2N4403	6¢

Deal 'N8': 60 pcs total, (10pcs of each).....\$3.50

I.C. SOCKETS

8 pin	4¢	30¢
14 pin	7¢	54¢
16 pin	8¢	62¢
18 pin	9¢	70¢
20 pin	10¢	78¢
24 pin	12¢	94¢
28 pin	14¢	1.10
32 pin	16¢	1.24
40 pin	20¢	1.56

1 W ZENER DIODE

1N4728A	3.3V	6¢
1N4733A	5.1V	6¢
1N4739A	9.1V	6¢
1N4742A	12V	6¢
1N4744A	15V	6¢
1N4746A	18V	6¢

Deal 'Z6': 30 pcs total, (5pcs of each).....\$2

DIODES

1N914A	3¢	
1N4148	2¢	
1N4001	1A/50V	3¢
1N4004	1A/400V	4¢
1N4007	1A/1kV	5¢

Deal 'P7': 50 pcs total, (10pcs of each).....\$2

TANTALUM CAPS

1uF/35V	18¢
2.2uF/35V	20¢
10uF/35V	35¢

Deal 'T6': 15 pcs total, (5pcs of each).....\$3.50

MONO CAPS...6¢ea

.01uF/50V	.047uF/50V	.1uF/50V
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Deal 'B5': 40 pcs total, (10pcs of each).....\$2.50

More Transistors

2N2222A	30¢
2N4124	8¢
2N4126	8¢
MPSA05	9¢
MPSA13	14¢
MPSA27	14¢
MPSA42	12¢
MPSA56	10¢
MPSA92	10¢
MPSH10	10¢
2N3055	52¢
TIP31C	40¢
TIP32C	40¢
TIP117	50¢
TIP120	50¢
TIP125	50¢

POWER DIODES

1N5401	3A/100V	7¢
1N5404	3A/400V	8¢
1N5408	3A/1kV	9¢
6A10	6A/100V	20¢
6A100	6A/1kV	30¢

Deal 'H8': 25 pcs total, (5pcs of each).....\$3

Toggle Switches

on-on	SPDT	60¢
on-on	DPDT	68¢
on-off-on	DPDT	85¢

Deal 'S7': 6 pcs total, (2pcs of each).....\$4

1/4W 5% Resistors

10, 47, 100, 470, 1K, 4.7K

Deal 'W2': 120pcs total, (20 of ea above).....\$2.50

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★ Model 750F, includes laser, power supply, polygon scanner, mirrors, detectors, & optics, runs on 115 VAC

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◆Power handling: 350 watts RMS/500 watts max
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◆Magnet weight: 90 oz. ◆Fs: 21 Hz ◆SPL: 88 dB 1W/1m
◆Vas: 5.9 cu. ft. ◆Qts: .421 ◆Xmax: .41" ◆Net weight: 11 lbs.

#EN-292-710 \$115.50 (1-3) \$107.80 (4-11) \$99.90 (12-UP)



Ultimate

Fluke Model 12 Multimeter

The Model 12 compact digital multimeter combines basic features, high performance, low cost and Fluke reliability. It was designed for first level electrical and electronic troubleshooting. Includes 9V battery, operating manual, and test leads. Two year manufacturer warranty.

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Turntable to speed repair of VCRs, TVs and more. Easily turn unit for convenient repair. Holds up to 200 lbs. Dimensions: 20" W x 15" D x 1-1/8" H. Black pebbled surface. Includes 4 anti-skid adhesive feet. Net weight: 9 lbs.

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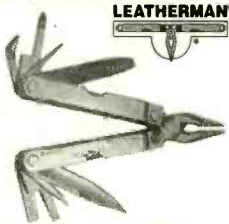
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Excellent performance at a moderate price. This ferro fluid cooled 1" poly dome tweeter features a high loss diaphragm, user replaceable voice coil assembly, and high power handling.

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◆Net weight: 1-1/4 lbs.

#EN-264-502 \$18.50 (1-3) \$16.80 (4-11) \$15.45 (12-UP)



vifa

Audio Generator

Square wave and sine wave generator useful for a variety of audio applications. Generates 10 Hz to 1 MHz in 5 ranges. Output voltage: 8V RMS sine wave, 10V p-p square wave. +/- 3% dial accuracy. Output impedance: 600 ohms. Synchronization: +/- 3% of oscillation frequency per VRMS. Dimensions: 6"H x 10"W x 5"D. Includes test lead, AC power cord, and manual. One year manufacturer warranty. Net weight: 6 lbs.

#EN-390-620 \$119.00



Mini Weatherproof Speaker System

These mini weatherproof speaker cabinets are made from high impact polypropylene which is completely weather sealed making these perfect for indoor or outdoor use. These great sounding mini speakers feature a 5" polypropylene cone woofer and a mylar dome tweeter. Ideal for use as extension speakers or for surround sound. Small size blends easily into any decor. Frequency response: 130-20,000 Hz. 8 ohm impedance: 30 watts RMS, 60 watts maximum power handling capability. Mounting brackets included. Dimensions: 8" (H) x 5-1/2" (W) x 4-1/2" (D). Net weight: 10 lbs.

#EN-310-020 (Black) \$79.95 (1-3 PRS) #EN-310-025 (White) \$74.80 (4 PRS-UP)



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No top notch lighting display is complete without a powerful, high speed strobe light. This professional unit features an ultra bright xenon flash tube, reflective bowl, variable speed control, and on/off toggle switch. A 1/16" clear plexiglass cover is mounted on glass stand-offs to protect the flash tube assembly. Includes adjustable mounting bracket. Dimensions: 9-1/2" (W) x 8-5/8" (H) x 6-7/8" (D). Net weight: 7 lbs.

#EN-243-072 \$92.80

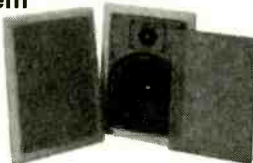


6-1/2" Two Way In-Wall System

This is our most popular in-wall. You won't believe how good these really sound. Big enough to produce great home theater sound and still fit everyone's budget. Put a pair in every room of your house. Great for front or rear speakers in your surround system. The 6-1/2" polypropylene woofer and 1" textile dome tweeter were specially designed with home theater in mind. The crossover network utilizes a mylar capacitor for crisp clean highs. 3 piece design make installation in new or existing walls a snap. Textured ABS frame and steel mesh grill are spray paintable to match (or blend into) any decor. Speaker front plate is "blacked out" for cleaner "through grill" appearance. System comes with speaker assembly, removable metal grill, heavy steel backer plates, screws and hardware, hole cut-out template, paint mask, and detailed installation instructions.

Specifications: ◆6-1/2" polypropylene cone woofer with poly foam surround. ◆1" textile dome tweeter/midrange. ◆8 ohm impedance. ◆3 component L/C crossover network. ◆Frequency response: 50-20,000 Hz. ◆Power handling capability: 60 watts RMS/100 watts max. ◆Sensitivity: 89 dB 1W/1M. ◆Overall dimensions: 8-1/2" W x 12" L x 3-1/2" D. ◆Hole size: 7-1/4" x 10-3/4". ◆Fits into standard 2" x 4" wall. ◆Net weight: 12 lbs. per pair.

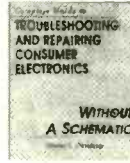
#EN-300-036 \$104.95 (1-3 PRS) \$96.50 (4-11 PRS) \$85.50 (12 PRS-UP)



Troubleshooting And Repairing Consumer Electronics Without A Schematic

A common problem faced by repair technicians is having to troubleshoot electronic equipment without a schematic. With hundreds of illustrations, this indispensable guide demonstrates how to locate, test, and repair amplifiers, TVs, CD players, radios, power supplies, and more. Written by Homer L. Davidson. 320 pages. Copyright: 1994. Net weight: 1-1/4 lbs.

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CIRCLE 262 ON FREE INFORMATION CARD

Parts Express™

3-in-1 Universal Remote

This remote will operate any remote controlled cable box, TV or VCR at just a fraction of the cost of a factory replacement! This unit is already preprogrammed to include the most common codes. It is attractively styled, durable, and easy to set up and operate. The manufacturer even offers a toll free consumer help line to answer questions and provide customer assistance. Requires 2 AAA batteries (not included).



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Part #	Length	Price (1-9)	Price (10-49)	Price (50-UP)
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EN-130-227	15 ft.	8.50	7.90	5.90
EN-130-228	25 ft.	10.90	9.50	7.90
EN-130-229	50 ft.	19.80	17.50	14.90

RS-232 A-B Switch

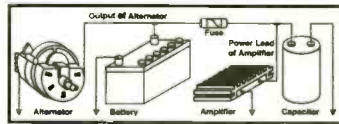
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EN-029-1005	1,000,000 uf	20 VDC	3"(dia.) x 8-1/2"	3 lbs.	79.80	73.50



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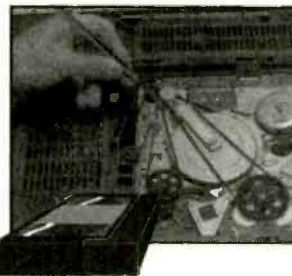
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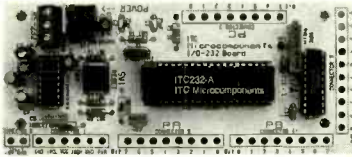
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- All standard Baud rates (300-115KB) supported.
- Bin, Hex or Dec formats.
- 24 I/O lines configurable individually as Inputs or latched Outputs.
- 8, 10 or 12 bit, 10 channel Analog to Digital converter.
- 10-10,000 Hz, 0-100% Pulse Width Modulation output.
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I/O-232-10 (10 bit ADC)	\$ 99	\$ 109
I/O-232-8 (8 bit ADC)	\$ 79	\$ 89

Enclosure: \$14, Serial cable: \$9 (specify connector), Power Supply: \$11
Add \$10 for manuals, diskette containing program examples and Shipping & Handling. Pay by cheque, M. Order, VISA or Master Card.

