THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

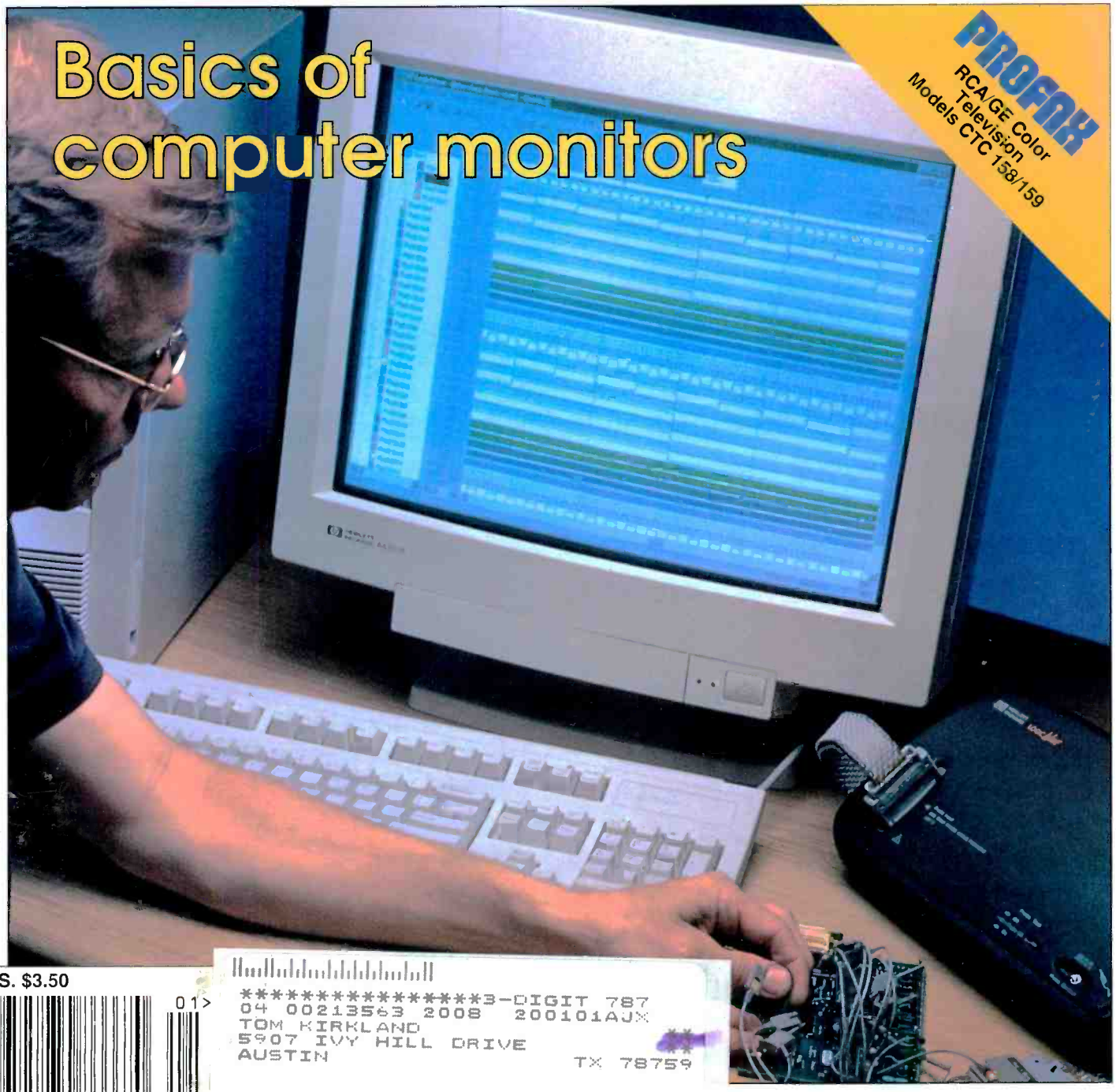
ELECTRONIC Servicing & Technology

T.M.

January 2000

Diagnostic software

Digital imaging



U.S. $3.50

01>

7 25274 86667 0

Bring home the cash with in-home servicing of high-end electronics. Quickly and accurately aligning big-ticket items like projection TVs for your customer's total viewing satisfaction can be your best opportunity for profitability. Sencore offers servicing solutions for progressive servicers with portable, durable and reliable test equipment that brings the "best of the bench" to every home.

HA2500 Universal Horizontal Analyzer

Localize horizontal and B+ Supply defects in less time and more profitably than ever before!

- Exclusive "Horizontal Output Load Test" makes setup and testing a snap - even without applying AC power for faster diagnosis
- Patented "ringer" proves the condition of flybacks and yokes in seconds
- Exclusive "dynamic tests" help you analyze the horizontal circuit in powered-up conditions

VG91 Universal Video Generator

This complete all channel RF/IF/MTS Universal Video Generator performance tests and isolates defects in any NTSC video system, including big screen TV systems!

- Proof-positive tests for MTS Stereo/SAP on all channels
- Exclusive and dynamic NTSC video test signals
- Standard, Y/C, composite video, and audio line outputs

SENCORE

www.sencore.com • email:sales@sencore.com

Circle (1) on Reply Card

1-800-SENCORE

ELECTRONIC
Servicing & Technology

Volume 20, No. 1 January 2000

contents

FEATURES

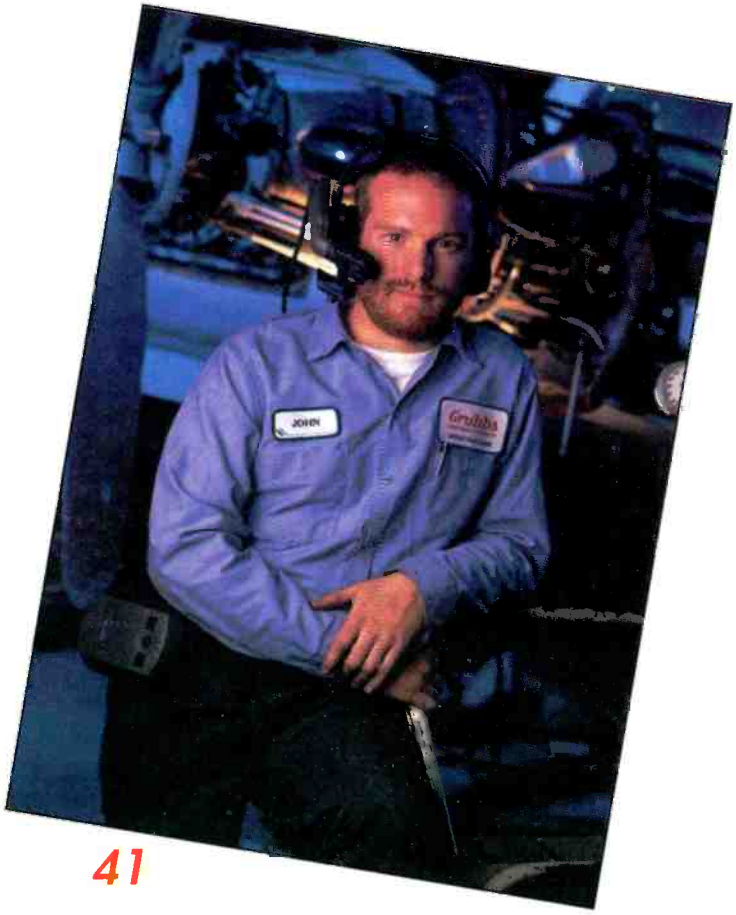
EDITORIAL INDEX

DEPARTMENTS

41

ON THE COVER

Personal computer servicing has created a new challenge for consumer electronics servicing technicians. These products are multifaceted, consisting of the basic computer unit, a monitor, and a growing array of permanent and erasable storage media and record/read devices. The service center that makes the decision to service these products will require a broad array of test equipment and diagnostic software to get the job done. (Photo courtesy of Hewlett-Packard.)



41

Editorial

by Nils Conrad Persson

If you're reading this editorial in January of the year 2000, then it's safe to assume that the world as we know it didn't end at midnight on December 31, 1999. Apparently, we all made it safely through the transition to the new century, and the new millennium.

Of course, there were those among us who thought that civilization would come to a screeching halt, and who fled to the wilds of the less populated states in the U.S., and hunkered down in their bunkers with a year's worth of supplies to await Armageddon. I bet they're feeling a bit silly now. And there were those who, for any of a number of reasons, were hoping that the world would end at the turn of the millennium, and even some who took action to try to see that apocalyptic events took place.

No doubt there were a few glitches, and there still will be, as a result of the so-called "millennium bug," or "the Y2K problem," but as the more level-headed among us predicted, I'm sure as I write this on the 9th day of December 1999, that for the most part, things are still functioning pretty much as they did as I wrote this. It has occurred to me that this is a very safe prediction to make since if I'm wrong, this issue of the magazine will never be delivered and there will be no one to read it.

O.K., I've had my fun. But there is a serious message for consumer electronics service technicians, and consumer electronics service centers in the deep fears that were engendered by the Y2K computer problem: computers are everywhere. Computers are used to control switching of electric utilities. If the computers don't work, the power grid won't either.

Computers are used to control the delivery of our drinking water. Computers control the delivery of petroleum products, natural gas, and other energy products. The bank, the credit card company, and everyone who sends us bills for any kind of services all use computers.

The world in general is increasingly digital (and that means computers of a sort). Current consumer products that are digital in nature are DVD, DTV, HDTV, CD, digital cameras, personal computers, and more. Moreover, where consumer electronic service centers are concerned, the information that they need to troubleshoot and repair products is increasingly in digital form. And then there's the fact that increasingly, manufacturers are encouraging service centers to submit warranty claim information via computer.

There are still some holdouts who feel that computers somehow intrude on their lives, so they just will not have anything to do with computers. The fact is, like it or not, that computers are everywhere, and affect our lives on a daily basis, whether we like it or not. We already mentioned the utilities, the airlines, the bank, and a few other entities that use computers, but whenever you go to the doctor's office or the dentist, the likelihood approaches 100% that they keep track of your account using computers. And when you go to the grocery store, the drugstore, the auto parts store, even the grocery store, what looks like a cash register is actually a point-of-sale (POS) terminal, and all the transactions are actually being handled by a computer. The use of computers, including consumer electronic servicing business, just makes sense.

Most of us don't really have a good appreciation of this fact, but many other technologies that were already in place when we were born actually had as profound an effect, or even more profound, on society when they were introduced, than the computer has had today. Take a technology that we take totally for granted, that seems so innocuous today: the chronometer (clock or watch). Before the invention of a device that could keep time to the minute, or even fraction of a second, peoples' lives were measured by the rising and setting of the sun, and the ebbing and flowing of the seasons through the year. Appointments for two people to meet were generally defined broadly; for example, mid-morning, midday, mid-afternoon, and if one person's definition of that time were different from the other person's definition, someone had to wait. Without the existence of the chronometer, the industrial revolution would not have taken place as it did. Mass production depends on the arrival of large numbers of people at the same place at the correct time.

The invention of electric light also had a profound effect on society that we, having lived in its presence all our lives, can't appreciate. Before cheap, reliable, artificial light sources were developed, people more or less got up with the rising of the sun and went to bed when the sun went down. Evening social events were planned to coincide with the full moon because that was the only light that the attendees had available to travel by.

And if you want to look to a technology that has caused fundamental changes in peoples' lives, you need look no further than the automobile. Besides the machine itself, the roads necessary for it to operate on have changed not only the landscape, but our lives. Before the automobile, most people lived in the city, or on the farm. Cars made it easy to live in a suburb and travel into the city to work. Whole communities owe their existence to cars. The roads not only connect us, but some roads, such as limited-access highways create artificial barriers between parts of communities that once were connected.

And remember; when cars were first invented, masses of people condemned them as being dangerous, noisy, smelly. It wasn't unusual when a car drove by for someone to yell out "get a horse." The automobile is now firmly ensconced in our society, and almost universally accepted.

Personal computers have had powerful effects on the entire world, both for good and for ill. But it is only the latest of many technologies whose sum makes the world vastly different from what it was in the first, and most of the second millennium. In spite of the lack of foresight on the part of computer programmers in the early years that led to the Y2K problem, we have made it through the crisis. Now that computers and their programs use a four-digit date, we no longer have to worry that computers will become confused at the turn of the century. Well, at least not until the year 10,000. ■

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.

EDITORIAL
Nils Conrad Persson, *Editor*
(Internet e-mail: cpersedit@aol.com)
Alycia Nicholsen, *Associate Editor*
(Internet e-mail: AlyciaEST@aol.com)
Richard S. Moseson, W2VU, *On-Line Coordinator*

CONSULTING EDITORS
Homer L.Davidson, *TV Servicing Consultant*
Victor Meeldijk, *Components Consultant*
John E. Shepler, *Audio Consultant*
Sam Wilson, *Electronics Theory Consultant*

PRODUCTION
Elizabeth Ryan, *Art Director*
Barbara McGowan, *Associate Art Director*
Edmond Pesonen, *Electronic Composition Mgr.*
Dorothy Kehrwieder, *Production Manager*
Emily Leary, *Assistant Production Manager*
Pat Le Blanc, *Phototypographer*

BUSINESS
Richard A. Ross, *Publisher*
Sal Del Grosso, *Accounting Manager*
Ann Marie DeMeo, *Accounting Department*
Judith Erickson, *Office Manager*
Catherine Ross, *Circulation Manager*
Melissa Gilligan, *Operations Manager*
Denise Kells, *Data Processing*
Jennifer Cormagi, *Customer Service*

ADVERTISING SALES OFFICE
Kaprelian & Company, Inc.
521 Illinois Avenue, St. Charles, IL 60174
Tel.: 630-584-5333 Ext. 10 • Fax: 630-584-9289

Bill Kaprelian, *Director of Advertising*
Emily Leary, *Sales Assistant*

EDITORIAL CORRESPONDENCE:
P.O. Box 12487
Overland Park, KS 66212
913-492-4857

ETA

National Electronics Service NESDA Dealers Association, Inc. Member, Electronic Servicing Dealers Association

Electronic Servicing & Technology (ISSN 0278-9922) is published 12 times a year by CQ Communications, Inc. 25 Newbridge Road, Hicksville, NY 11801. Telephone (516) 681-2922. Periodical class postage paid at Hicksville, NY and additional offices. Subscription prices (payable in US dollars only): Domestic—one year $26.95, two years $49.95. Canadian—one year $36.95, two years $69.95. Foreign Air Post—one year $44.95, two years $85.95.
Printed in the United States of America.

Postmaster: Please send change of address notice to Electronic Servicing & Technology, 25 Newbridge Road, Hicksville, NY 11801.

CQ Communications, Inc. is publisher of CQ The Radio Amateur's Journal, Popular Communications, CQ Radio Amateur (Spanish CQ), CQ VHF, CQ Contest, and Electronic Servicing & Technology.

News

Website makes choosing the proper antenna easy

Using the Internet, consumers soon will have a fast, effective tool to help them receive off-air local television signals, announced the Consumer Electronics Manufacturers Association (CEMA). The association is launching AntennaWeb.org this fall, a Website designed specifically to show users exactly what type of outdoor antenna will help bring free TV into their homes.

"AntennaWeb.org is the next logical stage in our Antenna Selector Mapping Program," explained Gary Shapiro, president of CEMA. "The paper maps being introduced at the retail level that show consumers what type of outdoor antenna will work in their geographic areas have been extremely well-received, but now we are taking the program one step further. We are using the Internet to bring the maps directly to consumers and to retailers who have Web access. It's as easy as a few clicks to find the proper TV antenna, and retailers and consumers alike will have the benefit of this sophisticated mapping tool."

The site is designed to be fast and friendly. At the site's main page, consumers type in their address and zip code, and a street map showing their house location will appear in the center of the screen. Consumers can easily see what color-coded area they live in, which corresponds to a legend that shows the type of outdoor antenna they need to receive local television signals.

A separate section for information on distant signal reception, e.g., a Washington, D.C. resident looking for a Baltimore, MD, signal, is an additional feature on the new site. Consumers can click on a button that will bring up another map that uses a point-to-point calculation that factors in the more distant, outlying stations, not just the local ones. The secondary map indicates what type of antenna is needed to bring in the distant signal, and also will show the direction of the TV tower transmit signal, giving consumers an additional tool when installing their antenna.

Shapiro continued, "Retailers without Web access can rely on the paper maps to recommend the proper outdoor antenna for their customers, and those with Web access will be able to do this electronically. Consumers who use the antenna selector maps in either form are better informed, and can be confident that the antenna they purchase will be the right one for them."

The roll-out of the CEMA maps is well underway, with more than 400 retailers and installers having ordered map kits to date. AntennaWeb.org is expected to launch sometime this fall.

CEMA urges FCC to create next generation radio system

Laying the groundwork for the creation of a new category of consumer electronics products, the Consumer Electronics Manufacturers Association (CEMA) is urging the Federal Communications Commission (FCC) to dedicate 36MHz of radio frequency bandwidth to provide free, high-quality multi-channel digital audio, information, and high capacity data services for a new broadcast service to mobile receivers. CEMA outlined the proposal in a filing submitted to the FCC regarding its proposals to adopt rules to permit new wireless and broadcast services using UHF TV channels 60–62 and 65–67. These channels are scheduled to become available in 2006 as part of the transition to digital television.

"This is an exciting and historic opportunity for the Commission, for mass media entities, for receiver and transmitter equipment manufacturers and mostly for the American public," said Gary Shapiro, CEMA president. "CEMA believes that the frequency bands under consideration in this proceeding are ideal to create a new terrestrial Mobile Multimedia Broadcast Service (MMBS) which will bring features currently popular in home entertainment and information products to the mobile environment."

Among the services that could be made possible by MMBS are 5.1 channel digital audio (left, center, right, left rear, right rear, and sub-woofer) with CD, or better, quality.

"With multi-channel audio, MMBS would give mobile listeners an exciting immersion into the entertainment experience already a part of high-definition television and DVD," noted Ralph Justus, CEMA director of Technology and Standards.

MMBS also would bring to the mobile user access to digital information including navigation, weather, and emergency data, such as evacuation warnings, in real time. And with data rates of up to 384 Kbps per channel and more than 70 channels, Internet Protocol (IP) services, other data services and Intelligent Transportation Systems also may be offered.

"Mobile access to this much digital information and data services would spawn an entirely new category of mobile products," explained Justus. "The entire local paper could be delivered electronically to mobile receivers throughout a given city. In-dash navigation systems could use real-time map and traffic data to calculate the fastest route dynamically. Everything from sports scores to flight schedules and congressional hearings to comic strips could be delivered to small wireless devices. The possible applications are limitless."

The two pieces of radio spectrum under consideration are 746 to 764 and 776 to 794 MHz , the frequencies currently used for television channels 60 through 62 and 65 though 67 in the UHF band. These frequencies have been made available by the FCC as part of the transition to digital television and will be auctioned off for commercial purposes after January 1, 2001. Outside of the basic public interest requirements, the FCC has currently proposed very few restrictions on how this spectrum can be used once it is sold to the highest commercial bidder.

In its submission, however, CEMA urged the FCC to designate the spectrum only for MMBS and adopt the specific technical system to use. Only then, CEMA argued, can the FCC realize the full benefits of MMBS for the public and maximize potential spectrum auction revenues.

(Continued on page 60)

Literature

Oscilloscope video measurement application note

LeCroy has published an 18-page application note that provides detailed technical insight into video standards and the use of analog oscilloscopes for video signal measurement. The fast screen update capability, alias-free operation, and application-specific techniques for measuring video signals using analog scopes are all discussed.

An introduction to video measurements found in the application note includes discussions of video basics, video triggers, pedestal clamping, delayed traces, and subcarrier horizontal phase adjustment. A section on display technology looks ar analog scope displays and how analog, storage , and color oscilloscope technology can be combined.

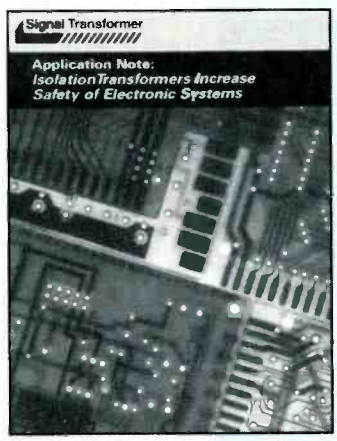
Photographs throughout the application note depict how an oscilloscope display would appear as each task being described is performed. Cutaway line drawings and charts provide additional information to the reader. Answers to frequently asked questions are also provided.

LeCroy, 700 Chestnut Ridge Road, Chestnut Ridge, NY 10977-6499, Phone: 914-425-2000, E-mail: contact.corp@lecroy.com, Internet: http://www.lecroy.com

Circle (89) on Reply Card

Application note on how isolation transformers increase safety of electronic systems

Signal Transformer Company has released a new application note entitled "Isolation Transformers Increase Safety of Electronic Systems."



The application note addresses the need for adequate isolation between a power source and a user of electronic equipment, and the role isolation transformers play in increasing safety by providing high isolation in electronic circuitry. Explanations of how these special transformers represent an effective means of achieving high isolation in switching power supplies and distributed-power systems is presented. Information is also provided on safety standards established by organizations such as Underwriters Laboratories (UL), the International Electrotechnical Commission (UEC), and the Verband Deutscher Electrotechniker.

Signal Transformer Co., Insilco Technologies Group, 500 Bayview Avenue, Inwood, NY 11096. Phone: 516-239-5777. Fax: 516-239-7208. Website: www.signaltransformer.com

Circle (90) on Reply Card

E-mail newsletter

Jensen Tools recently launched the premier edition of TooLink, a free monthly permission e-mail newsletter.

E-mail newsletters have become a very widespread medium for businesses to communicate with their customers. Jensen's TooLink provides news, information, exclusive product offers, and new product features in a dynamic html format that is easy to read and very customer focused. Within minutes after opening the e-mail, a reader can obtain information, access the website, place an order, contact the company, file the newsletter for later, or toss it until the next issue arrives. The newsletter is like a mini-website with selected content of special interest each month.

For more information, or to subscribe to TooLink, visit www.jensentools.com

Jensen Tools, 7815 S. 46th Street, Phoenix, AZ 85044, Phone: 800-426-1194, Fax: 800-366-9662, E-mail: jensen@stanleyworks.com, Website: www.jensentools.com

Circle (91) on Reply Card

Communication products resource guide

Jensen Tools has released an updated version of their Communication Products Resource Guide for Fall 1999. This 100-page, full color catalog offers a wide range of tool kits, specialty tools, diagnostics, and service aids for the electrical, telecom, cable television, data, wireless and audio visual alarm communications industries. Many new products are featured, including the new line of Jensen JTS test sets.

Jensen Tools, 7815 S. 46th Street, Phoenix, AZ 85044, Phone: 800-426-1194, Fax: 800-366-9662, E-mail: jensen@stanleyworks.com, Website: www.jensentools.com

Circle (92) on Reply Card

Transformer brochure

Signal Transformer has released a six-page brochure that details the company's new VA sizes of low-profile (LPI), high power (HPI), and multi-purpose (MPI) international transformers.

The brochure provides information on the performance features of each line of transformer, including the new 12 VA and 18 VA LPIs, as well as the new 1250 VA, 1500 VA, and 1750 VA HPIs and the newly TUV certified MPIs. The LPIs can be used as direct plug-in replacements for industry standard pin configurations on low profile transformers and feature a hermetic seal and rigid pin construction. Signal's HPI transformers feature a unique coil construction that complies with international safety standards and results in a smaller and lighter transformer. The MPI transformers feature a higher volumetric efficiency for improved performance compared to conventional 50/60 Hz transformers.

