

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

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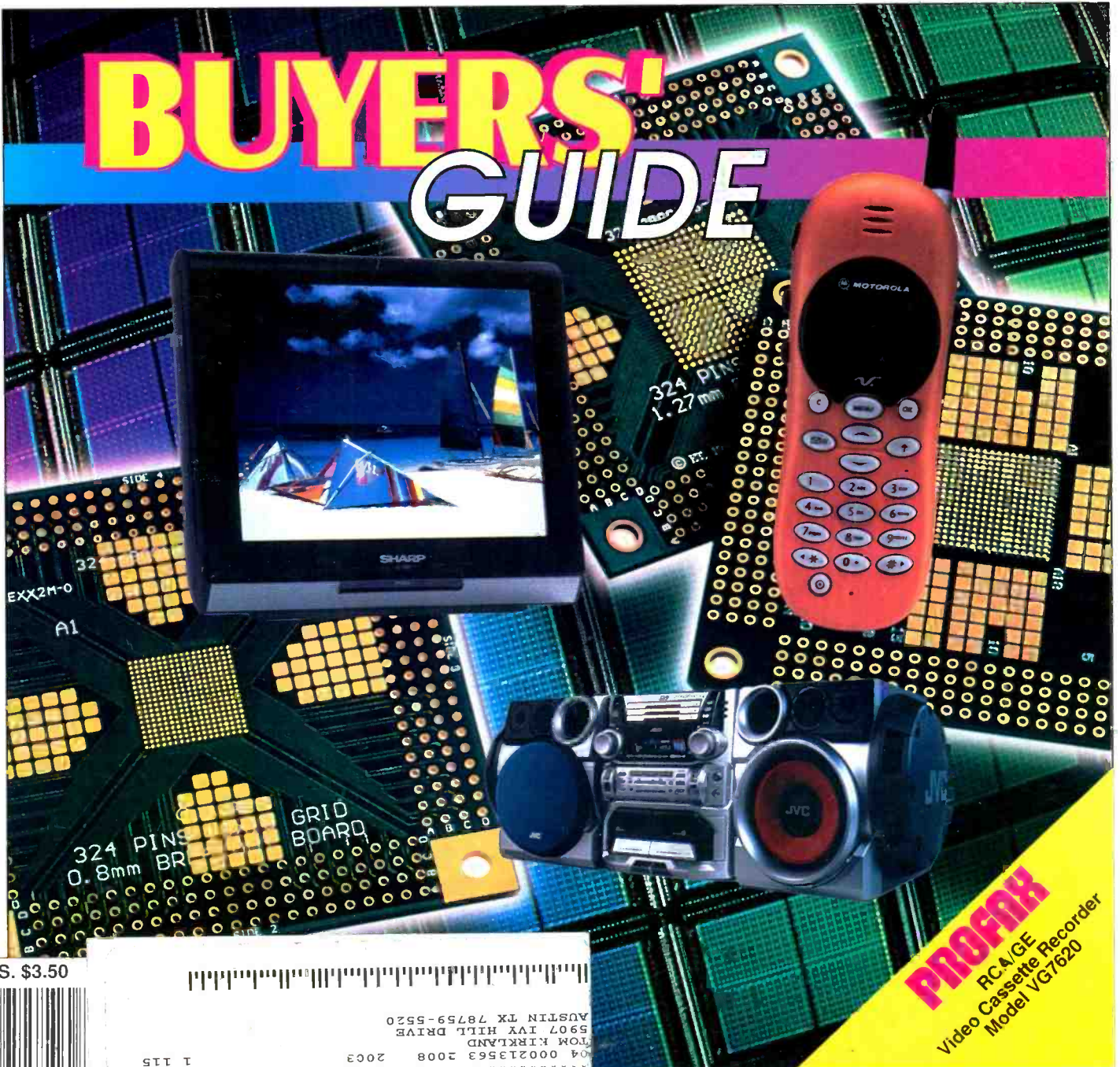
Servicing & Technology

March 2000

Selling service via the internet

Consumer electronics product handling

BUYERS' GUIDE



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The internet has proven to be a very good place for all kinds of companies to promote their business. A number of consumer service companies have generated significant amounts of business via their website. But the internet should be considered only one facet of a balanced marketing approach.
- 8 Consumer electronics product handling: Coping with ESD** by John Ross
As circuit fabrication and packaging technology produces smaller and smaller components and integrated circuits, simply handling them: soldering, desoldering, picking them up, placing them correctly, becomes more difficult. And ESD becomes a bigger problem. This article provides some tips on handling these delicate devices safely.

2000 BUYERS' GUIDE

What a difference a year makes. Some companies may go out of business, new companies start in business, move, their area codes change, companies establish a presence on the internet. All this change means that when a service center is looking for a tool, or a piece of test equipment, they might not find the right source. **ES&T** published this annual Buyers' Guide to provide service centers with the most up-to-date information possible.

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ON THE COVER
The scope of consumer electronics continues to grow and change, as does the technology on which it's based. Service technicians are constantly learning new technology and new products and buying new tools, test equipment, supplies and replacement components to stay abreast of all of those changes. The annual **ES&T** Buyers' Guide provides the most up-to-date names and addresses of the companies who market the products needed for consumer electronics service.

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Editorial

by Nils Conrad Persson

The Buyers' Guide

It's time for the annual Buyer's Guide issue again. We hope you find it useful. As usual, it was a struggle to get it going, and it took quite a bit of time to produce, but at last it's finished. With every passing year, it gets a little easier. As with any venture, what is new, and therefore daunting, one year becomes routine after a few years of doing the same thing.

It is amazing, though, how many changes have taken place that we tend to take for granted. As an example, as you page through the company listings, notice all those fax numbers. Of all the 689 companies listed, we have fax numbers for 582. No doubt all of them have fax machines, but some either didn't tell us about them, or just haven't returned questionnaires lately. How long ago was it that these listings didn't contain fax numbers, because no one had faxes?

Another phenomenon has been the growth of use of e-mail and internet web sites by companies. Just a few years ago, we didn't list e-mail or web site information for companies in our listing because no one had that type of communication capability. Today, 298 of our company listings include e-mail addresses, 324 listings include a website address, while 356 of the entries include one or the other. Both an e-mail address, and a web site address are included in 266 entries.

This year we once again took a look at the geographic distribution of companies in the listings. Interestingly, there is at least one company in 47 of the 48 contiguous states of the United States. Of course, there are more companies in some states than there are in other states.

California is the winner again with 140 entries. For a number of reasons, this makes a lot of sense. For starters, California is a big, and populous state. This makes sense since California is on the Pacific Coast, and so much of the bulk of products and materials of interest to consumer electronic service, from the finished products to replacement components, is imported from the other side of the Pacific.

The state where the next largest segment of the companies in our listings is located is New York, with 59. Illinois comes next with 54, then Massachusetts with 50, New Jersey with 45, Ohio and Texas with 31, and Florida with 30. Pennsylvania accounts for 21 of our entries. All the rest of the states represent fewer than 20 of our listings. Six of the states have only one entry. We don't have any listings in Montana.

On the other side of the coin is the product listings, and we found some interesting things there as well. Of the 689 company listings, we have listings of products for 529. That's an improved situation over last year, and we plan to continue to refine the listings.

There are 6,584 entries in the product listings. That means that whatever a service center is looking for, it's likely that they'll find a place to obtain it in these listings.

You can help us make the 2001 Buyers' Guide better

As anyone who has ever tried to take a survey by mail knows,

not everyone who receives the survey form fills it out. That makes it difficult to have listings that are totally accurate. For example, of the 689 companies in the company listings, 338 companies have returned the questionnaires in at least one of the past three years. A number of companies, 88, to be exact, have sent back the questionnaires every year. Obviously they recognize the value of being listed in this magazine.

But that means that 351 companies have not returned questionnaires in the past three years. Since we know many of those companies, we know that the data for them is accurate, even if they haven't returned forms lately. And we have delisted companies whose mail was returned as undeliverable, since they are obviously not there anymore.

During the coming months, the staff of this magazine are planning to continue to try to improve the accuracy of the Buyers' Guide. We'll be contacting those companies that haven't responded to questionnaires recently, in an attempt to get up-to-date information. If we can't confirm their listings that way, or in some other fashion, we'll delete those entries.

It would be a great help in this effort if readers could let us know when they call a number in this listing and are told that it's a wrong number, or if they write to an address in this listing and get either a notation that the address is wrong, or no response, or if they contact a company to buy a product that our listing says they have, but the company says that they don't sell that product.

And you can help us make the listing more complete. If you notice that there's a company that we don't have listed that you think should be here, please let us know.

The more accurate we can make the Buyers' Guide listing, the better for all concerned.

And finally, if you have any comments: positive or negative about the Buyers' Guide, we'd like to hear it.

Help us update the product listings

Another major effort we plan to make over the next several months is to update the product listings to reflect some of the new technology. The list of products that we carry in the product listings was established a number of years ago. We have updated it from time to time, and think it still adequately represents the product requirements of most consumer electronic service centers. However, the revolution in consumer electronics products has continued at a rapid pace, and things such as direct-by-satellite TV, HDTV, DVD, home networks, wireless communication, internet access and a lot more, have entered the market in the last few years.

That means that the arsenal of tools, test equipment, replacement parts, and supplies, has had to expand to accommodate that growth. We'd like to make sure that we're keeping up with all of the needs of service centers. So, if you're looking for a product for service, and don't find the item in these listings, let us know so that we can add it for next year. ■

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC

Servicing & Technology

Electronic Servicing & Technology is edited for servicing professionals who service consumer electronics equipment. This includes service technicians, field service personnel and avid servicing enthusiasts who repair and maintain audio, video, computer and other consumer electronics equipment.

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CEA endorses MobileToys.com

As part of an ongoing effort to educate consumers about the mobile electronics industry, the Consumer Electronics Association (CEA) Mobile Electronics Division announced its endorsement of MobileToys.com, a website dedicated to providing information on automotive electronics.

"The mobile electronics industry is expanding rapidly in scope and scale," said Gary Shapiro, CEA President and CEO. "The educational content on MobileToys.com is in keeping with our efforts to provide consumers and industry professionals with information about this growing category of products. Like our TechHome.org site dedicated to home systems, MobileToys.com is a resource for everyone interested in automotive electronics products."

Headquartered in Danvers, MA, MobileToys.com is based on an e-commerce model that gives consumers access to an extensive database of local retailers, mobile electronics products, and vehicle specifications. Visitors to the site are led through a selection process based on their mobile electronics needs and their vehicle's specifications. After making their selections, consumers are invited to have their purchase installed by a local retailer who participates in the Mobile Electronics Certification Program (MECP). Founded in 1991, MECP is the only nationally-recognized program that certifies 12-volt installers on electronics, installation knowledge/technique, and tools/shop safety. Owned and managed by CEA, the program is the benchmark of professionalism in the mobile electronics installation industry.

"Our Internet strategy provides consumers with the best of both worlds," explained MobileToys.com Vice President and COO Bob Fields. "The power and convenience of the Web, combined with the expertise and service of local MECP certified installing retailers, ensures product performance and customer satisfaction."

MobileToys.com serves as a vital resource for consumers, technicians, and industry professionals. In addition to product information, the website offers an expansive variety of services necessary to become the industry's search engine. Via the Internet, consumers nationwide and globally have access to the latest product and automotive fit information, in addition to referrals to local professional dealers and acknowledgment of industry associations.

MobileToys.com resulted from the collaboration of industry professionals and their organizations to provide information pertaining to all areas of mobile electronics. CEA's Mobile Electronics Division became involved in the project after Fields presented the idea at the CEA Fall Conference on October 17, 1998. The initial response from the manufacturers, retailers, and association leaders, who make up the Mobile Electronics Division board, was very positive, and CEA members have been actively involved in developing the site ever since.

December Caps Strong Year in Video Sales

Manufacturer-to-dealer sales of video products grew by 28.6 percent in December, totaling just under 5.6 million units and rounding out a year of strong growth in the category, according to figures issued by the Consumer Electronics Association (CEA). Total sales of video products in 1999 topped 60 million units, increasing by 22 percent over 1998. In addition, virtually every category (with the exception of direct view color TVs) experienced double-digit increases for the year.

The sales gains made in individual categories were even more impressive. Sales of direct view color TVs in 1999 rose by 5 percent, to a year-end total of 23.2 million units, the sub-category's best shipment year since 1995. In addition, VCR sales increased by 26 percent on the year to 22.8 million units — the best year for VCRs ever, and by a tremendous margin. Sales of TV/VCR combinations reached 366,170 units in the month, a 30 percent increase over last December, bringing total year sales more than 40 percent ahead of 1998. Finally, camcorders had a particularly strong month, with sales increasing by 72 percent over last December.

One of the more significant aspects of video sales in 1999 was the growth of home theater-related products. Sales of projection TVs increased by more than 15 percent for the year, and sales of direct view TVs 29 inches and higher grew by 11 percent. These figures, as well as the fact that sales of stereo VCRs (more than half of all VCRs) increased by 27 percent, all point to consumers' fast-growing interest in the home theater experience.

Another factor that contributed to the home theater trend was the product that realized the most explosive growth by far in the video category — DVD players. During 1999, DVD players became the fastest selling product in the history of consumer electronics (based on sales during the first three years of a product's introduction), with sales topping 4 million units.

Gary Shapiro, president and CEO of CEA, commented, "1999 was a tremendous year for video sales. Consumers' increasing interest in digital technologies and the home theater experience have made for an explosive video marketplace. We expect 2000 to continue this trend, with tremendous increases in the sales of new and exciting digital products such as DVD players, personal video recorders, and digital television."

1999 good year for DTV sales

Factory-to-dealer sales of digital television (DTV) products closed out the year by posting a fifth consecutive month of growth in December. DTV sales last month surpassed 23,000 units, according to numbers released by the Consumer Electronics Association (CEA). The December sales figure brought total 1999 sales to 121,226 and total sales since the introduction of DTV (in August of 1998) to 134,402.

DTV sales in December increased by five percent over November's sales, to a one-month record of 23,745 units. Total

fourth quarter DTV sales equaled 67,811 units, representing a 157 percent increase over third quarter sales, and 467 percent increase over second quarter sales.

"There can be no denying that DTV is the future of television. These sales figures show that consumer interest in DTV is growing everyday," said Gary Shapiro, President and CEO of CEA. "In 1999, DTV became a retail reality. In 2000, expanded programming will be necessary to exponentially grow sales. We are thrilled at this prospect, and encourage everyone in this industry, from manufacturers to broadcasters, to help us continue the DTV momentum."

CEA projects that the first 10 million DTV units will be sold by 2003, the next 10 million in 2004 and 2005, and 10.8 million to be sold in 2006.

Pentagon is not seeking to reopen DTV transmission standard, says CEA

The following statement was issued by Consumer Electronics Association (CEA) President and CEO Gary Shapiro regarding a meeting between CEA, consumer electronics manufacturers, broadcasters, and senior officials of the U.S. Department of Defense to discuss issues related to the transmission and reception of digital content.

"The Consumer Electronics Association joined representatives of the National Association of Broadcasters, consumer electronics manufacturers, and other parties involved in the transition to digital television (DTV) to meet with U.S. Department of Defense officials. The purpose of the meeting was to discuss the unique needs of the U.S. military regarding the transmission

and reception of digital video, audio, and data. Specifically, we met to discuss how the current U.S. transmission standard for digital television (DTV) — 8VSB — can meet these needs.