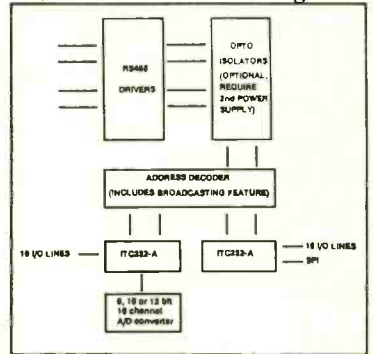
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I/O-485 boards block diagram

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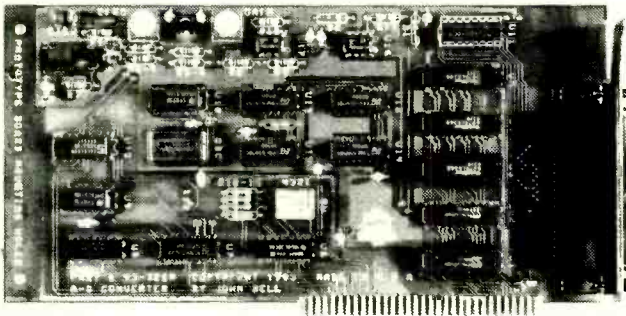
I/O-485-8 (8 Bit ADC)	\$ 139
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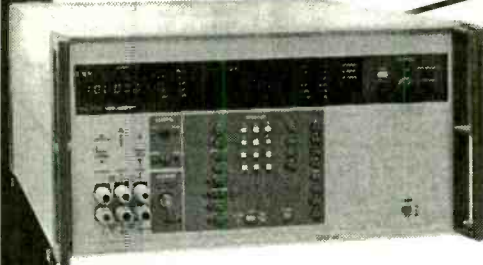
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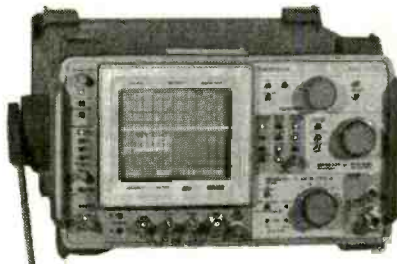
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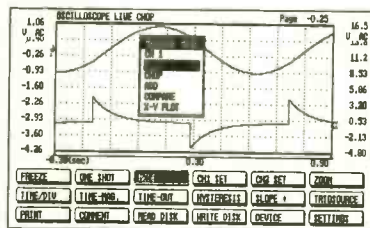
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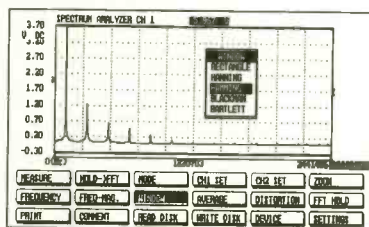
* oscilloscope



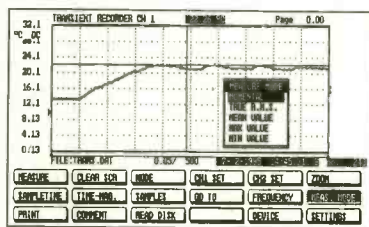
* voltmeter



* spectrum analyzer



* transient recorder



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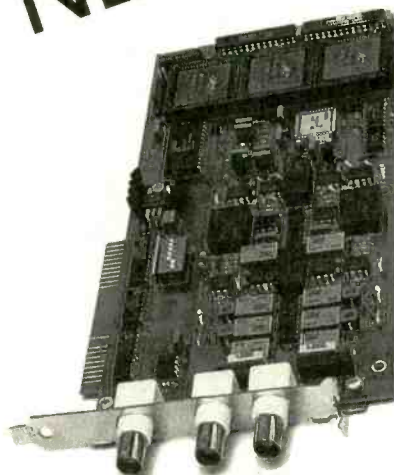
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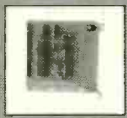
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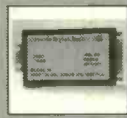
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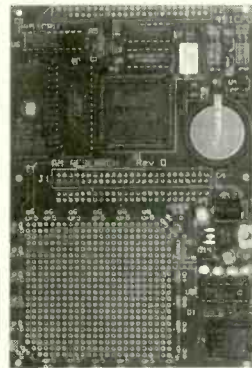
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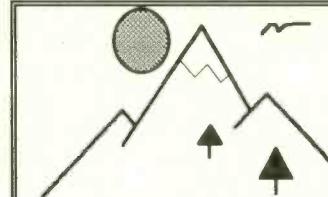
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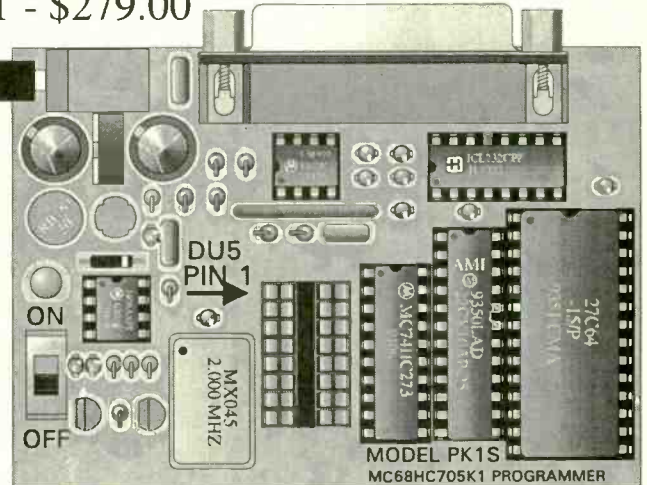
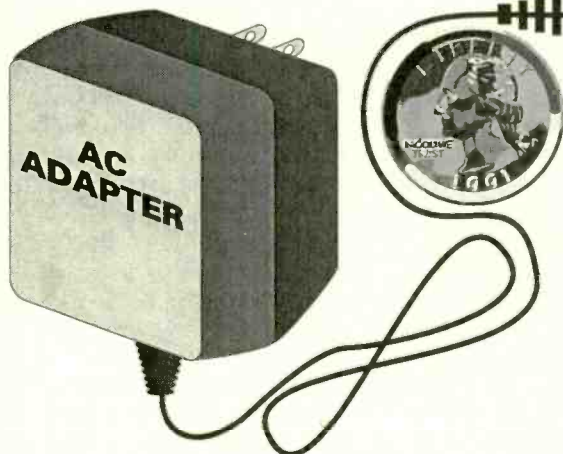
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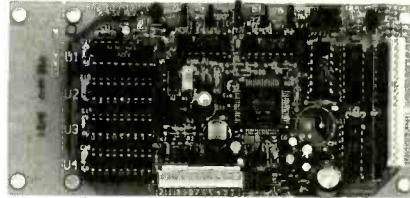
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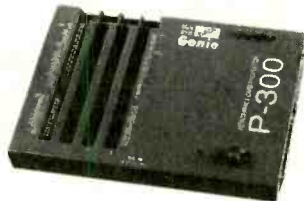
The RE-01 Motherboard will decode a 12-bit address or 8-bit address with 4-bits of data, depending on which of the two included IC's is installed into the board.

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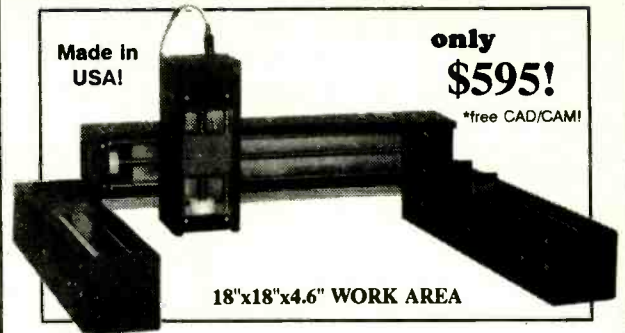
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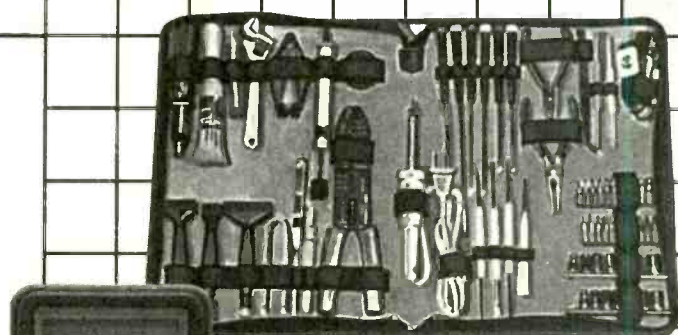
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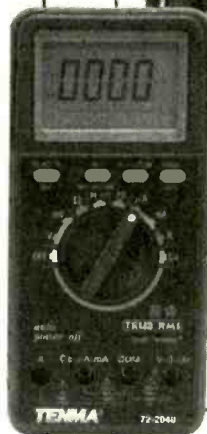


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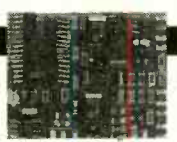
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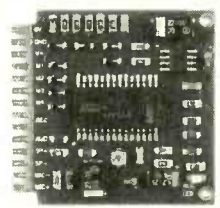


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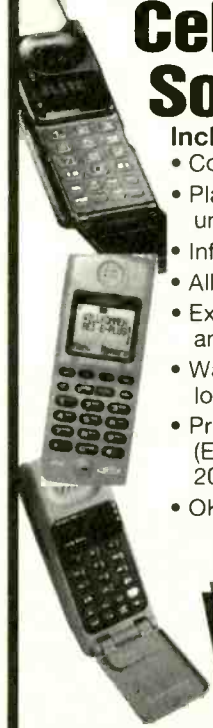
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Power Output: 250W into 4 ohms RMS (42Vx2 6A transformer is used). Frequency Response: 3-22,000HZ. THD: <0.03%. Signal to Noise Ratio: 91dB. Sensitivity: 1V RMS at 47K. Load Impedance: 4 or 8 ohms. Power Requirement: ±46VDC 4A or ±60VDC 6A. Suggested Mark V model 012 transformer. Capacitor: 10,000uf 80V model 016. Suggested Metal Cabinet LG-1925.

Kit: \$ 89.80 Asmb: \$ 114.80

AF-3 ▲▲▲ 300W MOSFET HIGH POWER MONO AMPLIFIER (7 lbs.)



Power Output: 300W into 4 ohms RMS. 200W into 8 ohms RMS. Frequency response: 10HZ-20KHZ. THD: < 0.03%. Signal to noise ratio: 91dB. Input Sensitivity & Impedance at 1KHZ, 1V 47K. Load Impedance: 4-16 ohms. Power Requirement: ±55 to ±65VDC 8A. Suggested Mark V model 009 Transformer. Capacitor 10,000uf 80V model 016. Recommended Metal Cabinet LG-1925.

Kit: \$ 165.00
Asmb: \$ 195.00

TA-800MK2 ▲▲ 120+120W PRE & MAIN STEREO AMP. (4 lbs.)



Power Output: 120W into 4 ohms RMS. 72W into 8 ohms RMS. Frequency Response: 10-20KHZ. THD: <0.01%. Tone Control: Bass ±12dB, Mid & Treble ±8dB. Sensitivity: Phono Input, 3mV into 47K. Line, 0.3V into 47K. Signal to Noise Ratio: 86dB. Power Requirement: 40VDC @ 6A. Suggested Mark V model 001 or 008 transformer. Recommended Metal Cabinet LG-1924.