General specifications for each line are outlines in the brochure and detailed charts include all product specifications. The literature also highlights the variety of agency standards that each type of transformer meets, including UL, CSA, and VDE.

Signal Transformer Co., Inc., 500 Bayview Avenue, Inwood,. NY 11906, Phone: 516-239-5777, Fax: 516-239-7208. Website: www.signaltransformer.com

Circle (93) on Reply Card

Electrostatic discharge

by Jim Van Laarhoven

To counter the adverse effects of electrostatic discharge (ESD), the electronics industry spends nearly 10 billion dollars a year. The textile, medical, and material processing industries also spend billions annually to reduce the destructive results that static electricity can produce.

The definition of static electricity states that it is the accumulation of an electrical charge on an insulated body. A different definition of this effect explains it this way: when two non-conductive materials are rubbed together to create friction, an imbalance occurs between the atoms of both materials (Figure 1). This imbalance leaves one material lacking electrons (positively charged) and the other material with an excess of electrons (negatively charged).

This resting potential can be low or relatively high depending on the number of atoms involved. Low potentials can cause such problems as IC damage, dust accumulation, and small shocks as they equalize. High potentials can cause high-magnitude sparking as their resting state becomes kinetic. This kind of ESD can be both dangerous and costly.

In the electronics field, the lower magnitude potentials are more common and easier to deal with. Research for practical methods to neutralize or remove static electricity is a never-ending effort, however the range of products currently available to the technician to reduce ESD is surprising. Grounding wrist straps and anti-static work surfaces have been around awhile. Many new products have recently been developed that may give technicians some additional protection.

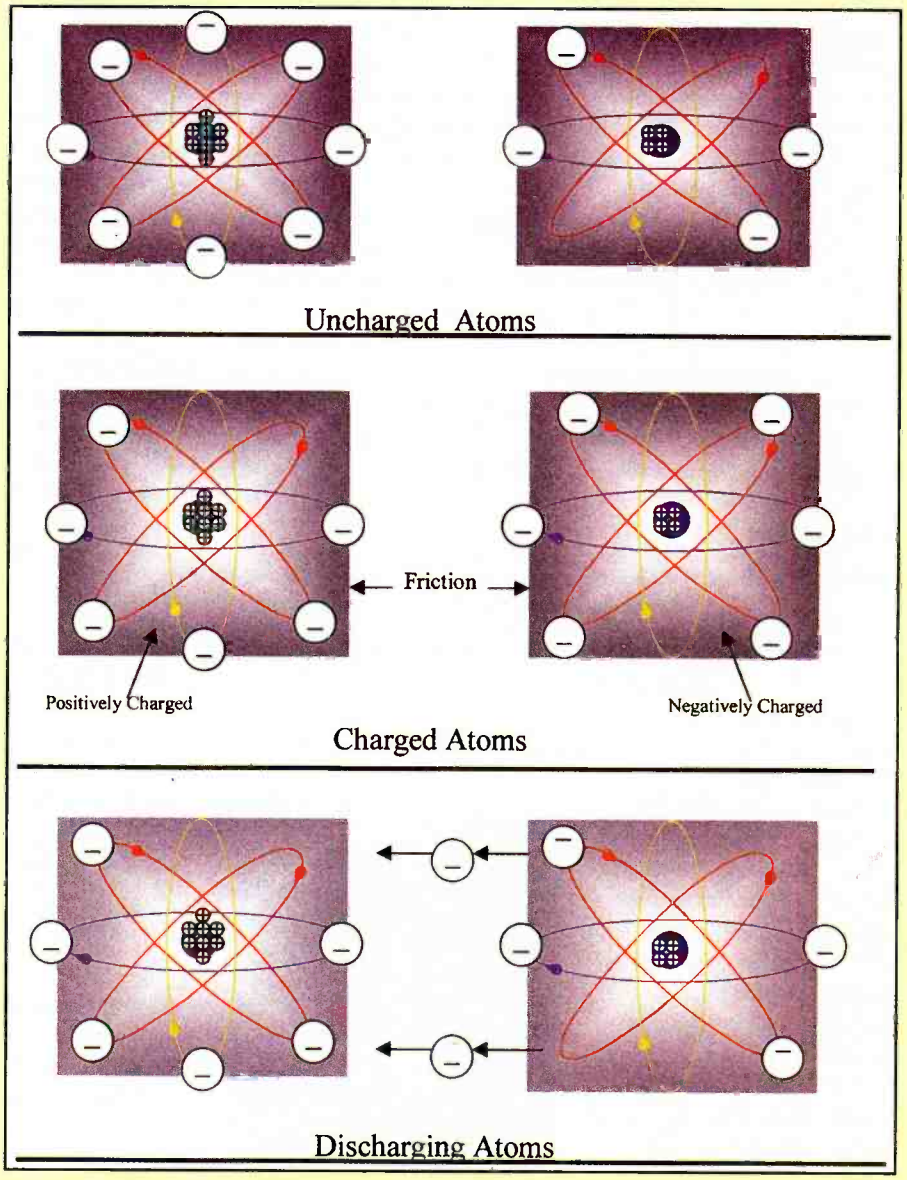


Figure 1. When two non-conductive materials are rubbed together to create friction, an imbalance occurs between the atoms of both materials. This imbalance leaves one material lacking electrons (positively charged) and the other material with an excess of electrons (negatively charged)

Some new products for ESD

A fairly new addition to the electrostatics market is an ionizing unit that clips to your belt to dissipate negative and positive charges. It generally runs on a 9V battery and is about the size of a standard pager, so it tends not to get in the way of your work. Static neutralization is its main working principle.

Anti-static gloves that use corona discharge technology are another new product on the market. The ionizing fibers of the gloves act as sponges to absorb stray static electricity. These work well for assembly purposes and volume handling of PC boards.

Another new area that many corporations are looking into is ESD-resistant furniture. Complete work tables, stools, and benches offer static protection by means of grounding, induction, and neutralization. Many of these products simply use materials that do not attract static electricity. Some of the materials that offer anti-static qualities are: ABS, Acetyl, Acrylics, Polycarbonates, Polyethylenes, and Polypropylenes.

Electronic static bags used to ship and store sensitive components utilize some

Van Laarhoven is an independent technician and consultant for computer based lighting.

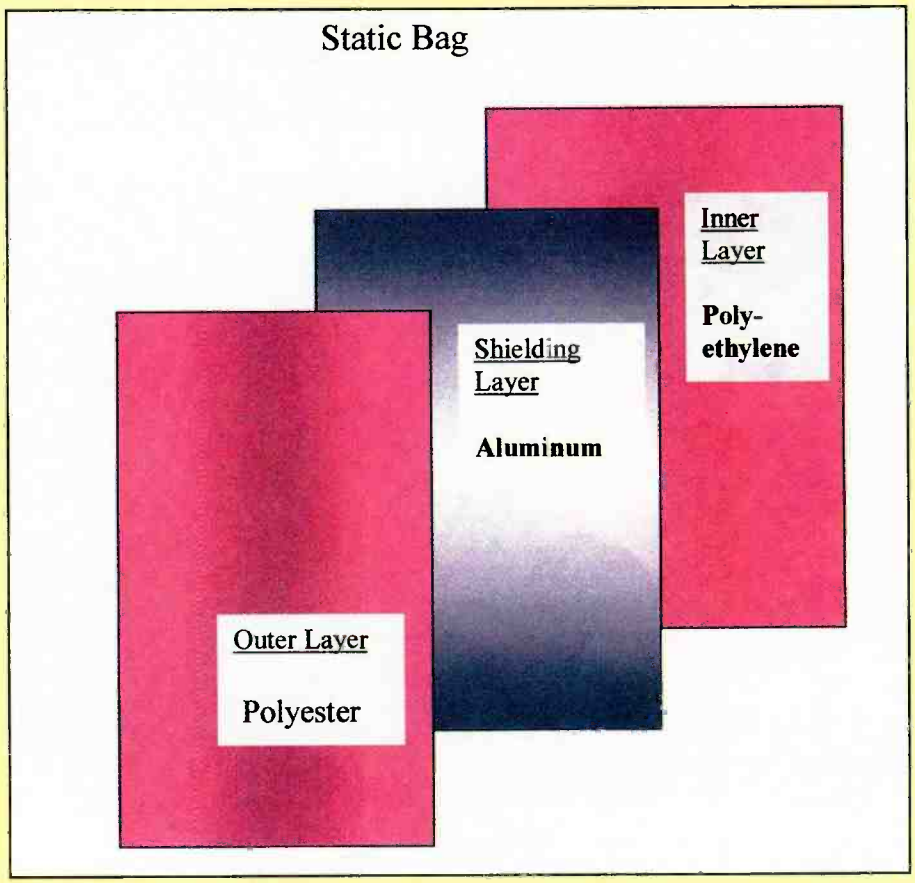


Figure 2. Some materials that offer anti-static qualities: ABS, Acetyl, Acrylics, Polycarbonates, Polyethylenes and Polypropylenes. Electronic static bags used to ship and store sensitive components utilize some of these materials in their construction.

of these materials in their construction (Figure 2). The polyester outer layer and polyethylene inner layer offer a resistance of about $10^{12}\Omega/in^2$. The metal sandwich layer is less than $2\Omega/in^2$. This aluminum layer also guards against EMI (electromagnetic interference).

Metals in themselves can offer anti-static qualities. Conductive materials, by their nature, are not subject to static build-up or discharges.

Electrostatic charges on the body

In electronics repair, the main issue of electrostatics seems to be the potential that the person themselves pick up or carry with them. Although you may not be generating a static charge, any object you handle may have a potential that will be transferred to you. A simple piece of plastic may have hundreds of volts of static charge that will transfer to you the second you pick it up. You probably will not feel the transfer, especially if you're wearing rubber soled shoes. This type of situation only isolates the charge until you come in contact with an adequate discharge source; possibly a sensitive PC board.

Many technicians say they have never taken any static precautions and have never had a problem. It really depends on many variables why this is true for some. If the relative humidity in the work place is high, this will decrease static activity. Tool coverings, material handling, grounding sources, clothing, and numerous other factors contribute to either high or low static potentials in the work place.

Since static electricity has three different states: generation, accumulation, and finally, discharge, it makes sense that control devices are made for each of these situations. Preventive devices deal with anti-generation and accumulation and active devices deal mainly with dissipation of the charge.

Static-prevention products

An explanation of some preventive devices will illustrate some of their positive characteristics. An aerosol static guard that is sprayed on a circuit board is a good example of a preventive device. Generally, this spray may also be used on work surfaces and can be an effective deterrent for weeks after treatment. A humidifier in the work area may reduce static charges, so this is also a good preventive measure. Anti-static floor mats fit into this category, but they can also be considered active devices because of their dissipating qualities. Cleaning supplies, such as copper gauze, anti-static chemicals, and ionizing vacuum cleaners, are some others that fit into both the preventive and active product categories. Anything that stops the generation and accumulation of static electricity is classified as a preventive device.

Active anti-static devices include products such as; compressed air ionizers (which include both blowers and air gun types), conductive heel straps, ionizing air filters, and clip-on belt ionizers. Anytime a constant activity is needed to dissipate a charge; the device will be an active one.

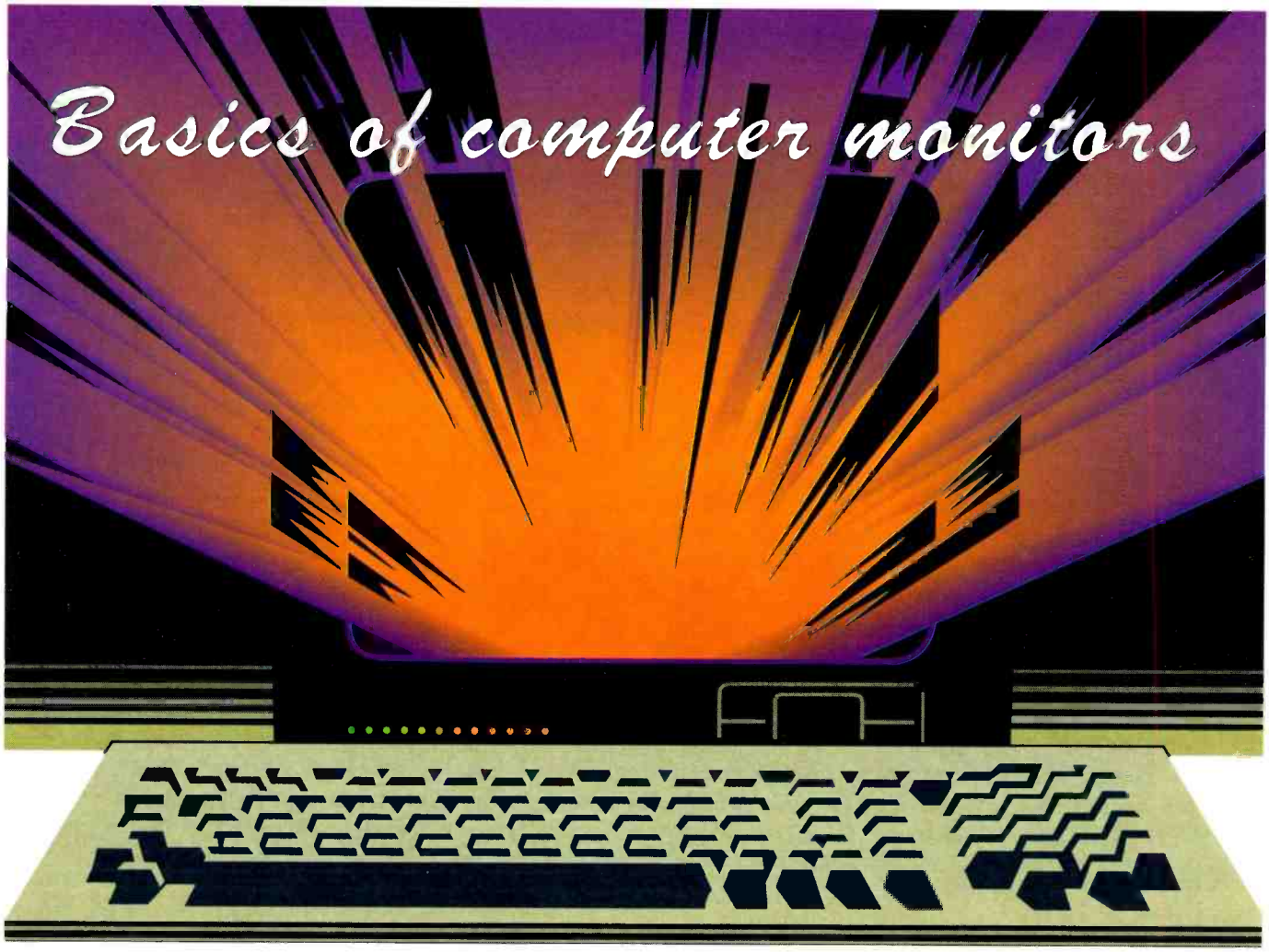
Grounding is a major factor in all anti-static systems. A potential cannot accumulate if it already has a low-resistance path to the earth. Workbenches, test equipment, and even the repair material itself should have proper grounding. It not only helps prevent circuit damage due to ESD; it also leads dangerous high-voltage faults safely to ground.

A static detector is another device that provides an added level of safety. Charged material can be located by waving a detection wand about an inch away from suspected areas. There are meters on the market that read voltages up to and beyond a 30,000V potential charge.

Each solution to the problem is unique

Different working environments require different protection. If electrostatic discharges are a problem in your work area, it may be a simple task to find out why they are happening and what you might be able to do to solve them. If discharges occur after moving about the room, maybe anti-static mats and heel straps will solve this problem. If your equipment seems to be collecting too many static charges, possibly your grounding system needs checking. Many ESD companies will work with you to find a solution that is both affordable and effective. ■

Basics of computer monitors



by Samuel Goldwasser

In the early days of small computers, a 110-baud teletype with a personal paper tape reader was the "preferred" input-output device (meaning that this was a great improvement over punched cards and having to deal with the bozos in the computer room. Small here, also meant something that would comfortably fit into a couple of 6 foot electronics racks.).

The earliest personal computers didn't come with a display — you connected them to the family TV. You and your kids shared the single TV and the Flintstones often won out. The Commodore 64 would never have been as successful as it was if an expensive monitor were required rather than an option.

However, as computer performance improved, it quickly became clear that a dedicated display was essential. Even for simple text, a TV can only display 40 characters across the screen with any degree of clarity.

The first computer monitors

When the IBM PC was introduced, it came with a nice 80 x 25 green monochrome text display. It was bright, crisp, and stable. Mono graphics (MGA or MDA) were added at 720 x 350, CGA at a range of resolutions from 160 x 200 to 640 x 200 at 2 to 16 colors, and EGA extended this up to a spectacular resolution of 640 x 350. This was really fine until the introduction of Windows (well, at least once Windows stayed up long enough for you to care).

All of these displays used digital video, TTL signals coded for a specific discrete number of possible colors and intensities. Both the video adapter and the monitor were limited to 2, 4, or 16 colors depending on the graphics standard. The video signals were logic bits — 0s and 1s.

Analog video for computers

With the introduction of the VGA standard, personal computer graphics became "real." VGA and its successors — PGA, XGA, and all of the SVGA (non) standards use analog video — each of the R, G, and B signals is a continuous voltage that can represent a continuous range of intensities for each color. In principle, an analog monitor is capable of an unlimited number of possible colors and intensities. (In practice, unavoidable noise and limitations of the CRT restricts the actual number to an order of 64 to 256 distinguishable intensities for each channel.)

Note that analog video was only new to the PC world. TVs and other video equipment, workstations, and image analysis systems had utilized analog signals for many years prior to the

Goldwasser is an engineering consultant with extensive experience in both industry and academia. He has authored most of the comprehensive consumer electronics troubleshooting and repair manuals available on the Internet.

PC's "discovery" of this approach. In all fairness, both the display adapter and monitor are more expensive so it is not surprising that early PCs did not use analog video.

Monitors discussed

Most of the information in this article applies to color computer video monitors and TV studio monitors, as well as the display portions of television sets. Black and white, gray scale, and monochrome monitors use a subset of the circuitry (and generally at lower power levels) in color monitors so much of it applies to these as well.

For most descriptions, an auto-scan PC SVGA monitor is assumed. For a fixed frequency workstation monitor, studio video monitor, or closed circuit TV monitor, only a subset of the possible faults and procedures will apply.

Note: we use the term "auto-scan" to describe a monitor that accepts a wide (and possibly continuous) range of scan rates. Usually, this refers mostly to the horizontal frequency as the vertical refresh rate is quite flexible on many monitors of all types. Fixed scan or fixed frequency monitors are designed to work with a single scan rate (though a 5% or so variation may actually be accepted). Multi-scan monitors sync at two or more distinct scan rates. While not very common anymore, multi-scan monitors may still be found in some specific applications.

Monitor fundamentals

In this article, the term "raster" refers to the entire extent of the scanned portion of the screen and the terms "picture," "image," or "display," to refer to the actual presentation content.

Monitors designed for personal computers, workstations, and studio video have many characteristics in common. Modern computer monitors are similar in many ways to TVs but the auto-scan and high-scan rate deflection circuitry and more sophisticated power supplies complicates their servicing.

Currently, most computer monitors are still based on the cathode ray tube (CRT) as the display device. However, handheld equipment, laptop computers, and the screens inside video projectors now use flat panel technology, mostly liquid crystal displays (LCDs). Desktop flat screen monitors have now dropped in price to the point that they are competitive, cost wise at least, with high-end CRT-based monitors. Current flat screen displays are a lot less bulky than CRTs, use less power, and have better geometry, but suffer from certain shortcomings.

First, the picture quality in terms of gray scale and color is generally inferior to that of a decent analog monitor. The number of distinct shades of gray or distinct colors is a lot more limited. They are generally not as responsive as CRTs when it comes to real-time video, which is becoming increasingly important with multimedia computers. Brightness is generally not as good as a decent CRT display. And last but not least, the cost is still higher due both to the increased complexity of flat panel technology and lower production volumes (though this is certainly increasing dramatically).

It is really hard to beat the simplicity of the shadow mask CRT. For example, a decent quality active matrix color LCD panel may add $500 to the cost of a notebook computer compared to $200 for a VGA monitor. More of these panels go into the dumpster than make it to product due to manufacturing imperfections.

However, a variety of technologies are currently competing for use in the flat panel displays of the future. Among these are advanced LCD, plasma discharge, and field emission displays. Only time will tell which, if any, survives to become the picture-on-the-wall or notepad display, at reasonable cost.

Projection, large screen, TVs and monitors, on the other hand, may be able to take advantage of a novel development in integrated micromachining: the Texas Instruments Inc. Digital Micromirror Device (DMD). This is basically an integrated circuit with a tiltable micromirror for each pixel fabricated on top of a static memory, RAM, cell. This technology would permit nearly any size projection display to be produced and would therefore be applicable to high resolution computer monitors as well as HDTV. Since it is a reflective device, the light source can be as bright as needed.

DMD technology is beginning to appear in professional video projectors and similar products, though am not aware of any consumer equipment that uses it. But this situation will no doubt change in the future.

Monitor characteristics

The following terms describe the capabilities that characterize a display:

1. Resolution — the number of resolvable pixels on each line and the number of scanning lines. Bandwidth of the video source, cable, and monitor video amplifiers, as well as CRT focus spot size, are all critical. However, maximum resolution on a color CRT is limited by the dot/slot/line pitch of the CRT shadow/slot mask or aperture grille.

2. Refresh rate — the number of complete images "painted" on the screen each second. Non-interlaced or progressive scanning posts the entire frame during each sweep from top to bottom. Interlaced scanning posts 1/2 of the frame (one field); first the even field and then the odd field. This interleaving reduces the apparent flicker for a given display bandwidth when displaying smooth imagery such as for TV. It is usually not acceptable for computer graphics, however, as thin horizontal lines tend to flicker at 1/2 the vertical scan rate.

Refresh rate is the predominant factor that affects the flicker of the display though the persistence of the CRT phosphors are also a consideration. Long persistence phosphors decrease flicker at the expense of smearing when the picture changes or moves. Vertical scan rate is equal to the refresh rate for non-interlaced monitors but is twice the refresh rate for interlaced monitors (1 frame equals 2 fields). Non-interlaced vertical refresh rates of 70 Hz to 75 Hz are considered desirable for computer displays. Television uses 25 or 30 Hz (frame rate) interlaced scanning in most countries.

3. Horizontal scan rate — the frequency at which the electron beam(s) move across the screen. The horizontal scan rate is often the limiting factor in supporting high refresh rate high resolution displays. Excessive scan rate speed may cause failure because of the stress it causes to components in high performance deflection systems.

4. Color or monochrome — a color monitor has a CRT with three electron guns each associated with a primary color —

red, green, or blue. Nearly all of the visible colors can be created from a mix of primary colors with suitable spectral characteristics using this additive color system.

A monochrome monitor has a CRT with a single electron gun. However, the actual color of the display may be white, amber, green, or whatever single color is desired as determined by the phosphor of the CRT selected.

5. Digital or analog signal — a digital input can only assume a discrete number of states depending on how many bits are provided. A single bit input can only produce two levels: usually black or white (or amber, green, etc.). Four bit EGA can display up to 16 colors (with a color monitor) or 16 shades of gray (with a monochrome monitor).

Analog inputs allow for a theoretically unlimited number of possible gray levels or colors though the actual storage and digital-to-analog converters in any display adapter or frame store and/or unavoidable noise and other characteristics of the CRT, and ultimately, limitations in the psychovisual eye-brain system will limit this to a practical maximum of 64 to 256 discernible levels for a gray scale display or for each color channel.