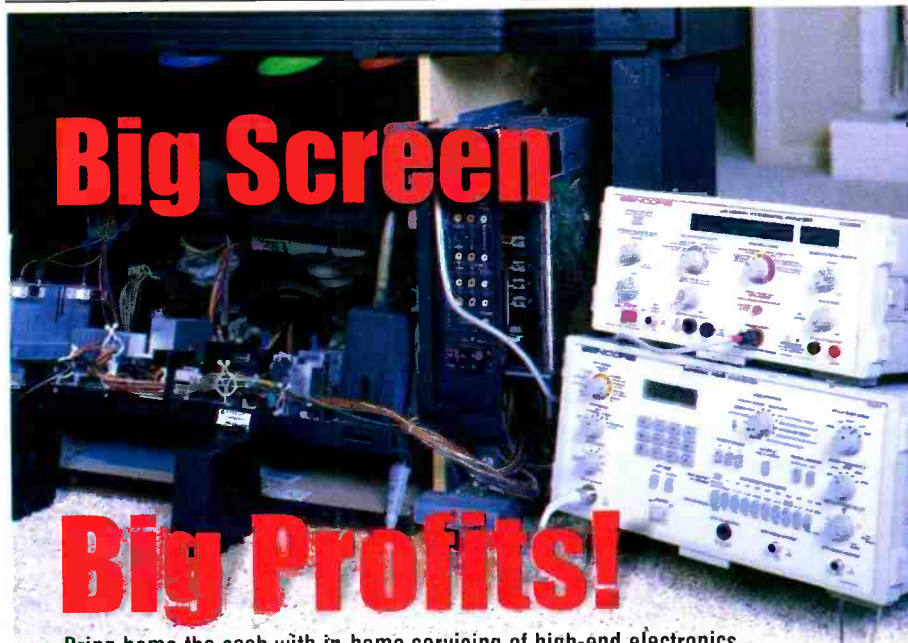
"During our discussions, the Pentagon made it clear that it has no desire to revisit the 8VSB transmission standard adopted by the Federal Communications Commission (FCC) and that it is not calling on the FCC to reopen the transmission standard debate.

"We look forward to continuing to work with the Department of Defense to ensure that the unique needs of the military are considered as the U.S. transition to DTV continues and as the consumer electronics industry develops new technologies. We strongly believe that VSB can meet the Pentagon's requirements for digital transmissions. The consumer electronics industry remains committed to helping the Department of Defense meet its needs through commercial products to the greatest extent possible."

CES panel predicts dramatic wireless growth & Internet convergence

Wireless technology fueled by the Internet and increasing consumer demand for many forms of data will have dramatic growth in the U.S. in the coming years, according to the Wireless Supersession industry panel at the 2000 International CES — Your Source for Workstyle and Lifestyle Technology. According to the panelists, there will be one billion wireless users by 2003 and as many as 400 million using wireless devices to access the Internet by 2004.

(Continued on page 76)



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Selling service via the internet

by Conrad Persson

An article in the Kansas City Star on February 1, quoting a survey by Inktomi and NEC Research Institute, described the amazing growth of the internet. The Web contained about 60 million pages of information in late 1996. In 1997, information content of the Web was at 320 million pages. In 1999, that had increased to 600 million pages. Currently, the web has more than 1 billion pages.

I just played with that information on the calculator. A ream of paper (500 pages) is about two inches thick. Dividing one billion pages by 500 pages per reams calculates out to about 2 million reams. Multiplying by two inches thick per ream, a stack of a billion pages, on paper, would be four million inches thick. At 12 inches to the foot, that stack would be about 333,000 feet high. Or, translating that into miles (dividing by 5,280 feet per mile) the information on the internet, printed on paper and piled into one pile would be about 60 miles high. That's a lot of information.

Selling via the internet

Of course, a lot of the information on the internet isn't commercial in nature. There are a lot of sites run by colleges and universities, governments, associations, etc., that are there to disseminate information. And there's a lot of good information available. And, as is true with any large information repository, there's a vast amount of junk too.

But a lot of companies do use the internet to promote sales of their products. In fact, anyone who watched the Super Bowl game was assaulted by a number of commercials about various web sites: AutoTrader.com, Britannica.com, Computer.com, The E*Trade Group, HotJobs.com, Kforce.com, LifeMinders.com, Monster.com, Netpliance.com, OnMoney.com, Pets.com, Wall Street Journal Interactive Edition, LastMinuteTravel.com.

There is no doubt that the internet has become an important place for people to do business, or to make people aware of their businesses.

Selling service via the internet

Many consumer electronics service centers have begun promoting their businesses on the internet, with varying results. Some service centers are receiving a steady stream of inquiries from people who have found their websites, while some are receiving almost no "hits," and some feel that the attention they receive as a result of being on the web about offsets the cost of having a website.

In short, whether or not any given service center should have a presence on the web depends on a number of factors. To get some ideas, we interviewed several people whose com-

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Drive Controller Cards	Tape Backup Systems

panies have websites in preparing this article. None of the people interviewed used any superlatives in describing their experiences with promoting their businesses via the internet, but the responses were generally positive.

Some of the details

Two of the interviewees approached the idea of a web page as a do-it-yourself project. They were interested in learning the internet scripting language, HTML (hypertext markup language), and thought that designing a web page for their own

business would be a useful project for the experiment. A third interviewee has engaged a local web site designer to create and maintain his company's website.

One do-it-yourself website

Jack Frost at Jack's Electronic Repair in Urbana, IL, not only wanted to learn about HTML, but he also wanted to support his local community internet service provider, Prairienet. Frost's site doesn't have a lot of frills: it's text only, in keeping with the prairienet philosophy of making the information on that system accessible to everyone regardless of the sophistication of their computer system.

In spite of the fact that it's text only, Frost manages to make it look quite attractive, and to impart some useful information to people visiting the site, as well as to do a nice job of promoting his business (<http://www.prairienet.org/vcr-repair/>).

Frost has not spent any time trying to get his website registered with any of the large search engines, so the number of visitors is limited. He figures that the business he receives from the site about pays for the cost of keeping it in operation.

A professionally designed site

McCann Electronics of Metairie, LA, one of the larger and more successful service centers in the country chose to go a different route and have a professional website designer design their website (www.mccann1.com). In contrast to the simple, text-based, website of Jack's Electronic Repair, this website includes animation, graphics, and other effects. Moreover, this web operator has gotten the address of the site registered with many of the large search engines, such as Yahoo, Lycos, Hotbot, so the site is visited quite often.

McCann Electronics is not a typical consumer electronics service center. The types of products serviced by this center is broader than most. For example, McCann does such things as speaker reconing and repair of Peg Prego toy automobiles. According to Gerry McCann, owner of McCann Electronics, they receive approximately one inquiry per day via their website from people all over the country interested in having speakers reconed. Another frequent source of hits is people asking questions about computer problems.

McCann feels that his website is definitely worthwhile, but it's only a part of his overall advertising/promotion program. Other aspects of that program include an answer desk, newsletters, yellow pages advertising, and his Saturday morning radio show: Living with Consumer Electronics. In fact, McCann says that, today, if he had to choose between his website and yellow pages advertising, he would drop the website and stick with the yellow pages. However, he adds, that could change in the future.

How to get started

If you want to have a web presence, but don't want to do it yourself, a good place to start is to contact several web page designers and get quotes. Ask them to see copies of their work. Or ask them to direct you to web sites that they've designed. If you like the look, and it seems to be easy to get the information you need, that designer might be a candidate for you. It might

be best to start simple (inexpensive) and work your way to a more involved site as you determine the usefulness of the page to you and the amount of business it generates.

If you want to do it yourself, there are a number of ways to go. For one thing, you can start from scratch. Get some kind of reference material: a book, or information on the internet to see how to apply HTML to documents. Simple HTML, documents that don't have animation, or a lot of graphics, or other fancy effects, is fairly simple. It is not programming.

One of the easiest ways to get started is to use a web page builder from your internet provider (if they have one). For example, AOL offers a system called 123Publish. Using this approach, there's no need to download software or learn HTML. You simply answer questions about what you want on your page and in minutes your page is published on the web.

123Publish offers lots of "fill in the blank" templates from Resumes to recipes to get you started. 123Publish is available for anyone using AOL 4.0 for Windows or Macintosh systems. 123Publish pages can include text, dividers, pictures, and hyperlinks to other pages or to your mailbox. 123Publish pages can't include background sounds, counters, forms, frames, guestbooks, raw HTML, or JavaScript.

A little more complicated, but more flexible

AOL offers another approach for someone who has mastered the basics and wants to do some things that 123Publisher won't let them do. This is called Easy Designer. You don't have to learn any HTML, but you have greater control over your page design. Using it, you can use your mouse to point, click, drag, and drop and you'll find this program easy to use. This system offers many ready-made templates. Or you can start with a blank page. Easy Designer includes the ability for advanced users to directly edit HTML, plus:

- Drag and drop objects on your page as you build it
- Add multiple pictures to your page and resize them as you go
- Instant access to thousand of pieces of clip art

Add your own personal chat room and counter with a click of your mouse.

Another way to build a web page is to use commercial HTML editing software. This is probably the easiest and best way to build an attractive, informative, page.

Something to think about

Based on the experiences of the few service centers we've spoken to so far, a reasonable conclusion, at this point, seems to be that the internet should not be dismissed by any service center as not useful in promoting their business, but on the other hand, it's not necessarily the best, nor should it be the only, way a service center should go about promoting its business. Rather, the internet should be considered by any service center as one possible segment in a well- designed program of advertising and promotion.

If any readers have had any significant positive, or negative, experiences in using the internet as a tool in advertising and promotion, we'd like to hear about it. ■

Consumer electronics product handling: Coping with ESD

by John A. Ross

During the earliest days of the Apollo space program, a fire in the Apollo command module killed the three astronauts manning the spacecraft. The fire did not occur in orbit but rather while the spacecraft sat atop the Saturn 5 rocket during a "power-up" test several days before the scheduled launch. Subsequent investigations of the cause of the accident revealed that static electricity in a 100% oxygen environment triggered the blaze. Combustible materials ignited in seconds and created the smoke that suffocated the astronauts.

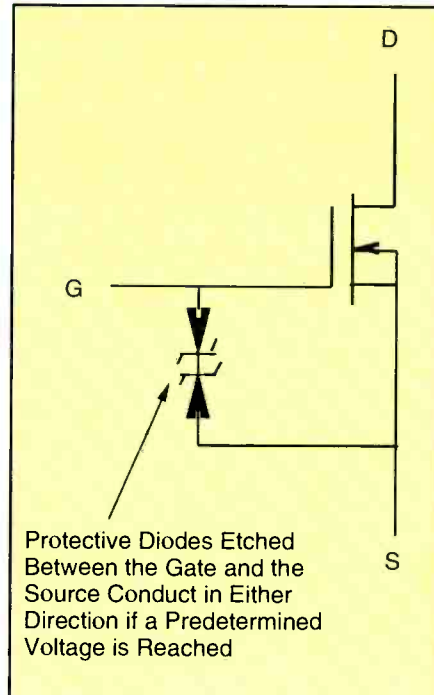
This brief look back at the Apollo 1 disaster illustrates several issues for this article. First, static electricity occurs because of consistent environmental conditions. Second, even the slightest static discharge can cause great damage. Finally, materials used in the workplace can either generate or prevent static discharge.

Electrical overstress vs. electrostatic discharge

Given our profession, we work with both electrical overstress (EOS) and electrostatic discharge (ESD). Each can cause significant damage to semiconductor devices in the blink of an eye. However, a major difference exists between EOS and ESD. That is, EOS and ESD have different causes and damage semiconductor devices in different ways.

Electrical overstress

Electrical overstress occurs when overvoltage or overcurrent conditions damage a device. Those conditions may exist during normal operation or while a technician tests a device. As an example, electrical overstress can result from a current surge that follows the turning of power on or off and measuring instruments on or off, the short-circuiting of



the load, solder chips, and circuit board patterns short-circuited by metallic foreign objects. Generally, we can track large-scale EOS problems through symptoms such as breaks in wiring on the chip due to melting, discoloration, and burning of the package.

Electrostatic discharge

In comparison to EOS, electrostatic discharge may have greater chances of occurring because of seasonal changes or because of environmental conditions. As an example, the decrease in humidity during winter establishes optimum conditions for ESD. In brief, ESD damages the IC chip of a semiconductor device when it discharges through the device.

Most of the time, electrostatic discharge occurs because of the contact of a charged body with the pins of a semiconductor device or because of the discharge of an electric charge that takes

place in the device itself. As opposed to the mostly noticeable symptoms of EOS, ESD problems usually affect smaller areas of a semiconductor device. Consequently, technicians have a more difficult task in locating the effect and source of the electrical discharge.

Generation of static electricity

Table 1 lists some of the prime causes of static electricity and the amount of charge that may occur in different environmental conditions. The phenomenon occurs as a result of the positive and negative charging of two objects rubbed against one another. Static electricity exists as the excessive electric charge existing on the objects. When the conductive objects contact each other, electric charge moves. If the speed of movement is fast, a high pulsating current flows. The characteristics and size of the objects, along with the relative humidity in the atmosphere, affect the quantity of the generated charge.

The table illustrates that a charge built up on the human body can cause extensive damage to a semiconductor device. The built-up charge discharges when a part of the body touches a pin of the device. Static induction takes place on the conductive part of the device. With the charge on the conductive part of the device immediately discharging, damage occurs if a pin of the device is grounded or if a pin touches a metal portion of attached test equipment, a test jig, or a tool.

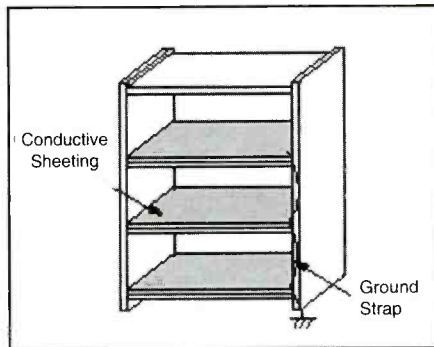
Electronic components and static electricity

Early electronic components, such as vacuum tube devices and early transistors, had little or no need for static control. The first transistors had enough size and bulk to remain relatively insensitive to static charges. However, as the size of semiconductor devices decreased and speed became an operational factor, stat-

Ross is a technical writer and microcomputer consultant for Ft. Hayes State University, Hays, KS.

Table 1 — Causes of Static Electricity

CAUSE	QUANTITY OF ELECTROSTATIC VOLTAGE (V)	
	10 to 20% Relative humidity	65 to 90% Relative humidity
Walking on a carpet	35,000	1,500
Walking on a vinyl floor	12,000	250
Worker at a bench	6,000	100
Vinyl cover of work specifications	7,000	600
Polyethylene bag picked up from bench	20,000	1,200
Work chair with polyurethane forming agent	18,000	1,500



ic sensitivity became more of a concern. The technological evolution that progressed from transistors to MOSFET's and then to large scale integration also introduced components that have greater sensitivity to static charges.

ESD and semiconductor devices

Generally, MOSFETs, ICs, and other high-frequency semiconductor devices have a greater sensitivity and become easily damaged by electrostatic discharges. Table 2 describes the sensitivity of popular semiconductor devices.

Manufacturers attempt to protect these devices from damage by including an internal protection circuit in the power block or input/output block. Figure 1 shows the schematic diagram of a MOSFET that includes static protection. The configuration of the diodes allows the devices to conduct in either direction if the MOSFET reaches a predetermined voltage that has a higher value than any working voltage. This protects the MOSFET from excessive static buildup.

However, an internal protection circuit does not provide a complete answer

to ESD problems. The effect of the protection circuit may differ from one device to another because of the characteristics, configuration, and dimensions of the protection circuit.

Examples of ESD Damage

Electrostatic discharge may occur because of different factors found at the workbench. As an example, a technician handling sensitive components while not wearing a wrist strap and conductive shoes risks damaging the product. In addition, certain types of clothing readily generates static electricity. Poor service practices such as directly touching the pins of an IC with the hand or using equipment that has an insufficient ground can also cause ESD damage. ESD problems may also occur if a technician touches a charged device with a metallic object or if a soldering tool produces leakage current.

Damage to oxide film

With MOS LSIs, the input pins of MOS devices connect to the silicon substrate with gate electrodes. In turn, the gate electrodes remain electrically isolated from the input pins by a very thin oxide film. ESD damage to the oxide film occurs because of overvoltage conditions that exceed 10^6 V/cm. Although this voltage quantity may seem excessively inflated, we should remember that the oxide film is approximately 10nm thick. As a result, a MOS LSI can withstand only several tens of volts. A static discharge that exceeds this level ruptures the insulation of the film. With newer and smaller MOS LSI technologies, the oxide film has become increas-

ingly thinner and can withstand only several volts without a protection circuit.