Kit: \$ 67.92
Asmb: \$ 86.95

TA-1000A ▲▲ 100W DYNAMIC CLASS A MONO AMP. (4 lbs.)



Power Output: 100W into 8 ohms RMS, 125W into 4 ohms RMS. Frequency Response: 10HZ-100KHZ. THD: <0.008%. Signal to Noise Ratio: 80dB. Sensitivity: 1V. Power Requirements: 35 to 45VDC @ 3A. Suggested Mark V model 001 or 008 transformer. Capacitor 10,000uf 80V model 016. Recommended Metal Cabinet LG-1924.

Kit: \$ 54.00 Asmb: \$ 74.00

TA-388 ▲▲▲ CLASS A FET DYNAMIC BUFFER STEREO PRE-AMP. (1 lb.)



Frequency Response (at rated output): Overall 10HZ-100KHZ +0.5dB-1dB. THD: Overall <0.007% at or below rated output level. Channel Separation (at rated output 1KHZ): Overall better than 70dB. Hum & Noise: Overall better than 90dB. Input Sensitivity (1KHZ for rated output): 300-600mV. Maximum Output Level: Pre-Amp output 1.8V (0.1% THD). Power Requirement: 30V X 2 AC 500mA.

Kit: \$ 64.00 Asmb: \$ 80.00

SM-100 ▲▲▲ 150 MHZ 8 DIGIT FREQUENCY COUNTER (2 lbs.)



Frequency Range: 10HZ-150MHZ. Gate Time: 0.01s, 0.1s, 1s, 10s. Input Sensitivity: KHZ range 10HZ-10MHZ 20mV(min.). MHZ range 1MHZ-120MHZ 20mV(min.), 120MHZ-150MHZ 35mV (min.), 150MHZ-200MHZ 40mV(typical). Time Base: 10MHZ crystal, ±10 ppm. Input Impedance: 1M ohm. Response Time: 0.2s. Resolution: 0.1 HZ: 10s gate time, 1HZ: 1s gate time, 10HZ: 0.1s gate time, 100 HZ: 0.01s gate time. Hold the last input signal. Reset counter to 0. DC 9V power adapter or 1.5Vx4"D" size batteries. (Adapter not included)

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Kit: \$ 19.75 Asmb: \$ 27.85

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SM-302 ▲ 60+60W STEREO POWER AMP.



Kit: \$ 75.00
Asmb: \$ 94.00

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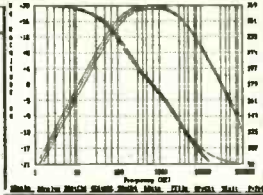
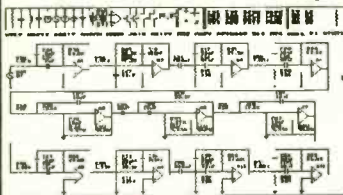
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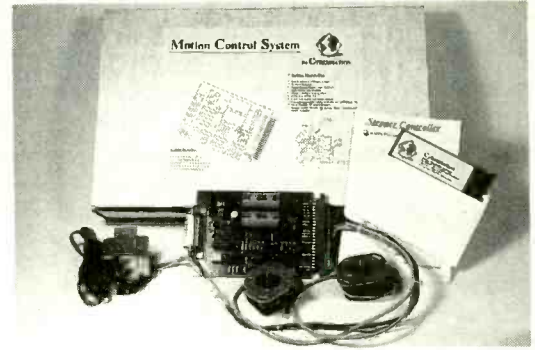
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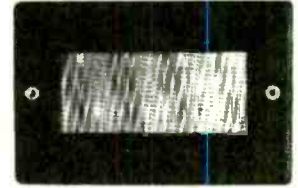
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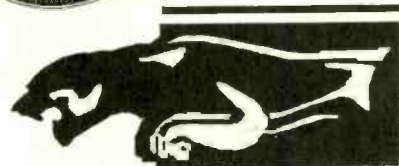
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3.3µf	.05	.040	.035	
4.7µf	.05	.040	.035	
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10µf	.05	.045	.04	
22µf	.05	.045	.04	
33µf	.06	.055	.05	
47µf	.06	.055	.05	
100µf	.08	.07	.05	
220µf	.08	.07	.055	
330µf	.09	.08	.06	
470µf	.10	.09	.08	
1000µf	.22	.20	.17	
2200µf	.42	.40	.38	
3300µf	.53	.50	.47	
4700µf	.91	.87	.83	

RAD. MONO				
50V				
QTY	1	100	1000	
.001µf	.05	.045	.035	
.0022µf	.05	.045	.035	
.0047µf	.05	.045	.035	
.01µf	.05	.045	.035	
.022µf	.05	.045	.035	
.047µf	.05	.045	.035	
.1µf	.05	.045	.035	
.22µf	.25	.22	.18	
.47µf	.42	.35	.28	

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50V				
QTY	1	100	1000	
5pF	.05	.038	.025	
10pF	.05	.038	.025	
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68pF	.05	.038	.025	
82pF	.05	.038	.025	
100pF	.05	.038	.025	
120pF	.05	.038	.025	
150pF	.05	.038	.025	
180pF	.05	.038	.025	
220pF	.05	.038	.025	
270pF	.05	.038	.025	
330pF	.05	.038	.025	
470pF	.05	.038	.025	
1000pF	.05	.038	.025	
2200pF	.05	.038	.025	
3300pF	.05	.038	.025	
4700pF	.05	.038	.025	
.01µf	.05	.038	.025	
.022µf	.05	.04	.03	
.047µf	.07	.055	.035	
.1µf	.07	.058	.04	

DIP TANT.				
25VDC				
QTY	1	100	1000	
1µf	.14	.11	.08	
2.2µf	.14	.11	.08	
4.7µf	.23	.185	.14	
10µf	.28	.26	.22	
22µf	.34	.27	.24	
47µf	1.22	1.07	.94	

AXIAL LYTC				
25VDC				
QTY	1	100	1000	
4.7µf	.09	.075	.054	
10µf	.10	.08	.06	
22µf	.14	.115	.084	
47µf	.16	.13	.096	
100µf	.19	.15	.11	
220µf	.27	.215	.16	
470µf	.35	.28	.21	
1000µf	.45	.36	.27	
2200µf	.89	.715	.54	

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QTY	1	100	1000	
1 AMP RECTIFIER				
IN4001	.03	.02	.015	
IN4004	.04	.025	.019	
IN4007	.05	.035	.022	
3 AMP RECTIFIER				
IN5401	.06	.05	.042	
IN5404	.07	.055	.045	
IN5408	.08	.06	.049	
6 AMP RECTIFIER				
6A10	.21	.185	.156	
6A100	.32	.29	.25	
1 AMP SCHOTTKY				
IN5817	.20	.145	.09	
IN5818	.23	.165	.10	
IN5819	.25	.18	.11	

3 AMP SCHOTTKY				
QTY	1	100	1000	
IN5820	.34	.255	.17	
IN5821	.38	.285	.19	
IN5822	.42	.315	.21	

GERMANIUM				
QTY	1	100	1000	
IN34A	.10	.08	.06	
IN60	.10	.08	.06	
IN270	.17	.15	.13	

SWITCHING				
QTY	1	100	1000	
IN914	.035	.025	.015	
IN4148	.025	.02	.01	
IN4448	.035	.025	.015	

INTEGRATED CIRCUITS				
QTY	1	100	1000	
PART #				
TL111	.38	.34	.31	
MC1458	.43	.36	.29	
LM1488	.47	.43	.39	
LM1489	.47	.43	.39	
CD4001	.29	.25	.21	
CD4011	.29	.25	.21	
CD4013	.37	.33	.29	
CD4017	.37	.33	.29	
CD4025	.37	.33	.29	
CD4028	.37	.33	.29	
CD4040	.47	.43	.39	
CD4049	.37	.33	.29	
CD4051	.44	.40	.36	
CD4066	.38	.34	.31	
CD4069	.37	.33	.29	
CD4093	.37	.33	.29	
MOC3011	.40	.36	.32	
LM311	.37	.33	.29	
LM324	.47	.43	.39	
LM339	.48	.43	.39	
LM358	.48	.43	.39	
LM386	.67	.49	.33	
LM393	.37	.33	.29	
4N25	.54	.49	.44	
4N28	.58	.41	.34	
LM555	.43	.38	.33	
LM556	.47	.42	.38	
LM741	.43	.38	.33	
74LS244	.40	.36	.32	
74LS245	.37	.33	.29	
74LS374	.37	.33	.29	

TRANSISTORS				
QTY	1	100	1000	
PART #				
2N2222A	.20	.18	.15	
2N3055	.55	.50	.45	
2N3904	.05	.045	.035	
2N3906	.05	.045	.035	
2N4124	.09	.07	.045	
2N4125	.09	.07	.045	
2N4126	.09	.07	.045	
2N4401	.05	.045	.035	
2N4403	.05	.045	.035	
2N5086	.09	.07	.045	
2N5087	.08	.06	.04	
2N5088	.08	.06	.04	
2N5089	.09	.07	.045	
2N5209	.09	.07	.045	
2N5210	.09	.07	.045	
2N5400	.12	.10	.065	
2N5550	.12	.10	.065	
2N5551	.09	.07	.045	
BU806	1.10	.80	.70	
MJE3055T	.65	.55	.44	
MPSA-05	10	08	05	
MPSA-10	12	09	06	
MPSA-13	15	11	07.5	
MPSA-14	15	11	07.5	
MPSA-42	14	10.5	07	
MPSA-44	22	18	12	
MPSA-56	10	08	05	
MPSA-63	45	34	22	
MPSA-92	12	09	06	
MPSA-93	15	11	07.5	
MPSH-10	12	09	06	
MPSH-81	44	33	21	
PN2222A	.05	.045	.035	
PN2907A	.05	.045	.035	
TI30	.42	.37	.32	
TIP31	.42	.37	.32	
TIP41	.49	.44	.39	
TIP112	.56	.51	.46	
TIP122	.57	.52	.47	
TIP125	.53	.48	.43	
TIP126	.56	.51	.46	

VOLTAGE REGULATORS				
QTY	1	100	1000	
7805	.48	.45	.42	
7812	.48	.45	.42	
7824	.48	.45	.42	
7905	.61	.55	.49	
7912	.61	.55	.49	
7924	.61	.55	.49	
78L05	.35	.31	.26	
78L12	.35	.31	.26	
79L05	.35	.31	.26	
79L12	.35	.31	.26	
LM317T	.95	.82	.68	
LM350T	2.05	1.70	1.35	