However, very high performance digital video sources may have RAMDACs (D/A converters with video lookup tables) of up to 10 or more bits of intensity resolution. While it is not possible to perceive this many distinct gray levels or colors (per color channel), this does permit more accurate tone scale ("gamma") correction to be applied (via a lookup table in the RAMDAC) to compensate for the unavoidable non-linearity of the CRT phosphor response curve or to match specific photometric requirements.

Types of monitors

Monitors can be classified into three general categories:

1. Studio video monitors — Fixed scanning rate for the TV standards in the country in which they are used. High quality, often high cost, utilitarian case (read: ugly), underscan option. Small closed circuit TV monitors fall into the class. Input for these monitors is usually composite (i.e., NTSC or PAL) although RGB types are available.

2. Fixed frequency RGB — High resolution, fixed scan rate. High quality, high cost, very stable display. Inputs are analog RGB using either separate BNC connectors or a 13W3 (Sun) connector. These often have multiple sync options. The BNC variety permit multiple monitors to be driven off of the same source by daisychaining. These monitors are generally used underscanned for computer workstation (e.g., X-windows) applications so that the entire frame buffer is visible. There are also fixed frequency monochrome monitors which may be digital or analog input using a BNC, 13W3, or special connector.

3. Multi-scan or auto-scan — Support multiple resolutions and scan rates or multiple ranges of resolutions and scan rates. The quality and cost of these monitors ranges all over the map. While cost is not a strict measure of picture quality and reliability, there is a strong correlation. Input is most often analog RGB but some older monitors of this type (e.g., Mitsubishi AUM1381) support a variety of digital (TTL) modes as well. A full complement of user controls permits adjustment of brightness, contrast, position, size, etc. to taste. Circuitry in the monitor identifies the video scan rate automatically and sets up the appropriate circuitry. With more sophisticated (and expensive) designs, the monitor automatically sets the appropriate parameters for user preferences from memory as well. The DB15 high density VGA connector is most common though BNCs may be used or may be present as an auxiliary (and better quality) input.

Why auto-scan?

Thank IBM for the existence of auto-scan. Since the PC has evolved over a period of 15 years, display adapters have changed and improved a number of times. With an open system, vendors with more vision (and willing to take more risks) than IBM were continuously coming up with improved higher resolution display adapters.

With workstations and the Apple MacIntosh, the primary vendor can control most aspects of the hardware and software of the computer system. Not so with PCs. New improved hardware adapters were being introduced regularly which were not following any standards for the high resolution modes (but attempted to be backward compatible with the original VGA as well as EGA and CGA, at least in terms of software).

Vast numbers of programs were written that were designed to directly control the CGA, EGA, and VGA hardware. Adapter cards could be designed to emulate these older modes on a fixed frequency high resolution monitor (and these exist to permit high quality fixed scan rate workstation monitors to be used on PCs). However, these would be (and are) much more expensive than basic display adapters that simply switch scan rates based on mode. Thus, auto-scan monitors evolved to accommodate the multiple resolutions that different programs required.

Note: we will use the generic term "auto-scan" to refer to a monitor that automatically senses the input video scan rate and selects the appropriate horizontal and vertical deflection circuitry and power supply voltages to display this video. Multiscan monitors, while simpler than true auto-scan monitors, will still have much of the same scan rate detection and selection circuitry. Manufacturers use various buzz words to describe their versions of these monitors including "multisync," "autosync," "panasync," "omnisync," as well as "autoscan" and "multiscan."

Ultimately, the fixed scan rate monitor may reappear for PCs. Consider one simple fact: it is becoming cheaper to design and manufacture complex digital processing hardware than to produce the reliable high quality analog and power electronics needed for an auto-scan monitor. This is being done in the specialty market now to allow discarded fixed-frequency workstation monitors to be used with Windows based PCs. Eventually, the development of accelerated chipsets for graphics mode emulation may be forced by the increasing popularity of flat panel displays — which are basically similar to these monitors in terms of their interfacing requirements.

Analog vs. digital monitors

There are two aspects of monitor design that can be described in terms of analog or digital characteristics:

1. The video inputs. Early PC monitors, video display terminal monitors, and mono workstation monitors use digital input signals which are usually TTL but some very high resolution monitors may use ECL instead.

2. The monitor control and user interface. Originally, monitors all used knobs, sometimes quite a number of them, to control all functions like brightness, contrast, position, size, linearity, pincushion, convergence, etc. However, as the costs of digital circuitry came down, and the need to remember settings for multiple scan rates and resolutions arose, digital: microprocessor control, became an attractive alternative in terms of design, manufacturing costs, and user convenience. Now, most better quality monitors use digital controls: buttons and menus, for almost all adjustments except possibly brightness and contrast where knobs are still more convenient.

Since monitors with digital signal inputs are almost extinct today, except for specialized applications, it is usually safe to assume that "digital" monitor refers to the user interface and microprocessor control.

Interlacing

Whether a monitor runs interlaced or non-interlaced is almost always strictly a function of the video source timing. The vertical sync pulse is offset by an amount equal to 1/2 the line time on alternate fields (vertical scans — two fields make up a frame when interlaced scanning is used).

Generally, a monitor that runs at a given resolution non-interlaced can run at a resolution with roughly twice the number of pixels interlaced at the same horizontal scan rate. For example, a monitor that will run 1024 x 768 non-interlaced at 70 Hz will run 1280 x 1024 interlaced at a 40 Hz frame rate. Whether the image is usable at the higher resolution also depends, of course, on many other factors including the dot pitch of the CRT and video bandwidth of the video card and monitor video amplifiers, as well as cable quality and termination. The flicker of fine horizontal lines may also be objectionable.

Monitor performance

The ultimate perceived quality of your display is influenced by many aspects of the total video source/computer-cable-monitor system. Among them are:

1. Resolution of the video source. For a computer display, this is determined by the number of pixels on each visible scan line and the number of visible scan lines on the entire picture.

2. The pitch of the shadow mask or aperture grille of the CRT. The smallest color element on the face of the CRT is determined by the spacing of the groups of R, G, and B colors phosphors. The actual conversion from dot or line pitch to resolution differs slightly among dot or slot mask and aperture grille CRTs but in general, the finer, the better — and more expensive.

The resolution of typical TV CRTs is rather coarse: a dot pitch of 0.75mm might be a reasonable specification for a 20-inch set. High resolution computer monitors may have dot pitches as small as 0.22mm for a similar size screen.

A rough indication of the maximum possible resolution of the CRT can be found by determining how many complete phosphor dot groups can fit across the visible part of the screen.

Running at too high a resolution for a given CRT may result in a phenomenon known as Moire: an interference pattern that will manifest itself as contour lines in smooth bright areas of the picture. However, many factors influence to what extent this may be a problem.

3. Bandwidth of the video source or display card — use of high performance video amplifiers or D to A converters.

4. Signal quality of the video source or display card — properly designed circuitry with adequate power supply filtering and high quality components.

5. High quality cables with correct termination and of minimal acceptable length without extensions or switch boxes unless designed specifically for high bandwidth video.

6. Sharpness of focus — even if the CRT dot pitch is very fine, a fuzzy scanning beam will result in a poor quality picture on the viewing screen.

7. Stability of the monitor electronics — well regulated power supplies and low noise shielded electronics contribute to a rock solid image.

Performance testing of monitors

Warning: No monitor is perfect. Running comprehensive tests on your monitor or one you are considering may make you aware of deficiencies you never realized were even possible. You may never be happy with any monitor for the rest of your life!

Note: the intent of these tests is not to evaluate or calibrate a monitor for photometric accuracy. Rather, they are for functional testing of performance.

The following should be evaluated:

- Screen size and general appearance.
- Brightness and screen uniformity, purity, and color saturation.
- Stability.
- Convergence.
- Edge geometry.
- Linearity.
- Tilt.
- Size and position control range.
- Ghosting or trailing streaks.
- Sharpness.
- Moire.
- Scan rate switching.
- Acoustic noise.

Monitor repair

Unlike PC system boards where any disasters are likely to only affect your pocketbook, monitors can be very dangerous. Read, understand, and follow the set of safety guidelines provided later in this document whenever working on TVs, monitors, or other similar high voltage equipment.

If you do go inside, beware: line voltage (on large capacitors) and high voltage (on CRT) for long after the plug is pulled. There is the added danger of CRT implosion if the technician carelessly drops a tool, and often sharp sheet metal shields which can injure if you should have a reflex reaction upon touching something you should not touch. The inside of a TV or monitor is no place for the careless or naive.

Most common problems

The following problems probably account for 95 percent or more of the common monitor ailments:

- Intermittent changes in color, brightness, size, or position — bad connections inside the monitor or at the cable connection to the computer or video source.
- Ghosts, shadows, or streaks adjacent to vertical edges in the picture — problems with input signal termination including use of cable extensions, excessively long cables, cheap or improperly made video cables, improper daisychaining of monitors, or problems in the video source or monitor circuitry.
- Magnetization of CRT causing color blotches or other color or distortion problems — locate and eliminate sources of magnetic fields if relevant and degauss the CRT.
- Electromagnetic Interference (EMI) — nearby equipment (including and especially other monitors), power lines, or electrical wiring behind walls, may produce electromagnetic fields strong enough to cause noticeable wiggling, rippling, or other effects. Relocate the monitor or offending equipment. Shielding is difficult and expensive.
- Wiring transmitted interference —noisy ac power possibly due to other equipment using electric motors (e.g., vacuum cleaners lamp dimmers or motor speed controls (shop tools), fluorescent lamps, and other high power devices), may result in a variety of effects. The source is likely local — in your house — but could be several miles away. Symptoms might include bars of noise moving up or down the screen or diagonally. The effects may be barely visible as a couple of jiggling scan lines or be broad bars of salt and pepper noise, snow, or distorted video. Plugging the monitor into another outlet or the use of a line filter may help. If possible, replace or repair the offending device.
- Monitor is not locking on one or more video scan ranges — settings of video adapter are incorrect. Use software setup program to set these. This could also be a fault in the video source or monitor dealing with the sync signals.
- Adjustments needed for background brightness or focus — aging CRT reduces brightness. Other components may affect focus. Easy internal (or sometimes external) adjustments.
- Dead monitor due to power supply problems — very often the causes are simple, such as bad connections, blown fuse, or other component.

Subsystems of a monitor

A computer or video monitor includes the following functional blocks:

1. Low voltage power supply (some supplies may also be part of the horizontal deflection system). Most of the lower voltages used in the TV may be derived from the horizontal deflection circuits, a separate switching power supply, or a combination of the two. Rectifier/filter capacitor/regulator from the ac line provides the B+ to the switching power supply or horizontal deflection system. Auto-scan monitors may have multiple outputs from the low voltage power supply that are selectively switched or enabled depending on the scan rate.

Degauss operates off of the line whenever power is turned on (after having been off for a few minutes) to demagnetize the CRT. Better monitors will have a degauss button that activates this circuitry as well, since even rotating the monitor on its base can require degauss.

2. Horizontal deflection. These circuits provide the waveforms needed to sweep the electron beam in the CRT across and back at anywhere from 15 kHz to over 100 kHz depending on scan rate and resolution. The horizontal sync pulse from the sync separator or the horizontal sync input locks the horizontal deflection to the video signal. Auto-scan monitors have sophisticated circuitry to permit the scanning range of horizontal deflection to be automatically varied over a wide range.

3. Vertical deflection. These circuits provide the waveforms needed to sweep the electron beam in the CRT from top to bottom and back at anywhere from 50 to 120 or more times per second. The vertical sync pulse from the sync separator or vertical sync input locks the vertical deflection to the video signal. Auto-scan monitors have additional circuitry to lock to a wide range of vertical scan rates.

4. CRT high voltage (also part of 2). A modern color CRT requires up to 30kV for a crisp bright picture. Rather than having a totally separate power supply, most monitors derive the high voltage (as well as many other voltages) from the horizontal deflection using a "flyback." Some high performance monitors use a separate high voltage board or module which is a self-contained high frequency inverter.

5. Video amplifiers. These buffer the low level inputs from the computer or video source. On monitors with TTL inputs (MGA, CGA, EGA), a resistor network also combines the intensity and color signals in a kind of poor man's D/A. Analog video amplifiers will usually also include dc restore (black level retention, back porch clamping) circuitry stabilize the black level on ac coupled video systems.

6. Video drivers (RGB). These are almost always located on a little circuit board plugged directly onto the neck of the CRT. They boost the output of the video amplifiers to the hundred volts or so needed to drive the cathodes (usually) of the CRT.

7. Sync separator. Where input is composite rather than separate H and V syncs, this circuit extracts the individual sync signals. Output of the sync separator is horizontal and vertical sync pulses to control the deflection circuits. This is not needed on a monitor that only uses separate sync inputs.

8. System control. Most higher quality monitors use a microcontroller to perform all user interface and control functions from the front panel (and sometimes even from a remote control). So- called "digital monitors," meaning digital controls not digital inputs, use buttons for everything except possibly user brightness and contrast. Settings for horizontal and vertical size and position, pincushion, and color balance for each scan rate may be stored in non-volatile memory. The microprocessor also analyzes the input video timing and selects the appropriate scan range and components for the detected resolution. These circuits rarely fail. If they do fail, however, debugging can be quite a treat.

Most problems occur in the horizontal deflection and power supply sections.

These run at relatively high power levels and some components run hot. This results in wear and tear on the components, as well as increased likelihood of bad connections developing from repeated thermal cycles. The high voltage section is prone to breakdown and arcing as a result of hairline cracks, humidity, dirt, etc.

The video circuitry is generally quite reliable. However, it seems that even after more than 15 years, manufacturers still cannot reliably turn out circuit boards that are free of bad solder connections or that do not develop them with time and use.

On-line tech-tips databases

A number of organizations have compiled databases covering thousands of common problems with VCRs, TVs, computer monitors, and other electronics equipment. Most charge for their information but a few, accessible via the Internet, are either free or have a very minimal monthly or per-case fee. In other cases, a limited but still useful subset of the for-fee database is freely available.

A tech-tips database is a collection of problems and solutions accumulated by the organization providing the information or other sources based on actual repair experiences and case histories. Since the identical failures often occur at some point in a large percentage of a given model or product line, checking out a tech-tips database may quickly identify your problem and solution.

In that case, you can greatly simplify your troubleshooting or at least confirm a diagnosis before ordering parts. My only reservation with respect to tech-tips databases in general, this has nothing to do with any one in particular, is that symptoms can sometimes be deceiving and a solution that works in one instance may not apply to your specific problem. Therefore, an understanding of the hows and whys of the equipment, along with some good old fashioned testing, is highly desirable to minimize the risk of replacing parts that turn out not to be bad.

The other disadvantage, at least from one point of view, is that you do not learn much by just following a procedure developed by others. There is no explanation of how the original diagnosis was determined or what may have caused the failure in the first place. Nor is there likely to be any list of other components that may have been affected by overstress and may fail in the future. Replacing Q701 and C725 may get your equipment going again but this will not help you to repair a different model in the future.

Having said that, here are three tech-tips sites for computer monitors, TVs, and VCRs:

http://www.anatekcorp.com/techforum.htm — (Free).

http://www.repairworld.com/ — ($8/ month).

http://elmswood.guernsey.net/ — (Free, somewhat limited).

The following is just for monitors. Some portions are free but others require a $5 charge. However, this may include a personal reply from a technician experienced with your monitor so it could be well worth it. <http://www.netis.com/members/bcollins/monitor.htm>

Some free monitor repair tips: http://www.kmrtech.com/

Tech-tips of the month and "ask a wizard" options:

http://members.tripod.com/~ADCC/ (Home page)

http://members.tripod.com/~ADCC/tips.htm (Tech-tips of the month)

The Resolve Monitor Tech-Tips database is a diskette that is priced out of the reach of most hobbyists. However, a reduced shareware version may be downloaded from a number of web sites. Go to http://www.filez.com/ and look for res16sw.zip.

References

Here is a list of books that contain information that may help your understanding of monitors, and how to service them.

Computer Monitor Troubleshooting & Repair by Joe Desposito

Howard W Sams & Co, 1997

ISBN: 0790611007

Also, since monitors share much in common with color TVs, books on color television repair would also be applicable for many problems.

There doesn't seem to be nearly as many TV repair books for modern solid state TVs as I recall for old tube sets. Here is

one suggestion that you may find (or its predecessor) at your local public library (621.384 if your library is numbered that way) or a technical book store.

Troubleshooting and Repairing Solid State TVs by Homer L. Davidson
2nd Edition, 1992
TAB Books, Inc.
Blue Ridge Summit, PA 17214

Philips Consumer Electronics has a technical training manual titled
Hi-Res Computer Display Systems
part # ST1496-1093LE/KGPGC
You may be able to order this from Philips Service Co., P.O. Box 555, Jefferson City, TN 37760 Telephone: 423-475-0044
This book explains how these monitors work. Most of the material concerns Philips monitors but the material is applicable to most manufacturers.

The following doesn't specifically deal with monitors but may be of interest as well:
Video demystified: A handbook for the digital engineer by Keith Jack,
Brooktree Corporation, 1993 (ISBN 1-878707-09-4).

FCC ID numbers of monitors

Only a few manufacturers actually produce the vast majority of computer and video monitors. For example, Radio Shack, Magnavox, and Emerson do not make their own monitors (I can tell you are not really surprised!). All those house-brand monitors that come bundled with mail order or "Mike and Joe's Computerama" PCs are not actually put together in someone's garage. Well, not that many, at least.

How do you determine the actual manufacturer? For most types of consumer electronics equipment, there is something called an "FCC ID" or "FCC number." Any type of equipment that may produce RF interference or be affected by this is required to be registered with the FCC. This number can be used to identify the actual manufacturer of the equipment.

A cross reference and other links can be found at: http://www.repairfaq.org/ REPAIR/F_FCC_ID.html.

Parts information

I have found some of the most useful sources for general information on semiconductors to be the semiconductors replacement guides, such as those published by Philips distributor, NTE, and RCA SK. The manuals enable you to look up U.S., foreign, and manufacturer "house" numbers and identify device type, pinout, and other information.

Note that I am not necessarily recommending using generic replacements if the original replacements are (1) readily available and (2) reasonably priced. However, the cross reference can save countless hours searching through databooks or contacting the manufacturers. Even if you have a wall of databooks, these sources are invaluable.

A couple of caveats: 1. Some of these crosses have been known to be incorrect: the specifications of the generic replacement part were not the same as the original. 2. Don't assume that the specifications provided for the generic part are identical to the original; they may be better in some ways. Thus, using a replacement part guide to determine the specifications of the parts in your junk bin can be risky.

Monitor schematics and manuals

In some cases, these may be available from the manufacturer and even reasonably priced (much less than other sources). For example, a manual for a typical CTX monitor is only $15 from CTX, but around $50 elsewhere. However, more often than not, this will not be the case.

The following three companies have an extensive inventory of computer monitor service manuals and schematics. Typical prices are between $25 and $100.

- Computer Component Source (CCS), 1-800-356-1227. CCS catalog "centerfolds" have had schematics for some common monitors like the IBM8513. So, just asking for a catalog may get you some information.
- MI Technologies (http://www.mitechnologies.com/).
- Electronix (http://www.electronix.com/schematics/)

The following may only be for IBM monitors (I don't know) and doesn't appear to have a web site:

- Eagan Technical Sevices, Inc, 1380 Corporate Center Curve, Suite 115, Eagan, MN 55121, 612-688-0098.

Eagan makes several schematics for IBM monitors. I believe it includes the 8503, 8512, 8513, 8514, 8518, and 8511. Most are $50. The 9517 schematic is an unbelievable $165. You can order them directly from Eagan or through Sams' Photofacts Howard Sams, http://www.hwsams.com, for the same price.

And another: Chuntex, 1-800-888-2120.

Information sources on the Internet

Many manufacturers are now providing extensive information via the World Wide Web. The answer to you question may be a mouse click away. Perform a net search or just try to guess the manufacturer's home page address. The most obvious is often correct. It will usually be of the form "http://www.xxx.com," where xxx is the manufacturers' name, abbreviation, or acronym. For example, Hewlett Packard is hp, Sun Microsystems is sun, Western Digital Corp. is wdc. NEC is, you guessed it, nec. It is amazing what is appearing freely accessible via the WWW. For example, monitor manufacturers often have complete information including detailed specifications for all current and older products. Electronic parts manufacturers often have detailed datasheets for their product offerings.

There are a lot of monitors to be serviced

When you consider the number of personal computers in use, that represents a lot of monitors. Many of those monitors will fail in some way during their useful lives, and many of those are expensive enough that the owners will wish to have them repaired rather than discard them. In many cases, service data on monitors has been hard to come by. However, that situation has been improved by the number of companies that now offer monitor service manuals and schematic diagrams, and by the information available on the internet.

If your company is not now servicing monitors, this might be a good time to at least consider it. ■

ES&T Calendar

The 2000 International CES — Your Source for Workstyle and Lifestyle Technology
January 6–9, 2000
Las Vegas Convention Center and Hotel
Las Vegas, NV

Digital Hollywood at CES
January 6–8, 2000
Las Vegas, NV

Consumer Electronics Manufacturers Association (CEMA)
2500 Wilson Blvd.
Arlington, VA 22201-3834
703-907-7600
Website: http://www.cemacity.org

National All Service Convention
(Will include members of Electronic Technicians Association (ETA), Florida Electronics Sales and Service Association (FESA), Professional Servicers Association (PSA), and the Association of Home Appliance Service Companies (AHASC) of NJ.
DoubleTree Conference Center and Resort
Orlando, Florida

ETA
602 N. Jackson
Greencastle, IN 46135
765-653-8262

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

NESDA
2708 W. Berry
Fort Worth, TX 76109-2356

Electronics training and studying

by Jim Van Laarhoven

The application of study material to practical work situations can be one of the greatest obstacles to overcome after recent training. Even with the additional use of hands-on experience during the training period, the ability to use what has been learned can be an issue with many technicians. In light of this point, preparing in advance for a course of study could greatly improve the comprehension of the curriculum's practical components.

The limitations of training courses

Study material is usually set up to cover many general subjects. Considering that time is a common limiting factor in a training course, the subject areas will most likely be restricted to little more than overviews. This can be good, since learning anything about a subject can be helpful. In addition, it is also essential to keep the study material brief, so that the learner is not mired down with too many facts to remember at one time. Bearing all these commendable elements in mind, the course will probably still leave technicians wondering how they will apply all this new information.

One of the apparent reasons for this lack of usable information after training, is that each individual learns how to do things in a different and unique way and courses are usually not organized to accommodate this. Some technicians can read an article and have a firm grasp on the practical applications. Some have to see someone else actually perform the task before they understand. Some have to hear a verbal explanation, and still there are others that have to do the task themselves to learn. On occasion, some need a combination of these. How well a technician does after a course of study will depend primarily on how the course itself was structured in relation to these learning categories. This article will explore different ways to maximize training and studying for its practical use in the area of electronics.