Thermal destruction

When static discharge generates excessive current and the current concentrates at the PN junction of a semiconductor device, thermal destruction occurs. Reverse bias conditions occur within the device and power is consumed at the junction and causes an increase of the temperature on the edge of the junction. As current concentrates at and flows through the edge of the junction, the temperature continues to increase and eventually damages the junction.

Preventing ESD problems

Several easy methods exist for preventing ESD problems. Those methods include maintaining a relative humidity of approximately 40 to 60 percent. With a low humidity, the dissipation of charge decreases and increases the possibility of the generation of static electricity. Maintaining a humidity level at 40 to 60% increases the dissipation of the static electric charge.

The use of an ionizer also prevents the build-up of static electricity through the generation of ions. As the ionizer generates ions, static electricity remains neutralized. Another method involves laying conductive sheet on the floor and the desk. The conductive sheet prevents the build-up of charges on the body when a technician walks past sensitive devices or during the transportation of devices. Moving to Figure 2, a metallic desk and metallic shelves also need covering with a conductive sheet to prevent the abrupt discharge of static electricity. If a conductive sheet is not available, technicians may also wear conductive shoes.

When working with test equipment, test jigs, or metallic tools, ground the equipment, jigs, or tools to prevent current leakage. In addition, always use a grounded soldering iron. With a device under test, always attach a conductive material to any metal part or chassis that may touch the pins of the device. Use a conductive container or conductive bag when storing or transporting static sensitive printed circuit boards.

The proper method for handling semiconductor devices and printed circuit boards is not to touch the pins of semiconductor devices and printed wiring

boards. To remove static electric charges from the body as it builds up, wear a wrist strap. A wrist strap must have a resistance of 1 MΩ to prevent the worker from electric shock. In addition, technicians must wear the wrist strap directly on the skin rather than on top of clothing, and check the conductivity of the wrist strap at least once a day to make sure the cable is not broken.

Anti-stat packages

As with semiconductor technologies, the ESD packaging industry has also evolved and grown with its support of the electronics industry. Traditionally, the industry has produced flat films, bags, and boxes. While early bags consisted of black carbon loaded polyethylene, newer methods of static control utilize pink polyethylene and other static dissipative films. Shielding bags utilize foil laminates that form a moisture barrier and metallized polyester laminates for static protection.

New types of static protective packaging

Shrink film packaging consists of thin biaxially-oriented films that shrink back



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Table 2 — Sensitivity to ESD by Different Semiconductor Device Types

RESISTANCE	VOLTAGE AMOUNT	DEVICE TYPE
<i>Very Sensitive</i> Super high-frequency switching devices MOS devices Bipolar ICs (LSIs)	150 V Maximum	High-frequency devices
<i>Moderately Sensitive</i> Small-signal transistors Diodes	150 to 1000 V	Bipolar ICs (SSI, MSI)
<i>Little Sensitivity</i> Power transistors Power diodes	1000 V Minimum	Power components

Source: "Handling Guidelines for Semiconductor Devices" (EIAJ EDR-4701A)

to the original size when exposed to relatively high temperatures. Most shrink film packaging produces 40% to 50% shrink characteristics. Anti-static shrink packaging provides several unique advantages for packaging electronics parts, subassemblies, and finished goods. Those advantages include overall package cost effectiveness, tamper-proofing, and the immobilization of the packaged parts.

Dissipative shrink film utilizes a three layer co-extruded film that has clean surfaces constructed from unloaded and uncoated Ethylene Propylene Copolymer. This type of film relies on a dissipative core that combines excellent surface cleanliness and shrink properties with suitable ESD properties.

When someone handles the product, static discharges occur against the shrink film which serves as an ESD event wall. In addition to the film, the packaging also includes an air gap that provides shielding attenuation. Increasing the effective distance between a packaged product and the point of an ESD event also increases the protection by the square of the distance.

Another type of static protection uses air channels surrounding the product to cushion and protect while providing

electrostatic shielding and a moisture barrier. The air channels surrounding the product provide physical cushioning. Multi-layer materials combine with the dry air found in the channels to establish a moisture barrier.

Conclusion

Modern semiconductor devices have become increasingly smaller because of market demands for multi-function, high-density, high-speed devices. The market demands combine with progress in the design and production technologies used during the manufacture of semiconductor devices. Unfortunately, increasing the density of a semiconductor device while decreasing the device size also lowers the resistance of the device to electrostatic discharge.

As the article has shown, technicians and manufacturers attempt to take the best possible measures for preventing damage due to ESD. Unlike other causes of failure, such as EOS, the damage to semiconductor devices from ESD remains difficult to recognize. The article has provided an overview of ESD symptoms that should help with fault analysis and a listing of methods that can prevent the build-up of static charges. ■

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What Do You Know About Electronics?

by J.A. "Sam" Wilson

Vocabulary and Statistics

In a past issue, I pointed out that you can raise your IQ (intelligence quotient) by as much as 10 points by studying vocabulary. I'm sure that that was a surprise to some readers, but it is true. That fact has been used as a criticism of IQ testing. A child raised by professionals is exposed to a broader range of vocabulary words than is a child raised by parents who are less educated.

The argument against IQ tests is that intelligence should not be dependent only on vocabulary. For example, a young college graduate is moved next door to an Eskimo in the bitter cold north. The Eskimo can use techniques he was taught by his parents, and is able to survive, but the college graduate would soon die. The college graduate would score higher on an IQ test, but the Eskimo is more able to use his mental ability to survive. So, "intelligence" should not be so dependent on vocabulary.

Remember that the IQ test does not measure intelligence. It has never been possible to do that. The IQ test merely compares the ability of an individual in a group. That explains why it is called a quotient.

Knowing this, why am I so sure that vocabulary words are so important when you are studying a new technology? The reason is that you cannot understand the writings about the new technology if you don't even know what the words mean.

Understanding basic statistics

Let me start with an example of how statistics might be used in electronics. Suppose that you are working for a large company that has an incoming inspection department. Its job is to assure that components the company has ordered meet the quality standards of the component.

Assume that the company has ordered 2000 resistors with a value of 500Ω , that will eventually be used in the manufacturing of radar receivers. The shipment arrives with an AQL of 980 resistors. That means that if 980 resistors are tested randomly and found to be $500\Omega \pm 20\%$, the complete family of resistors will be accepted. The AQL is calculated by statistics.

A technician calibrates the test equipment (actually an ohmmeter) so that resistors in the $500\Omega \pm 20\%$ range cause a green light to come on, meaning that it is acceptable. Resistors tested to be outside the $500\Omega \pm 20\%$ range will cause the red light to come on. Obviously, the tester is not a highly-trained technician. Also, some products outside of the range of acceptance can get by this station.

The point here is that it is not necessary to pay the cost of testing every resistor. If a bad resistor gets past this station, it will cause some kind of trouble that will cause the receiver to malfunction in some way.

You may feel that this is a rather slipshod way to test the resistors, but it saves a lot of money from unnecessary testing. As far as the company is concerned, labor is never cheap.

Is the AQL calculated by a technician? It might be, since the AQL levels are given on charts. The point here is that the whole procedure ultimately is based on statistics. Top level technicians (usually) like to know what is going on in their jobs.

Most statistics are based on probability. That is, the probability is that if 980 resistors, randomly selected, test "good," it is highly probable that they are all good.

Statistical calculations

If you toss a penny, the probability of getting a head is $1/2$. The probability of one type of happening of one occurrence of one type in a population of all types is given by:

$$P = Na/N$$

This is a very important equation.

In this equation, P is the probability of occurrence of one type (a head) divided by the total number of possibilities (2) head or tail. Applying the above equation to this situation, you get $P = 1/2$, where 1 is the type of possibility of a head, divided by the number of possibilities; 2 (head or tail) (this is a very important application).

A sample problem

Use the above equation to calculate the possibility of throwing a 4 with one die ("die" is the singular of "dice").

The answer is that there is only one possibility of this occurrence ($Na = 1$) out of six possibilities ($N =$ a die has six sides, any one of which may come up on top).

So the probability (P) of throwing a 4 with one die is: $P = 1/6$.

Another problem

Now calculate the probability of throwing either a 3 or a 4 with one toss of a die. In this case, the number of possibilities, Na , is 2 (either a 3 or a 4). The total number of possibilities is 6 (any one of six sides may come up on the top of the die). The probability (P) of throwing a 3 or 4 with a single die is: $P = 2/6 = 1/3$.

Since $1/3$ is a larger number than $1/6$, this problem shows that there is a greater possibility of throwing one of two numbers than there is of throwing any one number.

Still another problem

Calculate the probability of throwing a 1, 3, or 5 with one die.

There are now three possible desired outcomes, so $N_a = 3$. In this case, $P = 3/6$, or $1/2$. It is easier still to throw one of three numbers on a die.

Some memory cards

This is a good time to make some memory cards for what we have learned so far. Remember the new term is put on the Q side of the card, and the correct definition of the term is put on the other (A) side of the card.

Q — Does an IQ test measure intelligence?

A — No. At best, it compares the intelligence of one individual to the intelligence of a number of people in a group of similar people.

Q — You can raise your IQ score as much as _____ points by studying vocabulary words.

A — Ten points. One way to do this is to study a book called "30 days to a more powerful vocabulary."

Q — Define probability.

A — It is a measure of the likelihood of an occurrence. A probability is stronger than a possibility, but it falls short of certainty (dictionary definition: Webster 20th Century — 2nd Edition — Unabridged Dictionary).

Q — Give the important equation for probability.

A — P (probability) = N_a (ways to succeed)/ N (all possibilities).

Note: N includes all possible outcomes, those that are sought, and those that are not sought.

This is a good place to stop the introduction of statistics. This subject can get very deep in a short period of time. Engineers

sometimes feel that it is made unnecessarily deep, but that is an opinion. It should be mentioned here that a probability of 1 means that an occurrence is certain. That would occur if the number of occurrence equals the number of trials.

Reviewing your knowledge

People who study how we remember are usually in agreement about the value of reviewing; especially in the case of technical and scientific terminology. That is why I have introduced the idea of memory cards in this column. I am guessing that super technicians can identify every one of the abbreviations that follow. Check your answer with those given at the end. If you do miss any of these, put it on a memory card for review. These abbreviations have been taken from actual CET tests and licensing exams.

1. PPM _____
2. RISC _____
3. SINAD _____
4. EPIRB _____
5. FSK _____
6. IT _____
7. PCM _____
8. PAM _____
9. SAW Filter _____
10. TDM _____
11. A/D _____
12. ASCII _____
13. CODEC _____
14. EIRP _____

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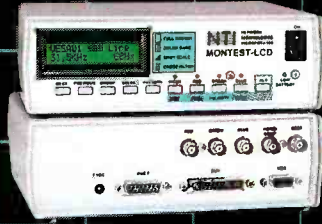
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- STC _____

- Answers to review questions**
- Pulse position modulation
 - Reduced instruction set computer
 - Signal and noise distortion
 - Emergency position indicating radio beacon
 - Frequency shift keying
 - International Telecommunication Commission
 - Pulse code modulation
 - Pulse amplitude modulation
 - Surface acoustic wave filter
 - Time division multiplexer
 - Analog/digital
 - American standard code for information interchange
 - Coder decoder
 - Effective isotropic radiated power
 - Double sideband with carrier
 - Distance measuring equipment
 - Emitter coupled logic
 - Tuned radio frequency (receiver)
 - Transverse magnetic
 - Voltage controlled oscillator
 - Vertical interval test signal
 - Pulse width modulation
 - Single sideband suppressed carrier
 - Transverse electric
 - Long Range
 - Metal oxide semiconductor field effect transistors
 - Peak envelope power
 - Working volts dc
 - Exclusive NOR
 - Automatic frequency control
 - Beat frequency oscillator
 - Lower sideband
 - Radio detection and ranging
 - Voltage standing wave ratio
 - Sensitivity time control

2000 Buyers' Guide

Owners of consumer electronics service centers know better than most that to stay in business they constantly have to be prospecting for new clients through word of mouth, ads in the local newspapers, yellow pages advertising, direct mail, etc. Part of the reason they have to be constantly finding new clients is that some of their old clients move away, or die, or are wooed away by some other company that provides the same service.

The same type of change is true of companies such as the companies that supply products for the consumer electronics service industry. All types of companies are formed and mature. Some of them thrive. Sometimes for a very long time. Sometimes, because of poor management, changing economic conditions, or other factors, companies fail very early.

But even those companies that remain in business year after year change locations for any of a number of reasons. Companies make other types of changes. For example, sometimes they change the products they sell, discontinuing some items, adding others, and improving yet others.

So much change sometimes makes it difficult for customers that buy products from these companies to locate them. It's certainly true in the consumer electronics service industry. And the pace of these changes seems to be accelerating rather than abating.

The ES&T Buyers' Guide

In order to help consumer electronics keep track of the companies that supply them, every year **ES&T** updates the Annual Buyers' Guide. Every year we send questionnaires to hundreds of manufacturers, distributors, publishers, software publishers; every type of company that might possibly have a piece of test equipment, a replacement part, a schematic diagram, a book, or a piece of software that one of our readers might find useful. The questionnaire asks the recipient to update all of the vital information that makes it easy for a service center to contact them: name, address, telephone, toll-free and fax numbers, and whether the company is a manufacturer or a distributor. Now, we even ask them for e-mail and website information.

The questionnaire also includes a list of over one hundred products, services, documents, information products, software products, and more, that service centers use. The recipients check off those products that apply to them, and when we receive that information, we enter it into our database.

So what you see in this Buyers' Guide is current, up-to-date as of the fourth quarter of 1999, or possibly even January of 2000.

Except. Well there are always exceptions. We don't understand it, but many of the companies to whom we send questionnaires don't send them back.

So please keep in mind as you use this Buyers' Guide that it is as current, up-to-date, and useful as we could make it. If you call one of the listees and find that the information that you found in this guide was out-of-date, it may not have been our fault. Of course, the way companies move around these days, it's entirely possible that the information was up-to-date when we published it, but has since gone out-of-date.

And one other word of caution. These days telephone area codes are changing constantly, so that the area code for any of the companies listed here may have changed since the publication date.

We welcome you to this new Buyers' Guide, and we hope you find it useful in finding companies that provide just the product or service you need. If you find it helpful, please let us know. Or if you think it could be improved, please contact us with any suggestions you may have.



Using the Buyers' Guide

We've broken down information in the Buyers' Guide into five categories:

- Product Directory..... page 16.
- Replacement Parts/Components Directory..... page 47.
- Software/Services Directory.....page 34.
- Association/Educational Sources Directory.....page 54.
- Company Address Directory.....page 44.

We have subdivided the product directory according to certain types of products:

- Test equipment.
- Test equipment accessories.
- Circuit damage protective equipment and supplies.
- Supplies/accessories equipment.
- Audio and video accessories.
- Tools.

For example, if you are looking for a VCR test jig kit, turn to the test equipment accessories section of the Product Directory. The companies listed there all say they offer test jig kits. If the company name is followed by a *D, that tells you this company is a distributor, not a manufacturer, of that product.

You will notice that certain company names are in color. Those companies have advertised in this issue. If you want to learn a little more about that company, turn to the page number listed to the far right. The ad alone might give you enough information to help you decide if they carry a product you need.

Once you know who you want to contact for more information, turn to the Company Address Directory. The address, telephone number and fax number for each company are listed there. (Of course, if the company you are interested in has advertised in this issue, you can just pull out your Reader Service card on page 35 and circle the reply number listed under the advertisement.)

The Replacement Parts/Components Directory works the same way. Just look up the type of component you need, then turn to the Company Address Directory to find out how to contact a company that supplies that product. The Company Address Directory lists information on over 600 companies and associations that offer products or services for the electronics servicer.

Checking out services

Consult the Services Directory if you need to contact a consultant, get a disk drive or head refurbished, plug into an on-line service, find a company to repair or rework a PC board, rent or lease equipment, calibrate your older test equipment, or repair a tuner.