CRYSTALS				
QTY	1	100	1000	
HCl8 case				
1.8432	.89	.67	.45	
2.0000	.74	.55	.39	
3.5795	.74	.55	.39	
3.6864	.74	.55	.39	
4.0000	.74	.55	.39	
4.9152	.74	.55	.39	
5.0688	.74	.55	.39	
7.3728	.74	.55	.39	
10.0000	.74	.55	.39	
11.0000	.74	.55	.39	
11.0599	.74	.55	.39	
12.0000	.74	.55	.39	
14.3181	.74	.55	.39	

frequencies are in MHZ

SWITCHES				
QTY	1	100	1000	
DIP STYLE				
4 POS.	.68	.58	.48	
6 POS.	.77	.67	.57	
8 POS.	.80	.70	.60	
10 POS.	.95	.85	.75	
TOGGLE				
SPDT	.62	.52	.40	
SPDT-off	.73	.63	.49	
DPDT	.69	.59	.46	
DPDT-off	.86	.76	.59	

PUSH BUTTON				
QTY	1	100	1000	
N. open	.28	.24	.20	
N. closed	.29	.25	.21	

All toggle and push button switches fit in a 1/4" panel hole

LED's				
QTY	1	100	1000	
3MM				
RED	.06	.05	.04	
GREEN	.07	.06	.045	
YELLOW	.08	.07	.05	

5MM				
QTY	1	100	1000	
RED	.06	.05	.04	
GREEN	.07	.06	.045	
YELLOW	.08	.07	.05	
BI-COLOR	.29	.22	.17	
BLUE	1.20	1.10	.95	

BLINKER				
QTY	1	100	1000	
RED 5mm	.65	.53	.41	

HOLDERS				
QTY	1	100	1000	
3mm	.10	.07	.055	
5mm	.10			

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CATV TEST CHIPS as low as \$8.95 for testing converter boxes in full service modes. Jerrold, Tocom, Scientific Atlanta, Pioneer BA5XXX — BA67XX cubes clears E2-E5. **Micro Masters, 1 (800) 360-7654.**

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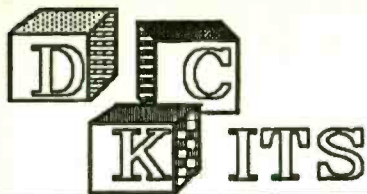
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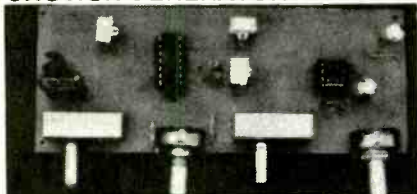
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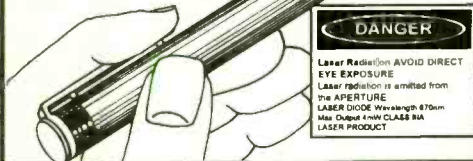
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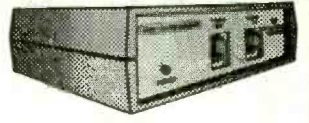
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Monitors your phone system, See how accurate your phone company really is!

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 - Date & time of each call.
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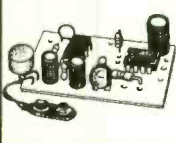
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TM-1 ONLY **\$99.95** KIT

BUILT \$169.95

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Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. SIZE: 1"x.75" 6 to 12VDC



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TV NOTCH FOR CHANNELS 2 thru 22



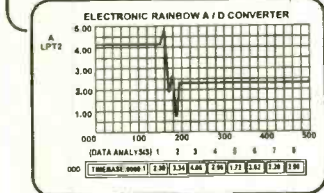
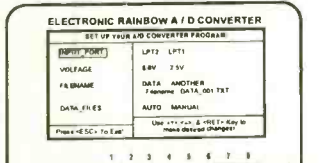
Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep - beep - beep.

NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

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Complete with Software. Over 20 DOS programs provided!



- Connect your computer to the outside world through a parallel port!
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- Enter a code (Code can be any number up to 16 digits) and control....
- Turn lights on while on vacation.
 - Start your furnace or air before you go home.
 - Switch your incoming line to a fax.
 - Make your phone so it will not call to a long distance or a 900 number.
 - Connect this unit to the AA-1 kit and listen to anything in the room.

Requires an answering machine to function.
DTMF-1 KIT **\$74.95**
BUILT **\$99.95**



WIRELESS FM MICROPHONE

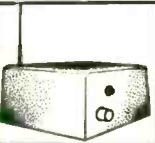
Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-1 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. SIZE: .8"x1" 6 to 12VDC

WM-2 **\$14.95**

This Manual contains schematics, parts lists, P.C.B., layouts for many of the Rainbow Kits. Use your own parts to construct our kits.

KIT BOOK \$14.95

\$9.95 with the purchase of any kit.



FM STEREO TRANSMITTER

Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your cd's while mowing the lawn, Play music on one channel sing on the other. Clarity is excellent, approx. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls, & crystal for stereo separation. 9v battery operation

FMST-100 \$29.95 / FMSTC cabinet \$8.95

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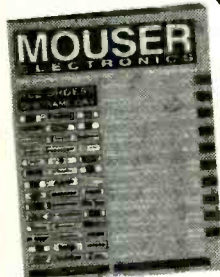
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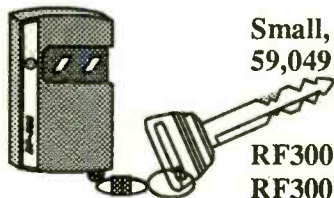
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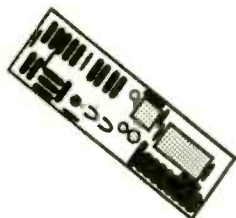
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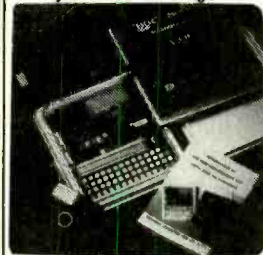
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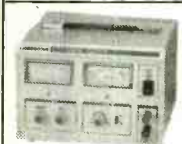
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PS-30S \$219.95, 0-30VDC, 0-5A.
PS-30SD \$399.95, dual outputs, over load protection.

8110 \$289.95
0-60VDC, 0-3A.
8112 \$399.95
0-60VDC, 0-5A.

8108(8109) \$549.95(\$699.95)
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PS-1610S(8107) \$289.00(\$399.95) 0-16VDC, 0-10A.
PS-224J(2245) \$139.00(\$159.00) 0-12/0-24VDC, 3A(5A).
8200(8201) \$179.95(\$239.95) 0-30VDC(digital meter), 0-3A(5A). **8210(8211) \$209.95(\$269.95)** two digital meters.
8202(8203) \$499.95(\$549.95) 3 outputs, digital display, dual 0-30VDC/0-3A(5A), a fixed 5VDC/3A, independent tracking operation, constant voltage and current.

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SM-6225B/C \$1999.95
Freq Range: (AM)490KHz, (FM) 10-11.4MHz, Accuracy: ±0.1%
Marker: (AM)455KHz, ±5KHz, ±10KHz, (FM)10.7MHz, ±7.5KHz, ±150KHz.

AM/FM STD SIGNAL GEN.

SG-4110A \$1799.00

Freq: 100KHz-110MHz
Display: 6-digit LED
Accuracy:
±±(5x10-E5 ± count)
Resolution: 100Hz (100-34.99MHz), 1KHz (35MHz-110MHz).
Output Range: -19dBu, -99dBu, 1dB step
Impedance: 50 Ohm VSWR 1.2.

TV COLOR PATTERN GEN.

CPG-1366A \$159.95

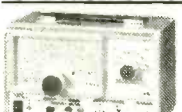
VHF NTSC;
Freq: 45.75, 175.25, 187.25 MHz,
RF Output: 10mV,
Impedance: 75 Ohm,
Video Output: BNC, 1Vp-p

SWR/RF POWER METER



310 \$89.95
Freq Range: 1.8-150MHz,
RF Power: 0-4W/20W/200W
SWR Measure: 1.0 - ∞, 4W min.
Accuracy: 5%-10%, SO-239 plugs.
Insertion Loss: 0.3dB.
Input/Output Imp: 50Ω.
320 \$89.95, 130-520MHz.
330 \$119.95, 1.8-520MHz.
SWR-3P \$26.95 1.7-150MHz.
RF Power: 0.5-10W, 0.5W-100W.
SWR-2P \$22.95, 1.7-30MHz; **RF Power:** 0.5-10W.
PM-330 \$136.00 1.8-500MHz, 0.5W/20W/120W.

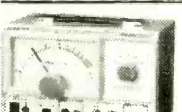
RF SIGNAL GENERATOR



SG-4160B \$119.00
100KHz-150MHz up to 450MHz on 6 3rd harmonics, 6 ranges; AM modulation. **RF Output:** 100mVrms to 3-5MHz. **Modulation:** Int. 1KHz AM, Ext. 50Hz-20KHz AM.
Audio Output: 1KHz, 1Vrms.

SG-4162AD \$229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals.

AUDIO GENERATOR



AG-2601A \$119.00
10Hz-1MHz, 5 ranges;
Output Level: sinewave 0-8Vrms, square 10Vp-p.
Output Impedance: 600 Ohm.
Distortion: <0.05% 500Hz-50KHz, <0.5% 50KHz-500KHz.

AG-2603AD \$229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals.

FUNCTION GENERATOR



FG-2100A \$169.95
0.2Hz-2MHz in 7 ranges; Sine, Square, Triangle, Pulse & Ramp
Output: 5mVp-p-20Vp-p, 1% distortion.
VCF: 0-10V control freq. to 1000:1.

FG-2102AD \$229.95 generates signals same as FG-2100; 4-digit counter display, TTL & CMOS outputs, 30ppm ±1 count accuracy.
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AG-2011A \$549.00

RF SECTION:
Carrier: 98MHz ±2MHz,
Output: 10mV, 1mV & 0.1mV
COMPOSITE SIGNALS:
Pilot: 19KHz ±2Hz, 0.8Vrms
INT. MODULATION: 400KHz, 1KHz ±1%, 1Vrms, distortion < 5%
L-R Separation: >50dB.
EXT. MODULATION: **Freq:** 50Hz-15KHz
L-R Separation: >45dB 100Hz-3KHz; >35dB 50Hz-15KHz.