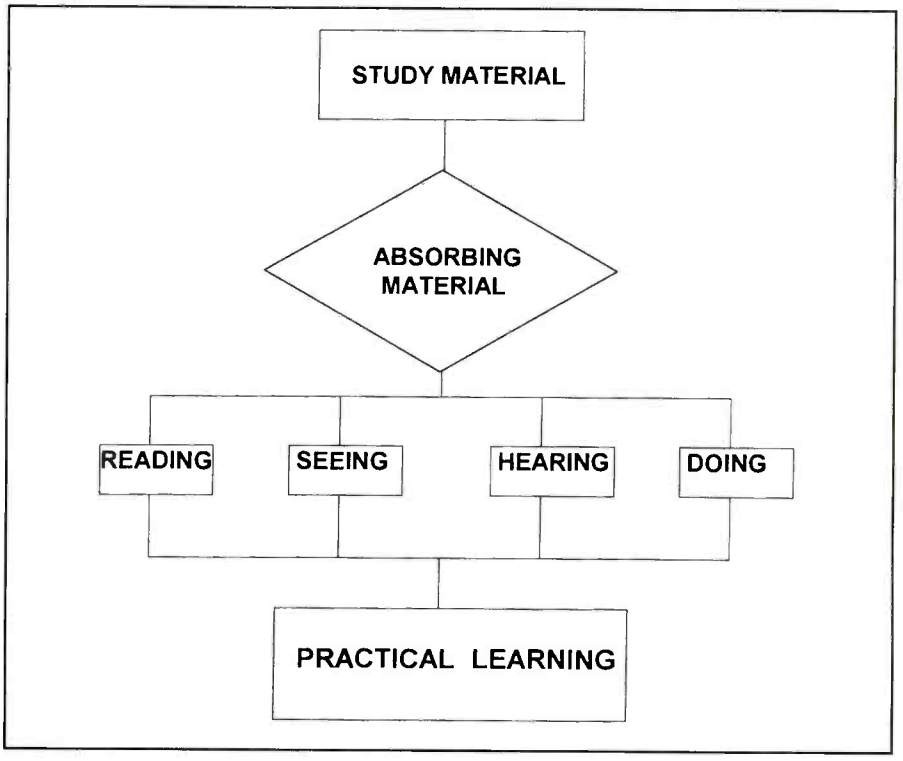


Figure 1. This graphic shows the elements of learning about a subject. If a particular area of study is hard to understand, you might have to look back to the way you learn as an individual: reading, seeing, hearing or doing, and make some adjustments.

What we mean by studying

Studying is another term for reading, seeing, or hearing the lesson and then absorbing its meaning. Later, when it is actually retained, it then can be considered learned. Many times, we want to learn a lesson immediately. It is kind of like skipping to the end of a book to see how it ends before you read the plot.

To absorb the full meaning of the lesson, it is a good idea to start at the beginning and patiently cover all of the material. Some may be able to skip a few steps and still learn, however, the majority will need to go through the whole lesson. If a particular area of study is hard to understand, you might have to look back to the way you learn as an individual: reading, seeing, hearing, or doing (Figure 1). Setting up a practical test-bed may be all you need to break free of the knowledge barrier. Many times, previously retained knowledge may parallel the new material in some way. Understanding part of the study material is only one step away from fully understanding it.

Taking notes

Note taking is sometimes harder than it appears. It can divide your attention away from a lecture and later, when you look at the notes, all reference to their true meaning may be lost. It made sense when you wrote it, now it looks foreign to you. To keep this from happening, you may want to jot down only the overall highlights of the lecture and let your associative skills help you when you reread them. It is helpful to add more information to your notes as soon as possible after the lecture. This will reinforce the

Van Laarhoven is an independent technician and consultant for computer based lighting.

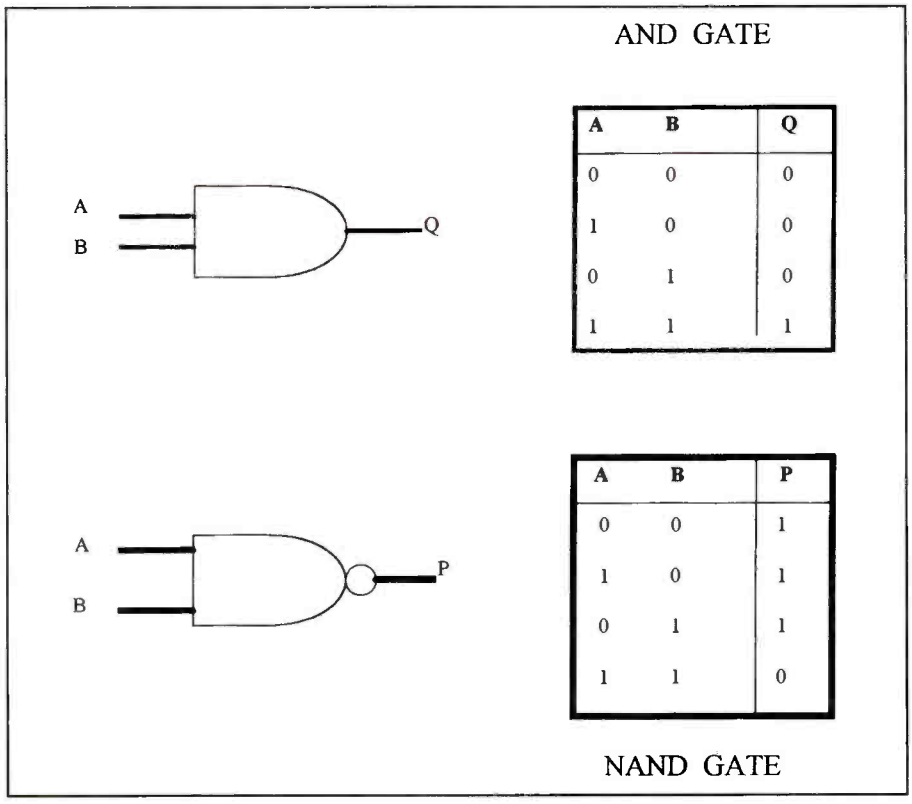


Figure 2. Associative skills play an important role in learning. A simple example of this would be the changing of an AND circuit to NAND. You only have to remember the rules for AND, then associate them with the rules for NOT. You associate NAND with AND and NOR with OR. Recognizing parallels between what you know and what you're learning make learning easier.

content of the lecture and strengthen your retention of the material.

Associative skills

Associative skills were mentioned in the last paragraph and they play an important role in most learning situations. A simple example of this would be the changing of an AND circuit to NAND (Figure 2). You only have to remember the rules for AND, then associate them with the rules for NOT. You associate NAND with AND and NOR with OR. Although these are extremely simple examples, they do demonstrate the point that most study material does not have to be learned from scratch. There are parallels that make learning easier.

Some say that studying only impairs their perception to accomplish real work. This may be true in the short term, due mostly to oversaturation. Everyone gets tired after too much information is ingested. Confusion is common and you may forget what door you came in before the lecture or study session started. Sometimes, it is impossible to sit down at the bench and implement your troubleshooting skills afterward. If this is the way you feel after studying, you probably have learned quite a bit. It sometimes takes awhile to realize this.

Computer-assisted training

A few guides to training have already been mentioned. Nevertheless, something should be said about the computer being used as a learning tool. While currently, there is no substitute for hands-on training, computers can be a very effective addition. Visual aids and interactive software programs have advanced to the point that many corporations use them as their main source of training.

As an example, computer programs are available that teach hands-on circuit design. These programs will indicate if the completed circuit will operate properly when you are through with the lesson. Of course, this is only one program of many available. There are interactive programs that deal with theory, repair, engineering, and many other electronics-related subjects. The Internet is a very good source for locating these types of software.

The Internet and VCRs

The Internet also has websites specifically geared toward education. One of the many good sources for study, information, and repair are the websites created by Samuel M. Goldwasser. In fact, an earlier article that appeared in **ES&T** about laser diodes included information from: www.repairfaq.org, an internet site maintained by Samuel Goldwasser.

The VCR is another learning device that has a special place in the electronics-training field. A good number of technicians reading this article have probably received some training in this manner. It gives you the advantage of being able to repeat the lesson until certain points are made clear. Repetition can be another factor that nurtures accuracy in the learning process.

Practical application makes theory valuable

The transformation of learned theory to practical reality is what makes a technician so valuable. To many of your customers, what you do seems like a form of magic. It makes you wonder how many of them realize that it is purely a combination of training, talent, and plain old hard work.

Diagnostic Software — A Comparison

by John A. Ross

With almost daily decreases in prices, it's little wonder that personal computers reside in American households, businesses, and schools. Whether you work on personal computers for a living or only want to maintain the PC that you use, diagnostic software can save you from frayed nerves. This article provides an overview of different diagnostic packages. Rather than compare the characteristics of the software, **ES&T** simply wants to provide a sampling of available products.

SYSTEMSOFT
SystemSoft Corporation
Two Apple Hill
Natick, MA 01760
Phone: (508) 651-0088
Toll Free: (800) 796-0088
Fax: (508) 651-8188
WWW: http://www.systemsoft.com

Starting in 1990, SystemSoft offers a product line that answers a wide range of hardware needs. **SystemWizard** automatically detects, diagnoses, and resolves common problems with devices such as hard disk drives, CD-ROMs, and other peripherals through the use of a graphical interface and a series of decision-set questions. The software combines the input from the user with system information as it searches for appropriate solutions in a database. Pressing the "AutoCorrect" button causes the software to begin implementing a solution. SystemSoft provides dynamic upgrades for SystemWizard through their World Wide Website and requires a minimum of 35 megabytes of hard disk space, 32 megabytes of random-access memory, and 256 displayable colors.

Hardware covered by SystemWizard

Modems
Keyboards
Mice
CD-ROM Drives
Sound Cards
Displays/Monitors
Backup, Jaz, Syquest, and Zip Drives
Disk Drives

Software and software problems covered by SystemWizard

Windows 95
Windows 98
Accessibility Option
Microsoft Outlook Express
Configuration
Microsoft Paint
General Protection Fault Crashes
Microsoft Phone Dialer
Dial-up Networking
Microsoft System Agent
Defragmenter
Telnet
DriveSpace
Windows Explorer
Notepad
Windows Messenger
HyperTerminal
WordPad
Microsoft Internet Explorer
Netscape Navigator
Microsoft Media Player
Network Issues

SystemSoft complements SystemWizard with **SmartMonitor**, a diagnostic solution intended for hard disk drive problems. The software relies on SystemSoft's S.M.A.R.T. (Self-Monitoring Analysis and Reporting Technology) technology that contains configuration data supplied by hard disk manufacturers. As the name implies, the software has the purpose of detecting and solving potential problems that could cause a hard disk crash before the crash occurs.

WATERGATE
Watergate Software, Inc.
2000 Powell Street, Suite 1200
Emeryville, CA 94608
Telephone: (510) 596-2080
Fax: (510) 596-2092
http://www.ws.com

Watergate Software Incorporated offers a product line that includes **PC-Doctor for Windows**, **PC-Doctor for Windows NT**, **PC-Doctor Factory**, and **PC-Doctor Service Center** diagnostic tools. According to Watergate, the packages contain over 350 professional low-level, hardware-direct test functions. Beginning with **PC-Doctor 3.0 for Windows**, the software works as a hardware diagnostic and system information tool that can run a series of tests, check the system set-up, assist with the installation of new components, or perform low-level hardware-direct testing. The diagnostic tests cover nearly every type of component used by a personal computer including storage devices and PCMCIA cards.

PC-Doctor for Windows diagnostic features

System Configuration
Processor
Memory
Motherboard
Sound Cards
Video Cards
Disk Drives
Mouse
Keyboard
Monitor
CD-ROM
Modems and Printers

WINDSOR TECHNOLOGIES, INC.
Windsor Technologies, Inc.
130 Alto Street
San Rafael, CA 94901-4768 USA
Phone (415) 456-2200
Fax (415) 456-2244
http://www.windsortech.com or http://www.tufftest.com

Based in San Rafael, California, Windsor Technologies, Incorporated, develops, manufactures, and then directly sells a comprehensive line of diagnostic tools. First released in 1984, **PC-Technician**™ functions as a stand-alone program that relies on a proprietary self-booting operating system. The application of self-booting software allows the diagnostic tests within the software to run without interference from the resident operating system. Windsor also offers a

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

downloadable version of **PC-Technician** called **TuffTEST-Pro**. Both packages test the configuration and operation of every part of a microcomputer system including memory, ports, and storage devices.

Hardware covered by PC-Technician diagnostic features

Processor
Extended MMX
Base, Extended, and Expanded Memory
CMOS and BIOS
Disk Drives
Serial and Parallel Ports
Motherboard
Video Adapter
Monitor
Works with Any Operating System

MICRO 2000
Micro 2000
1100 East Broadway, Suite 301
Glendale, CA 91205
Phone: (800) 864-8008, (818) 547-0125
Fax: (818) 547-0397

Offered by Micro 2000, the **Micro-Scope 7.0** set of diagnostic software tools provides the capability to low-level format all hard disk drives. In addition, **Micro-Scope 7.0** has a complete set of tests that cover the processor, interrupt request lines, memory, and video cards. The software utilizes a proprietary, self-booting operating system and functions at the hardware level of a microcomputer system. Micro 2000 also manufactures a Power-On Self-Test that complements the **Micro-Scope 7.0** package.

Hardware covered by Micro-Scope 7.0 diagnostic features

Processor
System Benchmark
Base, Cache, Extended, and Expanded Memory
CMOS and BIOS
Disk Drives
Serial and Parallel Ports
Motherboard
Video Adapter
System Configuration
Low-level Hard Disk Formatting
CD-ROM and DVD
Works with Any Operating System

TOUCHSTONE SOFTWARE CORPORATION
TouchStone Software Corporation
1538 Turnpike Street
North Andover, MA 01845.
WWW-www.touchstonesoftware.com

TouchStone Software Corporation has achieved notable success with its CheckIt and WINCheckIt diagnostic software packages and its new **CheckIt 98 Diagnostic Suite**. The Diagnostic Suite includes **CheckIt 98, CheckIt DOS, CheckIt NetOptimizer, FastMove**, and **Bigelow's PC Technician Troubleshooting Pocket Reference.** TouchStone provides a complete hardware troubleshooting utility with the tests, crash recovery, and Windows utility features found in the CheckIt 98 package.

Hardware covered by CheckIt 98 diagnostic features

Processor
Modem
Base, Extended, and Expanded Memory
CMOS and BIOS
Disk Drives
Serial and Parallel Ports
Motherboard
Video Adapter
Monitor
Indicates System Configuration Changes

SYMANTEC
Symantec Corporate Offices
10201 Torre Avenue
Cupertino, CA 95014-2132
Telephone: (408) 253-9600
WWW-http://www.symantec.com/

Symantec has been a long-time force in the diagnostic software market due to its marketing of the Norton Utilities product line**. Norton Utilities version 8.0** offers Windows configuration utilities along with Windows versions of Speed Disk and Disk Doctor. With those utilities, a technician or user can recover data and troubleshoot, repair, and optimize system problems. The diagnostic software checks all parts of a computer system including network connections and peripheral devices.

Hardware and software issues covered by Norton Utilities 8.0 diagnostic features

File System Repair and Recovery
Speed Disk
Disk Optimization and Repair
System Configuration
Windows Restoration (INI Tracker, INI Editor, INI Advisor)
Monitors System Resources
Disk Unerase
Disk Unformat
Password Protection
Testing of All Hardware Components

McAFEE SOFTWARE
McAfee Software
Corporate Headquarters
3965 Freedom Circle
Santa Clara, CA 95054
Telephone (408) 988-3832
WWW-www.mcafee.com

McAfee Software, a long-time leader in the production of virus detection and prevention software, also has a diagnostic software product line that includes **McAfee Utilities** and **First Aid Deluxe 2000**. McAfee Utilities uses a series of diagnostic and utility tools to provide crash protection, data recovery, and hard disk drive repair. The software also includes a utility that diagnoses and repairs problems that occur with Microsoft Windows. Disk optimization files included with the package allow users to defragment and clean disk drives along with repairing the registry. In addition, the software checks all parts of the system hardware and provides an automatic backup of the hard disk drive contents.

McAfee Utilities diagnostic features

Data Recovery
Disk Crash Prevention
Hard Disk Repair
Windows Restoration
Disk Optimization
Automatic Hard Disk File Backup
Registry Repair
Defragmentation
Checks All System Hardware
Cleans Disk Drives

Other sources for diagnostic tools and utilities

All the packages listed in this article are available either through retail outlets or directly from the manufacturer. Many manufacturers offer free downloads of limited versions of the software. Along with those sources for software, several World Wide Web sites also offer quality freeware and shareware diagnostic tools and utilities. Some of the sites are:

www.tucows.com
www.zdnet.com
www.cmpnet.com.

Generally, the sites offer software for different versions of operating systems or types of hardware. All-in-all, a wide range of selections are available through different sources. ■

Digital imaging equipment

by the ES&T Staff

Much has been said these days about digital still cameras. The technology is a perfect match for today's high-powered, highly-sophisticated, personal computers. With a standard still camera, an individual who wants to store, manipulate, and print still images has to take the picture, send the film in to be processed, return to the processor and pay for the photos, take them home, and scan them into the computer, then use the images as he wants.

With a digital camera, there's no film, no finished photos, no scanning in. The photographer simply takes the picture and it's stored on some kind of electronic medium. Unlike roll film, the medium is erasable and reusable, just as a disk, or EPROM is. So, rather than wait until a roll is used up before sending in the film, the photographer can take one picture, or the maximum that can be recorded on the medium, then go home and download them to the computer, view them, manipulate them, and/or print them out.

If any or all of the photographs are unusable, the photographer can simply erase them. Or he can keep those he likes and erase the rest, saving the good ones to hard drive, floppy disk, zip disk, or whatever the preferred medium is.

While digital cameras are not among the group of products that are of key interest to consumer electronics technicians, these cameras are becoming more popular, and more sophisticated. A passing knowledge of them might be useful. And some technicians might become interested enough in digital still cameras to want to service them. For those reasons, we present this article on digital still cameras.

Also described in the article are some of the accessories that enhance digital camera operation, and many types of printers that are used to print out the photo image. Moreover, since there are many ways in which images can be stored and manipulated digitally, the article concludes with a description of some of the more popular digital image file formats.

The information on which this article is based was prepared by CEMA, and is available, along with a great deal of other useful information, on their website at<http://www.cemacity.org/>. CEMA is a sector of the Electronic Industries Alliance (EIA), the 75-year-old, Arlington, Virginia, based trade organization representing all facets of electronics manufacturing. CEMA represents more than 500 U.S. manufacturers of audio, video, accessories, mobile electronics, communication, information technology, and multimedia products that are sold through consumer channels. CEMA can be reached at 703-907-7600.

Digital camera basics

In a digital camera system, images are captured using a solid-state image sensor instead of film. The most commonly used sensor is a CCD (charge coupled device). A new sensor technology, CMOS (complementary metal oxide semiconductor), is gaining popularity because it integrates the entire digital camera onto a single chip. As a result, the camera is light, has low power consumption, small dimensions, and lower cost. The output of the image sensor is stored in digital memory, typically using solid-state memory ICs, or a magnetic hard drive. The storage medium may be fixed inside the camera and/or contained on a removable card.

To view or edit images, stored images can be downloaded to a computer. The camera is connected by a cable to a computer or a removable card is inserted into the PCMCIA slot in a computer. Some cameras allow direct connection to a high-quality computer printer. Other cameras allow direct connection to a television for viewing images.

Evaluating a digital camera

Digital cameras can be evaluated based on a number of factors:

Resolution: Measured in pixels. The higher the number of pixels, the better the resolution.

Capacity: Determined by how much data the camera captures and how densely it packs that data before saving it to onboard memory.

1. Number of images for best quality
2. Maximum number of images

Storage: Image storage can be internal, external, or a combination of the two. External storage options include: PC Card, Solid State Floppy Disk Card (SSFDC), Compact Flash memory card, or a proprietary memory card.

Battery: LCD-equipped cameras will use up battery power quickly when pictures are viewed often. Some vendors suggest using rechargeable batteries (nickel-cadmium, lithium, nickel-metal hydride) which may last longer.

Connections: Download images with a serial cable, PC Card, or some cameras have a video cable for TV connection.

Controls: Fixed, macro, or telephoto lenses; manual and auto aperture; zoom

Flash: Options available: fill, auto, off, red-eye; or no flash

LCD: An LCD viewer allows immediate viewing of images and the ability to delete undesirable images.

Characteristic of digital cameras

Consumer-oriented digital cameras are comparable to point-and-shoot 35mm cameras that use photofilm. These cameras create 24-bit color images at resolutions ranging from 248x182 to 1280x960 pixels. Depending on the resolution desired, they can store as few as 8 or as many as 144 pictures before downloading the images to a PC. Here are some factors to consider when buying one of these products:

- Is color necessary? Gray-scale cameras are considerably cheaper than color.
- Which resolution or image size is best for your applications? Images embedded in a document or presentation, or posted on

a website, should be shot at a lower resolution setting to keep file sizes down.

Storage cards

Think of removable storage cards as "digital film." A digital storage card can be quickly inserted into the camera, you can take pictures until the card is filled, then quickly remove it and replace it with a fresh card. Like film cartridges, storage cards hold different numbers of pictures, and come in several sizes that fit particular cameras. But, the advantage of "digital film" is that you can selectively erase any of the images from the card, and the blank card can be reused.

There are three types of PC Cards that have been defined by the Personal Computer Memory Card International Association (PCMCIA): Type I & II, Type III, and Compact Flash. Type I & II, and Type III cards look basically the same, but the Type III card is twice as thick because it can store more data. Two Type I & II cards can be fit into a standard PCMCIA slot on a notebook computer, but the same slot holds only one Type III card. Compact Flash cards are smaller and more durable than the others, and are becoming the standard for digital cameras. A Compact Flash card can be used on a camera with a Type I & II slot with an adapter. Each camera model is designed to work with a specific kind of storage card. Obviously, the more storage capacity, the more expensive the card will be.

Accessories

There are several accessories that enhance the capabilities of digital imaging products.

Close-up lens: For filling the image area with more detail. Can produce images from as close up as 3". For capturing details in designs, schematics, catalog shots. Perfect for nature photography.

Telephoto lens: Adds to the field of view of the built-in lens. Adds width to the top, bottom, left, and right of the shot. A super wide angle lens adds twice the normal view. Used for travel and portraits.

Wide angle lens: Adds to the field of view of the built-in lens. Adds width to the top, bottom, left, and right of the shot. A super wide angle lens adds twice the normal view. Used for landscapes, buildings, large groups.

UV protector: To protect the lens from dust, scratches, and damage.

Filter: Adds warmth to pale or washed out images. Used in people photography.

812 color warming filter: Absorbs the blue cast caused by electronic flash.

Table top tripod: Gives stability to digital cameras. Used for on-the-go pictures and close up shots.

Optical/lens cleaning kit: To clean the lens elements and keep images sharper.

Color printer technology

A color printer is the place where the image captured by the camera is recorded on paper. There are a number of technologies used in color printers, some better than others for printing photographic images. Following is a rundown of current printer technologies.

Dye sublimation

The dye sublimation process uses a color-coated transfer ribbon made of a plastic film. Heating elements move across the transfer ribbon and cause the color on the ribbon to vaporize and diffuse onto the surface of the specially coated paper. Dye sublimation provides the best image quality, including excellent reproduction of subtle tone and continuous tone images.

Dye sublimation printers are used by service bureaus, desktop publishers, and graphic artists who require the best quality continuous tone output. Cost per page is high; $3 to $4 for a letter sized page, and this process requires special coated paper.

Ink-jet

In the ink-jet printing process, containers of ink are vibrated by piezoelectric crystals. A difference in voltage causes the crystals to vibrate, setting up precisely timed vibrations causing ink droplets to be sprayed through a nozzle onto the page. This is a low cost way to add color printing capabilities to your home or office computer systems. Ideal for businesses requiring a low-end, low-volume color printing solution. Ink jet printers are used in the home, home offices, and business.

Because of the fibrous nature of paper, the sprayed-on ink dots are absorbed, yielding softer edges and less vibrant colors. Specially coated ink-jet paper will lend better results. Printer speeds can be slower.

Bubble-jet

In a bubble jet printer, hundreds of ink-filled nozzles are arranged in a precise pattern. Each nozzle contains a heater. When the heater is charged, a bubble forms, forcing ink out of the nozzle. An ink reservoir replenishes the ink in each of the nozzles that were fired.