Your source for continuing education

The Association/Educational Sources Directory helps you find books, schools and training seminars for continuing your electronics servicing education. It also points you toward sources for service literature and schematics for the products you service. Finally, it lists those companies that produce management software systems that can help you run your business.

Product Directory

Note: An entry followed by *D means that this company is a distributor, not a manufacturer. An entry followed by a *MD means that this company is both a manufacturer and a distributor.

A line listing that is in color indicates that the company has an ad in this issue. The number following the listing is the number of the page on which the ad is located. BC means Back Cover; IBC means Inside Back Cover; IFC means Inside Front Cover.

See Adv. Page	See Adv. Page	See Adv. Page	See Adv. Page
Test Equipment			
AC LEAKAGE TESTERS			
Accutest Instruments, Inc.*D	Hi-Techniques, Inc.	RNJ Electronics Inc.*D	Electro Tool, Inc.
Alfa Electronics*D	Hy-Tronix Instruments, Inc.	RS Electronics*D	Electronic Design Specialists13
Amprobe	Keithley Instruments	Specialized Prods Company*D	Electronix Corporation*D80
AVO International	Kelvin Electronics*D	Techni-Tool Inc.*D	Electronix Express*D
Brunelle Instruments, Inc.	LaserImpact	Tenma Test Equipment	Fieldpiece Instruments
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Contact East, Inc.*D	National Instruments Corporation	Time Motion Tools*D	Fotronic Corporation*D
CSTS Inc.	Omega-Vanzetti, Inc.	Tritronics, Inc.*D80	Fox International*D
The Current Source*D	PC Instruments Incorporated	Union Electronics Distrib*D	GC Electronics*D
East Coast Transistor*D	Print Products International*D	Wavetek Corporation	Harco Electronics*D
Electronix Corporation*D80	H.C. Protek	Wholesale Electronics Inc.*D	HMC — Hub Material Company*D
Electronix Express*D	QuadTech, Inc.	Zack Electronics	Hy Tec Dealer Service
Fotronic Corporation*D	Racal Instruments Inc.	Zack/Joseph Electronics*D	JDR Microdevices*D
Fox International*D	RNJ Electronics Inc.*D		W.S. Jenks & Son*D
Herman Electronics*D	RS Electronics*D	CELLULAR TELEPHONE	Jensen Tools, Inc.*D
Marshall Industries*D	RS Electronics*D	TEST EQUIPMENT	Kelvin Electronics*D
M.A.T. Electronics*D	Schlumberger Technologies	Bird Electronics Corporations	Klein Tools, Inc.
MCM Electronics*D	Snap-On Incorporated	The Current Source*D	L-Com Inc.
Metric Supply*D	Sorensen	Electronix Express*D	Marshall Industries*D
Mouser Electronics*D	Specialized Prods Company*D	Fotronic Corporation*D	MCM Electronics*D
Omnitron Electronics*MD	Sun Equipment Corporation	Harco Electronics*D	Omega Engineering, Inc.
Print Products International*D	Techni-Tool Inc.*D	Keithley Instruments	Omnitron Electronics*MD
QuadTech, Inc.	Tektronix, Inc.	Marconi Instruments Inc.	Paladin Tools
RAG Electronics Inc.*D	Telogy*D	MCM Electronics*D	Parts Express International*D
RNJ Electronics Inc.*D	Telulex, Inc.	Omnitron Electronics*MD	Print Products International*D
RS Electronics*D	Test Equipment Depot*D	Print Products International*D	Progressive Electronics
Simpson Electronic Company	Time Motion Tools*D	Racal Instruments Inc.	QuadTech, Inc.
Snap-On Incorporated	Tritronics, Inc.*D80	RNJ Electronics Inc.*D	RAG Electronics Inc.*D
A.W. Sperry Instruments, Inc.	Tucker Electronics Company	RS Electronics Inc.*D	RNJ Electronics Inc.*D
Sun Equipment Corporation	UBM Corp	RS Electronics*D	RS Electronics*D
Techni-Tool Inc.*D	Ultra-X, Inc.	Simpson Electronic Company	Simpson Electronic Company
Tenma Test Equipment	Zack Electronics	A.W. Sperry Instruments, Inc.	A.W. Sperry Instruments, Inc.
Test Equipment Depot*D	Zack/Joseph Electronics*D	Sun Equipment Corporation	Sun Equipment Corporation
TIF Instruments, Inc.		TechAmerica*D	TechAmerica*D
Time Motion Tools*D	BREAKOUT BOXES	Techni-Tool Inc.*D	Techni-Tool Inc.*D
Tritronics, Inc.*D80	Arrow Electronics	Tenma Test Equipment	Tenma Test Equipment
Tucker Electronics Company	B&B Electronics Manufacturing	Test Equipment Depot*D	Test Equipment Depot*D
Universal Enterprises (UEI)	Vance Baldwin Inc.*D80	Time Motion Tools*D	Time Motion Tools*D
Vector-VID Inc.	B-B&W Electronics*D	Tritronics, Inc.*D80	Tritronics, Inc.*D80
Wavetek Corporation	Computer Services of America*D	Union Electronics Distrib*D	Union Electronics Distrib*D
Wholesale Electronics Inc.*D	Contact East, Inc.*D	Wavetek Corporation	Universal Enterprises (UEI)
Zack Electronics	The Current Source*D	Zack Electronics	Wholesale Electronics Inc.*D
Zack/Joseph Electronics*D	Dalco Electronics*D	Zack/Joseph Electronics*D	Zack Electronics
	E.I.L. Instruments, Inc.*D		Zack/Joseph Electronics*D
	Electro Standards Lab, Inc.	CONTINUITY TESTERS	
	Electronix Corporation*D80	Accutest Instruments, Inc.*D	
	Electronix Express*D	Alfa Electronics*D	
	Fotronic Corporation*D	American Reliance	
	Harco Electronics*D	Ames Supply Company*D	
	Heath Company	Amprobe	
	HMC — Hub Material Company*D	AVO International	
	Hosfelt Electronics, Inc.*D	Vance Baldwin Inc.*D80	
	International Disk Services, Inc.	B-B&W Electronics*D	
	Jameco Electronic Components*D	Bel Merit Corporation	
	JDR Microdevices*D	BK Precision	
	W.S. Jenks & Son*D	Brunelle Instruments, Inc.	
	Jensen Tools, Inc.*D	Burma Electronic Distrib.*D	
	Kasco Distributing*D	Connector Corporation	
	Kelvin Electronics*D	Consolidated Electronics, Inc.*D	
	L-Com Inc.	Conway Engineering, Inc.	
	Marshall Industries*D	The Current Source*D	
	MCM Electronics*D	Dandy Manufacturing Company	
	Nationwide Electronics	East Coast Transistor*D	
	Omnitron Electronics*MD	Eiger Electronics*D	
	Print Products International*D	Electronic Parts Supply*D	
		Electronix Corporation*D80	
		Electronix Express*D	
AUTOMATED TEST EQUIPMENT			
American Reliance			
Analogic Corporation			
Vance Baldwin Inc.*D80			
BK Precision			
Computer Services of America*D			
CSTS Inc.			
The Current Source*D			
East Coast Transistor*D			
E.I.L. Instruments, Inc.*D			
Electronic Prod. Specialties*D			
Electronix Express*D			
Electroservice Laboratories			
Fotronic Corporation*D			
Fox International*D			

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Hosfelt Electronics, Inc.*D	Sencore Electronics5	Fieldpiece Instruments	HMC — Hub Material Company*D
Hy Tec Dealer Service	Snap-On Incorporated	Fotronic Corporation*D	Hosfelt Electronics, Inc.*D
Instek Corporation*D	Specialized Prods Company*D	Harco Electronics*D	Howard Electronic Insts. Inc.*D
Jameco Electric Components*D	Herman H. Sticht Company, Inc.*D	HMC - Hub Material Company*D	Hy Tec Dealer Service
W.S. Jenks & Son*D	Sun Equipment Corporation	Hunter Products, Inc.	Instek Corporation*D
Jensen Tools, Inc.*D	Techni-Tool Inc.*D	Jameco Electric Components*D	Jameco Electric Components*D
Kelvin Electronics*D	Tenna Test Equipment	W.S. Jenks & Son*D	JDR Microdevices*D
LEM Instruments Inc	Test Equipment Depot*D	Marshall Industries*D	W.S. Jenks & Son*D
Marshall Industries*D	Time Motion Tools*D	M.A.T. Electronics*D	Keithley Instruments
MCM Electronics*D	Tritronics, Inc.*D80	MCM Electronics*D	Kelvin Electronics*D
Metric Supply*D	Tucker Electronics Company	Metric Supply*D	Kenwood U.S.A. Corporation
Morrow Wave Inc.	Union Electronics Distrib.*D	Omnitron Electronics*MD	Lascar Electronics Inc.
Mouser Electronics*D	Wavetek Corporation	Pacer Industries, Inc.	Leader Instruments Corporation
Omega Engineering, Inc.	Zack Electronics	Prime Technology, Inc.	Marshall Industries*D
Omega-Vanzetti, Inc.	Zack/Joseph Electronics*D	Print Products International*D	MCM Electronics*D
Omnitron Electronics*MD		RAG Electronics Inc.*D	Metric Supply*D
Philips ECG Company*D	METERS, SIGNAL LEVEL	RNJ Electronics Inc.*D	Mouser Electronics*D
Philips ECG	Accutest Instruments, Inc.*D	Simpson Electronic Company	Newport Electronics, Inc.
Print Products International*D	American Reliance	Snap-On Incorporated	Omega Engineering, Inc.
RAG Electronics Inc.*D	Vance Baldwin Inc.*D80	Sun Equipment Corporation	Omega-Vanzetti, Inc.
RNJ Electronics Inc.*D	B-B&W Electronics*D	Techni-Tool Inc.*D	Omnitron Electronics*MD
RS Electronics*D	Conway Engineering, Inc.	Telulex, Inc.	Parts Express International*D
Salen Enterprises*D	CSI/SPCCO	Tenna Test Equipment	Philips ECG Company*D
Simpson Electronic Company	The Current Source*D	Test Equipment Connection Corp.	Philips ECG
A.W. Sperry Instruments, Inc.	Dalbani Corporation*D	Test Equipment Depot*D	Prime Technology, Inc.
Sun Equipment Corporation	East Coast Transistor*D	Time Motion Tools*D	Print Products International*D
TechAmerica*D	Electronix Express*D	Tritronics, Inc.*D80	H.C. Protck
Techni-Tool Inc.*D	Fotronic Corporation*D	Tucker Electronics Company	QuadTech, Inc.
Tenna Test Equipment	Harco Electronics*D	Union Electronics Distrib.*D	RAG Electronics Inc.*D
Test Equipment Depot*D	W.S. Jenks & Son*D	Wholesale Electronics Inc.*D	RNJ Electronics Inc.*D
TIF Instruments, Inc.	Leader Instruments Corporation	Zack Electronics	RS Electronics*D
Time Motion Tools*D	Marshall Industries*D	Zack/Joseph Electronics*D	Salen Enterprises*D
Triplet Corporation	M.A.T. Electronics*D		Schlumberger Technologies
Tritronics, Inc.*D80	MCM Electronics*D	METERS, VOLTMETERS, AC	Sencore Electronics5
Tucker Electronics Company	Omega-Vanzetti, Inc.	Accutest Instruments, Inc.*D	Simpson Electronic Company
Union Electronics Distrib	Omnitron Electronics*MD	Alfa Electronics*D	Snap-On Incorporated
Universal Enterprises (UEI)	Parts Express International*D	Ames Supply Company*D	Specialized Prods Company*D
Wavetek Corporation	Prime Technology, Inc.	Amprobe	A.W. Sperry Instruments, Inc.
Wholesale Electronics Inc.*D	Print Products International*D	Antique Electronic Supply*D	Herman H. Sticht Company, Inc.*D
Zack Electronics	RAG Electronics Inc.*D	Arrow Electronics	Sun Equipment Corporation
Zack/Joseph Electronics*D	RNJ Electronics Inc.*D	AVO International	A.G. Tannenbaum*D
	RS Electronics*D	Vance Baldwin Inc.*D80	TechAmerica*D
METERS, FIELD STRENGTH	Sencore Electronics5	Bel Merit Corporation	Techni-Tool Inc.*D
Accutest Instruments, Inc.*D	Snap-On Incorporated	BK Precision	Tegam Inc.
Alfa Electronics*D	Herman H. Sticht Company, Inc.*D	Brunelle Instruments, Inc.	Tektrox, Inc.
American Reliance	Sun Equipment Corporation	Bursma Electronic Distrib.*D	Telogy*D
Vance Baldwin Inc.*D80	Techni-Tool Inc.*D	C&S Sales*D	Telulex, Inc.
Bel Merit Corporation	Tektronix, Inc.	Consolidated Electronics, Inc.*D	Tenna Test Equipment
Bird Electronics Corporation	Tektronix	Contact East, Inc.*D	Test Equipment Connection Corp.
Brunelle Instruments, Inc.	Telogy*D	CSI/SPCCO	Test Equipment Depot*D
Bursma Electronic Distrib.*D	Telulex, Inc.	The Current Source*D	TIF Instruments, Inc.
C&S Sales*D	Tenna Test Equipment	Dalbani Corporation*D	Time Motion Tools*D
Contact East, Inc.*D	Test Equipment Depot*D	Digi-Key D*	Triplet Corporation
The Current Source*D	Time Motion Tools*D	Dranetz-BMI	Tritronics, Inc.*D80
East Coast Transistor*D	Tritronics, Inc.*D80	East Coast Transistor*D	Tucker Electronics Company
Eiger Electronics*D	Tucker Electronics Company	Eiger Electronics*D	Union Electronics Distrib.*D
Electronix Express*D	Union Electronics Distrib.*D	E.I.L. Instruments, Inc.*D	Universal Enterprises (UEI)
Electroservice Laboratories	Universal Enterprises (UEI)	Electro Tool, Inc.	Wavetek Corporation
Fotronic Corporation*D	Wavetek Corporation	Electronic Design Specialists13	Wholesale Electronics Inc.*D
Harco Electronics*D	Zack Electronics	Electronic Parts Supply*D	Zack Electronics
Hy Tec Dealer Service	Zack/Joseph Electronics*D	Electronix Corporation*D80	Zack/Joseph Electronics*D
Integrity Design & Research		Electronix Express*D	
Jameco Electric Components*D	METERS, SOUND LEVEL	Extch Instruments Corporation*D	METERS, WOW, AND FLUTTER
JDR Microdevices*D	Accutest Instruments, Inc.*D	Fieldpiece Instruments	Accutest Instruments, Inc.*D
W.S. Jenks & Son*D	Alfa Electronics*D	Fixer Corporation	Alfa Electronics*D
Jensen Tools, Inc.*D	American Reliance	Fluke Corporation	Arrow Electronics
Kelvin Electronics*D	B-B&W Electronics*D	Foley-Belsaw*D	The Current Source*D
Leader Instruments Corporation	Brunelle Instruments, Inc.	Fotronic Corporation*D	East Coast Transistor*D
MCM Electronics*D	CSI/SPCCO	Fox International*D	E.I.L. Instruments, Inc.*D
Metric Supply*D	The Current Source*D	Galco Industrial Electronics*D	Electronic Parts Supply*D
Omnitron Electronics*MD	East Coast Transistor*D	GC Electronics*D	Electronix Express*D
Print Products International*D	E.I.L. Instruments, Inc.*D	Global Micro-Parts Depot*MD	Fotronic Corporation*D
RNJ Electronics Inc.*D	Electronix Express*D	Harco Electronics*D	Herman Electronics*D
RS Electronics*D	Extch Instruments Corporation*D	Herman Electronics*D	Instek Corporation*D