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MV-3100A \$159.95 wide band 5Hz-1MHz, 3 scales, mV, dB, &dBm; 300µV-100V in 12 ranges, 10µV resolution; -70-40dB in 12 ranges, 0dB=1Vrms, 0dBm=0.755V; ±3% accuracy. Input impedance 10MΩ; Noise <2%
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Audio Output: 1KHz, 1Vrms.

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MEASUREMENT:
Range: 0.01%-30%, 0.1/0.3/1/3/10/30% full scale.
Freq: 400Hz±10%, 1000Hz±10%(HPF).
Input: 3mV-100V, ratio measuring 20dB.
Auto. Switching Ranges: Fundamental Freq. = (fo)±10%;
Fund. Rejection: >80dB at (fo)±5%, >70dB at (fo)±10%.
Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.

AUTO DISTORTION METER

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MEASUREMENT:
Range: 0.01%-30%, 0.1/0.3/1/3/10/30% full scale.
Freq: 400Hz±10%, 1000Hz±10%(HPF).
Input: 3mV-100V, ratio measuring 20dB.
Auto. Switching Ranges: Fundamental Freq. = (fo)±10%;
Fund. Rejection: >80dB at (fo)±5%, >70dB at (fo)±10%.
Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.

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Input Imped: (HF) 1MΩ, (VHF) 50Ω.

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Display: 3 digit LED.
Unit indicator: pF, nF, µF, mF. Overrange indicator.

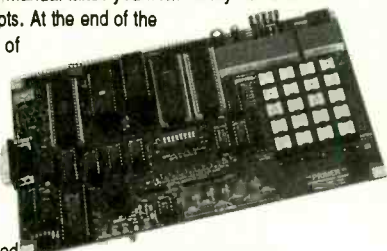
WOW-FLUTTER METER

WF-3103 \$699.95

Freq Range: 3KHz±10%
JIS/CCIR: 3.15KHz±10% DIN.
Range: 0.03/1/3/3% full scale.
Accuracy: ±5%.
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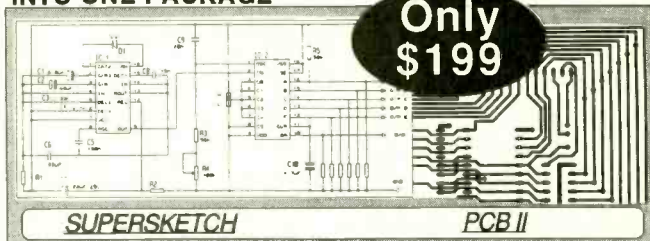
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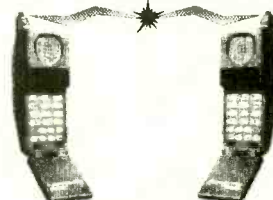
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TEK DD501 Digital Delay Generator	\$375.00
TEK FG502 11 MHz Function Generator	\$325.00
WAVETEK 135 2 MHz Lin/Log Sweep/Function Gen	\$275.00
HP 214B 10 MHz Pulse Gen., 50V / 50 ohms	\$2,250.00
HP 8080A 1 GHz Dual Channel Pulse Gen.	\$1,400.00
HP 8082A 250 MHz Pulse Generator	\$1,400.00
TEK PG502 250 MHz Pulse Generator, Tr<1nS	\$700.00
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HP 6181C DC Current Source, 100V, 250 mA	\$675.00
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BOONTON 62AD 1 MHz Ind. Meter, 2-2000 uH	\$700.00
BOONTON 72BD 1 MHz Cap. Meter, 2-2000 pF	\$700.00
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HP 6002A-opt 01 50V/10A Power Supply, to 200 W	\$875.00
HP 6023A Autorangeing Supply, 20V/30A/240W	\$1,150.00
HP 6114A Precision Power Supply, 40V 1A	\$875.00
HP 6261B-027 20V at 50A CV/CC Power Supply	\$675.00
HP 6264B 20V at 20A CV/CC Power Supply	\$500.00
HP 6266B 40V at 5A CV/CC Power Supply	\$400.00
HP 6267B 6V at 10A CV/CC Power Supply	\$550.00
HP 6296A 60V at 3A CV/CC Power Supply	\$400.00
HP 6299A 100V at 750mA CV/CC Power Supply	\$250.00
HP 6438B 60V at 5A CV/CC Power Supply	\$375.00
HP 6255A 40V 1.5A Dual Output Supply	\$500.00
TEK PS503A Dual Power Supply	\$250.00

ACME PS2L-1000 0-75 V/ 0-150 A/ 1000 Watt Load	\$450.00
HP 59501A HPIB Power Supply Programmer	\$175.00
HP 6827A Bipolar Supply/Amp, 100 V 500 mA	\$800.00
KIKUSUI PLZ-72W Prog. Load, 4-110V/0-12A/70W	\$200.00

TIME & FREQUENCY

HP 5315A 100 MHz/100 nS Universal Counter	\$550.00
HP 5316A 100 MHz/100 nS Univ. Count, HPIB	\$750.00
HP 5316A-003 100 MHz/100 nS Univ. 1.3 GHz ch	\$950.00
HP 5370B-001 Time Interval Counter, to 20 pS	\$2,250.00
HP E1420A-10, 30 VXI Counter, 200 MHz & 2.5 GHz	\$1,500.00
TEK 7D15 225 MHz Universal Counter/Timer	\$275.00
TEK DC5009 Programmable 135 MHz Count/Timer	\$750.00
TEK DC503A 125 MHz Universal Counter/Timer	\$500.00
TEK DC509 135 MHz High Resolution Counter	\$700.00
FLUKE 7220A-111 1.3 GHz Communications Counter	\$650.00
HP 5340A 18 GHz Frequency Counter	\$1,400.00
HP 5340A-01, 11 18 GHz Counter, OCXO, HPIB	\$1,900.00
HP 5342A-1.4, 5.24 GHz Counter, OCXO, DAC, HPIB	\$3,900.00
SYSTRON 6054B-05, 26.25 GHz Freq. Counter, GPIB	\$2,400.00
GR 1115C Crystal Frequency Standard	\$1,600.00

AUDIO & BASEBAND

HP 3580A-002 Spectrum Analyzer, 5 Hz-50 kHz	\$1,850.00
HP 3586C Selective Level Meter	\$1,750.00
TEK 7L5-025/7603 20 Hz-5 MHz Spectrum An., w/frame	\$2,250.00
HP 334A Distortion Analyzer, -60 dB THD	\$550.00
HP 339A Distortion Analyzer, -95 dB THD	\$2,400.00
TEK DA4084 Distortion Analyzer, 0.0025% THD	\$1,500.00
FLUKE 8920A TRMS Voltmeter, 10 Hz-20 MHz	\$700.00
HP 3400A RMS Voltmeter, 10 Hz-10 MHz	\$250.00
HP 4204A Synthesizer, 10 Hz-1 MHz	\$350.00
ROCKLAND S100 Synth., 1 mHz-1.999999999 MHz	\$400.00
KROHN-HITE 3202 Dual HP/LP Filter, 20 Hz-2 MHz	\$600.00
KROHN-HITE 3342 Dual Filter, 0.001 Hz-99.9 kHz	\$1,100.00
P.A.R. 189 Filter/Amplifier, 0.1 Hz-110 kHz	\$400.00
ROCKLAND 752A-opt 02 Dual Low Pass Filter, 115 dB/oct	\$1,100.00
TEK AM502 Differential Amplifier	\$575.00

RF & MICROWAVE

HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz	\$1,100.00
HP 5371A Modulation Domain Analyzer	\$5,900.00
HP 8406A Comb Gen., 1/10/100 MHz increment	\$450.00
HP 8443A Tracking Generator, 0.1-110 MHz	\$700.00
HP 8444A-opt 059 Tracking Generator, 0.5-1500 MHz	\$1,500.00
HP 8552B IF Section	\$750.00
HP 8553B RF Section, 1 kHz-110 MHz	\$500.00
HP 8554B RF Section, 0.1-1250 MHz	\$800.00
HP 8555A RF Section, 0.01-18 GHz	\$950.00
HP 8555A System, with 8552B & 141T	\$2,375.00
TEK TR503 Tracking Generator, 0.1-1800 MHz	\$1,750.00
HP 11665B Modulator, 0.15-18.0 GHz	\$375.00
HP 8405A Vector Voltmeter, 1-1000 MHz	\$700.00
HP 85020A Directional Bridge, 0.01-4.3 GHz	\$750.00
HP 85021A Directional Bridge, 0.01-18 GHz	\$1,200.00
NARDA 7000A Microwave Multimeter, 0.1-18 GHz	\$1,950.00
BOONTON 1020 Synth. Sig. Gen., 0.15-540 MHz	\$1,850.00
BOONTON 102C Signal Generator, 0.45-520 MHz	\$850.00
FLUKE 6060A/VN Synthesizer, 10 kHz-520 MHz	\$2,000.00
GIGATRONICS 875/86 Levelled Multiplier, Ka & V band	\$8,000.00
HP 85100V Freq. Multiplier, 50-75 GHz out	\$4,250.00
HP 8660C Synthesizer, with 86603A & 86633B	\$4,250.00
WILTRON 6742A-opt 01 Synth. Sig./Swp. Gen., 18-40 GHz	\$9,000.00

EIP 928-opt 9201 Programmable Sweep Gen., 1-18 GHz	\$4,000.00
HP 8620C Sweep Oscillator Frame	\$550.00
HP 8620C-opt 011 Sweep Oscillator Frame, HPIB	\$675.00
HP 86222A RF Plug-in, 10-2400 MHz	\$1,400.00
HP 86222B-opt 2 RF Plug-in, 10-2400 MHz, atten.	\$1,950.00
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10dBm	\$2,000.00
WAVETEK 1067 Sweep Gen., 10-2400 MHz, atten.	\$500.00
BOONTON 42B/41-4B Power Meter, 1 MHz-12.4 GHz	\$475.00
BOONTON 42B/41-4E Power Meter, 1 MHz-18 GHz	\$650.00
BOONTON 42B/42-S/3 Power Meter, 1 MHz-8 GHz	\$375.00
HP 432A/478A Power Meter, 0.01-10 GHz	\$375.00
HP 435A/8481A Power Meter, 10 MHz-18 GHz, 100mW	\$1,000.00
HP 435A/8482A Power Meter, 0.1-4200 MHz, 100mW	\$1,000.00
HP 435A/8482H Power Meter, 0.1-4200 MHz, 3 W	\$1,150.00
HP 435A/8484A Power Meter, 10 MHz-18 GHz, 10uW	\$1,000.00
HP K486A WR42 Thermistor Mount, 18-26.5 G	\$400.00
HP Q8486A WR22 Power Sensor, 33.0-50.0 GHz	\$1,500.00
HP R486A WR28 Thermistor Mount, 26.5-40 G	\$400.00
WAVETEK 1034A Portable Power Meter, 0.001-18GHz	\$375.00
ALLTECH 7618E Noise Source, 15 dB, 0.01-18 GHz	\$675.00
BOONTON 82AD Modulation Meter, 10-1300 MHz	\$1,000.00
M.S.C. MC5112 Noise Source, 25.5 dB, 1-12 GHz	\$325.00