Laser

In a laser printer, a laser beam is focused on a photoelectric belt or drum, creating an electrical charge. Electrostatic charges cause the toners to adhere to the belt. The image is then transferred to a drum which rolls the toners onto the sheet of paper, toners are then heat-fused using heat alone or in combination with pressure.

The laser printing process is fast and does not require special papers, thus reducing printer supply costs.

Laser printers are generally used by graphics professionals and business workgroups that require color output. Quality is not as high as dye sub printers.

Solid ink

In solid ink printers, color sticks of a crayon-like ink are installed in the printer. As the color sticks melt, the image is made when the liquefied ink is sprayed through tiny nozzles onto the paper's surface. The dot pattern cools and resolidifies before it can be absorbed by the paper. The paper is fed through a pair of rollers where the image is cold-fused.

Solid ink printers can print on almost any kind of paper stock, including color stock. This is good for people who do color proofs. These printers apply extremely vibrant and opaque color and are ideal for graphics.

Solid ink printers are used by package designers, graphic designers, and those needing proofs to be output on unusual types of stock. Some solid ink printers do not print well on transparency material.

Thermal-wax

In thermal-wax printers, a ribbon coated with the colored waxes, in page-sized panels, is moved over a thermal printhead. Thousands of heating elements on the printhead cause the wax to melt and adhere to specially coated paper or transparency material. The final printed image is composed of tiny dots of colored wax.

These printers are fast, deliver vibrant colors, good for printing presentation graphics, and per-page cost is low.

Thermal-wax printers are used by businesses that produce presentation transparencies and handouts. The process requires special coated paper.

Image file formats

There are many different formats in which to store images in digital form. Those of you who have done any work with computer images, or spent time on the internet, have probably heard of image file formats such as .jpg, .bmp, .tif, and many more. The following segments describe some of the file formats used in digital still cameras.

FlashPix

FlashPix is a multi-resolution image format in which the image is stored as a series of independent arrays, each representing the image at a different spatial resolution. *Compression methods for this format include*: uncompressed, single color compression, and JPEG compression.

Allows the image to be displayed on different output devices at different resolutions with minimal resizing of the image. Requires a less powerful computer — less data is stored in RAM and less data is processed, offering a significant speed advantage to the computer user.

This format is used for:

- low-end photo editing
- web browsers
- on-line information services
- office suites
- word processing
- presentation graphics
- low-end desktop publishing
- draw/illustration
- miscellaneous imaging products

TIFF (Tag Image File Format)

This is the most versatile, reliable, and widely supported bit-mapped format. It is capable of describing bi-level, grayscale, palette-color, and full-color image data in several color spaces. It includes a number of compression schemes and is not tied to specific scanners, printers, or computer display hardware.

The TIFF format is used for saving images from scanners, frame grabbers, and paint/photo-retouching programs

PICT

The PICT format is Macintosh native, originating in MacDraw software. It can contain both bit-mapped and object-oriented graphics. This format is used for images that are designed for screen previews.

EPS (Encapsulated PostScript)

An EPS file has 2 parts — a PostScript (text) description that tells a PostScript printer how to output the resolution-independent image, and a bit-mapped PICT image for on-screen previews. This format allows both Mac and Windows users to save bit-mapped screen representations of screen images.

This is the standard format for storing high-resolution PostScript illustrations. A drawing saved in EPS format can be imported into other documents and scaled and cropped, but its contents are often no longer editable.

GIF (Graphics Interchange Format)

The GIF data stream is a sequence of protocol blocks and sub-blocks representing a collection of graphics. GIF files define a protocol intended for the on-line transmission and interchange of graphic data in a way that is independent of the hardware used in their creation or display.

The GIF format was originally created for compressing 8-bit images that could be telecommunicated through Compu-Serve and exchanged among users.

JPEG

The Joint Photographic Experts Group wrote this standard for image compression. JPEG is not a file format, but a method of data encoding used to reduce the size of a data file. It is most commonly used within file formats such as JFIF and TIFF.

JPEG File Interchange Format (JFIF) is a minimal file format which enables JPEG bitstreams to be exchanged between a wide variety of platforms and applications.

JPEG was designed for compressing either full-color or grayscale images of natural, real-world scenes. It works well on photographs, and naturalistic artwork. This format is commonly used on web-sites.

Photoshop

This is the native file format for Adobe Photoshop. Files can only be opened and edited in Photoshop, but the user has the option to save the file in a variety of other formats that are readable in both the Mac and PC environment.

This format is used for documents with layers. Each layer is independent of the others and can be edited separately without affecting the contents of the other layers.

IVUE

IVUE is a new format developed by Live Picture to work with its FITS (Functional Interpolating Transformation System) technology. This format has the ability to deal only with that portion of an image being edited, thereby greatly speeding screen display between edits.

With IVUE, imaging editing actions are stored mathematically in a FITS file, while the original pixel data is saved in the IVUE format, avoiding cumulative processing error. ■

Adapted from information that appears at the Consumer Electronics Manufacturers Association (CEMA) website.

Test Your Electronics Knowledge

by J.A. Sam Wilson

Define the following terms:

1. Vector

2. Angstrom

3. High frequency

4. The number of centimeters in one inch = _____

5. The range of frequencies with wavelengths from 0.4um to 0.78um

6. One cm = _____ inch

7. The name of the oscillator in a phase-locked loop is _____

8. The name of the diode used to produce microwaves in a microwave oven is _____

9. The name of the oscillator that permits a superheterodyne to receive a CW signal is _____

10. The interval between two frequencies that has a ratio of two to one.

Answers to TYEK

1. An arrow that represents a magnitude and direction with respect to earth. Do not use the term vector to represent voltage, current, or impedance.

2. A unit of length that has been replaced by 10^{-8} cm.

3. The range of frequencies between 0.003 and 0.03 GHz.

4. If there are 2.54 centimeters in an inch, there are 1/2.54, or 0.3937 inches in a centimeter. The answer to question #4 is therefore 2.54. (See #6)

5. High frequency (HF) includes the range of frequencies between 3MHz and 30MHz.

6. 0.3937 inches in a centimeter.

7. VCO (voltage controlled oscillator).

8. Magnetron.

9. BFO (beat frequency oscillator).

10. Octave. (Note, if you missed any of these, make a study card of it and add it to your file card system.

Books

***Digital Audio Dictionary* (Includes CD ROM), by Cool Breeze Systems, Inc., 256 pages, $29.95**

The Digital Audio Dictionary includes more than 1,000 useful, easy-to-read terms and definitions. This is the essential reference for everyone working on or interested in digital audio and music, from the beginner to the hard-core professional, the dabbler to the whiz, the musician to the acoustic engineer, the programmer to the mixer/editor, says the publisher. Definitions cover sound, computers, midi, digital audio, DAWs, plug-ins, system upkeep, synchronization, and music. Also included is an interactive CD-ROM. The Mac/Windows compatible CD includes an interactive version of the Digital Audio Dictionary, which allows the user to search, print, or save found terms for printing later. In addition, you'll find interactive demos for Cool Breeze Systems' Cool School InteractusTM Vol.1, Pro Tools® Basics; Vol. 2, Pro Tools® and Plug-ins; Vol. 3, Desktop Audio; and Vol. 4, Logic Audio®.

Cool Breeze Systems, Inc., 440 Dublin Avenue, Suite 230, Columbus, OH 43215, Phone: 614-481-4000

***Guide to Satellite TV Technology*, by John A. Ross, 360 pages, $39.95**

Find out everything you've ever wanted to know about satellite television with Howard W. Sams Guide to Satellite TV Technology. Learn about the concepts and theories behind the transmission and reception of satellite TV signals while examining the building blocks and components that are found in satellite systems. Inviting and easy-to-understand schematics, drawings and photographs depict and introduce everything from basic circuitry operation to the installation of Digital Broadcast Satellite Systems.

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

***Guide to Servicing RCA/GE Televisions*, by Bob Rose, 352 pages, $34.95**

In *Guide to Servicing RCA/GE Televisions*, author Bob Rose has compiled years of personal experience to share his knowledge about the unique CTC chassis. From the early CTC130 through the CTC195/197 series, Bob reveals the most common faults and quickest ways to find them, as well as some not-so-common problems, quirks and oddities he's experienced along the way. From the RCA component numbering system to the infamous "tuner wrap" problem, the author gives you all you need to make faster diagnoses and efficient repairs, with fewer call-backs.

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

Photofacts

Service center management in the new century

by the ES&T Staff

Managing a consumer electronics service center has always been a difficult, complex, multifaceted job. If you take a long, comprehensive, look at the duties of a service manager, it's more complex than you may have realized. Here are some of the duties that many service managers are required to perform.

- Hiring/Firing
- Training (Technical and support people)
- Motivating employees
- Payroll
- Benefits
- Customer service
- Deciding which products to service
- Equipment purchasing
- Replacement component/ supplies purchasing
- Pricing of service
- Business analysis
- Accounts receivable
- Accounts payable

If all that sounds like a great deal for one person to do, it is. There may be other duties that we haven't thought of. And it's a good bet that things aren't going to get any easier. One of the things that a service manager can do to improve his skills for the next century is to examine that list, decide which of those functions he's really good at, which of those functions he's least good at, and resolve to take action to improve those skills.

What products to service

Some service centers decide what products to service on a more or less random basis. Most service centers service TVs, many service VCRs. Other service centers specialize in other areas such as automotive electronics or the like. Figure 1 is a fairly comprehensive list of consumer electronics products that we garnered by looking at CEMA documents, or own records, and advertising flyers from the local branches of the electronics discount stores.

One way to make sure that you're servicing all of the products you should be, and not missing any good bets would be to compose such a list and think about each item in the list. Should you be thinking about servicing that class of products? Why or why not?

More in-home service

As we reported in the October issue, at a recent service convention, at least one consumer electronics manufacturer states that, because manufacturers will be selling more high-end, large screen products, service will be in the home, and products will be increasingly digital. Because of these factors, as we enter the new century, service centers should look to antenna installation and component hookup business.

This company also emphasized that service centers should keep these ideas in mind: they will be servicing in the home, they have to maintain good quality of service (QOS), they will be called on to provide connection service, they will be called on to install antennas, they should be prepared to sell accessories on service calls, they need to become, or remain, technologically proficient, they need to become computer and internet savvy.

At one time, almost all consumer electronics service was performed in the home, for a couple of reasons: service was simple, usually a tube replacement; a lot of television sets were consoles, and really too heavy to be easily transported. When sets became more complex and more reliable, and generally smaller, most sets that needed repair were either brought in by the customer or picked up by an outside technician. This allowed the set to be serviced in an environment in which all of the necessary sophisticated test equipment was available.

Today, it is becoming more difficult to bring the products into the service center for service. It will become even more so

PRODUCT	PRICE RANGE	SERVICE	YES OR NO	COMMENTS
Antennas				
Television				
DTV				
Satellite systems				
HDTV				
Projection TV				
VCRs				
Camcorders				
Digital still cameras				
DVD				
DVD changers				
Home theater				
Boom boxes/personal stereos				
Audio/stereo				
CD players				
CD Changers				
Personal computer				
CPU				
Monitor				
Printer				
Hard drive				
Floppy drive				
Zip drive				
CD-ROM				
CD-RW				
DVD ROM				
Scanners				
Modems				
Answering machines				
Fax machines				
Internet				
Home automation				
Cordless Phones				
Cellular telephones				
Two-way family radio				
Global positioning systems				
Walkman type products				
Tape players				
CD players				
Hand held TV				
Video games				
Automotive electronics				

Figure 1. A grid such as this, which contains an almost comprehensive list of consumer electronics products could be used to help make decisions on which products to concentrate on servicing, and which to leave alone.

as the century progresses For one thing, many "portable" sets aren't. With screens approaching and exceeding 30 inches, sets get so heavy and bulky that it's difficult to wrestle them into a truck and bring them into the service center.

Moreover, many home entertainment systems involve large screen sets, some built into walls, with huge numbers of connections to VCRs, DVD players, and sophisticated sound systems. And as HDTV becomes more pervasive in the market, that trend will accelerate. If it is at all possible, such systems should be serviced in the home. Manufacturers are keeping this in mind as they design tomorrow's entertainment products, and they are encouraging in-home service.

Other in-home service

Since service centers technicians will be performing more in-home service, it might make sense in the early years or the new century for service centers, which have been experiencing a decline in demand for product service, to investigate other technical services that they might perform for homeowners: for example, installation of home theater systems, or hookup for such systems. Some service centers already offer such services to their customers.

It's a little daunting for some service centers to think about going into an upscale home and starting making holes in the walls and ceilings and pulling wires, or building enclosures for the system, so they shy away from installation work. But the service center wouldn't have to perform those tasks. The expertise of a service center is to service consumer electronics products, and to connect them so that they work properly.

One way to make a start into home theater installation is to contact, say, an interior decorator, or a builder, or a remodeling contractor and explore the possibility of working with one of these types of companies. The service center could take the role of a subcontractor whose role would be to specify the wiring that had to be run, where the terminations have to appear, what power outlets and power protection would be required.

Such a collaboration would have more than one benefit: not only would this provide immediate income for the service center, but it would make the homeowner aware of the service center and the high quality of the services offered by them.

Figure 2. This wearable computer system allows a service technician to carry needed information with him, or to use the internet to obtain it.

Computers for the service centers

We know from correspondence with readers that there are still some service centers that don't have computers. It's just really hard to imagine how service centers of today are able to work efficiently without computers. In this new century, it will become all but impossible. Certainly, almost all of the successful service centers we're aware of use computers for a number of purposes. Some service centers have only a single computer, some have multiple stand-alone computers, and some others have networked computers.

These days, computers are incredibly inexpensive so it's hard to believe that cost is a factor in the decision of a service center not to become compterized. For example, there was an ad flyer in the Kansas City Star just this past Sunday (November 14, 1999) from Circuit City. One of the items in the flyer was a Hewlett-Packard computer, with 15" monitor and inkjet printer for $979.99.

Here's what the computer offered:

- 466 MHz Processor
- 64 Mbytes of RAM
- 8.4 Gbytes of Hard Drive
- 40X CD ROM Drive
- V90 High Speed Modem

That's a lot of computer. That low price included all of that, plus the monitor, plus the color printer for under a thousand bucks. But wait, as they say, there's more. The ad offered $150 in mail-in rebates from Hewlett-Packard. But wait, there's still more. The store, Circuit City offered a $100 dollar rebate. That drops the price to $729.99.

But wait, I'm still not finished. If the purchaser chooses to enter into a three-year contract with Compuserve, they get yet another $400.00 rebate from them. The way the ad put it, that brought the cost of the computer down to just $329.99.

Now I'm not sure that that's not just a little misleading, because the cost of connection to CompuServe (with, I suppose internet access) gets added on to the total cost. At around $20/month (and I'm not sure that that's the cost of CompuServe) that would cost $240 per year, or $720 for three years, bringing the total cost for the computer and CompuServe for three years to around $1000. Still; that ain't bad for a computer with all the trimmings and three years of CompuServe and internet service.

So, if any service center still doesn't have a computer, cost is not the issue. There's some other reason they have decided not to use a computer. And look what you can do with a computer.

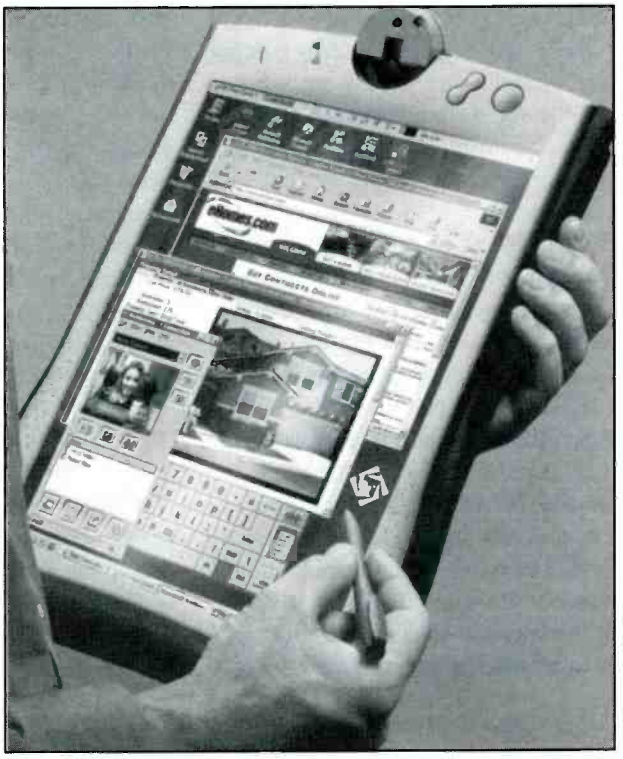


Figure 3. This computer-based notebook provides a mobile technician with a powerful information processing system.

Also consider the essential things you can't do these days without a computer.

Computers are becoming more and more essential

Not long ago, this magazine published an article that described electronic servicing information and discussed its consequence. Among other things, the article stated that Thomson Consumer Electronics was making their servicing information available in CD-ROM form only. There would no longer be any paper schematics or manuals.

Still more recently, we included a survey card in the magazine that asked readers how they would go about obtaining service information if they didn't have a computer. One respondent to that survey stated "I guess I won't be able to. I have no choice but to buy a computer." He was correct.

Service center management software

ES&T publishes an article on service center management software every year, so we won't spend a lot of time on that in this article. Suffice it to say that this type of software allows a service center to handle all in-house transactions regarding any product taken in for service using the computer.

So, when the consumer brings in the product, the front desk person logs in the name, address, telephone number, and other factors of the customer right into the computer. If this is a repeat customer, they merely have to type in the phone number and the rest of the date becomes available.

The computer is used to automatically print out a tracking label for the product, and a claim check for the customer.

When the technician gets the product, he logs that fact in, so the location of the product in the service center can be tracked at any time. If the product is a simple one, the tech types in

what he did to fix it and notes the location that it was restored to. Any components, supplies, etc. that were used to repair the set are noted so that they can be subtracted from inventory. That could trigger an inventory order to replenish those items.

If a part has to be ordered, the technician makes a note of that in the appropriate space. Now, the next time the purchasing person brings up the file of items to be ordered, that item is included in the list and can be ordered.

When the procedure is complete, that fact is included in the file that tells the front desk person to call the customer to come and pick it up. All the necessary information is available to automatically print up an invoice. Moreover, all pertinent information goes into the financial files to be used by accounting.

Using the internet for searching/ordering

The internet, once thought by many to be nothing but a waste of time and bandwidth, has proven itself to be a powerful tool for doing business. Think of the internet as a huge collection of wires and computers out there. Every company that has some kind of information that is either already in computer form, or can easily be turned into computer form and can make that information available to the general public via the internet.

Depending on the size of the company, they may have their own large computers on which they can set up software that connects them to the internet. And they can make certain information available to people who connect to their computer via the internet.

For companies that are not so big, they can contract with a service provider that will make a certain amount of space on their computers available so that the company can store information they want to make available to the internet.

As an example, most, if not all, consumer electronics manufacturers are connected to the internet. Some of them have portions of their data that are available to the general public, but reserve some of their information for service centers only. There is a lot of information available at these sites. Even better, it's available 24 hours a day, 7 days a week.

Making the whole thing even more attractive, assuming that the manufacturer has sufficient connections into the system, a technician at a service center needing to access that information never has to sit and listen to a voice-mail recording, never has to wait listening to music on hold. He simply gets on the computer, accesses the web site, and gets the information he needs.

Moreover, depending on the manufacturer, the service center may be able to order parts, input warranty claims, and perform other business using the internet.

Using the internet to advertise/ promote the business

Another aspect of the internet that exists now, and will no doubt increase during the early part of the new century, is the use of the internet to make customers aware of the existence of a business. There are a number of ways to promote your business on the internet:

- Develop your own website
- Advertise on a local website
- Advertise on a national website

When I searched for electronics service or electronics repair using the AOL search engine, I found 470,664 items. Of course, some are duplicates. I don't know why that happens. And some are manufacturers, and some are industrial, some marine, and other electronics repair/service centers. Still, a lot of service centers are promoting their services on the internet. Shouldn't you?

Using new technology

A great deal of technological products have been developed, and are being developed, that can help service centers make the transition to the demands of the new century. The successful service centers will be the ones who are able to remain aware of the technological developments that affect them, to accurately determine which of those technologies will be of use, and who are willing and able to make the capital expenditures to acquire them.

Consumer electronics manufacturers are making efforts to provide service information both in the form of computer firmware (CD ROMs) and on the internet. No doubt as computer information storage technology and computer data communications continue to evolve, it will be possible to carry more and more information, and/or to access it more quickly via the internet. Moreover, personal computers have been married to cellular telephone technology to provide totally portable computing/data communications.

Given these technologies, if a technician who is engaged in servicing in the home has a computer with him, he would be able to look up any information required to service the product. If the computer storage media didn't contain the required information, the technician could then dial up the manufacturer's website and download whatever he needs to complete the job.

Following are a couple of interesting technological developments that have the potential be of use to service centers.

A wearable computer

Computers have undergone a major evolution since they were first introduced. It's a cliché that today someone can carry around far more computing power in one hand than the first computer that filled a large room could muster. But it's true.

And let's pause here to reiterate what has been said in these pages before: the term "computer" was appropriate for that first computer that was used to calculate trajectories of artillery shells, but it's not really appropriate now. It's an outdated term. Today's "computers" are truly all-purpose information processing devices. Anything that can be converted to a digital equivalent: numbers, letters, pictures, sounds, voltages, temperatures, speeds, can be processed by these devices.

One interesting new form for computers (for want of a better generally accepted term) is the "wearable" computer. For about $5,000, you can now buy an IBM compatible battery-powered computer unit that can be worn on a belt. The wearable computer unit comes with a headset that consists of headphones, a microphone, and a viewscreen. One such unit, the MA IV (the 4th version of the Mobile Assistant, Figure 2) is offered by a company called Xybernaut.

The viewscreen is tiny, maybe an inch or so square, and is held in front of one of the wearer's eyes by a stalk connected to the headset. Depending on the product and desired application, the viewscreen may be opaque so that the eye viewing the screen doesn't see anything beyond it, or it may be a transparent screen onto which the image is projected.

There is also a small keyboard, but because the unit is voice activated, most of the commands would be by voice.

This unit could be used by the technician while he's in the home to access service manual/schematic/troubleshooting types of files, either from within the unit itself, from a main computer at the service center, or from the manufacturer's website via the internet. The initial cost is, of course, something to think about. But if it can be used to enhance the productivity of a highly-paid technician, it might prove to be worth the expense.

It does sound far fetched, but these units are available today. And think, at one time if someone had told people that they would one day wear highly accurate chronographs on their wrists, they would have branded him as a little loopy. And who could have ever thought that we'd be carrying around stereo systems, video recorders that fit the palm of your hand, or computers the size of a notepad. Why not wear a computer?

The personal computing tablet

Another interesting variation of the personal computer that service centers might find useful is the "personal computing tablet" (Figure 3). Called the Qbe (pronounced "cube") Altus, and offered by a company called Aqcess Technologies, this unit is powered by an Intel Pentium III processor. What follows is an adaptation of the description of the unit from a recent press release.

Ergonomically designed for the way people work, the lightweight Qbe Altus is slightly larger than a writing tablet, and can be used sitting at a desk or wandering around the building. The intuitive user interface, touch pen technology, handwriting recognition, digital camera, multimedia functions, and instant internet access are some examples of the unique features of this product. Speech recognition provided by VoiceExpress software from Lernout and Hauspice (L&H) allows users to navigate the system with voice commands, or create documents, e-mails and chat on the internet up to 140 words per minute.

Video conferencing or capturing a photo or video with the unit's detachable 270k pixel color CCD camera is an easy task. There's also an optional bar code reader, and with its 56k modem, users can connect to the internet on the go.