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W.S. Jenks & Son* D	BK Precision	Tektronix, Inc.	Leader Instruments Corporation
Kenwood U.S.A. Corporation	Brilliant King, Inc.	Tektronix	Morrow Wave Inc.
Leader Instruments Corporation	Brunelle Instruments, Inc.	Telegy* D	Marconi Instruments Inc.
Marshall Industries* D	Bursa Electronic Distrib.* D	Tenna Test Equipment	Marshall Industries* D
MCM Electronics* D	C&S Sales* D	Test Equipment Connection Corp.	M.A.T. Electronics* D
Metric Supply* D	Computer Component Source* D	Test Equipment Depot* D	MCM Electronics* D
Omnitron Electronics* MD	Computer Services of America* D	TIF Instruments, Inc.	Metric Supply* D
Print Products International* D	Consolidated Electronics, Inc.* D	Time Motion Tools* D	Mouser Electronics* D
RAG Electronics Inc.* D	Contact East, Inc.* D	Triplett Corporation	National Instruments Corporation
RNJ Electronics Inc.* D	Conway Engineering, Inc.	Tritronics, Inc.*D.....80	Omega-Vanzetti, Inc.
Specialized Prods Company* D	The Current Source* D	Tucker Electronics Company	Omnitron Electronics* MD
Herman H. Sticht Company, Inc.* D	Dalbani Corporation* D	Union Electronics Distrib.* D	Orion Instruments, Inc.
Sun Equipment Corporation	Dranetz-BMI	Universal Enterprises (UEI)	Panasonic Industrial Company
Techni-Tool Inc.* D	East Coast Transistor* D	Wavetek Corporation	Parts Express International* D
Tenna Test Equipment	Eiger Electronics* D	Wholesale Electronics Inc.* D	PC Instruments Incorporated
Test Equipment Depot* D	E.I.L. Instruments, Inc.* D	Zack Electronics	Print Products International* D
Tritronics, Inc.*D.....80	Electro Tool, Inc.	Zack/Joseph Electronics* D	H.C. Protek
Tucker Electronics Company	Electronic Design Specialists.....13		RAG Electronics Inc.* D
Union Electronics Distrib.* D	Electronic Prod. Specialties* D	OSCILLOSCOPES	RNJ Electronics Inc.* D
Wholesale Electronics Inc.* D	Electronic Parts Supply* D	Accutest Instruments, Inc.* D	RS Electronics* D
Zack Electronics	Electronix Express* D	Alfa Electronics* D	Salen Enterprises* D
Zack/Joseph Electronics* D	Elenco Electronics, Inc.	Allison Technology Corporation	Score Electronics.....5
	Exttech Instruments Corporation* D	Ames Supply Company* D	Snap-On Incorporated
MICROWAVE LEAKAGE	Fieldpiece Instruments	Analogic Corporation	Specialized Prods Company* D
TESTERS	Fluke Corporation	AnaTek Corporation	Herman H. Sticht Company, Inc.* D
Accutest Instruments, Inc.* D	Foley-Belsaw* D	Arrow Electronics	Sun Equipment Corporation
Amprobe	Fotronic Corporation* D	Vance Baldwin Inc.*D.....80	TechAmerica* D
Arrow Electronics	Fox International* D	B-B&W Electronics* D	Techni-Tool Inc.* D
B-B&W Electronics* D	Galco Industrial Electronics* D	Bel Merit Corporation	Tektronix, Inc.
Brunelle Instruments, Inc.	Hameg Instruments, Inc.	BK Precision	Tektronix
C&S Sales* D	Harco Electronics* D	Brunelle Instruments, Inc.	Telegy* D
The Current Source* D	Heath Company	Bursa Electronic Distrib.* D	Tenna Test Equipment
Dalbani Corporation* D	Herman Electronics* D	C&S Sales* D	Test Equipment Connection Corp.
Eiger Electronics* D	HMC — Hub Material Company* D	Computer Component Source* D	Test Equipment Depot* D
E.I.L. Instruments, Inc.* D	Hy Tec Dealer Service	Compuvideo Test Instruments	Tritronics, Inc.*D.....80
Electronix Corporation*D.....80	JDR Microdevices* D	Consolidated Electronics, Inc.* D	Tucker Electronics Company
Fotronic Corporation* D	W.S. Jenks & Son* D	Contact East, Inc.* D	Union Electronics Distrib.* D
Fox International* D	Jensen Tools, Inc.* D	Conway Engineering, Inc.	Wavetek Corporation
Global Micro-Parts Depot* MD	Keithley Instruments	The Current Source* D	Wholesale Electronics Inc.* D
W.S. Jenks & Son* D	Kelvin Electronics* D	Dalbani Corporation* D	Zack Electronics
Marshall Industries* D	Kenwood U.S.A. Corporation	Digi-Key D*	Zack/Joseph Electronics* D
M.A.T. Electronics* D	LaserImpact	East Coast Transistor* D	
MCM Electronics* D	Leader Instruments Corporation	Eiger Electronics* D	PERSONAL COMPUTER
Metric Supply* D	Morrow Wave Inc.	E.I.L. Instruments, Inc.* D	REPAIR/TEST EQUIPMENT
Nationwide Electronics	Marshall Industries* D	Electro Tool, Inc.	American Reliance
Omnitron Electronics* MD	M.A.T. Electronics* D	Electronic Prod. Specialties* D	Ames Supply Company* D
Print Products International* D	MCM Electronics* D	Electronic Parts Supply* D	AnaTek Corporation
RAG Electronics Inc.* D	Metric Supply* D	Electronix Corporation*D.....80	Arrow Electronics
RNJ Electronics Inc.* D	Mouser Electronics* D	Electronix Express* D	B&B Electronics Manufacturing
Simpson Electronic Company	National Instruments Corporation	Elenco Electronics, Inc.	Vance Baldwin Inc.*D.....80
A.W. Sperry Instruments, Inc.	Newport Electronics, Inc.	Emulation Technology, Inc.	Consolidated Electronics, Inc.* D
Techni-Tool Inc.* D	Omega Engineering, Inc.	Exttech Instruments Corporation* D	Contact East, Inc.* D
Telegy* D	Omega-Vanzetti, Inc.	Fluke Corporation	CSTS Inc.
Tenna Test Equipment	Omnitron Electronics* MD	Fotronic Corporation* D	The Current Source* D
Test Equipment Depot* D	Philips ECG Company* D	Galco Industrial Electronics* D	Dalco Electronics* D
Tritronics, Inc.*D.....80	Print Products International* D	Global Micro-Parts Depot* MD	Data Depot, Inc.
Tucker Electronics Company	Progressive Electronics	Global Specialties	Eagan Technical Services, Inc.
Union Electronics Distrib.* D	Prostat Corporation	Gould Instrument Systems Inc.	Electro Tool, Inc.
Zack Electronics	H.C. Protek	Hameg Instruments, Inc.	Electronic Parts Supply* D
Zack/Joseph Electronics* D	RAG Electronics Inc.* D	Harco Electronics* D	Electronix Corporation*D.....80
	RNJ Electronics Inc.* D	Heath Company	Electronix Express* D
MULTIMETERS: ANALOG/	RS Electronics* D	Herman Electronics* D	Fluke Corporation
DIGITAL	Salen Enterprises* D	Hi-Techniques, Inc.	Fotronic Corporation* D
Accutest Instruments, Inc.* D	Schlumberger Technologies	HMC — Hub Material Company* D	Harco Electronics* D
Alfa Electronics* D	Score Electronics.....5	Hosfelt Electronics, Inc.* D	HMC — Hub Material Company* D
Allison Technology Corporation	Simpson Electronic Company	Instek Corporation* D	Huntron Instruments, Inc.
American Reliance	Snap-On Incorporated	Iwatsu America	Hy-Tronix Instruments, Inc.
Amprobe	Specialized Prods. Company* D	Jameco Electronic Components* D	JDR Microdevices* D
Antique Electronic Supply* D	A.W. Sperry Instruments, Inc.	JDR Microdevices* D	W.S. Jenks & Son* D
Arrow Electronics	Sun Equipment Corporation	W.S. Jenks & Son* D	Jensen Tools, Inc.* D
AVO International	A.G. Tannenbaum* D	Jensen Tools, Inc.* D	Kasco Distributing* D
Vance Baldwin Inc.*D.....80	TechAmerica* D	Kelvin Electronics* D	Kewill E Commerce Inc* D
B-B&W Electronics* D	Techni-Tool Inc.* D	Kenwood U.S.A. Corporation	LaserImpact
Bel Merit Corporation	Tegam Inc.	LaserImpact	Leader Instruments Corporation

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Marshall Industries*D	Computer Component Source*D	MCM Electronics*D	Zack Electronics
M.A.T. Electronics*D	Consolidated Electronics, Inc.*D	Mouser Electronics*D	Zack/Joseph Electronics*D
MCM Electronics*D	The Current Source*D	National Instruments Corporation	
Micro 2000, Inc.	Dalco Electronics*D	Omnitron Electronics*MD	TEMPERATURE SENSORS
Moody Tools, Inc.	East Coast Transistor*D	Print Products International*D	Alfa Electronics*D
Nationwide Electronics	Eiger Electronics*D	H.C. Protek	Allison Technology Corporation
Netway 2000 Inc.	E.I.L. Instruments, Inc.*D	RAG Electronics Inc.*D	Anritsu Products
Network Technologies, Inc.	Electronic Design Specialists.....13	RNJ Electronics Inc.*D	Arrow Electronics
O.K. Industries, Inc.	Electronic Parts Supply*D	RS Electronics*D	Consolidated Electronics, Inc.*D
Omega-Vanzetti, Inc.	Electronix Corporation*D.....80	Schlumberger Technologies	Contact East, Inc.*D
Omnitron Electronics*MD	Electronix Express*D	Smith Design	The Current Source*D
PC Instruments Incorporated	Elenco Electronics, Inc.	Specialized Prods Company*D	Dalbani Corporation*D
Print Products International*D	Fotronic Corporation*D	Techni-Tool Inc.*D	Dranetz-BMI
Richardson Electronics, Ltd.*D	Fox International*D	Technology Programs	East Coast Transistor*D
RNJ Electronics Inc.*D	Galco Industrial Electronics*D	Tektronix, Inc.	E.I.L. Instruments, Inc.*D
RS Electronics*D	Harco Electronics*D	Tektronix	Electronix Express*D
SMH Electronics Company, Inc.	Hosfelt Electronics, Inc.*D	Telogy*D	Exttech Instruments Corporation*D
A.W. Sperry Instruments, Inc.	Hy-Tronix Instruments, Inc.	Tenna Test Equipment	Fotronic Corporation*D
Sprague Magnetics, Inc.*D	IET Labs, Inc.	Test Equipment Connection Corp.	Galco Industrial Electronics*D
Sun Equipment Corporation	W.S. Jenks & Son*D	Test Equipment Depot*D	Hexacon Electric Company
Telematic	Jensen Tools, Inc.*D	Tritronics, Inc.*D.....80	HMC — Hub Material Company*D
Tenna Test Equipment	Keithley Instruments	Tucker Electronics Company	JDR Microdevices*D
Test Equipment Depot*D	L'il Bitty Tester	Union Electronics Distrib*D	W.S. Jenks & Son*D
Time Motion Tools*D	Marshall Industries*D	Wholesale Electronics Inc.*D	Lascar Electronics Inc.
Tritronics, Inc.*D.....80	M.A.T. Electronics*D	Zack Electronics	Marshall Industries*D
Ultra-X, Inc.	MCM Electronics*D	Zack/Joseph Electronics*D	MCM Electronics*D
Video Products Inc.....14	Omega-Vanzetti, Inc.		Multicore Solders
Warrantech Corporation	Omnitron Electronics*MD	TELEPHONE ANALYZERS/	Newport Electronics, Inc.
Wescorp	Print Products International*D	TESTERS	Omega Engineering, Inc.
Zack Electronics	QuadTech, Inc.	American Reliance	Omega-Vanzetti, Inc.
Zack/Joseph Electronics*D	RAG Electronics Inc.*D	Vance Baldwin Inc.*D.....80	Omnitron Electronics*MD
	RNJ Electronics Inc.*D	BK Precision	Pacer Industries, Inc.
	RS Electronics*D	C&S Sales*D	Philips ECG Company*D
RECEPTACLE CIRCUIT	Sencore Electronics.....5	Consolidated Electronics, Inc.*D	Print Products International*D
TESTERS	Specialized Prods Company*D	Contact East, Inc.*D	RAG Electronics Inc.*D
Vance Baldwin Inc.*D.....80	Sun Equipment Corporation	Conway Engineering, Inc.	RNJ Electronics Inc.*D
Brunelle Instruments, Inc.	TechAmerica*D	CUI Stack	RS Electronics*D
Contact East, Inc.*D	Techni-Tool Inc.*D	The Current Source*D	Simpson Electronics Company
The Current Source*D	Telogy*D	Dalco Electronics*D	SAT/A SPIRIG Company*D
East Coast Transistor*D	Tenna Test Equipment	East Coast Transistor*D	Techni-Tool Inc.*D
E.I.L. Instruments, Inc.*D	Test Equipment Depot*D	Electro Tool, Inc.	Technology Programs
Electro Tool, Inc.	Tritronics, Inc.*D.....80	Electronix Express*D	Tenna Test Equipment
Electronix Corporation*D.....80	Tucker Electronics Company	Elenco Electronics, Inc.	Test Equipment Depot*D
Electronix Express*D	Union Electronics Distrib.*D	Fotronic Corporation*D	Time Motion Tools*D
Fieldpiece Instruments	Wholesale Electronics Inc.*D	Harco Electronics*D	Tritronics, Inc.*D.....80
Foley-Belsaw*D	Zack Electronics	Herman Electronics*D	Tucker Electronics Company
Fotronic Corporation*D	Zack/Joseph Electronics*D	HMC — Hub Material Company*D	Union Electronics Distrib.*D
HMC — Hub Material Company*D		W.S. Jenks & Son*D	Universal Enterprises (UEI)
W.S. Jenks & Son*D	SPECTRUM ANALYZERS	Jensen Tools, Inc.*D	Wavetek Corporation
Marshall Industries*D	Accutest Instruments, Inc.*D	Marshall Industries*D	Wholesale Electronics Inc.*D
MCM Electronics*D	Alfa Electronics*D	M.A.T. Electronics*D	Zack Electronics
Omnitron Electronics*MD	Allison Technology Corporation	MCM Electronics*D	Zack/Joseph Electronics*D
Print Products International*D	Analogic Corporation	Metric Supply*D	
Progressive Electronics	Arrow Electronics	Omnitron Electronics*MD	TRANSISTOR TESTERS
RNJ Electronics Inc.*D	Vance Baldwin Inc.*D.....80	Print Products International*D	Accutest Instruments, Inc.*D
RS Electronics*D	BK Precision	RAG Electronics Inc.*D	AnaTek Corporation
Sun Equipment Corporation	Brunelle Instruments, Inc.	RNJ Electronics Inc.*D	Arrow Electronics
Techni-Tool Inc.*D	C&S Sales*D	RS Electronics*D	B-B&W Electronics*D
Tenna Test Equipment	Consolidated Electronics, Inc.*D	Specialized Prods Company*D	Bel Merit Corporation
Test Equipment Depot*D	The Current Source*D	A.W. Sperry Instruments, Inc.	BK Precision
Time Motion Tools*D	East Coast Transistor*D	Sun Equipment Corporation	Bursma Electronic Distrib.*D
Tritronics, Inc.*D.....80	E.I.L. Instruments, Inc.*D	Techni-Tool Inc.*D	Computer Component Source*D
Tucker Electronics Company	Electronix Express*D	Tektronix, Inc.	Consolidated Electronics, Inc.*D
Wholesale Electronics Inc.*D	Fotronic Corporation*D	Telogy*D	The Current Source*D
Zack Electronics	Global Specialties	Tenna Test Equipment	East Coast Transistor*D
Zack/Joseph Electronics*D	Hameg Instruments, Inc.	Test Equipment Connection Corp.	Eiger Electronics*D
	Harco Electronics*D	Test Equipment Depot*D	Electronic Design Specialists.....13
SEMICONDUCTOR TESTERS	Hi-Techniques, Inc.	Time Motion Tools*D	Electronic Parts Supply*D
AnaTek Corporation	Integrity Design & Research	Triplett Corporation	Electronix Corporation*D.....80
Arrow Electronics	W.S. Jenks & Son*D	Tritronics, Inc.*D.....80	Electronix Express*D
Vance Baldwin Inc.*D.....80	Jensen Tools, Inc.*D	Tucker Electronics Company	Elenco Electronics, Inc.
B-B&W Electronics*D	Marconi Instruments Inc.	Union Electronics Distrib.*D	Fotronic Corporation*D
BK Precision	Marshall Industries*D	Wavetek Corporation	HMC — Hub Material Company*D
Bursma Electronic Distrib.*D	M.A.T. Electronics*D	Wholesale Electronics Inc.*D	W.S. Jenks & Son*D