COAXIAL & WAVEGUIDE

HP 11691D Dir. Coupler, 22 dB, 2-18 GHz	\$500.00
HP 11692D Dual Dir. Coupler, 22 dB, 2-18 GHz	\$900.00
HP 3330D Detector, 10 MHz-33 GHz, APC3.5	\$275.00
HP 764D Dual Dir. Coupler, 215-450 MHz	\$150.00
HP 778D-opt 011 Dual Dir. Coupler, 20 dB, 0.1-2GHz	\$400.00
HP 779D Dir. Coupler, 20 dB, 1.7-12.4 GHz	\$375.00
HP 8472A Crystal Detector, 10 MHz-18 GHz	\$150.00
HP R532A Frequency Meter, 26.5-40.0 GHz	\$500.00
KRYTAR 20202016 Directional Detector, 2-20 GHz	\$200.00
MILITARY AS-1346B Double Ridge Horn, 3-8 GHz, N(f)	\$75.00
NARDA 26298 20 dB Atten., 150 W, DC-1 GHz	\$175.00
NARDA 3000-SERIES Directional Couplers	\$150.00
NARDA 3090-SERIES Precision Hi Directivity Coupler	\$225.00
NARDA 4000-SERIES SMA Mini Directional Couplers	\$75.00
NARDA 4203-6 Dir. Coupler, 6 dB, 2-18 GHz, SMA	\$225.00
NARDA 5070-SERIES Precision Reflectorometer Couplers	\$300.00
NARDA 768-30 30 dB Atten., 20W, DC-11 GHz	\$125.00
TRG5A10 WR28 Precision Atten., 0-50 dB	\$1,000.00
WEINSCHTEL 1515 Power Divider, DC-18 GHz, SMA	\$125.00
WEINSCHTEL 1579 Power Divider, DC-26.5 GHz, 3mm	\$275.00
WEINSCHTEL 3200-1 Prog. Atten., 0-127 dB, DC-2 GHz	\$200.00
WILTRON 97SF50-1 Directional Bndge., 0.01-18 GHz	\$1,500.00

MISCELLANEOUS

HP 28687A LAN Wire Test Instrument	\$750.00
HP 4935A Transmission Test Set	\$1,650.00
HP 59401A HPIB Bus Analyzer	\$700.00
TEK 1411R-opt 04 PAL Test Signal Generator	\$2,750.00
TEK 144 NTSC Test Signal Generator	\$700.00
TEK 147A NTSC Test Signal Generator	\$950.00
TEK 1485R Waveform Monitor, NTSC & PAL	\$1,850.00
TEK 521A PAL Vectorscope	\$1,500.00
TEK J16/J6523 Spot Luminance Photometer	\$900.00
HP 59307A HPIB VHF Switch	\$200.00
P.A.R. 5206 Lock-in Amplifier, 2 Hz-200 kHz	\$3,000.00

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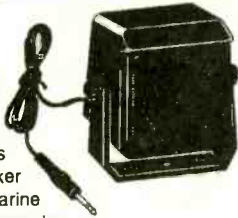
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\$6⁰⁰ each

CAT# SH-3

A.C. LINE CORDS

6 INCH IEC POWER CORD



That's right! 6 inch...Standard 3 prong grounded male one end and 3 prong IEC receptacle on other end. CSA listed.

2 for \$1⁰⁰ Large quantity available.

CAT # LCAC-36

10 for \$4.50 • 100 for \$35.00

6 FOOT IEC (SPH-386) CORD



6' BLACK 18/3 IEC female one end, standard grounded three prong male on other end.

CAT# LCAC-60

\$3⁰⁰ each

ROUND 4' BLACK 16/3 CORD



0.32" od, SJT insulation. Standard 3 prong grounded plug one end, molded strain relief on other end. Pigtail leads. CSA listed.

Large quantity available

CAT # LCAC-35

\$1⁷⁵ each

100 for \$150.00

7.2 Volt, 1000 mAh NICKEL-CAD PACK



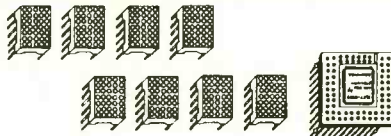
3.56" X
2.12" X 0.75"

CAT# NCB-72

Brand new rechargeable nickel-cadmium battery pack fits Olympus and other camcorders. Originally sold for over \$35.00.

\$5⁵⁰ each

MATRIX DISPLAYS WITH SMART DRIVER



Hewlett Packard# HDSP-L203

Eight 5 X 7, 0.68" high LED dot matrix displays along with one PGA-type smart driver. The driver can decode 128 ASCII characters which are permanently stored in ROM. In addition, 16 programmable symbols may be stored in on-board RAM. The IC is designed for standard microprocessor interface techniques and is accessed through a bi-directional eight-bit data bus. Operates on 5 Vdc. Spec./hook-up sheets included.

CAT# AND-203L

\$7⁵⁰ each

JUMBO LEDs

Liton # LTL 327C - 8MM

Ideal for eye-catching indicators and displays. A recent quantity purchase of these BIG, 8mm diameter, red diffused LEDs enables us to provide some very special pricing. The leads on these devices are 0.325" long, with plenty of room for soldering.



5 for \$1⁰⁰

CAT# LED-23

100 for \$ 15.00
1000 for \$ 120.00

MOISTURE RESISTANT D.P.D.T SWITCH

REDUCED PRICE!



Augat/Alcoswitch # MPE206N Miniature DPDT, push/on push/off switch. Splashproof: O-ring on shoulder and inside movable shaft provides moisture seal. Rated 6 amps @ 125 Vac. RED 0.4" dia. cap. 0.25" diameter threaded bushing. 0.8" behind panel depth. Solder lug terminals. UL and CSA listed.

CAT # MPB-20

\$1⁷⁵ each

25 for \$37.50 (\$1.50 each)

MINIATURE TOGGLE

D.P.D.T. (ON-ON)

ALCOSWITCH # MTM206NPC Short bat handle, 0.25" long. PC terminals.

CAT# MTS-82PC

\$1²⁵ each



25 for \$25.00 • 100 for \$90.00

S.P.D.T. (ON-OFF-ON) MOMENTARY ONE DIRECTION

ALCOSWITCH # MTG106H Standard toggle handle and 15/32" diameter bushing with miniature body. Rated 5 amps @ 125 vac. Center-off, momentary "on" in one direction.

\$1⁵⁰ each

CAT# STS-41

25 for \$ 31.25



S.P.D.T (ON-ON) LOCKING TOGGLE

ALCOSWITCH #AL0LKWB Locking toggle handle prevents accidental switching. Wirewrap pins.

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CAT # MTS-43

25 for \$ 21.25



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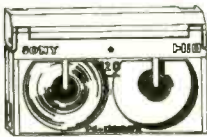
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\$3.00
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CAT# VCU-8

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PLASTIC ENCASED PIEZO ELEMENT



1.72" DIA. X 0.53"

Kyocera # KBT-44SB-1A

1.0 Khz. 75 db min. @ 10 V p-p

Louder than non-

encased piezo elements. Requires an external signal to produce a sound.

CAT# PE-26

75¢
each

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5 WAY MULTI-POINT TEST LEADS



High quality, flexible, cloth covered red and black test leads with telecom industry standard 5 way multipoint test clips on one end and spade lugs on the other end. 5 ways to connect clips: 1) U-shaped nose for qc terminals; 2) Notched jaw for gripping screws, wires or terminals; 3) Serrated teeth for threaded or wire wrap terminals; 4) Cluster of small needles for piercing small gauge wires; 5) Large piercing needle for piercing larger wires. 4 feet long. At one end of the cord is a 1500 ohm resistor that can be switched in and out of circuit.

CAT# TL-200

\$3.50
per set

KEYBOARD ADAPTERS & CABLES

DIN 5 FEMALE TO MINI-DIN 6 MALE

CAT# KBA-2

\$1.00
each

10 for \$8.50 • 100 for \$50.00

DIN 5 MALE TO MINI-DIN 6 FEMALE

CAT# KBA-1

\$1.00
each

10 for \$8.50 • 100 for \$50.00

COMPUTER KEYBOARD CABLE/ADAPTER

4' four conductor cable with 4 pin socket connector and strain relief on one end and a 5 pin male and female DIN connector on the other end.

CAT# KBA-3

\$1.00
each

10 for \$8.50 • 100 for \$50.00

MINI 12 Vdc COOLING FAN



Delta "Quietek" # SB0412M
12 Vdc, 0.12 amp mini cooling fan. 0.57" (40mm) square X 0.79" thick. 12" long pigtail leads. Ideal for cooling CPUs and small switching supplies. Moves a lot of air for its size.

CAT# CF-22

\$7.50
each

9 VOLT 60 MA SOLAR PANEL



These 6" X 6" glass enclosed photovoltaic panels produce 9 Vdc at 60 ma. Ideal for charging batteries and powering small devices. Put two or more together for more current and voltage.

Includes hook-up instructions.

CAT # SPL-960

\$5.25
each

15 AMP GROUNDED RECEPTACLE

3 prong grounded AC outlet. Snaps into 1" square hole. Rated 15 amps @ 125 Vac. 6" long pigtails. Black. UL and CSA listed.

CAT# ACS-1

\$1.00
each

10 for \$9.00



12 VOLT FLUORESCENT LIGHT STICK

12 volt, 8 watt fluorescent tube with cigarette lighter plug and alligator clips for running on 12 volt DC power. Comes with handy floor stand and hook for hands free operation. Lamp is protected by clear plastic housing. 15' cord. Ideal for emergency road repairs, working in a garage or outdoor lighting.