The first of these units will come with a Pentium III 450MHz processor, with later units up to 600MHz processors. The system comes complete with an 8GB hard drive, 128MB memory (upgradeable to 512MB), modem/Ethernet mini-PCI card, a CD-RW or DVD ROM, internal microphone, and stereo speakers, Smartcard (reader/writer) and magnetic strip card reader. A hot-swappable device bay, USB and Firewire ports and two Type II PCMCIA slots (or one Type III) allow for a wide variety of additional peripherals, including wireless and cellular modems. The unit also features an Image Capture Module (ICM) port that supports a wide array of digital cameras, barcode readers and scanners.

Yet more new technology for service

This subject will not be considered in detail, but many other new technological developments are in existence, and are under development, that will help service centers make the shift, where necessary, to in-home service. Many test instruments are constantly becoming more versatile, more sophisticated, more rugged, and less expensive.

For example, many companies now offer combinations of oscilloscope and DMM that offer a broad bandwidth, sophisticated digital features, and more, in an inexpensive (relatively), easily portable rugged package. These instruments can easily be carried to the worksite, and the digital features make them easy to use. Gas-powered soldering irons allow for soldering/desoldering with no electrical connections.

Clearly, thanks to modern technology, many of the tools and instruments that were at one time only available at the bench are becoming portable enough and rugged enough to be taken anywhere.

Meeting the challenges

There's no question that while the new century, the new millennium, will present greater challenges to consumer electronics service centers than ever before, the tools will be there to get the job done. But part of that job will be simply keeping abreast of the developments as they take place, and being ready for them. ■

What Do You Know About Electronics?

by J.A. "Sam" Wilson

Bridge Circuits

Phrone Smedge came to school early one day, and waited for his favorite teacher, Mr. Ray O'Brien. Phrone had worked out an easier way to solve for the current in the center leg of a Wheatstone Bridge. With Phrone's method, you don't need to write loop equations or do determinant solutions.

"Mr. O'Brien, I've been waiting for you. I've worked out a new way to solve for the center leg current in a Wheatstone Bridge. I've drawn the current on the blackboard in this room."

Mr. O'Brien looked around hoping for an interruption. No such luck. "Well now, Phrone, let's see what you have here."

Phrone's drawing is shown in **Figure 1**.

It's really very simple. Note that there are two parallel branches across a 30V source. By Ohm's law, the current in Branch ABC is:

$$I = \frac{V}{R} = \frac{30}{60 + 40} = 0.3A$$

So, the voltage across R_2 is:

$$V = IR = 0.3 \times 60 = 18V$$

Using the same reasoning, the current in branch ACD is also 3.0A, and the voltage across R_5 is:

$$V = IR = 0.3 \times 40 = 12V$$

That makes the voltage from B to D 18V - 12V = 6V. So, the current in the center leg is V/R = 6/20 = 0.3A.

One of the difficult jobs that goes with teaching is to keep a straight face when a student presents a "new" idea. Mr. O'Brien was a master at this.

What's wrong with that approach?

Now, stop a minute here. Think it over and explain what is wrong with Phrone's idea. I'll wait two seconds for your answer. If you laugh, you're out of the game.

Of course, Phrone's calculation of the voltages across R_2 and R_5 are wrong, because current through R_3 adds to and subtracts from currents through these resistors.

It is interesting to note that using a very high resistance value for R_3 (say 5MΩ) would give a close value of current through R_3. That would make the value of the current through it very low, so it has very little effect on currents on the voltages across R_2 and R_5. Incidentally, please don't say "small current," or "large current." Currents, voltages, and resistances are not generally referred to as "large" or "small." They are high or low.

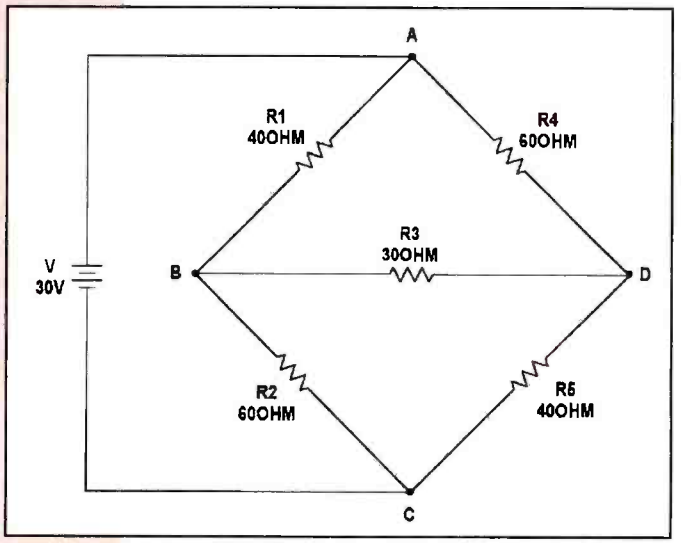


Figure 1. This is the student's drawing, showing his conception of the currents through the circuit.

Vocabulary again

In a previous issue, I suggested a file card method of reinforcing your knowledge of new technology. On one side of the card (marked "Q"), you put the technology term, and, on the other side (marked "A"), you put the definition of the term. Go through the cards marked "Q" and try to recall the meaning of the term. Go through the cards until you can define every term. After you have gone through the cards many times, you'll find you have learned many terms in the new technology.

My idea? No. When I first started teaching at Kent State University, I taught technical writing. The idea of using cards in this manner was given in one of the text books.

Did you know that you can add ten points to your IQ score by adding to your vocabulary using that file card system? Listen to this: it works. Before you know it, you will become an expert in a new technology that you never studied in school.

Now I will go through a different subject in a new technology (A/D and D/A), to show how it works. After a few issues, I'll turn it over to you.

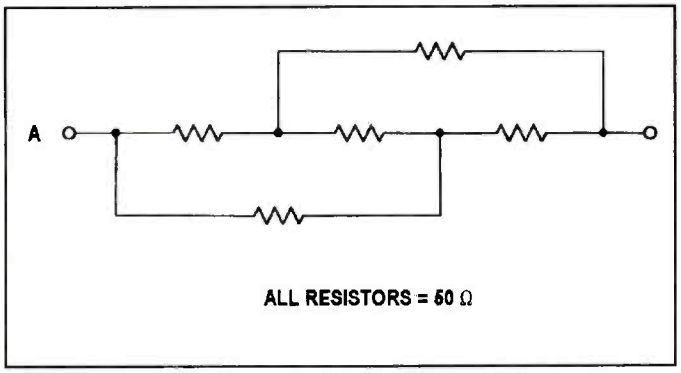


Figure 2. This circuit is usually called by another name. What is is called?

To start, I am using, as a subject, analog-to-digital conversion, in a well-written book by Kevin M. Daugherty. I'm only picking words out of Chapter 1 in this fine book.

Q. DSP
A. Digital signal processor

Q. Vref
A .Reference voltage required for the transducer, offset stage, and actual A/D converter required by the A/D converter

Q. Ratiometric
A. If Vref increased by 5%, and this causes VIN to also increase by 5%, no error will be introduced, and the system is said to be ratiometric

Q. PGA
A. Programmable Gain Amplifier

Q. Filter stages
A. Needed to attenuate out-of-band noise to prevent aliasing, or to remove system transients from the signal

Q. Aliasing
A. Condition in which the input signal cannot be reproduced accurately, which occurs if the A/D sampling frequency (f_S) is not at least twice the maximum filter cutoff frequency.

Whoa. These Q and A turns will only make sense if you read Chapter 1. I'm putting them in here to show how a file card system works. To be sure you have to read Chapter 1, and see the illustrations for these terms to understand the file cards. However, you can see the wide range of new terms in Chapter 1. By the way, always be sure to copy those illustrations by hand. That helps you visualize what's going on.

In Chapter 2, the author gives an excellent rundown on the components uses in an A/D system.

We'll discuss A/D systems in more detail in future issues.

Aliasing

Let me explain aliasing in a different way. I'm sorry to say I don't know where I saw it, but I feel it gives a good idea of what happens when sampling is too slow.

I'm sure you have seen a movie in which the spokes on a buggy wheel appear to be turning in the opposite direction to the direction in which the buggy is moving. To understand why this happens, imagine that one of the spokes is painted black and the position of the wheel is such that that spoke is at the top. At that point, the movie camera shoots one frame of film. Now picture that the next time the camera exposes a frame of film, the black spoke has gone almost all the way around, but is now slightly behind the position where it was in the previous position. The black spoke appears to have moved backward, while the position of the buggy has shifted forward.

In the case of filmmaking, the aliasing doesn't really matter, and in this case, obviously, there's really no way to correct the situation within the constraints of standard movie film speed. However, if you could change the speed of the film at will, you could adjust that rate any way you wanted to. You could make the black spoke appear to be standing still, or appear to be moving forward, or to be moving backward.

Aliasing occurs in a motion picture when the film samples are such that the film frames appear to be moving too slowly, or to be moving to quickly.

A question too far

Here is a circuit (**Figure 2**) that is usually called by another name. What is that name?

Answer: It is a Wheatstone Bridge. ■

Products

Computer monitor servicing course

The Advanced Computer Monitor Servicing Course Volume II from Sencore contains 11 chapters designed around the major circuits of a high resolution computer monitor. Each section delivers theory information, defect symptoms, practical troubleshooting guides and tips, plus alignment procedures. The course is written with a focus on issues pertinent to servicing high resolution displays such as color analysis, display geometry correction, digital alignment software, and microprocessor control.

According to the company, the course will help you quickly and efficiently troubleshoot, 17", 19", and 21" displays, provide practical troubleshooting knowledge, bring new technicians up to speed while increasing the efficiency of experienced technicians, provide insightful reference information while you're on the bench, provide chapter self-test to track the learning process, and improve hands-on troubleshooting skills via loads of diagrams, schematic drawings, troubleshooting flowcharts and hands-on activities.

Sencore, 3200 Sencore Drive, Sioux Falls, SD 57107, Phone: 1-800-SENCORE, Fax: 605-339-0317, Website: www.sencore.com

Circle (82) on Reply Card

Computer monitor service technical training

The Advanced Computer Monitor Service Training CD-ROM from Sencore contains 11 sections partitioned around the major circuits of a computer monitor. Each section delivers theory information, defect symptoms, practical troubleshooting guides and tips, plus alignment procedures. The material is geared specifically for beginning, intermediate, and advanced service technicians and can be immediately applied on the bench.

The new TC100CD teaches fast, efficient computer monitor troubleshooting using practical troubleshooting knowledge you can immediately use in your business. The product brings new technicians up to speed on monitor repair quicker, increasing their efficiency to the level of an experienced technician.

It also comes complete with section checks and tests to track the learning progress of your technicians.

Topics include: safety, scan frequencies, pixels, and blanking times, switch mode power supplies, vertical deflection, horizontal deflection/high voltage, sync, multi-mode, and multiscan, video amplifiers, CRT circuits, and component testing.

Sencore, 3200 Sencore Drive, Sioux Falls, SD 57107, Phone: 1-800-SENCORE, Fax: 605-339-0317, Website: www.sencore.com

Circle (83) on Reply Card

Universal device programmer

The Spectrum-48 from American Reliance was designed for the single device and mass production programming application and as a universal device programmer that works though the parallel port of a desk top or notebook computer. The programmer comes ready to use with menu driven software for both the DOS and Windows 3.1, 95, and NT (beta version) operating environment. With an onboard processor and Field Programmable Gate Array (FPGA), the 48-pin driver system provides the means of handling numerous DIP-style silicon PLD's, microprocessor, and high-density memory chips.

The products features include: 48-pin universal driver and current limit; onboard processor and power supply, fast programming speed <20 second to program a 1-MBIT EPROM and <100 seconds to program an 8-MBIT EPROM; smart system — checks for incorrect device insertion and poor pin contact, automatic EPROM ID search; high density memory up to 1-MBITS; compares device with buffer data and lists the differences; automatic file format conversion, fast device selection aid; optional ROM emulator for up to 4M BITS; and high-speed device function test and user-creatable test library.

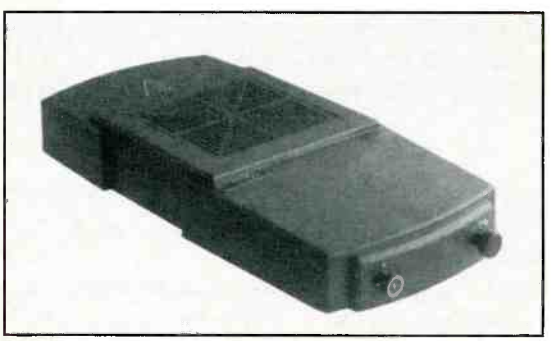
The unit performs these functions: self-check, reads, blank check, proper device insertion, proper contact, EPROM ID check, verify checksum, and compares.

American Reliance, Inc., 11801 Goldring Road, Arcadia, CA 91006. Phone: 626-303-6688, Fax: 626-358-3838, Website: www.amrel.com, E-mail: amrel@amrel.com

Circle (84) on Reply Card

Preheater for PCB rework

Metcal announces the QX Preheater, a forced convection heating unit that evenly preheats PCBs. The unit transfers heat to the PCB at a controlled rate. The variable flow control easi-



ly allows the user to deliver between 150W and 950W to the PCB at four discrete settings — this allows both low ramp rates when safety is of concern, and quick heating when rapid heating time is essential. The circuit board is heated to a temperature between 90 degrees and 120 degrees C.

Metcal Inc., 1530 O'Brien Drive, Menlo Park, CA 94025, Phone: 1-800-776-1778, Fax: 650-325-5932, Website: www.metcal.com

Circle (85) on Reply Card

Synthesized function/arbitrary/pulse generator

Telulex announces the SG-100A DC to 21.5 MHz fully synthesized signal/function/pulse/arbitrary waveform generator.

The unit offers signal analysis functions such as power and voltage level measurement and DTMF detection, allowing the user to upgrade in the field, flash memory that allows new and custom code versions to be sent via floppy or e-mail, data modulation, dual tone generation and DTMF generation capability.

The generator, says the manufacturer, delivers a clean, fully synthesized signal from DC to 21.5 MHz with 0.001% accuracy, offers arbitrary waveform generation, function generator, and pulse generator capabilities, offers reliability and ease-of-use, has many modulations modes: AM, FM, PM, SSB, BPSK, FSK, Burst, DTMF, Dualtone, VCO and Sweep for all of your design and testing needs.

The product uses a high speed DSP processor to control every aspect of the DDS system: frequency, phase, level, and the I and Q rails are under the direct control of the DSP processor.

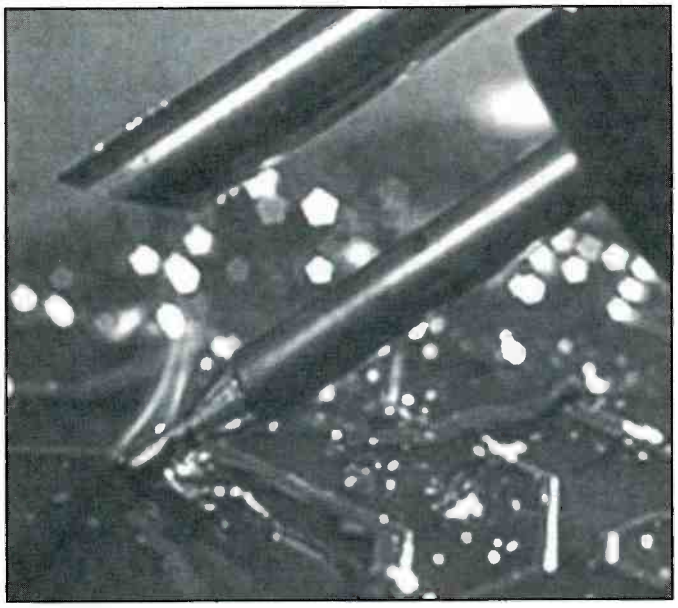
Telulex, 2455 Old Middlefield Way S, Mountain View, CA 94043, Phone: 415-938-0240, Fax: 415-938-0241, Website: www.Telulex.com, E-mail: sales@Telulex.com

Circle (86) on Reply Card

Tip fume extraction systems

Airidus' TX 081A fume extraction systems for tip extraction provide fume removal from soldering irons. An analog gauge provides monitoring of the differential pressure across the filter assembly, giving an indication of when to change the prefilter. A balance valves ensures correct flow rates at the extraction tube and a pressure relief valve eliminates motor overheating. A choice of filtration levels is available for each system, depending on the application, and each system can handle from 1 to 8 operators.

For hand soldering, tip extraction of fumes is effective and economical because it allows continuous removal of fume from the soldering iron while in use or at rest. These systems are available for light to heavy hand soldering and adapter kits are available to upgrade a customer's existing soldering irons.



Airidus, 1530 O'Brien Drive, Menlo Park, CA 94025, Phone: 650-853-7960, Fax: 650-325-5932, Website: www.airidus.com

Circle (87) on Reply Card

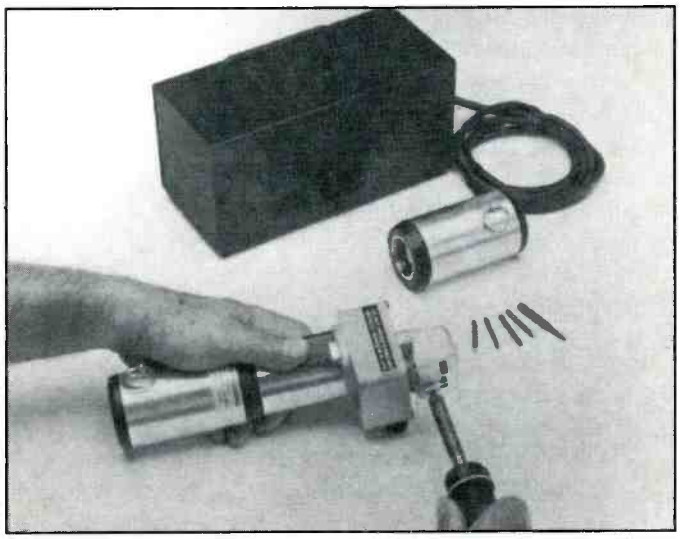
Portable solder tip cleaner

The Eraser Company announces its Model ST1 battery operated portable solder tip cleaner. Two rotating fiberglass wheels quickly clean oxidation and hardened flux residue from solder tips, increasing their useful life. Many tip configurations, including chisel, cone, spade, and bevel, may be cleaned. The wheels are fully adjustable to accommodate solder tips in a variety of sizes and shapes, and wheel pressure is adjustable using the spring tension screw.

The cleaner is powered by a rechargeable Ni-Cad battery. Its portability allows you to clean tips while attached to the soldering iron at the workstation.

Eraser Company, Inc., P.O. Box 4961/Oliva Drive., Syracuse, NY 13221-4961, Phone: 315-454-3237, Fax: 315-454-3090, Website: www.eraser.com, E-mail info@eraser.com

Circle (88) on Reply Card



1999 Article Index

ES&T 1999 Department Index

Profax Ten-Year Directory

(January 1989-December 1999)

	Profax #
January 1989	
Hitachi color TV, CT1955, NP85XA chassis	3038
NAP color TV, series 19C2 chassis (Magnavox)	3039
February 1989	
RCA/GE color TV, CTC145/146 chassis	3040
Zenith col. TV, CM-140/b-2 (G) chassis (Models SE2503G/SE2505P, SE2507N/SE2509H)	3041
March 1989	
NAP color TV, chassis E34-11	
Hitachi color TV, chassis	3042
CT1941/CT19A2, NP83X chassis	3043
April 1989	
GE VHS VCR, Model 1VCR2002X	3044
Hitachi CT1955 color TV	3045
May 1989	
Zenith CM-14-0/B-3(1) color TV Models SE2721H/SE2725R/SE272H)	3046
GE color TV, 1987 CTC 136	3047
June 1989	
RCA P42000-S1 projection TV (additional Models: RVM46700, 46GW700, P46000)	3048
NAP color TV, chassis E54-15 (Magnavox RD8518 and RD8520; Philco Model P8190S; Sylvania PSC410 and PSC420)	3049
July 1989	
Hitachi CT2066 color TV	3050
RCA CTC135 color TV	3051
August 1989	
GE CTC135-S1 color TV	3052
Zenith CM-140/B-2(I) color TV	3053
September 1989	
RCA CSM055 col. TV/AM/FM/clock radio	3054
October 1989	
Hitachi CT2086 B/W chassis G7NU3 color TV	3055
Zenith PV4661H rear-projector col. TV	3056
November 1989	
GE 1987 8-4500 projection color TV	3057
RCA/GE CTC 145/146 color TV	3058
December 1989	
Zenith CM-140/Digital (C) chassis color TV (Models SE3135P/SE3191H/SE3535H/ ZB2771H/ZB2771H2/ZB2777H/ ZB2777H2/ZB2797P/ZB2797P2/ ZB2797Y/ZB2797Y2/ZB3193H/ZB3193Y/ ZB3539T/ZB3539Y)	3059
January 1990	
Hitachi CT 1395W G7NSU2 color TV	3060
February 1990	
Zenith CM-139/B1 (Y) and (K) color TV receivers Models SD2097S (Y) and SD 327W3, SD1327Y, SD1327Y3 (K)	3061
March 1990	
RCA/GE CTC 148/149-S2 chassis color TV	3062
April 1990	
Hitachi G7XU2/3 chassis color TV G7XU2—Models CT2087B/W, A087 (MT2870 through MT2878) G7XU3—Models CT2088B/W, A088 (MT2880, MT2886, MT2887)	3063
May 1990	
Zenith PV-140/Digital (G) Rear Proj. digital TV receiver, Zenith surround stereo systems	3064
June 1990	
Hitachi CT4580K, VP7X2 chassis projection TV	3065
July 1990	
Zenith PV454-1P chassis color TV	3066
August 1990	
RCA/GE TX81 chassis color TV	3067
Septemeber 1990	
RCA/GE CTC156 chassis color TV	3068
October 1990	
Hitachi VP9X1 chassis color TV	3069
November 1990	
RCA/GE CTC169 (PV) chassis color TV	3070
December 1990	
RCA CTC91 chassis color TV	3071
January 1991	
RCA CTC91 chassis color TV	3072
February 1991	
RCA CTC107 chassis color TV	3073
March 1991	
RCA/GE CTC168 chassis color TV	3074
April 1991	
RCA/GE CTC86 chassis color TV	3075
May 1991	
RCA/GE KCS203 chassis B&W TV	3076
June 1991	
RCA CTC96 chassis color TV	3077
July 1991	
RCA CTC107 chassis color TV	3078
August 1991	
Hitachi CT1947/CT19A7 chassis color TV	3079
September 1991	
Hitachi CT2541/2542 chassis color TV	3080
October 1991	
RCA/GE CTC167 chassis color TV	3081