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<p> Kelvin Electronics*D L'il Bitty Tester Marshall Industries*D M.A.T. Electronics*D MCM Electronics*D Omega Engineering, Inc. Omnitron Electronics*MD Print Products International*D RAG Electronics Inc.*D RNJ Electronics Inc.*D RS Electronics*D Sencore Electronics.....5 Sun Equipment Corporation A.G. Tannenbaum*D Telogy*D Tenma Test Equipment Test Equipment Depot*D Time Motion Tools*D Tritronics, Inc.*D.....80 Tucker Electronics Company Union Electronics Distrib.*D Wholesale Electronics Inc.*D Zack Electronics Zack/Joseph Electronics*D VECTORSCHOPIES Accutest Instruments, Inc.*D Arrow Electronics AudioVisual Inc.*D Vance Baldwin Inc.*D.....80 Compuvideo Test Instruments The Current Source*D East Coast Transistor*D E.I.L. Instruments, Inc.*D Fotronic Corporation*D Herman Electronics*D W.S. Jenks & Son*D Kenwood U.S.A. Corporation Leader Instruments Corporation Marshall Industries*D MCM Electronics*D Metric Supply*D Omnitron Electronics*MD Print Products International*D RAG Electronics Inc.*D RNJ Electronics Inc.*D RS Electronics*D Sencore Electronics.....5 Techni-Tool Inc.*D Tektronix, Inc. Tektronix Tenma Test Equipment Test Equipment Depot*D Tritronics, Inc.*D.....80 Tucker Electronics Company Ultech Corp. Union Electronics Distrib*D Wavetek Corporation Wholesale Electronics Inc.*D Zack Electronics Zack/Joseph Electronics*D OTHER TEST EQUIPMENT Accutest Instruments, Inc.*D ACM Company Allison Technology Corporation American Reliance Ames Supply Company*D Amprobe Anritsu Products ASG Division of Jergens Inc. AVO International B&B Electronics Manufacturing Vance Baldwin Inc.*D.....80 Bel Merit Corporation Bird Electronics Corporation BK Precision Brunelle Instruments, Inc. Bursma Electronic Distrib.*D C&S Sales*D Computer Component Source*D Computer & Monitor Maintenance Consolidated Electronics, Inc.*D Conway Engineering, Inc. The Current Source*D Dalco Electronics*D Dranetz-BMI East Coast Transistor*D E.I.L. Instruments, Inc.*D Electro Standards Lab, Inc. Electronix Corporation*D.....80 Electronix Express*D Elenco Electronics, Inc. Emulation Technology, Inc. Fluke Corporation Fotronic Corporation*D Global Specialties Gould Instrument Systems Inc. Hameg Instruments, Inc. Herman Electronics*D HMC — Hub Material Company*D Howard Electronic Insts. Inc.*D Huntron Instruments, Inc. IET Labs, Inc. Instek Corporation*D Interconnect Devices, Inc. International Light, Inc. International Power Technologies Iwatsu America Jameco Electronic Components*D JDR Microdevices*D W.S. Jenks & Son*D Jensen Tools, Inc.*D Kasco Distributing*D Keithley Instruments Kenwood U.S.A. Corporation Kewill E Commerce Inc*D Lascar Electronics Inc. LaserImpact L-Com Inc. Leader Instruments Corporation LEM Instruments Inc L'il Bitty Tester Marshall Industries*D MCM Electronics*D Mouser Electronics*D Multicore Solders National Instruments Corporation Nutronix Inc. Omega-Vanzetti, Inc. Omnitron Electronics*MD Pacer Industries, Inc. Panasonic Industrial Company Print Products International*D Progressive Electronics QuadTech, Inc. Quantum Data RAG Electronics Inc.*D Richardson Electronics, Ltd.*D RNJ Electronics Inc.*D RS Electronics*D Sencore Electronics.....5 Sibley TV Simpson Electronic Company Sirius Technologies Snap-On Incorporated Sorensen Specialized Prods Company*D A.W. Sperry Instruments, Inc. Sun Equipment Corporation Synergetix TechAmerica*D Techni-Tool Inc.*D Technology Programs Tektronix, Inc. Tektronix Telogy*D Temptronic Corporation Ten-Lab Tenma Test Equipment Tentel Test Equipment Depot*D TIF Instruments, Inc. Time Motion Tools*D Triplett Corporation Tritronics, Inc.*D.....80 Tucker Electronics Company UBM Corporation Union Electronics Distrib.*D Universal Enterprises (UEI) Vector-VID Inc. Viking Electronics Walker Scientific Wavetek Corporation Zack Electronics Zack/Joseph Electronics*D </p>	<p> Hi-Techniques, Inc. W.S. Jenks & Son*D Kenwood U.S.A. Corporation LaserImpact Leader Instruments Corporation Marshall Industries*D MCM Electronics*D Metric Supply*D Omega-Vanzetti, Inc. Omnitron Electronics*MD PC Instruments Incorporated Print Products International*D RAG Electronics Inc.*D RNJ Electronics Inc.*D RS Electronics*D Sencore Electronics.....5 Specialized Prods Company*D Techni-Tool Inc.*D Tektronix, Inc. Tektronix Telogy*D Tenma Test Equipment Test Equipment Connection Corp. Test Equipment Depot*D Tritronics, Inc.*D.....80 Tucker Electronics Company Ultech Corp. Union Electronics Distrib*D Wavetek Corporation Wholesale Electronics Inc.*D Zack Electronics Zack/Joseph Electronics*D OTHER TEST EQUIPMENT Accutest Instruments, Inc.*D ACM Company Allison Technology Corporation American Reliance Ames Supply Company*D Amprobe Anritsu Products ASG Division of Jergens Inc. AVO International B&B Electronics Manufacturing Vance Baldwin Inc.*D.....80 Bel Merit Corporation Bird Electronics Corporation BK Precision Brunelle Instruments, Inc. Bursma Electronic Distrib.*D C&S Sales*D Computer Component Source*D Computer & Monitor Maintenance Consolidated Electronics, Inc.*D Conway Engineering, Inc. The Current Source*D Dalco Electronics*D Dranetz-BMI East Coast Transistor*D E.I.L. Instruments, Inc.*D Electro Standards Lab, Inc. Electronix Corporation*D.....80 Electronix Express*D Elenco Electronics, Inc. Emulation Technology, Inc. Fluke Corporation Fotronic Corporation*D Global Specialties Gould Instrument Systems Inc. Hameg Instruments, Inc. Herman Electronics*D HMC — Hub Material Company*D Howard Electronic Insts. Inc.*D Huntron Instruments, Inc. IET Labs, Inc. Instek Corporation*D Interconnect Devices, Inc. International Light, Inc. International Power Technologies Iwatsu America Jameco Electronic Components*D JDR Microdevices*D W.S. Jenks & Son*D Jensen Tools, Inc.*D Kasco Distributing*D Keithley Instruments Kenwood U.S.A. Corporation Kewill E Commerce Inc*D Lascar Electronics Inc. LaserImpact L-Com Inc. Leader Instruments Corporation LEM Instruments Inc L'il Bitty Tester Marshall Industries*D MCM Electronics*D Mouser Electronics*D Multicore Solders National Instruments Corporation Nutronix Inc. Omega-Vanzetti, Inc. Omnitron Electronics*MD Pacer Industries, Inc. Panasonic Industrial Company Print Products International*D Progressive Electronics QuadTech, Inc. Quantum Data RAG Electronics Inc.*D Richardson Electronics, Ltd.*D RNJ Electronics Inc.*D RS Electronics*D Sencore Electronics.....5 Sibley TV Simpson Electronic Company Sirius Technologies Snap-On Incorporated Sorensen Specialized Prods Company*D A.W. Sperry Instruments, Inc. Sun Equipment Corporation Synergetix TechAmerica*D Techni-Tool Inc.*D Technology Programs Tektronix, Inc. Tektronix Telogy*D Temptronic Corporation Ten-Lab Tenma Test Equipment Tentel Test Equipment Depot*D TIF Instruments, Inc. Time Motion Tools*D Triplett Corporation Tritronics, Inc.*D.....80 Tucker Electronics Company UBM Corporation Union Electronics Distrib.*D Universal Enterprises (UEI) Vector-VID Inc. Viking Electronics Walker Scientific Wavetek Corporation Zack Electronics Zack/Joseph Electronics*D </p>	<p> Test Equipment Accessories AUDIO DUMMY LOADS Accutest Instruments, Inc.*D American Reliance Computer Services of America*D The Current Source*D Dalco Electronics*D Electronic Parts Supply*D Fotronic Corporation*D IET Labs, Inc. Marshall Industries*D MCM Electronics*D Metric Supply*D Omnitron Electronics*MD Parts Express International*D Print Products International*D RNJ Electronics Inc.*D Tenma Test Equipment Test Equipment Depot*D Tritronics, Inc.*D.....80 Tucker Electronics Company Zack Electronics Zack/Joseph Electronics*D DECADE BOXES: CAPACITANCE/INDUCTANCE/RESISTANCE Accutest Instruments, Inc.*D Arrow Electronics Vance Baldwin Inc.*D.....80 B-B&W Electronics*D Brunelle Instruments, Inc. Bursma Electronic Distrib.*D C&S Sales*D Consolidated Electronics, Inc.*D The Current Source*D E.I.L. Instruments, Inc.*D Electronix Express*D Elenco Electronics, Inc. Fotronic Corporation*D GC Electronics*D HMC — Hub Material Company*D Hosfelt Electronics, Inc.*D IET Labs, Inc. W.S. Jenks & Son*D Jensen Tools, Inc.*D Kenwood U.S.A. Corporation Marshall Industries*D MCM Electronics*D Mouser Electronics*D Omnitron Electronics*MD Prime Technology, Inc. Print Products International*D Prostat Corporation RAG Electronics Inc.*D RNJ Electronics Inc.*D Sun Equipment Corporation Techni-Tool Inc.*D Tenma Test Equipment Test Equipment Depot*D Tritronics, Inc.*D.....80 Tucker Electronics Company Union Electronics Distrib*D Vector-VID Inc. Wavetek Corporation Zack Electronics Zack/Joseph Electronics*D IC TEST CLIPS Accutest Instruments, Inc.*D Arrow Electronics Vance Baldwin Inc.*D.....80 </p>	

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Bursma Electronic Distrib.* D	Electronix Corporation*D.....80	Omnitron Electronics* MD	Philips ECG
Cal Test Electronics	Electronix Express* D	Print Products International* D	Pomona Electronics.....IFC
Computer Component Source* D	Electroservice Laboratories	RNJ Electronics Inc.* D	Premium Parts+ Electronics Co* D
Computer Services of America* D	Elgar Corporation	Telematic	Print Products International* D
Consolidated Electronics, Inc.* D	Fluke Corporation	Tentel	Probe Master, Inc.
Contact East, Inc.* D	Foley-Belsaw* D	Test Equipment Depot* D	Prostat Corporation
The Current Source* D	Fotronic Corporation* D	Tritronics, Inc.*D.....80	RAG Electronics Inc.* D
Dalbani Corporation* D	Fox International* D	Union Electronics Distrib.* D	RNJ Electronics Inc.* D
Digi-Key D *	Global Specialties	Zack Electronics	RS Electronics* D
East Coast Transistor* D	Hameg Instruments, Inc.	Zack/Joseph Electronics* D	Schurter, Inc.
Eiger Electronics* D	Harco Electronics* D		Score Electronics.....5
Electronic Parts Supply* D	Heath Company		Simpson Electronic Company
Electronix Corporation*D.....80	Herman Electronics* D	TEST LEADS AND PROBES	Specialized Products Company* D
Electronix Express* D	HMC — Hub Material Company* D	Accutest Instruments, Inc.* D	Sun Equipment Corporation
E-Z Hook	Hosfelt Electronics, Inc.* D	Allison Technology Corporation	TechAmerica* D
Fotronic Corporation* D	IET Labs, Inc.	American Reliance	Techni-Tool Inc.* D
Fox International* D	Instek Corporation* D	Amprobe	Tegam Inc.
Harco Electronics* D	Jameco Electronic Components* D	Avex Probes, Inc. (API)	Tektronix, Inc.
Richard Hirschmann of America	JDR Microdevices* D	AVO International	Tektronix
HMC — Hub Material Company* D	W.S. Jenks & Son* D	Vance Baldwin Inc.*D.....80	Tenma Test Equipment
Hosfelt Electronics, Inc.* D	Jensen Tools, Inc.* D	B-B&W Electronics* D	Test Equipment Depot* D
Hy-Tronix Instruments, Inc.	Keithley Instruments	Bel Merit Corporation	TIF Instruments, Inc.
Jameco Electronic Components* D	Kelvin Electronics* D	BK Precision	Time Motion Tools* D
JDR Microdevices* D	Kenwood U.S.A. Corporation	Brunelle Instruments, Inc.	Triplett Corporation
W.S. Jenks & Son* D	Leader Instruments Corporation	Bursma Electronic Distrib.* D	Tritronics, Inc.*D.....80
Kelvin Electronics* D	Marconi Instruments Inc.	C & S Sales* D	Tucker Electronics Company
Marshall Industries* D	Marshall Industries* D	Cal Test Electronics	Union Electronics Distrib.* D
M.A.T. Electronics* D	M.A.T. Electronics* D	Computer Component Source* D	Universal Enterprises (UEI)
MCM Electronics* D	MCM Electronics* D	Consolidated Electronics, Inc.* D	Wavetek Corporation
Mouser Electronics* D	Metric Supply* D	Contact East, Inc.* D	Wholesale Electronics Inc.* D
Omnitron Electronics* MD	Omega Engineering, Inc.	CSI/SPCCO	Zack Electronics
Pomona Electronics.....IFC	Omega-Vanzetti, Inc.	CSTS Inc.	Zack/Joseph Electronics* D
Premium Parts+ Electronics Co* D	Omnitron Electronics* MD	CUI Stack	
Print Products International* D	Print Products International* D	The Current Source* D	TRANSFORMERS:
R.C. Distributing Co	RAG Electronics Inc.* D	Dalbani Corporation* D	ISOLATION/VARIABLE
RNJ Electronics Inc.* D	RNJ Electronics Inc.* D	Digi-Key D *	Accutest Instruments, Inc.* D
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Tenma Test Equipment	Herman H. Sticht Company, Inc.* D	Electro Standards Lab, Inc.	BK Precision
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Zack Electronics	Test Equipment Depot* D	Fluke Corporation	Electronic Parts Supply* D
Zack/Joseph Electronics* D	Total Power International* MD	Fotronic Corporation* D	Electronic Specialists, Inc.
	Tritronics, Inc.*D.....80	Fox International* D	Electronix Corporation*D.....80
	Tucker Electronics Company	Harco Electronics* D	Electronix Express* D
	Union Electronics Distrib.* D	Heath Company	Electroservice Laboratories
	Vector-VID Inc.	Herman Electronics* D	Elenco Electronics, Inc.
	Wholesale Electronics Inc.* D	Richard Hirschmann of America	Elgar Corporation
	Zack Electronics	HMC — Hub Material Company* D	Fotronic Corporation* D
	Zack/Joseph Electronics* D	Hosfelt Electronics, Inc.* D	Harco Electronics* D
		Huntron Instruments, Inc.	Herman Electronics* D
		Interconnect Devices, Inc.	HMC — Hub Material Company* D
		Jameco Electronic Components* D	Hosfelt Electronics, Inc.* D
		JDR Microdevices* D	Jameco Electronic Components* D
		W.S. Jenks & Son* D	JDR Microdevices* D
		Jensen Tools, Inc.* D	W.S. Jenks & Son* D
		Kelvin Electronics* D	Jensen Tools, Inc.* D
		Kenwood U.S.A. Corporation	Kelvin Electronics* D
		L-Com Inc.	Marshall Industries* D
		Leader Instruments Corporation	M.A.T. Electronics* D
		Marshall Industries* D	MCM Electronics* D
		M.A.T. Electronics* D	Mouser Electronics* D
		MCM Electronics* D	Omega-Vanzetti, Inc.
		Morrow Wave Inc.	Omnitron Electronics* MD
		Oldaker Corporation	Print Products International* D
		Omega-Vanzetti, Inc.	RAG Electronics Inc.* D
		Omnitron Electronics* MD	RNJ Electronics Inc.* D
		Parts Express International* D	RS Electronics* D
		PC Instruments Incorporated	