CAT #
FL-1

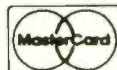
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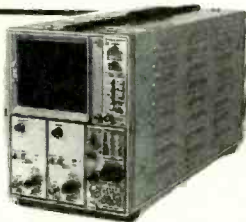


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TEK MODEL 7603N

Oscilloscope: Mil Spec AN/USM-281C, 8 x 10 CM display, 100 MHz response which accepts standard 7000 series Plug-Ins. Vertical Plug-In: 2 ea. 7A15 (AM-6565), frequency BW 75 MHz, maximum sensitivity 5mV/DIV. Horizontal Plug-In: 1 ea. 7B53 (TD-1085), triggering to 100 MHz, minimum, sweep-time 50 NS/DIV, has delayed sweep capacity. Includes cover probes accessories. Price: \$495.00

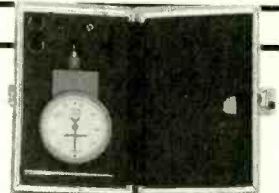


TEK453 MODEL 453

Oscilloscope: Portable, dual trace unit. DC to 50 MHz with 5 mV/div sensitivity. 1 usec to 5 sec/div timebase plus delay sweep. 6 x 10 div CRT Price: \$295.00

AN/URM-120 50 OHM THRU-LINE RF WATTMETER

Frequency range: 2MHz to 1000MHz. Power range: 10 Watts to 1000 Watts. USWR ≤ 1.08 to 1. Uses three plug-in coupler elements, (included). CU-753 2 to 30 MHz 50 to 100 Watts CU-754 25 to 250 MHz 10 to 500 Watts CU-755 200 to 1000 MHz 40 to 500 Watts Connector: Type N. Case included. Size: 7"W x 6 7/8"H x 7 1/2"D Weight: 6.5 lbs. Price: \$245.00



JONES INSTRUMENT TACHOMETER

Centrifugal Mechanical Tachometer. Measures RPM Scale to 500 RPM. Coupling shaft 1/4". Accessories: various size rubber tipped drive couplings. New Price: \$35.00



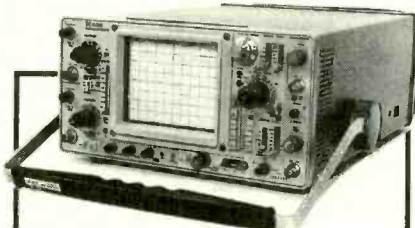
HEWLETT PACKARD 8640B-OPT 323 SOLID STATE SIGNAL GENERATOR

(w/o synchronizer) Frequency range: 450 KHz to 512 MHz, to 1100 MHz with external frequency doubler option supplied. Ten Frequency bands in octave increments from 500 KHz; band 11 for doubler use. Accuracy: 6 digit LED read out. Stability: < 1000 ppm. Output power: -145 dBm to +10 dBm (0.013 V to 2 V) into 50 Ω. Impedance is 50 Ω, VSWR < 2.0 on 2 V and 1 V range < 1.3 on other ranges >. Modulation: Internal AM, FM and PM, external AM, FM and PM. Pulse frequency: 0.05 to 5 kHz. General: Power Requirements: 100, 120, 220, 240 V, 48 Hz to 420 Hz, 2 amps. Size: 6" (H) x 19" (W) x 13 1/4" (D). Wt. 60 lbs. Includes ruggedized case and manual. Price: \$795.00
Current Hewlett Packard Prices: \$12,050.00



HP MODEL 200CD

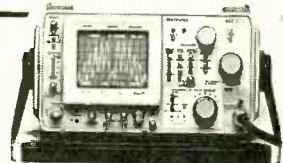
AUDIO OSCILLATOR: 5 HZ to 600 HZ, IN 5 RANGES, 10 VOLTS INTO 600 OHMS PRICE: \$95.00



TEKTRONIX 465M

100 MHz DUAL TRACE OSCILLOSCOPE

Operation is simplified by single-function push buttons, control knob design, layout and color-coordinated front panels. Bandwidth: DC to 100 MHz; Deflection Ranges: 5mV/div. to 5 V/div; 0.5 S/div. to 0.05 μS/div. sweep rate; horizontal display modes: A, A intensified by B, B delayed by A, mixed. Price: \$395.00



TEKTRONIX 492 PORTABLE SOLID STATE SPECTRUM ANALYZER

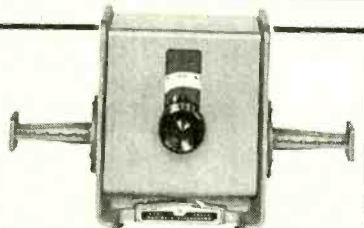
Frequency range: 50KHz to 21GHz to 220 GHz with external mixers (not supplied)
Built-in Digital Display Storage (Option 2)
Built-in RF Preselection (Option 4)
Built-in Frequency Stabilization and 100Hz accuracy
Sensitivity: 95 dBm to -5 dBm (Option 3) depending on option and frequency, at 1KHz resolution
CRT read out of display parameters. Dynamic range (on screen) 80dB. CRT size: 8 x 10 cm. Resolution Bandwidth: 1MHz to 1KHz (100 Hz-Option 3). Power: 210 watts, 115V/60Hz. Weight: 44lbs. Size: 6.9" x 12.9" x 19.7". Price: \$7,650.00 Option 1,2,3 Price: \$7,350.00 Option 1,2

SEXTANT AIRCRAFT PERISCOPE OR MARINE NAVIGATION

Price: \$50.00
As-Is
Complete
Bubble
Possibly Dry.



Kollsman Mig. Part #1471C-01, MS 28011-5 Periscope Aircraft Sextant, also useable for marine navigation. Range -10° to +92° in elevation 360° in azimuth 15° field of view. Bubble type instrument, contains timer used to integrate several readings. This is performed by a Deimel-Black hall integrator. Average interval of up to two minutes. Adjustable focus: ±2 diopters. Accuracy: Altitude: better than 2 minutes of arc timer, better than 1 second. Magnification: 2 power. Exit Pupil: 4/5 mm. Has coated lenses and built in illumination by a 28 volt lamp with controllable intensity. Used for high accuracy aircraft navigation. With case. Price: \$50.00 As-Is complete bubble possibly dry.



HEWLETT PACKARD G382A ROTARY VANE WAVEGUIDE ATTENUATOR

Frequency: 1/95 to 5.85 GHz. Attenuation: 0 to 50 db. Connector: WR187/UG407U waveguide. Price: \$395.00



HP331A AND HP333A DISTORTION ANALYZERS

HP331A covers 5 Hz to 600 kHz range and measures total distortion down to 0.1% full scale. Harmonics are indicated up to 3 MHz. Measures noise as low as 25 μV, and voltages over a wide range, 300 μV to 300 V RMS full scale. Frequency calibration accuracy is ≥ ±5% from 5 Hz to 300 kHz; ≥ ±10% from 300 to 600 kHz. Basic voltmeter accuracy is ±2%. Price: \$200.00

Model 333A Distortion Analyzer: Covers 5Hz to 600 kHz range. Measures down to 0.1% full-scale distortion. Includes auto nulling feature to speed up time consuming portion of measurements. Also includes switchable high-pass filter to attenuate frequencies below components. Price: \$400.00

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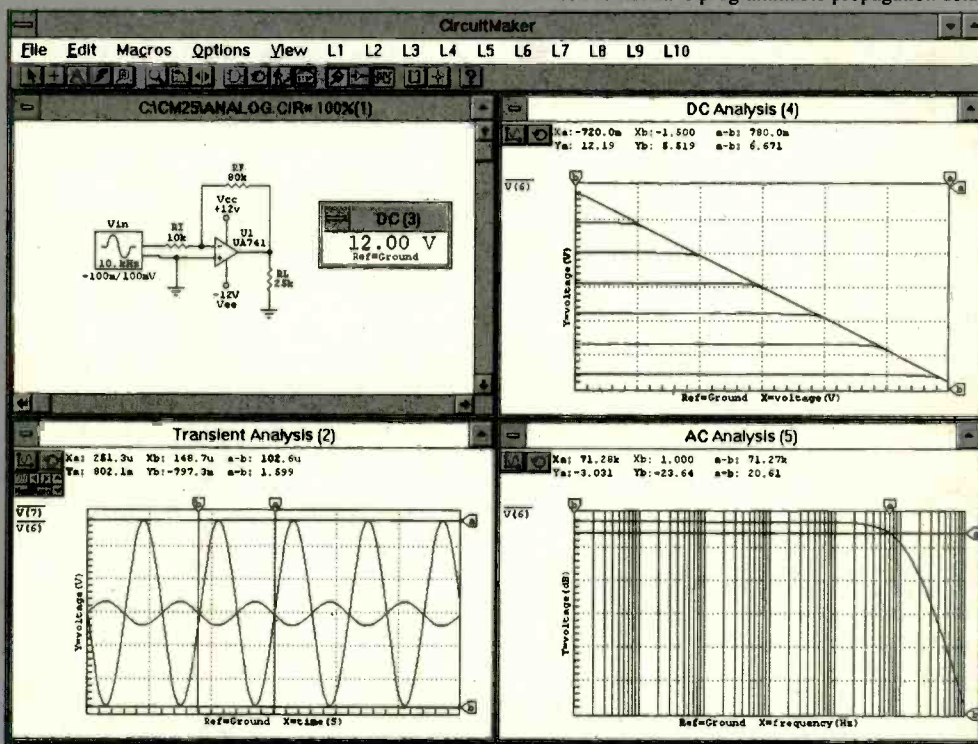
CircuitMaker's analog simulation results are shown in graph windows that provide powerful, interactive analysis options. You can plot multiple waveforms by clicking on the desired nodes and can select linear or logarithmic axes. Horizontal and vertical cursors facilitate quick and accurate measurements. You can also zoom in on any portion of the graph to obtain additional detail.

Electronics Workbench offers a single, small scope or Bode plot instrument window. The windows are not-sizeable and only two waveforms can be plotted at a time. EWB has a single measurement cursor and provides no direct way to read results from the instruments.

Superior Digital Simulation

CircuitMaker has an exclusive Trace feature where the state of every node is indicated in color as the simulation runs. You can monitor as many waveforms as your screen will allow, set edge or level breakpoints for analysis, and interactively see the state of any node by touching the logic probe to it. The data sequencer provides 1024 words of pattern data. Additional digital instruments include ASCII and HEX input keys and an ASCII display. CircuitMaker includes tri-state devices and devices have programmable propagation delays.

Electronic Workbench has no interactive logic probe or Trace capability and no Hex or ASCII keys. Their "word generator" is limited to 16 words. EWB does not have tri-state devices and digital devices do not have programmable propagation delays.