	Profax #
November 1991	
RCA/GE CTC166 chassis color TV	3082
December 1991	
RCA/GE CTC 169 chassis color TV	3083
January 1992	
RCA/GE CTC168 chassis color TV	3084
Feburary 1992	
Hitachi AP13 color TV	3085
March 1992	
Hitachi VT-M40A color TV	3086
April 1992	
Hitachi 3267E VCR	3087
May 1992	
RCA/GE CTC 168-53 color TV	3088
June 1992	
Hitachi VT-M231A VCR	3089
July 1992	
Hitachi VT-F551A VCR	3090
August 1992	
RCA/GE color TV No 7-7800A	3091
September 1992	
RCA/GE TX82 color TV	3092
October 1992	
Sharp Model 13C-M100 color TV	3093
November 1992	
Sharp Model 27C-5200 color TV	3094
December 1992	
Hitachi VT M150A VCR	3095
1992/1993 Profax Schematics Special Issue:	
Curtis Mathes Projections TV: Models SMP 4100, 4600, 5210	
Hitachi Camcorder Model UM-E2A	
Memorex Pocketvision 26, Catalog Number 16-163	
Mitsubishi VCR Model HS-U55	
Panasonic color TV Model SR400EK	
RCA/GE VCR Model VG4202	
Sharp color TV Model 27SV65	
Toshiba color TV Model CF2077A: CX21772	
Zenith color TV: Models SD5515/SD5535/SD555G	
January 1993	
Sharp Model 20C-5300 color TV	3096
February 1993	
Sharp chassis No. 25S1 color TV	3097
Sharp VCR Model VCA45U	3098
March 1993	
Sharp Model 20C-S200	3099
Sharp VCR Model VC-H86U/C	3100
April 1993	
Sharp Model 27SV70	3101
May 1993	
Sharp VCR Model VC-H870U/C, VC-8870U/C	3102
Sharp Model 20SB65 color TV	3103
June 1993	
Sharp VCR Model VC-A503U, VC-A504U/C	3104
July 1993	
Sharp VCR Model VC-H903U/C, VC-H904U/C	3105

	Profax #
August 1993	
Sharp VCR Model VC-H87U/C	3106
September 1993	
Sharp Models 19E-M40R, 19-EM50R color TV	3107
October 1993	
RCA color TV Model CTC176	3108
November 1993	
Hitachi Proj. color TV Models 55EX7K, 50EX6K, 46EX3B/4K, 50ES1B/K, 46EX3BS/4KS	3109
December 1993	
Sharp color TV Model 19E-M50	3110
1993/1994 Profax Schematics Special Issues:	
Curtis Mathes VCR/Model GV730/740	
Hitachi TV/Model NP 83LX	
IBM Monochrome Display/Model 8503	
Magnavox TV/Model RD0945C101, RD0946T101	
Memorex Portable Compact Disc Player/Model CD-3360	
Memorex VCR/Model 29	
Mitsubishi TV/Model CS-3535R/CK-3536R, CS3135R/CK-3136R	
Panasonic CTM1353R	
JC Penney TV/Model 2003	
Sharp color TV/Sigma 9700 chassis	
Thomson Consumer Electronics color TV/RCA CTC175	
Toshiba VCR/Model M222, M222C, M227C, M227L	
January 1994	
Memorez Portavision 9-inch color VHF/UHF TV monitor	3111
Feburary 1994	
Hitachi VHS VCR Models VT-F350A, VT-F351A, AW	3112
March 1994	
Sharp color TV Model 20SB55m chassis No 20R1	3113
April 1994	
GE VCR Models 9-7100, 9-7115, 9-7120, 9-7215	3114
May 1994	
Hitachi VCR Model VM-2400A (U,PX), AW	3115
June 1994	
Thomson Consumer Electroncis color TV: TX825	3116
July 1994	
Sharp CTV Models 13F-M40, 13F-M50, 13F-M100, 13F-M150	3117
August 1994	
Hitachi Video camera/recorder Models VM-2700A, VM-3700A (U,C)	3118
September 1994	
Sharp CTV Models 25F-M40/50/100/120, chassis No SN 41	3119
October 1994	
Hitachi VCR Model VM-1700A (U,C)	3120
November 1994	
Hitachi VCR Models VT-F380Z/F381A, VT-F382A/F385A	3121
December 1994	
Thomson Consumer Electronics color TV: TX825	3122

	Profax #
1994/1995 Profax Schematics Special Issue:	
Hitachi VCR Model VM-1600A	
Memorex VCR catalog no. 16-620	
Panasonic VCR Models PV-4962, PV4941-K, PV-4960-K	
JC Penney TV/VCR Model 2163	
Quasar Model CTM-1355R & TP-1330EE	
RCA color TV Model CTC168-S4	
Sharp color TV models 20C-S100 & 20C-S120	
Tatung color monitor	
Toshiba VCR Model SV-F990	
Zenith color TV receiver CM-139/B-1	
Zenith CM-143/Digital (A)	
January 1995	
Sharp video cassette recorder Models VC-A502U, VC-A506U, VC-A507U	3123
February 1995	
Sharp color TV Model 19TF30, chassis SN40A	3124
March 1995	
Hitachi video cassette recorder Model VT-F482A	3125
April 1995	
RCA video cassette recorder Model VR530	3126
May 1995	
RCA video cassette recorder Model VR530 (cont'd)	3126
June 1995	
Hitachi projections televisions Models 50UX 18B/19K, 46UX 16B/17K	3127
July 1995	
JC Penney combinations Model 2163	3128
August 1995	
Sharp video cassette recorder Model VC-H925U/H927U	3129
September 1995	
Thomson Consumer Electronics color TV Model CTC187	3130
October 1995	
Sharp TV/VCR combo Model 13VT-F40/13VT-F100	3131
November 1995	
Thomson Consumer Electronics VCR Model VG2030	3132
December 1995	
JC Penney color television Model 1048/1049	3133
1995/1996 Profax Schematcis Special Issue:	
Panasonic TV Model CTM-2092S Chassis ALEDP203	
JC Penney TV Model 2157	
JC Penney TV Model 2294	
Sharp TV/VCR Combinations Models 20VT-G60, 20VT-G100, 20VT-G200	
Sharp VCR Model VC-H946U, VC-H948U	
Thomson VCR Model VR516	
Thomson color video camcorder Models CC525, CPS014, CPS015	
Thomson TV, AM radio cassette combinations Model 7-7800A	
Toshiba TV Model CF2771A	
Zenith projection TV L-Line C-8 Chassis	
Zenith color TV receiver Models SD2501W, SD2509H	
January 1996	
Zenith wall projector Model PV-144	3134
February 1996	
Hitachi VCR Model VT-Ux605A	3135
March 1996	
Zenith digital direct view Model CM-142	3136
April 1996	
Thomson Consumer Electronics VCR Model VR321	3137
May 1996	
Sharp color television Models 25E-M100 & 25E-M120	3138
June 1996	
Sharp TV/VCR combincations Model 27VS-G300	3139
July 1996	
JC Penney color TV receiver Model 2307	3140
August 1996	
Zenith color TV receiver Model CM-142/C-1	3141
September 1996	
Sharp VCR Models VC-A555, 556 VC-H955, 956, 958U	3142
October 1996	
Thomson Consumer Electronics Color TV Model CTC177	3143
November 1996	
RCA/GE VCR Model VR520/523	3144
December 1996	
Memorex moviecorder Model 127	3145
1996/1997 Profax Schematics Special Issue:	
Hitachi video camera Model VM-E25A (U,C)	
Panasonic VCR Model PV-4066	
JC Penney color TV receiver Model 2158	
JC Penney color TV receiver Model 2509	
Sharp TV/VCR combination Model 20C-V300	
Thomson Consumer Electronics projection TV Model PTK 171	
Toshiba color TV Models 6F35661, CX37662	
Zenith digital color TV Receiver J-Line Model PV-143	
Zenith color TV Model S1322S, SMS 1324SS/X, SMS1325S	
January 1997	
Hitachi Color TV Models 35UX80B/CZ58, 35UX70B/CZ57	3146
February 1997	
Thomson video cassette recorder Model PTK171	3147
March 1997	
Thomson video cassette recorder Model PTK171 (cont'd)	3147
April 1997	
Sharp color TV Models 27H-S200, CH27S20	3148

	Profax #
May 1997	
Hitachi video cassette recorder Model VT-F390A/F391A	3149
June 1997	
Sharp color television Model 25H-M100	3150
July 1997	
Thomson Consumer Electronics video cassette recorder Model VR71HF	3151
August 1997	
Sharp TV/VCR combination Model 20VT-H60, 20VT-H200, 20VT-CH6	3152
September 1997	
Thomson Consumer Electronics color video camcorder Model CC710	3153
October 1997	
Toshiba video cassette recorder Model M-651/651C	3154
November 1997	
Thomson Consumer Electronics color TV Model CTC170	3155
December 1997	
Sharp video cassette recorder Model VC-A25U, CA55U, C	3156
January 1998	
Thomson Consumer Electronics video cassette recorder Model VR800HF	3157
Feburary 1998	
Zenith rear projections color TV receiver Model PV-145/c8 (A)	3158
March 1998	
Thomson Consumer Electronics color video camcorder Model CC390	3159
April 1998	
Sharp video cassette recorder Model VC-A70U, VC-H100U	3160
May 1998	
Sharp color TV Model 13H-M60/100/150, CH13M6/10/15	3161
June 1998	
Sharp color TV Model 19H-M60/ 100/150, CH16M6	3162
July 1998	
Sharp video cassette recorder VC-A575U, A578U, H973U, H974U, H975U, H976U, H978U	3163
August 1998	
Sharp TV/VCR combination 25VT-H200, 25VS-H300	3164
September 1998	
Sharp video cassette recorder Model VC-A523U	3165
October 1998	
RCA color TV Model CTC172	3166
November 1998	
Thompson RCA/GE Color video camcorder Model CC415	3167
December 1998	
Sharp video cassette recorder Models VC-H902U, VC-H906U, VC-H907U	3168

	Profax #
January 1999	
Hitachi color television CT2550/CT2551/CT2552/ CT2555/CT2556	3169
February 1999	
JC Penney 5.5 inch color TV receiver with AM/FM radio, Model No. 685-2189	3170
March 1999	
Sharp color television Model 19TG30	3171
April 1999	
Hitachi color television Model CT19C5/CT1966	3172
May 1999	
Hitachi color television Model CMT2138	3173
June 1999	
Hitachi color television Model CMT2138	3174
July 1999	
Zenith color TV receiver, Models SD2593W, SD2593Y, SD5539W, SD5557Y, SD5729W, SD5779H	3175
August 1999	
Zenith color TV receiver Model CM-144/C3	3176
September 1999	
Zenith color TV receiver Model SD1995W/ SD3923W/SD3961Y/SD3961YH	3177
October 1999	
RCA/GE video cassette recorder Model VG7685	3178
November 1999	
RCA/GE video cassette recorder Model VG7620	3179
December 1999	
Hitachi solid state color TV Model CT7970B/K	3180

Company Index — 1989–1999

	Profax#	Month/Year
CURTIS MATHES		
Models SMP 4100, 4600, 5210 Projection TV Set	Special	1992/93
Model GV 730/740 VCR	Special	1993/94
GENERAL ELECTRIC		
Model 1VCR2002X VHS VCR	3044	Apr 89
1987 CTC136 color TV	3047	May 89
CTCI35-S1 color TV	3052	Aug 89
1987 8-4500 projection color TV	3057	Nov 89
Models 9-7100, 9-7115, 9-7120, 9-7215VCR	3114	Apr 94
HITACHI		
CT1955 color TV, NP85XA chassis	3038	Jan 89
CT1941/CT19A2, NP83X chassis color TV	3043	Mar 89
CT1955 colorTV	3045	Apr 89
CT2066 color TV	3050	Jul 89
CT2086 B/W chassis G7NU3 color TV	3055	Oct 89
CTI39SW G7NSU2 color TV	3060	Jan 90
G7XU2/3 chassis color TV	3063	Apr 90
G7XU2 - Models CT2087B/W, A087 (MT2870 through MT2878)		
G7XU3 - Models CT2088B/W, A088 (MT2880, MT2886, MT2887)		

	Profax#	Month/Year
CT4580K, VP7X2 chassis proj. TV	3065	Jun 90
VP9X1 chassis color TV	3069	Oct 90
CT1947/CT19A7 chassis color TV	3079	Aug 91
CT2541/2542 chassis color TV	3080	Sep 91
chassis AP13 color TV	3085	Feb 92
Model 3267B VCR	3087	Apr 92
Model VT-F551A VCR	3090	Jul 92
Model VT-M40A VCR	3086	Mar 92
Model VT-150A VCR	3095	Dec 92
Model VT-M231A VCR		
Model UM-E2A Camcorder	Special	1992/93
Models 55EX7K, 50EX6K,		
Projection color TV	3109	Nov 93
46EX3B/4K, 50ES 1B/K,		
46EX3B5/4KS		
NP 83LX color TV	Special	1993/94
VCR Model VT-F350A,		
VT-F351A, AW	3112	Feb 94
Model 35UX80B/CZS8		
35UX70B/CZ57 color TV	3146	Jan 97
Model VT-F390A/F391A VCR	3149	May 97
Model VM-2400A (U,PX), AW VCR	3115	May 94
Model VM-1700A (U,C) VCR	3120	Oct 94
Models VT-F380Z/F381A,		
VT-F382A/F385A VCR	3121	Nov 94
Mods. VM-2700A, VM-3700A (U,C)		
Vid. cam/rec.	3118	Aug 94
Model VM- 1600A VCR	Special	1994/95
Model VT-F482A VCR	3125	Mar 95
Models 50UX 18B/19K		
projection television	3127	Jun 95
46UX 16B/17K		
Model VT-UX605A VCR	3135	Feb 96
Model VM-E25A video camera	Special	1996/97
Models CT2550/CT2551/CT2552/		
CT2555/CT2556 color television	3169	Jan 99
Model CT19C5/CT1966 color TV	3172	Apr 99
Model CMT2138 color TV	3173	May 99
Model 4146 color TV receiver	3174	Jun 99
Model CT7970B/K solid state		
color television	3180	Dec 99
IBM		
Model 8503 Monochrome Display	Special	1993/94
JC PENNEY		
Model 2003 color TV	Special	1993/94
Model 2163 TV/VCR	Special	1994/95
Model 2163 combination	3128	Jul 95
Model 1048/1049 color TV	3133	Dec 95
Model 2157 TV	Special	1995/96
Model 2294 TV	Special	1995/96
Model 2307 color TV	3140	Jul 96
Model 2158 color TV	Special	1996/97
Model 2509 color TV	Special	1996/97
Model 685-2189 5.5 inch color		
television receiver with AM/FM radio	3170	Feb 99

	Profax#	Month/Year
MAGNAVOX		
Model RD094SC101, RD0946T101		
color TV	Special	1993/94
MEMOREX		
Catalog Number 16-163		
Pocketvision 26 TV	Special	1992/93
Model CD-3360 Portable CD		
Player	Special	1992/93
Model 29 VCR	Special	1992/93
Portavision 9-inch color VHF/UHF		
TV Monitor	3111	Jan 94
catalog no.16-620 VCR	Special	1994/95
Model 127 Moviecorder	3145	Dec 96
MITSUBISHI		
Model CS-3535R/CK-3535R		
CS3 135R/CK3136R color TV	Special	1992/93
Model HS-U55 VCR	Special	1992/93
NAP		
(Magnavox) color TV	3039	Jan 89
chassis E34- 11 color TV	3042	Mar 89
chassis E54-15 color TV	3049	Jun 89
(Magnavox RD8518 and RD8520; Philco		
Model P8190S;Sylvania PSC410 and PSC420)		
PANASONIC		
Model SR400EK color TV	Special	1992/93
Model CTM1353R color TV	Special	1993/94
Models PV-4962, PV4941 -K		
PV4960-K VCR	Special	1994/95
Model CTM-2092S Chassis		
ALEDP203	Special	1995/96
VCR Model PV-4066	Special	1996/97
RCA		
P42000-S1 projection TV	3048	Jun 89
(additional Models: RVM46700, 46GW700, P46000)		
CTC 135 color TV	3051	Jul 89
CSM055 color TV/AM/FM/		
clock radio	3054	Sep 89
CTC9 1 chassis color TV	3071	Dec 90
CTC99 chassis color TV	3072	Jan 91
CTC107 chassis color TV	3073	Feb 91
CTC96 chassis color TV	3077	Jun 91
CTC107 chassis color TV	3078	Jul 91
CTC176 chassis color TV	3108	Oct 93
CTC175 chassis color TV	Special	1993/94
Model CTC 168-S4 color TV	Special	1994/95
Model VR530 VCR	3126	Apr/May 95
RCA/GE (Thomson Consumer Electronics)		
CTC145/146 chassis color TV	3040	Feb 89
CTC145/146 color TV	3058	Nov 89
chassis color TV	3062	Mar 90
TX81 chassis color TV	3067	Aug 90

	Profax#	Month/Year
CTC156 chassis color TV	3068	Sep 90
CTC169 (PV) chassis color TV	3070	Nov 90
CTC168 chassis color TV	3074	Mar 91
CTC86 chassis color TV	3075	Apr 91
KCS203 chassis B&W TV	3076	May 91
CTC167 chassis color TV	3081	Oct 91
CTC166 chassis color TV	3082	Nov 91
CTC169 chassis color TV	3083	Dec 91
CTC168 chassis color TV	3084	Jan 92
CTC168-53 chassis color TV	3088	May 92
Model 7-7800A color TV	3091	Aug 92
TX82 chassis color TV	3092	Sep 92
Model VG4202 VCR	Special	1992/93
TX825 colorTV	3116	Jun94
TX825 color TV	3122	Dec 94
Model VR516 VCR	Special	1995/96
Models CC525, CPS014, CPS015 color camcorder	Special	1995/96
TV AM radio cassette combination Model 7-7800A	Special	1995/96
Model CTC187 color TV	3130	Sep 95
Model VG2030 VCR	3132	Nov 95
Model VR321 VCR	3137	Apr 96
CTC177 color TV	3143	Oct 96
Model VR520/523 VCR	3144	Nov 96
Model PTK17 1 projection TV	Special	1996/97
ModelPTK171VCR	3147	Feb/Mar 97
Model VR71HF VCR	3150	Jul 97
Model CC710 color camcorder	3153	Sep 97
Model CTC170 color TV	3155	Nov 97
Model VR800HF VCR	3157	Jan 98
Model CC390 color video camcorder	3159	Mar 98
Model CTC172	3166	Oct 98
Model CC415 color video camcorder	3167	Nov 98
Model VG7685 VCR	3178	Oct 99
Model VG7620 VCR	3179	Nov 99

SHARP

Model 13C-M100 color TV	3093	Oct 92
Model 27C-5200 color TV	3094	Nov 92
Model 27SV65 color TV	Special	1992/93
Model 19E-M50	3110	Dec 93
Model 19E-M40R, 19E-M50R color TV	3107	Sep 93
Model 20C-5300 color TV	3096	Jan 93
Model 20C-5200 color TV	3099	Mar. 93
Model 20SB65 color TV	3103	May 93
25S1 chassis color TV	3097	Feb 93
Model 27SV70	3101	Apr 93
Sigma 9700 chassis color TV	Special	1993/94
Model VC-A45U VCR	3098	Feb 93
Model VC-A504U/C VCR	3104	Jun 93
Model VC-H86U/C VCR	3100	Mar 93
Model VC-H87U/C VCR	3106	Aug 93
Model VC-H870U/C, VC-8870U/C VCR	3102	May 93
Model VC-H903U/C, VC-H904U/C VCR	3105	Jul 93
Model 20SB55, chassis No. 20R1 VCR	3113	Mar 94
Models 13F-M40, 13F-M150, 13F-M100,13F-M150	3117	Jul 94
Models 25F-M40/50/100/120, chassis No SN 41	3119	Sep 94
Models 20C-S100, 20C-S120 color TV	Special	1994/95
Models VC-A502U, VC-A506U, VC-A507U VCR	3123	Jan 95
Model 19TF30, Chassis SN40A color TV	3124	Feb 95
Model VC-H925U/H927U VCR	3129	Aug 95
Model 13VT-F40/13VT-F100 Models 20VT-G60, 20VT-G100 TV/VCR combination	3131	Sep 95
20VT-G200, Chassis VN-51 TV/VCR combination	Special	1995/96
Model VC-H946U, VC-H948U VCR	Special	1995/96
Model 25E-M100, 25E-M120 color TV	3138	May 96
Model 27VS-G300 TV/VCR combination	3139	Jun 96
Models VC-A555, 556, VC-H955, 956, 958UVCR	3142	Sep 96
Model 20C-V300 TV/VCR combination	Special	1996/97
Models 27H-S200 CH27520 color TV	3148	Apr 97
Model 25H-M100 color TV	3149	Jun 97
Models 20VT-H60, 20VT-H200 20VT-CR6 TV/VCR combination	3151	Aug 97
Models VC-A25U,C A55U, C VCR	3156	Dec 97
Model VC-A70U, VCH100U VCR	3160	Apr 98
Model 13H-M60/100/150, CH13M6/ 10/15 color TV	3161	May 98
Model 19H-M60/100/150 CH19M6 color TV	3162	Jun 98
Model VC-A575U, A578U, H973U H974U, H975U, H976U, H978U VCR Model 25VT-H200, 25-VS-H300	3163	Jul 98
TV/VCR combination	3164	Aug 98
Model VC-A523U VCR	3165	Sep 97
Model VC-H902U, VC-H906U, VC-H907U VCR	3168	Dec 98
Model 19TG30 color television	3171	Mar 99

TATUNG

color monitor	Special	1994/95

TOSHIBA

Model CF2077A: CX21772 color TV	Special	1992/93
Model M222, M222C, M227C, M227L VCR	Special	1993/94

	Profax#	Month/Year
Model SV-F990 VCR	Special	1994/95
Model CF2771A TV	Special	1995/96
Models 6F35661, CX37662 color TV	Special	1996/97
Model M-651/651C VCR	3154	Oct 97
ZENITH		
CM-140/b-2(G) chassis color TV	3041	Feb 89
CM-14-0/B-3(1) color TV (Models SE2721H/SE2725R/SE2727H)	3046	May 89
CM-140/B-2(I) color TV	3053	Aug 89
PV4661H rear-projector color TV	3056	Oct 89
CM-140/DIGITAL(C) chassis color TV (Models SE3135P/SE3191H/SE3535H/ ZB2771H/ZB2771H2/ZB2777H/ ZB2777H2/ZB2797P/ZB2797P2/ZB2797Y/ ZB2797Y2/ZB3193H/ ZB3I93Y/ZB3539T/ZB3539Y)	3059	Dec 89
CM-I 39/B2 Models SD5515, SD5535, SD5556	Special	1992/93
Model CM-139/B-l color TV	Special	1994/95
CM143/digital (A)	Special	1994/95
L-Iine C-8 Chassis TV	Special	1995/96
Model SD2501W, SD2509H color TV	Special	1995/96
Model PV-l44 wall projector	3134	Jan 96
Model CM-142 digital direct view	3136	Mar 96
Model CM142/C-1 color TV	3141	Aug 96
J-Line Model PV- 143 digital color TV	Special	1996/97
Models S1322S, SMS13245/X, SMS 1325S color TV	Special	1996/97
Model PV-145/C8 (A) rear projection color TV receiver	3158	Feb 98
Models SD 2593W, SD2593Y, SD5539W, SD5557Y, SD5729W, SD5779H	3175	Jul 99
Model CM-144/C-3 color TV receiver	3176	Aug 99
Models SD1995W/SD3923W/SD3961Y/ SD3961YH color TV receiver	3177	Sep 99

News (from page 4)

"CEMA strongly supports the Commission's effort to adopt rules that will permit the creation of new services on these frequencies," explained Michael Petricone, CEMA director of Technology Policy and Legal Affairs. "It is clearly in the public interest to allocate the necessary bandwidth to new services for which there is demonstrable demand."

"We believe the FCC has an opportunity and an obligation to establish rules ensuring that this radio spectrum will be used in a way that best serves the public," added Shapiro. "MMBS serves this interest by integrating free over-the-air broadcasting of high-quality multi-channel audio with high-capacity data services intended for mobile use."

CEMA calls for economics and technical education in the new digital economy

The Consumer Electronics Manufacturers Association (CEMA) President Gary Shapiro spoke before a group of business and education executives at the Economics America Business and Education luncheon in Lexington, Kentucky, on the importance of an economics education in the new digital economy. Shapiro said policymakers and their constituents need to start with a common understanding of economic principles and the belief that the Internet provides a revolutionary boost toward the world of the most perfect competition.