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Staco Energy Products	Hameg Instruments, Inc.	Specialized Products Company* ^D	Powerline* ^D
Sun Equipment Corporation	Herman Electronics* ^D	Time Motion Tools* ^D	Print Products International* ^D
TechAmerica* ^D	HMC - Hub Material Company* ^D	Tritronics, Inc.*^D80	RNJ Electronics Inc.* ^D
Tenna Test Equipment	Hy-Tronix Instruments, Inc.	Zack Electronics	RS Electronics* ^D
Test Equipment Depot* ^D	Instek Corporation* ^D	Zack/Joseph Electronics* ^D	SL Waber, Inc.
Tritronics, Inc.*^D80	Interconnect Devices, Inc.		Specialized Products Company* ^D
Union Electronics Distrib.* ^D	International Light, Inc.	POWER LINE MONITORS	Sutton Designs, Inc.
Wholesale Electronics Inc.* ^D	JDR Microdevices* ^D	Accutest Instruments, Inc.* ^D	Tenna Test Equipment
Zack Electronics	W.S. Jenks & Son* ^D	Ames Supply Company* ^D	Tripp Lite
Zack/Joseph Electronics* ^D	Jensen Tools, Inc.* ^D	Arrow Electronics	Tritronics, Inc.*^D80
	Kenwood U.S.A. Corporation	Vance Baldwin Inc.*^D80	Union Electronics Distrib.* ^D
VCR TEST JIG KITS	Kewill E Commerce Inc* ^D	Bi-Tronics Inc.	Wholesale Electronics Inc.* ^D
Vance Baldwin Inc.*^D80	LaserImpact	BMI-Basic Measuring Instrument	Zack Electronics
Computer Component Source* ^D	L-Com Inc.	Brunelle Instruments, Inc.	Zack/Joseph Electronics* ^D
The Current Source* ^D	Marshall Industries* ^D	Computer Power Inc.	
Dalbani Corporation* ^D	M.A.T. Electronics* ^D	Consolidated Electronics, Inc.* ^D	SURGE/SPIKE PROTECTORS
East Coast Transistor* ^D	MCM Electronics* ^D	Contact East, Inc.* ^D	Alpha Technologies
Electronic Parts Supply* ^D	Moody Tools, Inc.	Conway Engineering, Inc.	American Power Conversion Corp.
Electronix Corporation*^D80	Mouser Electronics* ^D	The Current Source* ^D	Ames Supply Company* ^D
Electroservice Laboratories	Nationwide Electronics	Digi-Key D* ^D	Arrow Electronics
Foley-Belsaw* ^D	Omega Engineering, Inc.	E.I.L. Instruments, Inc.* ^D	Vance Baldwin Inc.*^D80
Fotronic Corporation* ^D	Omega-Vanzetti, Inc.	Electronic Specialists, Inc.	B-B&W Electronics* ^D
Fox International* ^D	Omnitron Electronics* ^{MD}	Electroservice Laboratories	Bi-Tronics Inc.
Herman Electronics* ^D	Parts Express International* ^D	Galco Industrial Electronics* ^D	Bursma Electronic Distrib.* ^D
Marshall Industries* ^D	Pomona Electronics IFC	Global Specialties	Computer Component Source* ^D
M.A.T. Electronics* ^D	Premium Parts+ Electronics Co.* ^D	HMC — Hub Material Company* ^D	Computer Services of America* ^D
MCM Electronics* ^D	Print Products International* ^D	Hosfelt Electronics, Inc.* ^D	Consolidated Electronics, Inc.* ^D
Nationwide Electronics	Probe Master, Inc.	IET Labs, Inc.	Contact East, Inc.* ^D
Omnitron Electronics* ^{MD}	RAG Electronics Inc.* ^D	JDR Microdevices* ^D	Controlled Power Company
RNJ Electronics Inc.* ^D	R.C. Distributing Co	W.S. Jenks & Son* ^D	The Current Source* ^D
Sencore Electronics5	RNJ Electronics Inc.* ^D	Jensen Tools, Inc.* ^D	Dalbani Corporation* ^D
Sun Equipment Corporation	RS Electronics* ^D	L-Com Inc.	Dalco Electronics* ^D
Tenna Test Equipment	Sencore Electronics5	M.A.T. Electronics* ^D	Dana Corp Warner Electric
Tentel	Simpson Electronic Company	PowerTronics	Delta Warranty
Test Equipment Depot* ^D	Specialized Prods Company* ^D	Print Products International* ^D	Digi-Key D* ^D
Tritronics, Inc.*^D80	Synergetix	RS Electronics* ^D	Eiger Electronics* ^D
Union Electronics Distrib* ^D	TechAmerica* ^D	SL Waber, Inc.	E.I.L. Instruments, Inc.* ^D
Zack Electronics	Techni-Tool Inc.* ^D	Specialized Products Company* ^D	Electro Standards Lab, Inc.
Zack/Joseph Electronics* ^D	Tektronix, Inc.	Sun Equipment Corporation	Electronic Parts Supply* ^D
	Tektronix	Techni-Tool Inc.* ^D	Electronic Specialists, Inc.
	Telematic	Tenna Test Equipment	Electronix Express* ^D
OTHER TEST EQUIPMENT	Tempron Corporation	Time Motion Tools* ^D	Excel Distributing* ^D
ACCESSORIES	Tenna Test Equipment	Tritronics, Inc.*^D80	Fox International* ^D
Accutest Instruments, Inc.* ^D	Tentel	Tucker Electronics Company	Galco Industrial Electronics* ^D
Allison Technology Corporation	Test Equipment Depot* ^D	Wholesale Electronics Inc.* ^D	GC Electronics* ^D
American Reliance	Time Motion Tools* ^D	Zack Electronics	Harco Electronics* ^D
Anritsu Products	Tritronics, Inc.*^D80	Zack/Joseph Electronics* ^D	Herman Electronics* ^D
Vance Baldwin Inc.*^D80	Tucker Electronics Company		HMC — Hub Material Company* ^D
Bel Merit Corporation	Ultech Corp	STANDBY POWER SYSTEMS	Hosfelt Electronics, Inc.* ^D
BK Precision	Union Electronics Distrib.* ^D	Alpha Technologies	International Power Technologies
Brunelle Instruments, Inc.	Universal Enterprises (UEI)	American Reliance	JDR Microdevices* ^D
Bursma Electronic Distrib.* ^D	Wavetek Corporation	Ames Supply Company* ^D	W.S. Jenks & Son* ^D
C & S Sales* ^D	Zack Electronics	Arrow Electronics	Jensen Tools, Inc.* ^D
Chicago Case Company	Zack/Joseph Electronics* ^D	Vance Baldwin Inc.*^D80	Kaligio Electronics Company, Inc.
Computer Component Source* ^D		Bi-Tronics Inc.	Kasco Distributing* ^D
Consolidated Electronics, Inc.* ^D	Circuit Damage	Computer Power Inc.	L-Com Inc.
The Current Source* ^D	Protective	Consolidated Electronics, Inc.* ^D	Marshall Industries* ^D
Dalbani Corporation* ^D	Equipment/Supplies	Controlled Power Company	M.A.T. Electronics* ^D
Dalco Electronics* ^D		The Current Source* ^D	MCG Surge Protection
East Coast Transistor* ^D	GROUNDING SYSTEMS	Dalco Electronics* ^D	MCM Electronics* ^D
E.I.L. Instruments, Inc.* ^D	Arrow Electronics	Dana Corp Warner Electric	Meirick, Inc.
Electro Standards Lab, Inc.	Bi-Tronics Inc.	Digi-Key D* ^D	MGE UPS Systems
Electronic Parts Supply* ^D	Bivar Inc	Fox International* ^D	Mouser Electronics* ^D
Electronix Corporation*^D80	Bursma Electronic Distrib.* ^D	Harco Electronics* ^D	Omega Engineering, Inc.
Electronix Express* ^D	Contact East, Inc.* ^D	Herman Electronics* ^D	Panamax, Inc.
Electroservice Laboratories	The Current Source* ^D	HMC — Hub Material Company* ^D	Parts Express International* ^D
Elenco Electronics, Inc.	Electroservice Laboratories	Hosfelt Electronics, Inc.* ^D	Philips ECG
Elgar Corporation	Fox International* ^D	W.S. Jenks & Son* ^D	J.S. Popper, Inc.
Emulation Technology, Inc.	HMC — Hub Material Company* ^D	M.A.T. Electronics* ^D	Powerline* ^D
E-Z Hook	W.S. Jenks & Son* ^D	Meirick, Inc.	Print Products International* ^D
Fluke Corporation	Mouser Electronics* ^D	Philips ECG Company* ^D	Recoton Corporation
Fotec Inc		Phililek Power Corporation	RNJ Electronics Inc.* ^D
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Fox International* ^D			

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Specialized Products Company*D	Wholesale Electronics Inc.*D	Dalbani Corporation*D	Zack Electronics
Sutton Designs, Inc.	Zack Electronics	Desco	Zack/Joseph Electronics*D
Techni-Tool Inc.*D	Zack/Joseph Electronics*D	East Coast Transistor*D	
Tenma Test Equipment		Eiger Electronics*D	ANTISTATIC MATS/ BENCHTOPS/ WRIST STRAPS/OTHERS
Time Motion Tools*D	VOLTAGE REGULATORS	Electro Dynamics, Inc.*D	All Metal Designs
Tripp Lite	Arrow Electronics	Electronic Prod. Specialties*D	Ames Supply Company*D
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Zack Electronics	Computer Power Inc.	GC Electronics*D	B-B&W Electronics*D
Zack/Joseph Electronics*D	Consolidated Electronics, Inc.*D	Harco Electronics*D	Bursma Electronic Distrib.*D
	Contact East, Inc.*D	Herman Electronics*D	Charleswater
UNINTERRUPTIBLE POWER SUPPLIES	Controlled Power Company	HMC — Hub Material Company*D	Clauss Electronics Div.
Alpha Technologies	The Current Source*D	Hy Tec Dealer Service	Computer Component Source*D
American Power Conversion Corp	Dalbani Corporation*D	W.S. Jenks & Son*D	Computer Services of America*D
American Reliance	Dalco Electronics*D	JIT Resources, Inc.	Contact East, Inc.*D
Ames Supply Company*D	Dana Corp Warner Electric	Klein Tools, Inc.	The Current Source*D
Arrow Electronics	Digi-Key D*	3M Black Watch c/o Ginther Group	Dalbani Corporation*D
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Behlman Electronics	E.I.L. Instruments, Inc.*D	M.A.T. Electronics*D	Den-On Instruments (USA), Inc.
Best Power	Electronic Parts Supply*D	MCM Electronics*D	Desco
Bi-Tronics Inc.	Electronic Specialists, Inc.	MG Chemicals	Digi-Key D*
C. Hoelzle Associates, Inc.	Electronix Express*D	Micro Care Corporation	Electro Tool, Inc.
Clary Corporation	Electroservice Laboratories	Miller-Stephenson Chemical Co.	Electronic Prod. Specialties*D
Computer Component Source*D	Fox International*D	Mouser Electronics*D	Electro-Tech Systems, Inc.
Computer Power Inc.	Harco Electronics*D	Nationwide Electronics	Electronix Express*D
Consolidated Electronics, Inc.*D	Herman Electronics*D	Philips ECG Company*D	Electroservice Laboratories
Contact East, Inc.*D	Hexacon Electric Company	Print Products International*D	Elenco Electronics, Inc.
Controlled Power Company	HMC — Hub Material Company*D	Prostat Corporation	Excel Distributing*D
CSI/SPCCO	Hosfelt Electronics, Inc.*D	Rogers Anti-Static Chemicals	Fox International*D
The Current Source*D	JDR Microdevices*D	RS Electronics*D	Harco Electronics*D
Dalco Electronics*D	W.S. Jenks & Son*D	Syon Corporation	Herman Electronics*D
Dana Corp Warner Electric	Kelvin Electronics*D	Tandy National Parts*D	HMC — Hub Material Company*D
Delta Warranty	M.A.T. Electronics*D	Tech Spray, Inc.	Hosfelt Electronics, Inc.*D
Digi-Key D*	MGE UPS Systems	Techni-Tool Inc.*D	W.S. Jenks & Son*D
Electronic Specialists, Inc.	Mouser Electronics*D	3M Electronic Prods Division	Jensen Tools, Inc.*D
Electronix Express*D	Parts Express International*D	Time Motion Tools*D	JIT Resources, Inc.
Electroservice Laboratories	Philips ECG	Tritronics, Inc.*D.....80	Kasco Distributing*D
Elgar Corporation	Print Products International*D	Union Electronics Distrib.*D	Marshall Industries*D
Fox International*D	RS Electronics*D	Wescorp	M.A.T. Electronics*D
Galco Industrial Electronics*D	Salen Enterprises*D	Wholesale Electronics Inc.*D	MCM Electronics*D
Harco Electronics*D	Shape Electronics	Zack Electronics	MG Chemicals
Herman Electronics*D	SL Waber, Inc.	Zack/Joseph Electronics*D	Micro Care Corporation
HMC — Hub Material Company*D	Snap-On Incorporated		Moody Tools, Inc.
Hosfelt Electronics, Inc.*D	Specialized Products Company*D	ANTISTATIC IONIZATION DEVICES	Mouser Electronics*D
International Power Tehnlgies	Staco Energy Products	Charleswater	Nationwide Electronics
JDR Microdevices*D	Sun Equipment Corporation	Computer Services of America*D	Platt Luggage, Inc.
W.S. Jenks & Son*D	Sutton Designs, Inc.	Contact East, Inc.*D	Pomona Electronics.....IFC
Jensen Tools, Inc.*D	TechAmerica*D	The Current Source*D	Print Products International*D
M.A.T. Electronics*D	Time Motion Tools*D	Desco	Prostat Corporation
MCM Electronics*D	Tritronics, Inc.*D.....80	Electronic Prod. Specialties*D	Richmond Technology
Meirick, Inc.	Wholesale Electronics Inc.*D	Electro-Tech Systems, Inc.	RNJ Electronics Inc.*D
MGE UPS Systems	Zack Electronics	Harco Electronics*D	Rogers Anti-Static Chemicals
Nationwide Electronics	Zack/Joseph Electronics*D	HMC — Hub Material Company*D	RS Electronics*D
Parts Express International*D		W.S. Jenks & Son*D	Semtronics Corporation
Philtek Power Corporation	Electrostatic Discharge Protection	JIT Resources, Inc.	Simco Static Control & Chrm Prd
J.S. Popper, Inc.	ANTISTATIC CHEMICALS	Marshall Industries*D	SAT/A SPIRIG Company*D
Powerline*D	Ames Supply Company*D	M.A.T. Electronics*D	Specialized Prods Company*D
Print Products International*D	Andrews Electronics*D.....IBC	Nationwide Electronics	Sun Equipment Corporation
RNJ Electronics Inc.*D	Vance Baldwin Inc.*D.....80	Print Products International*D	Tandy National Parts*D
RS Electronics*D	Bursma Electronic Distrib.*D	Prostat Corporation	TechAmerica*D
SL Waber, Inc.	CAIG Laboratories, Inc.	RS Electronics*D	Techni-Tool Inc.*D
Sorensen	Charleswater	Semtronics Corporation	Teclab-Kalamazoo Tech Furn
Specialized Prods. Company*D	Chemtronics	Simco Static Cntrl & Chrm Prd	3M Electric Hndlq & Prot Div
Staco Energy Products	Computer Component Source*D	Techni-Tool Inc.*D	3M Electronic Prods Division
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Marshall Industries*D
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Simco Static Control & Clnum Prd
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JDR Microdevices*D
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MCM Electronics*D
Mouser Electronics*D
Nationwide Electronics
Nesco Batteries
Omega Engineering, Inc.
ORA Electronics
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ELECTRONIC

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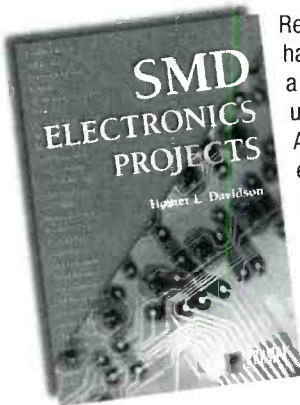
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<http://www.moodytools.com>

Moore Business Products

111 Barclay Blvd. #400
Lincolnshire, IL 60069
847-913-3200
Fax: 847-913-3293

Morrow Wave Inc.