Comprehensive Device Libraries

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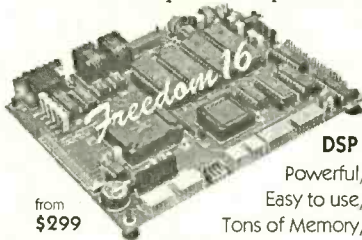
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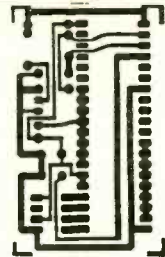
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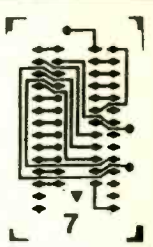
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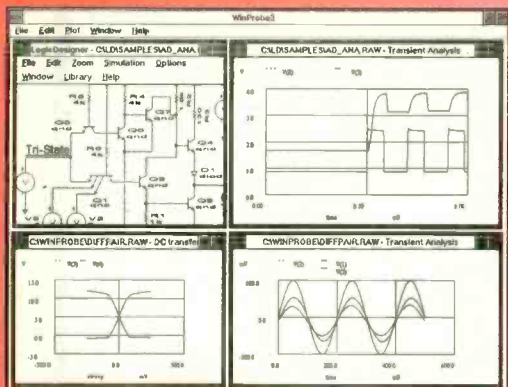
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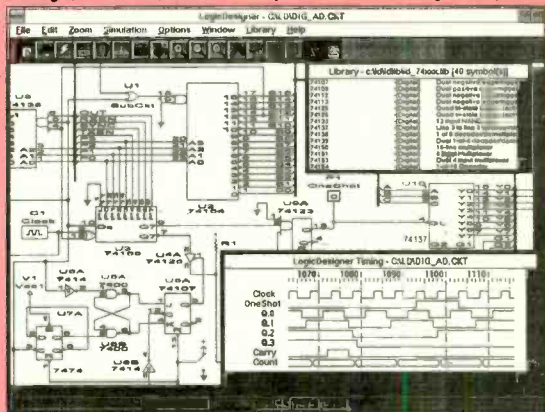
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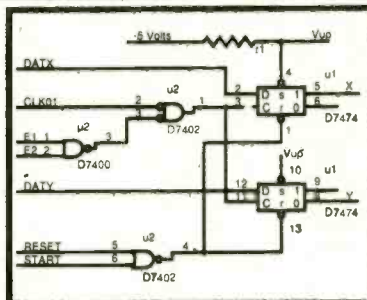
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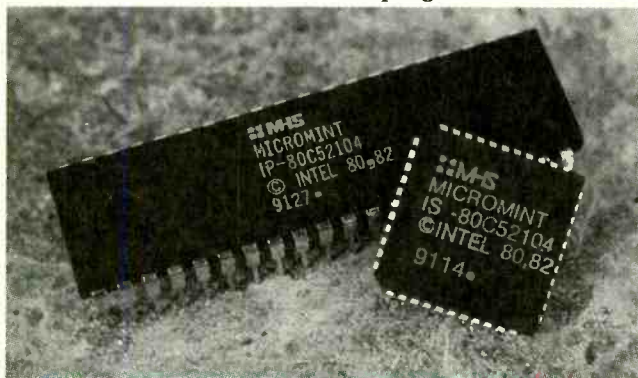
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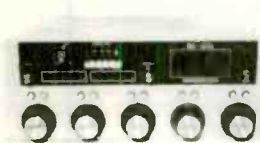
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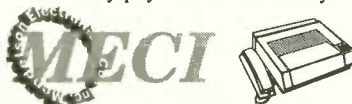
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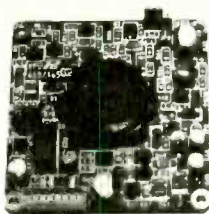
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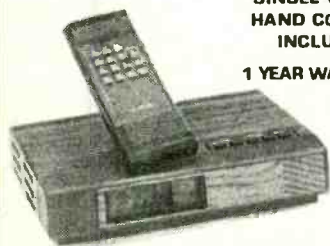
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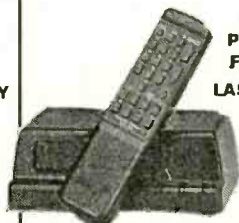
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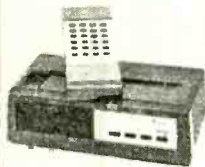
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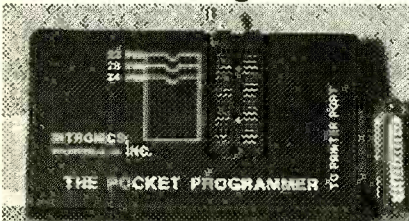
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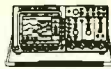
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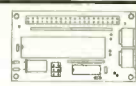
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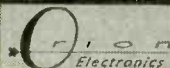
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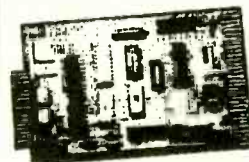
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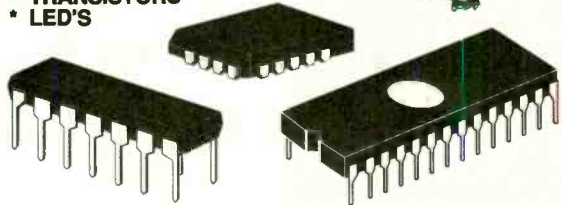
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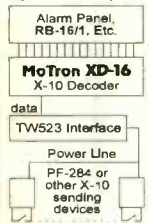


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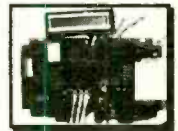
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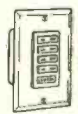
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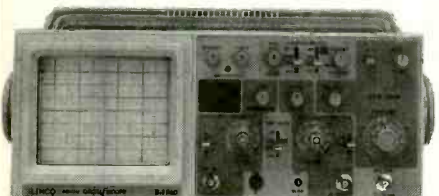
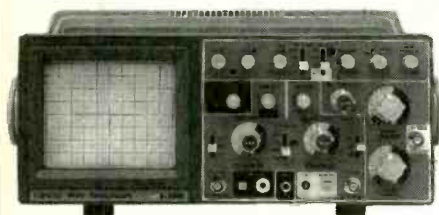
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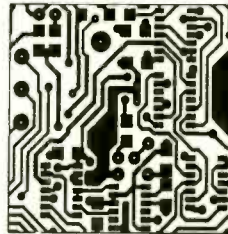
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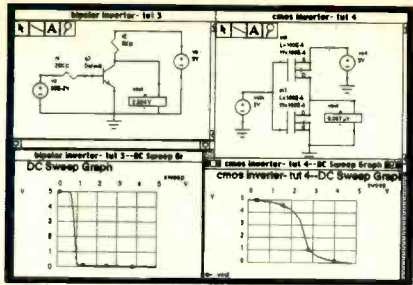


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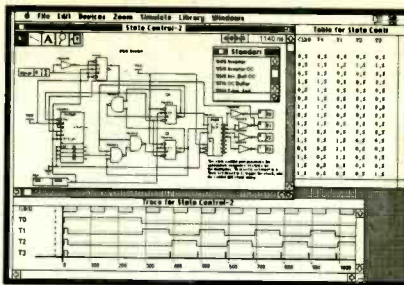
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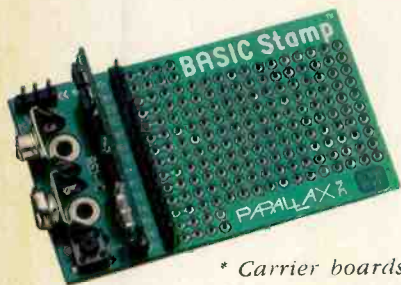
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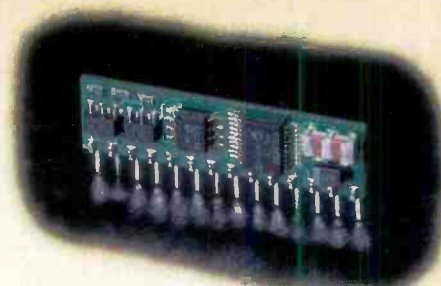
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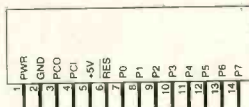


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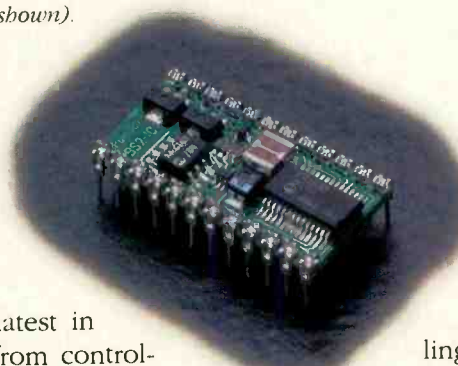
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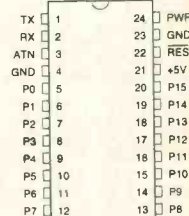
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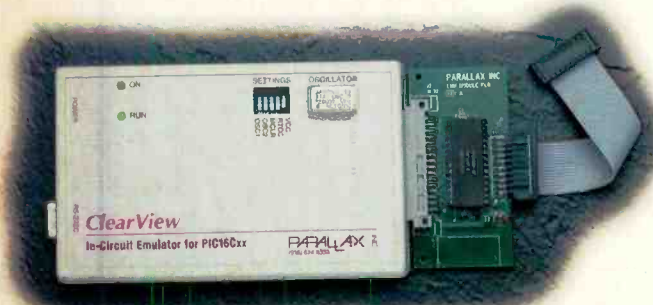
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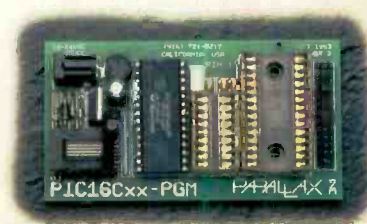


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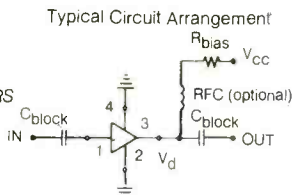
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RAM-7	2000	13.5	5.5	4.5	*6.40
RAM-8	1000	32.5	12.5	3.0	*6.40
MAV-1	1000	18.5	1.5	5.5	1.10
MAV-2	1500	12.5	4.5	6.5	1.40
MAV-3	1500	12.5	10.0	6.0	1.50
MAV-4	1000	8.3	11.5	7.0	1.60
MAV-5SM	50-1500	8.0	18.0	6.5	2.07
MAV-11	10-1000	12.7	17.5	3.6	2.10
VAM-3	2000	11.5	9.0	6.0	1.45
VAM-6	2000	19.5	2.0	3.0	1.29
VAM-7	2000	13.0	5.5	5.0	1.75

*Qty. 10

MAR & MAV MODELS: Plastic flat pack...for surface mount, add SM suffix to model number and 5¢ to price. Example: MAR-2SM...\$1.40. MAV-5SM available plastic surface mount only.

RAM MODELS: Ceramic surface mount.

VAM MODELS: Plastic surface mount.

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