"With the Internet and information technology as the basis of the new digital economy, you can think of information as the crude oil of the new economy," said Shapiro. "High-speed wired and wireless communications are the pipelines of the new economy. Computers, telephones, and televisions are the cars, trucks, and planes that are powered by the fuel or bits and bytes from this new economy."

Shapiro also praised electronic commerce, saying, "It will raise our world's standard of living, not only from a surging economy, but from improved access to information, education, and entertainment, and from a wealth of new services and concepts we can't even envision today."

But, Shapiro,warned that the transformation to a digital economy and e-commerce will not be easy, noting that even Federal Reserve Chairman Alan Greenspan repeatedly has said that the Internet is changing fundamental aspects of our economy. Digital technology is challenging traditional assumptions held by many of those in government.

"Public policy restricting Internet growth and usage must be weighed carefully so it does not impinge or retard the wonderful economic model the Internet creates," commented Shapiro. "A common viewpoint and set of parameters would help develop a national consensus as we learn to operate in a transitional, global society. Governments have always divided the power to regulate from the control over boundaries — oceans, borders, or airports. The global feat of digital renders these boundaries obsolete. As we move into a dynamic future and as supply and demand capitalism expands, (even as the influence of government is reduced), economic knowledge becomes more essential."

To further economic knowledge and technical skills, CEMA has been working with Jessamine County in a model program to produce the nation's future high technology workforce demanded by the industry. CEMA intends to make Jessamine the benchmark of excellence for schools across the country.

"Jessamine, and its partner, Central Kentucky Tech, are leaders in the drive to teach the industry developed National Skill Standards for electronics. These National Standards were developed to provide a basis for the digital technology workforce. Jessamine and Central Kentucky Tech will ensure a technologically competent workforce for the digital future. The measure of economic success for this program will be qualified professionals, eager to take this industry into the next millennium," remarked Shapiro.

CEMA forms television furniture safety committee

The Consumer Electronics Manufacturers Association (CEMA) recently announced the formation of the Home Entertainment Support Safety Committee. This committee, comprised of television and consumer electronics furniture manufacturers, will implement short- and long-term strategies to proactively address the issue of accidents involving falling televisions and home entertainment support units (TV stands and other furniture). One of the immediate objectives of the group is to conduct a public awareness campaign.

"A goal of this committee is to educate consumers about the safe use of television stands and other home entertainment support units. Educating consumers about the proper and safe use of our products is the right thing to do," explained Gary Shapiro, president of CEMA. "We are uniquely positioned to launch a public awareness campaign and other measures because of the enthusiastic support of our members, in both the video and consumer electronics furniture industries."

The committee, although recently formalized, has been meeting as an ad-hoc CEMA committee for over a year to consider ways the industry could proactively educate consumers regarding TV stand safety. Now a formal committee with broad industry participation, the group has succeeded in drawing attention to this issue within relevant industry engineering committees and standards-setting organizations.

Shapiro continued, "This CEMA group has brought together two industries that have been working for several months on strategies to encourage safe and intended use of TV sets and their support units. We have been also coordinating closely with the Consumer Product Safety Commission (CPSC) and Underwriters Laboratories (UL), and we are trying to garner the input and involvement of related industry and consumer organizations."

Shapiro indicated that the public awareness campaign, aimed primarily at consumers, will also target the educational and medical communities. The manufacturing and retail audiences will also be addressed.

DTV sales remain strong

Sales of the new video playback technology of choice, Digital Versatile Disc (DVD), reached 1 million units, according to numbers released by the Consumer Electronics Manufacturers Association (CEMA). CEMA also announced revised projections for total DVD unit sales in 1999, increasing previous predictions of 1.8 million to 3 million.

"DVD sales continue to vastly outpace introductory sales of VCRs and CDs. It has quickly become a mass market product, demonstrating that consumers want the best possible picture and sound quality they can get. For this reason, DVD is a great

harbinger for HDTV — people want theater quality video and sound," said Gary Shapiro, president of CEMA.

"Typically, two thirds of industry sales are made in the second half of the year. If DVD stays on track, volume should reach 3 million before the end of 1999," added Shapiro.

Shapiro noted that CEMA doesn't expect the absence of Divx to have a negative impact on DVD player sales, "We saw Divx simply as a product feature."

With its vastly improved picture quality and six-channel surround sound, DVD provides a host of advantages over existing video playback systems. DVD technology uses as many as 500 lines of horizontal resolution, as compared with the VHS format's 240 lines, and can store up to 133 minutes of full-motion video on a single-layer, CD-size disc (and more than four hours on dual-layer discs).

In addition to its stunning digital images and surround sound, DVD gives consumers the ability to modify the aspect ratio from the squarish (4:3) measurements of today's TV sets to the widescreen (16:9) dimensions of a movie theater screen. Capable of storing, on one side of a disc, more digital information than seven audio CDs, DVD's unequaled flexibility allows the consumer to select from as many as eight different soundtracks and 32 subtitle tracks, choose preferred camera angles, and access background information, for example, on the film's actors and director.

At a time of rising concern over whether certain movies are suitable for children, DVD gives parents the option to view a mature version of a particular film while limiting their children to a version edited for younger audiences. Another compelling feature is that DVD players are fully compatible with music CDs. Today, nearly two dozen companies manufacture or market DVD players at prices ranging from as little as $199.

CEMA urges FCC to issue strong must-carry rule

The following statement was released by Consumer Electronics Manufacturers Association (CEMA) President Gary Shapiro regarding a new report on the digital television (DTV) transition released last week by the Congressional Budget Office (CBO). The report concludes that a DTV must-carry requirement is essential to completing the DTV transition by 2006.

"The CBO's independent report reaffirms what we have long said: a strong must-carry requirement is critical to the success of digital television."

"Momentum is continuing to build surrounding digital television. Manufacturers have introduced a variety of products and retailers and customers are buying them. We expect sales to increase as more programming becomes available. However, nearly 70 percent of American homes are connected to cable. The CBO has confirmed that the DTV transition will slow if high-definition television and other new digital services are blocked or down converted by cable systems. It is essential that these new services are available to all Americans, including cable subscribers.

"A must-carry requirement would promote a successful DTV transition and expedite the auction of the analog spectrum in the time frame that Congress envisioned. We urge the FCC to heed the CBO's conclusions and issue a strong must-carry rule as quickly as possible." ■

Classified

Classified advertising is available by the word or per column inch.

By-the word. $1.65 per word, per insertion, pre-paid Minimum charge is $35 per insertion. Initials and abbreviations count as full words. Indicate free category heading (For Sale, Business Opportunities, Miscellaneous, Wanted). Blind ads (replies sent to ES&T for forwarding) are $40 additional. No agency discounts are allowed for classified advertising by the word. Contact Alycia Nicholsen at 516-681-2922 to place your classified ad (by-the-word). Mastercard, VISA, American Express and Discover are accepted for FAX or mail orders.

Per column Inch (classified Display): $235 per column inch, per insertion, with frequency discounts available, 1" minimum, billed at 1/4" increments after that 10" maximum per ad. Blind ads are $40 addition. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-inch or larger ads.) For more information regarding classified display advertising, please call 630-584-5333. Optional color (determined by magazine) $150 additional per insertion.

Electronic Servicing & Technology
25 Newbridge Rd, Hicksville, NY 11801 Attn: Classified Department
Ph: 516-681-2922 FAX: 516-681-2926

FOR SALE

WinSTIPS! — 125,000 Current tips from repair shops! All brands. Monitor and Consumer Electronics. Search any phrase. Vcrcross, Sams, Philips Ecg. One-button update Tips. Windows 95/98 **$149.95**.(CD or Web download). **http://www.kdtviwe.com.** KD TV 514 3rd St., Aurora, IN 47001. **1-888-KD-STIPS.** All c/cards. Ken Hull C.E.T. These tips are GREAT! See them all BEFORE you buy!

ServiceTalk & MonitorTalk. Email repair group. Why work alone? 30 day free trial. http://www.kdtviwe.com

IN-CIRCUIT ESR TESTER - Find bad caps FAST and RELIABLY with the new Capacitor Wizard in-circuit ESR Tester! Great for monitors switching power supplies, TVs, etc. Only $179.95. MC/VISA. **Independence Electronics, Inc., 800-833-1094, www.awiz.com**

PRICE REDUCTION. Diehl Mark III $39, Diehl Mark V Horizontal circuit tester $159. Conductive coating for remote control keypads $9.99 ppd. **WEEC, 2411 Nob Hill Road, Madison, WI 53713. 608-238-4629. Website: http://sites.netscape.net/duaneconger**

SENCORE, TEKTRONIX, HEWLETT PACKARD (all models). We **BUY, SELL, & TRADE**. Please call **"CHOICE ELECTRONICS"** for all of your test equipment needs. Complete financing options available. Call 1-800-609-0677, 605-361-6386 ask for Lance Tople.

TV CASE HISTORIES: Volume 7 with 3,045+ histories. Satisfaction assured. Only $59 (plus $3.25 shipping). Over 9,640 books and supplements sold with only 1 returned for a refund! **Mike's Repair Service**, P.O. Box 217, Aberdeen Proving Ground, MD 21005. Same mailing address 35+ years. Send SASE for samples. 410-272-4984,1-800-2-FIX-TVS 11a.m.-9 p.m. (http://mikesrs.webjump.com)

TEST EQUIPMENT BOUGHT & SOLD: OSCILLOSCOPES, ETC.925-706-0177. FAX: 925-706-0156. www.oscilloscope-setc.com

FOR SALE

*******NAP Tuner 340309******* RCA Tuner TCHRIA or TCCRIA and more. Snowy picture? **Will rebuild for $25.00**, Free Shipping!!! **Tip Top TV & VCR**, 18441 Sherman Way, Reseda, CA 91335, **818-345-1974.**

****FREE** Service Tips for TV's, VCR's, Projection TV's, CAMCORDER's. Must have IBM compatible computer. Send your Name and Address to: FREE SERVICE TIPS, P.O. BOX 464, WHEATLEY HEIGHTS, NY 11798.**

TEST EQUIPMENT FOR SALE: REASONABLE PRICES SENCORE, TEKTRONIX, HP and MUCH MORE. View complete list at: http://www.astglobal.com or contact: **AST GLOBAL ELECTRONICS**. Voice: 888-216-7159; Fax 814-398-1176; e-mail: sales@astglobal.com

'nControl!® COST-EFFECTIVE SOFTWARE
The most complete package tailored for service centers. Has features you won't see anywhere else! From $49/mo. Download free trial http://ServicerSolutions.com (888) PBS-6288

BUSINESS OPPORTUNITIES

ELECTRONIC SERVICE CENTER For Sale. Metro Detroit Area. Established over 30 years. (50K) 734-728-0618.

CENTRAL FLORIDA TV/ELECTRONICS Business/Building. Heart of the retirement area. 36 years (75K). Owner retiring. **941-385-0359.**

WANTED

WANTED:USED TEST EQUIPMENT. TURN IDLE OR EXCESS EQUIPMENT INTO CASH. AST GLOBAL ELECTRONICS. Voice: 888-216-7159; Fax 814-398-1176; e-mail: sales@astglobal.com.

Reader's Exchange

Readers' Exchange is a free service.

The following restrictions apply to Readers' Exchange:

- Only individual readers may use Readers' Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your message is in a paid advertisement, not Readers' Exchange.
- Readers' Exchange items must be restricted to no more than three items each for wanted and for sale.
- All submissions must be typed or printed clearly!

Send your Readers' Exchange submissions to:
Readers' Exchange, Electronic Servicing & Technology, 25 Newbridge Road, Hicksville, NY 11801

FOR SALE

STK 563 F regulator IC, new, $25.00 plus shipping. *Contact: Walter Hansel, 301-649-2234.*

Lot #1 - 30 good used radio output tubes, $65.00. Lot #2- 30 good radio tubes, top grid, $30.00. Lot #3, 14 N.O.S. TV high-volt rectifier, $30.00. Lot #4 - 2 used 2050 tubes, $15.00. Lot #5 - 30 N.O.S. 1-volt tubes for antique radios, no miniatures, $30.00. Shipping not included. *Contact: Maurer TV Service, 29 South 4th Street, Lebanon, PA 17042, phone 717-272-2481, e-mail radiobks@aol.com.*

Fluke 8024B multimeter, excellent condition w/new probes, $75.00. *Contact: Frank, 727-392-0230.*

B&K 545 in-circuit component analyzer, extremely advanced, $1500.00. *Contact: Kim Gutzke, 612-869-4963.*

Pocket size tungsol tube base connections, books for radio and TV diagrams. *Contact: Ann Bichanich, 15 W. Lake St., Chisolm, MN 55719.*

Tentel gauges, full set. Tentelometer T2-H7-UM tape tension; TSH-V4 spindle height/elevator; TQ 600 torque; TEACH cassette and instructional video, $500.00 or best offer for all. Panasonic WV-D5000 video camera, full setup w/power supply, carrying case, RGB module, cabling, instructions, $500.00 or best offer. High-end indoor/mobile cellular repeater system (Antenna Specialists ActiveLink Bi-Directional Active Repeater, Antennex outdoor Yagi, Decibel Products indoor antenna), $400.00 or best offer. Shipping not included. *Contact: Jonathan Hymer, 585 South K Street, Livermore, CA 94550, phone 510-219-8819 (day), 925-455-9514 (eves.), e-mail jdhymer@ricochet.net.*

Sencore VA62A video analyzer, like new with all manuals and probes, original box, $950.00. *Contact: Leroy Blalock, 919-837-5632.*

Sencore VC93 all format VCR analyzer and Sencore CR70 universal CRT analyzer & restorer, like new with all manuals and accessories, $1900.00 plus shipping for both. *Contact: Jim Fuller, 33 Standwood Lp., N. Little Rock, AK 72118, phone, 501-758-3064.*

Picture tube rebuilding equipment (TV, computer monitors, etc.) Complete setup. New, never used, manufactured by Lakeside Industries. Best offer. *Contact: J.W.A. Forgue, P.O. Box 56595, North Pole, AK 99705.*

ES&T magazines from 2/64; Radio Electronics/Electronics Now from 1/83; Radio Electronics/Popular Electronics from 8/86; Popular Mechnics from 1/83; Popular Science from 4/83; Family Handyman from 4/93; Mechanix Illustrated/Home Mechanix from 5/63; Today's Homeowner from 9/96. Best offer. *Contact: Jens Jensen, 303-733-1161.*

WANTED

Sharp Model GF 6060X stereo radio and tape recorder boombox idler assembly or idler tire only. *Contact: Walter Hansel, 301-649-2234.*

Schematics (service manuals) for the model Ulysses amp. made by Sumo, and the Funai TV Model XRC-941 (XR-1000). Copies o.k. *Contact: Harold Lejuez, 46-16 160th Street, Flushing, NY 11358, phone, 718-463-4110.*

Panasonic palmcorder, Model PV-21 service manual. *Contact: Ed Herbert, 410 North Third Street, Minersville, PA 17954.*

Hickok model 216 transistor tester, working or not. *Contact: Duane, 1-800-775-9213.*

REL (Radio Engineering Labs) precedent tuner. Any condition. Also SAE, Acoustech, CM Labs, Phase Linear service infor. *Contact: Mike Zuccaro, 8795 Corvus Place, San Diego, CA 92126, phone 858-271-8294, e-mail mjzuccaro@aol.com*

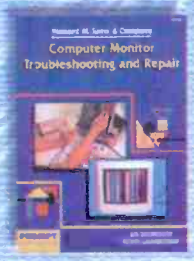
Advertisers' Index

Company	Page Number	Reader Service Number	Advertiser Hotline
A-Tech Systems, Inc.	11	60	215/949-0400
B & D Enterprises	3	6	888/815-0508
Computer & Monitor Main..	64	70	800/466-4411
Electronic Design Specialist	43	71	561/487-6103
Electronics Technicians Assoc.	45	8	800/288-3824
Electronix Corporation	64	66	937/878-1828
Iscet	19	73	817/921-9101
Jesse Jones Industries	59		800/825-6690
Sams & Company, Howard	15,61	72,75	800/428-SAMS
Sencore	IFC	1	800/736-2673
Thomson Consumer Elec.	BC	113	800/336-1900
Tritronics, Inc.	64	78	800/638-3328
Vance Baldwin	64	79	800/432-8542
Video Products, Inc.	15	74	800/626-7801

We'd like to see your company listed here too. Call Kaprelian & Company at 630-584-5333 Ext 18 to work out an advertising program tailored to suit your needs.

ES&T BOOK SHOP

ES&T Presents Computer Troubleshooting & Repair
Features information on repairing Macintosh computers, a CD-ROM primer, and a color monitor. Also included are hard drive repair tips and computer diagnostic software.
61087 • $24.95

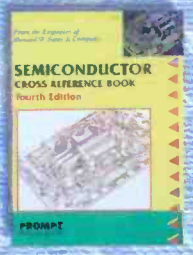


Computer Monitor Troubleshooting & Repair
Learn the basics of computer monitors with chapters on tools and test equipment, monitor types, special procedures, how to find a problem, and how to repair faults in the CRT.
61100 • $34.95

1999 Computer Monitor Troubleshooting Tips
Includes over 2,000 troubleshooting and repair tips listed by manufacturers name and model number featuring such major names as Apple, Gateway, Compaq, IBM, and Dell.
CD-ROM Included
61179 • $49.95

ES&T Presents the Test Equipment Guide
Includes the latest information on how to choose the best equipment, how to build test equipment and accessories, how to set up the ideal service bench, and how to put together a practical tool kit.
61089 • $24.95

Complete VCR Troubleshooting & Repair
In addition to troubleshooting procedures, this book contains nine detailed VCR case studies, each focusing on a particular model of VCR with a very specific and common problem.
61102 • $34.95



Semiconductor Cross Reference, 4th Edition
With more than 490,000 part numbers, type numbers, and other identifying numbers listed, technicians will have no problem locating the replacement or substitution information needed.
61080 • $29.95
Also available on CD-ROM.
61140 • $29.95

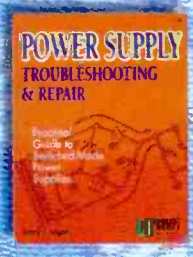
ES&T Presents TV Troubleshooting & Repair
Presents important and new information that will make it possible for technicians, students, and electronics hobbyists to service TVs faster, more efficiently, and more economically.
61086 • $24.95

Complete Projection TV Troubleshooting & Repair
Covers everything from the basics of projection circuits, tools and test equipment, TV types, safety procedures and measurements, to the finely detailed repair techniques.
61134 • $34.95

Troubleshooting & Repair Guide to TV, Second Edition
The most comprehensive, complete, and up-to-date television repair book available, with tips on how to troubleshoot the newest circuits in today's TVs.
61146 • $34.95

ES&T Presents VCR Troubleshooting & Repair
This book provides in-depth and thorough information on a variety of VCR troubleshooting and repair areas.
61158 • $24.95

Howard W. Sams Servicing Series RCA/GE Televisions
From RCA component numbering systems to the infamous "tuner wrap" problem, this book gives you all you need to make more efficient repairs.
61171 • $34.95

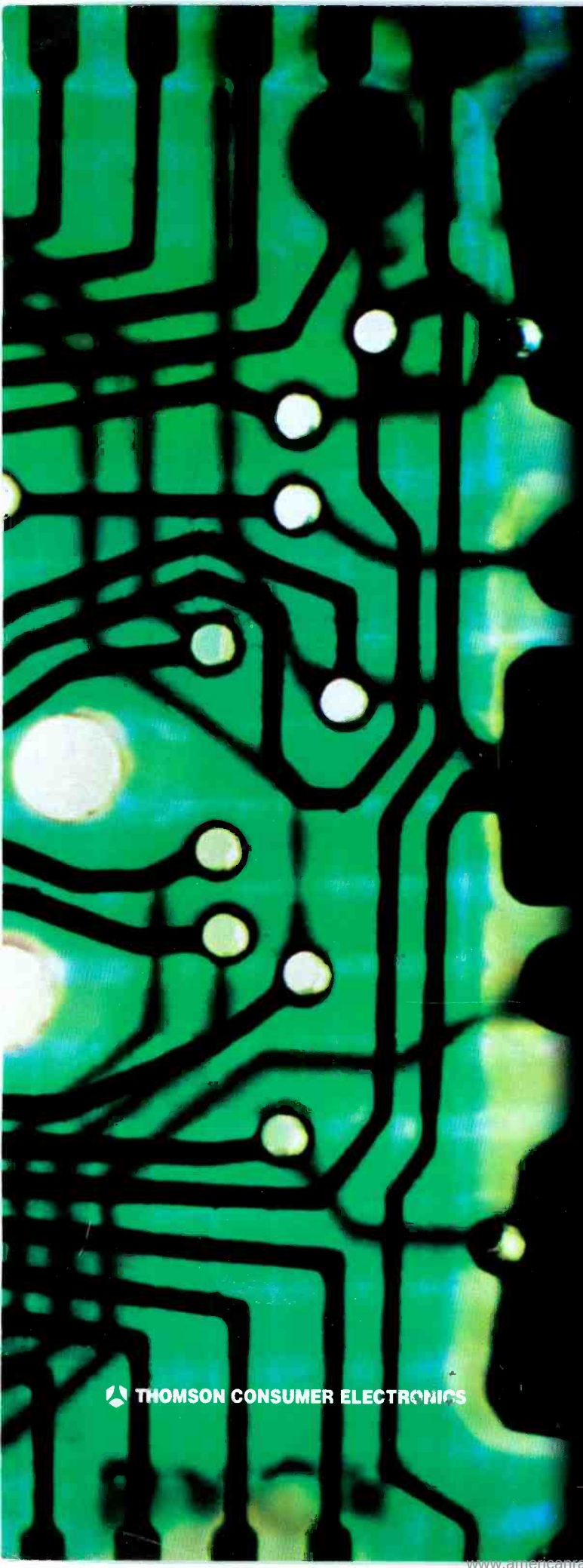


Power Supply Troubleshooting & Repair
Designed to provide technicians with a better understanding of how switched-mode power supplies operate. It also provides practical, useful procedures to follow when troubleshooting power supplies.
61138 • $24.95

TO ORDER TOLL FREE CALL 1-800-853-9797

When ordering books please include the following information: Name, address, city, state & zip. Please make a list of the books you're requesting. When paying by credit card send the number along with the expiration date. Check, Money Order, Mastercard, VISA, Discover and AMEX accepted. Please make your check or money order payable to: Electronic Servicing & Technology.
U.S. and possessions - add $4 shipping/handling. **FREE** shipping/handling on orders $50 and over. Foreign - shipping/ handling charges are calculated by order, weight & destination. A $4 credit will be applied for Foreign orders over $50.

Please mail your orders to:
Electronic Servicing & Technology
25 Newbridge Road, Hicksville, New York 11801 FAX 516-681-2926



Exact Semiconductors

The Right Parts For The Job

"Trust Me!"

How many times have you heard that!

You built your reputation on hard work and quality repairs. Why change now?

Put your reputation on the line with two names you *can* trust.

SK *Series* and Thomson Consumer Electronics.

With over 1,700 exacts in stock, you won't have to look anywhere else. And when you're in need of any video heads, belts, tires, flyback transformers or video replacement parts, we have them too.

But we don't stop there.

Our continuing quality assurance and accuracy goes into every SK *Series* product.

For more information on SK *Series* products, contact your nearest Thomson Distributor.

SK *Series*...The parts you need to do the job. "Trust me!"

THOMSON CONSUMER ELECTRONICS

SK *Series*

Circle (113) on Reply Card