13013 East 166th Street
Cerritos, CA 90703-2201
562-404-0101
Fax: 562-921-6227
E-mail: morrow@flashcom.net
Website:
<http://www.oscilloscope.com>

Mouser Electronics* D

958 North Main Street
Mansfield, TX 76063
817-483-6888
800-346-6873
Fax: 817-483-6899
E-mail: sales@mouser.com
Website: <http://www.mouser.com>

Mr Appliance

1020 North University Parks Drive
Box 3146
Waco, TX 76707
254-745-5050

Mueller Electric Company

1583 East 31st Street
Cleveland, OH 44114-4354
216-771-5225
800-955-2629
Fax: 216-771-3068

Multicore Solders

1751 Jay Ell Drive
Richardson, TX 75081-1835
14-238-1224
Fax: 214-437-0288

Multidyne Inc

191 Forest Avenue
Locust Valley, NY 11560-2132
516-671-7278
800-4TV-TEST
Fax: 516-671-3362
E-mail: Info@multidyne.com
Website: <http://www.multidyne.com>

Multiplex Technology, Inc.

3200 East Birch Street
Brea, CA 92621-6258
714-996-4100
800-999-5225
Fax: 714-996-4900

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National Computer Association

Ulmerton Business Center
13555 Automobile Blvd., Suite 240
Clearwater, FL 34622
813-556-2775
800-615-6224
Fax: 813-556-2783
E-mail: Nca@gte.net
Website: <http://www.nca-net.com>

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Lombard, IL 60148-4977
630-953-8950
800-621-0298
Fax: 630-953-8957
E-mail: Nardahdq@aol.com
Website: <http://www.narda.com>

National Parts Depot* D

31 Elkay Drive
Chester, NY 10918
914-469-4800
Fax: 914-469-4855

National Electronics Warranty

44873 Falcon Place
Sterling, VA 20166
703-318-7700
800-942-8763
Fax: 703-709-7929
E-mail: Info@newcorp.com

National Instruments Corporation

6504 Bridge Point Parkway
Austin, TX 78730-5039
512-794-0100
800-258-7022
Fax: 512-794-8411
E-mail: Info@natinst.com
Website: <http://www.natinst.com>

Nationwide Electronics

1242 East Lexington Avenue
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800-659-3186
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Website: <http://www.neiparts.net>

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New York, NY 10119
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NCM Electronics

20393 Kent Way
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NEC Technologies, Inc.* D

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Netway 2000 Inc.

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Network Technologies, Inc.

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Newport Electronics, Inc.

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Panasonic Services Company

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Philtex Power Corporation

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Pioneer Research

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San Jose, CA 95124-6133
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Plato Products, Inc.
18371 Railroad Street
City of Industry, CA 91748
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Fax: 626-965-8960
E-mail: Sales@plato products.com
Website:
<http://www.platoproducts.com>

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4051 W. 51st Street
Chicago, IL 60632-4211
773-838-2000
800-222-1555
Fax: 773-838-2010
E-mail: info@plattcases.com
Website:
<http://www.platluggage.com>

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Largo, FL 34643
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800-444-5920
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201-641-3252
Fax: 201-440-4283

Portasol, Inc.
3129 Chaucer Drive
Charlotte, NC 28210-4818
704-553-7346
Fax: 704-553-7974

Powerline*D
Battery Specialist Company
4268 Los Angeles Avenue
Simi Valley, CA 93063-3366
805-527-2288
800-234-2444
Fax: 805-527-8336
E-mail: Mail@powerline-battery.com
Website: Powerline-battery.com

PowerSource Online Inc.
5703 Oberlin Drive, Suite 202
San Diego, CA 92121
858-558-1227
800-215-0049
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Projector Recorder Belt*D
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Fax: 800-887-2727
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Houston, TX 77040
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Simon & Schuster Education Group
One Lake Street
Upper Saddle River, NJ 07458
201-236-7139
Fax: 201-236-7131

Prime Technology, Inc.
International Insts. Div.
Twin Lakes Road, P.O. Box 185
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El Cajon, CA 92020
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Production Devices
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The panelists, six corporate executives and an industry analyst, said wireless devices would perform a wide range of functions including peer-to-peer communications, digital chats, enterprise mail, brokerage and banking transactions, as well as paging and voice communication. Opinions of the panel participants differed on exactly what devices would be necessary to deliver the wide range of services.

"I do not believe all of this can be stuffed into any one telephone," said Bill Lenahan of Bell South Wireless Data Services. "People will have to carry two devices."

Mark Lowenstein, a Yankee Group analyst, predicted that the industry will become increasingly innovative with hardware. One device will be a telephone. The other will be a personal digital assistant or, perhaps, a "mobile companion." Lowenstein added, "CES is going to take center stage for hardware for wireless." Indeed, many people in the industry believe this wireless explosion is already developing.

The 2000 CES wireless product area features a host of advanced technologies from many of the world's leading manufacturers including Ericsson, Motorola, Nokia, Samsung, and others. Wireless products at the show range from telephones and pagers to hand-held GPS receivers and wireless Internet devices.

Panelist Bo Dimert of Ericsson predicted that disparate mobile communications hardware in the near future will be capable of seamless communications. There will be, he predicted, equipment — a phone, a headset, a printer, a keyboard, etc. — that all work together but are connected without wires.

Bluetooth, the standard that permits the networking and integration of arbitrary devices, is being demonstrated at the 2000 International CES. The underlying technology is based on low-

cost, short-range radio links among devices, and the Bluetooth compatibility standard is gaining acceptability among hardware companies and momentum in the world of software.

Panelists noted that wireless communications products soon will be imbedded into appliances to facilitate remote maintenance and monitoring; that wireless equipment could be woven into clothes and worn and could replace cameras, credit cards, and wireline telephones.

In fact, Roxanne Jozwick of AT&T Wireless noted that there are more mobile than wireline phones in Finland and suggested that a growing number of Americans are relying on wireless systems as their primary telephone service. She noted that some Internet users are turning to wireless access instead of waiting for digital subscriber line (DSL) service.

In contrast to the majority of the panel's predictions of more sophisticated wireless services, one panelist, Sue Swenson of Leap Wireless International, made the case for a more basic approach. Swenson explained that 30 percent of Americans have wireless phones and asked, "what about the other 70 percent?" Among that group, she said, is a substantial market for basic limited voice service.

Wireless technology discussions are included in the 11 conference tracks and 130 conference sessions offered at the 2000 International CES. In addition to wireless and mobile electronic communications, the show includes tracks on emerging technologies, lifestyle technology, e-commerce, retail management, specialty audio, and workstyle technology. Digital Hollywood and the Habitech Institute provide an array of sessions on home theater, integrated home systems, and digital entertainment.

CEA expresses concern with FCC lower power rule

The following statement was issued in January by Consumer Electronics Association (CEA) President and CEO Gary Shapiro in response to the previous week's ruling by the Federal Communications Commission (FCC) to develop a new low power FM (LPFM) radio service. The Commission announced that it will create two new classes of broadcast stations with power of up to 10 and 100 watts, respectively, and will remove the third adjacent channel interference protection currently enjoyed by FM broadcasters.

"We share the FCC's worthy commitment to promoting greater access to the airwaves. Unfortunately, we have found that the method chosen by the Commission — specifically, the removal of third adjacent channel protection — may result in interference to existing FM radio service and would adversely affect consumers' investment in the 710 million FM receivers currently in use in the United States. In addition, these new FM stations will cause interference that may hinder the introduction of terrestrial digital audio broadcasting (DAB).

"CEA conducted extensive FM receiver tests with the support of National Public Radio and the Corporations for Public Broadcasting. These tests, which were submitted to the FCC, demonstrated that third adjacent channel interference protection should be retained to prevent new interference to existing FM receptions."

"We look forward to working with the Commissions on additional ways to promote diversity in radio voices. But this laudable goal must not come at the expense of impairing the quality of FM radio service that the American public receives today."

ES&T Calendar

2000 National All Service Convention
March 1-5, 2000
Orlando, FL

Electronic Technicians Association
602 N. Jackson Street
Greencastle, IN 46135
Phone: 800-288-3824
Fax: 765-653-4287
E-mail: eta@indy.tdsnet.com
Website: www.eta-sda.com

Home Automation Convention
March 3-5, 2000
Orange County Convention Center
Orlando, FL
John Galanie 703-352-9111

ETA Annual Membership Meeting
May 5-6, 2000
ETA Headquarters
604 N. Jackson
Greencastle, IN 46135, and
The Walden Inn
Greencastle, IN
ETA: 765-653-8262

NESDA 50th/ISCET 30th/NIAS 8th Annual National Professional Service Convention and Professional Service Trade Show
August 7-12, 2000
John Ascuaga's Nugget Hotel
Sparks (Reno) NV

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***Automotive Electrical Systems: Troubleshooting and Repair Basics*, by Vaughn D. Martin, 272 pages, \$29.95**

Your car has an electrical problem — maybe your entire electrical system is shorting out or your battery is continually drained. Can you fix it yourself? *With Automotive Electrical Systems: Troubleshooting and Repair Basics*, you most likely can! Chilton manuals assume that you already know enough to fully understand and fix the problem you are having. *Automotive Electrical Systems* fills that knowledge and experience gap, allowing you to better understand your car's electrical systems and computers well enough to buy replacement parts and then use the manual to aid in the installation.

***Computer Monitor Troubleshooting and Repair*, by Joseph Desposito and Kevin Garabedian, 336 pages, \$34.95**

Learn the basics of computer monitor circuits, tools and test equipment, special safety procedures, how to find a problem, how to troubleshoot and repair dozens of specific circuits, how to find a faults in the CRT, plus much more.

PROMPT Publications, 2647 Waterfront Parkway, East Drive, Indianapolis, IN 46214-2041

***Troubleshooting & Repair Guide to TV, 2/E*, by the Engineering Staff of Howard W. Sams, 264 pages, \$34.95**

The most complete and up-to-date television repair book available with tips on how to troubleshoot the newest circuits in today's TVs. This useful guide contains comprehensive coverage of television basics, and extensive coverage of common TV symptoms and how to correct them. Included are tips on how to find electronic problems that interfere with TV performance, and a question-and-answer section at the end of each chapter — useful for instructors or anyone teaching themselves TV repair.

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***Complete VCR Troubleshooting and Repair*, by Joe Desposito and Kevin Garabedian, 192 pages, \$34.95**

Complete VCR Troubleshooting and Repair contains sound troubleshooting procedures beginning with an examination of the external parts of the VCR, then narrowing the view to the gears, springs, pulleys, belts, and other mechanical parts.

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PROMPT Publications, 2647 Waterfront Parkway, East Drive, Indianapolis, IN 46214-2041

***CSS Study Guide for Customer Service Specialists*, by the Electronics Technicians Association, 116 pages, paperback, \$30.00**

The Electronics Technician Association, International, Inc., has published the second edition of the *CSS Study Guide for Customer Service Specialists*.

The 116 page book contains 19 chapters of instruction, rules, policies, and techniques that have proven to be needed by workers who handle customers, as service technicians, installers, repairers, help-desk workers, receptionists, and sales people.

While ETA's Certification program for customer service specialists was originally intended for electronics technicians, in 1980 when it was conceived, it quickly was reconfigured to broaden its scope to cover virtually all areas of work that require interfacing with the public.

The CSS program is now offered as a stand-alone short course at some technical schools and as a segment added onto many computer and electronics technical courses. This CSS study guide provides a virtual course outline and prepares students to pass the CSS Certification Examination. It contains over 170 practice CSS Quiz questions.

ETA, 604 N Jackson, Greencastle, IN 46135, Phone: 765-653-8262, Fax: 765-653-4287, Website: www.eta-sda.com, E-mail: eta@indy.tdsnet.com

***U.S. Consumer Electronics Industry Today*, by the Consumer Electronics Manufacturers Association, \$11.99 (CEMA members), \$14.99 non-members**

The Consumer Electronics Manufacturers Association (CEMA) has published *U.S. Consumer Electronics Industry Today*. The book gives a historical perspective on the technological advances that have affected trends in the consumer electronics market as well as provides updated statistics for 1998.

Inclusive in *U.S. Consumer Electronics Industry Today* are chapters on video, audio, mobile electronics, communication and information technology, integrated home systems and accessories. For the first time, the publication will include a pull-out timeline showing significant industry events dating back more than a century and equates them with today's technological milestones. It also includes an overview of the industry during 1998 and a directory listing of other consumer electronics industry sources.

All statistics in *U.S. Consumer Electronics Industry Today* were compiled by CEMA's Market Research department.

CEMA, 2500 Wilson Blvd., Arlington, VA 22201, Phone: 703-907-7600, Fax: 703-907-7601, Website: www.CEMACity.org

***Power Supply Troubleshooting & Repair*, by Lanny L. Logan, 208 pages, \$29.95**

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Coming next month

ES&T's April issue will feature an article by John Ross on service management software: what it is, how it can help streamline the operation of a service center.

And for those of you who want to know a little more about digital television (DTV), we will feature an article that will describe some of the technology behind the DTV revolution.

The buzzwords of the day in consumer electronics today are "convergence," and "connectivity." Convergence means the coming together of previ-

ously disparate elements. For example, today, a lot of entertainment is now coming to consumers via the internet. And connectivity describes the many ways, other than computers, that consumers can now connect to the internet. This article will describe some of the new technology that's driving all the changes.

Also featured will be our annual "Distributor Showcase," in which we invite distributors to give readers a little more information than they can get across in an ad.

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Sencore VC93 all format VCR analyzer, like new with all manuals, schematics, tapes and accessories, \$525.00 plus shipping. *Contact: Gerald Wheaton, 252-745-4493 or 252-745-5707.*

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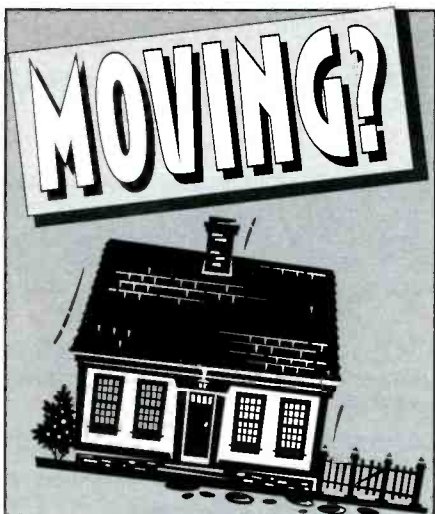
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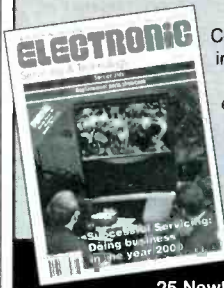
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